Animal husbandry in the British Later Iron Age: investigating economic and social change through zooarchaeology

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to mom and dad, because your unceasing support has given me the possibility to follow a complicated path.

to Alice, because you are always with me, even when I am far away to follow it.

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Abstract

The Later Iron Age in Britain was a transformative period: material culture, settlement patterns, technology, trade networks, and the structures of power changed, creating the conditions which attracted the attention of the Romans. In turn, the Roman conquest brought another wave of change and societal reorganization.

Radical changes in the relationship between humans and domestic animals are known for the Romano-British period, while diachronic developments were much less obvious during the Iron Age, due to dating issues and less substantial material evidence. Therefore, research on the subject has so far mostly treated the Iron Age as a uniform and static continuum or focused on the subsequent impact of Romanisation.

Since the relationship with domestic animals is a pervasive aspect of pre-industrial societies, this thesis argues that assessing its changes during the Later Iron Age is a fundamental step in the understanding of the British Iron Age societies.

Zooarchaeological techniques, with a focus on osteometry, have been used to characterise human-animal relationships in eastern and southern Britain in this period. The increasing reliance on sheep has been linked to their use in areas where landscape features limited access to pasture and to the colonisation of new lands.

The extent and pace of change indicated a broad pattern of continuity of practice, with relatively uniform livestock types and management strategies until the very end of the period. This has been discussed within the context of changes in arable farming, settlement pattern and material culture. The conservativeness of herding practices and their geographic patterning have been interpreted as signs of a successful system which promoted demographic expansion and contributed to the socio-economic developments that are suggested by the changes detected in the material evidence.

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CHAPTER 1

Introduction

The idea behind this thesis stems from my interest in the Iron Age, the understanding of how societies work, and our relationship with other animals. Combining these interests into a research project has been an incredible opportunity for me to learn. I can only hope the reader will find some of the same value and pleasure in reading it.

1.1 Research aims and questions

The main aim of this thesis is to investigate change during the English Iron Age from a zooarchaeological perspective. Previous research has highlighted substantial changes in the relationship with domestic animals at the beginning and after the end of the Roman presence in Britain (Albarella, Johnstone and Vickers 2008; Holmes 2014; Rizzetto, Crabtree and Albarella, 2017). This suggests that major socio-cultural changes are accompanied by changes in animal husbandry.

Animal husbandry during the British Iron Age is not a neglected subject per se. The literature counts hundreds of faunal reports and some useful regional and/or period reviews have been published over the last 30 years (Maltby, 1996; Hambleton, 1999; Albarella, 2007; Albarella, Johnstone and Vickers, 2008; Hambleton, 2008; Maltby, 2016; Albarella, 2019).

It is, however, a subject that has suffered from a strong chronological and geographic bias: most of the large assemblages come from site periods located in Southern England or dated to the Late Iron Age (often to its very end), and very few sites have both a Middle Iron Age and a Late Iron Age phase. These and other issues with the archaeological record make assessing change over time a difficult, but necessary, task.

The Later Iron Age was a transformative period (see Chapters 2 and 3) and one when the relationship with domesticated animals has been suggested to be particularly strong (Hill, 1995; Rainsford and Roberts, 2013), therefore it is reasonable to expect developments in animal husbandry. This thesis will try to assess the degree of change in animal husbandry practices and relate it to other aspects of societal change by answering the following set of research questions:

+ Are domestic livestock type and management part of a static or dynamic phenomenon? And to what extent?
+ If there was change through time, how was it related to the social, economic and cultural transformations that we know were happening during the Later Iron Age?
+ How did people respond to demographic pressure and a changing landscape?
+ How homogeneous were animal husbandry practices? Can we detect local and regional differences?
+ Do any of the processes related to animal husbandry and consumption that we attribute to the Romans in Britain a continuation of a Later Iron Age trajectory or tradition?

1.2 Summary of chapters

This chapter (CHAPTER 1 – INTRODUCTION) introduces the research questions, defines the chronological and geographic framework, and discusses the assumptions and approaches adopted in the thesis.
CHAPTER 2 – SOCIETY AND CHANGE IN THE LATER IRON AGE, summarises and discusses the body of archaeological research on the British Iron Age focusing on the aspects relevant to the reconstruction of how society and economy worked.
CHAPTER 3 – AGRICULTURAL ECONOMY AND ANIMAL USE IN IRON AGE BRITAIN: A REVIEW, discusses previous research on animal and plant economies in this period to create a framework to interpret the data collected and better define the research questions and hypotheses to be tested.
CHAPTER 4 – METHODS AND RECORDING PROTOCOL, discusses the zooarchaeological methods and techniques used in the analysis.

CHAPTER 5 – SITES AND MATERIALS, presents the sites that have provided the primary data for this project. Data and interpretation from the original reports are briefly summarised. It also mentions the sites from which the comparative osteometric data used in Chapter 7 have been garnered.

In CHAPTER 6 – RESULTS – THE ANIMAL REMAINS FROM THE CORE SITES the main body of zooarchaeological data from the core four sites is analysed and interpreted.

CHAPTER 7 – RESULTS – LIVESTOCK TYPE AND SIZE IN LATER IRON AGE focuses on the analysis of osteometric data from both the core assemblages and that obtained from the literature or kindly provided by other researchers.

In CHAPTER 8 – DISCUSSION the results from Chapters 6 and 7 are further discussed and contextualised to try and address the research questions proposed at the beginning of this chapter and expand on the considerations presented in Chapters 2 and 3.

CHAPTER 9 – CONCLUSION summarises the main findings of this research, critically assesses the approach and design of the project and suggests future directions and desiderata for the research on this topic.

1.3 Chronological and geographic frameworks

1.3.1 Iron Age chronologies

The sequence of the British Iron Age has been traditionally divided into an Early Iron Age (EIA from now on), a Middle Iron Age (MIA) and a Late Iron Age (LIA). There are, however, several variations in the literature, that are currently used depending on the area, author's preference and specific archaeological record of the site. Some of the most commonly adopted schemes are reported in Table 1.1.

The variability in the sequences adopted stems from a series of issues in dating due to regional variability in the sequence and in the reliability of the ceramic typologies on which the dating is based. For example, Scored Ware and Plain Ware pottery in Eastern England have been used to assign a MIA chronology to archaeological contexts. It has, however, become apparent that these ceramics were still being produced until the end of the Iron Age (Brudenell, 2013).

Although a distinctive LIA has been identified in the south-east of England and then applied to other areas, the dissatisfaction with its applicability outside of the south-east has led to the adoption of the simpler concept of the Later Iron Age (Champion, 2016). The last decades of the Iron Age are usually easiest to date since ‘Belgic’ related wares (Collins, 2016) and more frequent imports allow for a tighter chronology.

However, for analytical purposes, further categories had to be adopted. Many of the earlier sites had chronologies that straddled between the MIA and LIA, without reaching the last decades of the period or allowing their distinction. In this thesis, these will be mostly referred to as the Mid to Late Iron Age (MIA-LIA). Conversely, many of the later sites or phases had very short occupations, dated to the end of the first century BCE and/or to part of the first century CE. These will be referred to as Latest IA, following Cunliffe's (2004) scheme. When possible, the finer subdivision between MIA and LIA will also be kept, to give more insights into the diachronic developments.

<table>
<tr><th>Hill 1995</th><th>Cunliffe 2004</th><th>Haselgrove and Pope 2007; Haselgrove and Moore 2007</th></tr>
<tr><td rowspan="2">EIA 700-450 BCE</td><td>Earliest IA 800-600 BCE</td><td rowspan="2">Earlier IA 800-400/300 BC</td></tr>
<tr><td>EIA 600-400/300 BCE</td></tr>
<tr><td>MIA 450-100 BCE</td><td>MIA 400/300-100 BCE</td><td rowspan="3">Later IA 400/300 BCE to 43 CE</td></tr>
<tr><td rowspan="2">LIA 100 BCE to 43 CE</td><td>LIA 100-50 BCE</td></tr>
<tr><td>Latest IA 50 BCE to ~50 CE</td></tr>
</table>

Table 1.1. Subdivisions of the Iron Age according to different authors.

1.3.2 The geographic framework of this research and its scale

Since a few regional (Hambleton, 2008; Albarella, 2019), and national (Hambleton, 1999) reviews on the topic already exist, this thesis aims to bridge the gap in scale between those works and the individual site reports. Zooarchaeological research, especially when investigating animal husbandry, requires large sample sizes to be effective.

Because of that, the choice of sites and areas to investigate was conditioned by the availability of the faunal material. Due to the scope of most of the commercial excavation and the nature of the archaeological evidence[1], large assemblages are hard to come by. Therefore, it was not possible to select small areas to investigate in detail without losing the connection to the larger scale.

It was decided to select a few sites within a broader region and directly record data from their assemblages, discussing their results within a framework of background knowledge that is summarised in Chapter 3, and comparing the recorded osteometric data with data from other sites.

The choice for the region fell on Eastern England, while Wessex is used for its comparative value.

Eastern England is a region arbitrarily defined for this thesis. It is located between the Thames and the Humber, roughly corresponding to the 'villages and open settlement' grouping (Figure 1.1) defined by Cunliffe (2004) and to the distribution areas of the Breedon-Ancaster group ceramics from the Middle Iron Age and Aylesford-Swarling group ceramics during the Late Iron Age (Cunliffe, 2004, pp.70–125). The data used in this work comes from sites in the modern counties of Essex, Hertfordshire, Buckinghamshire, Cambridgeshire, Bedfordshire, Northamptonshire and Lincolnshire. The area is large and relatively uniform in the archaeological evidence. It has also been subject to recent urban development and extensively researched, making it ideal for data gathering.

Wessex is one of the regions whose prehistoric record has been better studied. Many of the type sites used in the early research on the Iron Age

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[1] Not only most Iron Age sites are extensive, making it impractical to excavate whole features, but many areas of the country (e.g. the north-west) do not present soil conditions favourable to the preservation of bones, significantly reducing their chance of recovery.

are located in this area and it is still central to the broad archaeological narratives on this period. It constitutes the core of the area that Cunliffe defines as the ‘hillfort dominated zone’ (Figure 1.1).

The Upper Thames Valley is a relatively small and area and is part of the ‘villages and open settlement’ grouping. It has often been studied as part of southern England, but its position at the junction between the other two regions makes it an ideal link. Although the zooarchaeological data is not particularly abundant, the area has been extensively researched and the area will be mentioned throughout the thesis when relevant.

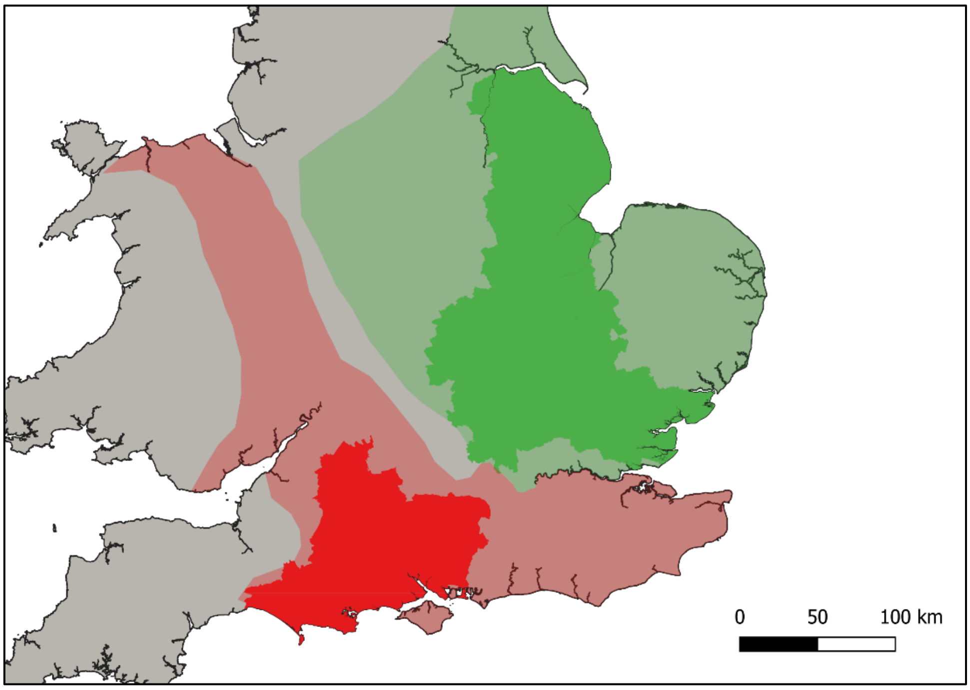

Figure 1.1. Map of southern and eastern Britain. ‘Village and open settlements’ area in green, ‘Hillfort dominated zone’ in red (after (Cunliffe, 2004, p.74, Figure4.3). The areas outlined in solid colours represent the counties where the sites mentioned in this thesis are located.

1.4 Research approach

This section will summarise the basic assumptions and approaches employed in reviewing past research on the British Iron Age and interpreting the new data to answer the research questions.

1.4.1 What does animal husbandry have to do with societal change?

The relationship between humans and other animals goes well beyond simple subsistence. The social and symbolic importance of animals is well rooted in their pervasiveness, the countless uses we make of them and the sense of empathy we feel for them due to their animate nature (Russell, 2011, pp.1–10).

Farming practices are tied to the social structure through their ramifications in dietary regimes, land use, mobility, property, and the division of labour. The production of surplus is the base for practices centred around wealth, trade, storage, and risk management.

Domestication has been one of the most radical revolutions in human history, and the role of animals and plants has changed through time hand in hand with the other developments of human societies.

The entanglement between society and livestock is relevant for all societies practising farming, but it is especially pervasive for pre-industrial and relatively unstratified societies where most of the populations would have been involved in its rearing in some capacity.

Given the complexity of the subject, the evidence from animal bones cannot be used alone to reconstruct social change, but it can be contextually analysed along with other strands of evidence to explore selected aspects of the inner workings of society.

The results from the faunal analyses will therefore be interpreted alongside the evidence from the archaeological literature presented in Chapter 2 and 3.

1.4.2 Assessing change

Since change is at the core of the majority of the research questions behind this thesis, it is worth discussing how this concept will be treated in relationship with the material evidence available.

1.4.2.1 The nature of change

Up until the 1970s, a widespread preconception in the archaeological literature saw the Iron Age populations of Britain as timeless and primitive (Collis, 2007). In this context, the possibility for change could have only been brought about by the invading Belgae and the civilising Romans. Although the archaeological narratives have substantially changed ever since (see 2.2 – Background studies), this idea is still present to some extent as an implicit stereotype. The silence of the written sources, the ephemerality of the material evidence, and the substantial issues in dating (see 1.3.1 – Iron Age chronologies) have contributed to its persistence. This is particularly true for zooarchaeology, where the investigation of change within the period has been very limited so far.

The critique of the invasionist models during the 1960s and 1970s has modified the interpretation of the Iron Age sequence, emphasising continuity and gradual change. Initially, this has mostly meant shifting from an imperialist to a postcolonialist point of view.

The core-periphery models used to interpret the archaeological record largely implied that change in Britain could have only happened as a reflection of the developments happening in the Mediterranean world. It has, however, also set the foundation for more recent interpretations (e.g. Hill, 2007; Sharples, 2010), giving agency to the Britons in terms of local development and negotiating the adoption of foreign objects and cultural traits.

However, Barrett and colleagues (2011) critiqued the gradualist approach noting that it has made researchers complacent with the vague and loose chronologies available. This has impaired the recognition of horizons of change and caused a failure to describe the developments within this period. In response, they suggested that we should look at change during the Iron Age as a history of punctuated equilibrium, rather than one of continuous evolution.

Even not considering the general issues related to chronology (1.3.1 – Iron Age chronologies) and scale (1.3.2 – The geographic framework of this research and its scale), the zooarchaeological evidence is rarely able to identify punctual events, and it is best used to understand change in the long duration. Therefore, even if some Iron Age events can be placed in time (e.g. the reappearance of gold and introduction of coinage, the making of rotary querns and wheel-thrown pottery, the adoption of brooches in clothes fastening, etc.) we cannot completely reject the gradualist approach in investigating animal husbandry.

Rather, we can work with the available data and narratives to assess the quality and rate of change, qualifying individual aspects of animal husbandry practices as conservative or dynamic. To do so, the next section will explore the possibility to adopt a rough unit of measure for societal change.

1.4.2.2 Romanisation as a yardstick for societal change

The process of cultural transmission happening at the turn of the millennium is often defined as Romanisation. It can be defined as the complex of processes in which “diverse indigenous peoples were either incorporated in or aligned themselves with the Roman Empire” (Barrett, 1997, p.52).

This term, if interpreted superficially, obscures a variety of influences (to describe which equally misleading terms such as Gallicisation or Germanisation have been created). It may also assume wholesale passive adoption of foreign cultural elements, while the evidence shows that people from different parts of Britain, and different social groups, reacted and adapted differently (Moore, 2016). Furthermore, the transmission was not unidirectional, with Britain and Northern Gaul between the Later Iron Age and the Roman period forming a “zone of cultural convergence” (James, 2001, 191).

Since the Empire itself was never ontologically a unified reality, but rather a “product of discourse” (Barrett, 1997, p.59), both for the people who lived in it and those who study them, the researcher’s task should be that of investigating Romanisation in practice, as a relationship between “the self and the ideal, rather than to reify the ideal” (Barrett, 1997, p.63).

It is then more productive here to avoid abstractions and focus on the more functional socio-economic aspects of Romanisation. These can be best intended as a dialectic process mediated, among other things, by the way Rome managed its conquests (Millett, 1992). In the beginning, the Empire was not a centralised economic imperialistic structure, but rather a loosely decentralised administration which created, manipulated and absorbed the local aristocracies to manage territories whose scale and diversity would have rendered otherwise impossible to control. Conquest itself was driven by a system in which the ‘Roman’ elites used military assignments to accrue political prestige and personal wealth, then used to maintain extended networks of clientage. Given the main preoccupation of the Roman elites was towards internal powers struggles, provinces had a good degree of local autonomy.

Whatever the participation of the local authorities in broader networks of political power and wealth was, what was more important is that their privileged access to the Roman world granted them the possibility to access a vaster spectrum of ways to express their identity through material culture and practices. This in turn created new needs that had to be, at least in part, satisfied by local productions, constituting a driver of change in the life of the general population. The other two major drivers were constituted by the logistics surrounding the large (and foreign) military apparatus, and the introduction of a taxation system that entailed, at least in part, the use of currency.

The material manifestations of these changes are very evident in the archaeological record (see Chapter 2 and 3), and they are very well studied thanks to the privileged place that the Roman period has had in the history of archaeology (both in terms of the cultural interest it elicits and the permanence and ubiquity of its remains). It is therefore not surprising that Romanisation has taken to be synonymous with change, to the point of relegating the Iron Ages and their ‘boring’ archaeological record to the position of a static continuum, a rural idyll (or backwater) where diachrony is secondary until its very end.

This bias is not only a matter of lack of interest or short-sightedness, rather it stems from the practical issues mentioned above. Since it is always easier to proceed from known to unknown, the transition from the Iron Age to the Roman period has largely taken precedence and spotlight.

For as much difficult, or frustrating, the investigation of change during the Iron Age might seem, it is nevertheless important to push the boundaries of current knowledge taking advantage of the great mass of data collected in the past decades.

Instead of being discouraged by this gap in knowledge, we can use the relatively known measure of the Roman period both as a guide to know what questions we want to ask, and as a yardstick to measure the reliability of the answers we get.

For this research, the knowledge and data about the Iron Age/Roman transition gathered from the literature will be used comparatively to assess and characterise what can be considered as change during the Later Iron Age. Change is not always sudden and discrete, and especially when discussing concepts as complex and multifaceted as society and time, it should rather be regarded as continuous or fuzzy. If the Roman conquest represents a revolutionary and relatively abrupt change in the way of life of the Early Britons (2.8 – The Roman conquest and its consequences; 3.3 – Agricultural change in Roman times), then it can be used as a rough ‘unit of measure’ to place single or compound aspects of Iron Age life on a scale from continuity to radical change.

1.4.3 On tribal identity and ‘Celtic’ past

The narrative on European Iron Age identities and socio-political structures has been long dominated by the application of the concept of tribe. This has been fitted on a framework constituted by the toponyms and colonial labels[2] that survived in classical sources, and the assumption that they were centralised political entities whose capitals – the oppida – were then adopted by the Romans as administrative centres. Tribes were bounded entities, in which territory and social group coincided.

This blanket approach has been applied to Britain as well, fitting the earlier interpretations of the then very limited known archaeological record to the contemporary understanding of a relatively small *corpus* of written sources. Furthermore, the concept of tribe emerged from 20th century perceptions of pre-industrial societies, and it has never been fully disentangled from those assumptions, even as anthropological approaches developed and became more critical (see Moore, 2011 for a full review of the historiography of the term and its implications for British Iron Age studies).

While alternatives to the term have been proposed (e.g. chiefdom or people), trying to replace it with another has tended to leave the perception of these societies unchanged.

There is a number of factors contributing to the difficulty of proposing convincing alternatives: the scarcity of material evidence, the way some concepts[3] underlying these narratives are interiorised in our society, and their comfortable vagueness that allows us to use ethnic labels to build a working framework.

So far the most common and productive reaction to the adoption of this model has been to disregard the tribes altogether and treat the Iron Age as a fully prehistoric time (as argued by Hill, 1989), proposing models of social organisation based only on the archaeological evidence and ethnographic analogies.

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[2] In the sense of generic names used to define the geographic location or social status of human groups by others. These names disregarded what these groups recognised as their own identity, were adopted by the Roman administration, and were later fossilised in historiography. These might well represent actual identities adopted by the locals in reaction to the conquest but can hardly be thought to represent the reality of pre-conquest social or political entities. See Moore (2011) for examples of this process in the more recent European colonial past in Africa and America.

[3] The idea of nation state, the existence of political borders, the primitiveness of societies that do not adhere to our standards, just to cite a few.

Although this approach limits somewhat the ability to attribute geographic trends to cultural differences, and it does not fully preclude the possibility of unconsciously leaning onto interiorised preconceptions, it is also less misleading, and it is therefore adopted in this thesis.

1.4.4 Re-analysing assemblages

Three out of four of the core assemblages come from old excavations and have already been recorded and thoroughly published by other zooarchaeologists (5.1 – Selection criteria). The range of methods employed is, however, very diverse, making comparisons difficult. Furthermore, the scope and approaches used in these faunal reports are not only diverse but also influenced by the time they were written.

Recording again all or part of these assemblages with a unified protocol, tailored for the research questions of this thesis, will provide better and more uniform data, and a better understanding of the practices for which they provide evidence.

1.4.5 The focus on osteometry

The collection and analysis of new data in this thesis focuses heavily on osteometric analysis (Chapter 7). There are two main reasons for this choice.

The first is that it represents an objective measure of change. This provides a clear research hypothesis and the possibility to test it: did livestock type change through time? Livestock improvement was a widespread practice across the Roman Empire[4]. Evidence for the start of the practice during the Late Iron Age would support the idea that contact with the areas of continental Europe already subject to Roman dominion was a substantial driver for change.

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[4] This is attested in various former Roman provinces, including Britain (e.g. MacKinnon, 2010; Duval et al., 2013; Grau-Sologestoa, 2015; Groot, 2017; Trentacoste et al., 2021).

The second is that osteometry has so far represented a neglected aspect of the zooarchaeological research in this period. In the words of Umberto Albarella (2019, p.104): “Evidence of the morphological characteristics of Iron Age livestock is frustratingly limited. This is only partly because of the limitation of the datasets, as more than 70% of the reports ignore this question altogether”. Therefore, while other strands of zooarchaeological evidence can be fruitfully investigated by reviewing the literature, the collection and analysis of osteometric data in this work contribute with a considerable amount of previously unavailable evidence.

CHAPTER 2

Society and change in the Later Iron Age

2.1. Introduction

This chapter will review aspects of the archaeological record and the history of studies that are relevant to the reconstruction of how society worked and changed during the Later Iron Age, with a focus on topics that have ramifications in our understanding of the farming economy, which will be explored in further detail in the next chapter.

2.2. Background studies

A critical understanding of the inner working of an ancient society cannot be separated from that of the way the knowledge about its archaeology has developed over time. Over time, Iron Age studies in Britain have demonstrated great interest in self-reflection, and several studies made useful contributions to the subject (Evans, 1989; Hill, 1995a; Cunliffe, 2004, pp.3-24; Sharples, 2011; Champion, 2016; Collis, 2019; Hingley, 2019).

It is useful to summarise, in broad strokes, the trajectory of these studies in order to better navigate the sea of interpretations and narratives concerning life in the British Later Iron Age and define what kind of change in the archaeological record can be related to societal development.

To do so, I will proceed by describing major developments in chronological order while specific themes will be discussed in the next sections. Given the little space that can be dedicated here to this subject, the account will have to be concise and sometimes simplistic, but references to other works that treat the matters in more detail are provided in relevant sections. The studies on technology and craft techniques, trade and exchange, coinage, and art, while influenced by theoretical and methodological developments in archaeology, proceeded in parallel with the Iron Age studies without suffering substantial slumps in interest. Although they have been influenced and used in the broader discussion on society, their histories as autonomous specialisms are not strictly relevant to this review and will be mentioned only in passing.

We can trace the beginning of Iron Age studies well before their formalisation into an independent sub-discipline in the 1930s and 1940s, with notions of a Celtic past tracing back to the fifteenth century and informing much of the romantic ideas that still weigh on the perception of this period in the scholarly discourse (James, 1999; Collis, 2003; Cunliffe, 2003; Pope 2022) and its relationship with the public (Hingley, 2019).

It is however with the early 19th-century sacking of barrows and amassing of artefacts from casual discoveries that prehistoric material cultures raised the interest of collectors setting the foundation for future scholarly interest and interpretation. At the time, on the European mainland, some important discoveries (e.g. the sites of Hallstatt in 1846 and La Téne in 1858) and classificatory work on archaeological collections (first by Thomsen in 1836 who suggested the existence of the Iron Age, followed in the ensuing decades by the ever finer classification of Halstattian and Latenian materials) were creating the conceptual frameworks against which the British finds could be interpreted.

The last decades of the century saw important milestones with the first studies of historical linguistics on Celtic languages (John Rhŷs published 'Celtic Britain’ in 1882) and the first systematic settlement excavations which brought attention to the importance of studying occupational debris to reconstruct the lives of ancient populations (seminal in this sense was the work of Augustus Pitt-Rivers in some of his earliest excavation such as that of Mount Caburn in Sussex in 1877-78). In 1890, Arthur Evans publishes the LIA graves from Aylesford (Kent) which, with their rich set of interred goods, opened the Iron Age studies to the ideas of diachronic change and regional cultural differences. This was also the moment when the link between the material culture found here (and later in other sites) and historical evidence was first explored, interpreting the graves as proof for the Belgic invasions mentioned by Caesar.

Building up on all the data available at the time and the development of invasionist theories, Christopher Hawkes proposed in the early 1930s the ABC system, in which to every phase corresponded a new wave of invasion from the continent. The next 30 years were dominated by this culture historical framework which was refined and tweaked by various scholars but never rejected. In this context, we see the first emergence of two different schools of thought and broad conceptualisations of the British Iron Age, led by scholars of the so-called 'dominant' and 'subversive' persuasions (Sharples, 2011). ’Dominant’ scholars were those who saw Iron Age societies as strongly hierarchical and warlike and focused their research on central sites (in particular hillforts) and cultural change, with the historical accounts (both classical and medieval) strongly leading their interpretations. Conversely, ‘subversive’ scholars focused on rural settlements, farmed landscapes and continuity, representing Iron Age society as largely egalitarian and peaceful and drawing from anthropological analogies.

This contrast was not absolute, as many scholars could be positioned somewhere in the middle, but the dialectic relationship between the two extremes of the spectrum has informed the development of the discourse on the Iron Age for almost a century. This debate has been at times somewhat unnecessarily vitriolic and the polarisation has inhibited more innovative approaches from a broader and more plural base. In fact, the so-called ‘subversive’ proponents are mostly represented by established white British male scholars at prominent institutions, and it has recently been argued that the subversive views have ultimately become predominant (Hingley, 2019). This dualism has, however, driven the debate so far, and it has had, at least, the merit of questioning the basic assumptions we have about past societies.

During the 1930s two landmark excavations contributed to the discourse. Mortimer Wheeler, with the excavation of the hillfort at Maiden Castle in Dorset (Wheeler, 1943), drove the attention of the public, sparking public interest and a period focus on the excavation of hillforts. He also applied the ABC system to his finds, amending it and anchoring it to the absolute chronology of continental Europe in a fundamental step of the popularisation of this framework. Roughly at the same time, but further away from the spotlight, Gerhard Bersu worked at Little Woodbury in Wiltshire (Bersu, 1940), a small enclosed settlement whose excavation set a fundamental example of the importance of rural settlements to reconstruct the daily life of ancient people. Together with the introduction of methodologies developed elsewhere in Europe, Bersu's merit lies in revolutionising the interpretation of Iron Age sites by correctly using large postholes to identify roundhouses, and by interpreting pits as storage facilities, whereas these had previously been seen as dug-out dwellings.

By the 1960s the narrative of subsequent invasions began to find opposition, with Roy Hodson and then Grahame Clark rejecting it in favour of indigenous development. The abandonment of cultural historical approaches with the paradigm shifting to processual archaeology helped clear out the assumption and terminologies of traditional Iron Age studies.

Hodson's model emphasised continuity across late prehistory, insularity, gradual change, and economic development over cultural change (Hodson, 1964). In 1971, a reassessment of the available knowledge led Barry Cunliffe to publish the first edition of his Iron Age Communities in Britain, a monumental work of synthesis that has dominated Iron Age Studies to this day and had its 4th edition published in 2004 (Cunliffe, 2004). Although, as we will see, the narrative presented by Cunliffe has been amended over time and convincingly and relentlessly challenged on almost every aspect during the intervening decades (Collis, 1977; Haselgrove, 1986; Hill, 1995a, 1996), no other scholar has so far attempted a comprehensive survey on the same scale, and very few have explicitly attempted to explain social organisation on such a large scale (Hill, 2007), leaving Cunliffe's work in its position of essential reading to approach the subject and a cornerstone that "sets the research agenda for others to follow or react against" (Hill, 1995a, p.52). This model of the Iron Age followed Hodson's model and was informed by Central Place Theory, social evolutionism, and the idea of a universal Celtic society. Cunliffe's narrative can be briefly summarised (at least for its initial formulations between the 1970s and 1980s, and for the Wessex region) as follows: during the EIA a dominant, warlike elite inhabited the hillforts, which functioned as central places for well-defined tribal territories, managing the redistribution of resources within and controlling trade without; during the MIA the hillforts became fewer, controlling ever larger territories that eventually developed into the tribal kingdoms of the LIA. Social forms and cultural practices are recognised by filling the gaps in the archaeological record with the classical accounts of Britain and the continent, and those from medieval Ireland (following the ideal of a pan-European and long-living Celtic culture; see Collis, 2011 on the pseudo-historical pitfalls of this approach).

During the 1980s the interpretative focus shifted to cultural transmission with the application of core-periphery models (Haselgrove, 1982; Cunliffe, 1988) in the relationship with the Mediterranean world. This was favoured by the abundance of finds related to craft production and distribution and the introduction of novel analytical techniques (Hill, 1995c). These models identified the cause of change in the increased frequency of imported objects from the continent in the south-east of England from c. 120 BCE: these materials were interpreted as evidence for a large-scale commodity trade with the Mediterranean which the local elites would have promptly monopolised, causing increased social stratification and the birth of a local core area from which social change would have spread to the rest of the island (Hill, 2007). The 1980s also saw an increased interest in zooarchaeological and archaeobotanical studies (Hill, 1995c), which followed and contributed to a new interest in understanding the environmental context of sites and their economic systems (see Chapter 3).

The 1990s brought a radical change in the pattern of archaeological investigations as the practice of rescue excavation and systematic survey became more widespread. A flood of data became gradually available from the large-scale development-led excavation of sites that were not targets for academic research, bringing about both opportunities and challenges (Moore, 2006).

The reverberations of this phenomenon have not been homogeneous, and the geographical imbalance of investigations, biased towards the south of

England since the inception of Iron Age studies, and more recently to the east, has significantly reduced over time. Regional studies have flourished in the last couple of decades, but the overarching narratives are still very much based on the work done in the afore-mentioned regions. This is in part tied to the development of the discipline, whose focus has shifted over time on specific themes forsaking the need for synthesis, in part due to the nature of rescue excavation. This last is on one hand focused on the site scale, not lending itself to larger-scale studies and, on the other hand, is primarily led by private-funded development which follows current socio-economic patterns of wealth and demography rather than a research agenda. In fact, the areas where excavations are more frequent correspond to the richer and more densely urbanised areas which largely coincide with the same areas where the archaeology is already better known.

One notable feature of Iron Age studies in the 1990s was the focus on belief and behaviour of which examples are the plethora of studies on the orientation of houses with their implied correlation with cosmological beliefs (Speed, 2010) and the influence of symbolic behaviour behind patterns of deposition (Hill, 1993). While these topics have the potential to influence the reconstruction of Iron Age society (for example at the household scale), the focus has mostly been on the symbolic meanings of space, structured deposition, and ritual (Hill, 2007).

The limited debate on social organisation between the 1980s and the 1990s focused mostly on the Wessex hillforts and the Scottish brochs. The argument has been roughly summarised by Hill (2011), for the sake of simplicity, as an opposition between 'hierarchs' and 'levellers' scholars. 'Hierarchs' are proponents of ideas of Iron Age society that shared their theoretical approach and broad conclusions with the model first proposed by Cunliffe. 'Levellers' dispute the assumptions behind a hierarchical Iron Age and envisage more horizontal societies using hillforts and brochs as communal gathering sites and habitation.

Such a need to break away from hierarchical models became central between the 1990s and 2000s with attempts to draw on alternative models of pre-industrial societies to create a new consensus. Some notable examples of this new approach are represented by the adoption of Crumley's (1995) heterarchical model (Armit, 2007; Cripps, 2007; Moore and González-Álvarez, 2021), Germanic mode of production (GMP) according to structural Marxism (Hingley, 1984; Hill, 1995a), grid and group matrix for social analyses (Sharples, 2010, 2011), segmentary societies (Hill, 2011), and anarchy (Armit, 2019).

Some implications of these models will be further discussed in section 2.7, but it suffices to say here that, although the models and interpretations are many, a wide consensus has been reached on interpreting society in the British Iron Age as plural, fluid and having non-triangular social forms[5].

The 1990s also saw a shift in focus to regional analysis, which highlighted how previous narratives were mostly built on the available evidence from Wessex at the time and not necessarily representative of other areas nor of the complexity within Wessex itself (Davis, 2011). This led in the ensuing decade to a rethinking of the temporalities implied by the material record, with the understanding of the Middle Iron Age as a formative period and the adoption of the concept of the Later Iron Age (Haselgrove and Moore, 2007).

The 2000s also saw a definite reassessment of the core-periphery models created during the 1980s: not only the newly adopted ideas on social stratification and exchange would not have allowed for the monopoly of trade, but also the reappraisal of the evidence for long-distance trade downsized the impact of Mediterranean trade on British Iron Age societies (Fitzpatrick, 2001; Hill, 2007).

With the increasing development of the archaeological sciences and the retirement of most of the scholars that had been prominent in the debate

[5] Hill (2011) noted that many of the (mostly implicit) interpretations of the Iron Ages envisaged a hierarchical social form that could be represented as a triangle on a Cartesian diagram, with population on the x axis and social distance on the y axis. He further argued that the wider family of social forms that characterised the British Iron Ages can be better described with other shapes, lacking an apex representing a small social elite. The triangular conceptualisation is reminiscent of the early 20th century socialist caricatural flyers entitled 'Pyramid of Capitalist System' (e.g. Industrial Worker, 1911). Alternative shapes for the European Iron Ages have been widely explored in several contributions to the book 'Alternative Iron Ages' (Currás and Sastre, 2019)

during the last decades, the 2010s have seen the focus of Iron Age studies shifting back to finds studies on the one hand, the continuation of studies on regionality and the consolidation of the narratives based on non-hierarchical models (Moore and González-Álvarez, 2021).

2.3. Landscape, environment, and climate

Southern and eastern Britain presents a rather uniform climate defined as Temperate Oceanic (cfb) in the Köppen classification. This is particularly true for the three main regions considered in this study, in which elevation is usually below 200m OD and never reaches 300m OD; average temperature, daylight and rainfall variations are also modest and the lack of any relevant geographic boundary between the areas makes these gradual.

There are, however, notable differences in the topography and prevalent underlying geology which help separate these regions.

The landscape of Wessex, although it can present diverse and complex underlying geologies, especially by the coast, is dominated by the rolling grasslands of the Chalk Downs (see Sharples, 2010, pp.13–89 for a more comprehensive description of Wessex landscape). These had been thoroughly cleared at least[6] by the Early Bronze Age, with pockets of woodland surviving only in localised areas of higher ground. The downlands instead were dominated by a densely settled open landscape characterised by cultivation and, increasingly during the Iron Age, pasture. River valley bottoms were prone to seasonal flooding which created wetland environments that could be exploited for natural resources.

The downland and the upper reaches of river valleys have good drainage and were therefore rather dry. However, water was abundant in the landscape, since the western location and exposition to the tropical winds blowing across the Atlantic Ocean subjects this area to substantial rainfall.

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[6] There is evidence, at least for some areas, that open grassland never developed into decidous woodland in the earlier Holocene and that the major clearance event happened earlier, during the Late Neolithic (French et al., 2003).

The Upper Thames Valley extends towards the southern-central part of England, from its origins in the Cotswold to Goring gap where the river cuts through the chalk formation, separating the Berkshire Downs to the west from the Chilterns to the east. The region mostly corresponds to the county of Oxfordshire and parts of the neighbouring counties. The landscape of the upper part of the river valley is dominated by the gravel terraces deposited by the Thames and its tributaries, covered with mostly calcareous soils deposited from the chalk formations surrounding it (Lambrick et al., 2009, pp.17–23). By the MIA most of the valley presented an open landscape, cleared from woodland and scrub (relegated to the tributary valleys), dominated by grassland and with arable land on the upper terraces (Lambrick et al., 2009, pp.43–51).

Eastern England has a more diverse topography and geology. In contrast with Wessex, this area is relatively dry in terms of rainfall and more continental in climate, nonetheless, water is perhaps the most characterising feature of the landscape. The region is delimited by two of the major rivers of the country – the Thames and the Trent – and includes the Great Ouse and Nene rivers flowing into the Wash estuary which is surrounded by the Fen basin. The Fens include the lowest land in the UK and notwithstanding several known and unknown historical drainage operations, it still retains areas of marshland. Therefore, we can imagine that most low-lying land and riverine valleys inside and outside the Fens were characterised by wetlands during the Iron Age, making it such an important feature to influence landscape use both in farming and other types of production. Palynological as well as plant macrofossil and molluscan evidence show that land clearance and the subsequent use of the land for mixed farming continued throughout the Iron Age (Parks, 2012, p.38).

The climate across the British Isles was significantly colder and wetter than today during the first part of the first millennium BCE (Turner, 1981; Lamb, 1981; Bell, 1996) up until around 400-300 BCE due to reduced solar activity (Plunkett and Swindles, 2008).

After that, temperature and rainfall conditions reverted gradually, reaching a situation similar to that of today around the first century CE and further improving until the fourth (Lamb, 1981; Turner, 1981; Meyer and Crumley, 2011). It is difficult to gauge the effect of these climatic trends. Variations in rainfall might have allowed or precluded cultivation in especially dry or wet environments, whereas fluctuations in temperature altered growing seasons by weeks (Turner, 1981). It is, however, unlikely that the study area was severely affected by these variations to the point of rendering any economic practice nonviable over any extended area. In fact, there is palynological evidence that the period of climate deterioration did not affect significantly overall land use (Dark, 2006).

While the resolution of our understanding is probably insufficient to tell us how specific activities were affected, in turn triggering changes in the organisation of Iron Age societies, it will be useful to keep in mind that the developments of the Later Iron Age were accompanied by a general climatic improvement and that there is a chance that during this period the more extreme environments reached a tipping point in terms of their exploitability.

2.4. Settlement pattern and demography

2.4.1. Settlement architecture and categories

In general, all settlement forms in this period are agricultural in nature, lacking any substantial evidence for specialist and consumer sites, while urbanism is totally absent.

The dominant architectural structure of the British Iron Age is the roundhouse, which sets it apart from the rectangular building tradition of continental Europe, although this simple separation has been demonstrated not to be absolute (Moore, 2003). In fact, there are exceptions on both sides of the Channel and roundhouses are a common occurrence in northern France from the Bronze Age through to the Iron Age (Webley, 2015). However, the relatively universal adoption of circular buildings (including the brochs, wheelhouses and crannogs of Scotland) is probably one of the main factors in creating the image of a unified British Iron Age isolated from the Continent. Within the study area, all roundhouses were built with perishable materials, usually timber-post structures furnished with wattle-and-daub walls topped by conical thatched roofs. The size of these houses is variable, however. In central and southern England they tended to be large in the Early Iron Age and decrease in average size during the Later Iron Age (Hill, 1995c). Other structures present on settlement sites are usually considered ancillary, like the four-post structures that are commonly referred to as granaries but could have been used to store any agricultural resource or had a completely different function (for example, it has been suggested that some four-posters could have been used as shrines or excarnation platforms, linking ritual with the agricultural cycle, see Carr, 2007).

These structures form the atoms of a variety of different settlement types, present across the study area with regional and local variations. A hard and fast classification is made impossible by a high degree of variability and interpretative issues tied to the ephemeral and often scattered nature of the architectural evidence, the more or less extensive investigation of sites and landscapes and fine dating of single structures. An example of this is the increasing awareness of Later Iron Age large aggregated settlements being more common than previously thought, thanks to large-scale surveys and excavations in advance of development projects since the introduction of PPG16 in 1990 (Thomas, 2010). Furthermore, different authors tend to focus on different defining aspects in their classification, such as size, presence and nature of enclosures, degree of nucleation, position in the landscape, shape, and number/quality of foci. In reviewing the settlement pattern within the study area, it will be sufficient to distinguish between enclosed and open settlements (any farmstead or hamlet not surrounded by a large bank and ditch in the definition of Hill, 2007) to describe broad patterns of prevalence and their change through time in each region, although other aspects (e.g. nucleation) and specific site types (e.g. hillforts) will be mentioned when relevant.

Site type also affects their visibility in the archaeological record. This has been widely recognised for unenclosed settlements (Hill, 1995c), but the extent to which this affects our ideas on Iron Age settlements is hard to gauge, especially thinking that isolated unenclosed farmsteads could be very strongly underrepresented, possibly leaving large gaps in the settlement record in periods when these were most common.

Open settlements usually presented a chronologically shifting pattern of usually three to four contemporary roundhouses, with pits, ditches and ancillary structures in close proximity. The degree of dispersal/nucleation and the relationship with the landscape and other clusters of evidence is variable and its understanding is limited by the lack if precise boundaries, extensiveness and incomplete archaeological record. This makes further categorisations difficult.

The bounded nature of enclosed settlements makes their categorisation easier, although there is often little consensus on the definition of the great number of types that have been described. The complexity of this subject is exemplified by the discussion on hillforts (see Harding, 2012 for a review). Regardless of layout and size, enclosures in the study area tend to have one easterly oriented entrance, usually a simple break in the ditch (Hill, 1995a; Speed, 2010). When no evidence of an entrance is detected, it is assumed that the ditch was crossed by a bridge or a causewayed entrance. Enclosures are usually characterised by one or a few roundhouses usually in the central area, groups of storage pits (usually at the back of the boundaries), and often a sub-enclosure sometimes containing evidence for four-post structures (Speed, 2010).

2.4.2. Settlement pattern developments

Wessex

Throughout the Iron Age, enclosures characterise the landscape of the Wessex region (Sharples, 2010, p.53) and, although there are instances of unenclosed settlements, the absolute majority of sites are constituted by simple enclosures and hillforts. There is some uncertainty in the distinction between the two site types, but in general terms, the difference lies in the larger extension and size of the boundaries of hillforts and secondarily in their position atop or by prominent hilltops, whereas simple enclosures tend to be distributed across the arable part of the landscape. Their functions and relationship have been widely debated, and while all agree that simple enclosures with roundhouses represent farmsteads, it is argued that hillforts have some special function. Hill (1995b) unironically defines them as 'Not-Farmsteads' to highlight their variability. The review below mostly concerns the Wessex Chalkland, the best-studied and most discussed area of this region but, although some general patterns and descriptions might apply to the whole region, it must be noted that other areas present very different settlement patterns.

One long-lived view is that hillforts represent centres of coercive power and focal places for complex redistribution networks (Cunliffe, 2004, p.396); an alternative explanation is that they functioned as exclusively communal centres dedicated to ritual activity and did not represent stably inhabited settlements (Hill, 1995a). Sharples (2010, p.53-77) however, argues that the two settlement types are not evenly distributed, that even the smallest simple enclosure contains at least two households and there are no distinctive formal or functional differences aside from monumentality and visual dominance. Hillforts and simple enclosures then would simply represent different communities of different scales that strongly identified with the architectural boundaries of their settlements.

Enclosures in this region tend to reflect both the circular plan and the orientation (with the entrance towards the east or south) of the roundhouses which has been interpreted both in functional and symbolic terms (Pope, 2007; Bradley, 2012).

During the Middle Iron Age the boundaries and entrances of a few hillforts such as Danebury grew increasingly in size and complexity (into what is defined as developed hillforts) while other settlements were progressively abandoned (Cunliffe, 2004, p.388, Cunliffe, 2000, p.166). This phenomenon probably represented a process of nucleation of the scattered population from surrounding abandoned settlements (Davis, 2013). This process has been likened to that of proto-urban *oppida* in Continental Europe (Sharples 2014). Off the chalk, 'marginal' areas such as the coastal plains saw increasing occupation throughout the Iron Age (Hill, 1995a).

During the Later Iron Age hillforts are largely abandoned and settlement forms grow more diverse and specialised (as opposed to the largely autonomous and independent settlements of the previous phases).

Eastern England and the Thames Valley

The Eastern region was characterised by a prevalence of open settlements with more frequent enclosures in some restricted areas (e.g. the Thames Estuary and the Midlands, see Bradley 2019, p.301). Occupation tended to extend over large areas. Clusters of roundhouses and enclosed compounds can often be identified but it is difficult to define the topography of these settlements and to establish whether they can be considered villages or not as the lack of well-defined boundaries blurs the separation between different units across the landscape. Furthermore, the position of structures shifts through time, and it is often difficult to establish a chronological sequence due to the lack of direct stratigraphic relationships between different structures and a too coarse dating. Their shape and size also vary considerably not only from one area to another but also through time, creating a complex history of shifting landscapes (Hill, 2007). Open settlements remained common in the Thames valley (Hill, 1995c; Thomas, 1997), while in Eastern England enclosed settlements became more common during the latter part of the Iron Age (Champion, 1994).

Middle Iron Age settlement record in Eastern England shows a pattern characterised by clusters of dense agglomerated settlement and agricultural activity in river valleys with larger areas having only sparse settlement evidence and material findings (Hill, 2007). These latter were probably exploited in a less intensive manner, likely for seasonal activities: transhumant herding, salt-production, hunting and gathering of wild resources.

Hillforts or similarly large enclosures were rare, their distribution patchy (Hill, 2007) while other types of boundaries and enclosures, when present, tended to be sub-rectangular, which allowed for their compounding, in contrast to the isolation of the circular enclosures of Wessex (Bradley 2012, 279).

In the East Midlands, Speed (2010) identifies two different patterns with enclosed settlement during the Late Iron Age. On low-lying river gravels, enclosures tended to be rectilinear or D-shaped because they were integrated into the boundaries of field systems in a heavily managed landscape. On the uplands, usually on heavier soils, land clearance was not so developed, therefore the enclosures did not have to respect pre-existing field systems, so their shape was more irregular and curvilinear. Speed suggests that these differences probably reflect different farming practices.

In parallel to the rise of developed hillforts in Wessex, it appears that a similar process of amalgamation and nucleation might have been at work in Eastern England since an increasing number of larger open aggregated settlements presenting a similar development trajectory is being recognised in the East Midlands (Thomas, 2010) and elsewhere, characterising the landscape of the Later Iron Age.

2.4.3. General trends and late developments

In contrast with the Earlier Iron Age, the later part of the millennium is characterised by the widespread increase of enclosures and the bounding of space (Thomas, 1997; Haselgrove and Moore, 2007). The bounding of settlement and landscape has been argued to be a way to display corporate identity and even physically define the limits of social inclusion and exclusion (Speed, 2010).

The Late Iron Age also sees the emergence of a heterogenous group of new sites which has been classed as *oppida* (for a review on this theme, see Pitts, 2010), a term used by the Romans to define large, defended settlements in Gaul. The use of this term is not without problems in its blanket application to continental sites (Woolf, 1993) and it is even more problematic in Britain (Hill, 1995c); nonetheless, attempts at classification have been made (Cunliffe, 1976). Most of the problems probably stem from the need to find a native site type to forcefully insert as a first step into a preconceived and necessary path towards urbanisation. It is true that some of the sites defined as *oppida* across Europe and Britain have ultimately become Roman cities, but it is evident that different sites could present favourable conditions for urbanisation under the Roman rule, without necessarily having urban or proto-urban characteristics themselves. It is equally evident that not all the *oppida* became cities. As a matter of fact, many Roman cities developed from *vici* associated with military forts or roadside settlements, showing that a fundamental drive for urbanisation came from the necessities created by the Roman system of political control.

What is common to these new sites is that they represent the expression of a wave of substantial change in the Iron Age way of life, with a new tendency for settlement specialisation (Bryant, 2007). Some of these sites present unprecedented size or degrees of nucleation whether they are enclosed, are part of a larger landscape bound by earthen banks (the so-called territorial *oppida*) or are simply large, nucleated settlements. Other sites' novelty resides in their strategic position by the sea (e.g. Hengistbury Head in Dorset and Mount Batten in Devon) or other major water courses, with their distinctive role in the trade network represented by a relatively more abundant frequency of continental imports when compared to contemporary sites in the same area (Pitts, 2010).

Many of these new settlements appeared in areas that were previously regarded as marginal (see 3.1 – Introduction). This can be seen as evidence for a changing landscape of social relationships in the context of demographic and settlement expansion (Hill, 1995c). Their foundation is, in fact, part of a larger phenomenon of expansion which characterises the Later Iron Age, with an increase of settlement density in the previously inhabited area and the new occupation of areas which previously did not support stable and/or large populations (Hill, 2007). The reasons and modalities of this 'colonisation' are not yet clear and, although they cannot be identified solely with demographic pressure, they surely required a population surplus.

Only one of these settlements, Silchester (Hampshire), appears to present substantial similarities with *oppida* in Northern France in terms of layout, artefact assemblages and dietary preferences, to the point that the presence of settlers from Gaul has been suggested (Moore, 2016). Similarly, the presence of Gaulish immigrants or traders has been suggested for Skeleton Green (Hertfordshire) and Hengistbury Head (Dorset) (Fitzpatrick, 2001) even though the idea of large-scale movement of population from Gaul to Britain in this period has been convincingly dismissed (Champion, 2016).

2.4.4. Evidence for demographic expansion?

During the Iron Age, most of Britain was cleared of woodland, even in areas (in the north and west of the country) where the process had been more discontinuous during previous periods (Dark, 2005). The process of clearance was not homogenous but apparently intensified from 400 BCE. This is suggested by an increase in arable weeds accompanied by a decrease in pasture weeds, with mollusc evidence changing accordingly (Turner, 1981). Furthermore, landscape studies suggest that farming expanded on heavier soils during the Later Iron Age (Haselgrove and Moore, 2007).

Demographics are assumed to correlate with settlement density and size, both of which seem to increase substantially during the Later Iron Age (Hill, 1995c, 2007) or even earlier in some areas (for central southern Britain see Cunliffe, 2004, p.593). Lands previously devoid of settlement evidence became increasingly more populated from the onset of the Middle Iron Age (valley bottoms, clays, fen edges and islands). Although this is generally accepted as evidence for population growth, we must note that it does not preclude other explanations like population displacement or the aforementioned archaeological bias towards enclosed and more stable forms of settlement. Even so, demographic expansion is widely accepted in Iron Age Studies, and in the lack of arguments to the contrary, it will be accepted in this research as a working hypothesis.

2.5. Modes and scales of production

2.5.1. Artefact production

The organisation of artefact production is central to the understanding of how society worked and changed over time. As with many other aspects of Iron Age societies, the model of accumulation and redistribution centred around hillforts (Cunliffe and Miles, 1984) has been widely adopted, frequently questioned and challenged, without being completely replaced. As with the other aspects, this has mostly to do with the fact that the increasing understanding of regional differences in Iron Age Britain makes it impossible to adopt a single model to explain a wide variety of archaeological realities, while the central place model remained a comfortable framework to work with even in areas where hillforts were absent. There is, however, no convincing evidence linking the hierarchy of production and distribution to site type (Morris, 1996).

Artefacts made with perishable materials probably represented the bulk of the tools and implements used on a daily basis in this period. Since these objects are generally not preserved in the archaeological record, the discussion on production and circulation is mostly limited to objects made of clay, metal, glass and stone.

Craft production saw a pattern of increasing scale and specialisation from the start of the Later Iron Age, which, however, was not linear nor geographically homogeneous and with little evidence for the centralisation of its control (Hill, 1995a; Champion, 2016). There was, in fact, a wide variety of levels of production, ways of organisation and networks of exchange (Morris, 1996).

Both iron working and pottery production appear to have been small-scale and short-term activities throughout most of the period. Substantial or permanent facilities were not built for the purpose (but appeared at or after the end of the period) and involved several tiers of workers, with at least some of the activities practised ubiquitously, pointing at the combination of widespread knowledge of some basic techniques, while itinerant specialists would take care of the production of more elaborate objects, as it is also suggested by the awareness of the changing continental styles (Hill, 1995c; Champion, 2016). A further division, seen both in iron and glass working, is that between the specialised skills of those who worked the raw materials (smelting and glass-making) and the often less specialised skills of those who made the materials into objects (smithing and glass objects crafting) (Morris, 1996). Materials with localised source areas such as shale, jet, stone for querns and glass obviously had more localised and possibly more specialised productions but were still conducted on a small scale.

During the EIA pottery was mostly produced on the small scale at the local level, although evidence for limited trade of fine wares exists (Morris, 1996). The MIA is characterised by distinctive types of pottery, with the emergence of larger scale productions and the disappearance of local productions in some areas: while most of the island retained a tradition of local productions, areas in the west and south developed a second tier of production destined for regional distribution. The LIA saw major changes in pottery production with south-western Britain adopting the technology for wheel-thrown vessels, investing in kiln structures and switching to a more specialised workshop industry scale of production (Morris, 1994), while Eastern England further retained local production systems. The spread of these new forms to other parts of the island was not even, and in many areas happened right before or with the Roman occupation (Morris, 1996).

The technology involved in salt production seems to have been relatively simple (coarse, handmade drying vessels, basic hearths, water channels and plank-lined pits), comparable to that of household pottery production. There is no evidence for strict control or prestige deriving from the practice (lack of structural defences and luxury items) and relatively small distribution areas for salt containers (Morris, 1996). Salt production seems to have intensified from the MIA onwards, though it does not seem that the increase in the frequency of salt-production finds is greater than that of pottery finds so that it represents just one aspect of the general intensification of production (Morris, 1996; Lane and Morris, 2001; Morris, 2007).

The seasonality of production activities can be driven by the seasonal availability of resources and/or by the timing of product requirements (DeRoche, 1997). That British Iron Age production did not deviate much from these basic necessities is mostly suggested by the lack of specialisation and stable structures. There is, however, for salt production, evidence of sites with briquetage but no pottery, which suggests they represent satellite camps dedicated to these activities (Lane and Morris, 2001).

2.5.2. Property and labour

The increasing enclosure and parcellisation of the landscape during the Later Iron Age might be symptomatic of a change in land tenure, with smaller communities owning and using the land (Hill, 2011). On a broader chronological scale, the prevalence of enclosed settlements during the Iron Age, as opposed to open settlements in earlier prehistory, has been argued to have symbolic significance, marking social divisions between groups valuing land property more as the landscape was used more intensively (Thomas, 1997).

Given the relative uniformity of finds within the same region and the generally small size of the settlements, it has been suggested that the means of production were generally owned at the household level in areas where small enclosed settlements predominated, and at the community level where larger agglomerations were more common (Hill, 1995a, 2007). However, the evidence does not suggest the existence of powerful individuals holding rights on land and people. Without more evidence pointing towards specific social forms, it is difficult to say on what level of communality property and labour were managed. What is certain, is the contrast between the apparent insularity of Iron Age settlements and their constant reconstruction. The amount of workforce and resources necessary for each construction event entailed some form of extra-household cooperation and was used to articulate social space (Moore, 2007; Wigley, 2007).

Assuming that communal and horizontal social forms constituted the norm (2.7 – Identity and social structure), even prestige objects, especially metalwork, could have been owned by a community and bestowed to its members as symbols of the offices or status acquired in competing and acting for the benefit of the whole group (Hill, 2011).

2.6. Exchange and mobility

2.6.1. Local mobility

The archaeological evidence gives us a picture of a society which focused its production on the local scale (see sections 2.5.1 – Artefact production and 3.4.1 – Self-sufficient communities?). Hill (1995a, pp.60–61) notes how in Iron Age Britain all the production, social and ritual activities had to revolve around the agricultural year, since the economic focus was on farming more than in any other period.

In practical terms, without evidence for any full-time specialised activity, we assume that at least some members of each community would have been engaged in non-agricultural activities when the farming cycles allowed it. These would have included the gathering of resources (quarrying, timber felling, clay winning, salt production), construction and craft activities (pottery making, metalworking, tanning, wood and bone working), but also exchange, warfare and ritual. Therefore, if we can imagine life focusing mostly in and around the settlement, some of these activities were dependent on resources that could have been found at some distance from the settlement, in upland, forested or wet areas. For example, just the amount of timber necessary to build a single roundhouse would have required more resources and labour than a single household and locale could have possibly provided (Lambrick et al., 2009, p.261; Davis, 2010).

Furthermore, although the evidence for transhumance is so far scant, some forms of short-distance horizontal livestock movement were probably necessary unless we assume very intense and advanced foddering practices. On a slightly larger scale, seasonal gatherings of people and animals were most probably required to exchange livestock to avoid inbreeding (Jones

1986, p.92) and procure whatever resources and objects were not available around the settlement.

Stable isotope analysis on animal remains has started elucidating these assumptions, confirming the existence of forms of cooperation between neighbouring sites and at least some form of long distance livestock mobility (see sections 3.2.2.6 – Livestock mobility and 3.4.1 – Self-sufficient communities?).

2.6.2. How did exchange work?

Iron Age studies have been traditionally conservative in the theoretical understanding of exchange when compared, for example, to Bronze Age studies (Sharples 2010, p.112). Exchange relationship largely exists on a spectrum, emphasising the exchange of either commodities or gifts. Since our contemporary society emphasises the former, it is much easier to think of objects moving hands in the past in a way that is more familiar to us. It is, however, evident from the anthropological literature ever since the publication of *The Gift* in 1925 (Mauss 2016; see Sharples 2010, p.92 for further references on the topic) that this is not necessarily the case in all societies.

While most of the discussion on exchange is done in specialistic work and/or in a rather dry tone, simply by stating distribution ranges and distances, the socio-economic implications of exchange are almost never formally discussed. Exchange is mostly assumed to consist of the trade of commodities, often implying the core-periphery models proposed in the 1980s and never fully replaced (see 2.2 – Background studies).

These models envisaged Iron Age Britain becoming a subaltern, peripheral part of an imperial trade system and its Mediterranean core. This in turn would have transformed areas in the south and east of the island into regional cores, exploiting their role as intermediaries in long-distance trading with Rome in a mercantile fashion, draining commodities from peripheral areas in northern and western England (Haselgrove, 1982). This idea has not held to scrutiny, as it has been recognised that the amount of imports from the Mediterranean world was not substantial (Hill, 2007), and the imports probably derived from cross-channel social interactions with Northern Gaul.

This means that the discourse on exchange is often addressed only for the Late Iron Age when the Roman conquest of Gaul is taken as the starting point of these relationships. The idea of a Late Iron Age shift to commodity exchange is actually supported by the evidence: low denomination coins make their appearance (Cunliffe, 2004, p.601), settlement nucleation and mobility intensified, and increasing specialisation is attested both in artefact production and farming. These factors both responded to and increased the opportunities to exchange without the restricted group of kith and kin, making forms of exchange that do not necessarily imply social debt more desirable.

It is more difficult to assess the intensity and homogeneity of this shift but given the nature of the evidence (see 2.5.1 – Artefact production), it was most likely gradual and piecemeal.

Therefore, we can envisage exchange during most of the Iron Age as being based on gift, where objects, labour and food were given to create friendship and social obligation, building complex relationships within and between social units. This had implications on how political entities and identities were constructed, and how objects moved over long distances and were displayed/disposed of. An example of how this applied is the construction of settlement boundaries in Wessex (Sharples 2007), which required kin groups to come together in a labour, food and construction resources potlatch that absorbed a good part of their spare capacity. While this does not apply to areas where hillforts were not built, we can imagine that similar relationships (perhaps on different scales and with different modes) were used to build roundhouses and boundaries and to obtain resources (e.g. salt-making).

2.6.3. Exchange networks and contact with the Continent

The discourse on Iron Age Britain, based on networks of prestige item exchange, has long implied its isolation from the continent after the breakdown of the Atlantic networks of bronze exchange at the end of the Bronze Age, and throughout the period until its last two centuries, which were seen as an anticipation of its entrance in the Roman market (see Webley 2015 also for an interesting discussion on the historical reasons of the insularity of Iron Age studies in Britain).

Webley (2015) attributes the idea of isolation to a disproportionate focus on certain classes of fine and decorated objects that actually stopped circulating during this period. Other aspects of Iron Age culture (utilitarian objects, settlement patterns and architecture, ritual and mortuary practices) remained part of a complex web of relationships with different parts of the near continent. Therefore, the Channel and the North Sea never really represented a cultural boundary, exchange simply took less univocal and definite forms.

While it is true that contact with the European mainland in terms of decorated artefacts and fine metalwork was strongly reduced during the period following c. 600 BCE, it was not completely absent with evidence of long-distance movement of both finished objects and working materials going both directions (e.g. Mediterranean coral in Britain, Dorset shale in Central Europe).

Within the context of the increasing regionalisation of decoration styles, it is interesting to note that clear parallels have been found between various parts of southern England and northern France (Cunliffe, 2009). Daily objects such as looming weights, combs, and iron tools were near identical on both sides of the Channel, while the rotary quern seems to have been introduced in northern France from Britain (Webley, 2015).

The aforementioned evidence for roundhouses in northern France as well as that of circular buildings in northern Iberia is probably more suggestive of the permanence of a long-lived Atlantic tradition than actual contact, but it is interesting to note that the pattern of increasing enclosure and more stable settlement pertained to both sides of the Channel (Webley, 2015). Southern

Britain also seems to have been participating in broad north-western European traditions of ritual metalwork deposition in the landscape (Webley, 2015).

As concerns weaponry and personal adornments, types used during the Iron Age were not usually direct imports but presented nonetheless a common development with those used on the continent (Champion, 2016). Brooches, introduced in the fifth century BCE, became more common than dressing pins at the beginning of the Late Iron Age (Adams, 2017). Gold, almost absent in the British record from about 800 BCE, reappears in the Later Iron Age, especially with the introduction of coinage during or before the second century BCE (Champion, 2016).

The appearance of gold coinage during the Late Iron Age has been interpreted as confirming the existence, attested by literary sources, of complex relationships based on gift-exchange between different communities in southern Britain and northern France, possibly also indicating the movement of mercenaries or allies across the Channel during the Gallic Wars (Sharples, 2010, p.148; Moore, 2016).With the tightening of the relationship with La Tène Gaul during the Late Iron Age the importation of wine and bronze vessels from Italy also intensified (Champion, 2016).

Along with the imported pottery, came both a new ceramic vessel repertoire and the wheel-thrown pottery technology, which progressively became widespread through the first century BCE.

If most of Britain presents a remarkable absence of formal burials in the archaeological record throughout the period, making it difficult to discern local and regional differences in practice, there are however a few areas were distinctive burial traditions have strong continental parallels suggesting forms of contact (Webley, 2015). One such case is that of the fourth BCE to first CE stone cists inhumations from Devon, Cornwall and Scilly, comparable to contemporary cemeteries in Guernsey and probably Brittany.

The second group is represented by the inhumation burials of east Yorkshire, dated between the fourth to second centuries BCE (a comprehensive review of this area and period can be found in Giles, 2013). These show a number of parallels with elements of traditions from different parts of northern Gaul, mixed with local elements.

The third regional tradition is represented by the cremation rite of south-eastern England during the first century BCE and first century CE, which shows close similarities to contemporary practices in northern France.

The presence of these different mortuary traditions demonstrates the movement of people and ideas to the point of influencing fundamental beliefs and practices.

With the Late Iron Age, we see a surge in the visibility of cross-Channel contacts, with more imported coins and pottery found in the record. These are initially concentrated in so-called ports of trade of the South-West, such as Hengistbury Head and Poole Harbour, although there is little evidence that the imported goods were redistributed further away from these centres. By the time of the Roman conquest of Gaul during the first century BCE, the major exchange route shifted to south-eastern England, where the materials appeared to have a wider distribution inland. Therefore, as Webley (2015) postulated, it is not the presence or absence of contact that changes in this latter period, but rather the nature of what and how things are exchanged and the implications they have for social relationships and their cultural use and the inclusion into an increasingly internationalised network of practices and ideas.

In noting that most of the Later Iron Age developments in Northern France mirror closely those on the other side of the Channel, Haselgrove (2007) pointed out that a sea journey connecting the estuaries of the Thames and the Somme would have been easier than travelling overland to most other places in Britain

It is therefore evident that isolation from the continent is only apparent. Britain’s participation in the north-western European Iron Age was constant across the period, though not as a passive receptacle for continental developments. The degree and quality of artefact exchange changed through time, as well as the adoption and interpretation of cultural traits. Even the aspects that were becoming more markedly regional, such as pottery decoration, in constructing a distinctive identity might have represented a reaction to increased contact (Hill, 1995c) and were part of a wide European trend (Haselgrove, 2001).

2.7. Identity and social structure

2.7.1. Identities

From the varied nature of settlement, burial rites and ceramic evidence, through analogues in the literary evidence from Roman and Medieval times, Moore (2011) suggests that identities might have been expressed on the local level rather than as ethnicity. These identities were based on complex and shifting perceptions of kinship and status with very little evidence for centralisation. Furthermore, identities could have been multiple and perceived on a diverse range of degrees for each individual, representing a complex of social relationships. Hill (2011) suggests that particular groups and the conquering Romans both would have tried to simplify this complexity to impose their control.

The general lack of formal burials[7] in the archaeological record has greatly contributed to obscuring our understanding of the British Iron Age identities, whether they be cultural or social. The general consensus, until recently, attributed the finding of human remains in settlement context to excarnation practices (Carr and Knüsel, 1997). While the general dearth of formal cemeteries and the practice of deposition of human remains within settlement could be seen as a general trait of British Iron Age societies, there is a growing corpus of evidence for local traditions and, even with excarnation, variations in practice have been observed (Carr 2007).

[7] An “archaeologically invisible “ mortuary rite (Carr and Knüsel, 1997), while the examples cited in 2.6.3 are regional traditions and furthermore probably represented minority rites (Carr, 2007).

Furthermore, recent works with a focus on bone taphonomy have started to paint a more complex picture, highlighting that a diverse range of practices can be detected even within single settlements and that excarnation was not likely to be a majority rite (Madgwick, 2008; Booth and Madgwick, 2016).

The distribution of coins does not appear to be particularly indicative of identities, rather it represents social networks in which coins changed hands reflecting the fluid shifting of individual allegiances (Moore, 2011).

The spread of different brooch types seems to be more informative, as it shows correlation to distinct areas of *oppida* foundations and the waxing and waning of Late Iron Age polities (Pitts, 2010).

2.7.2. Social structures: heterarchy in the U.K.?

During the Early and Middle Iron Ages, there is little evidence for social or wealth differentiation within and between settlements on the local scale: architecture, foodstuff and material culture (including the rare imported goods) are in general qualitatively uniform, allowing for distinctions based only on quantity and size (Hill, 2007), while the invisibility of the mortuary practice suggests, if anything, a certain degree of egalitarianism. During the Late Iron Age new site types, mortuary practices, production modes and relationships with objects and exchange make their appearance: this has often been taken to signify a shift to more hierarchical societies. However, this ignores the possibility that such material manifestations can as well be expression of the constantly negotiated nature of power (Moore and González-Álvarez, 2021).

The idea that we can define a single model of social form in the Iron Age has been refuted by the realisation that previous, easier narratives based on a single hierarchical model were built upon outdated ideas and colonialist preconceptions (see also 1.4.3 – On tribal identity and 'Celtic' past). These were inadequate to explain relative uniformity of the archaeological evidence on settlement or local scale, while the distinctive differences on the inter-regional scale point towards the idea that a diverse range of non-hierarchical social forms existed.

One thing all the models mentioned in section 2.2 capture from the archaeological record is the lack of a central authority. Whoever held power at different scales (households, communities, kinship groups, tribes) did so through competition and cooperation rather than by rank and status. This meant substantial fluidity of society, where social inequality between individuals and groups brought transient status differences that could have been renegotiated within a generation or less. This implied some form of social control, related to the agricultural regimes, the inheritance systems or other social institutions intended to prevent the passing of acquired privilege (Hill, 2011).

These relatively egalitarian societies (in comparison to the more stratified social forms appearing in central and southern Europe) can be described as composed of corporate groups (pooling resources and land), emphasising the collective over the individual. The scale of these groups and how these were built upon kinship or co-residence, as well as how they contributed to the construction of identity, is unclear as different models focus on different scales or social units (e.g. the household in the Germanic mode of production), but it probably varied greatly through time and space.

What is important to consider for the aims of this research, is how these societies reproduced themselves in the landscape and their relationship to production and ownership.

In terms of the reproduction of social units, it is interesting to consider the model of segmentary societies adopted by Hill (2011). In the absence of a centralised power, a possible way to resolve conflict within a group could have been the fission into two separate entities. This would have prompted one of the two sides to leave their original settlement to found another, resulting in the settlement expansion and discontinuity of settlement that we see during the Later Iron Age. A similarly fluid social dynamic is also suggested by Sharples (2010) who also includes the opposite phenomenon of fusion. Through warfare and/or social competition, Iron Age groups could have occasionally absorbed one another. An intensification of such episodes of fusion could explain the increasing nucleation and the appearance of aggregated settlements without necessarily requiring social stratification and a coercive elite.

As the demographic increase progressed, the communities emerging from said episodes of fission would have started finding it hard to secure the same level of access to resources, which would have fostered new types of relationships between communities (not necessarily in a purely hierarchic sense). In turn, this could have required the rethinking of land tenure, production and exchange. The shift to commodity exchange, in particular, could have greatly contributed to dismantling the institutions acting as social levellers by introducing the opportunity for individuals and communities to accrue and pass on economic power and prestige. The afore-mentioned (2.5.2 – Property and labour) change in the concept of land ownership entailed the increasing bounding of settlement and landscape could be seen in this case as a reaction to the difficulty encountered by later communities to maintain self-sufficiency: if agriculture was already a political activity, producing surplus used to fuel competition (Hill, 2011), then the creation of visible thresholds was most probably related to an increased need to physically enforce land rights and manage situations of conflict (by defining sides and either prevent or trigger confrontation).

However, the evidence for social and wealth stratification remains scant even for the Later Iron Age, mostly limited to the inscribed coins, new funerary practices including burials with grave goods and the mention of chiefs and kings in the Roman literary sources. These might well represent the fluidity of the substantially anarchic (or heterarchical) Iron Age society, rather than the completion of a social restructuration, a state of flux in which some of the Iron Age people of Britain were experimenting with heightened individual power and rank. The involvement of these early polities with the Romans and the subsequent Conquest never allowed them to stabilise in a new status quo. Alternatively, they might have just represented change within a heterarchical system. After all, the LIA traits of social complexity, or at least their heightened archaeological visibility, do not need to be necessarily explained with hierarchy, since we know that heterarchical society can be just as complex. Elements of hierarchy and heterarchy can coexist within a single social system, and hierarchy can sometimes be a temporary solution to maintain order during a crisis in a prevalently heterarchical society (Moore and González-Álvarez, 2021). Furthermore, in heterarchical societies, 'Big Men' usually acquire material visibility when they are able, or have the opportunity, to display their power (as emanation of their organisational talent). This means that material manifestations of power become more relevant as the scale of society[8] changes through increased population density and mobility (Moore and González-Álvarez, 2021).

2.8. The Roman conquest and its consequences

2.8.1. Roman influence before the conquest

Possibly, the Romans already had a limited presence in parts of Britain before the historical starting date of the Claudian campaign: Caligula's planned invasion might have already established some footholds, and in any case, client relationships with some British communities had been established since the Caesarian expedition in 55 BCE. Roman direct intervention and garrisoning of friendly or client kingdoms were not uncommon, and some early military sites in the south could have been established before we think (Creighton, 2001). There is no reason to think that Roman influence was limited to the military sphere, as there is plenty of evidence for increasing long-distance trading well before the conquest. As we will see in the next chapter, the Roman influence on Iron Age animal husbandry and farming, in general, is not apparent until the Conquest and not in a uniform manner even then. However, caution is needed in

[8] Intended as both the size of a society and the quality of the extent to which an individual interacts with the same people in different social situations. For example: a small-scale society could be composed by tens of individuals sharing virtually all their social relationships. For a review on the definition of small-scale society see Reyes-García et al., 2017.

interpreting data from sites closer to the transition period, as they could have already been touched by the incoming wave of change.

Past ideas on core-periphery relationships and Romanisation would have ascribed all or most of the changes occurring during the Later Iron Age to the shifting of Britain into the Roman orbit after the conquest of Gaul. The reality before and immediately after the conquest was probably more akin to that of the American Great Lakes region during the European colonisation: “the old cultural norms had been fatally disrupted, but neither side had established a new permanent social or political order; in which conflicting languages, religions, technologies, modes of exchange, and patterns of social relationships were accommodated” (Champion, 2016).

2.8.2. Roman Britain

Regardless of the more intangible expressions of cultural change, the Conquest translated into a series of intertwined developments that directly affected the farming economy (3.3 – Agricultural change in Roman times) and are therefore worth summarising here.

Entering the Roman world Britain saw a definite increase in mobility, with merchants, soldiers and a much higher number of people involved in the military logistics, as well as colonists of various extraction temporarily or permanently moving in and across the island (Wallace, 2016).

This in turn fuelled urbanisation and great demographic increase. The estimates on population size and rate of growth attempted by various scholars, based on the size and/or frequency of Roman settlements compared to historically recorded pre-industrial societies have yielded differing and sometimes contrasting figures. They are, however, in agreement concerning the radical character of the demographic increase that must have at least doubled over the first two centuries of occupation (Fulford and Allen, 2016).

As a consequence of population growth and the new phenomenon of urbanisation, the scale of production increased for virtually every artefact type, raw material or resource. What is more, the modes of production changed as an almost-industrial and specialised scale of production expanded to unprecedented quantities of commodities. These had to rely on new forms of social relationships to organise and feed the required workforce to be produced and were exchanged outside the 'traditionally' self-sufficient local communities of the Iron Age (to the new exclusively consumer military and urban sites).

These changes were expressed in the radical developments of settlement patterns and hierarchy as well as in the distribution strategies which were affected by the imperial administration in that they had to accommodate for the taxation system and the military: taxes required production surplus to be converted into commodity and money, while a large non-producing population of soldiers and camp-followers would have been largely maintained by said surplus (Millett, 1992; Mattingly, 2007; Bang, 2008; Campbell, 2017)

2.9. Summary and points to carry forward

There are several points across this review which will become very relevant while discussing the farming economy and social change later:

- Land clearance greatly intensified during the Later Iron Age; at the same time climate conditions became slightly more favourable for agriculture.
- Virtually all settlements were small and mostly involved in agriculture. This started changing towards the end of the period, when demographic pressure led to settlement expansion.
- Non-agricultural forms of production tended towards the small-scale and unspecialised, though there is some limited evidence of specialisation towards the end of the period.
- Mobility likely increased across the period, but exchange cannot be classified as commodities trade.

- Seasonal ‘gang’ work was at the base of much of the production and exchange between social groups.
- Although it is very difficult to define cultural or political identities in this period, it is evident that a plurality of social forms existed across time and space. These can mostly be described as heterarchical.
- The degree of general change after the Roman conquest is more substantial and definite, while in many respects more difficult to gauge throughout the Later Iron Age.
- Blurred boundaries between the Iron Age and the Roman period, ingrained colonialist preconceptions, and the manifestation of change through increasingly visible material culture in both periods, have created confusion between native developments and passive reception of alien cultural traits.

'Solum praeter oleam vitemque et cetera calidioribus terris oriri sueta patiens frugum pecudumque fecundum: tarde mitescunt, cito proveniunt; eademque utriusque rei causa, multus umor terrarum caelique.'

The soil bears crops besides oil and grapevines and the other things that usually arise in the warmer lands and is abundant in herds: they ripen slowly, while they come forth quickly; and there is the same cause of both things, the great wetness of the land and sky.

Tacitus, Agricola XII, 5

CHAPTER 3

Agricultural economy and animal use in Iron Age Britain: a review

3.1 Introduction

This chapter will try to present a state-of-play overview of the studies about farming practices, economy and diet in the Pre-Roman British Iron Age; it is not intended to represent an exhaustive review of all zooarchaeological and archaeobotanical work in the area, but rather, it will serve as a baseline to discuss the results presented in Chapters 6 and 7. More space will be dedicated to the faunal evidence since that is the nature of the primary evidence used in this study; additionally, archaeobotanical studies are less abundant in the literature. However, farming practices are complex and integrated systems, therefore botanical evidence should not be ignored. Evidence from other environmental and landscape studies is more difficult to link to farming practices and is less organically treated in the literature, so they will only be mentioned when relevant.

Some considerations, referring to the British Iron Age in general, are inevitably simplistic and biased towards the evidence from the areas that have received more attention in the literature. The regional divisions set out in Chapter 1 will be largely followed, although the regional reviews and larger-scale synthesis used here as sources consider larger or differently defined study areas. This is compensated by the fact that the majority of the evidence is concentrated in the areas that are shared by both this study and the reviews (e.g. Wessex in Hambleton, 2008 and the western part of the East of England in Parks, 2012 and Albarella, 2019).

In general, the faunal data available for this period is significantly richer than any other prehistoric period. This is due to a general increase in the frequency of archaeological sites and a shift in the relative abundance of different types of sites preserved, from the funerary monuments of the Bronze Age to the settlement sites of the IA, where most of the faunal material can be found.

This increase is partly tied to what has been referred to in the literature as agricultural intensification or, more appropriately, expansion (for a discussion on the associated terminology see van der Veen and O'Connor, 1998). A general and progressive, if asynchronous, increase in land clearance and management accompanies all of the later prehistory since the introduction of agricultural practices (Simmons and Tooley, 1981, pp.264-269; van der Veen and O'Connor, 1998; Lambrick et al., 2009, pp.34-35; Sharples, 2010; van der Veen, 2016), with extensive clearances in places creating open landscapes during the Bronze Age and throughout the Iron Age. The opening of the landscape corresponded to an increase in the proportion of land dedicated to arable agriculture, which reached an unprecedented scale in the Roman period with the establishment of a non-domestic agrarian system oriented to provide for the need of the Roman urban population, taxation cycle and military supply.

In between, and peaking between the Middle and Late Iron Age, population increase and settlement expansion accelerate dramatically (see Ch. 2).

It is therefore important to see how farming practices adapted to sustain such an increased population. Following van der Veen and O'Connor (1998) types of expansions, I will try to answer a series of questions after critically reviewing the literature:

+ were new areas brought under cultivation or pasture?
+ were choices made in terms of introducing or shifting to different crops and animals to increase productivity or adapt to different situations?
+ In what respects intensive (increase productivity without extending the cultivated area) and extensive (extend the cultivated area without increasing its productivity) practices were adopted?
+ were any forms of specialised production introduced?
+ did subsistence economies shift to any form of redistribution economy (i.e. market-oriented)?

Since the term will recur throughout the chapter, a note on the use of the word marginal is needed. With marginal will be defined all the land that in specific areas and times, under specific land management and farming practices is not considered suitable for crop farming. Defining them marginal does not equate to saying they had no economic value or were uninhabited. As a matter of fact, some of these were central to pastoral activities, woodland management, manufacturing and the exploitation of wild resources. Their marginality is a consequence of their more extensive, seasonal or occasional use. Marginal areas usually include wetlands, heavy clay soils and some steep or rough terrain.

3.2 Animal and plant economy: general trends

3.2.1 Evidence from plants

3.2.1.1 Crops cultivated

The principal crops cultivated across the British Iron Age were emmer (*Triticum dicoccum*), spelt wheat (*Triticum spelta*) and six-row hulled barley (*Hordeum vulgare*). It has been emphasised that generalisations applying to the whole island should not be used, as patterns of variations in crop choice could be regional as demonstrated by archaeobotanical studies

(Parks, 2012, pp.231-232). Both Southern and Eastern England show a dominance of spelt and barley, with spelt largely replacing emmer by the Middle Iron Age. Emmer is already thought to be present only as a contaminant of spelt crops in Southern England and the Thames Valley by the beginning of the Iron Age (Campbell, 2000; Lambrick et al., 2009, p.258). In contrast with Southern England, emmer and bread wheat (*Triticum aestivum*) cultivations are attested in Eastern England, where their use peaks during the Middle Iron Age (Parks, 2012, p.231); emmer remained an important crop in Surrey and Kent (Lambrick et al., 2009, p.252). There are currently two theories explaining the emmer to spelt transition, both relying on unconscious selection: the first, implies the sowing of both as maslin[9], in a context of extensive cultivation whereby the hardiness of spelt favoured it in the progressively impoverished soils (van der Veen and O'Connor, 1998), while the second regards the same effect having being produced by autumn-sowing (Lambrick et al., 2009, p.258).

Lambrick cites an experiment by the archaeobotanist Mark Robinson, entailing the repeated autumn and spring resowing of maslins which resulted in an almost complete emmer displacement after only five years. This would also suggest that both spring and autumn sowing were practised to some extent, perhaps as a buffer from the risk of crop failure and/or to spread harvesting activities over a longer time period as spring-sown crops mature later.

Emmer decline could also be linked to its reduced environmental tolerance as it is much more affected by cold winters. Experimental evidence showed, in fact, equivalent emmer and spelt yields in warm winter conditions at Butser Farm, Hampshire (Reynolds, 1992) and a few other sites, whereas in most other (colder) parts of the country spelt outperformed emmer (van der Veen and Palmer, 1997). As we have seen in Chapter 2, the cold climatic period spanning through the first millennium BCE up until the Middle Iron Age might have affected local sowing conditions. It must be noted that emmer did not disappear altogether and remained a prevalent crop in some

[9] The sowing and growing together of mixed grains.

areas of Eastern England and north of the Tyne (Parks, 2012, pp.231-233; van der Veen, 1992), probably favoured by more intensive farming regimes (van der Veen and O'Connor, 1998).

Other crops such as oats (*Avena sativa/strigosa*), rye (*Secale cereale*), bread wheat, pea (*Pisum sativum*), celtic bean (*Vicia faba*), flax (*Linum usitatissimum)*, gold of pleasure (*Camelina sativa*) and woad (*Isatis* tinctoria) also appear in the archaeological record but never on the same scale as the above-mentioned crops.

3.2.1.2 Cultivation strategies and scale

The evidence for Iron Age agricultural implements is not as abundant as it is for the ensuing Roman period (Rees, 1979) but it is generally assumed (Lambrick et al., 2009, pp.237-240; Cunliffe, 2004, pp.407-415) that a variety of general-purpose tools like baskets, rakes, shovels, sticks made of perishable materials for which there is little physical evidence was in use, along with iron adzes. All these tools could have been used for digging, weeding and ploughing the fields as well as the making and maintaining of any accessory structures (e.g. lynchets, water-holes, etc.). The use of simple wooden ards, sometimes with an iron-tipped share and drawn by two oxen, is testimonied by frequent findings of ard-marks and occasionally by remains of ard-frames or shares.

It is a general assumption that ploughing with the ard was the standard practice ever since large-scale cereal production took over on more horticulturally-oriented regimes in the Early Iron Age (Lambrick et al., 2009, p.256). It is however possible that alternative tillage techniques using hand tools and possibly exploiting animal trampling, or no-till farming was practised under certain conditions (soil type, crop choice, etc.)

In the very few sites where sample size allowed the analysis of multiple crops processing in Eastern England (e.g. in Essex and the Isle of Ely according to Parks, 2012, p.154), spelt and emmer were cultivated separately as monocrops. It has been suggested that maslin cultivation was adopted in other areas or periods, for example in Wessex and the Thames

Valley during the Late Bronze Age (Campbell, 2000; Campbell, 2008; Lambrick et al., 2009, p.258). Maslin sowing was perhaps more widespread than the available direct evidence can suggest as the afore-mentioned trend of progressive spelt predominance is best explained with its practice (see above 3.2.1.1).

In Eastern England (Parks, 2012, pp.209-210) the presence of *Anthemis cotula*, an invasive species that represents an indicator of cultivation on heavy clay soils, is restricted only to the Roman period. This would indicate that arable expansion on clay was not an Iron Age phenomenon. However, it is questionable whether this species genuinely represents a Roman introduction.

Wet soils were cultivated from the MIA in Southern England and possibly earlier in Eastern England (Parks, 2012, p.246). The increased representation of species that are tolerant of nutrient-poor soils has been interpreted by Jones (1981) as evidence of the farming of poorer soils.

An increase in the frequency of high-density deposits of grains and chaff[10] suggests a change in the scale of arable production (van der Veen, 2016). In the Danebury Environs, Campbell (2008) reports a steady increase in the occurrence of deposits derived from accidental fires across the Iron Age: 6% in the Early Iron Age, to 13% in the Mid/ Late Iron Age, 38 % in the Latest Iron Age, and 47% in the Roman period. In Eastern England, Parks (2012) has detected an increase in the frequency of both samples with dense plant remains (p.115-123), and the proportion of samples with substantial evidence of germination, indicating increasing accidental spoilage (p.134).

[10] The daily practice of preparing grain for consumptions tends to produce regular depositions of small quantities of grains and chaff in the archaeological record, as most of the grain is consumed. Dense deposits of grain in the record are relatively rare and usually associated with accidental loss (e.g. fire). The increase in frequency of such events is taken as a proxy for bulk-handling of grains which is more likely to generate these accidents. The increased presence of chaff suggests bulk-processing in preparation for transport and storage.

3.2.1.3 Processing, storage and utilisation

Milling was done by hand using saddle querns, and rotary querns can be found from the 3rd c. BCE, although the pattern and reasons for their uneven diffusion are not yet fully understood (Lambrick et al., 2009, pp.207-210).

There is no Iron Age evidence for corn driers, nor of large-scale malting (Parks, 2012 p.42; van der Veen and O'Connor, 1998, p.135), therefore it must be assumed that the production of beer was conducted on a very small scale to provide the needs of a community or household, rather than used as a cash crop as in Roman times.

At Danebury and its environs (Campbell, 2000; Campbell, 2008), there is evidence from weed assemblages and other processing byproducts, of a system of redistribution and multiple-stage processing. A model constructed there, where each site would coarse-sieve part of the harvest and send it to a central place for fine-sieving and storage has been used to represent standard practice in the British Iron Age, but there is currently no evidence that this was the case for other areas (although bulk processing has been detected by Parks, 2012 in restricted areas of Eastern England) and caution must be used, especially since different social systems (see Ch. 2) would have managed their surplus differently.

Aside from their main dietary role, cereal crops made a useful contribution with their harvesting and processing byproducts: straw could have been used as animal bedding, thatching and weaving material, while chaff as livestock fodder or fuel.

3.2.1.4 Wild species

The exploitation of wild green leaves and fruits is difficult to investigate and quantify, the former especially so, given they do not have parts which preserve in the archaeological record. As for species whose consumption leaves behind seed or shell remains, hazelnut (*Corylus avellana*), blackberry/raspberry (*Rubus sp.*), rosehip (*Rosa sp.*), sloe (*Prunus spinosa*), crab apple (*Malus sylvestris*) and elderberry (*Sambucus nigra*) are consistently recorded throughout the period (Parks, 2012, pp.218-219; van der Veen, 2016)

3.2.2 Evidence from animals

3.2.2.1 Livestock species and frequencies

British Iron Age faunal assemblages are, most of the time, almost completely dominated by the presence of domesticated species.

Across its long history of human occupation and animal husbandry, Britain has shown a pattern of prevalence of sheep (*Ovis aries*) and cattle (*Bos taurus*), usually followed by a smaller percentage (c. 0-20%) of pigs (*Sus domesticus*), and finally by small numbers of goats (*Capra hircus*), dogs (*Canis familiaris*) and horses (*Equus caballus*) (Maltby, 1996; Hambleton, 1999, 2008; Albarella, 2019). This stands true in general for most of British late prehistory, (except for the pig-dominated Late Neolithic assemblages) and in particular for the Iron Age, though in a few exceptional cases pigs are the most common species (Hambleton, 1999, pp.43-60). It is, however, noteworthy that during the LIA and even more during the Roman period, pig percentages while remaining relatively low, see a slight increase. The majority of sites are dominated by sheep and a smaller number by cattle, a pattern that sets Britain apart from the continent. For comparison, in Northern France, most Iron Age and Roman sites exhibit high percentages of pigs, closely followed by similar percentages of caprines and cattle (Meniel, 1987; Méniel, 1990; Lepetz, 1996; Paris, 2018).

Most of the sites in Wessex and Central Southern England exhibit very high percentages of sheep ranging between c. 40-70%, with only a few exceptions (Hambleton, 2008, 39-46). Cattle usually follows ranging in the c. 20-50%.

Several sites across the whole IA diverge from the pattern in that they are dominated by cattle. This has been explained by the possible existence of sub-regional husbandry systems in which site type and topographic location seem to be correlated to different proportions of the two species (Hambleton, 2008, pp.45-46). In particular, it appears that a tendency for larger proportions of cattle in sites at the bottom of river valleys and on low-lying floodplains and sheep in sites located on higher grounds is roughly consistent at least across the Southern region and the Upper Thames Valley. No substantial chronological variation has been noticed within long-lived sites (Maltby, 1996, 21; Hambleton, 2008, 41) supporting the idea that the identified pattern is real and not an artefact of low diachronic resolution.

Regardless of the sub-regional pattern, a steady declining trend of cattle in favour of sheep has been observed from the mostly cattle-dominated BA (Serjeantson, 2011) to the very end of LIA (Hambleton, 2008, p.41), when cattle numbers increase again in response to the Roman conquest.

All the considerations on the relative frequency of cattle and sheep are biased by differential preservation and recovery. Hambleton (2008, pp.58-59) notes that there is a correlation between cattle having the first rank order and poor preservation. Furthermore, the cattle count on a number of sites has been inflated by the inclusion of articulated remains. However, the extent of this bias is not clear and should be further investigated.

While it is unlikely that taphonomic bias is the only cause for the trends outlined above, it is certainly necessary to keep in mind that sheep and pig bones have been proven to be almost constantly under-represented in comparison to cattle, which is to be factored in any interpretation of herd compositions (Wilson, 1985; Maltby, 1996).

The range of species from the Upper Thames Valley (Hambleton, 1999, p.46; Mulville, Ayres and Smith, 2011; Lambrick et al., 2009, pp.242-243) does not differ radically from that of Wessex, although the percentages of sheep and cattle tend to be, on average, more similar to one another (both between c. 30-60%). The main difference is that sites dominated by cattle and those dominated by sheep are almost equally represented. Mulville, Ayres and Smith (2011) notice a prevalence of sheep on cattle during the MIA in contrast with the other periods (50% on 42% against 37-45% on 46-

51%). However, it must be noted that the percentage variation is very small and that the other periods (EIA 3 sites, LIA 4 sites, RB 5 sites) are underrepresented compared to the MIA (9 sites).

Central and Eastern England exhibit a wider range of species proportions than Wessex. A trend of increased importance of sheep, beginning during the Bronze Age, continues into the Iron Age. Therefore, cattle percentages are generally dominant during EIA and MIA, with a definite shift towards sheep during the LIA (Albarella, 2007; Albarella, 2019). The contrast with Southern England has been attributed to wetter environmental conditions and heavier soils, less suitable for sheep husbandry. The Roman conquest will see again an increased importance of cattle over sheep, but this pattern of reliance on both sheep and cattle, with a smaller contribution from pig, will characterise the animal husbandry of this region up to present times.

Goats are seldom identified in Britain. This is partly due to inherent difficulties in the application of identification criteria (see Chapter 4), and only a few of the studies even attempt it (less than 25% in Central and Eastern England according to Albarella, 2019, p.95). Whenever the separation is attempted, sheep are invariably the most common species by far, so much so that it is generally assumed that data obtained from caprine remains represent information about sheep husbandry. When goats are identified in good numbers, it is usually from horncore and cranial elements, which are not only particularly robust to taphonomic attrition, but also frequently a byproduct of craft activities (see also 3.2.2.5 – Carcass use).

Equid remains are usually identified as domestic horses. Although specific criteria for identification are seldom adopted, there are only a few dubious instances of specimens identified as donkeys at the very end of the Iron Age (Johnstone, 2010), so it is likely that donkeys were not a common presence in the British IA landscape if they were present at all.

Horse became more common in Eastern England than in any other period, and it was widespread across the whole region (Albarella, 2019). A few recorded instances of spavin (pathological exostosis and fusion of the lower hock joints) might indicate severe traction stress. Horses were present in most Wessex sites, usually the fourth species in ranked order, and more prevalent than in the BA (Hambleton, 2008, p.71); they appear to be more abundant during the Middle Iron Age.

Dogs are almost always present in the assemblages all over Britain, albeit usually as the least represented of the main domesticates. Even when skeletal remains are absent, the abundance of gnawing marks testifies to their ubiquity.

The status of domestic cats (*Felis catus*) is difficult to assess across British History due to the inherent scarcity of remains, substantial morphometric overlap with their wild counterparts, and complex relationship with humans (Kitchener and O'Connor, 2010). Although it is technically possible to separate the wild and domestic biometrically (O'Connor, 2007), the application of osteometric approaches is neither widespread in the literature nor easily applicable when, as in the case of cats, the available sample size is always minuscule. Most identifications are therefore based on context, rough autoptic estimation of size, or unspecified criteria, so it is difficult to map their introduction and diffusion (Hambleton, 2008, p.32). However, the prevalence of immature animals and a litter of kittens at Gussage All Saints would place the presence of the domestic form at least during the Middle Iron Age (Harcourt, 1979).

Chickens (*Gallus gallus*) were introduced to Britain probably in the Early Iron Age and, although much less represented than in later periods, they are not an unusual find in contexts dated to the Late Iron Age, when they are supposed to have been used for symbolic activities related to religion, leisure and display (Hambleton, 2008, p.30; Poole, 2010; Sykes, 2012).

The claim by Julius Caesar (Gallic War V,12) that the Britons kept domestic fowl but did not eat them, might be supported by the absence of butchery evidence on chicken remains except for very few specimens in very late sites post-dating his visit to Britain (Albarella, 2007).

Although anatid remains represent the second most common bird group, there is currently no evidence for the presence of their domestic forms before the Romans, while duck/goose (*Anas platyrhynchos* and *Anser anser*) remains ratios in archaeological contexts point towards a prevalence of wild fowling over underdeveloped goose farming until at least Medieval times (Albarella, 2005).

3.2.2.2 Livestock mortality

Overall, there is very little evidence for a relationship between the mortality profile of any species and any site characteristics (geology, altitude, type) or even the passage of time.

Despite a certain degree of variability, sheep mortality profiles show a number of common characteristics. Overall, there is very little evidence for neonatal mortality. The majority of animals were slaughtered before reaching full development, usually with a peak in mortality corresponding to 6-12 months of age (stage C of Payne mandibular wear), and few were killed throughout the stages corresponding to their meat-producing prime as subadults (1.5-3 years old) and the remaining individuals surviving into later adult age (Hambleton, 1999, pp.70-74). Furthermore, there are a few instances of groups of lambs of the same dental age deposited together in pits which probably represent seasonal cullings (e.g. Hambleton and Maltby, 2004).

The Wessex and the Upper Thames Valley regions roughly conform to the general pattern, although groups of lower and higher mortality incidence at 6-12 months can be detected (Hambleton, 1999, p.73).

Mortality curves from sites in Eastern England present a pattern roughly similar to the other regions, although never with the same steep survival drop at 6-12 months sometimes found elsewhere, and frequently with much lower percentages of animals slaughtered at that age (Hambleton, 1999, pp.73-74). Most sites were either dominated by immature animals or present a mixed-age profile.

Cattle husbandry seems to display a great deal of variation between sites during the Iron Age. Overall, mortality profiles tend to present steadily decreasing curves, with little preference for culling animals in a particular age range, little infant mortality and a considerable part of the population surviving well into adult age with a few individuals reaching an elderly age (Hambleton, 1999, pp.78-80). One possible exception is represented by the Upper Thames Valley Region, where several sites display higher mortality of subadult animals. No clear chronological trend has been identified.

In Eastern England, most sites (around 40%) present assemblages of mostly adult remains which, along with reported instances of splayed metapodials, would indicate widespread use for traction (Albarella, 2019, p.102). The prevalence of adult-dominated assemblages, however, is not as pronounced as it is among Roman sites (around 60%) and assemblages with prevalent immature animals are almost as frequent as those with mixed-age profiles, indicating that Iron Age cattle husbandry was much more diversified and generalised than it was in the subsequent period. Furthermore, Hambleton (1999, p.82), notes a greater variability of mortality curve shapes than in any other region.

Cattle assemblages in Wessex are usually characterised by the prevalence of adult animals but the combination of adults over four years and yearling juveniles is also common (Hambleton, 2008, p.63). Again, intra-site variability in terms of preservation is a biasing factor in the age composition, as assemblages mainly derived from pits tend to show more prevalence of juveniles in comparison to those mainly derived from ditches.

Upper Thames Valley mortality curves differ from those from Wessex in that there is a steep drop in the curve at most sites, corresponding either to the 6-12 months, 1-2 years, or 2-3 years ranges (Hambleton, 1999, p.82).

Pigs were bred in the majority of sites (presence of neonatal individuals), and most pigs were culled between 1 ½ and 2 ½ years of age (Hambleton, 1999), as is to be expected for a species whose main contribution to the human economy is to provide meat and whose large litters can sustain a stable population with few breeding animals. However, no clear pattern within the culling of immature animals has been detected.

The presence of horses on Iron Age sites is characterised by the overwhelming prevalence of old individuals, often very old and rarely young adults. Juveniles and subadults are very rare, while evidence for foetal/neonatal is almost absent. Notable exceptions are Bury Hill, Hants. (Hamilton, 2000) and Battlesbury Bowl, Wilts. (Hambleton and Maltby, 2004) where a considerable part of the population (more than 20%) died as young individuals and foetal/neonatal remains were recorded, indicating on-site breeding.

Dog remains usually pertain to adult individuals. Occasional findings of large groups of neonatal remains are interpreted as natural mortalities or intentional culling for population control (Hambleton, 2008, p.75).

3.2.2.3 Livestock type

Very little attention has been paid so far to the livestock type. In most zooarchaeological reports and reviews, the question is ignored or dismissed with a few qualitative observations on the overall size and the shape of the body or the horncores, likening these characteristics to those of modern 'primitive' breeds.

Biometric data is largely missing and, with it, a thorough analysis of the shape and size of the animals through time and space. Save for the few general summaries of biometric analyses on some regional reviews (Hambleton, 2008; Maltby, 1981; Albarella, 2019) specific works on osteometry are focused on the passage between LIA and the Roman period (Noddle, 1984; Albarella, Johnstone and Vickers, 2008; Rizzetto, Crabtree and Albarella, 2017; Rizzetto and Albarella, 2022). From these, we know that all types of livestock were largely unimproved before the conquest and their subsequent changes progressed in a piecemeal fashion with a difference regarding site type (culturally Roman sites like villas are the first to adopt the practice) and species (cattle are improved earlier and more to fit the needs of the new agrarian system). Recent work by Duval and Albarella (2022) shows the existence of different regional populations of cattle and, despite being overall small-sized if compared to other contemporary European areas, at least three size categories are represented: the smallest animals come from Wessex and the southern Channel coast (from Cornwall to Kent, although the number of sites is limited), intermediate size stock are found in Eastern England, while larger animals composed the herds kept in the north. The study also shows a small overall increase in the size of cattle between the Middle and Late Iron Age, interpreted as the possible influence of early cross-channel contacts. Despite the limited number of samples from sites with BCE dates and the increase being demonstrated only for the Wessex area, increased livestock mobility is demonstrated for this area during the Later Iron Age (Minniti et al., 2014). Therefore, the increase in size might well represent the mixing of local cattle with new stock exchanged with other areas around the island or across the Channel.

The distribution of congenital variations of dentition (e.g. absence of the hypoconulid in the lower third molar, absence of the lower second premolar) has been suggested as a possible way to characterise livestock populations (Albarella, 2019, p.105). This kind of evidence is, however, rarely systematically reported, limiting the possibility to explore the diffusion of these non-metric traits geographically and diachronically.

Hambleton (2008) describes sheep from most sites in southern Britain as small, slender and horned, likening their appearance to that of the Soay breed. She also states that the apparent uniformity of type until the Roman introduction of larger, hornless varieties is generally true. However, in the the LIA both hornless and four-horned sheep are introduced in a few sites.

Although very little metric data has been published, and mainly from sites in the south, it seems to confirm the impression of the uniformity and small size of sheep in this period (Maltby, 1981; Grant, 1984b; Hambleton, 2008, pp.48–49).

Autoptic observations and morphometric analyses agree in defining IA cattle as generally being of a small-sized and short-horned type (Maltby 1996), which has been commonly defined in the past as Celtic Shorthorn or *Bos longifrons* (an obsolete terminology), and likened to modern Dexter cattle (Cunliffe, 2004, pp.562-563). Some variety is expressed by the presence of hornless cattle, although size-wise there seems to be more uniformity than in the Bronze Age (Hambleton, 2008, pp.57-58). With the arrival of the Romans, variety increased again, with both the importation of stock from the continent and the beginning of a process of local improvement (Albarella, Johnstone and Vickers, 2008).

Pig size in the IA is small (Grant, 1984a; Hambleton, 2008) and measurements from Heybridge in Essex were notably lower than the those from Late Neolithic Durrington Walls (Albarella, Johnstone and Vickers, 2008).

Horse type, ranging in size between 10-14 hands, would be now considered that of a pony, with an apparent increase in average estimated withers height during the LIA (but still within that range) (Maltby, 1981, Maltby, 1996).

Dog biometric data comes mostly from associated bone groups[11], as remains from general waste are usually not frequent and well preserved enough to create useful datasets. It is unclear if this makes the data representative of the general population but Harcourt in his review on dogs from late prehistoric sites (1974) gives a withers height range between 29-58cm (skewed toward the upper part of the range). The relative uniformity of the Iron Age dog type has been confirmed by later studies (Maltby, 1996; Hamilton, 2000). On average, IA dogs are slightly smaller than Bronze Age dogs but have a wider range of size and morphology (Clark, 2000) that will increase greatly during the Roman period.

3.2.2.4 Hunting and fishing

Wild animals are a rare, but regular, presence in the faunal assemblages dated to the IA. Save for a few exceptional sites, single wild species do not usually represent more than 1% of the assemblage, and a total usually between 0 and 5% (Albarella, 2019, pp.98-101; Hambleton, 2008, pp.35-37).

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[11] Groups of articulated bones from the same individual, deposited in a single archaeological feature usually also containing general waste.

Hambleton (2008, p.35) notes that the relative contribution of wild species to the archaeological assemblages steadily decreases from the Bronze Age becoming of negligible importance towards the Later Iron Age. Although hunting practices never disappear altogether, their reduction corresponds to increasing deforestation and agricultural expansion, perhaps indicating that the exploitation of wild resources remained somewhat of an opportunistic activity in a more and more human-made landscape, depleted of wild fauna.

The list of species represented in IA assemblages often includes the red deer. However, whereas antlers are almost always present (see worked bones), post-cranial bones are scarce, indicating that hunting of large game was not a common practice. Despite their scarcity, the reporting of occasional butchery marks indicates that their presence is not incidental. By contrast, roe deer, while rarely found, is equally represented by antlers and postcranial bones. The presence of another large game species, the wild boar (*Sus scrofa*), is difficult to gauge because of its difficult separation from the domestic pig. The distinction is mostly in terms of size, but the application of osteometric criteria is seldom applied and usually, only particularly large specimens are tentatively attributed to the wild boar. Given the scarcity of other wild species, it is likely that wild boar follow the same pattern, but it would be interesting to further investigate the relationship with the domestic pig to better understand management practice.

Other species have been occasionally hunted, especially wild anatids and other birds (mostly water species and occasionally raptors), with cutmarks on wing bones suggesting the removal of the feathers for crafting (Albarella, 2019, pp.99-105).

Instances of specialised and systematic hunting are rare but more frequent in specific landscapes such as those within and in the proximity of wetlands, like the sites on the fenland edge. This is represented in particular by the sites in the Haddenham area (Cambs.) where, along with relatively large assemblages of wild fowl and fish, the systematic hunting activity is indicated by the substantial amount of beaver (*Castor fiber*) remains (the third most represented species in the assemblage, see Evans and

Serjeantson, 1988 and Serjeantson, 2006). Beaver hunting was a common activity in the Fenlands at least since the Late Bronze Age and it was motivated by the exploitation of meat and fur as attested by the butchery marks and possibly castoreum.

Other animals like foxes, badgers, and otters are also occasionally found in Iron Age assemblages (Hambleton, 2008, p.37) and were also probably exploited for furs.

Fish remains are absent from the absolute majority of Iron Age sites in England. In their review on the matter (Dobney and Ervynck, 2007) found that 90% of sites considered presented no fish remains, while the others had few remains and a limited variety.

To ascertain that this lack of evidence corresponds to a real avoidance of fishing a few taphonomic issues have to be considered.

Fish remains are tendentially very small and are underrepresented in assemblages from sites that are not systematically sieved. In the dataset reviewed by Dobney and colleagues (2007) only 18% of sites were sieved to any extent. However, some of the non-sieved assemblages lacking fish remains presented micromammal remains comparable in size with fish, while others had fish remains from contexts dated to the Roman period. This supports the idea that the lack of evidence is not an artefact.

Another issue is represented by the distribution of sites, as most of the reviewed, and more in general excavated, sites are located on the mainland.

Dobney and colleagues (2007) compare the English case to that of Belgium and the Netherlands: while the first present similar characteristics to England, the latter presents a more abundant and diverse record. While Belgium's coastal sites might have mostly disappeared due to receding coastlines, the avoidance of fishing is confirmed by the absence of fresh-water fish.

Furthermore, evidence from Northern Scotland (Barrett, Nicholson and Cerón-Carrasco, 1999) shows that fishing remained important throughout the whole of late prehistory.

This avoidance of fish has been explained as a socially prescripted food taboo (Hill, 1993; Dobney et al., 2007), perhaps linked to a more general domestic/wild duality that rendered all wild species, fish included, a shunned food source.

More recently, Rainsford and Roberts (2013) challenged this interpretation: an active proscription is unnecessary to explain the minimal consumption of fish, rather the strong focus on agriculture and animal husbandry would have not only pervaded social practice in daily life and made hunting and fishing skillsets less appealing to learn, but also reduced access to the actual areas where these practices could be viable. Therefore, fish would have become an irrelevant resource, potentially becoming unwelcome or unclean as a consequence of unfamiliarity and marginality.

3.2.2.5 Carcass use

Butchery marks are generally reported more often for IA sites than Bronze Age sites, possibly because of a more generalised adoption of metal implements that makes them easier to detect unambiguously (Albarella, 2019, p.105). However, while mention of butchery is widespread across the literature, in-depth qualitative descriptions and qualitative analyses are rare and the potential of butchery analyses to understand carcass use is underused (Hambleton and Maltby 2004)

Overall, butchery practices seem to be conducted on the household level and do not leave intense modification on the bones, with a general prevalence of localised cutmarks.

Butchery patterns on sheep and cattle bones in most IA sites across Britain are broadly similar to those identified by Wilson and colleagues (1978) at Ashville, Maltby (1987) at Owlesbury and Hambleton and Maltby (2004) at Battlesbury Bowl.

For sheep these include a generalised use of the knife to skin, disarticulate (shoulder, elbow and knee joints) and fillet (on limb bones, in particular on scapula). Vertebral bodies are laterally trimmed while removing flank meat.

The generally low frequency of elements presenting butchery marks, while surely influenced by taphonomic bias, can be seen as an expression of an affordance implicit in sheep butchery, where the small size and relative ease of dismemberment make for less intensive modification.

As in sheep, knife butchery is generally observed to be prevalent on cattle remains, with a higher incidence of butchery marks and, in particular, chop and filleting marks expressing the greater effort required to process larger animals (Hambleton, 2008, p.61). Usually, all parts of the animals are present on-site indicating that portions were not exported or imported. The carcasses, however, were dismembered so that different body parts would end up discarded in different parts of the settlement: the limb was removed from the body and the vertebrae were discarded with the head after being defleshed. Aside from the common skinning marks, other notable frequent patterns are represented by cutmarks and chop marks on the distal ends of long bones, usually interpreted as disarticulation and dismemberment since the marrow cavity is not always reached (Hambleton and Maltby, 2004).

Due to the relative dearth of their remains, it is difficult to detect patterns of butchery for pigs. Evidence for filleting has been detected on pig remains at Danebury and other sites in Wessex, but this is not the norm even within the same region as they are absent, for example, at Maiden Castle (Knight, 2003) indicating different cooking and consumption practices.

Concerning body part representation, for sheep, no specific pattern has been identified, except for a general tendency of discarding both butchery and food waste within settlements (Hambleton, 2008, pp.51-56). For cattle, the majority of sites present a body part representation influenced solely by preservation and recovery bias, with a few cases showing intra-site differential deposition of butchery and cooking waste and very few exceptions hinting at specialised crafting activities or meat production (Hambleton, 2008, pp.61-65). Horse remains in IA sites are usually represented with skeletal element frequencies compatible with their natural skeletal abundance, indicating disposal of full carcasses on-site (Hambleton, 2008, 71). Horse bones are often found complete and articulated in limb joints or complete skeletons (Associated Bone Groups).

Dogs, like horses, are frequently present as associated bone groups, often as complete skeletons. Both species are relatively more represented in ABGs than they are in general waste (Hambleton, 2008, 86), which reinforces the interpretation of both being separated on the symbolic and practical levels from the meat-producing animals.

Butchery and skinning of horses and dogs, although rare, are both attested at similar rates as other periods of British history (Albarella, 2019). In Wessex, Hambleton (2008, 71) notes that butchery marks on horses are present in over half the assemblages and that butchery patterns are reported to be similar to those of cattle. Horse age profiles by themselves indicate the animals were not kept for meat, therefore butchery evidence testifies for either occasional breaks of a generalised avoidance or the use of the carcasses of old animals for the production of dog meat.

By contrast, skinning marks on horse remains are almost invariably present and those attesting to the exploitation of dog pelts have been detected on several sites (Albarella, 2019, p.106; Hambleton, 2008, p.75).

In addition to meat production, the presence of some skeletal elements can be used as evidence for craft activities. Bone tools and bone-working debris are found at most sites, although with much lower frequencies than in historical periods (Albarella, 2019, p.107). This probably hints at a low-scale, local production.

Goat horncores are a relatively common find, as they are more robust and easier to identify than other elements, to the point of sometimes skewing the sheep/goat ratio in favour of the latter (e.g at Puckeridge and Braughing 75-9, see Croft, 1979). Their presence might be indirect evidence for horn-working as horn rarely survives in the archaeological record. Furthermore, the occurrence of severed horncores and cranial elements present along with foot bones might be present in the archaeological record as skinning debris from the tanning of goatskins. Horn represented a popular material to create tools, furniture and decorations thanks to its hardness and thermoplastic properties. Goatskins were a particularly prized raw material for leatherworking during the Roman period (Berg, 1999) and it is probable they were equally valued before the conquest.

In contrast with the Bronze Age, cervid remains in Iron Age and later sites are mainly represented by antlers (Albarella, 2019, p.107). This demonstrates that even as the value of wild game steeply decreased, antlers remained a prized working material.

3.2.2.6 Livestock mobility

In the Upper Thames Valley, Schulting and colleagues (2019) have found that Early/Middle Iron Age animals in the hillfort sites on the Oxfordshire Ridgeway and the nearby low-lying sites of the Vale of the White Horse uniformly presented local nitrogen ($\delta^{15}N$) and strontium ($^{87}Sr/^{86}Sr$) signatures, supporting the idea of relatively confined locales in which Iron Age people operated. Cattle, however, appeared to be bred almost exclusively in the Vale and moved on the chalk downs only later in life. Cattle were the most abundant species in the area, and one that required larger amounts of water (see section 3.4.2 – The role of sheep and cattle), so it makes sense that lactating cows and unweaned calves were kept closer to reliable sources of water.

In Wessex, Stevens and colleagues (2013) analysed the carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopic signatures of 347 samples from five sites in the Danebury Environs. Their results indicate extensive intra-population isotopic variability in all sites, tentatively interpreted as some form – the authors propose four different models – of complex animal and landscape management. All of the models, excluding the third that entails a larger apport of non-local animals, identify this variability in the interplay between different isozones (or micro-environments) within the Danebury Environs.

Hamilton and colleagues (2019) analysed the carbon, nitrogen, and sulphur ($\delta^{34}S$) signature of Middle Iron Age herbivore remains from Danebury and Sudden Farm, finding that around 20% of the animals were of non-local origin or highly mobile, with some evidence of occasional movement of livestock over distances in excess of 100km.

Furthermore, Minniti and colleagues (2014), based on $^{87}Sr/^{86}Sr$ isotopic analysis performed on teeth from the Iron Age and Roman rural site of Owslebury (Hampshire), have demonstrated an increase in mobility of cattle at the site in the Late Iron Age and even more after the conquest.

3.2.3 Livestock management

3.2.3.1 Breeding of the main livestock species

Most of the British Iron Age sites can be classified as producer sites, having evidence for the breeding of the three main domesticates (Albarella, 2019, p.104). It appears, however, that neonatal casualties of sheep and/or cattle are rare findings in most Wessex (Hambleton, 2008) where they seem to be concentrated in a few sites like Danebury and occasionally represented mostly by associated bone groups, and absent in the Upper Thames Valley (Mulville, Ayres and Smith, 2011, p.496). The relative dearth of infantile mandibles may find a partial explanation in poor preservation and recovery rates, which would account for the almost complete disappearance of relatively low infant mortality. However, this could also indicate a different form of management, where lambing and calving happened off-site, possibly implying a form of transhumance with spring pastures being at some distance from the settlement (Hambleton, 1999, p.70). As seen above (3.2.2.6 – Livestock mobility), stable isotope analysis has demonstrated that this strategy had been employed at least by some sites in the uplands of the Upper Thames Valley (Schulting et al. 2019).

Sex ratio profiles are rarely published and lack precision, therefore on this scale of analysis they do not yield meaningful information. When known, as expected, both cattle and sheep profiles are dominated by female individuals (Hambleton, 2008, p.54).

3.2.3.2 Sheep

Sheep mortality profiles across Britain uniformly show high rates of culling of individuals in the 6-12 months range (stage C), which might represent an indication of winter mortality and/or autumn culling of yearlings to keep the flock sustainable through the winter (Maltby, 1981, 70; Albarella, 2007). Albarella notes that for this strategy to be viable, starting flocks' numbers must have been quite sizable, while Pryor (1998), analysing Bronze Age landscape evidence in the Fenlands through the lens of historical and modern flock number records and his own experience in sheep farming, estimates large flocks of thousands of individuals. He hypothesises a shift from an economy dominated by intensive livestock farming in the Bronze Age to a mixed-farming regime in the Iron Age, which would have entailed much-reduced flocks. It is possible, however, that the abundance of yearlings represents in part an artefact of the afore-mentioned differential preservation between pits and ditches (see 3.2.2.2 – Livestock mortality), in which case the coincidence of natural mortalities and/or culling within that age group with the availability of old storage pits to be decommissioned at the same time of the year would result in their over-representation (Hambleton, 2008, 55-56).

The split in mortality in the 6-12 months age group can be interpreted as differences in husbandry strategies adapted to environmental conditions. It is possible that sites and areas (like those in the Upper Thames Valley and Eastern England), where the survival of this age group was comparatively higher, had the right conditions for keeping an unculled flock through winter, and put extra effort into keeping the animals alive to produce more meat or simply did not slaughter the animals on site. By contrast, other sites have markedly autumn killing profiles (Albarella, 2007). For example, at Outgang Road (Lincs.), a site located on the Fenland edge, the mortality profile has been interpreted as indicating that the flocks were probably culled before moving them to winter pastures to avoid the flooding season (Albarella and Mulville, 2001).

After the cullings, a reduced flock would have grazed the stubble and directly manured the fields around the settlement after the harvest, and subsequently required less fodder and care all the while remaining at hand to maintain control of reproduction during the breeding season (Hambleton, 1999, p.70).

The mixed character of sheep management in this period is illustrated by the presence of all stages with a generally steady rate of decrease in survival between subsequent stages. Manure, meat, milk and wool were all probably important products obtained from sheep farming.

In the past, a few authors proposed interpretations suggesting a focus on wool production (for example Grant, 1984b). This was based on the assumption that Iron Age sheep were efficient wool producers, for which there is no evidence. As a matter of fact, Iron Age sheep have been compared to modern Soay which produce limited quantities of coarse wool (O'Connor 1982). Equating prehistoric sheep to a modern landrace just because they are roughly comparable in terms of size and proportions would be a mistake, but we can ascribe them both to a 'primitive' type, due to the lack of any substantial human-induced improvement and the presence of traits that fit well with the adaptation to the British climate.

Furthermore, as Albarella (2007) demonstrated, Iron Age sheep mortality profiles are not compatible with those of historically documented sheep wool specialists (see discussion on mortality). Their profiles are instead compatible with mixed-use, using the full range of products to complement arable activity. Meat production surely had an important role, although not as much as it had during the Bronze Age (Hambleton, 2008, p.56). This is not to say that wool and milk were not produced, but rather that a generalised use of the animals produced more than enough for subsistence and a relatively low intensity of exchange. According to Lambrick and colleagues (2009), after being widely cultivated during the Bronze Age, flax practically disappeared from the archaeological record of the Upper Thames. He links the change to the increase in sheep husbandry, positing that flax had been substituted with wool as the main source of textile fibres.

3.2.3.3 Cattle

Cattle mortality profiles generally present mixed patterns of exploitation, with several animals kept alive after their prime (more than for sheep), suggesting a generalised use aimed at supporting arable agriculture and exploiting secondary products (Hambleton, 1999, p.78).

Within this general pattern, single sites or small regions display very different husbandry strategies: some, with a large number of immature animals, seem more oriented toward meat production; others with larger numbers of young animals, appear to be focusing on dairy products (Hambleton, 2008, 64); finally, sites with the majority of the population reaching mature and elderly age hint at a strategy aiming at the use of the animals for traction, also supported by the occurrence of splayed metapodials, and manuring (Albarella, 2007). It is, however, hard to pin down the reasons for these different profiles, as they do not seem to be strongly correlated to any site characteristic in terms of chronology, topography or environmental conditions.

For the Wessex and Thames Valley sites, Grant (1984b) suggested that the variability in cattle age profiles is due to the seasonal moving of livestock: juvenile and adult animals on the uplands would indicate that calving and the use of older animals in support of arable agriculture were taking place there, while the rest of the population was moved to graze in the lowlands where the surplus subadults were being slaughtered. Hambleton (2008, p.63), however, despite confirming the distribution of age categories noted by Grant, suggests that these were not part of a single integrated farming system, but rather the application of different management strategies as a reflection of different environments. Currently, neither hypothesis has been demonstrated, as this would require in-depth analysis in terms of mobility of contemporary upland and lowland sites in the same locale, integrating results from dental ageing and multi-proxy stable isotopes analysis.

3.2.3.4 A note on milking and dairy production

Even though it has been demonstrated that dairy products were widely exploited ever since the Neolithic (Copley et al., 2003), it is very difficult to ascertain when in history and how exactly lactation persistency was pursued and achieved. Modern dairy livestock is bred and managed specifically to increase daily yield and length of the lactation period. The latter is sustained by a tight cycle of breeding that maximises the yearly proportion of productive days (c. 305 days for cattle and 100 for sheep). This causes a surplus of offspring, of which the male part is almost completely culled for meat. In the zooarchaeological literature, this last component is assumed as evidence for dairy farming when looking at mortality curves. Conversely, the rest of the dairy production cycle is largely ignored due to the inherent difficulty of detection. It is, in the absence of substantial data, important to discuss at least the basic assumptions we use, if we want to discuss the role of dairying in livestock exploitation. The likelihood that largely unimproved Iron Age cattle and sheep had long lactation periods or high daily yields is very low. Still, calves and lambs could have been culled to increase the amount of milk that could be harvested with taphonomic biases masking the activity in the mortality profiles. Considering the ageing profiles, it is most likely that dairy production maintained an important, if accessory and seasonal, byproduct of the meat-focused and mixed-purpose livestock husbandry strategies common in the Iron Age.

3.2.3.5 Pig

Sites with an unusual abundance of pigs have been linked either to particularly favourable ecological conditions for pasturing or trading and cultural links to the continent, which might be confirmed by the tendency of sites in the south to have an increase in pig percentages during the later phases (Maltby 1996). Since the increased salt production through the Iron Age (Maltby 2006) would have favoured the use of preserved meat, the abundance of pigs in certain sites, an exclusively meat-producing species with fatty meat suitable for curing, can potentially indicate a role in either the production or consumption of such products.

At most sites, pigs are represented mostly by individuals between the second and third years of age, while individuals beyond the fourth year are virtually absent (Hambleton, 1999, p.69). This is because pigs' only substantial output is meat, affording little variability in the culling strategies and therefore making slaughter before or upon reaching full adulthood a common practice in pig husbandry over the ages.

However, it is difficult to claim that pig exploitation was uniform across Iron Age Britain as variations in pattern are obscured by the lack of resolution in ageing data and the usually small sample size of Iron Age pig assemblages.

The frequent and large litters would have meant little need for either a large breeding population or sex-informed culling strategies (Hambleton, 2008, p.68). The real differences in exploitation must be searched in the choice of rationalising meat production by culling off only fully developed animals or rather culling animals of different ages out of need or taste preference. Given the non-intensive nature of British Iron Age butchery and the small degree of carcass processing required for small animals, it is difficult to discern natural mortality from the intentional slaughter of juvenile piglets. There is, however, currently no evidence for the specific culling of suckling pigs. It is therefore even harder to interpret this part of the mortality curves in the absence of other forms of evidence.

It is however interesting to note that, being unlikely that sty husbandry was in practice, unimproved breeds and pre-modern foddering techniques did not grant development rates comparable to those of modern pigs in intensive farming, so it is reasonable to think that pigs did not reach their maximum meat-bearing potential within their first two years of life (Maltby, 1996). This means the existence of a potentially substantial difference in meat output between the younger and older groups of the main culling range. Some sites seem to have had a preference for one of the two ends of the spectrum, whereas others had them equally represented (Maltby, 1996; Hambleton, 1999, p.69), but the reasons for these choices have not yet found.

Pigs might have had some limited use in crop production by being released on the fields to turn and fertilise heavy soils before sowing, but this hardly seems reason enough to inform culling strategies.

3.2.3.6 Goat

The absolute prevalence of sheep over goat characterises not only the Iron Age but all periods since their introduction in the Neolithic. It can be explained by the difference in environmental tolerance ranges between the two species, as goats are not suited to the heavy soils and damp climate of Britain. This does not mean that it is particularly difficult to keep some, just that it is not convenient or outright viable to keep them in large herds. The fact that they never disappeared from the island is, however, testimony to the fact that herders deemed them useful. In fact goats, as browsers, can be kept in small numbers together with the grazing sheep flocks to improve land management (as they clear the pastures of different plant species, like thorn scrub). Furthermore, the more boisterous and aggressive behaviour of goats might have kept smaller predators away, helping protect the lambs.

3.2.3.7 Horse

The almost complete absence of young individuals below 5 years of age, and especially of foals aged less than 1 ½ years, from most sites has been interpreted as evidence supporting the hypothesis that horses were not commonly bred but rather kept in a feral state and occasionally rounded up for training and domestic use (Harcourt, 1979).

The hillfort at Bury Hill (Hants.) presents a faunal assemblage composed of 27% horses, evidence of breeding and large quantities of horse and vehicle gear (Hamilton, 2000). Building on Harcourts' hypothesis, it has been suggested to indicate that it was a specialised breeding and taming site from which trained horses would have been redistributed elsewhere. This hypothesis has been taken as a general model for the British Iron Age (Cunliffe, 2004, p.418).

It must be noted, however, that horse assemblages are usually very small, making foals difficult to identify. In fact, deciduous dentition is smaller and more fragile, while the management strategies would have implied very little juvenile mortality, which could have happened off-site. All of this would create a strong recovery bias towards the adult population, obscuring more widespread breeding practices. Mulville, Ayres and Smith (2011, p.506) notice a number of Upper Thames sites where the presence of juvenile and immature horses point toward on-site breeding; it is entirely possible that a similar review of the evidence in other areas could deconstruct the model of specialised free-range management so far widely adopted.

3.2.3.8 Dog

Direct evidence from dog osteological data is rather scarce. We are, however, allowed to think that Iron Age dogs were mainly kept as herding dogs, given the abundance of sheep in the faunal record. Herding behaviour represents the modified predatory behaviour of wolves and is therefore easy to obtain in dogs.

The relative rarity of butchery evidence rules out their role as meat-producers and the scarcity of wild animal remains makes it unlikely that they had a specialised hunting role. Their role as companions and guard animals is very probable, and their depositional pathway accounts for a markedly different role compared to all other domesticated animals except for the horse.

3.3 Agricultural change in Roman times

The body of knowledge about agricultural practice in the Roman period, both in Britain and in the rest of the Empire, is much more substantial than that of any of the prehistoric periods. In keeping with the theoretical principles exposed in Chapter 1, the contrast in evidence between the two periods will be used as a heuristic tool to better understand the Iron Age. A comprehensive review of the subject is beyond the scope of this thesis; therefore, I will summarise here only some relevant aspects that represent a known measure of change. Some of the Roman introductions and changes are already mentioned in the previous sections, but a general summary will make the character of the transition more evident.

3.3.1 Crop and livestock introductions

The main cereal crops do not change with the conquest: barley and spelt remain the dominant species, with other minor crops such as emmer, rye and oats being recorded in small quantities on some sites (van der Veen, 2016). The role of bread wheat is not yet understood. Even though it becomes the dominant cereal crop in Early Roman Gaul, it occurs in substantial quantities only in some high-status Romano-British sites (Campbell, 2008), possibly representing importations.

A major innovation is represented by the introduction of a great variety of plants cultivated in a horticultural regime for their fruits (cherry, plum, apple, pear, walnut), herbs (celery, lettuce, dill, coriander, summer savoury), and roots (carrot, leaf beet, turnip, parsnip) which were so far exotic or present only in their wild forms before the conquest (van der Veen, 2016). The introduction of these new foods, as well as those that were not cultivated locally but imported (e.g. figs), makes the existence of different consumer groups evident: some rural centres of the South-East had access to the exotic imports available in London and the other major towns; others, regardless of status, only to the new crops cultivated locally; while the centres in the west and north of Britain present no evidence for the new foods but started consuming more wild fruits and nuts (van der Veen, 2016).

Around the time of the conquest, the long-lasting trend of increasing importance of sheep shifted back quite rapidly to cattle dominance (Albarella, 2007). The process, however, was not homogeneous and until the late Roman period, there are two clear patterns of animal use and consumption where new settlement types like urban, military and villas present a higher frequency of cattle and pig, while more traditional rural settlements keep on with Iron Age traditions (King 1984, 1999).

Dog remains an important species in the Roman period. Their range of sizes increases to include both smaller and larger dogs, while their shape becomes more diverse (Clark, 2000). This diversity is taken to indicate the import of new types from the continent (Maltby, 2016) and probably relates to specialised roles as companions and hunting dogs.

Donkeys (*Equus asinus*) and mules (*Equus asinus* x *Equus caballus*) have been identified in very small numbers already in the Late Iron Age, their presence becomes established, although it remains rare, in the Roman period and linked to the transportation needs of the military apparatus. The small size of British mules has been linked to local breeding with the small local horses following the importation of donkeys from the continent (Johnstone, 2010).

The role of chickens expands significantly during this period as they become ubiquitous and supplemented the diet of military, urban and villa sites with eggs and meat (Sykes, 2012)

Other birds of culinary value like the anatids and pigeons (*Columba livia*) start being regularly consumed and exotic species like the pheasant (*Phasianus colchicus*) and the peafowl (*Pavo cristatus*) are introduced in small numbers (Maltby, 2016).

Whatever obstacle to their consumption there was during the Iron Age, in the Roman period fish becomes a common occurrence, although it seems they were sourced locally and deep-sea fishing was not practised (Locker, 2007). The influence of Roman culinary practices in this respect is also attested by the rare findings of *garum* (fermented fish sauce).

Wild game remains infrequent, but not so much on high-status sites, suggesting the introduction from abroad of gamekeeping practices aimed at leisure hunting. This finds confirmation in the evidence for the introduction of fallow deer (*Dama dama*) which was probably kept in parks as managed colonies at the most affluent villas (Sykes et al., 2011)

3.3.2 Techniques and scale of farming, storage and produce use

The frequency of high-density deposits of charred and germinated grains, already increasing throughout the Iron Age, reaches its highest levels by the middle Roman period (van der Veen, 2016). Evidence for tools related to hay-making (scythes, hay-forks) is found for the first time during this period (van der Veen, 2016).

One of the main indicators of the massive restructuring of the agricultural system over the Roman period comes from the structures required for the processing and storing of cereal crops. Grain pests such as the grain weevil (*Sitophilus granarius*) make their sudden appearance during the years of the Roman conquest and represent a significant change of practice, as they require large open grain storage to survive in Britain and the rapidity of their spread hints at the large scale of the movement of grain (van der Veen, 2016). Corn-driers make their appearance during the 1st c. CE and become widespread by the middle Roman period. These structures are associated both with the process of drying grain before storage and with malting (van der Veen, 1989). Drying is again evidence for the introduction of a new storage system, different from the Iron Age both in practice and scale, supporting the needs of a newly introduced market and/or taxation cycle and military supply. Malting is evidence for the large-scale production of beer, that from a house-made staple becomes a commodity to be exchanged, functioning as a cash crop to be sold for profit.

Another aspect of the restructured and expanded distribution system relates to meat. A new pattern of butchery accompanies the increased beef production in urban and romanised sites: the carcasses, mostly of cattle and to a lesser extent of the other meat-producing species, are heavily processed using heavy blades such as cleavers, with much more evidence for chop marks than in the previous period. Specific marks and patterns have been attributed to the actions of portioning, superficial filleting scoops and the axial splitting of upper limb bones and the transverse breaking of metapodials to access marrow (Maltby, 2007). All of these traits are absent or rare in Romano-British rural sites as they were previous to the conquest, lending to the idea that a slower and less intense traditional household butchery tradition persisted in the countryside. Butchery debris is now found in substantial dumps and the study of butchery marks and implements has linked the new techniques to the work of specialist butchers in urban and military settlements, engaged in the task of quickly processing large amounts of carcasses in an almost industrial process (Seetah, 2006; Maltby, 2007).

Furthermore, an increase in salt production (Maltby, 2006) and specific processing patterns (Maltby, 2007) hint at the diffusion of new curing practices and the trade of preserved joints of pigs and cattle.

The intensification of meat production is also suggested by mortality curves, showing an increased focus on adult individuals both in cattle and sheep (Maltby, 2016). Cattle were also extensively used for traction in the expanded arable system and consequently increased in size through breeding and importation of larger stock to fulfil their dual role as beef source and draft animal (Albarella, Johnstone and Vickers, 2008).

The absolute prevalence of adult cattle in the record, as well as its increase in size over the Roman period, follow the same pattern of diffusion described above for the introduction of new foodstuff and intensive butchery, happening immediately in romanised settlements (and in the South-East) and progressively spreading to the rest of the population by the end of the Roman period (Rizzetto and Albarella, 2022).

The appearance of hornless sheep suggests the introduction of new stock (Maltby, 2016) while the size improvement of both sheep and pigs becomes noticeable sometimes around a century after the conquest (Albarella, Johnstone and Vickers, 2008). Data and discussions on pig husbandry in Britain are limited. However, it is interesting to note the possibility. suggested by Maltby (2016) that the Romans might have introduced a limited form of sty-husbandry to the island. This would have entailed the practice, implemented in Roman Italy (MacKinnon, 2006) of stall-feeding small numbers of a larger landrace, whereas the majority of pigs would have belonged to a smaller landrace kept free-range in wooded areas.

The nature of the agricultural expansion is difficult to ascertain, given how little direct evidence of cultivation practices is available. The effort put into improving and maintaining larger and more numerous cattle for traction and the cultivation of heavier soils can be interpreted as part of a strategy to increase arable production by extending the cultivated areas without necessarily increasing their productivity.

Isotopic evidence from cereal remains from Stanwick (Northants.) also hints at extensive cultivation by showing a decline in δ^{15} N paired with stable values for δ^{13}C, which indicates lower levels of manuring (Lodwick et al., 2021). The geographical position of the site, fairly central to the Romano-British settlement and agricultural system, makes it tempting to generalise this isolated result, but more studies on this line of evidence are needed to obtain a clearer picture.

In fact, most of the other patterns outlined above are mostly based on evidence from Southern and Eastern England while, despite the relative lack of regional studies, there is evidence that in other parts of the country this process did not occur homogeneously or at all (van der Veen, 2016).

3.4 Agricultural economy and animal use in Iron Age Britain: some considerations and points to carry forward

3.4.1 Self-sufficient communities?

Parks (2012, pp.241-242) notes that in Eastern England the normal agricultural practice seems to be that of satisficing (safe return on minimal investment) or production in the context of a subsistence economy: labour and resources are invested to plough, manure and weed just enough to prevent soil impoverishment and ensure safeguarding. The success of spelt fits with this approach, as well as the avoidance of heavy clay soils that require a more intensive approach and will in fact be cultivated under the Roman farming regime. Rizzetto, Crabtree and Albarella (2017), link the increased reliance on cattle and their improved size to the Roman settlement pattern favouring the heavier soils of the British lowlands. It is currently impossible to confirm archaeobotanically that clay areas were restricted to pastoral practice only during the Iron Age (Parks, 2012, pp.247-248). It is, however, a tantalising interpretation, as their use as pasture would fit well with the increasing importance of sheep husbandry in a context of demographic, settlement and farming expansion.

Activities like salt-making and iron smelting which are thought to be seasonal, as well as work-intensive phases of the agricultural and pastoral regimes, would have inevitably coincided (e.g. the harvest with the optimum season for salt production, Parks, 2012, p.42). It is therefore reasonable to think that the workforce of a settlement or wider community would have been divided into different roles and activities, although it is difficult to say on which basis. The increase in the scale of production through time, demonstrated by archaeobotanical data, especially on some sites (Parks, 2012, pp.249-256), hints at the development of producer sites. Those would have created a considerable cereal surplus, which hints at the existence of people not involved in cereal production. The consumers of said surplus could have possibly been represented by segments of society focusing on pastoral farming or the exploitation of marginal/specialised environments for production activities such as salt-making, metalworking or the acquisition of wild resources such as pelts and feathers. However, no substantial evidence of the existence of a distinct producer/consumer site relationship has been so far detected from faunal assemblages.

The isotopic evidence from faunal remains, however limited (3.2.2.6 – Livestock mobility), points towards the existence of animal exchange and forms of cooperation in livestock rearing between neighbouring communities, reinforcing the idea that Iron Age people were not completely sedentary (Hamilton et al. 2019) and that food production had ramifications on a non-local level.

This discrepancy between faunal and botanical data could be interpreted as follows: while settlements, regardless of scale, had a generalist and self-sufficient attitude towards subsistence production, some form of surplus production and redistribution was required to sustain seasonal activities in specialised environments. These would not have been engaged by the whole of a settlement population but could have potentially involved more than one settlement in the same general area, fostering wider community social relationships. The aforementioned example of mobile cattle calving in the Upper Thames Valley (3.2.2.6 – Livestock mobility) could be an example of the interaction between settlements at a wider community scale, managing land rights and animal movement in a shared landscape.

Van der Veen and Jones (2006) have suggested that grain surplus was consumed in episodes of feasting. Again, this is compatible with the gathering of people from the larger community, which could have meant the coincidence of seasonal activities and festivities. A parallel interpretation has been suggested by Sharples (2010), who proposes the consumption of gathered grain by labourers taking part in communal rampart construction in Wessex.

3.4.2 The role of sheep and cattle

The chronological trend toward an increased emphasis on sheep is attested with confidence in the two regions with the largest number of zooarchaeological studies. It is impossible with the data available so far to ascertain if this trend was present in other areas of Britain, but it is interesting to note that these two regions start off with very different species frequency ranges to each other.

The predominance of cattle in some areas, as opposed to that of sheep in the English downlands, has been convincingly linked to ease of foddering and watering in different environments (Grant, 1984a; Maltby, 1996; Hambleton, 2008, pp.61-65). Indeed, cattle necessitate larger amounts of water to thrive, whereas sheep seem to be more resilient to water shortages but tend to develop more easily some illnesses in wet environments.

Cunliffe (2004, p.416) linked the increase in sheep husbandry to the spread of arable farming in the downlands, considering the hectarage of farmed fields too large to be maintained productive without the direct manuring activity performed by sheep while folded into fallow or already harvested fields.

In contrast, Grant (1984b) hypothesised that the increase in sheep husbandry could have been a symptom of soil impoverishment, as their lower nutritional requirements would have made them viable on overexploited land where cattle-rearing was not possible anymore. Furthermore, van der Veen and O'Connor (1998) and Albarella (2019) point out that an emphasis on crop production and the colonisation of areas with heavier soils would have been better served by focusing on cattle as ploughing animals (as will be the case during the Roman period).

The relationship between sheep and arable farming is a complex question that would require a project on its own to obtain a clearer picture. To understand this matter we would need more evidence from environmental, landscape and soil data as well as a comparison with historical and ethnographic analogies. I can, however, advance some considerations based on the information available from the literature.

With no clear indicators for specialised husbandry through most of the period, we have to assume a generalised economy. Sheep is the predominant species throughout much of the history of Britain, well adapted to life in even the harshest environments of the island and hugely versatile both in terms of husbandry techniques and product yield. Furthermore, it requires very little effort to raise in extensive husbandry regimes and has a relatively fast reproductive rate. This handiness is demonstrated by the husbandry system on and around the Oxfordshire Ridgeway in the Early/Middle Iron Age. While cattle, the dominant species, was managed in a relatively complex and mobile way, keeping the reproductive animals in the lowland during calving season to supply them with abundant water, sheep in each site had a very local isotopic signature, similar to pigs (Schulting et al. 2019).

Cattle have very high food and water requirements and therefore need more resources and effort to rear. As a consequence, there is probably a more limited capacity for them in each local landscape, unless more land is used for the purpose (extensification) or cultural and economic reasons induce the farmers to take steps to increase said capacity (intensification). That would be the case for the increase in cattle frequencies associated with the unprecedented arable-focused, market-oriented agricultural intensification during the Roman period. During the Iron Age, however, the agricultural expansion and the colonisation of new lands did not need necessarily a change in focus. Changes in settlement pattern and exchange networks were comparatively small (see Ch.2), with communities becoming more numerous and nearby, but not aggregating in ways that would have required massive redistribution networks, not even in the so-called *oppida* (this is suggested by the sourcing of local cereals in Late Iron Age Silchester; Lodwick, 2018).

Without a radical restructuring of the socio-economic system and farming regimes, the increased population density expanding on previously marginal areas, in the case of heavy clay soils still unsuitable to cereal agriculture, would have found it easier to increasingly rely on sheep for subsistence. The persistence of a more important role of cattle in the Upper Thames Valley has been linked to the suitability of the river valleys and gravel terraces for their husbandry (Mulville, Ayres and Smith, 2011, p.520).

Cattle remained the second most frequent species in this period, enough for ploughing even if arable production was intensifying. Van der Veen and O'Connor (1998) pointed out that whereas a large-scale cereal agricultural system such as that of Roman Britain required large numbers of cattle for traction (to which the faunal record accords), small-scale arable production could have coexisted with extensive hill-farming of sheep.

Cattle are the most represented animal in the La Tene art of England, while sheep is rarely represented (Ellis 2020), suggesting that on the symbolic level cattle were seen as more important. Ellis also notes that depictions of cattle are most common on high-status object used for display during the Late Iron Age, which might suggest some correlation between cattle handling and status. The abundance of cattle, their symbolic role and small size are at the base of the model proposed by Roymans (1999), for Northswestern Europe (and confirmed for the Netherlands by van Dijk and Groot, 2013), according to which Iron Age cattle were used as a medium for exchange and a standard unit of value. This association between cattle and wealth has also been suggested for Iron Age Britain by Haselgrove (1999).

Accepting this model, the reduction in relative numbers of cattle, concurrent to demographic expansion, would have meant increased wealth inequality rather than a shift in economic strategies. Depending on how the ownership was managed, this would have contributed to the increased hierarchisation of societies towards the end of the period.

It is interesting to note that in the Saxon period, as population density, reliance on the market economy and urbanisation reverted to conditions comparable to those of the Iron Age, the animal economy shifted back to relying primarily on sheep, while livestock in general reverted to a smaller size (Rizzetto, Crabtree and Albarella, 2017). Sheep will then remain the main species throughout the Middle Ages and Modern Era, even in periods when the aforementioned conditions will be closer to Roman standards, but with the substantial difference of increasing specialisation in wool production for the market economy (Albarella, 2019).

Instead, the end of the Roman Empire sees a return to the reliance on small domesticates, mixed livestock exploitation and household butchery, in a parabolic trajectory that entails the disappearance of all the Roman traits of animal exploitation described above (Rizzetto, Crabtree and Albarella, 2017; Rizzetto and Albarella, 2022).

Iron Age and early Saxon Britain are chronologically and culturally distant, the similarities in their animal economies show on one hand the exceptionality of the Roman system, while on the other environmental affordances which characterise the British Isles.

3.4.3 Foddering and manuring

A huge contribution to the issues presented in this chapter would be given by a better understanding of foddering practices. It is well known that substantial hay production did not start until Roman times[12] (van der Veen and O'Connor, 1998). The foddering alternatives discussed in the literature (Grant, 1984a; van der Veen, 1992) are the use of processing by-products such as chaff, the destination as fodder-crops of barley, oats or brome, and the folding of livestock into arable fields after harvest to graze on stubble. Unfortunately, not much work on manuring is yet available for Iron Age Britain as this would give us a better understanding of folding (van der Veen and O'Connor, 1998). Some considerations can be made nonetheless. The climatic conditions of Britain and the exploitation of fallow and marginal areas for pasture make the need for sheep foddering minimal, when an extensive husbandry regime minimal is practised. Larger animals like cattle and horse would have had higher requirements. This would have been especially true if the herds were culled before winter as in the case of sheep (Maltby, 1981). Stubble grazing therefore could have been more an opportunity than a necessity. It would have contributed to converting agricultural waste into meat, directly manuring the fields and (at least marginally in the case of sheep) working the soil through trampling.

[12] There is, however, evidence for haymaking in late first century BCE Silchester (Lodwick 2017).

3.4.4 Iron Age food

3.4.4.1 Diet

Throughout the Iron Age diet in Britain was based on a very limited array of staple plants and animals. Cereal grains were complemented by pulses like peas and beans and possibly oil seeds like flax, gold of pleasure and poppy with a limited contribution of wild plants such as hazelnut, blackberries and green leaves (van der Veen, 2016). Despite their limited representation, wild fruits and leaves would have probably made a fundamental nutritional contribution to the otherwise restricted diet. Given the ambiguous and limited role of other wild resources, it is likely that those were gathered opportunistically on the field-side and while venturing through uncultivated land to take care of the pasturing herds or to collect wood.

Animal protein was usually restricted to meat from a few domesticated species and dairy products.

Even on sites where caprines were the majority, cattle were likely a major meat source due to their far larger size (Hambleton, 2008, p.38). However, smaller species like sheep and pigs would have better suited small communities at the local level.

The relatively low frequency of pigs, an exclusively meat-producing species, in comparison to continental sites, may be an indication of little dietary reliance on meat in general (Albarella, 2007).

As discussed above (3.2.3.4 – A note on milking and dairy production), milk production would have been a seasonally limited activity. However, there is no reason to think that it would have been consumed unprocessed, and curdled or fermented dairy products would have been easy enough to obtain and store for consumption throughout the year. Strabo's claim (Geography, IV, 5, 145) that Britons were well supplied with milk but did not make cheese does not have to be taken literally and could be just an indication that the British dairying regime was somewhat alien to what the author considered normal in the Mediterranean.

3.4.4.2 Feasting

After the events of conspicuous consumption that caused the formation of the LBA/EIA middens, feasting becomes less clearly identifiable in Iron Age society. Recent applications of Bayesian modelling of radiocarbon dates have in part overcome the issues with the Hallstatt plateau and shown that the life of middens extended, at least in some cases, well past what previously thought and into the Middle Iron Age (Waddington et al., 2019). From the 5th/4th c. BCE, consumption is in any case documented by the massive accumulation of animal remains on ground surfaces and disused storage pits (Bradley, 2019, 291) and the more intensive use of cauldrons and buckets at large sites (Sharples, 2010, p.146).

Even assuming that meat was not the focus of cattle rearing, the culling of the herd for population control or contingent reasons would have caused a sudden abundance of meat. Even the slaughter of sheep or pigs could have led to waste without a way to redistribute or preserve the meat. With the increase in salt production, this would have represented a less urgent issue, and other forms of curing like smoking and fermenting were also possibly used.

In any case, cattle slaughter or the seasonal culling of sheep would have certainly produced a surplus, which could have been used to feed people gathering for social or ritual occasions or to carry out seasonal and communal endeavours.

Due to the number, fast rate of infilling, and the presence of structured depositions, it has been proposed that the infilling of disused storage pits with domestic waste would only have happened sporadically (Hill, 1995b). The material in these features would have therefore represented secondary refuse. Its primary provenance is however unclear. One hypothesis is that it came from surface middens located within the settlement, accumulated over time and destined both for manuring and the infilling of the pits (Parker Pearson, 1996). Another hypothesis is that they represented episodes of conspicuous consumption possibly related to the frequent communal works on the enclosures (Bradley, 2019).

Sharples, (2010, pp.116-124) argues that feasting would have been an integral part of the logistics of boundary-building and the social events that accompanied these activities.

van der Veen and Jones (2006) interpret the occurrence of grain-rich site assemblages, especially frequent in Southern England and in association with storage pits in hillforts as evidence for large communal feasts rather than surplus redistribution between producer and consumer sites as it was previously proposed by Jones (1985).

As Maltby (2007) noted, after the conquest, the emergence of urban centres with higher demand, a new redistribution system and specialist butchers and traders would have disrupted the traditional social habits related to meat consumption.

3.4.5 The agricultural expansion

In reviewing and discussing various aspects of animal and plant husbandry during the Iron Age and the Roman period, several aspects have emerged which could help answer the questions mentioned in the introduction of this chapter and aid the characterisation of the agricultural expansion at the end of British prehistory. All the considerations expressed below represent broad generalisations which require testing on a local or regional scale. Although some of these will be addressed in this thesis, others will inevitably require further work.

3.4.5.1 The character of the expansion

- were new areas brought under cultivation or pasture?

During the Later Iron Age, the diffusion of settlements into valley bottoms, wetlands and clay-rich areas entailed the farming of at least some of the previously marginal lands. Rather than a radical transformation of landscape use, the lack of evidence for arable farming on the clays, together with the increased reliance on sheep suggests that these new areas were brought into use as pasture. There is, however, evidence for an increase in the scale of arable production, which might have meant arable expansion at least in some sites or areas with suitable unused land.

+ were choices made in terms of introducing or shifting to different crops and animals in order to increase productivity or adapt to different situations?

The array of plant and animal species used throughout the Iron Age is remarkably restricted and stable. The only substantial element of dynamism is represented by the shifting of livestock frequencies, with the gradual increase of sheep until the very end of the period. Slaughter strategies, including the substantial autumn cullings, remain stable despite the demographic expansion, suggesting that the system was already successful and able to sustain the creation of new herds. During the Later Iron Age, livestock mobility increased, but so far there is no evidence to link it to a need for increased productivity.

+ In what respects intensive (increase productivity without extending the cultivated area) and extensive (extend the cultivated area without increasing its productivity) practices were adopted?

The preference for sheep and spelt, as well as the generalised patterns of livestock exploitation and the free-range husbandry practices, were all part of a system that required relatively low investment of labour and resources and could be defined as extensive farming. These practices, however, remained largely unchanged throughout the period, therefore it does not appear as if the farming system was going through further extensification.

The lack of evidence for the introduction of new agricultural technologies might not be meaningful in itself. However, the introduction of improved ploughing tools and the expansion of arable farming on clays during the Roman period reinforces the idea of more conservative arable techniques during the previous period.

+ were any forms of specialised production introduced?

Farming during the Iron Age appears to have a remarkably constant generalist attitude, the only possible exception being horse-rearing.

+ did subsistence economies shift to any form of redistribution economy (i.e. market-oriented)

Forms of produce redistribution seem to have been limited. Large-scale production of beer and the cultivation of plant species that could be sold as cash crops appear only after the Roman conquest, although cured meats, small animals and cereals could have performed that function. The appearance of coinage and the increased frequency of imports from the continent during the Late Iron Age may have been an early symptom of an incipient monetary economy and the increased livestock mobility and nucleation of settlements can also be interpreted as signs of the shifting of the system (see also Ch. 2). However, the evidence for the farming economy does not suggest it had been fully achieved yet.

3.4.5.2 If it isn't broken, don't fix it: a conservative system in a crowding landscape

The farming economy system of the British Iron Age appears to have been extremely successful in maintaining relatively stable core traits while supporting demographic and settlement expansion.

The colonisation of previously marginal areas seems to have been carried out without substantial changes in farming strategies. This implies that it was preferable or easier to replicate the current system on less productive land than it would have been to find unoccupied productive land or invest in more intensive approaches.

This stability is even more remarkable considering the accelerating changes to the way of life of prehistoric Britons towards the end of the Iron Age (see Ch. 2).

The improving climatic conditions in the second half of the millennium (see Ch. 1) could have increased the carrying capacity of the Prehistoric landscape, helping to maintain a conservative farming system in the face of a wave of innovation and societal reorganisation. However, it would be wrong to think of the farming system as divorced from the changing aspects of Iron Age society. The colonisation of less productive land and the decreased relative frequency of cattle were bound to create wealth inequality, which in turn could have contributed to the hierarchisation of society. Other less intelligible aspects of the social order might have been influenced by the expansion reaching its limits.

It is probable that the balance was already shifting by the Late Iron Age: the scale of cereal production, the availability of small livestock and cured meat for exchange, mobility, instances of specialisation and settlement nucleation were all increasing, creating the conditions for a new redistribution system which was soon to be superseded by the Roman conquest.

CHAPTER 4

Methods and recording protocol

4.1 Introduction

This chapter details the methods chosen for this project. Animal remains can be recorded and analysed in a wide variety of ways and every methodological choice should be motivated by the research aims and clearly stated.

For this project, a selective recording protocol has been adopted (4.4 – Quantification and 4.3 – Recorded species and elements) to maximise the amount of high-quality data in relation to the time spent recording. Animal remains have been identified by means of comparative anatomy, according to morphological and metric criteria (0 –

Taxonomic identification), and counted (4.4 – Quantification) to determine the composition of the herds which, in turn, can be an index of cultural and economic choices or environmental constraints. A number of taphonomic factors have been taken into consideration to better control the bias affecting the other analyses and to better understand the human activities that modify bones and assemblages perimortem, such as the carcass-processing activities (4.6 – Methods and recording protocol). The assessment of age (4.5 –

Ageing) was conducted to build mortality profiles to be combined with the sex (4.7 –

Sexing) ratios within herds to understand livestock management. A number of biometric analyses (4.9 – Measurements taken and biometric analyses), paired with the incidence of non-metric traits (4.10 – Pathology and non-metric traits), have been used to identify specific animal populations and their changes through time and space.

4.2 Terminology

The names of the animal taxa are given in their first instance with their common English names followed by their Latin binomial nomenclature, in accordance with Gentry, Clutton-Brock and Groves (2004), and the International Code of Zoological Nomenclature (all the taxa recorded as primary data are given in 'Recorded species and elements'). These are then referred to in-text with the English name only.

For quantification purposes, the terminology adopted is that defined in Lyman (2008). With skeletal element is implied a discrete and complete anatomical unit (bone or tooth) such as a humerus, a mandible or a first lower molar, regardless of the stage of development. Conversely, a specimen is used to indicate any individual skeletal remains, whether found as a complete, fragmentary, or as an unfused part of a skeletal element.

4.3 Recorded species and elements

All the specimens have been examined. However, only a limited suite of anatomical elements and taxonomic groups were recorded according to specific criteria.

The recording protocol largely follows that defined by Davis (1992) and Albarella and Davis (1994; from now on DA protocol) and is tailored to the research aims of this project. There are a number of reasons why this system has been adopted. Those related to quantification issues and what is recorded as a specimen will be explained in the section below: 4.4 – Quantification.

However, one of the main reasons is to reduce the amount of redundant and low-grade information, therefore maximising the data useful to answer the research questions by recording more assemblages, while maintaining reasonably large individual datasets.

Only domesticated mammals –namely cattle, sheep, goats, pigs, horses and dogs– were recorded. Wild animals, although they provide complementary economic and social information, are not relevant to the investigation of animal husbandry. Domestic fowl has also been excluded, as the effort of implementing a different methodology and recording system necessary to the study of bird species has not been deemed worthwhile and time-effective, given their relative rarity and marginal economic role in British IA assemblages (3.2.2.1 – Livestock species and frequencies). Nevertheless, all the assemblages that constitute the core of this project have already been studied and published with a broader approach in their original reports, therefore any complementary information from the excluded species can eventually be retrieved from the literature.

The skeletal elements selected for recording have been chosen among those bearing more information pertaining to age, sex, size, shape, and anthropic, biotic, and abiotic modification and selection. A notable exception is represented by the exclusion of ribs and vertebrae, which potentially bear useful information about carcass processing and butchery. These elements are extremely difficult to identify to species, therefore yielding biased and partial information, albeit requiring considerable time and effort to record. A full list of the elements always recorded is presented in Table 4.1.

4.4 Quantification

4.4.1 Number of Identified Specimens (NISP) and Number of Recorded Diagnostic Zones (NRDZ)

NISP is defined by Lyman (2008) as ‘the number of skeletal elements (bones and teeth) and fragments thereof … identified as to the taxon they represent’. As a simple, cumulative and direct tally of the specimens as they are identified, NISP is commonly used as a measure of taxonomic abundance. Being a direct tally, however, it does not by itself take into account recovery and fragmentation bias, interdependence, differential skeletal setup between species, nor any issue related to the identification (presence of species with strong morphological similarities, quality of reference material, the experience of the zooarchaeologist). These sources of bias can, however, be controlled by introducing a formalised set of rules regarding what qualifies as a countable specimen in the form of a suite of diagnostic zones (Watson, 1979).

In this project, the set of diagnostic zones (DZ) adopted largely follows that used by Albarella and Davis (1994) and is listed in Table 4.1.

Skeletal element	Diagnostic zone
Maxilla	Fragment with at least one recordable tooth
Mandible	Fragment with at least one recordable tooth
Horncore	Complete transverse section
Cranium	Zygomatic bone
Atlas	Whole element
Axis	Whole element
Scapula	Glenoid cavity
Humerus	Distal and proximal epiphyses*
Radius	Distal and proximal epiphyses*
Ulna	Proximal articulation
C3 or C2+3	Whole elements
Metacarpal	Distal and proximal epiphyses*
Pelvis	Ischial part of the acetabulum
Femur distal	Distal and proximal epiphyses*
Tibia distal	Distal and proximal epiphyses*
Astragalus	Whole element
Calcaneum	Sustentaculum tali
Scafocuboid or centroquartal	Whole element
Metatarsal	Distal and proximal epiphyses*
Metapodial	Distal and proximal epiphyses*
Phalanx 1	Distal and proximal epiphyses*
Phalanx 2	Distal and proximal epiphyses*
Phalanx 3	Proximal epiphysis

*Table 4.1. Diagnostic zones recorded per skeletal element. Zones marked with * have more than one DZ and their MNE is tallied from the most represented DZ.*

The criteria adopted for the selection of the zones are a high incidence of survival, low incidence of fragmentation, ease of definition and identification (both on anatomical and taxonomic level), and degree of independence from age and fusion. To avoid counting twice the same element, skeletal elements bearing more than one diagnostic zone will be corrected in their minimum number of elements (see below). Furthermore, a threshold has been established so that only specimens with more than 50% of the diagnostic zone preserved were counted. Unfused bones (both epiphysis and diaphysis) are counted when more than half of the fusion surface is present.

Specimens pertaining to anatomical elements or species not listed in the recording protocol have been occasionally recorded to preserve qualitative information. Lower loose teeth have always been recorded when more than 50% of the occlusal surface was preserved.

NISP counts using the DA protocol yield largely comparable results to recording systems without a formal definition of what is considered a specimen (Trentacoste 2009)

Since the current protocol includes some differences compared to the original DA (e.g. two DZ for long bones, horncores are considered DZ instead of elements recorded but not counted in NISP) the direct, cumulative tally of DZs will be defined as Number of Recorded Diagnostic Zones, while NISP will be only occasionally used to refer to all the recorded fragments.

4.4.2 Minimum Number of Elements (MNE) and Minimum number of Animal Units (MAU)

For all the elements that are represented in the tally by a single diagnostic zone, the MNE is equal to the NRDZ of that element. For those skeletal elements bearing two diagnostic zones, the MNE is tallied from the most represented zone. In this way, MNE is largely comparable to the NISP counted tallying DZ in the original DA protocol. The MAU is calculated by adjusting each MNE to the frequency of the element in the skeleton of each taxon (Lyman, 1994). MAU does not therefore include those skeletal elements, such as horncores, that are not present in all the considered species.

4.4.3 Minimum Number of Individuals (MNI) and normed minimal animal unit frequencies (%MAU)

The MNI indicates the estimated minimum number of individuals that could have produced the archaeological record (Grayson 1984) and is calculated here as the highest MAU for a species in an assemblage. MNI is often used as a measure of taxonomic abundance as it has the advantage of partly avoiding the problems of specimen interdependence and differential fragmentation. Its application for that purpose is however fraught with problems (see Lyman, 2008, pp.38-81), and it is therefore used in this project mainly to calculate survival percentages and to control bias in taxonomic frequencies. In fact, MNI is less affected by recovery bias, which is potentially the greatest bias affecting an assemblage.

To compare skeletal part frequencies, each MAU value is also standardised by dividing it by the highest MAU for each species; these percentages are referred to as %MAU. Equivalent procedures13 were used by Binford (1984, p.50) to compare samples with different sample size and by Brain (1969) to observe the proportion of each anatomical part that survived attritional processes.

4.4.4 Meat Yield (MY%)

Estimating the dietary contribution of a species is an extremely complicated exercise and is not attempted here. In order to obtain a rough order of magnitude of the meat yield of the main domesticates, it is assumed that individual sheep, pig, and cattle contributed according to the following proportion 2:3:14 (following the caprine units used in Bökönyi, 1992), and their MNI multiplied accordingly. The value of the meat yield estimate for each species is then presented as the percentage of the total for each assemblage.

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[13] See Lyman (1994) for the discussion on their synonymy.

4.4.5 Representing taxonomic abundance and comparing data

In this thesis most quantitative data are represented as percentages as a simple and effective way to scale data and compare different datasets.

It must be noted that MNI and all other measures of taxonomic or skeletal element abundance which entail calculating a minimum should not be expressed as ratios or percentages on a purely arithmetic basis, as they are not absolute values. However, this could also be said for NISP since, if used to express taxonomic abundance, it represents a maximum estimate (Lyman, 2008, pp.46-48). Between the life of the animal and the zooarchaeological publication, information is reduced and distorted by countless taphonomic processes and limitations, only a few of which are under our control (O'Connor, 2000, pp.19-27), making any tally an approximation and not a true number (which would be ratio scale and therefore amenable to be expressed as a percentage).

We must, however, be able to compare quantitative data. Since raw counts do a poor job of that, percentages and ratios are needed for effective data representation and the use of multiple counts helps us in controlling bias and approximating the reality of the past.

4.5 Taxonomic identification

The identification of faunal material has been assisted by comparison with modern reference material from the University of Sheffield Zooarchaeology Lab Reference Collection. Atlases of animal bone comparative osteology (e.g. Schmid, 1972; Barone, 1976) have also been consulted to guide the identification.

Every specimen has been assessed and, when attribution to a skeletal element was possible, taxonomic identification has been attempted.

An effort has been made to attribute each specimen to the lowest rank of taxonomic classification possible using morphological, size, bio-geographic and geo-chronological contextual criteria. When the identification to species level on a morphological basis was dubious, higher ranks were assigned. When possible, biometric criteria have been used to establish proportions of individual taxa within larger groups (see below: 4.9 – Measurements taken and biometric analyses).

Domestic mammals and their wild progenitors cannot be separated with certainty by morphology only, nor always by autoptic assessment of their size. The identification of domestic cattle (*Bos taurus*) does not pose any particular problem, as aurochs (*Bos primigenius*) were largely extinct in the British archipelago by the middle of the Bronze Age (Evans 2015). The work by Prummel (1988) has been used to separate those elements that present close similarities with those of the red deer (*Cervus elaphus*).

Although we can rule out the presence of wild sheep (*Ovis orientalis*) or goats (*Capra aegagrus*) which are not native to Britain, the morphological distinction between the domestic species (*Ovis aries* and *Capra hircus*) is very difficult and has been attempted on a limited suite of elements, following methodologies described in Boessneck (1969), Kratochvíl (1969), and Zeder and Lapham (2010) for post-cranial bones and in Payne (1985), Halstead, Collins and Isaakidou (2002) and Zeder and Pilaar (2010) for mandibular premolars, and listed in Table 4.2.

Horncore	dP_3 & dP_4	permanent lower molars
distal Humerus	prox Radius	distal Metacarpal
distal Tibia	Astragalus	Calcaneum
distal Metatarsal	1st, 2nd and 3rd phalanges	

Table 4.2. Elements on which the separation between sheep and goat has been attempted on a morphological basis.

Wild boar and wolf (Canis lupus) are both native to Britain and, although rare in assemblages from this period (Albarella, 2019), their presence cannot be ruled out. The separation from the domestic pig and the dog has not been attempted on the basis of morphological criteria.

Wild equids are not present in Iron Age Britain, whereas the donkey is reported in a few dubious instances (Johnstone, 2004). Therefore, although they were assigned to the genus Equus, equid remains are generally assumed to be pertaining to the domestic horse. However, morphological criteria have been applied on first phalanges (Davis, 1982), molars and premolars (Davis, 1980).

4.6 Taphonomy

Taphonomy is a broad term to define the sum of processes that transform a living animal population into the archaeological record. This includes the acts of slaughtering, carcass processing and use, every deliberate and unintentional step that leads to deposition, and every post-depositional process, including excavation and study (Lyman, 1994). This section includes a number of assessments and analyses to determine how these processes changed the appearance and composition of the assemblages, in order to control taphonomic bias and obtain information about human and animal activities on site.

4.4.1. Overall surface preservation

The degree of preservation of cortical bone surfaces has been observed and recorded by assigning each specimen to one of three degradation stages described in Table 4.3.

Anthropic modifications, fragmentation and gnawing marks have not been taken into consideration for the assessment. A certain degree of subjectivity is to be expected, especially in those specimens heavily affected by the above-mentioned modifications.

Stage	Description
Good	Absent or localised and superficial abrasion or flaking of the cortical bone (less than 10%), unaltered surface morphology
Medium	Partial abrasion and/or flaking of the cortical surface (less than 50%), some details masked by erosion, general bone profile maintained
Bad	Most or all the cortical surface abraded and/or flaked, heavy penetrating erosions, slightly altered morphology, identification still possible with a reasonable degree of confidence

Table 4.3. Stages of surface preservation assigned to every recorded specimen.

4.4.2. Bone modifications

The presence of a few types of modification of the bone surface and/or structure that are easily identifiable and can be used as a proxy for human activity has been recorded and quantified.

Gnawing marks produced by the scavenging activities of carnivores and rodents constitute by themselves evidence of the presence of these commensal animals on site. More importantly, the frequency and intensity of gnawing activity, the distribution of marks on different skeletal elements and species and its relationship with their survivability can inform us about their time of exposure before burial and therefore on pathways of waste disposal.

Butchery marks have been recorded as cut marks and chop marks for quantitative purposes. The quantification of these marks has the purpose of identifying cultural patterns of butchery and specialised practices, potentially detecting the introduction of new *chaîne opératoires.* Furthermore, the position, shape and number of butchery marks are briefly described for each specimen to detect qualitative differences within and between different assemblages, which are reported when relevant. This approach to butchery does not claim to be exhaustive (as that would be outside the scope of a work focusing on animal husbandry) and serves to detect broad patterns of change. Similarly, coarse-grained approaches have already proved sufficient to show differences between periods and culturally different practices (e.g. Albarella, 2019, p.105, Fig. 5.11).

The evidence for burning is recorded in different categories by extension and intensity, where burnt is defined as specimens whose surface is mostly black and shiny due to direct exposure to fire; singed are specimens with localised black areas due to partial exposure to fire; and calcined are specimen at least partially discoloured to white/grey/bluish hues due either to exposure to very intense heat or extended exposure. Colour alone is not always indicative of the exact way bone remains were exposed to fire (Shipman, Foster and Schoeninger, 1984; Nicholson, 1993). However, even a superficial analysis of burning patterns can be, to a certain extent, indicative of cooking or waste disposal practices. More importantly, exposure to intense heat alters the structure of the bone on a macroscopic level, with the shrinkage and deformation rendering the specimens potentially difficult to identify and unsuitable for biometric analysis.

4.4.3. Recovery bias

The impact of recovery bias, due to size differences between different species and anatomical elements, has been tested and demonstrated (Payne, 1975). It is therefore fundamental to assess its overall magnitude on each assemblage.

Recovery bias has been here assessed on cattle and caprines (to gauge the effect of size) in two complementary ways.

The first assumes that the chance of survival of skeletal elements sharing the same joint within a deposit should be similar, bar the differential recovery bias. Therefore, the comparison of MAU percentages of distal tibiae and astragali and distal metapodials and phalanges (first and second) of different species have been presented as bar charts for ease of comparison. MAU was chosen to make visually evident the divergence from the assumed 1:1 proportion in each joint. Second phalanges were added to control bias introduced by butchery practices: even if metapodials and phalanges were separated and differentially disposed of, it is unlikely that the first and second phalanges were intentionally separated.

The second compares the ratio between mandibles and mandibular loose teeth. Assuming negligible recovery bias, the proportions would be dictated by the differential degree of fragmentation of the mandibles, which have been linked to the differences in structural density and strength among the various species (Weiner, 2010). As stated above, recovery bias is inevitable in the absence of complete sieving of the archaeological deposits. Therefore, mandibles of all species will tend to be better represented in comparison to teeth whenever there is a strong recovery bias, as they will be more easily recognisable in the deposit during excavation. At the same time, medium-sized species like caprine will tendentially present a higher mandible to teeth ratio than large-sized animals like cattle in conditions of either low fragmentation or high recovery bias.

4.4.4. Distribution of anatomical elements

The analysis of the distribution of anatomical elements, paired with that of bone modification, can shed light on carcass processing and waste disposal practices. Skeletal elements are quantified using MAU to reduce the bias due to different numbers of body parts present in a skeleton influencing their chance of survival.

Their distribution has been analysed by comparing both percentages of the total MAU and %MAU values, to identify which elements were under or overrepresented when compared to other species in the assemblage or to the same species in different assemblages.

4.10. Ageing

Ageing methods are used in zooarchaeology to infer the age profiles (or their reverse, mortality profiles) of the communities of living beings that contributed to the formation of the archaeological deposit.

4.10.1. Mandibular Wear Stages and tooth eruption

Methods of age assessment based on teeth rely on the observed patterns in dental development and wear. Several factors influence eruption and wear, such as genetics, diet, health and the presence of abrasive particles in their foodstuff. Nonetheless, the framework they create gives a reliable way to compare relative ages within a population or kindred populations.

Mammals generally develop one set of deciduous and permanent teeth before reaching adulthood. The sequence of eruption and loss of deciduous teeth, as well as the eruption of permanent teeth, is species-specific and descriptive sequences can be created with reliable ranges of a few months. The stages used to describe dental eruptions in this study follow those in (Ewbank et al., 1964) and are listed in Table 4.4.

Code	Stage of eruption
C	Still in crypt
V	Visible
E	Erupting
H	Half-erupted
U	Fully erupted, yet unworn

Table 4.4 Stages of tooth eruption (after Ewbank et al., 1964).

The size and shape of teeth in domestic mammals are well-suited to wear analysis. Enamel and dentine form structures that evolve into recognisable patterns in time through wear. A few methods to describe and sequence dentine exposure of individual teeth (Tooth Wear Stage) have been devised. For this study, TWS has been recorded following Grant (1982) for cattle mandibular teeth, Payne (1973) for caprine mandibular teeth and Wright and colleagues (2014) for mandibular and maxillary teeth of pigs.

Eruption data and TWS in mandibles with at least two recorded teeth were combined into Mandibular Wear Stages using methods developed by O'Connor (1988) for cattle and pigs and by Payne (1973) for caprines. These methods are based on the eruption and wear stages of the further tooth in the jaw while using correlation tables when this was absent or not recorded (from Payne, 1973, Grant, 1982 and Wright et al., 2014).

4.10.2. Epiphyseal fusion

Epiphyseal plates, composed of hyaline cartilage, constitute the part (located in the metaphysis) where the length of long bones increases during growth. At the end of its growth, each epiphyseal plate ossifies, being replaced by an epiphyseal line (epiphyseal closure or fusion). The relative sequence of fusion of different epiphyses is approximately the same in all domesticated mammals, although on a different, species-specific, timescale. Skeletal maturity (when all the plates have already fused) roughly coincides with adulthood.

The knowledge of the time of fusion of different plates, gained by observations made on modern animals, allows the creation of a sequence that can be used to assess age at death from skeletal remains. Skeletal development can be altered by genetic, dietary, health and hormonal (e.g. castration) variables. Other sources of potential bias are given by the differential preservation of immature and fully ossified bones and by the uneven number of plates fusing in each stage of development as well as the different lengths of each stage.

Nonetheless, epiphyseal fusion data is usually extremely abundant so an adequate sample size is often obtained. This makes it a good complementary method to use along with MWS when its sample size is poor or recovery bias has obscured the presence of young animals.

The fusion events were grouped in Early, Middle, and Late fusing (Table 4.5) following Silver (1969).

	Epiphyseal plate	Cattle	Sheep	Pig	Horse	Dog
Early fusing	Humerus, distal	12-18 mo	10 mo	1 yr	15-18 mo	8-9 mo
	Radius, proximal	12-18 mo	10 mo	1 yr	15-18 mo	11-12 mo
	First phalanx	1½ yrs	13-16 mo	2 yrs*	13-15 mo	7 mo
	Second phalanx	1½ yrs	13-16 mo	1 yr	9-12 mo	7 mo
Middle fusing	Tibia, distal	2-2½ yrs	1½-2 yrs	2 yrs	20-24 mo	13-16 mo
	Metacarpal, distal	2-2½ yrs	18-24 mo	2 yrs	15-18 mo	8 mo
	Metatarsal, distal	2¼-3 yrs	20-28 mo	2¼ yrs	16-20 mo	10 mo
Late fusing	Humerus, proximal	3-3½ yrs	3½-4 yrs	3-3½ yrs	3½ yrs	15 mo
	Radius, distal	3½ yrs	3½-4 yrs	3 yrs	3½ yrs	11-12 mo
	Ulna, proximal	3½ yrs	3½-4 yrs	3 yrs	3½ yrs	9-10 mo
	Femur, proximal	3-3½ yrs	3½ yrs	2½-3 yrs	3½ yrs	1½ yrs
	Femur, distal	3-3½ yrs	3½-4 yrs	3-3½ yrs	3½ yrs	1½ yrs
	Tibia, proximal	3-3½ yrs	3½-4 yrs	3-3½ yrs	3½ yrs	1½yrs

Table 4.5. Epiphyseal fusion event groups for cattle, sheep, goat and pig (after Silver 1969).

4.8 Sexing

Sex ratio within domestic herds is an expression of their management strategy and it is, therefore, useful to complement ageing data to understand husbandry practices.

Sex can be assessed from skeletal remains through the assessment of sexual dimorphism. Sexual dimorphism is the presence within the same species of physical characteristics, besides their reproductive organs, that separate the two sexes. Sexual dimorphism is present, to different degrees, in all domesticated mammals, although usually to a lesser extent in comparison to their wild counterparts. Unfortunately, some secondary sexual characteristics are not reflected on the bones, while others are not easily detectable in terms of morphology and are best investigated morphometrically.

The only morphological criterion adopted for sexing in this study is the shape of the canines of boars and sows in pigs. Only canines embedded in jaw bones and jaw bones with canine alveoli but missing teeth were counted to avoid recovery (as male canines are larger) and fragmentation bias (in this case, the risk of over-representation by counting both the jaw and the loose tooth of the same individual).

Biometric analysis has been conducted comparing the size (in terms of lengths and width) of long bones to identify clusters of smaller (female) and larger (male) animals while controlling the presence of castrates by comparing their shape (in terms of ratios between lengths and widths) to identify clusters of large but slender animals.

Further evidence for sex distributions is obtained from the distribution of the Log Scaling Index histograms (see next section). Since each histogram reflects the size of a population composed of females, males and possibly castrates, and the distribution of the data from each group is expected to be normal, the overall distribution is potentially tri-modal. However, the three groups overlap in size, and the number of individuals for each can be vastly different. A population mostly composed of females, as it is frequent in human-managed herds, would present a unimodal, positively skewed curve, with a right tail representing the males. Therefore, assessing the shape and skewness of the curve can give a rough idea of the presence and proportion of castrates and males by comparing it with the female-dominated model curve.

4.9 Measurements taken and biometric analyses

Measurements from post-cranial bones and teeth were taken according to (von den Driesch, 1976; Payne and Bull, 1988; Davis, 1992, 2002; Albarella and Payne, 2005; Salvagno and Albarella, 2017). The suite of measurements was chosen according to preservation and the possibility of assessing their development stage (epiphyseal fusion). All selected measurements are widely employed by zooarchaeologists and recognised as being reliable or, in the case of the more recently devised, have been accurately tested for intra-observer reliability. Therefore, and in view of the time and material accessibility constraints, no further testing was deemed necessary. Table 4.6 and Table 4.7 list the complete suite of measurements. The length and diameter of the shaft of unfused long bones have also been measured.

Post-cranial elements	Bovinae	Caprinae	Suidae	Equidae	Canidae
Horncore	GL, maxD, minD	GL, maxD, minD	n/a	n/a	n/a
Atlas	-	-	H, BFcr	-	H, BFcr
Scapula	SLC, GLP	SLC, GLP	SLC, GLP	SLC, GLP	SLC, GLP
Humerus	GLC, BT, HTC, SD	GLC, BT, Bd, HTC, BE, Bel, SD	GLC, BT, HTC, SD	GLC, BT, HTC, SD	GLC, BT, HTC, SD
Radius	GL, SD, Bp	GL, SD, Bp, BFp, Dp	GL, SD, BpP, Bd	GL, SD, Bp	GL, SD, Bp, Bd
Ulna	BPC, DPA	BPC, DPA, SDO	BPC, DPA	-	BPC, DPA, SDO
Metapodials	GL, SD, BatF, BFd, WCM, WCL, DEM, DVM, DIM, DEL, DVL, DIL	GL, SD, Bd, WCM, WCL, DEM, DVM, DIM, DEL, DVL, DIL	GL	GL, SD, Bd, Dd	Gl
Pelvis	LA	LAR	LAR	LAR	LAR
Femur	GL, SD*, DC	GL, SD*, DC	GL, SD*, DC	GL, SD*, DC	GL, SD*, DC
Tibia	GL, Bd, SD, Dd	GL, Bd, SD, Dda, Ddb	GL, Bd, SD, Dd	GL, Bd, SD, Dd	GL, Bd, SD, Dd
Astragalus	GLl, GLm, Bd, Dl	GLl, GLm, Bd, Dl, H	GLl, GLm	GH, GB, BFd, LmT	GLl, GLm
Calcaneum	GL, GB, GD	GL, GB, c, d, DS, B, GD	GL, GB, GD	GL, GB, GD	GL, GB, GD
1st phalanx	-	-	-	GL, Bp, Dp, SD, Bd, Dd	-

Table 4.6. List of measurements taken on post-cranial elements.

	Equidae	Bovidae	Suidae	Canidae
P_2	L_1, W_a	-	-	L
P_3	L_1, W_a	-	-	L
P_4	L_1, W_a	-	-	L
dP_4	L_1, W_a	L, WP	L, WP	L, W
M_1	L_1, W_a, W_d	L, WA, WP,	L, WA, WP,	L, W
M_2	L_1, W_a, W_d	L, WA, WP,	L, WA, WP,	L
M_3	L_1, W_a, W_d	L, WA, WC, WP	L, WA, WC, WP	L
M^3	-	-	WA, WC, WP	L

Table 4.7. List of measurements taken on teeth.

Biometric analyses were conducted in order to achieve a number of aims. First, to assess the homogeneity of the populations of the same taxon within the same period and site in terms of size and shape. The distribution of such data potentially allows us to separate different taxa as well as wild and domestic forms. It may also inform us about sex ratios and the presence of individuals pertaining to different populations (different morphotypes).

Following this initial analysis, comparative analyses were performed between sites and phases to detect local patterns and diachronic change. The analyses involved the use of statistical hypothesis testing and the construction and interpretation of visual representations of the datasets.

Statistical tests, performed using GraphPad Prism, were used to detect significant differences between different phases/sites. The null hypothesis was that different datasets represented the same population and statistical significance was tested at the 95% confidence level – $p < 0.05$.

To compare the distribution of any two datasets, Welch's t-test was used in every case where both had a sample size of at least 50. When sample size was lower, the non-parametric Mann-Whitney U test was preferred to the t-test, to avoid possible false positives due to the skewness of the distribution. The non-parametric Kruskal-Wallis test was used in every case when more than two datasets had to be considered. In all tests, the following information is reported: the median (Mann-Whitney U) or mean (Welch's t-test); sample size; relevant statistic value, P value; ns (not significant, P>0.05) or a number of asterisks representing the level of significance (*, P ≤ 0.05; **, P ≤ 0.01; ***, P ≤ 0.001; ****, P ≤ 0.0001)

The skewness of the distributions was also tested and reported using the adjusted Fisher-Pearson coefficient of Skewness.

The preferred form of data visualisation consists of histograms and scatter plots of measurements of single skeletal elements. This allows to choose the most appropriate skeletal elements and measurements for the analysis, that is, those which are known to be more or less influenced by sex, age, and environmental/pathologic stress (Payne and Bull 1988), according to the target of the analysis.

To make up for datasets where sample size did not allow for same element biometric analysis, Logarithm Scaling Index (LSI) technique has been adopted. LSI works by dividing single measurements by a standard value and converting it into a decimal logarithm. In this way, values on the same scale are obtained from different measurements of different skeletal elements, which can, in turn, be aggregated and plotted on the same histogram (Meadow, 1999).

The standards used in this study are listed in Table 4.8. The choice of standards has mainly been driven by the availability of published standards with a high number of measurements used in this study. Standards obtained from British prehistoric assemblages have been preferred, as they reflect more closely the material under study (Albarella, 2002). The standards from the literature have been used mostly for the analysis of the data from the core assemblages, for two reasons: they had the most measurements across all three axes and the difference between the standard and the data gives an idea of the size of Iron Age livestock when compared to the periods from which the standards are dated. For comparisons on a broader area, standards obtained from the core assemblages have been chosen due to the higher number of postcranial width and teeth measurements available, and because their proportions better reflect the other more or less contemporary populations.

Taxon	Standard
Cattle	the mean of the measurements of cattle bones and teeth from Early Anglo-Saxon contexts at the site of **West Stow** (Suffolk), from Rizzetto and Albarella (2022)
	the mean of width measurements of cattle bones and teeth from Latest Iron Age **Dragonby**, recorded by the author.
Caprine	the mean of the measurements of caprine bones and teeth from Early Anglo-Saxon contexts at the site of **West Stow** (Suffolk), from Rizzetto and Albarella (2022)
	the mean of width measurements of caprine bones and teeth from Latest Iron Age **Dragonby**, recorded by the author.
Pigs	the mean of the measurements of pig bones and teeth from the late Neolithic site of **Durrington Walls** (Wiltshire) (Albarella and Payne 2005)
	the mean of the measurements of pig teeth from Latest Iron Age **Dragonby**, recorded by the author. The mean of width measurements of pig postctranial bones from Latest Iron Age **Skeleton Green**, recorded by the author.

Table 4.8. Standards used for LSI analyses. The names of the sites whose materials have been used to produce the standards are in bold and will be referenced in lieu of the respective standard in Chapter 7.

Measurements lying on different axes (lengths, widths and depths) were usually analysed separately because they tend to be poorly correlated (Davis 1996; Meadow 1999). Whenever the sample size did not allow it, lengths, widths, and depths were aggregated to increase sample size at the price of a decreased resolution.

Teeth and bones were analysed separately in the light of their different rate of reaction to selective pressure and environmental factors: changes in teeth tend to be slowest and more stable, therefore suggesting a genetic change (Payne and Bull, 1988).

To detect changes in size, the use of skeletal elements which are strongly influenced by age should be avoided, as it could skew the results due to a particular age or sex profile of the herd (Albarella, 2002). For this reason, SLC measurement in the scapula and the SD in long bone shafts both grow continuously throughout the life of the animal and are therefore not the best to assess overall size (Rowley-Conwy, 1995; Albarella and Payne, 2005).

4.10 Pathology and non-metric traits

Any mark of pathological alteration or presence of non-metric traits detected on teeth and bones has been recorded in order to better evaluate the use of specimens for different analyses.

A certain frequency of non-metric traits can be interpreted as typical of a specific population. Therefore, a set of few well-defined and relatively common traits have been regularly recorded in terms of presence/absence when possible. The traits that have always been recorded are agenesis of the first premolar in pigs, agenesis of the second premolar in cattle, absence or reduction of the hypoconulid of the third molar in cattle and caprine third molars, and the absence or redundancy of horncores on caprine and cattle skulls.

CHAPTER 5

Sites and materials

5.1 Selection criteria

The assemblages used in this study were selected on the basis of several considerations. Four sites within the core study area (Eastern England) have been selected for primary data collection. All these assemblages had previously been studied and published as full faunal reports, except for Northstowe, which was excavated more recently, and for which only preliminary reports are available. The choice to re-examine published materials gives a measure of control over the selection, allowing the prior assessment of the three criteria described below. This was done to improve the quality and quantity of data gathered through the application of the recording and analysis protocol described in the previous chapter.

The main criterion adopted was sample size. The quantitative and biometric analyses described in Chapter 4 require large datasets which can generally only be obtained from assemblages with tens of thousands of bone fragments, given that the specimens bearing the needed information represent a very small fraction of the record. Even though Iron Age sites are often rich in archaeological materials when compared with other prehistoric periods, the nature of the archaeological evidence within the sites is extensive, with materials mainly found in large ditches and pits that are seldom excavated to their full potential.

The second criterion was chronology. The main chronological uncertainties in Iron Age studies, which are discussed in chapter 1, mean that a degree of flexibility had to be adopted. However, as one aim of this research is to track change over time, it was important to select sites that allowed for meaningful inter-site diachronic comparison with materials from reasonably tightly dated contexts.

The chronology and sample size of the assemblages used for the primary data collection are presented in Table 5.1.

	Centuries					
Site	4th BCE	3rd BCE	2nd BCE	1st BCE	1st CE	→
Northstowe			1241		431	
Hadenham V			2404			
Dragonby					4211	
Skeleton Green					2502	

Table 5.1. Summary of chronologies for the sites whose assemblages have been analysed in this study; occupation phases in light grey, chronological ranges for the assemblages dated to Mid to Late Iron Age in black, to the Latest Iron Age in dark grey. The NISP for domestic mammals as reported in their original publication is indicated with a number within the period bar (materials from sieved contexts are excluded).

The third criterion was geography, restricting the selection to a broad core area (Figure 5.1) to avoid drawing comparisons from radically different cultural and environmental contexts.

As we will see in their description below, all the primary assemblages come from sites that are exceptional in their way. However, they also present common traits that form a baseline for their comparability, allowing for the use of their differences to enhance the discussion of the zooarchaeological data. The selected sites are all large, extensively excavated, rich in material culture, located at a low elevation, and part of a densely populated Prehistoric landscape near marshland environments. This is not to dismiss the differences in spatial organisation and plan, size, structural evidence and material culture but rather to point to the fact that they are not functionally different. They all represent rural settlements, where relatively small and autonomous communities lived within a heavily anthropic landscape, in close contact with their crops and livestock. Skeleton Green might be in part an exception to this, as it has been interpreted in the past as a trading centre. However, the evidence presented in the original faunal report does not suggest a radically different animal exploitation system. Furthermore, the abundance of pig remains in the assemblage gives us the unprecedented opportunity to analyse biometric data from a sizable sample of Iron Age pig remains, giving us more than enough reason to select this site.

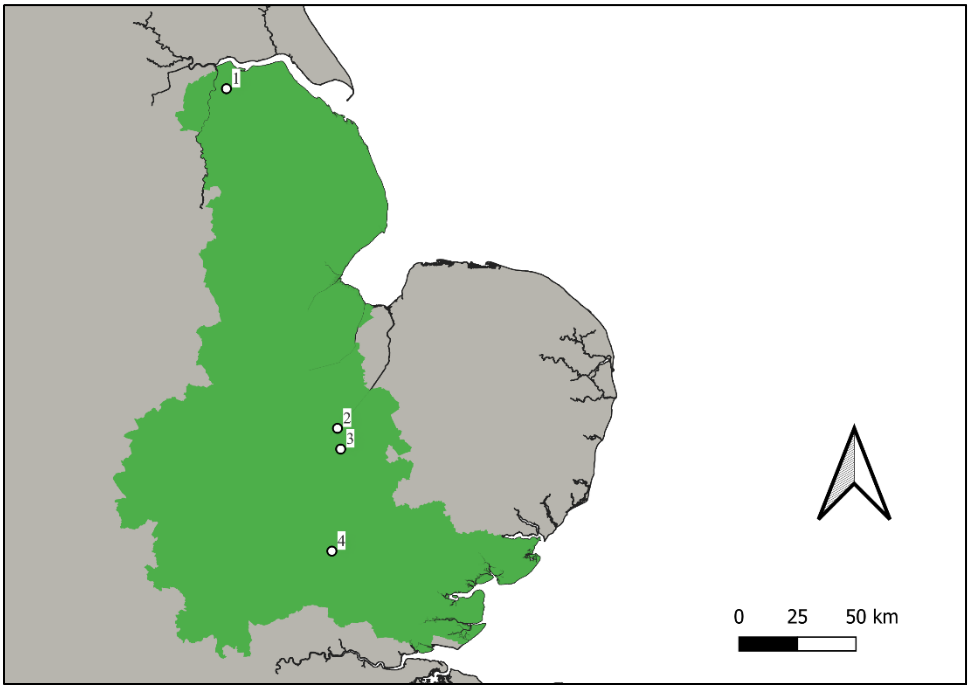


Figure 5.1. Map with the location of the sites whose assemblages have been recorded for this study. The boundaries of the core study area are outlined. 1 Dragonby, 2 Haddenham V, 3 Northstowe, 4 Skeleton Green.

5.2 Sites

The sections below will present a brief physical description, a summary of the finds and an overview of the published faunal reports for each of the core sites.

The location of other archaeological sites mentioned in this thesis is presented in Figure 5.2.

These include sites whose osteometric datasets have been analysed in Chapter 7. The measurements were either obtained from publicly available sources such as ABMAP (https://archaeologydataservice.ac.uk/archives/view/abmap/) or kindly shared by other zooarchaeologists (see the acknowledgements).

Figure 5.2 Map showing the location of the sites mentioned in the thesis. Core sites: 1 Dragonby; 2 Haddenham V; 3 Northstowe; 4 Skeleton Green. Eastern England:5 Billingborough; 6 Market Deeping; 7 Colne Fen; 8 Wardy Hill; 9 Elms Farm, Heybridge; 10 Bedford West By Pass; 11 Broom Quarry; 12 Moggerhanger; 13 Marston Park; 14 Northampton Road, Brackley; 15 Radstone Road, Brackley; 16 Wellinborough, Wilby Way; 17 Wellinborough, Burton Way; 18 Brackmills. Wessex:19 Flagstones, Dorchester; 20 Allington Avenue, Dorchester; 21 Battlesbury Bowl; 22 Rope Lake Hole; 23 Balksbury, Andover; 24 Silchester; 25 Popley, Basingtoke; 26 Micheldever Wood; 27 Knights Enham Hill, Andover; 28 A303 Stonehenge; 29 Owslebury; 30 Brighton Hill South.

5.2.1 Northstowe

Northstowe is a new town located five miles (8 km) northwest of the city of Cambridge, between the villages of Oakington and Longstanton. Its development has been taking place since the 2010s in an area previously occupied by a WWII airbase and a golf course; each phase of construction was preceded by a series of assessments and open area excavations, mainly conducted by Cambridge Archaeological Unit (Collins, 2020, 2016).

The area is characterised by a gentle northwest-southeast slope with an underlying subsoil of terrace sands and gravels and an Ampthill Clay plain at the bottom of the slope. The Great Ouse River runs further away to the North.

The investigations have revealed a sparse and discontinuous use from the Mesolithic to the Late Bronze Age when the evidence becomes more substantial. The area then sees an intense phase of occupation during the Mid to Late Iron Age and Romano-British period, the presence of an Anglo-Saxon settlement and cemetery, and later archaeological evidence for agricultural use and peripheral structures of the nearby village of Longstanton.

The Iron Age evidence has been dated to the Later Iron Age due to the presence of Scored and Plain Wares, distinguishing a later phase defined in the reports as Late Pre-Roman Iron Age (c. 50 BCE to 43 CE, phase 4,) thanks to the presence of 'Belgic' related form and the absence of post-conquest materials. The materials were further divided into a Mid to Late Iron Age (phase 2) and a Late Iron Age (phase 3) phase.

For analytical purposes, materials from phase 2 and 3 will be treated together as Mid to Late Iron Age, while those from phase 4 will be treated as Latest Iron Age.

The faunal material dated to the Iron Age came mostly from areas K (Collins, 2016) and DD (Collins, 2020), with very small samples from areas CC and GG (Sharman, 2020).

Settlement activity across Area K started during the Middle-Late Iron Age phase when an open field system was established. A banjo enclosure belonged to the same phase; although very little structural evidence has survived, the presence of a dwelling is indicated by a substantial accumulation of domestic debris. This developed into an enclosed settlement with at least two roundhouses during the Late Iron Age. During the Late Pre-Roman Iron Age phase new enclosures replaced those belonging to the previous phase and, although no substantial structural evidence remains, the distribution of the artefacts points to the focus and intensity of the settlements remaining the same, and the presence of post-holes and a few other discrete features is interpreted as part of lighter structures (post-built structures).

With the Roman Conquest, the settlement moved to other areas of the site (Area M).

Area DD presents a settlement sequence analogous to that of area K. During the Mid to Late Iron Age a system of boundary ditches was established, the remains of four possible roundhouses were located in a slightly raised unenclosed space, and a group of watering holes were dug in a lower-lying area. During the Late Iron Age, the main settlement area was fully enclosed, and the roundhouses were probably replaced by post-built structures. With the Roman Conquest, this area was used as a field for planting beds.

The evidence in Area CC is represented by a Mid to Late Iron Age roundhouse placed within an enclosure and having at least two construction phases after which the site was abandoned until its use for planting beds during the Roman period.

Area GG was occupied, throughout the Iron Age, by a group of three interconnected square enclosures, clusters of pits and a single ditched roundhouse. Throughout the period these structures were reworked several times and the area was completely abandoned after the conquest; it remained deserted until the Middle Ages.

Overall, the landscape at Northstowe during the Iron Age was characterised by small enclosures and settlements, often represented by single farmsteads.

Limited zooarchaeological data is available for these recently excavated sites, so far published as Post Excavation Assessments.

Area K yielded 11103 bone fragments, of which 2193 were recorded and 1014 were identified to species for the assessment (Rajkovača, 2016). The overall degree of preservation has been assessed as moderate due to the presence of specimens that are severely exfoliated or eroded, while fragmentation is heavy.

The Middle to Late Iron Age assemblage is small (NISP 381) and sees caprines as the prevalent taxon (48%), followed by cattle (26%), horse (12%), pig (10%) and dog (2%). Wild animals are absent and neonatal/foetal remains of cattle have been recovered.

The Late Iron Age (NISP 808) and Late Pre-Roman (NISP 906) assemblages see an increase in cattle remains (40.5% and 53.2%), overtaking caprines (33.6% and 24.3%) in terms of NISP. Pig and horse frequencies fluctuate with pigs (14.9%) becoming more abundant than horses (7.7%) in the Late Iron Age and then reverting to proportions similar to those of the Mid to Late Iron Age (5.5% and 12.5% respectively). Very few wild animal remains were identified. The Roman Conquest assemblage is negligible (NISP 98).

The assemblage from area CC is also negligible (128 fragments of which 14 are identified to species, Rajkovača, 2020b).

Area GG yielded 2125 bone fragments, of which 900 were recorded and 285 were identified to species for the assessment (Rajkovača 2020b). The degree of preservation has been assessed as moderate to quite good due to rare surface erosion and substantial fragmentation. The assemblage, dated to the Middle Iron Age, is composed of caprines (34.4%), cattle (31.8%), pigs (30.4%), horses (2.6%) and dogs (0.4). Rajkovača notes that the proportion of horses is much lower than elsewhere in Northstowe. All body parts are represented in the assemblage.

Area DD yielded 14525 bone fragments, of which 2141 were recorded and 902 were identified to species for the assessment (Rajkovača, 2020a). The degree of preservation has been assessed as moderate to good due to some degree of erosion and a relatively low degree of fragmentation. Rajkovača notes that notwithstanding the good degree of preservation, recorded butchery marks are unusually scarce (1.1%).

More than half of the assemblage was dated to the Iron Age.

Mid to Late Iron Age materials (NISP 371) were dominated by caprines (44.3%) followed by cattle (29.3%), horses (15%) and pigs (9%).

The Late Iron Age assemblage (NISP 758) sees a similar proportion of caprines (40.8%), a substantial increase in cattle (40.8%), horse (11.7%), an unusually low percentage of pig remains (3.5%), and dog (1.4%). Wild animals are represented by just one fragment of roe deer and one of red deer. All skeletal elements are represented with a slight emphasis on meat-bearing elements.

The Roman assemblage (aggregated NISP of three phases 424) is dominated by cattle and presents an unusually high number of horse remains (18.2%).

5.2.2 Haddenham V

Haddenham V (HAD V) is one of the best-preserved and materials-rich Iron Age sites excavated in response to the quarrying activity of the gravel terraces deposited by the Great Ouse paleochannel. The site is located in the western part of the Haddenham civil parish, to the east of the village of Earith (Evans and Hodder, 2006).

The whole Haddenham area is dense with Prehistoric evidence, spanning from the Neolithic to the Roman Era. In particular, the Iron Age evidence included a possible shrine (HAD IV) and several other areas of occupation (HADVI, VII, IX and X), with evidence for several enclosures and roundhouses dated to the Middle Iron Age. Right across the Great Ouse paleochannel another similarly large archaeological project at Colne Fen revealed a group of important Mid to Late Iron Age sites (Evans 2013). In general, extensive quarrying and development projects have revealed a densely populated Iron Age landscape at the fringe of the Fens.

Haddenham V is located on the Upper Delphs Terrace, on a slope of natural paleosubsoil of mixed terrace gravels. The area was sealed by an alluvial cover and partially waterlogged, allowing superb preservation of both artefacts and floor surfaces.

The evidence related to the period consists of an earlier horizon (Period 1) of seemingly unenclosed settlement. This was characterised in its first phase (1.1) by the use and abandonment of one structure (Building 1), subsequently ploughed out (ardmarks) and later by two structures (Building 2 and 3) and ditch boundary system (F110) in its second phase (1.2).

A second horizon (Period 2) sees the construction of a sub-square enclosure (F95) and two structures (Building 4 and 5) in its first phase (2.1) and the establishment of a causewayed entrance (F231) across the enclosure's ditch line and two new structures (Building 6 and 7) in its last phase (2.2). This was followed by the alluviation phenomenon that sealed the Iron Age stratigraphies and constituted the level on which Roman activities took place.

A variety of structures has been identified, though the ephemeral nature of the structural evidence and the intense re-use and stratification makes some of them difficult to read. While Building 1 survived only with the heavily truncated remains of the foundations, hearth, stake-holes and post-holes, Buildings 2 and 3 showed the full extent of circular ditch rings of around 7 m in diametres, although with little to no surviving floor surfaces.

The fully recognisable roundhouses (Buildings 4, 6 and 7) ranged between 7 and 9 m in diameter with an eaves-gully 1 m outside the wall line and were likely built with roundwood poles for the structural elements, wattle and daub for the wall and reed-thatch for the roof (Darrah 2006).

Building 5 consisted of a crescent-shaped trough lined with stake-holes, associated with other similar linear structures. Though the plan is peculiar and partial, it has been interpreted as a livestock pen with an antennae-like fence to funnel animals.

Some ancillary structures dated to Period 1 include a variety of clay-lined pits interpreted as ovens and tanks (for water storage or processing), a possible four-post granary obliterated by Building 7 and the remains of what could be interpreted as shed-like structures and screens.

Radiocarbon dates span from the 4th c. BCE to the 1st c. CE (Marshall 2006) and pottery typology gives a compatible range of datings (Hill and Braddock 2006). While a finer chronology through pottery typology is difficult, the assemblage is homogenous in style and comparable to others dated to the 2nd and 1st c. BCE. Furthermore, the near-absence of wheel-made pottery (and total absence of Aylesford-Swarling forms) most likely places the occupation before the turn of the millennium. Although distinctions are made between different periods, the faunal materials will be interpreted as a single assemblage pertaining to the Mid to Late Iron Age, since Period 1 materials are nearly absent and Period 3 is essentially earlier material reworked into secondary deposition.

The faunal assemblage from Haddenham is unique for a number of reasons (Evans and Serjeantson, 1988; Serjeantson, 2006).

Bone remains present exceptionally good preservation as they were deposited into soft ground and sealed by alluvial silts preserving them from destructive plant chemical activity in a stable environment. Fragmentation appears to be higher than in other contemporary sites, probably because part of the material was found outside closed contexts where substantial trampling added to the damage caused by butchery. Butchery marks were found in the typical Iron Age pattern of prevalent cuts indicating disarticulation with a knife.

Caprines were the most frequent species (59.6%), followed by cattle (24.8%), beaver (5.8%), pig (4.2%), horse (3.1%) and dog (0.3%).

All three main domestic species were represented by most body parts suggesting the animals were slaughtered and consumed on-site.

+ *Caprines*

Quantification from the sieved deposits suggests that caprines (75%) are underrepresented in the hand-collected assemblage; while this data is not particularly useful in comparing sites in terms of raw taxonomic frequencies, it is probably a good frame of reference to understand the order of magnitude of the underrepresentation of small species in Iron Age sites.

Data from epiphyseal fusion indicates that nearly half of the caprines did not reach one year of age, 60% 2 years and just over one quarter reached full skeletal maturity. Neonatal jaws are rare, possibly indicating that lambing was not happening on site. Mandibular data shows that a high proportion of lambs were slaughtered between 6 and 9 months, corresponding to a summer/sutumn culling. Most of the remaining animals survived up to 4-8 years. Serjeantson interprets this pattern as indicating a husbandry strategy aimed at the exploitation of wool and milk.

+ *Cattle*

Bone measurements from cattle remains show that their size was small, in keeping with most Iron Age sites. Epiphyseal and dental data indicate that more than half of the animals survived into skeletal maturity with fewer than a quarter culled in their first year. Serjeantson interprets the mortality profile as indicating the prevalent use for traction.

+ *Pig*

The proportion of pigs in the assemblage is very low, especially so for sites in this area. Marshland and woodland environments were available in the site surroundings, and it is suggested that only a few pigs were kept because enough meat was produced as a byproduct of the butchery of the other domesticates and that of the abundant wild animals primarily exploited for other products.

Most of the remains belonged to immature individuals.

+ *Horse*

Horse bones presented butchery and disarticulation marks, indicating their consumption. The presence of a juvenile mandible and deciduous teeth indicates that horses were raised and probably bred on-site.

+ *Other species*

One of the unusual features of Haddenham V is the abundance of fur animals (for the vast majority beavers) and birds. Beavers were hunted for meat, pelts (which in turn could have been converted into high-quality water-proof felt), and possibly castoreum (which could have been used in food, medicine and perfume preparation). The proportion and number of bird remains is one of the highest in British prehistory. A variety of species are present in the assemblage, mostly water birds but also corvids and birds of prey. Most of those were probably hunted primarily for feathers. Eggshells were also very abundant.

Very few (14) fish bones were retrieved; most of them are from pike, while the absence of eel, a very common catch in the fens, is notable. The avoidance of fish as a regular food source appears to be deliberate and is in keeping with general British Iron Age trends.

5.2.3 Dragonby

Several excavations and surface collections have been conducted in the general area over time, but most of the information on the Iron Age comes from the long series of campaigns of systematic excavation conducted between 1964 and 1973 in response to the threat to the archaeological deposits posed by expanding ironstone quarrying (May 1996).

The site lies south of Dragonby, a small modern roadside settlement located approximately two miles to the north of the modern town of Scunthorpe in North Lincolnshire. It was founded at the beginning of the 20th century to accommodate Catholic workers (separated from the protestant population) for the booming steel industry. The village took its name from a local major landmark called 'the Dragon', a limestone outcrop at the centre of local folk tales due to its unusual, serpentine shape.

The area lies between the Trent and Ancholme rivers 7-8 miles before they flow into the Humber to the North.

West of the Trent the landscape is currently characterised by flat arable land, but before the 17th century's drainage, the Isle of Axholme was characterised by a marshland environment not dissimilar to that of the Fens.

East of the Ancholme the ground rises to the Lincolnshire Wolds, now open high ground, but once possibly characterised by forested hills (as the name of Saxon origin suggests).

In between the two rivers, to the East, the Lincoln Cliff runs for around 50 miles North to South from Winteringham to Grantham. The Lincoln Cliff is a Jurassic limestone escarpment, representing the most prominent feature in the flat landscape reaching up to 60 m OD and creating a spring line. Roman Ermine Street runs between the Lincoln Cliff and the River Ancholme.

Dragonby lies on a Pecten Bed (a type of oolitic ironstone) that projects to form a halfway-up ledge from an isolated westward bulge of the Lincoln

Cliff, with the much less prominent scarp named Scunthorpe Mudstone hiding the view on the Trent to the West.

This position is raised from the valley bottom but somewhat sheltered from the winds by the Lincoln Cliff.

The site stands on sandy light soils suitable for occupation but prone to erosion, stabilised by the Pecten Ironstone shelf which impedes natural drainage creating a perched water table.

The excavated areas are within what is known as Money Field, whose name probably derives from the many coins found by farmers.

Initially, the excavation was conducted as a series of small cuttings, some of which were then incorporated into two main open areas: Site 1 and Site 2. The excavation was complemented by aerial, magnetic and field surveys.

It is not possible to reconstruct the full extent of the Iron Age and Romano-British settlement, especially since no evidence of defences has been found and part of the settlement could have been destroyed to the North by the construction of the Dragonby village, and to the South-east from ironstone quarrying. However, the magnetic and field surveys show a strongly decreased density of evidence in the surrounding fields. Furthermore, while the central part of Money Field, represented to the West by Site 1 and to the East by a concentration of crop marks and magnetic anomalies seems to represent a central area of the settlement, Site 2 to the South sees the density of evidence fluctuate throughout the life-span of the settlement, indicating a peripheral area.

The stratigraphy shows an almost uninterrupted continuity of use from the foundation to the Iron Age settlement probably during the 2nd c. BCE to the abandonment of the Romano-British structures during the 3rd c. CE after which the area was destined for funerary depositions until the definitive abandonment during the 4th c. CE.

The evidence for the earliest phase of the Iron Age settlement (ceramic phases 1-7) is mainly constituted by a series of ditched enclosures (which either contained buildings or were used to raise animals or crops), drainage gullies, and pits, some of which used as wells.

The evidence for the Latest Iron Age settlement (ceramic phases 8-9) includes ring-gullies interpreted as eaves drip for roundhouses that left no other structural evidence, pits, ditches and gullies. Among the pits, one with wicker-lined walls was interpreted as a watering hole, while another still containing a wooden ladder and planks was probably used for clay extraction.

All the pits interpreted as wells or watering holes intercepted the current level of the water table, with the presence of organic residues in the infilling confirming that said level has not changed significantly since their obliteration.

The Romano-British phase sees the construction of metalled roads servicing ditched enclosures containing rectangular aisled buildings and wells, some of these stone-lined.

May argues that there is an element of planning in the layout of the IA settlement which, paired with the abundance of fine quality pottery, metalwork and coins, and the large size of the roundhouse in site 2 would stand as evidence for high status. Conversely, the Romano-British settlement, though it largely follows and respects the previous layout, did not yield high-status materials nor building materials such as plaster, tiles and tesserae, therefore supporting the idea of a rural destination of use.

May stresses that an overarching impression of continuity does not allow for precise and distinct phases to be reconstructed. The obvious exception is represented by the changes in settlement layout and building technique after the conquest, reinforced, at least in the peripheral areas, by the contraction of the settlement creating a stratigraphic hiatus that corresponds to the Claudio-Neronian times. Notwithstanding the continuity and some issues of residuality, it was possible to attribute the LIA pottery to nine ceramic phases (12 including the conquest period), which helps in dating by association with the osteological materials.

The materials selected for recording were those associated in contexts with pottery belonging to the ceramic phases 6-8. The reason behind this choice was to analyse a large assemblage while restricting it to a precise chronological range: the material attributed to phases 1-5 was not abundant; the introduction of wheel-made pottery in ceramic phase 6 places the associated contexts in a moment around the beginning of the 1st century AD; the contexts attributed to ceramic phase 9 represent the last period of settlement life before the start of the Roman conquest campaigns, which guarantees a certain measure of safety from the intrusion of later materials. The selected assemblage will be treated as pertaining to the Latest Iron Age.

The excavation yielded about 150,000 animal bone fragments from the Iron Age, Roman and unstratified deposits, of which 35,000 were identified (Harman 1996). Most were well preserved with minor erosion and a relatively low degree of fragmentation. Harman noted a scarcity of small remains, both in terms of species and anatomical elements. Approximately two-thirds of the assemblage is dated to the Late Iron Age, with only a few hundred specimens from the ceramic phases 1-5. Most of the remains belong to domestic livestock, whose proportions vary very little across the Iron Age ceramic phases and Romano-British horizons. In decreasing order, there were caprines (46-64%), cattle (23-41%), pigs (12-14%), horses (less than 5%) and dogs (less than 3%). Fluctuations in the relative abundance of the main species occurred but were usually small or of limited significance due to the small sample size of some phases.

Age at death data based on mandibular development showed the following patterns. For cattle, in the period corresponding to ceramic stages 2-5, one-third of the individuals reached dental maturity, while in subsequent stages the proportion increases to over one-half. Harman noticed peaks in age at death distribution, which she explained with regular autumn killings.

By contrast, sheep mortality saw a fluctuating percentage of individuals surviving to dental maturity, usually between 30-40%, with slaughter peaks corresponding to development stages again interpreted as annual killings.

Pig data showed that two-thirds of the individuals survived beyond the first year but only a few reached the third year of life and even fewer in the fourth.

The number of lamb and piglet bones was roughly the same which, accounting for the much larger pig litters, indicates their underrepresentation. Harman suggested that this could mean that sheep were pastured some distance from the settlement, with the youngest fatalities dispersed by scavengers or buried in place by the herders. Since calves and piglets were better represented, she suggested that, unlike sheep, cattle might have been kept closer to exploit them for milk production.

Most horse and dog remains were from adult individuals, although both teeth and bones of younger individuals were present.

Harman noted an increase in the size of cattle long bones from the Iron Age to the Roman period as well as the presence of dental anomalies (absence of the second premolar and reduction of the third molar) limited to stages 6-11.

Sheep did not increase in size and when compared to data from a modern Soay sheep population (a very small breed), they showed a slightly larger size and a greater range of variability. Likewise, the pig did not see an increase in size and presented large size variability, this time attributed to sexual dimorphism or the presence of wild animals. Size variability was also a characteristic of horses and dogs.

Wild mammal and bird remains were present in small numbers suggesting a limited interest in hunting, while the very few fish remains were either from Romano-British or undated contexts, aligning Dragonby to the general British Iron Age avoidance of fish.

5.2.4 Skeleton Green

The site lies at the northern fringes of the modern settlement of Puckeridge in Hertfordshire, on the road to Braughing (Partridge, 1981). Like much of East Hertfordshire, the landscape of this area is characterised by undulating chalk hills capped with glacial drift (boulder clay, flint, gravel and sand). The two main watercourses in the area, the Rivers Rib and Quin, which join some 12 miles northeast of Puckeridge, have cut deeply into the geology depositing alluvium on the valley bottoms.

To the west of the Rib stands a narrow ridge three-quarters of a mile long, known as Wickham Hill. To the west of Wickham Hill, the land rises out of a dry valley into a series of low wooded hills. In said valley runs the Roman Ermine Street and lies the modern village of Puckeridge.

To the north of Wickham Hill, the land is low-lying and waterlogged to this day, so it was probably impassable marshland during the Iron Age. This landscape is punctuated by Iron Age and Roman sites, with a presumably earlier Iron Age settlement to the east of the Rib at Gatesbury (the pottery belonging to a collection coming from this site is dated to the 3rd century BC at the earliest) and a Roman town lying by Wickham Hill towards the Rib. Large-scale roadworks for the Puckeridge bypass prompted the excavation at Skeleton Green in 1971-1972.

Skeleton Green was part of a larger Late Iron Age settlement located between modern Puckeridge and Braughing (Partridge, 1981, 1979; Potter and Trow, 1988), sometimes defined in the archaeological literature as a territorial oppidum, that was later replaced by a small Romano-British town. Due to the presence of relatively abundant materials imported from Gaul, Italy and Spain, and the involvement of the area in the Caesarian campaign, the site has been interpreted as a trading centre and even as an emporium hosting foreign merchants.

The Iron Age evidence (Period I) is characterised by sub-rectangular buildings with weak or missing corners. The structural elements consist of post-holes and slots while floors were made of cobble, rammed chalk, and beaten dirt or gravel. The plan of each dwelling is unique, with some having porches, traces of rebuilding or additions over time. The associated ceramic material allows for the distinction of four internal phases, named in lower-case roman numerals i to iv as follows:

+ Phase i (15 BCE-1 CE)
+ Phase ii (10 BCE-20 CE)
+ Phase iii (15-25 CE)
+ Phase iv (30-40 CE)

This internal phasing is inevitably fuzzy, given the low resolution of its dating, but some events can be discerned from the stratigraphy. Some of the buildings were destroyed and rebuilt during phase iii and then most of the excavated area was abandoned from the end of phase iii throughout phase iv, with the notable exception of Building VII which was built on virgin ground during this period. A layer of flood silts seals the stratigraphy related to Period I.

The Romano-British evidence (Period II) consists of a series of level platforms of flint and gravel with faint traces of sill beams (longitudinal timbers) and no post-holes, arranged at the angle of a junction between two road sections). The coarse surface of the platforms, along with the absence of finds in the buildings, allows for the hypothesis of plank-covered floors. The roofs were probably thatched since no tiles have been found on site.

The scant structural evidence indicates that the settlement was probably short-lived (AD 43-65) and systematically dismantled and cleared at the end of its life.

After a period of abandonment, a small cemetery was laid out enclosed by a ditch and bank which was enlarged and replaced multiple times (Period III, AD 90-300+).

The faunal assemblage from Skeleton Green comes entirely from Period I and will be treated as pertaining to the Latest Iron Age.

The materials are mostly well preserved, albeit fragmentary (Ashdown and Evans 1981).

The relative frequency of species was presented in the report as follows: pig (47.7%), cattle (31.2%), caprines (17.8%), dog (1.3%), and horse (1.2%). Ashdown and Evans noted that cattle seemed to be underrepresented when compared to pigs due to the presence of a number of head bones that is excessive for pigs and deficient for cattle across the various deposits. This might represent to some extent the differential deposition of body parts, but it is likely inflated due to a well-known bias in survival between dense head parts and porous, fatty post-cranial elements in the pig.

Age at death data showed that 20% of the cattle died under two years of age, half between two and four and 70% by 4 years; no evidence for the slaughtering of calves has been found. More than half of the pigs died before reaching two years of age, while only 10% survived beyond the fourth.

Sheep present a very regular pattern of mortality with several peaks that have been interpreted as episodes of slaughter corresponding to weaning (at three months) and three consecutive autumnal killings (at 9-10, 21-22 and 33-34 months).

The size of cattle bones points toward consistently small-sized animals similar to those of other contemporary sites, compared by the authors to modern Chillingham cattle. Pig remains show really small and slender animals that have been compared to a specimen of Sardinian wild boar (an insular dwarf animal population) held at the Dublin Museum and used as reference material. Measurements and general appearance of sheep bones are comparable to that of modern Soay sheep. Evidence for dog size shows that both medium-sized and small-sized dogs were present on site.

The authors reported a very low incidence of burning marks on bones (interpreted as stewpot cooking), the intentional breaking of marrow-rich elements and the chopping of the epiphyseal ends of some elements. This included evidence for the chopping of the lateral coronoid process of the ulna, which from experimental evidence the authors claim can be easily inflicted with a hand axe to facilitate the disarticulation of the elbow.

The most striking feature of this assemblage is its relative abundance of pigs, infrequent by British standards and very rare during the Iron Age. The authors linked it to free-range practices in the probably forested chalky and boulder-clay lowland plateaux which, characterised by marshy river valleys would have been better suited to pigs than sheep (which prefer drier environments). This seems at odds with the scarcity of wild mammal remains which, even if underrepresented due to recovery and identification bias, probably suggests a real avoidance of mammalian game, considering the contrast with the sizable assemblage of bird remains (NISP 137).

CHAPTER 6

Results – the animal remains from the core sites

This chapter presents the results of the zooarchaeological investigation of assemblages from the four core sites which criteria of selection, detailed archaeological context and summary from the published faunal analyses are presented in Chapter 5.

For reference, the chronology (following the subdivisions adopted in Chapter 1) of the sites is repeated here:

Haddenham V (HAD V) – Mid to Late Iron Age

Northstowe – Mid to Late Iron Age, Late Iron Age and Latest Iron Age

Dragonby – Latest Iron Age

Skeleton Green – Latest Iron Age

The descriptions and references for the methods employed in this chapter can be found in Chapter 4, here repeated and expanded when deemed necessary.

Osteometrical analyses concerning livestock morphotypes are not included in this chapter as they represent the subject of Chapter 7.

6.1 Deposition and recovery

This section provides information on the effects of depositional processes and recovery strategies on the composition of the assemblages to assess and control their comparability.

6.1.1 Bone surface preservation

The material from Haddenham V presents an overall excellent state of preservation, with nearly half of the material attributed to a 'good' level of surface preservation (Figure 6.1.) The incidence of weathering and chemical erosion was minimal, physical abrasion relatively uncommon and frequently the specimens hardly presented any loss of cortical surface other than that which occurred with breakages. Fragmentation is relatively heavy with only 13% of the caprine (n: 566) and 6% of the pig (n: 64) NRDZ represented by whole specimens. Mineral stains of yellow, reddish and black hues were common and in a few cases, the presence of very hard concretions of the same nature limited the identification or measurement of the specimens.

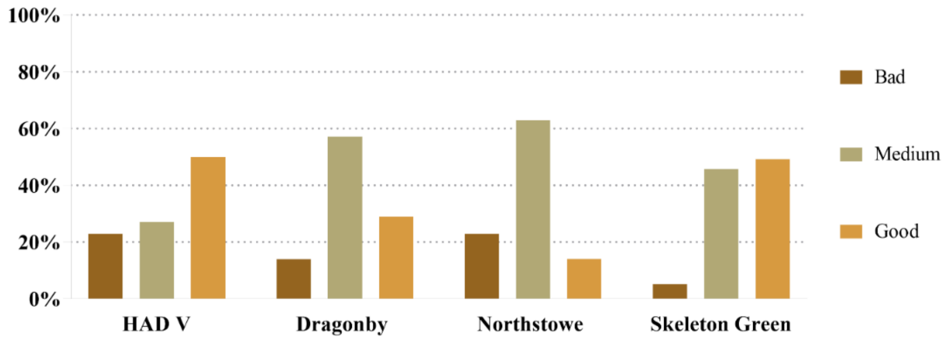


Figure 6.1. Percentages of the number of diagnostic zones (NRDZ) by the degree of surface preservation in the four recorded sites (HAD V n: 645; Dragonby n: 2077; Northstowe n: 654; Skeleton Green n: 1138)

The material from Dragonby presents an overall good state of preservation, with nearly a third of the material attributed to a 'good' level of surface preservation (Figure 6.1.). The incidence of weathering and chemical erosion was minimal, with physical abrasion and breaking accounting for most of the damage to the cortical surface. Fragmentation is relatively heavy with only 15% of the caprine (n: 1447) and 12% of the pig (n: 434) total NRDZ represented by whole specimens.

The material from Northstowe presents an overall medium state of preservation, with less than a sixth of the material attributed to a 'good' level of surface preservation (Figure 6.1.). The incidence of weathering, chemical erosion, physical abrasion and fragmentation was higher than in the other recorded sites, resulting in a slightly reduced number of measurable elements. Fragmentation is relatively heavy with only 11% of the caprine (n: 284) and 9% of the pig (n: 106) total NRDZ represented by whole specimens. In a few cases, the presence of very hard grey-coloured concretions limited the identification or measurement of the specimens.

The material from Skeleton Green presents an overall excellent state of preservation, with nearly half of the material attributed to a 'good' level of surface preservation and only around 5% to 'bad' (Figure 6.1.). The incidence of weathering and chemical erosion was minimal, with physical abrasion and breaking accounting for most of the damage to the cortical surface. Fragmentation is relatively heavy with only 9% of the caprine (n: 270) and 11% of the pig (n: 638) total NRDZ represented by whole specimens.

6.1.2 Recovery bias

Since the material of all four assemblages was hand-collected, it is important to assess the extent of the potential recovery bias. The analyses on proportions of adjacent elements use the Minimum Number of Anatomical Units (MAU) to keep the expected proportions of the hind leg 1:1. Analysis on teeth compares the Number of Diagnostic Zones of mandibular fragments (NRDZ, zone N) to the Number of Identified Specimens (NISP, all the elements) of loose teeth. See 4.4.3 – Recovery bias for the rationale behind these analyses.

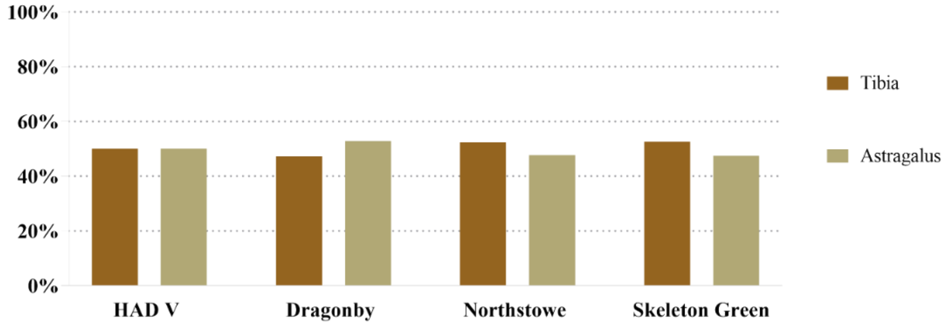


Figure 6.2. Recovery bias analysis: proportion of adjacent bones of the hind leg of cattle (MAU, distal tibiae vs astragali, expected proportion 1:1) in the recorded assemblages (HAD V n: 16; Dragonby n: 36; Northstowe n: 21; Skeleton Green n: 38)

The proportions of cattle tibiae and astragali are more or less equal in all four sites (Figure 6.2). These are both large-sized and dense elements that should be similarly represented in assemblages where carcass processing and disposal practices did not separate the extremities from the leg, regardless of recovery bias.

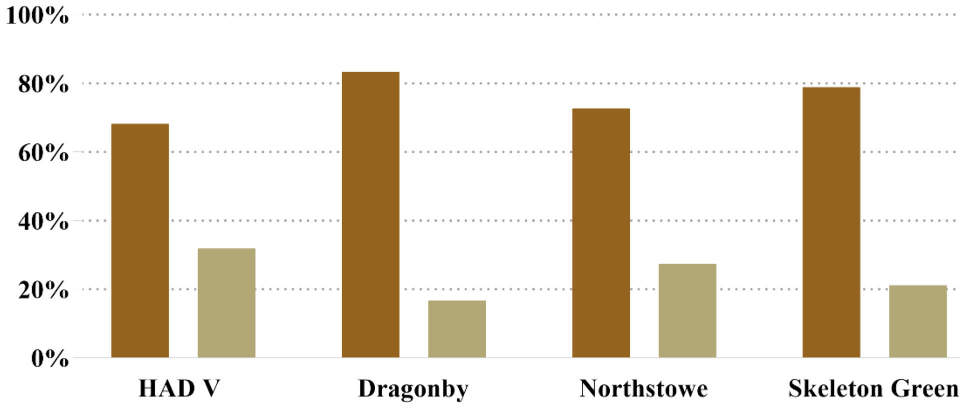


Figure 6.3. Recovery bias analysis: proportion of adjacent bones of the hind leg of caprines (MAU, distal tibiae vs astragali, expected proportion 1:1) in the recorded assemblages (HAD V n: 22; Dragonby n: 72; Northstowe n: 11; Skeleton Green n: 19)

The same elements should have similar chances to survive in caprines, however, distal tibiae are tendentially preserved with a portion of the shaft, which makes them larger and more visible during excavation than astragali in relatively small species like sheep or goats. In all recorded sites caprine astragali are represented with between half and a fifth of the number of tibiae.

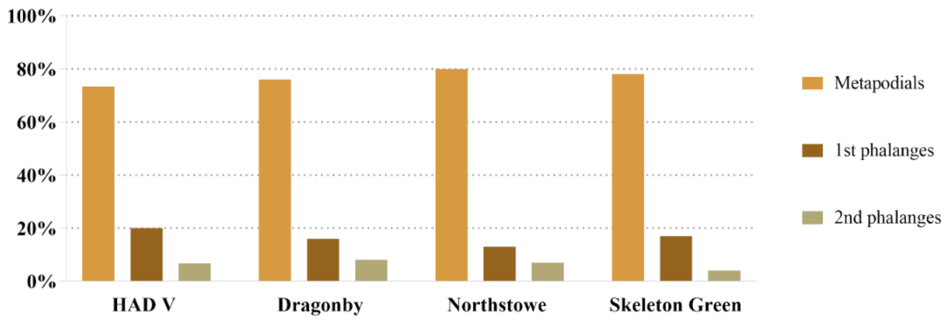


Figure 6.4. Recovery bias analysis: proportion of adjacent bones of the hind fetlock joint and the second phalanx of cattle (MAU, metapodials vs 1st and 2nd phalanges, expected proportion 1:1:1) in the recorded assemblages (HAD V n: 15; Dragonby n: 51; Northstowe n: 30; Skeleton Green n: 23)

The strong recovery bias is confirmed by the proportions of the adjacent bones in the hind fetlock of cattle (Figure 6.4) and caprines (Figure 6.5). Here the size differences are even more pronounced and, as a consequence, the smaller elements tend to disappear altogether, especially in caprines. The ratio between the bones in the fetlock is not a product of butchery practices involving their separation, as demonstrated by the ratio between the first and second phalanges also showing bias towards the larger element, while it is unlikely that they would have been disarticulated while processing the carcass.

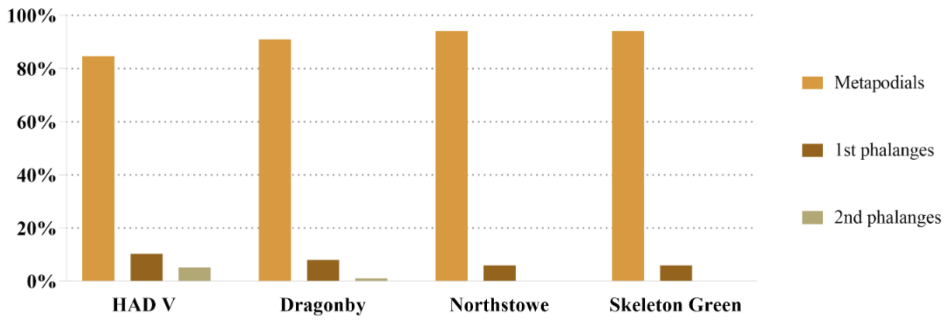


Figure 6.5. Recovery bias analysis: proportion of adjacent bones of the hind fetlock joint and the second phalanx of caprines (MAU, metapodials vs 1st and 2nd phalanges, expected proportion 1:2:2) in the four recorded assemblages (HAD V n: 39; Dragonby n: 105; Northstowe n: 18; Skeleton Green n: 16)

The ratio between the number of mandibular fragments and mandibular loose teeth (Figure 6.6), is in most cases in favour of the latter and especially for the very small caprine teeth, as can be expected in highly fragmented bone assemblages. Haddenham V presents the lowest ratios for both cattle and caprines, suggesting a more accurate recovery of the smaller elements. The ratio for caprines in the Dragonby assemblage is unusually high, with more mandibular fragments than loose teeth. This value is difficult to explain, and given that the analyses presented above show a similar degree of recovery bias to that of the other recorded sites, it might be due to site formation and post-depositional phenomena rather than recovery practice. The ratio for cattle in the Skeleton Green assemblage is the highest of the four and it is very similar to that of caprines, suggesting that rather than a bias towards size, a preference for the more complete specimens could have been driving the recovery.

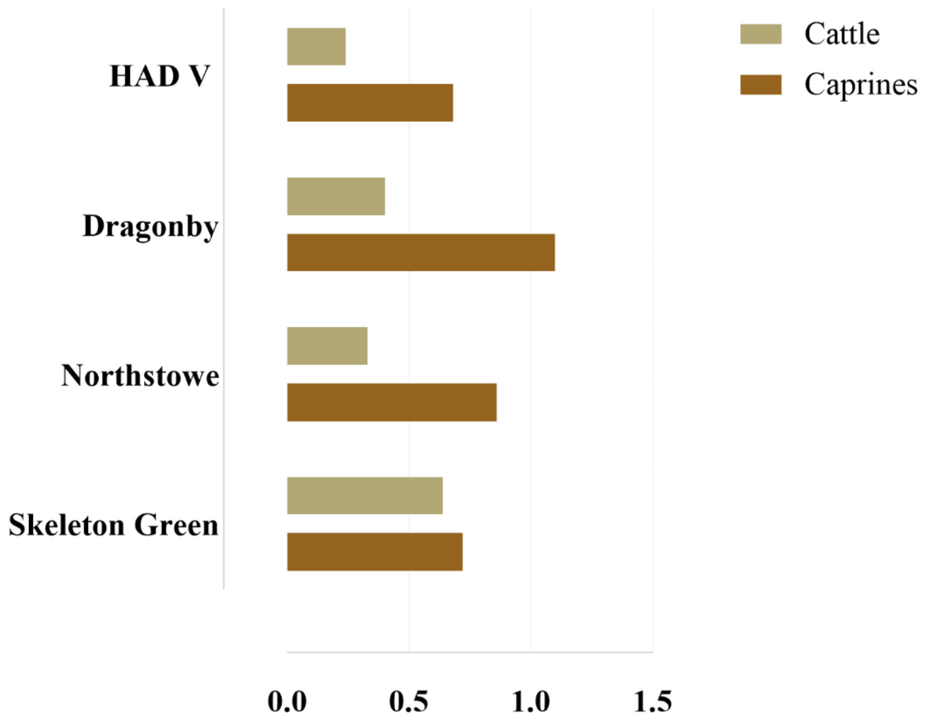


Figure 6.6. Recovery bias analysis: ratios between mandibular fragments (NRDZ, zone N) and loose mandibular teeth (NISP, all loose teeth elements) in the four recorded assemblages (HAD V cattle n: 129, caprine n: 531; Dragonby cattle n: 199, caprine n: 662; Northstowe cattle n: 144, caprine n: 216; Skeleton Green cattle n: 36, caprine n: 103)

6.1.3 Gnawing

In all the recorded sites the incidence of carnivore gnawing is between 10 and 16%. The variation in these percentages is minimal and the scavenging dogs producing the marks likely had similar access to butchery and kitchen waste.

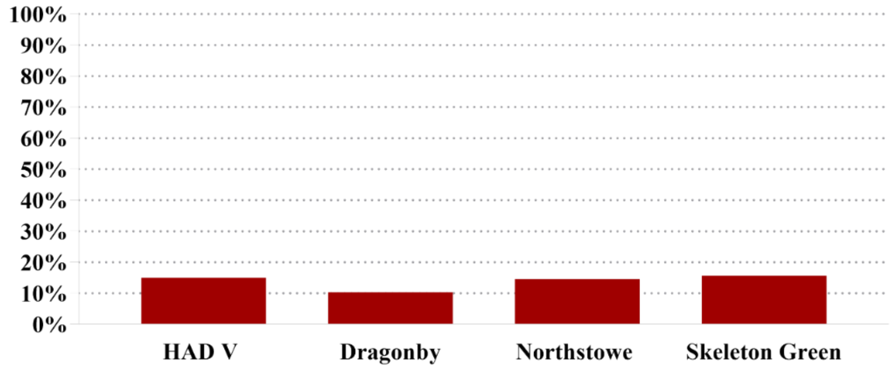


Figure 6.7. Incidence of dog gnawing: percentages of bones presenting dog gnawing marks, tallied on the total NRDZ of each site (HAD V n: 645; Dragonby n: 2078; Northstowe n: 656; Skeleton Green n: 1138)

6.1.4 Summary and discussion

Overall, the recorded sites had good levels of surface preservation which allowed for the collection of abundant taxonomic and osteometric data.

All the recorded sites have been affected by largely similar degrees of recovery bias. However, Haddenham V presents consistently lower rates in all the analyses, possibly due to ease of recovery given by the excellent preservation and/or favourable characteristics of the contexts or to more careful recovery practice. Conversely, bone collection at Northstowe was probably affected by the relatively poor preservation of the materials and unfavourable characteristics of the soil (hence the mineral concretions found on some of the material), while at Skeleton Green the very good state of preservation and the consistent low rate of recovery of the smaller elements suggests a slightly less careful collection.

Carnivore gnawing did not affect the preservation of the assemblages to a great extent, but it is nonetheless regularly present, showing that dogs had access to bone refuse at least during part of the waste disposal process.

6.2 Species frequency

Quantitative data on the five recorded taxa is presented in Table 6.1. For each of the quantification methods, raw numbers and percentage frequency relative to the site total are reported. A more in-depth description of the results for each site will be provided below in the following subsections.

Site		Taxon	NRDZ		MNE		MAU		MNI	
			n:	%	n:	%	n:	%	n:	%
HAD V	NISP 1517	Cattle	**271**	28%	**255**	28%	**111**	26%	**13**	10%
		Caprines	**566**	59%	**552**	60%	**252**	59%	**107**	79%
		Pig	**64**	7%	**63**	7%	**35**	8%	**11**	8%
		Horse	**55**	6%	**52**	6%	**26**	6%	**4**	3%
		Dog	**5**	1%	**5**	1%	**4**	1%	**1**	1%
		TOT	**961**		**927**		**428**		**136**	
Dragonby	NISP 4464	Cattle	**731**	26%	**664**	25%	**277**	23%	**29**	11%
		Caprines	**1447**	52%	**1384**	53%	**659**	54%	**174**	67%
		Pig	**434**	16%	**430**	16%	**207**	17%	**48**	19%
		Horse	**96**	3%	**93**	4%	**43**	4%	**4**	2%
		Dog	**51**	2%	**49**	2%	**29**	2%	**4**	2%
		TOT	**2759**		**2620**		**1215**		**259**	
Northstowe	NISP 1377	Cattle	**362**	41%	**328**	40%	**141**	35%	**18**	19%
		Caprines	**284**	32%	**266**	32%	**136**	34%	**50**	54%
		Pig	**106**	12%	**103**	13%	**54**	13%	**15**	16%
		Horse	**98**	11%	**87**	11%	**47**	12%	**5**	5%
		Dog	**37**	4%	**35**	4%	**23**	6%	**5**	5%
		TOT	**887**		**819**		**401**		**93**	
Skeleton Green	NISP 1744	Cattle	**417**	31%	**376**	29%	**175**	28%	**26**	24%
		Caprines	**270**	20%	**257**	20%	**129**	21%	**22**	20%
		Pig	**638**	47%	**614**	48%	**302**	48%	**57**	52%
		Horse	**29**	2%	**28**	2%	**14**	2%	**4**	4%
		Dog	**7**	1%	**7**	1%	**6**	1%	**1**	1%
		TOT	**1361**		**1282**		**626**		**110**	

Table 6.1. Taxonomic frequencies expressed as percentages of NRDZ, MNE, MAU and MNI of the elements attributed to each of the five recorded species in each of the four recorded assemblages. The sample size for each count is indicated under TOT, while NISP totals for each site are reported by the site name.

NRDZ, MNE and MAU are derived from one another by removing a subset of data representing a form of bias (see Chapter 4). These quantification methods yield very similar taxonomic frequencies for these four sites, therefore, taking into consideration the fragmentation of long bones (MNE) and species-specific skeletal setup (MAU) does not seem to alter the relative representation of the five species taken into consideration in this project.

Consequently, in the ensuing sections MNE will be used to represent taxonomic frequencies, as it is equivalent to the NISP of most of the studies using a version of the DA protocol diagnostic zones (see 4.3 – Recorded species and elements).

MNI will be compared to MNE as it is known to better represent smaller species, being less affected by recovery bias. MNI also tends to over-represent rare species with small NISP. However, due to the relatively large size of the assemblages, all four sites seem not to be affected by this phenomenon and MNE and MNI of dogs and horse yield similar results.

6.2.1 Haddenham V

The relative proportions of the three main domesticates MNE and MNI in the Haddenham V assemblage are represented in Figure 6.8.

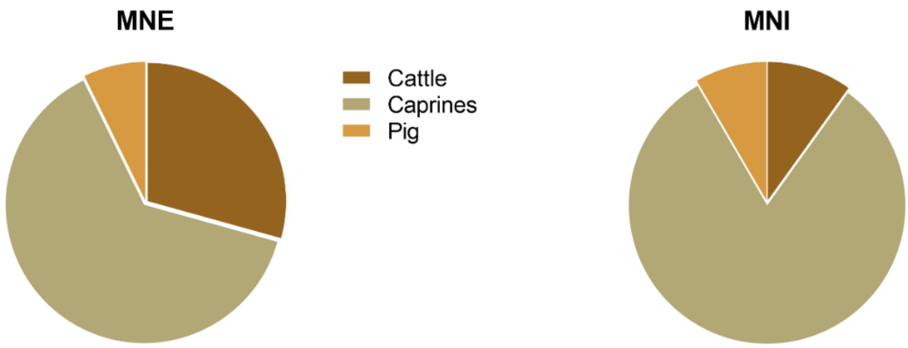


Figure 6.8. Proportions of the three main domesticates in the Haddenham V assemblage.
MNE n: 870 – Cattle 29%, Caprines 63%, Pig 7%
MNI n: 131 – Cattle 10%, Caprines 82%, Pig 8%

The assemblage is dominated by caprines, followed by cattle and pig on both counts, suggesting this ranking order must closely correspond to that of the taxa present on site. MNI counts show that caprines are strongly underrepresented due to recovery bias, and they would have probably dominated the headcount in the living population, constituting the primary focus of Haddenham's husbandry practice.

Since the composition of the caprine group is characterized by an absolute prevalence of sheep over goat (see 151 – Caprine species distribution), even accounting for cattle having a meat yield several times that of sheep, mutton would have probably still been the most common meat source (MY%: 50), closely followed by beef (MY%: 42), and with only marginal contribution from pork (MY%: 8).

6.2.2 Northstowe

The relative proportions of the three main domesticates MNE and MNI in the Northstowe assemblage are represented in Figure 6.9.

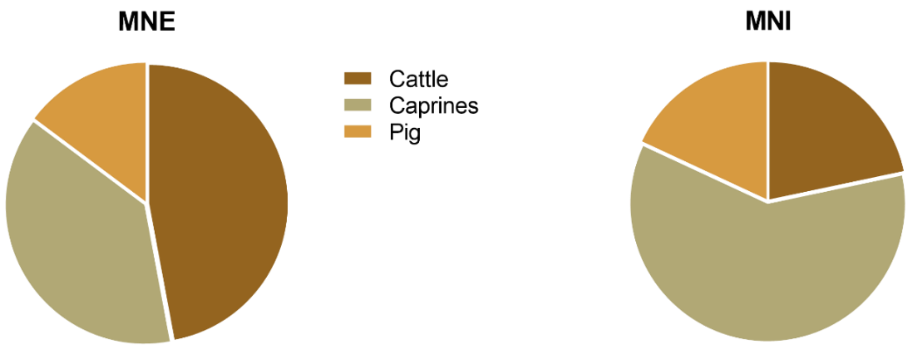


Figure 6.9. Proportions of the three main domesticates in the Northstowe assemblage.
MNE n: 697 – Cattle 47%, Caprines 38%, Pig 15%
MNI n: 83 – Cattle 22%, Caprines 60%, Pig 18%

The assemblage presents similar proportions of cattle and caprine in the MNE count, with the former being slightly better represented. Pigs follow at a distance with only around one-sixth of the total count. MNI counts show a completely different picture, with cattle and pigs being almost equally represented and caprines dominating the assemblage. This difference is most probably due to the strong recovery bias and low preservation rates in the assemblage. It is therefore more likely that MNI more accurately represents the overall living population and, as we will see in section 6.2.5.2, the focus on caprines characterised all the subphases, albeit with some chronological fluctuations.

Accounting for cattle having a meat yield several times that of sheep, beef would have probably been the most common meat source (MY%: 64), followed at a distance by mutton (MY%: 25), and with only a marginal contribution from pigs (MY%: 11).

6.2.3 Skeleton Green

The relative proportions of the three main domesticates MNE and MNI in the Skeleton Green assemblage are represented in Figure 6.10.

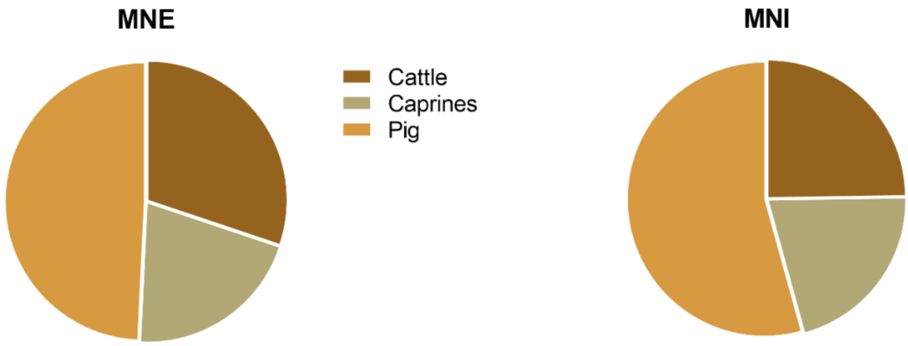


Figure 6.10. Proportions of the three main domesticates in the Skeleton Green assemblage.
MNE n: 1247 – Cattle 30%, Caprines 21%, Pig 49%
MNI n: 105 – Cattle 25%, Caprines 21%, Pig 54%

The assemblage is dominated by pigs, followed by cattle and caprines on both counts, suggesting this ranking order must closely correspond to that of the taxa present on site, although it might not correspond to that of the animals reared on site (6.6.2 – Some notes on processing). MNI counts do not show significantly different proportions, with only a hint of cattle being slightly over-represented in the MNE count due to recovery bias. It is therefore clear that pigs represented by far the most commonly slaughtered animal at Skeleton Green.

Accounting for cattle having a meat yield several times that of sheep, beef would have been the most common meat source (MY%: 63), followed at a distance by pork (MY%: 30) and with only marginal contribution from mutton (MY%: 8).

6.2.4 Dragonby

The relative proportions of the three main domesticates MNE and MNI in the Dragonby assemblage are represented in Figure 6.11.

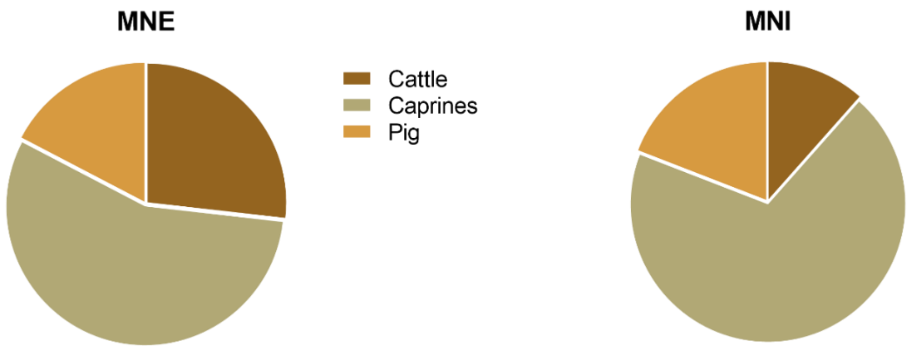


Figure 6.11. Proportions of the three main domesticates in the Dragonby assemblage.
MNE n: 2478 – Cattle 27%, Caprines 56%, Pig 17%
MNI n: 251 – Cattle 12%, Caprines 69%, Pig 19%

The assemblage is dominated by caprines, followed by cattle and pigs in the MNE count, whereas the MNI count shows that caprines and pigs are somewhat underrepresented due to recovery bias. It is therefore more likely that MNI more accurately represents the overall living population and, as we will see in section 6.2.5.1, the focus on caprines uniformly characterised the whole short time span represented by the ceramic association without substantial fluctuations.

Accounting for cattle having a meat yield several times that of sheep, mutton (MY%: 39) and beef (MY%: 45) would have probably been the most common meat sources, followed at a distance by pork (MY%: 16).

6.2.5 Subphases within the Dragonby and Northstowe assemblages

Raw numbers and percentage frequencies of MNE and MNI of the five recorded taxa for each of the subphases identified by association with ceramic materials in the Dragonby and Northstowe assemblages are presented in Table 6.2.

Taxon	Site	MNE		MNI		Site	MNE		MNI	
		n:	%	n:	%		n:	%	n:	%
Cattle	Dragonby CS 6	47	20%	3	14%	Northstowe Phase 2	69	28%	5	16%
Caprines		132	57%	12	57%		96	39%	18	56%
Pig		40	17%	4	19%		38	16%	5	16%
Horse		7	3%	1	5%		25	10%	3	9%
Dog		5	2%	1	5%		16	7%	1	3%
TOT		231		21			244		32	
Cattle	Dragonby CS 7	141	25%	8	14%	Northstowe Phase 3	103	42%	5	17%
Caprines		291	53%	37	64%		88	35%	16	55%
Pig		85	15%	9	16%		27	11%	5	17%
Horse		30	5%	3	5%		27	11%	2	7%
Dog		7	1%	1	2%		3	1%	1	3%
TOT		554		58			248		29	
Cattle	Dragonby CS 8	161	28%	7	13%	Northstowe Phase 4	157	48%	9	25%
Caprines		276	48%	31	57%		83	25%	16	44%
Pig		95	16%	12	22%		38	12%	5	14%
Horse		28	5%	2	4%		35	11%	3	8%
Dog		18	3%	2	4%		16	5%	3	8%
TOT		578		54			329		36	
Cattle	Dragonby CS 6-8	664	25%	29	11%	Northstowe Phases 2-4	328	40%	18	19%
Caprines		1384	53%	174	67%		266	32%	50	54%
Pig		430	16%	48	19%		103	13%	15	16%
Horse		93	4%	4	2%		87	11%	5	5%
Dog		49	2%	4	2%		35	4%	5	5%
TOT		2620		259			819		93	

Table 6.2. Taxonomic frequencies expressed as percentages of MNE and MNI of the elements attributed to each of the five recorded species in each of the subphases in the Dragonby and Northstowe assemblages. The sample size for each count is indicated under TOT, while NISP totals for each site are reported by the site name.

6.2.5.1 Dragonby

Taxonomic frequencies do not seem to vary significantly within the short time span represented by the materials attributed to Ceramic Stages six to eight, with the only visible chronological trend being a small relative increase of cattle in relation to caprines in the MNE count. This trend, however, is not confirmed by the MNI count.

6.2.5.2 Northstowe

Changes in taxonomic frequency at Northstowe are reflected in both MNE and MNI counts. A progressive increase in the relative proportion of cattle numbers with a corresponding decrease of caprines is detected across the relatively long life span of the site, from the Middle (phase 2) through the Late (phase 3) and Latest (phase 4) Iron Age, with the most substantial shift happening during the last phase. Fluctuations in the relative proportions of the other species are not substantial and seem to be due to chance.

Accounting for body size, even such a relatively small fluctuation in relative percentages would have meant a substantial shift in dietary contribution from the two animals.

6.2.6 Caprine species distribution

Morphological observation on postcranial bones and mandibular teeth according to the methodologies cited in Chapter 4 showed that the absolute majority of caprine bones in all sites belong to sheep. At Dragonby only 0.7% of the postcranial bones (sample size 751) and 7% of the mandibles (sample size 228) have been identified as goats. At Haddenham V only 1% of the postcranial bones (sample size 291) and 5% of mandibles (sample size 136) have been identified as goats. At Skeleton Green 10% of postcranial bones (sample size 54) and 3% of mandibles (samples size 38) have been identified as goats. At Northstowe 14% of postcranial bones (sample size 89) and 16% of mandibles (sample size: 51) have been identified as goats.

Discrepancies between postcranial and mandible results can be attributed to different, possibly concurrent, reasons: differential preservation due to different treatment of the carcasses, the smaller sample size in the mandible assemblages, and differential difficulty in identification depending on the anatomical element considered.

Osteometric analyses aimed at separating the two species (Figure 6.12, Figure 6.13, Figure 6.14, Figure 6.15) confirm this pattern and make sure that further osteometric analyses (see Chapter 7) are only marginally affected by the presence of goats. Most data points for all the indices plot in the areas of the distribution obtained from the modern specimens. When they fall in the intersection between the two areas, most of them cluster neatly with the data points that can be confidently attributed to sheep, with only a few isolated points falling further away from the main cluster and towards the goat distribution area (see for example Figure 6.12).

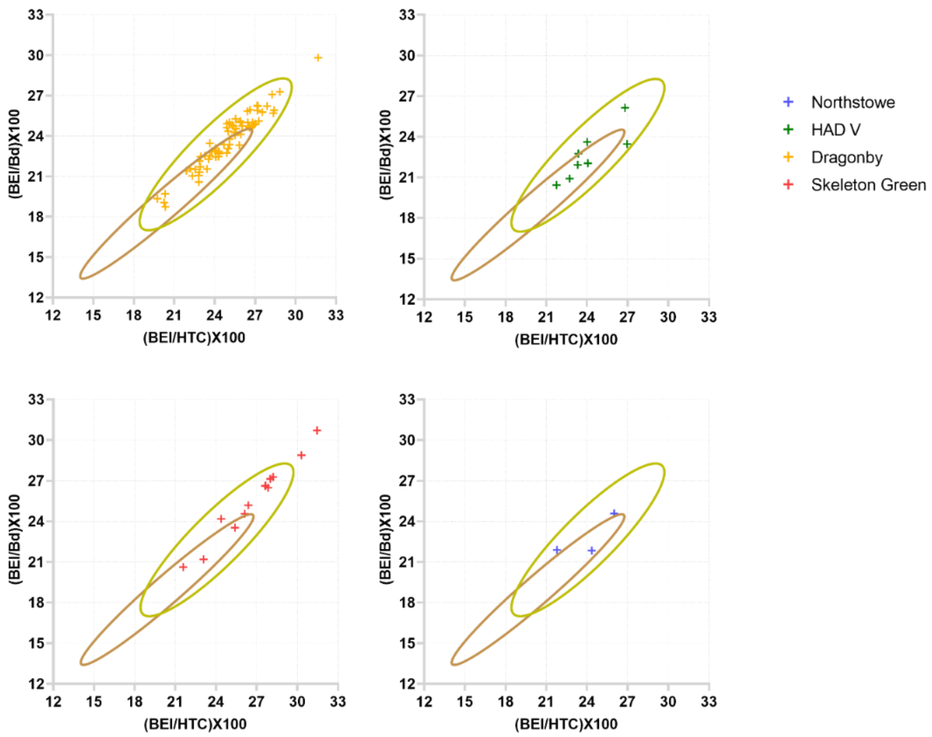


Figure 6.12. Osteometric shape analyses of caprine humeri against the approximate distributions of sheep (light green line) and goat (light brown line) modern values from Salvagno and Albarella (2017). The scatter plots include values from each of the four recorded assemblages (Dragonby n: 67. Haddenham V n: 8, Skeleton Green n: 13. Northstowe n: 3).

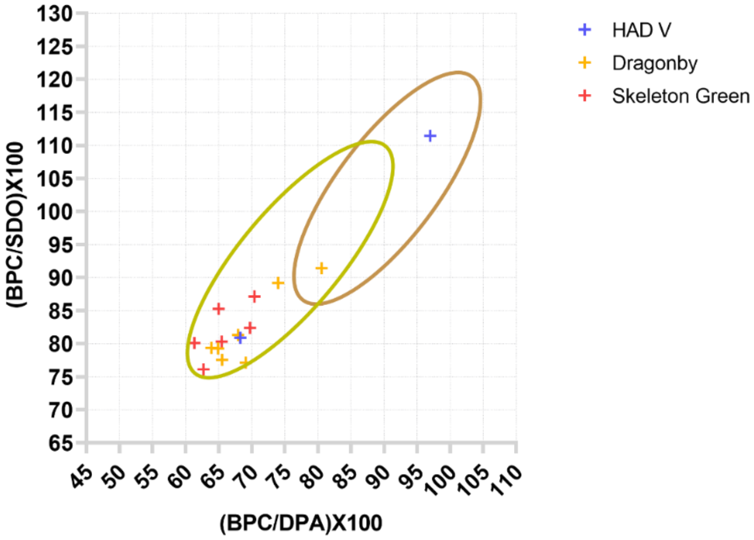


Figure 6.13. Osteometric shape analyses of caprine ulnae against the approximate distributions of sheep (light green line) and goat (light brown line) modern values from Salvagno and Albarella (2017). The scatter plots include values from three of the four recorded assemblages (Dragonby n: 7. Haddenham V n: 2, Skeleton Green n: 6).

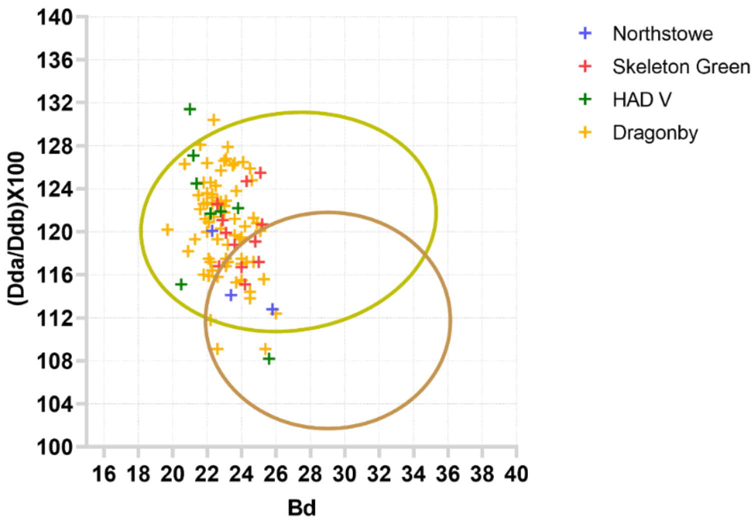


Figure 6.14. Osteometric shape analyses of caprine tibiae against the approximate distributions of sheep (light green line) and goat (light brown line) modern values from Salvagno and Albarella (2017). The scatter plots include values from each of the four recorded assemblages (Dragonby n: 71. Haddenham V n: 8, Skeleton Green n: 12. Northstowe n: 3).

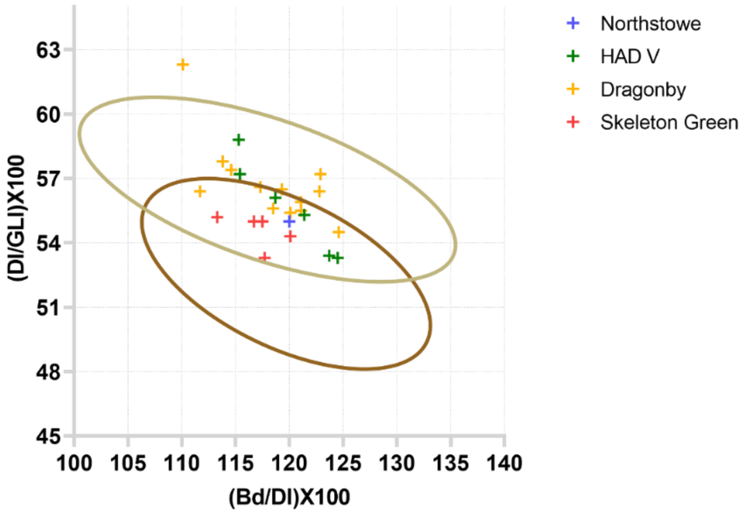


Figure 6.15. Osteometric shape analyses of caprine astragali against the approximate distributions of sheep (light green line) and goat (light brown line) modern values from Salvagno and Albarella (2017). The scatter plots include values from each of the four recorded assemblages (Dragonby n: 13. Haddenham V n: 6, Skeleton Green n: 5. Northstowe n: 1).

6.2.7 Horse and dog

Horses are well represented at all sites with percentages on the total MNE counts (between 2-11%) in line or above the average for Central England which is reported to be around 5% (Albarella, 2019, p.96) of the aggregated NISP in individual reports, thus frequently including loose teeth and other elements from ABGs causing overestimation due to the frequency of horses in special depositions. MNI counts yield lower proportions as is expected from a large mammalian species due to preservation bias (in the same way as cattle remains) and possibly to differential depositional pathways affecting the count due to interdependence.

Dogs are present at all sites in low MNE and MNI proportions. The proportions in the two counts are fairly similar, with only a slight increase probably due to the small sample size. Differences in dog frequencies between assemblages are probably only marginally representative of differences in living dog presence at the sites since the incidence of gnawing marks on bone refuse is fairly consistent across the sites (Figure 6.7).

Northstowe presents the higher frequency of both horses and dogs among the core sites, which will be discussed in Chapter 8.

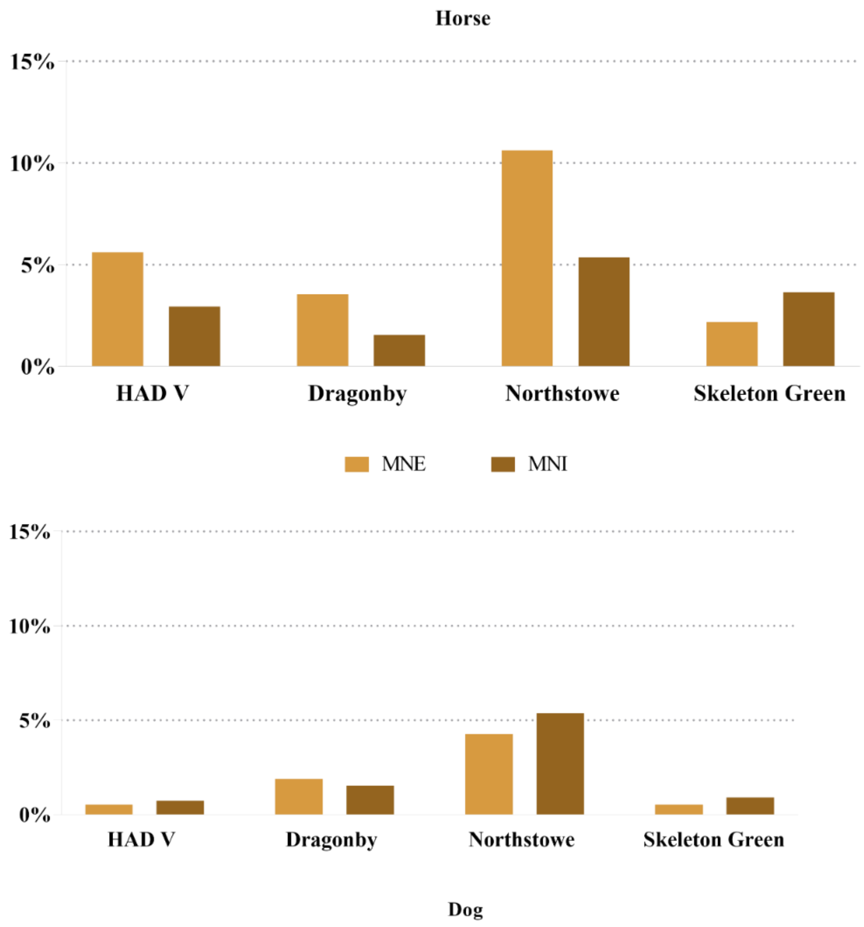


Figure 6.16. Percentages of horse (top) and dog (bottom) MNE and MNI relative to the total of the five recorded species in each of the four recorded assemblages (sample size indicated in Table 6.1).

6.2.8 On the presence of cats

Cat remains have only been identified in the Haddenham V assemblage. These consist of a fragment of pelvis with cutmarks on the ischiatic ramus, one calcaneum and seven long bone specimens of which, only a proximal tibia (a late fusing element) is unfused. The absence of very young individuals and the presence of abundant fur animals (see Chapter 5) in the assemblage suggests that cats were not reared on-site and were probably hunted.

6.2.9 Summary and discussion

Overall, the discussed sites present a general preference for sheep, which would have represented the absolute majority of individuals in the headcount of livestock. Caprines have relatively low representation only at Skeleton Green, where pigs were preferred. This might hint at a different nature of this site, which will be discussed in Chapter 8. Their underrepresentation in the MNE at Northstowe has been demonstrated to be due to taphonomic and recovery bias which, although it does set the site completely apart from the others in terms of husbandry strategies, does affect the sample size (and therefore the reliability) of osteometric analyses (see Chapter 7). As we will see in the next section, it did not impair ageing analysis per se, although the sample of single phases was rather low.

There is evidence that across the Later Iron Age, cattle became slightly more important at Northstowe. Given this is in contrast with the general trend described in section 3.2.2.1 – Livestock species and frequencies, this might be ascribed to local development. However, given the rarity of sites with such a long life and a reliable sample size, it is difficult to discern if the general increase in sheep was due to the way new settlements were created rather than to the focus and objectives of Iron Age herders.

Concerning the dietary contribution, if we think about the different species simply in terms of mass, beef was the most important meat resource across all sites, except for Haddenham V where mutton and beef had similar contributions. Pork was more important than mutton only at Skeleton Green. It is however obvious that factors other than raw meat yield can be culturally and socially important, and these will be discussed in Chapter 8.

Horses and dogs had a stable and relatively substantial presence across all sites. They evidently maintained a role, most probably not directly dietary, in the farming communities of this region. Horses are particularly well represented at Northstowe.

Cat in this period seems to be still a wild animal, relevant only in the economies of the rare settlements, such as Haddenham V, that were interested in the procurement of fur and feathers.

6.3 Ageing

The following sections discuss ageing data from mandibular teeth eruption and wear and the rate of epiphyseal fusion in postcranial bones

6.3.1 Caprines

6.3.1.1 Haddenham V

The age distribution of caprine mandibles at Haddenham V (Figure 6.17) shows the representation of most stages, hinting at the non-specialised exploitation of the animals. Stage A, corresponding to neonatal individuals is not represented, suggesting either that lambing happened off-site or that neonatal casualties were disposed of differently and/or were not preserved at all in the record due to taphonomic factors. A substantial peak at stage C suggests the intentional culling of yearlings, probably to reduce the flock before wintering. For this to be necessary and viable, flock numbers must have been substantial. More than half of the animals were culled before passing their prime age when they reach full size during stage D. This implies that meat production was central to caprine husbandry. However, a good number of animals reached full maturity and even elderly age, with no evident minor peaks, suggesting that although meat production was the primary objective, secondary products were also exploited.

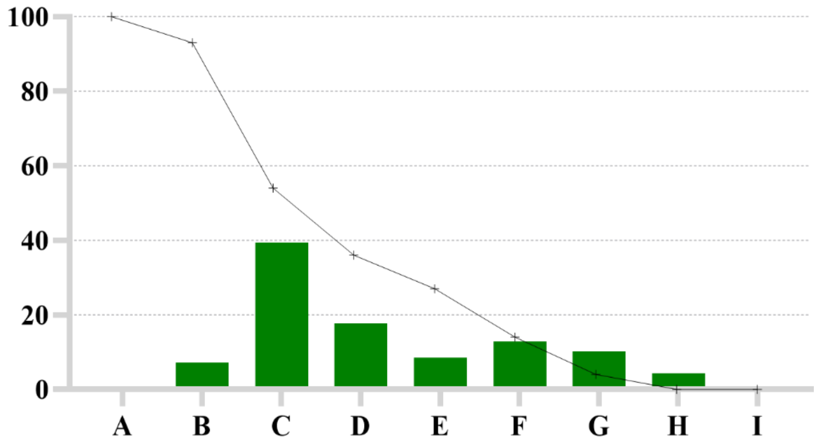


Figure 6.17. Distribution of caprine mandibular wear stages at Haddenham V. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 127)

The age distribution from epiphyseal fusion data (Figure 6.18) shows that roughly 60% of the caprine postcranial remains (early fusing elements) belong to animals which had passed or were about to pass their first winter. This is in accord with the dental data since postcranial elements of very young animals are more likely to be underrepresented and most of the casualties during the first year of life were concentrated in the second half. A good proportion of the remaining animals was then slaughtered in their prime (middle fusing elements), and only a few survived into full maturity (late fusing elements).

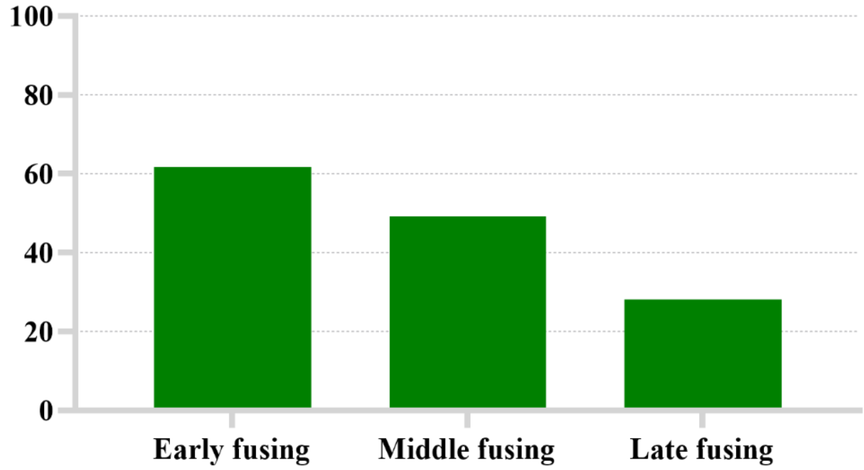


Figure 6.18. Percentage of aggregated fused and fusing post-cranial caprine elements within each fusion stage at Haddenham V (Early fusing n: 99, Middle fusing n: 61, Late fusing n: 39).

6.3.1.2 Northstowe

The age distribution of caprine mandibles at Northstowe (Figure 6.19) largely resembles that of Haddenham V, implying a similar model of livestock management.

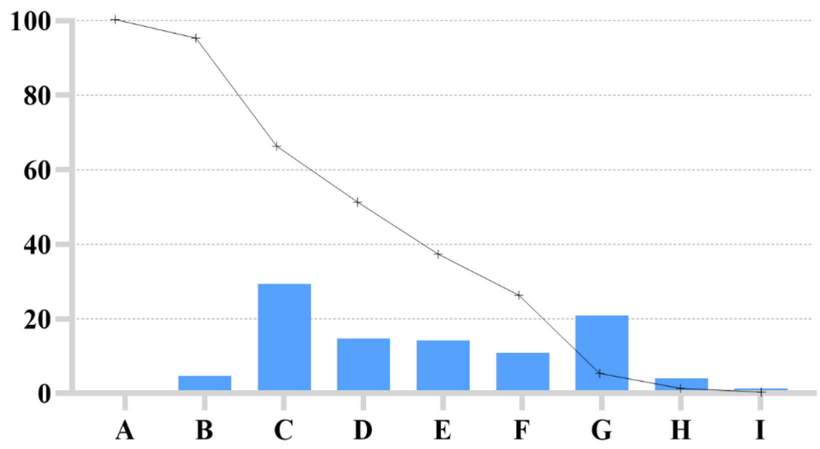


Figure 6.19. Distribution of caprine mandibular wear stages at Northstowe. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 75)

It seems that the focus here was increasingly on secondary products, suggested by the bimodality of the profile, with a second peak at stage G, corresponding to fully mature animals. This is not reflected in the age distribution from epiphyseal fusion data (Figure 6.21) which instead confirms the similarity with the previous assemblage.

However, if we break down the dataset into its three sub-phases, a rather different pattern appears (Figure 6.20). The reduced sample size of the sub-phases suggests some caution in interpreting these profiles, although the diachronic trend described below seems to reinforce the idea that the pattern detected is not due to chance. During the MIA, the mortality profile is indeed similar to that of its roughly contemporary Haddenham V, with a single high peak on stage C, although with a second lower peak at stage E. Conversely, during the Late and Latest Iron Ages the pattern is clearly bimodal, with peaks in the slaughter at stages C (and D for the later phase) and G. This pattern clearly indicates a change in practice over time, where the flocks were separated and slaughtered at a different age to increase the exploitation of secondary products. The progressive percentage decrease of the peak at C suggests a decrease in the need to cull the flocks before winter, although the practice persists through the LIA and, to an extent, the Latest IA.

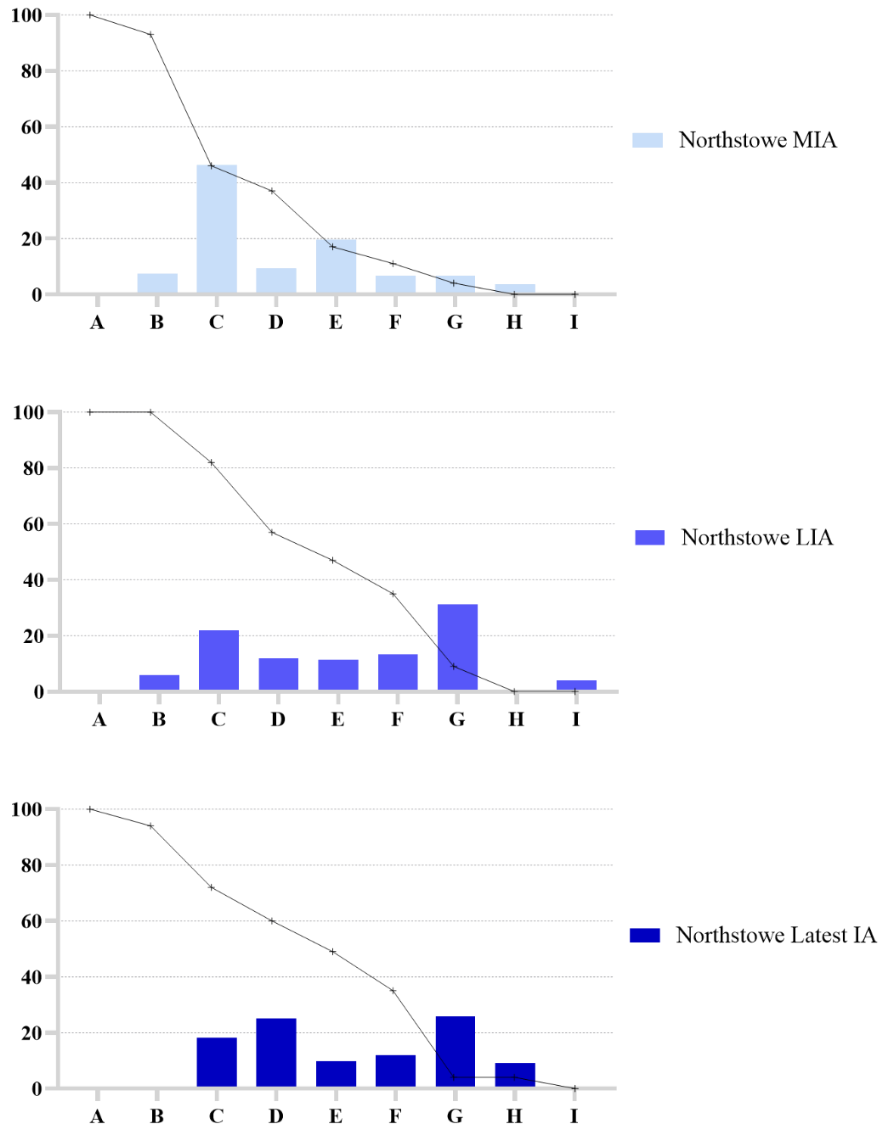


Figure 6.20. Distribution of caprine mandibular wear stages at Northstowe for each subphase. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (MIA sample size n: 25; LIA sample size n: 27; Latest IA sample size n: 22).

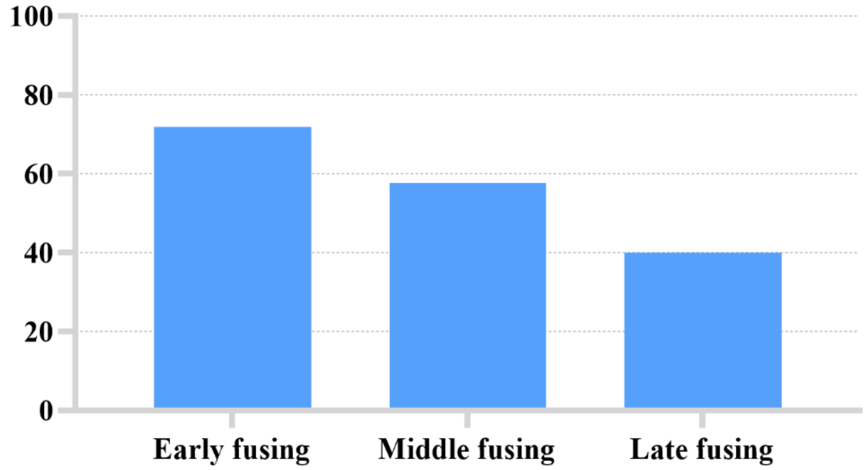


Figure 6.21. Percentage of aggregated fused and fusing post-cranial caprine elements within each fusion stage at Northstowe (Early fusing n: 32, Middle fusing n: 26, Late fusing n: 40).

6.3.1.3 Skeleton Green

The age distribution of caprine mandibles at Skeleton Green (Figure 6.22) shows the representation of most phases except for neonatal and elderly animals, similar to the previously described sites. The sample size here is much smaller than those of the other datasets, therefore its interpretation must be taken with caution. The mortality curve is however completely different, with peaks at stage B (young lambs) and E (animals reaching full skeletal maturity). Assuming the pattern is not due to chance, this suggests that either a different management strategy was in place or at least part of the mutton and lamb consumed on-site originated outside the site (see section 6.5). This will be further discussed in Chapter 8.

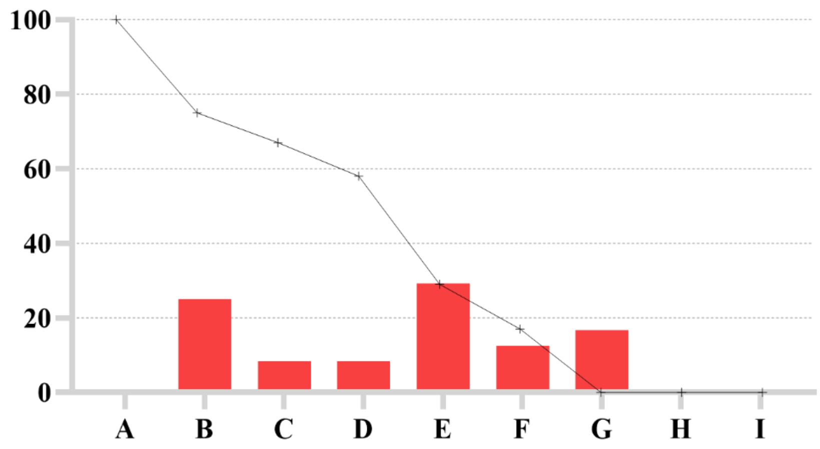


Figure 6.22. Distribution of caprine mandibular wear stages at Skeleton Green. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 24)

The age distribution from epiphyseal fusion data (Figure 6.23) shows proportions that are not too dissimilar from those of previously described sites, albeit with a lower proportion of animals surviving beyond reaching full skeletal maturity, which confirms the peak detected in the dental data.

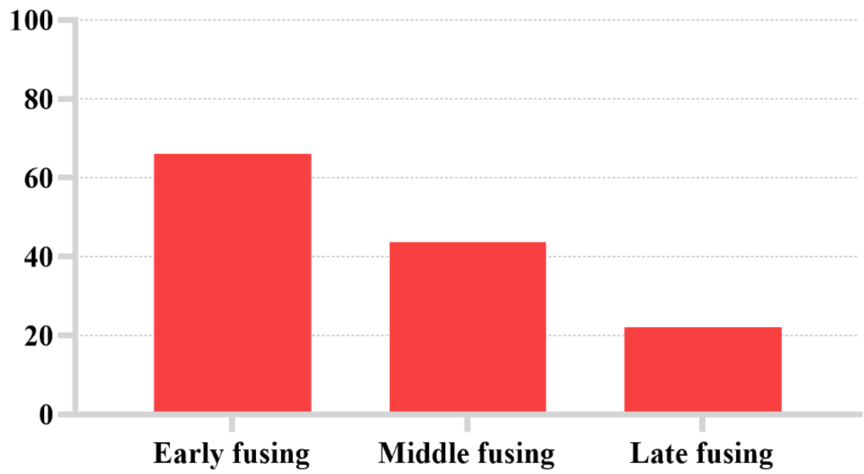


Figure 6.23. Percentage of aggregated fused and fusing post-cranial caprine elements within each fusion stage at Skeleton Green (Early fusing n: 47, Middle fusing n: 39, Late fusing n: 50).

6.3.1.4 Dragonby

The age distribution of caprine mandibles at Dragonby (Figure 6.24) shows a pattern that is similar to that of Haddenham V and Northstowe in the MIA, save for one major difference: the peak in mortality is at stages D and E, hinting at a stronger focus on meat production and/or to the lack of necessity to cull the lambs before winter.

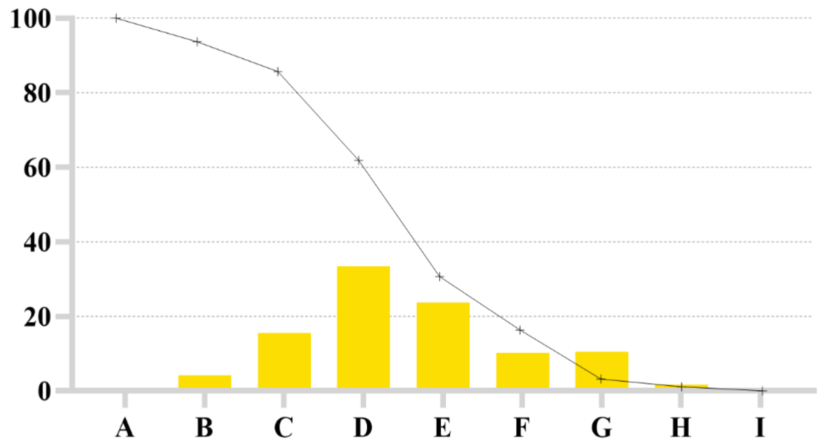


Figure 6.24. Distribution of caprine mandibular wear stages at Dragonby. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 293)

The pattern in epiphyseal fusion data from the previously described assemblages is maintained at Dragonby (Figure 6.25), albeit with much higher proportions of fused bones in each category, confirming the mixed exploitation pattern with a focus on meat production seen in the dental wear data.

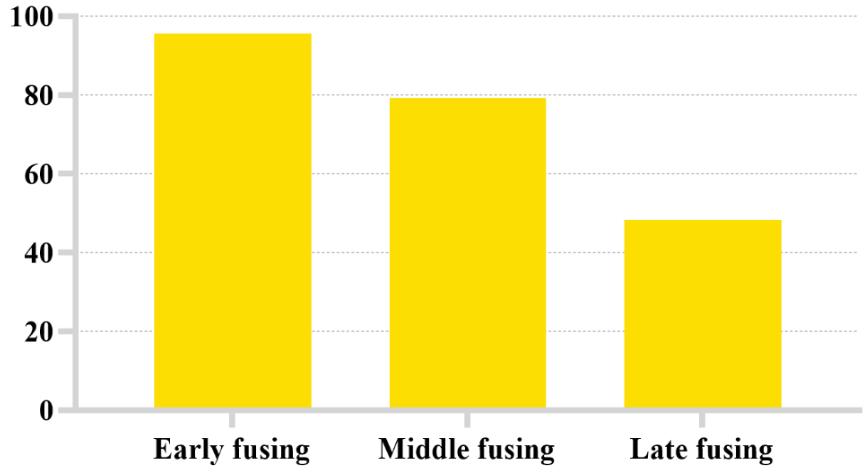


Figure 6.25. Percentage of aggregated fused and fusing post-cranial caprine elements within each fusion stage at Dragonby (Early fusing n: 264, Middle fusing n: 207, Late fusing n: 120).

6.3.2 Cattle

6.3.2.1 Haddenham V

The age distribution of cattle mandibles at Haddenham V (Figure 6.26) shows two distinct peaks with the culling of immature and adult animals. Neonatal casualties are not represented, possibly hinting at off-site calving, however, the sample size is small, so their absence could be justified simply by recovery bias and differential preservation.

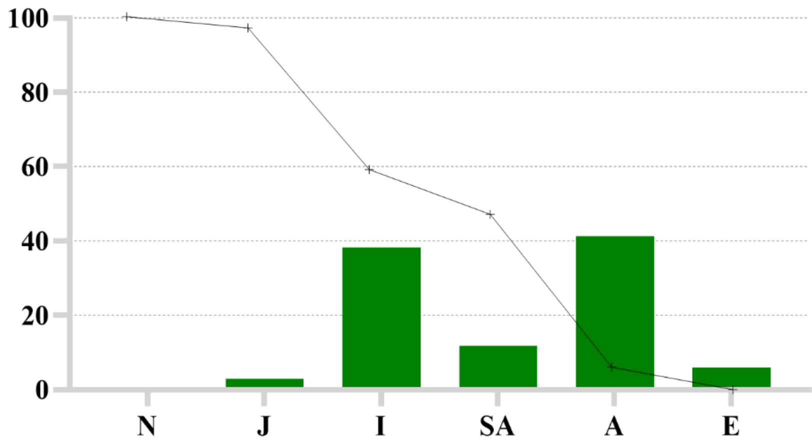


Figure 6.26. Distribution of cattle mandibular wear stages at Haddenham V. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 17)

The preference for culling mature individuals is confirmed by the data from epiphyseal fusion (Figure 6.27) for which there is almost perfect correspondence (multiplying the percentage of fused and fusing bones from each stage we obtain 43%, very close to the surviving 41% adults from mandibular data). The peak in the culling of immatures is not reflected in the proportion of early fusing postcranial bones, this could be due to differences in skeletal development and dental wear and the categories used by the two methodologies, or to chance and small sample size, recovery bias, or taphonomic reasons. The interpretation of the mortality profile, therefore, can indicate with confidence only the preference for mature animals, indicating their main use for meat production and traction.

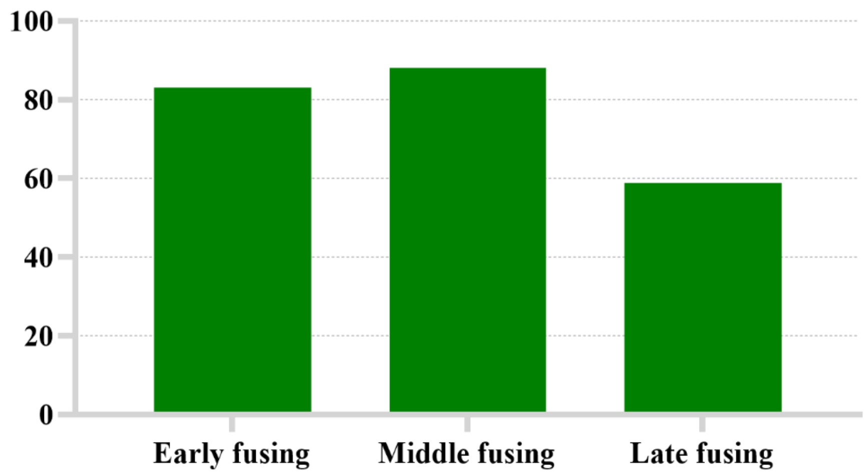


Figure 6.27. Percentage of aggregated fused and fusing post-cranial cattle elements within each fusion stage at Haddenham V (Early fusing n: 77, Middle fusing n: 25, Late fusing n: 34).

6.3.2.2 Northstowe

The age distribution of cattle mandibles at Northstowe (Figure 6.28) shows an absolute preference for the culling of adult and elderly animals. Neonatal and juvenile animals are not represented at all, for which the same explanation proposed for the Haddenham V data stands. The peak here is on the elderly stage, hinting at an even more pronounced focus on traction. The sample size for the single sub-phases is regrettably too small to build reliable mortality profiles. It is, however, interesting to note that elderly individuals are well represented in all sub-samples, suggesting that the pattern detected might be representative for all three periods.

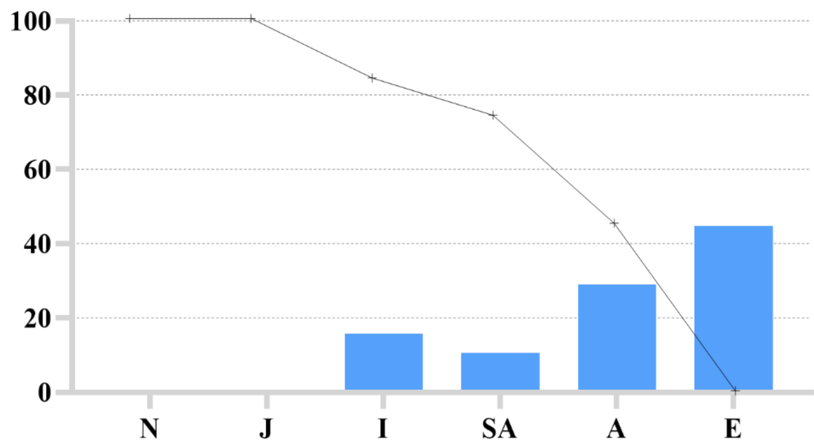


Figure 6.28. Distribution of cattle mandibular wear stages at Northstowe. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 19)

The epiphyseal fusion pattern (Figure 6.29) confirms the pattern with consistently high percentages of fused postcranial bones at all stages meaning that roughly half of the population reached full skeletal maturity.

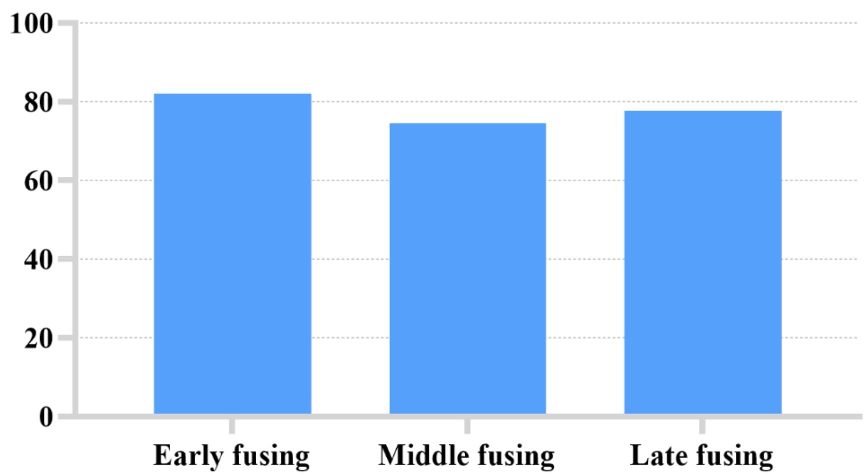


Figure 6.29. Percentage of aggregated fused and fusing post-cranial cattle elements within each fusion stage at Northstowe (Early fusing n: 67, Middle fusing n: 47, Late fusing n: 54).

6.3.2.3 Skeleton Green

The age distribution of cattle mandibles at Skeleton Green (Figure 6.30) shows, like in the previous assemblages, a preference for the slaughtering of mature animals.

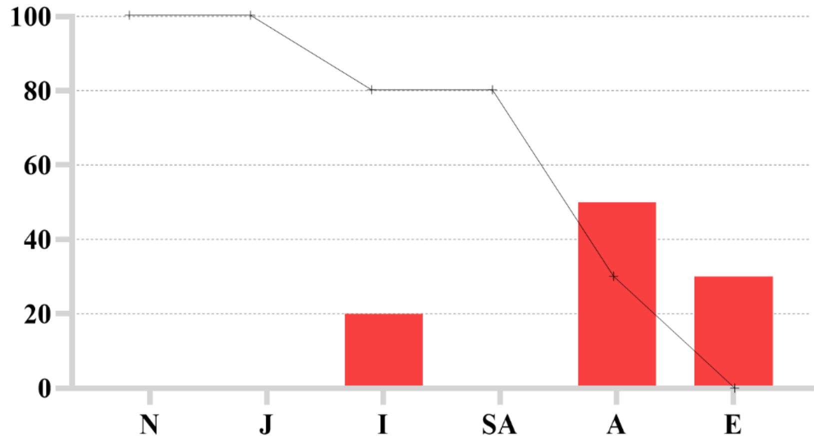


Figure 6.30. Distribution of cattle mandibular wear stages at Skeleton Green. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 10)

The mandibular sample size is, however, very small, so caution must be used in interpreting a potentially unreliable pattern. The epiphyseal data (Figure 6.31) with a much more reliable sample size, confirms the preference for older animals, but additionally, shows a peak in mortality corresponding to the latest fusion events, at odds with the absence of mandibles pertaining to subadults.

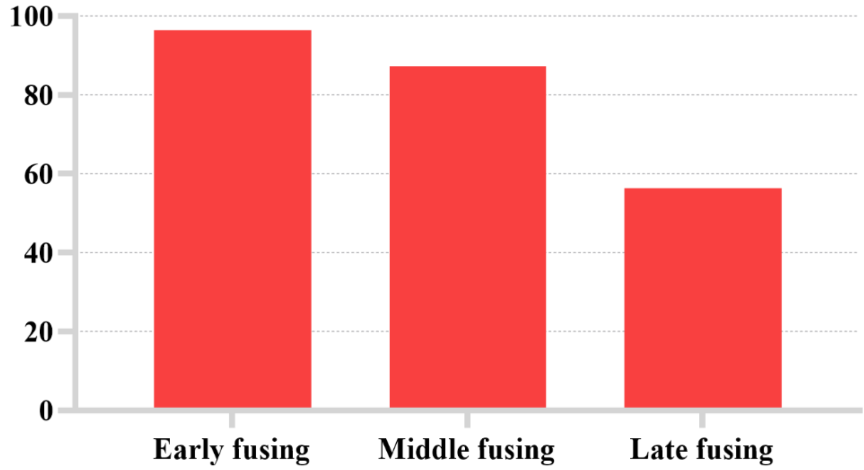


Figure 6.31. Percentage of aggregated fused and fusing post-cranial cattle elements within each fusion stage at Skeleton Green (Early fusing n: 84, Middle fusing n: 47, Late fusing n: 39).

6.3.2.4 Dragonby

The age distribution of cattle mandibles at Dragonby (Figure 6.32) shows, again, the preference for the culling of mature and elderly individuals and the absence of mandibles pertaining to neonatal individuals, this time with a relatively large sample size.

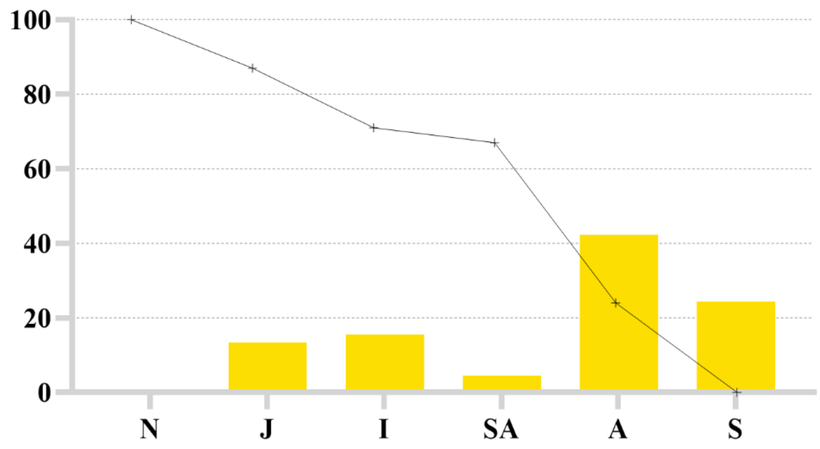


Figure 6.32. Distribution of cattle mandibular wear stages at Dragonby. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 45)

The keeping of cattle until and beyond skeletal maturity (more than 60% of the individuals with both methods) is confirmed by the epiphyseal fusion data (Figure 6.33) showing the highest proportion of fused and fusing postcranial bones in cattle at all stages among the core sites and suggesting a strong focus on traction.

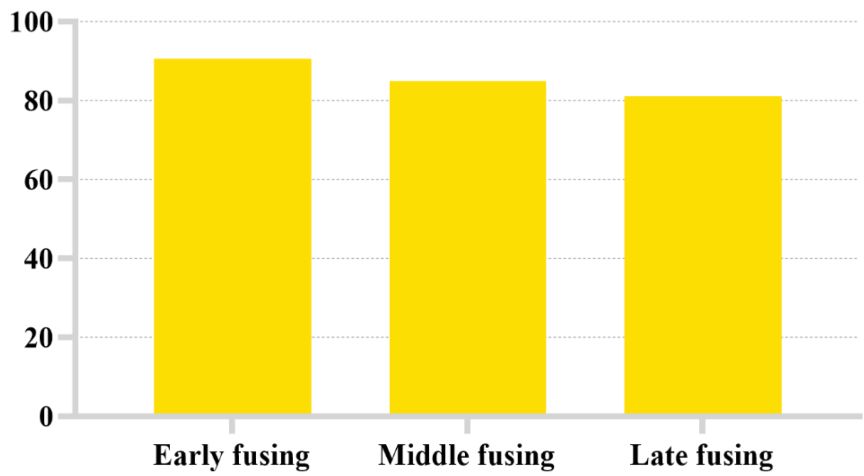


Figure 6.33. Percentage of aggregated fused and fusing post-cranial cattle elements within each fusion stage at Dragonby (Early fusing n: 160, Middle fusing n: 73, Late fusing n: 79).

6.3.3 Pig

6.3.3.1 Haddenham V

The age distribution of pig mandibles at Haddenham V (Figure 6.34) shows a lack of preserved neonatal and elderly remains, rare juveniles, an abundance of immature and adult remains and a moderate peak in subadult mandibles. This profile, fairly typical for unimproved (slow-growing) pigs, represents a practice oriented to maximise the meat output.

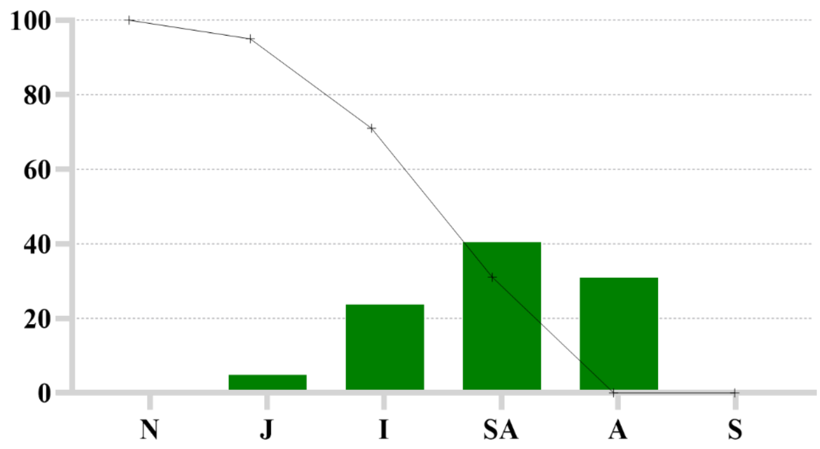


Figure 6.34. Distribution of pig mandibular and maxillar wear stages at Haddenham V. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 21)

The epiphyseal fusion data (Figure 6.35) has too small a sample size to give more insight into the interpretation of dental wear. However, the late fusing group, as the more abundant subset confirms that most of the animals would not have reached full skeletal maturity before slaughter.

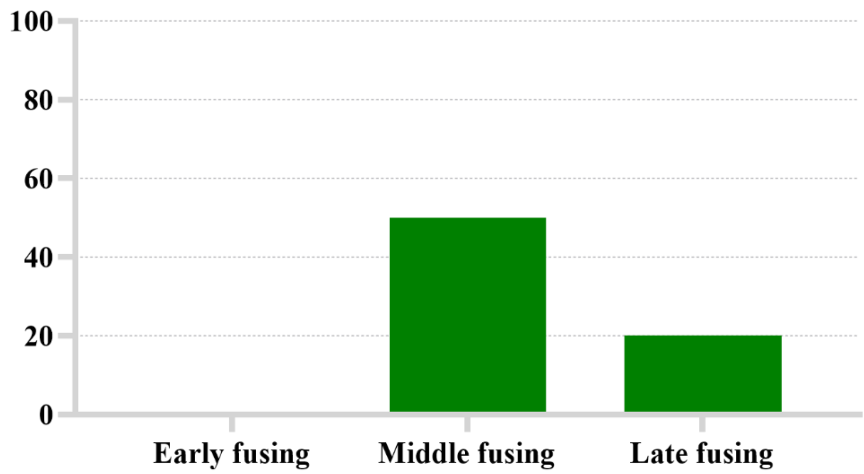


Figure 6.35. Percentage of aggregated fused and fusing post-cranial pig elements within each fusion stage at Haddenham V (Early fusing n: 3, Middle fusing n: 2, Late fusing n: 10).

6.3.3.2 Northstowe

The age distribution of pig mandibles at Northstowe (Figure 6.36) presents a pattern that is almost identical to that of Haddenham V.

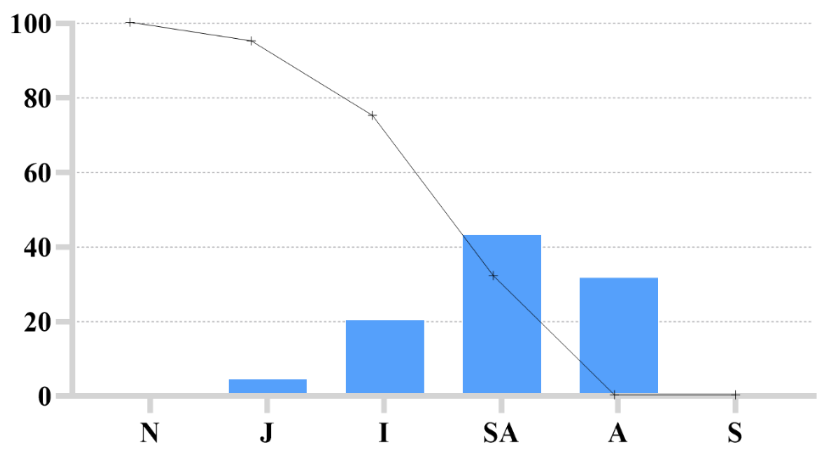


Figure 6.36. Distribution of pig mandibular and maxillar wear stages at Northstowe. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 22)

A more reliable sample size for postcranial elements fusion data (Figure 6.37) confirms the low proportion of animals reaching full skeletal development but also relatively low juvenile mortality and rather balanced distribution of cullings across the second and third year of life.

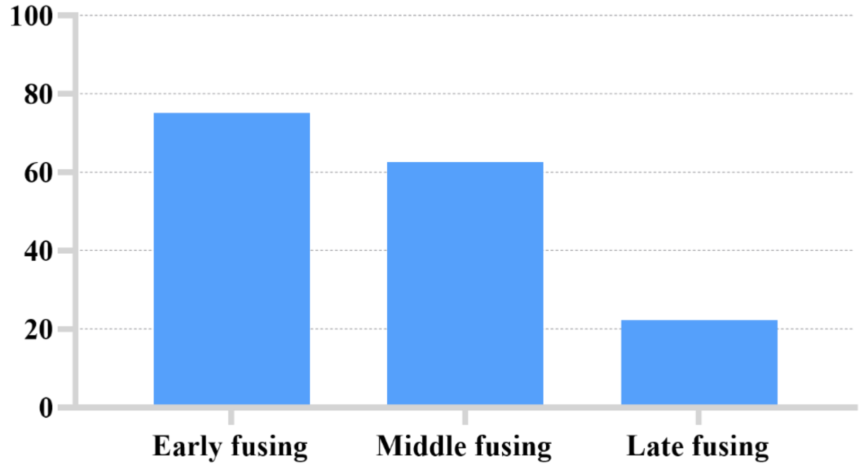


Figure 6.37. Percentage of aggregated fused and fusing post-cranial pig elements within each fusion stage at Northstowe (Early fusing n: 14, Middle fusing n: 6, Late fusing n: 9).

6.3.3.3 Skeleton Green

The age distribution of pig mandibles at Skeleton Green (Figure 6.38) shows an even stronger preference for subadult and adult animals, with low proportions of immature and absence of neonatal, juvenile and elderly animals. Given the large sample size, these absences are most likely real whether this means that the missing age categories were not present on-site or a different depositional pathway excluded them from this record. With unimproved pigs, slaughtering younger animals would have yielded very small meat quantities, confirming that the focus was on quantity.

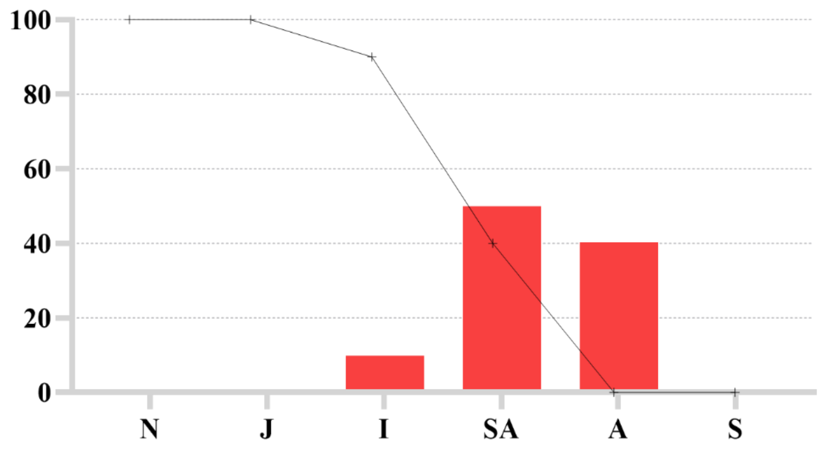


Figure 6.38. Distribution of pig mandibular and maxillar wear stages at Skeleton Green. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 92)

The epiphyseal fusion data (Figure 6.39) however, shows a similar pattern of mortality to that of the other sites, intermediate to Northstowe and Dragonby, both of which have higher juvenile and immature mortality. It is difficult to interpret this discrepancy, as cranial and dental pig remains are on average more durable than postcranial elements and the pattern of skeletal element distribution is fairly similar across the four sites (Table 6.6). In particular, it is difficult to imagine the removal of the heads of younger individuals if the carcasses were imported or exported.

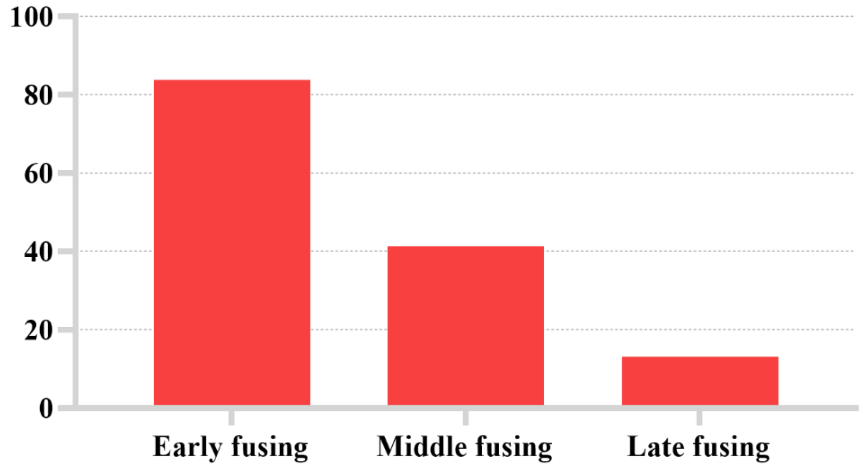


Figure 6.39. Percentage of aggregated fused and fusing post-cranial pig elements within each fusion stage at Northstowe (Early fusing n: 86, Middle fusing n: 90, Late fusing n: 84).

6.3.3.4 Dragonby

The age distribution of pig mandibles at Dragonby (Figure 6.40) shows a focus on subadult and adult individuals similar to that of Skeleton Green but with the neonatal and juvenile stages represented, albeit by a very small number of mandibles.

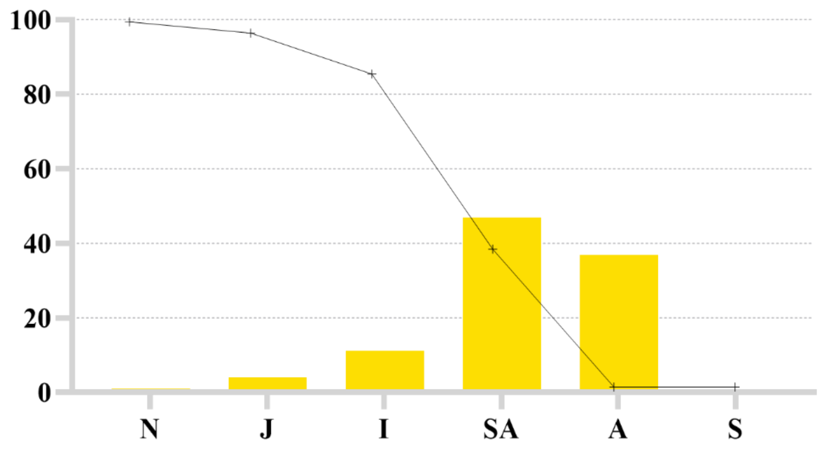


Figure 6.40. Distribution of pig mandibular and maxillar wear stages at Dragonby. The bars represent the relative distribution of the mandibles across the stages while the line represents the mortality curve (sample size n: 99)

Accordingly, epiphyseal fusion data (Figure 6.41) shows very low juvenile and higher subadult mortality.

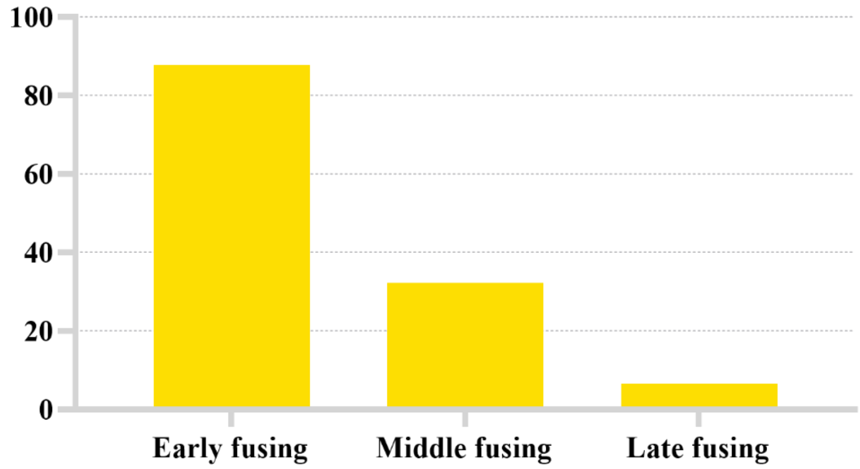


Figure 6.41. Percentage of aggregated fused and fusing post-cranial pig elements within each fusion stage at Dragonby. (Early fusing n: 65, Middle fusing n: 49, Late fusing n: 31).

6.3.4 Horse

The paucity of horse remains across the assemblages does not allow for the detailed reconstruction of their management. However, the presence of deciduous teeth and unfused bones constitutes evidence for the presence of young animals, suggesting that rearing or breeding happened on site.

At Haddenham V, a partial skull with deciduous premolars and, first molars fully erupted and second molars clearly visible in crypt but not yet erupted can be attributed to an individual between one and two years of age. That this is not a random occurrence is confirmed by the presence of a number of unfused postcranial bones and in particular an unfused distal humerus and a fusing distal tibia attesting the presence of other individuals at or below the age of two years.

At Northstowe subadult animals of less than three/three and a half years are represented by a mandible with complete deciduous premolar dentition, both proximal and distal unfused femora, and an unfused proximal tibia, while a fusing distal tibia attests for the presence of an individual of almost two years of age.

At Skeleton Green neither deciduous teeth nor unfused bone are attested.

At Dragonby, a set of 5 deciduous incisors likely from the same individual and 4 deciduous second premolars, including one completely unworn attest to the presence of both subadult and neonatal animals. Among the postcranial bones, unfused metapodials and proximal radii confirm the presence of animals younger than a year and a half.

6.3.5 Summary and discussion

The ageing data from caprine remains informs us that across all four sites, mutton production was important. Haddenham V and the earliest phase (MIA) of Northstowe (both located around the Fens) present similar patterns oriented primarily to the production of meat, although not strongly specialised (therefore not excluding the importance of secondary products). The latter two phases (LIA, Latest IA) at Northstowe suggest a change in practice where secondary products held a more substantial role in the economy. This is not replicated in the Latest IA assemblages from Dragonby and Skeleton Green, which show an even stronger emphasis on meat than the earliest datasets. Another difference between the two groups is the substantial culling of yearlings which is indicated only at Haddenham V and Northstowe (although much less pronounced in the Latest IA).

Cattle data instead suggest a fairly ubiquitous focus on traction, although less pronounced in Haddenham V, where beef production was also central.

Pig husbandry seems to have been uniformly focused on optimal pork production across all sites, which presents strikingly similar patterns of culling.

The rearing on-site of horses was practised at Dragonby and possibly at Haddenham V and Northstowe.

It is of note that all ageing data from Skeleton Green present some kind of peculiarity: the caprine profile is strikingly different from all the others, the pattern in cattle and pig epiphyseal fusion is in disagreement with that from dental wear, and young horses are completely absent. This might be due in all cases, except for pig, to the small sample size of dental datasets, due to the generalised underrepresentation of cranial elements in this site (see 6.5 – Distribution of anatomical elements).

6.4 Sexing

The separation of sexes in ruminants has been attempted through the metric analysis of different anatomical elements. Scatterplots of the measurements that are more sexually dimorphic and abundant in the core assemblages are reported in this section. Unfortunately, only Dragonby had substantial numbers of each measurement; data from the other sites is reported anyway as, given the normal distribution of metric data of each sex in each population, it is more likely that the few preserved elements yield near-average values rather than outliers. This type of analysis cannot give definite percentages of females, males and castrated males. It can, however, indicate rough proportions that can help us interpret management strategies and livestock morphotypes.

Given the results of the analyses presented in section 6.2.6 – Caprine species distribution, the results presented here are assumed to largely represent sheep, with the values plotting as outliers possibly representing the few goats. The sex separation has been aided, in the case of caprines, by the inclusion of a set of measurements from modern Soay sheep of known sex, published by Salvagno and Albarella (2017). Soay sheep are, among the modern landraces, the one that is closer in bone size and proportions to the remains of British Iron Age sheep.

The size and shape of horncores are influenced by sex, age and morphotype. Since the ageing of horncores is partly subjective and therefore not completely reliable (Sykes and Symmons, 2007; Salvagno and Albarella, 2017), it has not been attempted and all measurable elements have been included; this will inevitably lower the resolution of the analysis skewing the results towards the smaller (female) animals. It must be noted, however, that smaller and more porous horncores are less likely to survive intact and be collected, in part balancing this bias. Furthermore, at least for cattle, we know that the majority of remains belong to mature animals (see 6.3.2 – Cattle). Due to the dearth of horncore lengths, the analysis relied on the minimum and maximum diameters of the base.

Metapodials, and especially metacarpals, are well known for being highly sexually dimorphic, though age, breed and traction stress also influence their size and shape (Grigson 1982; Albarella 1997a). Although very few whole metapodials have been recovered in the core sites, some of the more sexually dimorphic measurements (BFd and WCL, as indicated for cattle by Davis et al., 2012) have very good chances of being measurable even in fragmented and abraded material.

Humeri are also somewhat sexually dimorphic and, since the distal part is very well represented in the core assemblages, it has been chosen to give additional evidence.

6.4.1 Caprines

Caprine horncore basal diameters (Figure 6.42) show three possible size clusters along the largely linear distribution. The data from modern Soay sheep shows an almost identical distribution between the cluster of the smallest size and the modern female individuals. The cluster of intermediate size is placed between the values of the two male castrates in the modern sample, while the cluster of large size is between the modern castrates and the modern uncastrated male. At Dragonby, assuming these clusters are representative of these three groups we would have a ewe to wether to ram ratio of approximately 6:3:1. The few values from the other sites all cluster with the females, hinting they might have a similarly female-dominated composition.

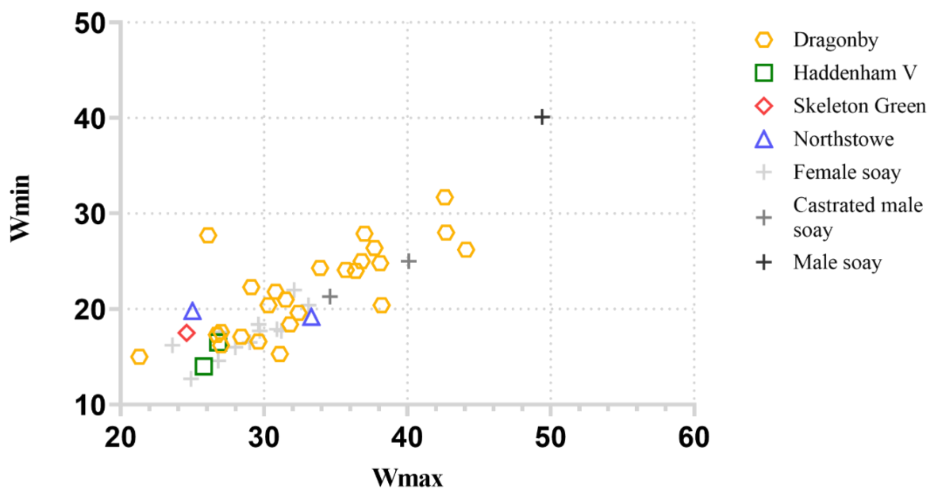


Figure 6.42. Size of caprine horncores (Wmin—smallest diameter of the base of the horncore; Wmax —greatest diameter). The scatter plot includes values from each of the four recorded assemblages (Dragonby n:25. Haddenham V n:2, Skeleton Green n:1. Northstowe n:2) and those from modern Soay sheep (1 male, 2 castrated males and 12 females) from Salvagno and Albarella (2017).

The size of caprine metacarpals yields similar results. Plotting the greatest length, a weakly sexually dimorphic measurement, against the width of the distal articulation – strongly dimorphic – yields one distinct cluster corresponding to the values of modern females, while another smaller cluster corresponds to males regardless of castration, to a rough female to male ratio of 3:1 (Figure 6.43).

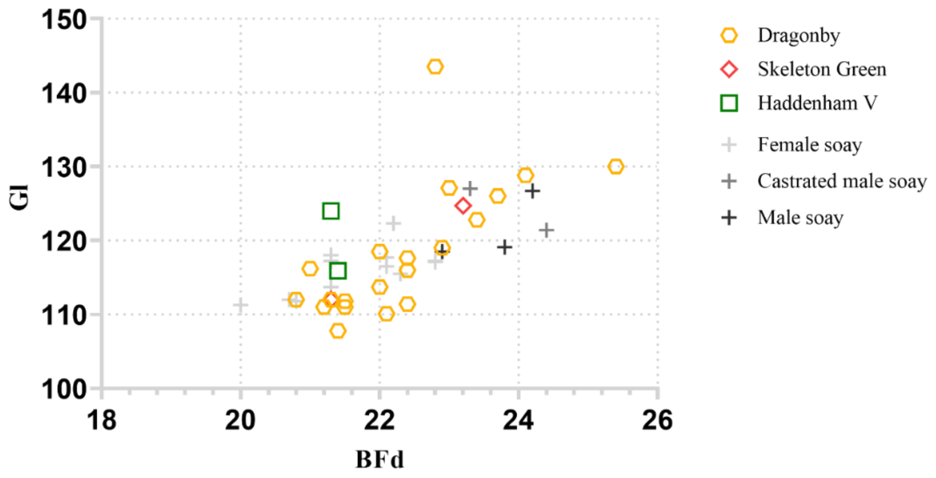


Figure 6.43. Size of caprine metacarpals (BFd—width of the distal articulation; GL —greatest length). The scatter plot includes values from the three recorded assemblages which had measurables metacarpals (Dragonby n:20. Haddenham V n:2, Skeleton Green n:2) and those from modern Soay sheep (3 males, 2 castrated males and 12 females) from Salvagno and Albarella (2017).

Plotting the width of the distal articulation with the width of the lateral condyle, the separation in clusters is even less clear, although the higher presence of females is confirmed.

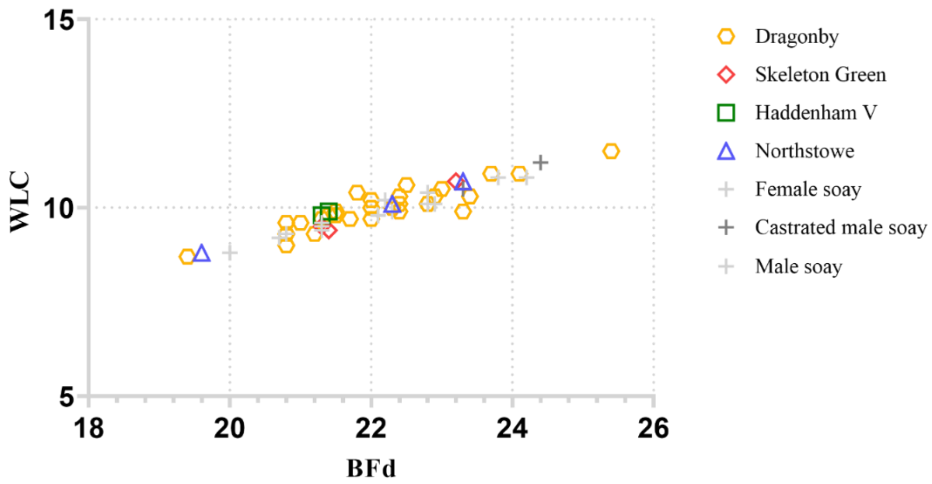


Figure 6.44. Size of caprine metacarpals (BFd—width of the distal articulation; WCL —width of the lateral condyle). The scatter plot includes values from the three recorded assemblages which had measurable metacarpals (Dragonby n:67. Haddenham V n:8, Skeleton Green n:12, Northstowe n:2) and those from modern Soay sheep (3 males, 2 castrated males and 13 females) from Salvagno and Albarella (2017).

The size of caprine humeri (Figure 6.45) presents a very small cluster of large-sized sheep which plots on the linear distribution between the values of the modern males, although these present some overlap with the larger cluster of smaller individuals. This suggests that either Iron Age sheep presented more marked dimorphism or the small number of males in the sample creates a random gap in the data representation separating the larger from the smaller rams (the former plotting together with ewes and wethers). The larger cluster presents a tail of smaller individuals probably just representing the great variability of size in the Iron Age population, and some values with lower Bd diverting from the linear distribution. This last group of values, although not separated from the main cluster, seems to correspond to the values of modern wethers and might represent this group due to differential development in the proportions of the distal end of the humerus.

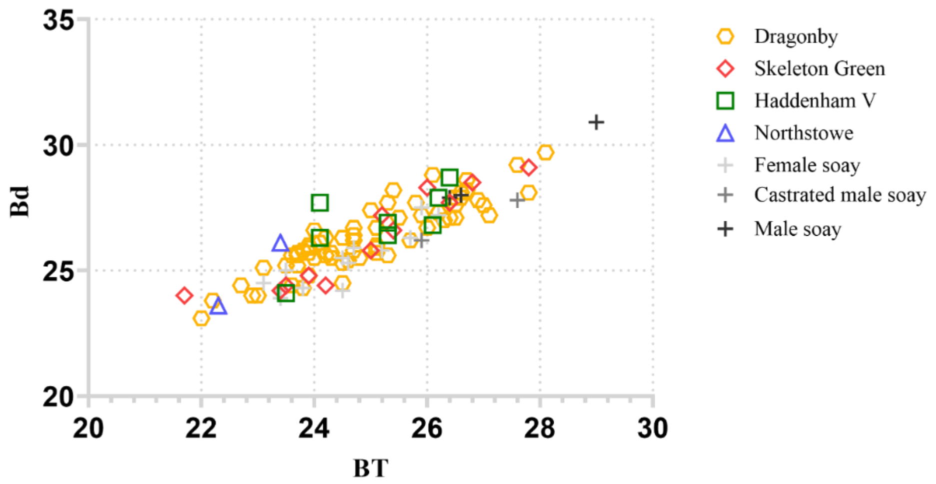


Figure 6.45. Size of caprine humeri (BT—breadth of the trochlea; Bd—breadth of the distal end). The scatter plot includes values from each of the four recorded assemblages (Dragonby n:67. Haddenham V n:8, Skeleton Green n:12, Northstowe n:2) and those from modern Soay sheep (3 males, 2 castrated males and 13 females) from Salvagno and Albarella (2017).

6.4.2 Cattle

Cattle horncore basal diameters (Figure 6.46) show a complex distribution. Due to the small sample size in each dataset and the lack of adequate reference material the following interpretations must be taken with caution.

The distribution of the overall dataset can be separated in three different ways:

- In the first, two main groups, one of the more robust horncores with Wmin/Wmax*100 values between 75 and 85, and one larger group of less robust horncores with Wmin/Wmax*100 values between 60 and 70, could represent two different morphotypes;
- In the second, one relatively large specimen from Northstowe representing a bull is separated from the vast majority of very small (when compared with data from any other period) specimens representing either cows or both cows and steers.
- In the third, despite the small sample size two small clusters can be tentatively identified both in the robust and less robust horncore

groups. In the study by Sykes and Symmons (2007) castrates plotted together with the other males and in contrast to Armitage (1982) who claimed the horncore of castrates to be similar to those of females but longer and with larger circumferences. However, said studies analysed data from horn-core types that emerged during the Middle Ages and it might well be that part of the elements of dimorphism that we notice in modern breeds are the consequence of progressively increasing human selection. Returning to the datasets, similar clusters have been identified in Roman and Saxon assemblages from Suffolk and interpreted as groups of females and castrates (Rizzetto, 2019). If correct, this would imply that steers/oxen were the most common sex both overall and in the Dragonby assemblage.

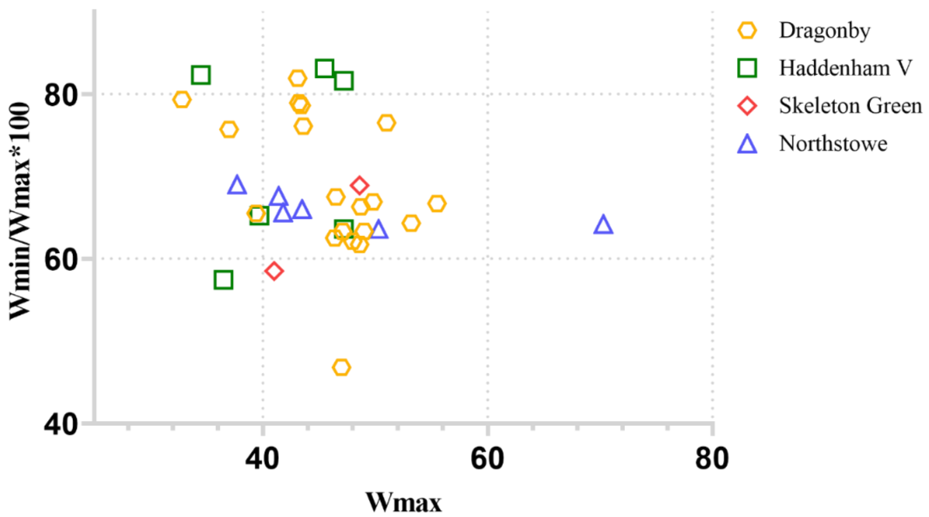


*Figure 6.46. Size of cattle horncores (Wmax —greatest diameter; Wmin/Wmax*100 — ratio between the smallest and greatest diameter of the base of the horncore). The scatter plot includes values from each of the four recorded assemblages (Dragonby n:20. Haddenham V n:7, Skeleton Green n:2. Northstowe n:6).*

However, the size and shape of cattle metapodials articulations (Figure 6.47) show a different, picture. One particularly large individual from Northstowe probably represents a large ox while one from Dragonby represents a bull (their WCL measurements correspond to the lower end of the distribution of aDNA sexed remains from medieval Beja, in Portugal reported by Davis and colleagues, 2012), a small cluster of slender individuals might represent steers, while the largest cluster of small individuals represents females. If we assume this distribution, then the sex distribution would be substantially in favour of females. If the horncore scatterplot is re-examined keeping these proportions in mind, we can then hypothesise that the small clusters of smaller individuals might represent young females.

Between the two largest datasets, we can notice that the assemblage at Skeleton Green seems to represent a more female-oriented herd than that at Dragonby.

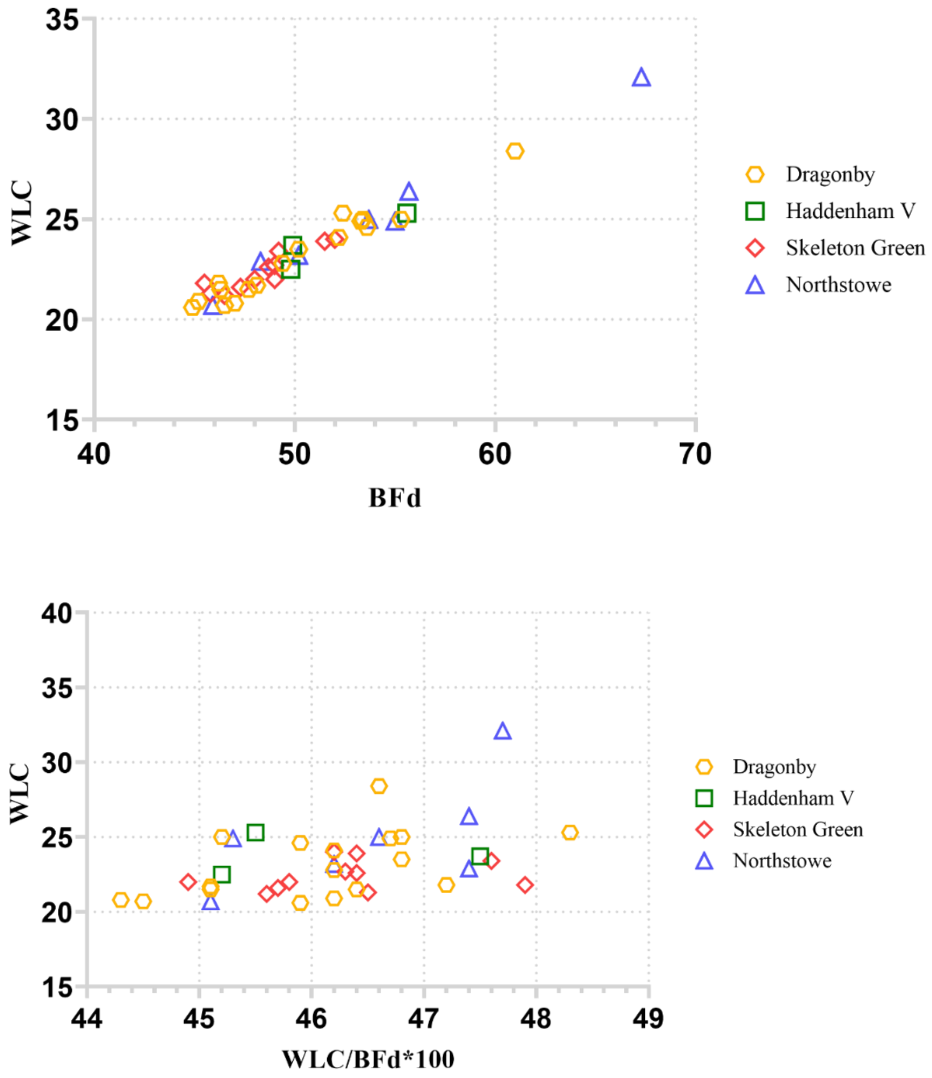


*Figure 6.47. Size (BFd—width of the distal articulation; WLC — width of the lateral condyle) and shape (WLC/BFd*100 – WLC) of cattle metacarpals. The scatter plot includes values from each of the four recorded assemblages (Dragonby n:17. Haddenham V n:3, Skeleton Green n:11. Northstowe n:7).*

The size of the distal humeri (Figure 6.48) yields a distribution that is somewhat of a summary of the two previous analyses. For instance, there is a number of values with higher BT deviating from the main linear distribution and almost lining up to form a different one, again hinting at a different, more robust, morphotype present on the same sites. Again, particularly large outliers can be seen as representing bulls and oxen, while the rest of the data represents a group of smaller individuals which are most likely females.

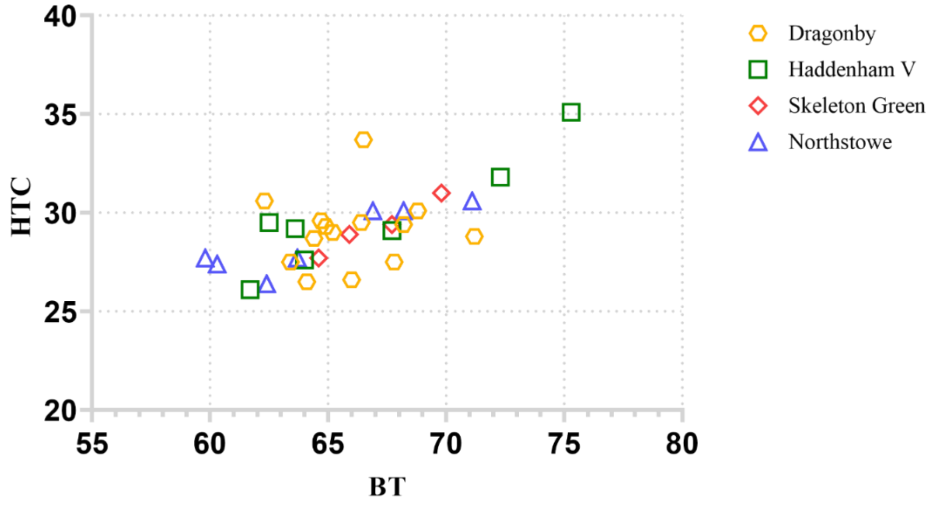


Figure 6.48. Size of cattle humeri (BT—breadth of the trochlea; HTC—diameter of trochlear constriction). The scatter plot includes values from each of the four recorded assemblages (Dragonby n:14. Haddenham V n:7, Skeleton Green n:4, Northstowe n:7).

6.4.3 Pig

The proportion of pig male and female canines/alveoli (Table 6.3) shows a strong representation of boars in the pig population. Since the vast majority of pig jaws from which this data was recorded is represented by individuals of at least subadult age, we can assume that castration was practised to maintain manageable these large numbers of males, increase fat content in the carcass and possibly avoid 'boar taint' in the meat.

Site	n:	% of males
Haddenham V	8	38
Skeleton Green	48	63
Dragonby	25	56

Table 6.3. Percentage of specimens identified as males over the total of pig canines embedded in jaws and jaw fragments with canine alveoli.

6.4.4 Summary and discussion

The metric data analysis targeted at separating sexes gives us a partial picture of the herd management strategies in the core sites, due to the small size of the datasets and lack of reference measurements from modern specimens of similar size and build. It does, however, suggest that females represented the majority of caprine and cattle herds. The distribution of data across different subsets consistently suggests that castrates were present in substantial numbers in the caprine herds. This is compatible with the generally meat-oriented but not hyper-specialised culling patterns noted in the ageing section (6.3.1 – Caprines).

The interpretation of the cattle data is more difficult: depending on how the data clusters are interpreted, the most conservative option is to consider all the herds to be mostly composed of females. The other option is to instead consider that castrates made up a portion of the herds as large or larger than that seen in caprines, at least at Dragonby and possibly Northstowe, while the distribution at Skeleton Green leans towards a female-dominated composition in any case. The idea that castrates were relatively frequent is perhaps supported by the generally traction-oriented culling patterns: if very few animals were killed before reaching skeletal maturity, where did all the bullocks go?

The widespread practice of castration is also suggested by the high occurrence of male pig canines across the assemblages, as castration is not necessary but certainly highly beneficial in pig herding.

6.5 Distribution of anatomical elements

6.5.1 Cattle

Almost all recorded anatomical elements of cattle (Table 6.4) are present across the four assemblages. In all sites except for Skeleton Green, the survival of the elements appears to be tied to their preservation in the archaeological record mediated by density and size, with jaws, limb long bones and the larger tarsals presenting the highest MAU percentages. The distribution of elements is fairly consistent in each assemblage, with the exception of a remarkably high number of forelimb bones in Dragonby and a lower percentage of metapodials in Haddenham V.

Skeleton Green presents a completely different pattern, with head elements – lower jaws included – underrepresented and tarsals overrepresented in comparison to the other sites.

Cattle		Haddenham V				Dragonby				Northstowe				Skeleton Green			
		MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU
Head	Horncore	**12**	6	5%	46%	**29**	15	5%	52%	**10**	5	3%	28%	**3**	2	1%	8%
	Upper jaw	**14**	7	6%	54%	**33**	17	6%	59%	**11**	6	*4%*	33%	**3**	2	1%	8%
	Lower jaw	**25**	13	11%	100%	**57**	29	10%	100%	**36**	18	13%	100%	**14**	7	*4%*	27%
	Zygomatic	**10**	5	4%	38%	**30**	15	5%	52%	**5**	3	2%	17%	**2**	1	1%	4%
	Atlas	**3**	3	3%	23%	**5**	5	2%	17%	**1**	1	1%	6%	**0**	0	0%	0%
	Axis	**2**	2	2%	15%	**3**	3	1%	10%	**2**	2	1%	11%	**3**	3	2%	12%
Front limb & girdle	Scapula	**13**	7	6%	54%	**28**	14	5%	48%	**18**	9	6%	50%	**34**	17	10%	65%
	Humerus	**17**	9	8%	69%	**22**	11	4%	38%	**18**	9	6%	50%	**38**	19	11%	73%
	Radius	**16**	8	7%	62%	**54**	27	9%	93%	**23**	12	8%	67%	**23**	12	7%	46%
	Ulna	**11**	6	5%	46%	**52**	26	9%	90%	**20**	10	7%	56%	**18**	9	5%	35%
Hind limb & girdle	Pelvis	**11**	6	5%	46%	**18**	9	3%	31%	**12**	6	*4%*	33%	**9**	5	3%	19%
	Femur	**16**	8	7%	62%	**33**	17	6%	59%	**22**	11	8%	61%	**40**	20	11%	77%
	Tibia	**10**	5	4%	38%	**22**	11	4%	38%	**8**	4	3%	22%	**9**	5	3%	19%
Extremities	Metacarpal	**9**	5	4%	38%	**36**	18	6%	62%	**22**	11	8%	61%	**13**	7	*4%*	27%
	Metatarsal	**9**	5	4%	38%	**38**	19	7%	66%	**21**	11	8%	61%	**19**	10	6%	38%
	Carpal 2+3	**2**	1	1%	8%	**3**	2	1%	7%	**0**	0	0%	0%	**0**	0	0%	0%
	Centroquartal	**2**	1	1%	8%	**12**	6	2%	21%	**5**	3	2%	17%	**13**	7	*4%*	27%
	Calcaneum	**12**	6	5%	46%	**23**	12	4%	41%	**12**	6	*4%*	33%	**52**	26	15%	100%
	Astragalus	**15**	8	7%	62%	**37**	19	7%	66%	**19**	10	7%	56%	**35**	18	10%	69%
	Phalanx 1	**26**	3	3%	23%	**67**	8	3%	28%	**28**	4	3%	22%	**32**	4	2%	15%
	Phalanx 2	**11**	1	1%	8%	**32**	4	1%	14%	**15**	2	1%	11%	**9**	1	1%	4%
	Phalanx 3	**7**	1	1%	8%	**22**	3	1%	10%	**10**	1	1%	6%	**5**	1	1%	4%
Total MNE		**253**				**656**				**318**				**374**			

Table 6.4. Body part representation for cattle across all four recorded sites. Elements are represented as MNE and MAU numbers, as percentages of the total MAU (with above-average percentages marked in red), and as percentages of survivorship against the highest MAU number (%MAU).

6.5.2 Caprines

All caprine anatomical elements except for some of the smaller elements in the extremities are present across all sites (Table 6.5). All sites seem to follow to an extent the same pattern described for cattle with the denser and larger elements better represented. Skeleton Green presents larger proportions of limb bones and slightly lower proportions of head elements when compared to the other sites.

Caprines		Haddenham V				Dragonby				Northstowe				Skeleton Green			
		MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU
Head	Horncore	5	3	1%	3%	35	18	3%	10%	4	2	1%	4%	6	3	2%	14%
	Upper jaw	28	14	6%	13%	76	38	6%	22%	5	3	2%	6%	8	4	3%	18%
	Lower jaw	214	107	43%	100%	347	174	26%	100%	100	50	36%	100%	43	22	17%	100%
	Zygomatic	9	5	2%	5%	11	6	1%	3%	2	1	1%	2%	1	1	1%	5%
	Atlas	2	2	1%	2%	11	11	2%	6%	4	4	3%	8%	2	2	2%	9%
	Axis	1	1	0%	1%	10	10	1%	6%	5	5	4%	10%	3	3	2%	14%
Front limb & girdle	Scapula	15	8	3%	7%	95	48	7%	28%	15	8	6%	16%	18	9	7%	41%
	Humerus	34	17	7%	16%	105	53	8%	30%	7	4	3%	8%	28	14	11%	64%
	Radius	24	12	5%	11%	96	48	7%	28%	18	9	7%	18%	23	12	9%	55%
	Ulna	12	6	2%	6%	46	23	3%	13%	7	4	3%	8%	19	10	8%	45%
Hind limb & girdle	Pelvis	6	3	1%	3%	31	16	2%	9%	15	8	6%	16%	10	5	4%	23%
	Femur	29	15	6%	14%	119	60	9%	34%	15	8	6%	16%	29	15	11%	68%
	Tibia	9	5	2%	5%	72	36	5%	21%	11	6	4%	12%	17	9	7%	41%
Extremities	Metacarpal	30	15	6%	14%	104	52	8%	30%	16	8	6%	16%	14	7	5%	32%
	Metatarsal	31	16	6%	15%	81	41	6%	24%	15	8	6%	16%	13	7	5%	32%
	Carpal 2+3	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
	Centroquartal	2	1	0%	1%	1	1	0%	1%	1	1	1%	2%	0	0	0%	0%
	Calcaneum	11	6	2%	6%	36	18	3%	10%	7	4	3%	8%	6	3	2%	14%
	Astragalus	13	7	3%	7%	24	12	2%	7%	6	3	2%	6%	7	4	3%	18%
	Phalanx 1	35	4	2%	4%	63	8	1%	5%	8	1	1%	2%	6	1	1%	5%
	Phalanx 2	15	2	1%	2%	8	1	0%	1%	3	0	0%	0%	2	0	0%	0%
	Phalanx 3	5	1	0%	1%	2	0	0%	0%	0	0	0%	0%	0	0	0%	0%
Total MNE		530				1373				264				255			

Table 6.5. Body part representation for caprines across all four recorded sites. Elements are represented as MNE and MAU numbers, as percentages of the total MAU (with above-average percentages marked in red), and as percentages of survivorship against the highest MAU number (%MAU).

6.5.3 Pig

Pig skeletal elements distributions (Table 6.6) present a more varied picture across sites, although this is mostly due to the very small sample size in the Haddenham V and Northstowe assemblages. Overall, most of the larger and denser elements are well represented in each site, with jaw elements strongly overrepresented when compared to postcranial bones as is common for pigs. Comparing the two larger samples, we can observe that Dragonby and Skeleton Green present very similar patterns, with only marginal fluctuations in the absolute percentages of MAU for each element.

Pig		Haddenham V				Dragonby				Northstowe				Skeleton Green			
		MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU
Head	Upper jaw	**13**	7	20%	64%	**68**	34	16%	71%	**23**	12	22%	80%	**75**	38	13%	67%
	Lower jaw	**22**	11	31%	100%	**95**	48	23%	100%	**29**	15	28%	100%	**113**	57	19%	100%
	Zygomatic	**1**	1	3%	9%	**6**	3	1%	6%	**2**	1	2%	7%	**11**	6	2%	11%
	Atlas	**0**	0	0%	0%	**3**	3	1%	6%	**0**	0	0%	0%	**0**	0	0%	0%
	Axis	**0**	0	0%	0%	**0**	0	0%	0%	**0**	0	0%	0%	**0**	0	0%	0%
Front limb & girdle	Scapula	**6**	3	9%	27%	**38**	19	9%	40%	**6**	3	6%	20%	**34**	17	6%	30%
	Humerus	**1**	1	3%	9%	**16**	8	4%	17%	**4**	2	4%	13%	**35**	18	6%	32%
	Radius	**3**	2	6%	18%	**31**	16	8%	33%	**7**	4	7%	27%	**35**	18	6%	32%
	Ulna	**6**	3	9%	27%	**27**	14	7%	29%	**9**	5	9%	33%	**46**	23	8%	40%
Hind limb & girdle	Pelvis	**5**	3	9%	27%	**10**	5	2%	10%	**1**	1	2%	7%	**17**	9	3%	16%
	Femur	**1**	1	3%	9%	**30**	15	7%	31%	**2**	1	2%	7%	**52**	26	9%	46%
	Tibia	**0**	0	0%	0%	**22**	11	5%	23%	**3**	2	4%	13%	**49**	25	8%	44%
Extremities	Metacarpal	**0**	0	0%	0%	**20**	11	5%	23%	**4**	3	6%	20%	**32**	16	5%	28%
	Metatarsal	**1**	1	3%	9%	**10**	5	2%	10%	**5**	3	6%	20%	**34**	18	6%	32%
	Carpal 3	**0**	0	0%	0%	**0**	0	0%	0%	**0**	0	0%	0%	**0**	0	0%	0%
	Central tarsal	**0**	0	0%	0%	**2**	1	0%	2%	**0**	0	0%	0%	**1**	1	0%	2%
	Calcaneum	**1**	1	3%	9%	**14**	7	3%	15%	**2**	1	2%	7%	**42**	21	7%	37%
	Astragalus	**1**	1	3%	9%	**11**	6	3%	13%	**1**	1	2%	7%	**14**	7	2%	12%
	Phalanx 1	**0**	0	0%	0%	**17**	1	0%	2%	**2**	0	0%	0%	**12**	1	0%	2%
	Phalanx 2	**0**	0	0%	0%	**6**	0	0%	0%	**1**	0	0%	0%	**8**	1	0%	2%
	Phalanx 3	**2**	0	0%	0%	**4**	0	0%	0%	**2**	0	0%	0%	**4**	0	0%	0%
Total MNE		**63**				**430**				**103**				**614**			

Table 6.6. Body part representation for pigs across all four recorded sites. Elements are represented as MNE and MAU numbers, as percentages of the total MAU (with above-average percentages marked in red), and as percentages of survivorship against the highest MAU number (%MAU).

6.5.4 Horse and dog

All horse datasets are affected by very small sample sizes, therefore their %MAU distributions are only marginally useful to analyse their skeletal element distribution (Table 6.7). The two larger datasets (Dragonby and Northstowe) present very different patterns, suggesting that their disposal practices affected their preservation more than their physical characteristics.

Horse		Haddenham V				Dragonby				Northstowe				Skeleton Green			
		MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU
Head	Upper jaw	3	2	8%	67%	2	1	2%	25%	8	4	9%	80%	8	4	29%	100%
	Lower jaw	3	2	8%	67%	4	2	5%	50%	7	4	9%	80%	7	4	29%	100%
	Zygomatic	2	1	4%	33%	1	1	2%	25%	1	1	2%	20%	0	0	0%	0%
	Atlas	0	0	0%	0%	3	3	7%	75%	1	1	2%	20%	0	0	0%	0%
	Axis	0	0	0%	0%	1	1	2%	25%	0	0	0%	0%	0	0	0%	0%
Front limb & girdle	Scapula	2	1	4%	33%	4	2	5%	50%	3	2	4%	40%	1	1	7%	25%
	Humerus	5	3	12%	100%	2	1	2%	25%	5	3	6%	60%	4	2	14%	50%
	Radius	4	2	8%	67%	6	3	7%	75%	7	4	9%	80%	0	0	0%	0%
	Ulna	1	1	4%	33%	2	1	2%	25%	4	2	4%	40%	0	0	0%	0%
Hind limb & girdle	Pelvis	2	1	4%	33%	2	1	2%	25%	8	4	9%	80%	0	0	0%	0%
	Femur	5	3	12%	100%	6	3	7%	75%	9	5	11%	100%	2	1	7%	25%
	Tibia	4	2	8%	67%	8	4	9%	100%	6	3	6%	60%	0	0	0%	0%
Extremities	Metacarpal	2	1	4%	33%	6	3	7%	75%	7	4	9%	80%	0	0	0%	0%
	Metatarsal	0	0	0%	0%	8	4	9%	100%	2	1	2%	20%	2	1	7%	25%
	Carpal 3	2	1	4%	33%	1	1	2%	25%	1	1	2%	20%	0	0	0%	0%
	Central tarsal	0	0	0%	0%	3	2	5%	50%	1	1	2%	20%	0	0	0%	0%
	Calcaneum	3	2	8%	67%	2	1	2%	25%	4	2	4%	40%	0	0	0%	0%
	Astragalus	2	1	4%	33%	3	2	5%	50%	5	3	6%	60%	1	1	7%	25%
	Phalanx 1	8	2	8%	67%	13	3	7%	75%	4	1	2%	20%	0	0	0%	0%
	Phalanx 2	1	0	0%	0%	9	2	5%	50%	3	1	2%	20%	1	0	0%	0%
	Phalanx 3	3	1	4%	33%	7	2	5%	50%	0	0	0%	0%	1	0	0%	0%
Total MNE		52				93				86				27			

Table 6.7. Body part representation for horses across all four recorded sites. Elements are represented as MNE and MAU numbers, as percentages of the total MAU (with above-average percentages marked in red), and as percentages of survivorship against the highest MAU number (%MAU).

The dog datasets (Table 6.8) are affected by the same issues described for horses. However, the distribution in the two sites with the larger datasets (Dragonby and Northstowe) shows more similar patterns, with survivorship seemingly mediated by density and size. The few elements recovered at Haddenham V and Skeleton Green also seem to roughly follow the same distribution.

Dog		Haddenham V				Dragonby				Northstowe				Skeleton Green			
		MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU
Head	Upper jaw	0	0	0%	0%	6	3	10%	75%	9	5	22%	100%	1	1	17%	100%
	Lower jaw	1	1	25%	100%	8	4	14%	100%	7	4	17%	80%	0	0	0%	0%
	Zygomatic	0	0	0%	0%	3	2	7%	50%	0	0	0%	0%	0	0	0%	0%
	Atlas	1	1	25%	100%	1	1	3%	25%	0	0	0%	0%	1	1	17%	100%
	Axis	0	0	0%	0%	2	2	7%	50%	1	1	4%	20%	0	0	0%	0%
Front limb & girdle	Scapula	0	0	0%	0%	4	2	7%	50%	3	2	9%	40%	0	0	0%	0%
	Humerus	0	0	0%	0%	4	2	7%	50%	4	2	9%	40%	2	1	17%	100%
	Radius	1	1	25%	100%	1	1	3%	25%	2	1	4%	20%	1	1	17%	100%
	Ulna	0	0	0%	0%	1	1	3%	25%	1	1	4%	20%	1	1	17%	100%
Hind limb & girdle	Pelvis	0	0	0%	0%	2	1	3%	25%	1	1	4%	20%	0	0	0%	0%
	Femur	1	1	25%	100%	7	4	14%	100%	1	1	4%	20%	0	0	0%	0%
	Tibia	0	0	0%	0%	5	3	10%	75%	0	0	0%	0%	1	1	17%	100%
Extremities	Metacarpal	0	0	0%	0%	2	1	3%	25%	2	2	9%	40%	0	0	0%	0%
	Metatarsal	0	0	0%	0%	3	2	7%	50%	1	1	4%	20%	0	0	0%	0%
	Carpal 3	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
	Central tarsal	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
	Calcaneum	0	0	0%	0%	0	0	0%	0%	1	1	4%	20%	0	0	0%	0%
	Astragalus	0	0	0%	0%	0	0	0%	0%	1	1	4%	20%	0	0	0%	0%
	Phalanx 1	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
	Phalanx 2	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
	Phalanx 3	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
Total MNE		4				49				34				7			

Table 6.8. Body part representation for dogs across all four recorded sites. Elements are represented as MNE and MAU numbers, as percentages of the total MAU (with above-average percentages marked in red), and as percentages of survivorship against the highest MAU number (%MAU).

6.5.5 Summary and discussion

The distribution of anatomical elements presented remarkably similar patterns for most species in the assemblages from Haddenham V, Northstowe and Dragonby. These can be explained by largely similar carcass processing and waste disposal practices, entailing the slaughtering and butchery of whole animals on-site.

Skeleton Green presented a different pattern with the over-representation of limb bones of caprines and cattle suggesting that part of the meat joints were processed off-site, while pigs were slaughtered locally.

6.6 Butchery and processing

6.6.1 Quantification of butchery marks

The incidence of butchery marks on caprine remains across the core assemblages (Table 6.9) presents a great degree of variability. In general, the sites can be split into a low-incidence group (Haddenham V, Northstowe) and a high-incidence group (Dragonby, Skeleton Green). As for the type of traces, chop marks are very rare at Skeleton Green, present on approximately a third of the specimens where marks were recorded at Dragonby and Northstowe, and represented in equal proportions to cut marks at Haddenham V. Whereas the proportions of butchery marks type in the high incidence group is likely to be representative, in the low incidence group the reduced number of specimens bearing marks makes it probable that the proportions are due to chance. Haddenham V and Northstowe also present the highest proportions of specimens with bad cortical preservation (6.1.1 – Bone surface preservation), meaning that especially cut marks could be underrepresented in the count.

Caprine	n:	B%	T%	P%	PT%
Haddenham V	325	3	38	38	25
Dragonby	1678	10	62	34	4
Northstowe	180	2	75	25	-
Skeleton Green	225	12	96	4	-

Table 6.9. Incidence of butchery marks (B%) and relative percentage of specimens bearing marks classified as cuts (T%), chops (P%) and both (PT%) across the four caprine assemblages.

All cattle assemblages present a relatively high incidence of butchery marks (Table 6.10). At Dragonby and Northstowe cut marks are prevalent, whereas chop marks represent the majority of butchery marks at Haddenham V and Skeleton Green, suggesting more intensive practices at these sites.

Cattle	n:	B%	T%	P%	PT%
Haddenham V	232	15	38	53	9
Dragonby	647	15	52	43	5
Northstowe	315	10	68	29	3
Skeleton Green	401	15	39	49	12

Table 6.10. Incidence of butchery marks (B%) and relative percentage of specimens bearing marks classified as cuts (T%), chops (P%) and both (PT%) across the four cattle assemblages.

The incidence of butchery marks on pig remains (Table 6.11) at Haddenham V and Northstowe is biased by their low sample sizes and preservation. They can, therefore, be thought to align with Dragonby in being characterised by an absolute prevalence of cut marks. At Skeleton Green, cut marks are prevalent too, but the incidence of chop marks is much more substantial, suggesting a more intensive practice.

Pig	n:	B%	T%	P%	PT%
Haddenham V	**29**	**3**	**100**	**-**	**-**
Dragonby	**271**	**12**	**91**	**6**	**3**
Northstowe	**55**	**0**	**-**	**-**	**-**
Skeleton Green	**484**	**9**	**69**	**29**	**2**

Table 6.11. Incidence of butchery marks (B%) and relative percentage of specimens bearing marks classified as cuts (T%), chops (P%) and both (PT%) across the four pig assemblages.

6.6.2 Some notes on processing

Although the qualitative assessment of the butchery marks and the thorough reconstruction of carcass processing is outside of the scope of this research, some notes are presented here in regard to the intensity and scale of exploitation.

The distribution of skeletal elements (see individual species charts in 6.5 – Distribution of anatomical elements) does not suggest any specific form of selection of parts at all sites except at Skeleton Green. Interestingly, this assemblage also presents the highest overall butchery rate among the assemblages and a very high rate of chopped elements for cattle and pigs. These two elements together suggest the possibility that a more specialised, large-scale form of processing was in place, with joints of meat introduced to this site from outside the settlement.

A specific pattern has been noted and regularly recorded across the four assemblages. Long bones are frequently split, either in half on a parasagittal plane (especially in the case of metapodials) or diagonally on one epiphysis (more frequently the distal, but not necessarily), resulting in one of the condyles being severed along with a sliver of shaft bone. The diaphysis, if preserved, often presents a spiral fracture. The splitting or splintering is usually very neat (except for Northstowe) and sometimes accompanied by one or more subparallel chop marks probably indicating failed initial attempts. They represent a form of processing akin to that which in Roman times composes the so-called ‘soup kitchen deposits’, although it lacks their frequency and concentration. Unless presenting other marks, these modifications have not been recorded as chop marks, making the figures presented in the previous section conservative in the representation of the intensity of butchery. This pattern, mostly present on cattle bones but detected also on caprines, has not so far been reported for the sites in southern England (Hambleton, 2008).

Butchery marks have been occasionally identified on both meat-bearing bones and the extremities of horses across all four sites. A single hind limb bone with butchery marks has been identified at Dragonby and Northstowe. The sample of butchered specimens for both specimens is too small to infer butchery patterns, however, the identified marks can be interpreted as pertaining to skinning, disarticulation and defleshing, suggesting that, at least in some cases, these animals were thoroughly processed.

6.6.3 Summary and discussion

Overall the incidence of butchery marks seems to be greatly influenced by preservation issues. It was possible to ascertain that the processing of pigs and caprines is mostly represented by cut marks, whereas the incidence of chop marks on cattle is usually much higher as can be expected from larger species that require more intensive treatment to be processed. Variations in the proportions of different butchery marks do not seem to correlate with chronology. It is of note that the two sites with the best sample size present different butchery patterns: at Dragonby caprines and cattle were quite intensely processed with around a third of the marks being chop marks, while these are almost absent in pigs; conversely, at Skeleton Green chop marks are almost absent on caprine bones and represent more than half of the marks on cattle and around a third of those on pigs.

6.7 Traction stress and dental pathologies

Traction stress on draft animals causes functional hypertrophy and exostosis in the metapodials (Bartosiewicz et al., 1997) causing changes in the size and sometimes shape (pronounced asymmetry) that can be detected metrically. The ratio between the width at the fusion point (BatF) and the width of the distal articulation (BFd) expresses an index (BatF/BFd) related to the swelling of the distal end. The ratio between the mediolateral width of the lateral (b) and medial condyles (a) expresses an index (b/a) related to the symmetry of the epicondyles. Plotting these two shape indices respectively on the x (BatF/BFd) and on the y (b/a) axes, values of specimens not presenting the effect of traction stress should plot in a cluster roughly between 0.90 and 1.00 on both axes. These values represent the range of physiological flaring of the epiphysis and slight asymmetry in favour of the medial condyle. This threshold is arbitrary but corresponds to the values yielded for both indexes by Roman and Saxon cattle metapodials visually identified as not splayed (Rizzetto 2019) and, for the b/a index, to those from the aggregated sheep (a bovid not usually used for traction) datasets in the core assemblages of this thesis (min:0.89, max:1.03, mean: 0.95).

In the scatterplot reporting metacarpal shape indices (Figure 6.49) almost half of the BatF/BFd values plot below 0.90; however, only the four lower values present sufficient articulation swelling to indicate traction stress.

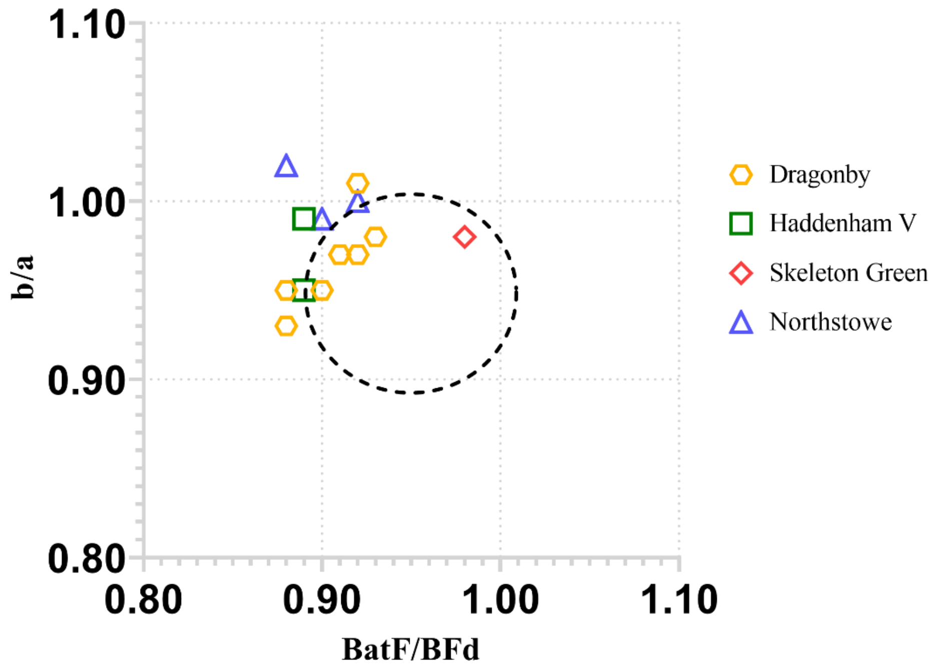


Figure 6.49. Scatter plots of shape indices (BatF/BFd and b/a) from cattle distal metacarpals across the four core assemblages (n:13).

In the scatterplot reporting metatarsal shape indices (Figure 6.50) only two values plot below the swelling threshold, while one plots below the symmetry threshold.

In general, cattle metapodials seem to show some degree of traction stress, although not extreme in intensity or its widespread use.

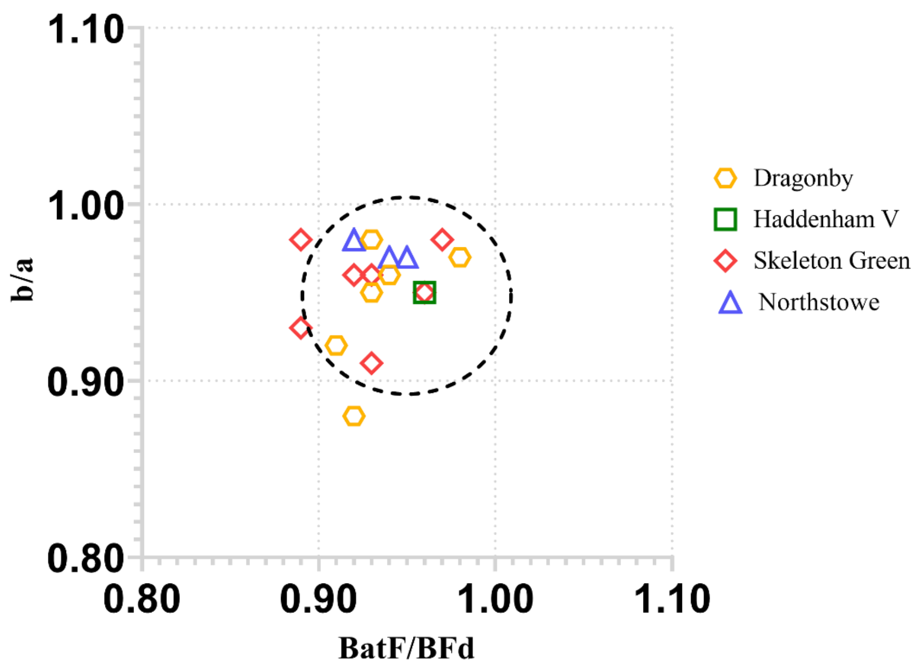


Figure 6.50. Scatter plots of shape indices (BatF/BFd and b/a) from cattle distal metatarsals across the four core assemblages (n:18).

Although investigating pathologies was not an objective of this study, the presence of substantial skeletal anomalies was recorded. Signs of infection and trauma were virtually absent, whereas abnormal patterns of toothwear were rather common (although difficult to quantify). These were mostly identified in caprines, but present also in cattle and pigs and do not seem to present patterns in intensity or in affecting specific portions of the jaw, ranging from a single tooth to the whole molar/premolar portion. Irregular patterns of toothwear are caused by masticatory dysfunctions and are also present in wild populations (Bartosiewicz and Gal, 2013, p. 173). Their origin is not always easy to detect, although in some of the recorded cases it was due to crowding, the abnormal presence of an additional tooth in the same jaw or the early loss of a permanent tooth.

6.8 Non-metric traits

During the recording, no hornless or polled cattle or caprine cranial remains were identified. Due to the generally high degree of fragmentation, this is not indicative of their complete absence.

The absence or reduction of the hypoconulid of the third lower molar in cattle has been recorded and their percentages are presented in Table 6.12.

Absence of the third hypoconulid in M_3		
Site	n:	%
Haddenham V	25	4
Northstowe	35	9
Skeleton Green	14	14
Dragonby	71	8

Table 6.12. Incidence of the absence of the hypoconulid in cattle M_3.

The reduction or modified shape of the hypoconulid of the third lower molar has been noted in caprines, but only at Dragonby (around 10% of the sample).

CHAPTER 7

Results – Livestock type and size in Later Iron Age Britain

This chapter presents the results of the osteometric analyses conducted on data from the core assemblages and data gathered from the work of other zooarchaeologists to investigate patterns in livestock size and type in Eastern England and Wessex.

7.1 Domesticates' morphometry in the core assemblages

This section presents the analyses conducted on measurements recorded on the four core sites to establish a baseline of livestock size and shape. The use of datasets from individual assemblages guarantees increased accuracy, while the recording by the author rules out inter-observer error. Analysis with a stronger focus on diachrony will be presented in section 7.2.

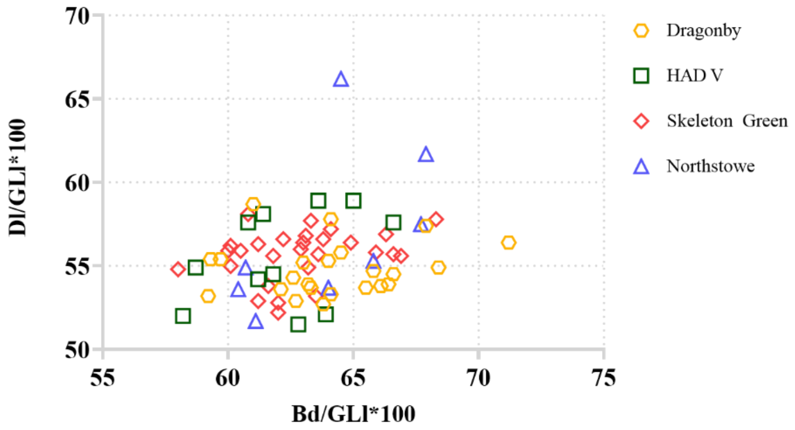
The standards used for LSI in this section are from West Stow for cattle and caprines, and Durrington Walls for pigs, except for the LSI pig teeth scatterplot for which Dragonby was used (4.9 – Measurements taken and biometric analyses). The use of standards obtained from faunal remains dated to periods when livestock was larger allows gauging a measure of the general size of the Iron Age animals.

7.1.1 Cattle

The analysis of shape in cattle astragali (Figure 7.1) yielded some interesting results. Most of the values from the four core assemblages (left diagram) plot in a single cluster, indicating overall uniformity. Even Roman animals from Elms Farm, Heybridge belong to the same type (right diagram).

There are, however, subtle differences in distribution, hinting at geographical variation. The values in the dataset from Dragonby, the northernmost site, consistently plot lower on the y axis (lower depth-to-length ratio) and higher on the x axis (higher breadth-to-length ratio). The Skeleton Green dataset mostly plots higher on the y axis, with a group of the most robust specimens overlapping with the Dragonby distribution.

The distributions of Haddenham V and especially Northstowe are more difficult to describe due to the small sample size, but Haddenham V seems to plot closely to Skeleton Green.



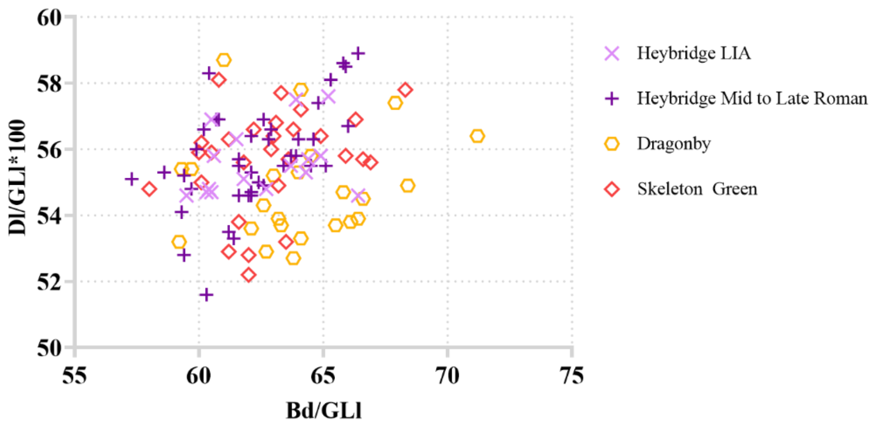


*Figure 7.1 Shape of cattle astragali (Bd/GLl*100 – ratio between the breadth of the distal end and the greatest length of the lateral half; Dl/GLl*100 – ratio between the depth of the lateral half and the greatest length of the lateral half). The scatter plot on top includes values from each of the four recorded core assemblages (Dragonby n:23, Haddenham V n:11, Skeleton Green n:28, Northstowe n:8), while the one on the bottom compares the values from Dragonby and Skeleton Green to those from Elms Farm, Heybridge (Phase II – Latest IA n:16, Phases IV-V – Mid to Late Roman n:41).*

These shape differences are independent of size, as shown in Figure 7.2. When plotting GLl on the x axis, we can notice that the distribution of the core datasets overlaps completely in terms of lengths. The Roman dataset has instead a much wider distribution and a greater length as noted by Johnstone and Albarella (2015).

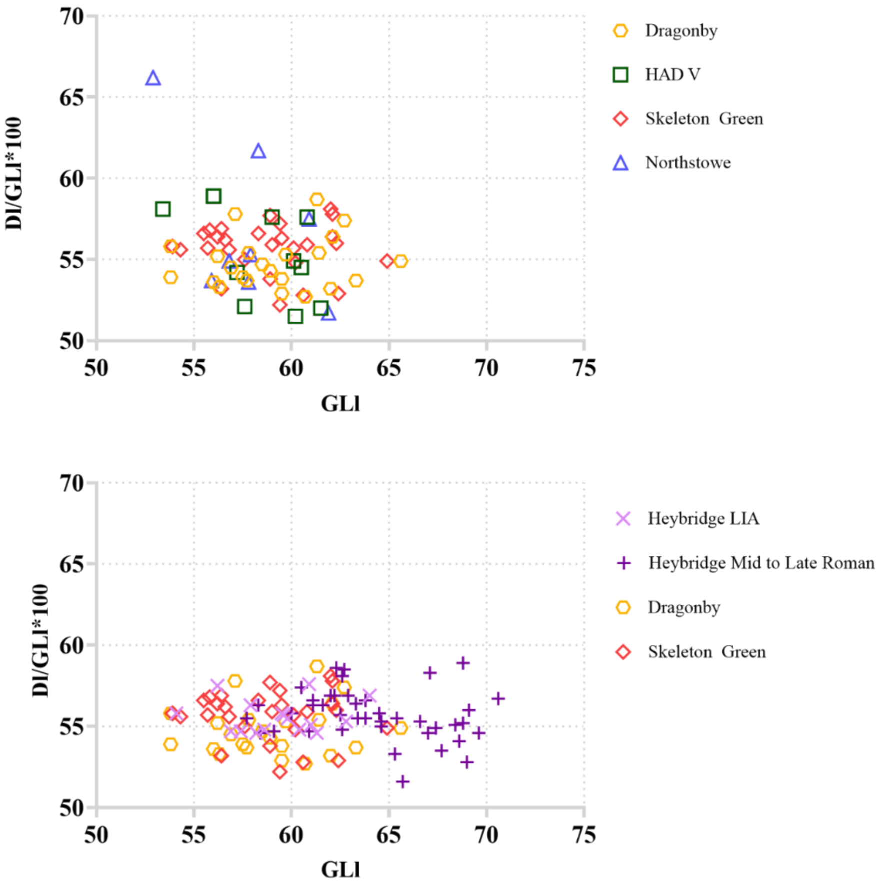


*Figure 7.2. Size and shape of cattle astragali (GLl – Greatest length of the lateral half; Dl/GLl*100 – the ratio between the depth of the lateral half and the greatest length of the lateral half). The scatter plot on the top includes values from each of the four recorded core assemblages (Dragonby n:23, Haddenham V n:11, Skeleton Green n:28, Northstowe n:8), while the one on the bottom compares the values from Dragonby and Skeleton Green to those from Elms Farm, Heybridge (Phase II – Latest IA n:16, Phases IV-V – Mid to Late Roman n:41).*

These patterns in the shape of astragali are supported by the statistically significant median difference between the Dl/GLl*100 datasets from Dragonby and Skeleton Green (Table 7.1). The samples from Skeleton Green and Dragonby could represent variations in the availability of different cattle populations or morphotypes within the region. However, the difference was not detected in the other tests and more data would be required to fully explore this hypothesis.

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Cattle AS Bd/GLl*100	Dragonby vs. Skeleton Green	64.00, n=23	62.95, n=28	238.5	0.1155	ns
	Skeleton Green vs. Heybridge, Mid to Late Roman	62.95, n=28	61.85, n=28	313.5	0.2013	ns
	Assemblages			**Kruskal-Wallis statistic**	**P value**	**Significance**
	Dragonby, Haddenham V, Skeleton Green, Northstowe, Heybridge Latest IA, Heybridge Mid to Late Roman			5.252	0.2624	ns

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Cattle AS Dl/GLl*100	Dragonby vs. Skeleton Green	54.50, n=23	55.90, n=28	202	0.0224	*
	Skeleton Green vs. Heybridge, Mid to Late Roman	55.90, n=28	55.50, n=41	545	0.7269	ns
	Assemblages			**Kruskal-Wallis statistic**	**P value**	**Significance**
	Dragonby, Haddenham V, Skeleton Green, Northstowe, Heybridge Latest Ia, Heybridge Mid to Late Roman			7230	0.2041	ns

Table 7.1. Hypothesis testing results for the astragali shape indices for cattle in the four core assemblages and Elms Farm, Heybridge.

Dental metric data also confirmed the relative uniformity in overall size (Figure 7.3). Breaking down the Northstowe dataset into subphases (right diagram), we can notice a hint of the distribution shifting towards a larger size. The sample size is very small and the difference in the median is not statistically significant (Mann Whitney U: 15.00; phase 3: n=5, median=15.60; phase 4: n=7, median=6.5; P value=0.0783; ns), therefore, to test this trend we would need to look at larger datasets.

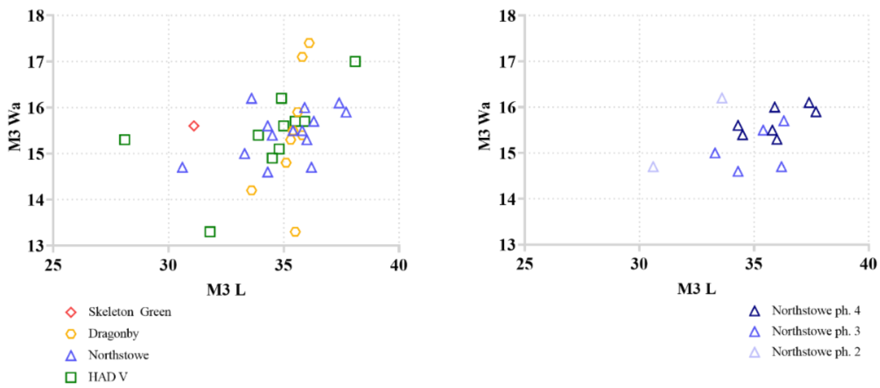


Figure 7.3. Size of cattle M_3 (L – maximum length, Wa – maximum width of the anterior crown). The scatter plot on the left includes values from each of the four recorded assemblages (Dragonby n:9, Haddenham V n:10, Skeleton Green n:1, Northstowe n:14), while the one on the right breaks down the Northstowe dataset into phases (Phase 2 – MIA n:2, Phase 3 – Mid to Late IA n:5, Phase 4 – Latest IA n:7).

The top diagram in Figure 7.4 shows a substantial increase in size due to improvement between the distribution of the Latest IA and Mid to Late Roman Elms Farm, Heybridge. If we then look at the distribution of the aggregated dental size data from Mid to Late IA and the Latest IA context in the bottom diagram, we can notice a very slight increase during the Later Iron Age, represented by only a few values from Dragonby and the latest phase in Northstowe. The difference, indicated in the diagram by a purple dashed line, is not supported by a significant median difference (Table 7.2) and lies well within the distribution of the larger cattle at Latest IA Heybridge.

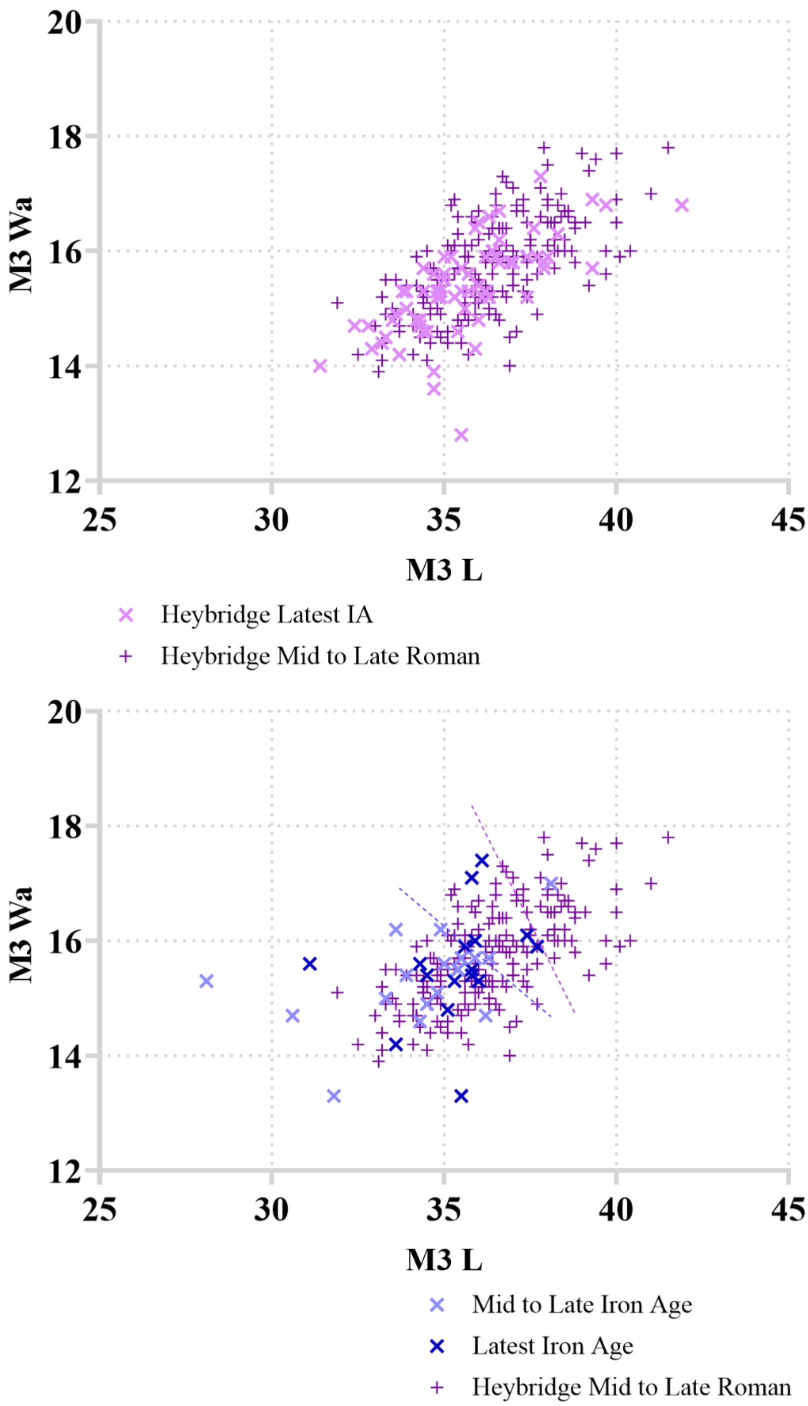


Figure 7.4. Size of cattle M_3 (L – maximum length, Wa – maximum width of the anterior crown). The scatter plot on the top includes values from Elms Farm, Heybridge (Phase II – Latest IA n:70, Phases IV-V – Mid to Late Roman n:192). The scatterplot on the bottom compares the aggregated datasets from the Mid to Late IA (n:17) to those from the Latest IA (n:17) and Mid to Late Roman dataset from Elms Farm, Heybridge. Dashed lines mark approximately the increase in size between the Mid to Late IA and Latest IA periods (blue) and between the Latest IA and Roman periods (purple). The Mid to Late IA aggregated datasets include the following sites: Haddenham

V, Northstowe ph. 2 and 3. The Latest IA aggregated datasets include the following sites: Dragonby, Northstowe ph.4, Skeleton Green.

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Cattle M3 Wa	Core sites MIA-LIA vs. Latest IA	15.40, n=17	15.50, n=17	121.5	0.4374	ns
	Core sites MIA-LIA vs. Heybridge Mid to Roman	15.40, n=17	15.70, n=192	1217	0.0824	ns
		Mean and sample size		**Welch-corrected t, df**		
	Heybridge Latest IA vs. Heybridge Mid to Roman	15.37, n=70	15.74, n=192	t=3.176, df=125.1	0.0019	**

Table 7.2. Hypothesis testing results for the Wa measurement of M3 for cattle in the core assemblages and Elms Farm, Heybridge Mid To Late Roman.

To further investigate potential biometrical differences in cattle bones, sets of length, width, and depth measurements were used to construct into log ratio histograms allowing to compare larger samples while still observing measurements lying on different axes.

Notwithstanding a smaller sample size for Northstowe and Haddenham V, the analysis of length measurements (Figure 7.5) shows very similar distributions and means across the four core datasets. The slight difference between the Dragonby and Skeleton Green datasets can be attributed to the aforementioned (6.4.2 – Cattle) difference in sex ratios between the two sites.

The analysis of cattle bone widths (Figure 7.6) yields similar overall results to that of lengths. This time Northstowe and Haddenham V align more with Skeleton Green, and the mean difference between the Dragonby and Skeleton Green is statistically significant (Table 7.3). However minimal in effect, the difference in widths is reinforced by the aforementioned presence of more slender cattle at Dragonby.

The analysis of cattle bone depths (Figure 7.7) shows comparable means and distributions for all assemblages. This confirms the general impression of the sites rearing similarly small-sized animals.

The shape and general positive skewness[14] of the length and width distributions indicate similarly female-reliant herds. The substantially

[14] Here is reported the Skewness for all the datasets:

negative skewness of the Dragonby depth distribution is probably related to the pattern detected in the shape of astragali (see 4.9 – Measurements taken and biometric analyses).

Dataset	Assemblages	Mean and sample size		Welch-corrected t, df	P value	Significance
Cattle L	Skeleton Green vs. Dragonby	-0.02, n=73	-0.01 n=52	t=1.725, df=111.5	0.0873	ns
Cattle W		-0.02, n=88	-0.01, =80	t=2.085, df=165.4	0.0386	*
Cattle D		-0.02 n=70	-0.02 n=70	t=0.2718, df=135.3	0.7862	ns
		Median and sample size		Mann-Whitney U		
Cattle L	Dragonby vs. Northstowe	-0.01, n=52	-0.02, n=26	615.5	0.5212	ns
Cattle W		-0.01, n=88	-0.02, n=39	1406	0.1034	ns
Cattle D		-0.02, n=70	-0.03, n=35	1157	0.6414	ns
Cattle L	Northstowe vs. Haddenham V	-0.02, n=26	0.00, n=23	281.5	0.7293	ns
Cattle W		-0.02, n=39	-0.03, n=33	637.5	0.9481	ns
Cattle D		-0.03, n=35	-0.02 n=35	575.5	0.6653	ns

Table 7.3. Hypothesis testing results for the post-cranial log ratio length, width and depth values for cattle in the four core assemblages.

•Length: Dragonby 0.2444; Haddenham V 0.9536; Northstowe -0.05264, Skeleton Green -0.1011
•Width: Dragonby 0.5633; Haddenham V 0.7489; Northstowe 1.004; Skeleton Green 0.2965
•Depth: Dragonby -0.5516; Haddenham V 0.4895; Northstowe 0.1171; Skeleton Green 0.08588

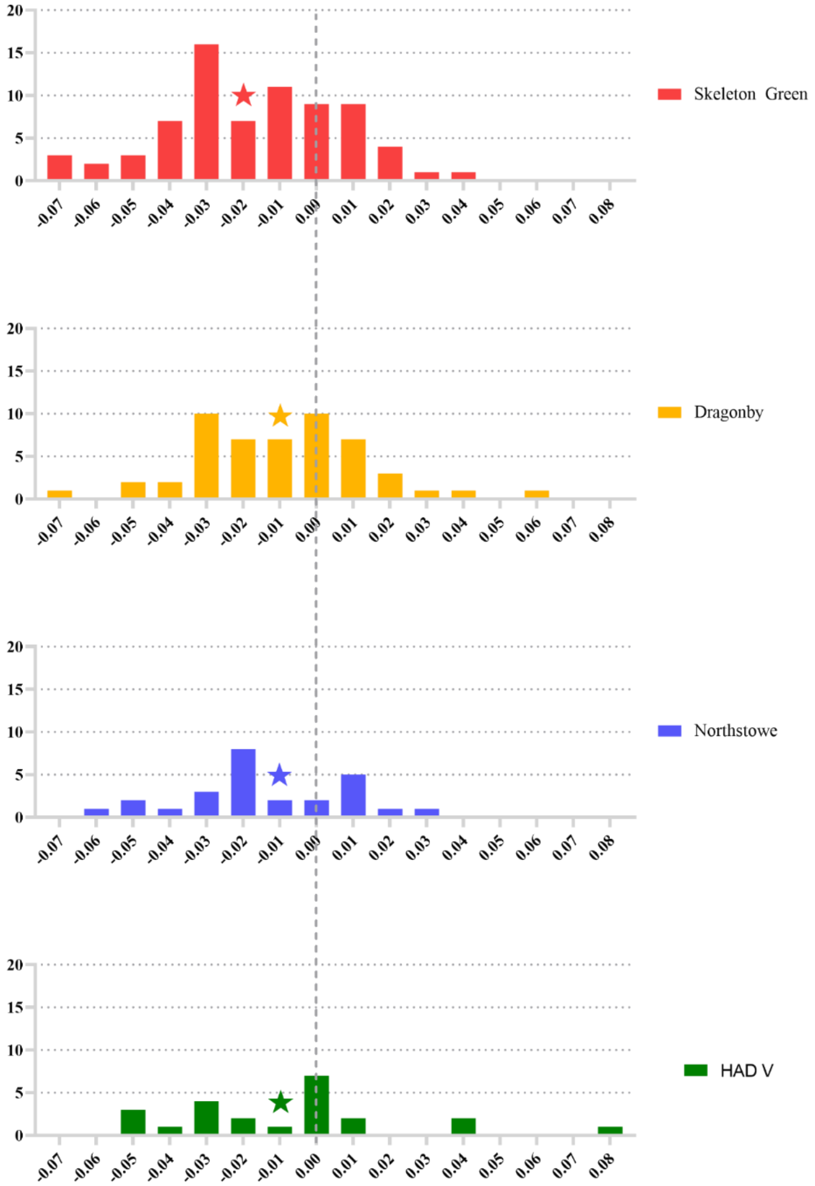


Figure 7.5. Distribution of log ratio values of a selection of cattle postcranial bone lengths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

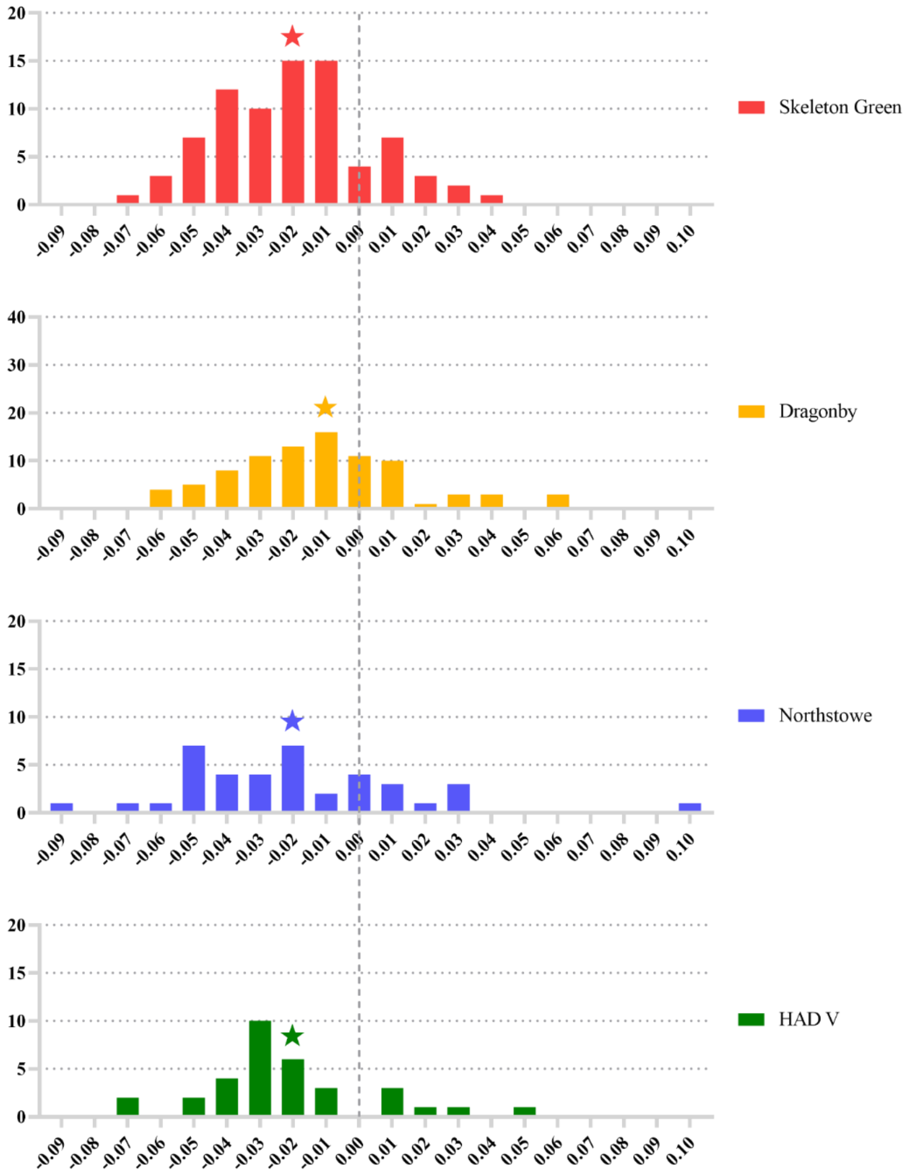


Figure 7.6. Distribution of log ratio values of a selection of cattle postcranial bone widths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

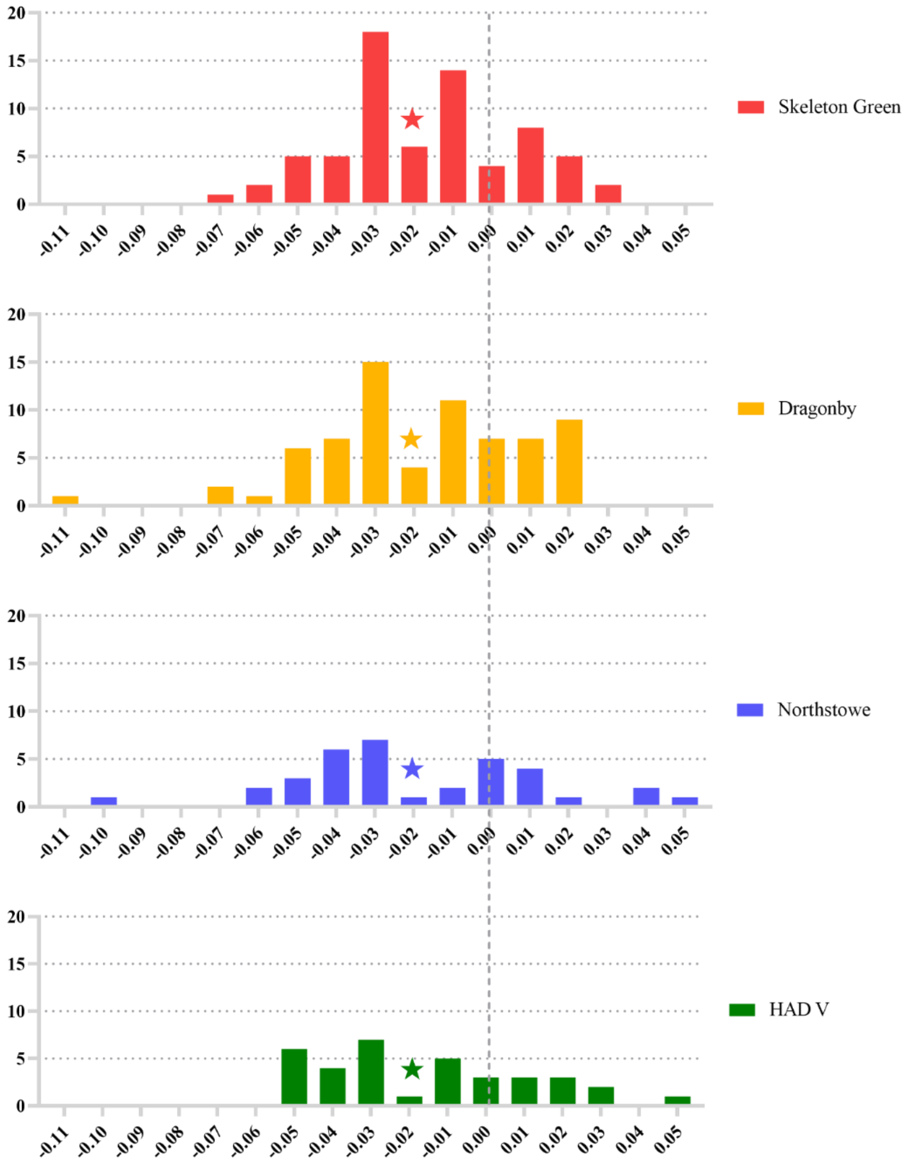


Figure 7.7 Distribution of log ratio values of a selection of cattle postcranial bone depths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

The dataset of teeth measurements was affected by a very small sample size, so the log scale indices of length and width measurements had to be combined (Figure 7.8). Even so, the dataset from Skeleton Green was too small to present a reasonably complete distribution and was therefore excluded from the figure. The dataset from Northstowe was large enough to be split into an earlier and later phase for diachronic comparison. The range of log ratio values for the four represented datasets is more or less consistent (with most of the values within -0.04 and 0.05) and the few values from Skeleton Green roughly falling within the same distribution (min: -0.06, max: 0.7, mean: 0.01). Dragonby and Latest Iron Age Northstowe present higher mean values which could hint at a diachronic trend of increasing size. The median differences between the distributions are, however, not statistically significant (Table 7.4)

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Cattle T	Dragonby vs. Northstowe Latest IA	0.000, n=38	0.000, n=24	357.5	0.147	ns
Cattle T	Northstowe Latest IA vs. Northstowe MIA-LIA	0.000, n=24	0.000, n=20	163	0.0651	ns
Cattle T	Northstowe MIA-LIA vs. Haddenham V	0.000, n=20	0.000, n=39	368.5	0.7329	ns

Table 7.4. Hypothesis testing results for the teeth log ratio of combined length and width values for cattle in the four core assemblages.

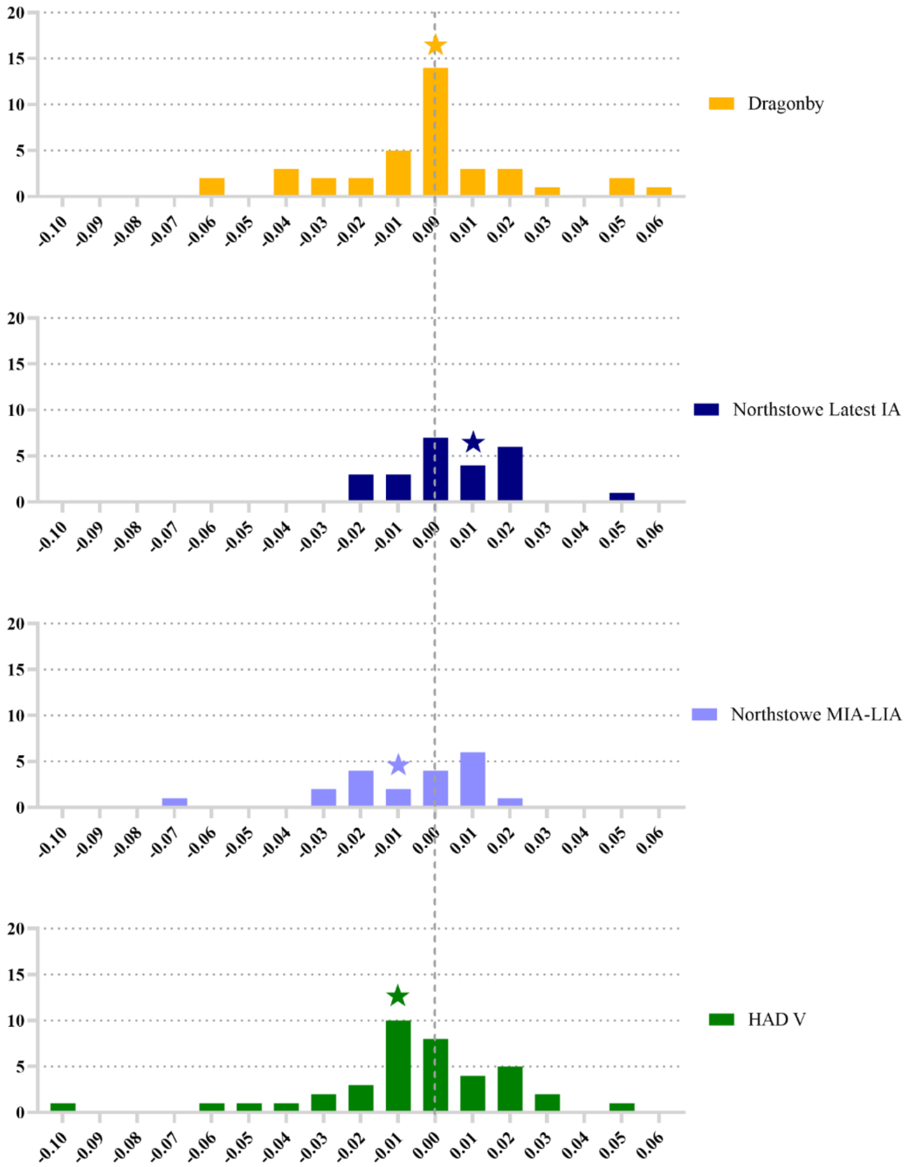


Figure 7.8. Distribution of log ratio values of a selection of cattle teeth lengths and widths at Dragonby, Northstowe MIA-LIA, Northstowe Latest IA and Haddenham V. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

7.1.2 Caprines

The analysis of shape in caprine astragali (Figure 7.9) shows most of the values plotting in a single cluster, indicating similarly conformed astragali at the four sites (left diagram). However, within this cluster, we can notice a remarkable lack of overlap between the Skeleton Green values and those from other sites. While this pattern must be interpreted cautiously because of the small sample size, Roman caprine astragali from Elms Farm, Heybridge also plot towards the bottom left corner, indicating that a more slender morphotype was reared in the southern sites. The sample sizes from Haddenham V and Northstowe are too small to indicate a transition zone where both types were reared, but it is interesting to note that a few values plot close to the Skeleton Green values.

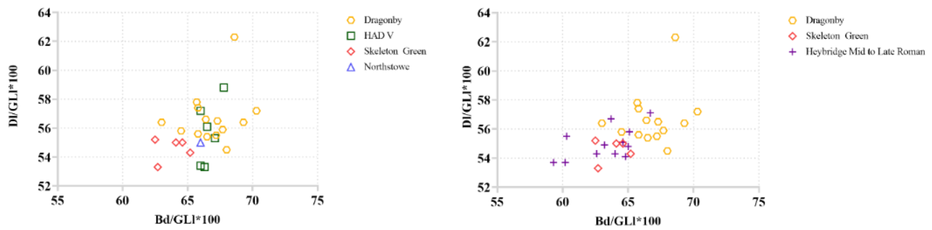


*Figure 7.9. Shape of caprine astragali (Bd/GLl*100 – ratio between the breadth of the distal end and the greatest length of the lateral half; Dl/GLl*100 – ratio between the depth of the lateral half and the greatest length of the lateral half). The scatter plot on the left includes values from each of the of the four recorded assemblages (Dragonby n:14, Haddenham V n:6, Skeleton Green n:5, Northstowe n:1), while the one on the right compares the values from Dragonby and Skeleton Green to those from Elms Farm, Heybridge (Phases IV-V – Mid to Late Roman n:12).*

These shape differences are independent of size, as shown in Figure 7.10. When plotting GLl on the x axis, we can notice that the distribution of the core datasets overlaps completely in terms of lengths. The Roman dataset has instead a much wider distribution and a greater length as noted by Johnstone and Albarella (2015).

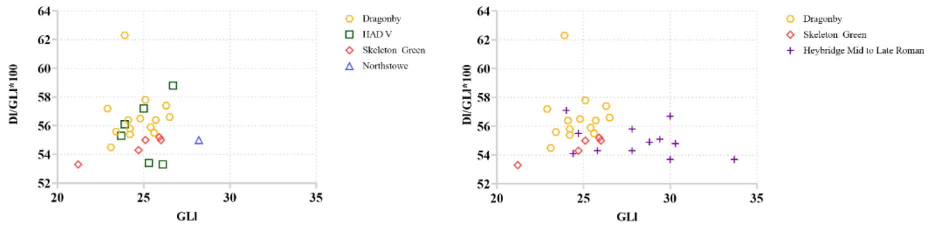


*Figure 7.10. Size and shape of caprine astragali (GLl – Greatest length of the lateral half; Dl/GLl*100 – ratio between the depth of the lateral half and the greatest length of the lateral half). The scatter plot on the left includes values from each of the of the four recorded assemblages (Dragonby n:14, Haddenham V n:6, Skeleton Green n:5, Northstowe n:1), while the one on the right compares the values from Dragonby and Skeleton Green to those from Elms Farm, Heybridge (Phases IV-V – Mid to Late Roman n:12).*

The shape differences are confirmed by statistically significant median differences between both indices at Dragonby and Skeleton Green (Table 7.5).

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Caprine AS Bd/GLl*100	Dragonby vs. Skeleton Green	66.85, n=14	64.10, n=5	5	0.0031	**
	Skeleton Green vs. Heybridge, Mid to Late Roman	64.10, n=5	63.85, n=12	27.5	0.8167	ns
	Assemblages			**Kruskal-Wallis statistic**	**P value**	**Significance**
	Dragonby, Haddenham V, Skeleton Green, Northstowe, Heybridge Mid to Late Roman			19	0.0003	***

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Caprine AS Dl/GLl*100	Dragonby vs. Skeleton Green	56.40, n=14	55.00, n=5	3	0.001	**
	Skeleton Green vs. Heybridge, Mid to Late Roman	55.00, n=5	54.85, n=12	26	0.7014	ns
	Assemblages			**Kruskal-Wallis statistic**	**P value**	**Significance**
	Dragonby, Haddenham V, Skeleton Green, Northstowe, Heybridge Mid to Late Roman			11.12	0.0111	*

Table 7.5. Hypothesis testing results for the astragali shape indices for caprines in the four core assemblages and Elms Farm, Heybridge.

The relative uniformity in overall size of the Iron Age sites is also confirmed by dental metric data (Figure 7.11). Breaking down the Northstowe dataset into subphases (right diagram) does not highlight any clear chronological pattern. The distribution of the Haddenham V values includes larger animals than the more recent sites, such as Dragonby.

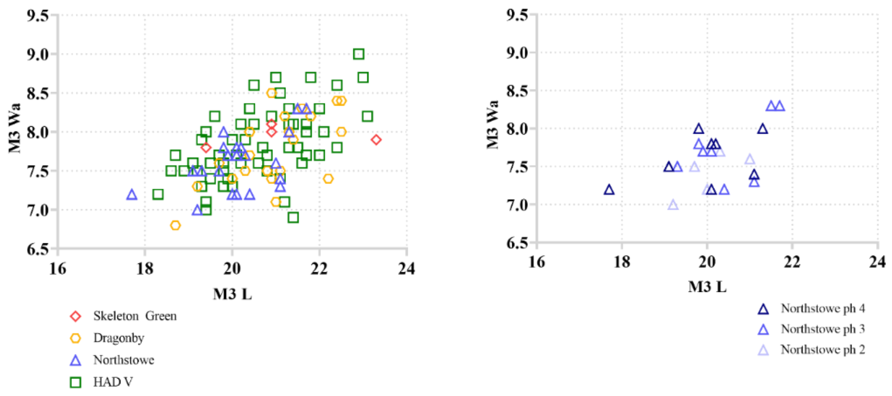


Figure 7.11. Size of caprine M3 (L – maximum length, Wa – maximum width of the anterior crown). The scatter plot on the left includes values from each of the of the four recorded assemblages (Dragonby n:23, Haddenham V n:57, Skeleton Green n:4, Northstowe n:23), while the one on the breaks down the Northstowe dataset into phases (Phase 2 – MIA n:6, Phase 3 – Mid to Late IA n:8, Phase 4 – Latest IA n:9).

Log ratio histograms of length, width and depth measurements of a selection of caprine bones were constructed. The analysis of lengths (Figure 7.12) confirms the impression of uniformity in size given by the analysis of the caprine astragali. The distribution of values in the Northstowe and Haddenham V may be affected by the small sample size, so the 0.1 difference in mean when compared with the other two sites is not worth elaborating on.

Comparing the distribution of log ratio values from caprine widths (Figure 7.13) and depths (Figure 7.14) the idea that animals at Skeleton Green were more slender than those at Dragonby is supported by the lower means of the former. The data from Northstowe and Haddenham V is more inconsistent across the different axes, possibly due to the presence of the two different morphotypes and the smaller sample of some of the datasets. The ranges of the various distributions are however consistent, hinting at an overall size similarity. No statistically significant median and mean difference has been detected (Table 7.6)

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Caprine L	Skeleton Green vs. Dragonby	-0.05, n=29	-0.05, n=148	1968	0.4807	ns
		Mean and sample size		**Welch-corrected t, df**		
Caprine W		-0.05 n=60	-0.04 n=77	t=0.5506, df=122.3	0.5829	ns
		Median and sample size		**Mann-Whitney U**		
Caprine D		-0.06, n=11	-0.05, n=152	810.5		ns
Caprine L	Dragonby vs. Northstowe	-0.05, n=148	-0.07, n=8	480.5	0.3759	ns
Caprine W		-0.04, n=77	-0.07, n=19	531.5	0.0638	ns
Caprine D		-0.05, n=152	-0.05, n=18	1266	0.6061	ns
Caprine L	Northstowe vs. Haddenham V	-0.07, n=8	-0.05, n=24	89.5	0.7882	ns
Caprine W		-0.07, n=19	-0.06, n=41	343.5	0.4671	ns
Caprine D		-0.05, n=18	-0.06, n=28	230.5	0.6333	ns

Table 7.6. Hypothesis testing results for the post-cranial log ratio length, width and depth values for caprines in the four core assemblages.

The shape of caprine distributions hints at a more substantial presence of castrates when compared to those of cattle, especially at Skeleton Green. The substantially negative skewness[15] of the Dragonby depth distribution is possibly related to the pattern detected in the shape of astragali.

[15] Here is reported the Skewness for all the datasets:
Length: Dragonby 0.4173; Haddenham V -0.5465; Northstowe 0.6706; Skeleton Green -0.3985
Width: Dragonby -0.006376; Haddenham V -0.02120; Northstowe 0.7181; Skeleton Green -0.9608
Depth: Dragonby -0.6375;Haddenham V 2.198; Northstowe -0.5828; Skeleton Green -0.7594

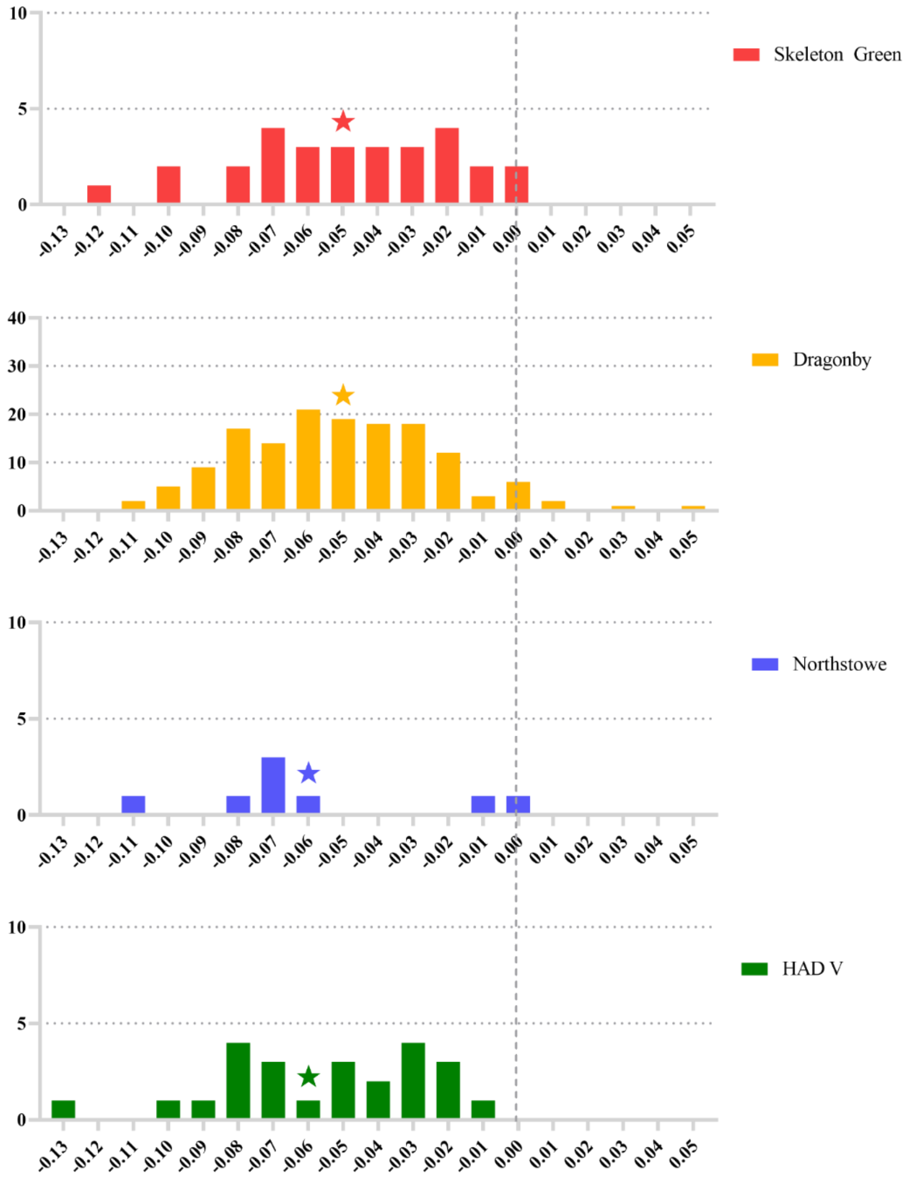


Figure 7.12. Distribution of log ratio values of a selection of caprine postcranial bone lengths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

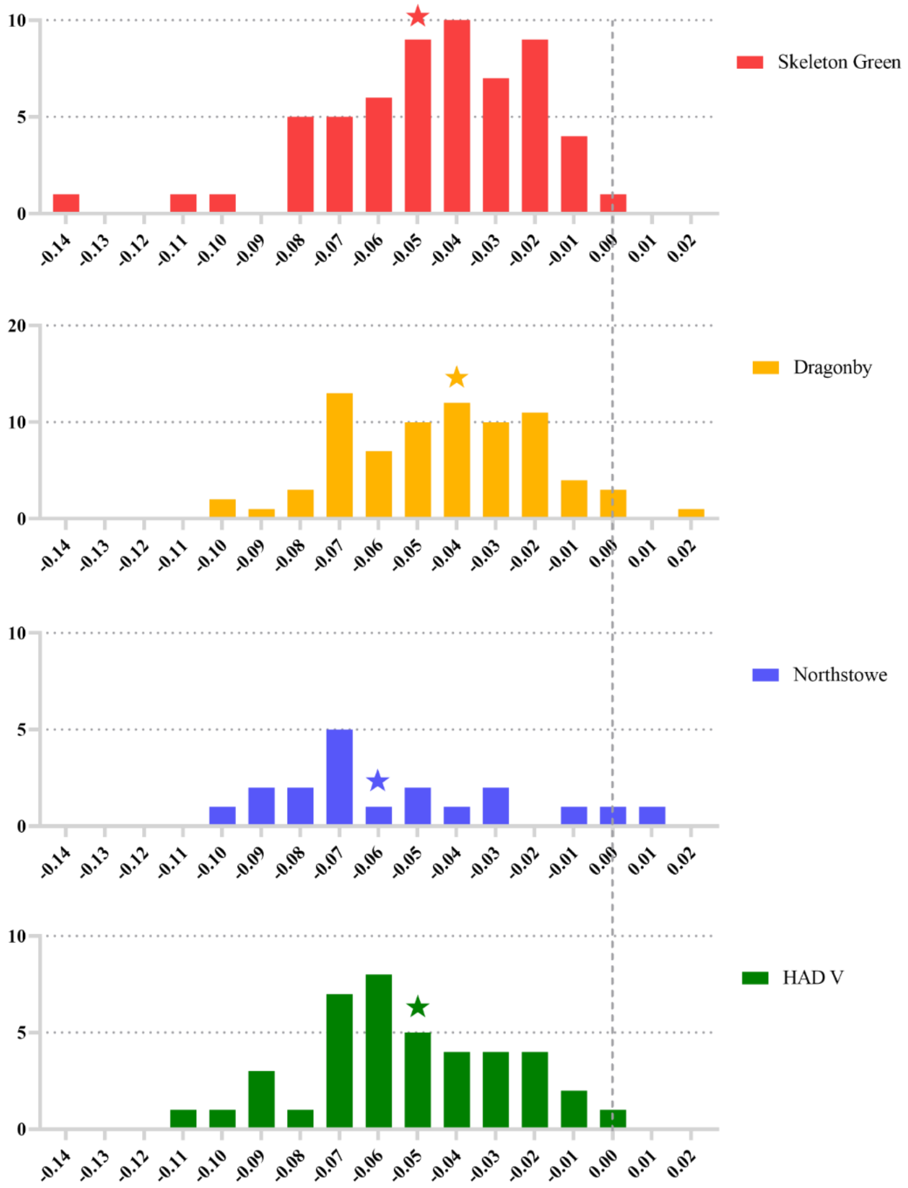


Figure 7.13. Distribution of log ratio values of a selection of caprine postcranial bone widths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

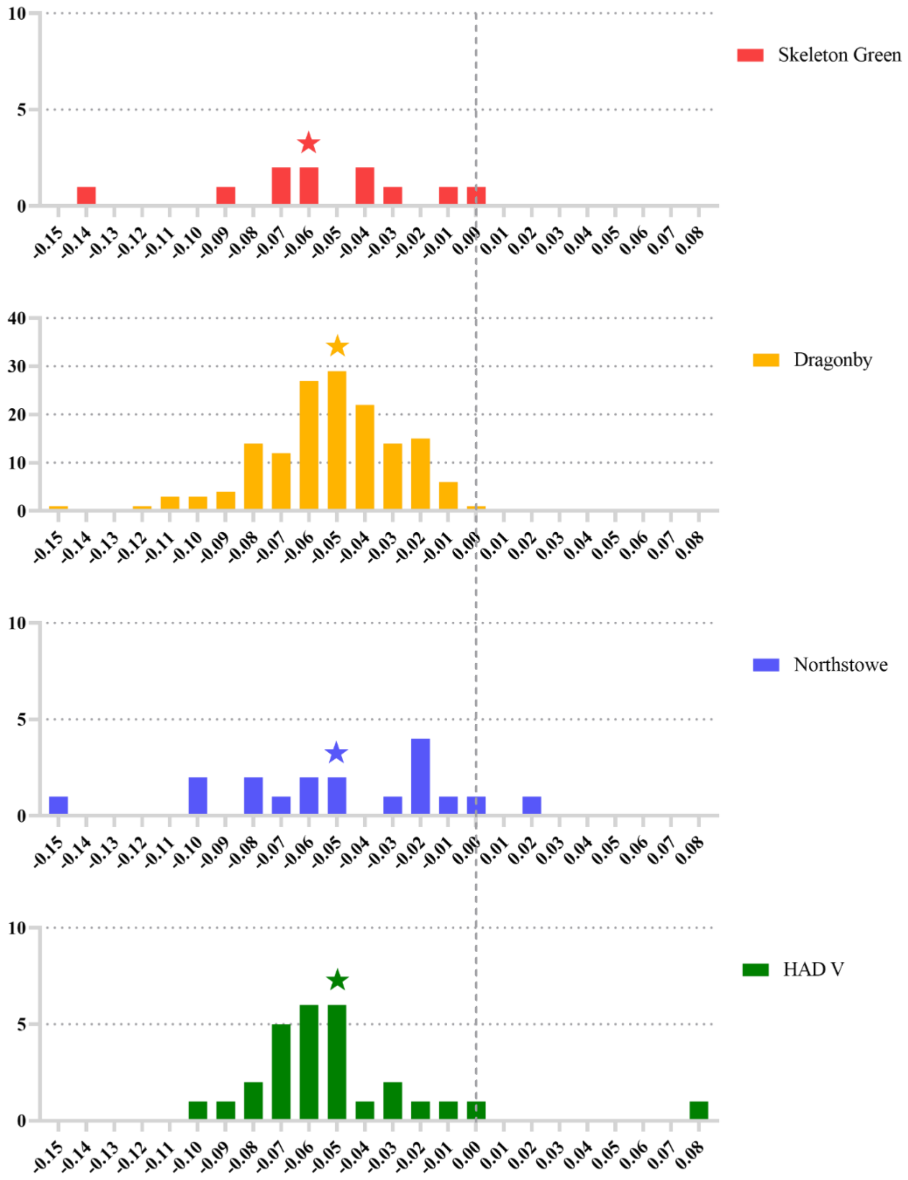


Figure 7.14. Distribution of log ratio values of a selection of caprine postcranial bone depths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

The analysis of log ratio values from dental data confirms the overall interpretation from the postcranial evidence: whenever the sample is sufficient to build a sufficiently complete distribution (Dragonby and Haddenham V in Figure 7.15, all four assemblages in Figure 7.16) ranges and means are fairly consistent. No statistically significant median difference has been detected Table 7.7).

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Caprine T L	Skeleton Green vs. Dragonby	-0.02, n=4	-0.02, n=26	47.5	0.7885	ns
	Dragonby vs. Northstowe	-0.02, n=26	-0.04, n=9	69.5	0.07	ns
	Northstowe vs. Haddenham V	-0.04, n=9	-0.03, n=59	202	0.2526	ns
Caprine T W	Skeleton Green vs. Dragonby	-0.03, n=23	-0.03, n=148	1307	0.07	ns
		Mean and sample size		Welch-corrected t, df		
	Dragonby vs. Northstowe	-0.04, n=148	-0.04 n=70	t=0.5956, df=157.7	0.5523	ns
	Northstowe vs. Haddenham V	-0.04 n=70	-0.04 n=210	t=0.7070, df=150.3	0.4807	ns

Table 7.7 Hypothesis testing results for the teeth log ratio of length and width values for caprines in the four core assemblages.

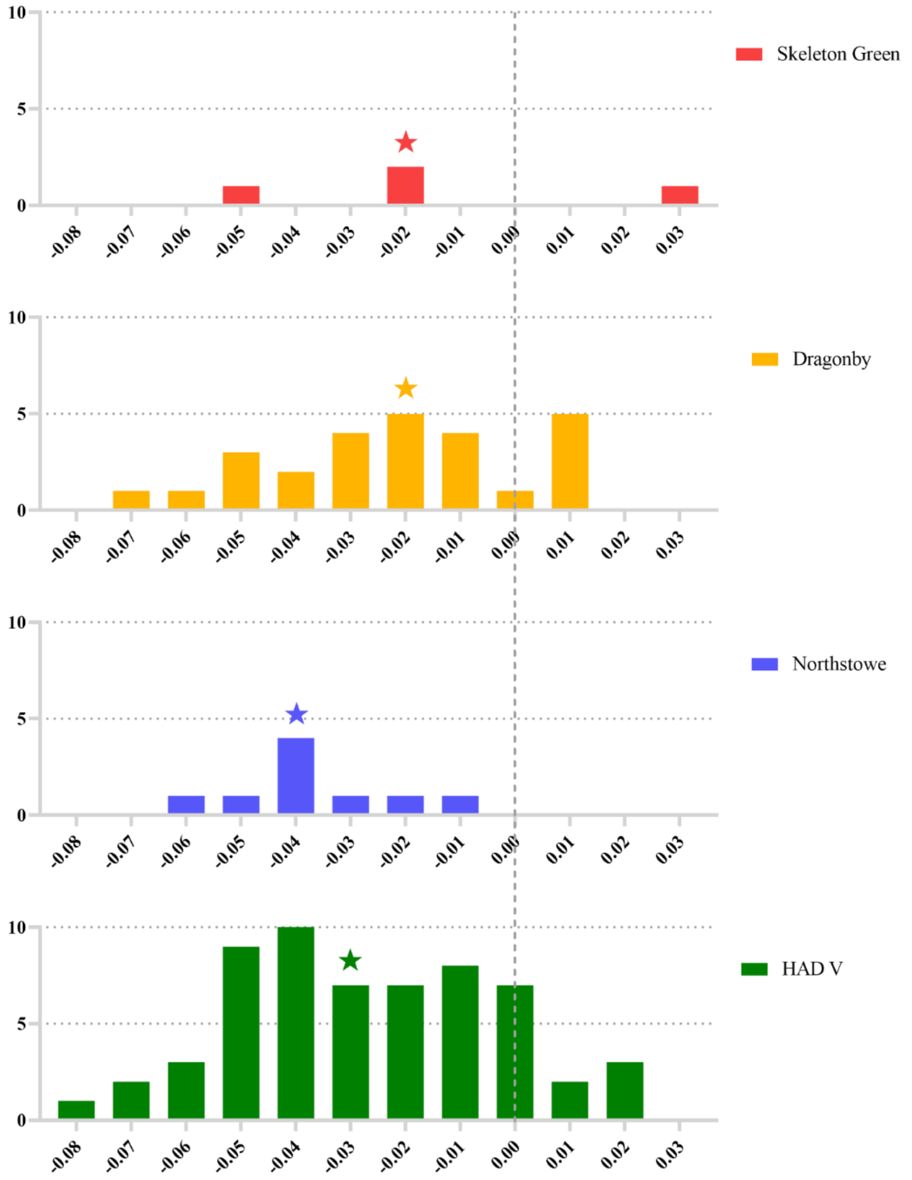


Figure 7.15. Distribution of log ratio values of a selection of caprine teeth lengths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

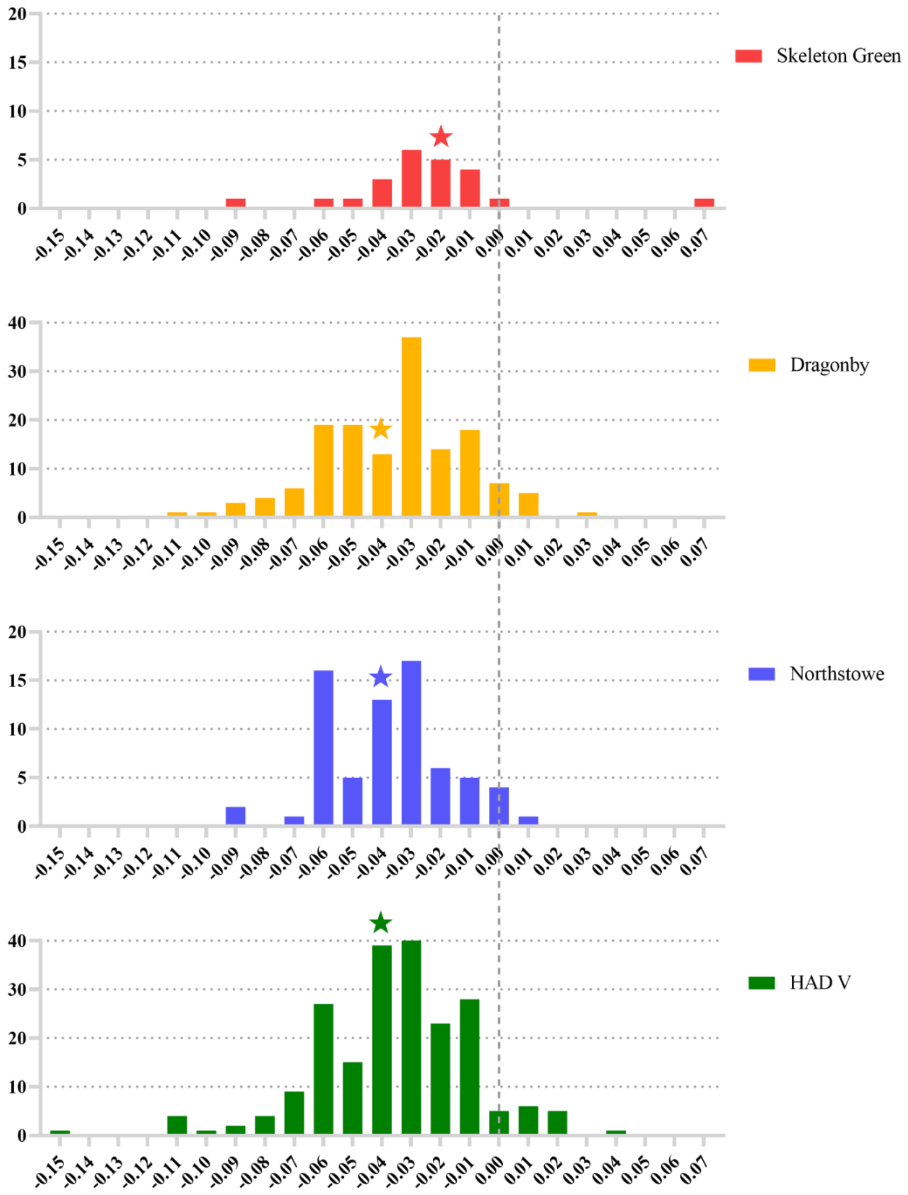


Figure 7.16. Distribution of log ratio values of a selection of caprine teeth widths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

7.1.3 Pig

The analysis of shape in the pig has been conducted on distal humeri (Figure 7.17) and tibiae (Figure 7.18), and only for the assemblages (Dragonby and Skeleton Green) that presented substantial numbers of postcranial bones. The values from the datasets of both sites plot closely together in the two analyses, suggesting similarly sized animals were reared, although the HTC/BT*100 values from Skeleton Green hint at a difference in shape. This difference is supported by a statistically significant median difference in the distribution of values (Table 7.8).

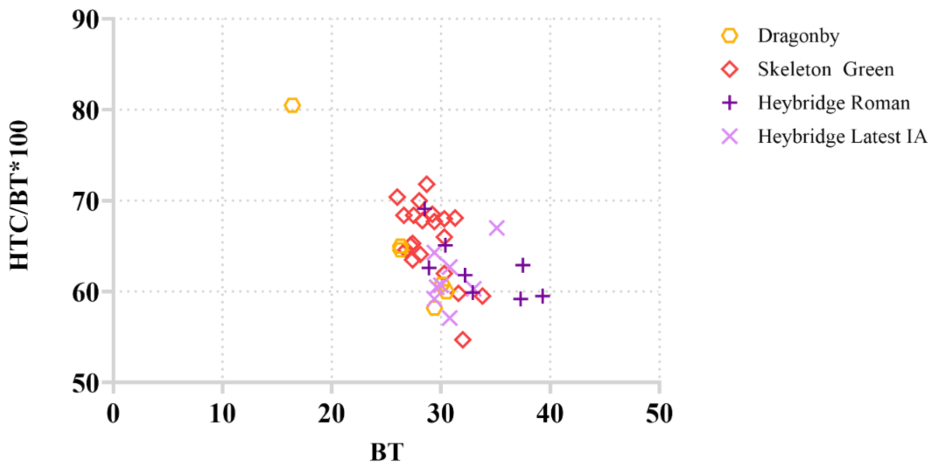


*Figure 7.17. Size and shape of pig distal humeri (BT – Greatest breadth of the trochlea; HTC/BT*100 – ratio between the diameter of trochlear constriction and the greatest breadth of the trochlea). The scatter plot on includes values from Dragonby (n:6), Skeleton Green (n:20), and Elms Farm, Heybridge (Phase II – Latest IA n:8, Phases IV-V – Mid to Late Roman n:8).*

Pigs from Dragonby and Skeleton Green were comparable in size to those from Latest Iron Age Elms Farm, Heybridge, but are smaller than those from the Mid to Late Roman periods at the same site. The values from Heybridge at all phases present lower Dl/Bd*100 shape indices (Figure 7.18) than those from the core sites, hinting at the presence of a different morphotype.

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Pig HU HTC/BT*100	Skeleton Green vs. Dragonby	66.85, n=20	62.70, n=6	40.5	0.2484	ns
	Skeleton Green vs. Heybridge, Mid to Late Roman	66.85, n=20	62.20, n=8	41	0.0471	*
Pig TI Dd/Bd*100	Skeleton Green vs. Dragonby	89.30, n=11	88.60, n=8	42.5	0.922	ns
	Skeleton Green vs. Heybridge, Mid to Late Roman	89.30, n=11	87.20, n=5	16.5	0.2301	ns

Table 7.8. Hypothesis testing results for the humeri and tibiae shape indices for pigs from Skeleton Green, Dragonby and Elms Farm, Heybridge.

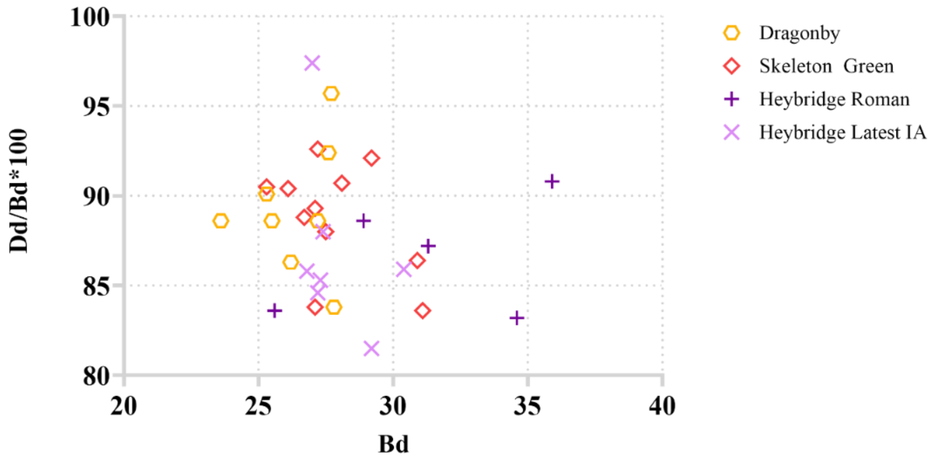


*Figure 7.18. Size and shape of pig distal tibiae (Bd – Breadth of the distal end; Dd/Bd*100 – ratio between the greatest depth of the distal end and the breadth of the distal end). The scatter plot includes values from Dragonby (n:8), Skeleton Green (n:11), and Elms Farm, Heybridge (Phase II – Latest IA n:7, Phases IV-V – Mid to Late Roman n:5).*

The LSI analysis of pig postcranial bones was only possible for widths (Figure 7.19). The comparison of the two distributions shows that the animals from Skeleton Green were substantially more robust than those at Dragonby. The median difference is statistically significant, supporting a real difference in the size of the two populations (Mann Whitney U: 618; Skeleton Green: n=53, median=-0.04; Dragonby: n=39, median=-0.06; P value=0.0008; ***).

Both distributions are roughly bimodal but the difference in shape is substantial (Skewness: Dragonby -0.5980; Skeleton Green 0.3769), possibly hinting at different sex proportions or in the prevalence of castration between the two sites.

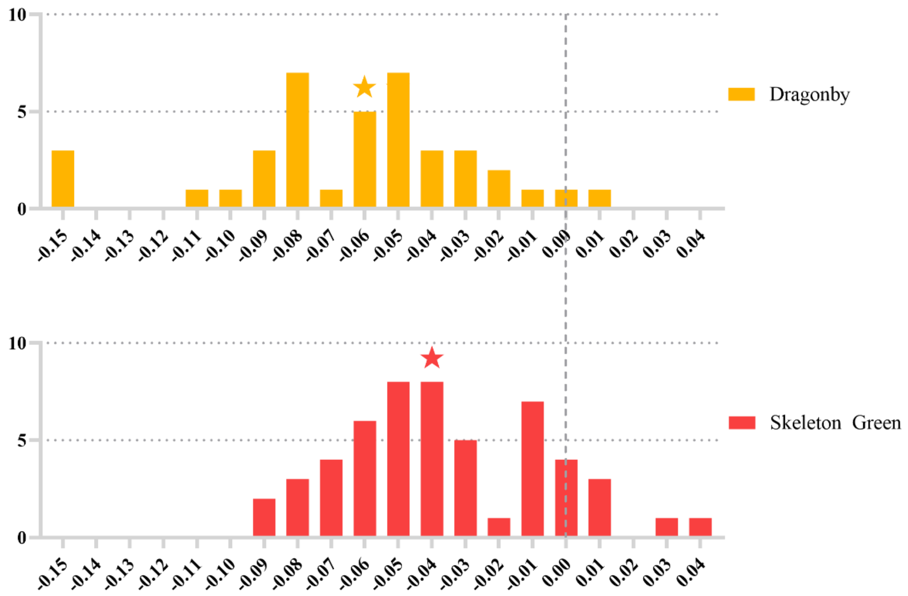


Figure 7.19. Distribution of log ratio values of a selection of pig postcranial bone widths at Dragonby and Skeleton Green. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

Metric data from teeth was more abundant – though still relatively small – making the comparison with the other core assemblages more reliable. The analysis of the log ratio values from length measurements (Figure 7.20) seems to confirm the difference in size between Dragonby and Skeleton Green, although the mean difference is not statistically significant (Table 7.9). Furthermore, it shows pigs from Haddenham V and Northstowe align with Skeleton Green in terms of size.

The analysis of log ratio values of width measurements (Figure 7.21) shows instead consistent distributions and means between Dragonby and Skeleton Green. Northstowe and Haddenham V present slightly higher means, but none of the median and mean differences tested are, however, statistically significant (Table 7.9).

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Pig T L	Dragonby vs. Northstowe	-0.02, n=71	-0.02, n=25	827	0.6146	ns
Pig T W		-0.03, n=79	-0.01, n=20	602	0.1001	ns
Pig T L	Northstowe vs. Haddenham V	-0.02, n=25	-0.03, n=18	219.5	0.897	ns
Pig T W		-0.01, n=20	-0.03, n=20	167.5	0.3841	ns
		Mean and sample size		**Welch-corrected t, df**		
Pig T L	Skeleton Green vs. Dragonby	-0.02 n=79	-0.03 n=71	t=1.461, df=146.6	0.1462	ns
Pig T W		-0.02 n=84	-0.02 n=79	t=0.6361, df=142.7	0.5257	ns

Table 7.9 Hypothesis testing results for the teeth log ratio of length and width values for pigs in the four core assemblages.

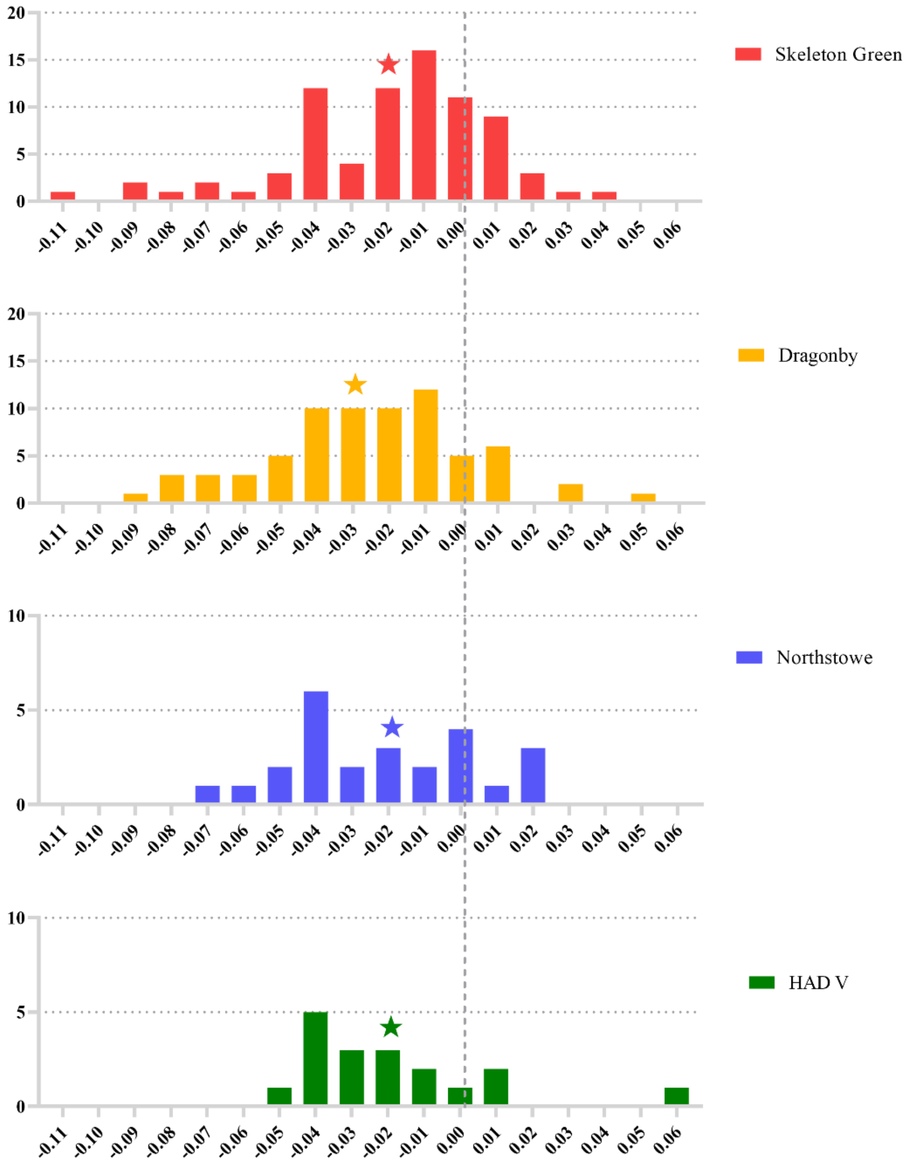


Figure 7.20. Distribution of log ratio values of a selection of pig teeth lengths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

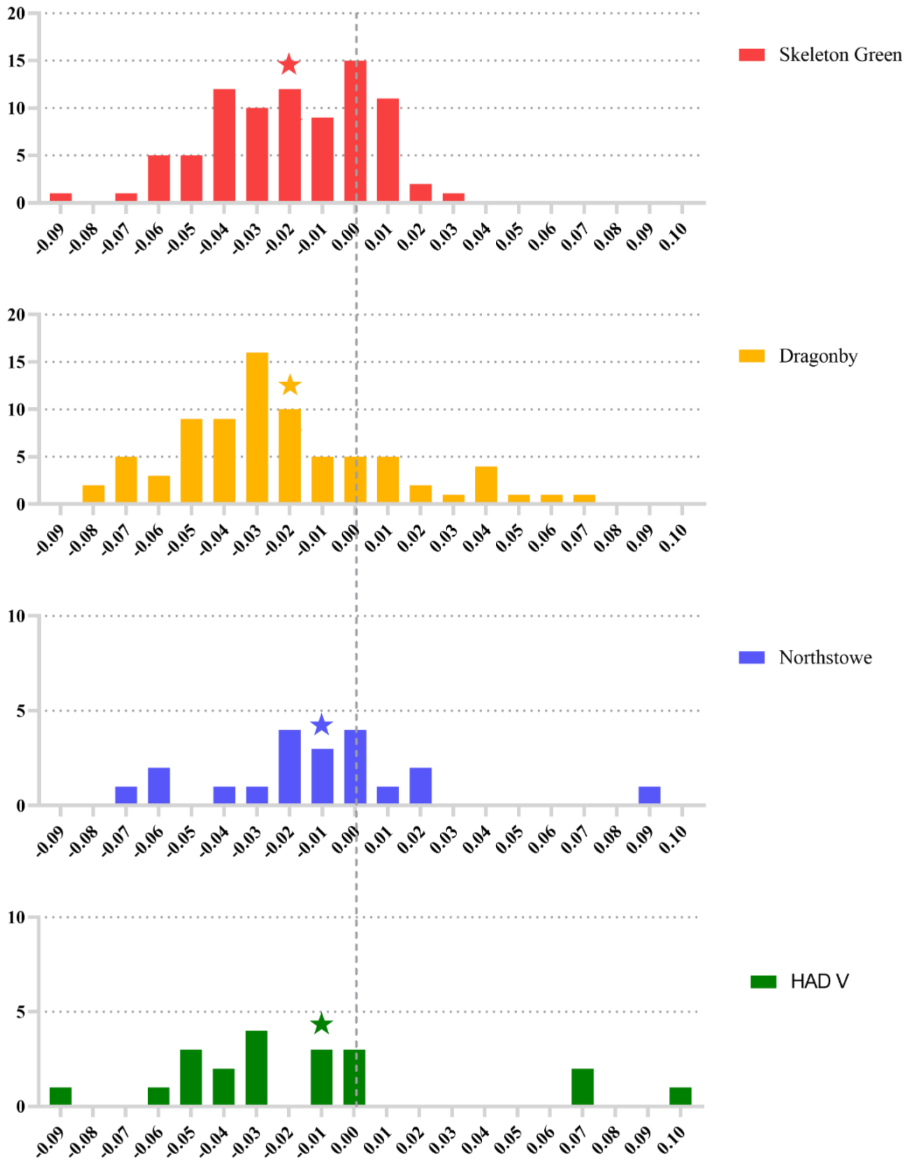


Figure 7.21. Distribution of log ratio values of a selection of pig teeth widths across the four core sites. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star.

To further investigate the patterns presented so far, the log ratios of length and width measurements from the same specimens have been plotted as scatter diagrams (Figure 7.22).

The diagram on the top left compares specimens from Dragonby and Skeleton Green, the two datasets plot on a similarly shaped and sized distribution confirming that pigs at the two sites were very similar in size but slightly more robust at the latter site. The distributions of values from Haddenham V and Northstowe are plotted with that from Dragonby in the top right diagram. The almost perfect overlap in their distributions suggests that pigs were rather uniformly shaped and sized across Eastern England throughout the period. On the contrary, the pigs from Elms Farm, Heybridge were already slightly larger during the Latest IA (bottom left diagram, Figure 7.22) and grew even larger across the Roman period (bottom right diagram).

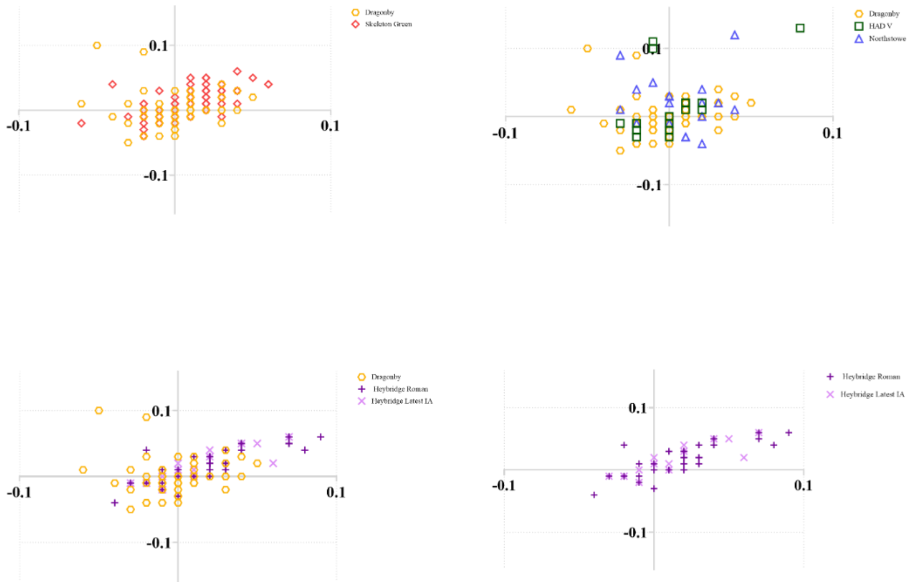


Figure 7.22. Size of pig teeth. The scatterplot includes the log ratio values of a selection of pig teeth lengths (x axis) plotted against the log ratio values of their widths (y axis) at Dragonby (n:54), Skeleton Green (n:59), Northstowe (n:19), Haddenham V (n:16), and Elms Farm, Heybridge (Phase II – Latest IA n:17, Phases IV-V – Mid to Late Roman n:31).

In all of the analyses presented particularly large individuals are rare; it is therefore likely that the contribution of wild animals to the pig sample is negligible, if not entirely absent.

7.1.4 Summary

The osteometric analyses showed that the size of the three main domesticates was more or less consistent in time and space across the four sites. There is a hint of an increase in the size of cattle throughout the period, but the evidence is limited and, in any case, the small variation can be attributed to the diverse geographies of the four sites. A difference in postcranial bone widths was also detected between pigs at Dragonby and Skeleton Green, which hints at a more robust population in the latter site.

The analysis of the log ratio distributions has also provided further evidence for the sex ratios and the practice of castration. The distribution of cattle data could be explained by a general prevalence of females, in agreement with the more conservative hypothesis presented in section 6.4.2 – Cattle. The idea of relatively abundant proportions of wethers in the caprine herds was also compatible with the distribution of caprine measurements, especially for Skeleton Green.

The analysis of shape has detected some possible regional patterns. Cattle and caprines seemed to be somewhat more slender at Skeleton Green and Heybridge. Whereas the overall shape of cattle and caprines (using their astragali as a proxy) seemed to indicate similar types of animals at Skeleton Green and Heybridge, this was not the case for pig (using distal humeri and tibiae as a proxy), suggesting that pig populations may have been more geographically diverse.

7.2 Filling the gaps: domesticates' morphometry across Eastern England

This section presents the analyses conducted on measurements from other assemblages from Eastern England. This allows for a better understanding of geographical variation and the integration of more data for the earlier period.

The standards used for LSI in this section are Dragonby for cattle and caprines, and Skeleton Green for pigs (4.9 – Measurements taken and biometric analyses). The use of standards obtained from the core assemblages analysed in the previous section helps in assessing diachronic and geographic variations.

7.2.1 Cattle

The Dl measurement of the astragalus was rarely taken in the recording of the datasets used in the present analysis. Therefore, the investigation on the shape of cattle astragali can be expanded on a larger scale only for what concerns the Bd/GLl*100 index (Figure 7.23). The distribution of the values across the Iron Age sites is fairly consistent (Kruskal-Wallis statistic 10.31; P value 0.244; ns). Comparing interquartile ranges and means, we can notice that four datasets plot lower on the y axis (more slender). With the exception of that from Haddenham V, these represent the two southernmost sites, consistent with the pattern previously detected in the scatterplots (Figure 7.1).

The nearly identical distributions between the two Lincolnshire sites, Dragonby (Latest IA) and Market Deeping (MIA-LIA), suggests that the shape of cattle in the northern part of the area remained stable across the period. Cattle became on average more slender at Heybridge during the Roman period. Since the astragalus is not highly sexually dimorphic, it is possible that this was due to changes in management practices or to the introduction of different morphotypes.

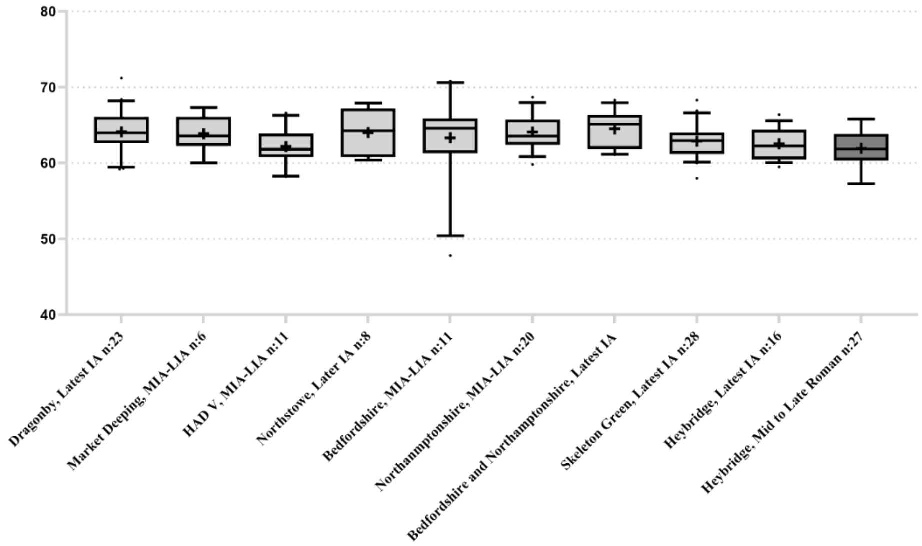


*Figure 7.23 Boxplots with whiskers of Bd/GLl*100 from cattle astragali from sites and areas within Eastern England. Site-periods are organised in geographical order from the northernmost to the southernmost. The whiskers are drawn down to the 10th percentile and up to the 90th. Points below and above the whiskers are drawn as individual points. Crosses: average values, bars: median values.*

The log ratio datasets from width measurements at various site-periods have been aggregated to assess the overall diachronic change in size in the core area. Combining all the available data (Figure 7.24) we can notice that the overall range and means of values did not change much across the Later Iron Age (Table 7.10), whereas data from Heybridge shows the extent of change during the Roman period. The shape of the curve also changes, with the earliest dataset being substantially less positively skewed than that from the Latest IA and having approximately the same shape as the Roman dataset (Skewness: MIA-LIA 0.5585; Latest IA 0.9295; Mid to Late Roman Heybridge 0.5033). This could be explained by an increased reliance on females rather than castrates in the herding strategies during the Latest IA.

Dataset	Assemblages	Mean and sample size		Welch-corrected t, df	P value	Significance
Cattle W	MIA-LIA vs. Latest IA	0.01 n=278	0.00 n=360	t=1.090, df=604.8	0.276	ns
	MIA vs. LIA	0.01 n=113	0.01 n=56	t=0.6282, df=79.21	0.5317	ns
	LIA vs. Latest IA	0.01 n=56	0.00 n=360	t=1.819, df=66.32	0.0734	ns

Table 7.10. Hypothesis testing results for the post-cranial log ratio width values for cattle across Eastern England by phase.

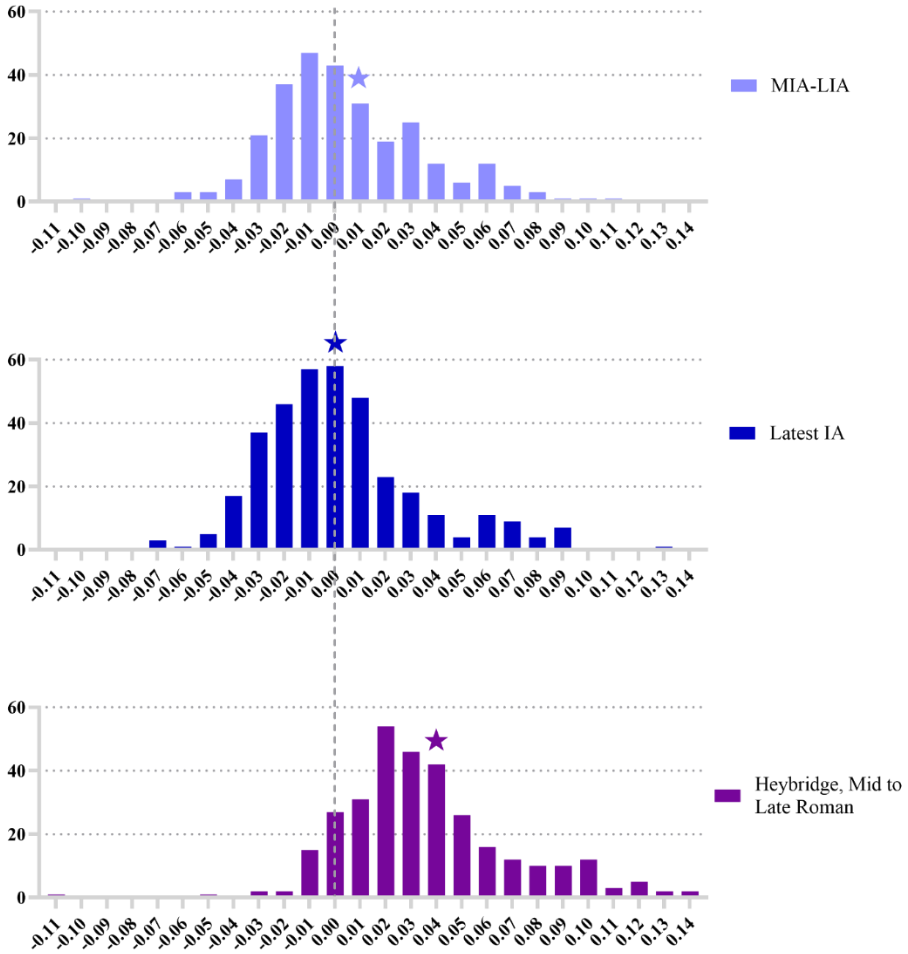


Figure 7.24. Distribution of log ratio values of a selection of cattle postcranial bone widths across Eastern England by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA-LIA datasets: Bedford West By Pass, Brackley Northampton Road, Brackley Radstone Fields, Brackmills, Broom, Haddenham V, Market Deeping, Marston Park, Northstowe, Wardy Hill, Wellingborough Burton Way, Wellingborough Wilby Way – n: 278; Latest IA datasets: Brackmills, Dragonby, Heybridge, Marston Park, Moggerhanger, Northstowe, Skeleton Green – n: 360.

Breaking further down the data into a MIA, LIA and Latest IA phases (which requires using only the datasets that were more tightly dated, Figure 7.25) confirms the idea of stability in overall size over time. The mean value for the two earliest phases is slightly higher than that for the Latest IA, suggesting that the selection of the sites might have introduced a geographic bias (Figure 7.26 shows the areas with overall larger cattle).

The shape of the distribution remains similar and positively skewed through time (Skewness: MIA 0.3714; LIA 0.2009; Latest IA 0.9295).

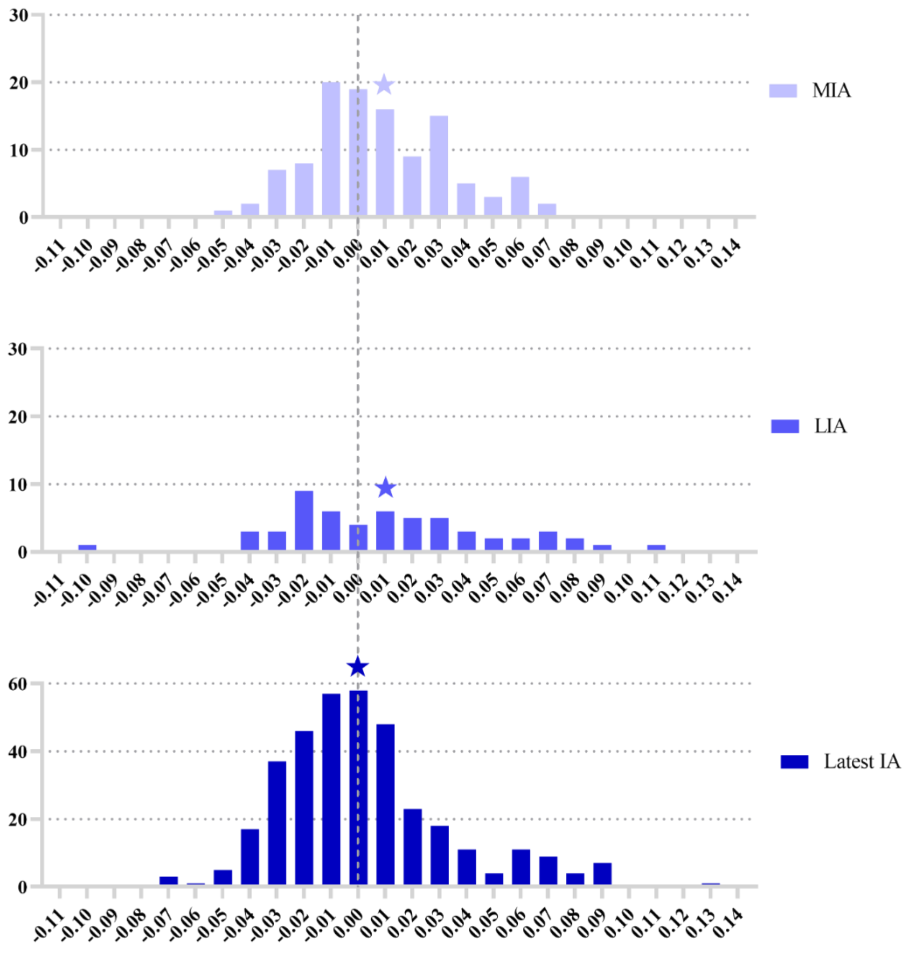


Figure 7.25. Distribution of log ratio values of a selection of cattle postcranial bone widths across Eastern England by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA datasets: Bedford West By Pass, Brackley Northampton Road, Broom Quarry, Marston Park, Wellingborough Burton Way – n:113; LIA datasets: Bedford West By Pass, Marston Park – n: 56; Latest IA datasets: Brackmills, Dragonby, Marston Park, Moggerhanger, Northstowe, Skeleton Green – n:360.

The log ratio values of cattle width measurements from the individual sites have been plotted in a boxplot diagram to detect possible geographic patterns (Figure 7.26). Note that the small sample size and uneven distribution of the sites in each grouping suggests caution, the interpretations presented below are best intended as hypotheses to be tested in future research. Cattle size appears to have been stable in time for the counties of Northamptonshire, Cambridgeshire and Lincolnshire, while a general trend of increase in size across the Later IA can be detected in Bedfordshire. Cattle from Cambridgeshire and Lincolnshire plots slightly lower than that from the Midlands (Beds. and Northants.) regardless of chronology. No Mid to Late Iron age data was available for the combined Hertfordshire and Essex area, but it is however interesting to notice the degree of variability within the Latest IA and the extent of change in the Roman period.

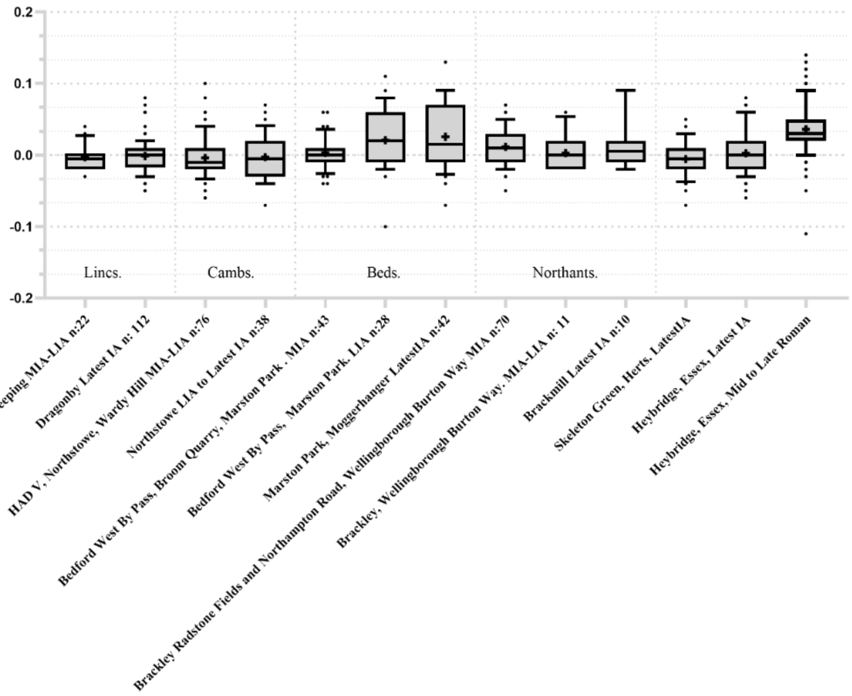


Figure 7.26. Boxplots with whiskers of cattle bone width log ratio values from all the sites used in the previous graphs. Site-periods are grouped by county of provenance and organised in chronological order. The whiskers are drawn down to the 10th percentile and up to the 90th. Points below and above the whiskers are drawn as individual points. Crosses: average values, bars: median values.

7.2.2 Caprines

The log ratio datasets from width measurements at various site-periods have been aggregated to assess the overall diachronic change in size in the core area. Combining all the available data (Figure 7.27) we can notice that the overall range and means of values did not change across the Later Iron Age (Table 7.11), whereas data from Heybridge shows the extent of change during the Roman period.

The shapes of the curves also change, with the earliest dataset positively skewed in contrast with the increasingly negatively skewed distributions from the latest IA (Skewness: MIA-LIA 0.5581; Latest IA -0.3336; Mid to Late Roman Heybridge -0.4561). This could be interpreted as an increasing reliance on castrates across the period.

Dataset	Assemblages	Mean and sample size		Welch-corrected t, df	P value	Significance
Caprine W	MIA-LIA vs. Latest IA	-0.01 n=292	0.00 n=398	t=1.915, df=615.0	0.0559	ns
				Mann-Whitney U		
	MIA vs. LIA	-0.01, n=123	0.00, n=49	2720	0.3159	ns
	LIA vs. Latest IA	0.00, n=49	0.000, n=398	9543	0.8068	ns

Table 7.11. Hypothesis testing results for the post-cranial log ratio width values for caprines across Eastern England by phase.

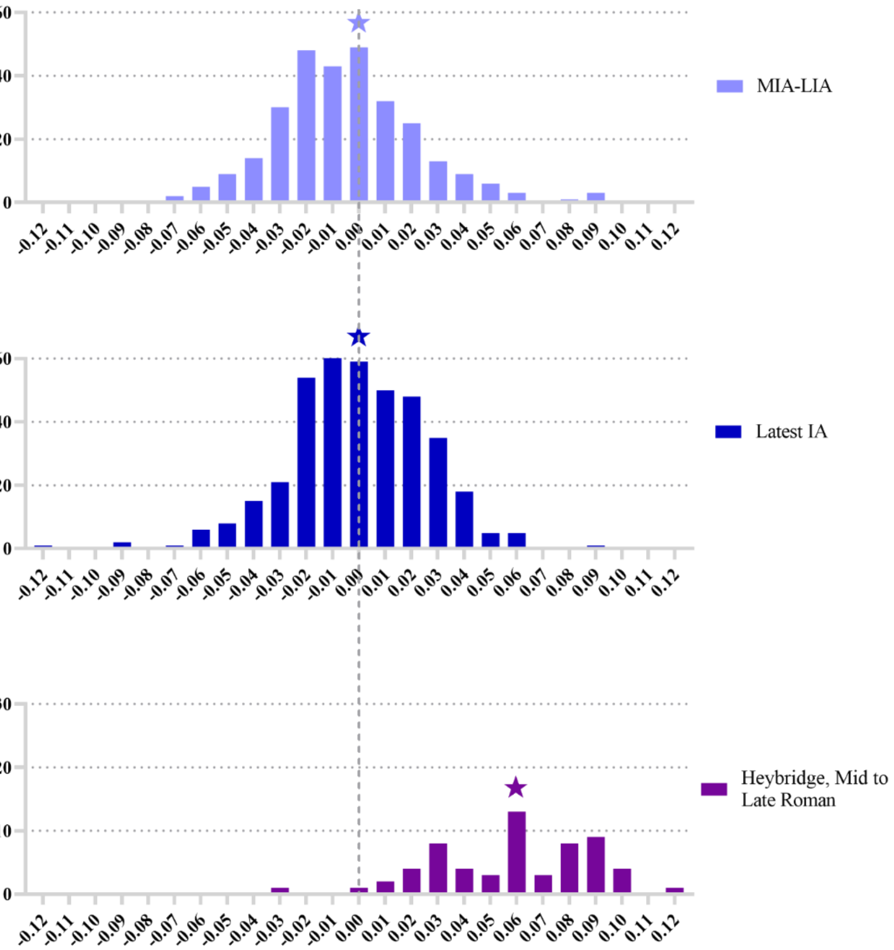


Figure 7.27. Distribution of log ratio values of a selection of caprine postcranial bone widths across Eastern England by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA-LIA datasets: Bedford West By Pass, Brackley Northampton Road, Brackley Radstone Fields, Brackmills, Broom Quarry, HAD V, Heybridge, Market Deeping, Marston Park, Northstowe, Wardy Hill, Wellingborough Burton Way, Wellingborough Wilby Way – n: 292; Latest IA datasets: Brackmills, Dragonby, Marston Park, Moggerhanger, Northstowe, Skeleton Green – n: 398.

Breaking further down the data into a MIA, LIA and Latest IA phases (Figure 7.28) confirms the idea of stability in overall size over time (Table 7.11).

The shape of the distribution in the Latest IA dataset seems to indicate a stronger reliance on castrates (Skewness MIA 1.146; LIA 0.2569; Latest IA -0.3336).

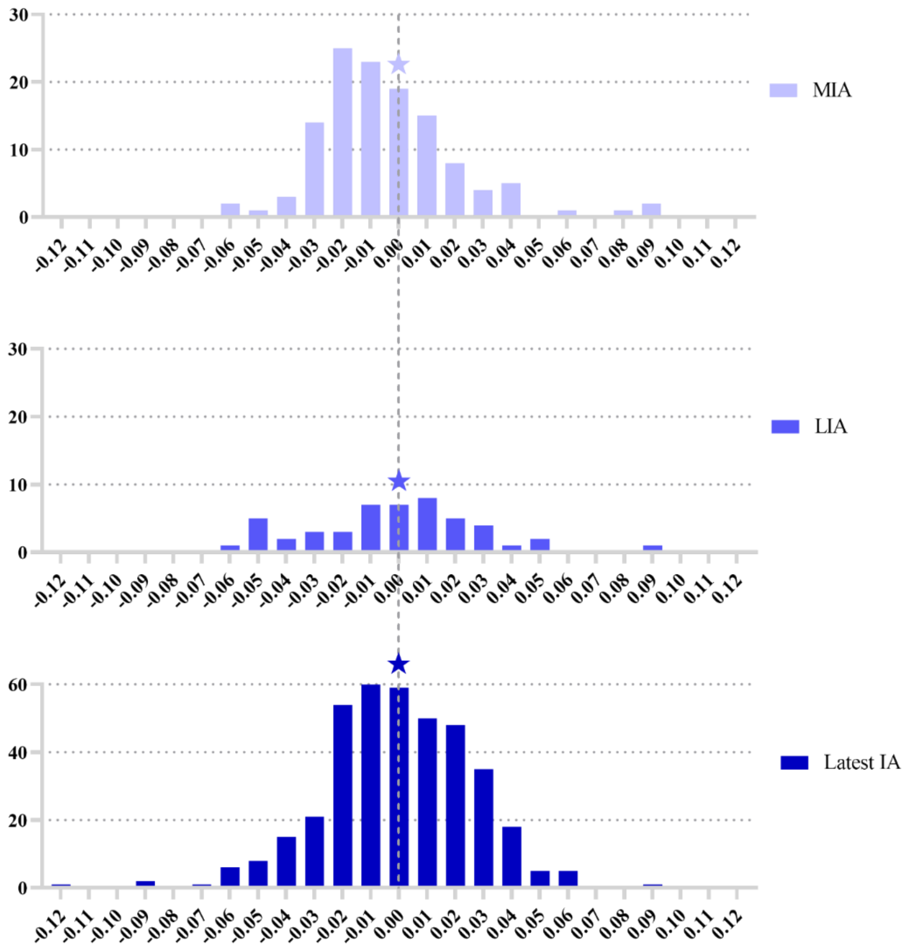


Figure 7.28. Distribution of log ratio values of a selection of caprine postcranial bone widths across Eastern England by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA datasets: Bedford West By Pass, Brackley Northampton Road, Brackley Radstone Fields, Broom, Marston Park, Wellingborough Burton Way – n: 123; LIA datasets: Heybridge, Marston Park, Northstowe – n: 49; Latest IA datasets: Brackmills, Dragonby, Marston Park, Moggerhanger, Northstowe, Skeleton Green – n: 398.

The log ratio values of caprine width measurements from either the individual sites or the combined datasets from a county (where more than one was available) have been plotted in a boxplot diagram to detect possible geographic patterns (Figure 7.29). As for cattle, note that the small sample size and uneven distribution of the sites in each grouping suggests caution, the interpretations presented below are best intended as hypotheses to be tested in future research. Caprine size appears to have been stable in time for Bedfordshire, increasing slightly in Northamptonshire and Lincolnshire, and decreasing in Cambridgeshire. No Mid to Late Iron age data was available for the combined Hertfordshire and Essex areas. The two Latest

IA datasets have comparable distributions, in line with the general Later Iron Age range, while the difference with the Mid to Late Roman dataset from Heybridge shows the extent of change in the Roman period.

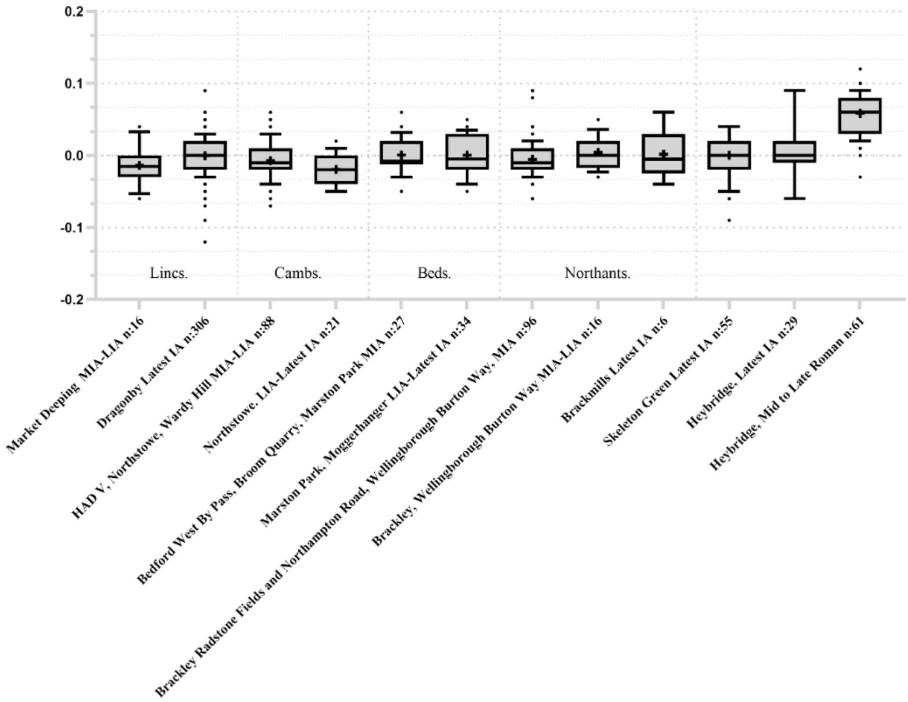


Figure 7.29. Boxplots with whiskers of caprine bone width log ratio values from all the sites used in the previous graphs. Site-periods are grouped (and aggregated when possible) by county of provenance and organised in chronological order. The whiskers are drawn down to the 10th percentile and up to the 90th. Points below and above the whiskers are drawn as individual points. Crosses: average values, bars: median values.

7.2.3 Pig

The log ratio datasets from width measurements at various site-periods have been aggregated to assess the overall diachronic change in size in the core area. Combining all the available data (Figure 7.30) we can notice that the size of pigs in the region did not change across the Later Iron Age (Mann Whitney U: 1352; MIA-LIA: n=25, median=-0.01; Latest IA: n=118, median=0.00; P value=0.512; ns).

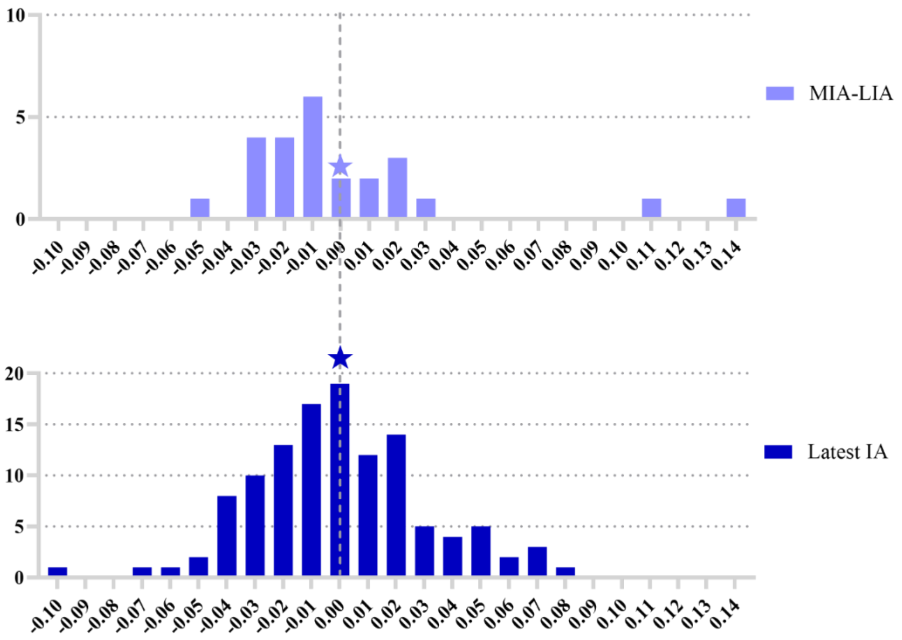


Figure 7.30. Distribution of log ratio values of a selection of pig postcranial bone widths across Eastern England by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA-LIA datasets: Bedford West By Pass, Brackley Northampton Road, Brackley Radstone Fields, Brackmills, Broom Quarry, Haddenham V, Market Deeping, Marston Park, Northstowe, Wardy Hill, Wellingborough Burton Way, Wellingborough Wilby Way – n: 25; Latest IA datasets: Brackmills, Dragonby, Heybridge, Marston Park, Moggerhanger, Northstowe, Skeleton Green – n: 118.

7.2.4 Summary

The analysis of osteometric data from across Eastern England has confirmed that the overall size of the three main domesticates did not substantially change through time. Some geographic variability in terms of size and shape has been detected for all three animals. This suggests that there is a complexity in the livestock of the region that could be further investigated. The overall diachronic pattern has, however, been investigated thoroughly and is fairly clear.

The analysis of the log ratio distributions has been used to gain more insights into sex ratios. Cattle data suggested a possible increased focus on females during the Latest IA before a return to more even ratios in the

Roman period. Caprine distributions instead suggested a progressive increase in the proportion of castrates.

The analysis of cattle robusticity has reinforced the idea of at least two different populations – more robust in the north and more slender in the south – although their exact geographic distribution remains uncertain.

7.3 Broadening the scope: a comparison with Wessex

In this section data from Wessex, combined by phase, will be compared to assess if domestic livestock changed in size over time in this area. The Wessex datasets will be then compared with those from Eastern England to obtain insights on livestock variability across Britain.

The standards used for LSI in this section are Dragonby for cattle and caprines, and Skeleton Green for pigs (4.9 – Measurements taken and biometric analyses).

7.3.1 Cattle

Log ratio values of cattle postcranial bone width measurements from all datasets from the Wessex region have been combined by phase to assess the extent of change throughout the Later Iron Age (Figure 7.31). Overall, no change in size has been detected (Table 7.12). The only difference between the three datasets lies in the positive skewness of the Latest IA distribution, which, however, must be interpreted cautiously due to the small sample size (Skewness: MIA -0.1117; LIA -0.02317; Latest IA 0.2845).

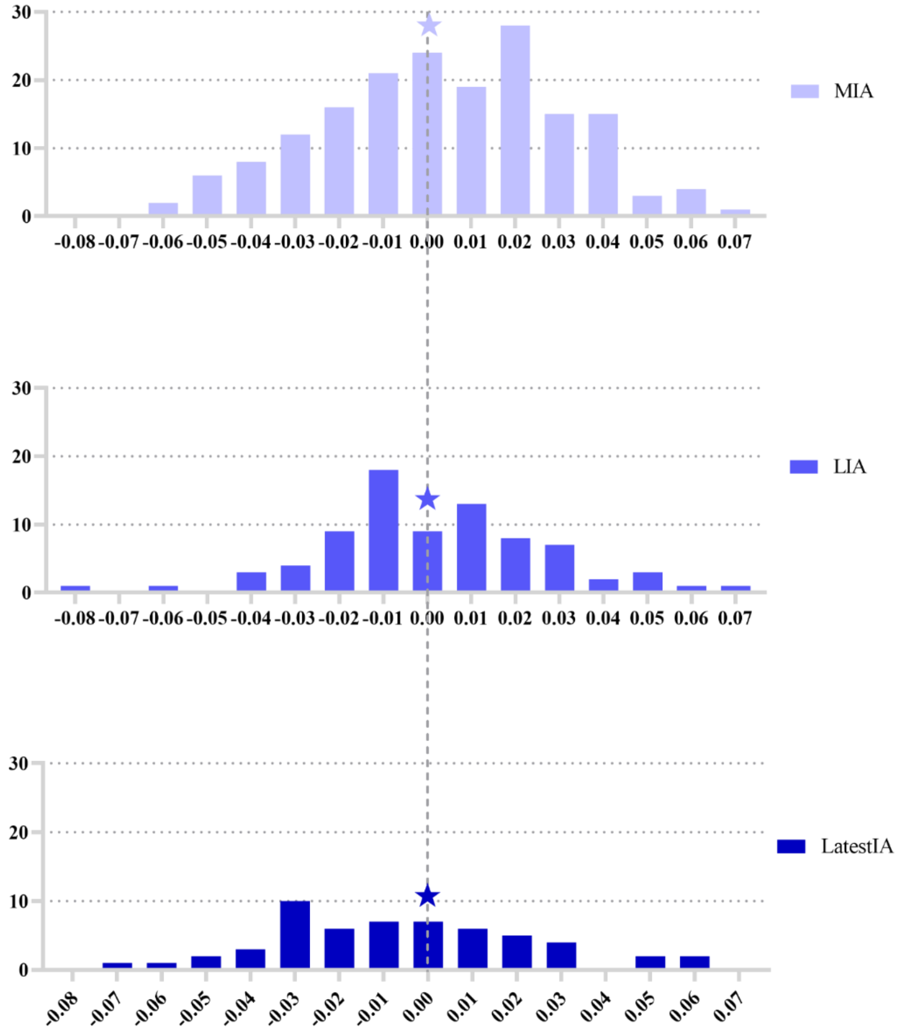


Figure 7.31. Distribution of log ratio values of a selection of cattle postcranial bone widths across Wessex by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA datasets: Owslebury, Balksbury, Battlesbury Bowl, Rope Lake Hole – n: 174; LIA datasets: Owslebury, Alington Avenue, Knights Enham Hill – n: 80; Latest IA datasets: Owslebury, A303 Stonehenge, Knights Enham Hill, Popley, Rope Lake Hole, Brighton Hill South – n:56.

Comparing data from the MIA phase in Eastern England and Wessex (Figure 7.32), no difference in size was detected (Table 7.12), while the shape of the distributions seemed to indicate a slightly stronger reliance on castrates in the latter (Skewness: Eastern England 0.3714, Wessex -0.1117)

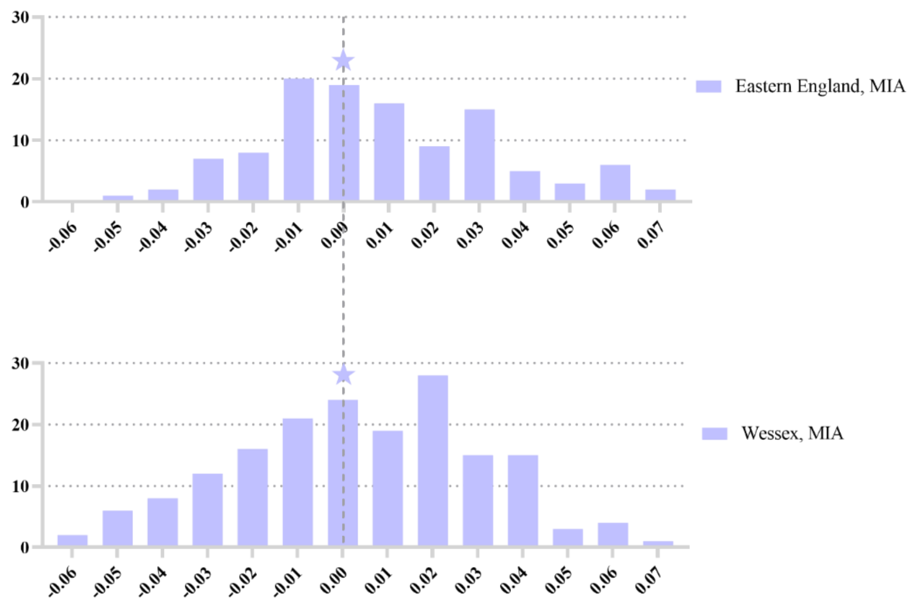


Figure 7.32. Distribution of log ratio values of a selection of cattle postcranial bone widths across Eastern England and Wessex during the MIA. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. Wessex datasets: Owslebury, Balksbury, Battlesbury Bowl, Rope Lake Hole – n: 174; Eastern England datasets: Bedford West By Pass, Brackley Northampton Road, Broom Quarry, Marston Park, Wellingborough Burton Way – n:113.

Dataset	Assemblages	Mean and sample size		Welch-corrected t, df	P value	Significance
Cattle W	MIA vs. LIA	0.00 n=174	0.00 n=80	t=0.5931, df=160.5	0.5539	ns
	LIA vs. Latest IA	0.00 n=80	-0.01 n=56	t=1.557, df=109.8	0.1224	ns
	Wessex vs. Eastern England	0.00 n=174	0.01 n=113	t=1.469, df=248.7	0.143	ns

Table 7.12. Hypothesis testing results for the post-cranial log ratio width values for cattle in Eastern England and Wessex.

7.3.2 Caprines

As in the case of cattle (p.233), further analysis of the shape of caprine astragali had to rely on the Bd/GLl*100 index (Figure 7.33).

The distributions of values show an increase in the robusticity of sheep over time in the Wessex site of Battlesbury Bowl. Both ranges fall within the variability of the assemblages from Eastern England whereas the Mid to Late Roman assemblage presented more slender animals.

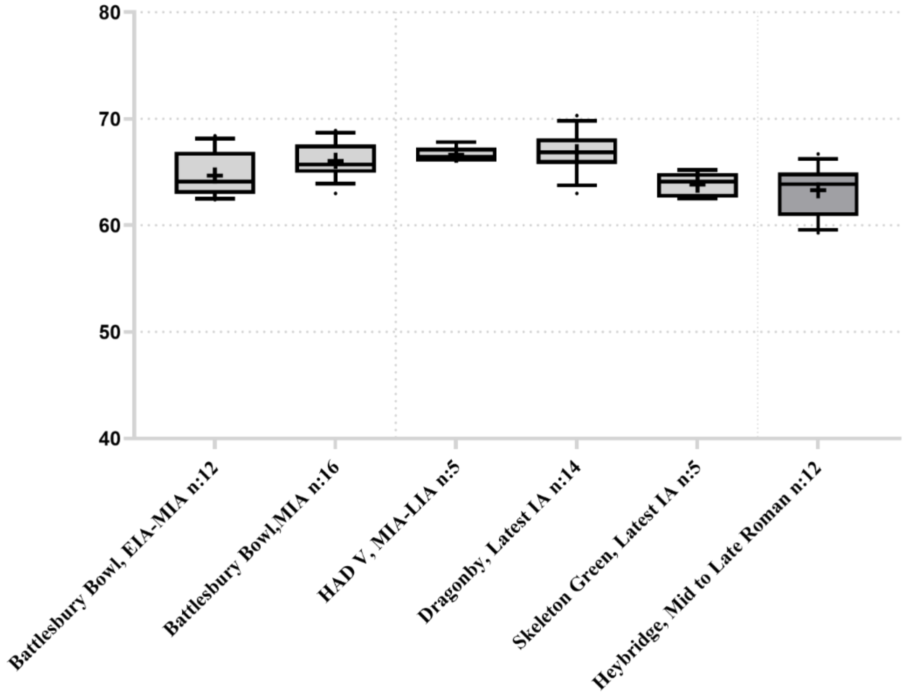


*Figure 7.33 Boxplots with whiskers of Bd/GLl*100 from caprine astragali from the core sites, compared to those from Battlesbury Bowl and Roman Heybridge. The whiskers are drawn down to the 10th percentile and up to the 90th. Points below and above the whiskers are drawn as individual points. Crosses: average values, bars: median values.*

Log ratio values of caprine postcranial bone width measurements from all datasets from the Wessex region have been combined by phase to assess the extent of change throughout the Later Iron Age (Figure 7.34). Overall, no change in size has been detected (Table 7.13). The only difference between the three datasets lies in the positive skewness of the MIA distribution, which given the shape of the distribution could indicate an increasing reliance on males throughout the period (MIA 0.2390; LIA -1.148; Latest IA -0.7397). However, the small sample size of the two later sets invites caution in accepting this interpretation.

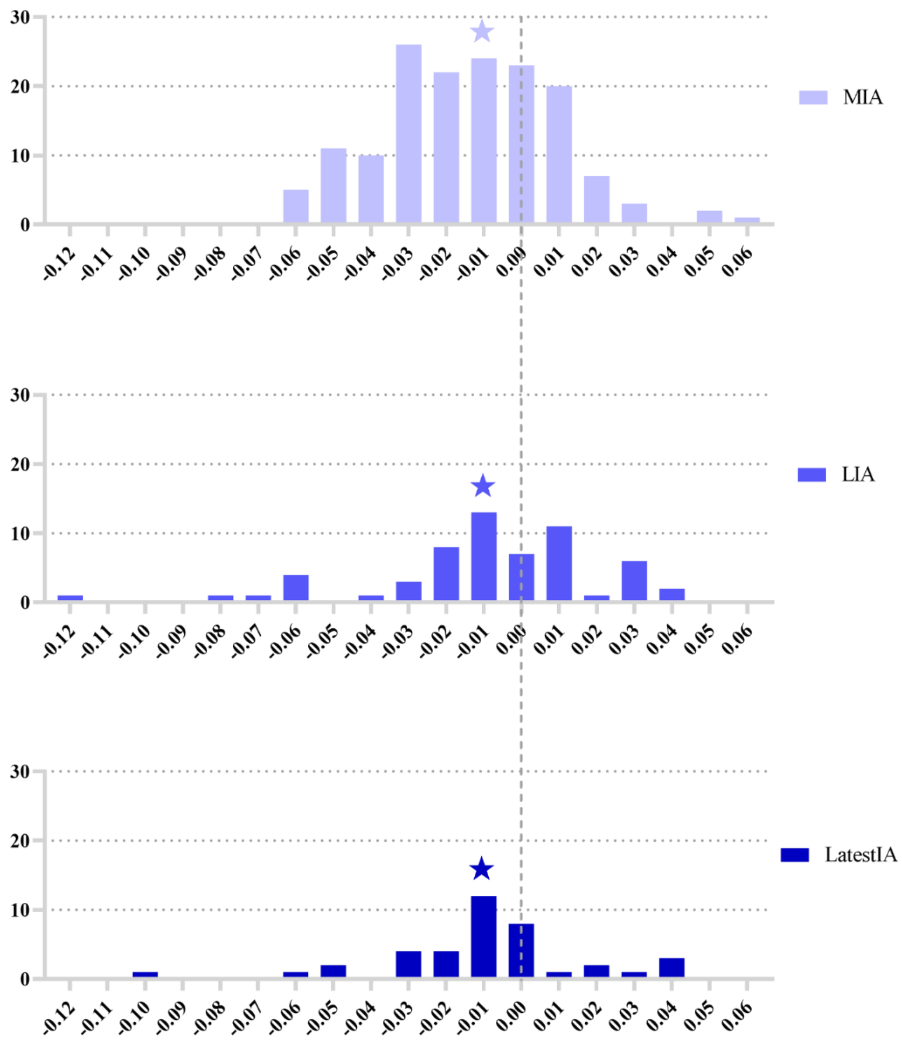


Figure 7.34. Distribution of log ratio values of a selection of caprine postcranial bone widths across Wessex by phase. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. MIA datasets: Owslebury, Balksbury, Micheldever Wood, Battlesbury Bowl, Rope Lake Hole – n: 154; LIA datasets: Owslebury, Alington Avenue, Flagstones, Knights Enham Hill – n:59; Latest IA datasets: Owslebury, Micheldever Wood, Popley, Rope Lake Hole, Brighton Hill South – n:39.

The comparison of data from the MIA phase in Eastern England and Wessex (Figure 7.35), showed that caprines from the former region were larger (Table 7.13). While the overall shape of their distributions is fairly similar, the distribution of values from Wessex is substantially more positively skewed, suggesting that it was slightly more reliant on castrates (Skewness: Eastern England 1.146; Wessex 0.2390).

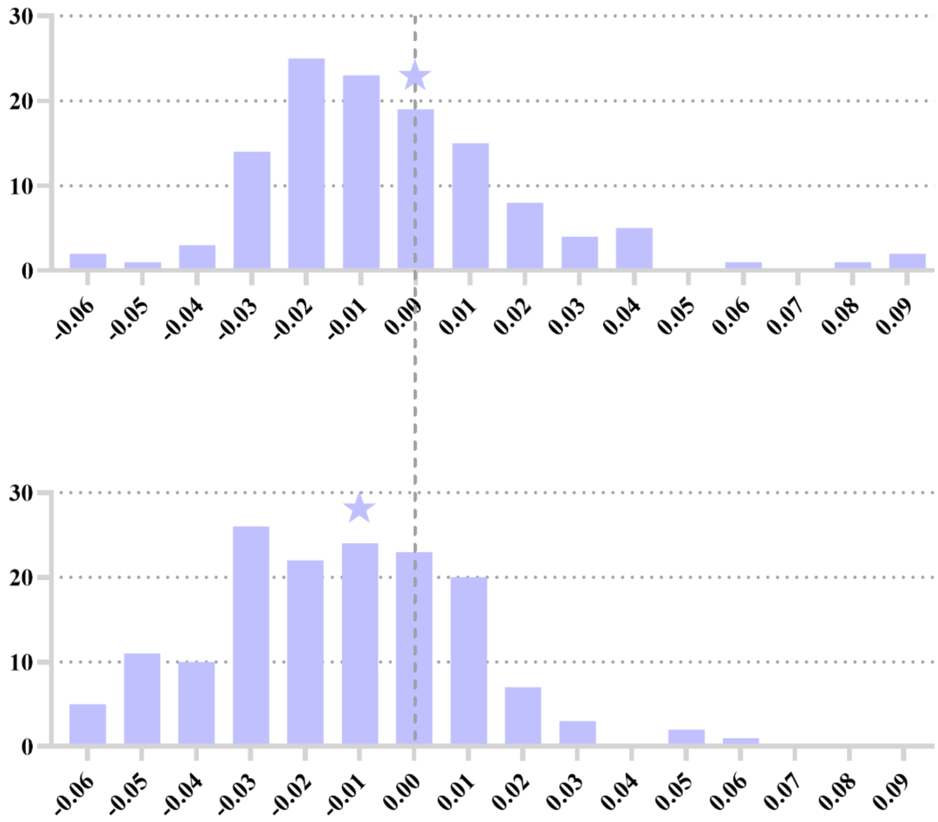


Figure 7.35. Distribution of log ratio values of a selection of caprine postcranial bone widths across Eastern England and Wessex during the MIA. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. Wessex datasets: Owslebury, Balksbury, Micheldever Wood, Battlesbury Bowl, Rope Lake Hole – n: 154; Eastern England datasets: Bedford West By Pass, Brackley Northampton Road, Brackley Radstone Fields, Broom, Marston Park, Wellingborough Burton Way – n: 123.

Dataset	Assemblages	Median and sample size		Mann-Whitney U	P value	Significance
Caprine W	LIA vs. Latest IA	-0.01, n=59	-0.01, n=39	1082	0.615	ns
		Mean and sample size		Welch-corrected t, df		
	MIA vs. LIA	-0.01 n=154	-0.01 n=59	t=1.050, df=85.15	0.2969	ns
	Wessex vs. Eastern England	-0.01 n=154	0.00 n=123	t=3.288, df=249.7	0.0012	**

Table 7.13. Hypothesis testing results for the post-cranial log ratio width values for caprines in Eastern England and Wessex.

7.3.3 Pig

Since pig remains in Wessex are relatively rare, it was possible to compare their size to that of Eastern England only by combining all the data available from different phases (Figure 7.36). Even so, the sample from Wessex was small, making direct comparisons difficult. However, the difference in the mean is most probably due to some small outliers in the Wessex dataset and the median difference between the distributions of the two samples is not statistically significant (Mann Whitney U: 2121; MIA-LIA: n=25, median=-0.01; Latest IA: n=25, median=0.00; P value=0.9224; ns). Although more data is needed to confirm the pattern detected, the pigs from Wessex did not appear to be different in size when compared to those from Eastern England (Wessex: n=30, median=0.000; Eastern England: n=143, median=0.000; Mann Whitney U: 2121; P value=0.9224; ns).

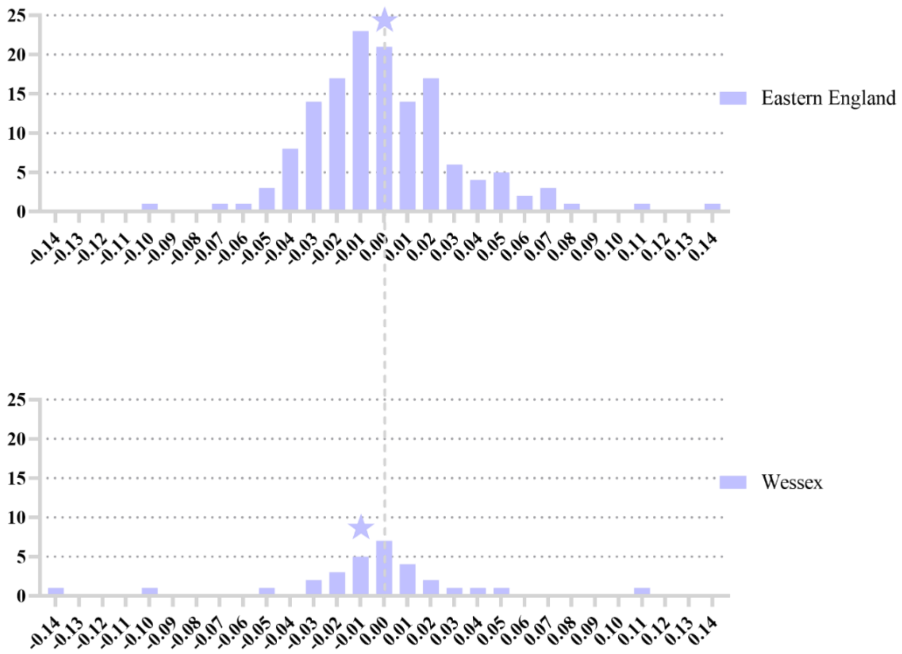


Figure 7.36. Distribution of log ratio values of a selection of pig postcranial bone widths across Eastern England and Wessex during the Later Iron Age. The standard is indicated by a dashed line. The mean of each distribution is indicated by a star. Wessex datasets: Alington Avenue, Balksbury, Micheldever Wood, Battlesbury Bowl, Flagstones, Rope Lake Hole, Brighton Hill South – n: 30; Bedford West By Pass, Brackley Northampton Road, Brackley Radstone Fields, Brackmills, Broom Quarry, Dragonby, Haddenham V, Heybridge, Market Deeping, Marston Park, Moggerhanger, Northstowe, Skeleton Green, Wardy Hill, Wellingborough Burton Way, Wellingborough Wilby Way – n: 143.

7.3.4 Summary

The osteometric data available for Wessex suggests that both cattle and caprine size remained stable in time. Cattle and pigs in Wessex and Eastern England presented the same overall size, whereas caprines were slightly smaller in Wessex. It is possible that the lesser homogeneity of sheep may indicate that these animals were moved around the country less than cattle – different populations would have therefore had less chances to cross and developed more regional traits.

The analysis of caprine robusticity has shown that animals at Battlesbury Bowl (Wessex) were initially more robust (although not as much as the Roman caprines at Heybridge) and became more slender in the MIA, with a range comparable to that of the 'northern' assemblages in Eastern England.

CHAPTER 8

Discussion

8.1 Contextualising the zooarchaeological data

This section will interpret and place the results of the analyses presented in the previous two chapters into a wider geographical context.

8.1.1 Livestock types

The osteometric analyses detailed in Chapter 7 have helped in reconstructing patterns of livestock size and shape in Later Iron Age Britain.

The analysis of the core assemblages showed that the size of all three main domesticates was similar among the core sites. The pattern of overall uniformity and stability over time was also confirmed by the comparison with further sites in Eastern England and, to some extent, Wessex. Minor differences, such as the smaller size of sheep in Wessex, can be explained by the existence of local or regional variation and possibly local landraces.

Some minor local variation in bone morphometry has also been detected within Eastern England. For example, cattle and caprines were represented by more slender individuals at Skeleton Green (the southernmost site) than at Dragonby (the northernmost site). Moreover, the sheep population at Dragonby was the only one where the absence of the hypoconulid in the lower third molar was recorded. These examples of geographic variability in livestock populations could hint at the presence of different morphotypes, but it was not possible to define precise areas of the prevalence of these traits.

There is, however, some evidence that, whatever morphotypes may have existed, they were not homogenously distributed nor mutually exclusive. A network aimed at sharing sires or exchanging livestock may have existed between geographically distant communities.

8.1.2 Cattle and sheep husbandry

Cattle and sheep represent the two most important animal species throughout the Iron Age. Their role in the animal economy has already been discussed in section 3.4.2 – The role of sheep and cattle. Here the results of the analyses are discussed against previous interpretations and compared with the evidence from other relevant published sites.

8.1.2.1 Haddenham V

The animal economy at the Mid to Late Iron Age enclosed settlement excavated at Haddenham V was substantially focused on sheep rearing.

Serjeantson (2006) deemed it implausible that sheep would have been raised for meat and interpreted the caprine ageing data as the result of a focus on both wool and milk production. Her arguments retain some validity but deserve further discussion. I would rather argue that the culling strategy was tailored to accommodate the production of wool and milk, within a strategy mainly focussed on meat production.

The main peak of mortality, as in many other Iron Age sites, corresponds to the 6-12 months of age range, which is taken to indicate the culling of yearlings before wintering. This assumes that winter grazing was limited, which fits with a local landscape where flooding was frequent and the limited dryland was used for growing crops. Haddenham V is located within the marshland environment of the Fens, and the focus on arable agriculture is indicated by the fact that cattle were partially reared for traction.

Lambs, however, could have been slaughtered as soon as weaned (three to five months) to boost milk production. Instead, they were kept as long as possible which means that the objective was to increase meat yield without resorting to winter foddering. The winter flock was still probably very substantial to maintain reproductive viability.

Milking per se is not incompatible with any mortality profile that preserves some adult females (Halstead, 2017), and at Haddenham V there were plenty. There is, however, no indication that it was practised intensively.

The culling pattern of sheep in assemblages that represent specialised wool producers tendentially shows as a left-skewed unimodal distribution, with the peak of mortality in adults (see for reference the kill-off pattern at the medieval site of West Cotton in Albarella and Davis, 1994). Such a distribution is the reverse as if reflected in a mirror, of what we see in the Haddenham V mortality pattern. The mortality after the autumn culling is, however, compatible with unspecialised wool production, with many animals reaching advanced adult age.

The osteometric evidence suggests that the castration of sheep was practised. This suggests that flock numbers were so large that the autumn culling did not have to imply the killing of most ram lambs. It is also further indication that the focus was on meat and wool rather than milk.

The idea that the inhabitants of Haddenham V would have rather kept pigs (which are uncommon) if their focus was on meat production, does not consider that all three products could have been obtained by the extensive management of sheep for meat and wool. In the kind of exchange system that we envisage for the Iron Age (2.6.2 – How did exchange work?), this type of mixed production could provide more than enough secondary products without adopting more intensive or specialised approaches. These would have required a change in technology or substantial investments of labour for which we have no evidence.

The diversified use of animals and the importance of meat production is also highlighted by the cattle mortality profile. This shows a second peak in the culling of immature animals which could potentially indicate the culling of yearlings for this species as well. Subadults and especially adults were well represented, but elderly animals were much less so. This can indicate a focus on meat production along with the keeping of mature animals for traction. The reason behind these strategies might have been in part because of the environmental constraints of the Fen edge landscape and its use. The presence and use of 'marginal' environments are confirmed by the abundance and diversity of wild species in the assemblage (5.2.4 – Skeleton Green). If the scope for arable farming and extensive pasture was limited by natural features, an emphasis on meat production could have offset these limitations and allowed the creation of a food surplus. That meat was mostly consumed locally is confirmed by the household-scale butchery practices adopted and by the patterns of skeletal distribution suggesting that the animals were slaughtered on-site without substantial selection of body parts. These patterns suggest that the aim was sustaining non-food production activities at the site.

The exploitation patterns of sheep and cattle at Haddenham V are replicated almost exactly in the nearby and roughly contemporary site of Colne Fen (Higbee, 2013) and probably[16] further to the northeast at Wardy Hill (Davis, 2003).

As we have seen in Chapter 3, these were overall fairly typical across the Iron Age both in eastern and southern England (Hambleton, 2008; Albarella, 2019).

8.1.2.2 Northstowe

The animal economy in the Mid to Late and Latest Iron Age enclosed farmsteads at Northstowe was increasingly dominated by cattle. Their ageing data, with almost two-thirds of the slaughtered animals being adults or elderly, suggests that they were mostly kept for traction, indicating a focus on arable farming. The management of the second most important species, sheep, was very similar to that of Haddenham V during the MIA but changed substantially in the later phases. The peak in age at death at an advanced adult age (6-8 years) suggests that the focus shifted more in favour of wool production. The culling of yearlings, already reduced in the LIA assemblages, is replaced by that of subadults (12-24 months) in the

[16] Here the interpretation had to rely on an in-depth analysis of loose teeth due to the scarcity of preserved mandibles.

Latest IA. This means that the need to reduce the flock before winter was becoming increasingly less important and the focus could shift towards the culling of prime-size animals.

Northstowe is located only a few kilometres to the south of Haddenham V. It is, however, far enough from the Fen edge proper, to render at least part of its surrounding landscape elevated and dry. Elevation and drainage have been linked elsewhere to a preference for sheep over cattle (see section 3.4.2 – The role of sheep and cattle).

I would argue that in this case, the opposite could have happened. In a landscape where the abundance of water was not an issue, the availability of arable land and pasture was a much more pressing concern. The idea that diseases such as footrot and liver fluke would have limited sheep husbandry in the wetland is a misconception: for one thing, the spread of footrot depends on many factors other than the wetness of the landscape (Aguiar et al., 2011; Zanolari et al., 2021); secondly, it is obvious from the large scale of sheep husbandry in the Fenland documented at least from the Bronze Age (Pryor 1996) that prehistoric sheep could be well suited to wetland environments.

Feeding large herds of cattle would have required more fodder and larger and better-quality pastures whereas the needs of sheep could have been in good part accommodated by pasturing them in the biomass-rich wetland environments. Furthermore, given the important role of cattle in arable agriculture, larger numbers would have possibly been required where arable land was available.

Therefore, the preference for cattle at Northstowe might have been linked to the availability of drier land, which is further confirmed by the progressive diachronic reduction of the autumn cullings of sheep.

8.1.2.3 Dragonby

The animal economy in the Latest Iron Age phase at the large open settlement at Dragonby focused primarily on sheep.

Their culling profiles show a strong emphasis on prime meat production, with most of the animals slaughtered between one and three years of age. The culling of yearlings was limited, comparable to that of the last phase at Northstowe. The production of wool and even milk was substantially less important than in the southern sites.

Cattle were kept primarily for traction, but unlike the other core sites, juveniles were relatively well represented, hinting that management practices at the site were somewhat different from those practised in the southern part of the region.

The archaeological literature does not offer much in terms of suitable published faunal reports to compare with Dragonby. However, two sites dated to the Mid to Late Iron Age located on the Fen edge in southern Lincolnshire can represent an interesting geographical link with the sites mentioned in the last two sections.

The excavation at Outgang Road, Market Deeping, yielded a small faunal assemblage (Albarella, 1997b) characterised by the prevalence in NISP of cattle among the three main domesticates (48%) followed closely by sheep (44%) and smaller numbers of pigs (8%). These taxonomic frequencies resemble more those at Northstowe than Dragonby, suggesting that it was culturally and environmentally closer to the former. A much larger assemblage from Billingborough (Iles 2001) yielded overall similar frequencies (cattle 54%, sheep 42%, pig 6%).

Neither report presents full mortality profiles, but ageing data from dental wear and epiphyseal fusion is reported and interpreted by the authors. For Market Deeping, the focus in cattle husbandry was on young and fully adult animals, interpreted as a milk and traction-oriented strategy. For Billingborough the focus was on adults but with only a few reaching more advanced age, which was interpreted as an emphasis on meat production. In both sites, the culling of sheep yearlings was identified and the overall pattern was interpreted as having an emphasis on meat production.

The unsubstantial culling of sheep yearlings could be related to a general diachronic development or landscapes less dominated by wetland environment, as I have suggested for the Later phases in Northstowe. Conversely, the focus on prime mutton was detected only at Dragonby. The presence of young cattle also rarely features in the Iron Age assemblages of Eastern England but was detected both at Dragonby and Market Deeping.

Together with the differences in livestock type reported in the previous section, these distinctive traits in husbandry strategies characterise Dragonby as being similar, but different from the sites around the Fenlands. While differences in the environment and morphology of the terrain in the immediate surroundings of the sites might have played a role in husbandry choices, the broader area in which Dragonby was located was probably as characterised by wetlands as the Fens were. We can therefore think about these differences as more related to the great geographic distance and consequently different socio-cultural networks in which it participated.

8.1.2.4 Skeleton Green

Although the animal economy of the Latest Iron Age open settlement at Skeleton Green was largely dominated by pigs, data on cattle and sheep was sufficient to reconstruct practices in broad strokes.

Cattle represent the second most represented animal, which is in line with the general prevalence of cattle in Iron Age Hertfordshire (Morris 2016).

The mortality profile of cattle indicates they were mostly kept for traction. Ageing data for sheep presents an atypical profile with a peak in age at death corresponding to the juvenile animals between two and six months, another one to the young adults between two and three years of age, and virtually no elderly animal represented. This pattern is difficult to interpret but could represent a focus on milk and prime meat. Ageing data is largely consistent with that from other assemblages from excavated sites in the Puckeridge-Braughing area (Croft, 1979; Fifield and King, 1988).

8.1.3 Pig husbandry

All four sites present consistently similar culling patterns. These are focused on the exploitation of subadults and, to a lesser extent, adults and immatures, indicating intense exploitation for meat. This is perhaps unsurprising for pigs, but together with the usually small numbers and the aforementioned isotopic evidence for their feeding of settlement waste (3.2.3.5 – Pig), it indicates that close control was widely practised.

8.1.4 What made Skeleton Green different?

The faunal analysis of the assemblage from Skeleton Green has highlighted a series of peculiar traits that set the site apart from the others considered in the same region. The most immediately striking characteristic is the prevalence of pigs, meat-producing animals that are usually more frequently found in continental Europe and, in general, in consumer sites (Albarella, 2019, p.89).

The evidence for butchery does not seem to support particularly intense or atypical processing patterns. However, Ashdown and Evans (1981) noted in the original report that the head bones of caprine and cattle were underrepresented in comparison to those of pigs. It is then worth comparing side by side the skeletal element distributions of the three species in this assemblage (Table 8.1). The distribution of pig elements is similar to that of the other core sites (6.5 – Distribution of anatomical elements), suggesting that they were raised and slaughtered on-site. The differential representation of cranial elements in pigs and caprines can be easily explained in the differential representation of cranial and postcranial elements in pigs. Comparable differences can be found, for example, in the Dragonby assemblage. More substantial is the under-representation of cattle cranial elements. Cattle are large animals, therefore the dearth of cranial elements might suggest that partially processed carcasses were imported on-site. Moreover, the limb bones of all three species are better represented when compared to the other core sites, supporting this hypothesis.

The atypical sheep mortality profile described above (8.1.2.4 – Skeleton Green) could then be explained by precise choices in the age range of the animals imported to the settlement.

Skeleton Green		Cattle				Caprine				Pig			
		MNE	MAU		%MAU	MNE	MAU		%MAU	MNE	MAU		%MAU
Head	Horncore	3	2	1%	8%	6	3	2%	14%				
	Upper jaw	3	2	1%	8%	8	4	3%	18%	75	38	13%	67%
	Lower jaw	14	7	4%	27%	43	22	17%	100%	113	57	19%	100%
	Zygomatic	2	1	1%	4%	1	1	1%	5%	11	6	2%	11%
	Atlas	0	0	0%	0%	2	2	2%	9%	0	0	0%	0%
	Axis	3	3	2%	12%	3	3	2%	14%	0	0	0%	0%
Front limb & girdle	Scapula	34	17	10%	65%	18	9	7%	41%	34	17	6%	30%
	Humerus	38	19	11%	73%	28	14	11%	64%	35	18	6%	32%
	Radius	23	12	7%	46%	23	12	9%	55%	35	18	6%	32%
	Ulna	18	9	5%	35%	19	10	8%	45%	46	23	8%	40%
Hind limb & girdle	Pelvis	9	5	3%	19%	10	5	4%	23%	17	9	3%	16%
	Femur	40	20	11%	77%	29	15	11%	68%	52	26	9%	46%
	Tibia	9	5	3%	19%	17	9	7%	41%	49	25	8%	44%
Extremities	Metacarpal	13	7	4%	27%	14	7	5%	32%	32	16	5%	28%
	Metatarsal	19	10	6%	38%	13	7	5%	32%	34	18	6%	32%
	Carpal 2+3	0	0	0%	0%	0	0	0%	0%	0	0	0%	0%
	Centroquartal	13	7	4%	27%	0	0	0%	0%	1	1	0%	2%
	Calcaneum	52	26	15%	100%	6	3	2%	14%	42	21	7%	37%
	Astragalus	35	18	10%	69%	7	4	3%	18%	14	7	2%	12%
	Phalanx 1	32	4	2%	15%	6	1	1%	5%	12	1	0%	2%
	Phalanx 2	9	1	1%	4%	2	0	0%	0%	8	1	0%	2%
	Phalanx 3	5	1	1%	4%	0	0	0%	0%	4	0	0%	0%
Total MNE		374				255				614			

Table 8.1 Body part representation for cattle, caprines and pigs at Skeleton Green. Elements are represented as MNE and MAU numbers, as percentages of the total MAU (with above-average percentages marked in red), and as percentages of survivorship against the highest MAU number (%MAU).

It is useful to compare these patterns to those found at Dragonby and Elms Farm, Heybridge. These two sites have similarly late chronologies, abundant findings of imported material culture and constitute large, aggregated settlements of the types that emerged at the very end of the British Iron Age. Latest Iron Age Dragonby and Elms Farm showed relatively large proportions of pig remains (19% and 12% of the total MNI for the three main domesticates). Although not comparable to the frequency of pigs in the Puckeridge-Braughing area, the mortality profile of caprines and cattle at these two sites showed a strong – for the Iron Age – emphasis on meat production.

They did not, however, show a similar pattern of processing and disposal, with their skeletal element distribution indicating the slaughtering and processing of carcasses on site.

Ashdown and Evans (1981) linked the strong presence of pigs to the availability of forested land in the proximity of the site. Given the relatively intense exploitation pattern and the probable closely controlled management, it is more likely that not much woodland was available. Rather, the presence of pigs and the contribution of imported carcasses from outside indicates a densely anthropised locale and the need to maximise meat production to sustain its population.

8.1.5 A note on horse husbandry

The model of free-range breeding of horses proposed by Harcourt (1979) and developed by Hamilton (2000) was discussed in Chapter 3. While it was probably widespread in southern England (Hambleton, 2008, p.72), it is evident from the available data that this model does not apply to Eastern England and the Upper Thames valley. Not only the frequency of horses in the assemblages is usually relatively high (see Chapter 6 for the core assemblages and Albarella, 2019 for Central and Eastern England in general), but there is evidence of on-site breeding in the form of remains of juvenile and immature horses from the core sites of Dragonby, Haddenham V, Northstowe, and from different sites in the Upper Thames Valley (Mulville, Ayres and Smith, 2011).

Given the symbolic and social importance of horses in pre-industrial societies, the existence of two radically different models of horse management in the two regions could represent an important element of cultural difference.

8.1.6 Cross-Channel relationships in animal husbandry

Given the strong relationships between Britain and the near continent highlighted in section 2.6.32.6.3 – Exchange networks and contact with the Continent, a comparison with the areas across the Channel and the North Sea can be used to obtain useful insights into the patterns described above in this chapter.

Belgic Gaul was an extremely large and diverse region, encompassing parts of modern northern France, Belgium, Germany and the Netherlands. This diversity is reflected in all aspects of the animal economy, from the taxonomic composition of the assemblages to mortality profiles and butchery practices (e.g. different regions of northern France in Auxiette and Hachem 2021, pp.92-115). Overall, the most obvious difference is the absence of the generalised preference for sheep that we find in Britain. Two case studies from the literature have been chosen for their comparative value, to highlight differences and similarities between the two macro-regions.

The first concerns the wetlands of the western Netherlands. The available faunal data from the Iron Age (800-12 BCE) in this area has been reviewed in detail by van Dijk (2016) to reconstruct husbandry practices. This region is characterised by a low-lying and flood-prone landscape, which presented environmental constraints and opportunities for its late prehistoric inhabitants largely similar to those of the English Fenlands. The settlement pattern is characterised by isolated farmsteads located on higher parts of the landscape. The overall interpretation of the husbandry strategies is that of mixed farming to support a subsistence economy. The herds were dominated by cattle, followed by sheep and a small proportion of pigs which tended to decrease towards the end of the period. Van Dijk links the dearth of pigs to the unsuitability of wetlands for growing enough cereals to feed them, and to the focus on mixed farming, which would have privileged animals providing multiple products. Sheep proportions were variable, and van Dijk links their abundance at some sites to the high salinity of some soils limiting the presence of the freshwater snails that host and spread liver fluke in sheep.

Most cattle were slaughtered as adults, with some sites focusing on younger adults (emphasis on meat) while others kept more older individuals (emphasis on secondary products). The keeping of adult cattle was also linked to their use as standards of value and gift exchange which had been previously suggested for the Iron Age in the Netherlands (Van Dijk and Groot, 2013).

Ageing data for sheep was not abundant but it appears that they were mainly slaughtered during their second year of age, with an emphasis on meat production.

When compared to the sites in the Fenland, there is an overall similarity in the scope of animal husbandry choices, favouring a diversified use of the animals with an emphasis on meat production without it being a specialised production. The main difference is probably in the scale of herding and arable farming: compared to the Fenlands the landscape in the western Netherlands was even more dominated by wetlands, and the size of settlements was smaller. In this context, the lack of intense autumn killings of sheep and the preference of cattle for meat production could have been supported by smaller herds.

The second case study regards the Aisne Valley in the Hauts-de-France region. The valley is characterised by free-draining calcareous soils on gravel river terraces, but the Iron Age settlements were often concentrated near the flood-prone valley bottoms (Innes and Haselgrove, 2019). The investigation of the palynological evidence from the surrounding area of the long-lived Iron Age and Roman farmstead of Beaurieux Les Grèves has been compared with that from other archaeological sites and has helped in reconstructing the vegetational history of the valley (Innes and Haselgrove 2019). The valley had been almost completely cleared of forests during the Early Iron Age with woodland persisting only on the steeper slopes and on the plateaux. By the Later Iron Age, it was supporting mixed agriculture, with pastures near the settlements and cereal fields further away.

The available faunal data from the Late Iron Age in this area has been reviewed in detail by Paris (2017; 2018) to reconstruct the animal economy.

The settlement pattern of the Aisne valley during the Late Iron Age is characterised by a variety of site types including isolated farmsteads, aggregated settlements of various sizes and fortified *oppida*. These last are particularly important in the comparison with Britain, as the appearance of *oppida* in northern France from the 2nd century BCE has been linked to a substantial specialisation of production (e.g. metalworking), the creation of larger redistribution networks, and increased societal stratification.

Concerning agriculture, this period saw considerable intensification and the adoption of specialised monocultural cereal farming. Notwithstanding the large population and ‘urban’ character of the *oppida*, there is both structural and faunal evidence for the rearing of livestock on site. Both the *oppida* at Villeneuve-Saint-Germain and Condé-sur-Suippe presented evidence for the intensive exploitation of pigs.

During the Iron Age, the Aisne valley saw a progressive general shift from cattle to pig, to the point that by the Late Iron Age, the assemblages were invariably dominated by pigs, followed by cattle and then caprines. Rural settlements, however, had comparatively higher percentages of cattle and caprines when compared to the *oppida*.

Cattle were also reared intensively, with most of the individuals slaughtered as subadults and early adults. Caprine husbandry strategies were more variable but consistently focused on secondary products. Neonatal individuals of both cattle and caprines were virtually absent. While the emphasis on prime meat was ubiquitous, rural sites tended overall to keep older animals to exploit secondary products.

Both *oppida* showed evidence for standardised and specialised butchery practices, and butchery quarters were identified at Villeneuve-Saint-Germain. While most animals were kept or at least slaughtered within the *oppida*, the analysis of the distribution of skeletal elements showed an under-representation of cranial elements, suggesting the redistribution of processed carcasses.

Overall, we can detect elements of similarity between the French *oppida* and the Puckeridge-Braughing settlement (Skeleton Green). Both showed a preference for pigs, intensive meat production and hints of redistribution of carcass parts.

There are however also substantial differences. For instance, the settlement type represented by the Puckeridge-Braughing sites was a very late and short-lived development. The focus on pigs was also rare in Britain, even at the large, aggregated settlements that are often referred to as *oppida*. Although data from rural sites near Skeleton Green is missing, data from elsewhere in Britain consistently shows more emphasis on secondary products and a secondary role for pigs.

Finally, there is no evidence in the Skeleton Green assemblage for either culling strategies or butchery practices as specialised as those described for the French *oppida*.

8.2 Continuity and change in animal husbandry at the end of the Iron Age

In this section, I will discuss the evidence presented so far to place it in a wider historical context and attempt to answer the research questions presented in Chapter 1.

8.2.1 Changes in animal husbandry over the Later Iron Age

The review of the evidence presented in Chapter 3 showed that overall, the animal economies of the Iron Age in eastern and southern Britain maintained a rather conservative character over time. The range of animal species exploited remained limited, with neither new introductions nor radical change in the generalist and extensive strategies of their exploitation. The only general element of change was the increased importance of sheep, which I have linked to settlement expansion (3.4.2 – The role of sheep and cattle).

The data analysed in Chapters 6 and 7 and discussed above supports the previously proposed interpretation for the earlier period (MIA and LIA) of a conservative and successful husbandry system that replicated itself with relatively little variation throughout the period.

The new osteometric evidence suggests that livestock improvement was not generally sought, although there is some evidence that cattle were considerably larger in Bedfordshire and increasing in size. Aside from that exception, both cattle and caprines were uniformly small across southern and eastern Britain throughout the period.

Furthermore, the analyses have provided some further insights into the Latest Iron Age.

The ageing data from the core assemblages showed limited autumn sheep cullings at Dragonby, Skeleton Green and in the later phases at Northstowe when compared to the earlier core assemblages. Reducing the autumn cullings meant that more animals survived into subadult and adult age, consequently increasing the emphasis on either prime meat or secondary products. This pattern is virtually unknown in previous reviews of the period (Hambleton, 1999). It is, however, present in the Latest Iron Age phase at Elms Farm, Heybridge (Johnstone and Albarella, 2015) where the culling of yearlings briefly reappeared in the Early Roman period.

In the absence of more assemblages covering both earlier and later phases, it is difficult to assess if this represents a real diachronic pattern, but it is interesting to note how it is mostly found in the large, aggregated settlements appearing at the end of the Iron Age.

Abandoning the intensive autumn cullings meant having more sheep to feed over winter which could have been offset by increased fodder production. Although we still know very little about foddering practices, it is interesting to note that the earliest evidence for haymaking in Britain comes from Silchester (Lodwick, 2017), another Latest IA large aggregated settlement where taxonomic frequencies and slaughtering strategies hint at an emphasis on meat production (Grant, 1977).

The increased emphasis on meat production was particularly evident at Skeleton Green. The character of the animal economy at this site has been discussed above and shown to partly reflect patterns found in the *oppida* of northern France. A direct relationship with the areas across the Channel is possible, and the presence of Roman or Gaulish traders living in the settlement has been proposed based on abundant findings of graffiti on pottery (Partridge, 1981, 351).

Regardless of the possible presence of continental immigrants, the intensification of meat production most likely represented a response to nucleation and the presence of a larger population. These settlement types appeared very late, and when they survived the Conquest, they were substantially altered to integrate into the new system. It is possible that the few decades between their foundation and the Roman conquest represented an experimental phase in which the traditional relationship with domestic animals was being renegotiated and restructured.

Developments related to the farming economy surely played a role in the formation of these new site types. Over the Later Iron Age climatic improvement, the increase in salt production, new foddering techniques and an overall stable and successful husbandry system contributed to creating the food surplus needed both to support demographic expansion and settlement aggregation.

8.2.2 Regionality and adaptation to the landscape

Animal husbandry techniques and livestock type were rather homogenous across eastern and southern England, but local and regional differences existed. In addition to the regional patterns summarised in section 3.2.3 – Livestock management and the possible difference in horse husbandry mentioned above, two considerations emerged from the analysis of data from Eastern England.

The first regards livestock types. As can be expected across such a large area, subtle differences in bone shape and size hint at the existence of different livestock types. The available data was unfortunately insufficient to characterise their exact geographic distribution. Future research might be able to give further insights on the matter, but at the moment we can probably see the area around the Fenlands as a transitional zone between the ‘southern’ and ‘northern’ types.

The second regards adaptation to the landscape topography and environment. As we have seen in sections 8.1.2.1 and 8.1.2.2, exploitation patterns in the Fenlands were uniform and similar to those found in other parts of the country such as Wessex. Furthermore, all the mentioned sites except Northstowe were similarly sheep-dominated. This pattern mirrors the topographic distribution of cattle and sheep-dominated assemblages originally detected by Grant (1984). Whereas in Wessex and the Upper Thames Valley, cattle were predominant in the wetter valley bottoms, around the Fenlands they became more frequent further away from the wetland environment (e.g. Northstowe).

Hambleton (2008, 45) noted the same seemingly counterintuitive abundance of sheep near the wetlands in Somerset and Avon. As discussed above (8.1.2.2), the arguments against sheep pasturing in the wetland are dubious; therefore, it seems that finer distinctions are needed to interpret the correlation between landscape and taxonomic frequencies.

It is possible for cattle to successfully graze on wetlands, but herding large numbers would have probably been more complicated than doing the same with sheep. Sheep are sturdy and versatile animals, and their smaller size and faster reproductive rate made their individual value lower than that of cattle. Thus, sheep were probably preferred in any situation where access to pasture or its quality was limited, whether it was in the upland areas in the south or the wetlands elsewhere.

If, as suggested by the archaeobotanical evidence, there was an increase in the scale of arable production, it is even possible that sheep grazing played a role in the reclaiming and management of arable land through grazing and direct manuring.

Although variations and local patterns existed, the alternation of sheep or cattle-dominated systems according to topography and management practices, as well as the progressively increased reliance on sheep were shared across southern Britain, making this model of animal husbandry, in broader terms, a common cultural trait.

8.2.3 The relationship with ‘Roman’ animal husbandry

Comparing the British Iron Age with the Romano-British period in terms of species used, their management, and processing, it is evident that the extent of the change occurring during the latter period was far greater than that occurring during the former (3.3 – Agricultural change in Roman times).

In terms of the relationship between the two husbandry systems, broad continuity of practice in rural settlements has already been discussed in section 3.3.2 – Techniques and scale of farming, storage and produce use. The main elements of change during the Later Iron Age, the increased age at death of sheep at some sites and a general increased emphasis on prime meat production, also characterised the Roman period (Maltby, 2017; Wright, Tecce and Albarella, 2019).

This similarity, however, does not imply cultural continuity. Both the Later Iron Age and the Roman period were characterised by demographic increase and settlement nucleation, requiring more substantial food surplus and new forms of redistribution. What was different in the two periods was the nature of these phenomena. The large centres of the Latest Iron Age each implemented their own system, adapting from the generalised practices that were already practised in their area and still conducting substantial livestock rearing at and around the settlements.

Conversely, during the Roman period, it was accompanied by the implementation of a distinct 'Roman' model of meat supply for the burgeoning urbanisation. This was characterised by the introduction of larger animals, standardised production and processing, market exchange, and a large scale redistribution system tied to the tax cycle and army supply.

Furthermore, that Iron Age people in Britain were not actively engaged in livestock improvement shows that the trajectory of local farming practices was largely independent and separate from Mediterranean developments.

This is not to completely discount the influence that the events happening in continental Europe during the last two centuries BCE might have had. The Late Iron Age was a period of intense contact with the continent, and the exchange of material culture (2.6.3 – Exchange networks and contact with the Continent) was certainly accompanied by that of ideas.

However, cultural contact can entail a variety of reactions that can range from replacement to syncretism and resistance. For example, studies on animal husbandry in the area of the Rhine border have shown that while different practices and larger or simply different (e.g. polled) animals were adopted even by some communities outside the direct control of the Roman Empire, a variety of practices and animal types persisted even within the border (van Dijk and Groot, 2013; Groot, 2017; Groot and Deschler-Erb, 2015; Lauwerier, 2015).

This patchy adoption of Romanised practices and livestock types, with the persistence of local husbandry strategies and landraces is a common trait in most regions of the western part of the Roman Empire (Valenzuela-Lamas and Albarella, 2017), including Roman Britain (Albarella, Johnstone and Vickers, 2008).

Therefore, while the latest developments in what was otherwise a conservative aspect of society represented a definite shift in societal organisation, it is perhaps unsurprising that the animal economy in Pre-Roman Britain followed its own trajectory despite increasing contacts with the Roman world.

8.2.4 Implications for social change: the discovery of inequality?

The evidence presented in Chapter 6 has confirmed the broad patterns of continuity in the animal husbandry systems throughout the Later Iron Age in southern Britain and the role of sheep in maintaining an extensive approach while exploiting previously unused land to increase production (3.4.2 – The role of sheep and cattle).

The relative geographic and diachronic uniformity of livestock management and type attests to their success in supporting demographic growth and adapting to different environments and changing social forms.

However, by the end of the period:

- Though faunal data is not informative on this aspect, the increased enclosure of the land tells us that the ideas around ownership and land tenure had probably been shifting from more communal to individual or at least smaller-scale forms (2.5.2 – Property and labour).
- Cattle had become rarer relatively to sheep numbers, increasing their value per unit. At the same time, cattle size remained stable (7 – Results – Livestock type and size in Later Iron Age Britain). If cattle

remained a measure of value and a wealth indicator (3.4.2 – The role of sheep and cattle), this means that wealth was becoming more unequally distributed and centred around the cattle owners, possibly fostering the production of objects with cattle iconography (Ellis, 2020).

- Human and livestock mobility was increasing (3.2.2.6 – Livestock mobility). This probably entailed the renegotiation of land use rights and the relationships between communities, creating opportunities for conflict and identity formation.
- Increased salt production made the management of meat surplus easier (3.3.2 – Techniques and scale of farming, storage and produce use), and the patterns of consumption found at large nucleated settlements (8.1.4 – What made Skeleton Green different?) make evident that part of the population was not directly involved in food production. This represents evidence that settlement aggregation was reaching a scale that required wider socio-economic differentiation.
- Craft specialisation (2.5.1 – Artefact production) represented a symptom of an incipient commodity exchange. This was probably a response to the increased population and scale of social relationships creating new opportunities, but it also might have meant that, for part of the population, it was not possible to make a living on traditional crop and animal farming anymore.

Most of these changes were progressive and started relatively early. In time, they most probably contributed to the developments in social complexity that we see in the material record of the Late Iron Age (see Chapter 2). The wide availability of food surplus and the increase in the scale of social relationships (2.7.2 – Social structures: heterarchy in the U.K.?) created the conditions for the development of an incipient redistribution economy, while the specialisation of production and the developments in animal husbandry produced increasing wealth inequality.

In a context in which social relationships were maintained through communal work and the sharing of resources, this would have meant that not everyone would have been able to contribute in the same way and amount. This fostered social diversification, making room for expressions of individuality and rank, which required a renegotiation of the traditional social forms.

CHAPTER 9

Conclusion

This project has shown the potential of investigating past animal husbandry through a perspective that includes attention to other sources of evidence, a flexible approach to chronology and scale, and consideration of the social implications of farming.

The study suggests that the human relationship with domesticated animals during the Later Iron Age in Britain was largely characterised by continuity, until the very late developments that precede, but do not herald, the changes brought about by the Roman conquest.

The slow pace of change in management practices, livestock types and butchery practices during this period should not be seen as a sign of backwardness. Rather, this research has discussed how these small adjustments, accompanied by much more substantial changes in other aspects of the daily life of Late prehistoric Britons, are proof of a successful system.

The trajectory of the changes in animal husbandry during the Iron Age was one that maintained stability, promoted progressive growth and expansion, and yet remained largely independent from Roman influence. We can then be comforted not only in abandoning the old-fashioned core-periphery views that see the British Pre-Roman Iron Age as an atemporal backwater but also those that tried to overcome that idea by playing down the effects of Romanisation and the substantial difference it brought to its ways of life (Albarella, 2007).

While the overall approach to animal husbandry was rather homogeneous across the investigated areas, the data showed fine differences and adaptations in management patterns and animal populations that, with further investigation, might lead to a clearer definition of local and regional systems.

The herding system based on sheep and cattle was well-adapted to the range of environments that could have been found across the island, allowing the colonisation of new land by adjusting the emphasis on the exploitation of one species or the other. More in-depth analysis of species frequencies and mortality profiles in relation to topography on the local scale should be conducted to further investigate the relationship between 'marginal' lands and sheep husbandry and this research has identified the Fenlands as a possible area where this could be done effectively. Further confirmation of this relationship would allow the testing of the hypothesis that the increased reliance on sheep detected in southern (Hambleton, 2008) and eastern (Albarella, 2019) Britain was a consequence of agricultural and demographic expansion.

Livestock size was overall uniform in time and across different geographic zones. The small animals reared in this period were evidently both well adapted to life in Britain (including grazing on and around the wetlands) and to the necessities of the Iron Age Britons. Though larger 'Roman' livestock was available through Gaul at the end of the Iron Age, there is so far no evidence that people in Britain were interested in it. The detection of geographic variability in bone shape, although not surprising, should be taken as an encouragement to further investigate livestock morphometry to identify regional morphotypes. This could be done both by expanding the still limited corpus of available bone and teeth measurements and by the application of Geometric Morphometrics Methods.

All the aforementioned aspects related to the adaptation to the environment, the use of the landscape, and human mobility would be better understood through analyses of stable isotope signatures in animal remains, such as oxygen ($\delta^{18}O$), carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), sulphur ($\delta\ ^{34}S$) and strontium ($\delta\ ^{87}Sr/\ \delta\ ^{86}Sr$). These would allow us to get insights into aspects like animal diet and foddering, seasonality, and the movement of herds in the landscape, with potential applications in clarifying the development of animal mobility through time, detecting aspects of local management strategies that are not visible from more traditional zooarchaeological approaches and contributing on the investigation of the afore-mentioned relationship between sheep husbandry and topography. The few available published papers using these techniques (Hamilton, Hedges and Robinson, 2009; Stevens et al. 2013;

Minniti et al. 2014; Hamilton et al. 2019; Schulting et al. 2019) have already provided valuable evidence suggesting the existence of local management systems (3.2.2.6 – Livestock mobility) and contributed to the overall narrative reconstructed by this thesis.

The most substantial elements of change, although probably still very limited in scale, occurred at the very end of the Iron Age, with the appearance of larger aggregated settlements. The evidence collected in this thesis is too limited for a satisfactory characterisation of their animal economies. The investigation of meat production through the analysis of mortality patterns and carcass processing at these site types and the contemporary sites in their surroundings could greatly contribute to the general discussion on the developments of the Late Iron Age by better defining the extent to which these sites were dependent on food redistribution networks and how these functioned.

The discussion on the effects of animal farming on the developments of Later Iron Age societies has led to the suggestion that arable expansion slowly created wealth inequality. Moreover, the developments in meat production fostered aggregation and influenced the way social relationships were constructed. These topics deserve more attention and a fully integrated approach, including all the archaeological sub-disciplines concerned with the reconstruction of farming practices. If agriculture was Iron Age politics (Hill, 2011, p.253), then it is possible that in the future its investigation will be able to shed light on sociological aspects whose understanding has been limited insofar.

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