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Title: The Use of Animals at Roman Roadside Settlements in Britain: contextualising some new results from Ware, Hertfordshire

Short running title: Animals at British Roman Roadside Settlements

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Abstract

Recent analysis of a large faunal assemblage from a Roman roadside settlement at Ware, Hertfordshire has indicated potentially strong links between the nature of animal exploitation on site and its location on Ermine Street. Animal husbandry was focused on the production of cattle and sheep, both of which experienced stock 'improvement' by the late Roman period. Relatively high proportions of horse, and the presence of young horses, suggest the importance of this animal and the potential for its local breeding; the site could have acted as a station for changing or selling horses. The presence of marine fish and black rat also indicate clear links to the wider trade network. This was not an isolated settlement, outside the sphere of Roman influence, as rural Roman sites are often considered to be, but well-connected to wider economic networks. This paper places these new results in context, by providing a review of faunal assemblages from Roman roadside settlements across Britain. The review indicates that most of the characteristics of animal exploitation at Ware are shared with other roadside settlement sites, though interesting differences also emerge.

1. INTRODUCTION

Rural sites in Roman Britain are considered to have been more slowly affected than urban sites by the political, social and economic changes brought about by the Roman occupation (Mattingly 2006; Millett 1990). The impact of the occupation, and the nature of these changes, often described as 'Romanisation', is complex and has been a subject of debate for many years (e.g. Freeman 1993; Hill 2001; Hingley 1996, 1997; James 2001, 2003; Mattingly 2006; Millett 1990; Woolf 1997; 1998).

Zooarchaeology – the study of animal remains from archaeological sites - has provided important evidence contributing to this debate. Research has shown a change in the relative proportions of domestic species compared to the preceding Iron Age, with cattle numbers increasing substantially at

the expense of sheep (e.g. Albarella 2007; Dobney 2001; Grant 1989, 2002; King 1999, 2001; Maltby 1981). Broad-scale studies have also identified differences between site types, with urban sites being largely cattle-based and rural sites having higher sheep frequencies (King 1978; 1984; 1999).

In addition to the increase in cattle frequency, there is also an increase in the size of livestock, and in the use of cattle for traction (Albarella 2007; Albarella et al 2008; Grant 1989; Maltby 1981). This is thought to be the result of shifts in agricultural practices related to emerging long-distance economic networks and an urgent need to feed the ever-growing urban population (Albarella 2007; Grant 1989). Isotopic work has also confirmed this widening of the market (Minniti et al. 2014). These patterns form the basis of our debates around Roman animal husbandry, and provide a useful framework for the interpretation of our results. However, they are not universal and when did they occur, it was not at the same rate at all sites (e.g. Albarella 2007; Gidney 1999; Grant 1989, 2002; Hamshaw-Thomas 2000). It has now become clear that, despite the benefits of these broad-scale approaches, we should not neglect variation within site types.

Urban sites, with their dominance of large cattle, are often considered to be more 'Romanised' than rural sites. These latter tend to be interpreted as continuing the tradition of Iron Age subsistence strategies, and therefore to be regarded as more 'native'. However, many of these assumptions rely heavily on species representation, and livestock from rural sites have more rarely been investigated biometrically, which means that our understanding of the impact of Roman-driven husbandry changes in rural locations is highly incomplete.

Roadside settlements have traditionally been classified as 'rural', as they tend to be located in open countryside. However, these sites straddle the boundaries between urban and rural, and it is often difficult to distinguish a 'roadside settlement' from a 'small town' or a 'village'. Roadside settlements make up a substantial part of the dataset that has been used to define 'rural' sites as sheep-focused (e.g. King 1999; 2001). Therefore, it is possible that this pattern may be determined by activities taking place at settlements near to a road, rather than only their rural location. Sheep are not unjustifiably considered as synonymous with a 'native' or less 'Roman' way of life, though this is likely to be an oversimplification.

The literature discussing the nature of roadside settlements is relatively slim. A gazetteer produced 30 years ago (Smith 1987) listed 158 such sites across Britain, and made a number of general observations about these site types. More recently, the Roman Rural Landscape Project has highlighted the variability of roadside settlement sites (Allen and Smith 2016; Allen et al. 2017). The basis on which sites were classified as 'roadside settlements' in these studies does differ slightly; for example, small towns and villages are dealt with differently in the two studies, but in both cases the location of sites either on, or very near, to a road was the most important feature needed for inclusion. According to these studies, roadside settlements occur relatively regularly across Roman Britain and a significant proportion of them are thought to have first century origins (Smith 1987). Many of these sites occur on the intersection between two or more roads, and a considerable number are located at river crossings (Allen and Smith 2016), as is the case at Ware. However, in general, excavations have not yielded large numbers of finds, including animal bones, and little work has been done to bring

faunal data together (although see Allen 2017 for the largest synthesis to date, undertaken as part of the Roman Rural Landscape Project).

One of the major obstacles to our understanding of faunal remains from roadside settlements has been the lack of detailed work undertaken on assemblages excavated decades ago. The faunal assemblage at Ware is one that falls into this category; a report was written when it was initially excavated in the 1970s (Ashdown Unpublished), but this was brief and did not provide useable or comparable data. The reanalysis of this material has proven to be valuable not only for the interpretation of this site, but also for our growing knowledge of rural life in Roman Britain. This paper presents these new data alongside those from other British roadside settlements, in an attempt to identify common trends and characterise these sites further. The overarching questions here addressed are whether roadside settlements have unique characteristics that can be defined zooarchaeologically and, if so, how these can help our understanding of Romano-British society.

2. MATERIAL AND METHODS

2.1 Material

The Roman settlement at Ware has been the subject of archaeological investigations since the early 19th century. Most of this work was undertaken during excavations which took place in the 1970s on the site of the GlaxoSmithKline (then Allen & Hanbury) campus. These excavations took place predominantly on the north bank of the River Lea, although some work was also undertaken on the southern side. The work was led by East Hertfordshire Archaeological Society and the Hart Archaeological Unit. Since then, investigations have continued as new parts of the site have been exposed during redevelopment, and work is still ongoing. KDK Archaeology, who commissioned the reanalysis of the faunal remains discussed here, are currently bringing together all of this work into a monograph (Kaye and Kaye Forthcoming). The assemblage discussed in this paper was unearthed during the 1970s excavations.

Recovered archaeological remains have been attributed to at least nine phases of occupation, from the Mesolithic to the post-Roman period, but the majority of material (including animal bone) was from the Roman phases (Phases four to eight). The Roman settlement is thought to have been established in the first century AD with the building of Ermine Street, which crossed the River Lea at this location (Kiln and Partridge 1995). Evidence strongly indicates that the development of the settlement was closely linked to activity on the road and the associated river crossing (Kiln and Partridge 1995; Shlasko Forthcoming) and it can logically be placed into the category of 'roadside settlement'. Some of the evidence is directly related to the use of animals; there are, for instance, large numbers of hipposandals (a predecessor of the horseshoe, used to protect horse hoofs), in addition to horse bits and harness fittings. These finds indicate that draught animals formed an important part of the traffic on the road (Crummy Forthcoming). Additionally, there is evidence that the site was influenced by long distance trade, through the presence of samian ware, and other imported fine wares and coarse wares (Shlasko Forthcoming). There is, therefore, extensive evidence that this site was not isolated as

rural sites are often seen, but instead was very well connected to the network of Roman economic and cultural influence.

The faunal assemblage from Ware is one of the largest from a roadside settlement in Britain, with more than 6000 recorded mammal and bird specimens (Wright et al. Forthcoming). The large sample allowed comprehensive ageing and biometrical studies, which constitute a useful comparative resource for the Roman period, especially rural settlements.

A number of faunal assemblages from other 'roadside settlements' were chosen for comparison with the assemblage from Ware (Table 1 and Figure 1). Our selection was based on a number of factors:

- Proximity to the road
- Size of settlement
- Excavators' interpretations of the site as a 'roadside settlement'[1]
- Size of faunal assemblage
- Data availability in faunal reports.

Where possible, raw data were extracted from faunal reports to enable a direct comparison with Ware. This was not always possible, as data were not always published, or were presented in a form that was not comparable with our data. The faunal report for the large roadside settlement site at Bainesse, in north Yorkshire, for example, divided only the biometrical data by phase; all other data, including relative frequencies and ageing, were presented as one 'Roman' group (Meddens 1998). This site has therefore only been included in the biometrical part of this study.

2.2 Methods

The animal bone assemblage from Ware was studied at the University of Sheffield, using the facilities of the *Tony Legge Zooarchaeology Laboratory*. The material was recorded using a protocol involving the selection of diagnostic zones (following a modified version of Davis 1992 and Albarella and Davis 1994); for a full description of the recording and quantification methods see Appendix 1 and 2. The full database is provided as Supporting Information.

There was no record regarding the mode of collection of the animal bones, and it is unknown whether any sieving was carried out. However, as part of our study we carried out an assessment of recovery bias. This suggested that differential recovery was impacting the assemblage, but the presence of relatively large numbers of amphibian and small rodent bones in some contexts, and large numbers of loose sheep teeth overall, indicated that sieving may have been taking place in some areas and/or that hand-collection was fairly efficient in some areas of the excavation.

[1] Some of the sites included in this paper were not necessarily described as a 'roadside settlement' by their excavators, but instead fell into the categories of 'small town' or 'village'. There was no reason we could see why these smaller settlements should not be comparable to sites interpreted as roadside settlements so long as they were in close proximity to the road. In Table 1 the sites are categorised according to the site 'type' ascribed by the excavators

For this paper the following broad chronological phasing has been adopted:

Early Roman: first - second century AD

Middle Roman: second - third century AD

Late Roman: third - fourth century AD

There was some variation in the way faunal assemblages were presented with regards to phasing and dating, with some sites only dated generically to the Roman period and others split into numerous defined phases, often with very small samples sizes. The above phasing provided the ability to use data that had been relatively broadly dated and also have large enough sample sizes for our analysis to be reliable. This is also the phasing adopted by the recent regional review of Roman sites for Central England (Albarella with al. Forthcoming) and so it allowed us to use some comparative datasets from that project in order to provide a broader picture, including various different site types. This review provided the largest collated zooarchaeology dataset in Britain, so is ideal for contextualising the Ware dataset. Regional datasets for the southern and northern regions of England have not yet been published.

3. KEY RESULTS IN CONTEXT

The results from our study of the faunal assemblage from Ware (Wright et al. Forthcoming) can be summarised as follows:

1. Species representation indicates a major focus on cattle and sheep husbandry, with the two species represented in relatively equal proportions.
2. The cattle population was relatively old, indicating the primary use of these animals for traction.
3. Sheep were slaughtered at a relatively young age – indicating their primary use for meat production.
4. Sheep postcranial bones are underrepresented – indicating either their deposition outside the unexcavated area, or that heads had been removed from the body before the meat was then sold and taken off site – perhaps by people using the road.
5. Cattle and sheep increased in size by the late Roman period.
6. Horses were important, and, to some extent, they must have been bred nearby.
7. There were good connections with the road network, as suggested by the presence of potentially imported species, such as marine fish, and black rat.

The aim of this review is to compare these results with those from other similar sites, to ascertain whether common zooarchaeological characteristics of roadside settlements can be identified.

3.1 Species representation – cattle and sheep focus

Figures 2-4 display proportions of cattle, sheep/goat and pig for the early, middle and late Roman periods for a variety of site types, alongside the material from Ware (there is no middle Roman period at Ware, but other sites with material from this period are displayed for comparison), and also the other roadside settlements considered in this review. Sites used in this broader comparison were selected from the regional review of Roman sites in Central England (Albarella with al. Forthcoming). All the assemblages, except Springhead, were exclusively hand-collected and they are expected to be affected by the same under-representation of smaller species as discussed for Ware. The degree of bias is likely to be variable, so comparisons need to focus on substantial differences, as minor ones may simply be the result of differential recovery bias. On all sites sheep and pig will be under-represented in relation to cattle and horse.

The Ware assemblage has relatively high proportions of sheep remains in both its early and late Roman phases, although they do reduce in importance by the late period. During the early phase sheep make up 57% of the three main domesticates, with cattle at 33%. By the late phase sheep and cattle show much more equal proportions with sheep accounting for 43% and cattle 45%. This broad shift to an increase in cattle can also be seen across other site types, as has previously been noted (Albarella 2007; Dobney 2001; Grant 1989, 2002; King 1999, 2001; Maltby 1981).

In both the early and late Roman periods the assemblage from Ware sits quite centrally within the plot of roadside settlements and therefore reflects well the overall pattern seen at these sites. Roadside settlements have some of the highest proportions of sheep during all phases. Even in the late Roman period, when there is a countrywide increase in cattle frequencies, roadside settlements never have a cattle representation of more than 60% (with the exception of Clausentum – which is one of the most 'urban' of the sites included), even when some other 'rural' sites do. Roadside settlements tend to have relatively equal proportions of cattle and sheep even by the late Roman period, and do not display such a large shift towards cattle as other sites. In contrast, other rural sites show a large shift to high proportions of cattle between the early and late Roman phases.

3.2 Age at death – cattle and sheep

*3.2.1 Cattl*e. At Ware adult and elderly cattle dominate the assemblage (Figure 5), a pattern that is reflected at other roadside settlements (Figure 6), and across the whole of Britain (Grant 1989:138; Grant 2004; Albarella 2007:397; Albarella with al. Forthcoming). This pattern is typical of populations that have been used primarily for traction, with the additional exploitation of younger adults for their meat.

At Ware there is also evidence of neonatal cattle deaths, indicating that cattle breeding was taking place on site. Remains of very young cattle have also been found at other roadside settlements, including Tort Hill East, Silbury and Neatham.

The higher frequency of juveniles at Nettleton and Shiptonthorpe may indicate a higher degree of infant mortality, and therefore a more challenging husbandry context. The exploitation of milk, which could also explain that pattern, is less likely, as Roman agricultural writers (Cato, Varro, Columella)

do not mention cattle dairy use (White 1970). It must be emphasised, however, that they did not write about Britain, where different customs may have existed.

3.2.2 Sheep. At Ware the sheep/goat mortality peak is consistently around the second or third year – Payne's age stages D and E - with some animals surviving into later adulthood (Figure 7). This is consistent with the pattern seen at other roadside settlements for which we have raw data (Figure 8). This high frequency of sub-adults and young adults is typical of a flock which would have been exploited predominantly for its meat, but additionally for wool.

This pattern is in contrast to that of the settlement at Grandford. We do not have raw data to display, but the publication presents a sheep/goat mortality peak at an older age, which has been interpreted as indicating a particular focus on wool (Stallibrass 1982). This pattern is certainly an exception, however, and the situation at Ware is in line with the evidence observed at most roadside settlement types in Roman Britain.

3.3 Sheep body part representation

At Ware both the cattle and, particularly, sheep assemblage were dominated by teeth (Figures 9 and 10). Teeth are made of a very hard tissue and tend to preserve better than bones; therefore, to some extent, this may be due to differential preservation. However, the pattern is too extreme, particularly for sheep, for this to constitute the only explanation.

It seems that postcranial remains were not being deposited on site, or at least in the excavated part of the site, at the same rate as cranial remains. It is possible that some postcranial remains may have been deposited in parts of the settlement outside of the excavation area, or that heads could have been brought to the site without their bodies. A more likely explanation, however, is that mutton, and perhaps some beef too, was being sold on the bone after the head had been removed from the body, which resulted in the postcrania being taken offsite. The position of the settlement on the side of a major roadway would have provided a good opportunity for this kind of activity.

It has been difficult to undertake a direct comparison of body part patterns across the different settlements included in this study, due to the variety of different methods used to calculate body part representation, in addition to the generally small sample sizes recovered from these sites. However, a general picture can be gathered from comments made in the text of a number of reports. Springhead stands out as having a similar sheep teeth:postcrania ratio as Ware (Worley 2011). At this site there is a considerable predominance of mandibles, which has been interpreted as either a situation where heads were being brought to the site, or where postcrania were taken away; a similar scenario to Ware.

Considering the dearth of sieving at most sites, small elements, such as loose teeth, may be underrepresented. Considering that sieving was practiced at Springhead and, possibly, in some Ware contexts, this may explain why more teeth were found at these sites than others. However, recovery bias still cannot explain the imbalance between teeth and postcranial bones, which, therefore, is likely to be attributed to human activity.

3.4 Cattle and sheep 'improvement'

The relatively large samples at Ware allowed for a biometrical study of both cattle and sheep remains, and our review of other roadside settlements has indicated that this is now the most thorough biometrical study from this site type in Roman Britain. Most of the settlements included in this study had sample sizes that were too small to conduct a detailed study, and even fewer had published raw data available for a direct comparison. Only Tort Hill, Stonea and Bainesse had raw biometrical data which could be compared to the dataset from Ware. Data from the farm site at Heybridge, where there are large samples, and there is clear evidence for size increase of the animals, have been used for comparative purposes (Albarella et al. 2008; Johnstone and Albarella 2015).

3.4.1 Cattle. At Ware the cattle population showed no change in size between the early and late Roman phases, according to both postcranial and tooth measurements (Figures 11 and 12). Comparison of the pattern from Ware with that seen at Heybridge, however, indicates that the cattle at Ware are larger than the Iron Age animals at Heybridge, and had therefore already undergone a process of stock improvement by the early Roman period.

Middle Roman cattle from both Tort Hill and Stonea seem to have been of a similar size to the early Roman animals at Ware (Figure 13). The population at Bainesse, where we have data from both the Early and Middle Roman period, shows a clear shift over time; from smaller sized animals during the early Roman period (albeit with a small sample) to a mixture of small and larger animals during the Middle Roman period. The majority of the Middle Roman sample at Bainesse is still made up of smaller cattle, however, suggesting that the process of stock improvement was still taking place. At Tort Hill and Stonea there is no sign of the small cattle seen at Bainesse during the Middle Roman period, suggesting that in southern areas the process was at a more advanced stage.

During the late Roman period (Figure 14), the cattle population at Bainesse also contains the smallest cattle, but does have some overlap with the southern sites, and a number of particularly large outliers. Again this suggests that the process of stock improvement at this northern site was lagging behind the southern sites, with perhaps the addition of a few large imports.

3.4.2 Sheep. Sheep at Ware underwent a slight increase in size between the early and late Roman phases, which can be seen in both postcrania and teeth (Figures 15 and 16). This indicates that our dataset covers at least part of a period of sheep improvement at the site. Interestingly, sheep from the early Roman phase at Ware are larger than those at the equivalent phase at Heybridge, whereas by the late Roman phase they are a similar size at both sites. This may indicate that the process of stock improvement began earlier at Ware than at Heybridge, which is noteworthy considering that Heybridge is thought to be the more urban of the two sites.

The sheep at early Roman Bainesse were of a much smaller size to those at Ware (Figure 17), indicating that the sheep at Ware had already undergone some improvement by the early Roman period, and that the sheep at Bainesse were of an unimproved type.

An increase in body size can be seen at Stonea between the middle and later Roman periods, indicating that some sheep improvement was taking place here during this time (Figure 18). The

sheep at Bainesse, however, do not show any clear size increase, although the Late Roman population does not contain as many small specimens as the Middle Roman population. At Tort Hill the pattern is unclear, due in part to small sample sizes; in the mid Roman period sheep seem to be a similar size to the improved animals at Ware, but during the late Roman period some particularly small individuals are present.

The size-increase in livestock such as that seen at Ware and some other roadside settlement sites can be seen across Britain at many Roman sites. It is thought to reflect a process of stock improvement, related to the intensification of agriculture and a need to increase meat production, as networks widened after the Roman invasion (Albarella et al. 2008).

3.5 The significance of horses

At Ware horse is better represented than one would usually expect during the Romano-British period. It makes up approximately 11% of the domestic assemblage in the early Roman period and around 9% in the late Roman period (Figure 19). Additionally, horse epiphyseal fusion and tooth data from Ware indicate that some young animals were present on site (Figure 20 and Table 2). In the late Roman phase this included an unfused humerus from a very young, perhaps neonatal animal, in addition to a number of deciduous teeth (Wright et al. Forthcoming).

The proportion of horses at Ware is higher than the average across all site types in both the early and late Roman phases, which show average proportions of under six percent (Figure 19 – comparative data from Albarella with al. Forthcoming), and a number of the other roadside settlement assemblages also have relatively large proportions of horse. The majority of these sites also have some young horse specimens. This is especially noteworthy in view of the small size of many of these assemblages, compared to those from larger urban sites. To provide some context, no immature horse remains were found in any of the very large Roman assemblages from Exeter (Maltby 1979) and Wroxeter (Hammon 2005) and none are mentioned at Colchester (Luff 1993).

3.6 Imported species

One of the most significant findings in the assemblage from Ware was the presence of a small number of specimens from species which must have been imported to the site, either deliberately or accidentally.

3.6.1 Marine Fish. At Ware we have identified two specimens of plaice (*Plueuronectes platessa*) from a late Roman context. Plaice are restricted to marine and estuarine environments, neither of which exist near to Ware. Comparing the situation at Ware to other roadside settlements is difficult, as when fish are present at most of our comparative sites, they do not tend to have been identified to species. One exception is at nearby Puckeridge-Braughing, the closest of our comparative small settlement sites, where flat fish has been identified (Fifield 1988). Flatfish are predominantly marine, but in this case these remains are thought to be from flounder (*Platichthys flesus*), which can enter fresh water and is found along rivers. Nevertheless, there is a possibility that these remains would have been imported. Both the settlements at Ware and Puckeridge are situated on the major roadway of Ermine Street, so it seems particularly interesting that both of these sites have potential evidence of

marine fish, whilst at the same time being very well connected to each other. The excavators confirmed that some marine shell, including oyster, were recovered at Ware, which provides further evidence of coastal imports, though these remains were not made available to us for this study.

3.6.2 Black rat. At Ware we have also identified two specimens of black rat (*Rattus rattus*) in the late Roman period. The black rat is thought to have been introduced to Britain in Roman times (Rackham 1979; Armitage et al. 1984; Armitage 1994), but the identification of this species is still a relatively rare occurrence at British Roman sites. Black rat was also found at Springhead, in an early Roman context (Worley 2011). The possibility that these specimens are intrusions cannot be completely disregarded, but it seems unlikely, as the black rat is not a burrowing animal (unlike the brown rat, *Rattus norvegicus*, which was introduced into Europe much later). Although there have been other black rat specimens identified on British Roman sites, including those that are not on roadways, it is worth thinking about the processes by which this species may have spread across Britain, after it arrived probably accidentally by boat. One potential scenario is that it could have spread inland in vehicles that travelled around the road network, such as in carts filled with hay. The proximity of both Ware and Springhead to roads therefore may not be accidental.

4. SUMMARY AND DISCUSSION

The faunal assemblage from the roadside settlement at Ware has provided an important contribution to our knowledge of these Romano-British settlement sites. The patterns from Ware also seem to reflect those seen at other roadside settlements. Sheep was particularly common and proportions of cattle do not increase as rapidly over time as at other site types, including other types of rural sites.

The tendency of rural sites to have higher sheep frequencies compared to other site types has previously been identified by King (1978; 1984; 1999), who suggested that this pattern indicates some form of continuity with an 'Iron Age' type of husbandry. King's work, however, was looking for broad patterns, and his general hypotheses may not be appropriate for the interpretation of every site; after all, the term 'rural' can be applied to sites with a variety of different functions. Bearing this in mind, a continuation of an 'Iron Age' way of life might make sense at more remote sites, but would seem more surprising at sites that would have been exposed to the passing influence of travellers on the road.

Cattle mortality profiles at roadside settlements tend to reflect the pattern seen across the whole of Roman Britain, regardless of site type, and reflect the specialisation of cattle as traction animals in addition to meat production. There is no evidence to suggest that cattle were being managed differently at these smaller settlement sites than they were elsewhere.

Most roadside settlements seem to have kept sheep for wool but, particularly, meat. There is evidence that such products were important for the economy of the local area surrounding these sites. Some settlements, such as Grandford, may have had specialised productions (e.g. wool), which must have been produced in quantities beyond the use of local residents. Others, such as Ware and Springhead, have interesting body part patterns which may be explained by the selling of certain portions of meat on the road. These sites, then, were sometimes used as production centres, well connected to wider economic networks.

Further indication that these sites were well connected and exposed to Roman influence comes from the clear evidence of stock improvement occurring even earlier than the more urban site of Heybridge. The production of larger cattle is thought to be partly down to the introduction of new, larger, breeds from the continent (Albarella et al. 2008). The patterns seen at these roadside settlement sites may be reflecting the geographical and temporal spread of larger breeds throughout the country. This process seems to begin particularly early at Ware (the southernmost site in our biometrical study), where there is evidence of both cattle and sheep improvement by the early Roman period. At Tort Hill and Stonea (geographically located between Ware and Bainesse) there is some evidence that stock improvement may have taken place by, or during the middle Roman period. At our most geographically northern site, Bainesse, in contrast, the process of stock improvement seems to be lagging behind the southern sites.

There does not seem to be much delay in stock improvement at sites a little further north than Ware (i.e. Stonea and Tort Hill). However, the adoption of animal improvement was delayed the longest at Bainesse, the most northern comparative site in this study, indicating a logical geographical pattern in the spread of these new innovations.

Roadside settlements also seem to have a particular focus on horses and horse breeding. Since Roman sites with high frequencies of horse tend to have specialised functions, such as the amphitheatre at Silchester (Grant 1989) or the 'ranching' farms highlighted by King (1978), this pattern implies that roadside settlements may have had some kind of specialised function involving horses, which potentially also involved horse breeding. Albarella (1997) previously noticed this pattern at the Tort Hill sites, and suggested that they may have been supplying horses to travellers on Ermine Street. Certainly the settlement at Ware had strong links with the transport on the road, as is attested by the large number of hipposandal fragments and other related items recovered here (Crummy Forthcoming). The results presented here indicate that this was a more generalised pattern and that horses were important at roadside settlements in general, probably a consequence of the connection these sites had with broader trade and exchange networks. Developed and well-maintained roads, draught animals, the driving of animals on the hoof, and the opportunity to transport goods, meant that long-distance commercial systems were indeed possible (cf. Groot 2016, 17).

Finally, the presence of black rat, oyster and marine fish at multiple roadside settlements provides further evidence of how connected many of these sites were.

5. CONCLUSION

There is much debate around how the Roman economy functioned, and whether the main driving force was trade and exchange at local markets (e.g. Silver 2007; Temin 2001; 2017) or political decisions made by the imperial estate (e.g. Bang 2008; Hopkins 1980; Wickham 2005). It is generally agreed, however, that the two main sources of demand for agricultural production in Roman Britain, and indeed other areas of North-western Europe were urban centres and the army (Allen and Lodwick 2016; Groot 2016; Thomas and Stallibrass 2008). We do not know exactly how the economic system, by which products were supplied to these destinations, was organised. Some products may have been

traded through markets, but some may have formed part of the taxation system. Either way, agricultural production responded to the demand from these two main stimuli.

Rural sites are generally considered to be producer sites and urban settlements consumer sites (Groot 2016), but this is of course an over-simplification, which does not take into account the complexity of production, consumption, trade and exchange networks – 'producer' sites also need to feed themselves. Roadside settlements may encapsulate this complexity by taking a role which cannot be classified along the lines of consumption and production.

Our evidence suggests that these sites were well 'plugged in' to the wider economic system through being centres for the movement of goods and innovations. In some cases, they were producing surpluses of certain products themselves - such as at Grandford, with its focus on wool - and in general they seemed to be a hub for horses, and perhaps even horse breeding. These products were evidently traded or exchanged at these roadside locations and then moved around using the road network. It is also clear that some roadside settlements were also quickly impacted by agricultural innovations brought about by the Roman occupation, such as the introduction of new larger cattle and sheep. These settlements may also have acted as stop-off points for traders moving their products around the road network, although this is difficult to detect in the archaeological record of these sites, as most would end up being deposited elsewhere.

Overall, roadside settlements had an important role as facilitators between net producer and consumer sites. They are likely to have had a key role in the organisation of the Roman society and economy and in facilitating the societal and agricultural changes that came about during the Roman occupation of Britain. They cannot therefore be treated as remote sites devoid of Roman influence, as rural sites often are. Despite their obvious importance, these sites have been slightly neglected, as emphasis placed on the physical reconstruction of the Roman road network has somewhat sidelined research focused on the activities of those who spent their lives alongside those roads. In this paper we have illustrated aspects of the vitality of these settlements and provided an insight in the key role they played in the Roman society.

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7. TABLES (SEE FOLLOWING PAGE)

Table 1. Comparative sites used in this review. Total NISP refers to the sum of cattle, sheep, pig, and horse NISP only.

SITE	CHRONOLOGY	NUMBER OF IDENTIFIED SPECIMENS (NISP)					REFERENCE
		Cattle	Sheep	Pig	Horse	Total[a]	
NORTHERN ENGLAND							
Roadside settlement							
Bainesse	Roman	3284	2224	926	764	7198	Meddens 1998
Nettleton and Rothwell	Late Iron - Early Roman (AD 20-120)	80	342	80	17	519	Rackham 2013
	Early Roman (AD 50 - 200/220)	53	188	49	4	294	
	Middle Roman (AD 150 - 300)	6	8	9	-	23	
	Mid - Late Roman (AD 200 - 330)	1	-	-	-	1	
	Late Roman (4th century AD)	6	26	5	-	37	
	Late - Post Roman	2	6	2	-	10	
	Roman	114	72	14	12	212	
Shiptonthorpe	Phases 1 - 2 (AD 100 - 255)	11	40	12	-	63	Mainland 2006
	Phases 3 - 4 (AD 225 - 325)	277	332	76	61	746	
	Phase 5 (AD 325 - 350)	369	409	92	34	904	
	Phase 6A - B (AD 340 - 410)	142	163	36	8	349	

CENTRAL ENGLAND							
Roadside settlement							
Racecourse 74	2nd century AD	162	162	22	24	370	Harman, Bramwell and Baker 1986
	3rd century AD	188	165	32	8	393	
Sidbury	Early Roman (1st - 2nd century AD)	431	451	71	231	1184	Scott 1992
	Late Roman (3rd - 4th century AD)	1690	874	237	61	2862	
Stonea	Middle Roman (2nd - 3rd century AD)	419	496	127	20	1062	Stallibrass 1996
	Late Roman (3rd - 4th century AD)	1294	1271	340	48	2953	
Tort Hill East	Phase 1 (late 1st - early 2nd century AD)	3	0	3	2	8	Albarella 1997
	Phase 2 (early - mid 2nd century AD)	47	37	6	19	109	
	Phase 3 (late 3rd - 4th century AD)	47	41	6	17	111	
	Phase 4 (post Roman)	2	1	-	-	3	
Tort Hill West	Phase 2 (pre Roman - Late Iron)	64	39	14	9	126	Albarella 1997
	Phase 3I (1st - 3rd century AD)	78	64	15	55	212	
	Phase 3II (late 2nd - 4th century AD)	4	14	-	1	19	
Village							
Grandford	Early Roman	218	461	91	9	779	Stallibrass 1982

	Middle Roman	224	462	53	2	741	
	Late Roman	636	1099	143	11	1889	
Small town							
Puckeridge-Braughing	Phase 1 (up to AD 75)	1348	1546	1412	53	4359	Fifield 1988
	Phase 2 (late 1st - mid 2nd century AD)	366	701	215	19	1301	
	Phase 3 (late 2nd - mid 3rd century AD)	105	107	75	20	307	
	Phase 4 (mid 3rd - late 4th century AD)	406	490	125	101	1122	
Roadside settlement	**SOUTHERN ENGLAND**						
Shepton Mallet	Roman	394	283	61	36	774	Pinter-Bellows 2001
Silbury	Early Roman (2nd century AD)	27	22	4	2	55	Baker 2013
	Late Roman (3rd - 4th century AD)	52	58	27	6	143	
Springhead	Early Roman	724	1201	221	72	2218	Worley 2011; Hamilton-Dyer 2011
	Mid Roman	219	149	47	24	439	
	Late Roman	135	77	39	14	265	
Wilcote 1990-92	Phase 1 (AD 40-75)	146	633	153	13	945	Hamshaw-Thomas 1993
	Phase 2 (AD 70-120)	465	914	134	20	1533	

	Phase 3 (AD 120-200)	732	1190	157	31	2110	
Small town							
Alchester	Period 3 (mid - late 1st century AD)	3	2	1	4	10	Powell and Clark 2002
	Period 4 (late 1st - early/mid 2nd century AD)	1	10	-	-	11	
	Period 5 (early/mid - later 2nd century AD)	40	28	9	47	124	
	Period 6 (late 2nd - mid 3rd century AD)	129	100	29	34	292	
	Period 7 (mid 3rd - late 3rd/early 4th century AD)	269	238	41	155	703	
	Period 8 (early - mid 4th century AD)	474	451	99	29	1053	
	Period 9 (late 4th century AD)	383	321	100	45	849	
Clausentum	Early Roman (AD 70-180)	88	12	12	-	112	Bilton 1958
	Late Roman (AD 350 - 400)	223	48	99	6	376	Cornwall 1958
Neatham	Early Roman (AD 75 - 250)	120	174	21	2	317	Done 1986
	Late Roman (AD 250 - 400)	942	318	127	70	1457	

Table 2. Frequency of horse deciduous and permanent teeth at Ware, by phase. NISP=Number of Identified Specimens. Percentages have only been calculated for overall NISPs of at least 10.

Horse Teeth	Phase 4 (Early Roman)		Phase 5+6 (Early Roman)		Phase 7+8 (Late Roman)	
	NISP	%	NISP	%	NISP	%
Deciduous	6	40	1	1	11	10
Permanent	9	60	67	99	97	90
Total	**15**	**100**	**68**	**100**	**108**	**100**

8. CAPTIONS OF ILLUSTRATIONS

Figure 1. Map of Great Britain showing the sites mentioned in the text. References: 1. Bainesse; 2. Shiptonthorpe; 3. Nettleton and Rothwell; 4. Racecourse; 5. Tort Hill; 6. Grandford; 7. Stonea; 8. Sidbury; 9. Wilcote; 10. Alchester; 11. Puckeridge-Braughing; 12. Ware; 13. Silbury; 14. Springhead; 15. Shepton Mallet; 16. Neatham; 17. Clausentum.

Figure 2: Relative proportions (according to Numbers of Identified Specimens - NISP) of cattle, sheep/goat and pig at Early Roman sites, grouped by site type.

Figure 3: Relative proportions (according to % NISP) of cattle, sheep/goat and pig at Middle Roman sites, grouped by site type.

Figure 4: Relative proportions (according to % NISP) of cattle, sheep/goat and pig at Late Roman sites grouped by site type.

Figure 5: Cattle mortality at Ware according to tooth eruption and wear for the whole archaeological assemblage, and then the Early and Late Roman phases. Age categories assigned according to O'Connor 1988.

Figure 6: Cattle mortality at Nettleton and Shiptonthorpe according to tooth eruption and wear. Age categories assigned according to O'Connor 1988.

Figure 7: Sheep/goat mortality at Ware according to tooth eruption and wear for the whole archaeological assemblage (top diagram), and then the Early (middle) and Late (bottom) Roman phases. Age categories assigned according to Payne (1973).

Figure 8: Sheep/goat mortality from roadside settlement sites: Early Roman Nettleton (top diagram), Middle and Late Roman Shiptonthorpe (middle two diagrams) and Late Roman Sidbury (bottom diagram). Note the E-H combined category for Nettleton and Sidbury - this is due to restrictions on the way that the data was presented in the original publications.

Figure 9: Cattle body part representation at Ware according to Minimum Animal Units - MAU, *sensu* Binford 1984 (see Appendix 2) for all archaeological phases combined, and then for Early and Late Roman phases. Only elements with the highest MAU value for each body portion (cranium, upper limbs, lower limbs and extremities) have been included, and are specified in parentheses.

Figure 10: Sheep/goat body part representation at Ware for all archaeological phases combined and then for the Early and Late Roman phases. Only elements with the highest MAU value for each body portion (cranium, upper limbs, lower limbs and extremities) have been included, and are specified in parenthesis.

Figure 11: Log ratio plots combining all cattle postcranial width measurements, from Ware (top two diagrams) and Heybridge (bottom four diagrams). The standard is marked with a line. The mean is marked with a circle (means only calculated for samples of more than 5). Note that the two sites are shown on a different vertical scale.

Figure 12: Cattle 3rd molar width measurements from Ware (top two diagrams) and Heybridge (bottom four diagrams). Note that the two sites are presented on a different vertical scale.

Figure 13: Log ratio plots showing Early and Middle Roman cattle postcranial width measurements from a number of roadside settlement sites. The standard is marked with a line. The mean is marked with a circle (means only calculated for samples of more than 5).

Figure 14: Log ratio plots showing Late Roman cattle postcranial width measurements from a number of roadside settlement sites. The standard is marked with a line. The mean is marked with a circle (means only calculated for samples of more than 5).

Figure 15: Log ratio plots showing sheep/goat postcranial width measurements from Ware and Heybridge. The standard is marked with a line, the mean is marked with a circle (means only calculated for samples of more than 5).

Figure 16: *Sheep/goat* 3rd molar width measurements from Ware (top two diagrams) and Heybridge (bottom three diagrams). Note that the two sites are presented on a different vertical scale.

Figure 17: Log ratio plots of *sheep/goat* postcranial widths from Early Roman Ware and Bainesse. The standard is marked with a line. The mean is marked with a circle (means only calculated for samples of more than 5).

Figure 18: Log ratio plots of *sheep/goat* postcranial widths from a number of Middle and Late Roman roadside settlements. The standard is marked with a line. The mean is marked with a circle (means only calculated for samples of more than 5).

Figure 19: Proportions of equid remains (according to total NISP of horse, cattle, sheep/goat, and pig) at roadside settlement sites, compared to the average for the central region (comparative data taken from the regional review by Albarella et al. Forthcoming).

Figure 20: Fusion of horse bones at Ware, for all archaeological phases combined and then Early Roman and Late Roman phases. Unfused epiphyses have been excluded. Fusion stages follow Silver 1969.

9. LIST OF APPENDICES

1. Recording Protocol for mammal and bird bones

2. Quantification formulae

10 SUPPORTING INFORMATION

1. The Ware animal bone database