The Bones at Binchester: An Exploration of Military and Civilian Identity through a Zooarchaeological Study of Cattle Remains from a Late Roman Fort and Vicus

CAMERON BURGESS CLEGG

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The interrelationship between forts and their attached vici during the Late Roman Period is still not fully understood, particularly in the North of Britannia. Furthermore, the Late/sub-Roman transitional period remains a nebulous topic of archaeological investigation, obfuscated not only by a dearth of dateable artefacts, but also by a paucity of large-scale research focusing on this time period.

The site of Binchester, located in Bishop Auckland, is ideal for providing unique insight into both of these areas. Binchester shows evidence of continuous occupation through the Late Roman Period and into the 6th century, providing insight into the Late/sub-Roman transitional period. Furthermore, the current project features the simultaneous excavation within both fort and vicus, yielding large amounts of cultural material from each location.

Among the finds recovered from both areas are robust assemblages of animal bones of Late Roman date, with the likely presence of sub-Roman inclusions. These faunal remains, particularly the cattle bone, representing a majority in both assemblages, provide a unique window into the practices, exchange and interrelatedness of the fort and vicus inhabitants, giving insight into the convergence or divergence of identity between these two areas.

Morphological analysis of the species representation and utilisation of cattle resources at the fort and vicus suggests a surprising degree of similarity in practice between the fort and vicus, suggesting a high degree of social cohesion and a shared, if not identical, identity in both areas. Metric analysis of recovered cattle elements, conversely, indicates a distinction in identity between fort and vicus, providing evidence of the preferential provisioning of larger, likely castrated, cattle within the fort. Comparison between sites across a range of site functions, locations and chronological dates revealed a widespread trend of larger cattle within military sites, with civilian or urban sites seeing fewer likely castrates. This cross-site comparison also shows a great deal of morphological and metric similarity between Late and sub-Roman cattle populations, indicating a continuity of practice and maintenance of local control.

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Submitted for PhD

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September 2016

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Statement of Copyright

Acknowledgements

I received much support and encouragement from my supervisors, David Petts and Peter Rowley-Conwy. I give thanks to Peter for stoking my interest in zooarchaeology and providing opportunities to expand my knowledge, as well as many 'planning pints' at the Victoria Pub on Fridays! I am grateful to David for his help in facilitating my participation in the Binchester field project, as well as giving me ample access to the faunal materials for analysis. Additionally, David should be commended for his saint-like fortitude in tolerating my own exuberance and passion, and nonstop discussion of the 'scratty animal bits' the Binchester excavations kept unearthing. Finally I am thankful to both of my supervisors for their help in furthering my own research even in areas outside of their own respective expertise, and for the many late nights and long days of correcting thesis drafts!

This study would not have been possible were it not for the Vinovia Durham-Stanford research project, and the willing and enthusiastic excavation of Binchester by the Durham year 1 undergraduate classes from 2009-2015, as well as multiple US-led field school participants, whose work provided many hundreds of pounds of faunal remains for analysis, with only a minimal amount of mattock and trowel damage.

For their help in the organisation and washing of vast amounts of animal bones I give my heartfelt thanks to the Arch & Arch Society of Durham and Northumberland volunteers who made bi-weekly visits to the Durham teaching labs for bone washing. While there were many volunteers over the years, including a number of Durham undergraduate students, I would like to thank several Arch & Arch members specifically, just as I promised in return for many years of dedicated help and friendship. Margaret Hudson, whose professional expertise and passion helped to motivate all around her, and a special thanks for her fierce defence of our lab space in the event of scheduling conflicts! Sue Tones Wilson, for her unbridled enthusiasm, thirst for knowledge, and a chipper attitude to rival my own! Tony and Barbara Metcalfe whose knowledge and willingness to share it never went unappreciated. And my sincere gratitude to everyone else who sacrificed their afternoons in order to wash bones and contribute towards our understanding of Binchester, you have my thanks. In a special note, I would also like to thank my friends Sue, Margaret, Tony and Barbara for helping to enhance the author's diction through instruction in critically important vernacular and vocabulary unique to the British North. Until I met the lot of you, I never could fancy swinging a mattock while knee deep in the claggy mud, digging up minging bones while feeling poorly; and now I can't help but feel chuffed every time I think back on the times we shared.

I am grateful to the help provided by the Durham Archaeological Services unit, who facilitated many hours of lab space and were always happy to lend a helping hand when asked. In particular Charlotte O'Brien, Lorne Elliott and my zooarchaeology allies Beth Upex and Carrie Armstrong provided invaluable help at countless critical times throughout my work on this project.

Finally I would like to thank my friends, family and loving wife for all of their support, help, and tolerance in the completion of this project. To my parents Drs Teresa Burgess and Dennis Clegg, your expertise and determination in your fields was always an inspiration to me. Thank you both for all of your support and encouragement through the years. To my sort-of sister Katharine, I know this isn't one of your three favourite things, but I think it's pretty great. To my amazing wife, Clarissa, you push me to be better, work harder, and have more fun. Without your love, help and support, this project would not have been possible.

This thesis is dedicated to my loving family, for their years of support and encouragement.

It is also dedicated to the hundreds of Romano-British cattle who gave their lives all those years ago. Born into servitude, it is your heroic sacrifice that allows us to better understand the time in which you lived. Without you, this project would not have been possible.

1. Introduction, Background, and Binchester.

The site of Binchester, Roman Fort is located in Bishop Auckland, co. Durham, along the Roman road of Dere Street. Built initially to house a cavalry contingent from Spain, the fort was to serve as a first responder in the case of an enemy incursion across Hadrian's Wall (Vinovia 2009). Binchester is notable for several factors: First, the site saw continued occupation after the withdrawal of Roman influence from Britain, functioning as a civilian settlement through the 5th century AD with the notable presence of several Anglo-Saxon Burials (Vinovia, 2009). Second, the site of Binchester is an iconic site, seeing various professional and amateur programs of excavation from as early as 1880 (Hooppell 1891), and as recently as 1986-91 (Ferris 2010), contributing much towards our understanding of the Northern frontier of the Roman Empire. Most notably, the current project of excavation features simultaneous excavations within both the fort and the neighbouring vicus, yielding large assemblages of cultural material in both trenches, including large faunal assemblages.

The analysis of well-preserved faunal assemblages can yield a wide array of information, elucidating the exploitation and utilisation of animal resources within archaeological sites. This information can give researchers insights into the dietary practices as well as other husbandry strategies employed by ancient occupants of archaeological sites. Zooarchaeological analysis of the faunal assemblages from the 2011/12 excavation seasons at Binchester has facilitated a direct comparison of the relative importance of major domesticated species, as well as showing potential differences in their utilisation, between the fort and vicus. Often comparison between sites can be hampered due to differing methods of material recovery employed on site (Historic England 2015). For Binchester, simultaneous excavation in both fort and vicus by the same archaeological team ensures that the same level of expertise in excavation, data collection and storage are employed towards both assemblages. This site provides a unique opportunity to examine the differences between fort and vicus from a zooarchaeological perspective, viewing the consistence of animal exploitation practices, interaction and exchange between fort and vicus, and assessing the divergence or convergence of identities between these two separate but connected areas.

This chapter provides context for the Binchester 2011/12 faunal analysis, which is the basis of this thesis. This includes background information relevant to the research aims in addition to a brief history of Binchester and its Archaeological significance.

1.1 Research Aims

This project was undertaken to address the following research questions:

- What do the faunal remains tell us about the subsistence strategies, culture, and identity of the occupants of the fort and vicus at Binchester?
    - Do the faunal assemblages resemble what would be expected of a 'Romanised' archaeological site?
- Are there differences in the cattle remains between the fort and vicus assemblages?
    - Is this indicative of different sources of supply, or potentially a divergence/convergence in culture, status or identity between the two areas?
- Do these patterns bear any similarity with other sites or time periods?

    Which site-type and time period bears the greatest similarity with the Binchester assemblages?

This analysis is aimed at creating two databases of morphological and metric data from the Binchester 2011/12 fort and vicus, is included in the appendix of this report. Beyond the creation of a detailed record of faunal material recovered, this project aims to assess three major aspects of the Binchester fort and vicus in particular, addressing major themes of academic debate and theory concerning the Northern frontier of Late Roman Britain.

1) Binchester in Life

Zooarchaeological analysis of the Binchester 2011/12 fort and vicus can provide a wealth of information concerning the occupation of the two areas. The cattle remains will undergo additional morphometric analysis. This analysis reveal butchery techniques, dietary preference and any utilisation of cattle remains for secondary processing, also it will provide valuable insight into the treatment and use of these animals in life. This includes potential exploitation of cattle resources for traction, dairy or even other specialty practices. Metric analysis will give us information concerning the size, sexual dimorphism, and robusticity of the cattle population at Binchester. This can help us further understand exploitation strategies, as well as giving clues as to the origin and type of cattle on site, or the presence of multiple breeds. All of this information concerning the life and death of cattle at Binchester will contribute to our overall understanding of the site and the lives and livelihoods of its Late Roman occupants.

2) Binchester in Comparison

As discussed above, Binchester represents a unique opportunity to gain a zooarchaeological perspective of the differences and similarities between fort and vicus faunal assemblages of likely Late Roman date. A direct comparison of the faunal material recovered from fort and vicus will yield insight into potential differences or similarities between the occupants of both areas. Morphological information can yield information pertaining to similarity in practice and preference, gleaning insight into the interaction, interdependence and possible shared identity between the two areas. Metric information will provide clues as to potentially different sources of supply for the vicus and fort cattle assemblages, as well as potential differences in herd exploitation strategies employed. Differences in sources of supply or practices of animal utilisation between the fort and vicus may indicate differences in supply, status or identity between the two areas. Alternatively, the presence of similar practices or herd dimorphism may suggest similar sources of supply, a conflation of identity, or the imitation of one group by another.

3) Binchester in Context

Although it has undergone countless previous excavations, the current excavation at Binchester does not yet have a definitive chronology for the stratigraphic layers excavated, making determining the actual date of the faunal material challenging. Thus, the faunal material recovered from the Binchester fort and vicus will be compared to a wide variety of site types, covering a wide chronological range. This will help to establish which site type, military, urban, small settlement or rural, is most similar to the Binchester assemblages. The comparison of Binchester to sites covering a wide range of time periods will help to solidify the best chronological fit with the Binchester assemblages. Beyond simplistic matching and comparison between sites, the whole range of faunal material compiled, including the Binchester assemblages, will be assessed for any regional or site-type specific trends or anomalies. In this fashion the compilation of comparative material can help to identify broader trends and indicators across the whole of Roman Britain.

These three pillars of the investigation will yield a wealth of information concerning the utilisation of animals by the occupants of the Binchester fort and vicus, revealing differences and similarities in practice and preference, and giving indicators of a convergence or divergence in identity between these two areas.

1.2 Romanisation and Identity

One important aspect of the faunal analysis of Binchester is to determine if it resembles a typically Romanised faunal assemblage. The definition of "Romanisation" as a concept is fraught with both theoretical and methodological challenges, making it a complicated matter for even the most stalwart of theoreticians. Seeing huge regional variance, this discussion will focus on the concept of "Romanisation" purely in Britannia. The ideas and definitions of what "Romanisation" entailed are a hotly debated topic in British Archaeology (e.g. Mattingly 2004; 2011; James 2001a). Recent shifts in the focus on the debate have moved away from ideas of a singular or universal Roman identity (e.g. Hingley 2000). Older ideas of detecting Romanization purely through notable stylistic elements or material culture have largely been declared untenable in practice (e.g. Webster 2001). Instead, a more nuanced approach is called for in the recognition of Roman cultural diffusion, especially in regards to frontiers such as Northern Britannia. The debate has migrated away, or beyond, singular ideas of diffusion through direct influence of the Roman state or competitive emulation by conquered native peoples (e.g. Petts 1998, Terrenato 1998, James 2001a, 2001b, Roth 2007). Instead new models of the concept of Romanisation have placed greater agency on individuals, particularly native elites, in the process of adopting Roman cultural norms (Petts 2013, 318). The idea of a cultural convergence, or the amalgamation of both native and foreign identities into one uniquely "Romanised" society with both local and Roman customs, is crucially important to these new models (Petts 2013, 318). With the idea of interaction and convergence between foreign and native customs at the forefront of these new models, several attempts to define these intersecting groups of identity have been made. Mattingly's (2006, 17-20) attempts to distil the vast web of individual human interaction into three major identity groups: Military, Civil (urban), and Rural society. These societies functioned both independently as well as interacting between groups, spurring societal shifts in practice and custom (Mattingly 2006, 18). James (2001a, 2001b, 205-6), finds further separation between cultural groups, identifying state, public, elite and mass culture as distinct entities within Roman Britain. Any model seeking to distil the essential aspects of what has to be a vast, multifaceted and largely individual-led path towards cultural convergence or change, can be accused of oversimplification, while more multifaceted approaches in an attempt to wholly encompass the vast varied terrain of identity and society in Roman Britain can be overly specific and difficult to apply in real archaeological situations (Gardner 2007, 345). Indeed, James (2001b) and Gardner (2007) both note that the identification of the military as a solitary, unified group grossly underestimates the complexity of a widespread, populous group with varied origins. Indeed it is probable that "military identity" varied greatly between different ethnic or social groups (Petts 2013, 314). However varied it may have been, it is very probable that "military identity," defined broadly, would bleed into civilian spheres, notably through the intermixing of soldiers and civilians in the vicus (Mattingly 2006, 511), as well as the presence of soldiers' families within the vicus and, sometimes, within the fort itself. Indeed it is probable that vici served as something of a medium between forts and local rural settlements, facilitating the diffusion and interaction between military, civilian and rural identities and groups (Petts 2013, 318). While the grouping of Roman British society into general subclasses may oversimplify the situation to a degree, this categorisation allows for researchers to attempt to reconstruct the interaction between groups, and garner further understanding of the formation of a “Romanised” society within Roman Britain.

The evolving ideas on what “Romanisation” entails as well as how it may have occurred in the interpretation of Binchester. As a fort, it certainly must have been a prime mover, or at the very least a significant source of Roman influence in the region. The likely intermixing of soldiers and civilians in the vicus (Mattingly 2006, 511) would help to further exchange between these two societal groups, disseminating Roman influence and cultural aspects beyond the walls of forts. In turn, this exchange could disseminate further afield, into the much less explored civilian or rural societal spheres (Petts 2013, 318). While the degree of influence and rate of spread during the early periods of the military occupation of the North are open to question, by the Late Roman Period it is likely that civilian and rural society had amalgamated aspects of “Romanised” culture imparted through interaction and exchange with military society (Mattingly 2006, 275). Put another way, “Romanisation” of the Northern frontier of Britannia likely occurred through the interaction between state and elite culture initially, bleeding through into public spheres and affecting mass culture as a whole (James 2001a, 2001b). By the Late Roman Period, practices and societal norms are likely to have converged between the disparate social groups, amalgamating aspects from each, and producing a uniquely “Romanised” culture on the northern frontier.

1.3. Northern Britannia: A frontier and its forts (and vici, and villas)

Although multiple divisions and subdivisions exist, the Roman province of Britannia can be roughly separated into two distinct zones (Petts 2013, 315). Below the River Severn and Humber lies a largely civilian zone, dominated by civitas level tribal governance (Millett 1990, Sargent 2002, Mattingly 2006). To the North, the landscape was dominated by linearly organised forts along key communication lines along Dere Street and Stangate, and frontier defences such as Hadrian’s Wall or the Antonine Wall (Petts 2013, 315). This zone featured a much heavier military presence, being governed and overseen more directly by military governors than its southern counterpart (Breeze & Dobson 2000, Symonds & Mason 2009). As a study of a Northern fort and vicus, this discussion will focus mainly on this northern zone.

Initially, a simplistic approach to the characterisation of the northern zone argued for a complete lack of villas or towns noted in the South. This largely fit into contemporary views on the division between highland and lowland utilisation (Fox 1959). However, recent work has pointed out that the truth of the matter is more complicated than a simple binary division (Hingley 1989). Across East Yorkshire a number of villas have been noted, distributed widely across Rydedale, the Wolds, and the Vale of York (Ottaway 2003, 139-40). It is possible that the distribution of these villas may in part be due to the civitas of the Parisi, with their capital situated at Brough on Humber (Ramm 1978). To the North and West, however, a lack of villas is perceived, instead the landscape appears to be dominated by forts with attached vici (Petts & Gerrard 2006, 51). In this area, the focus of excavation has largely centred on these easily visible forts, rather than the more obscure and difficult to locate native settlements (Petts 2013, 316). Furthered by what has been coined the “Durham School” of Roman military archaeology (James 2002, 17-26) in the mid-1900s, research in this time period and region was largely focussed on the military aspect of the northern frontier, pursuing research and interpretations to that effect. Although native settlements have been noted, such as at Thorpe Thewles (Heslop 1987) or Bonnygrove Farm in Teeside (Taylor 2007, Annis 1996), work on these sites was limited, involving minimal excavation and finding little evidence of occupation beyond the 3rd C (Petts 2013, 317). With the integration of cultural resource management into the town and planning system, a much larger volume of excavation and analysis has begun taking place (Fulford 2011, Fulford & Holdbrook 2011). Being at the discretion of necessary construction regardless of land type or formation, a functionally random sampling of archaeological excavation has been employed, revealing a wider range of cultural material. This wider sampling is sure to challenge some of the previous perceptions of archaeological thought in this region, however it introduces new challenges in the access to this new work, as much of it is unpublished and remains as grey literature (Petts 2013, 315). This new program of work independent of the guiding academic focus on military matters has produced new evidence that weakens previous interpretations of this area as purely military, helping to diversify the academic approach to the region as well (Petts 2013, 315). In particular, the mandatory excavation work to meet planning regulations has yielded several definite or probable villas in the area, including Old Durham (Richmond et al. 1944) and Faverdale (Proctor 2012) of County Durham, Piercebridge of Teeside (Harding 2008) and Leeming Bar of North Yorkshire (Arch. Services 2009). Rather than consisting only of forts and their attached vici, the North of Britannia, at least in the Lower Tees Valley, contains individuals with the means for large "Roman" construction. Beyond the large oppidum at Stanwick, Iron Age settlements were small in nature, with a notable absence of mid-range and larger settlements to indicate the presence of native elites (Haselgrove et al, 1991a, 1991b; Petts & Gerrard 2006, 35-37). As such, the occupants of these estates are not likely to be native elites, or at least not elites originating from the immediate vicinity (Petts 2013, 327). Some evidence may suggest that the occupants of these villas may be military officers or administrative officials whom purchased land and built as a means of enhancing their office or status (Petts 2013, 324). The presence of crossbow brooches, often interpreted as indicative of civil or military office, at several of these sites, including Binchester, South Shields and Piercebridge, reinforces this interpretation (Collins 2010, 67). The presence of Roman villas, possibly occupied by former military officers or civilian officials, in a zone previously thought to consist purely of forts, enhances our understanding of the region, forcing our theoretical models to incorporate these new discoveries into our understanding of the interaction and exchange between Mattingly's (2006) Military, Civilian and Rural societies. Rather than forts serving as bastions of foreign culture, we can begin to see the north as a complex web of interactions between military and civilian groups, where the individual agency of officials leads to the creation of Roman villas and the further "Romanisation" of the Northern frontier of the Roman Empire.

1.4. Late/sub-Roman Transition

Attempts to broadly define "Romanisation" and better understand the geopolitical landscape of the northern frontier of Britannia in the Late Roman Period are a critical step towards attempting to understand and conceptualise aspects of its political, geographical, and cultural metamorphosis during the Late/sub-Roman transitional period. For the purposes of this project, the term 'sub-Roman' is used to refer to the transitional period immediately following the cessation of centralised Roman input in Britannia, generally considered from the early 5th century into the early 6th. Traditionally cited as occurring in AD 409-410 (Petts 2013, 318-9), the removal of direct administration of Britannia by the Roman Empire brought about many changes in the archaeological record, showing a massive shift in cultural material and occupation of space. A total cessation of coinage is noted, along with a similar shift in the supply of ceramics to the area, indicating a lack in foreign trade (Petts 2013, 319). Additionally, local industry appears to have diminished during this time period, with stone construction being replaced with wooden buildings (Petts 2013, 319). The shift in construction materials, and a lack of coinage or ceramics, makes the definitive dating or extent of this period exceedingly difficult, as the traditional materials utilised in these methods are absent. This leads to an increased reliance on carbon dating methods, increasing the cost of research projects targeting this period (Petts 2013, 320). While the transitional period can often be described in a very general way, minimalizing differences in order to present a unified interpretation (e.g. Wickham 2009, Millett 1990), it is very likely that the province saw huge regional differences in its response to this development (Petts 2013, 320).

A notable shift in the use of space is seen in northern forts as well as their attached vici towards the end of the 4th century, immediately prior to the withdrawal of direct Roman oversight. Multiple areas within forts and vici saw the large scale deposition of waste material during this period (Dobney 2001, Gardner 2007). The forts at Birdoswald, Caerleon and South Shields all show the dumping of refuse in and around ostensibly abandoned buildings (Fox 1940, Hodgson 1994, Wilmott 2000). This refuse dumping is mirrored in civilian sites such as the forum at Caerwent and the Principia at York (Brewer 1990, Philips & Heywood 1995), suggesting a similarity in practice across multiple site types during this period. Notable among these refuse dumps is a high degree of butchery waste. This indicates either the presence of a large population within these areas, or the centrally located distribution of food resources, possibly outside of the fort and into the hinterland (Dobney et al. 1998, 417-424). Importantly, this suggests a high degree of economic and social complexity within these forts in the late 4th century (Petts 2013, 321). In this time period, a notable shift in supply and trade occurred, with resources being obtained locally rather than from long distance sources, possibly explaining the increase in agricultural activity such as the butchering of animals (Hopkins 1980, Collins 2012). The site of Filey in North Yorkshire also shows a high presence of butchered faunal remains that were likely supplied from elsewhere, with a very high representation of meat bearing elements, and an almost complete lack of primary butchery waste recovered (Dobney 2001, Ottaway 2001). The presence of these refuse dumps in many different areas within forts and civilian sites, including high-status areas such as the praetorium at Binchester (Ferris 2010), suggests a changing view of public and private space, and possibly the convergence of practice between the occupants of the fort and attached vicus in the late 4th c. (Petts 2013, 321). As Mattingly (2006) notes, the intermixing of fort and vicus personnel likely resulted in the intermingling of culture and societal practices between the two locations. Furthermore, the Vindolanda tablets show the expanded scope of interaction of military and civilian individuals beyond the walls of forts in the late 1st C. AD (Bowman 2003). It is possible that the removal of direct state level authority and input was the final barrier preventing the complete convergence of these two groups, as the uniformity of refuse disposal in both fort and vicus suggests a diminishing distinction between these areas (Petts 2013, 322).

Immediately following the removal of direct input and control from Britannia, it is likely that the militarised North experienced some troop withdrawal and desertion, as the cessation of pay would effectively remove any incentive to remain for some (Collins 2010, 67). However, evidence does not suggest an immediate mass exodus or abandonment of forts (Collins 2012, 154). Recent excavation projects at a number of forts have shown evidence for continued occupation into the 5th century, including Vindolanda, Piercebridge, South Shields, Carlisle, Birdoswald and Binchester itself (Bidwell 1985, Bidwell & Speak 1994, Wilmott 1997, Birley 2002, Cool & Mason 2008, Howard-Davis 2009, Zant 2009, Ferris 2010). These discoveries show that, although abandonment did eventually occur at most sites, the end of the occupation of forts did not chaotically cease at the moment of separation with the Empire. While the continued occupation of Roman forts into the sub-Roman period is becoming an increasingly accepted idea, questions arise as to the character of this occupation (Petts 2013, 322).

Archaeological evidence supports the continued occupation of forts into the sub-Roman period, as well as suggesting a blurring of the distinctions between occupants of the fort and neighbouring vicus. What, then, does a sub-Roman northern Britannia resemble? In what is commonly called the “warband model” (Petts 2013, 322), it is argued that the cessation of pay led to soldiers' extraction of resources from local sources more directly, shifting away from a taxation of coin paid to the Roman state towards tribute in kind derived locally (Casey 1993a, 1993b, Wilmott 2000, Collins 2011, Collins 2012, 58-60). This entails a shift in the function and format of the military forces away from a cohesive formal military and into something more reminiscent of war bands following warlords (James 2001a). The similarity in refuse dumping between fort and vicus noted earlier during the 4th century may be another symptom of this ongoing reformation of societies (James 2001a). While this model does put forward a possible characterisation of life in sub-Roman Britain, it is beset by a number of problems. First, the uneven linear distribution of forts along communication lines and frontier borders would pose challenges in the extraction of local resources across the entirety of the province. Second, while there is plentiful evidence of sub-Roman occupation of forts in the North, these forts did not remain occupied for long. By the mid-5th century, most of the forts were abandoned, although Vindolanda, Newcastle and South Shields continued to see use into the Mid Anglo Saxon period (Bidwell 1985, Wood 2008, Nolan 2010). Thus, although the withdrawal of Rome didn't see the immediate abandonment of forts in the North, their existence was not stable or long lasting (Petts 2013, 323).

Another issue with the "warband model" is that the location and concentrations of forts in the Tees Valley and Northumbria does not coincide with early Anglo-Saxon occupation patterns in the area (O'Brien 2010). The scale of Anglo-Saxon immigration into the North of England in the mid to late 5th c. is not well known (Petts 2013, 324). However, a general consensus exists positing that the assumption of Anglo-Saxon dominance in the region was through an elite takeover as opposed to a large scale population replacement event (Petts 2013, 324). This is due to the overall low levels of recovered cultural material bearing distinctive Anglo Saxon indicators recovered from the time period. The identification of Anglo Saxon presence is most often determined through the presence of cemeteries displaying distinctive burial practices or metalwork (Petts 2013, 323). The main areas of Anglo Saxon concentration in the lower Tees Valley are in the lowland areas away from forts (Miket & Peacock 1976, Sherlock and Welch 1992, Arch Services 2005). In the mapping out of Anglo Saxon 'culture cores' across the North of Britannia, Roberts (2010) notes that Anglo Saxon activity was focused away from the Roman forts. However, Anglo Saxon material has been recovered from within forts (e.g. O'Brien 2010, Collins 2012), including within Binchester itself, with the discovery of burials following Anglo Saxon practice (Ferris 2010). This indicates Anglo Saxon exchange and interaction with occupants of the forts, possibly former soldiers (Petts 2013, 329). At Binchester, occupation of the fort and vicus seems to have continued into the mid-5th century, possibly later (Petts 2013, 320). However, by the mid/late Anglo-Saxon Period, the focus of power and occupation had shifted 3 km south to Auckland Castle (Roberts 2008). These listed issues pose significant challenges to the warband model, and while they do not invalidate the model itself, they do necessitate the elaboration of the model to account for these issues, in particular the shift in focus between sub-Roman occupation into a predominantly Anglo Saxon dominated landscape with vastly different foci of power and occupation.

Recent archaeological projects and research have added further layers to our understanding of the sub-Roman British North, necessitating the increased complexity of theoretical models. The 'warband' model, falls short in failing to describe potential reasons for the eventual, but not immediate, abandonment of most forts, as well as the shift in focus and occupation occurring into the Anglo Saxon period. Petts (2013) offers two differing models that help to accommodate these concerns within the broader interpretation of the warband model. In the first, it is argued that the remainder of Roman society in the sub-Roman Period was centred on forts, which, due to their linear distribution, controlled narrow territories running to the East of Dere Street and West into the North Pennines (Petts 2013, 325). These minor polities were taken over by Anglo Saxon groups or elites. The now dominant Anglo Saxon groups preferred to settle in the East, away from the forts (Petts 2013). Due to their newfound secondary importance, the forts fell into disuse and eventually were abandoned. It is also possible in this model that the military successors themselves adopted Anglo Saxon practices, relocating into the Lower Tees Valley (Petts 2013, 325). Alternatively, the military successors of the Roman Empire may have had a more limited scope of power and influence (Petts 2013, 324). It is possible that they were only able to exert their hegemony within the immediate vicinity of the fort and vicus, possessing local but not regional control. This scenario would leave the area to the East of Durham in the Tees as a power vacuum to be filled by immigrant Anglo Saxon groups that eventually absorbed or outcompeted and subsumed the successor entities (Petts 2013, 324).

Both of these additions help to expand the complexity of the 'warband' model, amending archaeological models to better incorporate recent discoveries. However, as Petts (2013, 324) notes, this modelling method is largely, almost solely concerned with the military aspect of sub-Roman Britain, and does little to account for, or incorporate civilian populations, or the aforementioned growing body of evidence supporting the presence of civilian sites as well as villas in the North. Indeed, the discovery of villas and other civilian sites in the region, in addition to lessening the archaeological focus on military matters, may indicate that the agency of civilians and civilian elites may have played a part in the shift of focus away from forts and more in line with noted Anglo Saxon trends (Petts 2013, 324).   Indeed, the addition of an increased civilian agency in the North of Britannia further challenges past research's focus on military matters, necessitating further modelling, and, as always, further research (Petts 2013, 325). Challenges to existing models, and the incorporation of new ideas to modify older models helps researchers to better understand and conceptualise a complex time period, in which the convergence and divergence of interrelated groups was not static, but rather in an almost perpetual state of flux.

1.5. Binchester: A case study, a history, and a work in progress.

Binchester, Roman Fort, is located near modern day town of Bishop Auckland, Co. Durham (OS Grid NZ2085029450). The fort is stationed on the crossing of the river Wear on the Roman road of Dere Street, which ran from York to Corbridge. Extensive Geophysical survey of the fort and surrounding area have given detailed information as to the size of the site (Figure 1.1). The site of the Roman fort covers 3.6 hectares, making it one of the largest forts on the northern frontier (Petts 2013, 320). The fort is accompanied by a large civilian settlement, or *vicus*, on 3 sides, covering roughly 12 hectares. A majority of the site is under pasture, with few modern buildings. The two exceptions to this are Binchester Hall and Binchester Hall Farm. Binchester Hall was built in 1835, replacing the earlier hall which was constructed in the 17th century. The older hall was located further south than the current, and may have possibly disturbed some Roman deposits in its construction. These two buildings are located on top of the northern portion of the fort. To the southwest, a portion of the fort and vicus have been lost to a large landslip, although the area is now stable. In the centre of the fort there is a small visitor's centre, with the commandant's house (*praetorium*) and baths, along with a portion of Dere Street being displayed.

The fort was originally constructed of timber in the AD 70s, and, sometime in the early 2nd century, was replaced later by a smaller stone fort. Situated on the crossing of the river Wear, and purported to have been initially used for the housing of a Spanish cavalry contingent, the fort would have served dual purposes: guarding the river crossing as well as acting as a first responder in the case of an incursion or disturbance (Vinovia 2009). Cavalry, able to travel much more quickly than infantry, would be able to arrive at and reinforce any beleaguered allies. The fort layout is very much in line with similar forts along the northern frontier (Hodgson & Bidwell 2005), containing a number of linearly aligned barrack blocks, showing many instances of rebuilding, suggesting a potential shift in function towards the late 4th century. Additionally, the large praetorium in the centre of the fort has been partly excavated, containing the commandant's quarters, as well as a large bathhouse (Petts 2013, 321). While there has been scant evidence of water supply recovered, an extensive system of interconnected ditches showing signs of multiple reconstructions has been uncovered in the fort, leading to a culvert draining outside of the walls (Petts 2013, 321). It is likely that this drainage system was still visible and possibly in use during the latest phases of fort occupation (Petts 2013, 321). Furthermore, several bread ovens have also been identified, of probable late Roman date, giving evidence for the preparation of food inside of the walls of the fort during its later occupation. The vicus extends along both sides of Dere Street, containing at least 2 cemeteries, a large bathhouse, an industrial area, and a range of 'strip buildings' used for commercial and light industry (Petts 2013). The vicus bathhouse shows evidence of reconstruction and repurposing as a temple, possibly dedicated to the goddess Fortuna (Vinovia 2009).

1.5.1. Archaeological Background

Binchester has been the subject of numerous professional and amateur surveys and excavations, beginning in the late 19th century with Proud's work in 1887-80 and Hoopell's 1891 excavation. Further excavation and survey has occurred regularly over the 20th century, taking place in:

- 1937(Steer 1938)
- 1955 (Dobson and Jarrett, 1958)
- 1965-1969 (Dobson 1970)
- 1969-1972 (Wilson et al. 1973, Fawcett 1971, 2001, 2003, 2004)
- 1971(Webster and Cherry 1972)
- 1976(Jones 1977)
- 1977(Ferris 1978)
- 1977-1980(Grew et al. 1980, Ferris 1979, 1995)
- 1978(Webster & Cherry 1979)
- 1983-1984(Wittering 1986)
- 1986-1988(Frere et al. 1987)
- 1994(Fraser 1994)
- 1996(Speed 1996)
- 1997(Still 1997)

A large-scale excavation of the commandant's house and baths took place from 1976-81 and 1986-91, providing a large amount of material culture (Ferris 2010). Ferris and Jones' excavations and analysis show a continuous occupation of the fort from the AD 70s into the mid-5th century. Furthermore, their detailed chronology and phasing of the excavation has revealed a distinct shift in function dating to the late 4th century (Ferris 2010). In phase 9 of the excavation, the praetorium shifted from a high status residence into an area of intensive industrial and agricultural activity, with large deposits of refuse, consisting heavily of butchered faunal remains, recovered. This practice appears to have continued into the 5th century until the forts abandonment (Ferris 2010A full exploration of the faunal analysis of this earlier excavation is conducted in Chapter 4. Binchester's long history of both amateur and professional excavation, especially the recent analysis of the praetorium, provides a wealth of information concerning the occupation and utilisation of the site. This enhances the value of continued work on the site, adding to the already considerable volume of information accrued, facilitating the corroboration, and in some cases the amendment, of previously noted trends and interpretations. The previous excavations at Binchester have demonstrated its historical significance as well as the potential of the site to inform our interpretations of late Roman Britain and contribute unique insight into both the fort and the region as a whole.

1.5.2. The Current Project.

The current excavation, initiated by the Vinovia: Durham-Stanford Research Project, began in 2009 and is projected to finish in 2015 (Vinovia 2009). Partners of the project include the Architectural and Archaeological Society of Durham and Northumberland (2009-Present), Durham County Council Archaeology Section (2009-Present), Durham University Archaeology Department (2009-Present), Archaeological Services Durham University (2009-Present), Stanford University (2009-2012), Texas Tech University (2012-Present), and Vinovium.org (2012-2014). The project has two excavation trenches, with a 26 by 37 m trench (Trench 1) encompassing the north-east corner of the fort (Figs 1.2, 1.3). Excavation of Trench 1 began in 2009, with a second 43 by 20m trench (Trench 2) being opened in the Vicus in 2010 (Figs 1.4, 1.5). Both trenches have has small scale extensions, with additional extension being added to the fort in the 2010, 2012 and 2014, and the vicus excavation being extended in 2012 and 2014 (Arch Services, 2010, 2011, 2012). The project's goals are structured into three separate, but related, strands: Academic & Research Questions, Conservation and Management, and Empowerment and Education.

While the project's varying strands are all of equal importance, the study of the faunal remains recovered from the excavation of the 2011 and 2012 assemblages of the fort and vicus is most concerned with, and directly impacted by, the academic questions concerning the supply and animal economy of the fort and vicus. Before excavation, the project had a wide range of academic focuses and questions. Obtaining detailed information concerning the chronology of the fort and vicus was of prime importance. Additionally, the function, design and appearance were of interest, especially as they apply to the physical infrastructure of both fort and vicus. The material remains recovered can give clues as to the economy of the fort, vicus and surrounding area. Finally, specific finds could enhance our understanding of the cultural and religious life throughout the occupation of the site. Overall, the initial goal was to obtain a comprehensive view of the site, its construction, occupation, maintenance, and importance in social, political and geographic spheres. The information garnered through the analysis of faunal remains will allow us to comment on the environmental aspects of the fort occupation, as well as garner information concerning the supply and economy of the fort and vicus.

1.5.3. Dating Binchester

While the initial goals of the project were wide ranging and far reaching, the accomplishment of these goals is subject to the sometimes harsh realities of fieldwork in the region. Subsequent years of excavation have uncovered a very complex stratigraphy, with many layers of material culture dating to late/sub-Roman date. The sheer amount of finds excavated, along with a very complex Late Roman stratigraphy has made the detailed phasing of the site occupation challenging, lessening researcher's ability to view change over time until further work has been completed. Currently many areas of analysis are still in the formative stage, making the creation of a detailed chronology untenable for the time being. A careful selection of radiocarbon dates has indicated that the major depositions of faunal remains are of late Roman date, with the large depositions recovered from the vicus dating to the 4^{th} century. However, some of the later deposits of material culture in the fort were found to be of later date (5^{th} century), introducing a possible bias to our analyses. To avoid this potential contamination, this study focused on the 2011 and 2012 excavation seasons only, with the animal bone recovered from 2009 and 2010 not considered in this study. Furthermore, bone preservation in the 2009/2010 contexts was notably poorer, resulting in a lower amount of identifiable and measurable bones, thus reducing the amount of bias encountered.

1.5.4. The Excavation

In the 2011 and 2012 excavation season saw significant progress in the excavation of both the fort as well as the vicus at Binchester (Arch Services 2011, 2; 2012, 1). A large number of walls and structures were revealed, recovering great amounts of material culture from both trenches. In particular, large amounts of well-preserved faunal remains were recovered from both the fort and vicus, providing two robust assemblages ideal for analysis and comparison.

Within the fort (Trench 1), the 2011 and 2012 excavation enhanced our understanding of the inner layout of the fort, as well as providing large amounts of material culture. Very large amounts of animal bone were hand collected from the entirety of the trench during both seasons of excavation, with fragments recovered numbering in the tens of thousands. In 2011, bone was recovered across the trench, although it is notable that excavation of contexts within the system of gullies and pits yielded denser concentrations of animal bone (Arch Services 2011, 4). A number of smaller pits and depressions were noted outside of the barrack structures, containing deposits of animal bones of varying preservation. While they were identified as pits during the excavation, further analysis deemed that a number of these were likely depressions caused by the collapse of archaeology underneath these areas (Arch Services 2012, 3). Bone was widespread outside of the barrack blocks, suggesting the discarding of consumption waste. The 2012 excavations yielded very similar results, with large deposits of animal bones located in small depressions and larger pits, particularly within the series of gullies and pits, which was larger and more extensive than expected (Arch Services 2012, 3). One large pit in particular, towards the North East corner of the fort, contained exceptional amounts of animal bone, providing a distinct chronology of filling periods and cutting due to later activity (Arch services 2012, 4). It is hoped that radiocarbon dating of these contexts will help shed light on the occupation of this area of the fort, as well as provide insight into any shifting practices over time. Bone recovered from the fort shows variable preservation, with smaller concentrations or isolated elements showing poorer preservation than those recovered from dense deposits, fitting in with the taphonomic issues discussed in the chapter: Zooarchaeological Methodology with Special Reference to Binchester. Overall, a large amount of bone was recovered from the 2011 and 2012 excavation of the fort, with most of the bone coming from refuse depositions in pits, gullies or depressions located outside of the barrack blocks (Arch Services 2011, 3; 2012, 2).

In the vicus (Trench 2), similarly impressive progress was made during the 2011 and 2012 excavation seasons. Many of the strip buildings along Dere Street were revealed and excavated, with particular focus on the repurposed bathhouse at the northern end of the trench (Arch Services 2011, 2012). Similar to the fort, large deposits of refuse, particularly faunal remains, were recovered during both seasons of excavation, with tens of thousands of fragments collected by hand. Again, in similarity with the fort, some animal bone was widespread across the surface of Dere Street and exterior to the buildings. However, the largest concentrations of animal bone were recovered during excavations along the gutter of Dere Street and the excavation of the interior of the strip buildings and bathhouse. The interior excavations of the buildings yielded large deposits of dark soil with a very high animal bone content. These are colloquially known as "Dark Earth Deposits" and are a known feature of Late Roman sites, usually from the 4th century, although distinct dating of this phenomena varies somewhat between sites (e.g. Yule 1990). Excavation of these dark earth deposits yielded the majority of recovered faunal remains from both excavation seasons, providing a large assemblage likely of uniform date (Arch Services 2011, 3; 2012, 5). Many of these dark earth deposits stretched down to floor level of the strip buildings and within the bathhouse, suggesting that these deposits were made after the abandonment of the vicinity (Petts 2013, 320). On the whole the majority of the animal bone recovered from within the vicus during the 2011/2012 excavation season originated from notable dark earth deposits, providing a robust assemblage for analysis and comparison between the other Binchester assemblages as well as other comparative sites.

The large deposits of faunal remains recovered from the fort and vicus likely correspond to the same Late Roman refuse dumping phases noted during the excavation of the praetorium (Petts 2013, 321). It is notable that, even including the earlier excavations of the praetorium, only 0.6 hectares of the fort and vicus have been excavated (Petts 2013, 321). This makes it likely that the full scope of the refuse dumping on the site has not been captured (Petts 2013, 322). It is possible that a much wider area of both the fort and vicus were repurposed and used for waste disposal. The large amount of faunal remains recovered will be a distinct aid in addressing the academic goals concerning the economic infrastructure of the fort and vicus. Through an analysis of the species utilised in fort and vicus, we can glean information concerning the supply of the fort, and the exploitation of local resources. A detailed consideration of the animals exploited in fort and vicus will help us to better understand the environmental conditions in and around the fort. Further, any differences in faunal assemblage between fort and vicus can indicate differences in supply as well as potential divergence in identity.

1.6 Concluding Thoughts

Binchester, Roman Fort is a notable military stronghold, with a key position in the northern frontier of the Roman Empire and a vast and populous vicus. The large amount of past excavations grounds the site in academic interpretation, giving us an excellent profile of the site, as well as a detailed chronological sequence for comparative and analytical purposes. Furthermore, the centuries of academic attention have cemented the site as one of local, regional and national significance. The current project aims to capitalise on the significance of the site, using the current excavation to provide educational opportunities through outreach and conservation, as well as enhancing our academic knowledge of both the site and the greater area. Excavation at Binchester has yielded a wealth of cultural material, including large assemblages of faunal remains. The analysis of recovered material can help shed light on a wide array of research interests. Analysis of the recovered faunal remains can provide information concerning the utilisation of animal species within both fort and vicus, detecting potential differences in practice, function and even identity between military and civilian life. Furthermore, the large size and excellent preservation of the assemblage will facilitate a direct comparison between Binchester and other comparative sites in order to contextualize these assemblages within the wider theatre of Roman Britain. Finally, the utilisation of domesticate species in the late/sub-Roman depositions can give us key insight into the apparent shift in function in the fort dating to the late 4th century, as well as the transitional period after the withdrawal of Roman influence and infrastructure from Britannia.

Figure 1.1. Geophysical survey of Binchester. This figure shows the geophysical survey of Binchester, with Trenches 1 and 2 outlined in red. The square fort wall outlines and the presence of a large vicus on ll sides of the fort is notable. Geophysical surveys conducted by Geophysical Surveys of Bradford, GeoQuest Associates and Archaeological Services Durham University (Archaeological Services 2011, 18)

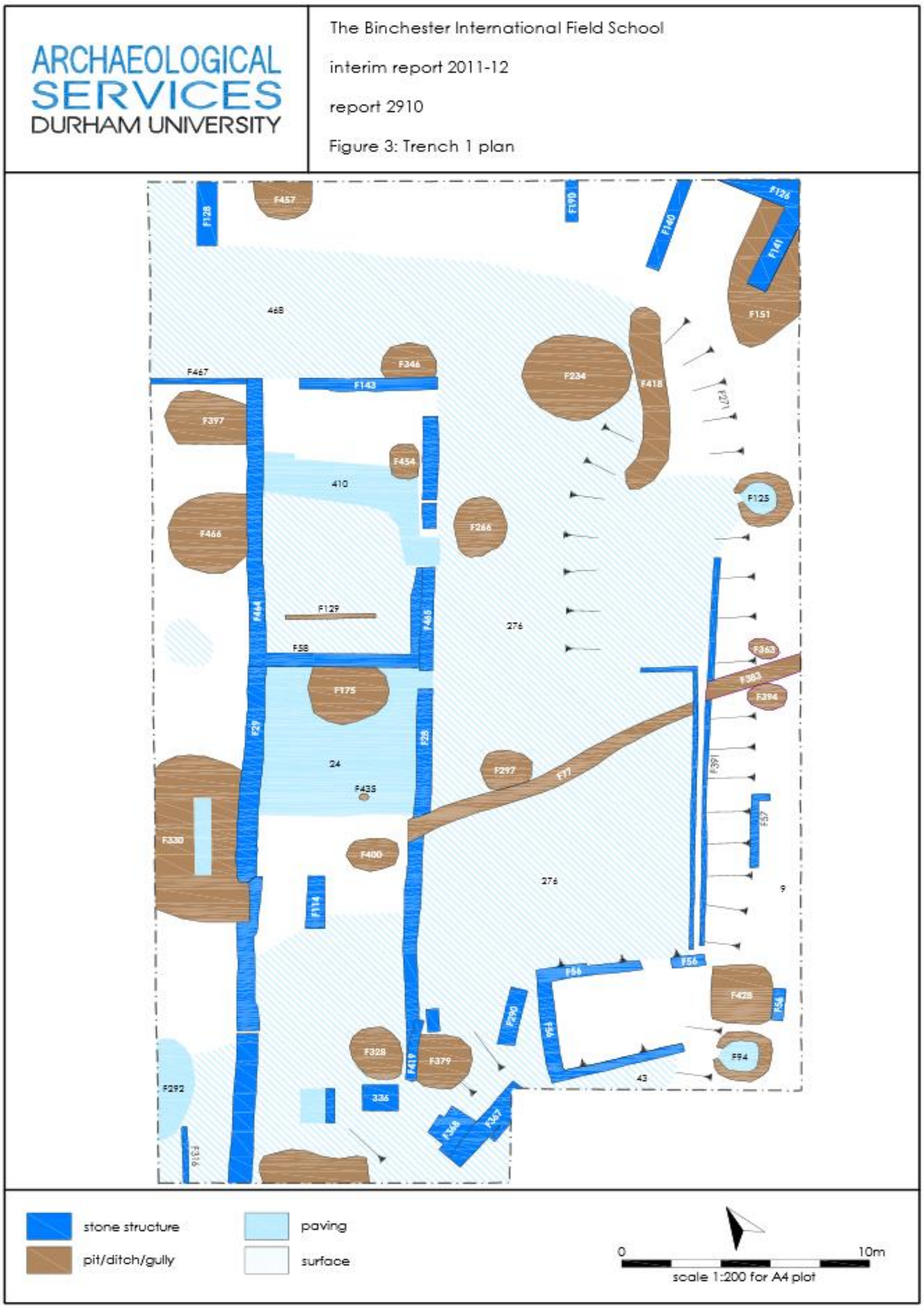

Figure 1.2. Binchester 2011 Fort Plan. This figure shows the plan of the Binchester fort after the 2011 excavation season (Archaeological Services 2011, 19).

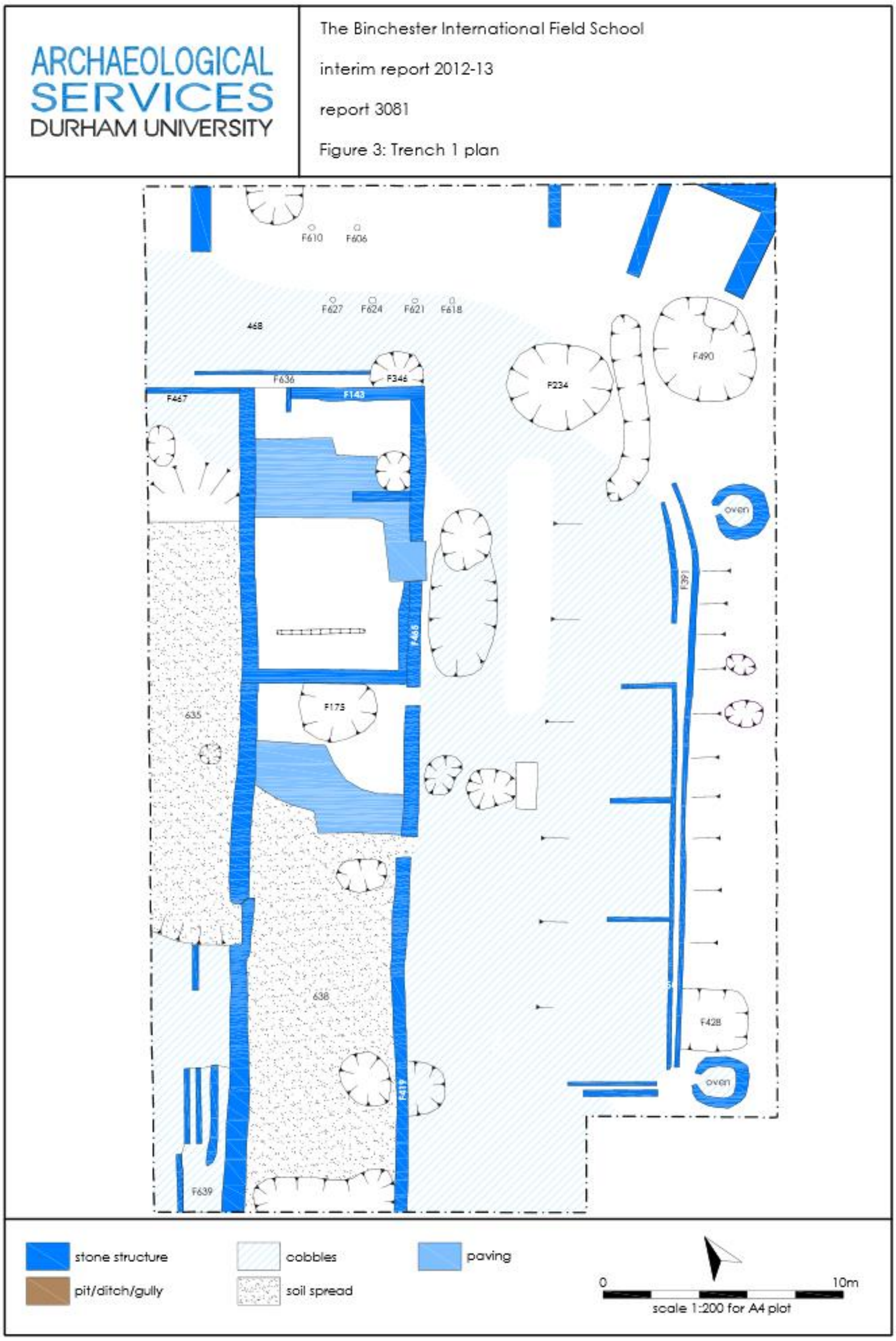

Figure 1.3. Binchester 2012 Fort Plan. This figure shows the Binchester fort plan after the 2012 excavation season (Archaeological Services 2012, 9)

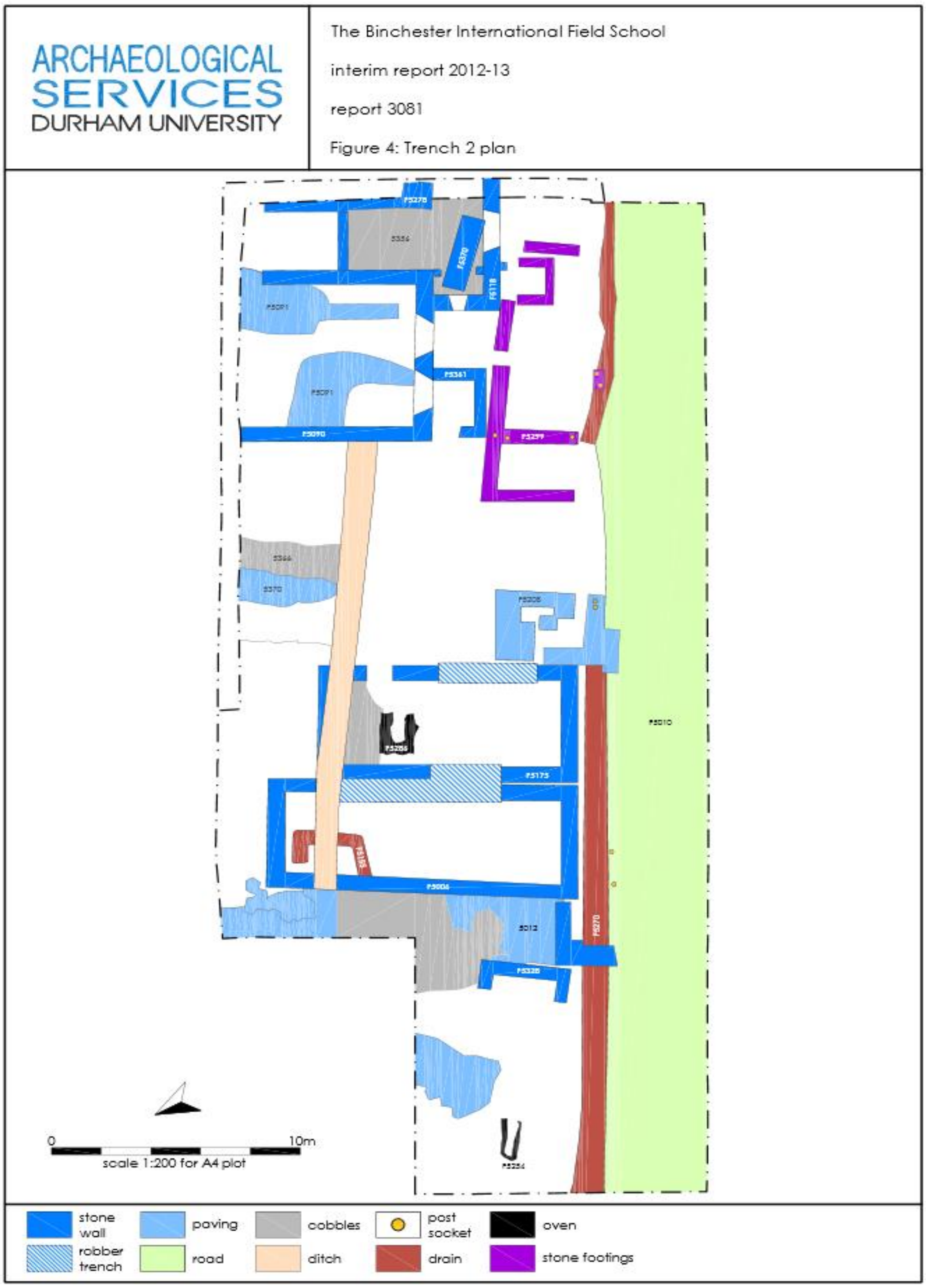

Figure 1.4. Binchester 2011 Vicus Plan. This figure shows the Binchester vicus plan after the 2011 excavation season (Archaeological services, 19).

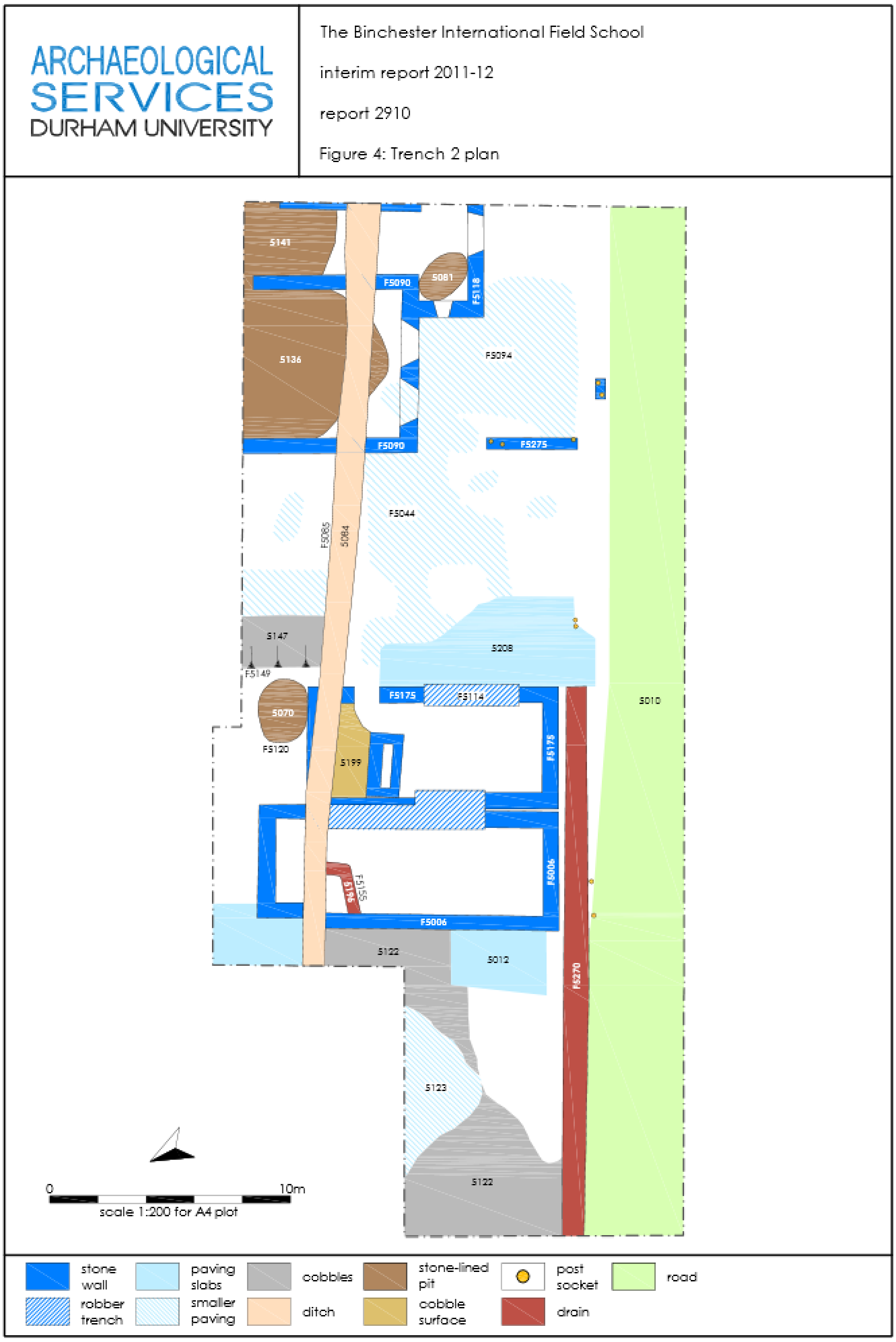

Figure 1.5. Binchester 2012 Vicus Plan. This figure shows the Binchester vicus plan after the 2012 excavation season (Archaeological Services 2012, 10).

2. Zooarchaeological Methodology with Special Reference to Binchester

Zooarchaeology is the study and analysis of animal bones recovered from archaeological sites, also known as faunal assemblages. Recovered faunal remains can be analysed morphologically as well as metrically. These two areas of analysis can reveal a wide range of information regarding the lives, lifeways, and deaths of animal species recovered from archaeological sites. This information provides a window through which we can view interaction between past peoples and animals. Thus, zooarchaeological analysis provides a method by which we may gain further understanding of ancient peoples through their interaction with, and exploitation of, domesticate species. This chapter will explore the methods of data collection, recording, and analysis employed during this project, and the justification for the use of these methods and the exclusion of others.

2.1. Project Aims

This project was undertaken to complete the following goals:

- Conduct a zooarchaeological analysis of the faunal material recovered during the 2011/12 excavation seasons at Binchester, Roman Fort, identifying animal bone fragments to species, element, diagnostic zone, side, and any further morphological features.
- Determine the relative importance of the three main domesticates (cattle, sheep/goat, and pig) at both fort and vicus
- Conduct a detailed morphometric analysis of recovered cattle elements, determining the following for both the fort and vicus assemblages:
    - The relative distribution of cattle body parts recovered
    - The presence and style of butchery marks
    - The occurrence of different types of pathological lesion
    - The use of mandibular tooth wear on intact cattle mandibles to estimate age at death, creating a mortality profile for the cattle population
    - Record metric information from all preserved cattle elements, measurements taken correspond to Von den Driesch (1976)
    - Estimate withers height using recovered complete metapodials according to Von den Driesch and Boessneck (1974)
    - Conduct a metric analysis of recovered distal humeri, plotting the breadth of the trochlea (BT), and BT against the height of the medial trochanter (HT)
    - Conduct a metric analysis of recovered metacarpals, plotting the greatest length (GL), GL against distal breadth (BD), and BD against diaphyseal depth (DD)
    - Conduct a metric analysis of recovered metatarsals, plotting GL, GL against BD, and BD against DD
- Compile a suite of comparative sites from across Roman Britain, containing multiple site types and spanning throughout the Roman Period and into the sub-Roman
    - Identify morphological and metric information, presenting it where possible in this report and identifying the overarching trends in animal preference, management and exploitation

2.2. Methods

2.2.1. Excavation and Processing

Decisions regarding the collection, processing, and storage of the Binchester faunal material had already been made before this project began. Bone was hand collected on site, with specific areas being screened to determine the presence of smaller animals on site. Excavation was conducted by Durham Archaeology first year undergraduates and local volunteers from the Northumbria Archaeology and Architecture Society, overseen by staff from Durham Archaeological services and faculty from Durham University.

Faunal remains were washed with toothbrushes in warm water, then allowed to air dry. After the bone was completely dry it was collected in ventilated plastic bags by context, and stored in boxes within the Dawson building at the University of Durham. The processing of recovered fragments was broadly overseen and organised by staff from Durham Archaeological services, making use of their lab space and materials. However, the majority of hands-on activity with the animal bone from 2011-2015 was managed and conducted by the author. This included the overseeing of processing by weekly volunteer groups of Durham University students and members of the Northumbria Arch. and Arch. Society, without which this project would not have been possible. Also involved were countless work hours spent washing, re-bagging, and organising the assemblage before analysis of the assemblage could begin.

The practice of hand collection can bias an assemblage in favour of larger elements and bones from larger species, a bias that can be mitigated through sieving (Payne 1972). Enghoff (2011) demonstrates the requirement for sieving down to 1mm gradient in order to ensure the capture of smaller fish bones.

Multiple taphonomic factors can lead to the differential destruction of bone within archaeological sites. At Binchester specifically, the use of mattocks during excavation is a large source of damage caused to bone otherwise preserved in situ (Historic England, 2015). Additionally, oftentimes during excavation bone would become exposed to open air, but intersect into the context below. In this case the decision was made to leave the bone exposed rather than disturb the lower contexts. No real effort was made to preserve or otherwise protect these bones, and oftentimes they remained exposed to the elements for multiple hours, in some cases for multiple days. After collection, the practice of cleaning bones with toothbrushes and water can further degrade and destroy animal bone. Unfortunately, attempting to mitigate any of these factors either through a slower pace of excavation or use of different processing methods would result in an undue burden on the finance and timetable of the project. Thus, a high amount of post mortem damage is noted on faunal remains.

Taphonomic factors occurring in situ at Binchester include the presence of partially acidic soils, causing recovered faunal remains to become brittle or dissolve entirely (Lyman 1994, 288). This is a particularly significant factor for juvenile animals with unfused elements, or smaller, less dense bones. This factor is limited somewhat in the case of Binchester, where large deposits of densely packed bones are noted (see Chapter 3), helping to preserve the majority of elements. Contemporary taphonomic factors can also negatively affect bone recovery and identification. At Binchester, these factors include the butchery of animal carcasses and the subsequent gnawing of dogs scavenging amongst the man-made refuse. The butchery of bones often renders elements unidentifiably fragmented, and the presence of dog gnawing on sites can further degrade bone and obscure identification (Lyman 1994, 279). Both of these factors were prevalent at Binchester, and caused a great deal of frustration during the analysis of the faunal remains.

2.2.2. Identification of Recovered Faunal Remains

After the bone was washed and stored, each fragment, where possible, was identified to species, element, portion present, and side, with further identification of the presence of butchery marks or pathological lesions. This was done through the use of the comparative collection at the Durham Archaeology Department labs. In order to record the portion of the bone present and accurately quantify the assemblage, the Diagnostic Zone Method (Dobney and Rielly, 1988) was employed. Thus, if more than 50% of a particular zone was present in the fragment, that zone would be listed as present during the analysis of recovered faunal material.

The diagnostic zone method utilised for the Binchester assemblage (Dobney and Rielly, 1988), maps out the bones of small, medium, and large mammals, ascribing different diagnostic areas on each bone to particular zones (Figure 2.1). As mentioned, at least 50% of the zone must be present in order for it to be marked as present. This allows for a descriptive and accurate recording of the recovered faunal assemblage. This method of recording is of further use in the quantification of minimum number of elements (see section 2.2.3. below). When in need of consultation on the identification of fragments, Dr. Carrie Armstrong (Durham Archaeological Services) and Dr. Beth Upex (Durham University) were available to offer assistance. In the case of a particularly difficult or anomalous fragment identification, Prof. Peter Rowley-Conwy (Durham University) was consulted.

2.2.3. Quantification

Fully identified fragments were totalled into the number of identified specimens (NISP) count by species to provide a rough outline of animal utilisation on side. In addition to the NISP count, the minimum number of individuals (MNI) of the major domesticates was also calculated and used to determine species representation of the major domesticates. Recovered cattle elements saw further quantification. Making use of the recorded diagnostic zones, the minimum number of elements (MNE) of the recovered cattle remains was calculated to assess the element distribution of the assemblages.

As previously mentioned, the hand collection at Binchester can lead to an overrepresentation of larger elements, thus biasing the total NISP count in their favour. Quantifying the assemblage into the MNI expresses the assemblage in terms of whole animals, found through the most commonly occurring element and side of each assemblage (e.g. right humeri) (Grayson 1984). While a true representation of animals actually utilised on site is near impossible (e.g. Chaplin 1971), the MNI is a quantification tool that approximates this, framing discussion around a distinct number of animals and allowing for a clearer conceptualisation of oftentimes complex interpretations (Gautier 1984, 237). Being based on the fragments collected, MNI shares the same bias towards larger mammals noted for the NISP, leading to a likely overrepresentation of larger mammals (Casteel 1977, 125). MNI quantification can often lead to the interpretation of an assemblage solely as the result of whole animals being deposited on site, and obfuscates the potential presence of faunal remains from secondary sources such as antler tines or leather processing remains (Legge 2008, 536).

Quantification of the MNE of the assemblage can help to fill in some of the gaps left from MNI quantification. MNE faces a similar bias towards larger animals, as noted for the MNI and NISP quantifications, as they are all based on a hand collected assemblage, but sheds further light on specific aspects of the assemblage. For this quantification, use of the diagnostic zone minimizes the risk of counting the same element or part of an element multiple times (Dobney and Rielly, 1988). MNE calculation results in an MNE for each element recovered, as well as a total MNE for each assemblage (Legge 2008, 543). Thus, MNE is better suited to calculate the relative frequencies of each element, helping to identify secondary processes, or processes resulting in the deposition of particular elements on a site.

2.2.4. The Focus on Cattle

As mentioned above and in the previous chapter, the major focus of this project will be a detailed morphometric analysis of the cattle remains recovered from the Binchester fort and vicus. This decision was initially influenced by the preliminary reports from the Binchester 2011 and 2012 excavations (Archaeological Services 2011 1-5; 2012, 1-6). Both reports indicate that the majority of recovered animal remains from the site are cattle, suggesting that this domesticate was of primary importance for the site.

As discussed previously, the examination and exploration of cattle resource exploitation strategies are of prime importance in the theatre of zooarchaeology in Late Roman Britain. The Roman Period in Britain is largely characterised by an intensive utilisation and exploitation of cattle resources, a feature of most, although not all, sites in Roman Britain. This feature, a sharp deviation away from the sheep/goat centred Iron Age faunal assemblages, is demonstrated to increase throughout the Roman Period. Cattle provide a much larger amount of meat per head, provide numerous secondary goods such as dairy, leather, and even building material in the form of horn cores (Legge 2008, 543). Furthermore, and most importantly, cattle resources represent an immense source of work for traction purposes such as pulling carts or ploughing fields. The Roman conquest brought with it a massive military infrastructure, requiring large amounts of food rations and goods, all needing overland transport. Given the preliminary Late Roman date of the assemblages, and the military and civilian aspects of the site, cattle are the most important of the major domesticates, and their analysis can give insight into management and subsistence strategies employed by both military and civilian occupants of the site.

Thus, after consultation with project leaders and the author's supervisory team, it was determined that analysis of the cattle would yield the greatest amount of information about the character of the site and the potential identities of its occupants. This decision is not meant to imply that the pig, sheep/goat, or other taxa are not of value, but rather that, given the prevalence of cattle on site, and the time and space constraints involved in a PhD research project, more would be gained by a more singular focus on the cattle remains, explored and analysed in depth, than attempting to effect a more broad, and, inevitably, less detailed exploration of all of the major domesticates.

2.2.5. Morphological Features

The morphological analysis of recovered cattle elements focused on two factors: Pathology and butchery. Pathological lesions of any variety were recorded, paying particular attention to lesions indicative of occupational stresses or particular utilisation strategies. The butchery marks on identifiable fragments were noted during the initial analysis, differentiating between chops, filleting, and cuts associated with hide removal.

Pathological lesions recorded at Binchester are done so in order to reveal aspects of the interrelationship between animals and humans. This is primarily seen through two different factors: congenital pathologies caused by selective breeding, and occupational or stress-related injuries. The introduction of breeding programs and domestication brought about an increase in congenital pathologies, such as tooth crowding or congenitally missing or altered teeth (Bartosiewicz et al 1997, 1-2). This feature is often interpreted as a sign of a genetically limited herd and can be indicative of cattle originating from smaller, likely local herds. Occupational injuries include the distal splaying of metapodials from traction work (Bartosiewicz et al 1997, 1). This splaying is the result of repeated pulling of heavy ploughs or overloaded carts. Osteologically this splaying is seen as a thickening of the distal bone, particularly on the medial side (Figure 2.2). Although this splaying is a clear indicator of utilisation for traction work, it can often go unnoticed in archaeological assemblages, as light or even moderate splaying is not immediately apparent within archaeological assemblages (Bartosiewicz et al. 1997, 1). More noticeable signs of traction utilisation include the infection of the hindlimb known commonly as spavin (Bartosiewicz et al. 1997, 43). Spavin manifests osteologically as the partial or full fusion of the naviculo-cuboid bone, cuneiform bone, and the proximal metatarsal (Figure 2.3) (Baker and Brothwell 1980, 117). The identification of these pathological markers can indicate strategies of cattle utilisation and further our understanding of the interaction between the occupants of Binchester and the cattle they utilise.

While pathological indicators will help us better understand the cattle populations at Binchester in life, butchery marks are a key indicator of how they were utilised in death. Different processes such as butchery, skinning, dismemberment and consumption all leave different and distinct marks upon bone fragments in an assemblage (King 1984, 2). Furthermore, in societies with distinctive butchery practices such as the Roman Military in Britain, the butchery marks left behind can serve as an indicator of who was butchering the animals (Grant 1989, 137). This is of particular importance for the Roman Period and for Binchester specifically. Butchery marks could help to differentiate between fort and vicus animal utilisation, and possibly reflect differences in practice, suggesting different identities between the two areas. The Roman military in Britain practiced what is commonly called 'block butchery'. As described by Stokes (2000, 148), block butchery emphasises expediency and visible fairness in the butchery process, with cattle being hewn into roughly even sized 'blocks' for distribution of rations. This practice leads to the distinctive chop marks associated with Roman sites, often cutting through thick bone articulations rather than cutting around (Figure 2.4). Initial analysis characterised stylistic Roman butchery as haphazard or without skill compared to the fine knife marks noted in Iron Age Britain. Seetah (2005) demonstrates that, rather than a lack of skill, Roman butchery instead represents a paradigm shift in butchery, with greater value placed on expediency over finesse, emphasizing the fast and efficient dismemberment and distribution of large numbers of cattle carcasses (Seetah 2005, 4-5; 2006, 112-113).

2.2.6. Age at Death

During analysis of the Binchester faunal material, the tooth eruption and wear of well-preserved cattle mandibles was recorded using the tooth wear stages outlined by Grant (1982) and the eruption stages described by Ewbank et al. (1964). These wear stages were then organised into the age groups detailed by O'Connor (1988, 84). In cases where loose teeth could only belong to a single age group, such as exceedingly worn mandibular M3s (stage j or higher) or stage a-b mandibular dp4s, the data points were added to the O'Connor age groups. This practice is unlikely to bias the results, as mandibles without these teeth would not be included, and the tooth wear stages included could only belong to either the very young or very elderly age groups. This method increased the amount of age related data, although the majority of the data comes from fully intact mandibles. The grouped mandibles were used to construct a kill off pattern for the populations in the fort and vicus, giving insight into the exploitation of cattle resources in these two areas. These kill-off profiles are assessed for similarity with ideal practice profiles (Figure 2.5), which show the idealised slaughter pattern if only a single process was practiced on a population. Admittedly these ideals are rarely the case, as the depositions recovered often come from a multitude of different processes, however, the overall trends are helpful in determining what practices occurred more often. Although the O'Connor (1988) age groups have been refined to further differentiate cattle ages at death (O'Connor 1991, 250, Table 67). The decision was made to instead adopt the original simplified groupings. This serves to facilitate a broader comparison with other sites, which may not be as differentiated as the 1991 groupings call for.

While epiphyseal fusion data was recorded during morphological analysis, the decision was made not to include it in this report. This decision was made for multiple reasons, and after much discussion with project staff and the supervisory team. Speaking in general terms, the analysis of epiphyseal fusion is rife with methodological pitfalls for large, disarticulated assemblages such as Binchester. The determination for epiphyseal fusion relies on a particular age-range for each element's fusion areas (Silver 1963, 251). Any elements found unfused are interpreted simply as younger than that age range, and any fully fused elements, older. This limits the data gleaned from cattle aged both very young and adult – elderly, limiting the utility of this analysis. Only when an element is recovered partially fused (with both epiphysis and diaphysis intact and attached) does bone fusion yield a more relevant and useable age range. Furthermore, the age ranges utilised by observers assume a similarity between the observed assemblage and the reference material (O'Connor 2008, 95). Moran & O'Connor (1994) demonstrate not only differing rates of maturation between sheep populations, but also in recording criteria between different analysts. While useful in the ageing of an articulated skeleton, for disarticulated assemblages this method is overly general, and forces analysts to employ basic percentage based quantifications of fused and unfused elements (O'Connor 2008, 96). It is also important to note that epiphyseal fusion has been noted to vary to a significant degree based on the quality of nutrition of a herd population. A number of factors have been found to affect the fusion times of cattle in modern research (e.g. Owens et al. 1993, 3138-39). This noted discrepancy in fusion rates between different groups of cattle (and different nutrition) is virtually unknowable for archaeological samples, further obfuscating what limited claims can be made from incomplete epiphyseal fusion records.

Beyond methodological concerns with the accuracy and variability of epiphyseal fusion, the taphonomic processes at Binchester described above (see section 2.2.1.) disproportionately affect bones of lower density, namely unfused elements. Butchery of unfused elements often results in their fragmentation beyond the point of identification, and scavenger gnawing disproportionately targets, and destroys, unfused elements at a much greater rate than that of fused, denser elements (Lyman 1994, 279-281). Considering the high rate of dog gnawing and butchery noted on site (see Chapter 3), this is likely a huge source of bias for this particular group. Beyond contemporary sources of differential destruction, unfused elements feature a notably lower survival during the excavation process itself. On site, it was observed that unfused bones suffered much higher rates of breakage and erosion than fully fused elements during excavation, processing and storage (Personal observation).

It is true that cattle mandibles experience the same taphonomic concerns as cattle epiphyses do. The overall preservation of younger mandibles is markedly lower than those of adults. However, cattle mandibles are destroyed by butchery and scavenger gnawing at a much reduced rate to that of long bone epiphyses, likely due to their lack of meat and unpalatability for intensive gnawing. Furthermore, cattle tooth eruption does not suffer the same interruption in timetables due to nutrition (O'Connor 2008, 93), and remains largely similar across multiple breeds and types of cattle (Silver 1969, Jones and Sadler 2012, 11-12). This is an important quality, as is largely negates what amounts to a substantial potential source of error and bias in epiphyseal fusion rates.

Considering the overall advantages of mandibular tooth eruption and wear over epiphyseal fusion rates, and the potential methodological and taphonomic drawbacks of the latter, it was decided that the ageing method for this project will focus exclusively on the mandibular tooth wear.

2.2.7. Metric Recording

Measurements were taken according to Von den Driesch (1976) (Figure 2.7). One of the project goals was to accrue as much metric information from the assemblage as possible, to make all potential lines of metric enquiry possible. Thus, any element intact enough to be measured was done so using digital Vernier callipers, and recorded during the initial analysis of the assemblage. Long bones that were fully intact, or elements too large for callipers were instead measured using an osteometric box. All measured elements from both fort and vicus are present in the Appendix of this report.

2.2.8. Metric Analysis

Several factors have a key influence on the selection of elements for metric analysis in this project. Most importantly, it is important to note that the Binchester assemblages do not yet have any distinct phasing applied to them (see Chapter 1). Thus, it is impossible to assess any change over time within each assemblage at this time. Thus, the metric analysis of cattle remains will be focused on two key aspects: comparison of the size, robusticity, and sexual dimorphism within the fort and vicus assemblages, and comparison with a number of other sites (see Chapter 4). The focus on sexual dimorphism, and inability to assess change over time, makes a number of elements with notably low sexual dimorphism unsuitable. Teeth feature excellent survival on site, and often see analysis on comparative sites. Their measurements, however, are known to be less sexually dimorphic, and are used primarily to show differences in breed or the introduction of new genotypes within a population over time (Albarella et al. 2008, 1832). This analysis is of exceptional value for sites, especially those covering transitional periods or with the introduction of new breeding populations (e.g. Albarella et al. 2008; Albarella 2003). However, this analysis would be of much more use to the Binchester assemblages after a more distinct chronology is established for the site. Astragali are another element commonly recovered in good conditions on site, due to their density and smaller size. These elements are somewhat sexually dimorphic, and are a commonly analysed element. However, their rate of overlap in terms of sexual dimorphism is rather high (upwards of 21% according to Higham 1969a, 66). Where available, other elements with higher degrees of sexual differentiation are favoured, as a higher differentiation makes for a clearer interpretation of trends.

It should also be noted that, for this project, the decision was made not to make use of a scaling system such as log ratios. Log ratios are a helpful method of expressing the variation of recorded measurements from a known sample, and are of great use in determining change over time within a single site (e.g. Albarella et al 2008, 1830-1833). However, this method can often exaggerate the variance in a population, and is subject to bias based on the choice of a known sample (O'Connor 2008, 116-117). Furthermore, this method would be of limited use at Binchester currently, as there is no distinct phasing of the material. Once the faunal materials can be organised into distinct chronological phases, the use of scaling methods and element measurements that are ideal for viewing variance over time will be of great use.

With these factors in mind, the metric analysis for this project will focus on 3 cattle elements: Metacarpals, metatarsals, and distal humeri. Although considered separately, the same analyses will be applied to both metacarpals and metatarsals: a histogram will plot their greatest lengths (Gl), and scatterplots will be made for their greatest length (GL) against distal breadth (Bd) and for distal breadth against diaphyseal depth (Dd). For distal humeri, a histogram will plot the trochlear breadth (BT), and a scatterplot will display trochlear breadth (BT) against the height of the medial trochanter (HT).

Metacarpals feature a large degree of sexual dimorphism, featuring only a 4% overlap in Higham's (1969a, 64-66) study. Overall, intact males tend to be larger and more robust, castrates taller with less robusticity than intact males, and females being diminutive in both size and stature (Figure 2.6). While the sexual dimorphism does reflect the height of the animal, captured through the measurement of the greatest length, the stature is also an important component of the differentiation. This is reflected through both the Bd and Dd measurements. Thus, scatterplots of greatest length against distal breadth reflect both aspects of sexual differentiation, and Bd against Dd views differentiation primarily from the stature and robusticity of the animals. Metacarpals contain little muscle attachment, and are therefore more likely to be spared the butcher's cleaver, appearing complete in assemblages more often than other long bones. Hide removal can often lead to scoring on the proximal or distal end of the element, however this usually does not interfere with the measurement of the element.

Metatarsals are often treated as of lesser value than their more sexually dimorphic counterparts, metacarpals, their metric analysis can still reflect the sexual dimorphism of the population, as well as providing a valuable cross-check for metacarpals. Higham's (1969a) study showed metatarsals as having a higher degree of overlap between males and females. However, metatarsals are measured in the same fashion as metacarpals, and also are exposed to the same taphonomic factors, making them an ideal comparative element. All else being the same, an analyst would expect metatarsals to show a higher degree of overlap, but otherwise display the same sexual dimorphism and robusticity patterns noted in the metacarpal metric analysis. Telldahl et al.'s (2012) analysis of 2699 metapodials from the site of Eketorp demonstrates the utility of metatarsals in distinguishing between males, females and castrates (Figure 2.8). The same general trends in terms of size and robusticity are noted for both metacarpals and metatarsals, with females being the most diminutive, intact males the most robust, and castrates the tallest but also gracile. Similarly, the same metric analyses are carried out as metacarpals, with similar justification for each metric analysis chosen.

Cattle humeri have a large amount of muscle attachment, and are often recovered on archaeological sites broken or heavily butchered. This limits the recovery of measurable elements to some degree (Legge 2008, 539). However, the distal humerus is one of the thickest areas of lamellar bone in the skeleton, increasing its resistance to taphonomic factors such as soil acidity as well as excavation damage. Their heightened survival in archaeological contexts and known sexual dimorphism make distal humeri an excellent choice for metric analysis. First, the BT of recovered distal humeri will be plotted on a histogram, giving a rough outline of the sexual dimorphism of the cattle population. Plotting the BT against the height of the medial trochanter (HT), presents the sexual dimorphism as a function of the robusticity of the population, helping to further differentiate males, females and castrates.

2.2.9. Statistical Analysis

In addition to a morphometric analysis of the recovered faunal remains, statistical tests will be employed to test the significance of any finds. Initially, data sets, such as those from measured elements, will be tested for normal distribution using the Kolmogorov-Smirnov and Shapiro-Wilk tests, with any P results < 0.05 considered statistically significant, and those values <0.001 to be considered of high statistical significance (Laerd, 2013). In our comparison between fort and vicus, the data sets will be tested for statistically significant difference, using an independent-variable T test for normally distributed data sets, and the Mann-Whitney U test for non-normal distribution (Laerd, 2013). In our calculation of frequency and percent representations, such as that of body part representation and age at death calculations, the chi square test will be used to test for statistically significant difference between both assemblages (Laerd, 2013). In this manner the observed differences or similarities between fort and vicus faunal assemblages will be tested for statistical significance, strengthening any interpretations or distinctions drawn from or between these assemblages.

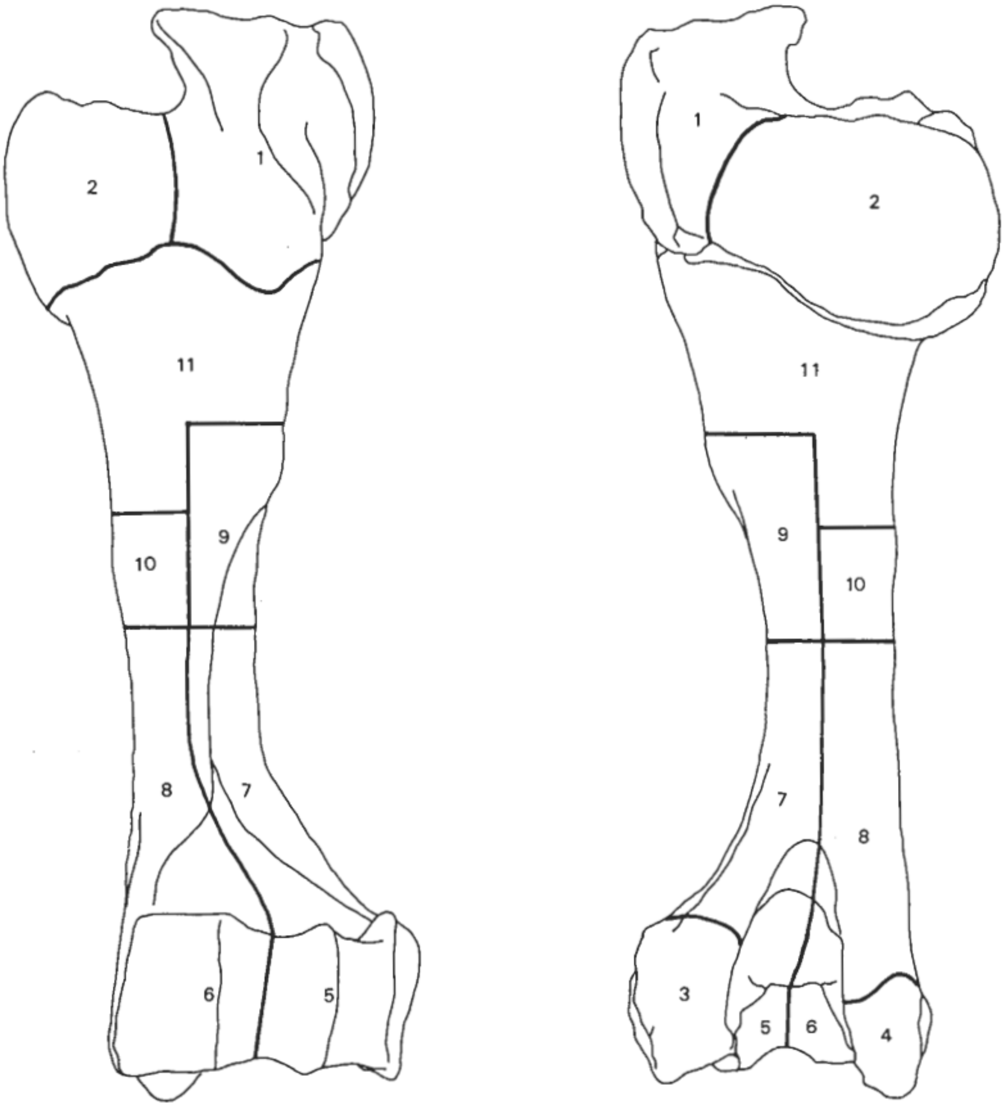

Figure 2.1. Dobney and Rielly Diagnostic Zone Method. This figure displays a cattle humerus divided into its diagnostic zones according to the method outlined by Dobney and Rielly. (Dobney and Rielly, 1988, 33)

Figure 2.2. Metacarpal Distal Splaying.

Figure 2.2. Metacarpal Distal Splaying. This figure shows a cow metacarpal of Roman date displaying iconic splaying of the distal end, a potential indicator for traction. The radiograph image on the right shows the increased bone density. (Bartosiewicz 2013, 145, Figure 120)

Figure 2.3. Spavin.

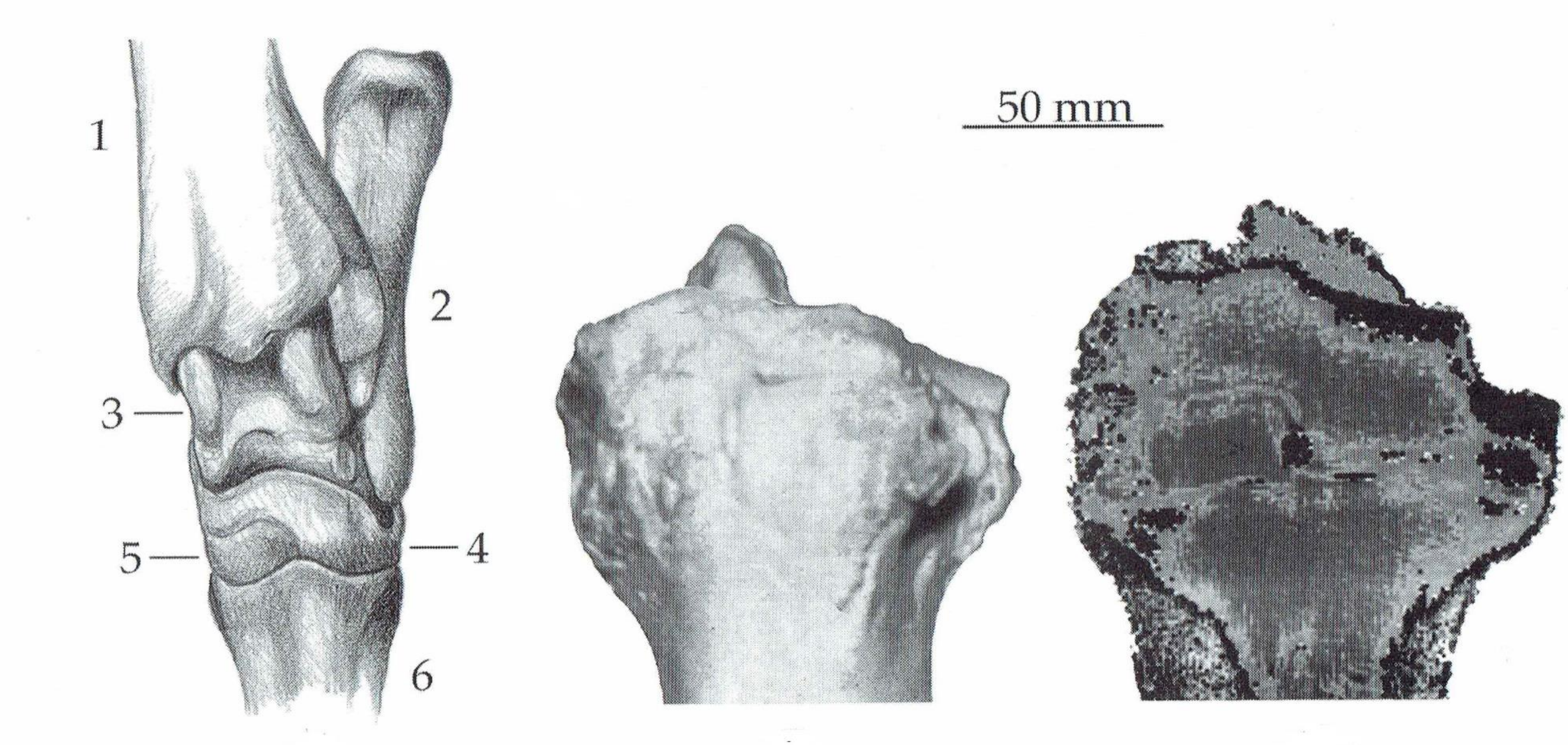

Figure 2.3. Spavin. This figure shows a health cattle hind hock on the left, clearly showing the interlocking tibia (1), calcaneus (2), astragalus (3), naviculo-cuboid (4), fused 2nd and 3rd tarsal bones (5), and the metatarsal (6). Centre: the fusion of the tarsal bones indicative of Spavin. Right: MRI of the same lesion showing distinct bones. (Bartosiewicz 2013, 123, Figure 101)

Figure 2.4. Butchered Distal Femur. Butchered distal femur from Binchester, showing multiple ineffective chop marks made with a cleaver into dense articular bone. (Photo credit: Durham Archaeology Department)

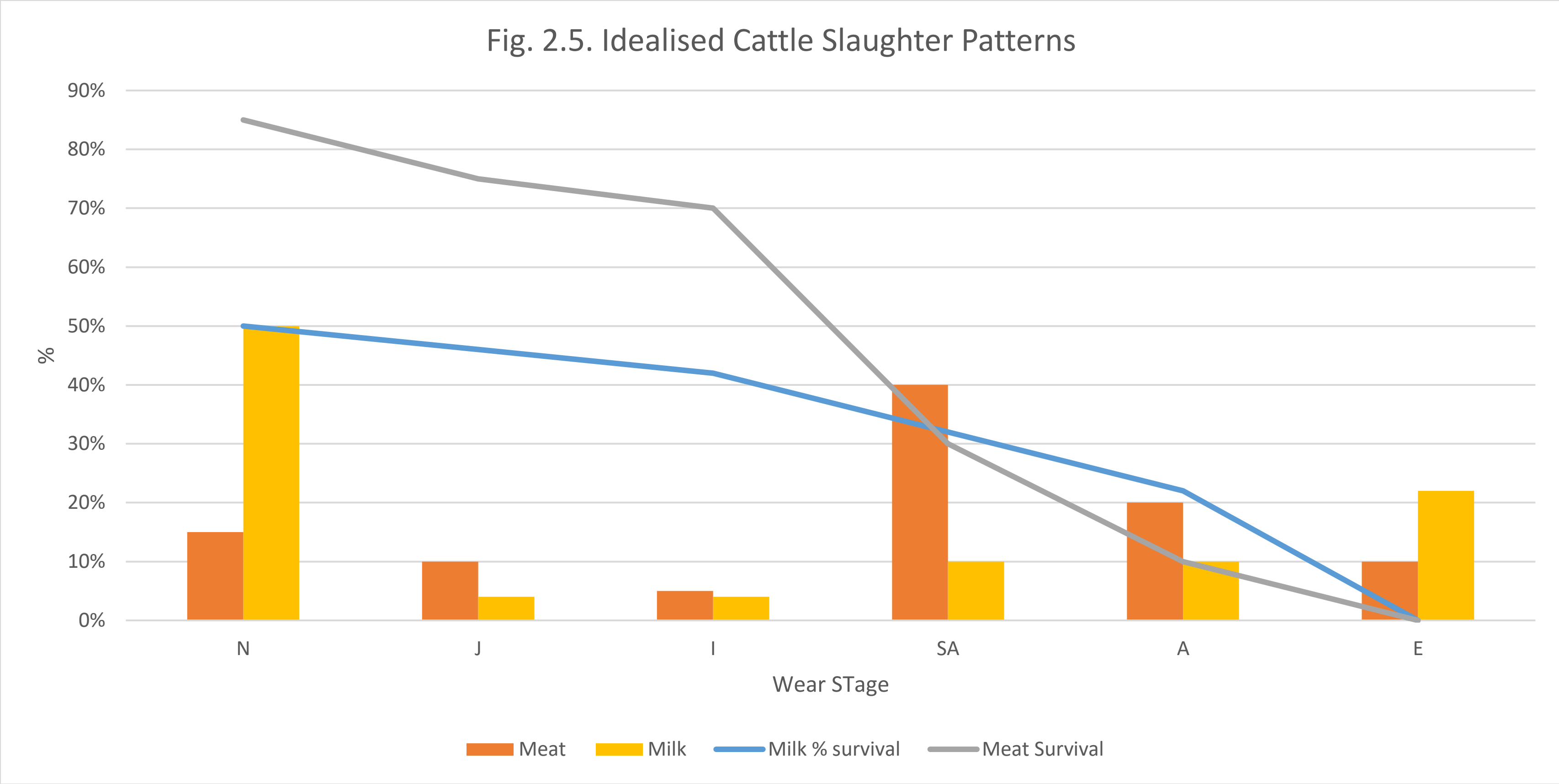

Figure 2.5. Idealised Cattle Slaughter Patterns. This figure represents the rough concentrations of age at death from self-sustaining cattle populations purposed solely for either meat or milk production. Age Stages Listed are according to O'Connor (1988, 84).

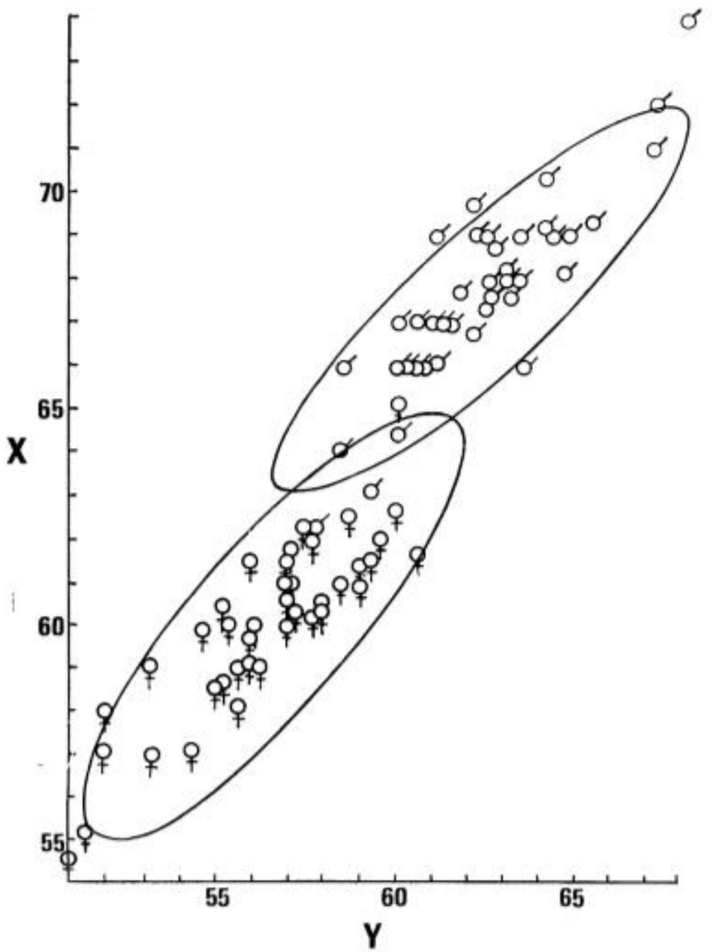

Figure 2.6. Scatterplot of Modern Aberdeen Angus Metacarpals.

Showing separation between females and castrates. X axis: Diaphyseal width, Y axis: Distal width. Measurements are in mm. (Higham 1969b, 140, Figure 1)

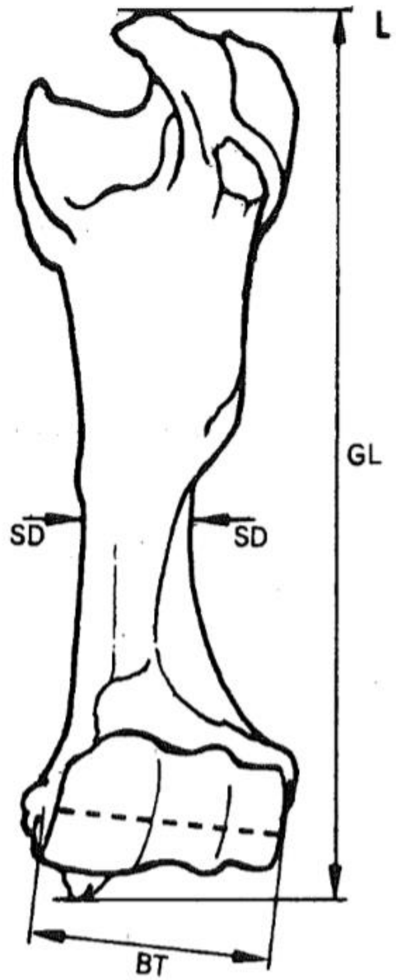

Figure 2.7. Humeri Measurements. This figure shows the measurements listed and figures provided in Driesch's (1976) specialty-defining tome. (Page 76, Figure 32b)

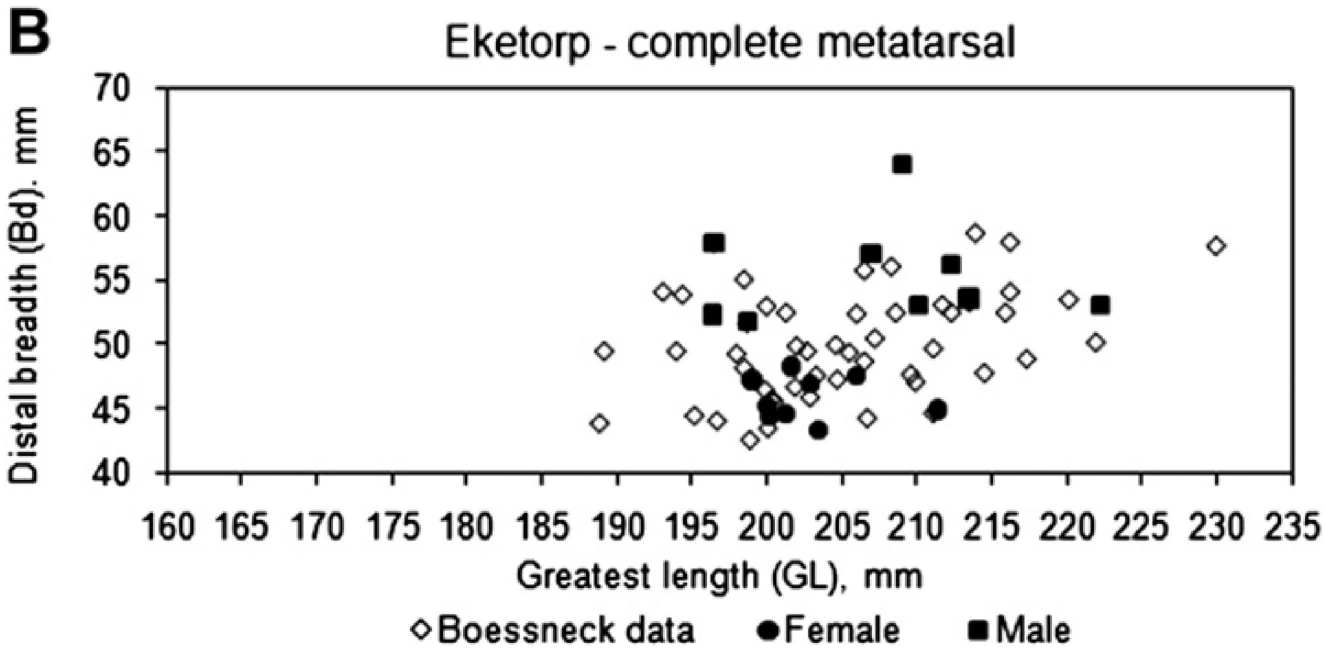

Figure 2.8. Eketorp Metatarsals. This figure shows complete metatarsals compared with Boessneck's data, plotting greatest length against distal breadth. (Telldahl 2012, 123, Figure 3b)

3. Parting the Veil: Fort and Vicus Results and Analysis

This chapter will explore the recovered faunal remains from Binchester, Roman Fort during the 2011 and 2012 excavations seasons, showing the results of the analyses described in the previous chapter. Furthermore, the fort and vicus assemblages will be compared with each other in order to assess similarity or difference in preferences, practices, or potentially identities between the two areas. While this chapter will contain graphical representations of the data, the measured elements will be presented in the Appendix.

3.1. Final Counts: Recovery of Faunal Remains

Deposition of animal bones occurred across the entirety of both the fort and vicus, with few contexts bearing no bone. The fort contained large, sometimes stone-lined, pits which appear to have been used as waste disposal, with large amounts of animal bone and other material culture being recovered from deposits of dark soil within these features (Arch. Services 2011, 1-3; 2012, 1-4). Additionally, a long system of interconnected ditches along the barrack block contained dark soil with large amounts of animal bone. A number of tentatively identified pits were found to contain deposits of animal bone, although further excavation suggests that these were instead depressions formed through the collapse of underlying structure, possibly the hypocaust (Petts 2012, pers. communication). In the vicus, a number of stone-lined pits were identified, containing large amounts of bone. Additionally, a number of the structures adjacent to the Roman road were found to contain large deposits of dark soil, containing large amounts of animal bones (Arch. Services 2011, 1-3; 2012, 1-4). The presence of large amounts of animal bone within these structures suggest that the buildings were abandoned and subsequently utilised for waste disposal (Arch. Services 2012, 1-4).

A total of 169, 291 fragments were recovered, washed and analysed from the 2011 and 2012 excavation seasons at Binchester. It is important to consider possible sources of bias in the collection and analysis of the faunal remains from Binchester. Excavation on site was carried out by Durham Archaeology first year undergraduates, with material being hand collected. Due to their size and robusticity, cattle bones survive better in archaeological contexts and are easier to identify when fragmented, contributing to the bias towards larger mammals (Lyman 1984, 257). A project of sieving within specific contexts was undertaken to determine, among other things, the extent to which fish, bird and smaller mammal bones were going unnoticed during hand collection (Arch Services 2011, 2012). Findings indicated that, while fish, bird and small mammal bones were present in the sieved samples, the low numbers recovered suggest a minimal utilisation of the animals, not significantly altering the dominance of cattle utilisation on site.

3.2. All Things Great and Small: Species Representation

Morphometric analysis of the assemblage resulted in a Number of Identifiable Specimens (NISP) of 18,847, with 10,466 from the fort and 8,243 in the vicus. A breakdown of the NISP data shows a similar species representation between the Fort and Vicus (Fig. 4.3.1 & 4.3.2). Of the main domesticates, cattle is the majority, represented by 68.8% of recovered fragments in the fort (NISP count of 7299), and 70.5% in the Vicus (NISP count of 5811). Further, the NISP data reveals equal representation between sheep/goat and pig in the fort (13.4% and 13.1%) as well as the vicus (12.5% and 12.1%). Besides the three main domesticate species, small amounts of horse, dog and bird bone were hand collected as well as a few specimens of fish, small mammal and bird. Viewing Species representation through the minimum number of individuals present reveals overall trends similar to the NISP (Figure 3.alkjadfl;kj) Although the cattle dominance is lessened, particularly in the vicus, it still by far the most prevalent. Considering the bulk associated with each beast, it is clear that cattle was the primary source of meat in both areas. Additionally, the prevalence of sheep/goat and pig are still equal in each area.

In both the fort and vicus, cattle were the main resource utilised on site, with sheep goat and pig populations being an almost equally distant second. The almost identical species representation between the fort and vicus is an unexpected result. The low degree of variation between fort and vicus assemblages is surprising considering the distinction between military and civilian identity often drawn by researchers (King 1984, 188), although some theoretical modelling has suggested the intermixing of fort and vicus personnel could lead towards a convergence of identity, especially in the Late Roman period (Mattingly 2006, 511). This could be the result of similar practices being employed in both the fort and vicus, or the convergence of identities between the two groups. Alternatively, both depositions recovered are from a single group of inhabitants, rather than two separate ones. A Chi Square Independence test was conducted, testing this similarity. No statistical significance between the proportions of major domesticates in fort and vicus was noted (P=0.919). This reinforces the noted similarity between fort and vicus, indicating the same utilisation of domesticate species between the two areas.

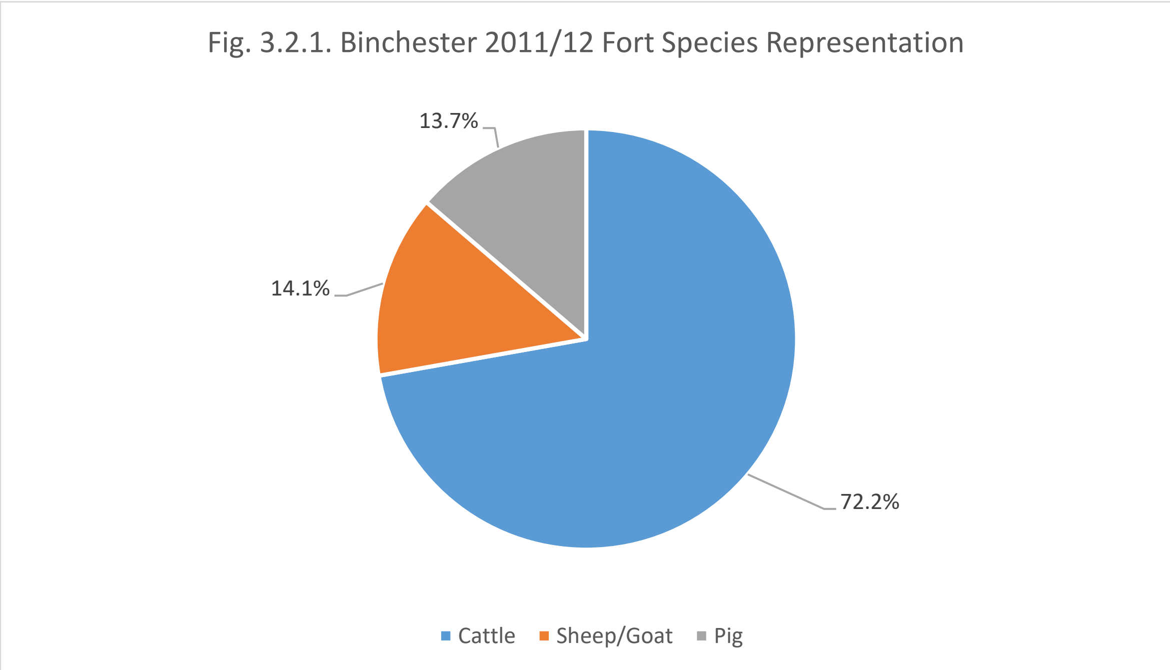

Fig. 3.2.1. Binchester 2011/12 Fort Species Representation

The percent representation of the main. Based on the recovered identifiable fragments from the Fort at Binchester. Sample size: 10108.

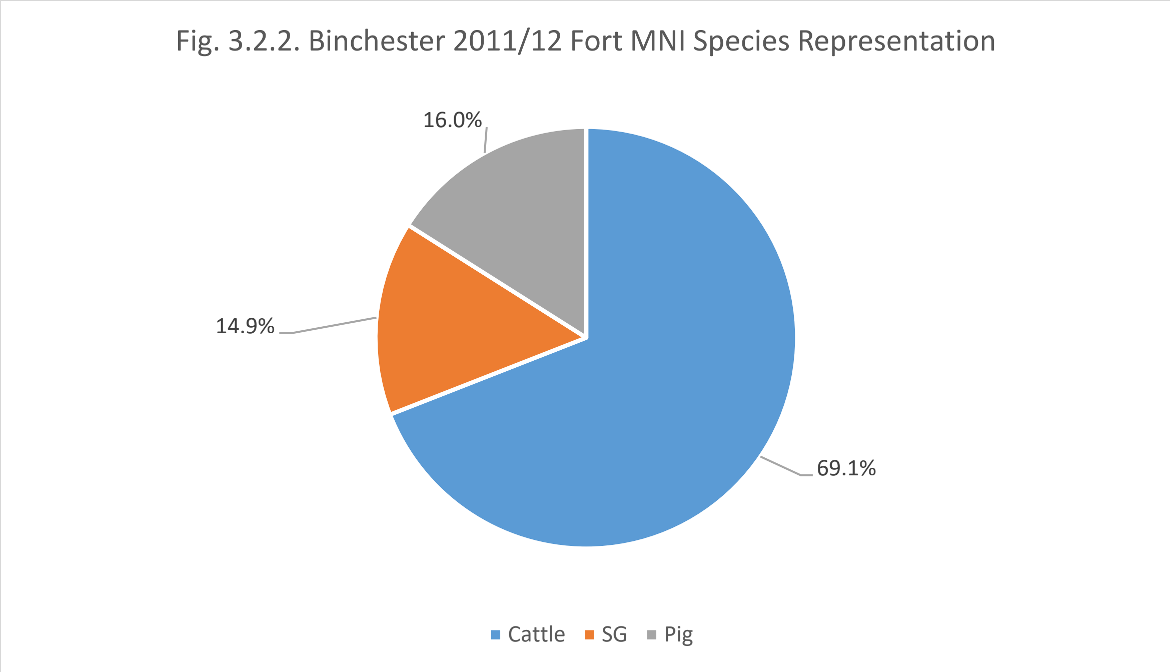

Fig. 3.2.2. Binchester 2011/12 Fort MNI Species Representation

The percent representation of the main. Based on the minimum number of individuals from the Fort at Binchester. Sample size: 181.

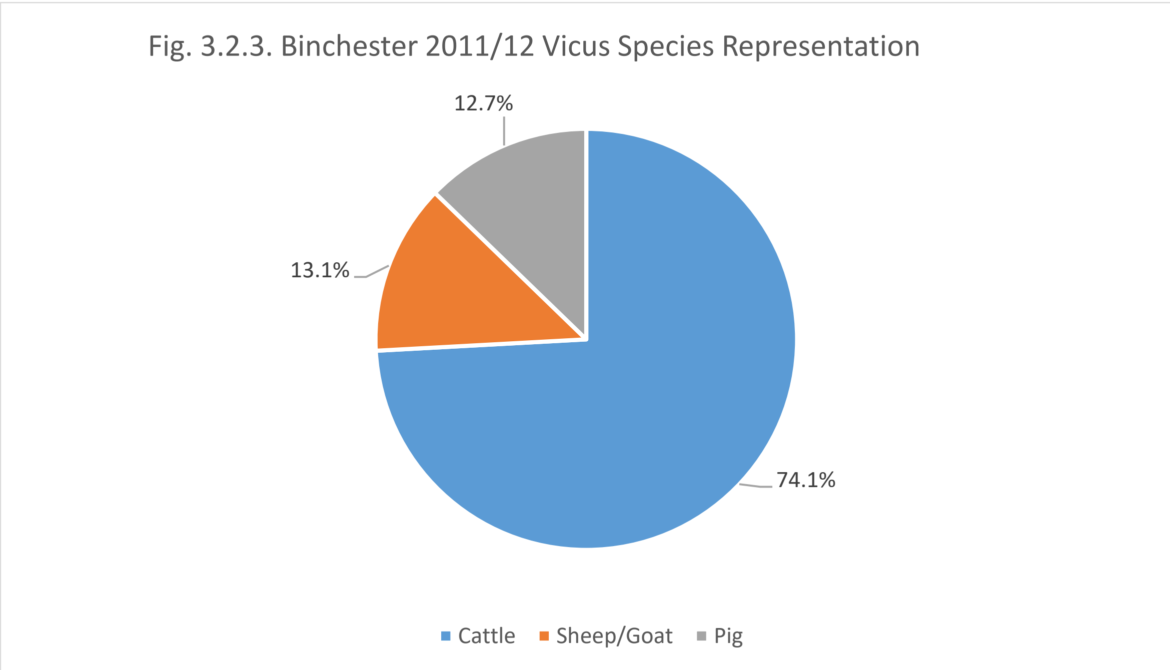

Fig. 3.2.3. Binchester 2011/12 Vicus Species Representation

The percent representation of the main domesticates. Based on the recovered identifiable fragments from the Vicus. Sample size: 7838.

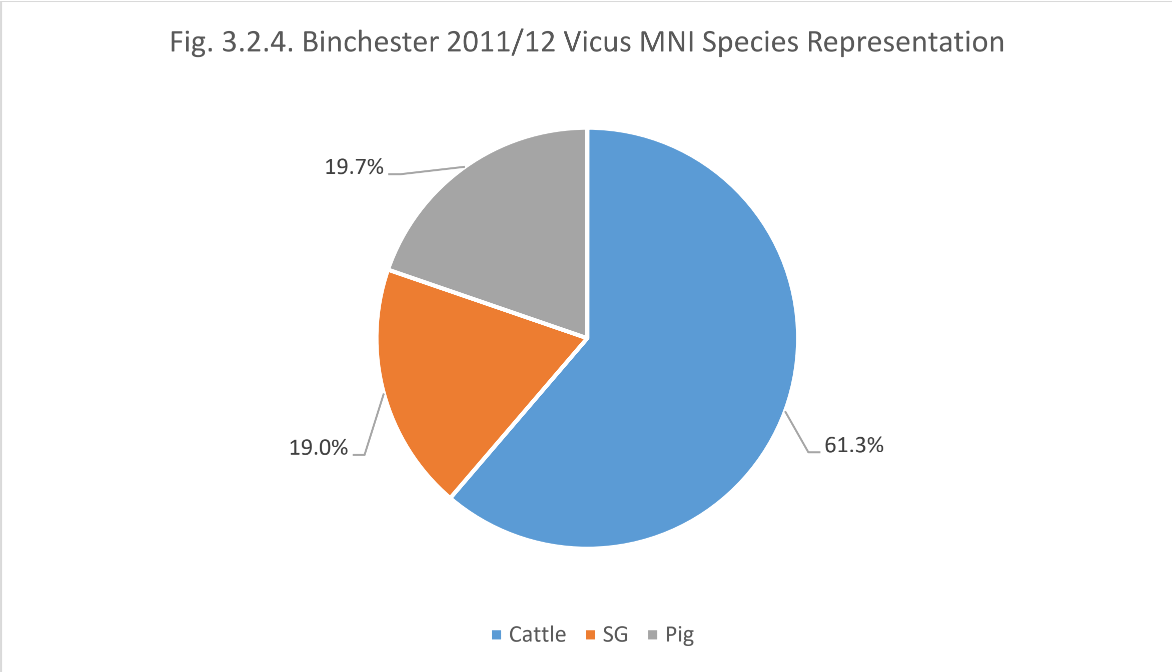

Fig. 3.2.4. Binchester 2011/12 Vicus MNI Species Representation

The percent representation of the main domesticates. Based on the minimum number of individuals from the Vicus. Sample size: 142.

3.3. Fine Roast or Butcher's Waste: MNI, MNE, Element and Body Part Representation

As noted, cattle represents the majority of recovered identifiable specimens. In addition to calculating the NISP, both the Minimum Number of Individuals (MNI) as well as the Minimum Number of Elements (MNE) represented within the assemblage are calculated for the fort and vicus. Within the fort, a total of 7299 fragments of cattle bone were identified. Of the cattle assemblage, the most commonly occurring element was the left humerus, resulting in a calculated MNI of 125 heads of cattle (Table 3.3.1). The MNE of the fort was calculated by counting the most commonly occurring diagnostic zone of each major cattle element, resulting in an MNE of 3015.

T. 3.3.1. Binchester 2011/12 Fort MNE				
	Total	MNE (L)	MNE (R)	MNE (Total)
Maxillae	-	35	30	65
Astragalus	206	97	90	187
Atlas	77	-	-	77
Axis	76	-	-	76
Calcaneus	228	73	102	175
Femur	331	42	41	83
Humerus	377	125	100	225
Mandible	263	61	45	106
Metacarpal	308	69	78	147
Metatarsal	297	85	71	156
Pelvis	341	79	64	143
Radius	426	119	111	230
Scapula	345	80	64	144
Tibia	297	84	85	169
Ulna	206	53	67	120
1st Phalanx	450	215	235	450
2nd Phalanx	252	130	122	252
3rd Phalanx	210	107	103	210
Overall MNE				3015

Table 3.3.1. Binchester 2011/12 Fort MNE

This table displays the minimum number of each major cattle element present within the fort assemblage, as well as the total of these elements, representing the overall MNE of the assemblage.

From the vicus a total of 5811 identifiable cattle fragments were recovered. Table 3.3.2 shows the recovered fragments by element, as well as calculating the MNI and MNE. The most commonly occurring element in the assemblage is the right astragalus, giving an MNI of 87. Using the most commonly occurring diagnostic zone of each major element, the total MNE for the vicus assemblage is 2425.

T. 3.3.2 Binchester 2011/12 Vicus MNE				
	Total	MNE (L)	MNE (R)	MNE (Total)
Maxillae	-	63	58	121
Astragalus	180	67	87	154
Atlas	52	-	-	52
Axis	55	-	-	55
Calcaneus	181	72	81	153
Femur	214	40	41	81
Humerus	238	61	60	121
Mandible	337	54	65	119
Metacarpal	243	64	67	131
Metatarsal	240	73	60	133
Pelvis	339	57	59	116
Radius	280	56	54	110
Scapula	192	42	49	91
Tibia	227	58	60	118
Ulna	159	61	62	123
1st Phalanx	348	177	171	348
2nd Phalanx	233	118	115	233
3rd Phalanx	166	85	81	166
Overall MNE				2425

Table 3.3.2. Binchester 2011/12 Vicus MNE

This table displays the minimum number of each major cattle element present within the vicus assemblage, as well as the total of these elements, representing the overall MNE of the assemblage.

Using the MNE data, the relative frequency of each element is calculated for both fort and vicus (Fig. 3.3.1). Most elements occur twice in an individual, a left and a right element. Vertebrae, such as the atlas and axis, only occur once per individual, thus the MNE count for these elements has been doubled to give it an accurate representation. Conversely, 1st, 2nd and 3rd phalanges occur 8 times per individual, with one left and right of each phalanx per limb. To avoid their over representation when portraying relative frequencies, the MNE has been divided by four in order to weight their occurrence appropriately. It is important to note that, while skulls and maxillae were notably present on site, the excavation, washing and storage of these elements resulted in the destruction of the majority, resulting in their diminished representation in quantified totals. However, a large number of loose teeth were recovered, providing some ability to attempt to quantify the presence of skulls on site. A method similar to that used by Rowley-Conwy at Arene Candide (1997) was employed. The records were reviewed, with intact mandibles and maxillae used to create a minimum number of jaws and skulls. The number of missing teeth from these jaws was then calculated, and this number was compared to the recovered number of loose teeth. In cases where the number of loose teeth was greater than the number missing, the loose teeth were used to modify the minimum number of elements recovered. This is of particular use for the quantification of skulls, as the number of recovered maxillae was exceptionally low. Account was taken of wear stages and tooth eruption to avoid matching teeth of obviously different age, such as a worn M3 with an unworn dp4, within the same mandible. This method was utilised to achieve a notional representation of skulls within the assemblage, as their survival was adversely affected by excavation, processing and storage. This method is not without problems, as jaws or maxillae that are fragmented into multiple loose teeth may see a greater representation within the assemblage than other easily damaged elements such as juvenile bones or proximal humeri. This method is a simple solution to a complex problem, and only the full recovery of all loose teeth through screening of the site, or a far more detailed analysis of recovered skull fragments would produce a better representation. While this method produced an MNE for mandibles that was similar to the traditional use of the Diagnostic Zone Method, and thus was not used to replace said MNE, it was of particular use in calculating an MNE for cattle maxillae, yielding an MNE of 65 from the fort and 121 from the vicus. For skulls, this translates into an MNE of 35 for the fort and 63 for the vicus.

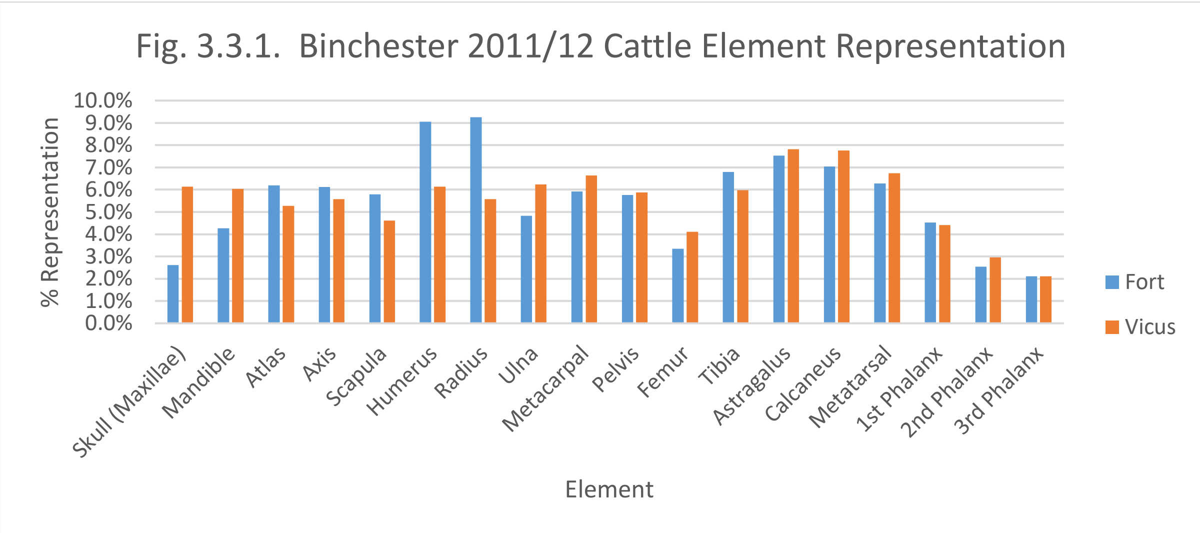

Fig. 3.3.1. Binchester 2011/12 Cattle Element Representation

This figure displays the relative frequency of the major cattle elements recovered from the fort. The representation given is based on the minimum number of elements quantified. The atlas, axis, and phalanges have been scaled to give an accurate representation. Sample size: Fort=3015; Vicus=2425

As the figure above shows, all elements are present in both assemblages, suggesting that whole animals were transported, or driven, onto site for slaughter and consumption. The fort and vicus show largely similar representations of most elements, with a few exceptions. In the fort, there is a notably higher representation of humeri and radii recovered. In the vicus, there are more mandibles and maxillae than recovered at the fort, as well as metapodials. The elevated presence of forelimb bones at the fort could be indicative of a higher degree of consumption taking place in the vicinity. Skulls, mandibles, and metapodials are all associated with primary butchery waste (Seetah 2005, 5-6), thus, their elevated presence in the vicus suggests a higher degree of carcase preparation. In order to facilitate a more general approach towards the element representation, the major cattle elements recovered are further grouped into forelimb, hind limb, metapodials, lower limb, and other to more accurately view the representation of different body parts within the assemblage (Figure 3.3.2 & 3.3.3). The 'Other' grouping is to include skulls, mandibles, and vertebrae. The element distribution from both fort and vicus suggest that multiple processes were taking place, or that multiple processes made depositions in the same area. The presence of metapodials and lower limb elements suggests butchery, possibly hide processing as well. The presence of a large degree of upper hind and forelimb elements suggests consumption taking place on site or nearby. The element and body part representation both show the presence of all elements and body parts, suggesting that animals were brought to both areas 'on the hoof,' for slaughter, butchery and consumption (Thomas and Stallibrass, 2008, 9). While it is possible that the animals could have been butchered elsewhere, possibly in the vicus, the element distribution indicates that the butchers then transported the meat, waste, and secondary products into the fort and disposed of them there. Elevated metapodials and skulls in the vicus suggest a higher presence of carcase processing, while the elevated representation of forelimbs in the fort suggests more consumption taking place in the vicinity. The most surprising feature of the element representation of both assemblages is not their differences, but rather their similarity. With the greatest difference in representation being between forelimbs, and that only a 6% difference in representation, the element and body part representation shows a surprising similarity in practice between vicus and fort. The cattle body part representation was tested with two different Chi Square tests. The first, comparing fort and vicus, found no significant difference between the two (P: 0.542). The second Chi Square compared the fort and vicus against an even body part representation. Again, no statistically significant difference was found between an even body part representation and the fort or vicus data (Fort P: 0.249; Vicus P: 0.131). This reinforces the interpretation of whole animals being brought on to site, with all body parts seeing representation in both assemblages.

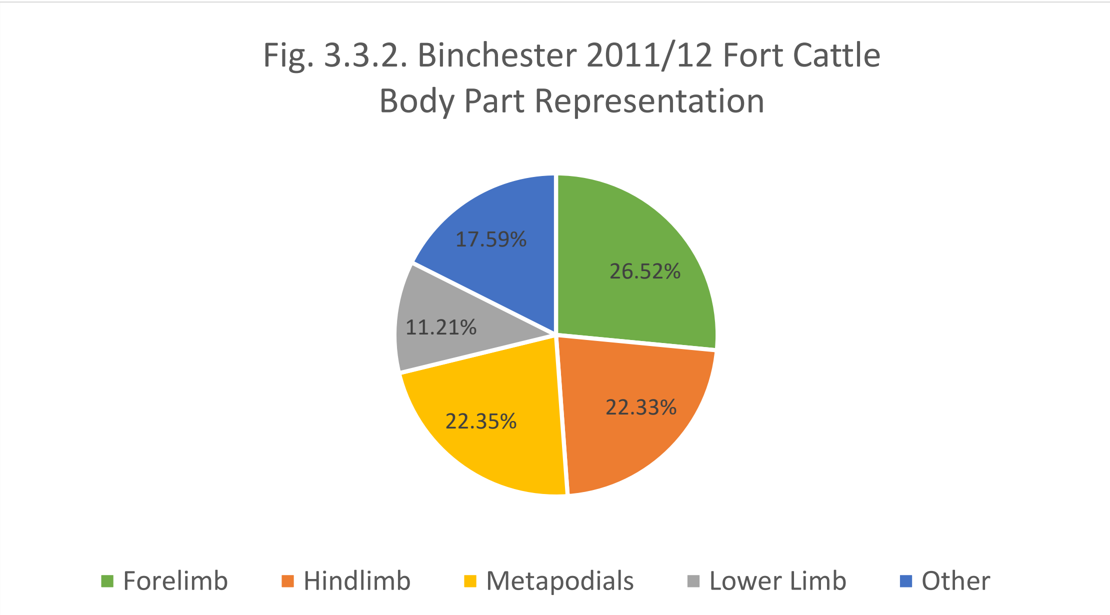

Fig. 3.3.2. Binchester 2011/12 Fort Cattle Body Part Representation

This figure groups the fort relative frequencies of the major cattle elements by body part, with other including the skull, mandible, axis and atlas. Representation is based on the MNE. Sample size: 3015

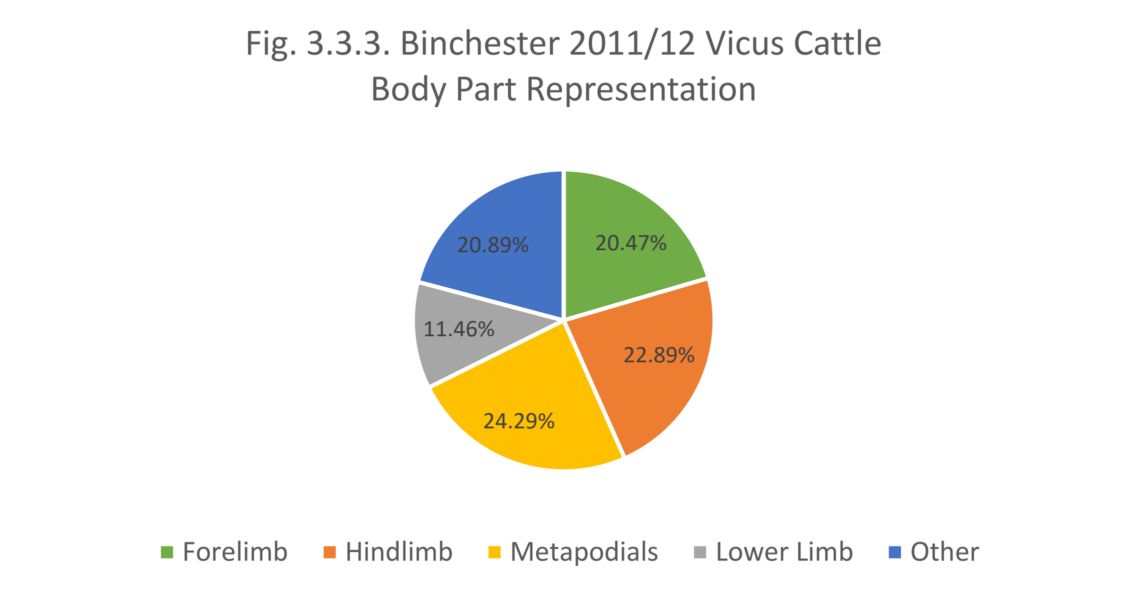

Fig. 3.3.3. Binchester 2011/12 Vicus Cattle Body Part Representation

This figure groups the vicus relative frequencies of the major cattle elements by body part, with other including the skull, mandible, atlas and axis. Representation is based on the MNE. Sample size: 2425

3.4. Cleavers and Cattle: Butchery Patterns

In both fort and vicus extensive butchery of meat bearing bones was noted. In the fort 1029 recorded elements were found to have butchery marks, making up 14.1 percent of the assemblage. In the vicus, 989 identifiable fragments were butchered, making up 17 percent of the total. The butchery marks recorded largely correlate to meat bearing elements, with some evidence for hoof, hide and skull removal. It is important to note that the butchery and consumption of cattle elements can often produce many identifiably butchered fragments from single elements, introducing the possibility of selection bias (Seetah 2006, 112-113). Unlike the fine, slicing knife marks commonly associated with the Iron Age, the butchery marks noted at Binchester were mainly large cleaver marks, often hewing through the bone entirely, and readily associated with the Late Roman military butchery style (Figure 3.4.1) (Seetah 2005, 5-6). The distribution of butchery marks by element is shown in Figure 3.4.2. There is relatively little difference between fort and vicus in the elements butchered, with a larger percentage of butchery marks on humeri in the fort, and elevated recovery of butchered pelves from the vicus. As the figure is counting butchered fragments, it is highly likely that some elements, such as pelves or humeri, may be overrepresented due to multiple butchered fragments from the same original element being counted. However, the overall trends show a high

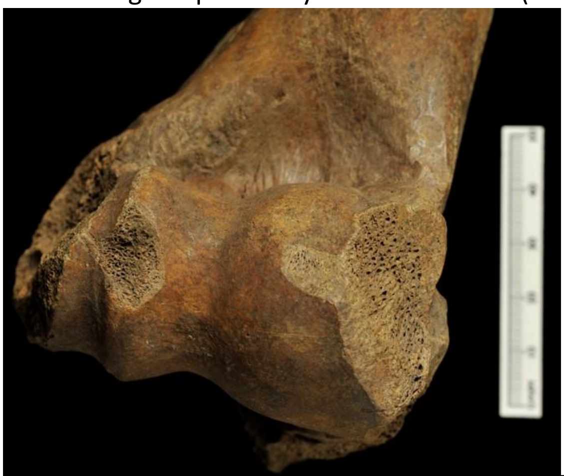

Figure 3.4.1. Distal cattle humerus, anterior view. Along the articulations are many cleaver marks, iconic of the Roman Military butchery style.

degree of butchery of upper hind and forelimb bones, with the pelvis, humerus and scapula having the largest representation among the butchered elements, indicating the consumption of meat on site or nearby (Seetah 2005, 7; Figure 3.4.2, 3.4.3). It should be noted that ribs and vertebrae also displayed a moderate degree of butchery. However, due to their fragmentary nature and quantitative difficulties, they were not included in the overall count of identified fragments, and thus are not included in this analysis. The presence of cleaver marks on vertebrae and ribs contributes to the evidence for consumption on site. The presence of butchered 1st and 2nd phalanges, along with butchered skulls, atlas, axis and metapodials indicates the presence of butchery waste, with some evidence of secondary processing. Some of the only knife marks found were on proximal metapodials and corresponding carpals and tarsals, indicative of hide removal for secondary processing. Furthermore, the presence of butchered horn core fragments indicates the possible procurement of horn cores for secondary processing as well. Overall the trends show a focus on butchery and consumption, with smaller amounts of evidence suggesting some secondary processing taking place.

Figure 3.4.4. Cattle scapula showing distinctive puncture damage.

A number of recovered cattle scapulae show signs of deliberate piercing (Figure 3.4.4). This practice is commonly associated with the hanging of the shoulder joint and either drying or smoking the meat, preserving it for later consumption (Maltby 2015, 181, Seetah 2006, 116). While a common feature of Roman Britain and Late Roman sites, this feature is not limited to this area or time period. It does, however, suggest that these deposits consist not only of consumption refuse but also the remains of secondary processing of cattle resources.

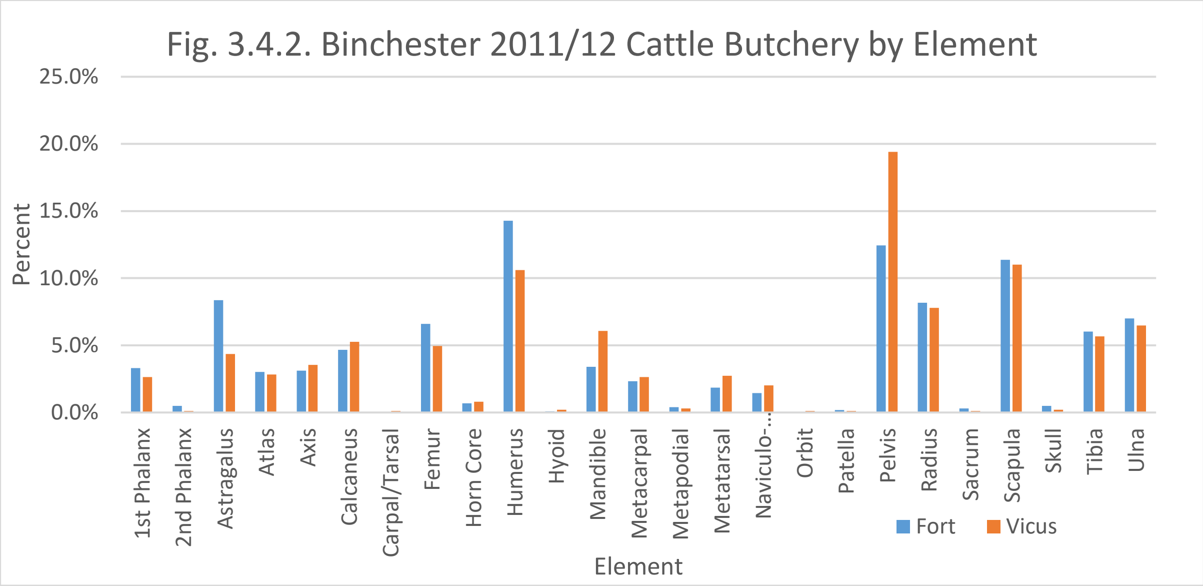

Fig. 3.4.2. Binchester 2011/12 Cattle Butchery by Element. This figure shows the percent of recovered fragments of each element that contained butchery marks. Percentages are based on the NISP count. (Fort: 10108; Vicus: 7838)

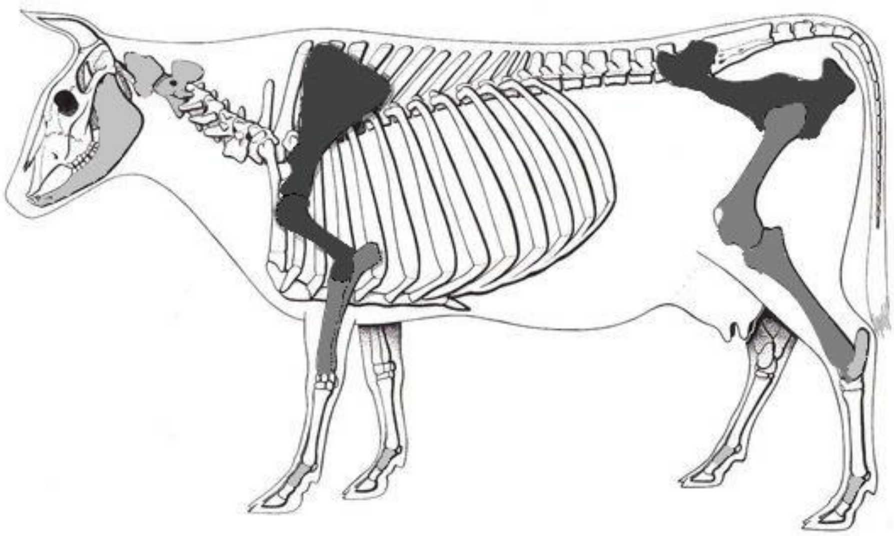

Fig. 3.4.3. Binchester 2011/12 Fort and Vicus Cattle Butchery Distribution

This figure shows the representation of butchered elements recovered from both the fort and vicus at Binchester, Roman Fort. Although there was some variation in butchery representation, both fort and vicus had similar concentrations of butchery marks on specific elements. Darker elements on the above figure saw greater proportional butchery than others. It should be noted that while butchery marks were noted on vertebrae and rib fragments, the difficulty in accurately quantifying and analysing these fragments precluded them from inclusion in this figure.

3.5. Strains, Sores and Stress: Pathological Lesions

Pathological specimens from both the fort and vicus were recovered and identified, with 78 pathological elements in the fort and 34 recorded from the vicus, making up 1.1 and 0.6 percent of total recovered fragments, respectively. Figure 3.5.1 shows the relative frequency of pathological elements in both fort and vicus, with the number of pathologies recorded listed in Table 3.5.1. When attempting to draw distinction between fort and vicus, it is very important to note that both assemblages feature a very low degree of pathology, and thus any seemingly large discrepancies between pathological representations seen in Figure 3.5.1 should be viewed with healthy scepticism. However, the individual pathologies noted are of value in providing information concerning the life and lifeways of the cattle population recovered from Binchester.

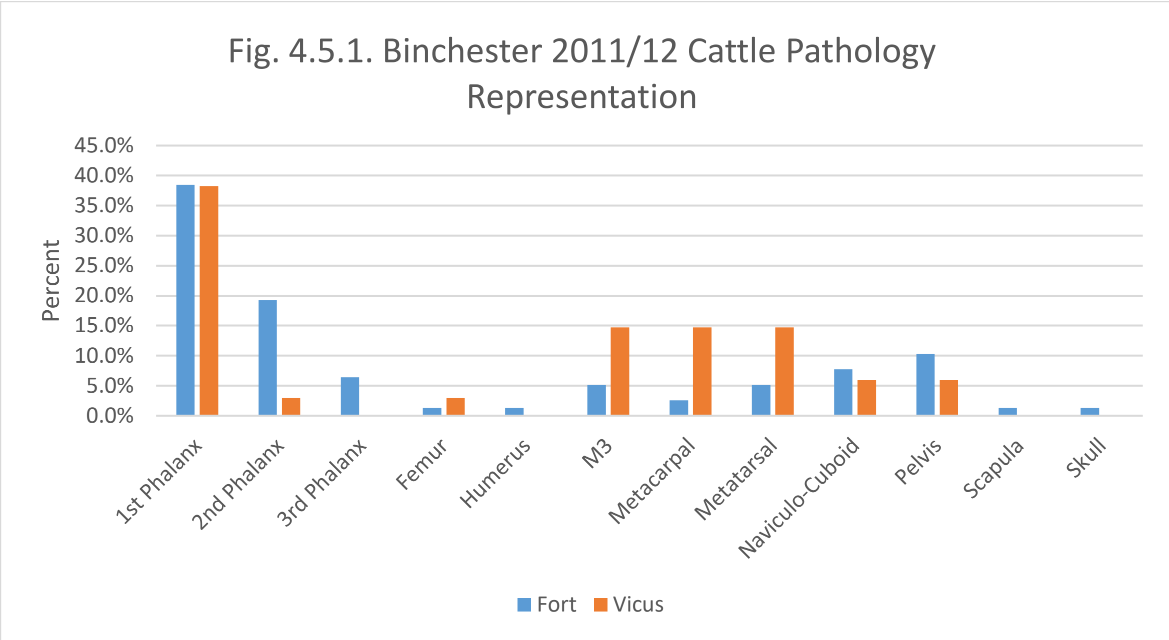

Fig. 3.5.1. Binchester 2011/12 Cattle Pathology Representation

This figure shows the representation of pathological elements recovered from both the fort and vicus at Binchester, Roman Fort. Note that this figure shows the relative representation of pathological elements among all pathological lesions noted, not as a percentage of all recovered elements. Fort n=78, vicus n=34.

T. 3.5.1. Binchester 2011/12 Cattle Pathologies		
	Fort	Vicus
1st Phalanx	30	13
2nd Phalanx	15	1
3rd Phalanx	5	0
Femur	1	1
Humerus	1	0
M3	4	5
Metacarpal	2	5
Metatarsal	4	5
Naviculo-Cuboid	6	2
Pelvis	8	2
Scapula	1	0
Skull	1	0
Total	78	34

Table 3.5.1. Binchester 2011/12 Cattle Pathologies. This table shows the number of pathological elements recovered from Binchester in 2011/12

Figure 3.5.2. Pathological 1st Phalanx

Non pathological 1st phalanx left, 1st phalanx demonstrating splayed pathological growth and eburnation, right.

Figure 3.5.3. Pathological 3rd Phalanx.

Top: distal view. Bottom: proximal view, showing pathological deformation

While the overall presence of pathology was low, several recurring pathologies give insight into the lifeways of these ancient animals. The phalanges show signs of lipping and the growth of exocytoses (Figure 3.5.2). The pathological responses seen to stress and injury in the first and second phalanges is interpreted as an indicator of traction work. Beyond occupational markers, the 3rd phalanges recovered from the fort show signs of severe infection, with the entirety of the articular surface eroded away due to pathological growth (Figure 3.5.3). With an infection as severe as this, it is unlikely that any weight could have been put on this limb at all, and the creature would only have moved under extreme duress, making it of little to no use for traction purposes. This suggests that the animal may have provided some other use, such as meat or milk. Metacarpals and metatarsals both show signs of distal splaying, a further indication of utilisation for traction. Only the most severe cases of distal splaying were recorded, as those elements with a small or moderate degree of splaying are difficult to definitively identify, resulting the in the possible underrepresentation of splayed metapodials within each assemblage. Again, there is also evidence of injury and infection on metapodials that would have precluded the individual from carrying out any strenuous tasks (Figure 3.5.4). Further evidence suggesting traction can be found in the pathologies associated with the naviculo-cuboid. All pathological elements show varying degrees of fusion to both the proximal metatarsal as well as the cuneiform bone (Figure 3.5.5). The ossified fusion of these tarsals has left the articulations largely unaffected, indicating spavin. The pelves and long bones show signs of eburnation and the growth of osteophytes, both signs of osteoarthritis as noted by Bartosiewicz (1997, 43). Also of note is the presence of congenital abnormalities within both assemblages, namely, congenitally missing third pillars of the mandibular M3. Often noted among Roman sites (e.g. Dobney et al. 1996, 34; Noddle 1993,), this missing M3 pillar has often been cited as evidence of inbreeding or a limited gene pool within a population (Dobney et al. 1996, 34). This provides evidence of the supply of cattle to both the vicus and fort, suggesting a similar, if not identical source of supply to both fort and vicus. Alternatively, it may be that multiple local sources for cattle display this condition, each suffering from limited gene pools within their local sources. Overall the pathological lesions noted on metapodials, phalanges and tarsals suggest the utilisation of cattle from both fort and vicus for traction work, but also gives examples of trauma and disease that would prevent utilisation of animals for this purpose, giving rise to the possibility of multiple strategies of exploitation taking place.

Figures 3.5.6 and 3.5.7 show the differences in pathological presence between fort and vicus. While the overall representation of pathology in both assemblages was very low, exceptionally so in the vicus, some differences in representation do exist, and are worth some discussion. The vicus shows a higher percentage of noted pathologies located in the metapodials, possibly indicating a higher presence of traction utilisation among the vicus population. Additionally, a higher representation of congenitally missing 3rd pillars of mandibular third molars is noted in the vicus. This could indicate multiple sources of supply, with local, genetically limited, cattle herds being sent in higher numbers to the vicus.

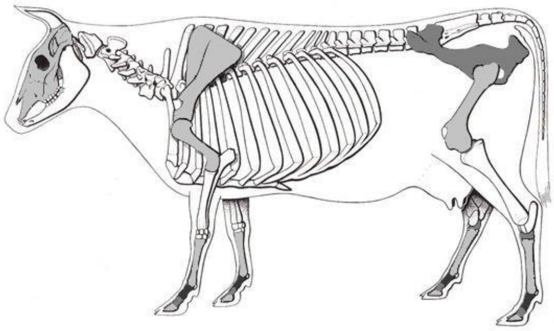

Figure 3.5.6. Binchester 2011/12 Fort Cattle Pathology Distribution.

Darker filling indicates a higher prevalence of pathological lesions.

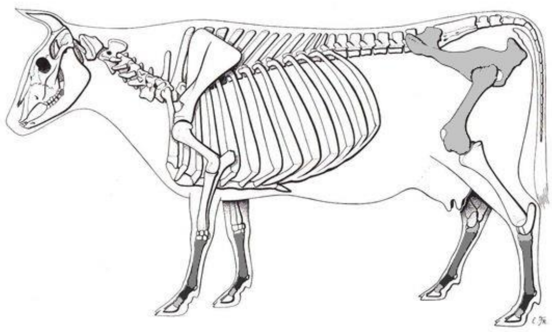

Figure 3.5.7. Binchester 2011/12 Vicus Cattle Pathology Distribution.

Darker filling indicates a higher prevalence of pathological lesions.

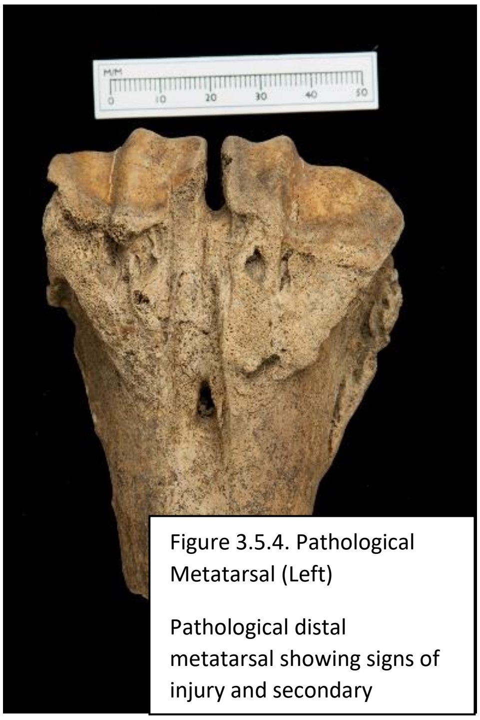

Figure 3.5.4. Pathological Metatarsal (Left)

Pathological distal metatarsal showing signs of injury and secondary

Figure 3.5.5. Spavin

View of a fused naviculo-cuboid, cuneiform and proximal metatarsal, with unaffected articulations (see right view), an indicator of spavin.

3.6. Standing Tall: Wither's Height Estimation

Due to the fragmentary nature of the assemblage, only the metatarsals and metacarpals, bearing little meat and thus escaping aggressive Roman butchery techniques, were recovered intact and in numbers great enough for analysis (Figure 3.6.1). Figure 3.6.2 shows the range of withers height estimations from both fort and vicus.

Figure 3.6.1. Complete Articulated Cattle Forelimb

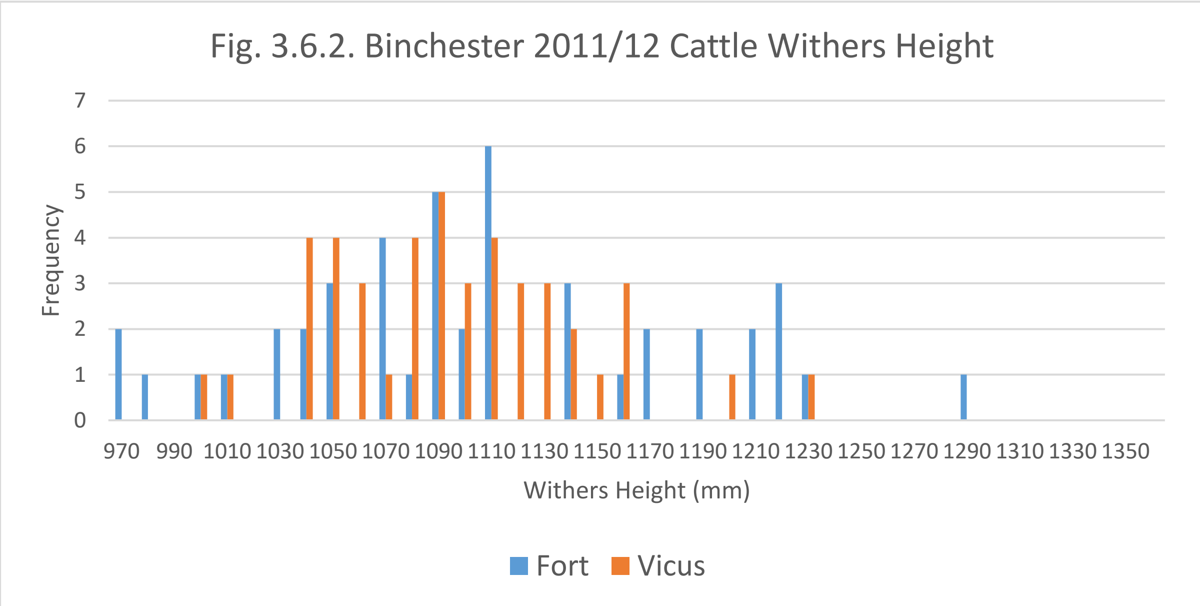

Fig. 3.6.2. Binchester 2011/12 Cattle Withers Height

This figure shows the calculated withers height from recovered elements in the fort and vicus at Binchester, Roman Fort. Calculations based on recovered complete metacarpals and metatarsals.

The cattle recovered from both fort and vicus fall within the noted range for the native 'celtic shorthorn' variety of cattle, ranging from 950-1130mm in withers height (Stokes 2000, 145). Both assemblages are likely to include females, castrates, and intact males, with the majority consisting of likely females and castrates, with fewer likely intact males present. While occupying similar ranges, there are a larger number of likely castrate sized animals in the fort than in the vicus. Without broad signs of malnutrition on the bones of the smaller elements, or on a large portion of the elements recovered, we can assume a relatively stable nutrition for the herd, making any differentiation likely to be either a difference in genetics or sex. The Withers Height calculations were first tested for normal distribution using the Kolmogorov–Smirnov and Shapiro-Wilk test for fitness, finding in both tests a normal distribution (Fort P: 0.199, 0.233; Vicus P: 0.2, 0.766, respectively). With a normal distribution noted in both fort and vicus, the Student's T test for independence was used to view any significant difference between the two data sets. Despite the conspicuous presence of larger animals within the fort, no statistical significance was found between fort and vicus withers height measurements (P: 0.442).

3.7. Measuring Up: Metrics and Sex Differentiation

As cattle are sexually dimorphic, with females being less robust and of smaller stature, metric analysis of the recovered elements can help to elucidate the separation between female, castrate and intact male. While most elements are dimorphic to some degree, certain elements display a lower amount of overlap between the sexes (Higham 1969a, 64). While rarely found completely intact, the distal humerus diagnostic zones 5 and 6 (Dobney and Rielly 1988) directly articulate with the radius, and thus the measureable portions are often spared the Roman butcher's cleaver. Due to their presence in the assemblage and low amount of overlap between sexes, the metacarpal (Figures 3.7.1, 3.7.2), metatarsal (Figures 3.7.3, 3.7.4), and humeri (Figures 3.7.5, 3.7.6) are measured to show the sexual dimorphism of the assemblage.

3.7.1. Metacarpals

The high rate of survival in archaeological contexts, low occurrence of butchery damage, relatively late age of fusion, and low overlap between sexes makes cattle metacarpals ideal for metric analysis. Figure 3.7.1 shows the greatest length (GL) plotted against distal breadth (Bd) of recovered complete metacarpals from both trenches. The measurement GL is an excellent indicator of stature, while BD is considered to be indicative of both size and robusticity. However, it is important to note that when animals are utilised for traction, the added strain of pulling carts or ploughs can cause a splaying of the distal metacarpal, giving an increased Bd measurement (Bartosiewicz 1997, 43). While this has the potential of biasing measurements, it can also provide valuable information.

Both fort and vicus share a similar range of measurements, with GL ranging between 160 and 204 mm, and Bd between 44 and 67 mm. However, there is major difference between fort and vicus: elements recovered in the Vicus show a grouping in the lower range (GL 165-185, Bd 45-55), with only 4 elements registering a Bd greater than 55. Of these, all feature a GL greater than 180, showing a distinct separation from the smaller sized grouping. The elements recovered from the fort show a higher degree of variation, with a larger occurrence of outliers. However, there is a notable increase in the number of larger, more robust elements (with Bd greater than 55 and GL greater than 180). This is indicative of a higher occurrence of likely castrates in the fort as opposed to the vicus. The larger number of elements with the highest GL measurements and increased BD could further indicate the elevated presence of castrates previously utilised for traction at the fort, possibly suggesting a system of preferential provisioning. Analysis of the metacarpal greatest length using the KS and Shapiro-Wilk test revealed a normal distribution (Fort P: 0.2, 0.768; Vicus P: 0.136, 0.417). The implementation of a Student's T test comparing the two assemblages revealed no statistically significant difference between the two groups (P: 0.45).

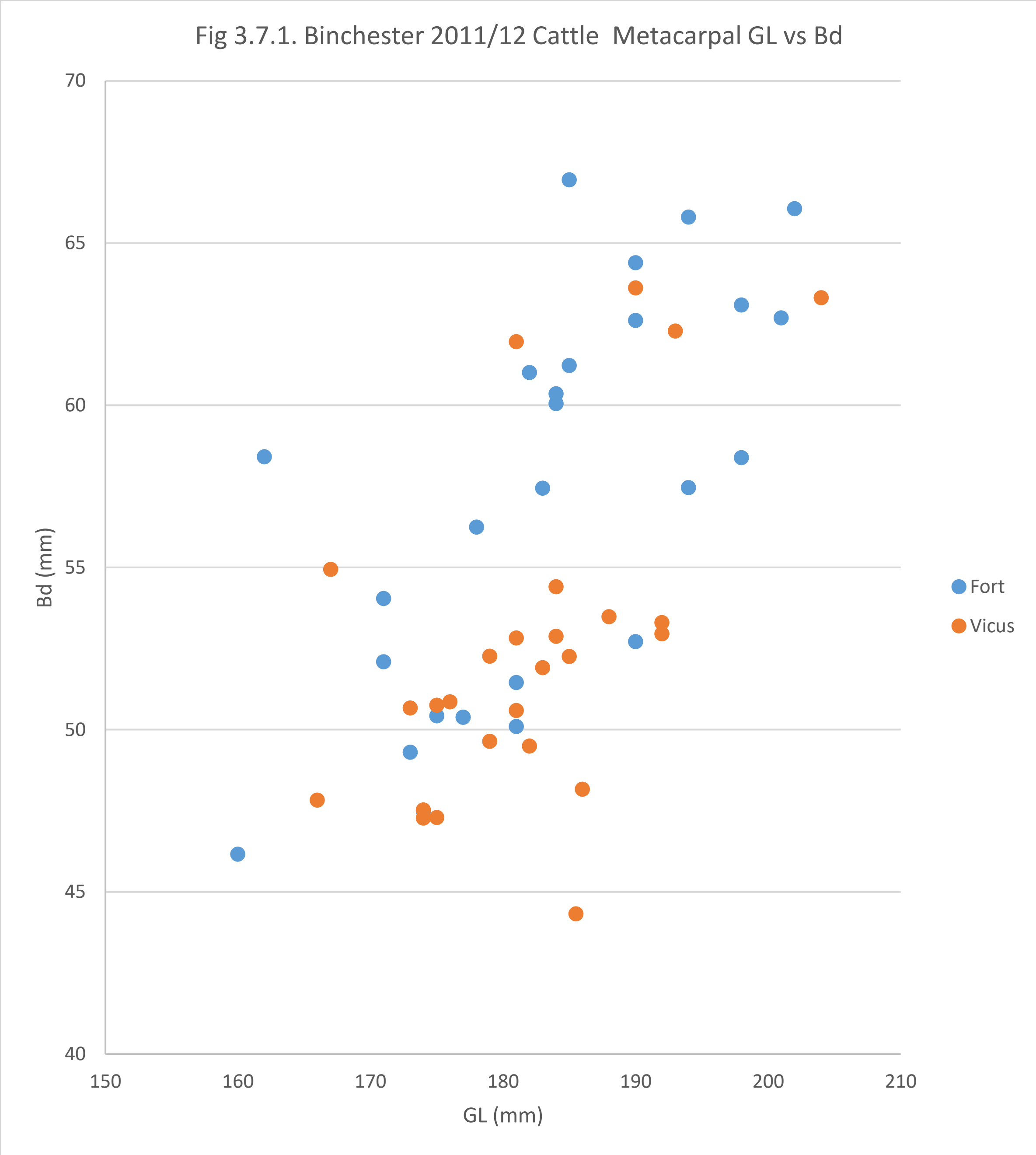

Fig. 3.7.1. Binchester 2011/12 Cattle Metacarpal GL vs Bd

This figure plots the greatest length against the distal breadth of recovered metacarpals from the fort and vicus at Binchester, Roman Fort in order to examine the sexual dimorphism of the cattle population. Measurements taken are in mm.

Measurements of metacarpal distal breadth can be plotted against the maximum diaphyseal depth (Dd) in order to gain a more specific look at the sex ratio in a larger sample (Figure 3.7.2). Examination of distal metacarpals helps to provide a more detailed view of the variance in robusticity within the population. This allows for a more concentrated look at the possible presence of distal splaying, as well as the overall differentiation of cattle sexes. Severely pathological specimens are not included in this figure, although, as noted previously, light or moderate distal splaying may have gone unnoticed during analysis and measurement. Again, we see a concentration of smaller elements present in the vicus (Bd range 47-57, Dd range 25-32), with 9 elements extending beyond this grouping, to a maximum distal breadth of 64 and diaphyseal depth of 33. This suggests a majority of female sized individuals, with a few larger individuals, possibly castrates. On the other hand, the fort features an almost even spread of measurements, with a much higher ceiling than the vicus (maximum Bd of 70 as opposed to 64). . Despite initial concerns from the author that the larger outliers noted may be pathological, secondary morphological analysis of the elements found little evidence of severe pathology contributing towards the size and robusticity of these elements. This analysis again suggests an elevated presence of larger animals in the fort, with the vicus consisting mainly of likely females. Analysis of the metacarpal distal breadth and diaphyseal depth measurements, using the Mann-Whitney U test after the KS test revealed non-normal distribution (Fort and vicus P: <0.001, 0.005, respectively), revealed statistically significant differences between the fort and vicus assemblages (P: <0.001). This finding bolsters the findings of the metric analysis of distal metacarpals, strengthening the suggestion that the fort contains a higher representation of larger animals, indicating a system of preferential supply favouring the fort.

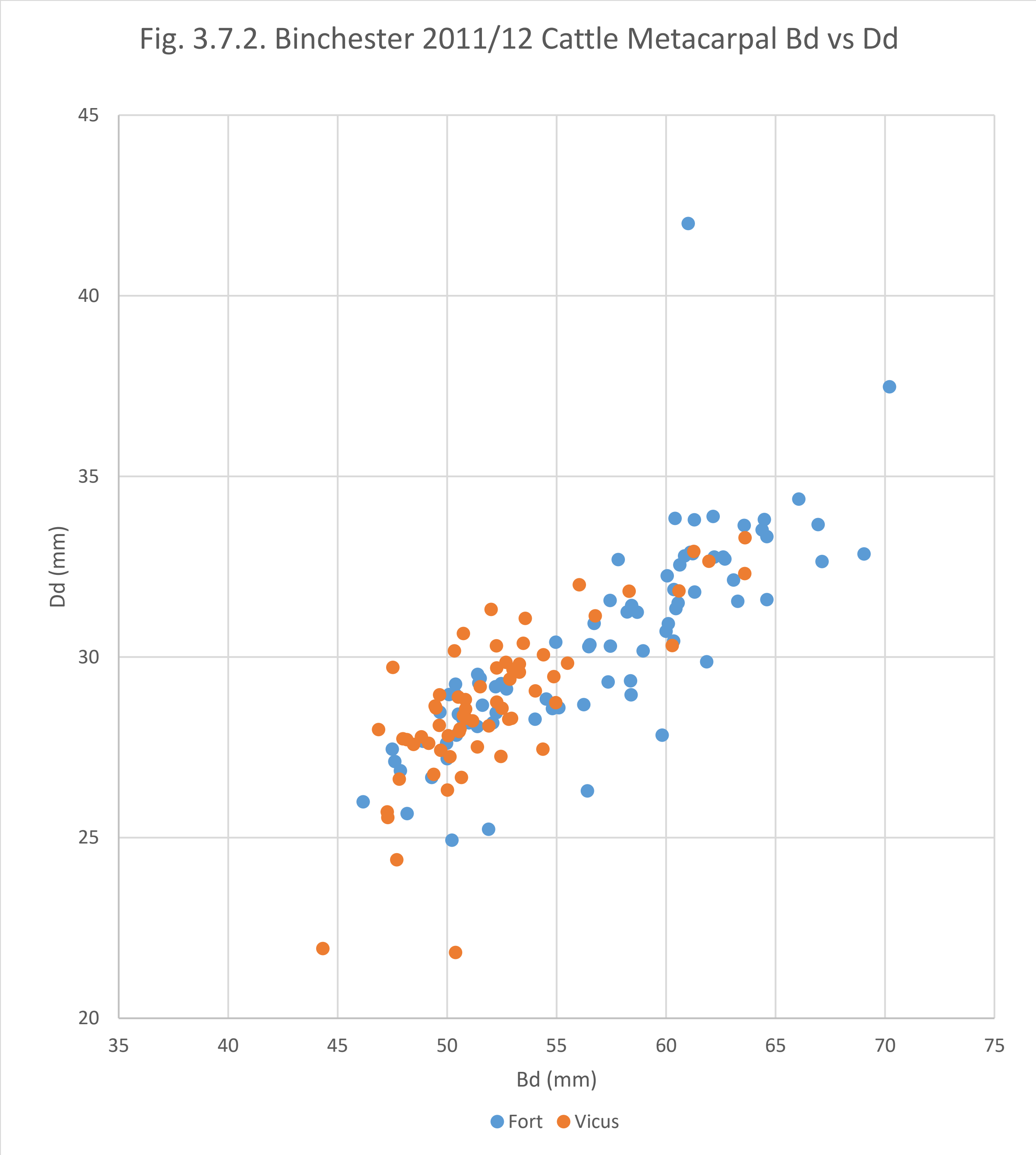

Fig. 3.7.2. Binchester 2011/12 Cattle Metacarpal Bd vs Dd

This figure plots the distal breadth against the diaphyseal depth of recovered distal metacarpals from the fort and vicus at Binchester, Roman Fort in order to examine the sexual dimorphism of the cattle population. Measurements taken are in mm.

3.7.2. Metatarsals

While metatarsals have a slightly larger degree of overlap between sexes than metacarpals, they undergo very similar taphonomic processes (Higham 1969a, 66). Generally longer and narrower than metacarpals, they bear little meat, and thus have a similarly elevated survival rate. Figure 3.7.3 plots the measurements of fully intact metatarsals GL against BD, allowing for a comparison to the groupings found with the metacarpals. While fewer fully intact metatarsals were recovered, a similar trend can be discerned. A concentration of smaller measurements can be seen in the vicus, with no GL measurements beyond 215 mm. In the fort, however, 6 recovered elements exceeded the range found in the vicus, with a maximum length of 240mm. The fort also boasts a greater amount of outliers as well that do not adhere to the aforementioned groupings. Application of the KS and Shapiro-Wilk tests to the metatarsal GL measurements revealed normal distribution (Fort P: 0.2, 0.31; Vicus P: 0.165, 0.232), necessitating the use of the Student's T Test, which revealed no statistically significant difference (P: 0.882) between the two assemblages with regards towards the measurement of GL.

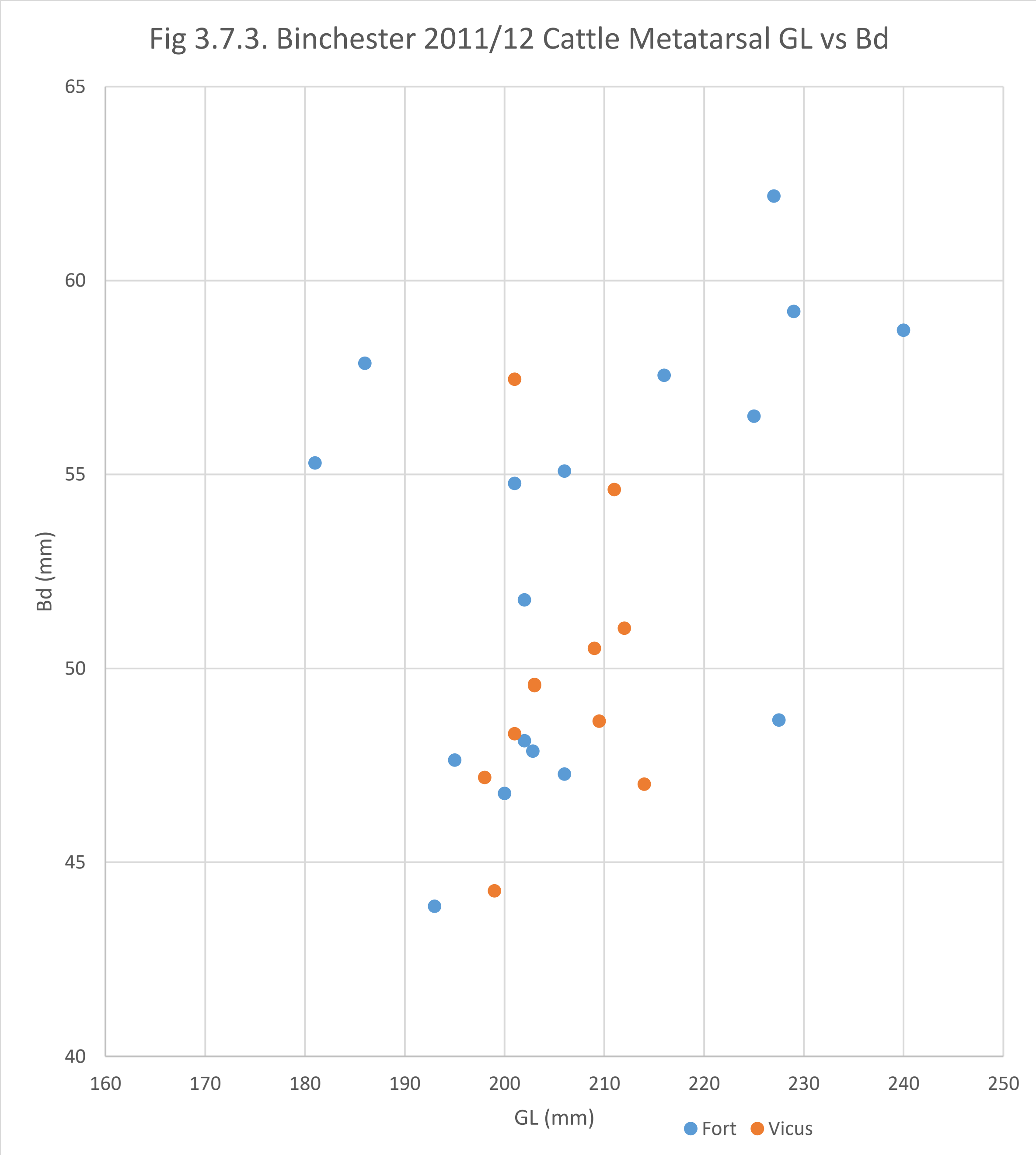

Fig. 3.7.3. Binchester 2011/12 Cattle Metatarsal GL vs Bd

This figure plots the greatest length against the distal breadth of recovered Metatarsals from the fort and vicus at Binchester, Roman Fort in order to examine the sexual dimorphism of the cattle population. Measurements taken are in mm.

Figure 3.7.4 shows the plotted measurements of the distal metatarsals, showing a very similar pattern to that of the metacarpals in Figure 3.7.2. A concentration of likely females can be seen in both trenches, Bd ranging from 43-52mm (With Dd ranging from 26-30mm). As seen with the metacarpals, elements recovered from the fort show a higher occurrence of larger elements than found in the vicus. The vicus shows only 10 elements larger than the probable female group, ranging from 54-63mm in size (and corresponding Dd of 30-34), interpreted as probable castrates. In the fort, more than double this amount of larger elements were recorded, exhibiting a greater variation in both measurements, with a maximum Bd at 67mm and Dd as low as 28mm and at 36mm maximum. Statistical analysis of the distal breadth and diaphyseal depth of recovered distal metatarsals showed a non-normal distribution of Bd measurements from the KS test and Shapiro Wilk (Fort P: <0.001, 0.002; Vicus P: 0.008, <0.001; respectively), while the Dd measurements were found to be normally distributed (Fort P: 0.2, 0.32; Vicus P: 0.2, 0.598). A Mann-Whitney U test of the Bd measurements and Student's T test of the Dd measurements both revealed no statistically significant difference between the data sets. (P-values: Bd: 0.284; Dd: 0.225).

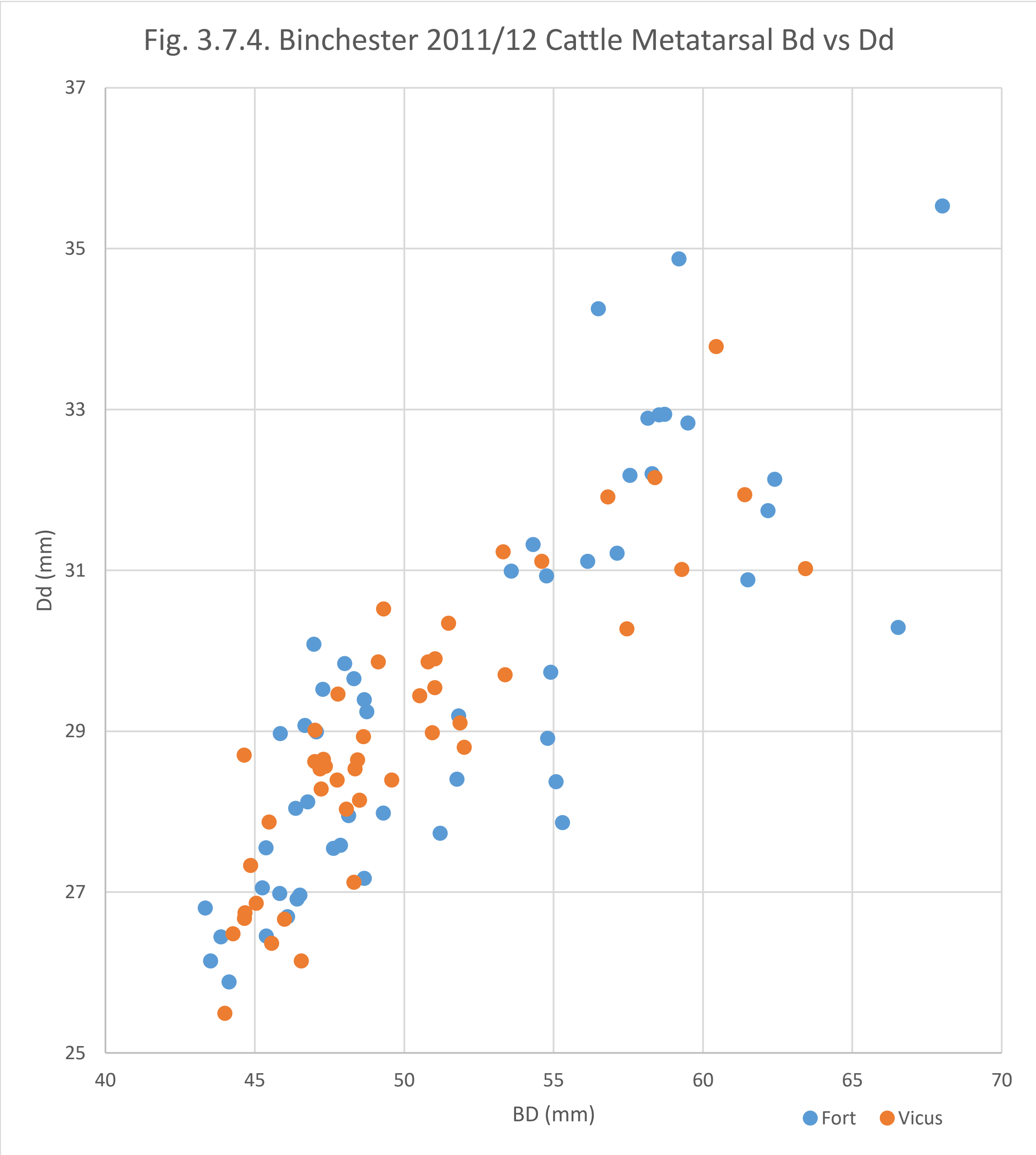

Fig. 3.7.4. Binchester 2011/12 Cattle Metatarsal Bd vs Dd

This figure plots the distal breadth against the diaphyseal depth of recovered metatarsals from the fort and vicus at Binchester, Roman Fort in order to examine the sexual dimorphism of the cattle population. Measurements taken are in mm.

3.7.3. Humeri

Figure 3.7.5 shows the measurements of the trochlear breadth (BT) of intact distal humeri from both the fort and vicus. It is important to note that the distinct ranges for different sexes are not well established in cattle and, with the likely presence of castrates in the population there is further potential for overlap between the sexes, particularly between females and castrates. Elements in the 54-58 belong to particularly small individuals, possibly evidence of local, unimproved breeds of cattle. Elements within the 58-70 range are interpreted as probable females, and are present in both the fort and vicus. Individuals in the 70-80 range are interpreted as probable castrates, with the most robust animals being considered as potential intact males. There are two elements with a notably large BT one from the vicus (82mm) and one from the fort (85mm), these are interpreted as probable intact males. The much higher frequency of larger animals (above about 70 mm) in the fort, once again suggests the elevated presence of castrates. This, as with other metric analyses, suggests a possible system of preferential supply in favour of the fort, suggesting in turn a divergence in identity between the occupants of the two areas.

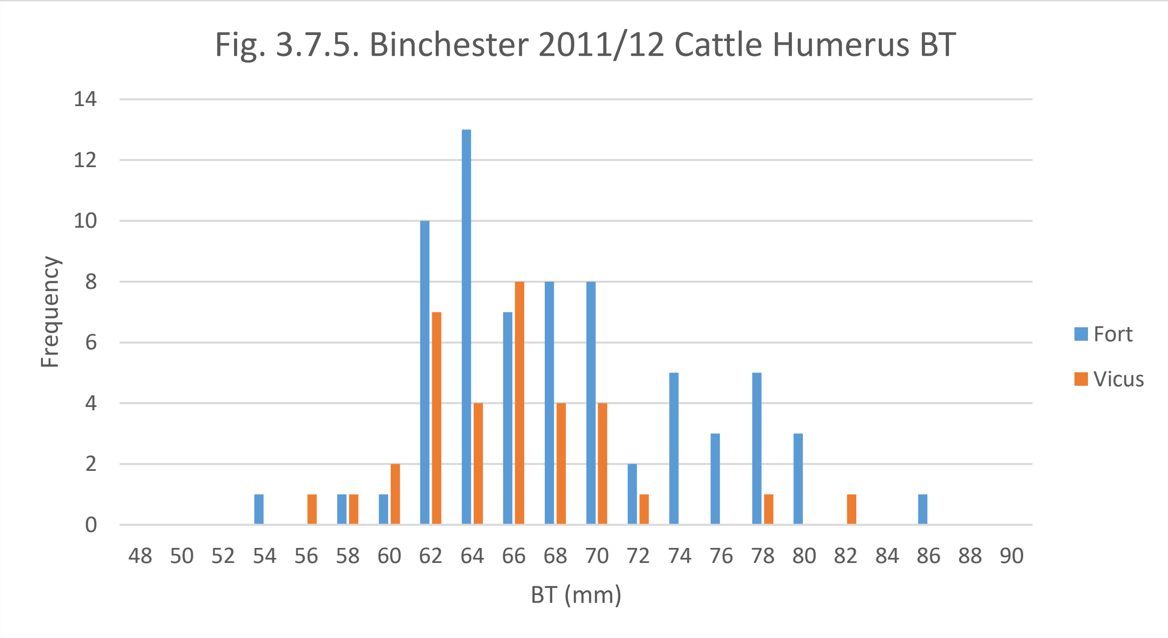

Fig. 3.7.5. Binchester 2011/12 Cattle Humerus BT

This figure shows the breadth of the trochlea of distal humeri recovered from the fort and vicus at Binchester, Roman Fort in order to examine the sexual dimorphism of the cattle population. Measurements taken are in mm.

In order to gain a more nuanced view of the sexual dimorphism displayed by humeral measurements, the distal breadth of recovered humeri was plotted against the height of the medial trochlea (HT) in Figure 3.7.6. The patterns displayed closely follow those outlined above, with a majority of measurements falling into the female range, present in both fort and vicus (using the 58-70mm BT range outlined above, with HT ranging from 35-43mm). Similar to the metapodials, a greater amount of larger measurements are present in the fort, interpreted as probable castrates. This indicates the increased presence of castrate sized elements recovered from the fort. The metric analysis of distal humeri trochlear breadth against medial trochanter height (BT vs HT) is the final metric analysis applied to the Binchester 2011/12 assemblages. Similar to the metacarpals and metatarsals analysed, the findings indicate a greater representation of likely castrate-sized elements within the fort, while the vicus consists of mainly female-sized cattle. While the KS test shows normal distribution for the vicus measurements and the fort HT, the Shapiro-Wilk normality test indicates a non-normal distribution for all measurements (P-Values: Fort BT: <0.001; HT: 0.036; Vicus BT: 0.038; HT: 0.026). As previously noted, in cases where the KS test and Shapiro-Wilk test differ, the Shapiro-Wilk result will be accepted over that of the KS test, thus, we accept the humerus measurements as not normally distributed. A Mann-Whitney U test of the humerus measurements shows statistically significant variation between the fort and vicus measurements (P-values BT: 0.044; HT: 0.022). This final piece of metric evidence reinforces the interpretations made throughout the metric analysis of the Binchester faunal assemblages.

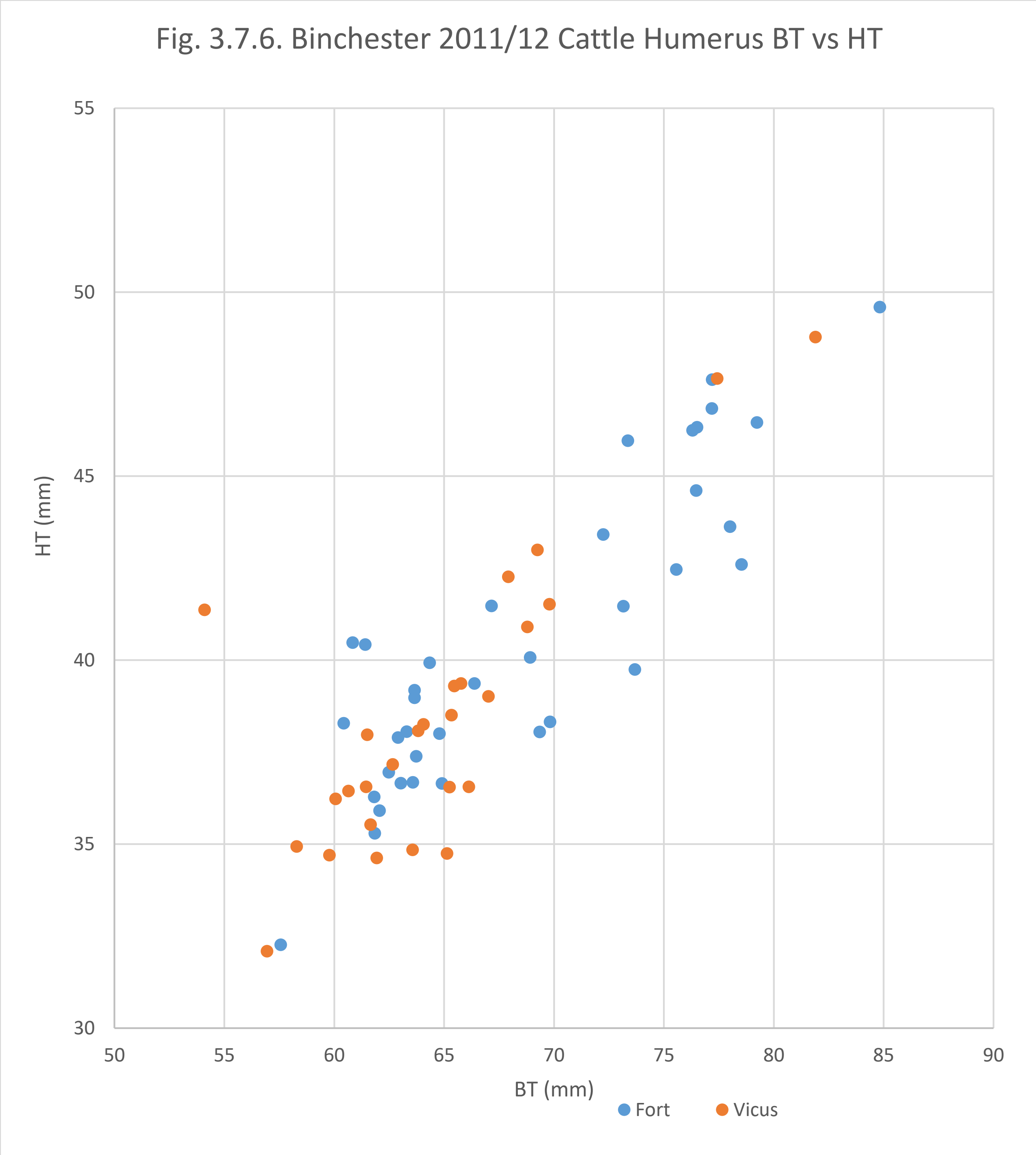

Fig. 3.7.6. Binchester 2011/12 Cattle Humerus BT vs HT

This figure plots the trochlear breadth against the height of the medial trochlear of distal humeri recovered from the fort and vicus at Binchester, Roman Fort in order to examine the sexual dimorphism of the cattle population. Measurements taken are in mm.

Overall the metric data from recovered metacarpals, metatarsals and humeri form a rough outline of the sexual dimorphism of the assemblages from the fort and vicus, while outlining key differences at the same time. Females and castrates are present in both trenches, with some possible evidence for intact males as well. Additionally, the measurements recorded occupy the same or similar ranges between the two areas, suggesting a singular source, or access to the same sources of cattle between both fort and vicus. Measurements indicate the utilisation of cattle resources from both fort and vicus for traction work. This, however, is where the similarities between fort and vicus end. Metacarpals, metatarsals, and humeri all display a surprising degree of distinction between the fort and vicus, with the fort assemblage containing many more elements that fall within the size range for probable castrates than are present at the vicus. This unexpected difference occurs in spite of the vast morphological similarity noted in the species representation, element and body part distribution, and pathological indicators recorded. The elevated presence of castrates, potentially utilised for traction work, in the fort assemblage indicates a potential distinction in identity between the fort and vicus. While morphological evidence demonstrates a convergence of preference, practice, and utilisation, the metric analysis of recovered elements suggests a system of preferential provisioning in place favouring the occupants of the fort, providing taller, more robust cattle while the vicus subsists on smaller, less robust animals.

3.8. The End of the Road: Age at Death and Kill-Off Profiles

Figure 3.8.1 displays the age categories of mandibles recovered on site from both trenches in addition to tracking the percent survival. Only very few recorded mandibles were of younger age, with almost no neonatal, juvenile or immature individuals recorded, much lower than that expected from natural mortality of a cattle population (Maltby 2015, 181-2). This indicates that the recovered cattle bones are those from individuals transported to the site for slaughter or disposal, rather than a self-sustaining population. Both fort and vicus show similar trends, with a majority of mandibles showing as either Adult or Elderly, most of them differing by only a single age stage. The survival graph indicates a culling of adult cattle older than the idealised meat culling profile would suggest, adding to the idea that the majority of cattle were utilised for traction work and culled after their usefulness had begun to wane and then slaughtered. Additionally there are several examples of severely worn third molars, indicating the presence of severely aged animals, most likely those that have died of natural causes or outlived any potential usefulness.

While similar in overall shape and range, differences do exist between fort and vicus. A Chi Square test found that the fort and vicus kill-off patterns were significantly different (P= 0.01). In the fort, there is an elevated presence of Elderly cattle, while the vicus shows a higher representation of Adult and Sub Adults. The subadult cattle within the fort and vicus may indicate a greater presence of cattle raised or sold specifically for slaughter, rather than facing prior traction utilisation. This meat, being of higher status, may reflect an elite desire for higher quality beef on site. Considering the possibility of multiple sources of cattle on site, the spread of age stages suggests that both fort and vicus had access to subadult, adult and elderly cattle.

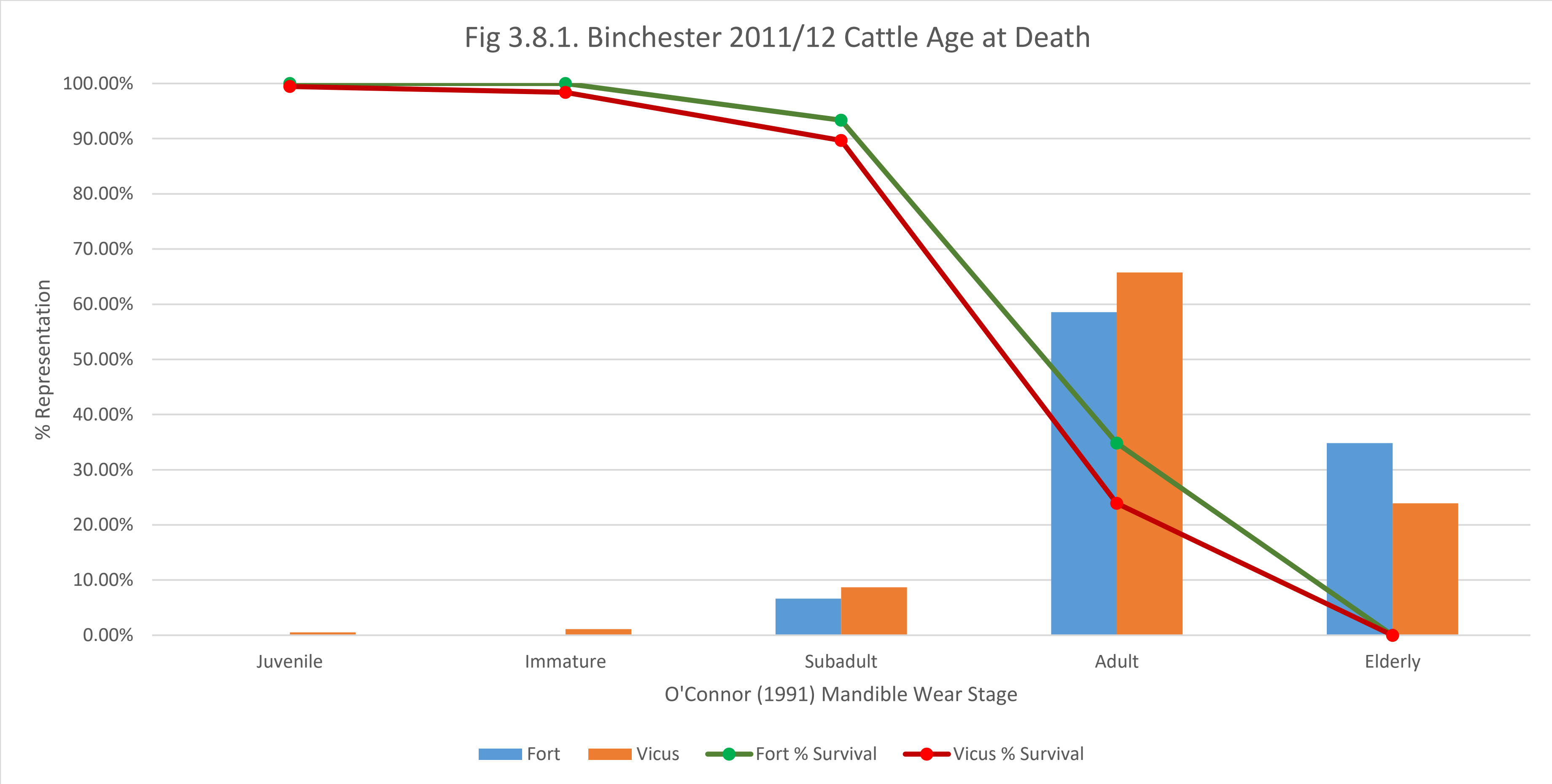

Fig. 3.8.1. Binchester 2011/12 Cattle Age at Death

This figure plots the recorded mandible wear stages of mandibles recovered from the fort and vicus at Binchester, Roman fort. Additionally, the percent survival of each population is also plotted. Wear stages used are the groupings categorised by O'Connor (1988, 84). Fort n=181, Vicus n=184.

3.9. Discussion

3.9.1 Morphology: Similarity in Practice, Convergence in Identities

Species representation reflects cattle as the dominant domesticate from both assemblages, suggesting its prime importance as a source of food and other products such as a source of traction. The element distribution of recovered cattle remains shows the presence of all elements within both assemblages. No statistically significant difference between the representations of elements in each assemblage was noted, nor did the distributions differ significantly from that left by whole animals. This suggests that, within both fort and vicus, animals were driven to the site 'on the hoof' for summary slaughter, butchery and consumption, with all resulting waste products being deposited within the same general vicinity (Thomas and Stallibrass 2008, 9). The pathological evidence shows cattle utilised for traction at both fort and vicus in the form of splayed distal metapodials (Bartosiewicz 1997, 43). Additionally, congenitally missing third cusps on mandibular third molars were present within both assemblages, a testament to the likely local origins of these cattle. The large occurrence of butchery marks suggests that cattle at both sites were destined for the butcher's cleaver regardless of their purpose in life. Butchery marks were almost invariably made with cleavers, following the pattern of block butchery identified by Stokes (2000, 145). Some evidence of hide removal is also apparent in the form of knife marks around lower limb bones, indicating the removal of the skin. Although some degree of variation between fort and vicus was noted, the almost complete lack of neonatal and juvenile cattle from both that both faunal assemblages represent imported cattle resources transported from elsewhere, rather than being representative of a self-sustaining herd. The majority of recovered mandibles were sorted into the 'elderly' category, being of an age greater than four years, significantly older than the idealised age of slaughter. This advanced age is seen to support the pathological interpretation of cattle serving as beasts of burden prior to their demise and consumption.

Overall, the lines of morphological inquiry depict similarity in practice between the fort and vicus. Cattle were consumed in large numbers on site, being butchered in a distinctly 'Roman' fashion, using cleavers in order to efficiently and expediently dismember large carcasses. Displaying congenital traits associated with a limited gene pool, the cattle were likely imported from local rural sources in the nearby hinterland. In life, cattle were utilised as a source of traction, suffering distinctive pathologies associated with this practice. After their utility as beasts of burden or breeding stock had diminished, they were transported to the site 'on the hoof,' whereupon they were slaughtered, butchered, and consumed on site, with some evidence of processing for secondary products as well. A smaller portion of the cattle brought on site appear to have been raised solely as a source of meat. The morphological evidence depicts a clear, and uniform, system of animal utilisation and processing across both the fort and the vicus, suggesting a similarity not just in practice but also possibly in identity within and without the fortifications.

It is important to note that material evidence cannot indicate identity on its own. Gardner (2002, 324) cautions against this very practice, as to correlate a particular pattern of material culture with a specific identity is to ascribe that identity inexorably to that pattern, an unreliable correlation causing conflict with different identities as well as different strategies of identification (Wells 2001, 25). This is of particular importance to faunal remains, as a number of other aspects of material culture, such as military dress, does not survive in archaeological contexts, limiting the lines of evidence available for analysis (James 1999a, 18-21). Faunal analysis must be conducted with caution, as certain practices are linked with certain depositional patterns, a small step away from directly associated particular identities with specific patterns of faunal depositions (Pitts 2007, 702). Additionally, the concept of identity is a modern construction being applied to past practices (Pitts

2007, 710). Considering this it is entirely possible for ancient individuals to migrate between what today are considered separate identities (James 1999 b, 70-77), adopting whichever identity best suits their current endeavours. Instead, material culture is a tool through which we can investigate the aspects of social life from which identity is formed (Pitts 2007, 700). Indeed, as Jones (1997, 13-14) contends, identity is 'rooted in ongoing daily practice'. If we accept identity as arising from repeated practices (Pitts 2007, 701), then material culture such as faunal remains, capturing large aspects of daily life, is of great value in inferring identity.

The Binchester assemblages reflect the daily practices of the occupants of the two areas. While some similarity in practice between fort and vicus is expected, the uniformity displayed between fort and vicus across all lines of morphological inquiry is notable. Some older work paints the Roman Military as somewhat insulated from the local populace (Haynes 1999, 8-9), however modern interpretations of life within military forts, as well as the morphological data recovered from Binchester, do not support this view. This cohesion demonstrates the importance of artefact-based enquiries into aspects of identity (Allison 2002, 1, Allison et al. 2004, 2), rather than labelling areas based solely on their location (Gardner 2007, 114). The economic interdependence between the two areas, with craftsmen, traders, and entrepreneurs providing goods and services to see to the spiritual, physical, and, most likely, carnal needs of the soldiers likely fosters a large degree of cohesion between both areas (Allason-Jones 1995, 22, Petts 2013, 319). This is evidenced in the presence not only of generic strip buildings along the via principia, indicative of commercial activity, but also the presence of a large bathhouse, likely frequented by soldiers, and later repurposed as a temple to the goddess Fortuna, again a noted patron of the military rank and file (Petts 2013, 320). Furthermore, the likely presence of wives, concubines, and families of soldiers within the vicus would further foster a shared identity between both areas, with soldiers a frequent presence in these areas, and non-military individuals a not uncommon sight among the barrack blocks (Hassall 1999, 36, Allason-Jones 1989). As Petts (2013) points out, the vicus likely served as an intermediary between military personnel and native sources of supply, leading to a likely convergence of identity between them. In the Late Roman Period, it is likely that this initial interrelatedness and interdependence increased.

If, as Mattingly (2006, 238) point out, the reduction in military numbers led to the repurposing of newly available space within the fort as family housing, or even areas of industry, as argued in the previous excavations of Late Roman deposits within the commandant's house and baths at Binchester (Cussans and Bond 2010, 485), this would signal the removal of, or at least the further permeation, of physical boundaries that could be used to distinguish identities between military and non-military personnel. Indeed, considering the wide degree of similarity in practice noted between the occupants of the fort and vicus, Haynes' (1999) description of a 'military community' as opposed to a strict separation along military and non-military lines seems particularly apt. If we are indeed dealing with a more cohesive than divided 'military community' at Binchester, the similarity in practice is likely due to the diffusion and exchange of ideas and practices between occupants of the different areas, with the vicus likely adopting the butchery practices of the military soldiers. Additionally, as discussed above, the vicus at Binchester was likely administrated through the military bureaucracy that managed the fort, further increasing the cohesion between the two areas (Goldsworthy & Haynes 1999 1-10). This shared administration would add further credence to the idea that the animals supplied to the fort and vicus were likely from the same sources, explaining the similarities in species representation, pathological indicators, and age at death. Although recent academic work has moved away from top-down models of direct diffusion of culture, military administration of distribution and butchery of animals would offer an alternative method by which the fort and vicus assemblages display seemingly identical butchery methods. Overall, the morphological data recovered from the Binchester fort and vicus are almost identical, varying only by a small margin. This similarity in practice suggests a strong degree of social cohesion between the two areas, possibly due to the likely shared administration and the familial and economic interdependence of the two areas.

For one of the first times, we are able to directly identify similarity of practice in the utilisation of cattle resources between a Northern fort of likely Late Roman date and its attached vicus through a morphological analysis of robust faunal assemblages simultaneously excavated from each area, displaying an astounding degree of homogeneity between areas previously thought to possess two distinct identities. This enhances our understanding of Binchester specifically, but also gives us insight into the social cohesion and interdependence between fort and vicus in the Late Roman North of Britain.

3.9.2. Metrics: The End of Similarity, the Divergence of Identity

While the morphological lines of inquiry in both fort and vicus at Binchester showed a convergence in practice, and possibly in identity, at both locations, the metric information offers a starkly different perspective of the two areas.

These metrical analyses reveal a wide range of information concerning the sexual dimorphism, size and utilisation of cattle in the Binchester 2011/12 fort and vicus. In the measurement of size and calculation of withers height, we see cattle occupying the range often associated with native breeds of cattle, colloquially referred to as the 'celtic shorthorn,' although whether this represents a distinct breed or a Breton amalgamation of smaller breeds is unknown (Stokes 2000). This provides further evidence that the breed improvements and importation of larger continental breeds did not extend into the Northern frontier of Roman Britain (Albarella 2003). Likely females, likely castrates, and possibly intact bulls are represented within both assemblages. Cattle from both fort and vicus vary greatly in recorded distal breadth of metapodials. Finally, and indeed most significantly, all lines of metric inquiry show a distinct divergence between the fort and vicus assemblages. Both assemblages display a large concentration of likely females, but the fort contains an elevated presence of larger, more robust animals, likely representing an increased presence of castrated males within the fort assemblage. In turn, this suggests the presence of a system of preferential provisioning of these larger beasts to the occupants of the fort, with the vicus occupants subsisting generally on smaller, more gracile fare.

This clear metric distinction between fort and vicus resoundingly bucks the morphological trends towards convergent identities between the two areas. It appears that, at least in some regard, a distinction between military and non-military still persisted into the Late Roman Period. The idea that this reflects a large amount of social cohesion and exchange between the two groups is valid, and this idea is supported through the many cultural and social intersections between these two groups existing in such close proximity (Mattingly 2006, 170-2). In fact, it is the evidence supporting social cohesion and exchange that makes the elevated representation of castrates of further interest. Metric homogeneity between the fort and vicus would suggest, rather definitively, that the consideration of these two groups as distinctly different is in error, and that the disparate faunal assemblages likely belonged to a single group, or two different 'groups' that did not draw distinctions between one another in a zooarchaeologically identifiable capacity. However, we do indeed see a clear discrepancy between military and non-military provisioning of cattle resources. This instead suggests that while the fort and vicus occupants may exhibit a substantial amount of similarity in practice, the metric discrepancy between the two areas indicates a distinction in identity between the two. We must remember that the community of fort and vicus is, as James (1999a, 18) puts it, one of deliberate construction, with identities being reinforced through repeated action and interactions (James 1999b, 72-76). Being deliberately constructed, we must consider the role of power relations between the two areas (Pitts 2007, 709). As previously surmised, the administration of both fort and vicus likely fell under the purview of military administrators (Mattingly 2006, 172). As these administrators are employed by the military to see to the well-being of military personnel (Mattingly 2006, 238), it is not too much of an intellectual reach to entertain the idea of personal or professional bias as a prime mover in the discrepancy between fort and vicus. As rationing and requisitioning of animals is likely to have been conducted by head of cattle, rather than weight or some other metric, it is feasible that military administrators might preferentially provision the occupants of the fort with a higher proportion of larger beasts, thus providing greater amounts of meat while maintaining similar head counts of cattle. Alternatively this may be reflective of a response to the general shifts occurring throughout the Late Roman Period. As coinage diminished, particularly in the North, the system of taxation is likely to have shifted away from a monetary tax to one in kind, with food rations doled out in lieu of cash (Mattingly 2006, 251). Thus, the preferential provisioning of larger cattle to the fort may be in order to pay the requisite salaries of the military occupants. If this system of preferential provisioning is indeed of military origin or design, either through preference, administration, or individual requisitioning, it remains expressive of the military hegemony over both the fort and the vicus, influencing access to particular cattle resources.

4. Assemblages in Context:

Comparative Site Review and Binchester

This chapter will introduce the comparative sites selected for this project, and briefly describe their comparative value. Following this introduction, the data recovered from the Binchester 2011/12 assemblages will be compared with the suite of comparative data amassed. This comparison will explore species representation generally, and then will delve into a more detailed comparison of the cattle remains recovered. This will include element distribution, pathological and butchery data, and age at death of the cattle populations. Further, a comparison of general cattle size will view the calculated withers heights of recovered cattle. Finally, a detailed metric comparison of measured humeri, metacarpals and metatarsals will be undertaken. Comparison between sites will allow us to determine is the size, shape or sexual differentiation of cattle recovered from Binchester deviate from established norms for the time period and site type, as well as examining any potential difference in practice or identity of the occupants of military, rural and urban sites.

4.1 Comparative sites.

Zooarchaeological analysis is a specialised practice, requiring both a trained individual and considerable time to wash and analyse the bone in the case of large assemblages (Historic England 2015). Large scale excavations will often opt for a smaller scale analysis of a selected section of the excavation, as opposed to an analysis of all bone recovered, citing either prohibitive costs or a lack of time (Stallibrass and Thomas 2008, 1). Thus the location of faunal analysis of a scale comparable with Binchester is challenging. Even in the case of large faunal work being completed, oftentimes these reports are included at the end of site reports, and do not fully synthesise other lines or evidence, nor are they fully synthesised into the interpretation of the site (Cool 2006, 1). Furthermore, the dating of Binchester is still in its infancy, with only a few radiocarbon dates and some preliminary coinage and pottery reports (Petts 2013, 319). Binchester represents one of the first simultaneous excavations from within the fort as well as the vicus, yielding large assemblages of faunal remains from both trenches (Petts 2013, 319). Containing data from two nearby yet ostensibly different areas, it is possible that the differences between fort and vicus assemblages noted in Chapter 3 may reflect differences between 'military' and 'civilian' occupants. Thus, our inter-site comparison must include sites that allow us to assess these potentially different aspects.

Table 4.1.1 shows the various type of site as well as chronological periods for the comparative material. In order to fully contextualise Binchester within the greater theatre of Roman Britain, a number of different types of site from different regions and covering multiple chronological periods were selected for comparison. This includes forts, urban centres, small towns or settlements, and rural settlements.

The sites listed below vary greatly in the size of their assemblages. While larger assemblages are of great use in comparison with Binchester, the comparison of notable trends and metric data from smaller assemblages is also of value. The inclusion of too many large, generically 'Roman' assemblages would have a deleterious effect on any between-sites comparison or investigation of Late Roman civilian and military identity, blurring distinction between established trends rather than displaying areas of interest in a clear and concise manner. Thus, effort was made not to include too many large, generically similar sites, instead making use of single sites to encapsulate general trends. While Binchester sits in the North of England, near the Roman frontier, there is much to be gained by comparing the site to sites from different regions (Figure 4.1.1). A wealth of data has been recovered from the South of England, providing well known and established trends and interpretations for a variety of different site types (Thomas and Stallibrass 2008, 3). This is of particular importance when attempting to view comparative aspects associated with the Roman military, as conditions in Northern Roman Britain are markedly different from the more fully urbanised and incorporated South, possibly entailing differences in practice, interaction and identities between military and civilian areas (Petts 2013, 318). Thus, deliberate effort was made to use some notable sites from outside this general area, including Segontium (Noddle 1993), Carlisle (Zant 2009), Wroxeter (Hammon 2005, 2011), and Lincoln (Dobney et al 1996), favouring these sites over notable assemblages situated in the South such as Colchester (Luff and Brothwell 1993) or Winchester (Maltby 1994). This will help to compare against differing trends from multiple regions, rather than only presenting sites from the South.

It is also important to note that Binchester, consisting of assemblages from within the fort and vicus, will likely contain trends most similar to those from military sites, as well as containing aspects of civilian-military interaction most commonly associated with urban sites, where a permanent military force was present (Petts 2013, 318). Thus, primary importance is placed on the selection of military and urban assemblages for comparison, as it is unlikely that the depositions within the fort and vicus are the result of rural occupation and practice. This idea is reinforced through the analysis done in Chapter 3, noting that the lack of neonatal cattle indicates that the depositions are likely from imported beasts rather than animals raised on site or nearby. Thus, the large assemblages from notable Southern assemblages such as Elms Farm in Heybridge (Albarella et al. 2007, Johnstone and Albarella 2002) or Owslebury in Hants (Collis, 1994, Maltby 1987) are less suitable for comparison. Instead, the smaller rural assemblages of Haddon and Great Holts farm are utilised for their unique characteristics (discussed below), rather than the general trends of their assemblages. The settlement site of Hacheston (King 2004) is included for similar reasons, with the site of Wavendon Gate (Williams et al. 1995) included to reinforce the general trends noted from smaller settlement-type sites.

Thresholds were established in order to avoid utilising materials unsuitable for comparison, but also to allow some material that, although low in number, contained enough information to reasonably encapsulate the general trends of the site. Sites with fewer than 400 identified fragments were not considered for species representation, or an MNE fewer than 40 considered for element distribution. Fewer than 10 mandibles was not considered a suitable sample for comparison. Lower sample sizes are treated with greater scepticism in the comparison of bodies of data, but are still considered to have valuable information.

What follows is a brief introduction of the comparative sites selected. Included in this introduction is a site description, chronological phasing, methods, and some discussion concerning the comparative value of the site. As the data and results from these comparative sites will be explored alongside the Binchester assemblages, the findings and general interpretations of each site are included in the comparative portion of this chapter, to avoid repetition. The sites explored below all provide notable metric data, or display iconic trends, indicative of unique or even aberrant practices taking place during the Roman and sub-Roman Period (e.g. Albarella 2003, Baxter 2003, King 2004). This makes them ideal for comparison with the raw data gleaned from the faunal assemblages of the Binchester 2011/12 fort and vicus.

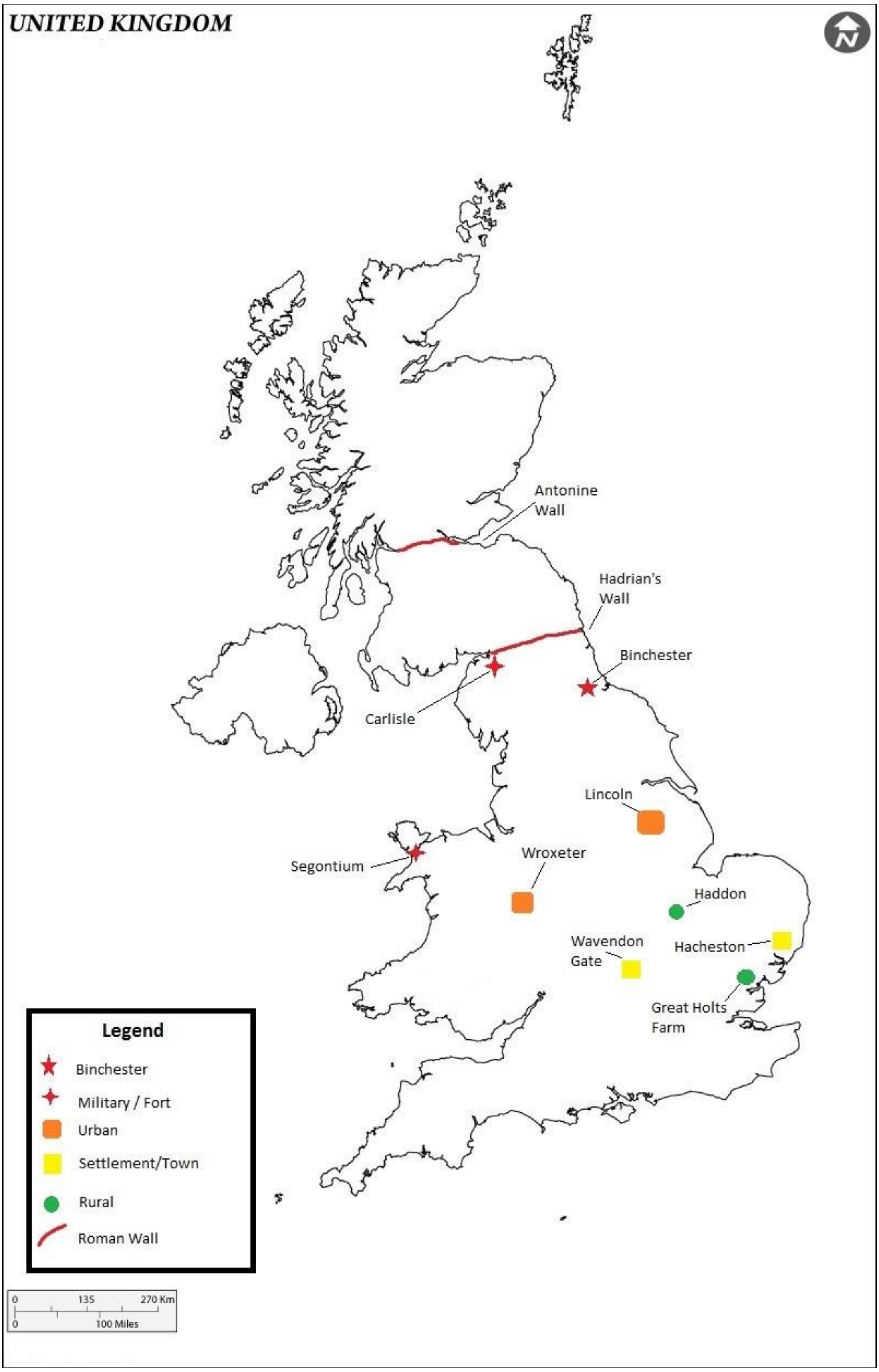

Figure 4.1.1 Site Map. This figure denotes the general location of comparative sites examined in this review. Outline map obtained from (www.mapsofworld.com).

4.1.1. Binchester 1976-81, Bishop Auckland

Perhaps one of the best sources of comparative data for Binchester is the analysis of faunal remains recovered from previous excavations on the site itself. Questions may arise as to the utilisation of the previous analysis at Binchester as a comparative source rather than incorporating the data into the current analysis. It should be noted that this dataset is accrued from only within the fort, and that the location of the excavated area is in a potentially high-status area. Thus, incorporation between Cussans and Bond's (2010) data and that of the current project may unintentionally bias the interpretation of activity within the fort, if considerations are not made towards areas of differing status. Due to the uncertain phasing of the 2011/12 assemblages, the data from previous excavations at Binchester cannot yet be fully incorporated into this current project. Once a more definitive phasing of the site is established, however, incorporation of these two data sets will result in one of, if not the largest, faunal dataset for a Late Roman fort in the North of Roman Britain. For the purposes of this analysis, and considering the early stage of the analysis of faunal remains from the current excavations at Binchester, the previous data will be utilised as a comparative source rather than attempting to incorporate the two datasets.

The Commandant's house, baths and a section of the main road through the fort were excavated from 1976-81 and 1986-91 (Cussans and Bond 2010, 489). A selection of 20 radiocarbon dates was obtained, and was used in conjunction with recovered pottery and coins to sort the cultural material into 14 different phases of activity (Cussans and Bond 2010, 489). While all animal bone recovered was examined, only the largest of assemblages were deemed worthy of further analysis beyond an initial investigation. The animal bone collected from phases 1, 2, 6, 7, 8, 10, 11, 12, 13, and 14 was minimal, and it was recommended that no further work be done on these phases (Cussans and Bond 2010, 490-491). Phases 3-5 were combined to create a larger faunal assemblage, spanning from AD 90 – AD 130, and providing an important view into the early habitation of the fort. Phase 9, dating to the late 4th/early 5th century AD provides a somewhat unique view into the final Roman occupation of the fort, as well as providing some insight into the forts occupation immediately following the cessation of central Roman input (Ferris 2010). Analysis of these two phases of occupation help to depict the site's habitation during its early years shortly after its founding, as well as before its final abandonment.

Faunal remains were collected by hand, with some sieving undertaken to assess the veracity of the trends noticed from the hand-collected assemblage (Cussans and Bond 2010, 489). While sieving did reveal a greater representation of smaller mammals and fish, the trends noted in the assemblage are not significantly altered by these findings (Cussans and Bond 2010, 489). The site featured excellent preservation, with a total of 3903 fragments recovered from Phase 3-5 and 11,586 fragments from Phase 9. While the bone was very well preserved, high occurrence of butchery and dog gnawing contributed to the fragmentation of the assemblage, as well as obscuring identification in some cases (Cussans and Bond 2010, 491). The element distribution of recovered cattle elements was assessed in addition to the prevalence of the major domesticate species (Cussans and Bond 2010, 508). Morphological features on recovered elements were analysed for butchery marks and pathological lesions (Cussans and Bond 2010, 501). Cattle dentition and epiphyseal fusion were analysed in order to determine the age at death of recovered cattle (Cussans and Bond 2010, 497). Although the initial intent was to measure all recovered intact elements, this task was reportedly impossible, and instead only a set of particular measurements were taken (Cussans and Bond 2010, 508). This includes the measurement of intact metapodials in order to assess the sexual dimorphism of the herd as well as calculate the withers height of the cattle population (Cussans and Bond 2010, 491, 508).

The previous analysis conducted at Binchester is of extreme value to the current analysis, in essence providing a third and fourth assemblage for the site. Assemblages are gathered from both the early occupation of the fort as well as the 4th century, as Roman influence in Britain began to wane. Similar collection and analysis methodologies help to facilitate analysis and comparison. The species representation and element distribution data recorded will be of interest in comparison to a different area of the fort as well as to the neighbouring vicus, potentially revealing differences in status or identity. The general trends noted are a helpful standard by which to assess the 2011/12 material. The presentation of wear stages allows for the easy comparison of cattle age at death between this material and the 2011/12 fort and vicus. In particular, the Phase 9 material is of value in assessing the continued occupation of Binchester into the sub-Roman Period, providing insight into potential continuity of practice. On the whole, the earlier work at Binchester provides us with a picture of life in the fort at its beginning as well as towards the end of its occupation in the Roman Period, making it of great value for comparison with the current assemblages from elsewhere in the fort and the nearby vicus.

4.1.2. Great Holts Farm, Essex

The site of Great Holts Farm in Essex, situated on the North slope of the River Chelmer, was excavated from 1992-4. Material was hand collected during excavation of the Roman Villa in advance of gravel extraction, preceded by field walking and geophysical survey (German 2003, 1). The cultural material suggests an affluent lifestyle enjoyed by the inhabitants in spite of its rural function, with many high status objects being recovered. Radiocarbon dating places this assemblage in the late 3rd – 4th century (Albarella 2003, 193). The recovered faunal assemblage is small, being made up of only 136 identifiable bones.

While a small assemblage, the site features excellent preservation, with a number of complete elements recovered. Sieving carried out on site suggests that the overall trends noted from hand collection are correct, finding little in the way of fish, bird or other small animals. The cattle element distribution shows a greater representation of crania and foot elements. Additionally, many of the carpals, tarsals, metapodials, and first phalanges had cut marks on them, indicating the removal of hides (Albarella 2003, 195). These lines of evidence suggest that the source of the faunal assemblage is mainly butchery waste. A large number of the recovered crania have had their horn cores removed, suggesting their utilisation elsewhere in or around the site as craft material (Maltby 2015, 2). While the number of recovered mandibles was low, tooth eruption and wear paired with epiphyseal fusion data suggests that the cattle population consisted mainly of mature animals. The occurrence of pathology was low on site. However, the evidence recovered shows distinct traits associated with traction work, namely the distal splaying of metapodials (Bartosiewicz 1997, 43). Eleven complete metapodials intact enough for metric analysis were recovered. The measured metapodials suggest that the cattle population at Great Holts Farm consists mainly of castrates and females (Albarella 2003, 196). The large size of the metapodials, particularly the metatarsals, suggests the importation of a larger continental breed of cattle, either as breeding stock or castrates for heavy duty traction (Albarella 2003, 196-198). This practice has been noted elsewhere in South East England, and although it is not apparent in the North, its occurrence remains a distinct possibility (Thomas and Stallibrass 2008, 7).

The metric data recorded from this site is of excellent comparative value towards the analysis of the Binchester 2011/12 faunal material. In particular, the displayed indicators of imported continental breeds of larger cattle will provide a standard by which it can be determined if similar occurrences are taking place at Binchester, or at other comparative sites.

4.1.3. Segontium (Caernarfon), North Wales

Segontium or Caernarfon is a Roman fort in North Wales. It occupies a strong defensive position with steep slopes to the North and West. The only easy access to the fort is from the East, giving the fort easy access to the sea, across which sat Anglesey, the 'Granary of North West Wales.' The fort, occupying roughly 2.27 hectares, was first excavated from 1845-6 (Noddle 1993, 1). Building encroachment in the late 19th century revealed an extensive vicus surrounding the fort, leading to large scale rescue excavation from 1921-1923. Excavation for this project took place from 1975-1979, with the final write-up occurring in 1993 (Noddle 1993, 1). The almost 20 year separation between excavation, analysis, and writing up introduces the possibility of bias. However, recording of metric data shortly after excavation reduces the loss of information from the 20 year hiatus. From the recovered cultural material, many phases of occupation were noted. Due to the dating methods employed some overlap between phases is seen in the contexts. The phases listed are as follows:

- Phases 1-4 span over the 1st c. AD
- Phases 5-6 date to the late 1st-2nd c. AD
- Phase 7 dates from the mid-2nd-early 4th c. AD
- Phases 8 and 9 stretch from the late 3rd-early 4th c. AD
- Phases 10 and 10A cover the 4th c. AD. Allowing for an in-depth look at the Late Roman occupation and transitional period that followed it.
- Phase 11 covers the Post-Roman occupation of the site. Providing an interesting opportunity to view continuity of practice following the cessation of centralised Roman input.

Segontium features excellent preservation of faunal remains, with a lower degree of fragmentation than is seen at other sites. 13,000 fragments were hand collected during excavation, with most recovered remains dating to the 4th century (Noddle 1993, 97). The species representation and element distribution of the major domesticates was tabulated. Butchery marks and pathological lesions were recorded whenever morphological analysis revealed them. Mandibular tooth wear, using wear stages outlined by Grant (1982), and epiphyseal fusion were used to create age profiles for the cattle populations from each phase of occupation. Intact cattle elements were measured and recorded according to von den Driesch (1976).

On the whole, the faunal assemblage recovered from Segontium fits well within established national trends for a typical Roman military site (E.G. King 2001). The site provides large assemblages of faunal remains, with the largest concentrations dating to the 4th c., providing an excellent view of the general trends associated with both this site type and time period.

Having a large assemblage from a fort is of great value for comparison with Binchester. The detailed chronology preserved at Segontium allows comparison and analysis to take place phase by phase, allowing for a much more detailed comparison of the data recovered at Binchester to different centuries of occupation at Segontium. Furthermore, the size of the assemblages, particularly those of 4th c. date, makes the interpretations from them more compelling. The species representation, element distribution and butchery noted at Segontium is typical of Roman military occupation, as well as the change in animal representation over time. Most helpfully, the raw data recorded after excavation is presented in the report, including the measurements of selected elements. The metric data, particularly that from metacarpals, metatarsals, and humeri, will allow for the trends and changes over time seen in this site to be compared to the metric data recovered from the Binchester 2011/12 fort and vicus. The inclusion of this raw information will further help to contextualise Binchester within the greater arena of Roman Britain, allowing for a direct comparison of data between the two sites. Segontium provides us with a wealth of information in addition to the raw metric data, its display of overall trends typical in Roman military sites will help provide a litmus test for the assemblage recovered from within the fort at Binchester, as well as potentially contrasting the vicus.

4.1.4. Hacheston, Suffolk

The site at Hacheston, Suffolk was excavated from 1973-4 in response to scheduled construction rerouting the A12, and represents a large Romano-British settlement, or a small town periphery (Blagg et al. 2004, 1). The site itself is located north of the River Debon, and is roughly 30ha in size. The site extends north almost to the watershed between Debon and the River Ore (Blag et al. 2004, 1). Through radiocarbon dates the site was erected in the 1st c. AD, consisting of a series of circular houses, which were later replaced by a road with rectangular structures along it. Activity on site included some pottery manufacturing. The site yielded large deposits of material culture ranging from the Late Iron Age to sub-Roman (Blagg et al. 2004, 3).

Analysis of the faunal assemblage followed excavation, which took place from 1975-76. The final write up of the faunal assemblage, however, was delayed due to funding problems, taking place 20 years later (King 2004, 188). Such a long delay between analysis and writing up introduces a significant possibility for bias, as the analyst's familiarity with the assemblage and excavation is sure to have eroded in the interim. However, it confers the advantage of more modern analytical practice as well as an enhanced understanding of both the subject material as well as the time period (King 2004, 188).

Through analysis of architecture as well as recovered pottery and coinage, the excavated contexts are separated into 5 different phases:

A) Up to the 1st C. AD
B) 1st - Mid 2nd C. AD
C) Mid-2nd – Late 3rd C. AD
D) Late 3rd – Late 4th C. AD
E) Sub-Roman

The material culture provides some evidence of military presence in the 2nd and 3rd C. The overall representation is too small to be indicative of a permanent residence on site, but more likely shows that the site provided goods and services to military personnel (King 2004, 190). In the Late Roman phases a distinct shift in waste disposal seems to have taken place. Rather than being deposited into identifiable pits, waste materials are instead left on the surface (King 2004, 188). These "dark earth deposits" are indicative of an economic change in later periods, possibly a shift towards the periphery of the occupied area located elsewhere in the vicus (King 2004, 190).

Excavation took place in ten nearby areas, comprising a very small percentage of the total site. Only areas 1, 2, 3, 4, and 9 contained enough faunal remains for analysis. In order to increase numbers and enhance the visibility of any present trends in the assemblage, the site will be considered as a whole, combining the different areas and dividing them instead by chronological phase (King 2004, 188). This is done with the exception of the cattle recovered from Area 2. Any contexts believed to be from mixed phases or otherwise contaminated are not included.

A total of 12,500 mammal bone fragments were hand collected, with 55% of the assemblage being preserved well enough for identification (King 2004, 188). Species representation and element distribution of the major domesticate species was tabulated. Morphological analysis was conducted, recording any occurrence of butchery marks or pathological lesions. Mandibular tooth wear and epiphyseal fusion were used to craft age profiles for the cattle populations from each phase of occupation. Intact elements were measured according to Von den Driesch (1976).

Of particular interest in this site is the presence of a large number of articulated cattle skeletons recovered from Area 2 (King 2004, 192). The cattle were intact save that cranium and foot elements were missing from all recovered specimens. Additionally, the individuals were all of the same, sub-adult, age, and were lacking in butchery marks besides those for head and hoof removal (King 2004, 192). This phenomenon is interpreted as evidence of hide processing. Further, it is surmised that the cattle in question were specially bred for their hides, or that their meat was for some reason undesirable, possibly due to a disease or other factor (King 2004, 194). Interestingly, no significant pathological lesions were noted on the articulated skeletons, although, considering their age, it is likely that any disease or affliction would not have had time to affect bone growth before their slaughter (Bartosiewicz 2013, 34).

Hacheston provides a view of the processes that can be expected to occur in the periphery of a small town, with animal collection, primary butchery and processing for hides and horns, along with dumping grounds for waste products. The delay between analysis and wring up introduces bias, as the actual assemblage is not as well preserved, as well as eroding the author's familiarity with the site and material. However, it does confer the distinct benefit of having more modern analytical methods employed in the interpretation of the site, allowing an easier comparison with Binchester and other contemporary sites. The site is located in East Anglia, some distance from Binchester itself. The distance from Binchester is actually something of a boon for the site, potentially revealing regional differences between civilian activity and animal utilisation. The presence of the distinctively Roman butchery style shows the diffusion of these practices from military into civilian spheres. Furthermore, the species representation and element distributions show strong trends over time associated with distinct methods of animal exploitation contemporary with Binchester. Finally, despite a lack of metric and pathological data, these few data points will nevertheless contribute to the overarching picture of Late Roman cattle measurements and disease, aiding the contextualisation of the material recovered from Binchester. On the whole Hacheston provides a clear picture of a non-militarized small town periphery, and the strategies of animal husbandry and exploitation employed therein. This makes the site an excellent source of material to compare with the faunal assemblage recovered from Binchester.

4.1.5. Haddon, Peterborough

The Site of Haddon is a Late Romano-British farmstead located in Peterborough, three kilometres southeast of the Roman town of Durobrivae. Excavation of the site took place in 1989 and 1999, with the excavated area covering roughly 9.4 ha (Hinman 2003, 3). Dating of the site has given us a series of phases of occupation. The first signs of habitation date prior to 20 AD (Hinman 2003, 1). Although levels of occupation vary through time, the site is seen to represent a local farmstead, functioning as a subset of a larger Roman villa (Hinman 2003, 1). Two separate trenches were excavated. Due to their close proximity and similar chronology, both assemblages were combined, and are viewed by chronological phase. The phases of occupation relevant to this project are as follows:

1. Late Iron Age-Early Roman Period: covering the transition therein, roughly from 50 BC-50 AD. The site functioned as a small farmstead.

2. Mid 1st C. – Late 1st C: Evidence of intensification of occupation is present, with signs of pottery production. The cultural material indicates a somewhat low status Romano-British site.
3. Late 1st C. – Mid 2nd C: This phase represents the peak intensity of occupation, functioning as a stockyard with a high degree of organisation.
4. Mid 2nd C – Mid 3rd C: The site transitions into a more open field layout, possibly for intensified meat production.
5. Mid 3rd C – Mid 4th C- The site sees a gradual decrease in intensity over this period, still functioning as a farmstead, but with a lower degree of occupation.
6. Mid 4th C – Late 4th C: The site seems to have been completely abandoned by roughly 370AD.
7. 5th C – 6th C: The site sees a very little activity, and is likely to have been abandoned. The only cultural material recovered from Phases 7 and 8 are small amounts of Anglo-Saxon Pottery.

Only a small assemblage of animal bone was hand collected during excavation. However, the preservation was exemplary, making the site of comparative value. Some of the phases were grouped together in order to see general trends, with phases 2-4 being grouped, and 5-6 (Baxter 2003, 119). Bucking trends normally noted during the Roman Period, Haddon features a majority of sheep/goat, with cattle in second and pig being the least represented of the three major domesticates (Baxter 2003, 119). Unexpectedly, the sheep/goat dominance does not decline over the course of the Roman Period, but instead these animals increase in importance. This is interpreted as a 'native farmstead,' where the preferences of the Iron Age were maintained through the Roman Period (Baxter 2003, 120). It is possible that, being a smaller farmstead, Haddon did not face the same pressures that led other sites, especially military and urban centres, to shift towards a cattle-dominated animal economy (Baxter 2003, 120). Haddon has many differences with Binchester, being a rural, non-military establishment that is interpreted as maintaining Iron Age preferences throughout its occupation. The seeming lack of Roman influence on the site over time further separates it from other comparative sites. However, these differences make it an ideal control for the Binchester 2011/12 faunal assemblages. The Binchester fort and vicus are not expected to display trends similar to a rural site, making a site such as Haddon an excellent comparative null hypothesis. Furthermore, although the assemblage is small, the metric data provided be of value to help accurately capture the metric fingerprint for this type of site. On the whole, Haddon is a great example of an atypical site, featuring a more 'native' faunal assemblage. This makes it of value in the contextualization of Binchester within the theatre of Roman Britain.

4.1.6. Wavendon Gate, Milton Keynes

The Roman settlement site of Wavendon Gate is in Milton Keynes, in the Northeast corner of the Parish of Walton, 4 km Northeast of Bletchley and 3 km east of central Milton Keynes (Williams et al. 1995, 3). The site area totalled 35 square hectares. Excavation took place from April-November of 1989 in three areas, A, B, and C. The site features evidence of occupation in the Late Iron Age, with a few Bronze Age or Early Iron Age features. The Bronze/Early Iron Age feature is a solitary pit, and predates the later Iron Age activity by several centuries (Williams et al. 1995, 4). In the Late Iron Age (LIA), uncovered features include rectilinear enclosures, several small ditches, a small number of pits and postholes, and eight roundhouse ditches (Williams et al. 1995, 5).

The site features a large amount of cultural material dating to the Roman period. Through an analysis of the recovered materials the chronology of the site is broken down into 3 phases. These phases are as follows:

A) Mid-1st – Mid 2nd C. AD
B) Late 2nd – Early 3rd C. AD
C) 3rd – 4th C. AD

In Phase A, the settlement appears to have moved south of the previous Iron Age settlement. The features recovered include pottery kilns, ditch cuts, and pits. Phase B shows the digging of boundary ditches (Williams et al 1995, 27). Interestingly, no pottery later than the 2nd century was recovered in this phase (Dobney and Jaques 1995, 169). This indicates a shifting of emphasis within the site, or a decrease in the production within the site as a whole (Dobney and Jaques 1995, 170). Phase C shows continued occupation, with the construction of minor ditches. However, in the late 3rd C. a trend of declining intensity of occupation becomes apparent (Williams et al. 1995, 76). The recovered material indicates continued occupation of the site through the 4th century. However, the site appears to have gone into decline in the late 3rd and 4th century, and fallen into disuse by the Anglo Saxon Period, with only a small amount of domestic refuse recovered dating to this period (Williams et al. 1995, 92).

The hand-collected faunal assemblage recovered from Wavendon Gate was poorly preserved, with very brittle bones with low organic content. However, a large enough sample was identifiable to elicit the overarching trends from the site (Dobney & Jaques 1995, 205). Targeted wet-sieving was undertaken in order to test the veracity of the trends noted in the hand collected assemblage. While smaller domesticates saw a slight increase in representation, the overall trends noted were not altered (Dobney & Jaques 1995, 204). Fragments were identified using the Diagnostic Zone Method outlined by Dobney and Rielly (1988). In addition to the prevalence of major domesticates, the element distribution of domesticate species was assessed (Dobney & Jaques 1995, 206). Morphological analysis was conducted, identifying butchery marks and pathological lesions on recovered elements (Dobney & Jaques 1995, 209). Cattle mandibles were analysed using tooth wear stages outlined by Grant (1982) in order to determine the age at death of the population (Dobney & Jaques 1995, 209). Analysis of the epiphyseal fusion of postcranial elements was also used, reinforcing the interpretation of the mandibular tooth wear. Intact elements were measured, according to Driesch (1976) (Dobney & Jaques 1995, 219).

Wavendon Gate, showing broad trends typical of a Roman settlement, provides an excellent comparative baseline for this site-type. Being located in Milton Keynes, the site is some distance from Binchester. However, the collection of the faunal assemblage, its quantification and analysis all mirror the techniques used at Binchester. Its detailed chronology allows for a more in depth comparison with different phases of occupation within the Roman Period. The metric data will provide excellent comparative material with Binchester, allowing us to compare not only the size of the animals present but also the makeup of the herd as a whole. As a civilian settlement displaying key aspects of Roman influence, the comparison between Wavendon Gate and the Binchester 2011/12 fort and vicus will help to determine the presence or absence of civilian aspects within the two assemblages.

4.1.7. Wroxeter, Shropshire

The site of Wroxeter is the Northernmost crossing of the river Severn, located in modern day Shropshire (Hammon 2011, 280). Growing over time, the site of Wroxeter eventually became the 4th largest Roman city in Britain. The city had a large effect on its area, intensifying agriculture in the region (Hammon 2011, 281). The baths basilica was excavated over the course of 1966-1990, showing a continuous occupation of the site throughout the Roman Period and into the 6th/7th century (Hammon 2011, 281). The site shows an urban setting growing in intensity. Several phases of occupation were established through proxy dating using the analysis of pottery (Hammon 2011, 281). Some contamination of the contexts may introduce bias into this phasing system, listed below (Barker 1997, 240-41):

T-V: 3rd-4th century, showing evidence of public amenity

W: Late 4th- Mid 5th century, showing the baths functioning as a public amenity.

X: Late 5th – Mid 6th century, showing a shift in purpose of the site, functioning as an industrial site.

X-Y: Late 5th – Late 6th century.

Y: Early 6th – Late 6th century, shifting back into use as a public amenity.

Y-Z: Early 6th – Late 7th century.

Z: Early 6th – Late 7th century, seeing majority reorganization and development of the site.

A large amount of cultural material was recovered from the site, seen as waste material that accumulated elsewhere in the city before being deposited into the baths, although there is some evidence of primary deposition within the baths themselves (Hammon 2011, 282). This suggests a program of municipal waste collection taking place in Wroxeter, indicating a complex management of the city (Hammon 2011, 283). The cultural material recovered from the site indicates that the local economy and distribution within Wroxeter was largely unaffected by the demise of the Western Roman Empire, maintaining industry, municipal management, and even long-distance trade lines (Hammon 2011, 283).

Preservation of the site is good, and consistent through each phase of occupation. The assemblage was hand collected, with some sieving carried out, which indicates that the interpretation of the hand-collected assemblage is accurate. Large faunal assemblages were recovered from each phase of occupation. This indicates that the utilisation of the site remained consistent, maintaining the same ability to procure resources from its hinterland into the 6th/7th century (Hammon 2011, 284). This is reinforced through the recovery of the 1st phalanx of a Barbary ape in Phase Y/Z. The presence of this exotic species indicates that Wroxeter's capability for long distance trade remained intact after its desertion by the Roman Empire (Hammon 2011, 290). In addition to the representation of major domesticates, the element distribution of these species is calculated (Hammon 2011, 285). The presence of butchery marks and pathological lesions is assessed through a morphological analysis of the bones (Hammon 2011, 287-294). Age at death was calculated for cattle through the analysis of epiphyseal fusion and mandibular tooth wear, with wear stages given according to Grant (1982), and organised into the categories outlined by O'Connor (1991, 250, Table 67) (Hammon 2011, 287).

Overall, Wroxeter represents a successful urban centre whose local economy remained strong through the Roman Period and throughout the transitionary period into sub-Roman Britain. The consistent number of animal bones recovered from each phase of occupation demonstrates a maintained ability to import domesticated animals into the site from its hinterland. On the whole the cattle at Wroxeter are interpreted as representing a 'native' population that was utilised for traction work before being slaughtered on site for meat, with little evidence of any interbreeding with continental herds.

4.1.7.1. Wroxeter, a Note

The discussion concerning urban life and living during, and immediately following, the Roman Period in Britain is a topic often discussed at great length. Indeed, urbanisation is considered one of the more critical impacts of the Roman conquest and occupation of Britannia (Clearly 2013, 97). Barker et al's (1997) work at Wroxeter helped to shape the discussion of sub-Roman occupation of sites, particularly urban centres. As Wood (2003, 429) claims, the extended occupation, and continued affluence, of Wroxeter into the 6th and 7th century 'effectively revolutionised' academic thoughts concerning sub-Roman Britain. However, a short review by Fullford (2002), and further work by Lane (2014), calls this lengthy and intensive occupation into question. In particular, the sub-Roman sequencing and differentiation of phases is called into question.

As noted in Barker's original work and interim reports, the later phases of occupation at Wroxeter were heavily disturbed due to robber trenches, previous excavations, and later Anglo Saxon stone gathering for church building, estimating that roughly 50% of the site area was lost to these disturbances (Barker et al. 1997). The extensive amount of disturbance left isolated 'islands' of stratigraphy, which were matched together to form cohesive layers, and dated as a group, despite some lack of similarity between layers (Lane 2014, 506). Fulford's (2002) review explored the difficulties associated with dating these islands of stratigraphy, and notes that the interrelationships between these groups may be more difficult to definitively state. Furthermore, it is posited that the large timber structure rubble foundation noted in Phase 'Z' (White & Barker 1998) may in actuality be the refuse and detritus resulting from the later Anglo Saxon stone quarrying of the site (Fulford 2002). This, paired with Lane's (2014, 508) noted discrepancies between the reported radiocarbon and archaeomagnetic dating of the different phases between interim reports and the final publication, cast further doubt as to the actual sequencing of sub-Roman activity on the site. This likely indicates that the sub-Roman phases of occupation noted by Barker are intermixed to some degree.

Another key area of concern for the late phasing at Wroxeter is the absence of material culture necessitating such a late date (Lane 2014, 511). While there is evidence of sub-Roman activity on the site, with many artefacts giving 5th century date, no recovered material has been identified that must be given a 6th or 7th century age (Lane 2014, 511). Going further afield, Early Medieval and Anglo Saxon artefacts have been recovered from sites close to Wroxeter. This includes Early Medieval glass fragments recovered from Wenlock Priory (Cambell 2007, 54-73) and Much Wenlock, which functioned as a 7th c. monastery (Pretty 1989, 175-78). The presence of such material elsewhere, while being absent from the Wroxeter finds, suggest that, while occupation and activity on the site continued beyond the Roman Period, the 6th/7th century dates given by Barker are suspect.

The overall findings from these lines of evidence suggests that the phasing of the sub-Roman phases of occupation at Wroxeter are likely intermixed, casting doubts concerning the interpretations raised from each disparate phase. Furthermore, the dates given for the sub-Roman occupation are questionable, and it is likely that occupation of the site did not extend into the late 6th/early 7th century as previously posited.

Hammon's (2011) work on the faunal remains recovered from Wroxeter makes exclusive use of the phasing given by Barker. The potential for intermixed phases of occupation of the site blur any potential distinctions between them, as any distinguishing characteristics in general trends, morphological traits, or metric data would be effectively hidden through the inclusion of contexts of a different date. This lessens the value of a comparison between sub-Roman phases. However, it is important to note that while sub-Roman occupation of the site did occur, there is little to no evidence that the occupation stretched as late as posited by Barker (Lane 2014, 511). Thus, if sub-Roman occupation only occurred over a century or less, as is posited occurred at Binchester, the differentiation of the material recovered into different phases may be wholly unnecessary. Thus, while the review and Lane's (2014) exploration of the Wroxeter sequencing do cast doubt on the continued occupation and prominence of Wroxeter as an urban centre into the 6th and 7th century, the confirmation of sub-Roman occupation of the site during the 5th c. fortifies the sites value for assessing the presence of, and practices employed during, the sub-Roman occupation of sites.

Wroxeter is of excellent comparative value for Binchester. Wroxeter has a large faunal assemblage with excellent preservation. Being from an urban centre, it will be of great significance to contrast the trends seen at Wroxeter with the assemblage from the fort at Binchester, while at the same time comparing with the probably more urban setting of the civilian vicus. Further, the Wroxeter faunal assemblage covers occupation through the Late Roman, sub-Roman, and the transitional period in between, with assemblages large enough for individual analysis recovered from each phase. This will provide an excellent comparison with Binchester, who's less distinct chronology can pose challenges to its analysis. While recent work has cast doubt on the extent of the sub-Roman occupation of Wroxeter reaching into the 6th and 7th century, the presence of distinct assemblages of sub-Roman date are still of value for comparison with the Binchester 2011/12 material. Being representative of 'native' animals, this site provides an excellent litmus test for the presence or absence of larger continental breeding stock being introduced into the herds at Binchester. Furthermore, the consistency in size of the animals recovered provides us with a view of cattle populations unaltered in size by the potential introduction of new Roman husbandry techniques. The kill-off patterns noted through each phase of occupation at Wroxeter will be useful for discerning any differentiation of practice or utilisation between the urban centre and other sites over time. The presence of a large set of metric data from Hammon's (2005) thesis will provide a detailed image of cattle populations at Wroxeter during both the Roman and sub-Roman time periods. Overall, Wroxeter represents an assemblage with an extensive body of work and interpretation, providing an excellent comparative source for assessing the similarity towards, and differences from, the Binchester 2011/12 fort and vicus assemblages.

4.1.8. Carlisle, Carlisle Castle

The site in Carlisle was excavated from 1998-2000 (Zant 2009, 1). The area excavated is to the south of Carlisle castle. From the cultural material and architecture uncovered, a detailed chronology, divided into 8 parts, has been established, with phases given as follows (Zant 2009, xvii):

- 1-2) Iron Age (Prior to 1st C. AD.)
- 3) Roman Period (1st-2nd C. AD.)
- 4) Roman Period (2nd-3rd C. AD.)
- 5) Roman Period (3rd-4th C. AD.)
- 6) Roman Period (4th-5th C. AD.)
- 7) Post Roman (5th C. AD)
- 8)Medieval (12th-15th C. AD)

In the Iron Age very little was found besides features possibly indicating a field system (Zant 2009, xvii). In the Roman Period, the use of dendrochronology has aided our understanding of the site immensely. The original timber fort was constructed between AD 72-3, with a period of reconstruction taking place through AD 83-5 (Zant 2009, xvii). From AD 103-5 it appears that the timber fort was demolished, with evidence of rebuilding using timber following in AD 105 (Zant

2009, xvii). In the Hadrianic Period a shift in purpose is evident, with the fort being utilised as a works depot (Zant 2009, xvii). In the mid-2nd C. AD there is evidence of demolition, possibly due to the Antonine conquests (Zant 2009, xvii). The status of the fort is largely unknown for this period, with signs of only intermittent occupation, and not as a conventional fort (Zant 2009, xvii). The 3rd C. AD saw the purpose of this fort restored, with it being rebuilt in stone. Occupation of the fort continued well into the 5th C. AD (Zant 2009, 904). While there is some evidence of Post Medieval occupation, the faunal assemblage is too small to be analysed, and is beyond the purview of this project.

Faunal remains were hand collected during the excavation at Carlisle, resulting in an assemblage of 30,250 fragments (Zant 2009, 904). Some sieving was undertaken as well. Other than revealing the presence of some smaller mammals including vole and shrew, the overall trends found through hand collection were not significantly altered when taking the sieving data into account (Zant 2009, 904). Preservation of the recovered fragments was fair, with some erosion making the identification of fragments difficult. Five trenches were opened, each yielding various amounts of faunal remains. The majority of the animal bones recovered came out of trench 5 (Zant 2009, 905). All trenches are combined and divided by period of occupation. Very little bone was recovered dating to the Iron Age, with only 12 fragments recovered from Period 1 and 6 from Period 2. The faunal remains recovered from the Roman Periods (3-6) comprise 56% of the assemblage, allowing for a detailed analysis of this time period (Zant 2009, 905). There is a sizeable assemblage recovered from both period 7 and 8. The remains recovered from Period 7 are poorly preserved, making identification of the fragments challenging. Fragments were identified to species, element, side and diagnostic zone according to Dobney (1988). The representation of major domesticates was calculated for each period, in addition to the element distribution of each species. Morphological analysis was conducted, with butchery and pathological markers being recorded. Grant (1982) was used to analyse the tooth eruption and wear of the recovered cattle mandibles, grouped into rough ages according to Halstead (1985), and Levine (1982), and with epiphyseal fusion data being analysed using the methods of Grant (1982). Metrical measurements were taking using the methodology proposed by Von den Driesch (1976). Pelvic morphology was also utilised to elicit the sexual dimorphism of the cattle population.

Cattle represent the majority of recovered elements. Distinctive Roman butchery and element distribution indicate that the primary purpose of the cattle was for meat procurement, although evidence for hide processing exists as well. The population of cattle found at Carlisle is mainly female, with only a few instances of castrate or bull sized elements being recovered. A few of these females display distal splaying of their metapodial articulations, possibly indicating their utilisation for traction purposes. A majority of the animals are older, with over 80% of cattle being slaughtered at an adult age (Zant 2009, 908). The size of the elements recovered indicates that the animals were of the native breed, and that their size increased over time through the Roman Period, possibly through the introduction of advanced husbandry practices.

Carlisle is of great comparative value towards the analysis of the faunal remains recovered at Binchester. Being located along Hadrian's Wall, Carlisle can provide us with a better understanding of provisioning to the norther peripheries of the Roman Empire. Being a dedicated military fort, the faunal assemblage can help us to better understand military provisioning, helping to further establish distinctive military practices. The excellent chronology of the site makes us able to compare the Binchester material to distinct time periods, including sub-Roman activity. Additionally, the metric information provided gives an excellent view of a female-dominated assemblage, contrasting with other comparative assemblages and allowing for a comparison of the sexual dimorphism of the Binchester 2011/12 material. Furthermore, the presence of native animals provides excellent comparison with Binchester in order to ascertain whether or not breed improvement or the introduction of larger continental breeds of cattle took place in either the fort or vicus. On the whole, Carlisle will provide excellent comparative data and interpretation to Binchester, helping us to contextualize the site within the greater context of Roman Britain.

4.1.9. Lincoln

The report "of Butchers and Breeds" (Dobney et al. 1996, 1), is a synthesis of faunal assemblages recovered from within Lincoln. The excavations yielded a wealth of cultural material from a variety of chronological periods. Making use of radiocarbon dating, and evidence from coin, architecture and pottery, the phasing for the excavations (relevant to this project) are as follows:

> IA: Iron Age, very little evidence of occupation, only a single roundhouse found in 1972.
>
> ER: Early Roman occupation of the area began with a hilltop fort constructed of timber in AD 55-60. The main focus of occupation of the area was military, although a sizeable population would have been present nearby to support the military, resulting in a neighbouring civil settlement with grazing and industry.
>
> LR: The Late Roman Period saw an intensification of occupation of the area. In the third century Lincoln was named the capital of a new province with the restructuring of Roman Britain. This saw a distinct intensification of occupation in the city itself and in the surrounding region. In the 4th century, the defences of the city were refurbished on a massive scale. It has been postulated that Britain underwent a recession in the 4th century. However, Lincoln appears to have done quite the opposite, yielding cultural material suggesting a more active, prosperous urban centre.
>
> PR: Post Roman, a decline is evident during this period, seeing overall disuse and abandonment, with only the construction of a timber church seen in excavated contexts. By the 5th century, the town of Lincoln was largely abandoned.

This synthesis features data gathered from many different excavations spanning a 16 year time period utilising a panoply of different collection and excavation methodologies (Dobney et al. 1996, 1). The sites are organised into 4 main areas within the city of Lincoln (Dobney et al. 1996, 7-14). The area of Wigford is located to the South East of the river Witham, it yielded a large assemblage dating to the 3rd/4th century, as well as a moderate Late Saxon assemblage as well (Dobney et al. 1996, 3). The Waterfront encompasses the Northern bank of the Witham River, outside of the Southernmost Roman defences of late 4th century date, yielding the largest assemblage, with over 5420 identifiable fragments, most dating to the Late Roman Period, with some Saxon material as well (Dobney et al. 1996, 10). The Lower City represents the Southern portion inside of the walled town, yielding a small but well dated assemblage of 1504 identifiable fragments, with Late Saxon, High and Post Medieval deposits (Dobney et al. 1996, 11). The Upper City covers the Northern portion of the walled city, and yields a large Post Medieval assemblage, with over 2000 identifiable elements dating to the English Civil War (Dobney et al. 1996, 13). Some Early Roman material was recovered as well, although this assemblage is very small.

Where possible, the faunal assemblage was sorted by chronological phase rather than area, making use of a pottery index as well as a number of radiocarbon dates to determine which phase each context belongs to (Dobney et al. 1996, 18). While residuality is a distinct concern for the faunal material, the use of both a pottery index and radiocarbon dating is thought to ameliorate this concern somewhat (Dobney et al. 1996, 18). The different areas saw varying preservation of faunal remains, with the best preservation noted in the Waterfront excavations. Furthermore, dog gnawing, although it is noted in each area, is quite limited, indicating that the faunal remains were incorporated and covered shortly after deposition, as opposed to being left exposed (Dobney et al. 1996, 18). Consisting mainly of major domesticates, the relative frequency of the three species is calculated. Further, the element distributions are tabulated as well, separated into area of excavation in order to capture possible intra-site variation. Morphological analysis makes note of pathological lesions as well as butchery marks on recovered cattle elements. Both epiphyseal fusion and mandibular tooth wear were analysed in order to create age profiles for the cattle populations recovered from each phase of occupation. Mandible wear stages were recorded according to Grant (1982), and organised into the age categories outlined by O'Connor (1991, 250 Table 67). A large suite of metric data was recorded from intact elements, with a majority of measurable elements dating to the 4^{th} c.

Overall, the faunal assemblages recovered from Lincoln dating to the Roman period depict an affluent city that maintained its population and societal complexity through the supposed decline of Roman Britain in the 4^{th} century. During the 4^{th} century, city infrastructure continued to intensify, the deliberate deposition of the waterfront suggests the existence of a complex society with a large population and a centralised municipal system.

The information presented in this synthesis of excavations within the city of Lincoln is of excellent comparative value. Of particular use is the large Late Roman assemblage, which is dated to a similar timeframe as the provisional dates for the Binchester 2011/12 material. Also of particular use is the presence of sub-Roman activity on the site, making it a useful tool in examining possible sub-Roman inclusions in the Binchester assemblages. The species representation, butchery patterns, pathological evidence and element distribution are all indicative of Roman urban living, with the systematic slaughter and distribution of animals previously utilised for traction. In addition to the basic information, a wealth of metric data was recorded and is included in the report, which will allow for a direct comparison of the size of Late Roman cattle from Lincoln to those from Binchester.

4.2 Species Representation

Table 4.2.1 shows the species representation of the major domesticates as well as horse, dog and bird at Binchester, as well as the comparative sites. Figures 4.2.1 – 4.2.7 display this information, separated out by century, allowing us to assess any potential change over time, as well as accurately place the 2011/12 material from Binchester. Sites with exceedingly small assemblages, such as Great Holts Farm, are not included in this section due to their susceptibility to bias. All comparative sites have a low occurrence of wild species, with the vast majority of faunal material belonging to the three major domesticate species, albeit in varying proportions.

Wavendon Gate, Haddon and Hacheston all had small Iron Age assemblages that were preserved enough to determine the representation of the major domesticates (Figure 4.2.2). Haddon fits closely with trends associated with the Iron Age, displaying an elevated representation of sheep/goat, with slightly lower cattle representation (Baxter 2003, 120). Very few pig specimens were identified in this time period. The opposite seems to occur at Hacheston, where a majority of cattle closely followed by pig was recovered, with very little representation of sheep/goat (King 2004, 188). Both of these sites display much lower representation of cattle than is seen at Binchester. The Iron Age assemblage at Wavendon Gate shows a very high representation of cattle, with sheep/goat of secondary importance (Dobney and Jaques 1995, 219). Interestingly, pig is exceedingly low at Wavendon Gate in the Iron Age, almost completely absent from the assemblage (Dobney and Jaques 1995, 220). The Iron Age assemblages from Wavendon Gate and Hacheston are somewhat small, making them vulnerable to selection and preservation bias. Overall the Iron Age assemblages display a wide degree of variation, with Haddon representing the more 'traditional' Iron Age assemblage, displaying a majority of sheep/goat with low representation of pig. As expected, the species representation of the 2011/12 faunal assemblage from Binchester, does not closely match any of the Iron Age assemblages. Despite Wavendon Gate showing a majority of cattle, the low representation of pig sets it apart from Binchester.

The 1st-2nd C. saw a shift in Britain from the mainly sheep/goat dominated Iron Age to the cattle and pig dominated husbandry practices of Roman Britain. This shift, however, was far from universal and saw a large degree of variation. The comparative sites yield a greater amount of information dating to the 1st-2nd C. (Figure 4.2.3), allowing us to view the general trends in species representation. The data from Binchester phase 3-5 is similar to the 2011/12 representation, although with slightly lower representation of cattle and sheep/goat and an elevated pig representation. This representation fits within the expected trends of Roman Britain, with cattle and pig rising in importance at the expense of sheep/goat. Reminiscent of its Iron Age assemblage, Wavendon Gate continues to show a majority of cattle, albeit with a low pig representation (Dobney and Jaques 1995, 219). Lincoln and Carlisle display a similar cattle majority to that of Binchester phase 3-5, with a slightly elevated representation of sheep/goat and pig (Dobney et al. 1996, 21-22; Zant 2009, 908). Segontium and Haddon display trends that run somewhat counter to expected patterns, with a lower representation of cattle (Noddle 1993, 97; Baxter 2003, 120). While still maintaining a majority representation of cattle, Segontium features an elevated presence of pig over sheep/goat, while Haddon retains its Iron Age sheep/goat dominance with very little representation of pig. Shifting from its previous pig dominance, Hacheston displays a huge cattle majority, with over 80% of recovered elements being identified as cattle (King 2004, 189). Pig represents a distant second in representation, with a very minimal presence of sheep/goat at Hacheston. The species representation of the Binchester 2011/12 assemblage fits better with the trends noted in the 1st-2nd century, finding close matches in the military site of Carlisle, urban Lincoln, and the earlier excavations within the Binchester fort. However, Binchester 2011/12 both fort and vicus diverge from the 1st-2nd century sites in that they show a greater utilisation of cattle resources, with lower, and almost even, representation of sheep/goat and pig.

In the 2nd-3rd C. we expect to see an increase in the trends noted in the 1st-2nd C., with a continued increase in cattle and pig representation at the expense of sheep/goat (Figure 4.2.4). Fitting with this trend, Carlisle, Lincoln and Wavendon Gate all see a slight increase in the representation of cattle (Zant 2009, 908; Dobney et al. 1996, 21-22; Dobney and Jaques 1995 1995, 219). Wavendon Gate diverges from the other two, maintaining its low representation of pig as well as featuring an elevated horse representation (Dobney and Jaques 1995, 219). In a striking similarity with Binchester 2011/12, Carlisle shows a similar, if higher than Binchester, representation of sheep/goat and pig, with cattle in the clear majority, representing almost 60% of the total identifiable fragments (Zant 2009, 908). Hacheston shows a diminished representation of cattle (King 2004, 189), falling in line with Lincoln (Dobney et al. 1996, 21-22), showing both a similar representation of cattle as well as a heightened pig percentage over sheep/goat. Segontium, while still displaying a majority of cattle, has elevated sheep/goat and pig when compared to the other sites (Noddle 1993, 97). Of the comparative sites in this period, Binchester 2011/12 most closely matches Carlisle, showing a cattle majority with neither remaining man domesticate being of a clear secondary importance. However, the 2011/12 assemblage features a ten percent greater cattle representation than that of Carlisle, at the expense of the other two domesticates.

The 3rd-4th C. features increased assemblage sizes for a number of sites. Furthermore, several of our comparative sits show signs of abandonment within or shortly after this chronological period, including Hacheston, Haddon, and Wavendon Gate (Figure 4.2.5). Wavendon Gate remains largely unchanged in its general representation of the three main domesticates (Dobney and Jaques 1995, 219). Cattle is of primary importance with markedly lower representation of sheep/goat and exceedingly few pig recovered. Interestingly the presence of horse at Wavendon Gate continues to be high, rivalling sheep/goat for secondary importance (Dobney and Jaques 1995, 219). Segontium in the 3rd-4th C. continues to more strongly feature the trends associated with Roman Britain, showing elevated cattle representation, with pig of secondary importance and sheep/goat a low third (Noddle 1993, 97). This trend is increased greatly from phase 7-7B to 8-9, where cattle representation increased by over ten percent at the expense of sheep/goat and, to a lesser degree, pig (Noddle 1993, 97). Hacheston and Carlisle display similar trends, fitting well with the trends noted of the time period. Both sites show a large majority of cattle, with pig of secondary importance and sheep/goat third, although not as low as Segontium (King 2004, 189; Zant 2009, 908). Lincoln in the 3rd century has a similarly low representation of sheep/goat as that of Carlisle and Hacheston. However, Lincoln diverges from these two sites in having an elevated representation of pig. While still maintaining a majority of cattle, the level is much lower than that of other contemporary comparative sites (Dobney et al. 1996, 21-22). Remaining stuck in time, Haddon continues to display species representation more in line with Iron Age Britain, showing a high representation of sheep/goat, with cattle of secondary importance and pig are virtually absent, seeing less representation than horse on site (Baxter 2003, 120). An additional outlier to the trends outlined above can be found in Wroxeter. The assemblage likely being the result of redeposited materials, the Wroxeter assemblage is subject to some degree of potential bias (Barker et al. 1997). However, the assemblage recovered and dated to the 3rd-4th C. shows a heightened representation of sheep/goat, with cattle only slightly in the majority (Hammon 2011, 285). Pig is also moderately represented, seeing similar levels to that of Hacheston, but not as high as Carlisle or Lincoln. This is very different from expected trends, as Wroxeter represents a semi-urban and partially militarised environment (Hammon 2011, 286). The species representation at Wroxeter does not match up with Binchester 2011/12 at all, nor with the general trends outlined by the other comparative sites. The town periphery of Hacheston and the fort of Carlisle are the closest matches to the 2011/12 assemblage in this time period. However, Binchester features higher representation of cattle and even representation of pig and sheep goat, setting it apart from the 3rd-4th C. data.

The 4th-5th C. approaches the transitionary period as Rome withdrew its direct influence from Britannia. The effects of this shift are not immediately visible in the animal husbandry practiced, as a continuation of the trends previously noted is visible, with increased emphasis on cattle production at the expense of sheep/goat (Figure 4.2.6). Binchester phase 9 is similar to the 2011/12 material in its large cattle majority. However, this is somewhat lower than that of the 2011/12 material. Furthermore, the representation of pig is significantly higher in the phase 9 assemblage (Cussans and Bond 2010, 508). As the excavation was within the commandant's house and private bathhouse, an elevated presence of higher status meat, such as pig, is to be expected (Ferris 2010, 1). Segontium shows an elevated representation of cattle over previous centuries, with the cattle majority increasing from phase 10 to 10A (Noddle 1993, 97). Pig is of secondary importance at Segontium, with low representation of sheep/goat. Carlisle and Lincoln both display similar representation to that of Segontium 10A, with a large cattle majority, pig of secondary importance, and low sheep/goat representation. The representation of these domesticates is close between sites, with cattle representing between 69 and 80 percent of identifiable fragments, pig between 10 and 20 percent representation, and sheep goat at the lowest range of 4-10 percent representation (Zant 2009, 908, Dobney et al. 1996, 21-22). Overall there is a much higher degree of similarity between the comparative sites in this time period. One outlier can be seen in Wroxeter, where although a cattle majority persists, an elevated representation of sheep/goat can be seen (Hammon 2011, 285). Pig is of tertiary prevalence at Wroxeter, although its representation is similar to that of the other comparative sites. The faunal assemblage from the 2011/12 excavations in the Binchester fort and vicus fit best with the comparative material from this period, showing a similarly large majority of cattle with pig and sheep/goat of significantly lower importance. However, the representation of sheep/goat in the 2011/12 material is higher than the general trends of this time period would lead us to expect. This is the one major area of divergence between the 2011/12 assemblage and the Binchester 9 material. As has been mentioned previously, this discrepancy could be due to the area of the site excavated, with higher status environs such as the commandant's house and baths containing a greater proportion of pig (Grant 1982, Ferris 2010, Cussans and Bond 2010, 508). Conversely, the barrack block and area of vicus excavated in 2011/12 may contain a higher amount of sheep/goat bones.

The Binchester 2011/12 material does bear some similarity with the comparative Late/sub Roman assemblages (Figure 4.2.7), particularly Carlisle, which displays a similarly even representation of sheep/goat and pig. However, the Binchester material representation of the secondary domesticate species remains distinctively lower than is noted among the Segontium or Wroxeter assemblages, possibly indicating a regional similarity with Carlisle. Overall the species representations at comparative sites show a continuation of practice into the Late/sub Roman levels. Throughout the Roman Period, and into the sub-Roman assemblages, we see a distinct trend towards increased cattle utilisation, at the expense of sheep/goat, over time. While this trend is not absolute, with sites such as Haddon being a particularly poignant example, in Roman Britain the dominance of cattle resources is commonly considered an indicator of a typically 'Romanised' site. On the whole, the 2011/12 species representation from Binchester displays a typically Romanised animal exploitation strategy, most closely matching trends found at other military sites, and displays levels commonly noted in assemblages dated between the 4th and 5th C.

The collection of sites, with Binchester among them, is remarkable not only for its differences, but also for the degree of homogeneity displayed across multiple regions, site types and centuries. In the transition towards local supply outlined in Chapter 1, it is possible, or even likely, that the needs of the military were imposed, either directly or through the use of economic or other incentives, in order to meet the needs of the occupying force at military and urban sites (King 2001, 215; 1984, 190; Mattingly 2006, 502; Collins 2012, 17). It is entirely possible that the dominance of cattle at all varieties of site, with notable exceptions, is a direct result of this interrelationship (King 2001, 215; 1984, 190), with the general increase in cattle utilisation over time reflecting the maturation of this process, culminating, or at least changing in form, in the late 4th / early 5th century (Thomas and Stallibrass 2008, 10; Mattingly 2006, 505). Thus, we can view the cattle majority found at a number of disparate sites as a result of a long term increase in demand for cattle resources, both as a source of work and food. The similarity between Binchester and other notable frontier sites is also of note. Located at the proverbial fingertips of Rome's substantial reach, and quite far removed from one another, the military sites considered in this review are likely to have completely separate sources of supply in the 4th century, with local variations in availability a distinct likelihood. Yet, all the sites considered display a surprising uniformity in their utilisation of animal resources. One possibility for this similarity is the presence of military rationing (King 2001, 220; 1984, 195). Given a broad understanding of the Roman military complex, it is not unreasonable to assume that the occupants of forts, subject to the whims of a bureaucracy far removed from their particular reality, would have less free agency in their choice of meal than urban, small town, or even rural sites, although the latter may be more constrained by local availability than the others (Phillips, 2010, 4). The Vindolanda Tablets are a valuable resource in this regard, providing a unique view into the travel, preference, and purchase of resources by military agents far removed from their base of operations (e.g. Birley 2002, Bowman 2003, Evers 2011). It is possible military sites were adhering to prescribed rationing ratios rather than expressing personal preference, thus accounting for noted inter-site similarity across significant geographic separation.

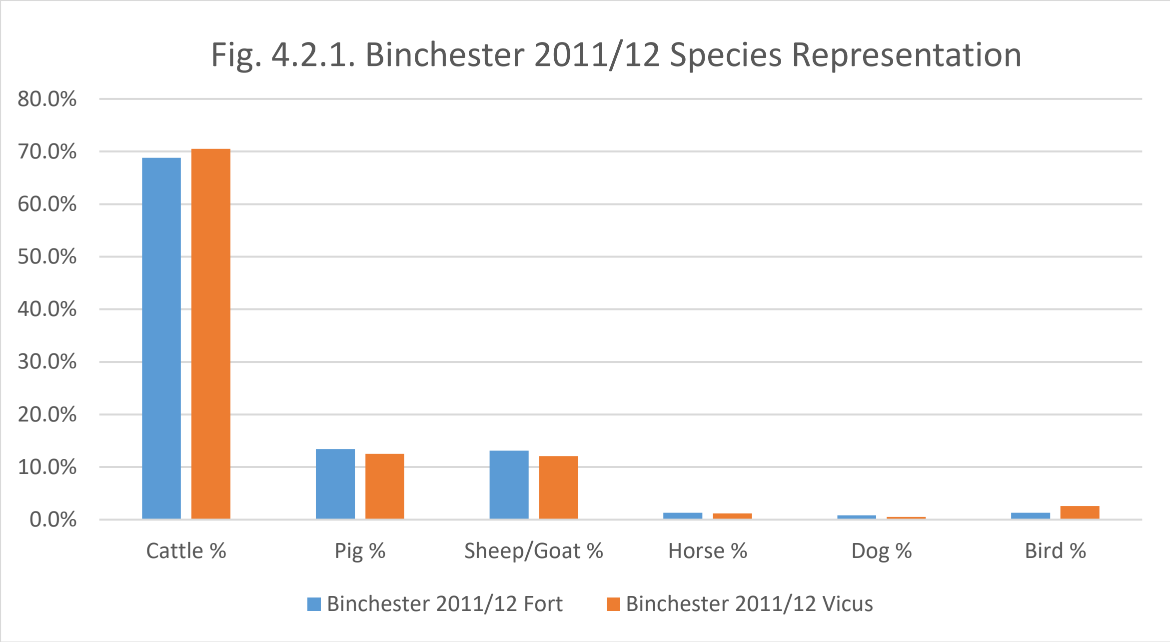

Fig. 4.2.1. Binchester 2011/12 Species Representation. This figure shows the relative representation of major domesticate species recovered from Binchester during the 2011/12 excavation seasons in the fort and vicus. Sample Size: Fort: 10108, Vicus: 7838.

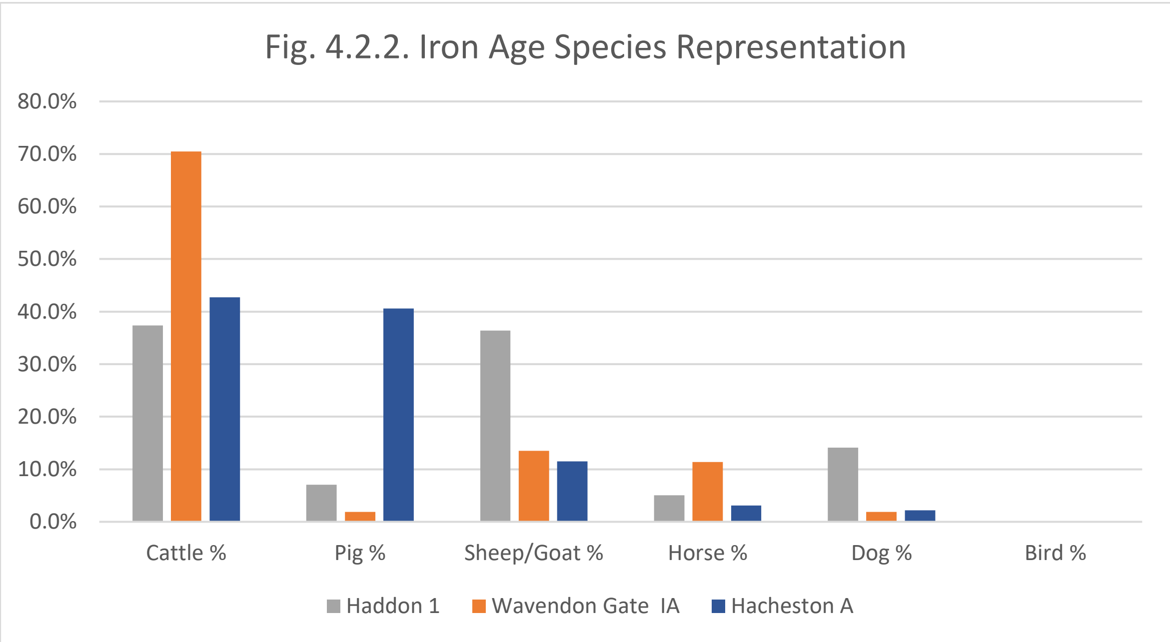

Fig. 4.2.2. Iron Age Species Representation. This figure shows the relative representation of major domesticate species recovered from comparative assemblages of Iron Age date. (Baxter 2003, 120; Dobney and Jaques 1995, 119; King 2004, 189) Sample size: Haddon 1: 99; Wavendon Gate IA: 586; Hacheston A: 323.

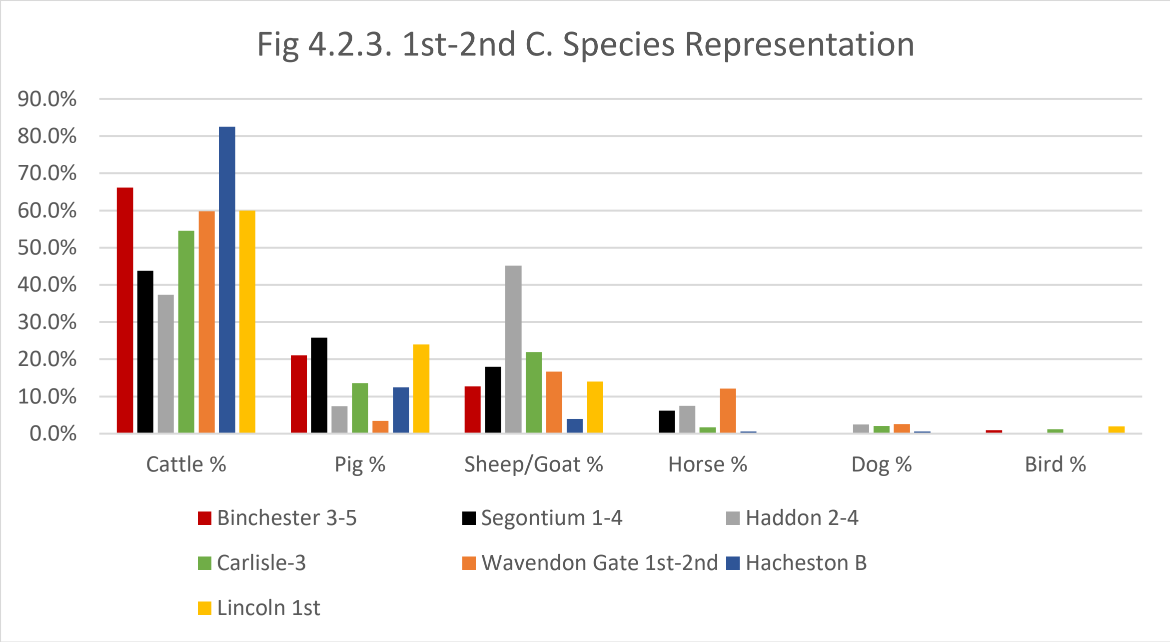

Fig. 4.2.3. 1st-2nd C. Species Representation. This figure shows the relative representation of major domesticate species recovered from comparative sites dating within the 1st-2nd C. AD. (Cussans and Bond, 2010, 495 T. 129; Noddle 1993, 104 Table 6.1; Baxter 2003, 120; Zant 2009, 908; Dobney and Jaques 1995, 119; King 2004, 189; Dobney et al. 1996, 132-133, Tables 7-11). Sample size: Binchester 3-5: 3903; Segontium 1-4: 178; Haddon 2-4: 693; Carlisle 3: 583; Wavendon Gate 1st-2nd: 1022; Hacheston B: 360; Lincoln 1st: 362.

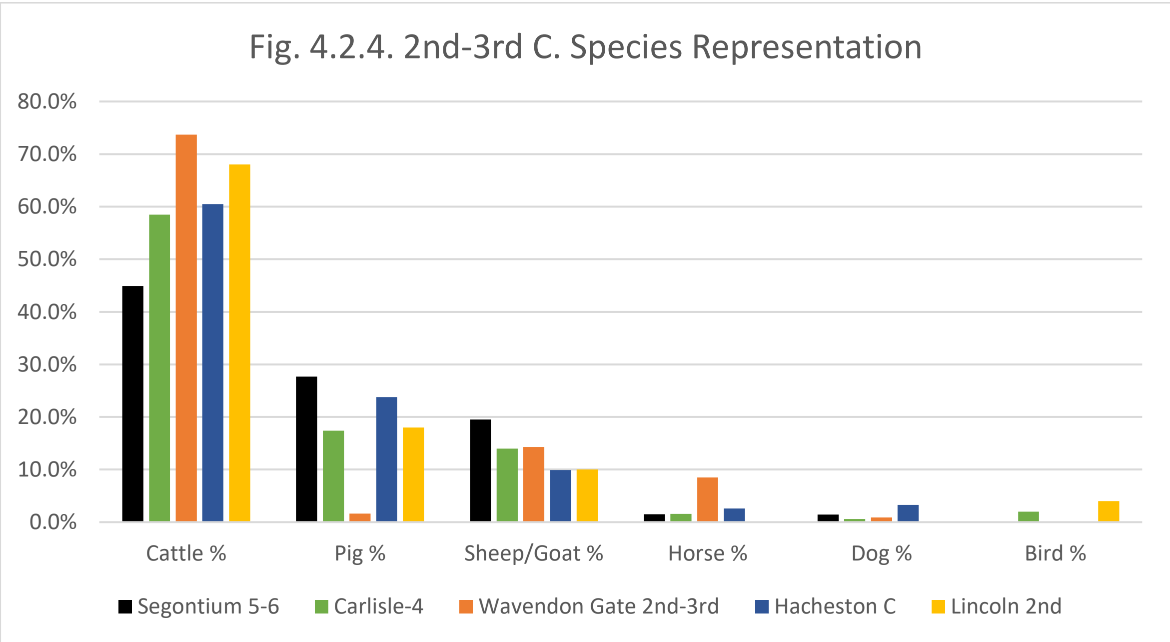

Fig. 4.2.4. 2nd-3rd C. Species Representation. This figure shows the relative representation of major domesticate species recovered from comparative sites dating within the 2nd-3rd C. AD. (Noddle 1993, 104 Table 6.1; Zant 2009, 908; Dobney and Jaques 1995, 119; King 2004, 189; Dobney et al. 1996, 132-133, Tables 7-11). Sample size: Segontium 5-6: 917; Carlisle 4: 501; Wavendon Gate 2nd-3rd: 448; Hacheston C: 2381; Lincoln 2nd: 233.

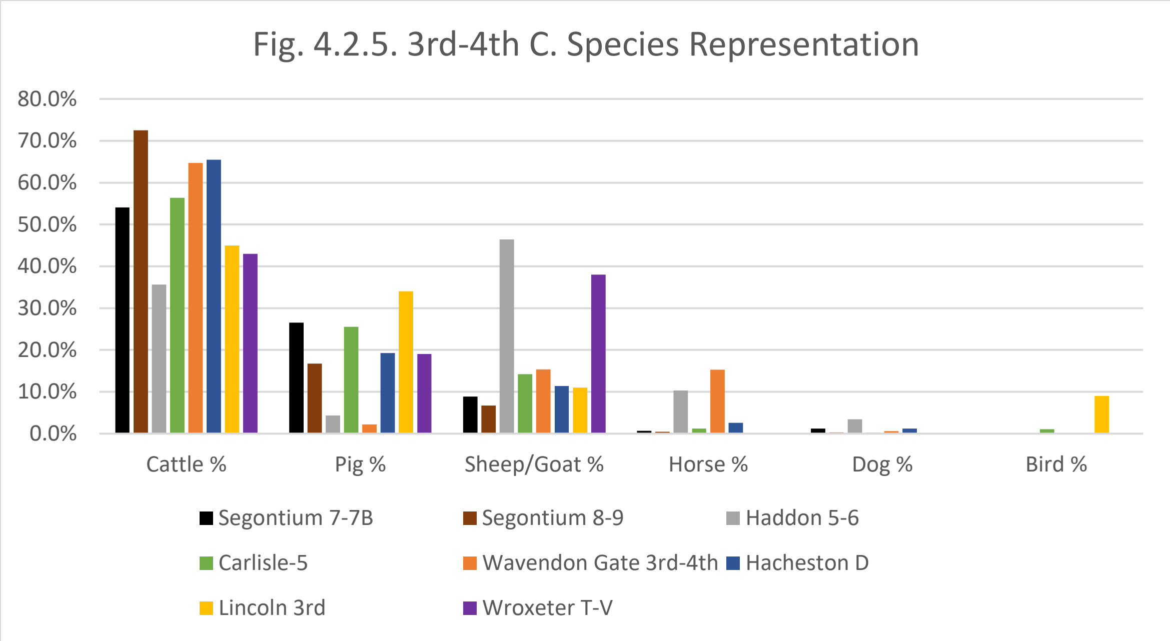

Fig. 4.2.5. 3rd-4th C. Species Representation. This figure shows the relative representation of major domesticate species recovered from comparative sites dating within the 3rd-4th C. AD. (Noddle 1993, 104 Table 6.1; Baxter 2003, 120; Zant 2009, 908; Dobney and Jaques 1995, 119; King 2004, 189; Dobney et al. 1996, 132-133, Tables 7-11; Hammon 2011, 285, Fig. 3). Sample size: Segontium 7-7b: 1461; Segontium 8-9: 1974; Haddon 5-6: 845; Carlisle 5: 486; Wavendon Gate 3rd-4th: 675; Hacheston D: 2463; Lincoln 3rd: 499; Wroxeter T-V: 388.

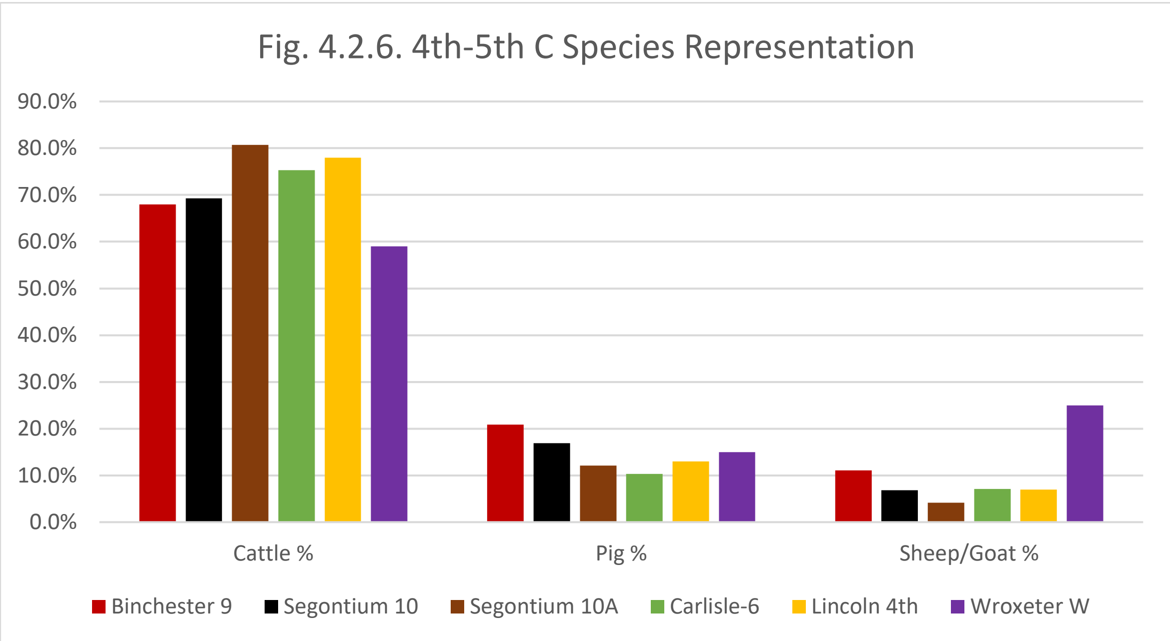

Fig. 4.2.6. 4th-5th C. Species Representation. This figure shows the relative representation of major domesticate species recovered from comparative sites dating within the 4th-5th C. AD. (Cussans and Bond, 2010, 495 T. 129; Noddle 1993, 104 Table 6.1; Zant 2009, 908; Dobney et al. 1996, 132-133, Tables 7-11; Hammon 2011, 285, Fig. 3). Sample size: Binchester 9: 11586; Segontium 10: 3347; Segontium 10A: 4883; Carlisle 6: 3551; Lincoln 4th: 5277; Wroxeter W: 4479.

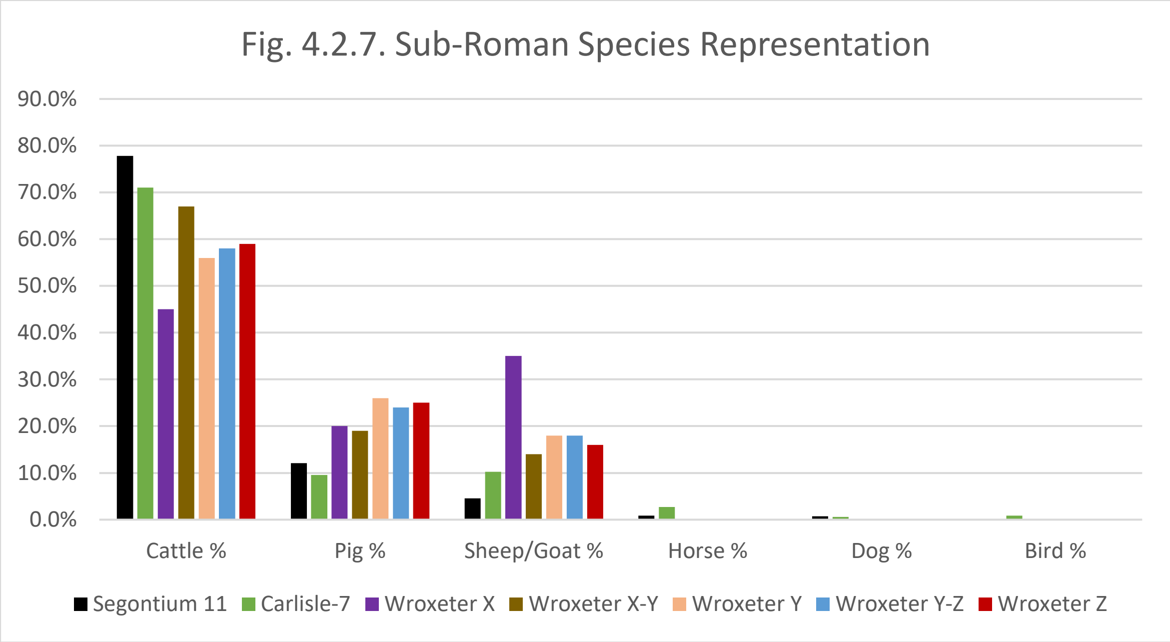

Fig. 4.2.7. Sub-Roman Species Representation. This figure shows the relative representation of major domesticate species recovered from comparative sites dating to the Late/sub Roman Period. (Noddle 1993, 104 Table 6.1; Zant 2009, 908; Hammon 2011, 285, Figure 2). Sample size: Segontium 11: 937; Carlisle 7: 1371; Wroxeter X: 159; X-Y: 2302; Y: 4599; Y-Z: 3362; Z: 7912.

Table 4.2.1. Comparative Sites and Species Representation.					
Site	Site Type	Date	Cattle	Pig	Sheep/Goat
Binchester 3-5	Fort	1st-2nd	66.2%	21.1%	12.7%
Binchester 9	Fort	4th-5th	68.0%	20.9%	11.1%
Segontium 1-4	Fort	1st-2nd	43.8%	25.8%	18.0%
Segontium 5-6	Fort	2nd-3rd	44.9%	27.7%	19.5%
Segontium 7-7B	Fort	3rd-4th	54.1%	26.6%	8.8%
Segontium 8-9	Fort	3rd-4th	72.5%	16.8%	6.7%
Segontium 10	Fort	4th-5th	69.3%	16.9%	6.8%
Segontium 10A	Fort	4th-5th	80.7%	12.1%	4.2%
Segontium 11	Fort	PR	77.8%	12.1%	4.6%
Haddon 1	Farmstead	IA	37.4%	7.1%	36.4%
Haddon 2-4	Farmstead	1st-2nd	37.4%	7.4%	45.2%
Haddon 5-6	Farmstead	3rd-4th	35.6%	4.4%	46.4%
Carlisle-3	Fort	1st-2nd	54.5%	13.6%	22.0%
Carlisle-4	Fort	2nd-3rd	58.5%	17.4%	14.0%
Carlisle-5	Fort	3rd-4th	56.4%	25.5%	14.2%
Carlisle-6	Fort	4th-5th	75.3%	10.3%	7.1%
Carlisle-7	Fort	PR	71.0%	9.6%	10.2%
Wavendon Gate IA	Settlement	IA	70.5%	1.9%	13.5%
Wavendon Gate 1st-2nd	Settlement	1st-2nd	59.8%	3.4%	16.7%
Wavendon Gate 2nd-3rd	Settlement	2nd-3rd	73.7%	1.6%	14.3%
Wavendon Gate 3rd-4th	Settlement	3rd-4th	64.7%	2.2%	15.4%
Hacheston A	Settlement	IA	42.7%	40.6%	11.5%
Hacheston B	Settlement	1st-2nd	82.5%	12.5%	3.9%
Hacheston C	Settlement	2nd-3rd	60.5%	23.8%	9.9%
Hacheston D	Settlement	3rd-4th	65.5%	19.3%	11.4%
Lincoln 1st	City	1st-2nd	60.0%	24.0%	14.0%
Lincoln 2nd	City	2nd-3rd	68.0%	18.0%	10.0%
Lincoln 3rd	City	3rd-4th	45.0%	34.0%	11.0%
Lincoln 4th	City	4th-5th	78.0%	13.0%	7.0%
Wroxeter T-V	City	3rd-4th	43.0%	19.0%	38.0%
Wroxeter W	City	4th-5th	59.0%	15.0%	25.0%
Wroxeter X	City	PR	45.0%	20.0%	35.0%
Wroxeter X-Y	City	PR	67.0%	19.0%	14.0%
Wroxeter Y	City	PR	56.0%	26.0%	18.0%
Wroxeter Y-Z	City	PR	58.0%	24.0%	18.0%
Wroxeter Z	City	PR	59.0%	25.0%	16.0%
Binchester 2011/12 Fort	Fort	?	68.8%	13.4%	13.1%
Binchester 2011/12 Vicus	Vicus	?	70.5%	12.5%	12.1%

Table 4.2.1. Comparative Sites and Species Representation. This table displays the comparative sites, their type of site, relative date of the assemblage, and the representation of the major domesticates. (Cussans and Bond 2010, 495 T. 129; Noddle 1993, 104 Table 6.1; Baxter 2003, 121; Zant 2009, 908; Dobney and Jaques 1995, 119; King 2004, 189; Dobney et al. 1996, 21-22; Hammon 2011, 285 Fig. 3)

4.3. Cattle Element Distribution

This discussion focusses on the cattle populations at each site. The element distribution from each time period is displayed in Figures 4.3.1. – 4.3.7. For simplicity of presentation and comparison, elements were sorted into forelimb, hindlimb, metapodials, phalanges and other. The 'Other' category consists of cranial and identifiable elements of the axial skeleton, and is considered to be primary butchery waste along with metapodials and phalanges. For the purposes of this analysis, phalanges, metapodials carpals and tarsals are classed as low utility elements, with forelimb (scapulae, humeri, radii, ulnae) and hindlimb (pelves, femora, tibiae) elements classed as high utility, or meat bearing. Sites with exceedingly small assemblage sizes, such as Great Holts Farm, are not included due to their susceptibility to bias. It should also be noted that the site of Lincoln is subdivided into several different areas of excavation, helping to elucidate intra-site variation. The element distributions of each of these depositional areas is displayed in this section. It is also important to note that the site of Lincoln did not include phalanges as identifiable fragments. Thus, their absence from this metric is not definitively indicative of their absence from the assemblage, but rather may be a discrepancy in zooarchaeological practice and data presentation. Furthermore, in both the Carlisle and Wroxeter analyses, element distribution is expressed as a factor of the most commonly occurring element. For these two sites, Table 4.3.1 displays the most common elements and breaks down the overall implications of the element distribution. The various element distributions at sites are separated out into chronological period in order to facilitate a direct comparison with the 2011/12 material from Binchester. Where phalanges are accounted for, their small size and lack of fragmentation in a number of sites has had the effect of diminishing their recovery, especially with regards towards the third phalanx, whose shape and size makes it difficult to differentiate between it and small stones. This lower representation is seen as a taphonomic effect rather than a lack of or absence from the site.

The element distribution data for cattle populations at Carlisle combines phases 3-5 (spanning from the 1st-4th C.) and presents the totals in terms of the most common element present, while separating out phase 6 (4th -5th C.) as its own assemblage (Table 4.3.1). In phases 3-5, the most common element noted the scapula, followed closely by metacarpals (Zant 2009, 908-9). All elements see some representation at Carlisle, indicating that whole animals were being transported on site, where they underwent slaughter, butchery, and consumption, with the waste from all processes being deposited in the same location (Zant 2009, 908-9). This suggests further that the same process of transporting meat and secondary products into Carlisle 'on the hoof' was still practiced into the 4th-5th C (Thomas and Stallibrass 2008, 9). The Binchester 2011/12 material, while showing different representation of elements and body parts, still shows the presence of all body parts within both the fort and vicus assemblages. This indicates that a similar process was taking place at both sites, where whole animals were dismembered and consumed within a similar area and the waste products from these different processes was deposited in the same space.

Limited data is available for the Iron Age comparative assemblages, with only small amounts recovered from Hacheston and Wavendon Gate (Figure 4.3.2). Hacheston displays a low representation of hindlimb, metapodials and phalanges, with elevated levels of forelimb and other (King 2004, 191). The heightened representation of both meat bearing forelimbs and lower utility 'other' suggests that whole animals were being brought on site, butchered and consumed nearby. The low incidence of metapodials may be indicative of hide processing taking place elsewhere on site. Furthermore, the exceedingly low levels of hind limb elements recovered could be due to taphonomic factors, or could have been consumed elsewhere on site (King 2004, 192). Both Wavendon Gate and Haddon show similarly higher hindlimb representation while maintaining a similar level of forelimb representation. Wavendon Gate displays very few recovered metapodials, and even fewer phalanges, suggesting the possibility of hide processing, where the lower limb elements were left attached to the hide and transported elsewhere for secondary processing (Dobney and Jaques 1995, 219). The IA assemblages at Hacheston and Wavendon Gate show an elevated presence of meat bearing bones, indicating the source of the assemblage is likely consumption rather than primary butchery. This is largely different from the general trends noted from the Roman Period assemblages, where butchery and consumption refuse tends to be deposited within the same general area. This suggests a key difference between Iron Age practices and those employed during the Roman Period at the same sites, possibly suggesting a distinction between food preparation and consumption areas, or a differentiation in waste disposal.

The 1st-2nd C. cattle element distribution can be seen in Figure 4.3.3. The Binchester 3-5 data shows a high occurrence of primary butchery, seen through the high incidence of 'other' elements as well as a low representation of higher utility limb bones (Cussans and Bond 2010, 495). Hacheston continues to show similar element distribution to its IA assemblage, with low hindlimb representation, higher forelimb levels, and an elevated representation of 'other' elements (King 2004, 190). Wavendon Gate shows some change over time, with a heightened presence of metapodials (Dobney and Jaques 1995, 220). However, the general trends seen in the IA, namely a higher representation of forelimb and other over hind, with a low phalanx representation, remain. We see some differentiation between the different areas of Lincoln. Lincoln Wigford shows a low representation of hindlimb bones, with elevated forelimb and 'other' (Dobney et al. 1996, 23-24). Conversely, Lincoln Upper City shows a more even representation between hind and forelimb bones, as well as increased metapodials (Dobney et al. 1996, 23-24). Segontium 1-4 bears the most in common with the Binchester 2011/12 assemblage, showing an even representation of hind and forelimb, metapodials and 'other' elements (Noddle 1993, 98). As mentioned earlier, the diminished phalanx levels are likely a result of taphonomic processes rather than their absence from the assemblage. This even representation of body parts at Segontium suggests that animals were brought in to the area 'on the hoof,' butchered, processed, consumed and disposed of within the same area, with few body parts leaving the general vicinity of the site (Thomas and Stallibrass 2008, 9). This bears some similarity with Binchester 2011/12, which features a similarly even representation between the limb bones and other elements. However one key difference exists in that the limb bone representation at Binchester was somewhat elevated over the lower utility items, suggesting increased consumption waste in the depositions. The presence of all body parts again suggests the utilisation of whole beasts rather than imported cured or preserved elements.

The 2nd-3rd C. cattle element distributions of comparative sites show much variation with other chronological periods (Figure 4.3.4). Hacheston shows a decrease in 'other' elements and forelimb representation, displaying an almost even representation of high and low utility elements, although forelimbs are still slightly more prevalent than hind (King 2004, 190). Wavendon Gate continues to show a low representation of phalanges, with a sharp decline in forelimb representation as well (Dobney and Jaques 1995, 219). Hindlimb representation remains constant, with 'other' element representation increasing by 20% (Dobney and Jaques 1995, 220). Lincoln shows a wide degree of variation between depositional locations. Containing a somewhat small assemblage, the element distribution at Wigford is biased due to a large number of recovered metapodials, indicating a possible dump of secondary processing materials (Dobney et al. 1996, 23-24). Representation of other elements at Wigford is relatively even. At the Upper City in Lincoln, forelimb elements see an elevated representation over that of hindlimb and metapodials, with a high incidence of 'other' elements as well (Dobney et al. 1996, 23-24). This indicates the presence of butchery waste as well as consumption, further suggesting the presence of secondary processing strategies for cattle metapodials. The presence of all body parts at each site suggests that multiple processes were depositing waste in a similar area, as well as indicating that whole animals were brought on site for slaughter, butchery and consumption (Thomas and Stallibrass 2008, 9). The different representational levels of each element indicates the varying degrees which each process was taking place within this area. Segontium shows an elevated representation of low utility 'other' elements (Noddle 1993, 98). However, Segontium also displays a lower representation of metapodials. While this could be interpreted as the removal of metapodials due to secondary processing elsewhere, the heightened presence of phalanges suggests that this is not the case, as the removal of articulated metapodials would also result in the diminished representation of phalanges (Noddle 1993, 98). Instead, it is possibly the result of poorer preservation or specific processes targeting metapodials that results in their diminished representation at Segontium. The 2nd-3rd C. cattle element distribution largely suggests an elevated presence of butchery waste over consumption, with the low metapodial presence suggesting the removal of metapodials either as a side effect of hide removal or for secondary processing themselves elsewhere. The Binchester 2011/12 data does not closely match the element distributions of the 2nd-3rd C. comparative material, showing greater representation of high utility elements as well as an overall more even representation between different body parts.

The 3rd-4th C. cattle element distribution shows increased similarity between most sites, mainly varying in the representation of metapodials (Figure 4.3.5). Hacheston continues to show a low representation of hindlimb elements, with other body parts relatively even in representation, suggesting that the lower hindlimb representation may be due to poorer preservation (King 2004, 188). Wavendon gate shows low phalanx and metapodial representation, with a slightly elevated presence of hindlimb. The representation of hindlimb and 'other' elements is even, suggesting that both butchery and consumption were practiced to similar degrees on site (Dobney and Jaques 1995, 220). The element distributions from the different areas of Lincoln show little variation in the representation of limb bones and other elements. However, it is interesting to note that the representation of metapodials shows a large degree of variation between areas. The Lincoln areas of the Wigford and Waterfront have similar representation of hind and forelimbs, suggesting the presence of consumption on site (Dobney et al. 1996, 23-24). Additionally, the representation of metapodials and 'other' elements is also similar. Wroxeter phase T-V is also dated to the 3rd-4th C. (Table 4.3.1). Similar to Carlisle, the element distribution is presented with all element values being set as a percentage of the most common element, making the grouping of elements into distinct body parts difficult (Hammon 2011, 287). The most common element from this time period was the mandible, followed by lower limb and other cranial elements. The presence of high utility elements were markedly low in this time period, suggesting that consumption was taking place elsewhere, and that the depositions recovered are the result of primary butchery waste (Hammon 2011, 287). However, some small presence of meat bearing bones suggests that consumption did take place within the general vicinity to a limited extent. Segontium phase 7 and 8-9 are very similar, showing even numbers of hind and forelimb, with lower metapodial and phalanx representation (Noddle 1993, 98). Segontium 8-9 shows an increased representation of 'other' elements with slightly lessened presence of hindlimb, phalanges and metapodials (Noddle 1993, 98). The lower presence of metapodials paired with the higher levels of 'other' elements may be evidence of secondary processing such as hide production taking place after primary butchery, with the metapodials being taken in tow to the processing location (Noddle 1993, 98). This would account for the lower metapodial levels in spite of a large amount of primary butchery waste. On the whole, the Binchester 2011/12 faunal assemblages bear an increased amount of similarity with the general trends displayed across the 3rd-4th C. comparative data. The increasingly even representation of hind and forelimb, as well as the presence of primary butchery waste, contributes to the interpretation of the assemblage as whole cattle being transported on site, where they are butchered and consumed within the same area. Binchester bears the greatest similarity with the assemblages from Segontium, although a higher incidence of metapodials is noted at Binchester.

The 4th-5th C. cattle element distributions for our comparative sites show a general discrepancy between hind and forelimb, with elevated forelimb representation (Figure 4.3.6). The Binchester 9 data bears some similarity to the 2011/12 material in its large proportion of both limb elements as well as 'other' elements, indicating a mix of primary butchery and consumption (Cussans and Bond 2010, 510). Interestingly the Binchester 9 data shows a low overall representation of metapodials recovered, a phenomenon not noted in the 2011/12 assemblage (Cussans and Bond 2010, 510). This discrepancy could be due to different areas of the site being excavated, each with depositions from slightly different processes taking place. Segontium 10 and 10A, representing each half of the 4th C., display very similar element distributions. The hind and forelimb representations only differ marginally, with low metapodial representation (Noddle 1993, 98). This is very similar to the result from the previous century and, besides the low metapodial representation, matches quite closely to the Binchester 2011/12 assemblages, showing a largely even representation of different body parts, suggesting that whole animals were being transported to, butchered and consumed on site (Stallibrass and Thomas 2008, 2). The different areas of Lincoln offer the greatest variation for our comparative sites, particularly in the representation of metapodials recovered. The area of Wigford shows a high representation of forelimb elements while hindlimb representation is exceedingly low. This could indicate a preference in cut of meat, but likely represents better survival of forelimb elements in the assemblage (Dobney et al. 1996, 23-24). The assemblage from the Lincoln Waterfront has the most similarity with other sites, showing an even representation of limb bones and 'other' elements, with only slightly lower metapodial representation (Dobney et al. 1996, 23-24). These levels are reminiscent of Segontium, and bear a marked similarity with the Binchester 2011/12 element distributions as well. The Lower and Upper City both show a marked increase in the representation of metapodials, with the Upper City showing over 45% metapodial representation (Dobney et al. 1996, 23-24). This extreme elevation is the result of very small sample sizes rather than anomalous processes taking place. Wroxeter phase W shows a majority of metapodials followed by cranial elements, suggesting a majority of primary butchery waste (Hammon 2011, 287). Similar to the previous chronological period, Wroxeter (Table 4.3.1) displays a low incidence of high utility elements, although they see a slightly elevated prevalence when compared to the previous century (Hammon 2011, 288). Overall, the Binchester 2011/12 element distributions from both fort and vicus most closely match with the 4th-5th C. comparative sites. The distribution bears considerable similarity with previous excavations at Binchester, although with a much higher representation of metapodials. Indeed, while the representation of hind and forelimbs recovered from Binchester 2011/12 resembles that noted at Segontium 10 and 10A, the level of metapodials recovered at these sites is much lower than that noted at Binchester. Lincoln Wigford and Waterfront both have metapodial representation approaching that noted from the Binchester 2011/12 material, and the Waterfront displays the characteristically even distribution of hind and forelimbs. Overall the element distributions from the Binchester 2011/12 assemblages most closely match that of the Lincoln Waterfront from this time period.

The element distributions between sub-Roman Periods at both Segontium and Wroxeter both show a great deal of similarity between these two time periods, adding further support to the continuity of practice after the cessation of direct Roman input in Britannia (Figure 4.3.7). This, in turn, suggests that the procurement, processing and management of cattle resources remains unchanged, or at least that change in practice is not visible. This reinforces the static species representation noted previously, and further supports continuity in practice and possibly in identity through the sub-Roman Period.

As opposed to the species representation, which created a cohesive narrative of animal utilisation transitioning towards cattle from the Iron Age into the Roman Period, and increasing through to the 5th century, the cattle element distribution at comparative sites offers a much more complicated picture. As element distribution can be used to identify distinct practices at archaeological sites, it should come as no surprise that this method of analysis is exceedingly vulnerable to intra-site variation. Lincoln provides an excellent example of this, demonstrating how likely different processes in different areas can result in entirely different distributions of cattle elements within the same site (Dobney et al. 1996, 23-24). With such susceptibility towards bias, it is difficult to determine if any differences between sites reflect legitimate inter-site variation, or if they are merely a consequence of different areas of excavation in comparative sites. Viewing sites individually, some patterns do emerge. During the Roman period, whole animals were driven to the site for slaughter and consumption, a noted trend in Roman sites (Stallibrass and Thomas 2008, 2The Binchester fort and vicus match this interpretation, with roughly even levels of elements recovered. While evidence of this can be seen across the majority of comparative material throughout the Roman and sub-Roman assemblages, the relative levels of representation of different elements recovered at Binchester most closely matches those noted from the 4th-5th C. particularly those of Segontium and Lincoln Wigford.

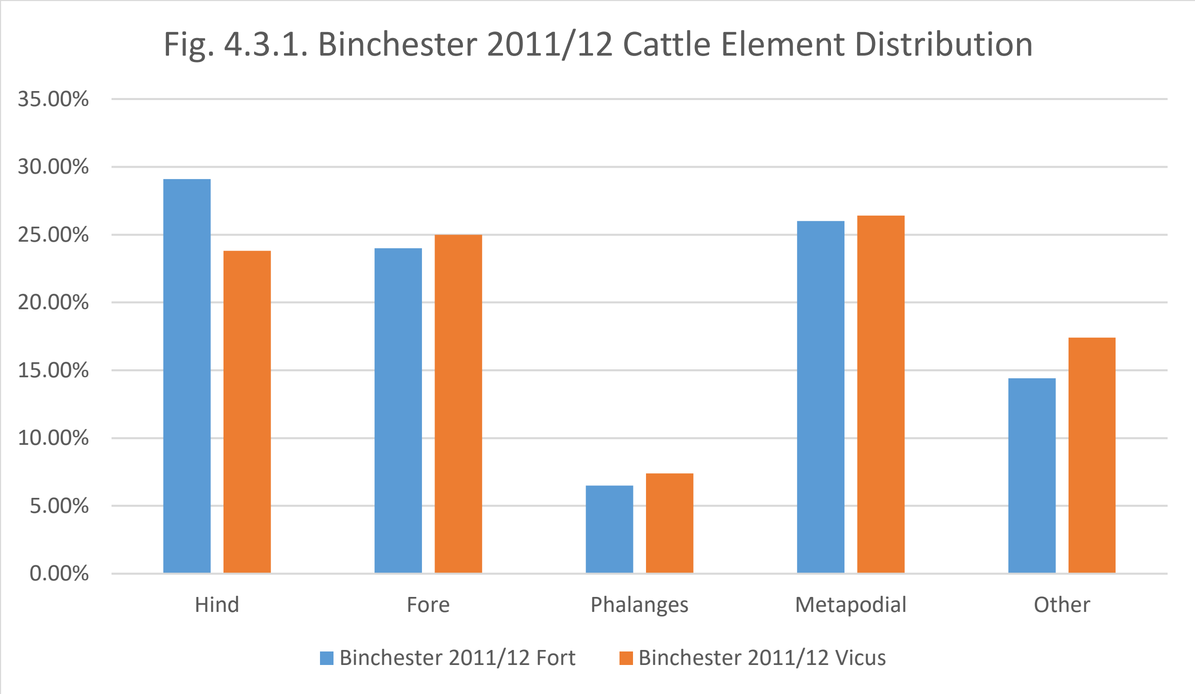

Fig. 4.3.1. Binchester 2011/12 Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from the Binchester 2011/12 fort and vicus. Sample Size: Fort: 3015; Vicus: 2425.

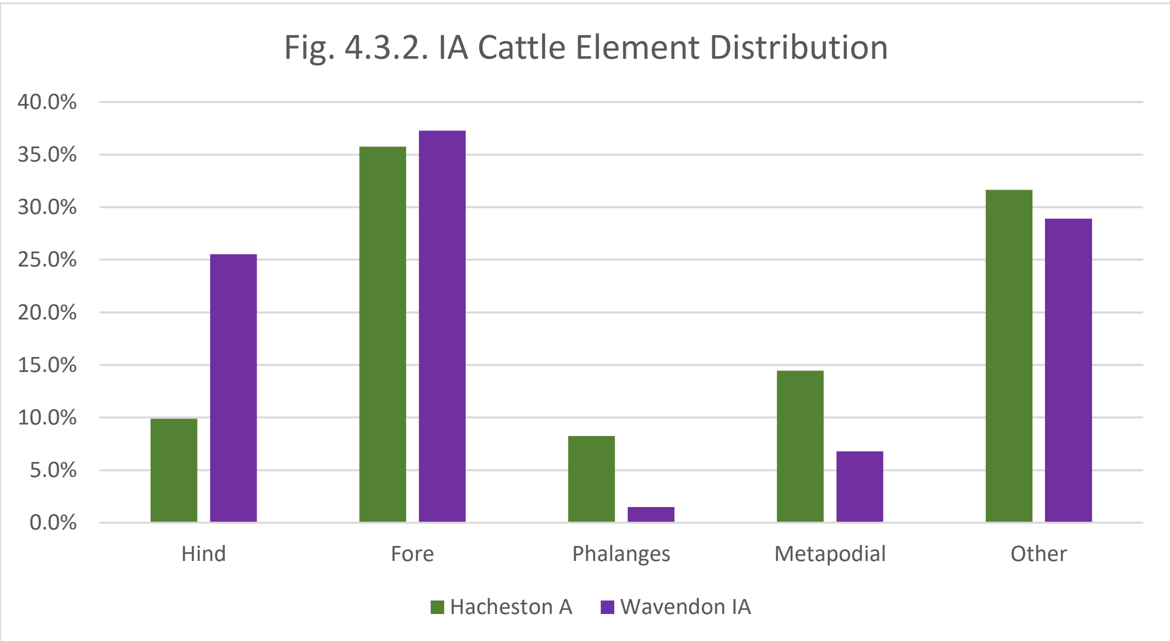

Fig. 4.3.2. Iron Age Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from comparative sites dating to the Iron Age. (King 2004, 190; Dobney and Jaques 1995, 219). Sample size: Hacheston A: 109; Wavendon IA: 362.

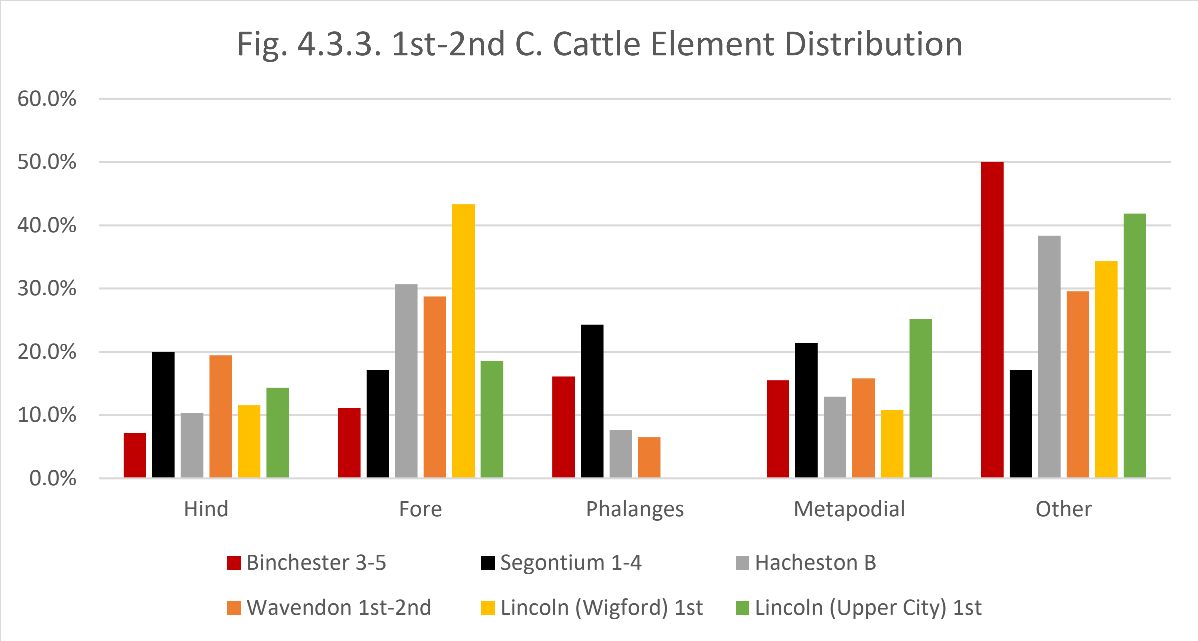

Fig. 4.3.3. 1st-2nd C. Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from comparative sites dating within the 1st-2nd C. AD. (Cussans and Bond 2010, 496, T 130; Noddle 1993, 104 Table 6.2; King 2004, 190; Dobney and Jaques 1995, 219; Dobney et al. 1996, 23-24, 72-79, Figs 12-26, 135-141, Table 17-27). Sample size: Binchester 3-5: 303; Segontium 1-4: 78; Hacheston B: 181; Wavendon 1st-2nd: 512; Lincoln Wigford: 80; Lincoln Upper City: 72.

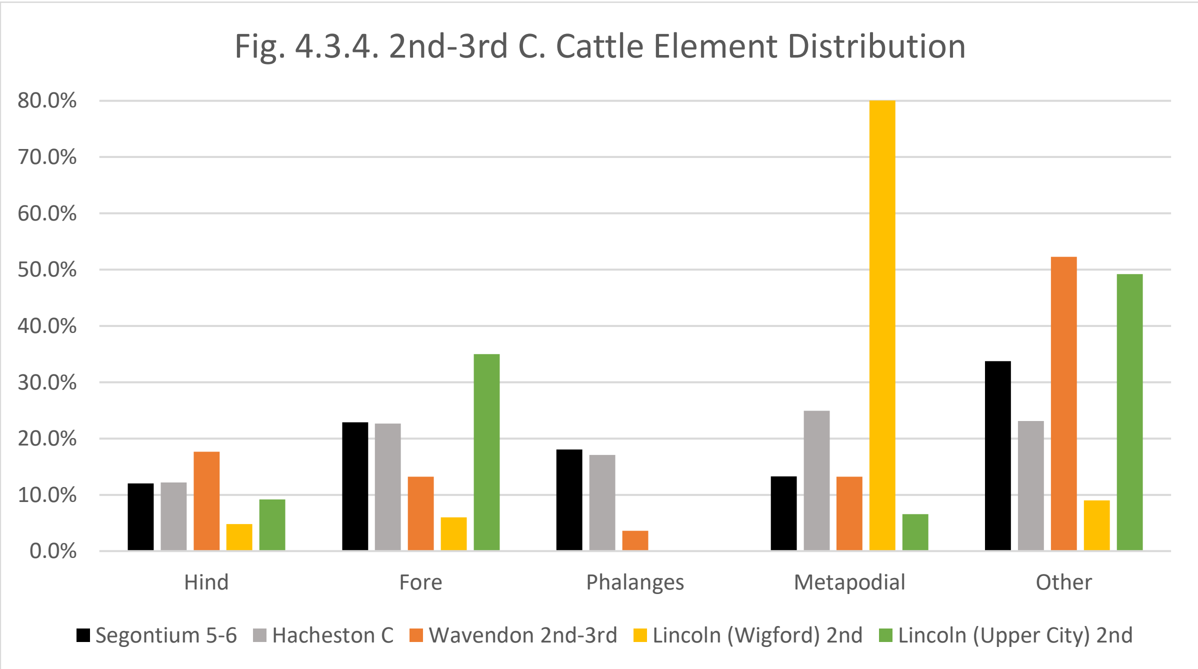

Fig. 4.3.4. 2nd-3rd C. Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from comparative sites dating within the 2nd-3rd C. AD. (Noddle 1993, 104 Table 6.2; King 2004, 190; Dobney and Jaques 1995, 219; Dobney et al. 1996, 23-24, 72-79, Figs 12-26, 135-141, Table 17-27). Sample size: Segontium 5-6: 412; Hacheston C: 1145; Wavendon 2nd-3rd: 244; Lincoln Wigford: 50; Lincoln Upper City: 41.

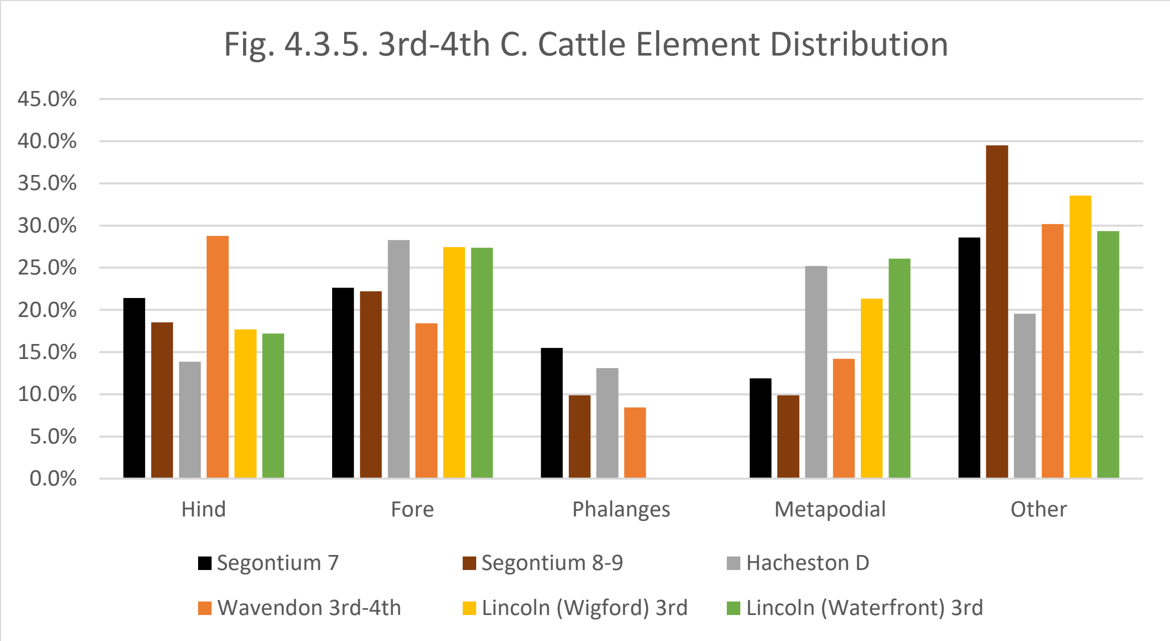

Fig. 4.3.5. 3rd-4th C. Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from comparative sites dating within the 3rd-4th C. AD. (Noddle 1993, 104 Table 6.2; King 2004, 190; Dobney and Jaques 1995, 219; Dobney et al. 1996, 23-24, 72-79, Figs 12-26, 135-141, Table 17-27). Sample Size: Segontium 7: 790; Segontium 8-9: 1431; Hacheston D: 1288; Wavendon 3rd-4th: 363; Lincoln Wigford: 99; Lincoln Waterfront: 78.

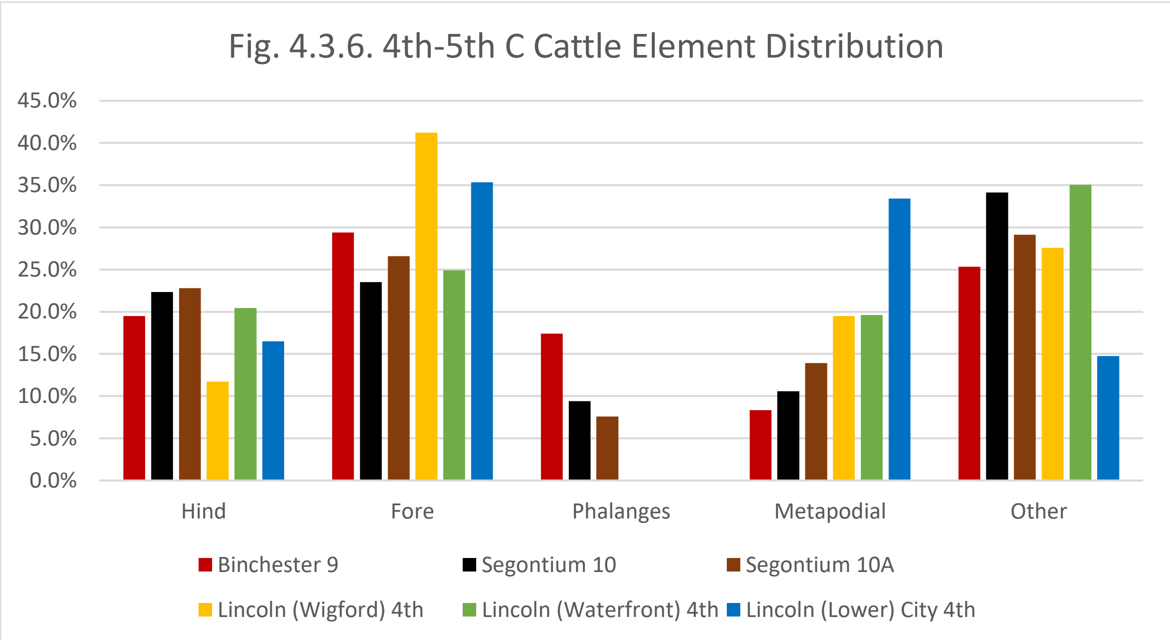

Fig. 4.3.6. 4th-5th C. Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from comparative sites dating within the 4th-5th C. AD. (Cussans and Bond 2010, 510, T. 145; Noddle 1993, 104 Table 6.2; Dobney et al. 1996, 23-24, 72-79, Figs 12-26, 135-141, Table 17-27) Sample Size: Binchester 9: 811; Segontium 10: 2319; Segontium 10A: 3941; Lincoln Wigford: 177; Lincoln Waterfront: 2893; Lincoln Lower City: 54.

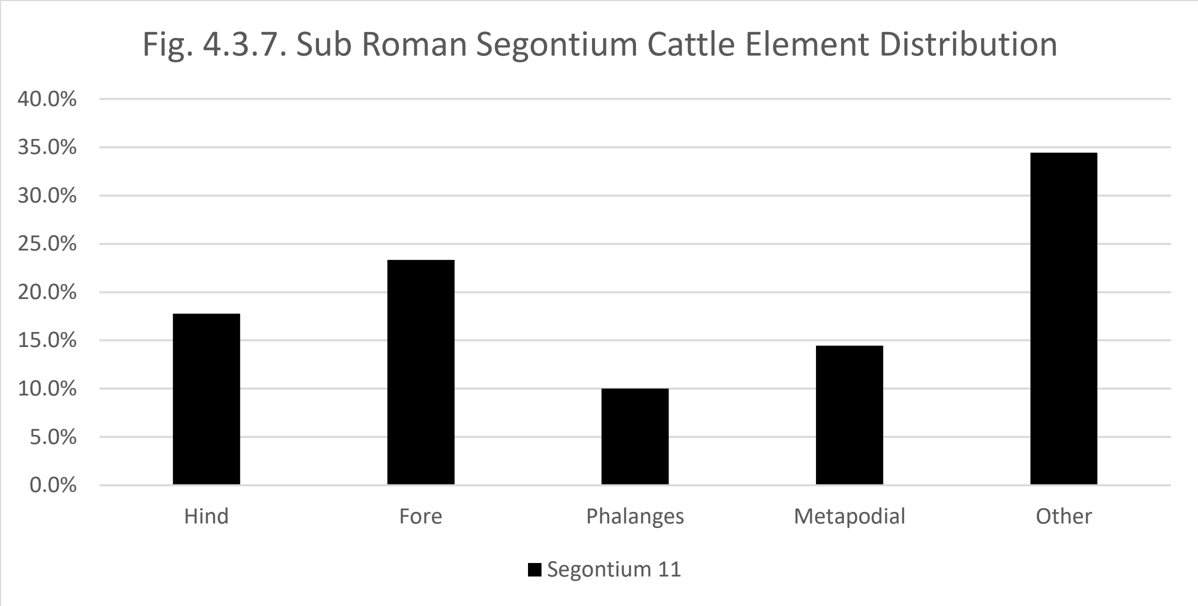

Fig. 4.3.7. Sub-Roman Segontium Cattle Element Distribution. This figure shows the relative distribution of cattle elements recovered from the sub-Roman levels at Segontium (Noddle 1993, 104 Table 6.2). Sample Size: 729

Table 4.3.1. Carlisle and Wroxeter Cattle Element Representation			
	Most Prevalent Element	Second Most Prevalent	Breakdown
Carlisle 3-5	Scapula	Metapodials	Both low and High Utility elements
Carlisle 6	Metacarpal	Scapula, pelvis, metatarsal	Both low and High Utility elements
Wroxeter T-V	Mandible	None	Lower Limbs and Cranial elements
Wroxeter W	Mandible	Metacarpal, Metatarsal, Scapula	Metapodials and Cranial Elements
Wroxeter X	Mandible, Metacarpal	Metatarsal, Radius	Lower limbs and Cranial elements, some limb bones present
Wroxeter X-Y	Mandible	Metacarpal, Metatarsal, Scapula	Lower limbs and Cranial elements, with representation of limb bones as well
Wroxeter Y	Astragalus, Mandible	Calcaneus, Metacarpal, Scapula, Humerus, Radius, Tibia	Both low and High utility, lacking upper hind limb
Wroxeter Y-Z	Mandible	Metacarpal, Metatarsal	Lower limbs and Cranial elements, with representation of limb bones as well
Wroxeter Z	Mandible	Humerus, Astragalus, Calcaneus	Roughly equal distribution of elements, low Femur

Table 4.3.1. Carlisle and Wroxeter Cattle Element Representation. This table shows the most common and second most common element recovered from the sites of Carlisle and Wroxeter. (Zant 2009, 1461-2, Figure 654, 655; Hammon 2011, 287, Figure 4)

4.4. Cattle Butchery Patterns

A wide degree of variation in the reporting and discussion of cattle butchery is noted across comparative sites. The farmstead sites of Haddon and Wavendon Gate both have a notable presence of butchered elements within their assemblages (Baxter 2003, 122; Dobney and Jaques 1995, 219-220). Wavendon Gate shows a distinct shift in style of butchery from the Iron Age into the Roman Period. This transition was seen through a shift away from fine accurate knife marks in the Iron Age to broader, less accurate chop marks from cleavers in the Roman Period, focusing on the dismemberment of cattle carcasses (Seetah 2005). The Haddon assemblage, likely representing excess cattle butchered for food, shows butchery throughout, although Baxter (2003) doesn't mention whether these marks correspond to the fine knife marks noted in the Iron Age, or the distinctive cleaver marks associated with Roman butchery. This could be further evidence of the Haddon occupants continuance of Iron Age practices, in keeping with the species frequencies noted previously. The site of Great Holts Farm, consisting mainly of a collection of cattle metapodials, notes the presence of knife marks indicative of hide removal. The practice of hide removal appears to be similar to the knife marks noted at Binchester, with proximal and distal metapodials seeing knife marks circling the articulation in order to remove the hide. The site of Hacheston offers some interesting information regarding the practice of butchery in the Roman Period. On site, butchery is noted fitting with the Roman style, with cleavers used to chop away and efficiently dismember carcasses. In Area 2 of the site, however, no dismemberment or primary butchery is evident. Instead, whole skeletons, minus the skull, metapodials and phalanges are present (King 2004, 192). Knife marks consistent with hide removal are noted on the otherwise articulated skeletons. This is interpreted as the presence of disease or some other unwanted condition that warranted the culling of the herd without consuming the meat. However, the hides were still of value, being removed and taken elsewhere (King 2004, 192). The Binchester butchery bears some similarity with that noted at the rural sites of Great Holts Farm, Wavendon Gate and Hacheston. A similar focus on the efficient and expedient dismemberment of cattle carcasses is noted. Further, the utilisation of finer knives for the purpose of hide removal, as seen at Great Holts Farm, is also present at Binchester. However, while the use of cleavers is noted across all sites save Haddon, the practice is not identified as distinctly military in style, as is noted at Binchester, suggesting a trait unique to military sites.

The urban sites of Wroxeter and Lincoln both have a large amount of butchery. Hammon (2011, 297) notes the presence of chop marks with cleavers throughout all phases of occupation at Wroxeter, with the goal of expediently and efficiently dismembering cattle carcasses into smaller portions of meat. Similarly Dobney (1996) notes the presence of cleaver marks with the purpose of disjointing cattle carcasses at Lincoln. Further, the practice of bone splitting was noted in the Lincoln assemblage, attributed to marrow procurement for use in a variety of products. Additionally, the practice of puncturing scapulae for the purpose of drying or smoking the meat is noted throughout the Roman Period at Lincoln (Dobney et al. 1996, 24-28). The urban sites of Lincoln and Wroxeter again show a similar use of cleavers to Binchester, with Lincoln showing pierced scapulae very similar to the practices noted in the Binchester 2011/12 assemblage. However, the practice of long bone splitting noted at Lincoln is not seen in the Binchester 2011/12 assemblages.

Binchester displays butchery practices most similar to that noted at other military sites such as Carlisle, Segontium and, unsurprisingly, the data from earlier excavations at Binchester itself. The extensive use of cleavers to efficiently and expediently dismember and distribute cattle carcasses is noted at all sites during the Roman Period, being of a distinctive style indicative of the presence of Roman military butchery (Seetah 2005, 2006, Maltby 2014 Carlisle contains the presence of scapulae puncturing, either for drying or smoking of the joint of meat for future consumption (Zant 2009, 913). Carlisle quantifies their available data, seeing a butchery rate of 35% across all elements in the early Roman Period (Zant 2009, 913). The butchery rate remains more or less constant through the period. The previous excavations at Binchester present quantified butchery evidence as well, noting that phase 3-5 featured 779 butchery marks, of which 92% were chop marks caused by cleavers (Cussans and Bond 2010, 486). Phase 9 shows similar evidence, with 90% of recorded butchery marks being indicative of cleaver strokes (Cussans and Bond 2010, 495). Hide removal along with scapulae puncturing was also noted from the previous excavations at Binchester, mirroring the butchery practices noted from the 2011/12 assemblages. The butchery practices noted in the 2011/12 assemblages from Binchester Roman Fort, display a great deal of similarity with contemporary comparative military sites. Butchery marks cover a majority of recovered meat bearing elements, the vast majority of which are caused by the use of cleavers. The style and location of butchery marks indicates the presence of Roman military block butchery, focusing on the expedient and efficient dismemberment and distribution of even portions of meat throughout the fort. Furthermore, the practice of scapulae puncturing for smoking or drying purposes is noted at Binchester 2011/12 and mirrored in the findings at Carlisle, Segontium and at the previous excavations at Binchester.

The continuing use of cleavers offers further evidence for the maintenance of identity and practice into the sub-Roman Period, although the development of slightly different butchery practices in sub-Roman Wroxeter suggest that these practices were not entirely static (Hammon 2011, 295). On covering the static nature of learned practices and identities, Hammon (2011, 296) makes the point that the occupants of Roman Britain, even after becoming non-Roman, would not suddenly develop a wholly new method for butchering cattle. With the Iron Age far beyond living memory and clever-centric butchery a commonplace feature of Roman Britain, it is unlikely that there were distinctively different practices to adopt in the time span immediately following the Late/sub-Roman transition (Hammon 2011, 296). The presence of distinctive butchery marks and very little evidence of deviation from stylistic practices does suggest that individuals who were butchering animals in Roman Britain, were also butchering animals in sub-Roman Britain, likely making use of the same system of requisition or supply from the same local sources for some time before the systems in place were supplanted. The continuation of butchery practices in the century following the cessation of direct input from Rome in Britain suggests that the transition, and its dramatic effects on Britannia, was more of a gradual than immediate occurrence.

Overall the butchery marks noted at the Binchester 2011/12 fort and vicus assemblages closely resemble one another, showing a similar overall presence of butchered elements, and similar representation of butchery marks on those elements. The marks almost entirely consist of cleaver marks intended to quickly dismember and distribute cattle carcasses. This provides further evidence suggesting that fort and vicus employed similar practices, possibly reflecting a convergence in identity between the two areas. The use of cleavers is a distinctly Roman introduction in Britain, with the use of accurate knife marks being a cornerstone of the Iron Age in British butchery (Maltby 2014). The site also displays the practice of hide removal and scapulae puncturing in both assemblages. The analysis and comparison of the Binchester 2011/12 butchery marks to those from a number of different site types across Roman Britain has helped to solidify the interpretation of the Binchester 2011/12 butchery marks as evidence of Roman military butchery, bearing the greatest similarity with other forts and a secondary similarity with urban sites with notable military presence.

4.5. Pathological Lesions

The presence of pathological lesions on recovered cattle elements can help us glean insight into the husbandry strategies employed by past societies. While the presence or absence of pathological lesions saw varying quantification and consideration across comparative sites, pathology was present among all comparative sites as well as the Binchester 2011/12 assemblages. The pathologies noted at Binchester are compared with other assemblages on a site-by-site basis in order to view any similarities between different types of archaeological site.

The assemblages from 2011/12 at Binchester both show a limited presence of pathological lesions, with 1.1% of identifiable elements showing pathology in the fort, and 0.6% in the vicus. From these lesions, 3 main pathologies were noted in both assemblages, to roughly even degrees between assemblages. First, signs of osteoarthritis were noted in the eburnation and presence of bone reformation on the articulation of long bones, including the metapodials and phalanges in particular. Osteoarthritis can be an indicator of advanced age, but is also seen as indicative of the use of cattle for traction (Bartosiewicz 1997, Brothwell 1980). Further supporting the utilisation of the Binchester cattle as beasts of burden is the presence of two other indicators of traction: distal splaying of metapodials and phalanges, and spavin (Bartosiewicz 1997, Bartosiewicz 2013). Finally there was a notable presence of third mandibular molars that displayed a congenitally absent third cusp. While the causes of this feature are not definitively known, it is often viewed as a potential sign of inbreeding within a herd, or the lack of genetic diversity (Bartosiewicz 1997, Dobney et al. 1996, 34). These three factors make up the majority of notable pathological lesions. While some signs of injury and infection are noted, the overall dearth of these pathological lesions suggest that the cattle arriving and being consumed at Binchester were of generally good health, having served as beasts of burden prior to their consumption.

Pathology showed a low overall occurrence at the rural sites of Haddon, the settlement at Wavendon Gate and Great Holts Farm, displaying similar levels to the Binchester 2011/12 fort and vicus. Great Holts Farm, featuring a small assemblage including a large proportion of metapodials, shows distal splaying indicative of the utilisation of cattle for traction work (Bartosiewicz 1997, 43). Interpreted as imported large continental cattle, the utilisation of the cattle at Great Holts Farm for traction fits with this idea (e.g. Albarella 2003). Pathology at Wavendon Gate is almost non-existent, with only two pathological metacarpals within the assemblage (Dobney and Jaques 1995, 220). One displays a developmental abnormality while the other shows a severe infection, providing no further information or insight into practices at Wavendon Gate (Dobney and Jaques 1995, 220). Pathological lesions were rare within the Haddon assemblage. Evidence of traction was noted in the form of distal splaying of metapodials as well as spavin (Baxter 2003, 122; Bartosiewicz 1997, 43). Furthermore, the presence of eburnation and bone reformation is indicative of osteoarthritis on the articulations of long bones, supporting the suggestion of traction utilisation (Brothwell 1980). Finally, the Haddon assemblage, representing local excess cattle slaughtered for food, show congenitally missing third cusps of the mandibular third molar, suggesting a possible lack of genetic diversity within the population (Baxter 2003, 122). Representing excess cattle, it is likely that farmsteads such as Haddon would be a primary source of cattle from which the Roman military sites would be provisioned with military rations. Thus the presence of congenital deformations at both site types is to be expected. The major pathological indicators noted from the 2011/12 assemblages at Binchester are also noted at rural sites, suggesting that similar utilisation of cattle was taking place, or that cattle such as those found at rural sites were used to provision military sites.

The urban sites of Lincoln and Wroxeter, along with the small town periphery of Hacheston, display a low incidence of pathology. Hacheston shows evidence of osteoarthritis in the form of eburnation on the articulations of long bones, interpreted as possible evidence of traction (Brothwell 1980), although no splaying of distal metapodials or spavin is noted (King 2004, 192). Furthermore, the assemblage also contains congenitally missing third cusps of mandibular third molars. As the cattle are interpreted as local stock, this may be indicative of a lack of genetic diversity in the population (King 2004, 194). Wroxeter displays a limited suite of pathological data, however a number of recovered metapodials display splaying, indicating the utilisation of cattle for traction work (Bartosiewicz). The site of Lincoln offers more extensive quantification of pathology, although it is still limited overall. The 4th century assemblage sees a slightly elevated presence of pathological lesions, with 1.6% of recovered mandibles showing congenitally missing third cusps on the third molar, suggesting a lack of genetic diversity in the cattle being supplied to the urban centre (Dobney et al. 1996, 34). 3.6% of recovered metapodials show eburnation on the distal articulation, a sign of osteoarthritis (Brothwell 1980). While this can be interpreted as a possible indicator of the utilisation of cattle for traction, no identified metapodials showed distal splaying in the Roman Period, suggesting that the cattle supplied to the urban centre were not utilised for traction (Dobney et al. 1996, 34) A higher variation in the presence of pathological lesions is noted in the urban sites of Lincoln and Wroxeter, as well as the town periphery of Hacheston. While some of the pathological indicators suggest a similar lack of genetic diversity within cattle populations, the lack of other indicators, indicates a higher degree of variability in the husbandry strategies employed at the urban sites than seen at Binchester.

The presence of pathological lesions among the comparative military sites was low overall, with varying degrees of quantification and presentation between them. Segontium shows a particularly low incidence of pathology with most noted lesions occurring in phases 8-9 and 10A (Noddle 1993, 103). The presence of osteoarthritic lesions and spavin are interpreted as evidence of traction on site, although no splayed metapodials are noted (Bartosiewicz 1997). Additionally, Segontium also features the presence of congenitally missing third cusps of mandibular third molars within the assemblage, suggesting a greater degree of homogeneity within the cattle population (Noddle 1993, 103). Carlisle shows a somewhat higher presence of pathological lesions, although only 3.7% of recovered elements are deemed pathological (Zant 2009, 918). Osteoarthritic lesions are noted on long bone articulations, as well as splayed metapodials, indicating the use of cattle for traction prior to consumption (Bartosiewicz 1997). Furthermore, congenitally missing third cusps are also present within the assemblage (Zant 2009, 910). The previous excavations at Binchester also revealed a number of pathological lesions, although overall occurrence within the assemblages is low. 57 pathologies were noted in phase 3-5, with 94 noted in phase 9 (Cussans and Bond 2010). In phase 3-5 splayed metapodials, arthritic articulations, and congenitally missing third cusps are noted, suggesting a similar cattle population to that detailed in the 2011/12 assemblages. Phase 9 shows similar results, with one key difference: there is an absence of congenitally missing third cusps. This could indicate the introduction of new stock, or a shift in cattle provisioning over time (Cussans and Bond 2010). It is also important to consider that, in the case where intact mandibles see a lower survival, mandibular third molars missing a third cusp can be misidentified as first or second molars, thus eliminating their presence from the assemblage. The pathological lesions noted in the Binchester 2011/12 fort and vicus assemblages show the highest degree of similarity with the comparative military sites listed, with a greater overall representation of the distinctive lesions noted.

Wroxeter, Segontium and Carlisle all contain pathological lesions on cattle bones that suggest a continuity of practice and a maintenance of the regional hegemony of large sites in the sub-Roman Period. The presence of splayed metapodials at Wroxeter shows a continued use of cattle for traction purposes. Segontium and Carlisle, significantly, contain evidence suggesting that the relationship between these forts and their respective hinterlands remained largely similar to Late Roman times, with military sites able to requisition or receive cattle resources from similar, or the same, local sources as in the previous chronological period. Again, we see further evidence of continuity of practice and the maintenance of relationships between military sites and their hinterlands through the pathological evidence recovered from Wroxeter, Segontium, and Carlisle, suggesting, in turn, that similar processes are likely to have taken place at Binchester.

Although their occurrence is rare, the pathological lesions noted from the Binchester 2011/12 material and across the comparative sites provide key insights into the utilisation of cattle within Roman Britain. The three notable pathological lesions include indicators of traction, such as spavin and distal splaying of metapodials, osteoarthritic lesions, and congenitally missing third cusps on the mandibular M3. The occurrence of these lesions vary throughout comparative assemblages. However, the occurrence of spavin and splayed metapodials is most common at military sites, with the notable exception of Segontium. The presence of congenitally missing third cusps on mandibular M3s is of great interest. Their occurrence at urban and military sites, especially within the ostensibly more cosmopolitan Binchester 2011/12 vicus assemblage, may at first glance be surprising. However, their somewhat more mundane presence at small rural sites provides a key insight into local husbandry strategies within Roman Britain. These sites, raising the cattle that contain this congenital absence, are the main sources of local supply of cattle for military forces, and likely for commercial consumption as well, especially later in the Roman Period (Mattingly 2006, Collins 2012). Thus, it is not surprising that local cattle demonstrating these traits would consequently appear within military and urban assemblages. Assuming the local supply of these sites, and accepting the contention that the congenital absence of the third cusp of the mandibular M3 is indicative of inbreeding or a limited gene pool, this suggests that cattle herds across the majority of Roman Britain may have, at least to a certain degree, a limited gene pool. This is a wide-reaching conclusion to arrive at, but the evidence does suggest the widespread presence, if not prevalence, of this congenital trait, certainly warranting further investigation.

4.6. Mandibular Tooth Wear

The 1st-2nd C. kill off patterns for comparative sites can be viewed in Figure 4.6.2 The data from previous excavations at Binchester phase 3-5 presents a good amount of recovered elements. A majority of adult and elderly animals is noted from the assemblage, aged beyond the ideal age for meat production (Cussans and Bond 2010, 497 T. 132). This, paired with a lack neonate animals suggests the importation of older cattle to site for the purpose of butchery and consumption, possibly after their utilisation for traction work (Cussans and Bond 2010, 497 T. 132). Binchester 3-5 displays a high level of similarity with the Binchester 2011/12 assemblages, reinforcing the interpretations of the processes taking place at the site. The rural site of Haddon shows an elevated presence of younger individuals (Baxter 2003). As the assemblage is representative of excess or culled cattle from the nearby area, the presence of younger individuals reinforces the indication that the cattle were raised in the vicinity (Baxter 2003). Furthermore, the presence of younger animals may indicate a preference for younger beef (Baxter 2003). Haddon shows patterns of utilisation and slaughter quite different from those seen in the Binchester 2011/12 assemblages, indicating that different processes likely took place. The presence of cattle utilised for traction is also noted, likely resulting in an older age at which cattle are consumed. The levels noted at Carlisle are interesting, with a large representation of elderly cattle, possibly representing animals utilised for traction work before being slaughtered and consumed on site. Segontium and Binchester 3-5 all indicate that cattle were transported on site and consumed, rather than being raised nearby. Furthermore, the presence of animals aged beyond the ideal age of slaughter for meat production suggests the utilisation of cattle for traction work prior to consumption

The 2nd-3rd C. shows only minor differences from the 1st-2nd C. suggesting a continuation of previous husbandry practices (Figure 4.6.3). The military site of Segontium shows little deviation from the trends noted during the previous century. A slight change is notable in the absence of neonatal mandibles from the assemblage, however few immature mandibles are still present (Noddle 1993, 98). Some subadult are present within the assemblage but the commanding majority of elements are found in the adult category (Noddle 1993, 98). With the absence of an elderly category, it is likely that some of the 'adult' range are of a more advanced age. The lack of younger mandibles suggests that adult cattle were brought to the site as military rations, rather than raised nearby (Noddle 1993, 98). More mandibles were available from the site of Hacheston during this chronological period, showing a majority of subadult cattle, followed by elderly and adults (King 2004, 193). These concentrations are of interest, suggesting a heightened presence of idealised meat production (King 2004, 193). Interpreted as representing excess cattle slaughtered for food and secondary products in the town periphery (King 2004, 193), the age at death of recovered cattle reinforces this interpretation, with the majority of cattle recovered fitting the idealised age of slaughter for meat production, suggesting a large commercial presence. Binchester continues to see similar concentrations of cattle ages as other military sites, with the importation of cattle past the ideal age of slaughter, indicating their utilisation for traction prior to consumption.

The 3rd-4th C. shows a higher degree of variation from previous centuries, but still depicts similar age concentrations to those noted at Binchester (Figure 4.6.4). The farmstead of Haddon still displays differing concentrations of cattle age at death, indicating differing practices (Baxter 2003, 122). The elevated presence of immature animals suggests that cattle were raised in the vicinity (Baxter 2003, 122). Interestingly, no subadult mandibles were recovered, with a large representation of elderly and adult animals. Although this may be the result of a sampling bias, it is possible that animals of an ideal age of slaughter were transported elsewhere in this time period, with the depositions at Haddon representing the natural mortality and culling of a resident cattle population (Baxter 2003, 122). Carlisle continues to display a high proportion of elderly mandibles. However, this assemblage differs from previous centuries, displaying a lower level of adult mandibles, with an increase in immature and subadult cattle (Zant 2009, 909). This suggests two peaks of cattle mortality within the population, one at the ideal age of slaughter and the other at a more advanced age. This could indicate the utilisation of some cattle for traction prior to slaughter and consumption at Carlisle, while others are utilised only for meat, possibly indicating the presence of elites (Zant 2009, 909). The urban site of Lincoln shows a majority of subadult cattle, with moderate amounts of adult cattle and only small amounts of neonatal, immature and juvenile cattle represented (Dobney et al. 1996, 30). No elderly cattle were noted dating to this time period. The concentrations from this assemblage deviate from other comparative sites, providing an interesting view of urban cattle utilisation (Dobney et al. 1996, 30). It is possible that this time period saw an increased demand for cattle closer to the ideal age of slaughter, providing higher quality meat for occupants of the urban site. The presence of young cattle may be indicative of the presence of young beef production on site (Dobney et al. 1996, 30). Similarly, the town periphery of Hacheston shows a majority representation of subadult and adult cattle, with lower concentrations of immature and elderly mandibles (King 2004, 193). This too could represent a focus on meat production at the ideal age of slaughter, similar to the concentrations viewed at Lincoln. Two assemblages from Segontium date to this chronological period, displaying similar representation of age stages. While some young and neonatal mandibles are recovered, a majority of subadult and adult cattle are present in the assemblages (Noddle 1993, 98). While this appears to be in accordance with trends noted at Lincoln and Hacheston, the lack of an elderly category for the Segontium assemblages obfuscates the potential similarities between sites, as 'adult' cattle may consist of both adult and elderly aged individuals. The site of Wroxeter provides a moderate assemblage dating to this time period. An exceedingly small representation of neonatal mandibles is noted, with small amounts of immature cattle as well (Hammon 2011, 288, Figure 5). The majority of recovered elements are aged to adult and elderly, with some subadult presence noted (Hammon 2011, 288, Figure 5). This pattern closely matches with the Binchester 201/12 assemblages, suggesting that cattle were imported to the site for the purpose of consumption and that the cattle, at least in some cases, were utilised for traction work prior to their consumption, resulting in a more advanced age of slaughter. The 3rd-4th C. shows an increased representation of subadult and adult majorities of cattle at comparative sites, indicative of an increased demand for cattle closer to the ideal age of slaughter, resulting in higher quality meat. These trends are noted at Hacheston, Lincoln, and possibly Segontium as well, although the absence of an elderly category obfuscates this interpretation. Sites such as Wroxeter still show evidence of cattle majorities being slaughtered at a more advanced age. The Binchester 2011/12 fort and vicus assemblages do not reflect this elevated subadult presence, showing instead a majority of adult and elderly cattle, suggesting their utilisation as beasts of burden until their slaughter and consumption at a more advanced age.

The 4th-5th C. comparative material display a higher degree of similarity with the Binchester 2011/12 fort and vicus than is noted in previous chronological periods, although some variation between sites persists (Figure 4.6.5). The urban site of Lincoln continues to present a majority of subadult cattle as previously noted (Dobney et al. 1996, 30). This indicates a continued focus on meat production, with cattle being imported to the site and slaughtered at the ideal age of slaughter for meat, producing high quality beef (Dobney et al. 1996, 30). It is likely that the animals represented by the Lincoln assemblage would have been too young to be utilised for any other purposes prior to slaughter, making their use for traction unlikely. The site of Segontium shows an elevated representation of subadult cattle over adult cattle (Noddle 1993, 98). When we consider that a portion of the adult category may in fact represent elderly category, the prominence of subadult cattle is increased. This indicates the importation of cattle at the ideal age of slaughter, suggesting an increased demand for or provisioning of higher quality meat to the fort, with fewer animals seeing use as beasts of burden before consumption (Noddle 1993, 98). The excavation of the commandant's house dating to this time period is shown in Binchester phase 9. Similar to the Binchester 2011/12 data, no young animals are noted reinforcing the interpretation of the assemblage as representative of imported cattle, likely military rations (Cussans and Bond 2010, 511, T. 146). However, an increased representation of subadult cattle is noted at Binchester 9, making up the majority of recovered elements (Cussans and Bond 2010, 511, T. 146). This could indicate a collection bias, as elements belonging to older individuals often see poorer preservation in archaeological contexts. Alternatively, it could indicate a heightened demand for and consumption of higher quality meat in and around the commandant's house, with other occupants of the barrack block and vicus subsisting on older cattle. The Binchester 9 assemblage reinforces the interpretation of the cattle utilisation strategies employed on site, while suggesting a possible increased demand for higher quality meat at the commandant's house (Cussans and Bond 2010). The site of Wroxeter offers a large assemblage dating to this period, with 283 elements analysed and quantified (Hammon 2011, 288, Figure 5). The overall concentrations and survival line matches that of the Binchester 2011/12 assemblages very closely, with no younger cattle and only low amounts of subadult mandibles noted. The Wroxeter assemblage dating to the 4th-5th C. is composed mainly of adult mandibles, with a moderate representation of elderly elements as well (Hammon 2011, 288, Figure 5). This suggests the importation of cattle advanced beyond the ideal age of slaughter, likely utilised for traction before their slaughter and consumption. Overall the Binchester 2011/12 assemblages display a great deal of similarity with comparative sites dating to the 4th-5th C. Urban Lincoln shows a much higher utilisation of subadult cattle for meat, with the animals being butchered and consumed at the ideal age of slaughter, producing higher quality meat for the occupants of the site (Dobney et al. 1996, 30). Segontium shows an increased demand for higher quality meat with the slaughter of subadult cattle (Noddle 1993, 98). The Binchester 2011/12 data does not show this high utilisation of subadult cattle, instead matching most closely with Binchester 9 and Wroxeter, which feature a majority of adult and elderly cattle, likely utilised for traction prior to consumption, resulting in a more advanced age at death.

The age at death information shows continued practices into the sub-Roman, with urban centres and military sites showing evidence for some commercial activity in the presence of younger cattle, providing higher quality beef, with a majority of animals seen to represent older animals likely procured or requisitioned as rations for the occupants of military sites (Figure 4.6.6). With the lack of an 'elderly' category for the Segontium animals. Wroxeter and Segontium show a distinct continuation of age at death preferences for cattle resources, reflecting a potential maintenance of Roman identity into sub-Roman times. Overall, the concentrations of age at death found in the Binchester 2011/12 fort and vicus most closely match the comparative data from the 4th-5th C. In particular, the site of Wroxeter demonstrates a great degree of similarity with the Binchester assemblages. Across non-rural comparative sites, the absence of younger cattle indicates that cattle were imported into the site rather than raised in the vicinity, as is noted by the presence of younger animals at rural sites such as Haddon. While the ideal age of slaughter for cattle is around 3 - 3 ½ years of age (Silver 1969), on the cusp of the subadult and adult age categories, Binchester displays a majority of elements aged older than this. Thus, it does not show the increased demand for high quality meat seen at Lincoln and Segontium in the 3rd-4th C. Considering the pathological evidence previously discussed, it is likely that the cattle were exploited as beasts of burden for some time until their utility decreased or they were replaced by younger animals. Only then were they butchered and consumed. This practice is evident at both Binchester 2011/12 and Wroxeter, as well as being present at Carlisle, where a large representation of cattle of an age advanced beyond the ideal age of slaughter is present. Furthermore, this trend is also reinforced by the previous excavations at Binchester, with Binchester 9 showing a majority of adult aged mandibles as well as showing a moderate presence of elderly elements, drawing further parallels between this phase and the 2011/12 material. Thus, through a direct comparison between sites across a number of chronological periods, it is evident that the cattle at Binchester represent imported food stock, likely military rations, utilised for traction prior to slaughter, fitting best with the trends noted in the 4th-5th C.

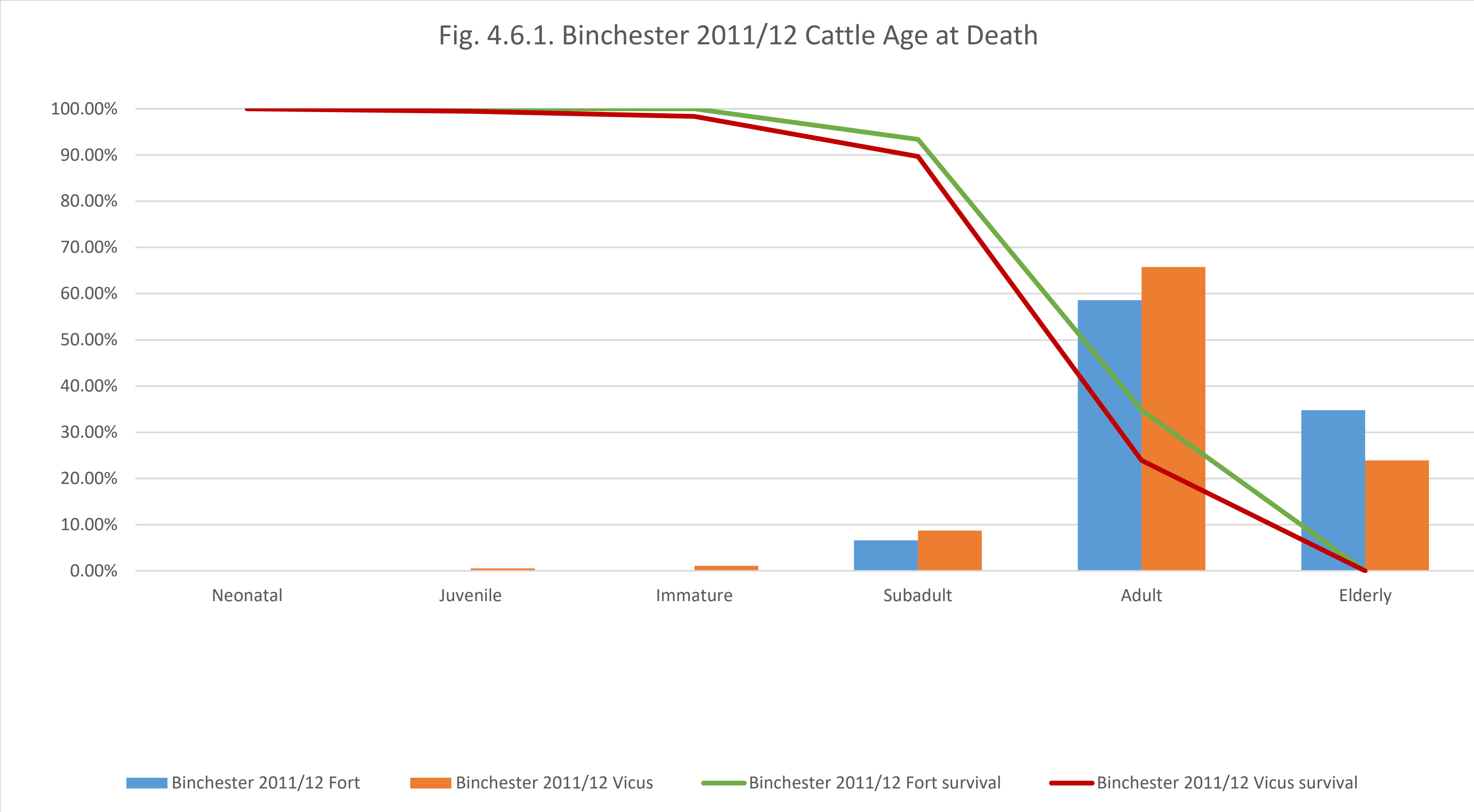

Fig. 4.6.1. Binchester 2011/12 Cattle Age at Death. This figure shows the mortality profile and percent survival of Cattle mandibles recovered from the Binchester 2011/12 fort and vicus. (Fort n= 181, Vicus n= 184)

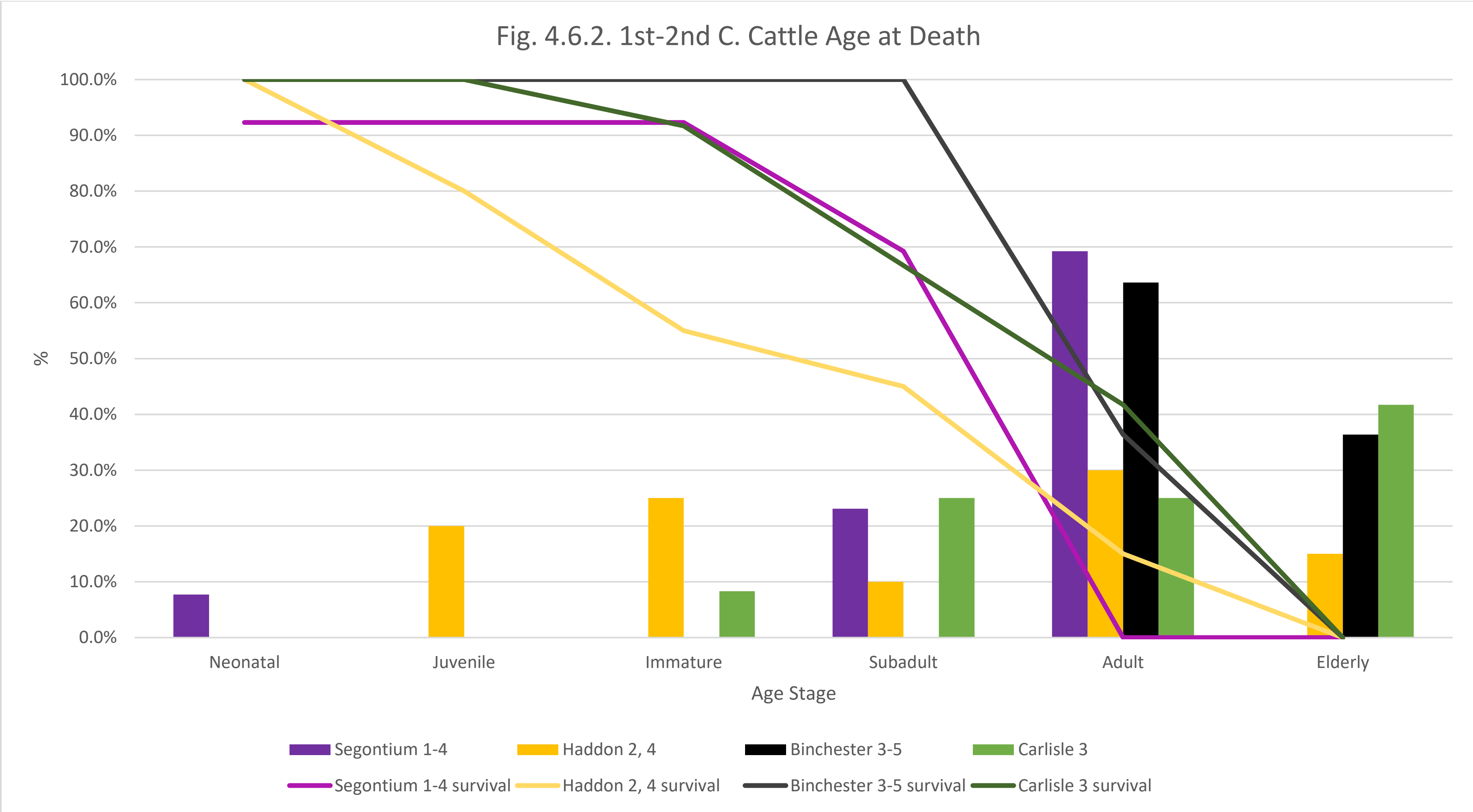

Fig. 4.6.2. 1st-2nd C. Cattle Age at Death. This figure shows the mortality profile and percent survival of Cattle mandibles recovered from comparative sites dating within the 1st-2nd C. AD. (Dobney et al. 1996, 85 Figure 31, 32, 142, Table 30; Noddle 1993, 105 Table 6.3; Baxter 2003, 122; Cussans and Bond 2010, 497 T. 132). Sample size: Segontium 1-4: 13; Haddon 2, 4: 20; Binchester 3-5: 33; Carlisle 3: 12.

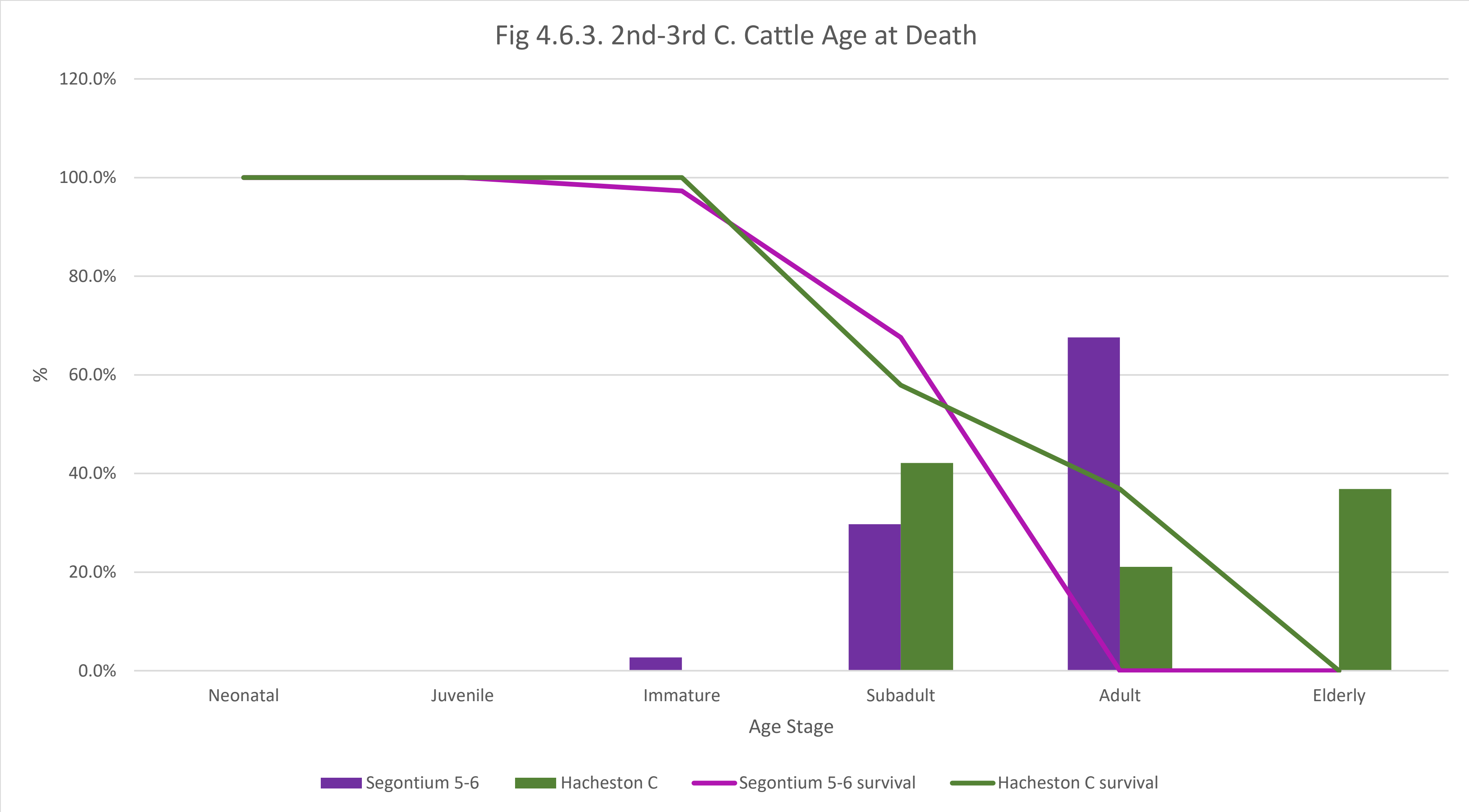

Fig. 4.6.3 2nd-3rd C. Cattle Age at Death. This figure shows the mortality profile and percent survival of Cattle mandibles recovered from comparative sites dating within the 2nd-3rd C. AD. (Noddle 1993, 105 Table 6.3; King 2004, 193 Table 40). Sample size: Segontium 5-6: 37; Hacheston C: 19.

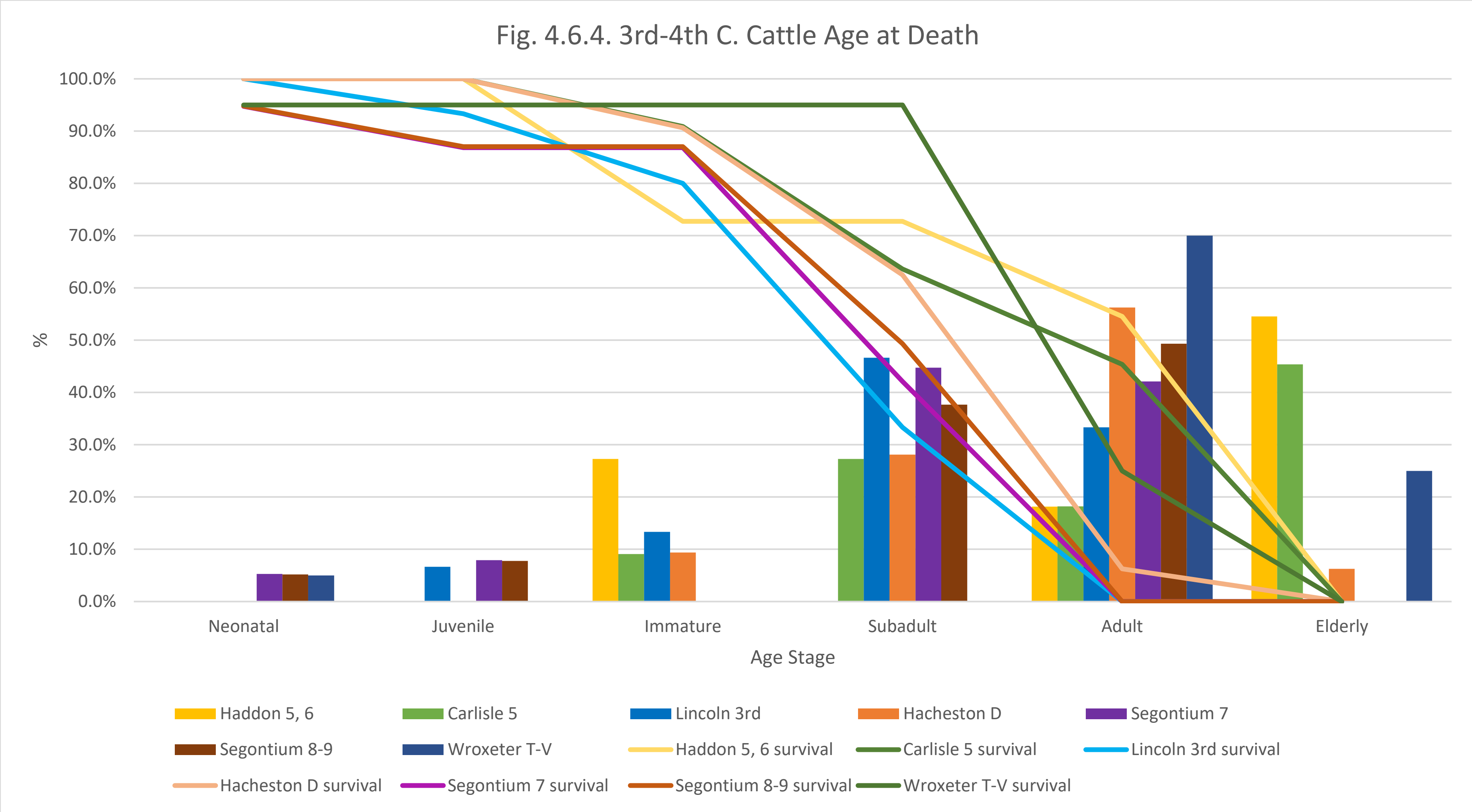

Fig. 4.6.4. 3rd-4th C. Cattle Age at Death. This figure shows the mortality profile and percent survival of Cattle mandibles recovered from comparative sites dating within the 3rd-4th C. AD. (Baxter 2003, 122; Zant 2009, 909Dobney et al. 1996, 85 Figure 31, 32, 142, Table 30; King 2004, 193 Table 40; Noddle 1993, 105 Table 6.3; Hammon 2011, 288, Figure 5). Sample size: Haddon 5, 6: 11; Carlisle 5: 11; Lincoln 3rd: 15; Hacheston D: 32; Segontium 7: 76; Segontium 8-9: 76; Wroxeter T-V: 22.

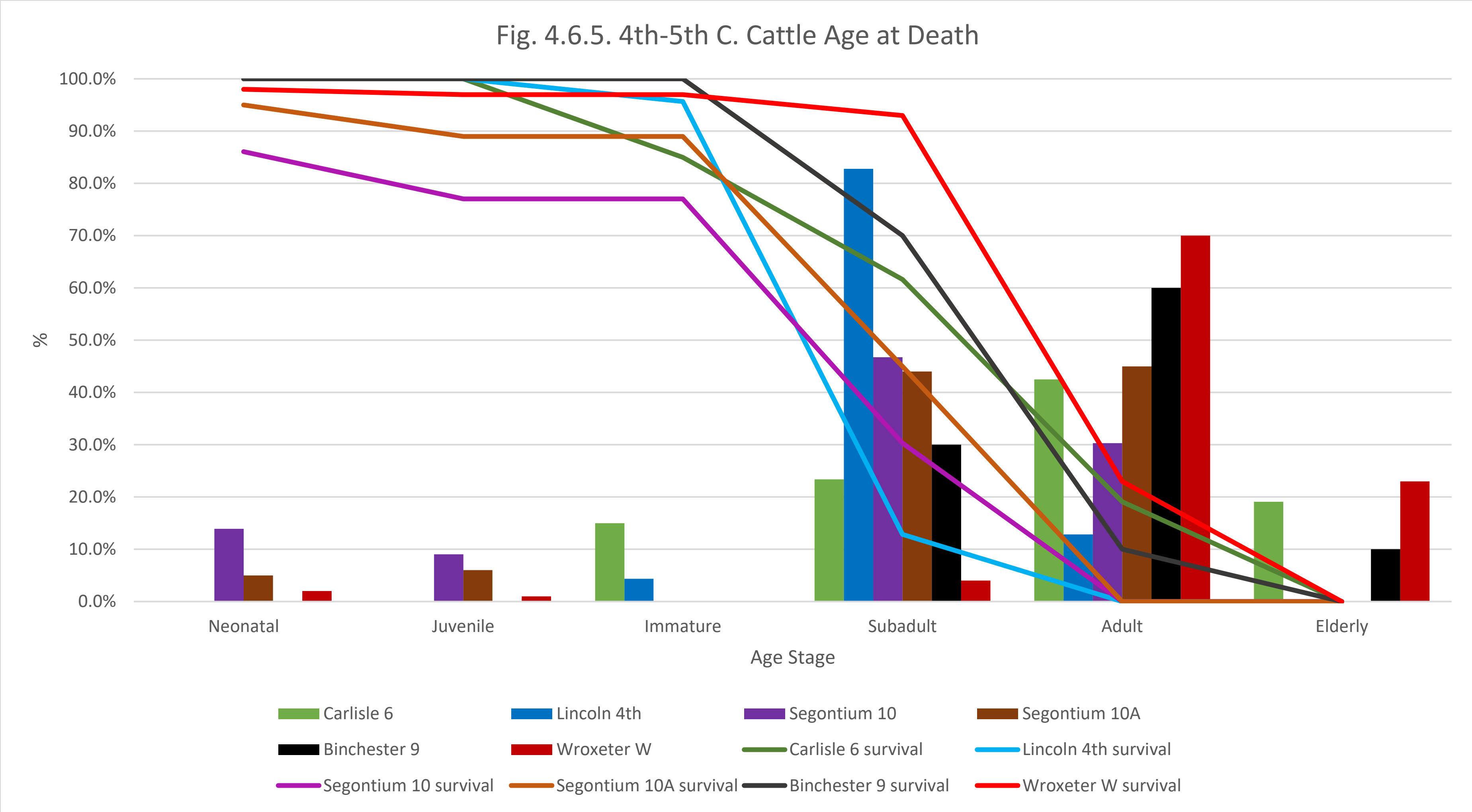

Fig. 4.6.5. 4th-5th C. Cattle Age at Death. This figure shows the mortality profile and percent survival of Cattle mandibles recovered from comparative sites dating within the 4th-5th C. AD. (Zant 2009, 909 Dobney et al. 1996, 85 Figure 31, 32, 142, Table 30; Noddle 1993, 105 Table 6.3; Cussans and Bond 2010, 511, T. 146; Hammon 2011, 288, Figure 5). Sample size: Carlisle 6: 47; Lincoln 4th: 459; Segontium 10: 122; Segontium 10A: 100; Binchester 9: 10; Wroxeter W: 283.

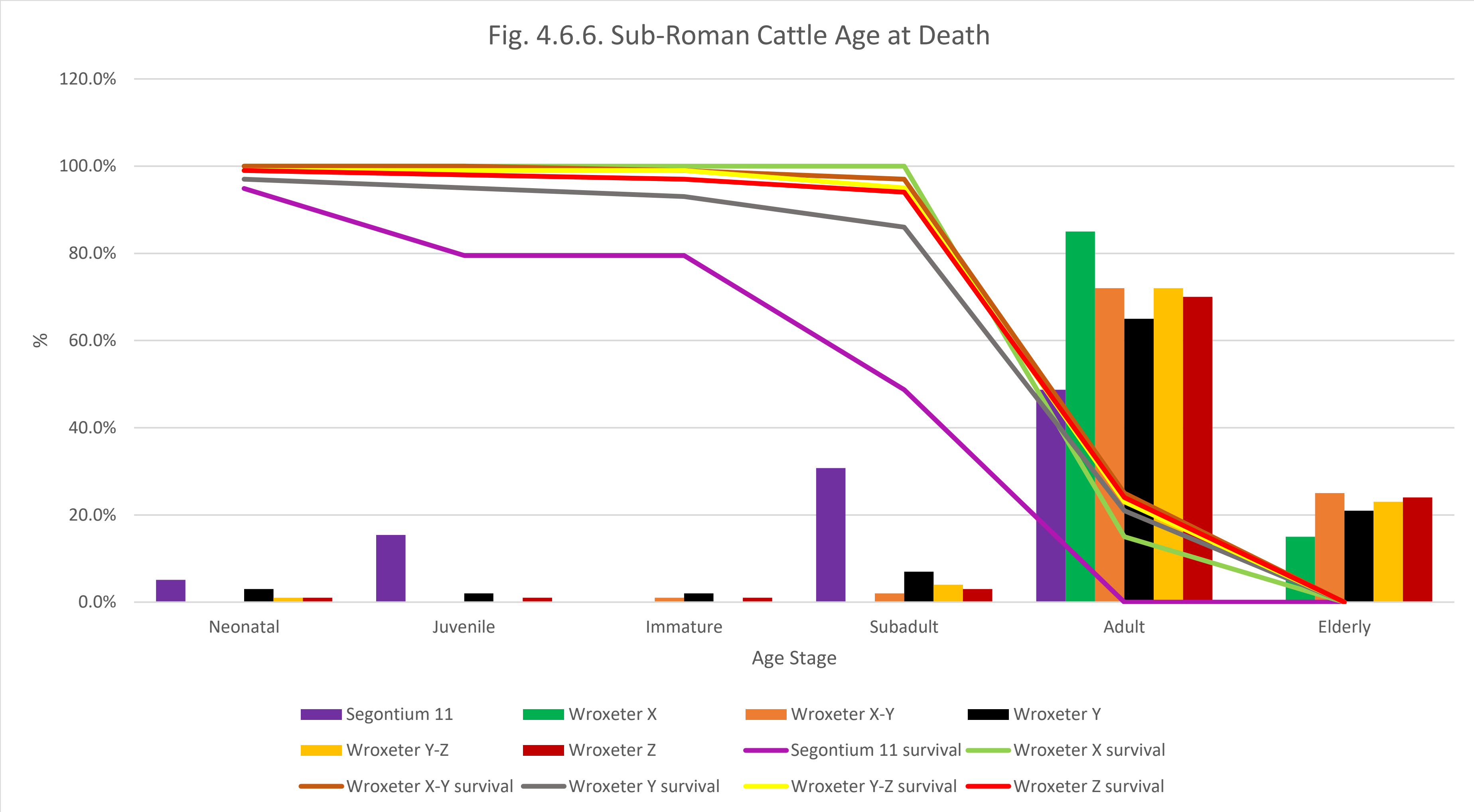

Fig. 4.6.6. Sub-Roman Cattle Age at Death. This figure shows the mortality profile and percent survival of Cattle mandibles recovered from comparative sites dating to the sub-Roman Period. (Noddle 1993, 105 Table 6.3; Hammon 2011, 288, Figure 5). Sample size: Segontium 11: 39; Wroxeter X: 9; X-Y: 148; Y: 172; Y-Z: 171; Z: 403.

4.7. Beasts of all Shapes and Sizes: Metric Analysis

4.7.1. Withers Height

In order to facilitate a clear comparison across chronological periods as well as between sites, the comparative data has been separated into those dating within the 1st-4th C. and those in the 4th-5th C. Additionally, some sites, rather than providing the raw data, instead give a range of withers height calculations, along with the mean measurement. For these sites, the range is plotted with a larger point marking the mean measurements. Further, the previous excavations at Binchester only provide a mean measurement, which is marked on the graphs. The comparison of the height ranges of the cattle populations from the 2011/12 assemblages at Binchester with other comparative data will help us to place the assemblages within a more definite time period, as well as see any similarities with particular site types.

Limited data is available from a number of comparative sites dating to the 1st-4th C., however, the presentation of these sites together allows us to view the general range of sizes present at each site during this time period. For ease of interpretation, rural and smaller settlement sites are placed in Figure 4.7.2, with military and urban sites in Figure 4.7.3. The previous excavation at Binchester only provides a mean of the compiled measurements for this time period. Phase 3-5 shows a mean measurement of 1100mm, an average measurement on the lower side, likely indicating the elevated presence of female and smaller cattle within the assemblage (Cussans and Bond 2010). This fits within the female range outlined in the consideration of the Binchester 2011/12 material. Interestingly, the mean withers height of Binchester 3-5 is significantly lower than other ranges given at Wavendon Gate and Lincoln. This suggest an overall presence of smaller cattle, or the presence of a larger contingent of female individuals. More than the average withers height being elevated beyond Binchester 3-5, the entire ranges are elevated beyond the mean withers height at the site, suggesting a much higher presence of taller castrates at these other comparative sites. However, due to the small number of elements recovered from Binchester 3-5, it is entirely possible that this discrepancy is due to a sampling bias rather than being indicative of differences is size or sexual dimorphism. Wavendon Gate is interpreted as excess cattle slaughtered for food, making the composition of the assemblage likely to contain mainly castrates, as females would maintain their utility as breeding stock for many years (Dobney and Jaques 1995, 218-219). However, it is important to note that the sample size from each chronological period at Wavendon Gate is limited, possibly biasing any trends noted (Dobney and Jaques 1995, 218-219). The range of animal size at Wavendon Gate covers the same range noted at Great Holts Farm, introducing the possibility of directly imported continental breeds to this settlement. The military site of Segontium shows withers heights somewhat lower than that noted from the Binchester 2011/12 material, with phases 5-6 and 7 consisting mainly of shorter individuals, likely female (Noddle 1993, 106-109 Table 6.4). Phase 8-9, however, shows a few taller elements, likely belonging to castrates, present within the assemblage (Noddle 1993, 106-109 Table 6.4). It is likely that castrates would be present at the earlier phases of the site, their absence likely being the result of a small sample size. Very limited data is available from the town periphery of Hacheston, showing only shorter individuals, likely representing females (King 2004, 193). Due to the small sample size, further comparison is neither warranted nor advisable. The rural site of Haddon shows an increase in size over time, with phase 5-6 cattle being distinctly taller than those noted in phase 2-4, possibly representing an elevated presence of taller, likely castrated, cattle (Baxter 2003, 122). Great Holts Farm is of much interest, displaying exceedingly taller individuals, with all recovered metapodials showing a higher withers height calculation than any elements measured from the Binchester 2011/12 assemblages (Albarella 2003). Representing imported continental cattle, the withers height estimation from Great Holts

Farm shows an elevated size range from that noted at Binchester. Although it is possible that the recovered metapodials are representative of imported breeding stock (cf. Albarella 2003), it is also entirely possible that the exceptionally tall individuals are larger continental castrates, imported for heavy-duty traction wok (Murphy 2000). Lincoln displays a lower range of withers heights that exceeds the entirety of the supposed female range outlined by the Binchester 2011/12 assemblages (Dobney et al. 1996, 100, Figure 49). This suggests that Lincoln may have seen the importation of larger continental breeds of cattle, similar to Great Holts Farm, or that the cattle imported to the urban site were the product of improved breeding programs introduced during the Roman Period, resulting in taller animals (Dobney et al. 1996, 100, Figure 49). Alternatively, it is possible that the Lincoln assemblage is representative of mainly castrated individuals, which would account for the taller range of animals present. The urban site of Lincoln features a range elevated far beyond that noted at Binchester, while the military sites of Segontium as well as the previous excavation at Binchester phase 3-5 show a lower overall representation of withers height estimations. The rural sites of Haddon and Wavendon Gate show height estimations falling within the range outlined by the 2011/12 material, but with a higher incidence of female sized cattle at Haddon, and an elevated representation of castrates at Wavendon Gate due to a small sample size. On the whole, the Binchester 2011/12 fort and vicus withers height estimations do not closely match the size ranges outlined by the comparative data dating to the 1st-4th C.

While fewer sites present data within the 4th-5th C., larger assemblages from each site are noted (Figure 4.7.4). Segontium phase 10 and 10A fall within this chronological period. The military site shows mainly likely females with fewer taller individuals, likely castrated males, in phase 10 (Noddle 1993, 106-109 Table 6.4). Phase 10A, showing a larger dataset, displays a greater portion of taller withers height estimates, possibly indicating an increased presence of castrates in the later 4th C (Noddle 1993, 106-109 Table 6.4). The urban site of Lincoln in the 4th C. shows a shift in the size range noted in the 3rd C. displaying a range of withers height estimates with greater similarity to the Binchester 2011/12 range (Dobney et al. 1996, 100, Figure 49). Interestingly, while a wide range of height estimates are shown, the mean withers height estimate for Lincoln in the 4th C. is within the likely female range noted in the Binchester 2011/12 assemblages (Dobney et al. 1996, 100, Figure 49). This mean withers height is mirrored by the previous excavations at Binchester phase 9, indicating a similar proportion of likely females. Additionally, the site of Wroxeter offers a moderate suite of measurements dating to this time period, occupying a size range similar to those noted at other sites. However, the presence of likely castrates is markedly low, showing a broad similarity with the Binchester 2011/12 vicus (Hammon 2005, 573-585 Appendix 19, 595-608 Appendix 23). The Binchester 2011/12 fort and vicus withers height estimates fit best with the range of estimates present in the 4th-5th C. showing a lower degree of variation as seen in the 1st-4th C.

The Binchester 2011/12 withers height estimates from the fort and vicus show a wide range of withers height present on site, with the fort seeing a distinct increase in the presence of castrate sized height estimates. This trend is most similar to the comparative material dating to the 4th-5th C. In particular, the military site of Segontium displays similar proportion of female and castrate sized estimates, particularly in phase 10 A, dating to the later 4th century. At the urban sites of Lincoln and Wroxeter, the presence of castrates is noted, although few in number, showing similarity with the Binchester vicus. The mean withers height estimate at Lincoln matches the mean estimate from the previous excavations at Binchester in phase 9. We note something of a divide between different site types and within different regions in the analysis of the withers height. Military sites show the presence of generally smaller cattle, seen to fall within the range of the native 'celtic short horn' (Stokes 2000). Unsurprisingly, rural and small town sites, presumably similar to the areas from which military sites are receiving their cattle resources, also display smaller animals. The range of withers heights recorded from Lincoln in the 3rd and 4th century broadly corresponds to the ranges recorded from these other sites, with the average size mirroring that of Binchester phase 9. This suggests that both military and urban sites, including Binchester, utilised local sources of supply for both likely female and castrated animals.

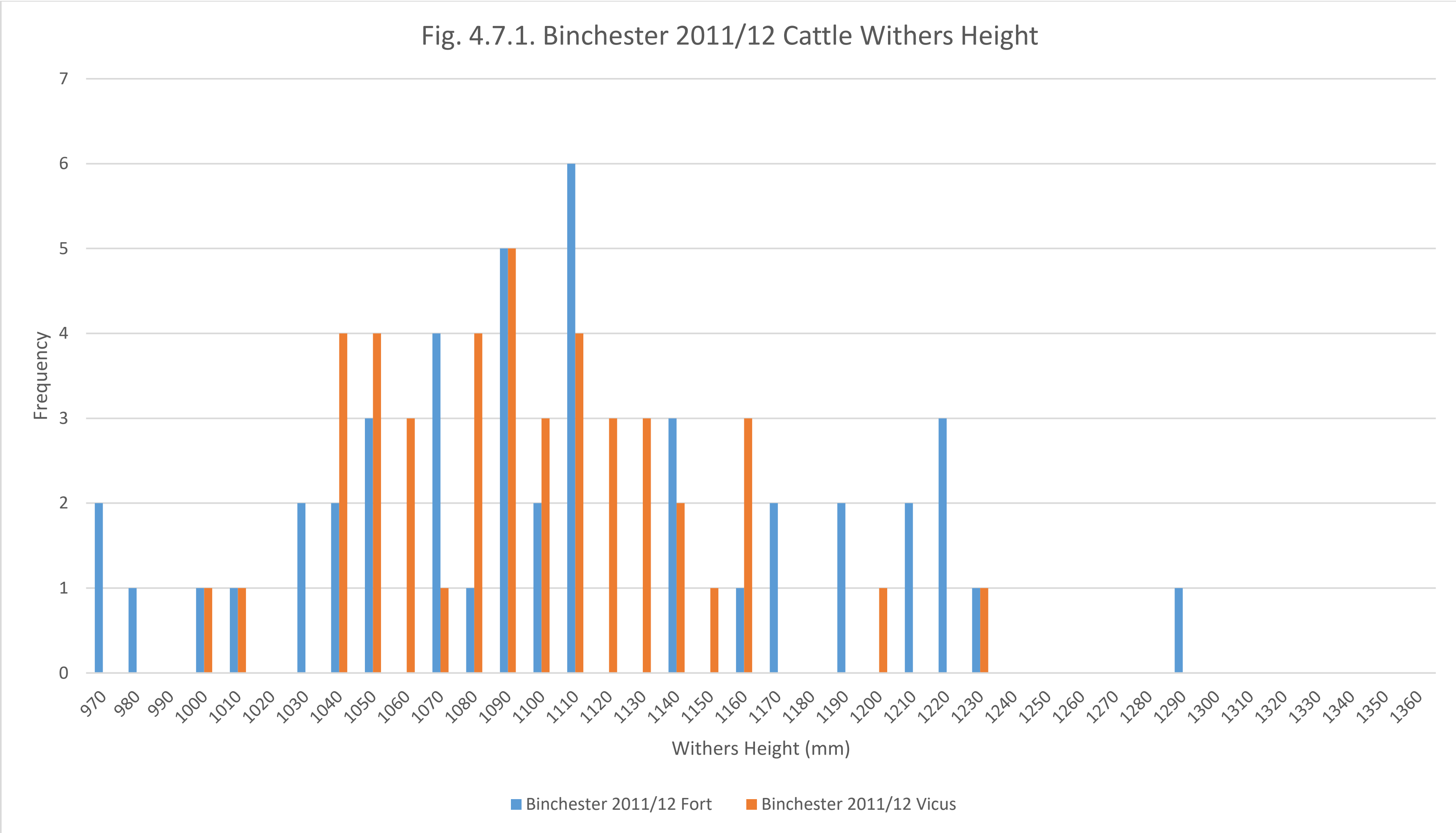

Fig. 4.7.1. Binchester 2011/12 Cattle Withers Height. This figure shows the Withers Height estimations from the Binchester 2011/12 fort and vicus.

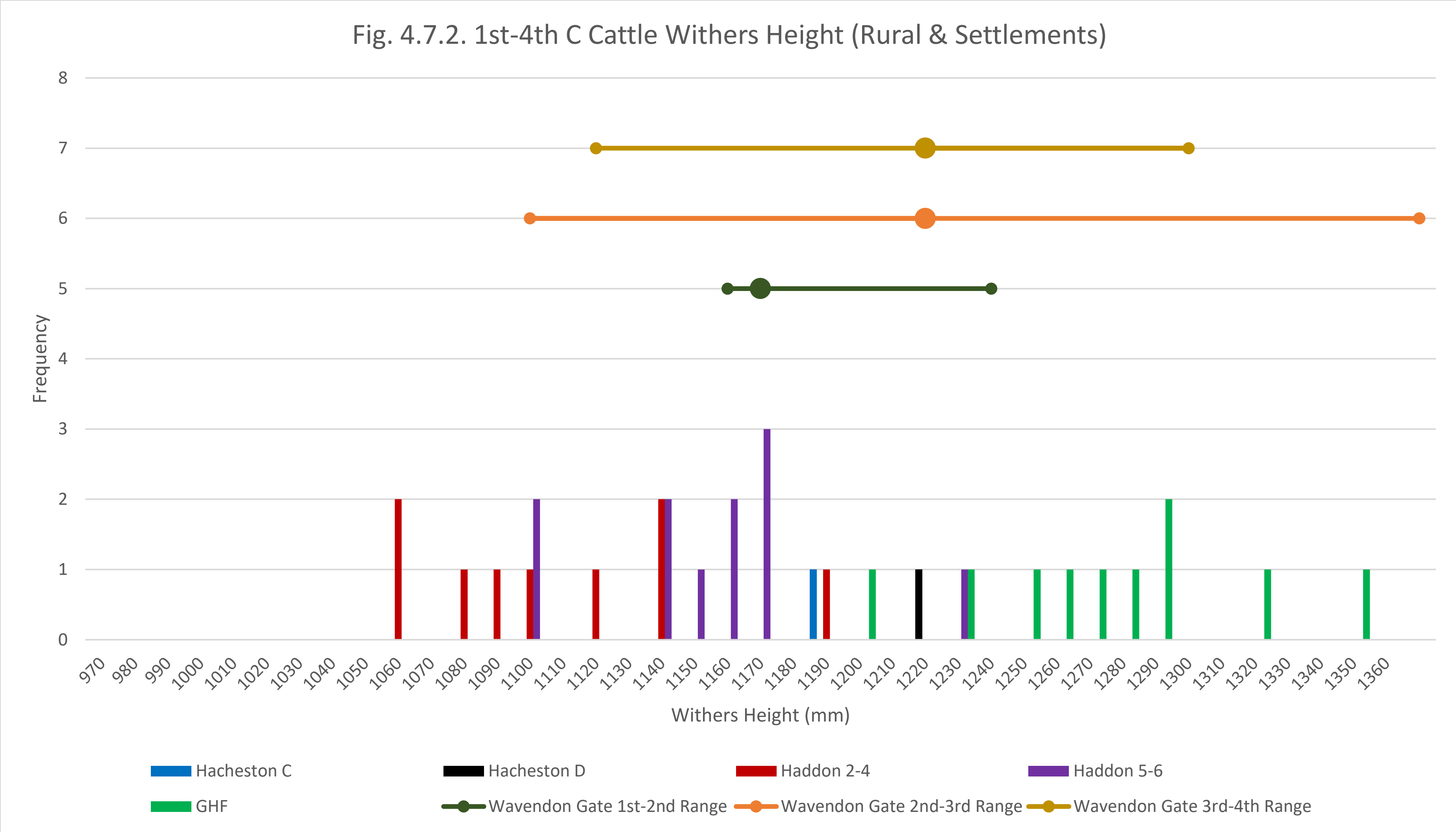

Fig. 4.7.2. 1st-4th C. Cattle Withers Height. This figure shows the Withers Height estimations from rural and settlement-type comparative sites dating to within the 1st-4th C. AD. (King 2004, 194 Table 42; Baxter 2003, 130 Table 6.14; Albarella 2003, 196-198; Dobney and Jaques 1995, 218-219)

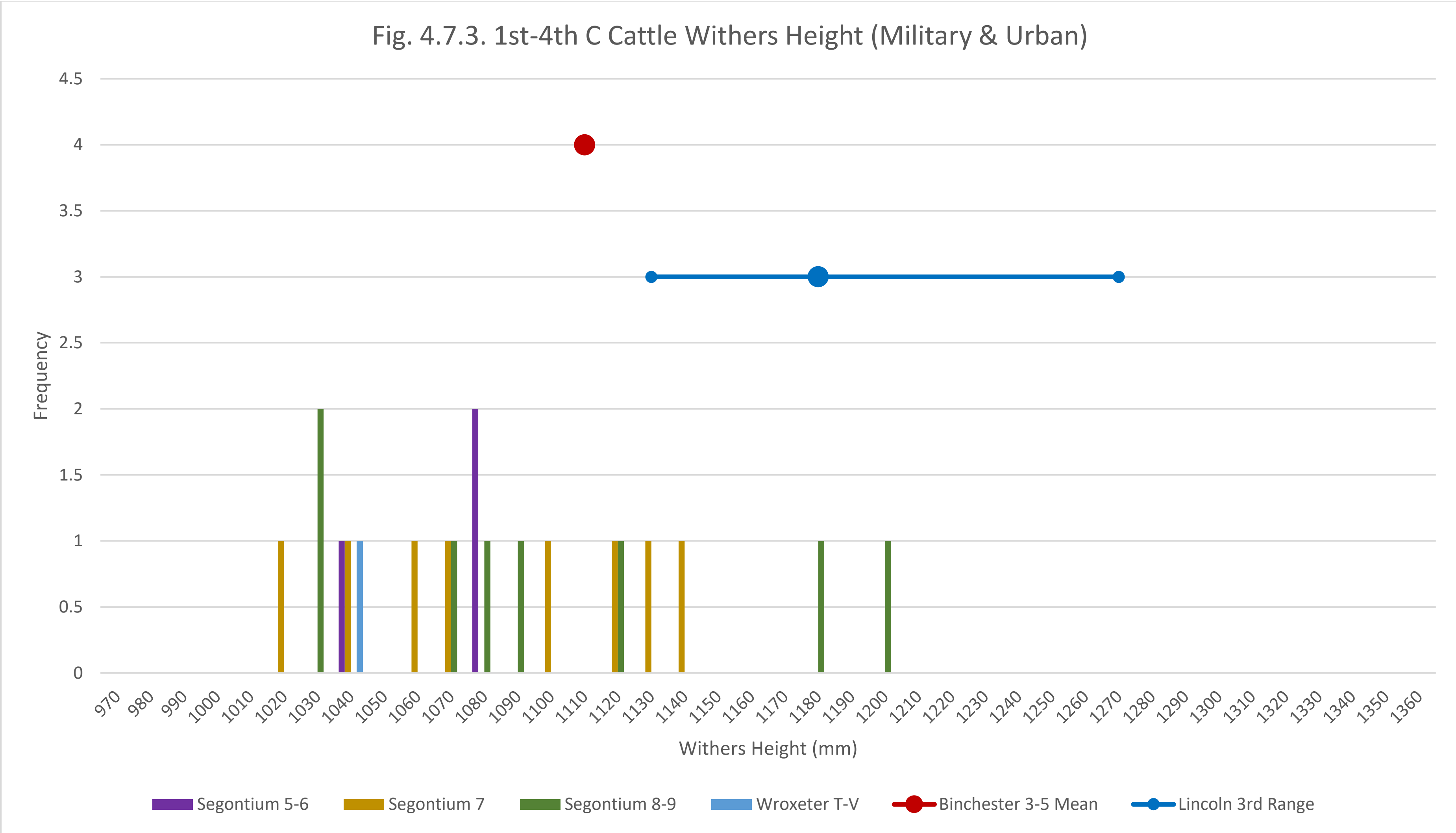

Fig. 4.7.3. 1st-4th C. Cattle Withers Height. This figure shows the Withers Height estimations from military and urban-type comparative sites dating to within the 1st-4th C. AD. (Noddle 1993, 106-109 Table 6.4; Cussans and Bond 2010, Dobney et al. 1996, 156-165, Appendix 1, Hammon 2005, 573-585 Appendix 19, 595-608 Appendix 23)

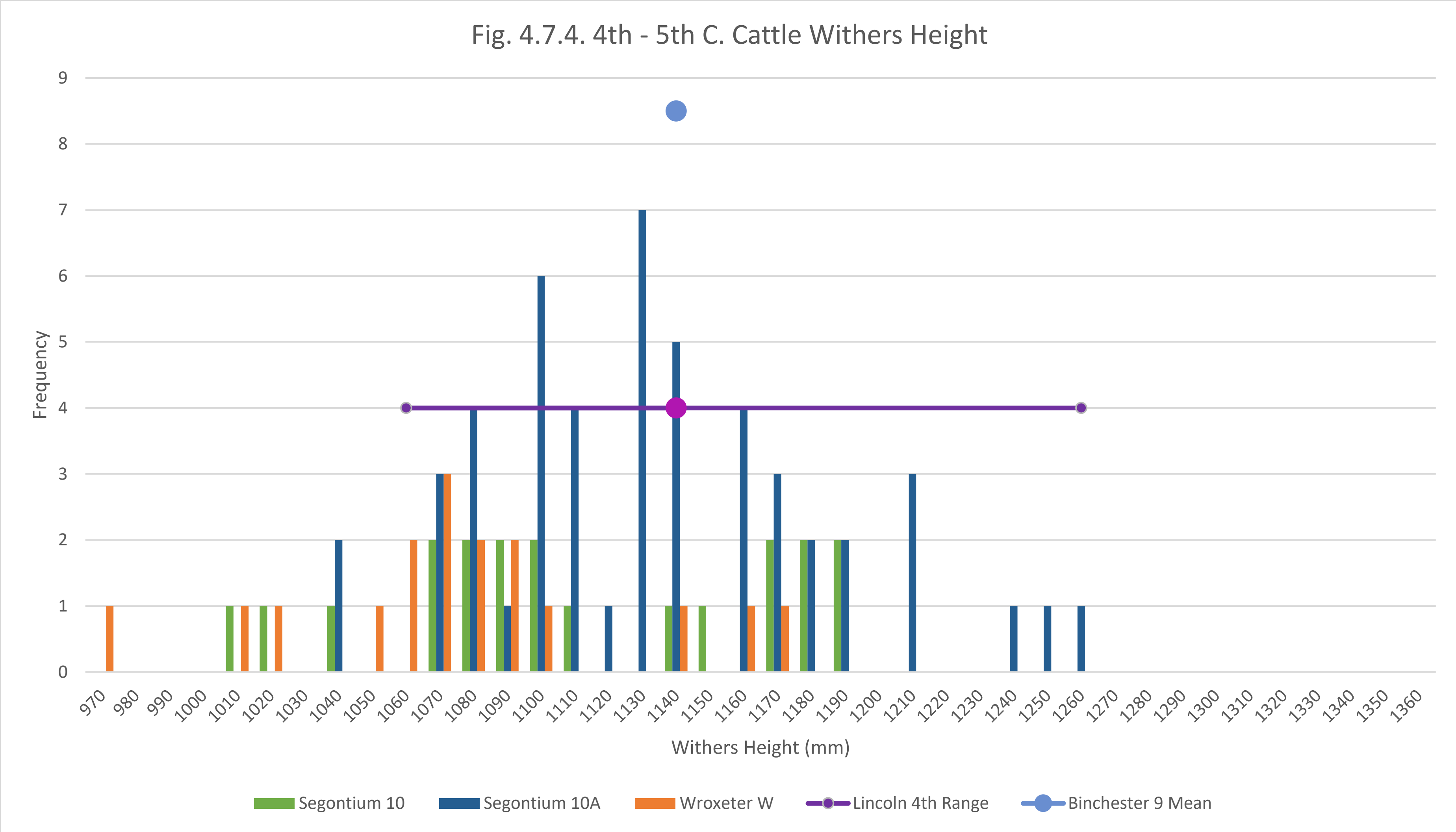

Fig. 4.7.4. 4th-5th C. Cattle Withers Height. This figure shows the Withers Height estimations from comparative sites dating to within the 4th-5th C. AD. (Noddle 1993, 106-109 Table 6.4; Dobney et al. 1996, 156-165, Appendix 1, , Cussans and Bond 2010, 489, Hammon 2005, 573-585 Appendix 19, 595-608 Appendix 23)

4.7.2. Humeri

Distal humeri are a valuable indicator of the size and robusticity of cattle, making a strong suggestion as to the proportion of the sexes within the herd. Furthermore the measureable portion of humeri have a very high rate of survival in archaeological contexts. The humeri are examined in two fashions: First, the distal breadths of the trochlea (BT) is measured, providing a general indicator for size and sexual dimorphism. In order to facilitate a comparison between comparative sites and Binchester, these measurements are separated by chronological period. Second, in order to include robusticity in the analysis, BT will be plotted against the maximum height of the medial trochlea (HT), separating cattle elements by size and robusticity. This will function to further separate out female and male/castrate sized elements, in addition to elucidating any differences between sites.

4.7.2.1. Trochlear Breadth (BT)

The Binchester 2011/12 fort and vicus trochlear breadth measurements can be seen in Figure 4.7.5. Both assemblages display a similar range of measurements, with the fort reaching slightly larger breadths overall. Two concentration ranges are evident, a large concentration of smaller measurements ranging from 62-70 and a smaller concentration of large measurements ranging from 72-80. The smaller range is interpreted as likely females, with the larger concentration likely representing castrated males. While both assemblages feature a large number of likely females, distinctly more castrate and male sized elements are present in the fort assemblage. This is a key difference between the fort and the vicus, suggesting a possible preferential provisioning of larger castrates and males as military rations to the fort, with the vicus subsisting mainly on smaller cattle, possibly from a different source. This second piece of metric evidence reinforces the interpretation of the Binchester assemblages as evidence of a system of preferential provisioning in favour of the occupants of the fort.

The sites of Haddon and Wavendon Gate both present a limited suite of measurements dating from the Iron Age. All recorded Iron Age measurements fall within the range of the Binchester assemblages. Further, the measurements from both Haddon and Wavendon Gate fall within the likely female grouping, ranging from 60-70mm (Baxter 2003, 122; Dobney and Jaques 1995, 218-219). With such a limited array of data it is unclear if this is the result of different processes taking place or a sampling bias. The small sample size prevents further comparison with Binchester.

The 1st-2nd C. shows a similarly low output of metric data, again only from Haddon and Wavendon Gate. However, the measurements present show some separation into two different concentrations. Both Haddon and Wavendon Gate show measurements falling into the likely female range (60-70 mm), as well as a number of larger measurements falling into the castrate/male range (78-80 mm) (Baxter 2003, 122; Dobney and Jaques 1995, 218-219). These measurements fall well within the range outlined by the Binchester 2011/12 assemblages. The small sample size prevents further comparison with the Binchester 2011/12 material.

A limited suite of metric information from the 2nd-3rd C. is available from Lincoln, Segontium and Haddon. For the most part the recorded measurements fall within the range outlined by the Binchester 2011/12 assemblages. Haddon displays some increase in size over time, with a notable presence of larger elements (Baxter 2003, 122). Some separation is evident at Haddon, with measurements falling into both the likely female range as well as the castrate/male range. Segontium occupies the lower range of available measurements, firmly within the likely female range (Noddle 1993, 110 Table 6.4). Only one measurable element was recovered from Lincoln dating to the 2nd-3rd C., being of a likely female size (Dobney et al. 1996, 155, Appendix 1). A limited number of recovered elements prevents a further comparison with the Binchester material beyond noting that recovered elements fall within a similar range noted in the 2011/12 assemblages.

The 3rd-4th C. displays a greater amount of metric data (Figure 4.7.6). The overall trends present fit well with the range and concentrations noted in the Binchester 2011/12 assemblages. Segontium 7 and 8-9 show a majority of smaller animals than is noted at Binchester, with most measured elements falling within the likely female concentration, and only a few elements venturing into the likely castrate/male range (Noddle 1993, 110 Table 6.4). Wavendon Gate shows elements that fall into the likely female, castrate, and male ranges, indicating the likely presence of all sexes within the assemblage (Dobney and Jaques 1995, 218-219). Again, Lincoln shows only 1 measurement dating to this time period, falling within the likely castrate/male range (Dobney et al. 1996, 155, Appendix 1). Overall the 3rd-4th C. humeri measurements match more closely with the Binchester 2011/12 material, although this could simply be due to increased sample size. Segontium displays somewhat smaller cattle than are noted at Binchester

The 4th-5th C. shows a large amount of recovered measurable elements (Figure 4.7.7), particularly from Segontium and Lincoln. Segontium bears some similarity with the Binchester 2011/12 assemblages, with recorded measurements falling within the same range and with similar concentrations in the likely female and male/castrate ranges (Noddle 1993, 110 Table 6.4). The military site of Segontium shows a higher presence of likely castrate/males, bearing a closer similarity with the concentrations noted in the fort Noddle 1993, 110 Table 6.4). Conversely, the urban site of Lincoln bears a greater similarity with the vicus, showing a lower representation of likely castrate/male sized element (Dobney et al. 1996, 155, Appendix 1). Bearing fewer measurements than other comparative sites, the trends at Wroxeter are harder to definitively state. However, all measurements fall within a similar range to that of the other comparative sites, bearing the greatest similarity with urban Lincoln in the elevated presence of likely females, with fewer likely castrates (Hammon 2005, 569-571, Appendix 17).

On the whole the majority of sub-Roman cattle measurements from Wroxeter and Segontium fall within the range occupied by their 4th-5th c. assemblages, suggesting little difference in the size of animals deposited on site (Figure 4.7.8). This reinforces the idea of continuity of practice and maintenance of identities at military and urban sites introduced by the sub-Roman morphological data.

Overall the humeri breath of the trochlea recorded from the 2011/12 fort and vicus at Binchester most closely match with the material recovered dating to the 4th-5th C. The fort shows the most similarity with the military site of Segontium, featuring an increased representation of likely castrate and male sized elements. Conversely, the vicus, with its low representation of likely castrate and male sized elements, most closely fits with the concentrations seen at the urban sites of Lincoln and Wroxeter. This is an important distinction between military and civilian occupants within archaeological sites, lending strength towards the tentative interpretation of the discrepancy between the Binchester 2011/12 fort and vicus as a result of a system of preferential provisioning, supplying a greater portion of available castrates to the occupants of the fort, and leaving the remainder of mostly females cattle to the vicus.

4.7.2.2. Trochlear Breadth (BT) vs Height of the Medial Trochanter (HT)

While the breadth of the trochlea is a good measure for the size of animals, when this is plotted against the height of the medial trochanter (HT), we are able to view the recovered elements not only in terms of size but also robusticity. This will allow us to see key differences not only between sexes of cattle represented, but also any differences between the cattle at different sites. Sadly, only Lincoln (4th C.) and Haddon provided the raw data for this metric, limiting our ability to compare between sites.

Figure 4.7.9 displays the recovered humeri scatterplot of trochlear breadth against the height of the medial trochanter (BT vs HT). A clear difference between the Binchester 2011/12 fort and vicus is evident in the elevated presence of larger, more robust elements in the fort, with the vicus possessing more elements of a smaller, less robust size. The smaller range of humeri is interpreted as likely females, with the larger, more robust elements likely to be castrates or intact males. This reinforces the difference in the concentration of different sizes of cattle in the fort and vicus noted previously, supporting the interpretation that cattle utilised in the fort see a preferential selection of larger, more robust cattle, possibly from a different source than those in the vicus.

Only the sites of Haddon and Lincoln present HT measurements on recovered humeri. Unfortunately, as can be seen in Figure 4.7.9, the measurements taken at Haddon are incorrect, possibly being from a different measurement altogether, possibly the measured height of the centre of the trochlea (HTC) rather than the height of the medial trochlea. Thus, we have only recorded measurements from Lincoln to compare. The urban site of Lincoln most closely matches the Binchester 2011/12 vicus, showing a large concentration of likely females, with a lower representation of likely castrate or male sized elements (Dobney et al. 1996, 155, Appendix 1).

Overall the Humeral measurements recorded at Binchester and comparative sites provide a wide range of analytical value. The measure of the trochlear breadth of humeri from Binchester reveals the elevated presence of larger, likely castrate or male, elements at the fort, while the vicus mainly consists of female sized elements. This may indicate a difference in provisioning of cattle for these two areas, with larger animals being sent preferentially to the fort. A comparison between multiple different sites and chronological period places the Binchester assemblages firmly within the 4th-5th C, with the fort showing a great deal of similarity with the military site of Segontium. Conversely, the vicus displays higher similarity with urban Lincoln and Wroxeter. This similarity persists when trochlear breadth is plotted against the height of the medial trochanter, allowing the humeri to be separated not only by size but also by robusticity. The humeri at Lincoln dating to the 4th C. fall within a very similar range as those of the Binchester 2011/12 vicus, while the larger, more robust elements noted in the fort are absent. The humeri recovered from Binchester reveal the possibility of preferential provisioning of larger, more robust beasts, likely castrates, to the fort, with a different system of provisioning in place for the vicus.

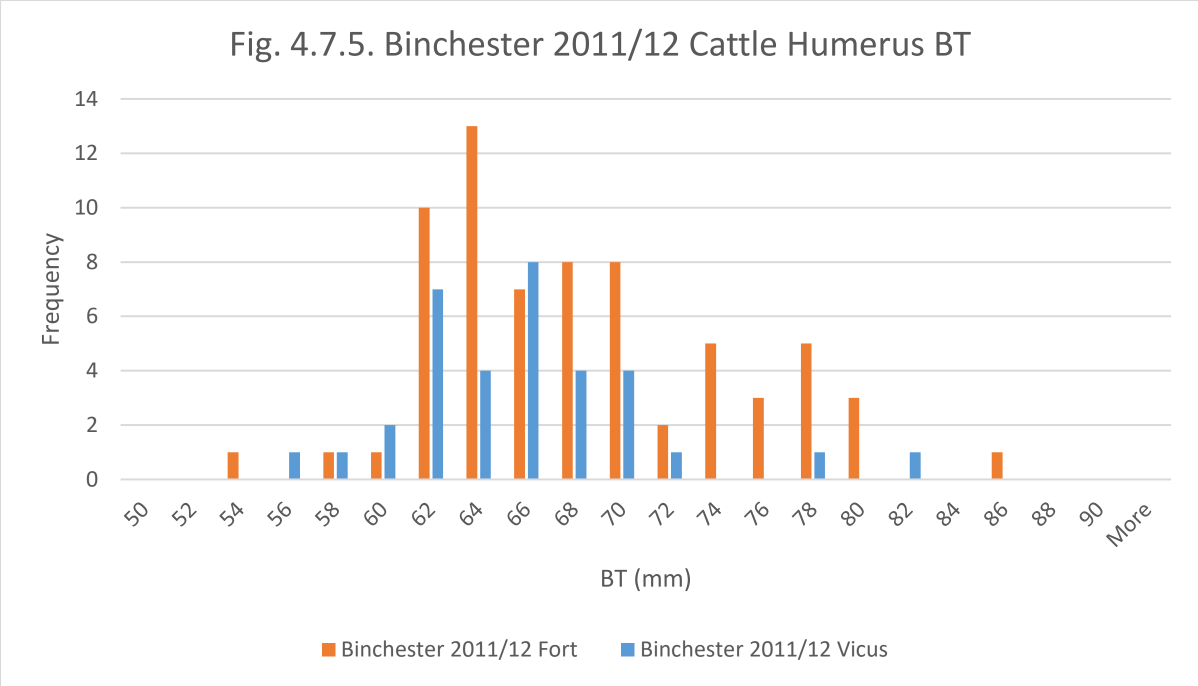

Fig. 4.7.5. Binchester 2011/12 Cattle Humerus BT. This figure shows the cattle humeri trochlear breadth measurements recorded from the Binchester 2011/12 fort and vicus.

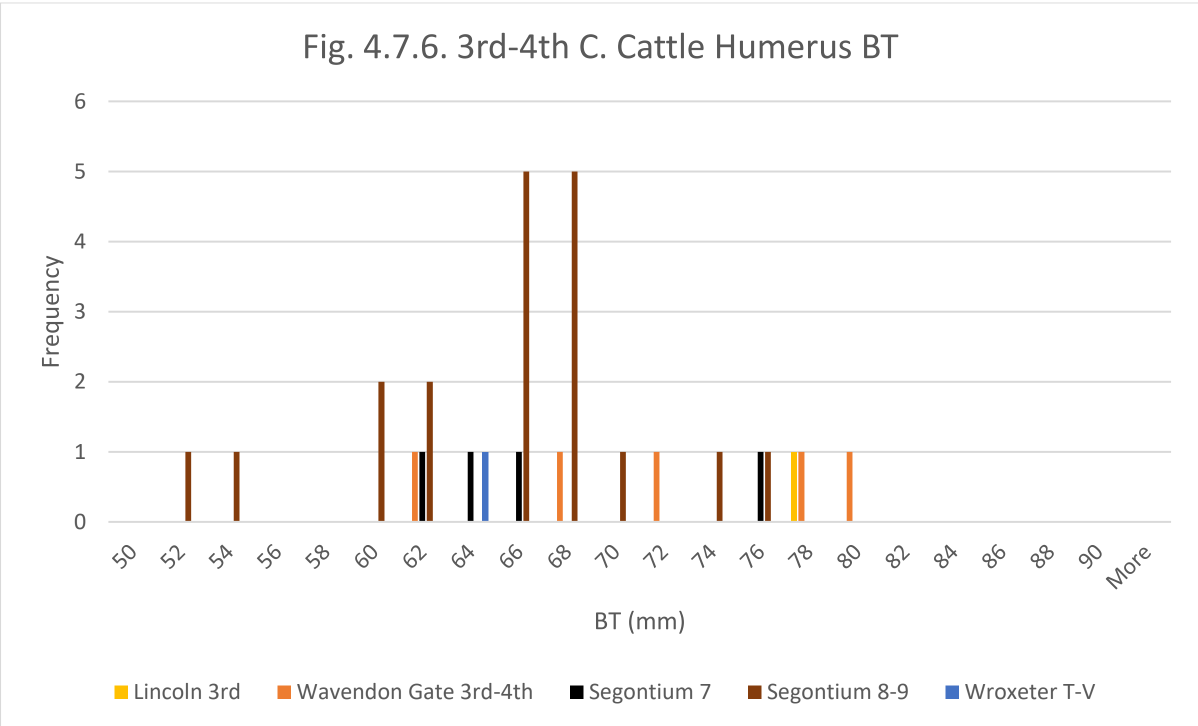

Fig. 4.7.6. 3rd-4th C. Cattle Humerus BT. This figure shows the cattle humeri trochlear breadth measurements recorded from comparative sites dating to within the 3rd-4th C. AD. (Dobney et al. 1996, 155, Appendix 1; Dobney and Jaques 1995, 218-219; Noddle 1993, 110 Table 6.4; Hammon 2005, 569-571, Appendix 17)

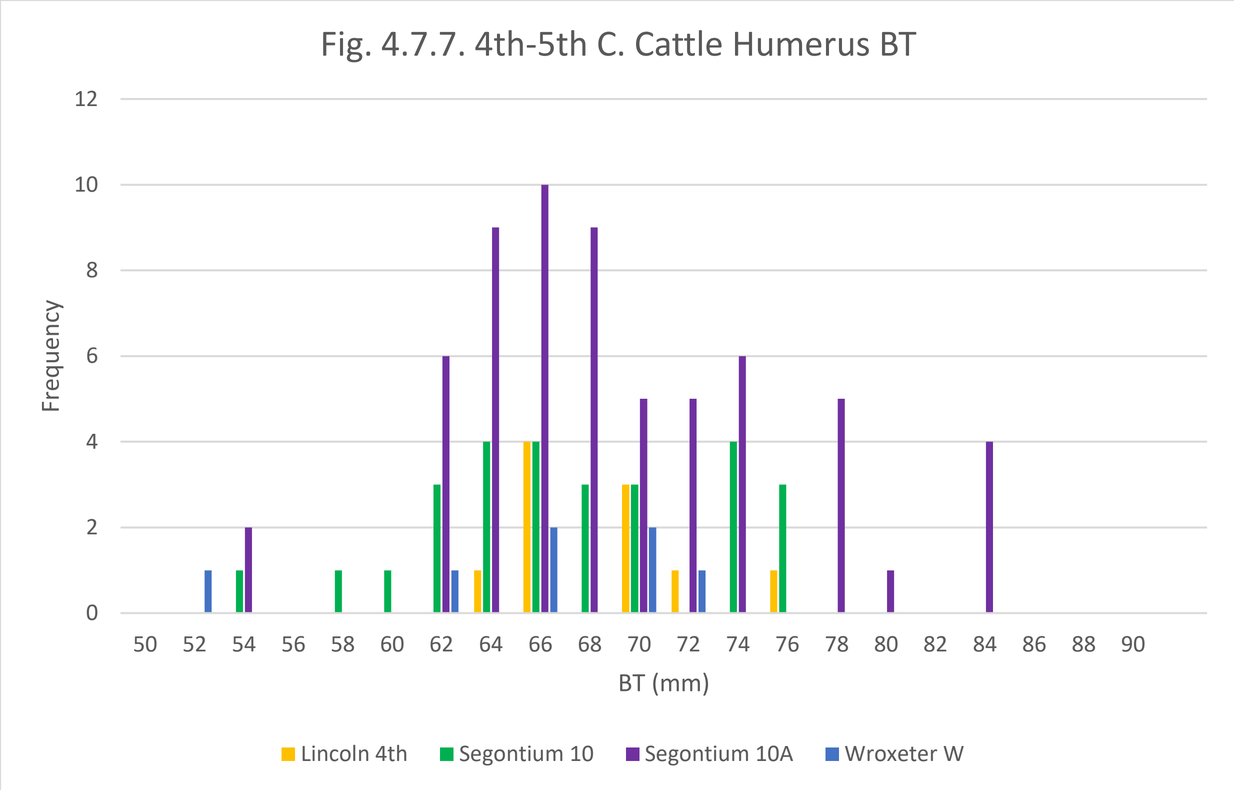

Fig. 4.7.7. 4th-5th C. Cattle Humerus BT. This figure shows the cattle humeri trochlear breadth measurements recorded from comparative sites dating to within the 4th-5th C. AD. (Dobney et al. 1996, 155, Appendix 1; Noddle 1993, 110 Table 6.4; Hammon 2005, 569-571, Appendix 17)

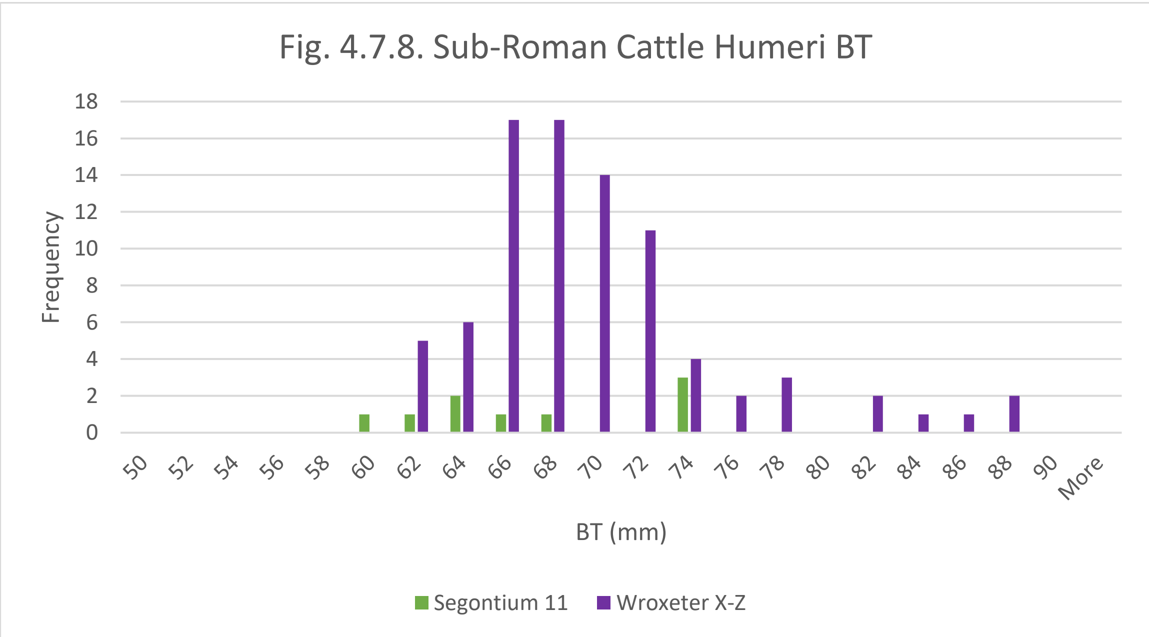

Fig. 4.7.8. Sub-Roman Cattle Humerus BT. This figure shows the trochlear breadth measurements of recovered cattle distal humeri from the comparative sites of Segontium and Wroxeter dating to the sub-Roman Period. Measurements are in mm. (Noddle 1993, 110 Table 6.4; Hammon 2005, 569-71 Appendix 17)

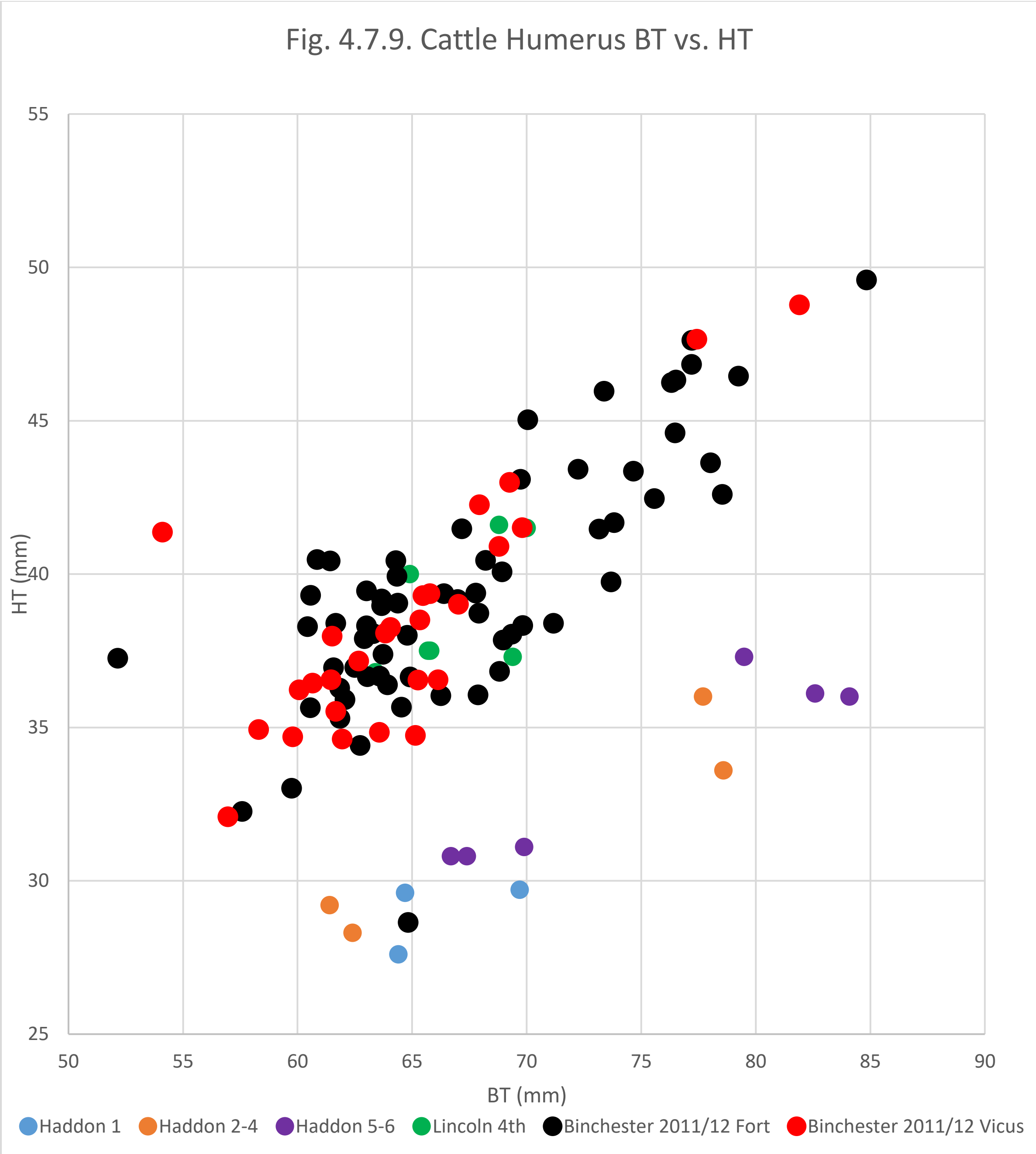

Fig. 4.7.9. Cattle Humerus BT vs. HT. This figure shows the cattle humeri trochlear breadth plotted against the height of the medial trochanter from the Binchester 2011/12 fort and vicus as well as comparative sites. The measurements recorded from Haddon are likely in error, either measured incorrectly or mislabelled in the final report. (Baxter 2003, 130 Table 6.14; Dobney et al. 1996, 155, Appendix 1)

4.7.3. Metacarpal

Metacarpals are measured at Binchester and compared to those recovered from comparative sites. The measurements of metacarpals are expressed in three ways. First, a general measure of the greatest length of recovered complete elements are separated out by chronological period as an indicator of overall size as well as sexual dimorphism. Second, complete elements have their greatest length (GL) plotted against the greatest distal breadth (BD) to serve as an indicator of size as well as sexual dimorphism and, to a lesser degree, robusticity. For ease of analysis this scatterplot is separated into chronological periods as well. Finally, the distal breadth is plotted against the maximum diaphyseal depth (DD) of recovered elements as a further indicator of robusticity and sexual dimorphism. This third metric is not as often recorded, and is less likely to survive intact in assemblages that are not as well preserved, limiting the number of comparative sites to Wavendon Gate and Lincoln. A large number of metacarpals were recovered from both fort and vicus in the Binchester 2011/12 assemblages, allowing for a detailed comparison with other comparative sites.

4.7.3.1 Greatest Length (GL)

The measurements of the greatest length of metacarpals are separated out into two chronological groups. The first spans from the 1st-4th C. (Figure 4.7.11 & 4.7.12), encompassing the majority of the Roman Period, and capturing any general trends and evident change over time therein. The 1st-4th c. is separated into rural and settlement-type sites (Figure 4.7.11) and military and urban sites (Figure 4.7.12) for ease of interpretation. Due to the large degree of later comparative material, the 4th-5th century is separated from the 1st-4th (Figure 4.7.13).

The 1st-4th C. shows limited comparative metric data recovered from comparative sites. Thus, metric information across these time periods has been compiled into Figure 4.7.11 & 4.7.12 in order to show the general range of measurements recorded. Due to the limited data available, it is difficult to see concentrations or general trends on a by-site basis. However, the metric data recorded from comparative sites falls within the range noted from the Binchester 2011/12 assemblages, with one key exception. The metacarpals recovered from Great Holts Farm are spectacularly tall when compared to the other sites (Albarella 2003, 198). Without exception, all Great Holts Farm metacarpals occupy the tallest range, exceeding all other sites including Binchester 2011/12 (Albarella 2003. 198). With this comparison in mind, the interpretation of these individuals as imported continental cattle utilized for traction or breed improvement is well substantiated. Wavendon Gate features only one measurable metacarpal, dating to the 2nd-3rd C. However, with a greatest length of 204 mm, this metacarpal matches the longest recorded metacarpal recovered from the Binchester 2011/12 faunal assemblages, suggesting the presence of castrates on site (Dobney and Jaques 1995, 220). The measurements from Haddon 2-4 and 5-6 fall well within the range of other comparative sites. Haddon 2-4 shows a majority of recovered elements falling on the lower end of the range, representing probable female elements (Baxter 2003, 122). However, one recovered element falls squarely within the range of probable castrates noted from the Binchester 2011/12 assemblages. Further, Haddon 5-6 features a number of elements within the probable castrate range (Baxter 2003, 122). This metric information supports the interpretation of the Haddon assemblage as excess cattle slaughtered for the purposes of consumption at the farmstead, rather than any other secondary processes (Baxter 2003, 122). However, the cattle appear to be of a similar size to other contemporary comparative sites, indicating that, while animal utilisation may more closely resemble an Iron Age site, the cattle present on site are distinctly Roman in size. Containing only a single measurement, Wroxeter phase T-V falls within the range of size established by the other comparative sites, as well as that of the Binchester 2011/12 material. Besides Great

Holts Farm, the 1st-4th C. metric information from our comparative sites matches well with the range of metacarpal lengths recovered from the Binchester 2011/12 assemblages.

The 4th -5th C. comparative assemblages feature a much larger amount of recorded metacarpal lengths (Figure 4.7.13). Overall, the range of metacarpal lengths recorded match up well with those recorded at Binchester. Segontium 10 features some of the smallest measurements in the range, with two concentrations of measurements at 180-184 and 196-198 (Noddle 1993, 106-107 Table 6.4). It is probable that the smaller metacarpal concentration represents female cattle, while the taller concentration is indicative of castrated males. This corresponds well with the similar concentrations noted from the Binchester 2011/12 data, although Binchester displays a higher of variation in measurements. Segontium 10A shows similar concentrations, although with slightly increased length measurements (Noddle 1993, 106-7 Table 6.4). It appears that females represent the majority followed by castrates and with few intact males represented, although consulting only the greatest length does not display sexual dimorphism as explicitly as other metric comparisons (Higham 1969a). The metacarpals from Wroxeter fall within the range outlined by Segontium, although there are many fewer likely castrate measurements, with most measured elements falling within the likely female range (Hammon 2005, 573-585, Appendix 19). Finally, Lincoln shows a heightened concentration of females and smaller castrate/intact male sized metacarpals, with a lower occurrence of the taller castrate sized metacarpals noted at Segontium and Binchester 2011/12 (Dobney et al. 1996, 156-161, Appendix 1). Interestingly the cattle from Wroxeter are smaller on average than those of Lincoln, suggesting that Lincoln may have access to larger animals. The cattle assemblages at the military sites of Binchester and Segontium are interpreted as mainly consisting of military rations, where the more urban nature of Lincoln and Wroxeter may afford a greater variety in sources of cattle. This difference in sources could potentially explain the lower incidence of cattle falling within the taller castrate range noted at both sites. Interestingly, the metacarpal greatest lengths recovered from the Binchester 2011/12 fort most closely match the concentrations and range seen in the military site of Segontium, whereas the range and concentrations of the 2011/12 vicus more closely match with Wroxeter and Lincoln. This is due in large part to the discrepancy in the number of tall castrate sized metacarpals recovered, seeing a higher incidence at Segontium and the Binchester fort, and lower occurrence at Lincoln, Wroxeter, and the Binchester Vicus. This further suggests a preferential supplying of larger animals to the occupants within the fort, suggesting a divergence in identity between the occupants of the two areas.

Sub Roman measurements of metacarpals (Figure 4.7.14) at Wroxeter show little change from their 4th-5th c. assemblage. This reinforces the perceived continuity between sub-Roman and previous levels of occupation, suggesting that the identities of occupants within these sites did not immediately change following the withdrawal of centralised Roman influence on Britannia.

4.7.3.2. Greatest Length (GL) vs Distal Breadth (Bd)

The metric information for Binchester 2011/12 and our comparative sites is sorted into three groups: 1st-3rd C. (Figure 4.7.15), 3rd-4th C. (Figure 4.7.16) and 4th-5th C. (Figure 4.7.17 & 4.7.18), with the Binchester 2011/12 fort and vicus metrics displayed in black and red, respectively. This is done in order to facilitate a direct comparison between the metric information recorded from the Binchester 2011/12 material and that of the comparative sites.

The metric data from comparative sites dated to the 1st-3rd C. is shown in Figure 4.7.15. The probable female and male/castrate clusters fall within the ranges outlined by the Binchester material. Similar to the greatest length measurements alone, the metacarpals recovered from

Haddon show a similar level of robusticity, with several likely female elements falling within the same concentration as the Binchester 2011/12 groupings (Baxter 2003, 122). This again demonstrates that although the species representation at Haddon may indicate species preferences more in line with the Iron Age, the cattle being utilised are of a similar size and robusticity to those utilised elsewhere in Roman Britain (Baxter 2003, 122). With few recovered elements, Segontium 6 only shows metacarpals firmly in the probable female range, with no probable male or castrates represented (Noddle 1993, 106-7 Table 6.4). This could be due to a small sample size rather than a difference in practice or sexual dimorphism. Furthermore, the likely females recorded display distinctly lower degrees of robusticity than those recovered from Binchester (Noddle 1993, 106-7 Table 6.4). The settlement of Wavendon Gate sows fewer elements in the probable female range, but shows a number that fall within the probable castrate range noted from the Binchester 2011/12 material, displaying a similar level of height as well as robusticity (Dobney and Jaques 1995, 221). Overall the metacarpals recovered from the 1st-3rd C. fall within a similar range as the Binchester 2011/12 assemblages, with evidence of females and male/castrates present across the comparative sites. However, a low number of recorded metric information prevents us from viewing any site-specific concentrations dated to this time period. Still, the general concentrations revealed for the 1st-3rd C. reinforce our interpretations of the Binchester assemblages, showing a similar separation between female and male/castrate sized elements.

The 3rd-4th C. comparative material features a greater number of elements recorded, particularly from Segontium and Great Holts Farm, allowing for a more site-specific comparison with the Binchester 2011/12 assemblages (Figure 4.7.16). Great Holts Farm continues to be anomalous. Not only are the metacarpals displayed very long, but they also display a very high level of robusticity, with all metacarpals measured being of greater length and breadth than almost all other recorded metacarpals (Albarella 2003, 198). This helps assure us that the cattle recorded at Binchester are not similarly anomalous gigantic continental animals imported to expand the breeding programs to the far North of the Roman Empire, nor to intensify agricultural production in the region. Haddon continues to surprise by not diverging from other comparative sites, with Haddon 5, 6 displaying metacarpals within the lower end of the male/castrate range, possibly representing excess castrates or males utilised for traction before being consumed (Baxter 2003, 122). Wavendon Gate displays very tall and robust element measurements, falling beyond the range of Binchester and matching with those metrics recorded from Great Holts Farm. This introduces evidence that the occupants at Wavendon Gate may be, at least in part, practicing the importation of larger continental breeds as either breeding stock or for heavy-duty traction work (Dobney and Jaques 1995, 218-219). The metacarpals measured from Lincoln fall within the same general groupings noted from the Binchester 2011/12 (Dobney et al. 1996, 156-161, Appendix 1). Interestingly, Segontium 7 presents metacarpals in the probable female range with a noticeably low robusticity compared to those of Binchester, while containing no probable male/castrate sized elements (Noddle 1993, 106-7 Table 6.4). Segontium 8-9 only contains 2 measurable metacarpals, one in the female grouping, displaying a similar robusticity to those of Binchester, and one likely male/castrate metacarpal of a robusticity similar to Binchester as well (Noddle 1993, 106-7 Table 6.4). With only a single measured element, Wroxeter provides little comparable material, although it does fall within the likely female range outlined by the other comparative sites, suggesting the utilisation of similarly sized cattle. On the whole the 3rd-4th C. metacarpal metrics show a higher degree of variation, with some exceedingly large examples likely the result of the introduction of larger continental breeds of cattle, and the possibility of smaller cattle from more remote sites such as Segontium.

The 4th-5th C. sees an increase in the number of recovered measurable metacarpals from comparative sites (Figure 4.7.17 & 4.7.18). The fort of Segontium provides a multitude of metric data from both halves of the 4th century, represented by Segontium 10 and 10A respectively. A clear shift is evident when compared to earlier assemblages from the site, as much larger numbers of slightly taller cattle are evident (Noddle 1993, 106-7 Table 6.4). Furthermore, two distinct groupings can be seen which, in terms of height, match up very well with the concentrations noted in the Binchester 2011/12 assemblages (Noddle 1993, 106-7 Table 6.4). A key difference between the two sites is definitively illuminated by the larger sample sizes: the cattle metacarpals from Segontium display a distinctly lower robusticity than those of Binchester. It is possible that this increase in robusticity, and not in height, is the result of the utilisation of the Binchester cattle for traction work before consumption, thus splaying the distal metacarpals to varying degrees, resulting in an increased distal breadth for all elements (Bartosiewicz 1997, 43). Offering a moderate suite of measured elements, Wroxeter phase W very closely matches with the Binchester metacarpals in size and robusticity. Bearing great similarity towards the Binchester vicus, the majority of measured elements fall within the likely female range, with only two elements being of likely castrate size (Hammon 2005, 573-585, Appendix 19). The metacarpals measured from Lincoln in the 4th century also bear some similarity to the Binchester 2011/12 material, showing concentrations of both female and male/castrate sized individuals (Dobney et al. 1996, 156-161, Appendix 1). Overall the 4th-5th C. cattle metacarpal metrics match up well with the Binchester data in terms of size, while some variation in the robusticity of recovered elements is seen between sites. The concentrations of likely females and likely castrates are noted at all comparative sites, as well as the Binchester 2011/12 assemblages. However, the military site of Segontium most closely matches the Binchester 2011/12 fort, showing an elevated representation of likely castrates, while the urban centres of Lincoln and Wroxeter most closely matches the Binchester 2011/12 vicus, showing mainly likely females with fewer likely castrates.

Unfortunately, sub-Roman Segontium and 4th-5th c. Wroxeter contain a limited number of measurable elements, limiting our ability to assess change over time (Figure 4.7.19). Both sub-Roman assemblages fall within similar ranges to their respective 4th-5th c. measurements, suggesting a continued subsistence on similarly sized cattle. This provides support for the idea of continuity of practice into the sub-Roman Period. Overall, large degree of variation in robusticity is noted among comparative sites as well as from the Binchester 2011/12 material. The concentrations of likely female and male/castrate sized cattle at Binchester most closely match those detailed in the 4th-5th C. Throughout all chronological periods, cattle from Segontium display a pervasively lower robusticity than that of Binchester. With the indicated utilisation of cattle from Binchester for traction, the heightened robusticity could be a physiological difference rather than a genetic one. The intra site and inter site variation in robusticity is likely to be the result of the presence of animals utilised for different processes, with those beasts utilised for traction giving a higher robusticity measurement, while those raised solely for meat or females whose utility as breeding stock has declined will provide more normalised measurements.

4.7.3.3. Distal Breadth (Bd) vs Diaphyseal Depth (Dd)

In order to more closely examine the issue of cattle robusticity, the distal breadth is plotted against the maximum diaphyseal depth (DD), this allows for a more detailed exploration of the robusticity of cattle metacarpals. The metric information can be seen in Figure 4.7.20 Only a small amount of recorded elements are available from Wavendon Gate, but these show robusticity in two groups across the different chronological periods (Dobney and Jaques 1995, 220). The lower robusticity falls within the middle range of the Binchester assemblages, slightly beyond the vicus concentration, possibly representing females. The other marks the highest robusticity recorded, beyond the levels of the Binchester 2011/12 fort. A large number of recovered elements were measured from Lincoln dating to the 4th century. The measured robusticity of recovered elements at Lincoln very closely matches the Binchester 2011/12 vicus, with a vast majority of elements falling among the lower robusticity likely female range, and only a few elements reaching the higher robusticity range noted in the fort (Dobney et al. 1996, 156-161, Appendix 1). The similarity between the Binchester vicus and the urban site of Lincoln indicates the possibility of a different practice of provision for civilian as opposed to military individuals during the Roman period, with soldiers occupying forts being provisioned with more robust animals as military rations.

Chronologically, Binchester most closely matches with the metric comparative data recovered from sites dating to 4th-5th century, bearing some similarity with the urban site of Lincoln and the fort Segontium, in particular. The measurement metacarpal greatest length, greatest length against distal breadth, and distal breadth against diaphyseal depth all tell similar tales across available comparative material. The military site of Segontium and urban centre at Lincoln present the most robust data sets, allowing for a comparison between military and urban life. Overall, a higher degree of variation in measurements is noted from Lincoln, although Segontium shows an elevated presence of likely castrates. This variation in distal breadth is apparent within the Lincoln, Segontium and Binchester 2011/12 assemblages, suggesting that multiple processes of exploitation were being practiced. The elevated presence of likely castrates noted at Segontium is also present in the Binchester 2011/12 fort assemblage, yet absent in the vicus, reinforcing previous evidence suggesting a program of preferential provisioning of larger cattle to the occupants of the fort. Evidence supporting the idea of preferential provisioning of military occupants further suggests the presence of a division in identity between military and non-military, a division coming into sharper focus from the divergence of the Binchester 2011/12 fort and vicus metacarpal metrics.

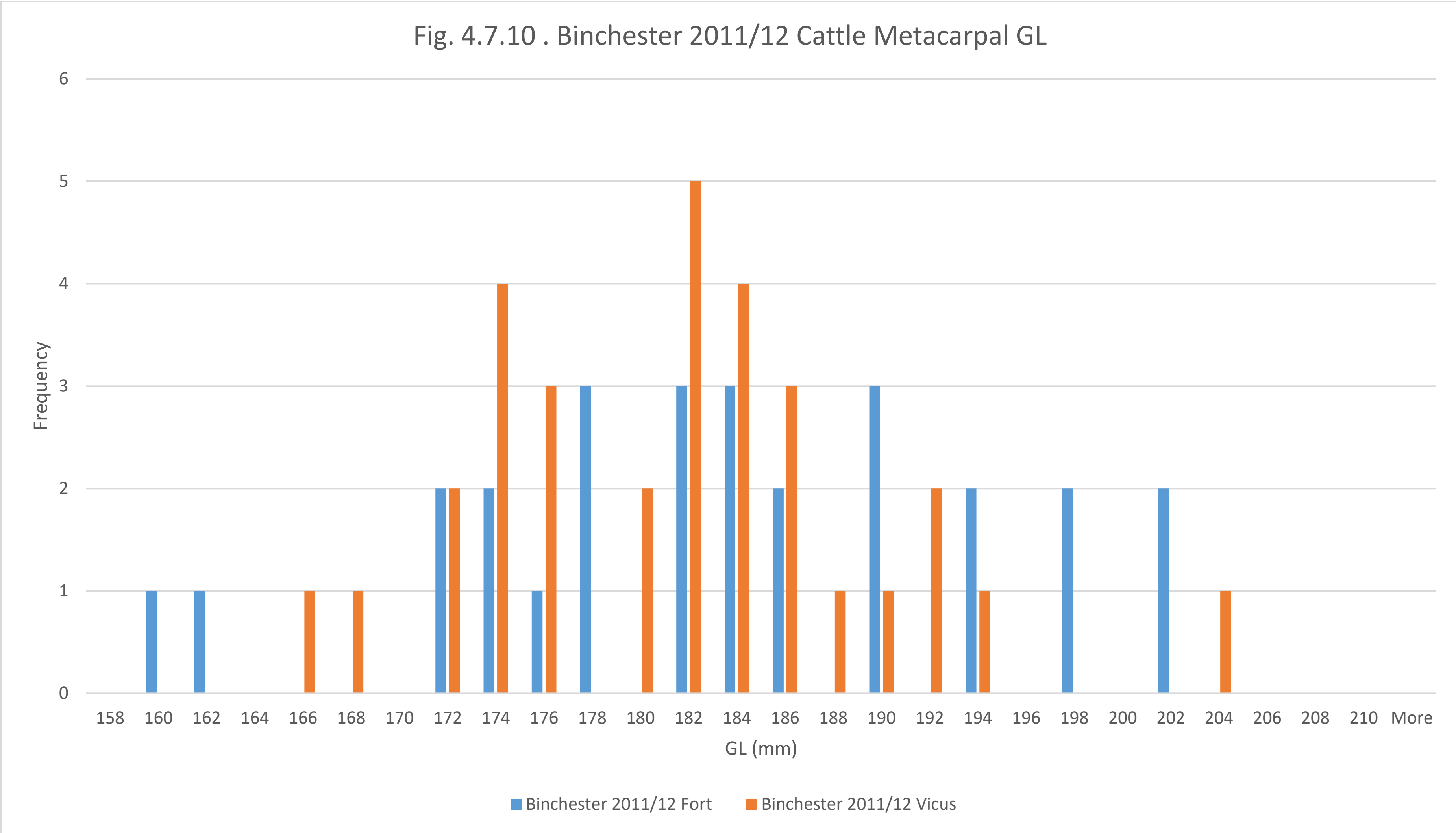

Fig. 4.7.10. Binchester 2011/12 Cattle Metacarpal GL. This figure shows the cattle metacarpal greatest length measurements recorded from the Binchester 2011/12 fort and vicus.

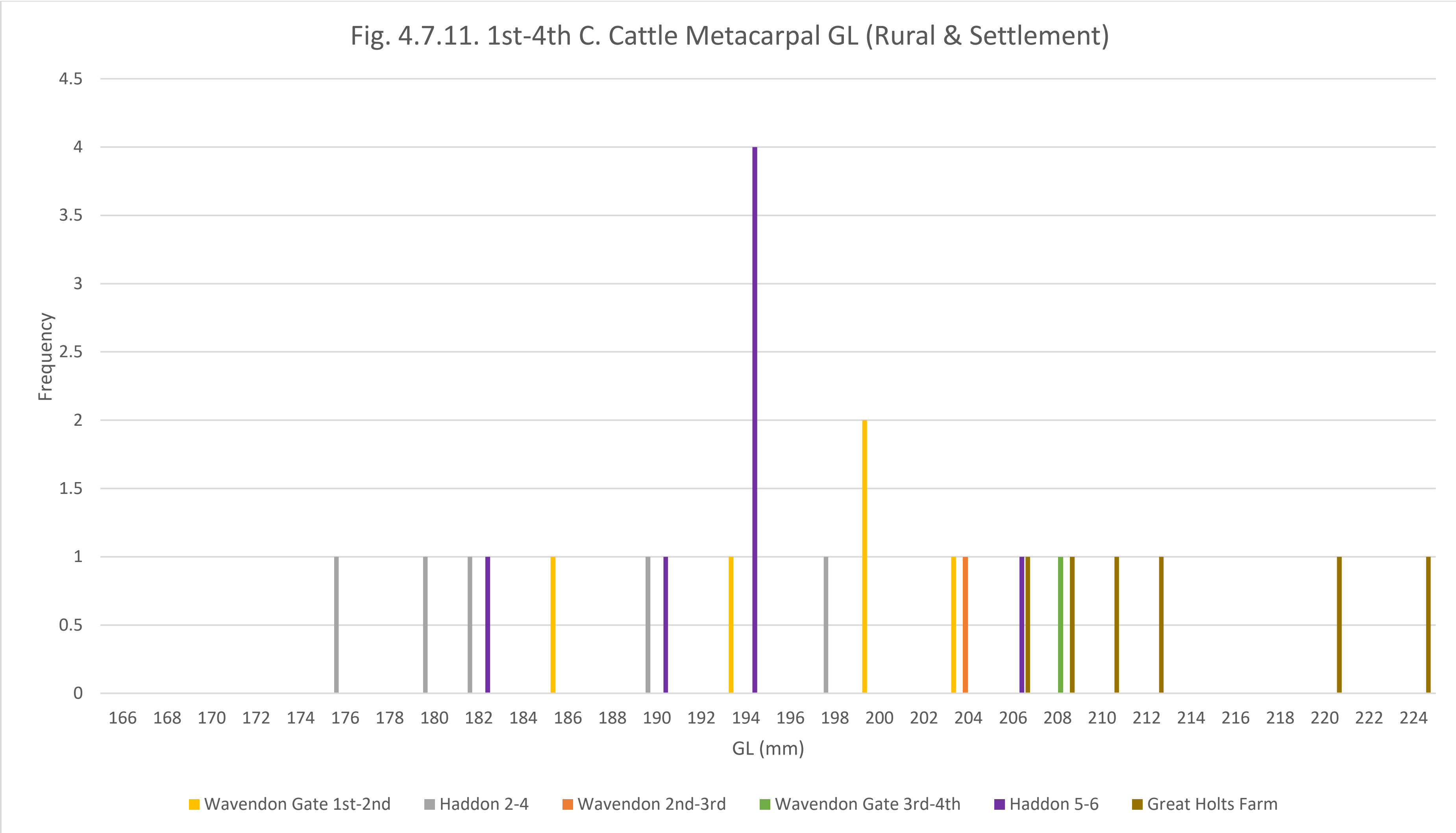

Fig. 4.7.11. 1st-4th C. Cattle Metacarpal GL (Rural & Settlement). This figure shows the cattle metacarpal greatest length measurements recorded from rural and settlement-type comparative sites dating to within the 1st-4th C. AD. (Dobney and Jaques 1995, 218-219; Baxter 2003, 130 Table 6.14; Albarella 2003, 196-198)

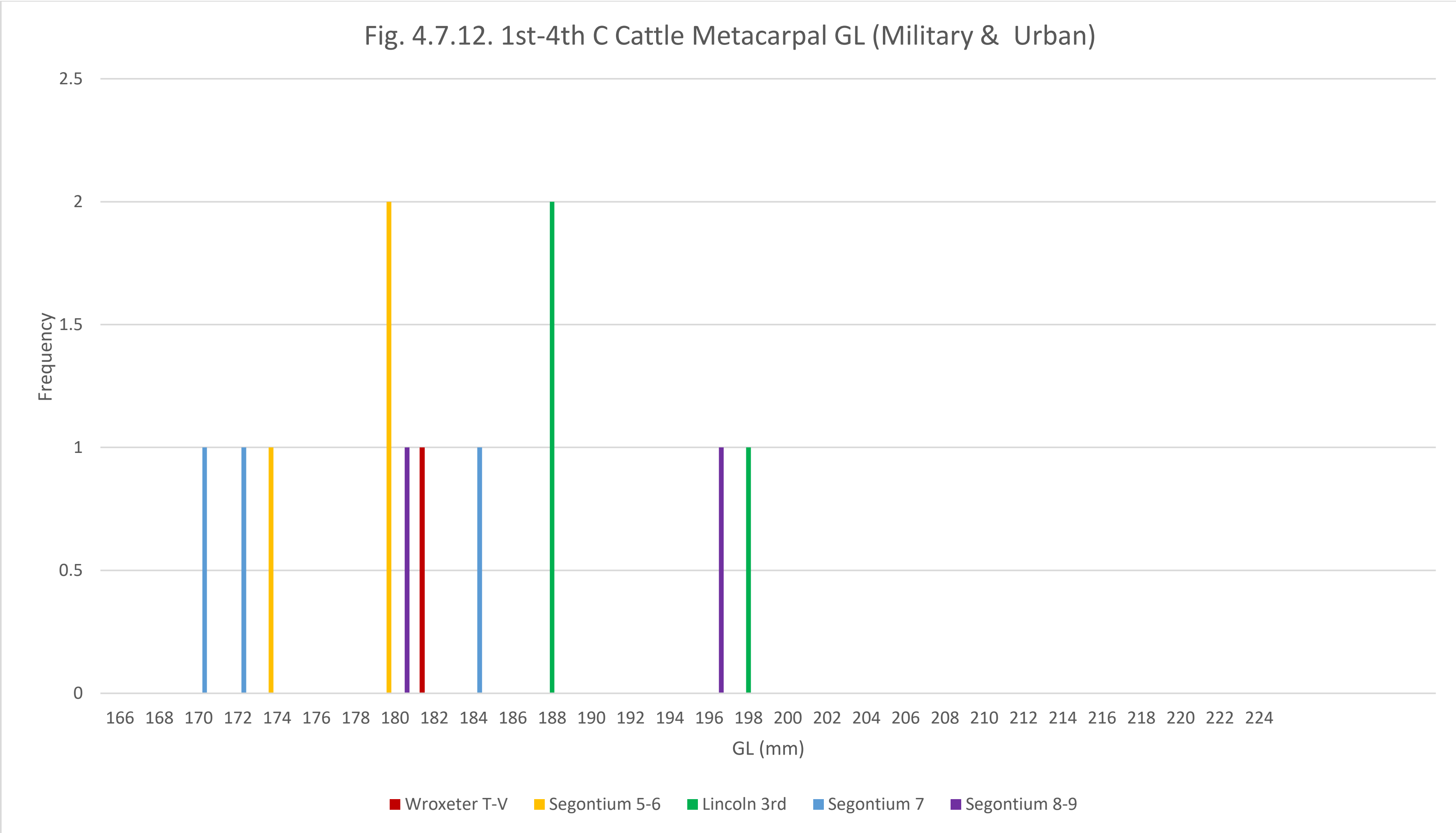

Fig. 4.7.12. 1st-4th C. Cattle Metacarpal GL (Military & Urban). This figure shows the cattle metacarpal greatest length measurements recorded from military and urban comparative sites dating to within the 1st-4th C. AD. (Noddle 1993, 106-7 Table 6.4; Dobney et al. 1996, 156-161, Appendix 1; Hammon 2005, 573-585, Appendix 19)

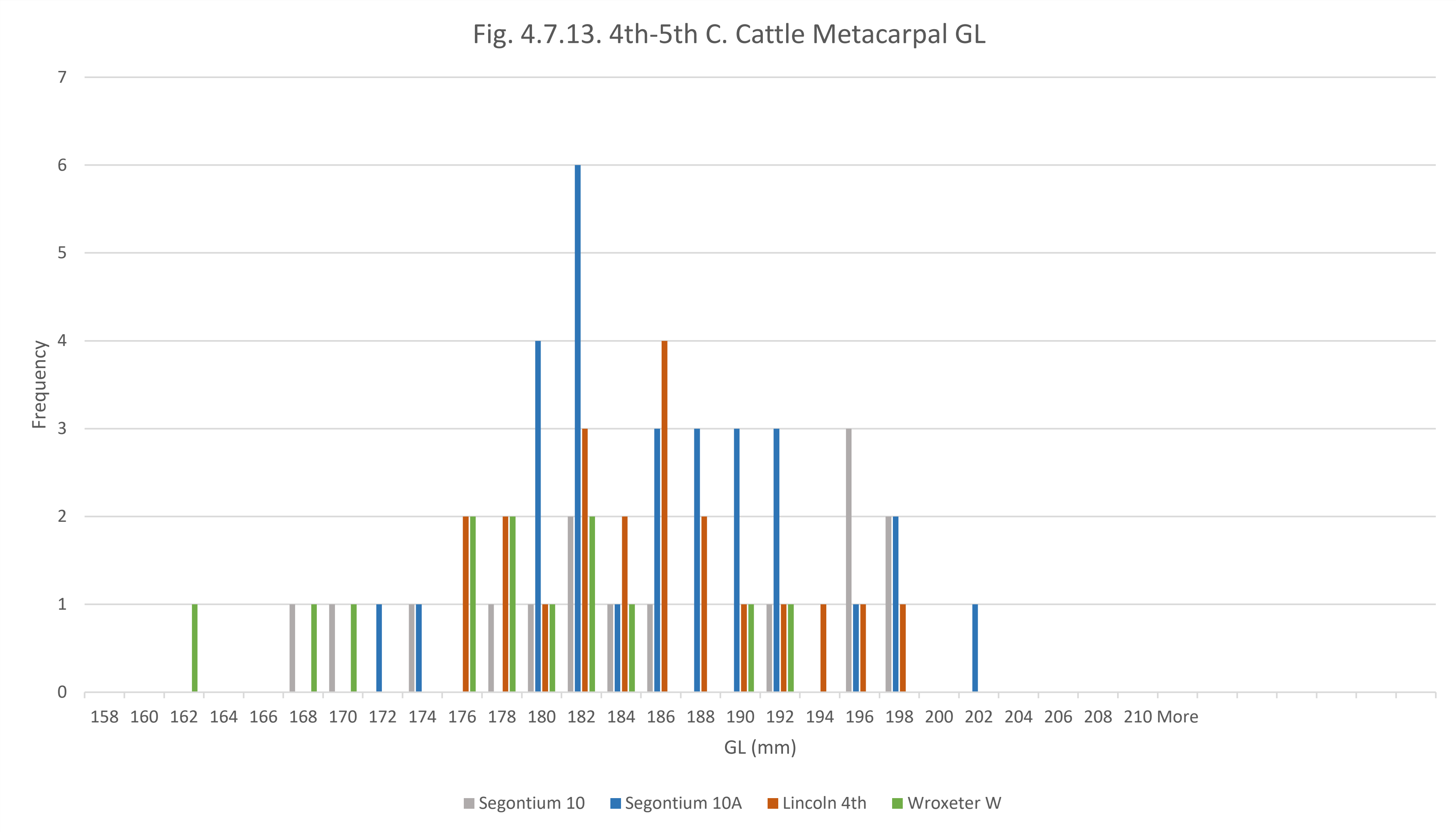

Fig. 4.7.13. 4th-5th C. Cattle Metacarpal GL. This figure shows the cattle metacarpal greatest length measurements recorded from comparative sites dating to within the 4th-5th C. AD. (Noddle 1993, 106-7 Table 6.4; Dobney et al. 1996, 156-161, Appendix 1; Hammon 2005, 573-585, Appendix 19)

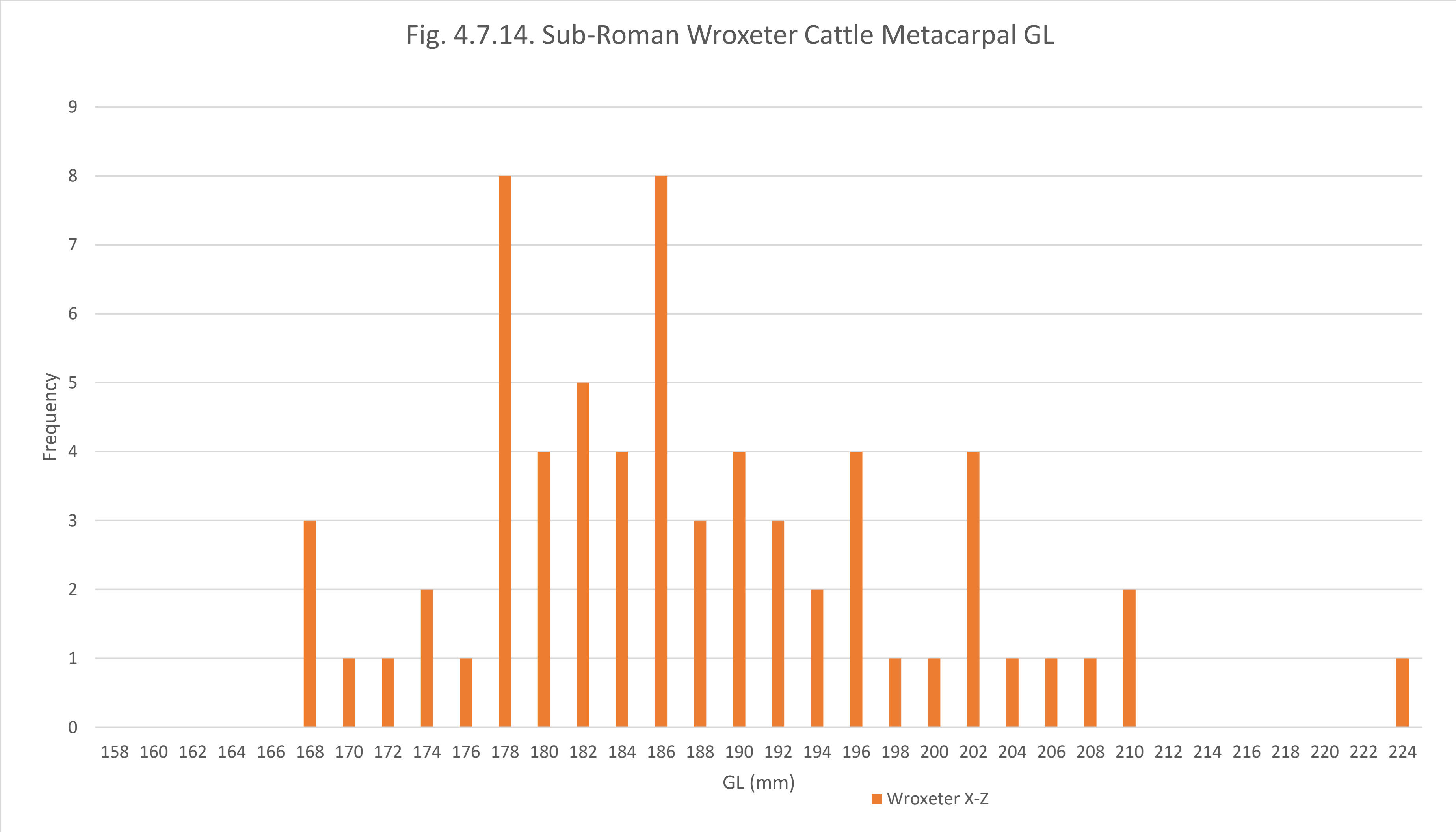

Fig. 4.7.14. Sub-Roman Wroxeter Cattle Metacarpal GL. This figure shows the greatest length measurements of recovered cattle metacarpals from the comparative site of Wroxeter dating from the sub-Roman Period. Measurements are in mm. (Hammon 2005, 573-85 Appendix 19)

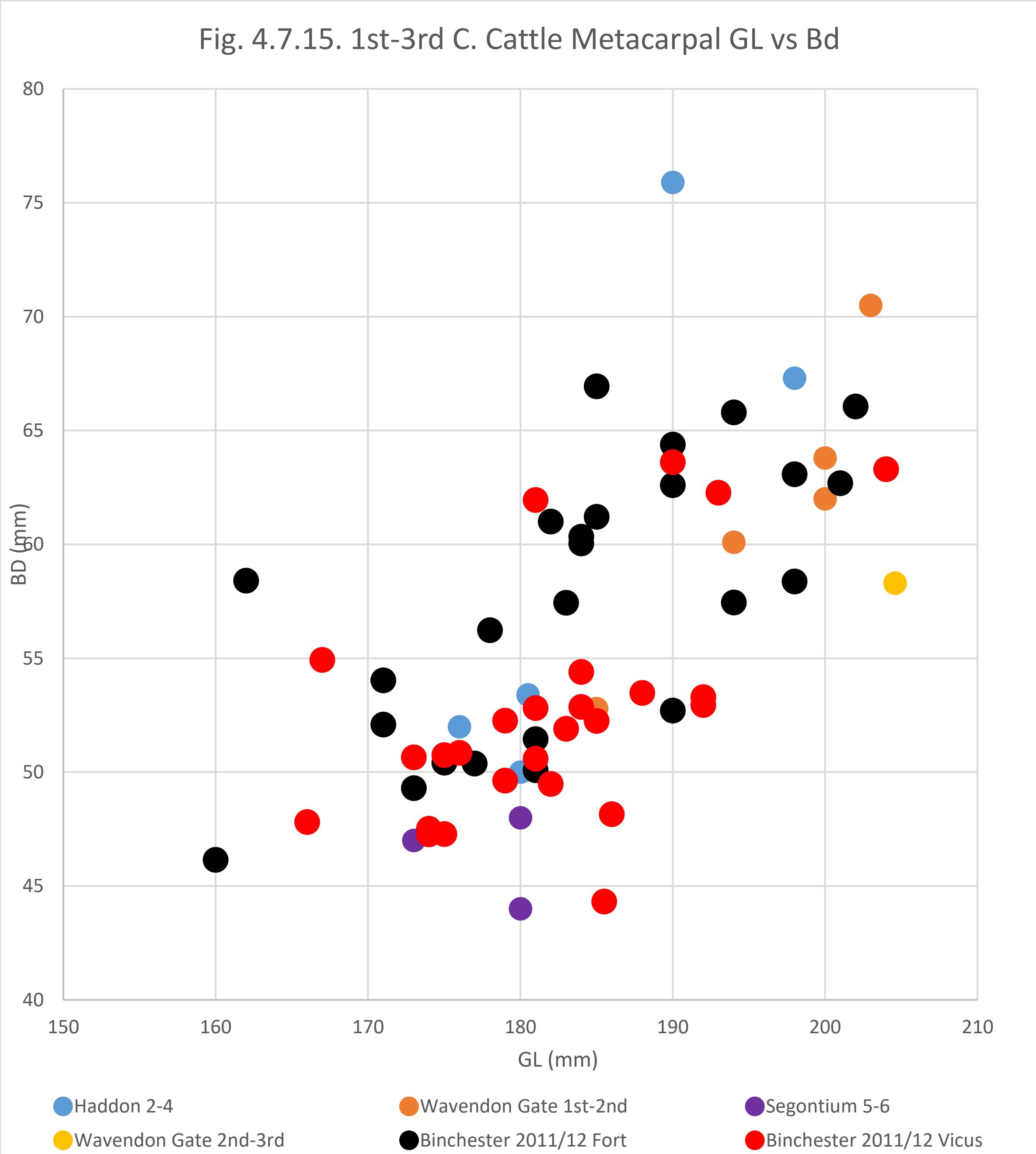

Fig. 4.7.15. 1st-3rd C. Cattle Metacarpal GL vs Bd. This figure shows the cattle metacarpal greatest length plotted against distal breadth measurements for the Binchester 2011/12 fort and vicus and comparative sites dating within the 1st-3rd C. AD. (Baxter 2003, 130 Table 6.14; Dobney and Jaques 1995, 218-219; Noddle 1993, 106-7 Table 6.4)

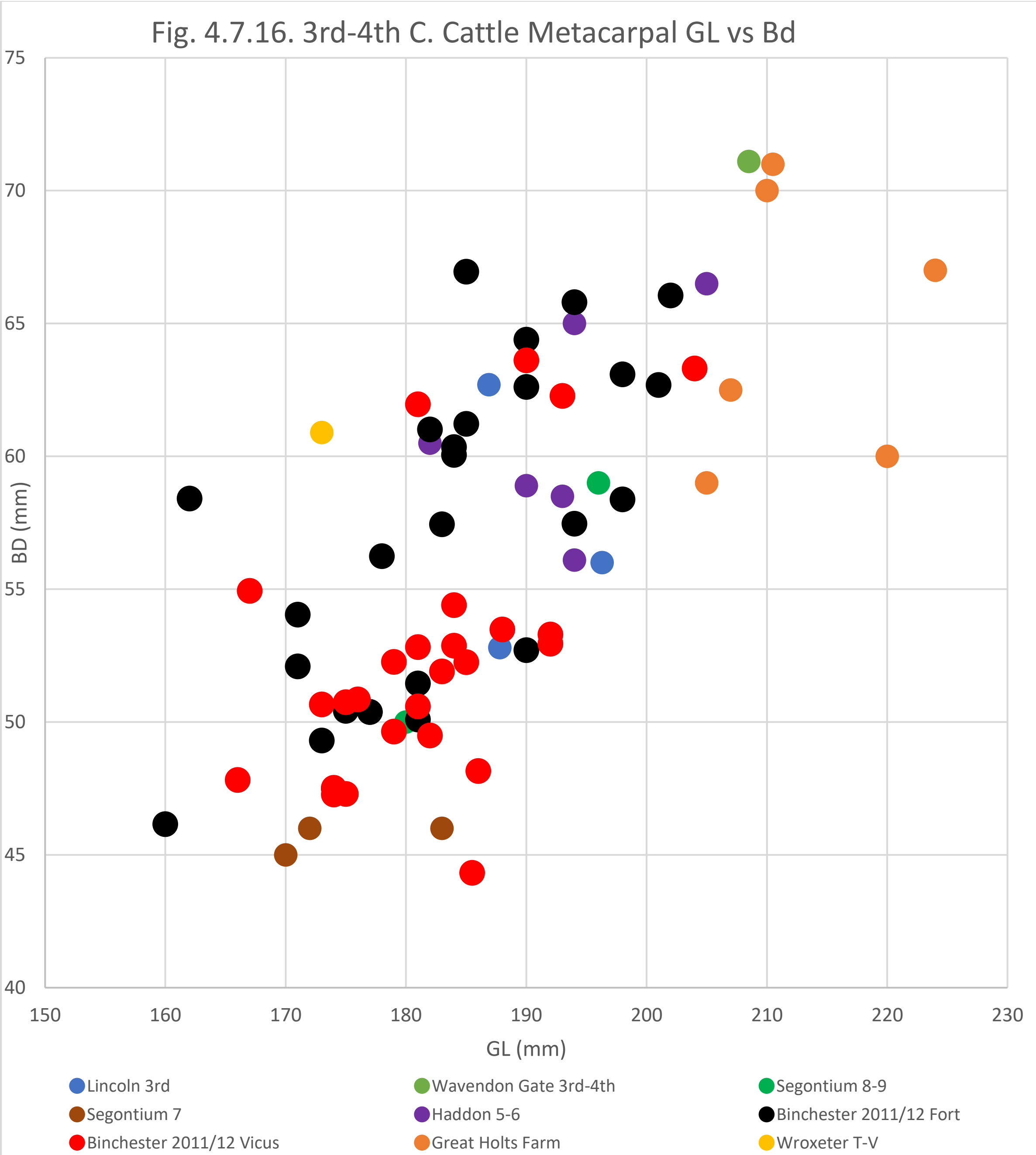

Fig. 4.7.16. 3rd-4th C. Cattle Metacarpal GL vs Bd. This figure shows the cattle metacarpal greatest length plotted against distal breadth measurements for the Binchester 2011/12 fort and vicus and comparative sites dating within the 3rd-4th C. AD. (Dobney et al. 1996, 156-161, Appendix 1; Dobney and Jaques 1995, 218-219; Noddle 1993, 106-7 Table 6.4; Baxter 2003, 130 Table 6.14; Albarella 2003, 196-198; Hammon 2005, 573-585, Appendix 19)

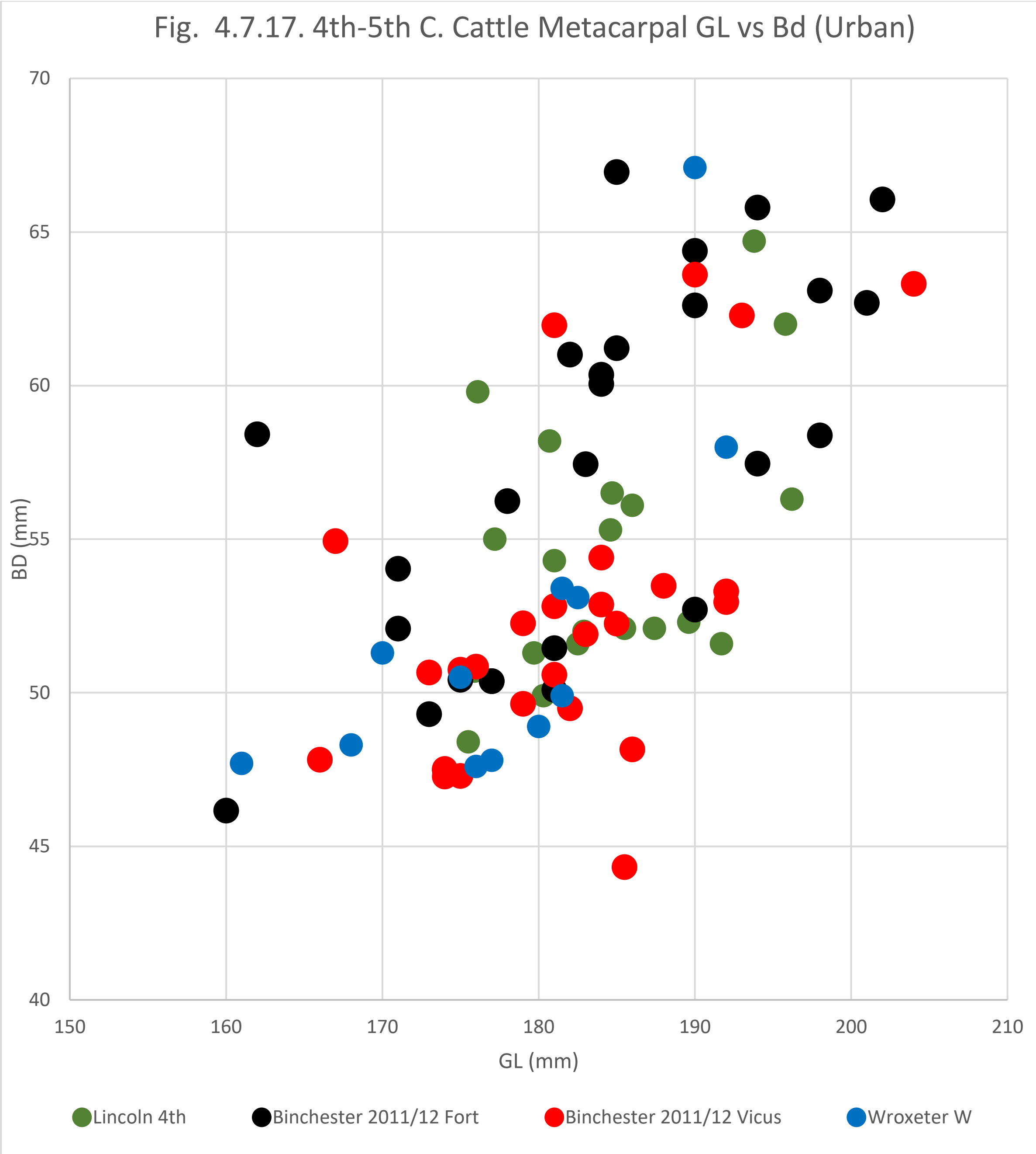

Fig. 4.7.17. 4th-5th C. Cattle Metacarpal GL vs Bd. This figure shows the cattle metacarpal greatest length plotted against distal breadth measurements for the Binchester 2011/12 fort and vicus and urban Lincoln, dating to within the 4th-5th C. AD. (Dobney et al. 1996, 156-161, Appendix 1; Hammon 2005, 573-585, Appendix 19)

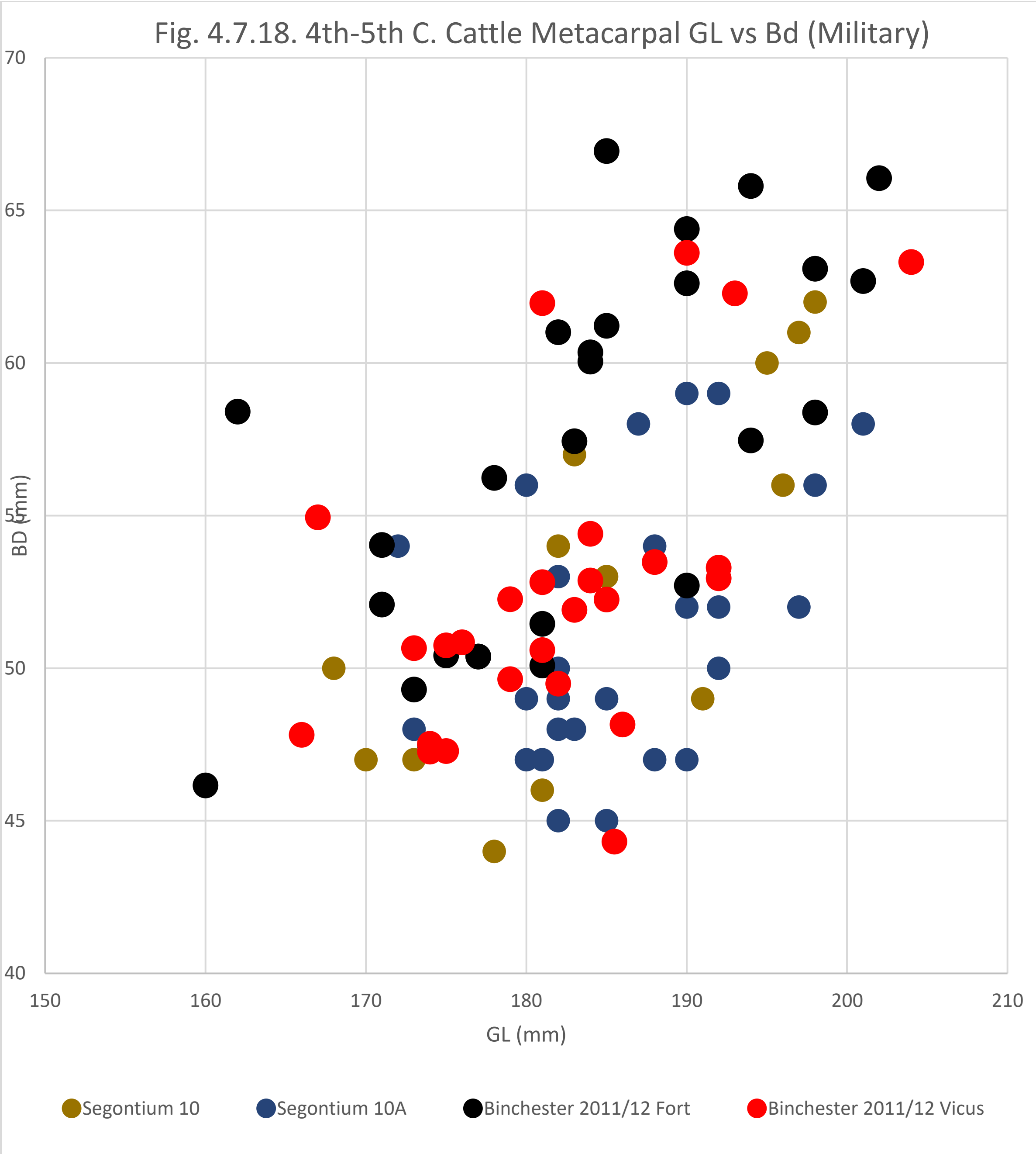

Fig. 4.7.18. 4th-5th C. Cattle Metacarpal GL vs Bd. This figure shows the cattle metacarpal greatest length plotted against distal breadth measurements for the Binchester 2011/12 fort and vicus and military Segontium, dating to within the 4th-5th C. AD. (Noddle 1993, 106-7 Table 6.4)

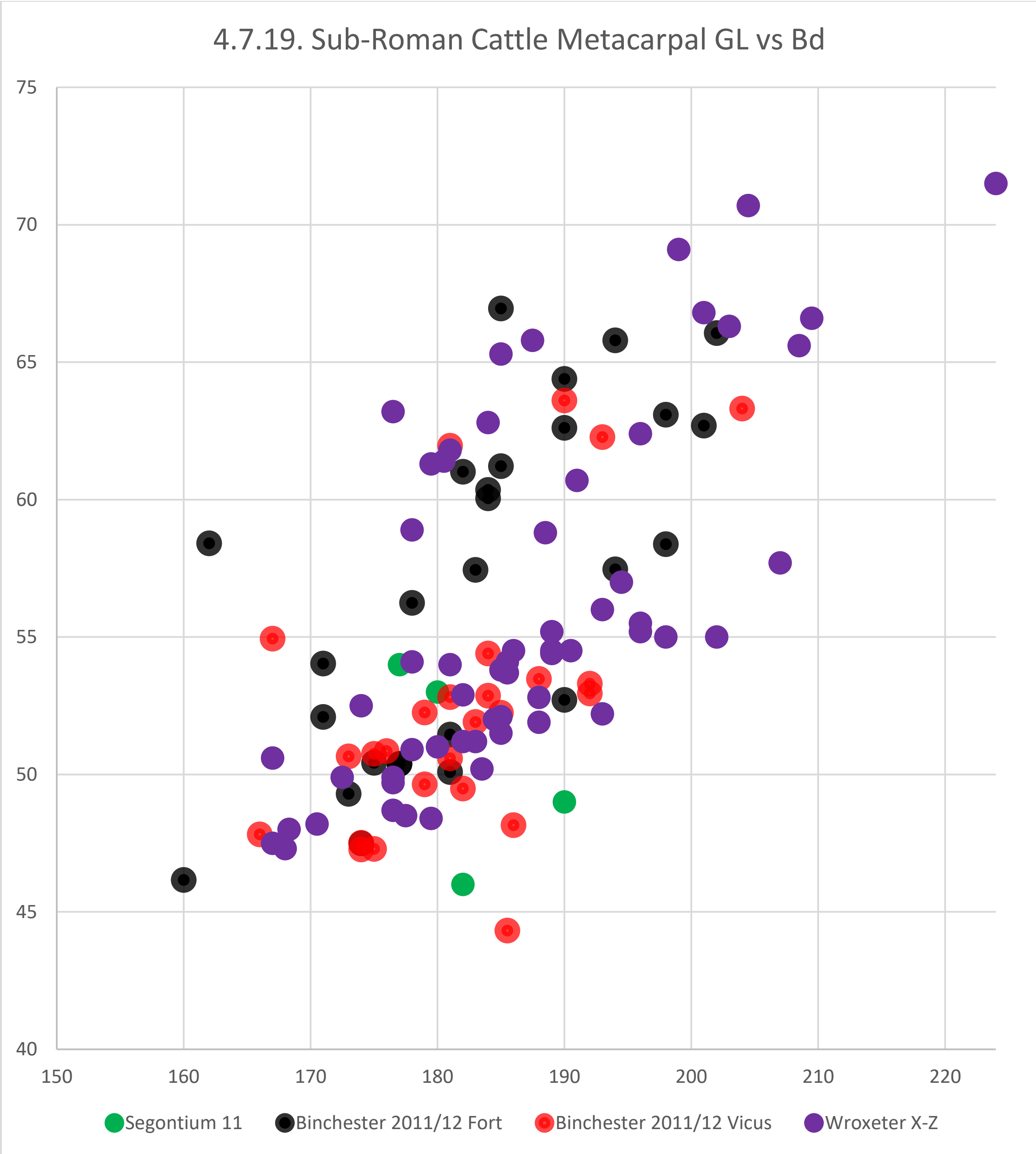

Fig. 4.7.19. Sub-Roman Cattle Metacarpal GL vs Bd. This figure shows the cattle metacarpal greatest length plotted against distal breadth measurements for the Binchester 2011/12 fort and vicus and comparative sites. (Noddle 1993; 106-7 Table 6.4; Hammon 2005, 573-585, Appendix 19)

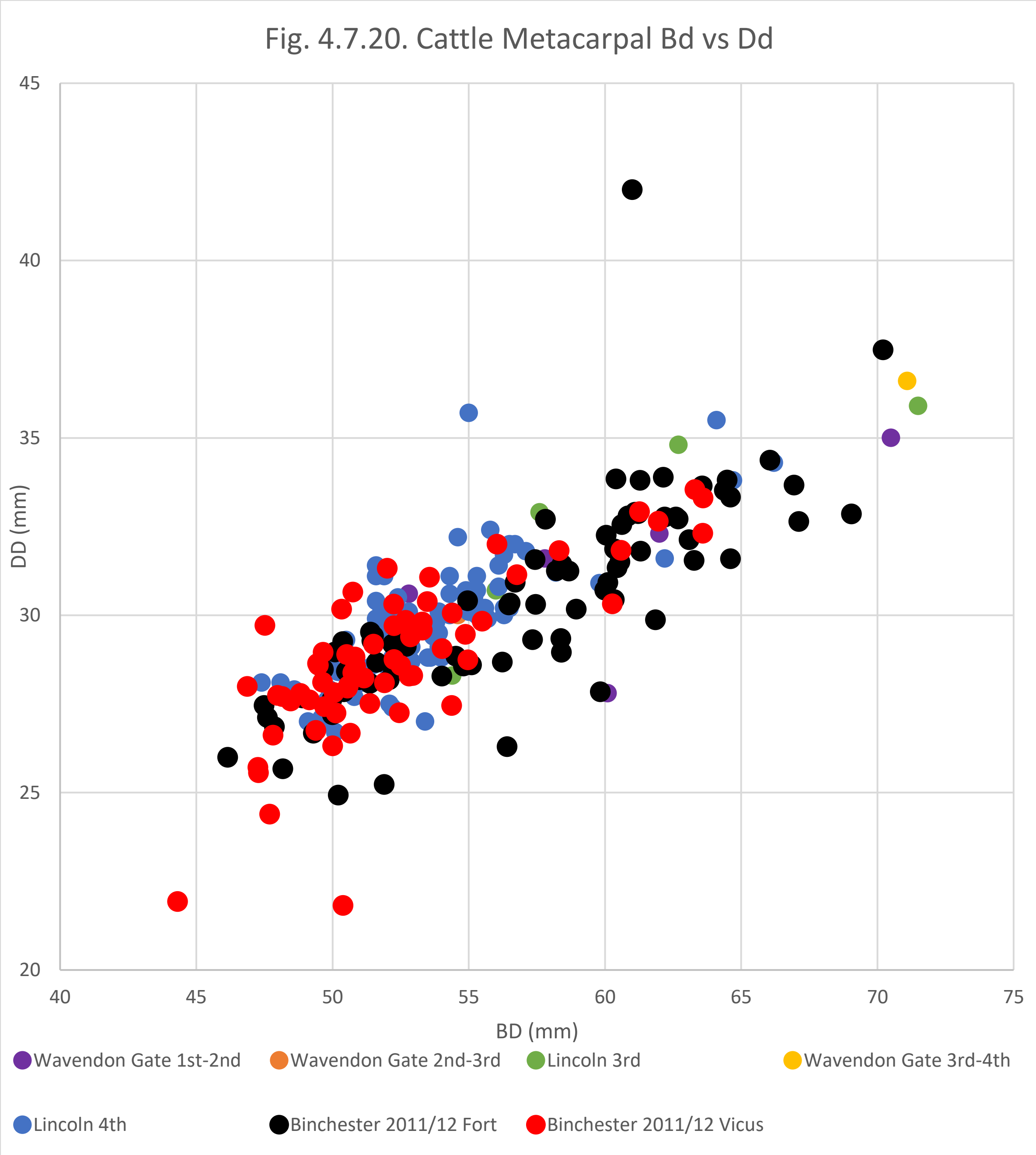

Fig. 4.7.20. Cattle Metacarpal Bd vs Dd. This figure shows the cattle metacarpal distal breadth plotted against diaphyseal depth for the Binchester 2011/12 fort and vicus and comparative sites. (Dobney and Jaques 1995, 218-219; Dobney et al. 1996, 156-161, Appendix 1)

4.7.4. Metatarsal

The metatarsal metrics are organized similar to the metacarpals, with the greatest length measurement shown in Figures 4.7.21-4.7.25, separated out into 1st-4th century and 4th-5th century. Figures 4.7.26-4.7.29 display the scatterplot of greatest length measured against distal breadth, organised in a similar fashion. However, the Binchester 2011/12 measurements have been included on each scatterplot in order to facilitate a direct comparison. Finally, distal breadth is plotted against diaphyseal depth, including all chronological periods, in Figure 4.7.30.

4.7.4.1. Greatest Length (GL)

The greatest length measurements have been separated by chronological period, with the 1st-4th C. plotted separate from the 4th-5th C., with the metric information from Binchester plotted separately to allow for a comparison with each chronological period.

The total recorded measurements for the 1st-4th C. largely fit within the range outlined by the Binchester 2011/12 assemblages (Figure 4.7.22 &4.7.23). Some separation of likely female and male/castrate sized elements is visible within the aggregate metric information from comparative sites, fitting within the ranges outlined by Binchester. Of interest are the metatarsals collected from Great Holts Farm. Similar to the metacarpals, the Great Holts Farm metatarsals are of an exceptional length, measuring far beyond any other comparative site or Binchester. This reinforces the interpretation of the cattle recovered from Great Holts Farm as potential large continental castrates imported for heavy duty traction (Albarella 2003, 198; Murphy 2000).

Segontium, Wroxeter and Lincoln present assemblages dating to within the 4th-5th C. (Figure 4.7.24). Overall the comparative sites show similar groupings and concentrations of likely female and male/castrate sized elements, matching the ranges noted for the Binchester assemblages (Noddle 1993, 107-9 Table 6.4; Dobney et al. 1996, 162-165 Appendix 1; Hammon 2005, 595-608, Appendix 23). The military site of Segontium offers two separate assemblages, phases 10 and 10A. Phase 10 shows a large proportion of female sized elements, with only one likely castrate represented, although data from this phase is more limited than others (Noddle 1993, 107-9 Table 6.4). Phase 10A shows an increased number of recovered elements, falling within both female and male/castrate ranges (Noddle 1993, 107-9 Table 6.4) Lincoln displays a limited suite of metric data. However, the elements recovered fall within the likely female range, showing only one potentially male/castrate sized element (Dobney et al. 1996, 162-165 Appendix 1). This is similar to the Wroxeter data, although it is fewer in number, only one likely castrate is noted, with a majority of likely females (Hammon 2005, 595-608, Appendix 23). The urban assemblages most closely match the Binchester 2011/12 vicus, which displays a lower concentration of male/castrate sized elements than the fort. The 4th-5th c. data fits well within the range outlined by the Binchester 2011/12 material, lending further support to the idea that military sites such as Segontium and Binchester received larger numbers of castrates than urban sites or vici, suggesting the preferential provisioning of larger beasts for the occupants of military sites.

Wroxeter and Segontium provide measured metatarsals of sub-Roman date (Figure 4.7.25). Although only few measurements are available from Segontium, they fall within the range outlined by the 4th-5th c. Wroxeter provides a larger data set, showing a wider range of element sizes. This, too, correlates with the range of measurements recovered from the 4th-5th c. and broadly matches with the Binchester 2011/12 data. The sub-Roman metatarsal GL measurements suggest the presence of similarly sized cattle as in the 4th-5th c. suggesting a continued utilisation of similar sources of supply for cattle resources at the site.

4.7.4.2. Greatest Length (GL) vs Distal Breadth (Bd)

This metric is divided similarly to the greatest length, with comparative sites separated into three chronological periods: 1st-4th C. (Figure 4.7.26 & 4.7.27), 4th-5th C. (Figure 4.7.28) and sub-Roman (Figure 4.7.29). Additionally, the Binchester 2011/12 metric information from the fort and vicus are plotted on each graph in order to facilitate a direct comparison between Binchester and comparative sites.

The 1st-4th comparative data can be seen in Figure 4.7.26& 4.7.27. With metatarsals being less sexually dimorphic than metacarpals, concentrations into female and male/castrate ranges is less consistent (Higham 1969a, 1969b). However, available data from comparative sites fits roughly with the ranges demonstrated by the Binchester 2011/12 material. Both female and castrate-sized elements are present at Wavendon Gate. For the site of Haddon, the measurements taken fit within the ranges outlined by the Binchester 2011/12 assemblages (Baxter 2003, 122). The elements from Haddon 5-6 show elements fitting into the likely female range, but displaying a greater degree of robusticity and slightly elevated size, possibly indicating their utilisation for traction work (Baxter 2003, 122). The settlement at Hacheston offers only limited information. However, recovered elements show slightly elevated size and robusticity than the Binchester likely female range (King 2004, 193). Metatarsals from Segontium show the presence of animals sized similarly to those recovered from Binchester 2011/12, although they display a somewhat lower overall robusticity. The elements at Great Holts Farm again form the highest range of elements analysed, with almost all recovered elements displaying a greater length and robusticity than even the largest elements recovered from Binchester (Albarella 2003, 198). This again solidifies the interpretation of the Great Holts Farm cattle as potential continental imports, and of a completely different variety than the cattle recovered from Binchester.

The metric data recorded from comparative materials dating to the 4th-5th C. shows more similarity to the Binchester 2011/12 assemblages than those of earlier date (Figure 4.7.28). The urban site of Lincoln in the 4th C. shows a large number of mainly female sized elements, displaying only 1 castrate sized individual (Dobney et al. 1996, 162-165 Appendix 1). The low occurrence of castrate-sized elements with a majority of measurements falling into the likely female range at Lincoln is highly similar to the Binchester 2011/12 vicus assemblage, possibly indicating a similarity in supply at both sites. Wroxeter, although it presents fewer measured elements within this time period, also bears a great deal of similarity with the Binchester 2011/12 vicus, presenting only one likely castrate, with the remainder of measured elements falling within the likely female range (Hammon 2005, 595-608, Appendix 23). Segontium presents two assemblages, each covering half of the 4th C. While only a limited data set is available from Segontium 10, the measurements continue in the trend of earlier assemblages, displaying a lower overall robusticity of recovered elements while maintaining a similar height profile (Noddle 1993, 107-9 Table 6.4). With a larger assemblage, the concentrations of Segontium 10A are more discernible. Elements recovered from Segontium 10A show a slight increase in robusticity from Segontium 10 (Noddle 1993, 107-9 Table 6.4). However, in spite of this increase in robusticity, the overall distal breadth measurements are still lower than similarly sized elements from the Binchester 2011/12 data. A larger occurrence of castrate sized individuals at the fort at Segontium shows much similarity with those seen at the Binchester 2011/12 fort, suggesting a similar preference or provisioning of animals for the site (Noddle 1993, 107-9 Table 6.4). The Binchester 2011/12 material, when viewed through the lens of our comparative sites, shows a discrepancy between civilian and military sites, with the fort at Binchester more closely matching the fort of Segontium, and the vicus fitting best with the concentrations noted at urban Lincoln and Wroxeter. This may suggest a maintained distinction in identity between military and civilian occupants of sites, with military forces better able to acquire larger animals in greater numbers for consumption.

Sub-Roman Wroxeter roughly correlates to the measurements of 4th-5th c. date, suggesting the presence of similarly sized cattle in both time periods (Figure 4.7.29). Segontium, although presenting limited data, falls within the same range of measurements outlined by the larger 4th-5th c. assemblage. This sub-Roman data indicates a maintenance of sources of supply for cattle resources into the sub-Roman period, with similarly sized cattle seeing continued utilisation at these sites.

4.7.4.3. Distal Breadth (Bd) vs Diaphyseal Depth (Dd)

Expanding on our analysis of the robusticity of cattle populations from different comparative sites, distal breadth is plotted against diaphyseal depth in Figure 4.7.30. All sites show measurements falling squarely within the likely female concentration outlined by the Binchester 2011/12 assemblages. In fact, the measurements provided within this range show very little variation, and almost all are closely grouped together. The grouping is more robust than the smallest measurements found in the Binchester 2011/12 fort and vicus, falling towards the middle of the established likely female range. Hacheston D shows one measurement that exceeds the robusticity of likely females, approaching the castrate range (King 2004, 193). This element is likely representative of a castrated male, although it may be a larger female. Wavendon Gate provides one element dating to the 1st-2nd C that shows a greater robusticity, falling within the castrate or intact male range, indicating the presence of castrates at the site during this chronological period (Dobney and Jaques 1995, 220).

The Binchester 2011/12 fort and vicus most closely match metric data recovered from the Late Roman Period dating to the 4th-5th c. Furthermore, the fort metric data closely matches other assemblages recovered from within forts, showing the presence of both likely female and castrates. The vicus, on the other hand, bears greater similarity to the urban sites of Lincoln and Wroxeter in the 4th c. This elucidates a clear difference between fort and vicus, with occupants of the fort, and at other military sites, seeing an elevated presence of larger animals, while civilian settlements such as urban Lincoln and the vicus at Binchester subsist mainly on smaller likely females. The metric information gleaned from metatarsals suggests a weighted system of provision, with a greater amount of larger individuals being driven to butchered and consumed within the military sites, with urban sites seeing a lower representation of larger beasts.

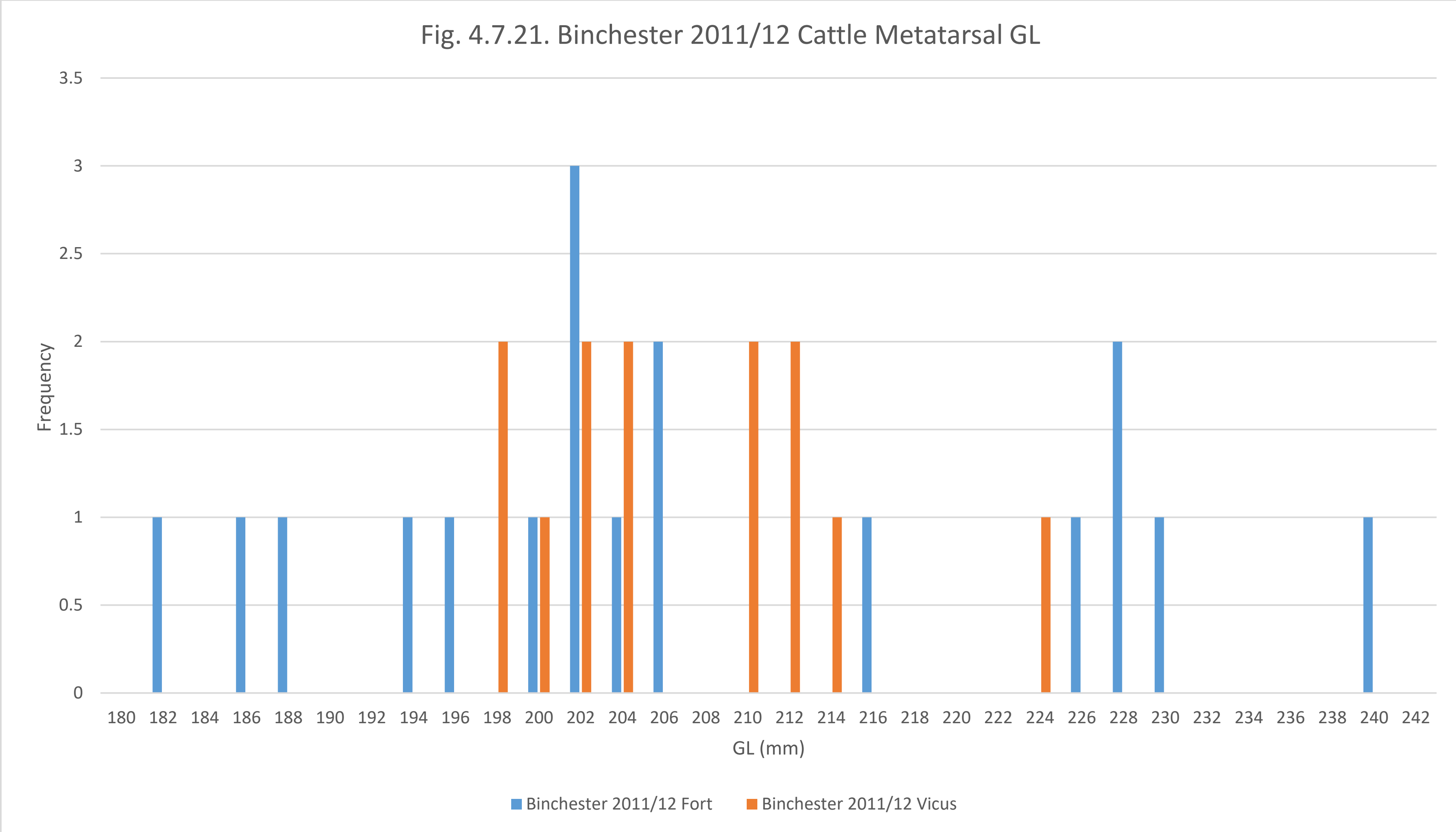

Fig. 4.7.21. Binchester 2011/12 Cattle Metatarsal GL. This figure shows the cattle metatarsal greatest length for the Binchester 2011/12 fort and vicus.

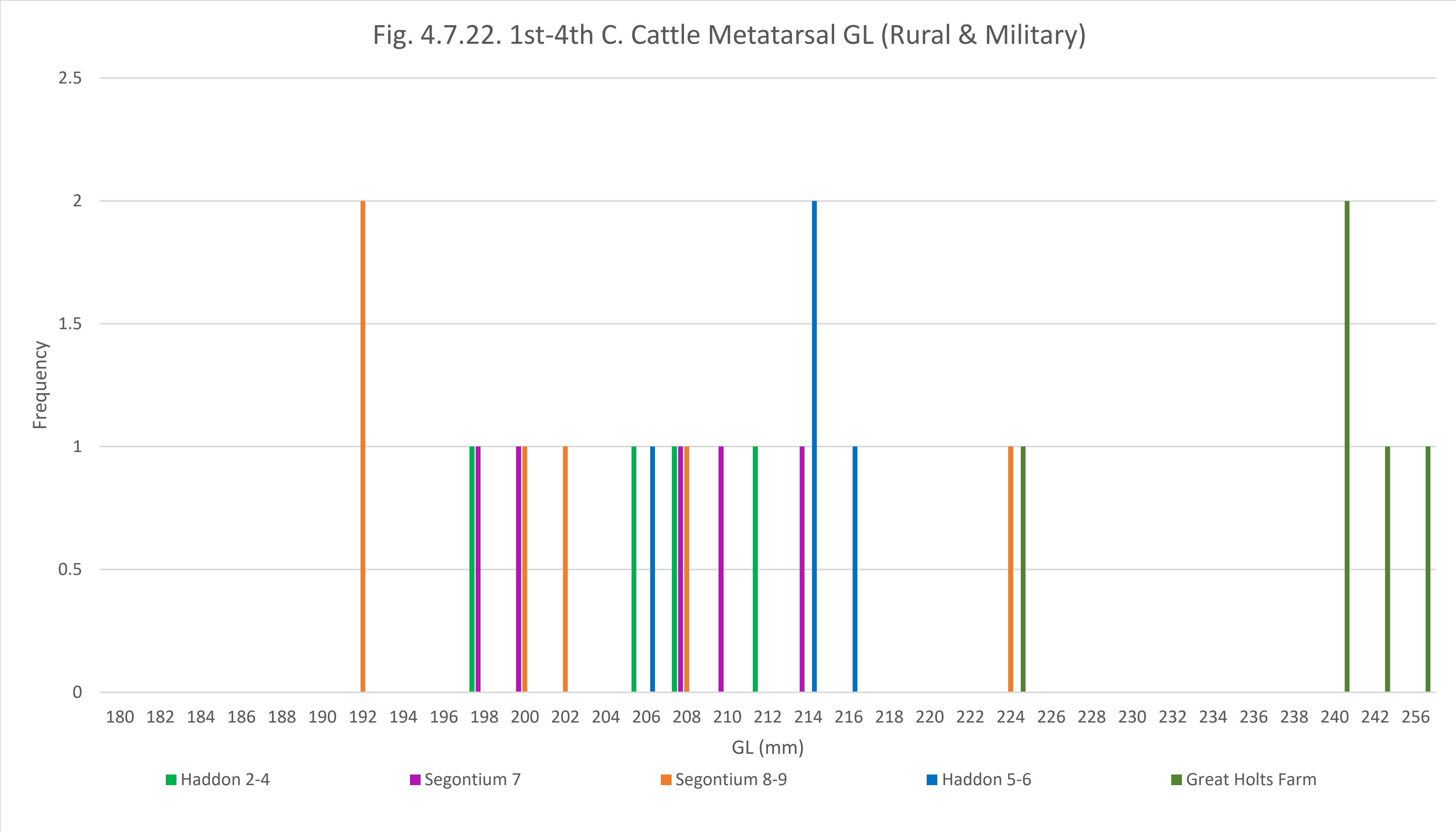

Fig. 4.7.22. 1st-4th C. Cattle Metatarsal GL (Rural & Military). This figure shows the cattle metatarsal greatest length for rural and military comparative sites dated to within the 1st -4th C. AD. (Baxter 2003, 130 Table 6.14; Noddle 1993, 107-9 Table 6.4; Albarella 2003, 196-198)

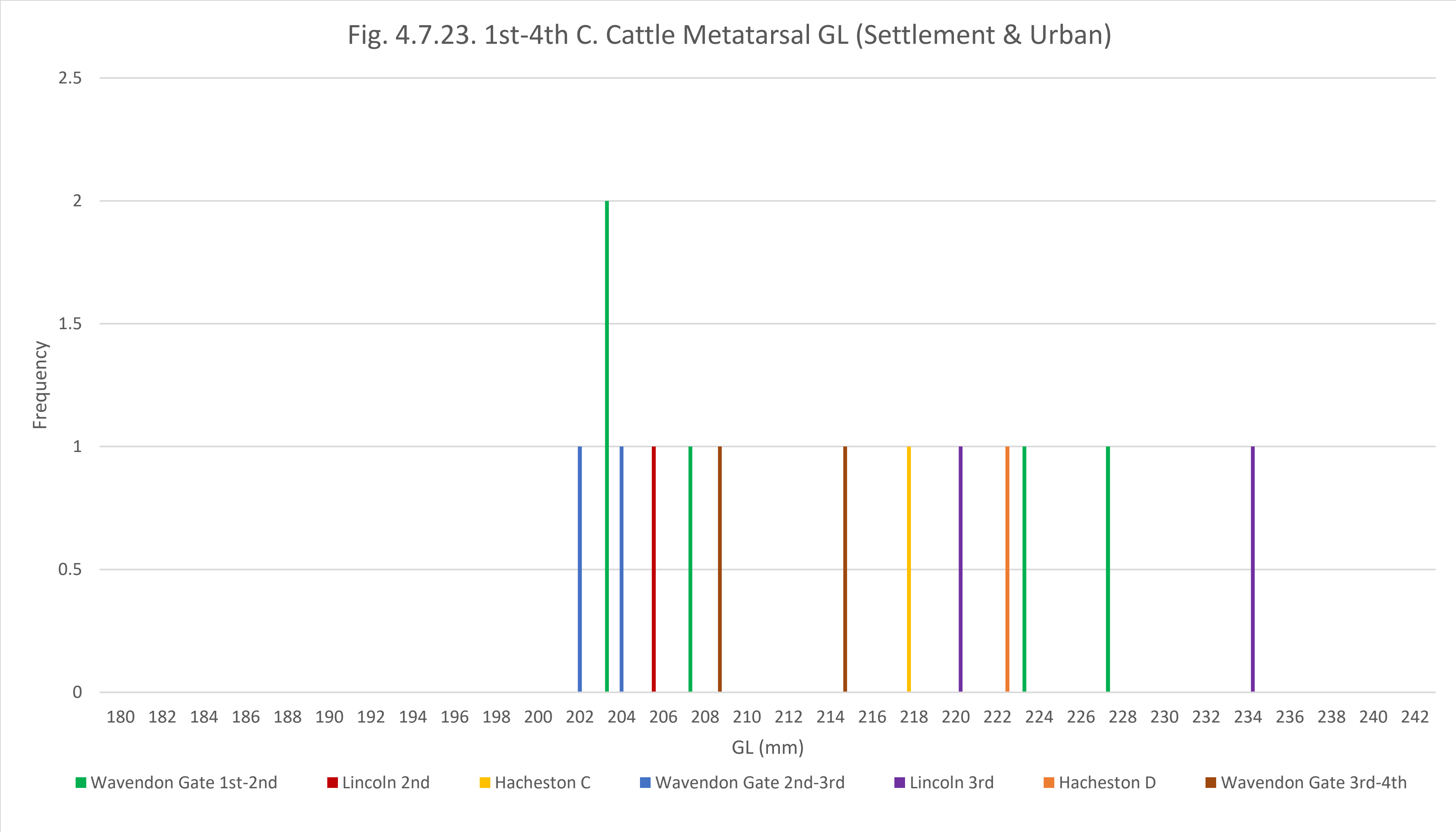

Fig. 4.7.23. 1st-4th C. Cattle Metatarsal GL (Settlement & Urban). This figure shows the cattle metatarsal greatest length for settlement and urban comparative sites dated to within the 1st -4th C. AD. (Dobney and Jaques 1995, 218-219; Dobney et al. 1996, 162-165 Appendix 1; King 2004, 194 Table 42)

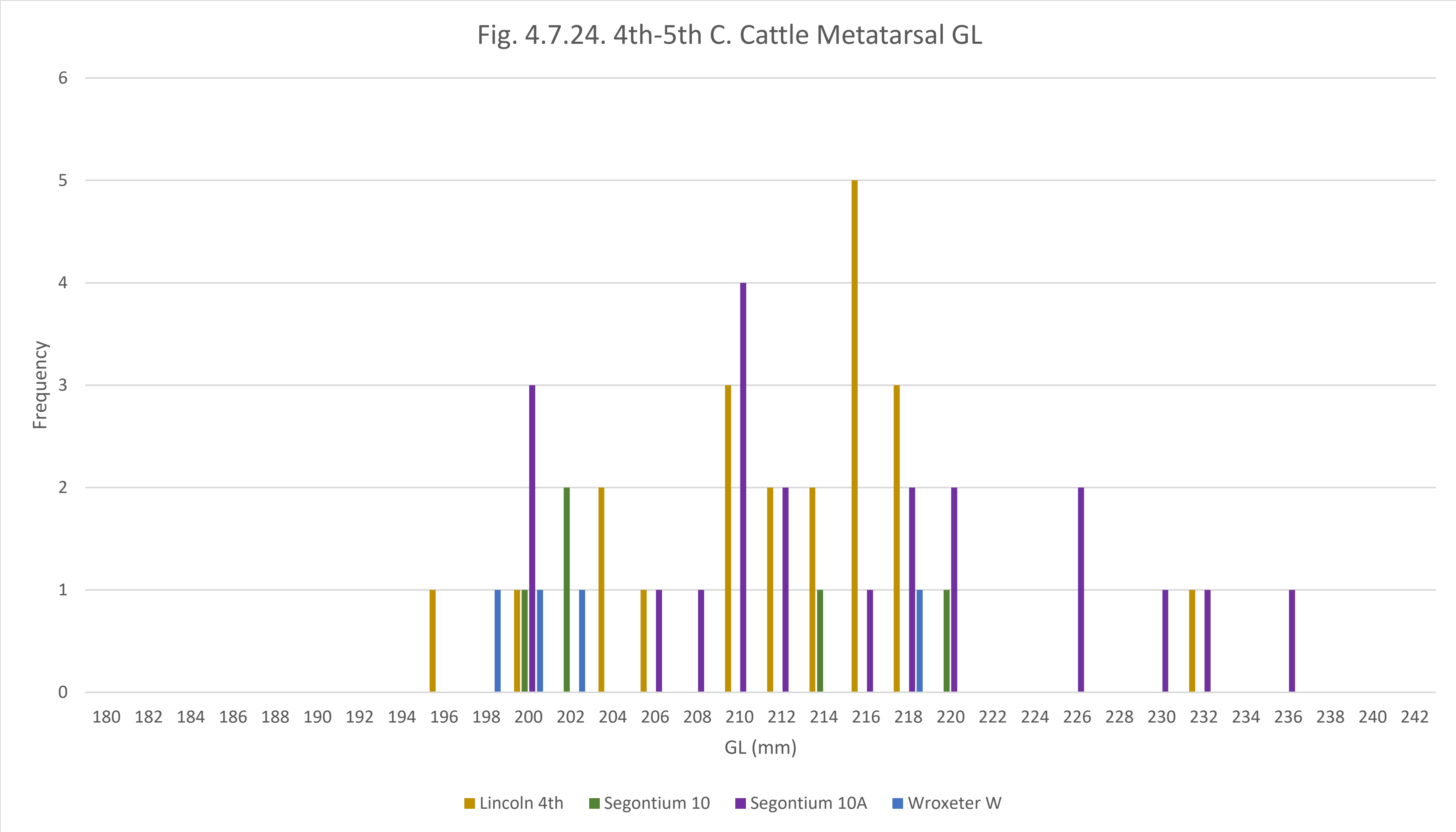

Fig. 4.7.24. 4th-5th C. Cattle Metatarsal GL. This figure shows the cattle metatarsal greatest length for comparative sites dated to within the 4th-5th C. AD. (Dobney et al. 1996, 162-165 Appendix 1; Noddle 1993, 107-9 Table 6.4; Hammon 2005, 595-608, Appendix 23)

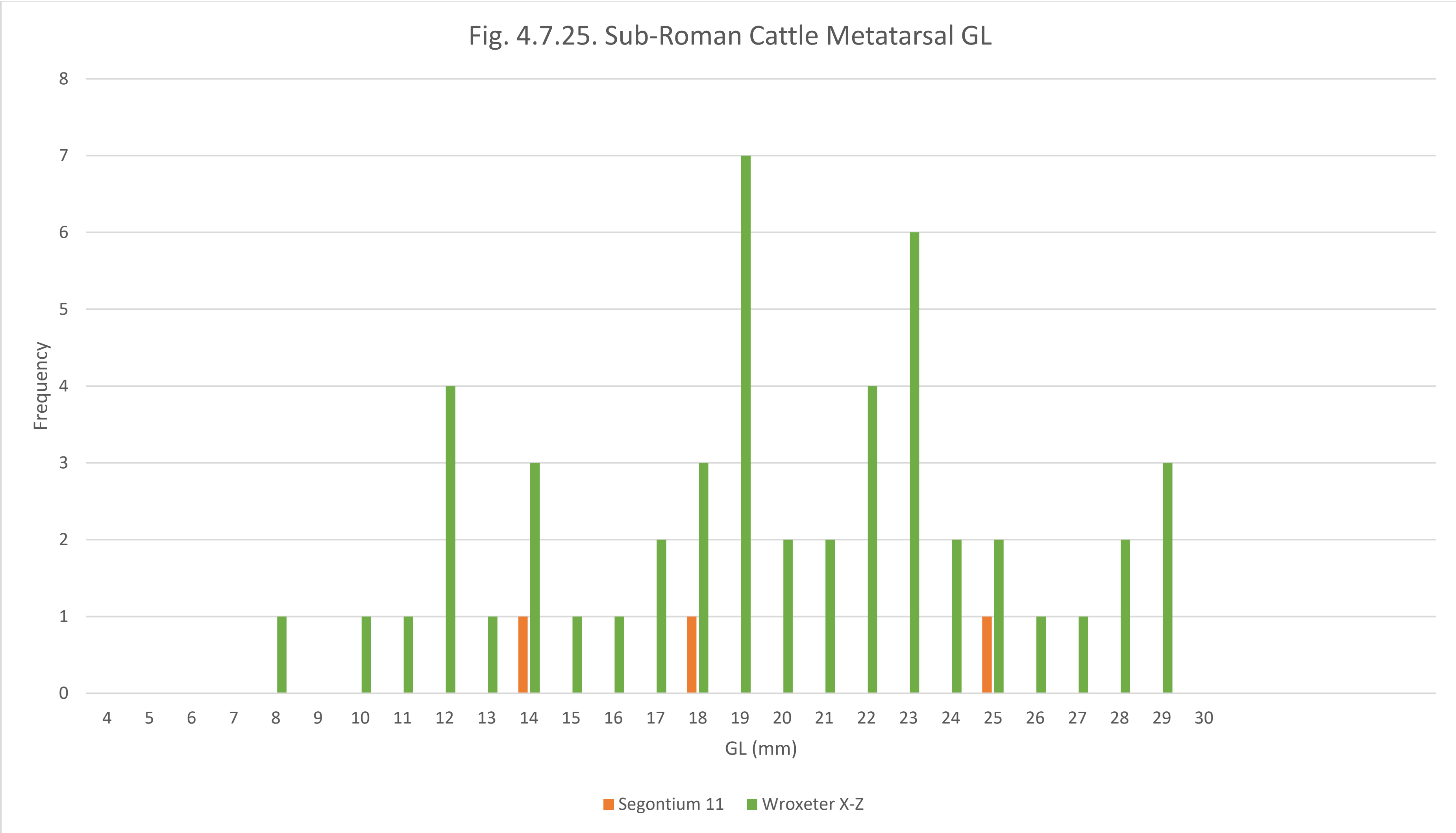

Fig. 4.7.25. Sub-Roman Cattle Metatarsal GL. This figure shows the cattle metatarsal greatest length for comparative sites dated to the sub-Roman Period. (Noddle 1993, 107-9 Table 6.4; Hammon 2005, 595-608, Appendix 23)

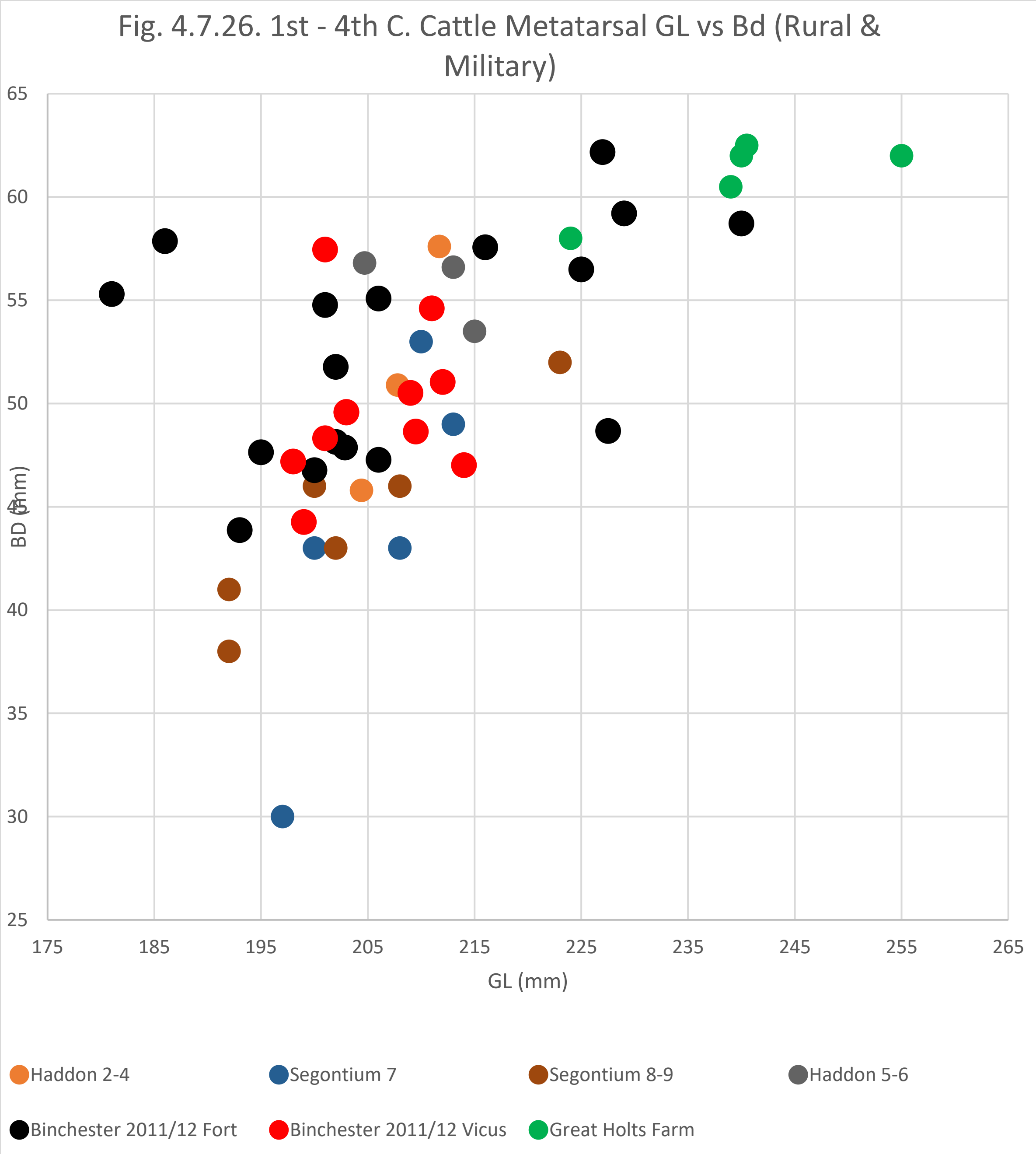

Fig. 4.7.26. 1st-4th C. Cattle Metatarsal GL vs Bd (Rural & Military). This figure shows the cattle metatarsal greatest length plotted against distal breadth for the Binchester 2011/12 fort and vicus and rural and military comparative sites. (Baxter 2003, 130 Table 6.14; Noddle 1993, 107-9 Table 6.4; Albarella 2003, 196-198)

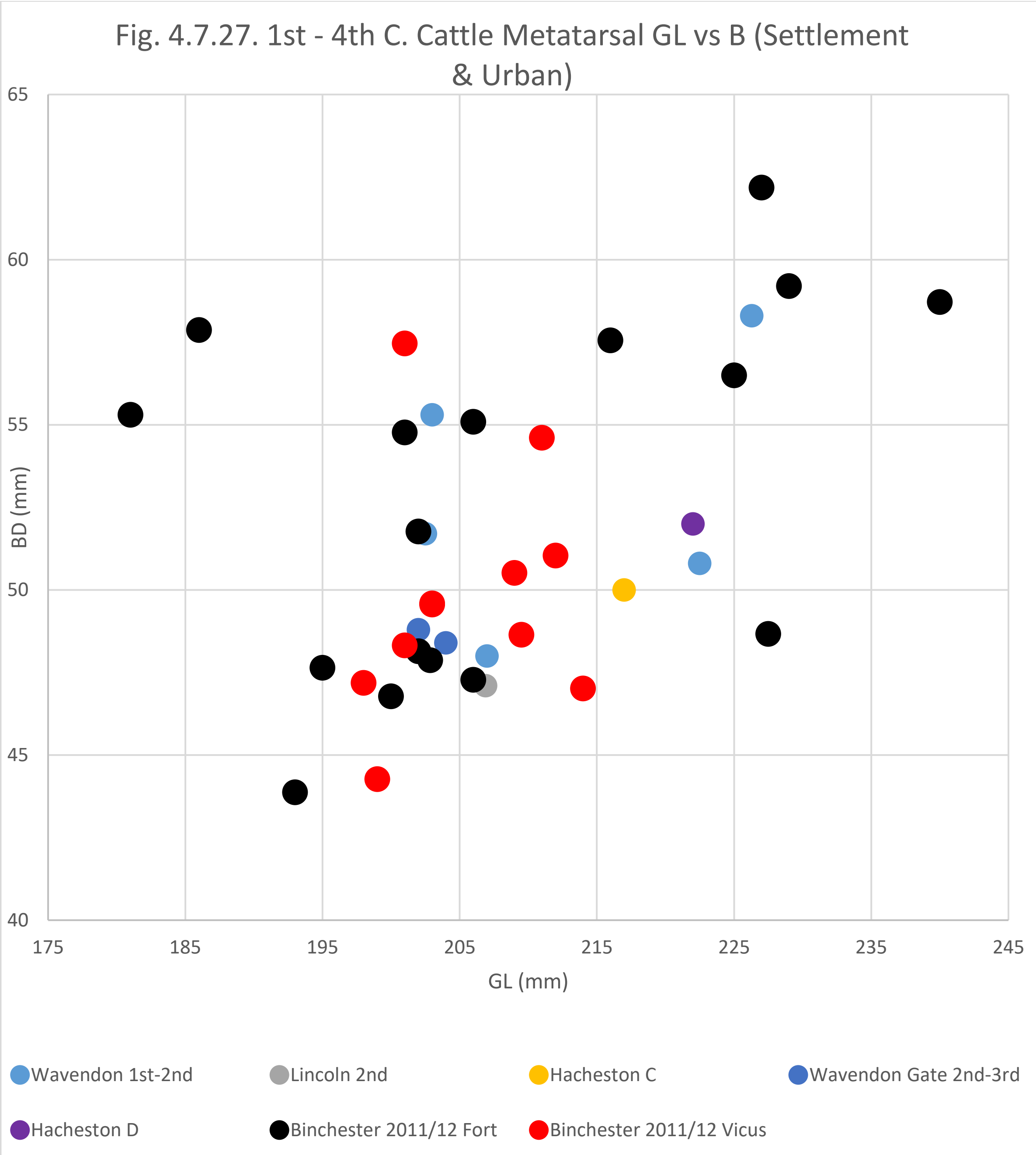

Fig. 4.7.27. 1st-4th C. Cattle Metatarsal GL vs Bd (Settlement and Urban). This figure shows the cattle metatarsal greatest length plotted against distal breadth for the Binchester 2011/12 fort and vicus and settlement and urban comparative sites dating to within the 1st-4th C. AD. (Dobney and Jaques 1995, 218-219; Dobney et al. 1996, 162-165 Appendix 1; King 2004, 194 Table 42)

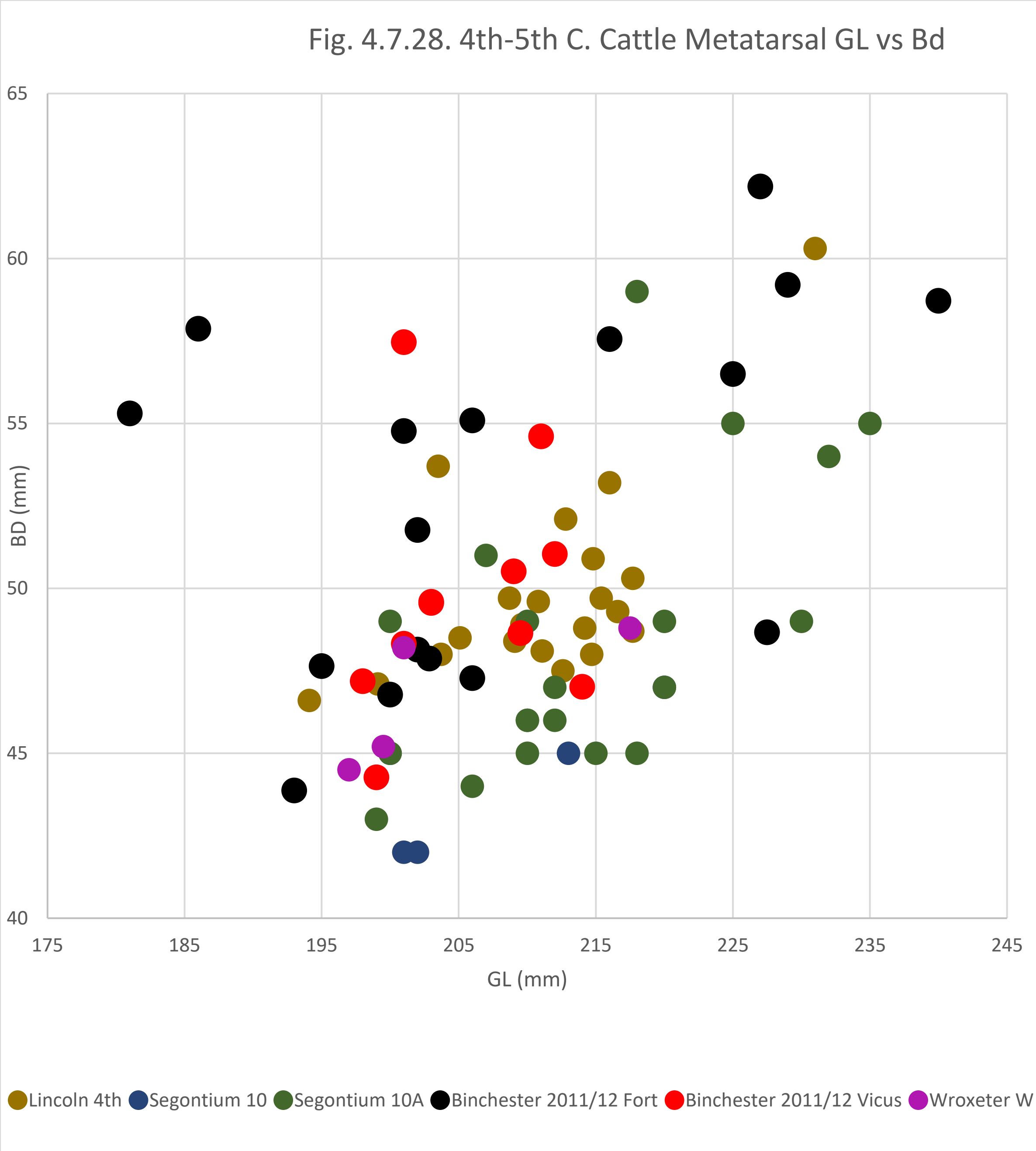

Fig. 4.7.28. 4th-5th C. Cattle Metatarsal GL vs Bd. This figure shows the cattle metatarsal greatest length plotted against distal breadth for the Binchester 2011/12 fort and vicus and comparative sites dating to within the 4th-5th C. AD. (Dobney et al. 1996, 162-165 Appendix 1; Noddle 1993, 107-9 Table 6.4; Hammon 2005, 595-608, Appendix 23)

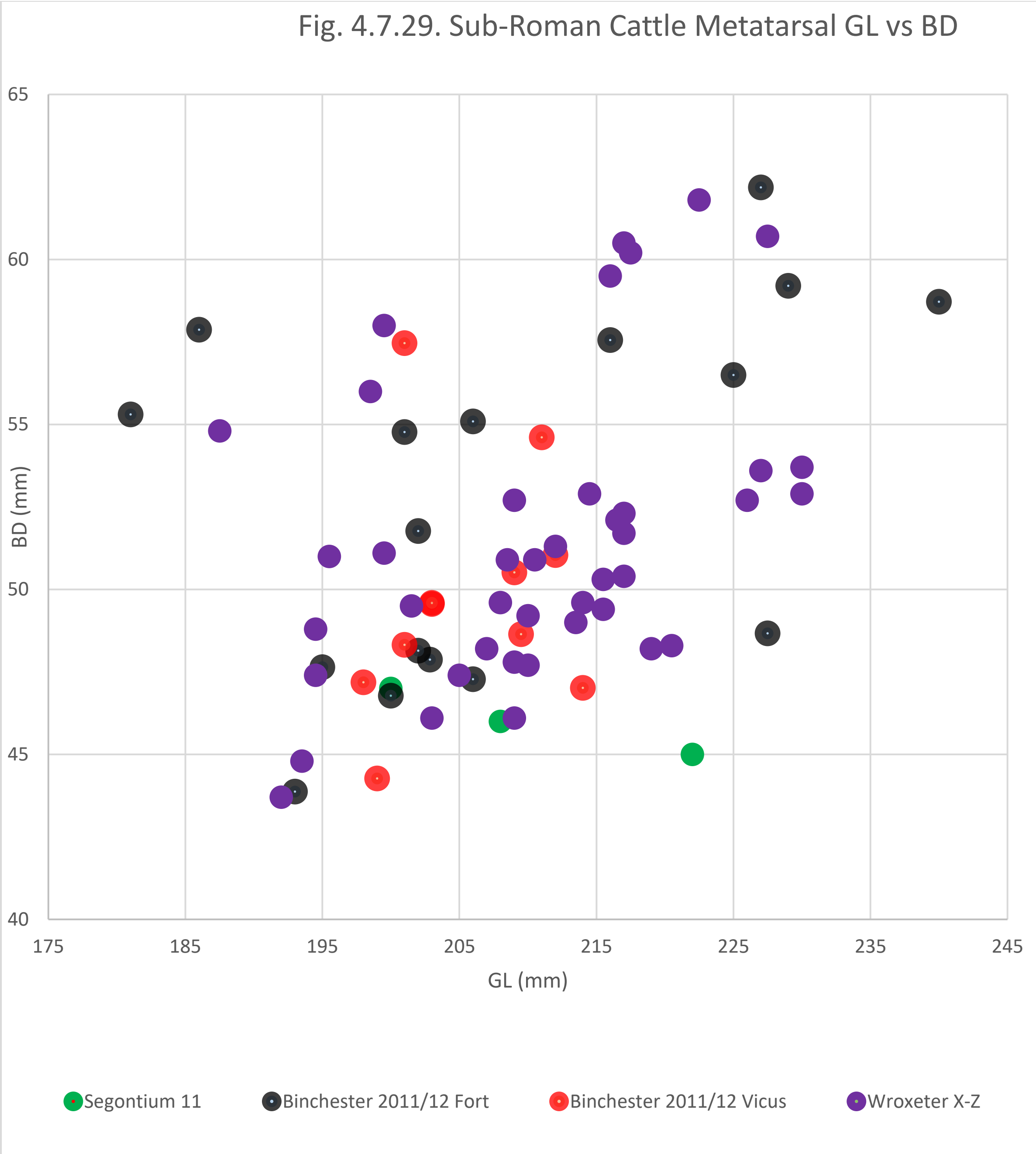

Fig. 4.7.29. Sub-Roman Cattle Metatarsal GL vs Bd. This figure shows the cattle metatarsal greatest length plotted against distal breadth for the Binchester 2011/12 fort and vicus and comparative sites dating to within the sub-Roman Period. (Noddle 1993, 107-9 Table 6.4; Hammon 2005, 595-608, Appendix 23)

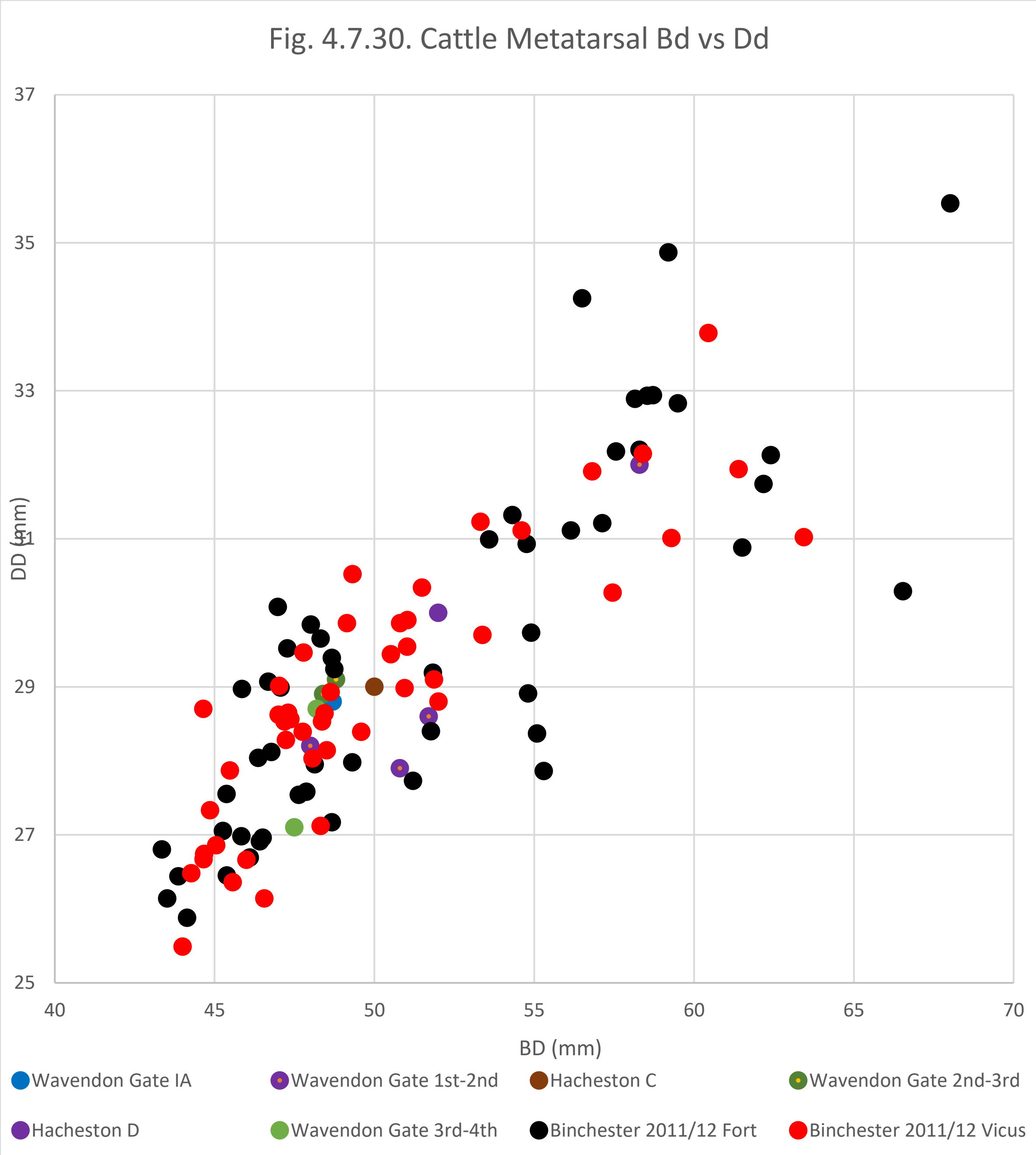

Fig. 4.7.30. Cattle Metatarsal Bd vs Dd. This figure shows the cattle metatarsal distal breadth plotted against diaphyseal depth for the Binchester 2011/12 fort and vicus and comparative sites. (Dobney and Jaques 1995, 218-219; King 2004, 194 Table 42)

4.8 Overall Implications

The comparison of the recovered data against a number of different site types covering a wide range of chronological periods will help to fortify our interpretations of the 2011/12 assemblages as well as more definitively place them within a distinct chronological period. The widespread nature of the comparative sites chosen will help to identify regional variation in animal utilisation and cattle husbandry, as well as enhance the understanding of cattle supply and utility within Roman Britain.

4.8.1. Shape and Function: Morphological Features

Morphologically, the Binchester 2011/12 assemblages fit well within the stereotypical description of a 'Romanised' assemblage. Cattle represent the vast majority of recovered elements, with butchery marks consistent with cleaver use and pathological markers indicating the utilisation of some individuals as a source of traction. Comparative sites share these features, with all sites save the notably different Haddon containing cattle-dominated assemblages, with signs of utilisation of cattle for traction. Cattle elements at all sites show a high incidence of butchery with cleavers, with element distribution suggesting that whole animals were brought on site and butchered at Binchester and a majority of comparative sites. Congenitally missing M3 3rd cusps suggests that the cattle recovered at military and urban sites were likely sourced locally rather than imported from afar. Age at death for cattle reinforces the morphological analysis, showing the heightened presence of cattle aged beyond the ideal age of slaughter. This contributes further evidence in support of the prevalent utilisation of cattle resources as a source of traction, particularly in the 4th-5th c. Little morphological difference between urban, military and rural cattle is noted, further attesting to the local origins of cattle resources and prevalence of typically 'Roman' use of cattle in the Late Roman Period. Examination of sub-Roman assemblages suggests the continuity of practices into the century following the cessation of direct Roman influence on Britannia. The Binchester fort and vicus, continuing to display a remarkable degree of similarity, have the most in common with other Late Roman assemblages dating to the 4th-5th c., particularly the military sites of Carlisle and Segontium, and the urban centres of Lincoln and Wroxeter.4.8.2. Metrics: Convergent practices, Divergent identities

4.8.2. Metric Analysis: Similar Practices, Divergent Identities

The similar size ranges noted between different site types suggests that the cattle at these sites were likely procured through locally derived sources. Metric analysis of recorded metacarpals, humeri and metatarsals across all comparative sites shows a potential division in identity between military and civilian sites, with forts seeing a higher presence of larger cattle. While both site types feature a large concentration of smaller, likely female, cattle, only the fort of Segontium and the Binchester 2011/12 fort show an elevated presence of likely castrates, and the occurrence of these animals within the Binchester 2011/12 vicus, Wroxeter and Lincoln is rare. The similarity in the range of measured elements suggests that the cattle within these sites are of the same breed, or are at least of similar sizes, even into sub-Roman assemblages. This similarity in size indicates that the divergence is not one of source of supply, but potentially a system of preferential provisioning of larger animals within military sites. Overall the Binchester 2011/12 assemblages bear the greatest similarity with comparative material dating to the 4th-5th c. with the fort best matching with military Segontium and the vicus bearing greater similarity to urban Lincoln and Wroxeter.

5. In Retrospect: Future Work and Conclusions

5.1. Future Work

The study of the faunal remains collected from the 2011/12 excavations at Binchester has yielded a great deal of valuable information concerning the husbandry strategies employed at the fort and vicus. This initial analysis provides the opportunity for a wide array of further work on the site of Binchester.

First, a large amount of further faunal material has yet to be analysed. This study only considers the faunal remains recovered from the 2011 and 2012 excavation seasons, with the program of excavation continuing through 2015. The assemblages recovered from both fort and vicus in the 2013 assemblage is roughly equal in size to that analysed in this study, with further large assemblages recovered in 2014 and 2015. Preservation of the assemblages from further years of excavation ranges from moderate to excellent, with large, dense concentrations of animal bones lending further survivability. With a large amount of the remaining assemblages being unwashed, a full analysis of the recovered materials represents a large amount of work. However, a complete analysis of all recovered faunal materials would amount to an exceptionally large assemblage, possibly the largest in Northern Britain. Furthermore, the full analysis of excavated faunal remains would result in a huge amount of metric and nonmetric information recorded from well-preserved elements. This would help to further explore any potential differences between the practices and identities of the occupants of the fort and vicus. Second, and crucially important. The dating of the current project’s stratigraphy is quite limited, relying on preliminary pottery and coinage reports as well as a few radiocarbon dates. A detailed phasing of the stratigraphic layers of an excavation allows researchers to assess change over time, as well as accurately date the material being examined. This is crucially important for the Binchester faunal remains. First, faunal remains on their own offer little insight into the chronology of a site. Instead analysts must rely on the phasing offered through other means in order to accurately sort faunal remains into the correct chronological period. Second, Binchester itself is known to see continued occupation into the sub-Roman Period (Ferris 2010). However, without a detailed chronology of the site, it is difficult to assess which contexts are of sub-Roman date, and which are Late Roman, making it difficult to assess the transitional period between late- and sub-Roman Binchester. The completion of exhaustive pottery or coinage reports at the site, or the acquiring of a greater number of radiocarbon dates, will dramatically increase the ability of faunal analysts to assess change over time at Binchester.

Butchery is an important, and often overlooked, morphological feature of faunal assemblages. Detailed analysis and quantification of butchery marks can yield a wide range of information concerning butchery practices as well as cultural norms (Historic England 2015). Some analysis has gone so far as to note distinctive trends in the location of particular cleaver marks, positing that different schools of butchery and the distribution of joints of meat across urban sites (e.g. Seetah 2006). Thus, a more complete and detailed analysis of the style and location of butchery marks on recovered elements within the Binchester assemblage may reveal further differences between the fort and vicus with regard to distinctive styles of butchery between practitioners.

Building on the completion of the analysis of the faunal material recovered from Binchester, there are a large number of sites across the north of Britain with moderate to large faunal assemblages that remain without analysis, including a number of forts along Hadrian’s Wall, such as South Shields. As noted previously, large-scale zooarchaeological analysis of large assemblages can be cost-prohibitive, often resulting in the storage of large amounts of faunal material without any detailed analysis (Stallibrass 2008, 1). However, zooarchaeological analysis of the already collected and stored assemblages can help further understanding of the Northern frontier of the Roman Empire, as well as contribute valuable information concerning the transitionary period in the late 4th/early 5th C., when Roman influence was withdrawn from Britannia.

With the differences between fort and vicus suggested by the metric analysis of the 2011/12 faunal assemblages, the possibility of different sources of cattle must be considered. Unfortunately, metric information can only hint at different sources of supply, giving few indications as to the geographical location of the cattle population. With this in mind, conducting radioisotopic analysis of recovered cattle molars may yield valuable information on these points (Heaton 2008, 508; Viner et al. 2010, 2814). The analysis of oxygen and carbon radioisotopes can give information concerning the dietary patterns and locations of cattle populations (Heaton 2008, 508). This could provide valuable information concerning the cattle populations excavated at Binchester. Furthermore, radioisotopes such as strontium can provide geographic indicators for animal populations, both where they originated and where they were raised (Viner et al. 2010, 2813). While these indicators are susceptible to some degree of interpretive difficulty, the information they provide is largely unique, allowing for interpretations to be made regarding sources of supply and the interaction between Binchester and its hinterland. The analysis of isotopic evidence recovered from Binchester would be of great interpretive value, helping researchers to further understand the husbandry strategies employed on site, as well as the function and relation of the site with its hinterland and other localities.

9.2. Conclusions

This purpose of this study was to conduct a zooarchaeological analysis of the recovered faunal material from the 2011/12 excavation seasons at Binchester, with assemblages recovered from within the fort and within the attached vicus. As discussed in Chapter 1, this analysis was conducted in an attempt to answer the following research questions:

- What do the faunal remains tell us about the subsistence strategies, culture, and identity of the occupants of the fort and vicus at Binchester?
    - Do the faunal assemblages resemble what would be expected of a 'Romanised' archaeological site?
- Are there differences in the cattle remains between the fort and vicus assemblages?
    - Is this indicative of different sources of supply, or potentially a divergence/convergence in culture, status or identity between the two areas?
- Do these patterns bear any similarity with other sites or time periods?
    - Which site-type and time period bears the greatest similarity with the Binchester assemblages?

5.2.1 Binchester in Life

Zooarchaeological analysis of the faunal remains from the 2011/12 fort and vicus assemblages revealed a wealth of information about animal utilisation on site. Cattle were of primary importance, representing over 70% of recovered fragments, with a similar representation in terms of minimum numbers of animals recovered. The morphometric analysis of cattle remains paints a picture of their lives. The cattle population at Binchester was likely born in a more rural locale, possibly located within the site's hinterland. A large number of the cattle were used as beasts of burden, pulling heavy carts or ploughs, and suffering the injuries and skeletal responses associated with this practice. Shortly after reaching adulthood, either due to a proscribed age or outliving their utility as beasts of burden, the cattle were transported to Binchester, likely being driven there rather than carted themselves. Some cattle appear to have been the ideal age for meat, although the majority was significantly older, further suggesting their utilisation as beasts of burden. The high occurrence of cleaver marks on recovered bones suggests that, no matter what their purpose in life, their path inevitably ended at the butcher's block, with cattle carcasses being expediently chopped into manageable and easily distributable portions. Knife marks on the lower limb bones suggest that some hide removal was taking place, probably for leather production. Likely butchered nearby, the waste from cattle butchery, secondary processing, and consumption was all deposited within the same features, including pits, gullies, and even abandoned buildings along the road in the vicus.

The cattle were of a native size, and consisted mainly of females and castrated males. While the females may represent breeding stock outliving their utility, it is possible that they were also utilised as beasts of burden prior to consumption. Most recovered metapodials show a degree of distal splaying, further reinforcing the exploitation of these animals for traction work. Overall, cattle were of exceptional value to the occupants of the Binchester fort and vicus. In life they were utilised as beasts of burden, and in death served as sustenance and secondary products.

5.2.2 Binchester in Comparison

Morphologically, a great deal of similarity is seen between the fort and vicus assemblages, suggesting a high degree of social cohesion and interrelatedness between the two areas. Little variation between species representation, age at death, butchery, pathology, or element distribution is noted. The depositions likely originate from the same series of practices, being practiced in a similar style and to a similar degree. As discussed in chapter 3, this similarity between two contiguous areas is not unexpected, as there is likely to be a good deal of exchange and interrelation between them.

While every line of morphological evidence suggests that the fort and vicus, at least in terms of the utilisation of cattle resources, are all but identical, the metric analysis shows a clear division between them. The cattle from both areas occupy similar size ranges, likely belonging to the same population, or at least the same breed of cattle. It is through the frequency of cattle size that we see a distinct discrepancy between the fort and vicus. Both assemblages have large concentrations of likely females, and castrates are represented in both as well. However, the fort displays a significantly higher proportion of taller, likely castrated male cattle elements, while relatively few are represented within the vicus assemblage. Given the potential military oversight of cattle provisioning for both areas, it is possible that this represents a system of preferential provisioning of larger cattle to the occupants of the fort.

Where the morphological analysis shows a convergence in practice and utilisation of cattle resources, the metrics of the recovered cattle show a clear difference in the provisioning of the larger animals. This, in turn, is evidence of a possible division in identity between the occupants of the two areas.

5.2.3 Binchester in Context

Morphologically and metrically, Binchester shares a great deal of similarity with comparative urban and military sites. Binchester displays the general trends of species utilisation and cattle processing and exploitation that are associated with a typically ‘Romanised’ site of Late Roman date. In this period, cattle represented the dominant domesticate utilised in all sites consulted, save for those notable for their rejection of Roman ways and adherence to Iron Age animal exploitation strategies (Baxter 2003). The presence of all cattle body parts across all site assemblages indicates the widespread practice of droving cattle to their final destinations, where upon their arrival they are butchered, slaughtered and consumed within the same general vicinity, with the resultant waste from each process being deposited in the same area (Stallibrass 2009, 102). Pathological indicators show the presence of cattle utilised for traction across all site types and time periods. Further, the presence of congenital defects at a number of military and urban sites indicates the likely local origins of their cattle resources. The Roman style of expedient butchery with cleavers is present in all Late Roman assemblages, suggesting the ubiquity of the practice during this period. Mandibular wear shows a high presence of animals aged into adulthood, years past the ideal age for slaughter. This further suggests the widespread utilisation of cattle as beasts of burden prior to slaughter and consumption. After the initial invasion and occupation of Roman Britain, there was likely a sharp divide between military and civilian, foreign and native (Mattingly 2006, 170). However, by the Late Roman Period, this division, at least in terms of observable practice and cattle exploitation, appears to have converged through economic, social and proximal motivators to form at least some aspects of shared identity as a uniquely Roman Britain.

Metric analysis reveals a number of broad trends across Roman Britain, reinforcing some aspects of the morphological analysis, but also drawing a distinction between military and non-military sites. The size of measured cattle elements reinforces the idea of local cattle sourced from local populations, as they do not approach the larger sizes of likely continental imports (e.g. Albarella 2003). While Binchester and all comparative sites displayed the presence of likely females, metric analysis revealed a distinct divergence between military and non-military sites in the proportional presence of likely castrates.   Lincoln, Wroxeter, and the Binchester vicus all displayed lower amounts of likely castrated cattle, Segontium and the Binchester fort show an elevated presence of these taller beasts. Considering the morphological similarity explored above, and that the metric information from these disparate sites occupies similar ranges, it is likely that the larger specimens, likely castrated males utilised for traction, are being requisitioned through a system of preferential provisioning towards military sites, rather than the presence of a different breed or variety of cattle. The metric information recovered from comparative sites suggests a divergence of identity between military and non-military sites, with the military better able to procure or requisition larger animals, while urban centres and non-military sites subsist mainly on smaller, gracile animals.

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Appendices

Measurements taken are according to Von Den Driesch (1976), with all listed measurements being expressed in mm.

Appendix 1. Fort Measured Cattle Elements

Element	Context	Side	Zone(s)	Measurements
1st Phalanx	323	N/A	1,3	[Bp: 24.91]
1st Phalanx	236	N/A	1,3	[Bp: 30.2]
1st Phalanx	345	N/A	1,3	[Bp: 33.34], SD: 27.89
1st Phalanx	320	N/A	1,3	[Bp: 43.27], SD: 21.95
1st Phalanx	329	N/A	Complete	[GL: 25.31], [Bp: 14.24], SD: 12.09
1st Phalanx	353	N/A	Complete	[GL: 27.7], SD: 10.93
1st Phalanx	446	N/A	Complete	[GL: 50.87], [Bp: 25.71], SD: 22.24
1st Phalanx	236	N/A	Complete	[GL: 51.13], Bp: 26.23, SD: 23.74
1st Phalanx	309	N/A	Complete	[GL: 51.36], Bp: 22.48, SD: 22.72
1st Phalanx	320	N/A	Complete	[GL: 52.22], Bp: 29.49, SD: 24.96
1st Phalanx	335	N/A	Complete	[GL: 53.64], Bp: 31.08, SD: 25.09
1st Phalanx	362	N/A	Complete	[GL: 54.13]
1st Phalanx	356	N/A	Complete	[GL: 54.83], Bp: 32.3, SD: 27.1
1st Phalanx	285	N/A	Complete	[GL: 55.86], Bp: 33.35, SD: 27.45
1st Phalanx	236	N/A	Complete	[GL: 56.75], Bp: 26.63, SD: 22.61
1st Phalanx	287	N/A	Complete	[GL: 58.2], SD: 23.78
1st Phalanx	285	N/A	Complete	[GL: 60.2], [Bp: 30.21], [SD: 25.06]
1st Phalanx	5	N/A	Complete	[GL: 51.1], SD: 23.11
1st Phalanx	5	N/A	Complete	[GL: 57.5], Bp: 26.52
1st Phalanx	291	N/A	3	[SD: 23.16]
1st Phalanx	285	N/A	3	[SD: 26.06]
1st Phalanx	355	N/A	1,3	Bp: 13.27, SD: 10.94
1st Phalanx	289	N/A	1	Bp: 22.15
1st Phalanx	314	N/A	1	Bp: 22.46
1st Phalanx	355	N/A	1	Bp: 23.59
1st Phalanx	338	N/A	1	Bp: 24.25
1st Phalanx	314	N/A	1	Bp: 25.11
1st Phalanx	314	N/A	1,3	Bp: 25.86, SD: 22.67
1st Phalanx	384	N/A	1,3	Bp: 26.17, SD: 22.5
1st Phalanx	287	N/A	1	Bp: 26.55
1st Phalanx	289	N/A	1	Bp: 26.91
1st Phalanx	314	N/A	1	Bp: 27.32
1st Phalanx	314	N/A	1	Bp: 27.77
1st Phalanx	320	N/A	1	Bp: 28.51
1st Phalanx	285	N/A	1,3	Bp: 29.16, SD: 24.39
1st Phalanx	384	N/A	1,3	Bp: 29.46, SD: 24.9
1st Phalanx	201	N/A	1, 3	Bp: 29.49, SD: 25.08
1st Phalanx	192	N/A	Complete	Bp: 29.99, SD: 26.91

1st Phalanx	414	N/A	1,3	Bp: 30.84, SD: 23.8
1st Phalanx	320	N/A	1	Bp: 31.68
1st Phalanx	291	N/A	1	Bp: 31.7
1st Phalanx	353	N/A	1	Bp: 33.58
1st Phalanx	482	L	Complete	Bp: 23.17, SD: 19.95
1st Phalanx	531	L	1	Bp: 24.54
1st Phalanx	585	L	Complete	Bp: 24.68, SD: 21.56
1st Phalanx	594	L	1	Bp: 24.86
1st Phalanx	543	L	Complete	Bp: 25.3, SD: 22.42
1st Phalanx	508	R	1	Bp: 25.53
1st Phalanx	611	L	1	Bp: 25.57
1st Phalanx	508	L	1	Bp: 25.89
1st Phalanx	276	L	Complete	Bp: 26.27, SD: 22.07
1st Phalanx	593	L	1, 3	Bp: 26.83
1st Phalanx	276	L	Complete	Bp: 27.83
1st Phalanx	586	L	1, 3	Bp: 28.62
1st Phalanx	570	L	Complete	Bp: 29.02
1st Phalanx	506	R	1, 3	Bp: 29.39, SD: 24.24
1st Phalanx	276	R	Complete	Bp: 30.47, SD: 26.77
1st Phalanx	588	L	1, 3	Bp: 30.53, SD: 23.24
1st Phalanx	592	L	1	Bp: 31.2
1st Phalanx	5	N/A	1	Bp: 31.57
1st Phalanx	276	L	1, 3	Bp: 32.22
1st Phalanx	481	L	1, 3	Bp: 33.26
1st Phalanx	531	L	Complete	Bp: 33.6, SD: 29.56
1st Phalanx	546	R	1	Bp: 34.58
1st Phalanx	321	N/A	Complete	GL: 42.59, Bp: 21.17, SD: 19.11
1st Phalanx	69	N/A	Complete	GL: 44.01, BP: 25.18, SD: 21.15
1st Phalanx	443	N/A	Complete	GL: 45.21, Bp: 17.11, SD: 13.99
1st Phalanx	402	N/A	Complete	GL: 46.23, Bp: 24.36, SD: 20.15
1st Phalanx	415	N/A	Complete	GL: 48.85, Bp: 24.89, SD: 21.08
1st Phalanx	236	N/A	Complete	GL: 49.05, Bp: 24.09, SD: 20.12
1st Phalanx	415	N/A	Complete	GL: 49.07, Bp: 25.79, SD: 21.75
1st Phalanx	329	N/A	Complete	GL: 49.13, Bp: 22.56, SD: 19.06
1st Phalanx	329	N/A	Complete	GL: 49.42
1st Phalanx	285	N/A	Complete	GL: 49.42, Bp: 25.65, SD: 22.15
1st Phalanx	314	N/A	Complete	GL: 49.42, Bp: 27.03, SD: 23.76
1st Phalanx	384	N/A	Complete	GL: 49.51, Bp: 26.24, SD: 22.26
1st Phalanx	369	N/A	Complete	GL: 49.6, Bp: 25.1, SD: 22.03
1st Phalanx	201	N/A	Complete	GL: 49.82
1st Phalanx	285	N/A	Complete	GL: 49.9, Bp: 25.47, SD: 21.94
1st Phalanx	323	N/A	Complete	GL: 50.23, Bp: 26.19, SD: 22.47
1st Phalanx	353	N/A	Complete	GL: 50.45
1st Phalanx	415	N/A	Complete	GL: 50.54, Bp: 26.03, SD: 21.8

1st Phalanx	433	N/A	Complete	GL: 50.64
1st Phalanx	291	N/A	Complete	GL: 50.71, Bp: 26.46, SD: 22.15
1st Phalanx	448	N/A	Complete	GL: 50.9, Bp: 25.82, SD: 22.12
1st Phalanx	395	R	Complete	GL: 51.14, Bp: 25.35, SD: 22.4
1st Phalanx	291	N/A	Complete	GL: 51.18, Bp: 25.98, SD: 21.38
1st Phalanx	321	N/A	Complete	GL: 51.29, Bp: 26.7, SD: 22.58
1st Phalanx	285	N/A	Complete	GL: 51.3, Bp: 24.12, SD: 21.07
1st Phalanx	340	N/A	Complete	GL: 51.31, SD: 20.11
1st Phalanx	395	R	Complete	GL: 51.35, Bp: 25.85, SD: 21.07
1st Phalanx	287	N/A	Complete	GL: 51.37, Bp: 26.49, SD: 22.99
1st Phalanx	314	N/A	Complete	GL: 51.47
1st Phalanx	314	N/A	Complete	GL: 51.49, Bp: 26.97, SD: 22.75
1st Phalanx	204	N/A	Complete	GL: 51.7, SD: 22.8
1st Phalanx	314	N/A	Complete	GL: 51.76, Bp: 24.55, SD: 22.25
1st Phalanx	314	N/A	Complete	GL: 52.02, Bp: 25.88, SD: 21.78
1st Phalanx	338	N/A	Complete	GL: 52.06, Bp: 26.6, SD: 22.9
1st Phalanx	425	N/A	Complete	GL: 52.29, Bp: 25.49, SD: 21.04
1st Phalanx	314	N/A	Complete	GL: 52.32, Bp: 24.23, SD: 20.31
1st Phalanx	444	N/A	Complete	GL: 52.61, SD: 23.74
1st Phalanx	204	N/A	Complete	GL: 52.73
1st Phalanx	293	N/A	Complete	GL: 52.91, Bp: 26.69, SD: 23.68
1st Phalanx	408	N/A	Complete	GL: 53.06, Bp: 25.87, SD: 21.12
1st Phalanx	353	N/A	Complete	GL: 53.13, SD: 21,86
1st Phalanx	291	N/A	Complete	GL: 53.15, Bp: 22.93, SD: 21.18
1st Phalanx	393	N/A	Complete	GL: 53.28, Bp: 25.46, SD: 21.79
1st Phalanx	321	N/A	Complete	GL: 53.31, Bp: 25.71, SD: 22.66
1st Phalanx	353	N/A	Complete	GL: 53.38
1st Phalanx	324	N/A	Complete	GL: 53.43, Bp: 30.21, SD: 24.06
1st Phalanx	314	N/A	Complete	GL: 53.59, SD: 23.46
1st Phalanx	408	N/A	Complete	GL: 53.6, Bp: 19.57
1st Phalanx	338	N/A	Complete	GL: 53.6, Bp: 26.35, SD: 22.75
1st Phalanx	415	N/A	Complete	GL: 53.62, Bp: 25.26, SD: 22.17
1st Phalanx	373	N/A	Complete	GL: 53.66, Bp: 24.8, SD: 20.62
1st Phalanx	314	N/A	Complete	GL: 53.73, SD: 22.67
1st Phalanx	204	N/A	Complete	GL: 53.8, Bp: 24.82, SD: 22.2
1st Phalanx	353	N/A	Complete	GL: 53.9, Bp: 29.45, SD: 24.53
1st Phalanx	314	N/A	Complete	GL: 53.96, Bp: 27.77, SD: 23.09
1st Phalanx	323	N/A	Complete	GL: 54.07, Bp: 27.11, SD: 23.47
1st Phalanx	236	N/A	Complete	GL: 54.1, Bp: 28.65, SD: 24.75
1st Phalanx	319	N/A	Complete	GL: 54.17
1st Phalanx	255	N/A	Complete	GL: 54.21, SD: 28.6
1st Phalanx	204	N/A	Complete	GL: 54.35, Bp: 28.78, SD: 24.07
1st Phalanx	444	N/A	Complete	GL: 54.37, Bp: 25.88, SD: 23.37
1st Phalanx	421	N/A	Complete	GL: 54.41, Bp: 19.46, SD: 15.34

1st Phalanx	446	N/A	Complete	GL: 54.46, Bp: 25.98, SD: 22.84
1st Phalanx	320	N/A	Complete	GL: 54.48, Bp: 29.07, SD: 24.99
1st Phalanx	415	N/A	Complete	GL: 54.7, Bp: 27.63, SD: 23.27
1st Phalanx	335	N/A	complete	GL: 54.71, Bp: 27.67, SD: 24.37
1st Phalanx	447	N/A	Complete	GL: 54.9, Bp: 24.94, SD: 20.58
1st Phalanx	321	N/A	Complete	GL: 55.16, Bp: 23.71, SD: 21.23
1st Phalanx	293	N/A	Complete	GL: 55.32, Bp: 24.67, SD: 21.64
1st Phalanx	353	N/A	Complete	GL: 55.34, SD: 23.72
1st Phalanx	354	N/A	Complete	GL: 55.36, Bp: 28.31, SD: 23.22
1st Phalanx	415	N/A	Complete	GL: 55.37, Bp: 26.24, SD: 22.14
1st Phalanx	415	N/A	Complete	GL: 55.42, Bp: 33.77
1st Phalanx	384	N/A	Complete	GL: 55.52, Bp: 26.97, SD: 22.36
1st Phalanx	323	N/A	Complete	GL: 55.61, Bp: 27.46, SD: 22.41
1st Phalanx	314	N/A	Complete	GL: 55.72, Bp: 30.1, SD: 26.3
1st Phalanx	323	N/A	Complete	GL: 55.77, Bp: 24.11, SD: 21.69
1st Phalanx	414	N/A	Complete	GL: 55.85, Bp: 27.8, SD: 24.39
1st Phalanx	354	N/A	Complete	GL: 56.06, Bp: 23.58, SD: 20.15
1st Phalanx	271	N/A	Complete	GL: 56.34, Bp: 33.33, SD: 29.5
1st Phalanx	291	N/A	Complete	GL: 56.4, Bp: 30.92, SD: 25.43
1st Phalanx	355	N/A	Complete	GL: 56.48, Bp: 29.11, SD: 25.03
1st Phalanx	307	N/A	Complete	GL: 56.53, Bp: 30.05, SD: 27.51
1st Phalanx	415	N/A	Complete	GL: 56.65, Bp: 32.9, SD: 29.13
1st Phalanx	253	N/A	Complete	GL: 56.74, Bp: 28.63, SD: 24.3
1st Phalanx	335	N/A	complete	GL: 56.89, Bp: 26.45, SD: 22.30
1st Phalanx	415	N/A	Complete	GL: 56.93, Bp: 30.5, SD: 24.89
1st Phalanx	291	N/A	Complete	GL: 57.15, Bp: 26.76, SD: 21.66
1st Phalanx	286	N/A	Complete	GL: 57.18
1st Phalanx	335	N/A	complete	GL: 57.19, Bp: 28.12, SD: 26.41
1st Phalanx	413	N/A	Complete	GL: 57.64, Bp: 27.35, SD: 22.58
1st Phalanx	5	N/A	Complete	GL: 57.82, Bp: 32.01, SD: 27.85
1st Phalanx	323	N/A	Complete	GL: 57.84, Bp: 26.36, SD: 23.77
1st Phalanx	203	N/A	Complete	GL: 58.09
1st Phalanx	384	N/A	Complete	GL: 58.2, Bp: 32.3, SD: 27.44
1st Phalanx	285	N/A	Complete	GL: 58.22, Bp: 27.75, SD: 23.07
1st Phalanx	285	N/A	Complete	GL: 58.33
1st Phalanx	384	N/A	Complete	GL: 58.36, Bp: 32.26, SD: 27.48
1st Phalanx	369	N/A	Complete	GL: 58.81, Bp: 33.46, SD: 27.26
1st Phalanx	354	N/A	Complete	GL: 59.17, Bp: 31.07, SD: 27.48
1st Phalanx	285	N/A	Complete	GL: 59.21, Bp: 28.46, SD: 23.65
1st Phalanx	314	N/A	Complete	GL: 59.25
1st Phalanx	192	N/A	Complete	GL: 59.4, Bp: 28.65, SD: 24.52
1st Phalanx	453	N/A	Complete	GL: 59.49, Bp: 28.52, SD: 24.25
1st Phalanx	321	N/A	Complete	GL: 59.49, Bp: 31.26, SD: 26.6
1st Phalanx	384	N/A	Complete	GL: 59.52, Bp: 32.82, SD: 27.87

1st Phalanx	384	N/A	Complete	GL: 59.67, Bp: 33.92, SD: 27.46
1st Phalanx	320	N/A	Complete	GL: 60.06
1st Phalanx	222	N/A	Complete	GL: 60.2, Bp: 28.13, SD: 23.14
1st Phalanx	323	N/A	Complete	GL: 60.3, Bp: 28.67, SD: 23.05
1st Phalanx	285	N/A	Complete	GL: 60.79, Bp: 30.84, SD: 25.75
1st Phalanx	353	N/A	Complete	GL: 60.99, [Bp: 32.91], SD: 28.71
1st Phalanx	369	N/A	Complete	GL: 61.42, Bp: 33.77, SD: 28.55
1st Phalanx	389	N/A	Complete	GL: 62.18, Bp: 34.6, SD: 28.05
1st Phalanx	339	N/A	Complete	GL: 62.52, Bp: 38.33, SD: 34.38
1st Phalanx	324	N/A	Complete	GL: 62.73, Bp: 32.76, SD: 27.93
1st Phalanx	323	N/A	Complete	GL: 63.01, Bp: 31.28, SD: 30.13
1st Phalanx	446	N/A	Complete	GL: 64.51, Bp: 31.03, SD: 26.61
1st Phalanx	314	N/A	Complete	GL: 65.98, Bp: 29.74, SD: 24.07
1st Phalanx	339	N/A	Complete	GL: 68.65, Bp: 43.3, SD: 38.5
1st Phalanx	339	N/A	Complete	GL: 68.83, Bp: 40.54, SD: 37.4
1st Phalanx	470	R	Complete	GL: 35.93
1st Phalanx	481	L	Complete	GL: 44.71
1st Phalanx	570	L	Complete	GL: 45.6, Bp: 21.42, SD: 14.74
1st Phalanx	476	L	Complete	GL: 47.02, SD: 19.81
1st Phalanx	570	R	Complete	GL: 47.98, Bp: 20.72, SD: 17.13
1st Phalanx	470	L	Complete	GL: 48.02, Bp: 26.03, SD: 22.3
1st Phalanx	276	L	Complete	GL: 48.2, SD: 19.07
1st Phalanx	586	R	Complete	GL: 48.27
1st Phalanx	506	R	Complete	GL: 48.56, Bp: 22.68, SD: 19.51
1st Phalanx	569	R	Complete	GL: 48.64, Bp: 23.64, SD: 19.81
1st Phalanx	481	R	Complete	GL: 48.67, Bp: 26.42, SD: 23.63
1st Phalanx	320	R	Complete	GL: 48.76, Bp: 24.12, SD: 18.6
1st Phalanx	U/S	L	Complete	GL: 49.01, Bp: 27.32, SD: 23.66
1st Phalanx	585	L	Complete	GL: 49.15, Bp: 26.02, SD: 22.25
1st Phalanx	469	R	Complete	GL: 49.36, Bp: 25.29, SD: 23.26
1st Phalanx	320	R	Complete	GL: 49.41, SD: 20
1st Phalanx	481	L	Complete	GL: 49.48, Bp: 29.33, SD: 22.89
1st Phalanx	481	L	Complete	GL: 49.81, SD: 22.29
1st Phalanx	531	R	Complete	GL: 50.03, Bp: 28.91,SD: 25.6
1st Phalanx	593	R	Complete	GL: 50.17, Bp: 25.9, SD: 22.18
1st Phalanx	570	R	Complete	GL: 50.29, Bp: 22.83, SD: 18.73
1st Phalanx	481	L	Complete	GL: 50.3, Bp: 27.54, SD: 23.74
1st Phalanx	476	R	Complete	GL: 50.37, Bp: 28.68, SD: 22.57
1st Phalanx	613	R	Complete	GL: 50.44, Bp: 27.87, SD: 23.28
1st Phalanx	570	R	Complete	GL: 50.45
1st Phalanx	506	R	Complete	GL: 50.45, Bp: 22.85, SD: 8.85
1st Phalanx	431	L	Complete	GL: 50.55, Bp: 28.32, SD: 23.71
1st Phalanx	481	L	Complete	GL: 50.57, Bp: 24.39, SD: 21.13
1st Phalanx	506	R	Complete	GL: 50.6, Bp: 24.13, SD: 20.15

1st Phalanx	480	R	Complete	GL: 50.6, Bp: 26.74, SD: 22.34
1st Phalanx	593	L	Complete	GL: 50.64, Bp: 26.53, SD: 22.71
1st Phalanx	535	R	Complete	GL: 50.66, Bp: 22.23,SD: 19.59
1st Phalanx	570	L	Complete	GL: 50.67, Bp: 25.75, SD: 0.9
1st Phalanx	570	L	Complete	GL: 50.78, Bp: 26.56, SD: 22.02
1st Phalanx	613	R	Complete	GL: 50.97, Bp: 28.81, SD: 22.93
1st Phalanx	585	R	Complete	GL: 51.01, Bp: 27.79, SD: 23.46
1st Phalanx	320	R	Complete	GL: 51.02, Bp: 25.57, SD: 21.41
1st Phalanx	482	L	Complete	GL: 51.04, Bp: 25.67, SD: 21.66
1st Phalanx	508	R	Complete	GL: 51.06, Bp: 26.61, SD: 23.82
1st Phalanx	476	R	Complete	GL: 51.1, Bp: 27.24, SD: 23.09
1st Phalanx	469	L	Complete	GL: 51.11, SD: 26.68
1st Phalanx	569	R	Complete	GL: 51.13, Bp: 26.43, SD: 21.63
1st Phalanx	506	R	Complete	GL: 51.18
1st Phalanx	470	L	Complete	GL: 51.33, Bp: 24.62, SD: 21.47
1st Phalanx	476	R	Complete	GL: 51.4, Bp: 24.68, SD: 22.53
1st Phalanx	588	R	Complete	GL: 51.45, SD: 24.59
1st Phalanx	469	L	Complete	GL: 51.49, Bp: 27.78, SD: 23.48
1st Phalanx	472	L	Complete	GL: 51.52, Bp: 25.97, SD: 23.44
1st Phalanx	276	R	Complete	GL: 51.61, Bp: 27.8, SD: 23.98
1st Phalanx	469	L	Complete	GL: 51.67, Bp: 27.06, SD: 22.41
1st Phalanx	276	L	Complete	GL: 51.72, Bp: 25.45, SD: 21.27
1st Phalanx	506	L	Complete	GL: 51.77
1st Phalanx	506	L	Complete	GL: 51.82, Bp: 29.4, SD: 24.85
1st Phalanx	470	R	Complete	GL: 51.83, Bp: 26.51, SD: 23.89
1st Phalanx	276	L	Complete	GL: 51.84, Bp: 29.4, SD: 25.11
1st Phalanx	472	L	Complete	GL: 51.87
1st Phalanx	5	N/A	Complete	GL: 51.87, SD: 23.36
1st Phalanx	476	R	Complete	GL: 51.89, Bp: 28.14, SD: 21.95
1st Phalanx	469	R	Complete	GL: 51.9, Bp: 25.28, SD: 23.04
1st Phalanx	476	L	Complete	GL: 51.96, Bp: 24.87, SD: 20.54
1st Phalanx	415	N/A	Complete	GL: 52.01, Bp: 22.99
1st Phalanx	545	R	Complete	GL: 52.16, Bp: 24.07, SD: 21.18
1st Phalanx	276	R	Complete	GL: 52.2, Bp: 23.8, SD: 20.06
1st Phalanx	470	R	Complete	GL: 52.26, Bp: 24.81, SD: 23.65
1st Phalanx	476	L	Complete	GL: 52.31, Bp: 27.17, SD: 21.77
1st Phalanx	320	R	Complete	GL: 52.32, Bp: 27.72, SD: 23
1st Phalanx	588	L	Complete	GL: 52.5, Bp: 30, SD: 24.4
1st Phalanx	476	L	Complete	GL: 52.51, Bp: 27.19, SD: 24.35
1st Phalanx	531	L	Complete	GL: 52.53, Bp: 29, SD: 23.87
1st Phalanx	630	L	Complete	GL: 52.57, Bp: 25.24, SD: 21.8
1st Phalanx	593	R	Complete	GL: 52.57, Bp: 27.55, SD: 22.67
1st Phalanx	482	L	Complete	GL: 52.59, Bp: 26.91, SD: 21.99
1st Phalanx	320	L	Complete	GL: 52.75, Bp: 24.68, SD: 21.54

1st Phalanx	470	L	Complete	GL: 52.81, Bp: 26.24, SD: 21.05
1st Phalanx	276	L	Complete	GL: 52.83, Bp: 25.25, SD: 21.32
1st Phalanx	634	R	Complete	GL: 52.85, Bp: 27.31, SD: 24.81
1st Phalanx	543	R	Complete	GL: 52.87, SD: 19.99
1st Phalanx	588	L	Complete	GL: 52.92, Bp: 27.93, SD: 21.77
1st Phalanx	612	L	Complete	GL: 53.04, Bp: 26.9, SD: 21.61
1st Phalanx	482	R	Complete	GL: 53.1, Bp: 26.43, SD: 23.4
1st Phalanx	481	L	Complete	GL: 53.16, Bp: 26.98 SD: 23.4
1st Phalanx	276	R	Complete	GL: 53.22, SD: 22.5
1st Phalanx	510	R	Complete	GL: 53.27, SD: 22.54
1st Phalanx	583	L	Complete	GL: 53.32, Bp: 26.78, SD: 22.85
1st Phalanx	531	L	Complete	GL: 53.37, Bp: 24.9, SD: 21.92
1st Phalanx	482	R	Complete	GL: 53.37, Bp: 26.2, SD: 24.04
1st Phalanx	476	L	Complete	GL: 53.38, Bp: 26.27, SD: 20.82
1st Phalanx	276	L	Complete	GL: 53.54, Bp: 28.03, SD: 25.37
1st Phalanx	470	L	Complete	GL: 53.59, Bp: 26.51, SD: 2153
1st Phalanx	543	R	Complete	GL: 53.67, Bp: 25.4, SD: 21.92
1st Phalanx	531	R	Complete	GL: 53.85, Bp: 26.06, SD: 21.68
1st Phalanx	476	R	Complete	GL: 53.9, Bp: 27.67, SD: 24.2
1st Phalanx	507	R	Complete	GL: 54.01, Bp: 27.26, SD: 23.86
1st Phalanx	595	L	Complete	GL: 54.04, Bp: 24.97, SD: 20.83
1st Phalanx	320	R	Complete	GL: 54.07, Bp: 25.27, SD: 21.46
1st Phalanx	431	L	Complete	GL: 54.07, Bp: 25.63, SD: 21.93
1st Phalanx	482	R	Complete	GL: 54.09, Bp: 24.89, SD: 22.55
1st Phalanx	506	R	Complete	GL: 54.09, Bp: 30, SD: 26.95
1st Phalanx	500	L	Complete	GL: 54.29, Bp: 27.29, SD: 23.12
1st Phalanx	476	L	Complete	GL: 54.31, Bp: 30.12, SD: 24.13
1st Phalanx	511	R	Complete	GL: 54.4, Bp: 25.1, SD: 22.01
1st Phalanx	508	L	Complete	GL: 54.45, Bp: 23.55, SD: 20.78
1st Phalanx	482	L	Complete	GL: 54.58, Bp: 26.87, SD: 23.09
1st Phalanx	570	R	Complete	GL: 54.61, Bp: 26.87, SD: 22.93
1st Phalanx	570	R	Complete	GL: 54.62, Bp: 28.09, SD: 21.85
1st Phalanx	508	L	Complete	GL: 54.63, Bp: 27.62, SD: 24.6
1st Phalanx	470	R	Complete	GL: 54.8, Bp: 28.66, SD: 23.83
1st Phalanx	563	R	Complete	GL: 54.86
1st Phalanx	540	R	Complete	GL: 54.87, Bp: 24.37, SD: 20.09
1st Phalanx	592	R	Complete	GL: 54.94, Bp: 25.18, SD: 24.11
1st Phalanx	511	R	Complete	GL: 55.03, Bp: 26.3, SD: 23.33
1st Phalanx	476	L	Complete	GL: 55.07, Bp: 28.66, SD: 25.11
1st Phalanx	570	L	Complete	GL: 55.18, Bp: 27.78, SD: 22.18
1st Phalanx	523	R	Complete	GL: 55.26, Bp: 31.62, SD: 26.28
1st Phalanx	508	L	Complete	GL: 55.3, Bp: 27.89, SD: 24.77
1st Phalanx	535	L	Complete	GL: 55.4, SD: 25.52
1st Phalanx	569	R	Complete	GL: 55.52, Bp: 26.63, SD: 23.73

1st Phalanx	469	L	Complete	GL: 55.57, Bp: 26.67, SD: 25.43
1st Phalanx	546	R	Complete	GL: 55.84, Bp: 32, SD: 27.28
1st Phalanx	614	R	Complete	GL: 55.9, Bp: 25.33
1st Phalanx	535	L	Complete	GL: 55.97, Bp: 31.21, SD: 28.16
1st Phalanx	535	R	Complete	GL: 56.04, Bp: 29.88, SD: 23.5
1st Phalanx	470	L	Complete	GL: 56.07, Bp: 32.99, SD: 26.4
1st Phalanx	535	R	Complete	GL: 56.08, Bp: 31.57, SD: 25.98
1st Phalanx	613	L	Complete	GL: 56.13, Bp: 25.65
1st Phalanx	531	R	Complete	GL: 56.28, SD: 24.18
1st Phalanx	531	L	Complete	GL: 56.34, SD: 24.66
1st Phalanx	276	R	Complete	GL: 56.5, Bp: 25.28, SD: 22.96
1st Phalanx	523	R	Complete	GL: 56.51
1st Phalanx	476	L	Complete	GL: 56.9, Bp: 26.3, SD: 21.44
1st Phalanx	482	R	Complete	GL: 57.05, Bp: 26.15, SD: 21.64
1st Phalanx	320	L	Complete	GL: 57.08, Bp: 31.39, SD: 27.03
1st Phalanx	535	L	Complete	GL: 57.13, Bp: 28.6, SD: 25.01
1st Phalanx	569	L	Complete	GL: 57.23, Bp: 32.96, SD: 27.23
1st Phalanx	506	R	Complete	GL: 57.25, Bp: 32.74, SD: 28.45
1st Phalanx	276	R	Complete	GL: 57.33, Bp: 28.36, SD: 22.37
1st Phalanx	506	R	Complete	GL: 57.65, Bp: 29.21, SD: 25
1st Phalanx	528	R	Complete	GL: 57.75, Bp: 31.35, SD: 26.42
1st Phalanx	628	R	Complete	GL: 58, Bp: 29.65, SD: 24.51
1st Phalanx	566	R	Complete	GL: 58.13, Bp: 27.07, SD: 22.67
1st Phalanx	482	R	Complete	GL: 58.22, Bp: 33.1, SD: 27.41
1st Phalanx	508	L	Complete	GL: 58.34
1st Phalanx	595	L	Complete	GL: 58.82
1st Phalanx	470	L	Complete	GL: 59.06, Bp: 31.81, SD: 27.87
1st Phalanx	476	R	Complete	GL: 59.07, SD: 23.66
1st Phalanx	592	R	Complete	GL: 59.21, Bp: 33, SD: 27.48
1st Phalanx	593	L	Complete	GL: 59.22, Bp: 30.72, SD: 26.32
1st Phalanx	592	R	Complete	GL: 59.42, Bp: 30.51, SD: 24.96
1st Phalanx	593	L	Complete	GL: 59.61, SD:24.91
1st Phalanx	470	L	Complete	GL: 59.77, Bp: 30.64, SD: 26.76
1st Phalanx	613	L	Complete	GL: 59.85, Bp: 30.41, SD: 26.61
1st Phalanx	276	L	Complete	GL: 60.02, Bp: 31.39, SD: 27.22
1st Phalanx	611	R	Complete	GL: 60.05, Bp: 26.32, SD: 23.11
1st Phalanx	531	L	Complete	GL: 60.06, Bp: 29.21, SD: 25.86
1st Phalanx	566	R	Complete	GL: 60.27, Bp: 28.67, SD: 25.02
1st Phalanx	470	R	Complete	GL: 60.75, Bp: 31.92, SD: 26.65
1st Phalanx	506	L	Complete	GL: 61.06, Bp: 30.14, SD: 25.84
1st Phalanx	520	R	Complete	GL: 61.07, Bp: 33.3, SD: 30.16
1st Phalanx	536	R	Complete	GL: 61.12
1st Phalanx	546	L	Complete	GL: 61.42, Bp: 34.17, SD: 29.41
1st Phalanx	476	R	Complete	GL: 62.28, Bp: 34.41, SD: 29.59

1st Phalanx	531	R	Complete	GL: 62.29, SD: 29.54
1st Phalanx	592	R	Complete	GL: 62.41, Bp: 32.37
1st Phalanx	470	R	Complete	GL: 63.02, Bp: 33.52, SD: 27.19
1st Phalanx	508	R	Complete	GL: 63.77, SD: 28.25
1st Phalanx	276	L	Complete	GL: 64.49, Bp: 34.45, SD: 29.07
1st Phalanx	569	R	Complete	GL: 64.74, Bp: 31.42, SD: 24.54
1st Phalanx	593	R	Complete	GL:52.33
1st Phalanx	291	N/A	3	SD: 11.2
1st Phalanx	433	N/A	3	SD: 11.54
1st Phalanx	402	N/A	3	SD: 16.05
1st Phalanx	291	N/A	3	SD: 18.73
1st Phalanx	415	N/A	3	SD: 19.36
1st Phalanx	314	N/A	3	SD: 20.73
1st Phalanx	357	N/A	3	SD: 21. 77
1st Phalanx	236	N/A	3	SD: 21.23
1st Phalanx	201	N/A	Complete	SD: 22.65
1st Phalanx	204	N/A	3	SD: 23.11
1st Phalanx	357	N/A	3	SD: 23.18
1st Phalanx	415	N/A	3	SD: 23.95
1st Phalanx	366	N/A	3	SD: 24.93
1st Phalanx	353	N/A	3	SD: 25.73
1st Phalanx	415	N/A	3	SD: 25.82
1st Phalanx	169	N/A	Complete	SD: 26.78
1st Phalanx	314	N/A	3	SD: 29.07
1st Phalanx	570	R	2, 3	SD: 15.21
1st Phalanx	474	L	2, 3	SD: 15.9
1st Phalanx	563	L	2, 3	SD: 20.04
1st Phalanx	520	Unk	3	SD: 21.07
1st Phalanx	69	N/A	Complete	SD: 21.41
1st Phalanx	485	R	2, 3	SD: 22.08
1st Phalanx	276	R	Complete	SD: 22.15
1st Phalanx	320	L	3	SD: 22.5
1st Phalanx	482	R	2, 3	SD: 23.91
1st Phalanx	510	R	Complete	SD: 24
1st Phalanx	586	L	2, 3	SD: 24.69
1st Phalanx	482	R	Complete	SD: 27.28
1st Phalanx	560	R	2, 3	SD: 27.93
1st Phalanx	531	L	3	SD: 30.96
2nd Phalanx	285	N/A	1,3	[Bp: 26.18], SD: 23.13
2nd Phalanx	201	N/A	Complete	[Bp: 27.78]
2nd Phalanx	271	N/A	Complete	[GL: 33.61]
2nd Phalanx	356	N/A		[GL: 37.96], Bp: 30.7, SD: 24.22
2nd Phalanx	415	N/A	Complete	[GL: 38.47], [Bp: 30.7], [SD: 22.47]
2nd Phalanx	314	N/A	1	Bp: 24.94

2nd Phalanx	264	N/A	1	Bp: 25.56
2nd Phalanx	433	N/A	1	Bp: 26.02, SD: 20.9
2nd Phalanx	288	N/A	1, 3	Bp: 26.16, SD: 22.1
2nd Phalanx	355	N/A	1, 3	Bp: 26.88, [SD: 20.28]
2nd Phalanx	354	N/A	1, 3	Bp: 31.73, SD: 27.97
2nd Phalanx	355	N/A	1, 3	Bp: 32.7, SD: 25.68
2nd Phalanx	323	N/A	1	Bp: 34.9
2nd Phalanx	U/S	R	Complete	Bp: 23.14, SD: 19.85
2nd Phalanx	476	L	1	Bp: 24.49
2nd Phalanx	520	L	Complete	Bp: 25.61
2nd Phalanx	508	L	1, 3	Bp: 26.6, SD: 22.62
2nd Phalanx	482	R	1, 3	Bp: 27.41
2nd Phalanx	508	R	1	Bp: 27.47
2nd Phalanx	571	L	1, 3	Bp: 31.9, SD: 22.98
2nd Phalanx	476	L	1, 3	Bp: 33.6
2nd Phalanx	366	N/A	Complete	GL: 28.71, [Bp: 23.89], SD: 19.16
2nd Phalanx	201	N/A	Complete	GL: 30.76, Bp: 24.8, SD: 20.21
2nd Phalanx	340	N/A	Complete	GL: 31.56, [Bp: 23.18], SD: 19.14
2nd Phalanx	275	N/A	Complete	GL: 31.74, Bp: 22.86, SD: 18.7
2nd Phalanx	353	N/A	Complete	GL: 31.93, Bp: 26.56, SD: 20.95
2nd Phalanx	314	N/A	Complete	GL: 32.1, Bp: 26.01, SD: 21.18
2nd Phalanx	285	N/A	Complete	GL: 32.19, Bp: 30.1, SD: 24.93
2nd Phalanx	411	N/A	Complete	GL: 32.25, Bp: 25.52, SD: 19.86
2nd Phalanx	288	N/A	Complete	GL: 32.33, Bp: 23.94, SD: 19.25
2nd Phalanx	321	N/A	Complete	GL: 32.44, Bp: 25.33, SD: 19.84
2nd Phalanx	329	N/A	Complete	GL: 32.63, Bp: 21.58, SD: 17.94
2nd Phalanx	416	N/A	Complete	GL: 32.76, Bp: 23.85, SD: 19.25
2nd Phalanx	206	N/A	Complete	GL: 32.83, Bp: 21.87, SD: 17.66
2nd Phalanx	285	N/A	Complete	GL: 33.02, Bp: 26.33, SD: 20.02
2nd Phalanx	314	N/A	Complete	GL: 33.05, Bp: 26.77, SD: 21.78
2nd Phalanx	335	N/A	complete	GL: 33.26, Bp: 25.40, SD: 21.54
2nd Phalanx	369	N/A	Complete	GL: 33.51, Bp: 22.46, SD: 18.42
2nd Phalanx	271	N/A	Complete	GL: 33.64, Bp: 28.96, SD: 22.72
2nd Phalanx	314	N/A	Complete	GL: 33.65, Bp: 24.71, SD: 19.99
2nd Phalanx	236	N/A	Complete	GL: 33.7, Bp: 23.28, SD: 18.24
2nd Phalanx	333	N/A	Complete	GL: 33.71, Bp: 27.08, SD: 21.45
2nd Phalanx	314	N/A	Complete	GL: 33.8, Bp: 26.1, SD: 20.26
2nd Phalanx	323	N/A	Complete	GL: 33.89, Bp: 23.77, SD: 19.39
2nd Phalanx	192	N/A	Complete	GL: 33.89, Bp: 25.21, SD: 21.11
2nd Phalanx	307	N/A	Complete	GL: 33.91, SD: 19.93
2nd Phalanx	291	N/A	Complete	GL: 33.95, Bp: 22.98, SD: 19.12
2nd Phalanx	69	N/A	Complete	GL: 34.07, Bp: 27.3, SD: 22.75
2nd Phalanx	285	N/A	Complete	GL: 34.19, SD: 19.82
2nd Phalanx	236	N/A	Complete	GL: 34.22, Bp: 24.55, SD: 19.06

2nd Phalanx	365	N/A	Complete	GL: 34.24
2nd Phalanx	448	N/A	Complete	GL: 34.26, Bp: 22.63, SD: 17.4
2nd Phalanx	320	N/A	Complete	GL: 34.36, Bp: 27.94, SD: 21.65
2nd Phalanx	236	N/A	Complete	GL: 34.53, Bp: 24.73, SD: 20.54
2nd Phalanx	415	N/A	Complete	GL: 34.56, Bp: 25.6, SD: 19.12
2nd Phalanx	451	N/A	Complete	GL: 34.74, Bp: 24.78, SD: 19.92
2nd Phalanx	395	R	Complete	GL: 34.74, Bp: 25.96, SD: 19.53
2nd Phalanx	446	N/A	Complete	GL: 34.77, Bp: 28.67, SD: 22.02
2nd Phalanx	395	R	Complete	GL: 34.95, Bp: 25.19, SD: 19.49
2nd Phalanx	318	N/A	Complete	GL: 34.98, Bp: 26.27, SD: 21.06
2nd Phalanx	345	N/A	Complete	GL: 35.04, Bp: 27.23, SD: 21.34
2nd Phalanx	320	N/A	Complete	GL: 35.13, Bp: 22.93, SD: 19.52
2nd Phalanx	371	N/A	Complete	GL: 35.19, Bp: 22.7, SD: 18.36
2nd Phalanx	426	N/A	Complete	GL: 35.21, Bp: 22.14, SD: 18.08
2nd Phalanx	285	N/A	Complete	GL: 35.25, Bp: 30.41, SD: 24.22
2nd Phalanx	285	N/A	Complete	GL: 35.35, Bp: 25.8, SD: 20.63
2nd Phalanx	192	N/A	Complete	GL: 35.79, Bp: 28.43, SD: 23.79
2nd Phalanx	320	N/A	Complete	GL: 35.9, Bp: 28.63, SD: 24.42
2nd Phalanx	285	N/A	Complete	GL: 35.92, Bp: 26.39, SD: 19.87
2nd Phalanx	451	N/A	Complete	GL: 36.02, Bp: 28.4, SD: 23.47
2nd Phalanx	236	N/A	Complete	GL: 36.11, Bp: 29.04, SD: 22.68
2nd Phalanx	415	N/A	Complete	GL: 36.24, Bp: 30.19, SD: 23.94
2nd Phalanx	320	N/A	Complete	GL: 36.41
2nd Phalanx	321	N/A	Complete	GL: 36.46, Bp: 26.15, SD: 21.14
2nd Phalanx	426	N/A	Complete	GL: 36.5, Bp: 25.74, SD: 19.79
2nd Phalanx	314	N/A	Complete	GL: 36.7, Bp: 32.3, SD: 25.78
2nd Phalanx	192	N/A	Complete	GL: 36.72, Bp: 31.66, SD: 26.83
2nd Phalanx	331	N/A	Complete	GL: 36.75, Bp: 25.66, SD: 19.72
2nd Phalanx	321	N/A	Complete	GL: 36.75, Bp: 28.06, SD: 22.14
2nd Phalanx	355	N/A	Complete	GL: 36.89
2nd Phalanx	285	N/A	Complete	GL: 36.91, Bp: 29.05, SD: 24.01
2nd Phalanx	285	N/A	Complete	GL: 37.02, Bp: 26.34, SD: 21.61
2nd Phalanx	446	N/A	Complete	GL: 37.16, Bp: 34.39, SD: 26.95
2nd Phalanx	415	N/A	Complete	GL: 37.17, Bp: 30.59, SD: 25.33
2nd Phalanx	314	N/A	Complete	GL: 37.18, Bp: 28.33, SD: 24.78
2nd Phalanx	314	N/A	Complete	GL: 37.21, Bp: 31.76, SD: 26.12
2nd Phalanx	291	N/A	Complete	GL: 37.29, Bp: 25.06, SD: 20.41
2nd Phalanx	395	N/A	Complete	GL: 37.35, Bp: 28.84, SD: 23.6
2nd Phalanx	321	N/A	Complete	GL: 37.51, Bp: 27.93, SD: 20.92
2nd Phalanx	291	N/A	Complete	GL: 37.63, Bp: 28.98, SD: 21.17
2nd Phalanx	314	N/A	Complete	GL: 37.8, Bp: 26.88, SD: 21.77
2nd Phalanx	415	N/A	Complete	GL: 37.83, Bp: 27.01, SD: 22.03
2nd Phalanx	353	N/A	Complete	GL: 37.86, Bp: 33.06, SD: 26.56
2nd Phalanx	314	N/A	Complete	GL: 37.87, Bp: 23.84, SD: 19.73

2nd Phalanx	5	N/A	1, 3	GL: 38.28, Bp: 32.48
2nd Phalanx	353	N/A	Complete	GL: 38.3
2nd Phalanx	384	N/A	Complete	GL: 38.33, Bp: 32.71, SD: 24.91
2nd Phalanx	371	N/A	Complete	GL: 38.4, Bp: 31.46, SD: 26.43
2nd Phalanx	415	N/A	Complete	GL: 38.47, Bp: 27.97, SD: 21.1
2nd Phalanx	291	N/A	Complete	GL: 38.77, Bp: 32.84, SD: 26.85
2nd Phalanx	353	N/A	Complete	GL: 39.01, SD: 26.92
2nd Phalanx	285	N/A	Complete	GL: 39.08, Bp: 30.93, SD: 26.74
2nd Phalanx	285	N/A	Complete	GL: 39.12, [Bp: 28.11], SD: 23.15
2nd Phalanx	415	N/A	Complete	GL: 39.27, Bp: 30.3, SD: 25.17
2nd Phalanx	446	N/A	Complete	GL: 39.34, Bp: 27.68, SD: 21.7
2nd Phalanx	291	N/A	Complete	GL: 39.43, Bp: 28.35, SD: 26.09
2nd Phalanx	236	N/A	Complete	GL: 39.44, Bp: 28.36, SD: 22.34
2nd Phalanx	384	N/A	Complete	GL: 39.63, Bp: 31.53, SD: 26.23
2nd Phalanx	353	N/A	Complete	GL: 39.83, Bp: 30.4, SD: 24.63
2nd Phalanx	338	N/A	Complete	GL: 39.88, Bp: 29.88, SD: 24.66
2nd Phalanx	291	N/A	Complete	GL: 39.93, Bp: 34.21, SD: 28.11
2nd Phalanx	353	N/A	Complete	GL: 40.01, Bp: 32.08, SD: 27.66
2nd Phalanx	353	N/A	Complete	GL: 40.43, Bp: 46.05, SD: 29.35
2nd Phalanx	446	N/A	Complete	GL: 40.56, Bp: 33.26, SD: 27.47
2nd Phalanx	314	N/A	Complete	GL: 41.04, Bp: 32.76, SD: 25.16
2nd Phalanx	354	N/A	Complete	GL: 41.18, Bp: 35.21, SD: 29.25
2nd Phalanx	373	N/A	Complete	GL: 41.24, SD: 24.43
2nd Phalanx	433	N/A	Complete	GL: 41.26, Bp: 35.39, SD: 27.29
2nd Phalanx	402	N/A	Complete	GL: 41.38, Bp: 30.16, SD: 23.68
2nd Phalanx	285	N/A	Complete	GL: 42.08, Bp: 34.31, SD: 27.72
2nd Phalanx	314	N/A	Complete	GL: 42.95, Bp: 32.77, SD: 25.25
2nd Phalanx	354	N/A	Complete	GL: 43.78, Bp: 31.72, SD: 25.67
2nd Phalanx	415	N/A	Complete	GL: 44.23, Bp: 34.61, SD: 27.43
2nd Phalanx	369	N/A	Complete	GL: 44.62, Bp: 33.26, SD: 27.63
2nd Phalanx	339	N/A	Complete	GL: 45.63, Bp: 41.8, SD: 35.37
2nd Phalanx	339	N/A	Complete	GL: 46.24, Bp: 35.49, SD: 31.32
2nd Phalanx	339	N/A	Complete	GL: 50.44, Bp: 42.3, SD: 38.79
2nd Phalanx	570	L	Complete	GL: 27.74, Bp: 21.38, SD: 14.99
2nd Phalanx	570	R	Complete	GL: 30.11, Bp: 23.35, SD: 15.54
2nd Phalanx	472	R	Complete	GL: 30.47
2nd Phalanx	535	L	Complete	GL: 31.58, Bp: 22.83, SD: 17.76
2nd Phalanx	476	R	Complete	GL: 32.18, Bp: 30.67, SD: 22.72
2nd Phalanx	613	L	Complete	GL: 32.26, Bp: 24.43, SD: 19.95
2nd Phalanx	U/S	R	Complete	GL: 32.68, Bp: 26.01, SD: 21.01
2nd Phalanx	535	R	Complete	GL: 32.77, Bp: 24.99, SD: 18.56
2nd Phalanx	588	R	Complete	GL: 32.79, Bp: 25.87, SD: 20.75
2nd Phalanx	593	R	Complete	GL: 32.97, Bp: 23.79, SD: 18.43
2nd Phalanx	570	L	Complete	GL: 33.06, Bp: 24.32, SD: 18.53

2nd Phalanx	510	R	Complete	GL: 33.56, Bp: 23.21, SD: 17.45
2nd Phalanx	613	R	Complete	GL: 33.57, Bp: 30.26, SD: 24.1
2nd Phalanx	575	L	Complete	GL: 33.6, Bp: 26.85, SD: 20.41
2nd Phalanx	476	L	Complete	GL: 33.95, Bp: 28.98, SD: 22.01
2nd Phalanx	536	R	Complete	GL: 34.25, Bp: 22.24, SD: 17.64
2nd Phalanx	481	R	Complete	GL: 34.26, Bp: 26.66, SD: 20.45
2nd Phalanx	506	L	Complete	GL: 34.31
2nd Phalanx	476	L	Complete	GL: 34.39, Bp: 31.03, SD: 25.49
2nd Phalanx	526	R	Complete	GL: 34.4
2nd Phalanx	570	R	Complete	GL: 34.84, Bp: 24.47, SD: 20.61
2nd Phalanx	470	R	Complete	GL: 34.86, Bp: 23.05, SD: 18.05
2nd Phalanx	570	L	Complete	GL: 35.09, Bp: 26.36, SD: 21.75
2nd Phalanx	U/S	R	Complete	GL: 35.17, Bp: 27.32, SD: 21.98
2nd Phalanx	570	L	Complete	GL: 35.17, Bp: 27.37, SD: 23.18
2nd Phalanx	476	L	Complete	GL: 35.37, Bp: 29.68, SD: 23.81
2nd Phalanx	476	L	Complete	GL: 35.52, Bp: 27.18, SD: 20.81
2nd Phalanx	527	R	Complete	GL: 35.6, Bp: 30.2, SD: 24.29
2nd Phalanx	470	R	Complete	GL: 35.63, Bp: 27.08, SD: 21.06
2nd Phalanx	506	R	Complete	GL: 35.75, Bp: 25.26, SD: 19.25
2nd Phalanx	613	L	Complete	GL: 35.81, Bp: 25.24, SD: 19.95
2nd Phalanx	509	L	Complete	GL: 35.87, Bp: 24.17, SD: 19.01
2nd Phalanx	563	L	Complete	GL: 35.96, Bp: 29.55, SD: 25.82
2nd Phalanx	482	R	Complete	GL: 36.03
2nd Phalanx	543	R	Complete	GL: 36.07, Bp: 29.76, SD: 23.28
2nd Phalanx	523	R	Complete	GL: 36.19, Bp: 26.5, SD: 19.32
2nd Phalanx	506	R	Complete	GL: 36.28
2nd Phalanx	276	L	Complete	GL: 36.33
2nd Phalanx	601	L	Complete	GL: 36.39
2nd Phalanx	506	R	Complete	GL: 36.56, Bp: 27.27, SD: 21.45
2nd Phalanx	476	L	Complete	GL: 36.57, Bp: 27.72, SD: 22.72
2nd Phalanx	519	R	Complete	GL: 36.59, Bp: 24.69, SD: 19.79
2nd Phalanx	320	L	Complete	GL: 36.62, Bp: 25.98, SD: 20.6
2nd Phalanx	593	R	Complete	GL: 36.67, Bp: 27.31, SD: 21.07
2nd Phalanx	476	R	Complete	GL: 36.74, Bp: 33.02, SD: 25.02
2nd Phalanx	506	R	Complete	GL: 36.86, Bp: 25.96, SD: 21.6
2nd Phalanx	476	R	Complete	GL: 36.88, Bp: 27.83, SD: 22.44
2nd Phalanx	544	R	Complete	GL: 36.9, Bp: 30.5, SD: 24.96
2nd Phalanx	516	L	Complete	GL: 37.1, Bp: 27.59, SD: 21.05
2nd Phalanx	470	R	Complete	GL: 37.21, Bp: 28.14, SD: 20.72
2nd Phalanx	608	L	Complete	GL: 37.4
2nd Phalanx	531	R	Complete	GL: 37.57, Bp: 28.86, SD: 23.36
2nd Phalanx	507	L	Complete	GL: 37.69, SD: 23.13
2nd Phalanx	482	R	Complete	GL: 37.87, Bp: 29.34, SD: 24.89
2nd Phalanx	469	R	Complete	GL: 37.95, Bp: 29.91, SD: 22.43

2nd Phalanx	531	L	Complete	GL: 37.96, Bp: 30.23, SD: 23.6
2nd Phalanx	578	L	Complete	GL: 38.02, Bp: 25.83, SD: 20.81
2nd Phalanx	508	R	Complete	GL: 38.04, Bp: 30.5, SD: 24.88
2nd Phalanx	585	L	Complete	GL: 38.24, Bp: 27.84, SD: 2.83
2nd Phalanx	481	L	Complete	GL: 38.25 Bp: 31.99, SD: 27.84
2nd Phalanx	U/S	R	Complete	GL: 38.3, SD: 22.87
2nd Phalanx	276	L	Complete	GL: 38.31, Bp: 29.4, SD: 22.72
2nd Phalanx	608	R	Complete	GL: 38.31, SD: 24.99
2nd Phalanx	608	L	Complete	GL: 38.67, Bp: 27.71, SD: 21.77
2nd Phalanx	535	R	Complete	GL: 38.72, Bp: 32.29, SD: 24.7
2nd Phalanx	576	L	Complete	GL: 38.86, Bp: 32.92, SD: 25.18
2nd Phalanx	546	R	Complete	GL: 38.9, Bp: 31.23, SD: 25.84
2nd Phalanx	476	R	Complete	GL: 39.04, Bp: 34.29, SD: 26.75
2nd Phalanx	482	R	Complete	GL: 39.09, Bp: 31.39, SD: 26.1
2nd Phalanx	476	L	Complete	GL: 39.13, Bp: 31.61, SD: 25.43
2nd Phalanx	U/S	L	Complete	GL: 39.25, Bp: 26.37, SD: 21.08
2nd Phalanx	276	R	Complete	GL: 39.45, Bp: 30.27, SD: 22.49
2nd Phalanx	566	R	Complete	GL: 39.95, Bp: 30.76, SD: 25.35
2nd Phalanx	506	R	Complete	GL: 39.98, Bp: 29.31, SD: 22.7
2nd Phalanx	540	L	Complete	GL: 40.18, Bp: 31.5, SD: 25.04
2nd Phalanx	570	R	Complete	GL: 40.25, Bp: 33.03, SD: 29.42
2nd Phalanx	506	L	Complete	GL: 40.38,Bp: 32.16, SD: 25.91
2nd Phalanx	585	L	Complete	GL: 40.39, Bp: 28.53, SD: 21.44
2nd Phalanx	470	R	Complete	GL: 40.43, Bp: 32.26, SD: 25.93
2nd Phalanx	608	L	Complete	GL: 41.1
2nd Phalanx	507	L	Complete	GL: 41.35, Bp: 31.89, SD: 25.05
2nd Phalanx	470	L	Complete	GL: 41.45, Bp: 34.95, SD: 28.16
2nd Phalanx	585	R	Complete	GL: 41.51, Bp: 29.39, SD: 23.12
2nd Phalanx	593	R	Complete	GL: 41.78, Bp: 29.9, SD: 24.59
2nd Phalanx	482	L	Complete	GL: 42.0, SD: 25.78
2nd Phalanx	593	L	Complete	GL: 42.56, Bp: 30.81, SD: 22.94
2nd Phalanx	525	R	Complete	GL: 44.09, Bp: 33.05, SD: 27.43
2nd Phalanx	470	R	Complete	GL: 46.56, Bp: 31.99, SD: 26.8
2nd Phalanx	611	L	Complete	L: 38.44, Bp: 28.57, SD: 23.08
2nd Phalanx	314	N/A	3	SD: 18.8
2nd Phalanx	271	N/A	3	SD: 19.28
2nd Phalanx	314	N/A	3	SD: 19.48
2nd Phalanx	405	N/A	3	SD: 24.69
2nd Phalanx	285	N/A	3	SD: 25.36
2nd Phalanx	570	R	2, 3	SD: 19.39
2nd Phalanx	546	L	2, 3	SD: 22.81
2nd Phalanx	543	R	2, 3	SD: 23.26
Astragalus	323	L	Complete	[BD: 37.1]
Astragalus	201	L	Complete	[BD: 43.41]

Astragalus	236	L	Complete	[DL: 27.64]
Astragalus	323	R	Complete	[DL: 32.76]
Astragalus	320	L	Complete	[Gll: 55.65], DL: 30.48
Astragalus	314	R	Complete	[Gll: 56.79], BD: 38.04, DL: 31.83
Astragalus	353	R	Complete	[Gll: 56.8], BD: 34.2, DL: 32.88
Astragalus	69	L	Complete	[GLL: 57.9], [BD: 38.84], [DL: 30.52]
Astragalus	323	R	Complete	[Gll: 58.2], BD: 37.11, DL: 33.25
Astragalus	275	R	Complete	[Gll: 59.49], [BD: 38.46], [DL: 34.35]
Astragalus	303	L	Complete	[Gll: 60.77], DL: 33.91
Astragalus	415	L	Complete	[Gll: 65.25], [BD: 42.69]
Astragalus	286	R	Complete	[Gll: 66.56], [BD: 42.75]
Astragalus	204	L	Complete	[Gll: 66.83], BD: 44.16, DL: 35.94
Astragalus	353	R	Complete	[Gll: 74.41], BD: 47.59, DL: 40.7
Astragalus	307	L	Complete	BD: 38.95
Astragalus	318	L	3, 4	BD: 40.45
Astragalus	310	L	1, 2	BD: 41.08
Astragalus	527	L	1, 2	BD: 38.92
Astragalus	510	L	1, 2	BD: 39.42
Astragalus	520	R	Complete	BD: 40.75
Astragalus	285	R	1, 2	DL: 29.73
Astragalus	415	R	Complete	DL: 31.48
Astragalus	369	L	Complete	DL: 33.23
Astragalus	414	L	Complete	DL: 33.34
Astragalus	415	L	2, 4	DL: 33.84
Astragalus	353	L	Complete	DL: 37.02
Astragalus	585	R	Complete	DL: 30.53
Astragalus	570	R	Complete	DL: 31.61
Astragalus	520	R	Complete	DL: 32.4
Astragalus	510	R	Complete	DL: 35.21
Astragalus	570	R	Complete	DL: 36.9
Astragalus	498	L	Complete	DL: 37.22
Astragalus	592	L	Complete	GL: 62.5, Bp: 40.62, DL: 35.37
Astragalus	357	R	Complete	Gll: 34.31, BD: 31.98, DL: 27.64
Astragalus	369	L	Complete	Gll: 49.5, BD: 30.01, DL: 26.52
Astragalus	275	L	Complete	Gll: 53.87, BD: 31.49, DL: 28.73
Astragalus	402	R	Complete	Gll: 53.87, BD: 35.91, DL: 28.84
Astragalus	320	R	Complete	Gll: 54.34, BD: 35.39, DL: 30.48
Astragalus	291	R	Complete	Gll: 54.86, BD: 36.93
Astragalus	353	R	Complete	Gll: 56.43, BD: 37.53, DL: 31.76
Astragalus	314	L	Complete	Gll: 56.73, BD: 36.6, DL: 31.27
Astragalus	201	R	Complete	Gll: 56.94, BD: 39.55, DL: 31.35
Astragalus	314	L	Complete	Gll: 57.17, BD: 34.55, DL: 30.83
Astragalus	352	L	Complete	Gll: 57.84, BD: 35.74, DL: 32.67
Astragalus	285	R	Complete	Gll: 57.91, BD: 36.75, DL: 32.55

Astragalus	323	L	Complete	Gll: 58.27, BD: 38.15, DL: 33.21
Astragalus	415	L	Complete	Gll: 58.38, BD: 35.98, DL: 31.59
Astragalus	415	R	Complete	Gll: 58.61, BD: 36.75, DL: 32.03
Astragalus	314	L	Complete	Gll: 58.71, BD: 39.92, DL: 32.95
Astragalus	318	L	Complete	Gll: 59.0, BD: 36.23, DL: 33.14
Astragalus	235	L	Complete	Gll: 59.17, Bp: 35.88, DL: 32.45
Astragalus	236	R	Complete	Gll: 59.4, BD: 36.78, [DL: 31.57]
Astragalus	440	L	Complete	Gll: 59.66, BD: 37.74, DL: 33.09
Astragalus	201	L	Complete	Gll: 59.82, BD: 36.99, DL: 33.12
Astragalus	415	R	Complete	Gll: 59.86, BD: 38.04, DL: 32.97
Astragalus	314	L	Complete	Gll: 60.01, DL: 34.57
Astragalus	236	L	Complete	Gll: 60.06, BD: 35.42, DL: 31.42
Astragalus	415	L	Complete	Gll: 60.17, BD: 37.5, DL: 33.72
Astragalus	415	R	Complete	Gll: 60.28, BD: 39.75, DL: 34.33
Astragalus	236	R	Complete	Gll: 60.67, BD: 38.12, DL: 33.3
Astragalus	415	L	Complete	Gll: 60.72, BD: 37.24, DL: 33.21
Astragalus	353	R	Complete	Gll: 61.05, BD: 37.67, DL: 32.53
Astragalus	314	R	Complete	Gll: 61.87, BD: 41.84
Astragalus	323	R	Complete	Gll: 62.59, BD: 37.87, DL: 33.62
Astragalus	314	R	Complete	Gll: 62.62, BD: 38.52, DL: 35.55
Astragalus	392	R	Complete	Gll: 62.86, BD: 38.73, DL: 35.32
Astragalus	353	R	Complete	Gll: 63.19, BD: 43.4, DL: 36.73
Astragalus	339	R	Complete	Gll: 63.75, BD: 42.43, [DL: 47.57]
Astragalus	291	L	Complete	Gll: 64.02, BD: 40.58
Astragalus	415	L	Complete	Gll: 64.27, BD: 44.46, DL: 63.39
Astragalus	204	R	Complete	Gll: 64.37, [BD: 36.78], DL: 34.98
Astragalus	201	R	Complete	Gll: 64.37, BD: 39.69, DL: 34.62
Astragalus	443	R	Complete	Gll: 66.61, BD: 44.34
Astragalus	366	R	Complete	Gll: 66.63, BD: 41.26, DL: 38.1
Astragalus	322	L	Complete	Gll: 66.67, BD: 43.41
Astragalus	353	R	Complete	Gll: 67.86, BD: 42.13, DL: 38.38
Astragalus	314	L	Complete	Gll: 68.03, BD: 42.21, DL: 39.22
Astragalus	449	R	Complete	Gll: 68.03, BD: 44.13, DL: 37.05
Astragalus	366	L	Complete	Gll: 69.82
Astragalus	613	L	Complete	Gll: 52.18, BD: 31.25, DL: 28.93
Astragalus	506	R	Complete	Gll: 53.22, BD: 33.45, DL: 28.31
Astragalus	482	L	Complete	Gll: 54.7, BD: 33.94
Astragalus	320	L	Complete	Gll: 55.55, BD: 36.61, DL: 31.63
Astragalus	482	R	Complete	Gll: 55.57, BD: 34.78, DL: 31.37
Astragalus	481	R	Complete	Gll: 55.67, BD: 33.85
Astragalus	566	L	Complete	Gll: 56.33, BD: 35.59, DL: 2.11
Astragalus	320	R	Complete	Gll: 56.48, BD: 39.05, DL: 31.42
Astragalus	574	R	Complete	Gll: 57.17, BD: 37.66, DL: 31.48
Astragalus	593	L	Complete	Gll: 57.87, DL: 32.48

Astragalus	506	L	Complete	Gll: 57.9, BD: 36.21, DL: 32.07
Astragalus	481	R	Complete	Gll: 58.25, BD: 39.83, DL: 32.27
Astragalus	320	R	Complete	Gll: 58.56
Astragalus	469	R	Complete	Gll: 58.71, BD: 34.42, DL: 32.88
Astragalus	527	L	Complete	Gll: 58.78, BD: 36.67, DL: 31.33
Astragalus	613	R	Complete	Gll: 59.54, BD:37.39, DL: 34.16
Astragalus	588	R	Complete	Gll: 60.35, DL: 33.25
Astragalus	592	L	Complete	Gll: 60.58, BD: 35.96, DL: 34.48
Astragalus	634	R	Complete	Gll: 61.01
Astragalus	589	L	Complete	Gll: 61.01, BD: 37.22, DL: 34.14
Astragalus	512	R	Complete	Gll: 61.28, BD: 38.37, DL: 33.6
Astragalus	482	L	Complete	Gll: 61.48, DL: 34.82
Astragalus	506	L	Complete	Gll: 61.51, BD: 37.18, DL: 33.38
Astragalus	482	R	Complete	Gll: 61.54, BD: 39.95, DL: 35.48
Astragalus	482	L	Complete	Gll: 62.48, BD: 42.05, DL: 34.17
Astragalus	613	L	Complete	Gll: 63.11, BD: 41.22, DL: 35.27
Astragalus	575	R	Complete	Gll: 63.24. BD: 39.34, DL: 35.58
Astragalus	586	L	Complete	Gll: 63.47, BD: 41.4, DL: 36.26
Astragalus	476	L	Complete	Gll: 63.55, BD: 39.6, DL: 36.23
Astragalus	482	R	Complete	Gll: 64.31, BD: 43.72, DL: 35.4
Astragalus	586	L	Complete	Gll: 65.15, BD: 41.16 DL: 37.02
Astragalus	569	L	Complete	Gll: 67.08, BD: 45.16, DL: 37.79
Astragalus	510	R	Complete	Gll: 67.3, BD: 38.41
Astragalus	544	L	Complete	Gll: 67.59, BD: 47.79, DL: 38.65
Astragalus	276	L	Complete	Gll: 67.61, BD: 42.16, DL: 37.02
Astragalus	U/S	L	Complete	Gll: 68.12, BD: 40.33, DL: 39.25
Astragalus	476	L	Complete	Gll: 68.21, BD: 45.94, DL: 37.71
Astragalus	570	R	Complete	Gll: 70.72, BD: 43.97, DL: 39.82
Astragalus	508	L	1, 3	Gll: 71.4
Astragalus	569	L	Complete	Gll: 71.8, DL: 39.84
Astragalus	482	R	Complete	Gll: 71.92, BD: 44.8, DL: 41.12
Astragalus	612	R	Complete	Gll: 72.3, BD: 42.74, DL: 41.44
Astragalus	470	R	Complete	Gll: 72.41, DL: 41.53
Calcaneus	353	L	Complete	[GL: 113.34]
Calcaneus	321	R	Complete	GL: 102.33
Calcaneus	204	L	Complete	GL: 111.98
Calcaneus	314	R	Complete	GL: 118.59
Calcaneus	353	L	Complete	GL: 120.33
Calcaneus	236	R	Complete	GL: 124.17
Calcaneus	324	L	Complete	GL: 128.33
Calcaneus	201	L	2, 3, 4, 5	GL: 128.55
Calcaneus	329	R	Complete	GL: 128.95
Calcaneus	339	R	Complete	GL: 129.23
Calcaneus	280	R	Complete	GL: 129.66

Calcaneus	371	R	Complete	GL: 135.5
Calcaneus	285	L	Complete	GL: 68.93
Calcaneus	570	R	Complete	GL: 113.7
Calcaneus	535	L	Complete	GL: 117.09
Calcaneus	470	R	Complete	GL: 118.36
Calcaneus	531	L	Complete	GL: 121.54
Calcaneus	595	R	Complete	GL: 134
Calcaneus	482	R	Complete	GL: 145.36
Humerus	323	L	5, 6, 7, 8	[BT: 53.76], HT: 35.34, HTC: 26.72
Humerus	415	R	5, 6, 7, 8	[BT: 65.58], HT: 40.91, HTC: 29.53
Humerus	415	R	5, 6, 7, 8	[BT: 65.58], HTC: 29.54
Humerus	291	R	5, 6, 7, 8	[BT: 70.9]
Humerus	339	L	5, 6, 7, 8	[BT: 77.34], HTC: 34.71
Humerus	320	R	5, 6, 7, 8	[HT: 34.6], [HTC: 30.14]
Humerus	321	L	5, 6	[HTC: 29.47]
Humerus	236	R	5, 6, 7, 8	BT: 52.16, HT: 37.25, HTC: 27.74, [SD: 25.75]
Humerus	415	L	5, 6, 7, 8	BT: 59.74, [HT: 33.01], HTC: 27.06
Humerus	236	R	5, 6, 7, 8	BT: 60.56, HT: 35.64, HTC: 27.65
Humerus	339	L	5, 6, 7, 8	BT: 60.57, HT: 39.3, HTC: 28.93
Humerus	353	L	5, 6	BT: 61.35
Humerus	236	L	5, 6, 7, 8	BT: 61.57, HT: 36.94, HTC: 26.69
Humerus	353	L	5, 6, 7, 8	BT: 61.67, HT: 38.39, HTC: 28.3
Humerus	369	R	5, 6, 7, 8	BT: 62.74, [HT: 34. 41], HTC: 28.21
Humerus	236	L	5, 6, 7, 8	BT: 63.01, HT: 38.31, HTC: 29.15
Humerus	320	R	5, 6, 7, 8	BT: 63.01, HT: 39.45, HTC: 28.63
Humerus	353	L	5, 6, 7, 8	BT: 63.93, HT: 36.39, HTC: 26.86
Humerus	323	R	5, 6, 7, 8	BT: 64.29, HT: 40.43, HTC: 28.67
Humerus	323	L	5, 6, 7, 8	BT: 64.38, HT: 39.05, HTC: 29.88
Humerus	285	L	5, 6, 7, 8	BT: 64.54, HT: 35.66, HTC: 26.72
Humerus	381	R	5, 6, 7, 8	BT: 64.83, HTC: 28.64
Humerus	353	R	5, 6, 7, 8	BT: 66.26, HT: 36.03, HTC: 25.84
Humerus	314	L	5, 6, 7, 8	BT: 66.99, HT: 39.17, HTC: 31.36
Humerus	236	L	5, 6, 7, 8	BT: 67.78, HT: 39.38, HTC: 30.03, [SD: 33.65]
Humerus	204	R	5, 6, 7, 8	BT: 67.88, HT: 36.06, HTC: 27.34
Humerus	332	L	5, 6, 7, 8	BT: 67.92, HT: 38.72, HTC: 28.78
Humerus	415	L	5, 6, 7, 8	BT: 68.21, HT: 40.44, HTC: 29.21
Humerus	275	R	5, 6	BT: 68.5
Humerus	353	L	5, 6, 7, 8	BT: 68.82, HT: 36.82, HTC: 27.92
Humerus	320	L	5, 6, 7, 8	BT: 68.98, HT: 37.84, HTC: 31.9
Humerus	314	L	5, 6, 7, 8	BT: 69.74, HT: 43.09, HTC: 34.26
Humerus	339	L	5, 6, 7, 8	BT: 70.06, HT: 45.03, HTC: 33.1
Humerus	353	L	5, 6, 7, 8	BT: 71.18, HT: 38.39, HTC: 29.94
Humerus	426	R	5, 6, 7, 8	BT: 73.82, HT: 41.67, HTC: 31.42
Humerus	339	R	5, 6, 7, 8	BT: 74.66, HT: 43.35, HTC: 32.97

Humerus	247	R	5, 6	BT: 75.67
Humerus	69	R	5, 6	BT: 76.48, HT: 44.6, HTC: 34.0, SD: 37.41
Humerus	288	R	5, 6, 7, 8	BT: 78.03, HT: 43.62, HTC: 33.04
Humerus	291	R	5, 6, 7, 8	BT: 78.55, HT: 42.59, HTC: 32.87
Humerus	339	R	5, 6, 7, 8	BT: 84.84, HT: 49.59, HTC: 37.26
Humerus	570	R	5, 6	BT: 57.58, HT: 32.25, HTC: 21.83
Humerus	571	L	5, 6, 8	BT: 6.85, HT: 40.47, HTC: 28.75
Humerus	569	R	5, 6	BT: 60.44, HT: 38.28, HTC: 28.63
Humerus	570	R	5, 6	BT: 61.43, HT: 40.42, HTC: 30.06
Humerus	578	R	5, 6	BT: 61.84, HT: 36.28, HTC: 26.86
Humerus	489	L	5, 6	BT: 61.86, HT: 35.29, HTC: 28.2
Humerus	523	L	5, 6	BT: 62.08, HT: 35.9, HTC: 27.24
Humerus	276	R	5, 6, 7, 8	BT: 62.5, HT: 36.95, HTC: 27.15
Humerus	476	L	5, 6	BT: 62.92, HT: 37.89, HTC: 28.02
Humerus	506	L	5, 6, 7, 8	BT: 63.05, HT: 36.65, HTC: 27.99
Humerus	586	L	5, 6	BT: 63.31, HT: 38.05, HTC: 26.61
Humerus	589	L	3, 5, 6, 7, 8	BT: 63.59, HT: 36.67, HTC: 26.42
Humerus	469	R	5, 6, 7, 8	BT: 63.67, HT: 38.97, HTC: 29.32
Humerus	614	R	5, 6, 7, 8	BT: 63.67, HT: 39.18, HTC: 30.19
Humerus	506	L	5, 6, 7, 8	BT: 63.74, HT: 37.38, HTC: 26.74
Humerus	508	L	5, 6, 7, 8	BT: 64.35, HT: 39.92, HTC: 29.13
Humerus	570	L	5, 6	BT: 64.8, HT: 38.0, HTC: 28.48
Humerus	511	L	5, 6	BT: 64.92, HT: 36.64, HTC: 29.36
Humerus	535	L	3, 5, 6	BT: 66.4, HT: 39.36, HTC: 29.96
Humerus	586	R	5, 6	BT: 66.63
Humerus	470	L	5, 6	BT: 67.17, HT: 41.47, HTC: 29.7
Humerus	511	L	5, 6	BT: 68.93, HT: 40.07, HTC: 29.45
Humerus	276	L	5, 6, 7, 8	BT: 69.36, HT: 38.04, HTC: 26.8
Humerus	481	R	5, 6	BT: 69.83, HT: 38.32, HTC: 30.28
Humerus	276	R	5, 6	BT: 72.25, HT: 43.41, HTC: 31.16
Humerus	506	L	5, 6, 7, 8	BT: 73.17, HT: 41.46, HTC: 30.22
Humerus	482	R	5, 6	BT: 73.38, HT: 45.96, HTC: 32.43
Humerus	506	L	5, 6	BT: 73.69, HT: 39.74, HTC: 32.86
Humerus	482	L	5, 6	BT: 75.58, HT: 42.46, HTC: 36
Humerus	578	L	5, 6	BT: 76.32, HT: 46.24, HTC: 35.59
Humerus	546	R	5, 6, 7, 8	BT: 76.52, HT: 46.32, HTC: 34.3
Humerus	320	R	5, 6	BT: 77.2, HT: 46.83, HTC: 32.23
Humerus	276	R	5, 6	BT: 77.21, HT: 47.62, HTC: 33.33
Humerus	593	R	5, 6	BT: 79.25, HT: 46.45, HTC: 35.05
Humerus	345	R	5	HT: 28.91
Humerus	426	R	5, 6	HT: 34.35, HTC: 27.9
Humerus	323	R	5	HT: 34.45
Humerus	301	L	5, 6	HT: 34.95, HTC: 27.19
Humerus	236	L	5	HT: 35.61

Humerus	339	R	5	HT: 35.83
Humerus	446	R	5	HT: 36.07
Humerus	289	L	5	HT: 36.08
Humerus	236	R	5, 6	HT: 36.74, HTC: 29.38
Humerus	385	R	5	HT: 36.79
Humerus	291	L	5	HT: 37.06
Humerus	288	L	5	HT: 37.13
Humerus	255	UNK	5	HT: 37.15
Humerus	355	L	5, 7	HT: 37.19, HTC: 29.31
Humerus	366	R	5, 6	HT: 37.45, HTC: 28.02
Humerus	415	L	5, 6	HT: 37.46, HTC: 27.94
Humerus	287	R	5	HT: 37.63
Humerus	201	R	4, 5, 6	HT: 37.63, HTC: 26.7
Humerus	358	L	5, 6	HT: 37.71, HTC: 28.75
Humerus	285	L	5, 6	HT: 37.72, HTC: 28.23
Humerus	329	R	5, 6	HT: 37.78, HTC: 27.52
Humerus	291	L	5, 6	HT: 38.08, HTC: 29.05
Humerus	384	R	5, 6	HT: 38.09, HTC: 27.78
Humerus	314	R	5, 6	HT: 38.1, HTC: 29.58
Humerus	201	R	5, 6	HT: 38.18, HTC: 29.88
Humerus	291	R	5	HT: 38.32
Humerus	291	L	5, 6	HT: 38.52, HTC: 28.34
Humerus	247	L	5, 6	HT: 38.57, HTC: 28.78
Humerus	69	L	5, 6	HT: 38.6, HTC: 28.81
Humerus	321	R	5, 6	HT: 39.05, HTC: 28.58
Humerus	353	L	5, 6	HT: 39.24, HTC: 30.16
Humerus	321	R	5, 6	HT: 39.67, HTC: 29.8
Humerus	255	R	5, 6	HT: 39.76
Humerus	203	R	5, 6	HT: 40.2, HTC: 29.31
Humerus	411	R	5, 6	HT: 40.65, HTC: 31.65
Humerus	353	R	5, 6	HT: 40.72
Humerus	314	R	5, 6	HT: 40.77
Humerus	288	UNK	5, 6	HT: 40.83
Humerus	285	L	5, 6	HT: 40.9, HTC: 31.44
Humerus	353	R	5, 6	HT: 40.91, [HTC: 29.77]
Humerus	289	R	5, 6	HT: 41.37, HTC: 29.9
Humerus	203	L	5, 6	HT: 41.6, HTC: 29.16
Humerus	421	L	5, 6	HT: 41.83, HTC: 31.05
Humerus	314	R	5	HT: 42.04
Humerus	285	L	5, 6	HT: 42.09, [HTC: 30.73]
Humerus	415	L	5, 6	HT: 42.27, [HTC: 32.22]
Humerus	285	L	5, 6	HT: 42.37, HTC: 29.92
Humerus	444	R	5	HT: 43.06
Humerus	203	R	5, 6	HT: 43.15, [HTC: 32.37]

Humerus	295	R	5	HT: 43.41
Humerus	448	L	5, 6	HT: 43.78, HTC: 31.67
Humerus	247	L	5, 6	HT: 44.07, HTC: 33.17
Humerus	414	L	5	HT: 44.45
Humerus	323	R	5	HT: 44.74
Humerus	415	L	5, 6	HT: 44.83, HTC: 32.33
Humerus	339	R	5	HT: 45.01
Humerus	169	R	5, 6	HT: 46.51, HTC: 33.3
Humerus	288	L	5, 6	HT: 46.7, HTC: 37.03
Humerus	508	L	6	HT: 32.85
Humerus	531	R	5, 6	HT: 35.73
Humerus	557	L	6	HT: 36.15
Humerus	593	R	6	HT: 36.2
Humerus	476	R	5	HT: 36.53, HTC: 28.84
Humerus	570	R	6	HT: 36.96, HTC: 27.17
Humerus	470	L	5, 6	HT: 37.05, HTC: 28.87
Humerus	589	R	5	HT: 37.09
Humerus	U/S	R	5, 6	HT: 37.53, HTC: 27.45
Humerus	470	L	5, 6	HT: 37.54, HTC: 27.68
Humerus	531	R	6	HT: 37.77
Humerus	574	L	5, 6	HT: 38.53
Humerus	571	L	6	HT: 38.56
Humerus	583	R	6	HT: 38.63, HTC: 28.2
Humerus	508	L	5, 6, 7, 8	HT: 39.48, HTC: 28.94
Humerus	276	L	5, 6	HT: 39.75, HTC: 29.44
Humerus	607	R	5, 6	HT: 39.91, HTC: 31.8
Humerus	520	L	6	HT: 40.2
Humerus	469	L	6	HT: 40.27
Humerus	485	L	6,7, 8	HT: 40.42
Humerus	554	L	5, 6	HT: 40.52, HTC: 30.12
Humerus	520	L	5, 6	HT: 40.55, HTC: 30.43
Humerus	545	L	5, 6	HT: 41.28, HTC: 31.83
Humerus	554	R	6	HT: 41.38
Humerus	613	L	6, 8, 9	HT: 41.49
Humerus	526	L	6, 8	HT: 42.66
Humerus	470	L	5, 6	HT: 43.11, HTC: 31.96
Humerus	476	R	5	HT: 43.26, HTC: 33.25
Humerus	540	R	5, 6	HT: 43.44
Humerus	555	L	6	HT: 45.28
Humerus	506	R	6, 8	HT: 45.7
Humerus	481	R	5, 6	HT: 46.7, HTC: 16.91
Humerus	276	L	6	HT: 52.35
Humerus	345	R	6	HTC: 21.58
Humerus	314	L	6	HTC: 27.06

Humerus	201	R	6	HTC: 27.47
Humerus	286	L	6	HTC: 27.63
Humerus	285	L	6	HTC: 27.95
Humerus	236	L	6	HTC: 28.57
Humerus	320	L	6	HTC: 28.94
Humerus	339	L	6	HTC: 29.05
Humerus	433	R	6	HTC: 29.32
Humerus	352	L	6	HTC: 29.36
Humerus	192	UNK	6	HTC: 29.4
Humerus	443	L	6	HTC: 29.74
Humerus	286	L	6	HTC: 30.11
Humerus	236	L	6	HTC: 30.11
Humerus	314	L	6	HTC: 30.88
Humerus	314	L	6	HTC: 31.19
Humerus	236	R	6	HTC: 31.63
Humerus	415	L	6	HTC: 36.58
Humerus	204	R	6	HTC: 38.51
Humerus	U/S	L	5, 6	HTC: 28..8
Humerus	508	L	6	HTC: 28.14
Humerus	469	L	5, 6	HTC: 28.87
Humerus	510	L	5	HTC: 29.99
Humerus	595	R	5, 6	HTC: 31.08
Humerus	482	R	5, 6	HTC: 31.82
Humerus	506	R	5, 7	HTC: 36.68
Humerus	482	L	5	HTC: 44.57
Humerus	393	R	5, 6, 7, 8	SD: 36.62, HT: 40.48, HTC: 30.26
M3	319	R	N/A	[L: 31.6]
M3	353	L	N/A	L: 24.79
M3	353	R	N/A	L: 25.09
M3	332	R	N/A	L: 26.94
M3	353	L	N/A	L: 26.95
M3	384	L	N/A	L: 27.02
M3	236	R	N/A	L: 27.43
M3	320	L	N/A	L: 27.52
M3	314	R	N/A	L: 27.58
M3	191	L	N/A	L: 27.77
M3	446	R	N/A	L: 27.99
M3	236	R	N/A	L: 28.05
M3	353	R	N/A	L: 28.16
M3	247	L	N/A	L: 28.39
M3	384	R	N/A	L: 28.58
M3	318	R	N/A	L: 28.78
M3	371	L	N/A	L: 28.86
M3	285	L	N/A	L: 28.9

M3	236	L	N/A	L: 29.49
M3	332	L	N/A	L: 29.64
M3	288	R	N/A	L: 29.69
M3	369	L	N/A	L: 29.8
M3	204	R	N/A	L: 30.03
M3	415	L	N/A	L: 30.2
M3	288	L	N/A	L: 30.33
M3	288	R	N/A	L: 30.48
M3	291	R	N/A	L: 30.48
M3	236	L	N/A	L: 30.68
M3	353	R	N/A	L: 30.84
M3	236	R	N/A	L: 30.94
M3	286	L	N/A	L: 30.95
M3	288	L	N/A	L: 31.01
M3	308	L	N/A	L: 31.27
M3	355	R	N/A	L: 31.54
M3	320	L	N/A	L: 31.57
M3	362	L	N/A	L: 31.66
M3	285	R	N/A	L: 31.71
M3	236	L	N/A	L: 31.84
M3	289	L	N/A	L: 31.85
M3	319	R	N/A	L: 31.88
M3	353	L	N/A	L: 32.08
M3	314	R	N/A	L: 32.23
M3	415	L	N/A	L: 32.28
M3	353	L	N/A	L: 32.56
M3	329	L	N/A	L: 32.74
M3	329	R	N/A	L: 32.87
M3	353	R	N/A	L: 32.88
M3	353	R	N/A	L: 32.97
M3	314	R	N/A	L: 33.04
M3	288	L	N/A	L: 33.05
M3	285	L	N/A	L: 33.06
M3	421	L	N/A	L: 33.1
M3	320	R	N/A	L: 33.24
M3	286	L	N/A	L: 33.52
M3	320	R	N/A	L: 33.53
M3	236	R	N/A	L: 33.54
M3	314	L	N/A	L: 33.66
M3	355	L	N/A	L: 33.69
M3	287	L	N/A	L: 33.71
M3	323	L	N/A	L: 33.82
M3	247	L	N/A	L: 33.83
M3	353	L	N/A	L: 34.01

M3	353	L	N/A	L: 34.3
M3	236	R	N/A	L: 34.46
M3	286	R	N/A	L: 34.5
M3	321	R	N/A	L: 34.65
M3	302	R	N/A	L: 35.03
M3	352	R	N/A	L: 35.1
M3	291	R	N/A	L: 35.14
M3	323	R	N/A	L: 35.21
M3	321	R	N/A	L: 35.23
M3	324	R	N/A	L: 35.24
M3	236	R	N/A	L: 35.27
M3	286	L	N/A	L: 35.28
M3	201	R	N/A	L: 35.34
M3	314	R	N/A	L: 35.45
M3	320	L	N/A	L: 35.45
M3	203	L	N/A	L: 35.5
M3	285	R	N/A	L: 35.6
M3	287	R	N/A	L: 35.64
M3	288	L	N/A	L: 35.65
M3	288	L	N/A	L: 35.73
M3	236	R	N/A	L: 35.81
M3	314	L	N/A	L: 35.95
M3	307	L	N/A	L: 36.05
M3	271	R	N/A	L: 36.19
M3	236	R	N/A	L: 36.34
M3	255	L	N/A	L: 36.65
M3	247	R	N/A	L: 36.95
M3	236	L	N/A	L: 36.99
M3	318	L	N/A	L: 37.04
M3	247	L	N/A	L: 37.08
M3	201	R	N/A	L: 37.14
M3	396	R	N/A	L: 37.32
M3	393	L	N/A	L: 37.36
M3	433	R	N/A	L: 37.4
M3	353	L	N/A	L: 37.57
M3	415	R	N/A	L: 38.15
M3	208	L	N/A	L: 38.38
M3	5	R	N/A	L: 38.44
M3	320	R	N/A	L: 38.55
M3	353	L	N/A	L: 38.56
M3	353	R	N/A	L: 38.89
M3	286	L	N/A	L: 39.16
M3	339	R	N/A	L: 45.02
M3	339	R	N/A	L: 45.48

M3	482	R	N/A	L: 26.39
M3	506	R	N/A	L: 27.01
M3	482	R	N/A	L: 27.3
M3	482	L	N/A	L: 28.19
M3	634	L	N/A	L: 28.21
M3	570	R	N/A	L: 28.9
M3	276	R	N/A	L: 29.01
M3	507	L	N/A	L: 29.39
M3	276	R	N/A	L: 29.41
M3	U/S	L	N/A	L: 29.52
M3	592	R	N/A	L: 30.26
M3	276	R	N/A	L: 30.6
M3	482	L	N/A	L: 30.77
M3	506	L	N/A	L: 30.91
M3	500	L	N/A	L: 31.65
M3	593	R	N/A	L: 31.9
M3	482	L	N/A	L: 32.03
M3	527	R	N/A	L: 32.04
M3	520	L	N/A	L: 32.09
M3	586	L	N/A	L: 32.16
M3	592	R	N/A	L: 32.2
M3	482	R	N/A	L: 32.34
M3	527	L	N/A	L: 32.43
M3	276	R	N/A	L: 32.59
M3	506	L	N/A	L: 32.6
M3	474	L	N/A	L: 32.67
M3	320	R	N/A	L: 32.75
M3	574	L	N/A	L: 32.9
M3	482	R	N/A	L: 33.24
M3	320	L	N/A	L: 33.32
M3	476	L	N/A	L: 33.38
M3	595	R	N/A	L: 33.53
M3	593	L	N/A	L: 33.57
M3	276	R	N/A	L: 33.77
M3	586	R	N/A	L: 33.93
M3	482	R	N/A	L: 33.96
M3	555	L	N/A	L: 33.97
M3	470	R	N/A	L: 34.08
M3	276	L	N/A	L: 34.2
M3	276	R	N/A	L: 34.24
M3	470	R	N/A	L: 34.25
M3	494	R	N/A	L: 34.29
M3	276	R	N/A	L: 34.33
M3	476	L	N/A	L: 34.73

M3	482	L	N/A	L: 34.77
M3	554	R	N/A	L: 34.97
M3	613	L	N/A	L: 35.04
M3	485	R	N/A	L: 35.39
M3	476	L	N/A	L: 35.4
M3	520	R	N/A	L: 35.8
M3	276	L	N/A	L: 35.86
M3	583	R	N/A	L: 35.92
M3	320	L	N/A	L: 36.58
M3	541	L	N/A	L: 36.95
M3	506	L	N/A	L: 36.97
M3	507	R	N/A	L: 37.7
M3	568	L	N/A	L: 37.9
M3	482	R	N/A	L: 37.91
M3	520	L	N/A	L: 38.15
M3	508	L	N/A	L: 38.52
M3	U/S	R	N/A	L: 40.71
Mandible	285	L	1	[D1: 38.73], [D2: 45.81], Lp: 42.39
Mandible	236	L	6	[D3: 54.81]
Mandible	276	R	1	3L: 37.3
Mandible	244	R	1, 2	D1: 29.74, D2: 41.15, D3: 56.14, Lp: 33.95, Lm: 80.34
Mandible	236	L	1, 2	D1: 29.94, D2: 44.54, Lp: 48.06
Mandible	314	L	1, 2	D1: 30.26, D2: 46.99, Lp: 57.0
Mandible	329	L	1, 3, 6	D1: 30.58, D2: 45.05, D3: 60.7, Lp: 43.1, Lm: 79.41
Mandible	329	R	1, 6	D1: 31.07, D2: 43.71, D3: 60.67, Lp: 43.12, Lm: 78.55
Mandible	320	R	1, 2	D1: 31.36
Mandible	384	R	1, 2, 3, 6	D1: 31.46, D2: 43.94, D3: 61.23, Lp: 51.65, Lm: 82.07
Mandible	369	L	1	D1: 31.48, D2: 45.32, Lp: 55.48, [Lm: 81.07]
Mandible	384	L	1, 2	D1: 32.27, D2: 46.55, D3: 62.36, Lp: 50.65, Lm: 77.86
Mandible	320	R	1, 2	D1: 32.32, D2: 40.01, Lp: 50.11
Mandible	314	R	2	D1: 32.71
Mandible	236	R	1, 2, 6	D1: 33.66, D2: 46.06, D3: 50.17, Lp: 45.23, Lm: 75.57
Mandible	187	R	1, 2, 3	D1: 34.02, Lp: 52.88
Mandible	353	R	1	D1: 34.74, D2: 44.15, Lp: 47.44
Mandible	222	L	1, 2	D1: 35.32
Mandible	191	L	1	D1: 35.9, D2: 49.0, Lp: 54.12, Lm: 82.28
Mandible	291	L	2	D1: 35.92
Mandible	236	L	1, 2	D1: 37.33, Lp: 35.93
Mandible	208	L	1	D1: 38.67, D2: 50.18, Lp: 46.88, Lm: 87.23
Mandible	415	R	2	D1: 38.78
Mandible	69	R	1, 3	D1: 39.15, D2: 47.31, D3: 62.24, Lp: 35.26, Lm: 80.55
Mandible	324	L	1, 2	D1: 39.74
Mandible	339	L	1, 2, 3, 6	D1: 42.59, D2: 54.13, Lp: 68.61
Mandible	570	R	1	D1: 24.15, D2: 45.14, D3: 64.34, Lp: 70.73, Lm: 83.7, M3L: 34.54

Mandible	469	R	1, 2, 7	D1: 27.82, D2: 35.06, D3: 63.97, Lp: 46.97, Lm: 81.5
Mandible	506	L	1, 2, 7	D1: 27.88, D2: 44.78, Lp: 54.75
Mandible	470	L	1	D1: 27.93, D2: 39.13, Lp: 52.5
Mandible	506	R	1	D1: 28.38
Mandible	431	L	1, 2	D1: 29.03, D2: 43.24, D3: 62.68, Lp: 51.79, Lm: 72.02, M3L: 23.44
Mandible	569	L	1	D1: 29.17
Mandible	511	L	1	D1: 29.17
Mandible	613	R	1, 2, 6	D1: 31.42, D2: 42.25, D3: 59.76, Lp: 48.38, Lm: 82.17, M3L: 33.57
Mandible	566	R	1	D1: 31.53; D2: 41.98, D3: 67.07, Lp: 51.06, Lm: 79.99, M3L: 30.03
Mandible	520	R	1	D1: 31.58, D2: 38.45, Lp: 36.2
Mandible	476	L	1	D1: 32.49, D2: 37.01, Lp: 45.51
Mandible	613	L	1, 6	D1: 32.56, D2: 42.56, D3: 59.96, Lp: 48.05, Lm: 81.47, M3L: 32.9
Mandible	476	L	1, 2, 3, 7	D1: 32.59, D2: 43.02, D3: 60.81, Lp: 40.3, Lm: 77.7, M3L:33.37
Mandible	613	L	1	D1: 33.42, D2: 41.79, Lp: 35.61
Mandible	276	L	1	D1: 33.92, Lp: 42.21, Lm: 79.62
Mandible	536	L	1	D1: 34.67
Mandible	506	L	1, 2	D1: 35.33
Mandible	276	R	1, 2	D1: 35.47, D2: 48.58, Lp: 45.65, Lm: 80.7
Mandible	476	L	1, 2, 3, 7	D1: 35.68, D2: 47.11, Lp: 48.11
Mandible	431	L	1, 2	D1: 36.13, D2: 46.4, D3: 64.19, Lp: 44.93, Lm: 79.18, M3L: 34.74
Mandible	507	L	1	D1: 36.47, D2: 46.54, Lp: 48.49
Mandible	592	R	1	D1: 37.69, D2: 45.65, Lp: 33.89, M3L: 35.15
Mandible	569	L	1	D1: 38.28, D2: 47.79, Lp: 48.76
Mandible	480	R	1	D1: 38.82, D2: 53.83, Lp: 36.33, Lm: 83.09
Mandible	508	L	2	D1: 39.04
Mandible	506	L	1	D1: 40.17, D2: 47.2, Lp: 52.66
Mandible	571	L	1	D1: 40.82
Mandible	476	R	1, 2, 6, 7	D1: 42.35, D2: 53.52, D3: 73.43, Lp: 48.11, Lm: 85.18, M3L: 35.83
Mandible	522	L	1, 2	D1: 44.47
Mandible	402	L	1	D2: 39.28
Mandible	293	L	1, 6	D2: 42.1, D3: 58.71
Mandible	286	R	1	D2: 42.71, D3: 53.68, Lm: 89.46
Mandible	371	L	1, 2	D2: 44.53, D3: 65.01, Lm: 74.84
Mandible	291	R	1, 2	D2: 46.84, D3: 61.16, Lm: 81.29
Mandible	320	R	1, 6	D2: 47.87, Lm: 84.96
Mandible	314	L	1, 6	D2: 48.19, D3: 66.82, Lm: 86.61
Mandible	531	L	1	D2: 34.22
Mandible	566	R	1	D2: 34.94
Mandible	476	R	1	D2: 37.46, Lm: 80.37
Mandible	586	L	1	D2: 41.11, D3: 63.88, Lm: 79.28, M3L: 31.57
Mandible	535	R	1	D2: 44.46, D3: 65.21, Lm: 77.57, M3L: 25.19
Mandible	276	L	1	D2: 46.44, D3: 62.64, Lm: 73.16
Mandible	506	R	1	D2: 47.02, D3: 66.45, Lm: 83.54, M3L: 32.71
Mandible	593	R	1	D2: 47.16

Mandible	506	L	1	D2: 48.25, D3: 68.84, Lm: 88.6, M3L: 38.01
Mandible	470	L	1, 6	D2: 50.26, D3: 61.74, Lp: 45., Lm: 81.86, M3L: 31.9
Mandible	543	R	1	D3: 56.52
Mandible	509	L	1	D3: 64.39
Mandible	545	R	1	D3: 65.02, Lm: 84.83
Mandible	276	L	1	D3: 67.48, Lm: 77.66, M3L: 29.36
Mandible	545	L	1	D3: 68.04, Lp: 47.25, Lm: 82.85, M3L: 34.6
Mandible	506	L	1	D3: 68.82
Mandible	247	L	1, 2	Lm: 79.4
Mandible	314	L	1	Lm: 79.83
Mandible	236	R	1	Lm: 87.02
Mandible	320	R	1	Lm: 71.81, M3L: 29.32
Mandible	320	R	1	Lm: 74.69, M3L: 29.95
Mandible	276	L	1	LM: 78.08, M3L: 34.06
Mandible	506	R	1	Lm: 85.52, M3L: 36.8
Mandible	593	L	1	Lm: 86.6
Mandible	353	L	1	Lp: 46.40, Lm: 89.42
Mandible	353	L	1	Lp: 52.32, Lm: 89.45
Mandible	482	L	1	Lp: 44.54
Mandible	482	R	1	Lp: 45.21
Mandible	470	R	1	Lp: 45.7
Mandible	482	R	1	Lp: 47.56
Mandible	320	L	1	Lp: 48.04
Mandible	476	L	1	Lp: 49.94
Mandible	500	R	1	Lp: 53.98
Mandible	520	L	1	Lp: 83.97, M3L: 37.33
Mandible	520	R	1	M3L: 36.53
Mandible	276	R	1	M3L: 38.22
Mandible	469	L	1	M3L: 39.61
Metacarpal	288	UNK	3, 4, 7, 8	[BD: 48.66]
Metacarpal	320	R	1, 2	[Bp: 43.27]
Metacarpal	318	R	1, 2	[Bp: 46.15]
Metacarpal	314	R	1, 2	[Bp: 46.26]
Metacarpal	324	L	1, 2	[Bp: 67.89]
Metacarpal	354	R	3, 4, 7, 8	BD: 46.83
Metacarpal	201	R	3, 4, 7, 8	BD: 47.87, DD: 26.85
Metacarpal	204	R	3, 4, 7, 8	BD: 47.95
Metacarpal	353	R	3, 4, 7, 8	BD: 48.18, DD: 25.67
Metacarpal	415	L	3, 4, 7, 8	BD: 48.9, DD: 27.67
Metacarpal	291	L	3, 4, 7, 8	BD: 51.38, DD: 28.08
Metacarpal	285	L	3, 4, 7, 8	BD: 51.9, DD: 25.23
Metacarpal	406	R	3, 4, 7, 8	BD: 54.02, DD: 28.28
Metacarpal	287	R	3, 4, 7, 8	BD: 54.81, DD: 28.57
Metacarpal	314	R	3, 4, 7, 8	BD: 54.95, [DD: 27.9]

Metacarpal	201	L	3, 4, 7, 8	BD: 54.96, DD: 30.41
Metacarpal	332	L	3, 4, 7, 8	BD: 56.71, DD: 30.93
Metacarpal	285	UNK	3, 4	BD: 57.23
Metacarpal	203	L	3, 4, 7, 8	BD: 58.43, DD: 31.43
Metacarpal	247	L	3, 4, 7, 8	BD: 60.0, DD: 30.71
Metacarpal	288	L	3, 4	BD: 60.09
Metacarpal	353	L	3, 4, 7, 8	BD: 60.27
Metacarpal	354	L	3, 4, 7, 8	BD: 61.4
Metacarpal	5	R	3, 4, 7, 8	BD: 62.2, [DD: 32.77]
Metacarpal	314	R	3, 4, 7, 8	BD: 64.49, DD: 33.81
Metacarpal	415	L	3,4, 7, 8	BD: 64.61, DD: 31.59
Metacarpal	323	R	3, 4, 7, 8	BD: 64.61, DD: 33.33
Metacarpal	339	L	3, 4, 7, 8	BD: 82.35, DD: 47.48
Metacarpal	613	L	3, 4	BD: 49.67, DD: 28.47
Metacarpal	508	Unk	3, 4, 7, 8	BD: 49.89
Metacarpal	320	L	3, 4, 7, 8	BD: 49.98, DD: 27.61
Metacarpal	276	R	3, 4, 7, 8	BD: 50, DD: 27.19
Metacarpal	506	L	3, 4	BD: 50.22, DD: 24.93
Metacarpal	566	R	3, 4, 7, 8	BD: 50.51, DD: 28.42
Metacarpal	520	R	3, 4, 7, 8	BD: 50.71, DD: 28.3
Metacarpal	506	L	3, 4	BD: 51, DD: 28.18
Metacarpal	583	L	3, 4	BD: 51.4, DD: 29.52
Metacarpal	320	R	3, 4, 7, 8	BD: 51.51, DD: 29.41
Metacarpal	469	R	3, 4, 7, 8	BD: 51.62, DD: 28.67
Metacarpal	506	L	3, 4, 7, 8	BD: 52.21, DD: 29.18
Metacarpal	593	L	3, 4	BD: 52.24, DD: 28.46
Metacarpal	482	L	3, 4	BD: 52.47, DD: 29.26
Metacarpal	U/S	L	3, 4, 7, 8	BD: 54.22
Metacarpal	543	R	3, 4	BD: 54.53, DD: 28.84
Metacarpal	570	R	3, 4, 7, 8	BD: 55.11, DD: 28.6
Metacarpal	570	L	3, 4, 7, 8	BD: 56.41, DD: 26.29
Metacarpal	320	L	3, 4, 7, 8	BD: 56.47, DD: 30.29
Metacarpal	276	R	3, 4, 7, 8	BD: 56.52, DD: 30.34
Metacarpal	571	L	3, 4, 7, 8	BD: 57.35, DD: 29.31
Metacarpal	571	R	3, 4, 7, 8	BD: 57.82, DD: 32.7
Metacarpal	507	L	3, 4	BD: 58.22, DD: 31.25
Metacarpal	U/S	L	3, 4, 7, 8	BD: 58.68, DD: 31.24
Metacarpal	508	R	3, 4	BD: 58.95, DD: 30.17
Metacarpal	511	R	3, 4	BD: 60.11, DD: 30.92
Metacarpal	588	R	3, 4	BD: 60.36, DD: 31.87
Metacarpal	535	L	3, 4	BD: 60.41, DD: 33.84
Metacarpal	476	L	3, 4, 7, 8	BD: 60.45, DD: 31.34
Metacarpal	476	L	3, 4	BD: 60.55, DD: 31.5
Metacarpal	535	R	3, 4	BD: 60.63, DD: 32.55

Metacarpal	500	R	3, 4	BD: 60.85, DD: 32.8
Metacarpal	570	R	3, 4, 7, 8	BD: 61.11, DD: 32.9
Metacarpal	482	R	3, 4, 7, 8	BD: 61.29, DD: 33.8
Metacarpal	506	L	3, 4	BD: 61.31, DD: 31.8
Metacarpal	482	R	3, 4, 7, 8	BD: 61.86, DD: 29.87
Metacarpal	276	R	3, 4, 7, 8	BD: 62.15, DD: 33.89
Metacarpal	276	L	3, 4, 7, 8	BD: 62.32
Metacarpal	531	R	3, 4	BD: 62.73
Metacarpal	508	L	3, 4, 7, 8	BD: 62.87
Metacarpal	276	R	3, 4, 7, 8	BD: 63.28, DD: 31.54
Metacarpal	276	L	3, 4	BD: 63.57, DD: 33.64
Metacarpal	531	L	3, 4, 7, 8	BD: 67.12, DD: 32.64
Metacarpal	476	L	3, 4	BD: 69.05, DD: 32.85
Metacarpal	592	L	3, 4	BD: 9.83, DD: 27.84
Metacarpal	415	L	1, 2, 5, 6, 7, 8	Bp: 32.49, SD: 15.51
Metacarpal	69	R	1, 2	Bp: 44.15
Metacarpal	286	L	1, 2	Bp: 46.51
Metacarpal	314	R	1, 2, 5, 6	Bp: 47.89, SD: 26.94
Metacarpal	353	L	1, 2	Bp: 49.16
Metacarpal	415	R	1, 2	Bp: 49.41
Metacarpal	236	L	1, 2	Bp: 50.57
Metacarpal	421	L	1, 2	Bp: 51.22
Metacarpal	288	R	1, 2	Bp: 52.11
Metacarpal	236	L	1, 2	Bp: 52.2
Metacarpal	443	R	1, 2	Bp: 52.39, SD: 32.28
Metacarpal	355	L	1, 2	Bp: 53.26
Metacarpal	286	R	1, 2, 5, 6	Bp: 54.77, SD: 36.23
Metacarpal	289	R	1, 2	Bp: 54.87
Metacarpal	415	R	1, 2	Bp: 56.03
Metacarpal	415	R	1, 2	Bp: 58.54
Metacarpal	411	R	1, 2, 5, 6	Bp: 59.33, SD: 36.87
Metacarpal	353	R	1, 2	Bp: 59.72
Metacarpal	222	L	1, 3	Bp: 60.17
Metacarpal	201	L	1, 2	BP: 60.95
Metacarpal	415	R	1, 2	Bp: 61.05
Metacarpal	342	L	1, 2	Bp: 61.23
Metacarpal	204	R	1, 2	Bp: 65.17, SD: 36.62
Metacarpal	570	R	1, 2, 5, 6	Bp: 42.49, SD: 23.14
Metacarpal	482	R	Complete	Bp: 45.44, SD: 24.33
Metacarpal	506	R	1, 2	Bp: 45.55
Metacarpal	506	L	1, 2, 5, 6	Bp: 46.72
Metacarpal	578	L	1, 2	Bp: 47.05
Metacarpal	469	L	1, 2	Bp: 47.42
Metacarpal	506	R	1, 2, 5, 6	Bp: 47.66, SD: 25.7

Metacarpal	555	L	1, 2	Bp: 47.99
Metacarpal	320	L	1, 2, 5, 6	Bp: 48.07, SD: 26.48
Metacarpal	597	L	1, 2, 5, 6	Bp: 49.33, SD: 28.83
Metacarpal	476	L	1, 2, 5, 6	Bp: 49.53
Metacarpal	583	L	1, 2	Bp: 49.77
Metacarpal	476	R	1, 2, 5, 6	Bp: 49.93
Metacarpal	583	R	1, 2	Bp: 50.76
Metacarpal	593	R	1, 2, 5, 6	Bp: 50.87, SD: 26.79
Metacarpal	506	R	1, 2, 5, 6	Bp: 51.82, SD: 31.66
Metacarpal	470	L	1, 2	Bp: 52.85
Metacarpal	570	R	1, 2	Bp: 53.07
Metacarpal	476	R	1, 2	Bp: 53.42
Metacarpal	613	L	1, 2	Bp: 53.7
Metacarpal	276	L	1, 2	Bp: 54.47
Metacarpal	320	L	1, 2, 5, 6	Bp: 54.7
Metacarpal	570	R	Complete	Bp: 55.87, SD: 34.08, BD: 71.54
Metacarpal	476	R	1, 2	Bp: 57.24
Metacarpal	570	L	1, 2	Bp: 58.41
Metacarpal	476	L	1, 2, 5, 6	Bp: 59.04
Metacarpal	595	R	1, 2	Bp: 59.95
Metacarpal	276	L	1, 2	Bp: 61.07
Metacarpal	531	L	1, 2, 5, 6	Bp: 61.87
Metacarpal	592	R	1, 2	Bp: 62.31
Metacarpal	470	L	1, 2	Bp: 62.38
Metacarpal	482	L	1, 2, 5, 6	Bp: 62.54
Metacarpal	470	R	1, 2	Bp: 63.32
Metacarpal	285	L	3, 4, 7, 8	DD: 25.88
Metacarpal	288	R	3, 4, 7, 8	DD: 27.37
Metacarpal	415	L	3, 4	DD: 29.15
Metacarpal	415	L	3, 4, 7, 8	DD: 31.83
Metacarpal	585	R	Complete	GL: , Bp: 47.06, SD: 25.72, BD: 47.61, DD: 27.11
Metacarpal	291	R	Complete	GL: 162, Bp: 46.26, BD: 58.41, DD: 28.95, SD: 30.58
Metacarpal	318	L	Complete	GL: 171, Bp: 55.37, [BD: 54.04], SD: 33.73
Metacarpal	415	L	Complete	GL: 173, Bp: 49.52, BD: 49.3, DD: 26.67, SD: 29.38
Metacarpal	415	R	Complete	GL: 174, BD: 47.94, DD: 27.45, SD: 27.56
Metacarpal	395	R	Complete	GL: 177, Bp: 47.52, BD: 50.38, SD: 27.15, DD: 29.25
Metacarpal	329	R	Complete	GL: 177, Bp: 51.55, BD: 50.09, DD: 28.96, SD: 25.19
Metacarpal	339	R	Complete	GL: 181, Bp: 61.48, BD: 61.01, DD: 42.0, SD: 36.9
Metacarpal	345	R	Complete	GL: 182, Bp: 50.45, BD: 58.11, DD: 28.78, SD: 31.53
Metacarpal	342	R	Complete	GL: 183, Bp: 56.0, [BD: 57.44],DD: 31.57, SD: 31.98
Metacarpal	338	R	Complete	GL: 185, [Bp: 60.69], BD: 66.95, DD: 33.67, SD: 35.64
Metacarpal	353	L	Complete	GL: 185, Bp: 60.09, BD: 61.22, DD: 32.86, SD: 34.93
Metacarpal	320	L	Complete	GL: 190, Bp: 59.84, BD: 62.61, DD: 32.77, SD: 38.36
Metacarpal	371	L	Complete	GL: 190, Bp: 59.91, BD: 64.39, DD: 33.52, SD: 35.2

Metacarpal	244	R	Complete	GL: 190.0, Bp: 50.51, BD: 52.71, DD: 29.12, SD: 30.49
Metacarpal	353	L	Complete	GL: 198, Bp: 58.54, [BD: 58.38], DD: 29.34, SD: 36.88
Metacarpal	384	R	Complete	GL: 198, Bp: 59.44, BD: 63.09, DD: 32.13, SD: 35.8
Metacarpal	569	L	Complete	GL: 160, Bp: 45.24, SD: 26.5, BD: 46.16, DD: 25.99
Metacarpal	480	L	Complete	GL: 165, Bp: 48.44, SD: 27.52, BD: 50.97, DD: 28.47
Metacarpal	586	L	Complete	GL: 171, Bp: 48.93, SD: 28.68, BD: 52.09, DD: 28.18
Metacarpal	476	L	Complete	GL: 175, SD: 26.55, BD: 50.42, DD: 27.84
Metacarpal	506	R	Complete	GL: 178, Bp: 52.09, SD: 29.14, BD: 56.24, DD: 28.68
Metacarpal	482	R	1, 2, 3, 5, 6, 7, 8	GL: 180, Bp: 58.11, SD: 34.58, DD: 29.74
Metacarpal	520	L	Complete	GL: 181, Bp: 50.92, SD: 28.94, BD: 51.45, DD: 29.28
Metacarpal	634	R	Complete	GL: 184, Bp: 55.62, SD: 31.84, BD: 60.35, DD: 30.44
Metacarpal	586	L	Complete	GL: 184, Bp: 57.46, SD: 35, BD: 60.05, DD: 32.25
Metacarpal	595	R	Complete	GL: 194, SD: 31.15, BD: 57.46, DD: 30.3
Metacarpal	476	R	Complete	GL: 194, SD: 38.54, BD: 65.8
Metacarpal	482	R	Complete	GL: 201, Bp: 59.17, SD: 36.46, BD: 62.69, DD: 32.71
Metacarpal	569	L	Complete	GL: 202, Bp: 63.75, SD: 35.14, BD: 66.06, DD: 34.37
Metacarpal	353	UNK	3/4	HBD: 55.49
Metacarpal	395	UNK	5, 6, 7, 8	SD: 21.47
Metacarpal	415	UNK	5, 6, 7, 8	SD: 24.96
Metacarpal	353	L	5, 6	SD: 26.68
Metacarpal	411	UNK	5, 6, 7, 8	SD: 27.66
Metacarpal	291	UNK	3, 4, 7, 8	SD: 30.35
Metacarpal	5	L	1, 2, 5, 6	SD: 30.48
Metacarpal	288	R	5, 6, 7, 8	SD: 34.1
Metacarpal	570	L	1, 2, 5, 6, 7, 8	SD: 23.19
Metacarpal	470	R	5, 6, 7, 8	SD: 27.39
Metacarpal	608	L	5, 6, 7, 8	SD: 29.13
Metacarpal	320	R	5, 6, 7, 8	SD: 30.58
Metatarsal	320	UNK	3, 4	[BD: 40.32]
Metatarsal	286	R	3, 4, 7, 8	[BD: 46.44], [DD: 28.24]
Metatarsal	339	R	3, 4	[BD: 59.53], DD: 40.11
Metatarsal	204	UNK	3, 4, 7, 8	[BD: 61.14], SD: 27.56
Metatarsal	324	R	1, 2	[Bp: 40.71]
Metatarsal	353	L	1,2	[Bp: 51.35]
Metatarsal	19	R	Complete	[GL: 226], Bp: 48.18, SD: 26.13
Metatarsal	329	R	3, 4, 7, 8	BD: 43.52, DD: 26.14
Metatarsal	236	L	3, 4, 7, 8	BD: 44.14, DD: 25.88
Metatarsal	320	L	3, 4, 7, 8	BD: 44.86
Metatarsal	415	R	3, 4	BD: 45.26, DD: 27.05
Metatarsal	236	R	3, 4	BD: 45.38, DD: 27.55
Metatarsal	371	R	3, 4	BD: 45.39, DD: 26.45
Metatarsal	415	R	3, 4, 7, 8	BD: 45.84, DD: 26.98, SD: 23.42
Metatarsal	203	R	3, 4, 7, 8	BD: 46.98, DD: 30.08
Metatarsal	353	L	3, 4, 7, 8	BD: 48.32, DD: 29.65

Metatarsal	447	R	3, 4, 7, 8	BD: 49.31,DD: 27.98
Metatarsal	5	L	3, 4	BD: 50.06
Metatarsal	314	L	3, 4, 7, 8	BD: 50.46
Metatarsal	415	L	3, 4	BD: 51.21, DD: 27.73
Metatarsal	285	L	3, 4, 7, 8	BD: 51.83, DD: 29.19
Metatarsal	366	R	3, 4	BD: 52.58
Metatarsal	355	R	3, 4	BD: 53.59, DD: 30.99
Metatarsal	323	L	3, 4, 7, 8	BD: 54.81, DD: 28.91
Metatarsal	353	R	3, 4	BD: 54.91, DD: 29.73
Metatarsal	236	R	3, 4, 7, 8	BD: 55.17
Metatarsal	414	R	3, 4, 7, 8	BD: 57.13, DD: 31.21
Metatarsal	448	L	3, 4, 7, 8	BD: 58.3, DD: 32.2
Metatarsal	335	R	3, 4, 7, 8	BD: 59.5, DD: 32.83
Metatarsal	236	L	3, 4	BD: 61.51, DD: 30.88
Metatarsal	354	L	3, 4, 7, 8	BD: 66.54, DD: 30.29
Metatarsal	285	L	3, 4	BD: 68.02, DD: 35.53
Metatarsal	320	L	3, 4, 7, 8	BD: 43.35, DD: 26.8
Metatarsal	574	L	3, 4, 7, 8	BD: 45.86, DD: 28.97
Metatarsal	506	R	3, 4	BD: 46.1, DD: 26.69
Metatarsal	593	R	3, 4	BD: 46.37, DD: 28.04
Metatarsal	506	R	3, 4	BD: 46.42, DD: 26.91
Metatarsal	481	R	3, 4	BD: 46.51, DD: 26.96
Metatarsal	476	R	3, 4, 7, 8	BD: 47.07, DD: 28.99
Metatarsal	583	L	3, 4	BD: 48.01, DD: 29.84
Metatarsal	570	R	3, 4, 7, 8	BD: 48.67, DD: 27.17
Metatarsal	508	R	3, 4	BD: 48.75, DD: 29.24
Metatarsal	510	R	3, 4	BD: 49.6
Metatarsal	592	L	3, 4	BD: 54.32, DD: 31.32
Metatarsal	508	L	3, 4	BD: 55.71
Metatarsal	506	L	3, 4	BD: 56.15, DD: 31.11
Metatarsal	510	R	3, 4	BD: 56.95
Metatarsal	511	L	3, 4, 7, 8	BD: 58.16, DD: 32.89
Metatarsal	476	L	3, 4	BD: 58.54, DD: 32.93
Metatarsal	508	L	3, 4	BD: 59.52
Metatarsal	630	R	3, 4	BD: 62.41, DD: 32.13
Metatarsal	288	L	1, 2	Bp: 42.47
Metatarsal	236	R	1,2, 5, 6	Bp: 36.93, SD: 21.45
Metatarsal	321	L	1, 2, 5, 6	Bp: 38.35, SD: 20.36
Metatarsal	275	L	1, 2, 5, 6	Bp: 38.65, SD: 20.58
Metatarsal	308	L	1, 2	Bp: 39.95
Metatarsal	415	R	1, 2	Bp: 40.02
Metatarsal	420	L	1, 2	Bp: 40.23
Metatarsal	285	R	1, 2, 5, 6	Bp: 40.6, SD: 23.45
Metatarsal	69	L	1, 2	Bp: 41.45

Metatarsal	314	R	1, 2	Bp: 41.45
Metatarsal	323	L	1, 2	Bp: 41.59
Metatarsal	381	R	1, 2	Bp: 41.65
Metatarsal	204	R	1, 2, 5, 6	Bp: 41.82, SD: 23.7
Metatarsal	295	R	1, 2	Bp: 42.67
Metatarsal	203	L	Complete	Bp: 43.44, BD: 50.26, SD: 25.69, DD: 30.53
Metatarsal	411	L	1, 2, 5, 6	Bp: 43.9, SD: 23.55
Metatarsal	306	L	1, 2	Bp: 44.34
Metatarsal	415	L	1, 2	Bp: 44.46
Metatarsal	201	R	1, 2, 5, 6	Bp: 44.98, SD: 25.68
Metatarsal	353	R	1, 2, 5, 6	Bp: 45.69, SD: 21.92
Metatarsal	247	R	1, 2, 5, 6	Bp: 47.74, SD: 23.24
Metatarsal	285	R	1, 2, 5, 6	Bp: 48.44, SD: 29.7
Metatarsal	201	L	1, 2	Bp: 48.57, [SD: 32.67]
Metatarsal	204	R	1, 2	Bp: 48.91
Metatarsal	449	R	1, 2	Bp: 49.88
Metatarsal	446	R	1, 2	Bp: 50.74
Metatarsal	353	L	1, 2	Bp: 51.82, SD: 28.19
Metatarsal	285	R	1, 2	Bp: 52.37
Metatarsal	415	R	1, 2	Bp: 52.37
Metatarsal	331	L	1, 2	Bp: 52.91
Metatarsal	338	L	1, 2	Bp: 52.94
Metatarsal	320	L	1, 2	Bp: 53.54
Metatarsal	320	L	1, 2, 5, 6	Bp: 53.79, SD: 29.99
Metatarsal	446	L	1, 2	Bp: 55.25
Metatarsal	482	R	1, 2, 5, 6	Bp: 37.11, SD: 20.78
Metatarsal	508	L	1, 2	Bp: 38.97
Metatarsal	482	R	1,2, 5, 6, 7, 8	Bp: 39.22, SD: 22.32
Metatarsal	320	L	1, 2, 5, 6	Bp: 41.23
Metatarsal	592	L	1, 2	Bp: 41.27
Metatarsal	531	L	1, 2	Bp: 41.67
Metatarsal	476	L	1, 2, 5, 6 7, 8	Bp: 41.78, SD: 24.12
Metatarsal	276	L	1, 2	Bp: 42.29
Metatarsal	569	R	1, 2, 5, 6	Bp: 42.92, SD: 24.4
Metatarsal	506	R	1, 2	Bp: 43.29
Metatarsal	506	R	1, 2, 5 , 6	Bp: 43.31, SD: 21.17
Metatarsal	500	R	1, 2, 5, 6	Bp: 43.5
Metatarsal	320	R	1, 2, 5, 6	Bp: 43.77
Metatarsal	276	L	1, 2, 5, 6	Bp: 43.97, SD: 22.5
Metatarsal	476	L	1, 2	Bp: 44.26
Metatarsal	470	R	1, 2	Bp: 44.39
Metatarsal	585	R	1, 2	Bp: 45.67
Metatarsal	470	L	1, 2, 5, 6	Bp: 48.25
Metatarsal	630	L	1, 2	Bp: 49.26

Metatarsal	476	R	1, 2	Bp: 49.4
Metatarsal	613	R	1, 2	Bp: 49.5
Metatarsal	611	R	1, 2, 5, 6	Bp: 49.55
Metatarsal	469	R	1, 2, 5, 6	Bp: 49.81
Metatarsal	506	R	1, 2	Bp: 51.87
Metatarsal	508	R	1, 2	Bp: 51.98
Metatarsal	569	R	1, 2	Bp: 52.15
Metatarsal	500	R	1, 2, 5, 6	Bp: 55.65
Metatarsal	476	L	1, 2	Bp: 55.93
Metatarsal	353	R	Complete	GL: 181, BD: 55.3, DD: 27.86, SD: 28.46
Metatarsal	355	R	Complete	GL: 186, BD: 57.87, SD: 30.43
Metatarsal	333	L	Complete	GL: 187, DD: 27.79, [SD: 23.69]
Metatarsal	415	L	Complete	GL: 193, [Bp: 37.99], BD: 43.87, DD: 26.44, SD: 20.72
Metatarsal	323	R	Complete	GL: 202, Bp: 43.06, BD: 51.77, [DD: 28.4], [SD: 23.06]
Metatarsal	321	R	Complete	GL: 202.85, Bp: 43.26, BD: 47.87, DD: 27.58, SD: 22.67
Metatarsal	153	L	Complete	GL: 225, Bp: 51.14, [BD: 56.5], SD: 31.33, DD: 34.25
Metatarsal	506	R	Complete	GL: 195, SD: 23.34, BD: 47.64, DD: 27.54
Metatarsal	595	R	Complete	GL: 200, Bp: 42.54, SD: 22.6,BD: 46.78, DD: 28.12
Metatarsal	506	L	Complete	GL: 201, Bp: 0.24, SD: 25.19, BD: 54.77, DD: 30.93
Metatarsal	470	R	Complete	GL: 202, Bp: 40.98, SD: 24.16, BD: 48.14, DD: 27.95
Metatarsal	520	L	Complete	GL: 206, Bp: 42.39, SD: 24.92, BD: 47.28, DD: 29.52
Metatarsal	506	L	Complete	GL: 206, Bp: 48.9, SD: 27.73, BD: 55.09, DD: 28.37
Metatarsal	476	R	Complete	GL: 216, Bp: 52.03, SD: 25.94, BD: 57.56, DD: 32.18
Metatarsal	506	L	Complete	GL: 227, SD: 28.01, BD: 62.18, DD: 31.74
Metatarsal	578	L	Complete	GL: 227.5, Bp: 42.52, SD: 24.03, BD: 48.67, DD: 29.39
Metatarsal	566	L	Complete	GL: 229, Bp: 52.3, SD: 30.98, BD: 59.2, DD: 34.87
Metatarsal	320	R	Complete	GL: 240, Bp: 53.81, SD: 28.05, BD: 58.72, DD: 32.94
Metatarsal	353	UNK	5, 6, 7, 8	SD: 20.76
Metatarsal	293	UNK	7, 8	SD: 21.23
Metatarsal	314	R	5, 6, 7 8	SD: 21.82
Metatarsal	293	UNK	3, 4, 7, 8	SD: 22.57
Metatarsal	314	R	7, 8	SD: 26.26
Metatarsal	319	L	7, 8	SD: 26.91
Metatarsal	353	L	1, 2, 5, 6	SD: 27.86
Metatarsal	339	L	1, 2, 5, 6	SD: 36.97
Metatarsal	593	Unk	5, 6, 7, 8	SD: 19.57
Metatarsal	511	L	3, 4, 7, 8	SD: 22.23, BD: 46.68, DD: 29.07
Metatarsal	320	L	5, 6	SD: 22.3
Radius	289	R	3, 4	[BD: 50.31], [Bfd: 48.01]
Radius	236	L	3, 4	[BD: 54.44], [Bfd: 53.82]
Radius	447	R	3, 4, 9, 10	[BD: 61.05], [Bfd: 58.2]
Radius	222	L	3, 4	[BD: 62.35], [Bfd: 52.96]
Radius	320	R	3, 4	[BD: 68.46], [Bfd: 64.42]
Radius	323	L	3, 4	[BD: 74.88], [Bfd: 71.37]

Radius	285	R	3, 4	[BD: 75.08], Bfd: 69.54
Radius	353	R	3, 4	[Bfd: 67.43]
Radius	291	L	1, 2, 5	[Bfp: 61.9]
Radius	236	L	1, 2, 5	[Bp: 62.18], [Bfp: 60.76]
Radius	222	L	1, 2, 5	[Bp: 68.63], [Bfp: 62.64]
Radius	447	R	1, 2, 5	[Bp: 74.38], [Bfp: 66.99]
Radius	320	R	1, 2	[Bp: 71.42], Bfp: 66.3
Radius	323	L	3, 4, 9, 10	BD: 28.97, Bfd: 26.21
Radius	339	L	3, 4, 9, 10	BD: 57.72, Bfd: 55.51
Radius	402	R	3, 4	BD: 57.93, Bfd: 56.0
Radius	339	R	3, 4	BD: 58.57, [Bfd: 52.74]
Radius	293	R	3, 4	BD: 58.68, Bfd: 55.83
Radius	335	L	3, 4	BD: 58.71, Bfd: 53.81
Radius	204	R	3, 4, 9, 10	BD: 58.85, Bfd: 56.94
Radius	414	R	3, 4, 9, 10	BD: 58.86, Bfd: 57.32
Radius	314	L	3, 4	BD: 59.3, Bfd: 55.74
Radius	314	L	3, 4	BD: 60.65, Bfd: 35.12
Radius	291	L	3, 4	BD: 62.01, Bfd: 59.79
Radius	320	L	3, 4	BD: 63.35, Bfd: 56.58
Radius	236	L	3, 4	BD: 64.21, Bfd: 59.7
Radius	291	R	3, 4, 9, 10	BD: 64.35, Bfd: 58.17
Radius	285	R	3, 4, 9, 10	BD: 65.18, Bfd: 64.05
Radius	338	L	3, 4	BD: 68.62, Bfd: 59.58
Radius	291	R	3, 4	BD: 68.79, Bfd: 66.74
Radius	201	L	3, 4	BD: 69.54, Bfd: 66.65
Radius	342	L	3, 4, 9, 10	BD: 73.11, Bfd: 64.7
Radius	236	R	3, 4	BD: 74.81, Bfd: 69.41
Radius	353	L	3, 4	BD: 74.97, Bfd: 71.27
Radius	447	L	3, 4, 9, 10	BD: 78.29, Bfd: 73.92
Radius	443	R	3, 4	BD: 80.13, Bfd: 76.95
Radius	560	L	3, 4, 9, 10	BD: 55.78, Bfd: 54.56
Radius	469	L	3, 4	BD: 56.09
Radius	511	R	3, 4	BD: 58.49, Bfd: 52.59
Radius	276	L	3, 4	BD: 64.27, Bfd: 60.94
Radius	512	R	3, 4	BD: 70.4, Bfd: 64.61
Radius	320	R	3, 4	BD: 70.5
Radius	469	L	3, 4	BD: 70.63
Radius	470	L	3, 4	BD: 71.09, Bfd: 65
Radius	593	R	3, 4, 9, 10	BD: 75.45, Bfd: 69.77
Radius	570	R	3, 4	Bfd: 62.16
Radius	236	R	1, 2	Bfp: 62.41
Radius	358	L	1, 2, 5	Bfp: 63.85
Radius	443	R	1, 2	Bfp: 70.79
Radius	355	L	1, 2	Bfp: 71.5

Radius	288	R	1, 2	Bfp: 72.21
Radius	320	R	1, 2, 5, 6, 7	Bfp: 60.48
Radius	571	L	1, 2	Bfp: 61.97
Radius	506	L	1, 2	Bfp: 62.05
Radius	506	R	1, 2, 5, 6, 7	Bfp: 62.44
Radius	570	R	1, 2, 5	Bfp: 62.49
Radius	593	R	1, 2, 5, 6, 7, 8	Bfp: 64.01
Radius	531	L	1, 2	Bfp: 66.1
Radius	482	R	1, 2	Bfp: 75.39
Radius	411	R	Complete	Bp: 55.93, Bfp: 53.23, BD: 49.13, Bfd: 46.0
Radius	405	R	1, 2	Bp: 58.73, Bfp: 54.98
Radius	236	L	1, 2	Bp: 65.57, Bfp: 61.3
Radius	291	L	Complete	Bp: 66.62, Bfp: 58.26, BD: 57.64, Bfd: 53.0
Radius	354	L	1, 2	Bp: 67.23, Bfp: 59.91
Radius	314	L	1, 2	Bp: 68.1, Bfp: 65.24
Radius	291	L	1, 2	Bp: 69.25, Bfp: 60.86
Radius	411	R	1, 2, 5	Bp: 69.88, Bfp: 62.93
Radius	236	L	1, 2	Bp: 70.14, Bfp: 65.05
Radius	323	R	1, 2	Bp: 70.3, Bfp: 65.35
Radius	153	R	1, 2	Bp: 70.82, Bfp: 66.28
Radius	431	L	1, 2	Bp: 70.96, Bfp: 66.47
Radius	323	L	1, 2	Bp: 71.0, Bfp: 66.38
Radius	291	R	1, 2, 5	Bp: 71.23, Bfp: 63.61
Radius	415	L	1, 2	Bp: 72.57, Bfp: 66.06
Radius	369	R	1, 2, 5	Bp: 72.84, Bfp: 65.58
Radius	449	R	1, 2	Bp: 74.0, Bfp: 67.65
Radius	321	R	1, 2	Bp: 74.55, Bfp: 66.85
Radius	353	L	1, 2, 5	Bp: 77.44, Bfp: 68.08
Radius	353	L	1, 2	Bp: 78.33, Bfp: 73.32
Radius	357	L	1, 2	Bp: 79.61, Bfp: 71.61
Radius	384	L	1, 2, 5	Bp: 80.79, Bfp: 74.77
Radius	353	L	1, 2	Bp: 82.63, Bfp: 76.82
Radius	314	L	1, 2	Bp: 83.59, Bfp: 78.19
Radius	285	L	1, 2, 5	Bp: 83.77, Bfp: 76.43
Radius	415	R	1, 2, 5	Bp: 85.97, Bfp: 82.27
Radius	446	L	1, 2	Bp: 91.14, Bfp: 81.45
Radius	570	L	1, 2, 5, 6, 7, 8 ,9, 10	Bp: 64.67,Bfp: 60.37
Radius	506	R	1, 2, 5	Bp: 66.37, Bfp: 61.29
Radius	500	L	1, 2, 5	Bp: 66.6, Bfp: 62.3
Radius	630	L	1, 2	Bp: 69.26, Bfp: 63.2
Radius	506	R	1, 2	Bp: 69.46, Bfp: 64.38
Radius	613	R	1, 2	Bp: 69.99, Bfp: 63.64
Radius	476	R	1, 2, 4, 6, 7, 8, 9, 10	Bp: 70.16, Bfp: 65.55
Radius	586	L	1, 2, 5	Bp: 70.6, Bfp: 65.2

Radius	320	L	1, 2	Bp: 71.26, Bfp: 66.06
Radius	470	R	1, 2, 5	Bp: 71.28, Bfp: 65.95
Radius	579	R	1, 2	Bp: 71.63, Bfp: 65.54
Radius	523	L	1, 2, 5	Bp: 72.14, Bfp: 64.25
Radius	469	L	1, 2, 5	Bp: 72.39, Bfp: 66.14
Radius	U/S	L	1, 2	Bp: 72.68, Bfp: 66.46
Radius	506	R	1, 2, 5	Bp: 73.76, Bfp: 66.45
Radius	523	R	1, 2	Bp: 75.35, Bfp: 68.4
Radius	570	L	1, 2	Bp: 76.46, Bfp: 69.56
Radius	630	L	1, 2	Bp: 76.91, Bfp: 72.08
Radius	506	R	1, 2	Bp: 78.68, Bfp: 72.02
Radius	276	L	1, 2, 5	Bp: 79.59, Bfp: 74.11
Radius	476	L	1, 2, 5	Bp: 80.57, Bfp: 72.82
Radius	506	L	1, 2, 5	Bp: 80.61, Bfp: 74.25
Radius	480	L	1, 2	Bp: 81.29, Bfp: 75.59
Radius	595	L	1, 2, 5	Bp: 82.82, Bfp: 74.8
Radius	546	R	Complete	Bp: 85, Bfp: 77.94, BD: 77.75, Bfd: 73.58
Radius	508	R	1, 2, 5	Bp: 87.21, Bfp: 80.16
Radius	339	L	Complete	GL: 266, [Bp: 74.37], Bfp: 69.21, [BD: 69.66], [Bfd: 58.65]
Radius	320	L	Complete	GL: 240, Bp: 66.9, Bfp: 62.73
Scapula	285	R	1, 2, 3, 5	[GLP: 48.34], SLC: 36.1
Scapula	285	L	1, 2, 3, 5	[GLP: 53.19], SLC: 38.48
Scapula	293	L	1, 2, 3, 5	[GLP: 54.68], SLC: 41.4
Scapula	246	L	1, , 3	[GLP: 61.09] SLC: 46.32
Scapula	339	R	1, 2, 3, 5	[GLP: 67.8], SLC: 53.21
Scapula	236	UNK	1, 2, 3	[GLP: 71.42]
Scapula	393	R	1, 2, 3, 5	[SLC: 41.77], GLP: 58.28
Scapula	320	L	5	[SLC: 48.87]
Scapula	384	R	1, 2, 3, 5	GLP: 55.26, SLC: 42.69
Scapula	324	L	1, 2, 3, 5	GLP: 50.95, SLC: 29.57
Scapula	320	L	1, 2, 3, 5	GLP: 52.57, SLC: 42.03
Scapula	236	L	1, 2, 3, 5	GLP: 54.2, SLC: 44.77
Scapula	335	R	1, 2, 3, 4, 5, 6, 7	GLP: 54.82, SLC: 39.89, puncture: L: 42.52, W: 3.62
Scapula	384	L	1, 2, 3, 5	GLP: 55.76, SLC: 40.95
Scapula	285	R	1, 2, 3, 5	GLP: 55.82, SLC: 41.53
Scapula	289	L	1, 2, 3, 5	GLP: 56.03, SLC: 42.08
Scapula	236	R	1, 2, 3	GLP: 56.19
Scapula	426	R	1, 2, 3, 5	GLP: 58.07, SLC: 42.36
Scapula	236	R	1, 2, 3, 5	GLP: 58.18, SLC: 45.88
Scapula	288	R	1, 2, 3, 5	GLP: 58.72, SLC: 48.03
Scapula	236	UNK	1, 2, 3, 5	GLP: 59.24, SLC: 46.13
Scapula	244	R	1, 2, 3, 5	GLP: 59.41, SLC: 42.15
Scapula	314	R	1, 2, 3, 5	GLP: 59.84, SLC: 44.89
Scapula	402	L	1, 2, 3, 5	GLP: 60.14, SLC: 42.94

Scapula	318	R	1, 2, 3	GLP: 60.16
Scapula	247	R	1, 2, 3	GLP: 61.5
Scapula	415	L	1, 2, 3, 5	GLP: 61.54, SLC: 45.61
Scapula	291	L	1, 2, 3,	GLP: 62.19, SLC: 48.59
Scapula	353	L	1, 2, 3	GLP: 63.03
Scapula	353	R	1, 2, 3, 5	GLP: 63.1, SLC: 50.84
Scapula	318	L	1, 2, 3, 5	GLP: 64.78, SLC: 49.21
Scapula	353	R	1, 2, 3, 5	GLP: 65.74, SLC: 55.95
Scapula	415	R	1, 2, 3, 5	GLP: 66.72, SLC: 51.92
Scapula	285	R	1, 2, 3, 5	GLP: 67.32, SLC: 57.04
Scapula	338	R	1, 2, 3, 5	GLP: 68.65, SLC: 52.38
Scapula	353	R	1, 2, 3, 5	GLP: 68.81, SLC: 50.57
Scapula	354	L	1, 2, 3, 5	GLP: 69.06, SLC: 50.89
Scapula	339	R	1, 2, 3	GLP: 72.65
Scapula	443	R	1, 2, 3, 5	GLP: 74.92, SLC: 57.57
Scapula	314	R	1, 2, 3, 5	GLP: 79.11, SLC: 59.11
Scapula	520	R	1, 2, 3, 4, 5	GLP: 54.79, SLC: 40.77
Scapula	320	L	1, 2, 3, 5	GLP: 55.34
Scapula	482	R	1, 2, 3 ,5	GLP: 56.01, SLC: 45.34
Scapula	531	L	1, 2, 3	GLP: 56.62
Scapula	470	L	1, 2, 3	GLP: 57.6, SLC: 40.64
Scapula	469	L	1, 2, 3	GLP: 58.41
Scapula	470	L	1, 2, 3	GLP: 59.11, SLC: 43.68
Scapula	476	L	1, 2, 3, 4	GLP: 59.39, SLC: 45.04
Scapula	506	L	1, 2, 3	GLP: 60.33, SLC: 46.26
Scapula	276	L	1, 2, 3	GLP: 60.8
Scapula	276	L	1, 2, 3	GLP: 61.03
Scapula	320	L	1, 2, 3, 4, 5	GLP: 61.04, SLC: 47.81
Scapula	535	L	1, 2, 3, , 5	GLP: 61.19, SLC: 43.97
Scapula	546	L	1, 2, 3	GLP: 61.41
Scapula	531	L	1, 2, 3, 4	GLP: 61.99, SLC: 44.1
Scapula	506	R	1, 2, 3	GLP: 62.58
Scapula	482	R	1, 2, 3, 4, 5	GLP: 62.88, SLC: 44.67
Scapula	431	R	1, 2, 3, 5	GLP: 63.02, SLC: 48.44
Scapula	593	L	1, 2, 3, 4, 5	GLP: 63.32, SLC: 49.34
Scapula	476	R	1, 2, 3, 4, 5	GLP: 63.93, SLC: 48.6
Scapula	320	R	1, 2, 3	GLP: 64.62
Scapula	535	R	1, 2, 3, 4, 5	GLP: 65, SLC: 47.85
Scapula	320	L	1, 2, 3, 5	GLP: 65.35, SLC: 53.63
Scapula	570	R	1, 2, 3, 4, 5	GLP: 65.6, SLC: 49.4
Scapula	506	L	1, 2, 3, 4, 5, 7	GLP: 65.78, SLC: 51.07
Scapula	536	L	1, 2, 3	GLP: 66.11
Scapula	481	L	1, 2, 3, 4, 5	GLP: 68, SLC: 58.39
Scapula	482	L	1, 2, 3, 5	GLP: 68.73, SLC: 56.5

Scapula	506	R	1, 2, 3, 4, 5, 6	GLP: 69.53, SLC: 52.78
Scapula	470	L	1, 2, 3	GLP: 70.55, SLC: 54
Scapula	482	R	1, 2, 3, 5	GLP: 70.86
Scapula	470	R	1, 2, 3, 4	GLP: 71.73, SLC: 57.01
Scapula	552	R	1, 2, 3, 4, 5	GLP: 72.08, SLC: 54.63
Scapula	560	L	1, 2, 3, 4, 5	GLP: 72.18, SLC: 57.03
Scapula	506	L	1, 2, 3, 4, 5	GLP: 72.46, SLC: 54.85
Scapula	472	L	1, 2, 3, 5	GLP: 73.31, SLC: 54.33
Scapula	536	L	1, 2, 3	GLP: 73.34
Scapula	276	L	1, 2, 3	GLP: 73.34, SLC: 55.82
Scapula	481	R	1, 2, 3, 4, 5, 6	GLP: 75, SLC: 54.4
Scapula	483	L	1, 2, 3, 4, 5, 7, 9	GLP: 75.45, SLC: 57.05
Scapula	470	L	1, 2, 3	GLP: 77.34, SLC: 60.45
Scapula	276	R	1, 2, 3, 4, 5	GLP: 81.01, SLC: 59.12
Scapula	506	1 L, 3 R	L: 1, 2, 3; R: 1, 2, 3 (2), 4, 5	R: 1, 2, 3; 4, 5 Butchered
Scapula	369	L	5	SLC: 38.03
Scapula	443	L	5	SLC: 39.13
Scapula	415	L	4, 5	SLC: 40.12
Scapula	446	L	5	SLC: 41.94
Scapula	396	L	5	SLC: 43.57
Scapula	385	L	5	SLC: 44.08
Scapula	288	R	4, 5	SLC: 44.18
Scapula	288	L	4, 5	SLC: 44.76
Scapula	385	L	5, 6	SLC: 45.91
Scapula	415	R	5	SLC: 46.99
Scapula	420	L	5	SLC: 48.67
Scapula	415	R	5	SLC: 50.68
Scapula	285	R	1, 2, 5	SLC: 51.63
Scapula	324	L	1, 5	SLC: 51.69
Scapula	353	L	1, 2, 3, 5	SLC: 51.77
Scapula	339	L	5, 6	SLC: 53.15
Scapula	285	L	5	SLC: 54.15
Scapula	415	R	5, 6	SLC: 55.98
Scapula	506	R	1, 2, 3, 4, 5	SLC: 18.48
Scapula	482	L	4, 5	SLC: 31.91
Scapula	320	L	2, 3, 4, 5	SLC: 36.5
Scapula	482	R	5	SLC: 36.75
Scapula	613	L	1, 2, 3, 4	SLC: 42.54
Scapula	575	R	1, 2, 4	SLC: 42.67
Scapula	494	L	1, 2, 3, 4, 5	SLC: 43.79
Scapula	569	R	5	SLC: 43.89
Scapula	545	L	1, 2, 3, 4, 5, 6	SLC: 44.67
Scapula	276	L	2, 3	SLC: 45.28
Scapula	469	L	1, 2, 3, 4, 5	SLC: 45.91

Scapula	U/S	L	5	SLC: 46.05
Scapula	480	R	2, 3, 4	SLC: 46.53
Scapula	569	L	2, 3, 4, 5, 6, 7	SLC: 46.83
Scapula	592	L	2, 3, 4, 5	SLC: 47.19
Scapula	506	R	1, 2, 3	SLC: 48.26
Scapula	592	R	1, 2, 3, 4	SLC: 48.26
Scapula	520	L	1, 2, 3	SLC: 48.55
Scapula	570	R	1, 2, 3, 4, 5, 6	SLC: 49.09
Scapula	525	R	1, 2, 3, 4, 5	SLC: 49.18
Scapula	485	L	1, 2, 3, 5	SLC: 49.86
Scapula	570	L	1, 2, 3, 4, 5, 6	SLC: 52.25
Scapula	546	L	1, 2, 3, 4, 5	SLC: 52.45
Scapula	578	R	1, 2, 3, 4, 5, 6	SLC: 52.92
Scapula	481	L	1, 2, 3, 4, 5	SLC: 53.03
Scapula	583	L	1, 2, 3, 4, 5, 6	SLC: 53.45
Scapula	470	L	2, 3, 4, 5, 6, 7	SLC: 53.69
Scapula	566	R	4, 5, 6	SLC: 53.93
Scapula	588	L	1, 2, 3, 4, 5	SLC: 54.68
Scapula	531	L	1, 2, 4, 5	SLC: 55.45
Scapula	570	R	1, 2, 4, 5	SLC: 56.1
Scapula	546	L	1, 2, 3, 4, 5	SLC: 57.94
Tibia	308	UNK	5, 6	[BD: 48.35]
Tibia	415	R	5, 6	[BD: 50.76]
Tibia	415	R	5, 6	[BD: 52.94]
Tibia	321	L	5, 6	[BD: 52.97]
Tibia	353	R	5, 6	[BD: 56.75]
Tibia	323	R	5, 6	BD: 25.67
Tibia	371	R	5, 6, 10	BD: 29.86
Tibia	353	R	5, 6	BD: 49.0
Tibia	323	L	5, 6	BD: 51.62
Tibia	307	R	5, 6	BD: 51.69
Tibia	357	R	5, 6	BD: 52.23
Tibia	415	L	5, 6	BD: 52.89
Tibia	320	R	5, 6	BD: 53.64
Tibia	321	R	5, 6	BD: 53.64
Tibia	314	R	5, 6	BD: 53.81
Tibia	236	L	5,6, 10	BD: 53.88
Tibia	285	R	5, 6	BD: 53.94
Tibia	236	L	5, 6	BD: 54.01
Tibia	323	L	5, 6	BD: 54.53
Tibia	314	R	5, 6	BD: 54.55
Tibia	236	L	5, 6	BD: 54.6
Tibia	415	R	5, 6, 10	BD: 54.72
Tibia	285	L	5, 6	BD: 54.78

Tibia	291	R	5, 6	BD: 55.18
Tibia	293	L	5, 6	BD: 55.25
Tibia	440	L	5, 6, 10	BD: 55.31
Tibia	323	L	5, 6	BD: 55.67
Tibia	236	R	5, 6	BD: 56.09
Tibia	323	R	5, 6, 10	BD: 56.72
Tibia	303	L	5, 6	BD: 58.56
Tibia	357	L	5,6	BD: 58.63
Tibia	255	L	5, 6, 10	BD: 60.5
Tibia	338	L	5, 6	BD: 60.99
Tibia	355	L	5, 6	BD: 61.55
Tibia	353	R	5, 6	BD: 62.48
Tibia	222	R	5, 6	BD: 67.58
Tibia	482	L	5, 6, 10	BD: 47.38
Tibia	508	L	5, 6	BD: 48.33
Tibia	566	L	5, 6	BD: 48.69
Tibia	570	R	5, 6	BD: 48.72
Tibia	546	L	5, 6	BD: 50.21
Tibia	481	L	5, 6	BD: 51.71
Tibia	276	L	5, 6	BD: 53.12
Tibia	508	L	5, 6	BD: 53.19
Tibia	512	R	5, 6	BD: 53.19
Tibia	523	L	5, 6	BD: 53.48
Tibia	276	R	5, 6	BD: 54.28
Tibia	476	R	5, 6	BD: 54.56
Tibia	276	R	5, 6	BD: 54.61
Tibia	507	R	5, 6	BD: 54.86
Tibia	553	R	5, 6	BD: 54.97
Tibia	520	L	5, 6	BD: 55.26
Tibia	476	L	5, 6	BD: 55.76
Tibia	523	L	5, 6	BD: 56.99
Tibia	276	L	5, 6	BD: 57.82
Tibia	482	R	5, 6	BD: 58.6
Tibia	276	R	5, 6	BD: 58.86
Tibia	628	R	5, 6	BD: 59.14
Tibia	482	L	5, 6	BD: 59.32
Tibia	276	L	5, 6	BD: 60.39
Tibia	U/S	L	5, 6, 10	BD: 60.7
Tibia	613	L	5, 6, 10	BD: 61.16
Tibia	593	R	5, 6	BD: 62.21
Tibia	528	L	5, 6	BD: 63.52
Tibia	511	L	5, 6	BD: 63.98
Tibia	506	R	5, 6	BD: 63.99
Tibia	470	L	5, 6	BD: 64.64

Tibia	566	R	5, 6	BD: 65.89
Tibia	536	R	5, 6, 9, 10	BD: 66.27
Tibia	476	R	5, 6	BD:56.17
Tibia	69	L	5, 6	SD: 31.42
Tibia	69	R	5, 6	SD: 38.04
Tibia	246	L	5, 6	SD:33.56

Appendix 2. Vicus Measured Cattle Elements

Element	Context	Side	Zone(s)	Measurements
1st Phalanx	5010	L	1	Bp: 22.68
1st Phalanx	5044	R	1, 2	Bp: 23.91, SD: 21.56
1st Phalanx	5085	L	Complete	Bp: 24.15, SD: 20.49
1st Phalanx	5085	L	1	Bp: 24.23
1st Phalanx	5135	L	1	Bp: 24.48
1st Phalanx	5085	R	1, 2	Bp: 24.66
1st Phalanx	5085	R	1	Bp: 25.15
1st Phalanx	5074	R	1	Bp: 25.19
1st Phalanx	5085	R	1	Bp: 25.26
1st Phalanx	5097	R	1	Bp: 25.75
1st Phalanx	5085	L	1, 2	Bp: 26.03
1st Phalanx	5036	L	1	Bp: 26.12
1st Phalanx	5142	R	Complete	Bp: 26.92, SD: 22.9
1st Phalanx	5085	R	1	Bp: 27.15
1st Phalanx	5141	R	1, 2	Bp: 27.2, SD: 25.07
1st Phalanx	5207	L	1	Bp: 28.06
1st Phalanx	5195	R	1, 2	Bp: 28.47, SD: 23.15
1st Phalanx	5146	L	1	Bp: 28.72
1st Phalanx	5010	L	1	Bp: 29.35
1st Phalanx	5085	L	1, 2	Bp: 30.68
1st Phalanx	5264	R	1	Bp: 32.42
1st Phalanx	5264	R	1	Bp: 22.96
1st Phalanx	5085	R	1, 3	Bp: 23.14
1st Phalanx	US	L	1, 3	Bp: 24.61, SD: 21.9
1st Phalanx	5347	L	1, 3	Bp: 25.91, SD: 22.85
1st Phalanx	5264	L	Complete	Bp: 26.87, SD: 22.04
1st Phalanx	5195	R	1, 3	Bp: 27.5, SD: 22.44
1st Phalanx	5347	L	Complete	Bp: 27.56, SD: 24.65
1st Phalanx	5050	R	1	Bp: 28.36
1st Phalanx	5284	L	Complete	Bp: 29.97, SD: 23.43
1st Phalanx	5281	R	1	Bp: 31.77
1st Phalanx	5161	L	1, 3	Bp: 32.55, SD: 25.47
1st Phalanx	5236	R	Complete	GL: 47.02, SD: 20.86
1st Phalanx	5044	L	Complete	GL: 47.92, SD: 22.37

1st Phalanx	5186	R	Complete	GL: 47.97, SD: 20.0
1st Phalanx	5088	L	Complete	GL: 48.16, Bp: 23.97, SD: 20.43
1st Phalanx	5141	R	Complete	GL: 49.21, Bp: 23.97, SD: 21.59
1st Phalanx	5085	L	Complete	GL: 49.77, Bp: 24.62, SD: 21.18
1st Phalanx	5160	L	Complete	GL: 49.87, Bp: 24.43, SD: 20.63
1st Phalanx	5195	L	Complete	GL: 49.91, Bp: 27.96, SD: 21.25
1st Phalanx	5157	R	Complete	GL: 49.94, Bp: 22.9, SD: 19.47
1st Phalanx	5085	L	Complete	GL: 50.08, Bp: 24.9
1st Phalanx	5085	R	Complete	GL: 50.1, Bp: 24.78, SD: 21.51
1st Phalanx	5085	L	Complete	GL: 50.21, Bp: 24.77, SD: 21.56
1st Phalanx	5218	R	Complete	GL: 50.27, Bp: 28.53, SD: 25.47
1st Phalanx	5085	R	Complete	GL: 50.42, Bp: 26.79, SD: 20.75
1st Phalanx	5239	L	Complete	GL: 50.51, Bp: 30.28, SD: 25.32
1st Phalanx	5116	R	Complete	GL: 50.53, Bp: 26.53, SD: 22.43
1st Phalanx	5219	R	Complete	GL: 50.63, Bp: 22.85, SD: 19.96
1st Phalanx	5085	L	Complete	GL: 50.78, Bp: 25.75, SD: 22.91
1st Phalanx	5239	L	Complete	GL: 50.85, Bp: 24.68, SD: 20.98
1st Phalanx	5010	L	Complete	GL: 50.86, Bp: 24.82, SD: 22.31
1st Phalanx	5142	L	Complete	GL: 50.89, Bp: 24.77, SD: 20.88
1st Phalanx	5085	L	Complete	GL: 51.54, Bp: 26.38, SD: 23.71
1st Phalanx	5222	L	Complete	GL: 51.59, Bp: 26.71, SD: 23.08
1st Phalanx	5122	R	Complete	GL: 51.62, Bp: 26.4, SD: 22.36
1st Phalanx	5136	L	Complete	GL: 51.64, Bp: 27.29, SD: 22.5
1st Phalanx	5146	L	Complete	GL: 51.67, Bp: 27.83, SD: 21.97
1st Phalanx	5195	R	Complete	GL: 51.77, Bp: 24.48, SD: 19.95
1st Phalanx	5239	R	Complete	GL: 51.83, Bp: 28.53, SD: 23.34
1st Phalanx	5086	L	Complete	GL: 51.99, Bp: 25.06, SD: 22.49
1st Phalanx	5010	R	Complete	GL: 52.05, Bp: 25.39, SD: 23.69
1st Phalanx	5074	L	Complete	GL: 52.15, SD: 26.9
1st Phalanx	5085	R	Complete	GL: 52.19, Bp: 23.27, SD: 20.81
1st Phalanx	5181	R	Complete	GL: 52.21, Bp: 24.16, SD: 20.49
1st Phalanx	5086	L	Complete	GL: 52.26, Bp: 25.11, SD: 21.96
1st Phalanx	5195	R	Complete	GL: 52.4, SD: 21.84
1st Phalanx	5181	L	Complete	GL: 52.5
1st Phalanx	5239	L	Complete	GL: 52.58, Bp: 23.57, SD: 19.87
1st Phalanx	5177	R	Complete	GL: 52.59, Bp: 24.57, SD: 22.79
1st Phalanx	5134	L	Complete	GL: 52.63
1st Phalanx	5280	R	Complete	GL: 52.75, Bp: 24.41, SD: 20.65
1st Phalanx	5280	L	Complete	GL: 52.77
1st Phalanx	5074	R	Complete	GL: 52.81, Bp: 27.33, SD: 21.59
1st Phalanx	5280	L	Complete	GL: 52.86, Bp: 27.18, SD: 22.24
1st Phalanx	5085	R	Complete	GL: 52.88, Bp: 29.38, SD: 24.14
1st Phalanx	5239	R	Complete	GL: 53.05, Bp: 25.27
1st Phalanx	5186	R	Complete	GL: 53.07, Bp: 27.33, SD: 24.15

1st Phalanx	5218	R	Complete	GL: 53.15, Bp: 22.79, SD: 19.96
1st Phalanx	5157	R	Complete	GL: 53.21
1st Phalanx	5141	L	Complete	GL: 53.25, Bp: 24.5, SD: 21.29
1st Phalanx	5280	L	Complete	GL: 53.29, Bp: 27.41, SD: 22.76
1st Phalanx	5141	L	Complete	GL: 53.33, Bp: 26.2, SD: 22.46
1st Phalanx	5214	L	Complete	GL: 53.56, Bp: 23.36, SD: 19.97
1st Phalanx	5101	R	Complete	GL: 53.63, Bp: 26.79, SD: 22.9
1st Phalanx	5279	L	Complete	GL: 53.67, Bp: 25.04, SD: 21.77
1st Phalanx	5280	R	Complete	GL: 53.75
1st Phalanx	5115	L	Complete	GL: 54.04, Bp: 24.75, SD: 20.58
1st Phalanx	5085	R	Complete	GL: 54.06, Bp: 26.77, SD: 22.13
1st Phalanx	5116	R	Complete	GL: 54.15, Bp: 24.43, SD: 21.61
1st Phalanx	5085	R	Complete	GL: 54.24, Bp: 27.48, SD: 23.63
1st Phalanx	5142	L	Complete	GL: 54.27, Bp: 27.72, SD: 22.91
1st Phalanx	5239	L	Complete	GL: 54.32, Bp: 28.73, SD: 25.27
1st Phalanx	5121	L	Complete	GL: 54.36, Bp: 23.99, SD: 20.12
1st Phalanx	5085	L	Complete	GL: 54.42, Bp: 27.59, SD: 22.61
1st Phalanx	5085	L	Complete	GL: 54.42, Bp: 27.78, SD: 23.34
1st Phalanx	5136	R	Complete	GL: 54.45, Bp: 25.32, SD: 23.12
1st Phalanx	5195	L	Complete	GL: 54.5, Bp: 26.72, SD: 22.54
1st Phalanx	5085	R	Complete	GL: 54.51, Bp: 25.9, SD: 22.14
1st Phalanx	5136	R	Complete	GL: 54.57, Bp: 26.83, SD: 23.32
1st Phalanx	5134	R	Complete	GL: 54.58, Bp: 28.1, SD: 22.54
1st Phalanx	5239	R	Complete	GL: 54.59
1st Phalanx	5127	R	Complete	GL: 54.61, Bp: 25.05, SD: 21.7
1st Phalanx	5180	R	Complete	GL: 54.61, SD: 21.45
1st Phalanx	5036	R	Complete	GL: 54.64, Bp: 23.76, SD: 20.21
1st Phalanx	5135	R	Complete	GL: 54.7, Bp: 28.52, SD: 24.88
1st Phalanx	5085	R	Complete	GL: 54.73, Bp: 23.69, SD: 20.57
1st Phalanx	5169	R	Complete	GL: 55.02, Bp: 26.1, SD: 22.84
1st Phalanx	5280	L	Complete	GL: 55.04, SD: 24.52
1st Phalanx	5085	R	Complete	GL: 55.08
1st Phalanx	5205	R	Complete	GL: 55.12, Bp: 25.8, SD: 21.04
1st Phalanx	5085	L	Complete	GL: 55.16, Bp: 24.33, SD: 18.82
1st Phalanx	5085	L	Complete	GL: 55.25, Bp: 28.39, SD: 24.5
1st Phalanx	5085	L	Complete	GL: 55.28, Bp: 26.23, SD: 23.34
1st Phalanx	5044	L	Complete	GL: 55.29, Bp: 24.41, SD: 20.81
1st Phalanx	5195	L	Complete	GL: 55.47, Bp: 26.01, SD: 23.84
1st Phalanx	5169	L	Complete	GL: 55.63, Bp: 27.47, SD: 23.16
1st Phalanx	5195	R	Complete	GL: 55.65, Bp: 24.57, SD: 21.84
1st Phalanx	5044	R	Complete	GL: 55.82, Bp: 29.5, SD: 26. 97
1st Phalanx	5085	L	Complete	GL: 55.86, Bp: 26.23, SD: 22.96
1st Phalanx	5121	R	Complete	GL: 55.92, SD: 23.91
1st Phalanx	5085	L	Complete	GL: 55.94, Bp: 27.07, SD: 22.78

1st Phalanx	5074	R	Complete	GL: 55.94, Bp: 29.69, SD: 24.32
1st Phalanx	5122	L	Complete	GL: 56.27, Bp: 30.64, SD: 22.59
1st Phalanx	5136	L	Complete	GL: 56.44, Bp: 23.78, SD: 20.98
1st Phalanx	5074	R	Complete	GL: 56.64, Bp: 33.67, SD: 27.81
1st Phalanx	5044	L	Complete	GL: 56.66, Bp: 24.6, SD: 20.97
1st Phalanx	5089	L	Complete	GL: 56.79, Bp: 26.03, SD: 22.72
1st Phalanx	5146	R	Complete	GL: 56.91, Bp: 25.6, SD: 20.65
1st Phalanx	5085	R	Complete	GL: 56.94, Bp: 29.83, SD: 23.75
1st Phalanx	5280	R	Complete	GL: 56.95, Bp: 28.05, SD: 23.97
1st Phalanx	5161	L	Complete	GL: 57.0, Bp: 25.89, SD: 23.63
1st Phalanx	5097	R	Complete	GL: 57.01, SD: 25.28
1st Phalanx	5085	R	Complete	GL: 57.42, Bp: 28.06
1st Phalanx	5136	L	Complete	GL: 57.42, Bp: 30.55
1st Phalanx	5156	L	Complete	GL: 57.45, Bp: 30.37, SD: 25.62
1st Phalanx	5031	L	Complete	GL: 57.53, Bp: 26.32, SD: 22.78
1st Phalanx	5010	R	Complete	GL: 57.62, Bp: 27. 33, SD: 23.82
1st Phalanx	5074	L	Complete	GL: 57.62, Bp: 33.99, SD: 26.9
1st Phalanx	5134	L	Complete	GL: 57.86, Bp: 29.63, SD: 24.92
1st Phalanx	5195	L	Complete	GL: 58.21, Bp: 28.06, SD: 23.41
1st Phalanx	5195	R	Complete	GL: 58.33, Bp: 29.31, SD: 24.07
1st Phalanx	5271	R	Complete	GL: 58.43, Bp: 28.88, SD: 24.93
1st Phalanx	5044	R	Complete	GL: 58.66, Bp: 26.01, SD: 22.24
1st Phalanx	5085	R	Complete	GL: 59.04, Bp: 33.26, SD: 27.3
1st Phalanx	5197	L	Complete	GL: 59.15, Bp: 30.38, SD: 26.4
1st Phalanx	5085	L	Complete	GL: 59.28, Bp: 29.56, SD: 23.17
1st Phalanx	5122	R	Complete	GL: 59.91, Bp: 31.84, SD: 27.62
1st Phalanx	5085	R	Complete	GL: 59.92, Bp: 29.51, SD: 24.99
1st Phalanx	5085	L	Complete	GL: 59.92, Bp: 30.98, SD: 27.3
1st Phalanx	5195	R	Complete	GL: 60.01, Bp: 27.63, SD: 23.56
1st Phalanx	5216	L	Complete	GL: 60.01, Bp: 28.61, SD: 23.61
1st Phalanx	5125	R	Complete	GL: 60.06
1st Phalanx	5239	L	Complete	GL: 61.39, Bp: 30.87, SD: 25.6
1st Phalanx	5085	R	Complete	GL: 61.61, Bp: 30.42, SD: 26.71
1st Phalanx	5136	L	Complete	GL: 62.47, Bp: 32.87, SD: 26.65
1st Phalanx	5136	L	Complete	GL: 64.0, Bp: 32.66, SD: 24.21
1st Phalanx	5122	L	Complete	GL: 64.09, Bp: 35.32, SD: 29.02
1st Phalanx	5085	R	Complete	GL: 64.47, SD: 29.77
1st Phalanx	5085	L	Complete	GL: 64.58, Bp: 30.69, SD: 26.04
1st Phalanx	5264	R	Complete	GL: 47.55, Bp: 24.37, SD: 20.86
1st Phalanx	5340	L	Complete	GL: 47.74, Bp: 25.65, SD: 21.22
1st Phalanx	5284	R	Complete	GL: 48.29, Bp: 24.97, SD: 21.87
1st Phalanx	5264	L	Complete	GL: 49.07, Bp: 23.7, SD: 19.38
1st Phalanx	5036	L	Complete	GL: 49.19, Bp: 21.55, SD: 17.12
1st Phalanx	5284	L	Complete	GL: 49.4, Bp: 24.69, SD: 21.52

1st Phalanx	5284	R	Complete	GL: 49.78, SD: 17.47
1st Phalanx	5281	R	Complete	GL: 5.04, Bp: 25.08, SD: 20.9
1st Phalanx	5264	R	Complete	GL: 50.3, Bp: 24.87, SD: 22.21
1st Phalanx	5284	R	Complete	GL: 50.4, Bp: 23.42, SD: 19.02
1st Phalanx	5264	L	Complete	GL: 50.45, Bp: 25.57, SD: 22.28
1st Phalanx	5264	R	Complete	GL: 50.54, Bp: 32.08, SD: 22.41
1st Phalanx	5284	R	Complete	GL: 50.55, Bp: 24.48, SD: 22.09
1st Phalanx	5136	L	Complete	GL: 50.62, Bp: 24.39, SD: 20.22
1st Phalanx	5264	L	Complete	GL: 50.8, Bp: 25.38, SD: 23.55
1st Phalanx	5085	L	Complete	GL: 51.02, Bp: 27.33, SD: 22.33
1st Phalanx	5247	L	Complete	GL: 51.03, Bp: 27.01, SD: 21.93
1st Phalanx	5264	R	Complete	GL: 51.09, SD: 21.55
1st Phalanx	5161	R	Complete	GL: 51.27, SD: 21.34
1st Phalanx	5264	L	Complete	GL: 51.3, SD: 23.76
1st Phalanx	5247	R	Complete	GL: 51.37, BD: 22.39, SD: 19.6
1st Phalanx	5264	L	Complete	GL: 51.44, Bp: 23.55, SD: 19.77
1st Phalanx	5264	L	Complete	GL: 51.53, Bp: 26.59, SD: 21.05
1st Phalanx	5340	L	Complete	GL: 51.56, Bp: 26.99, SD: 22.26
1st Phalanx	5085	R	Complete	GL: 51.78, SD: 21.07
1st Phalanx	5264	R	Complete	GL: 51.82, Bp: 27.76, SD: 23.49
1st Phalanx	5264	L	Complete	GL: 51.85, Bp: 27.05, SD: 21.87
1st Phalanx	5228	R	Complete	GL: 51.85, Bp: 27.79, SD: 23.05
1st Phalanx	5281	L	Complete	GL: 51.96, Bp: 21.6, SD: 22.3
1st Phalanx	5264	L	Complete	GL: 51.98, Bp: 21.95, SD: 19.02
1st Phalanx	5284	L	Complete	GL: 52, Bp: 25.4, SD: 21.94
1st Phalanx	5264	R	Complete	GL: 52.03, Bp: 23.58, SD: 20.23
1st Phalanx	5146	R	Complete	GL: 52.09, Bp: 23.22, SD: 20.44
1st Phalanx	5264	R	Complete	GL: 52.14, Bp: 24.96, SD: 21.18
1st Phalanx	5264	L	Complete	GL: 52.2, Bp: 28.34, SD: 23.51
1st Phalanx	5347	L	Complete	GL: 52.28, Bp: 23.7, SD: 20.54
1st Phalanx	5281	R	Complete	GL: 52.32, Bp: 23.84, SD: 24.48
1st Phalanx	5284	L	Complete	GL: 52.32, Bp: 24.78, SD: 21.05
1st Phalanx	5284	L	Complete	GL: 52.34, Bp: 23.72, SD: 18.64
1st Phalanx	US	L	Complete	GL: 52.35, Bp: 26.57, SD: 24.14
1st Phalanx	5247	R	Complete	GL: 52.37, BD: 23.73, SD: 20.79
1st Phalanx	5044	L	Complete	GL: 52.54, Bp: 26.06, SD: 22.87
1st Phalanx	5264	R	Complete	GL: 52.56, Bp: 26.32, SD: 22.15
1st Phalanx	5085	R	Complete	GL: 52.71, Bp: 25.94, SD: 21.8
1st Phalanx	5161	R	Complete	GL: 52.91, SD: 20.37
1st Phalanx	5161	L	Complete	GL: 52.92, Bp: 24.32, SD: 20.35
1st Phalanx	5347	L	Complete	GL: 53.02, Bp: 23.77, SD: 21.41
1st Phalanx	5044	R	Complete	GL: 53.04, Bp: 25.27, SD: 21.48
1st Phalanx	5161	R	Complete	GL: 53.09, Bp: 25.08, SD: 20.78
1st Phalanx	5161	R	Complete	GL: 53.17, Bp: 27.4, SD: 23.76

1st Phalanx	5264	L	Complete	GL: 53.18, Bp: 27.55, SD: 23.52
1st Phalanx	5264	L	Complete	GL: 53.25, Bp: 24.3, SD: 17.51
1st Phalanx	US	L	Complete	GL: 53.31, Bp: 25.66, SD: 20.7
1st Phalanx	5284	L	Complete	GL: 53.33, Bp: 28.09, SD: 23.75
1st Phalanx	5264	R	Complete	GL: 53.34, SD: 20.95
1st Phalanx	5146	L	Complete	GL: 53.38, Bp: 25.6, SD: 21.91
1st Phalanx	5284	R	Complete	GL: 53.4, Bp: 24.73, SD: 22.18
1st Phalanx	5264	L	Complete	GL: 53.47, Bp: 25.34, SD: 21.03
1st Phalanx	5325	R	Complete	GL: 53.47, Bp: 28.08, SD: 24.6
1st Phalanx	5247	L	Complete	GL: 53.48, Bp: 27.2, SD: 23.59
1st Phalanx	5284	L	Complete	GL: 53.48, SD: 20.24
1st Phalanx	5347	R	Complete	GL: 53.6, Bp: 24.93, SD: 20.85
1st Phalanx	5347	L	Complete	GL: 53.7, Bp: 25.2, SD: 23.41
1st Phalanx	5264	R	Complete	GL: 53.78, Bp: 24.6, SD: 20.44
1st Phalanx	5347	L	Complete	GL: 53.85, Bp: 29.15, SD: 23.8
1st Phalanx	5347	L	Complete	GL: 53.86, Bp: 24.34, SD: 20.16
1st Phalanx	5136	L	Complete	GL: 53.9, SD: 23.46
1st Phalanx	5161	L	Complete	GL: 53.91
1st Phalanx	5264	R	Complete	GL: 53.92, Bp: 28.85, SD: 24.54
1st Phalanx	5195	R	Complete	GL: 53.99, Bp: 26.55, SD: 21.7
1st Phalanx	5284	L	Complete	GL: 53.99, SD: 24.34
1st Phalanx	5284	L	Complete	GL: 54.01, Bp: 24.07, SD: 21.41
1st Phalanx	5347	R	Complete	GL: 54.03, Bp: 27.44, SD: 22.92
1st Phalanx	5264	R	Complete	GL: 54.08, Bp: 24.35, SD: 20.14
1st Phalanx	5264	L	Complete	GL: 54.08, Bp: 26.1, SD: 21.72
1st Phalanx	5264	L	Complete	GL: 54.2, Bp: 24.51, SD: 20.3
1st Phalanx	5284	R	Complete	GL: 54.2, SD: 17.08
1st Phalanx	5308	L	Complete	GL: 54.23, Bp: 24.21, SD: 20.5
1st Phalanx	5044	L	Complete	GL: 54.27, Bp: 24.8, SD: 19.6
1st Phalanx	5264	L	Complete	GL: 54.3, Bp: 27.22, SD: 23.71
1st Phalanx	5284	L	Complete	GL: 54.34, Bp: 28.93, SD: 24.45
1st Phalanx	5146	L	Complete	GL: 54.35, Bp: 25.46, SD: 20.81
1st Phalanx	5284	L	Complete	GL: 54.41, Bp: 27.75, SD: 21.77
1st Phalanx	5281	L	Complete	GL: 54.44, Bp: 26.6, SD: 21.8
1st Phalanx	5264	R	Complete	GL: 54.53, SD: 23.5
1st Phalanx	5264	R	Complete	GL: 54.54, Bp: 24.99, SD: 22.02
1st Phalanx	5264	R	Complete	GL: 54.55, SD: 23.88
1st Phalanx	US	R	Complete	GL: 54.62, Bp: 25.2, SD: 21.09
1st Phalanx	5161	R	Complete	GL: 54.74, Bp: 25.09, SD: 22.93
1st Phalanx	5264	R	Complete	GL: 54.8, Bp: 25.35, SD: 21.39
1st Phalanx	5326	L	Complete	GL: 54.8, Bp: 31.4, SD: 28.05
1st Phalanx	5284	R	Complete	GL: 54.83, Bp: 26.76, SD: 23.41
1st Phalanx	5347	R	Complete	GL: 54.9, Bp: 24.75, SD: 20.8
1st Phalanx	5340	L	Complete	GL: 54.92, Bp: 27, SD: 23.55

1st Phalanx	5284	R	Complete	GL: 54.93, SD: 27.99
1st Phalanx	5195	R	Complete	GL: 54.99, Bp: 30.61, SD: 26.17
1st Phalanx	5264	L	Complete	GL: 55.04, Bp: 24.09, SD: 19.97
1st Phalanx	5347	L	Complete	GL: 55.14, Bp: 27.55, SD: 23.57
1st Phalanx	5264	L	Complete	GL: 55.18, SD: 23.71
1st Phalanx	5161	L	Complete	GL: 55.2, SD: 22.3
1st Phalanx	5161	L	Complete	GL: 55.23, Bp: 29.15, SD: 25.17
1st Phalanx	5195	R	Complete	GL: 55.3, Bp: 24.97, SD: 23.03
1st Phalanx	5264	L	Complete	GL: 55.3, Bp: 26.48, SD: 22.44
1st Phalanx	5284	L	Complete	GL: 55.34, Bp: 30.37, SD: 21.71
1st Phalanx	5085	R	Complete	GL: 55.35, Bp: 27.07, SD: 25.29
1st Phalanx	5161	L	Complete	GL: 55.4, Bp: 24.48, SD: 22.1
1st Phalanx	5284	L	Complete	GL: 55.43, Bp: 26.64, SD: 22.85
1st Phalanx	5284	R	Complete	GL: 55.47, Bp: 23.47, SD: 16.62
1st Phalanx	5281	R	Complete	GL: 55.49, Bp: 23.72, SD: 22.06
1st Phalanx	5044	R	Complete	GL: 55.72, Bp: 23.84, SD: 20.67
1st Phalanx	5284	R	Complete	GL: 55.8, Bp: 23; SD: 22.02
1st Phalanx	5284	L	Complete	GL: 55.82, Bp: 28.77, SD: 24.85
1st Phalanx	5308	R	Complete	GL: 55.85, Bp: 26.15, SD: 22.85
1st Phalanx	5264	R	Complete	GL: 55.85, Bp: 26.62, SD: 23.05
1st Phalanx	US	R	Complete	GL: 55.92, SD: 22.55
1st Phalanx	5161	L	Complete	GL: 56.01, Bp: 23.86, SD: 20.07
1st Phalanx	5284	R	Complete	GL: 56.07, Bp: 27.58, SD: 23.36
1st Phalanx	5264	L	Complete	GL: 56.07, SD: 22.71
1st Phalanx	5264	R	Complete	GL: 56.26, Bp: 26.25, SD: 22.92
1st Phalanx	5264	L	Complete	GL: 56.41, Bp: 26.42, SD: 22.5
1st Phalanx	5264	R	Complete	GL: 56.43, Bp: 25.31, SD: 21.7
1st Phalanx	5347	L	Complete	GL: 56.43, Bp: 31.05, SD: 26.04
1st Phalanx	5281	L	Complete	GL: 56.59, Bp: 28.24, SD: 25.14
1st Phalanx	5284	R	Complete	GL: 56.6, Bp: 21.97, SD:21.92
1st Phalanx	5281	L	Complete	GL: 56.62, Bp: 26.14, SD: 21.44
1st Phalanx	US	R	Complete	GL: 56.82, Bp: 28.4, SD: 23.46
1st Phalanx	5161	L	Complete	GL: 57.03, Bp: 26.33, SD: 22.93
1st Phalanx	5085	R	Complete	GL: 57.23, Bp: 26.24, SD: 23.26
1st Phalanx	5136	L	Complete	GL: 57.24, Bp: 25.96, SD: 21.89
1st Phalanx	5264	L	Complete	GL: 57.37, Bp: 25.06, SD: 23.35
1st Phalanx	5264	L	Complete	GL: 57.4
1st Phalanx	5264	R	Complete	GL: 57.44, Bp: 24.49, SD: 22.05
1st Phalanx	5136	L	Complete	GL: 57.61
1st Phalanx	5347	R	Complete	GL: 57.9, Bp: 29.7, SD: 23.75
1st Phalanx	5347	L	Complete	GL: 58.01, Bp: 28.6, SD: 23.82
1st Phalanx	5351	R	Complete	GL: 58.02, Bp: 29.39, SD: 24.7
1st Phalanx	5347	L	Complete	GL: 58.05, Bp: 28.8, SD: 24.79
1st Phalanx	5161	R	Complete	GL: 58.07, Bp: 29.23, SD: 24.25

1st Phalanx	5161	L	Complete	GL: 58.17
1st Phalanx	5337	R	Complete	GL: 58.4, Bp: 28.15, SD: 24.81
1st Phalanx	5161	R	Complete	GL: 59.4, Bp: 31.9, SD: 26.44
1st Phalanx	5264	R	Complete	GL: 59.42, Bp: 32.2, SD: 26.48
1st Phalanx	5308	R	Complete	GL: 59.8, Bp: 27.4, SD: 24.07
1st Phalanx	5284	L	Complete	GL: 59.96, SD: 26.55
1st Phalanx	5343	R	Complete	GL: 60.05, Bp: 26.95, SD: 21.97
1st Phalanx	5264	R	Complete	GL: 60.18, Bp: 28.05, SD: 24.92
1st Phalanx	5364	L	Complete	GL: 60.21, SD: 28.4
1st Phalanx	5264	L	Complete	GL: 60.41, Bp: 34.9, SD: 28.78
1st Phalanx	5085	L	Complete	GL: 60.97, Bp: 31.13, SD: 25.8
1st Phalanx	5085	R	Complete	GL: 61.4, Bp: 28.29, SD: 26.27
1st Phalanx	5264	L	Complete	GL: 61.72, Bp: 29.07, SD: 24.13
1st Phalanx	5072	L		GL: 47.55, Bp: 24.73, SD: 19.68
1st Phalanx	5136	R	Complete	GL: 62.63
1st Phalanx	5136	R	Complete	GL: 62.86, Bp: 29.28, SD: 23.71
1st Phalanx	5161	R	2, 3	SD: 19.53
1st Phalanx	5279	R	2, 3	SD: 19.77
1st Phalanx	5044	R	2, 3	SD: 21.12
1st Phalanx	5195	R	2, 3	SD: 21.16
1st Phalanx	5085	R	2, 3	SD: 21.34
1st Phalanx	5195	R	2, 3	SD: 21.52
1st Phalanx	5010	R	2, 3	SD: 21.76
1st Phalanx	5160	R	2	SD: 22.16
1st Phalanx	5044	R	2, 3	SD: 22.87
1st Phalanx	5044	L	2, 3	SD: 23.79
1st Phalanx	5085	R	2, 3	SD: 23.82
1st Phalanx	5074	L	Complete	SD: 25.27
1st Phalanx	5264	R	2, 3	SD: 19.71
1st Phalanx	5085	R	2, 3	SD: 20.07
1st Phalanx	5161	R	2, 3	SD: 20.72
1st Phalanx	US	L	2, 3	SD: 20.87
1st Phalanx	5264	L	2, 3	SD: 21.09
1st Phalanx	5288	R	2, 3	SD: 21.47
1st Phalanx	5161	R	2, 3	SD: 21.5
1st Phalanx	5242	L	2, 3	SD: 21.63
1st Phalanx	5340	L	2, 3	SD: 25.36
1st Phalanx	5264	L	2, 3	SD: 25.47
1st Phalanx	5264	R	2, 3	SD: 26.77
1st Phalanx	5340	R	Complete	SD: 28.15
2nd Phalanx	5044	L	1, 2	Bp: 26.61
2nd Phalanx	5157	R	1	Bp: 26.81
2nd Phalanx	5151	R	1	Bp: 27.26
2nd Phalanx	5308	L	Complete	Bp: 24.38, SD: 19.02

2nd Phalanx	5336	L	Complete	Bp: 25.35, SD: 21.31
2nd Phalanx	5161	L	1	Bp: 25.49
2nd Phalanx	5264	R	1, 3	Bp: 25.81, SD: 20.89
2nd Phalanx	5284	R	1	Bp: 27.98
2nd Phalanx	5247	R	1, 3	Bp: 28.05, SD: 21.43
2nd Phalanx	5010	L	Complete	GL: 29.35, Bp: 24.34, SD: 19.53
2nd Phalanx	5031	L	Complete	GL: 30.9, Bp: 22.59, SD: 20.39
2nd Phalanx	5239	L	Complete	GL: 31.61, Bp: 27.2, SD: 21.46
2nd Phalanx	5122	L	Complete	GL: 31.69, Bp: 25.14, SD: 18.8
2nd Phalanx	5085	R	Complete	GL: 32. 59, Bp: 24.8, SD: 20.4
2nd Phalanx	5010	L	Complete	GL: 32.28, Bp: 24.8, SD: 18.99
2nd Phalanx	5279	L	Complete	GL: 32.31, Bp: 27.26, SD: 22.41
2nd Phalanx	5207	R	Complete	GL: 32.74, Bp: 28.27, SD: 22.9
2nd Phalanx	5019	L	Complete	GL: 32.82, Bp: 25.67, SD: 18.91
2nd Phalanx	5031	R	Complete	GL: 33.55, Bp: 27.65, SD: 21.64
2nd Phalanx	5169	L	Complete	GL: 33.57, Bp: 26.03, SD: 20.31
2nd Phalanx	5074	L	Complete	GL: 33.7
2nd Phalanx	5109	L	Complete	GL: 33.76, Bp: 23.25, SD: 18.15
2nd Phalanx	5085	L	Complete	GL: 34.05, Bp: 29.1, SD: 21.07
2nd Phalanx	5239	R	Complete	GL: 34.29, Bp: 30.55, SD: 25.21
2nd Phalanx	5279	L	Complete	GL: 34.33, Bp: 24.83, SD: 19.7
2nd Phalanx	5277	R	Complete	GL: 34.33, Bp: 29.04, SD: 22.71
2nd Phalanx	5074	L	Complete	GL: 34.34, Bp: 29.63, SD: 25.4
2nd Phalanx	5088	R	Complete	GL: 34.45, Bp: 27.02, SD: 22.97
2nd Phalanx	5239	L	Complete	GL: 34.54, Bp: 27.49, SD: 21.21
2nd Phalanx	5181	L	Complete	GL: 34.57, Bp: 26.82, SD: 19.93
2nd Phalanx	5109	L	Complete	GL: 34.6, Bp: 25.17, SD: 19.7
2nd Phalanx	5085	L	Complete	GL: 34.66, Bp: 24.31, SD: 19.31
2nd Phalanx	5085	L	Complete	GL: 34.7, Bp: 24.12, SD: 18.75
2nd Phalanx	5146	L	Complete	GL: 34.74, Bp: 24.27, SD: 18.67
2nd Phalanx	5053	L	Complete	GL: 34.78, Bp: 32.0, SD: 24.91
2nd Phalanx	5222	R	Complete	GL: 35.02, Bp: 30.91, SD: 28.48
2nd Phalanx	5279	R	Complete	GL: 35.05, Bp: 24.99, SD: 19.38
2nd Phalanx	5280	L	Complete	GL: 35.05, SD: 20.29
2nd Phalanx	5074	R	Complete	GL: 35.11, Bp: 27.58, SD: 23.52
2nd Phalanx	5195	L	Complete	GL: 35.11, Bp: 27.72, SD: 22.67
2nd Phalanx	5070	L	Complete	GL: 35.12, Bp: 24.78, SD: 20.62
2nd Phalanx	5044	R	Complete	GL: 35.12, Bp: 27.57, SD: 20.64
2nd Phalanx	5044	L	Complete	GL: 35.17, Bp: 24.28, SD: 19.79
2nd Phalanx	5222	L	Complete	GL: 35.21, Bp: 25.82, SD: 21.42
2nd Phalanx	5122	R	Complete	GL: 35.23, Bp: 24.42, SD: 18.94
2nd Phalanx	5239	L	Complete	GL: 35.28, SD: 20.9
2nd Phalanx	5036	R	Complete	GL: 35.3, Bp: 25.89, SD: 21.57
2nd Phalanx	5085	R	Complete	GL: 35.3, Bp: 30.73, SD: 24.13

2nd Phalanx	5085	R	Complete	GL: 35.38, Bp: 26.17, SD: 21.41
2nd Phalanx	5239	L	Complete	GL: 35.43, Bp: 24.5, SD: 18.96
2nd Phalanx	5181	L	Complete	GL: 35.64, Bp: 23.86, SD: 20.33
2nd Phalanx	5046	L	2, 3	GL: 35.64, Bp: 25.04, SD: 20.46
2nd Phalanx	5141	R	Complete	GL: 35.82, Bp: 27.25, SD: 21.1
2nd Phalanx	5074	L	Complete	GL: 36.03, Bp: 24.52, SD: 19.53
2nd Phalanx	5146	L	Complete	GL: 36.03, Bp: 26.98, SD: 21.09
2nd Phalanx	5085	L	Complete	GL: 36.05, Bp: 25.84, SD: 20.24
2nd Phalanx	5279	R	Complete	GL: 36.2, Bp: 24.26, SD: 19.51
2nd Phalanx	5161	L	Complete	GL: 36.36, Bp: 24.77, SD: 18.5
2nd Phalanx	5279	R	Complete	GL: 36.47, Bp: 26.39, SD: 20.07
2nd Phalanx	5215	L	Complete	GL: 36.49, Bp: 28.12, SD: 20.72
2nd Phalanx	5146	L	Complete	GL: 36.53, Bp: 24.96, SD: 19.7
2nd Phalanx	5247	L	Complete	GL: 36.56, Bp: 22.9, SD: 19.52
2nd Phalanx	5135	L	Complete	GL: 36.58, Bp: 27.68, SD: 21.95
2nd Phalanx	5186	L	Complete	GL: 36.61, SD: 22.18
2nd Phalanx	5121	R	Complete	GL: 36.68, Bp: 31.03, SD: 25.24
2nd Phalanx	5136	R	Complete	GL: 36.77, Bp: 24.51, SD: 20.26
2nd Phalanx	5085	R	Complete	GL: 36.91, Bp: 27.72, SD: 22.91
2nd Phalanx	5141	R	Complete	GL: 36.92, SD: 20.86
2nd Phalanx	5121	L	Complete	GL: 37, Bp: 26.2, SD: 20.86
2nd Phalanx	5085	L	Complete	GL: 37.11
2nd Phalanx	5247	R	Complete	GL: 37.13, Bp: 27.2, SD: 21.72
2nd Phalanx	5085	R	Complete	GL: 37.22, Bp: 26.72, SD: 21.0
2nd Phalanx	5074	R	Complete	GL: 37.42, Bp: 30.22, SD: 24.34
2nd Phalanx	5239	L	Complete	GL: 37.46, Bp: 24.36, SD: 19.46
2nd Phalanx	5074	L	Complete	GL: 37.79, Bp: 27.0, SD: 22.99
2nd Phalanx	5085	R	Complete	GL: 37.8, Bp: 25.2, SD: 20.7
2nd Phalanx	5141	L	Complete	GL: 37.84, Bp: 30.87, SD: 23.35
2nd Phalanx	5115	R	Complete	GL: 37.92, Bp: 32.6, SD: 25.64
2nd Phalanx	5180	L	Complete	GL: 38.0, Bp: 30.05, SD: 24.78
2nd Phalanx	5085	L	Complete	GL: 38.03, Bp: 26.27, SD: 21.4
2nd Phalanx	5085	R	Complete	GL: 38.13
2nd Phalanx	5214	R	Complete	GL: 38.18, Bp: 31.45, SD: 24.92
2nd Phalanx	5141	L	Complete	GL: 38.27, Bp: 26.91, SD: 20.65
2nd Phalanx	5215	R	Complete	GL: 38.29, Bp: 29.77, SD: 23.57
2nd Phalanx	5085	R	Complete	GL: 38.37, Bp: 26.45, SD: 21.81
2nd Phalanx	5085	R	Complete	GL: 38.41, Bp: 23.04, SD: 20.14
2nd Phalanx	5161	R	Complete	GL: 38.41, Bp: 26.88, SD: 21.45
2nd Phalanx	5218	L	Complete	GL: 38.42, SD: 23.79
2nd Phalanx	5141	R	Complete	GL: 38.46, Bp: 31.09, SD: 25.54
2nd Phalanx	5122	L	Complete	GL: 38.5
2nd Phalanx	5195	R	Complete	GL: 38.61, SD: 23.07
2nd Phalanx	5186	R	Complete	GL: 38.68, SD: 20.47

2nd Phalanx	5036	R	Complete	GL: 38.69, SD: 22.01
2nd Phalanx	5222	R	Complete	GL: 38.8, Bp: 24.07, SD: 19.86
2nd Phalanx	5085	L	Complete	GL: 38.81, Bp: 28.1, SD: 22.73
2nd Phalanx	5236	R	Complete	GL: 38.81, Bp: 31.02, SD: 25.0
2nd Phalanx	5085	L	Complete	GL: 38.94, Bp: 30.32, SD: 22.55
2nd Phalanx	5074	L	Complete	GL: 39.29, Bp: 32.44, SD: 24.87
2nd Phalanx	5239	R	Complete	GL: 39.41, Bp: 28.19, SD: 21.98
2nd Phalanx	5247	R	Complete	GL: 39.85, Bp: 29.66, SD: 23.83
2nd Phalanx	5236	R	Complete	GL: 39.88, Bp: 22.42
2nd Phalanx	5195	L	Complete	GL: 39.94, Bp: 29.16, SD: 24.05
2nd Phalanx	5085	L	Complete	GL: 40.11, Bp: 26.27, SD: 22.0
2nd Phalanx	5085	R	Complete	GL: 40.42, SD: 22.64
2nd Phalanx	5252	L	Complete	GL: 40.46, Bp: 27.82, SD: 22.24
2nd Phalanx	5085	R	Complete	GL: 40.47, Bp: 27.12, SD: 20.66
2nd Phalanx	5201	L	Complete	GL: 40.7, Bp: 32.52, SD: 24.85
2nd Phalanx	5074	R	Complete	GL: 40.74, Bp: 33.14, SD: 21.25
2nd Phalanx	5205	R	Complete	GL: 40.89, Bp: 31.03, SD: 23.81
2nd Phalanx	5195	R	Complete	GL: 41.37, Bp: 27.23, SD: 21.25
2nd Phalanx	5195	L	Complete	GL: 41.43, Bp: 29.07, SD: 22.45
2nd Phalanx	5195	R	Complete	GL: 42.15, Bp: 28.59, SD: 22.96
2nd Phalanx	5044	R	Complete	GL: 42.46, Bp: 32.31, SD: 25.69
2nd Phalanx	5085	L	Complete	GL: 44.0, Bp: 31.9, SD: 25.28
2nd Phalanx	5280	R	Complete	GL: 45.95, SD: 24.16
2nd Phalanx	5284	L	Complete	GL: 29.76, Bp: 22.87, SD: 18.32
2nd Phalanx	US	L	Complete	GL: 30.04, Bp: 21.45
2nd Phalanx	5036	R	Complete	GL: 30.44, Bp: 22.8, SD: 17.85
2nd Phalanx	5195	R	Complete	GL: 30.63, Bp: 22.1, SD: 17.84
2nd Phalanx	5247	L	Complete	GL: 30.79, Bp: 25.51; SD: 21.67
2nd Phalanx	5264	L	Complete	GL: 31.4, SD: 17.34
2nd Phalanx	5264	R	Complete	GL: 31.88, Bp: 24.6, SD: 19
2nd Phalanx	5228	L	Complete	GL: 32.06, Bp: 26.27, SD: 21.87
2nd Phalanx	5264	L	Complete	GL: 32.37, Bp: 25.39, SD: 19.91
2nd Phalanx	5085	L	Complete	GL: 32.7, Bp: 27, SD: 19.76
2nd Phalanx	5044	R	Complete	GL: 33.18, SD: 20.91
2nd Phalanx	5342	L	Complete	GL: 33.34, Bp: 26.5, SD: 21.36
2nd Phalanx	5363	L	Complete	GL: 33.5, Bp: 24.54, SD: 20.32
2nd Phalanx	5264	L	Complete	GL: 33.6, Bp: 21.77, SD: 17.35
2nd Phalanx	5264	R	Complete	GL: 33.63, Bp: 26, SD: 19.49
2nd Phalanx	5036	R	Complete	GL: 33.67, Bp: 22.2, SD: 16.5
2nd Phalanx	5347	R	Complete	GL: 33.81
2nd Phalanx	5161	R	Complete	GL: 33.82, Bp: 24.5, SD: 18.61
2nd Phalanx	5161	R	Complete	GL: 33.95, Bp: 26.28, SD: 20.65
2nd Phalanx	5264	L	Complete	GL: 34.17, Bp: 23.64, SD: 18.51
2nd Phalanx	5264	R	Complete	GL: 34.19, Bp: 25.18, SD: 19.95

2nd Phalanx	5161	L	Complete	GL: 34.22, Bp: 24.87, SD: 18.55
2nd Phalanx	5340	R	Complete	GL: 34.22, Bp: 27.4, SD: 20.09
2nd Phalanx	5264	R	Complete	GL: 34.31, Bp: 25.14, SD: 18.85
2nd Phalanx	5284	L	Complete	GL: 34.35, Bp: 21.82, SD: 20.27
2nd Phalanx	5381	R	Complete	GL: 34.5, Bp: 26.49, SD: 21.42
2nd Phalanx	5136	L	Complete	GL: 34.58, Bp: 26.24, SD: 19.97
2nd Phalanx	5264	L	Complete	GL: 34.67, SD: 19.06
2nd Phalanx	5381	L	Complete	GL: 34.76, Bp: 25.79, SD: 20.28
2nd Phalanx	5348	L	Complete	GL: 34.84, Bp: 27.61, SD: 19.98
2nd Phalanx	5264	R	Complete	GL: 34.87, Bp: 25.35, SD: 19.81
2nd Phalanx	5308	L	Complete	GL: 34.98, Bp: 27.47, SD: 20.43
2nd Phalanx	5284	L	Complete	GL: 35.06, Bp: 24.62, SD: 19.04
2nd Phalanx	5264	L	Complete	GL: 35.08, Bp: 24.37, SD: 19.48
2nd Phalanx	5358	L	Complete	GL: 35.08, Bp: 28.87, SD: 23.5
2nd Phalanx	US	R	Complete	GL: 35.12, Bp: 28.25, SD: 21.68
2nd Phalanx	5264	R	Complete	GL: 35.43, Bp: 25.45, SD: 20.77
2nd Phalanx	5363	L	Complete	GL: 35.47, Bp: 28.3, SD: 22.7
2nd Phalanx	5357	L	Complete	GL: 35.59, Bp: 25.21, SD: 20.6
2nd Phalanx	5044	L	Complete	GL: 35.63
2nd Phalanx	5284	R	Complete	GL: 35.71, Bp: 24.67, SD: 19.41
2nd Phalanx	5284	L	Complete	GL: 35.71, Bp: 26.5, SD: 20.79
2nd Phalanx	5264	R	Complete	GL: 35.76, Bp: 23.88, SD: 18.66
2nd Phalanx	5146	R	Complete	GL: 35.84, Bp: 25.25, SD: 18.19
2nd Phalanx	5210	L	Complete	GL: 36.02, Bp: 26.75, SD: 20.38
2nd Phalanx	5365	L	Complete	GL: 36.12, Bp: 23.84, SD: 17.51
2nd Phalanx	5161	R	Complete	GL: 36.18, Bp: 25.77, SD: 20.04
2nd Phalanx	5264	R	Complete	GL: 36.24, Bp: 24.95, SD: 19.4
2nd Phalanx	5161	R	Complete	GL: 36.29, SD: 20.07
2nd Phalanx	5264	L	Complete	GL: 36.36, Bp: 26.38, SD: 19.73
2nd Phalanx	5264	R	Complete	GL: 36.37, Bp: 26.44, SD: 21.33
2nd Phalanx	5381	R	Complete	GL: 36.42, Bp: 26.31, SD: 20.9
2nd Phalanx	5085	L	Complete	GL: 36.46, Bp: 29.77, SD: 24.24
2nd Phalanx	5264	R	Complete	GL: 36.5, Bp: 25.43, SD: 18.27
2nd Phalanx	5284	R	Complete	GL: 36.6, SD: 23.55
2nd Phalanx	5161	R	Complete	GL: 36.64, Bp: 26.19, SD: 20.67
2nd Phalanx	US	R	Complete	GL: 36.67, Bp: 24.06, SD: 18.51
2nd Phalanx	5161	L	Complete	GL: 36.68, Bp: 26.27, SD: 20.53
2nd Phalanx	5347	R	Complete	GL: 36.7, Bp: 26.57, SD: 21.84
2nd Phalanx	5264	L	Complete	GL: 36.7, Bp: 28.45, SD: 23.06
2nd Phalanx	5284	R	Complete	GL: 37.05, Bp: 24.85, SD: 16.55
2nd Phalanx	5284	R	Complete	GL: 37.32, SD: 24.25
2nd Phalanx	5284	L	Complete	GL: 37.4, Bp: 27.09, SD: 21.06
2nd Phalanx	5347	L	Complete	GL: 37.45, Bp: 26.47, SD: 21.4
2nd Phalanx	5284	L	Complete	GL: 37.48, Bp: 25.84, SD: 21.03

2nd Phalanx	5264	R	Complete	GL: 37.59, Bp: 28.6, SD: 20.28
2nd Phalanx	5161	R	Complete	GL: 37.72, Bp: 29.42, SD: 22.04
2nd Phalanx	5264	R	Complete	GL: 37.74, Bp: 24.52, SD: 17.36
2nd Phalanx	5284	L	Complete	GL: 37.74, Bp: 27.31, SD: 22.16
2nd Phalanx	5284	L	Complete	GL: 37.98, Bp: 27.55, SD: 21.8
2nd Phalanx	5264	L	Complete	GL: 38.18
2nd Phalanx	5161	R	Complete	GL: 38.29, Bp: 25.96, SD: 20.97
2nd Phalanx	5284	L	Complete	GL: 38.44, Bp: 28.83, SD: 17.35
2nd Phalanx	5284	L	Complete	GL: 38.545, Bp: 31.96, SD: 25.95
2nd Phalanx	5284	L	Complete	GL: 38.58, Bp: 27.79, SD: 22.38
2nd Phalanx	5264	R	Complete	GL: 38.78, Bp: 24.31, SD: 19.37
2nd Phalanx	5161	R	Complete	GL: 38.91, Bp: 25.03, SD: 19.77
2nd Phalanx	5284	R	Complete	GL: 39.02, Bp: 24.83, SD: 16.4
2nd Phalanx	5284	R	Complete	GL: 39.09, Bp: 28.56, SD: 21.9
2nd Phalanx	5381	L	Complete	GL: 39.19, Bp: 28.25, SD: 22.6
2nd Phalanx	5284	R	Complete	GL: 39.34
2nd Phalanx	5347	R	Complete	GL: 39.42, Bp: 27.45, SD: 21.56
2nd Phalanx	5264	R	Complete	GL: 39.53, Bp: 31.49, SD: 23.9
2nd Phalanx	5347	R	Complete	GL: 40.59, Bp: 28.67, SD: 22.9
2nd Phalanx	5195	R	Complete	GL: 40.6, Bp: 28.52, SD: 23.55
2nd Phalanx	5136	R	Complete	GL: 40.7, Bp: 30.7, SD: 23.48
2nd Phalanx	5161	L	Complete	GL: 41.05, Bp: 28.48, SD: 22.77
2nd Phalanx	5284	L	Complete	GL: 41.1, Bp: 30.89, SD: 24.58
2nd Phalanx	5364	R	Complete	GL: 41.21, Bp: 27.1, SD: 26.56
2nd Phalanx	5264	R	Complete	GL: 41.36
2nd Phalanx	5146	L	Complete	GL: 41.68, Bp: 29.28, SD: 22.65
2nd Phalanx	5284	L	Complete	GL: 42.21, Bp: 31.37, SD: 25.4
2nd Phalanx	5281	R	Complete	GL: 42.54, Bp: 30.22, SD: 23.52
2nd Phalanx	5364	L	Complete	GL: 42.54, Bp: 34.9, SD: 27.8
2nd Phalanx	5044	R	Complete	GL: 43.25, Bp: 29.46, SD: 22.73
2nd Phalanx	5334	L	Complete	GL: 55.4, Bp: 26.95, SD: 22.3
2nd Phalanx	5186	R	2, 3	SD: 19.51
2nd Phalanx	5134	UNK	2	SD: 19.58
2nd Phalanx	5036	L	2, 3	SD: 19.67
2nd Phalanx	5126	R	2, 3	SD: 20.51
2nd Phalanx	5136	L	2, 3	SD: 19.77
2nd Phalanx	5334	R	2, 3	SD: 20.26
Astragalus	5055	R	1, 2	BD: 33.61
Astragalus	5280	L	Complete	BD: 36.36
Astragalus	5347	R	Complete	BD: 34.3, DL: 32.25
Astragalus	5264	R	1, 3	BD: 35.45
Astragalus	5161	L	Complete	BD: 38.22
Astragalus	5161	R	1, 3	BD: 38.86
Astragalus	5364	L	1, 2	BD: 39.02

Astragalus	5351	R	Complete	BD: 40.03
Astragalus	5281	R	Complete	BD: 40.93
Astragalus	5055	L	1, 3	DL: 32.19
Astragalus	5085	L	Complete	DL: 32.76
Astragalus	5125	R	Complete	DL: 33.7
Astragalus	5264	L	Complete	DL: 31.96
Astragalus	5364	R	Complete	DL: 32.32
Astragalus	5161	L	Complete	DL: 33.91
Astragalus	5136	L	Complete	DL: 34.14
Astragalus	5264	L	Complete	DL: 37.94
Astragalus	5085	R	Complete	Gll: 52.96, BD: 31.86, DL: 29.06
Astragalus	5126	R	Complete	Gll: 54.93, BD: 34.93, DL: 31.1
Astragalus	5186	L	Complete	Gll: 54.93, BD: 35.31, DL: 29.1
Astragalus	5216	L	Complete	Gll: 55.03, BD: 35.61, DL: 30.92
Astragalus	5074	L	Complete	Gll: 55.56, BD: 34.99, DL: 31.63
Astragalus	5247	L	Complete	Gll: 55.79, BD: 36.7, DL: 30.91
Astragalus	5197	R	Complete	Gll: 55.84, BD: 28.86, DL: 30.51
Astragalus	5088	R	Complete	Gll: 55.88, BD: 34.96, DL: 31.9
Astragalus	5161	L	Complete	Gll: 56.18, BD: 33.92, DL: 31.75
Astragalus	5036	L	Complete	Gll: 56.3, BD: 34.71, DL: 31.32
Astragalus	5161	R	Complete	Gll: 56.73, BD: 38.66, DL: 31.19
Astragalus	5085	R	Complete	Gll: 57.05, BD: 36.01, DL: 29.88
Astragalus	5207	R	Complete	Gll: 57.24, BD: 38.4, DL: 30.37
Astragalus	5157	L	Complete	Gll: 57.57, BD: 33.59, DL: 32.37
Astragalus	5121	L	Complete	Gll: 57.61, BD: 37.83, DL: 31.87
Astragalus	5280	L	Complete	Gll: 57.74, BD: 35.57
Astragalus	5271	L	Complete	Gll: 57.77, BD: 37.47
Astragalus	5019	R	Complete	Gll: 58.15, BD: 36.33, DL: 32.46
Astragalus	5146	L	Complete	Gll: 58.15, BD: 37.64, DL: 32.71
Astragalus	5085	L	Complete	Gll: 58.18, BD: 37.35
Astragalus	5085	R	Complete	Gll: 58.37, BD: 39.75, DL: 33.38
Astragalus	5085	L	Complete	Gll: 58.41, BD: 35.7, DL: 33.76
Astragalus	5085	L	Complete	Gll: 58.5, BD: 39.47, DL: 32.15
Astragalus	5157	R	Complete	Gll: 59.0, BD: 35.84, DL: 32.85
Astragalus	5146	R	Complete	Gll: 59.02, DL: 33.34
Astragalus	5280	R	Complete	Gll: 59.19, DL: 32.55
Astragalus	5142	L	1, 2, 3	Gll: 59.55, BD: 36.26, DL: 32.79
Astragalus	5074	R	1, 3	Gll: 59.56
Astragalus	5085	R	Complete	Gll: 59.94, BD: 38.49, DL: 33.79
Astragalus	5085	R	Complete	Gll: 60.23, BD: 38.53, DL: 33.39
Astragalus	5195	R	Complete	Gll: 60.26, BD: 42.3, DL: 36.3
Astragalus	5215	L	Complete	Gll: 60.31, BD: 39.2, DL: 32.73
Astragalus	5280	R	Complete	Gll: 60.45, BD: 39.49, DL: 33.46
Astragalus	5085	R	Complete	Gll: 61.34, BD: 39.79

Astragalus	5215	R	Complete	Gll: 61.43, BD: 39.11, DL: 32.48
Astragalus	5085	R	1, 3	Gll: 61.69
Astragalus	5195	R	Complete	Gll: 61.95, BD: 41.07, DL: 35.54
Astragalus	5279	R	Complete	Gll: 61.99, BD: 41.53, DL: 34.51
Astragalus	5085	R	Complete	Gll: 62.2, BD: 42.27, DL: 35.42
Astragalus	5085	L	Complete	Gll: 62.3, BD: 40.18, DL: 35.09
Astragalus	5280	L	Complete	Gll: 62.59, BD: 40.57, DL: 34.9
Astragalus	5280	L	Complete	Gll: 62.86, BD: 43.83, DL: 36.38
Astragalus	5279	R	Complete	Gll: 63.05, BD: 38.84
Astragalus	5085	R	Complete	Gll: 63.13, BD: 41.92, DL: 35.97
Astragalus	5142	R	Complete	Gll: 63.18, BD: 42.31, SD: 34.94
Astragalus	5085	R	Complete	Gll: 63.19, BD: 40.97, DL: 36.76
Astragalus	5085	R	Complete	Gll: 63.21, BD: 39.01, DL: 35.79
Astragalus	5085	L	Complete	Gll: 63.77, BD: 43.73, DL: 35.71
Astragalus	5085	R	Complete	Gll: 63.99, BD: 41.19, DL: 36.11
Astragalus	5085	R	Complete	Gll: 64.17, BD: 43.09, DL: 34.46
Astragalus	5085	R	Complete	Gll: 64.87, BD: 41.16, DL: 36.86
Astragalus	5004	R	Complete	Gll: 65.03, BD: 39.87, DL: 37.08
Astragalus	5085	R	Complete	Gll: 67.41, BD: 42.31, DL: 37.94
Astragalus	5109	L	Complete	Gll: 68.37, BD: 45.68, DL: 38.22
Astragalus	5340	R	Complete	Gll: 54.85, BD: 36.3, DL: 31.53
Astragalus	5247	L	Complete	Gll: 54.92, DL: 31.8
Astragalus	5308	L	Complete	Gll: 54.98, BD: 33.02, DL: 30.19
Astragalus	5264	L	Complete	Gll: 55.8, BD: 34.27, DL: 29.78
Astragalus	5264	R	Complete	Gll: 56.08, BD: 34.96, DL: 31.72
Astragalus	5347	R	Complete	Gll: 56.1, DL: 31.47
Astragalus	5161	R	Complete	Gll: 56.22, BD: 36, DL: 33.91
Astragalus	5347	R	Complete	Gll: 56.4
Astragalus	5284	L	Complete	Gll: 56.58, BD: 37.79, DL: 31.43
Astragalus	5308	R	Complete	Gll: 56.76, BD: 36.59, DL: 32.12
Astragalus	5264	L	Complete	Gll: 57.04, BD: 25.27, DL: 32.14
Astragalus	5284	L	Complete	Gll: 57.47, BD: 37.51, DL: 31.44
Astragalus	US	L	Complete	Gll: 57.74, BD: 38.6, DL: 32.6
Astragalus	5340	L	Complete	Gll: 58.1, BD: 37.13, DL: 31.9
Astragalus	5264	R	Complete	Gll: 58.19, BD: 39.83
Astragalus	5348	R	Complete	Gll: 58.27, BD: 35.75
Astragalus	5264	R	Complete	Gll: 58.34, BD: 36.5, DL: 32.24
Astragalus	5308	R	Complete	Gll: 58.83, BD: 33.59, DL: 32.29
Astragalus	5284	R	Complete	Gll: 58.91, BD: 39.3, DL: 36.14
Astragalus	5340	R	Complete	Gll: 59.09, BD: 36.72, DL: 33.81
Astragalus	5347	R	Complete	Gll: 59.1, BD: 40.65, DL: 33.95
Astragalus	5347	L	Complete	Gll: 59.15, BD: 36.39, DL: 32.3
Astragalus	5264	L	Complete	Gll: 59.17, BD: 37.77, DL: 32.5
Astragalus	5264	L	Complete	Gll: 59.33, BD: 39.14, DL: 33.42

Astragalus	5264	L	Complete	Gll: 59.46, DL: 32.6
Astragalus	5284	R	1, 2, 4	Gll: 59.47, BD: 41.4, DL: 33.91
Astragalus	5347	L	Complete	Gll: 59.48, BD: 37.35, DL: 32.85
Astragalus	5326	L	Complete	Gll: 59.82, BD: 35.95, DL: 32.44
Astragalus	5308	R	Complete	Gll: 59.97, BD: 39.73, DL: 32.46
Astragalus	5264	R	Complete	Gll: 60.04, BD: 37.91, DL: 34.02
Astragalus	5347	L	Complete	Gll: 60.5, BD: 40.15, DL: 34.9
Astragalus	5264	R	Complete	Gll: 60.72, BD: 38.41, DL: 34.84
Astragalus	5264	R	Complete	Gll: 61.54, BD: 39.59, DL: 34.7
Astragalus	5146	L	Complete	Gll: 61.61, DL: 34.82
Astragalus	5288	R	Complete	Gll: 61.98, BD: 29.48, DL: 34.76
Astragalus	5347	L	Complete	Gll: 62.06, DL: 35.43
Astragalus	5284	R	Complete	Gll: 62.32
Astragalus	5381	R	Complete	Gll: 62.7, BD: 38.92, DL: 35.89
Astragalus	5085	R	Complete	Gll: 62.89, BD: 42.83
Astragalus	5136	L	Complete	Gll: 63.04, DL: 35.75
Astragalus	5044	R	Complete	Gll: 63.29, BD: 41.09, DL: 35.25
Astragalus	5284	R	Complete	Gll: 63.45, BD: 39.18, DL: 35.12
Astragalus	5264	L	Complete	Gll: 63.61, BD: 39.91, DL: 36.21
Astragalus	5264	L	Complete	Gll: 63.93, BD: 39.75, DL: 35.73
Astragalus	5161	R	Complete	Gll: 64.72, DL: 37.05
Astragalus	5264	L	Complete	Gll: 64.84, BD: 37.58, DL: 36.2
Astragalus	5347	R	Complete	Gll: 64.96, BD: 39.73, DL: 35.4
Astragalus	5161	R	Complete	Gll: 65.26, BD: 41.35, DL: 37.46
Astragalus	5146	R	Complete	Gll: 65.74, BD: 42.5, DL: 37.66
Astragalus	5284	L	Complete	Gll: 69.93, BD: 44.1, DL: 37.41
Calcaneus	5055	R	2, 3, 4, 5	GL: 101.93
Calcaneus	5161	R	2, 3, 4, 5	GL: 102.53
Calcaneus	5239	L	2, 3, 4, 5	GL: 105.33
Calcaneus	5280	L	Complete	GL: 115.57
Calcaneus	5169	R	Complete	GL: 117.84
Calcaneus	5280	L	Complete	GL: 118.54
Calcaneus	5036	L	Complete	GL: 122.13
Calcaneus	5195	L	Complete	GL: 123.55
Calcaneus	5085	R	Complete	GL: 127.01
Calcaneus	5019	L	Complete	GL: 128.12
Calcaneus	5280	L	Complete	GL: 128.25
Calcaneus	5144	L	Complete	GL: 128.3
Calcaneus	5121	L	Complete	GL: 132.72
Calcaneus	5089	R	Complete	GL: 132.82
Calcaneus	5146	L	Complete	GL: 133.9
Calcaneus	5195	R	2, 3, 4, 5	GL: 83.61
Calcaneus	5186	L	2, 3, 4, 5	GL: 88.45
Calcaneus	5264	L	Complete	GL: 100.82

Calcaneus	5281	R	Complete	GL: 114.68
Calcaneus	5161	R	Complete	GL: 115.89
Calcaneus	5264	R	Complete	GL: 115.9
Calcaneus	5264	L	Complete	GL: 116.31
Calcaneus	5264	L	Complete	GL: 119.08
Calcaneus	5146	R	Complete	GL: 121.42
Calcaneus	5085	R	Complete	GL: 127.63
Calcaneus	5264	R	Complete	GL: 133.82
Humerus	5085	R	5, 6	BT: 56.96, HT: 32.08, HTC: 23.86
Humerus	5088	L	3, 4, 5, 6, 7, 8	BT: 58.3, HT: 34.93, HTC: 26.21
Humerus	5280	R	3,4, 5, 6, 7, 8	BT: 59.79, HT: 34.69, HTC: 26.03
Humerus	5085	L	3, 4, 5, 6, 7, 8	BT: 61.67, HT: 35.52, HTC: 26.16
Humerus	5085	R	3, 4, 5, 6	BT: 63.58, HT: 34.84, HTC: 27.35
Humerus	5239	L	3, 4 5, 6, 7, 8	BT: 63.84, HT: 38.07, HTC: 29.17
Humerus	5085	R	3, 4, 5, 6, 7	BT: 64.07, HT: 38.25, HTC: 30.4
Humerus	5085	R	3, 4, 9, 10	BT: 64.61, HTC: 27.97
Humerus	5136	R	5, 6	BT: 65.48, HT: 39.29, HTC: 29.06
Humerus	5247	R	5, 6	BT: 66.14, HT: 36.55, HTC: 29.63
Humerus	5085	L	5,6,7,8	BT: 68.8, HT: 40.9, HTC: 30.03
Humerus	5085	L	3, 4, 5, 6	BT: 69.26, HT: 42.99, HTC: 30.76
Humerus	5252	R	5, 6	BT: 77.44, HT: 47.65, HTC: 35.7
Humerus	5004	L	3, 4, 5, 6	BT: 81.91, HT: 48.77, HTC: 36.51
Humerus	5161	R	4, 5, 6, 7, 8	BT: 54.11, HT: 41.36, HTC: 29.59
Humerus	5281	R	5, 6	BT: 60.07, HT: 36.22, HTC: 28.21
Humerus	5085	L	5, 6	BT: 60.66, HT: 36.44, HTC: 27.86
Humerus	5264	R	5, 6	BT: 61.47, HT: 36.55, HTC: 30.25
Humerus	5044	L	5, 6	BT: 61.51, HT: 37.97, HTC: 28.27
Humerus	5284	R	5, 6	BT: 61.72, HTC: 26.72
Humerus	5044	L	3, 4, 5, 6, 7, 8	BT: 61.95, HT: 34.62, HTC: 26.69
Humerus	US	R	5, 6, 7, 8	BT: 62.67, HT: 37.16, HTC: 26.73
Humerus	5308	L	5, 6	BT: 63.94, HTC: 28.12
Humerus	5347	R	5, 6, 7, 8	BT: 64.18, HTC: 28.33
Humerus	5351	R	3, 4, 5, 6, 7, 8	BT: 65.15, HT: 34.74, HTC: 26.41
Humerus	5161	L	3, 4, 5, 6, 7, 8	BT: 65.26, HT: 36.54, HTC: 26.57
Humerus	US	R	5, 6	BT: 65.35, HT: 38.5, HTC: 29.57
Humerus	5340	L	5, 6, 7, 8	BT: 65.78, HT: 39.36, HTC: 28.01
Humerus	5284	R	3, 5, 6	BT: 67.03, HT: 39.01, HTC: 31.97
Humerus	5195	L	5, 6, 7, 8	BT: 67.11, HTC: 28.79
Humerus	5161	L	5, 6	BT: 67.94, HT: 42.26, HTC: 30.41
Humerus	5085	R	3, 5, 6	BT: 69.81, HT: 41.51
Humerus	5264	L	5, 6	BT: 69.86
Humerus	5264	R	5, 6	BT: 71.95
Humerus	5116	R	6	HT: 33.48
Humerus	5044	L	8, 6	HT: 34.49, HTC: 24.43

Humerus	5070	L	5, 6, 8	HT: 35.76, HTC: 25.92
Humerus	5085	R	6	HT: 35.79
Humerus	5136	R	6	HT: 36.71
Humerus	5201	L	5	HT: 36.88
Humerus	5280	R	6	HT: 36.93
Humerus	5010	R	5, 6	HT: 37.49
Humerus	5121	L	5, 6	HT: 37.51, HTC: 26.42
Humerus	5280	R	5, 6	HT: 37.96, HTC: 29.27
Humerus	5136	L	5, 6, 7, 8	HT: 38.01, HTC: 28.58
Humerus	5195	L	3, 5, 6	HT: 38.47, HTC: 29.44
Humerus	5085	R	5	HT: 39.07
Humerus	5157	R	6	HT: 39.37
Humerus	5239	R	5, 7	HT: 39.7, HTC: 30.1
Humerus	5239	R	3, 4, 5, 6, 7, 8	HT: 39.9, HTC: 29.63
Humerus	5085	R	5, 6	HT: 40.3, HTC: 33.89
Humerus	5177	R	6	HT: 40.51
Humerus	5101	R	5, 6	HT: 40.54, HTC: 30.47
Humerus	5097	L	4, 6	HT: 41.0
Humerus	5085	L	3, 4, 5, 6	HT: 41.36, HTC: 30.95
Humerus	5085	R	3, 4, 5, 6	HT: 41.75, HTC: 32.15
Humerus	5216	R	5, 6, 7, 8	HT: 41.93, HTC: 30.81
Humerus	5195	L	6, 7, 8	HT: 44.49
Humerus	5010	L	5, 6	HT: 48.11
Humerus	5264	R	5, 6, 7, 8	HT: 32.18, HTC: 25.24
Humerus	5264	R	6	HT: 34.05
Humerus	5264	L	6	HT: 34.73
Humerus	5264	L	6	HT: 34.75
Humerus	5281	R	5, 6	HT: 35.01
Humerus	5264	L	6	HT: 36.27
Humerus	5264	R	5, 6, 7, 8	HT: 36.28, HTC: 28.25
Humerus	5284	R	5, 6, 7, 8	HT: 36.59, HTC: 27.9
Humerus	5284	L	4, 5, 6	HT: 36.69, HTC: 28.46
Humerus	5364	L	5, 6	HT: 37.01, HTC: 30
Humerus	5161	R	6	HT: 37.17
Humerus	5146	R	5	HT: 37.36
Humerus	5356	R	5, 6, 7, 8	HT: 37.45, HTC: 30
Humerus	5264	R	5	HT: 38.3
Humerus	5284	R	4, 6	HT: 38.63, HTC: 28.23
Humerus	US	L	5, 6, 7, 8	HT: 38.77, HTC: 28.47
Humerus	US	L	5, 6, 7	HT: 38.77, HTC: 31.07
Humerus	5364	L	5, 6	HT: 38.89, HTC: 29.5
Humerus	5085	L	5, 6	HT: 39.87
Humerus	5264	R	5, 6	HT: 40.08, HTC: 29.57
Humerus	5281	R	5, 6	HT: 40.13, HTC: 29.36

Humerus	5340	L	5, 6, 7, 8	HT: 40.57, HTC: 30.71
Humerus	5210	L	5	HT: 40.92
Humerus	5161	L	6	HT: 41.74
Humerus	5381	L	6	HT: 42.53, HTC: 31.52
Humerus	5284	L	5, 6	HT: 45.43, HTC: 34.2
Humerus	5280	R	6	HTC: 26.72
Humerus	5047	L	5, 6	HTC: 28.37
Humerus	5136	R	5	HTC: 29.54
Humerus	5125	L	5, 6	HTC: 30.01
Humerus	5085	L	3, 4, 5, 6	HTC: 31.44
Humerus	5109	R	5, 6	HTC: 31.86
Humerus	5044	R	5	HTC: 34.24
Humerus	5186	L	5	HTC: 35.18
Humerus	5161	R	5	HTC: 24.92
Humerus	5288	L	3, 4, 5, 6	HTC: 26.76
Humerus	5264	L	6	HTC: 27.4
Humerus	US	L	6	HTC: 27.62
Humerus	5085	R	5, 6	HTC: 28.28
Humerus	5136	L	5, 6	HTC: 28.82
Humerus	5044	R	5	HTC: 29.63
Humerus	5264	R	5, 6	HTC: 29.92
Humerus	5264	L	5, 6	HTC: 30.1
Humerus	5284	R	5, 6	HTC: 31.59
Humerus	5284	R	5, 6	HTC: 32.1
Humerus	5347	L	6	HTC: 43.4
M3	5308	R	N/A	L: 29.77
M3	5010	R	N/A	L: 28.04
M3	5044	L	N/A	L: 28.59
M3	5010	L	N/A	L: 28.66
M3	5121	L	N/A	L: 28.84
M3	5242	R	N/A	L: 28.92
M3	5010	L	N/A	L: 29.24
M3	5126	L	N/A	L: 29.72
M3	5085	L	N/A	L: 29.76
M3	5010	L	N/A	L: 29.88
M3	5010	L	N/A	L: 29.91
M3	5010	L	N/A	L: 29.94
M3	5044	R	N/A	L: 29.94
M3	5010	R	N/A	L: 30.18
M3	5010	L	N/A	L: 30.44
M3	5135	R	N/A	L: 30.51
M3	5038	L	N/A	L: 30.54
M3	5239	R	N/A	L: 30.77
M3	5195	L	N/A	L: 30.96

M3	5010	R	N/A	L: 31.24
M3	5177	R	N/A	L: 31.42
M3	5207	R	N/A	L: 31.45
M3	5010	L	N/A	L: 31.51
M3	5085	R	N/A	L: 31.53
M3	5031	R	N/A	L: 31.57
M3	5136	L	N/A	L: 31.57
M3	5086	L	N/A	L: 31.59
M3	5036	L	N/A	L: 31.78
M3	5236	R	N/A	L: 31.79
M3	5088	L	N/A	L: 31.87
M3	5055	L	N/A	L: 31.9
M3	5074	R	N/A	L: 31.91
M3	5085	L	N/A	L: 31.97
M3	5121	L	N/A	L: 31.97
M3	5252	L	N/A	L: 32.02
M3	5031	L	N/A	L: 32.03
M3	5281	L	N/A	L: 32.07
M3	5010	L	N/A	L: 32.1
M3	5072	L	N/A	L: 32.11
M3	5135	L	N/A	L: 32.18
M3	5085	L	N/A	L: 32.2
M3	5083	R	N/A	L: 32.53
M3	5031	R	N/A	L: 32.54
M3	5186	L	N/A	L: 32.95
M3	5218	R	N/A	L: 32.96
M3	5280	R	N/A	L: 33.17
M3	5074	L	N/A	L: 33.32
M3	5085	R	N/A	L: 33.42
M3	5207	R	N/A	L: 33.54
M3	5010	L	N/A	L: 33.65
M3	5207	R	N/A	L: 33.98
M3	5085	L	N/A	L: 34.04
M3	5134	L	N/A	L: 34.08
M3	5089	R	N/A	L: 34.11
M3	5092	R	N/A	L: 34.14
M3	5125	R	N/A	L: 34.35
M3	5134	L	N/A	L: 34.35
M3	5126	L	N/A	L: 34.4
M3	5055	L	N/A	L: 34.47
M3	5126	R	N/A	L: 34.68
M3	5126	R	N/A	L: 34.93
M3	5044	L	N/A	L: 35.13
M3	5085	L	N/A	L: 35.14

M3	5085	L	N/A	L: 35.37
M3	5010	R	N/A	L: 35.44
M3	5085	R	N/A	L: 35.5
M3	5121	R	N/A	L: 35.57
M3	5207	L	N/A	L: 35.58
M3	5177	R	N/A	L: 35.63
M3	5085	L	N/A	L: 35.83
M3	5085	L	N/A	L: 36.18
M3	5207	R	N/A	L: 36.55
M3	5135	R	N/A	L: 36.87
M3	5086	R	N/A	L: 37.06
M3	5085	R	N/A	L: 37.68
M3	5085	R	N/A	L: 37.8
M3	5072	R	N/A	L: 38.17
M3	5264	L	Wear stage a	L: 23.7
M3	5264	R	N/A	L: 25.94
M3	5284	R	N/A	L: 27.04
M3	5247	L	N/A	L: 27.68
M3	US	L	N/A	L: 27.87
M3	5264	R	N/A	L: 28.31
M3	5264	L	N/A	L: 29.24
M3	5195	L	N/A	L: 29.64
M3	5264	R	N/A	L: 30.08
M3	5347	R	N/A	L: 30.1
M3	5085	R	N/A	L: 30.29
M3	5044	L	N/A	L: 30.3
M3	5381	L	N/A	L: 30.49
M3	5242	R	N/A	L: 30.56
M3	5210	R	N/A	L: 31.04
M3	5264	L	N/A	L: 31.42
M3	5347	R	N/A	L: 31.47
M3	5308	R	N/A	L: 31.7
M3	5264	R	N/A	L: 32.02
M3	US	R	N/A	L: 32.07
M3	5210	R	N/A	L: 32.08
M3	US	R	N/A	L: 32.38
M3	5347	R	N/A	L: 32.55
M3	5264	L	N/A	L: 32.77
M3	5264	R	N/A	L: 33.13
M3	5264	R	N/A	L: 33.76
M3	5381	L	N/A	L: 33.8
M3	5085	L	N/A	L: 33.97
M3	5264	R	N/A	L: 33.97
M3	5264	L	N/A	L: 34.06

M3	5308	L	N/A	L: 34.22
M3	5284	L	N/A	L: 34.3
M3	5264	L	N/A	L: 34.5
M3	5284	R	N/A	L: 34.83
M3	5308	R	N/A	L: 34.87
M3	5284	R	N/A	L: 35.07
M3	5264	R	N/A	L: 35.24
M3	5264	R	N/A	L: 35.53
M3	5334	L	N/A	L: 36.26
M3	5044	R	N/A	L: 36.46
Mandible	5279	L	1, 2	D1: 27.4
Mandible	5146	L	1	D1: 28.71, D2: 40.7, Lp: 49.97, Lm: 80.11, M3L: 26.69
Mandible	5086	L	1	D1: 28.95, D2: 47.34, Lp: 53.03
Mandible	5134	R	1, 2	D1: 28.97
Mandible	5239	L	1, 2	D1: 29.09, D2: 48.82, Lp: 49.81
Mandible	5135	L	1	D1: 29.84, D2: 43.3, Lp: 52.13
Mandible	5142	R	1, 2	D1: 30.86
Mandible	5109	L	1	D1: 32.09, D2: 44.94, Lp: 45.35, Lm: 76.34, M3L: 28.08
Mandible	5247	R	1	D1: 32.47, D2: 44.11, D3: 60.01, Lp: 44.77, Lm: 77.47, M3L: 31.97
Mandible	5053	L	1, 2	D1: 33.1, D2: 46.53, Lp: 54.65, M3L: 28.37
Mandible	5047	L	1, 2, 5	D1: 33.42, Lp: 41.08, M3L: 28.45
Mandible	5136	L	1, 2	D1: 33.71, D2: 37.64, Lp: 36.6, Lm: 87.46
Mandible	5116	R	1	D1: 35.64
Mandible	5280	L	1	D1: 37.37, D2: 47.41, Lp: 52.6
Mandible	5136	R	1, 2	D1: 40.76
Mandible	US	L	1	D1: 15.15, Lp: 57.24
Mandible	5161	R	1	D1: 20.12, D2: 34.23
Mandible	US	R	1	D1: 28, D2: 36.36
Mandible	5161	L	2	D1: 29.5
Mandible	5085	R	1	D1: 29.73
Mandible	5264	R	1	D1: 29.85
Mandible	5364	R	1, 2	D1: 31.25, Lp: 48.11
Mandible	5325	L	2	D1: 31.47
Mandible	5363	R	1, 2	D1: 31.75
Mandible	5264	L	2	D1: 32.46
Mandible	5325	R	1	D1: 32.64
Mandible	5284	R	1	D1: 32.75
Mandible	5136	R	2	D1: 32.8
Mandible	5264	R	1	D1: 33.4
Mandible	5284	L	1	D1: 33.44, D2: 43.98, D3: 66.28, Lp: 45.87, Lm: 84.21, M3L: 36.36
Mandible	5347	L	1	D1: 33.5, D2: 40.2, Lp: 45.29, Lm: 78.4, M3L: 30.6
Mandible	5264	L	1	D1: 33.59, D2: 39.75, Lp: 44.5, Lm: 69.4
Mandible	5325	L	1, 2, 3	D1: 33.7, D2: 45.47, D3: 60.48, Lp: 46.96, Lm: 80.03, M3L: 33.5
Mandible	5358	R	1	D1: 34.21, Lp: 48.5

Mandible	5264	L	1	D1: 34.27
Mandible	5161	L	1, 2	D1: 34.27, D2: 44.62, D3: 65.29, Lp: 41.63, Lm: 78.71, M3L: 34.47
Mandible	5363	L	1, 2	D1: 34.31
Mandible	5364	R	1, 2, 6	D1: 34.55, D2: 39.38, D3: 61.4, Lp: 44.95, Lm: 78.05, M3L: 30.5
Mandible	5228	R	1	D1: 35.07, D2: 47.14, D3: 67.9, Lp: 45.49, Lm: 82.16, M3L: 35.68
Mandible	5284	R	1	D1: 35.12, D2: 46.53, D3: 66.5, Lp: 46.24, Lm: 77.83, M3L: 32.75
Mandible	5161	R	1	D1: 35.17
Mandible	5247	R	1	D1: 35.26, D2: 43.67, D3: 59.87, Lp: 39.92, Lm: 74.26, M3L: 26.37
Mandible	5381	L	1, 2, 6	D1: 35.3, D2 49.59, D3: 73.5, Lp: 46.58, Lm: 88.2, M3L: 36.95
Mandible	5347	R	1	D1: 35.3, D2: 48.27, Lp: 53.2
Mandible	5308	R	1	D1: 35.5
Mandible	5264	L	1	D1: 36.3, D2: 44.07, D3: 60.63, Lp: 34.35, Lm: 82.93, M3L: 33.34
Mandible	5247	R	1	D1: 37.24, D2: 50.02, D3: 70.4, Lp: 47.64, Lm: 84.28, M3L: 37.13
Mandible	5343	R	1, 2, 3, 4, 5, 6	D1: 37.41, D2: 45.95, Lp: 39.09, Lm: 80.58, M3L: 31.08
Mandible	5351	R	1	D1: 37.59, Lp: 48.11, Lm: 83.35, M3L: 31.27
Mandible	5347	R	1	D1: 38, D2: 41.6, D3: 67.3, Lp: 40.9, Lm: 80.35, M3L: 33.9
Mandible	5264	R	1	D1: 38.27, Lp: 46.14
Mandible	5284	L	1	D1: 39.09, D2: 49.45, D3: 73.76, Lp: 45.97, Lm: 84.28, M3L: 33.34
Mandible	5364	R	1, 2, 6	D1: 40.51, D2: 52.3, D3: 72.2, Lp: 51.7, Lm: 86.6, M3L: 37.9
Mandible	5264	R	1	D1: 41.53, D2: 51.46, Lp: 48.76
Mandible	US	R	1	D1: 43.03
Mandible	5264	L	1	D1: 49.4, D2: 51.79, D3: 60.82, Lp: 48.84, Lm: 86.28, M3L: 35.29
Mandible	5141	R	1	D2: 37.16
Mandible	5247	L	1	D2: 39.84, M3L: 32.07
Mandible	5085	R	1	D2: 42.69
Mandible	5085	R	1	D2: 44.71, D3: 64.6, Lp: 44.63, Lm: 83, M3L: 34.9
Mandible	5236	L	1	D2: 45.35, D3: 62.15, Lm: 82.14, M3L: 32.37
Mandible	5085	R	1	D2: 45.49, Lp: 43.9, Lm: 76.78, M3L: 31.96
Mandible	5121	R	1	D2: 45.7
Mandible	5109	L	1	D2: 47.18, D3: 62.8, Lm: 78.58, M3L: 32.95
Mandible	5252	L	1	D2: 48.15, Lp: 54.98
Mandible	5279	R	1	D2: 48.41, Lp: 51.55, Lm: 89.51, M3L: 32.47
Mandible	5216	L	1	D2: 48.69
Mandible	5161	L	1	D2: 39.6
Mandible	5264	L	1	D2: 42.17, D3: 65.06, Lp: 52.47, Lm: 82.12, M3L: 30.97
Mandible	5136	L	1	D2: 42.47, D3: 64.01, Lm: 80.4, M3L: 30.04
Mandible	5284	L	1	D2: 42.91
Mandible	5284	L	1	D2: 44.05
Mandible	5284	R	1	D2: 44.17, D3: 55.31, Lp: 37.9, Lm: 80.12, M3L: 30.14
Mandible	5284	R	1	D2: 44.72
Mandible	5136	R	1	D2: 46.28, D3: 71.43, Lm: 82.76, M3L: 32.32
Mandible	5308	R	1	D2: 46.37, D3: 60.98, Lm: 76.33, M3L: 29.8
Mandible	5284	R	1	D2: 47.04, D3: 63, Lm: 69.41, M3L: 29.84
Mandible	5264	R	1	D2: 49.35, D3: 69.84, Lm: 69.77, M3L: 29.72

Mandible	5264	R	1	D2: 49.5, Lm: 85.34, M3L: 33.4
Mandible	5347	L	1, 6	D2: 53.01, D3: 74.64, Lm: 83.5, M3L: 36.01
Mandible	5109	R	1	D3: 59.91, M3L: 24.86
Mandible	5121	R	1	D3: 60.39, M3L: 30.53
Mandible	5239	R	1	D3: 71.0, M3L: 31.89
Mandible	5284	R	1, 3, 4, 5, 6	D3: 59.41, M3L: 34.84
Mandible	5340	R	1, 2, 3	D3: 61.09, Lm: 83.75, M3L: 36.38
Mandible	5364	L	1	D3: 63.62, Lp: 48.2, Lm: 68.6, M3L: 25.8
Mandible	5284	R	1	D3: 64.38, M3L: 29.35
Mandible	5264	L	1	D3: 64.72, Lm: 90.32, M3L: 33.07
Mandible	5308	R	1	D3: 72.57, M3L: 33.38
Mandible	5083	R	1	LM: 83.15, M3L: 33.78
Mandible	5218	L	1	Lm: 84.55, M3L: 30.17
Mandible	5239	L	1	Lm: 85.63
Mandible	5085	L	1	Lm: 86.9, M3L: 86.9
Mandible	5247	L	1	Lm: 82.37, M3L: 32.37
Mandible	5264	L	1	Lm: 82.99, M3L: 29.06
Mandible	5264	R	1	Lm: 86.87, M3L: 37.92
Mandible	5085	R	1	Lp: 45.65
Mandible	5264	R	1	Lp: 39.13
Mandible	5264	L	1	Lp: 40.33
Mandible	5264	L	1	Lp: 44.25, Lm: 69.45, M3L: 33.36
Mandible	5264	L	1	Lp: 44.46, M3L: 35
Mandible	5247	R	1	Lp: 45.83
Mandible	5284	L	1	Lp: 47.5, Lm: 70.15, M3L: 34.18
Mandible	5044	R	1	Lp: 49.68, Lm: 84.29, M3L: 34.23
Mandible	5264	R	1	M3L: 34.83
Mandible	5264	L	1	M3L: 31.91
Metacarpal	5239	L	3, 4, 7, 8	BD: 46.87, DD: 27.99
Metacarpal	5141	R	3, 4, 7, 8	BD: 47.39
Metacarpal	5207	L	3, 4	BD: 47.7, DD: 24.39
Metacarpal	5142	R	3, 4	BD: 47.98, DD: 27.74
Metacarpal	5044	R	3, 4	BD: 49.16, DD: 27.61
Metacarpal	5123	L	3, 4	BD: 49.45, DD: 28.64
Metacarpal	5264	R	3,4, 7, 8	BD: 49.66, DD: 28.95
Metacarpal	5142	L	3, 4	BD: 50.75, DD: 30.65
Metacarpal	5264	L	3, 4, 7, 8	BD: 50.83, DD: 28.82
Metacarpal	5085	R	3, 4, 7, 8	BD: 50.86, DD: 28.3
Metacarpal	5280	R	3, 4, 7, 8	BD: 52.01, DD: 31.32
Metacarpal	5074	L	3, 4, 7, 8	BD: 52.14
Metacarpal	5010	R	3, 4, 7, 8	BD: 52.46, DD: 27.25
Metacarpal	5279	R	3, 4, 7, 8	BD: 52.69, DD: 29.85
Metacarpal	5090	R	3, 4	BD: 53.3, DD: 29.58
Metacarpal	5181	R	3, 4, 5, 6, 7, 8	BD: 53.34, SD: 28.71

Metacarpal	5195	L	3, 4, 7, 8	BD: 53.57, DD: 31.07
Metacarpal	5136	L	3, 4	BD: 54.38, DD: 27.45
Metacarpal	5085	R	3, 4, 7, 8	BD: 54.97, DD: 28.74
Metacarpal	5085	R	3, 4, 7, 8	BD: 56.04, DD: 32.0
Metacarpal	5146	L	3, 4	BD: 56.61
Metacarpal	5053	L	3, 4, 7, 8	BD: 56.77, DD: 31.14
Metacarpal	5109	UNK	3, 4	BD: 56.86
Metacarpal	5121	R	3, 4, 7, 8	BD: 57.55
Metacarpal	5180	R	3, 4, 7, 8	BD: 58.36, DD: 31.82
Metacarpal	5280	L	3, 4, 7, 8	BD: 60.59, DD: 31.83
Metacarpal	5074	R	3, 4, 7, 8	BD: 60.6
Metacarpal	5074	UNK	3, 4, 7, 8	BD: 67.09
Metacarpal	5264	R	3, 4	BD: 48.47, DD: 27.58
Metacarpal	5050	L	3, 4	BD: 48.83
Metacarpal	5381	L	3, 4, 7, 8	BD: 48.83, DD: 27.79
Metacarpal	5247	L	3, 4, 7, 8	BD: 49.39, DD: 26.75
Metacarpal	5264	R	3, 4	BD: 49.71, DD: 27.42
Metacarpal	5264	L	3, 4, 7, 8	BD: 50.01, DD: 26.32
Metacarpal	5284	R	3, 4, 7, 8	BD: 50.06, DD: 27.82
Metacarpal	5210	L	3, 4	BD: 50.13, DD: 27.24
Metacarpal	5284	L	3, 4, 7, 8	BD: 50.39, DD: 21.82
Metacarpal	5264	L	3,4	BD: 50.52, DD: 28.89
Metacarpal	5264	R	3, 4, 7, 8	BD: 51.16, DD: 28.23
Metacarpal	5264	L	3, 4	BD: 51.51, DD: 29.18
Metacarpal	5343	L	3, 4	BD: 51.74
Metacarpal	5044	R	3, 4	BD: 52.26, DD: 28.75
Metacarpal	5161	R	3, 4	BD: 52.31
Metacarpal	5161	R	3, 4	BD: 52.51, DD: 28.58
Metacarpal	5264	L	3, 4	BD: 53.01, DD: 29.66
Metacarpal	5264	L	3, 4	BD: 54.88, DD: 29.46
Metacarpal	5343	L	3, 4, 7, 8	BD: 55.5, DD: 29.83
Metacarpal	5085	R	3, 4, 7, 8	BD: 60.28, DD: 30.32
Metacarpal	US	R	3, 4, 7, 8	BD: 61.27, DD: 32.92
Metacarpal	5381	L	3, 4	BD: 63.6, DD: 32.31
Metacarpal	5186	L	1, 2	Bp: 43.57
Metacarpal	5195	R	1, 2, 5, 6	Bp: 45.32
Metacarpal	5239	L	1, 2	Bp: 47.4
Metacarpal	5036	L	1, 2, 5, 6	Bp: 47.46
Metacarpal	5044	L	1, 2, 5, 6; 3, 4, 7, 8	Bp: 47.73, SD: 26.9; BD: 51.38, DD: 27.51
Metacarpal	5036	L	1, 2, 5, 6, 7, 8	Bp: 47.84, SD: 29.95
Metacarpal	5236	R	1, 2	Bp: 48.59
Metacarpal	5157	L	1, 2	Bp: 48.69
Metacarpal	5242	L	1, 2	Bp: 48.93
Metacarpal	5085	R	1, 2, 5, 6	Bp: 49.14

Metacarpal	5115	L	1, 2, 5, 6	Bp: 49.46
Metacarpal	5122	L	1, 2	Bp: 49.5
Metacarpal	5074	R	1, 2	Bp: 49.66
Metacarpal	5177	L	1,2 , 5, 6	Bp: 49.89
Metacarpal	5044	R	1, 2	Bp: 50.43
Metacarpal	5161	L	1, 2, 5, 6	Bp: 50.59
Metacarpal	5085	R	Complete	Bp: 50.95, SD: 28.64, BD: 50.63
Metacarpal	5053	R	1, 2, 5, 6	Bp: 50.97
Metacarpal	5085	L	1, 2, 5, 6	Bp: 51.21
Metacarpal	5141	L	1, 2, 5, 6	Bp: 51.63
Metacarpal	5136	L	1, 2, 5, 6	Bp: 52.11, SD: 24.96
Metacarpal	5070	L	1, 2, 5, 6	Bp: 52.25
Metacarpal	5280	L	1, 2	Bp: 53.3
Metacarpal	5085	L	Complete	Bp: 54.02, SD: 26.92, BD: 54.03, DD: 29.06
Metacarpal	5044	L	1, 2	Bp: 54.38
Metacarpal	5136	R	1, 2, 5, 6	Bp: 54.46
Metacarpal	5085	R	1, 2, 3, 6, 7, 8	Bp: 55.1, SD: 30.84
Metacarpal	5279	R	1, 2, 5, 6, 7, 8	Bp: 55.36, SD: 32.45
Metacarpal	5074	L	1, 2, 5, 6	Bp: 55.45
Metacarpal	5279	R	1, 2, 5, 6, 7, 8	Bp: 56.62, SD: 32.78
Metacarpal	5085	R	1, 2, 5, 6, 7, 8	Bp: 57.33, SD: 32.3
Metacarpal	5181	L	1, 2	Bp: 57.79
Metacarpal	5085	L	1, 2, 5, 6, 7, 8	Bp: 60.29, SD: 31.74
Metacarpal	5264	L	1, 2, 5, 6	Bp: 43.45
Metacarpal	5351	R	1, 2	Bp: 44.9
Metacarpal	5264	R	1, 2	Bp: 45.64
Metacarpal	5195	R	1, 2	Bp: 46.51
Metacarpal	5264	R	1, 2, 5, 6, 7, 8	Bp: 47.04, SD: 24.08
Metacarpal	5264	L	1, 2	Bp: 47.07
Metacarpal	5247	L	1, 2, 5, 6	Bp: 47.12
Metacarpal	5264	R	1, 2	Bp: 48.34
Metacarpal	5264	L	1, 2, 5, 6, 7, 8	Bp: 48.51, SD: 26.67
Metacarpal	5264	R	1, 2, 5, 6	Bp: 48.54, SD: 27.02
Metacarpal	5161	L	1, 2, 5, 6, 7, 8	Bp: 49.18, SD: 27.61
Metacarpal	5161	R	1, 2, 3, 5, 6, 7, 8	Bp: 49.3, SD: 25.81
Metacarpal	5284	R	1, 2, 5, 6	Bp: 49.45, SD: 28.36
Metacarpal	5264	R	1, 2, 5, 6	Bp: 49.88
Metacarpal	5297	R	1, 2	Bp: 50.14
Metacarpal	5264	L	1, 2	Bp: 51.05
Metacarpal	5161	L	1, 2	Bp: 51.34
Metacarpal	5161	R	1, 2	Bp: 51.7
Metacarpal	5264	L	1, 2	Bp: 52.17
Metacarpal	5264	R	1, 2, 5, 6	Bp: 52.27
Metacarpal	5161	L	1, 2	Bp: 52.94

Metacarpal	5102	R	Complete	Bp: 53.7, SD: 29.02, BD: 50.34, DD: 30.17
Metacarpal	5195	R	1, 2	Bp: 53.8
Metacarpal	5136	R	1, 2, 5, 6, 7 ,8	Bp: 56.18, SD: 32.84
Metacarpal	5264	R	1, 2	Bp: 56.83
Metacarpal	5347	R	1, 2	Bp: 57.54
Metacarpal	5347	R	1, 2	Bp: 60.13
Metacarpal	5347	L	1, 2	Bp: 60.3
Metacarpal	5122	L	1, 2	Bp: 60.49
Metacarpal	5247	L	1, 2, 5, 6	Bp: 60.52, SD: 37.8
Metacarpal	5247	L	1, 2, 5, 6	Bp: 62.78
Metacarpal	5169	R	Complete	GL: 166, Bp: 48.19, SD: 25.54, BD: 47.82, DD: 26.62
Metacarpal	5239	L	1, 2, 4, 5, 6, 7, 8	GL: 172.5, Bp: 48.36, SD: 27.98
Metacarpal	5239	R	Complete	GL: 174, Bp: 44.94, SD: 24.23, BD: 47.27, DD: 25, 71
Metacarpal	5279	R	Complete	GL: 175, Bp: 45.1, SD: 26.44, BD: 47.29, DD: 25.56
Metacarpal	5085	L	Complete	GL: 175, Bp: 49.6, SD: 27.09, BD: 50.75, DD: 28.38
Metacarpal	5089	R	Complete	GL: 179, Bp: 49.25, SD: 27.26, BD: 49.64, DD: 28.11
Metacarpal	5085	R	Complete	GL: 181, Bp: 47.51, SD: 27.85, BD: 52.82, DD: 28.28
Metacarpal	5279	R	Complete	GL: 181, Bp: 49.0, SD: 26.96, BD: 50.59, DD: 28.01
Metacarpal	5276	L	Complete	GL: 182, Bp: 48.92, SD: 29.71, BD: 49.49, DD: 28.59
Metacarpal	5136	R	Complete	GL: 184, Bp: 51.19, SD: 27.68, BD: 54.4, DD: 30.06
Metacarpal	5085	L	Complete	GL: 185, SD: 28.32, BD: 52.25, DD: 30.31
Metacarpal	5169	R	Complete	GL: 188, Bp: 54.74, SD: 30.7, BD: 53.48, DD: 30.38
Metacarpal	5085	R	Complete	GL: 190, Bp: 60.79, SD: 37.66, BD: 63.61, DD: 33.3
Metacarpal	5085	L	Complete	GL: 167, BD: 54.94
Metacarpal	US	L	1, 2, 4, 5, 6, 7, 8	GL: 172 , Bp: 47.39, SD: 26.45
Metacarpal	5264	R	1, 2, 4, 5, 6, 7, 8	GL: 172, SD: 27.2
Metacarpal	5264	L	Complete	GL: 173, SD: 62.12, BD: 50.66, DD: 26.67
Metacarpal	5364	L	Complete	GL: 174, Bp: 46.97, SD: 27.14, BD: 47.52, DD: 29.71
Metacarpal	5284	R	Complete	GL: 176, Bp: 50.62, SD: 30.14, BD: 50.85, DD: 28.56
Metacarpal	5364	L	Complete	GL: 179, Bp: 48.37, SD: 27.7, BD: 52.26, DD: 29.7
Metacarpal	5264	R	Complete	GL: 181, Bp: 58.42, SD: 34.37, BD: 61.96, DD: 32.65
Metacarpal	5284	L	Complete	GL: 182, Bp: 50.28, SD: 28.37
Metacarpal	5264	L	Complete	GL: 183, Bp: 46.37, SD: 26.74, BD: 51.91, DD: 28.09
Metacarpal	5264	L	1, 2, 4, 5, 6, 7, 8	GL: 184, Bp: 48.36, SD: 26.76
Metacarpal	5085	L	Complete	GL: 184, Bp: 49.56, SD: 27.08, BD: 52.87, DD: 29.39
Metacarpal	5036	R	Complete	GL: 185.5, Bp: 44.76, SD: 23.06, BD: 44.32, DD: 21.93
Metacarpal	5264	L	Complete	GL: 186, Bp: 47.17, SD: 23.87, BD: 48.16, DD: 27.71
Metacarpal	5343	L	Complete	GL: 192, Bp: 51.08, SD: 31.31, BD: 52.95, DD: 28.3
Metacarpal	5325	R	Complete	GL: 192, Bp: 53.09, SD: 31.38, BD: 53.3, DD: 29.81
Metacarpal	5284	R	Complete	GL: 193, Bp: 59.82, SD: 34.42, BD: 62.28
Metacarpal	5364	L	Complete	GL: 204, Bp: 61.69, SD: 35.5, BD: 63.31, DD: 33.54
Metacarpal	5053	UNK	5, 6, 7, 8	SD: 19.9
Metacarpal	5161	UNK	5, 6, 7, 8	SD: 20.08
Metacarpal	5142	L	1, 2, 5, 6, 7, 8	SD: 25.92

Metacarpal	5085	L	Complete	SD: 26.93, BD: 50.55, DD: 27.94
Metacarpal	5055	L	3, 4, 7, 8	SD: 27.42
Metacarpal	5086	R	2, 5, 6	SD: 27.77
Metacarpal	5264	Unk	5, 6, 7, 8	SD: 16.5
Metacarpal	5347	R	1, 2, 5, 6, 7, 8	SD: 23.5
Metacarpal	5247	Unk	5, 6, 7, 8	SD: 25.7
Metacarpal	5347	R	3, 4, 7, 8	SD: 26.94, BD: 49.7
Metacarpal	5281	L	1, 2, 5, 6	SD: 28.86
Metacarpal	5161	L	1, 2, 5, 6, 7, 8	SD: 29.45
Metacarpal	5308	R	1, 2, 5, 6	SD: 29.49
Metatarsal	5157	R	3, 4, 7, 8	BD: 40.44
Metatarsal	5086	R	3, 4, 7, 8	BD: 44.66, DD: 26.67
Metatarsal	5195	L	3, 4, 7, 8	BD: 44.68, DD: 26.74
Metatarsal	5044	UNK	3, 4	BD: 45.95
Metatarsal	5280	R	3, 4, 7, 8	BD: 46.12
Metatarsal	5089	R	3, 4, 7, 8	BD: 46.56, DD: 26.14
Metatarsal	5044	R	3, 4, 7, 8	BD: 47.01, DD: 28.62
Metatarsal	5086	R	3, 4, 7, 8	BD: 47.76, DD: 28.39
Metatarsal	5279	L	3, 4, 7, 8	BD: 48.44, DD: 28.64
Metatarsal	5157	L	3, 4, 7, 8	BD: 48.51, DD: 28.14
Metatarsal	5201	L	3, 4	BD: 49.14, DD: 29.86
Metatarsal	5047	R	3, 4	BD: 50.95, DD: 28.98
Metatarsal	5146	R	3, 4, 7, 8	BD: 51.03, DD: 29.54
Metatarsal	5074	R	3, 4	BD: 51.3
Metatarsal	5151	R	3, 4, 7, 8	BD: 51.35
Metatarsal	5186	L	3, 4, 7, 8	BD: 51.87, DD: 29.1
Metatarsal	5085	R	3, 4, 7, 8	BD: 52.01, DD: 28.8
Metatarsal	5086	R	3, 5, 7, 8	BD: 55.47
Metatarsal	5085	R	3, 4, 7, 8	BD: 56.82, DD: 31.91
Metatarsal	5177	R	3, 4, 7, 8	BD: 58.4, DD: 32.15
Metatarsal	5239	L	3, 4	BD: 60.45, DD: 33.78
Metatarsal	5264	R	3, 4	BD: 44, DD: 25.49
Metatarsal	5340	R	3, 4, 7, 8	BD: 44.65, DD: 28.7
Metatarsal	5281	R	3, 4	BD: 44.86, DD: 27.33
Metatarsal	5264	L	3, 4	BD: 45.05, DD: 26.86
Metatarsal	5264	R	3, 4	BD: 45.47, DD: 26.36
Metatarsal	5264	L	3, 4	BD: 45.48, DD: 27.87
Metatarsal	5281	R	3, 4	BD: 46, DD: 26.66
Metatarsal	5264	L	3, 4	BD: 46.67
Metatarsal	5284	R	3, 4	BD: 46.71
Metatarsal	5161	L	3, 4, 7, 8	BD: 47.23, DD: 28.28
Metatarsal	5264	L	3, 4, 7, 8	BD: 47.3, DD: 28.65
Metatarsal	5264	L	3, 4	BD: 47.37, DD: 28.56
Metatarsal	5085	L	3, 4, 7, 8	BD: 47.79, DD: 29.46

Metatarsal	5284	R	3, 4	BD: 48.07, DD: 28.03
Metatarsal	5161	L	3, 4	BD: 48.36, DD: 28.53
Metatarsal	5161	R	3, 4	BD: 49.32, DD: 30.52
Metatarsal	5264	R	3, 4, 7, 8	BD: 50.81, DD: 29.86
Metatarsal	5264	L	3, 4	BD: 51.49, DD: 30.34
Metatarsal	5161	L	3, 4	BD: 53.32, DD: 31.23
Metatarsal	5381	R	3, 4, 7, 8	BD: 53.38, DD: 29.7
Metatarsal	5161	R	3, 4	BD: 54.2
Metatarsal	5343	L	3, 4	BD: 59.3, DD: 31.04
Metatarsal	5264	L	3, 4, 7, 8	BD: 61.4, DD: 31.94
Metatarsal	5347	L	3, 4	BD: 63.44, DD: 31.02
Metatarsal	5122	L	1, 2, 5, 6	Bp: 38.79
Metatarsal	5207	L	1, 2, 5, 6	Bp: 38.92, SD: 21.9
Metatarsal	5010	L	1, 2, 5, 6	Bp: 40.76, SD: 23.62
Metatarsal	5047	R	1, 2	Bp: 40.87
Metatarsal	5085	R	1, 2	Bp: 41. 98
Metatarsal	5109	L	1, 2, 5, 6	Bp: 41.64
Metatarsal	5085	L	1, 2, 5, 6	Bp: 42.34
Metatarsal	5085	R	1, 2	Bp: 42.84
Metatarsal	5093	L	1, 2	Bp: 42.93
Metatarsal	5085	L	1, 2	Bp: 43.56
Metatarsal	5264	L	1, 2	Bp: 43.56
Metatarsal	5169	L	1, 2	Bp: 43.74
Metatarsal	5036	L	1, 2, 5, 6	Bp: 43.8
Metatarsal	5085	L	1, 2, 5, 6	Bp: 43.95, SD: 24.52
Metatarsal	5122	L	1, 2, 5, 6	Bp: 44.2
Metatarsal	5239	L	1, 2, 5, 6	Bp: 44.58, SD: 24.02
Metatarsal	5085	R	1, 2, 5, 6	Bp: 44.64
Metatarsal	5085	R	1, 2, 5, 6	Bp: 45.19, SD: 25.79
Metatarsal	5146	L	1, 2, 5, 6	Bp: 45.75
Metatarsal	5086	R	1, 2	Bp: 45.81
Metatarsal	5121	R	1, 2	Bp: 45.9
Metatarsal	5144	L	1, 2, 5, 6	Bp: 45.97, SD: 26.05
Metatarsal	5247	L	1, 2	Bp: 46.04
Metatarsal	5085	R	1, 2	Bp: 46.12
Metatarsal	5085	L	1, 2	Bp: 47.92
Metatarsal	5085	L	1, 2, 5, 6	Bp: 48.09
Metatarsal	5146	L	1, 2	Bp: 49.79
Metatarsal	5044	R	1, 2	Bp: 50.99
Metatarsal	5085	L	1, 2	Bp: 52.06
Metatarsal	5085	R	1, 2, 5, 6	Bp: 52.2
Metatarsal	5036	R	1, 2	Bp: 35.05
Metatarsal	5340	L	1, 2	Bp: 37.33
Metatarsal	5264	L	1, 2, 5, 6	Bp: 38.32

Metatarsal	5264	R	1, 2	Bp: 38.49
Metatarsal	5347	R	1, 2	Bp: 39.3
Metatarsal	5284	L	1, 2	Bp: 39.34
Metatarsal	5264	R	1, 2, 5, 6	Bp: 39.41
Metatarsal	5264	R	1, 2, 5, 6	Bp: 39.56, SD: 24
Metatarsal	5102	L	1, 2	Bp: 39.68
Metatarsal	5264	L	1, 2, 5, 6	Bp: 40.01, SD: 22.25
Metatarsal	5195	L	1, 2, 5, 6	Bp: 40.26, SD: 22.8
Metatarsal	5264	R	1, 2, 5, 6	Bp: 40.75
Metatarsal	5284	L	1, 2	Bp: 41.01
Metatarsal	5347	L	1, 2, 5, 6, 7, 8	Bp: 41.25, SD: 23.6
Metatarsal	5085	R	1, 2	Bp: 41.47
Metatarsal	5264	L	1, 2	Bp: 42.13
Metatarsal	5044	R	1, 2, 5, 6	Bp: 42.64
Metatarsal	5264	R	1, 2	Bp: 42.71
Metatarsal	5264	L	1, 2, 5, 6	Bp: 42.83, SD: 22.67
Metatarsal	5161	L	1, 2, 5, 6, 7, 8	Bp: 42.88, SD: 22.44
Metatarsal	5085	R	1, 2	Bp: 43.05
Metatarsal	5347	R	1, 2	Bp: 43.1
Metatarsal	5334	R	1, 2	Bp: 43.11
Metatarsal	5347	L	1, 2	Bp: 43.19
Metatarsal	5085	R	1, 2, 5, 6	Bp: 43.55, SD: 21.58
Metatarsal	5350	R	1, 2, 5, 6, 7, 8	Bp: 43.62, SD: 26.1
Metatarsal	5364	R	1, 2	Bp: 43.7
Metatarsal	5161	L	1, 2	Bp: 43.76
Metatarsal	5340	L	1, 2	Bp: 44.29
Metatarsal	5347	R	1, 2	Bp: 44.75
Metatarsal	5356	L	1, 2	Bp: 45
Metatarsal	5284	L	1, 2, 5, 6, 7, 8	Bp: 45.38, SD: 23.09
Metatarsal	5334	L	1, 2	Bp: 45.49
Metatarsal	5085	R	1, 2, 5, 6	Bp: 45.86
Metatarsal	5161	R	1, 2	Bp: 46.21
Metatarsal	5264	R	1, 2, 5, 6, 7, 8	Bp: 46.27, SD: 27.74
Metatarsal	5284	R	1, 2	Bp: 46.82
Metatarsal	5146	R	1, 2	Bp: 47.04
Metatarsal	US	R	1, 2	Bp: 48.36
Metatarsal	5085	L	1, 2	Bp: 51.4
Metatarsal	5085	L	3, 4	DD: 27.99
Metatarsal	5264	R	3, 4	DD: 29.04
Metatarsal	5195	R	Complete	GL: 198, Bp: 37.9, SD: 22.95, BD: 47.19, DD: 28.53
Metatarsal	5085	L	Complete	GL: 198, SD: 23.27
Metatarsal	5239	R	Complete	GL: 201, Bp: 43.62, SD: 23.5, BD: 48.32, DD: 27.12
Metatarsal	5181	L	Complete	GL: 201, Bp: 50.12, SD: 28.53, BD: 57.46, DD: 30.27
Metatarsal	5180	L	Complete	GL: 203, Bp: 43.88, SD: 23.98, BD: 49.56

Metatarsal	5195	R	Complete	GL: 211, Bp: 47.48, SD: 26.77, BD: 54.61, DD: 31.11
Metatarsal	5085	R	Complete	GL: 223, Bp: 48.2, SD: 27.91
Metatarsal	5343	L	Complete	GL: 199, Bp: 40.33, SD: 24.04, BD: 44.27, DD: 26.48
Metatarsal	5264	L	Complete	GL: 203, SD: 22.95, BD: 49.59, DD: 28.39
Metatarsal	5264	R	Complete	GL: 209, Bp: 45, SD: 25.4, BD: 50.52, DD: 29.44
Metatarsal	5161	L	Complete	GL: 209.5, Bp: 44.92, SD: 4.3, BD: 48.64, DD: 28.93
Metatarsal	5334	R	Complete	GL: 212, Bp: 46, SD: 25.06, BD: 51.04, DD: 29.9
Metatarsal	5325	L	Complete	GL: 214, Bp: 44.11, SD: 25.15, BD: 47.02, DD: 29.01
Metatarsal	5308	L	1, 2, 5, 6, 7, 8	p: 44.36, SD: 25.89
Metatarsal	5085	UNK	5, 6, 7, 8	SD: 12.6
Metatarsal	5280	R	3, 4, 7, 8	SD: 24.72, BD: 51.01, DD: 30.16
Metatarsal	5142	UNK	7, 8	SD: 25.72
Metatarsal	5136	R	1, 2, 5, 6	SD: 23.38
Metatarsal	5347	R	5, 6, 7, 8	SD: 24.5
Metatarsal	5284	L	1, 2, 5, 6, 7, 8	SD: 24.67
Radius	5085	R	3, 4	BD: 58.84, Bfd: 54.12
Radius	5195	R	3, 4	BD: 59.33, Bfd: 53.28
Radius	5279	R	3, 4	BD: 59.89, Bfd: 53.23
Radius	5280	R	3, 4	BD: 60.31, Bfd: 57.16
Radius	5181	R	3, 4, 9, 10	BD: 60.55, Bfd: 54.4
Radius	5121	R	3, 4, 9, 10	BD: 60.99, Bfd: 56.21
Radius	5085	L	3, 4, 9, 10	BD: 61.95, Bfd: 56.08
Radius	5141	R	3, 4	BD: 61.98, Bfd: 55.29
Radius	5121	R	3, 4, 9, 10	BD: 62.74, Bfd: 58.92
Radius	5161	L	3, 4, 9, 10	BD: 63.14, Bfd: 56.06
Radius	5085	R	3, 4, 9, 10	BD: 63.14, Bfd: 57.8
Radius	5086	L	3, 4, 9, 10	BD: 64.18, Bfd: 57.93
Radius	5264	L	3, 4	BD: 65.61, Bfd: 55.64
Radius	5085	L	3, 4, 9, 10	BD: 65.85, Bfd: 62.48
Radius	5279	R	3, 4	BD: 66.04, Bfd: 57.84
Radius	5085	L	3, 4, 9, 10	BD: 77.73, Bfd: 69.56
Radius	5136	L	3, 4	BD: 57.22, Bfd: 55.3
Radius	5284	L	3, 4	BD: 57.31, Bfd: 54.92
Radius	5348	L	3, 4, 8, 9, 10	BD: 58.69, Bfd: 53
Radius	5284	L	3, 4, 9, 10	BD: 58.77, Bfd: 53.05
Radius	5284	L	3, 4	BD: 58.97, Bfd: 61.41
Radius	5085	R	3, 4, 10	BD: 60.48, Bfd: 57.15
Radius	5364	R	3, 4	BD: 62.8, Bfd: 56.7
Radius	5264	L	3, 4, 9, 10	BD: 62.81, Bfd: 55.47
Radius	5284	L	3, 4, 9, 10	BD: 63.6, Bfd: 57.05
Radius	5136	R	3, 4	BD: 64.45, Bfd: 59.68
Radius	5161	L	3, 4	BD: 64.59, Bfd: 57.54
Radius	5284	L	3, 4	BD: 64.72, Bfd: 60.01
Radius	5284	L	3, 4, 9, 10	BD: 67.49, Bfd: 60.18

Radius	5350	L	3, 4	BD: 68.63, Bfd: 59.85
Radius	5161	L	3, 4	BD: 69.15, Bfd: 64.13
Radius	5161	R	3, 4	BD: 72.03
Radius	5093	L	3, 4, 9, 10	Bfd: 53.82
Radius	US	L	3, 4, 9, 10	Bfd: 51.13
Radius	5247	L	5, 6, 10	Bfd: 54.51
Radius	5264	R	3, 4	Bfd: 63.68
Radius	5146	R	1, 2	Bfp: 66.56
Radius	5239	R	1, 2	Bfp: 67.07
Radius	5070	R	1, 2, 5	Bfp: 71.15
Radius	5363	R	1, 2, 5	Bfp: 65.34
Radius	5347	R	1, 2, 5	Bfp: 66.98
Radius	5347	L	1, 2, 5	Bfp: 70.1
Radius	5085	R	1, 2	Bp: 67.54, Bfp: 61.29
Radius	5280	L	1, 2	Bp: 70.73, Bfp: 67.51
Radius	5161	L	1, 2, 5	Bp: 71.84, Bfp: 65.72
Radius	5279	R	1, 2, 5	Bp: 72.54, Bfp: 66.64
Radius	5141	L	1, 2	Bp: 73.93, Bfp: 67.61
Radius	5136	R	1, 2	Bp: 74.29, Bfp: 68.59
Radius	5141	R	1, 2	Bp: 75.21, Bfp: 67.73
Radius	5215	R	1, 2	Bp: 77.49, Bfp: 68.97
Radius	5195	L	1, 2	Bp: 79.59, Bfp: 72.64
Radius	5264	R	1, 2	Bp: 63.2, Bfp: 57.45
Radius	5264	L	1, 2, 5	Bp: 64.18, Bfp: 69.49
Radius	5284	L	1, 2	Bp: 66.32, Bfp: 61.54
Radius	5161	R	1, 2	Bp: 68.1, Bfp: 63.75
Radius	5284	L	1, 2	Bp: 68.43, Bfp: 62.14
Radius	5050	L	1, 2	Bp: 68.67, Bfp: 62.93
Radius	5264	R	1, 2, 5	Bp: 69, Bfp: 64.19
Radius	US	R	1, 2, 5, 6, 7, 8, 9, 10	Bp: 73.36, Bfp: 68.2
Radius	5363	R	1, 2, 5	Bp: 82.5, Bfp: 75.21
Radius	5161	R	Complete	GL: 247, Bp: 67.65, Bfp: 64.01, BD: 62.4, Bfd: 57.25
Radius	5247	R	Complete	GL: 242, BD: 60.4, Bfd: 54.13
Scapula	5216	L	6, 7	23.29 Tall, 7.4 Wide
Scapula	5085	L	1, 2, 3, 4, 5	GLP: 60.05, SLC: 45.44
Scapula	5237	L	1, 2, 3	GLP: 54.21
Scapula	5247	L	1, 2, 3, 5	GLP: 55.28
Scapula	5086	L	1, 2, 3	GLP: 56.33
Scapula	5089	R	1, 2, 3, 5	GLP: 57.77, SLC: 42.54
Scapula	5195	L	1, 2, 3, 5	GLP: 61.16, SLC: 46.74
Scapula	5222	R	1, 2, 3	GLP: 61.25
Scapula	5280	R	1, 2, 3, 5	GLP: 61.27, SLC: 42.87
Scapula	5216	L	1, 2, 3, 5	GLP: 61.6, SLC: 44.56
Scapula	5136	R	1, 2, 3, 5	GLP: 61.66

Scapula	5177	R	1, 2, 3	GLP: 63.07
Scapula	5279	L	1, 2, 3	GLP: 63.16
Scapula	5195	L	1, 2, 3, 5	GLP: 64.28, SLC: 48.92
Scapula	5085	R	1, 2, 3	GLP: 67.94, SLC: 53.81
Scapula	5036	R	1, 2, 3	GLP: 68.29
Scapula	5195	L	1, 2, 3, 5	GLP: 68.45, SLC: 50.74
Scapula	5036	R	1, 2, 3	GLP: 54.19
Scapula	5247	R	1, 2, 3	GLP: 55.18
Scapula	5264	L	1, 2, 3, 4, 5, 7	GLP: 55.8, SLC: 40.62
Scapula	US	L	1, 2, 3, 4, 5	GLP: 56.4, SLC: 42.13
Scapula	5264	R	1, 2, 3, 4, 5	GLP: 56.49, SLC: 41.74
Scapula	5264	R	1, 2, 3	GLP: 58.01
Scapula	5284	R	1, 2, 3	GLP: 59.43, SLC: 47.06
Scapula	5264	L	1, 2, 3, 4, 5, 6	GLP: 59.46, SLC: 40.2
Scapula	5264	L	1, 2, 3, 4	GLP: 60.17, SLC: 44.89
Scapula	5284	R	1, 2, 3	GLP: 60.17, SLC: 45.36
Scapula	5347	R	1, 2, 3, 4, 5, 6	GLP: 60.7, SLC: 45.1
Scapula	5264	R	1, 2, 3, 4, 6	GLP: 61.42, SLC: 47.14
Scapula	5284	R	1, 2, 3	GLP: 61.87
Scapula	5264	L	1, 2, 3, 4	GLP: 62.43, SLC: 47.38
Scapula	5264	L	1, 2, 3, 4, 5	GLP: 62.62, SLC: 48.43
Scapula	5264	R	1, 2, 3, 4, 5	GLP: 64.5, SLC: 49.79
Scapula	5284	R	1, 2, 3, 4, 5	GLP: 65.04, SLC: 49.46
Scapula	5146	R	1, 2, 3	GLP: 66.97
Scapula	5284	L	1, 2, 3	GLP: 68.1
Scapula	5264	L	1, 2, 3, 4, 5	GLP: 70.95, SLC: 49.39
Scapula	5161	L	1, 2, 3, 5	SLC: 38.41
Scapula	5279	R	2, 3, 5	SLC: 38.97
Scapula	5085	L	1, 2, 3, 5	SLC: 39.51
Scapula	5070	L	3, 4, 5, 6, 7	SLC: 40.23
Scapula	5187	R	2, 3, 5	SLC: 40.78
Scapula	5117	R	2, 3, 5	SLC: 42.55
Scapula	5279	R	2, 3, 5	SLC: 43.01
Scapula	5109	R	2, 3, 5	SLC: 43.55
Scapula	5195	R	1, 2, 3, 5	SLC: 43.89
Scapula	5161	R	2, 3, 5	SLC: 44.31
Scapula	5142	L	2, 3, 5	SLC: 46.49
Scapula	5090	L	2,3, 5	SLC: 46.79
Scapula	5089	L	3, 5	SLC: 46.94
Scapula	5195	R	1, 2, 3, 5	SLC: 47.23
Scapula	5222	L	1, 2, 3, 5	SLC: 48.37
Scapula	5085	R	1, 2, 3, 5	SLC: 48.57
Scapula	5239	L	1, 2, 3, 5	SLC: 48.61
Scapula	5281	R	1, 2, 3, 4, 5	SLC: 32.75

Scapula	5264	R	1, 2, 3	SLC: 34.8
Scapula	5347	R	1, 2, 3, 4, 5	SLC: 37.95
Scapula	5264	L	1, 2, 3	SLC: 38.24
Scapula	5264	L	4, 5	SLC: 39.51
Scapula	5264	R	1, 2, 3, 4	SLC: 39.56
Scapula	5340	L	1, 2, 3, 4, 5, 6	SLC: 40.8
Scapula	US	R	1, 2, 3, 4, 5, 6	SLC: 41.5
Scapula	5161	R	1, 2, 3, 4, 5	SLC: 41.82
Scapula	5264	L	1, 2, 3, 4, 5, 6	SLC: 42.37
Scapula	5247	R	4, 5	SLC: 42.48
Scapula	5284	R	1, 2, 3, 4	SLC: 42.73
Scapula	5284	L	1, 2, 3, 4, 5	SLC: 42.91
Scapula	5284	R	1, 2, 3, 4, 5	SLC: 45.42
Scapula	5284	L	1, 2, 3, 4	SLC: 45.46
Scapula	5136	L	4, 5	SLC: 46.16
Scapula	5357	R	1, 2, 3, 4, 5, 6	SLC: 46.4
Scapula	5364	L	1, 2, 3, 4	SLC: 48.7
Scapula	US	L	1, 2, 3, 4, 5	SLC: 49.12
Scapula	5284	R	1, 2, 3, 4	SLC: 50.52
Scapula	5358	L	1, 2, 3, 4	SLC: 51.75
Scapula	5284	L	1, 2, 3, 4, 5, 6	SLC: 53.1
Scapula	US	R	1, 2, 3, 4, 5	SLC: 57.6
Scapula	5284	L	1, 2, 3, 4, 5	SLC: 61.92
Tibia	5195	R	5, 6	BD: 49.17
Tibia	5085	R	5, 6	BD: 49.3
Tibia	5121	L	5, 6	BD: 49.55
Tibia	5181	L	5, 6	BD: 49.74
Tibia	5085	L	5, 6	BD: 50.21
Tibia	5085	L	5, 6	BD: 50.28
Tibia	5280	L	5, 6	BD: 50.85
Tibia	5214	L	5, 6	BD: 50.87
Tibia	5088	R	5, 6	BD: 51.78
Tibia	5085	L	5, 6, 10	BD: 51.84
Tibia	5085	L	5, 6	BD: 52.35
Tibia	5279	L	5, 6, 10	BD: 52.47
Tibia	5195	L	5, 6, 10	BD: 52.71
Tibia	5239	R	5, 6	BD: 52.84
Tibia	5085	L	5, 6	BD: 52.85
Tibia	5169	R	5, 6, 7, 8, 9, 10	BD: 52.86
Tibia	5197	L	5, 6	BD: 53.3
Tibia	5280	R	5, 6	BD: 54.07
Tibia	5085	R	5, 6, 10	BD: 54.46
Tibia	5085	L	5, 6	BD: 55.28
Tibia	5085	R	5, 6	BD: 56.43

Tibia	5146	R	5, 6	BD: 56.43
Tibia	5242	R	5, 6, 10	BD: 56.91
Tibia	5239	R	5, 6	BD: 58.52
Tibia	5085	R	5, 6	BD: 58.98
Tibia	5085	R	5, 6	BD: 6.51
Tibia	5122	L	5, 6	BD: 60.17
Tibia	5161	R	5, 6	BD: 61.13
Tibia	5147	R	5, 6	BD: 61.15
Tibia	5085	R	5, 6, 10	BD: 63.61
Tibia	5280	L	5, 6	BD: 64.38
Tibia	5161	L	5, 6	BD: 64.84
Tibia	5284	R	5, 6	BD: 41.44
Tibia	5381	L	5,6, 9, 10	BD: 49.2
Tibia	5347	L	5, 6	BD: 50.02
Tibia	5264	R	5, 6, 10	BD: 51.42
Tibia	5284	R	5, 6	BD: 53.7
Tibia	5343	R	5, 6, 10	BD: 53.73
Tibia	5347	R	5, 6	BD: 53.95
Tibia	5161	R	5, 6, 10	BD: 54.37
Tibia	5347	R	5, 6	BD: 54.6
Tibia	5264	L	5, 6	BD: 54.94
Tibia	5357	R	5, 6	BD: 55.18
Tibia	5364	L	5, 6	BD: 55.54
Tibia	5381	R	5, 6, 10	BD: 55.77
Tibia	5161	R	5, 6	BD: 56.12
Tibia	5347	L	5, 6, 10	BD: 56.2
Tibia	5161	L	5, 6	BD: 56.58
Tibia	5284	R	5, 6, 10	BD: 57.1
Tibia	5161	R	5, 6, 10	BD: 57.27
Tibia	5136	R	5, 6	BD: 57.47
Tibia	5161	L	5, 6	BD: 58.98
Tibia	5343	L	5, 6	BD: 59.06
Tibia	5281	R	5, 6	BD: 59.71
Tibia	5284	L	5, 6	BD: 59.9
Tibia	5347	L	5, 6, 10	BD: 59.9
Tibia	US	R	5, 6	BD: 61.33
Tibia	5264	L	5, 6	BD: 61.46
Tibia	5044	R	5, 6	BD: 61.5
Tibia	5102	R	5, 6	BD: 61.73