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**Counting Roman chickens: Multidisciplinary approaches to human-chicken interactions in Roman Britain**

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(Article begins on next page)

## Manuscript Details

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### Abstract

This paper discusses some of the approaches and results from two multi-disciplinary projects. The first is the AHRC-funded 'Cultural and Scientific Perceptions of Human-Chicken Interactions' Project. This is investigating the history of the exploitation of chickens in Europe. The second is the Leverhulme Trust-funded Rural Settlement of Roman Britain Project, which has collated evidence from excavation reports from thousands of sites. This paper updates the evidence for the exploitation of chickens in Roman Britain, showing that there were significant variations in the abundance of chicken bones found on different types of settlement. There was also a modest increase in their abundance during the Roman period suggesting chickens became slightly more frequent contributors to the diet, albeit still only a rare commodity. However, they continued to be frequently represented in graves, shrines and other ritual deposits. The paper also discusses evidence of egg production and avian osteopetrosis, demonstrating that when traditional zooarchaeological research is integrated with scientific analyses, a deeper understanding of past human diet can be acquired.

<b>Keywords</b>	Zooarchaeology; Chickens; Roman Britain; Eggshell; Medullary bone; Pathology
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Table 1 Roman Chicken Manuscript MM MA JB TF BD.pdf [Table]

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Dear Sir/Madam,

Please find attached the manuscript entitled: "Counting Roman Chickens: Multidisciplinary Approaches to Human-Chicken Interactions in Roman Britain" for consideration in the following special issue: "Interdisciplinary approaches to ancient Roman diets".

Yours Sincerely,

Mark Maltby and Julia Best



37 currently from the site of White Horse Stone in Kent where a femur provided a radiocarbon  
38 date of 770-390 cal BC with modelled dates of 560-390 cal BC (Kitch 2006). However,  
39 chicken bones are rare finds in the pre-Roman period in Britain, being recorded in only  
40 around 30% of the Iron Age faunal assemblages from southern England, nearly always in  
41 very small numbers (Hambleton 2008). Only on a few Late Iron Age (100BC-AD43) sites in  
42 the south-east of England, where continental contact was more evident, did chickens appear  
43 in larger numbers (Maltby 1997; Hambleton 2008), despite the fact that images of chickens  
44 were depicted on coins minted in two areas of southern England during that period (Best et al  
45 2016). Indeed, the regular occurrence of partial or complete skeletons of chickens along with  
46 Julius Caesar's frequently quoted, albeit enigmatic, observation from *De Bello Gallico* that  
47 the Britons kept chickens but did not eat them, has led to the very plausible contention that  
48 chickens were initially valued for some of their other qualities rather than for food (Sykes  
49 2012).

50

51 Despite its recent introduction and continued presence in contexts associated with human  
52 burials and other ritual sites (King 2005) chickens are often summarily dismissed in  
53 zooarchaeological reports of Romano-British assemblages merely as an unremarkable  
54 addition to the diet. A previous survey (Maltby 1997) indicated that there is some evidence to  
55 suggest that chickens became more abundant during the Romano-British period but the  
56 potential complexity of production, distribution and consumption of chickens and their  
57 products in the diet was not fully explored. This potentially undervalues their impact, and  
58 their dismissal limits our understanding of their multiple roles. Two recent large multi-  
59 disciplinary research projects have provided opportunities to review the evidence for human-  
60 chicken relationships in more depth. The Arts and Humanities Research Council-funded  
61 'Cultural and Scientific Perceptions of Human-Chicken Interactions' Project has brought  
62 together over 20 researchers from six universities to examine the social, cultural and  
63 environmental impact of chickens in Europe. This research has included the collation of  
64 zooarchaeological data from both published works and unpublished archives from all periods  
65 including the Roman era. In addition, innovative research has been carried out (inter alia) in  
66 analyses of metrical data, pathology, ancient DNA, stable isotopes, pottery residues,  
67 eggshells, ecology, material culture and anthropology associated with chickens. Meanwhile,  
68 the Leverhulme Trust-funded 'Rural Settlement of Roman Britain Project' has collated  
69 evidence from over 2,500 excavated rural settlements from England and Wales, enabling a  
70 comprehensive reassessment of the countryside of Roman Britain to be carried out (Smith et

71 al 2016). Over 1,600 sites have produced animal bones and counts of the bones of chickens  
72 and other species can be accessed via the wide-ranging online resource created by the project  
73 (Allen et al 2015; Allen 2017 in press).

74

75 This paper will examine whether there is evidence for an increase in importance of chickens  
76 as a source of food in Roman Britain, and whether there are variations in its abundance in  
77 different types of site and periods. It will also consider some other analyses that can be used  
78 in considering the evolution of the relationships between humans and chickens in the western  
79 provinces of the Roman Empire.

80

## 81 **2. Chicken abundance in Romano-British zooarchaeological samples:**

82

83 An initial survey into variability in the abundance of chickens from Romano-British  
84 archaeological sites was carried out by Maltby (1997). The sample consisted of 123  
85 assemblages from 68 sites and compared data from military sites, major towns, nucleated  
86 settlements, villas and other rural settlements. Results suggested that chickens tended to be  
87 more common in assemblages from military sites and major towns, but the numbers of  
88 assemblages from some types of site rendered these conclusions tentative and precluded  
89 investigation of possible chronological variations. During the last 20 years, the number of  
90 assemblages has increased enormously principally due to the large number of developer-  
91 funded excavations that have been carried out since 1990 both on rural (Allen 2017 in press)  
92 and urban sites (Maltby 2015), thus enabling a much more comprehensive survey to be  
93 undertaken.

94

### 95 *2.1 Materials and methods*

96 This survey will focus on comparing the abundance of chicken bones with those of  
97 sheep/goat. Some comparisons with the abundance of pigs will also be made. Inter-site  
98 comparisons of species abundance are faced with a series of well-known challenges  
99 concerning differential identification, retrieval, preservation, quantification and deposition.  
100 With particular regard to chickens, it is not possible to distinguish all chicken bones from  
101 those of other galliforms such as pheasant (*Phasianus colchicus*) and guineafowl (*Numida*  
102 *melagris*) via morphological and metrical analysis, but in Roman assemblages where such  
103 distinctions have been made, nearly all the diagnostic bones have been positively identified as  
104 chicken. It is therefore assumed that the vast majority, if not all, of the galliform bones

105 recorded on these sites belonged to chickens. Retrieval and preservation biases have long  
106 been recognised, and bones from small birds have a greater likelihood of being destroyed or  
107 overlooked than the generally larger and more robust bones of mammal species during hand-  
108 excavation. Unfortunately, many reports do not separate or list the bones recovered by  
109 sieving. However, the great majority of the assemblages are derived mainly or totally from  
110 hand-collection and, with caution, can be compared. It is impossible, however, to fully assess  
111 whether all assemblages were recovered with the same level of efficiency. Where known,  
112 assemblages derived mainly from sieving have been excluded. Obviously sheep and pigs are  
113 larger than chickens and there will still inevitably be some bias in recovery standards, but  
114 these will not be as marked as they would be in comparisons with larger mammals such as  
115 cattle and horse. Quantification methods used by zooarchaeologists also vary. Most counts  
116 are derived from the total number of identified specimens (NISP). However, what constitutes  
117 a NISP count varies significantly. Some counts include vertebrae and ribs, whilst others do  
118 not; some zooarchaeologists count all identifiable limb bone fragments; others count only a  
119 selected suite of diagnostic elements. Another issue concerns the inclusion or exclusion of  
120 bones from partial or complete skeletons in the counts. Where known in this survey, counts  
121 exclude associated groups of bones but this was not feasible in every case. It is also quite  
122 common for urban sites, in particular, to include assemblages dominated by waste  
123 accumulated by the large-scale butchery of cattle, (Maltby 2015), which is another reason  
124 why cattle have been excluded from this survey. To minimise problems created by small  
125 samples, a minimum NISP count of 50 sheep/goat and chicken elements was set.

126

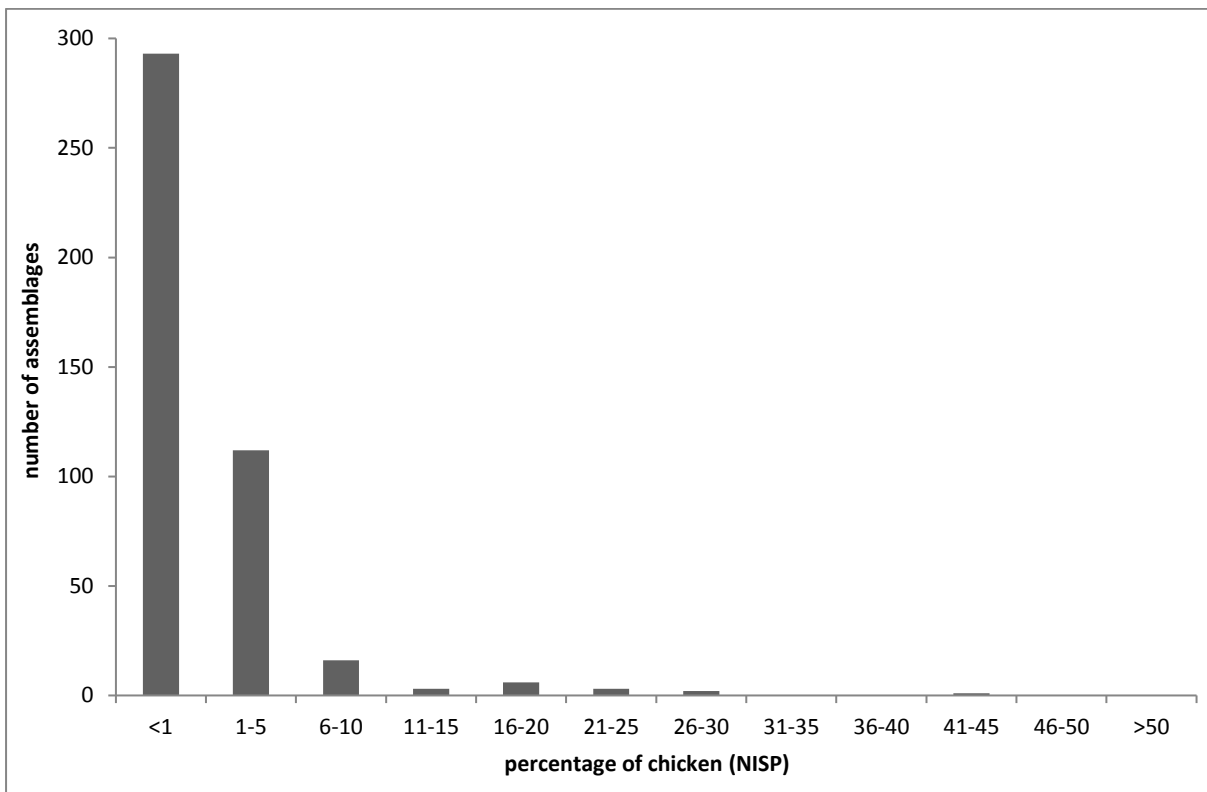
127 Data for the rural settlements, including nucleated sites, were obtained from the Roman Rural  
128 project website (Allen et al 2015). Data for the assemblages from the major urban sites were  
129 obtained from Maltby (2010a, 276) and supplemented by data obtained from more recently  
130 reported assemblages. Data from military sites were gathered from unpublished and  
131 published reports.

132

### 133 *2.2 Farmsteads and Villages*

134 Rural settlements were split into categories of farmsteads, villages, villas and roadside  
135 settlements based on the definitions set out by the Roman Rural Project. Many of the  
136 farmsteads could be further subdivided into unenclosed, enclosed or complex categories  
137 (Smith et al 2016). Over 67% of the 436 assemblages from farmsteads produced either no  
138 chicken bones at all or <1% of the total number of sheep/goat and chicken elements (Figure

139 1). A further 26% had <5% chicken. Of the few assemblages with unusually high percentages  
 140 of chicken (>15%) most had extenuating reasons to explain why they were unusually well  
 141 represented (Table 1). In several cases, most or all of the chicken bones accompanied human  
 142 burials; in others, they were derived from single contexts and were probably part of  
 143 associated bone groups (ABGs, Morris 2010). In one case they came from a site with  
 144 evidence of industrial processing and specialist butchery, more commonly encountered on  
 145 larger nucleated sites where chicken bones have often more commonly recovered.  
 146



147  
 148 Figure 1: Percentage of chicken of total sheep/goat and chicken NISP counts from farmsteads  
 149 (n=436)

150  
 151 Table 1: Rural assemblages with high percentages of chicken bones. Data derived from Allen  
 152 et al. (2015)

153  
 154 Thirty-two assemblages came from sites categorised by the Roman Rural Project as villages  
 155 (Smith et al. 2016). Of these, 18 (56%) contained <1% chicken and 10 (31%) 1%-5% chicken  
 156 of the total sheep/goat and chicken NISP counts. Three contained between 6% and 10%  
 157 chicken and only one, a very small assemblage from Abingdon, Oxfordshire, produced an



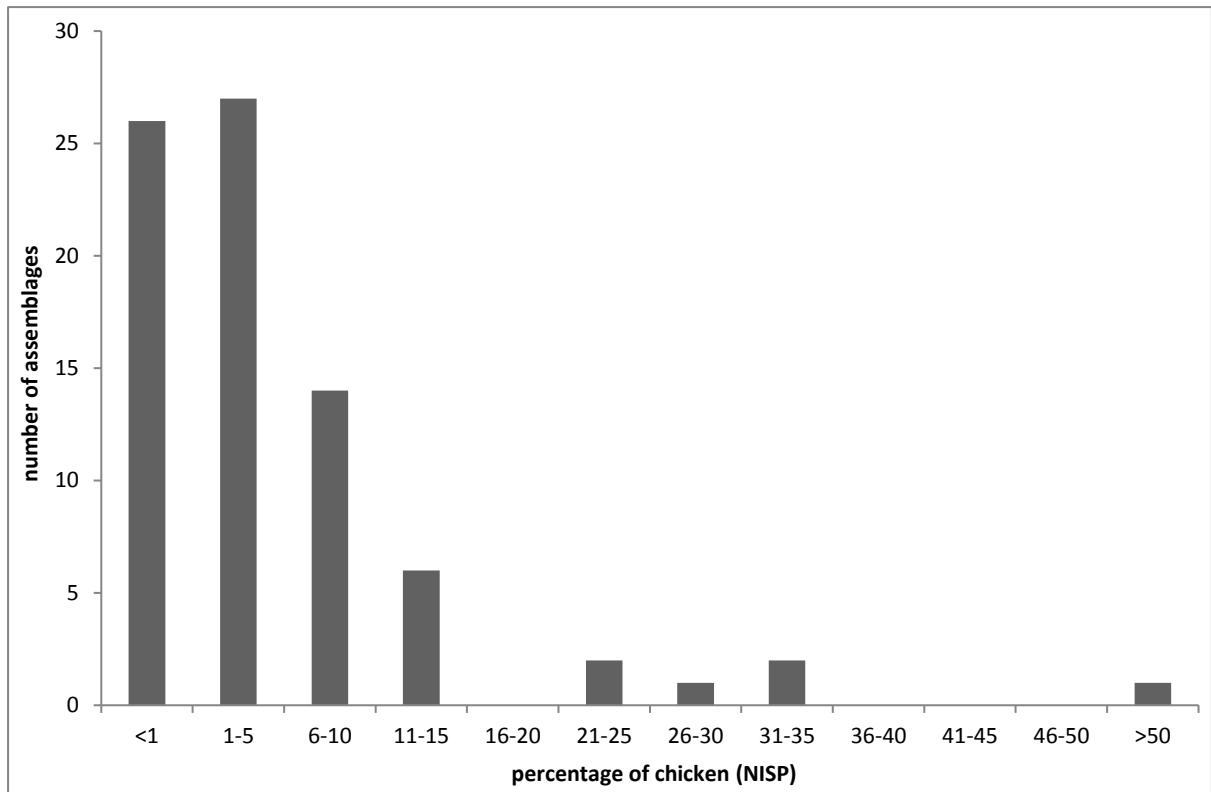
158 assemblage with over 15% chicken (Table 1). Generally, however, chicken bones were very  
159 uncommon components of faunal assemblages from all types of farmsteads and villages.

160

### 161 *2.3 Villas*

162 Most assemblages from villas also produced few chicken bones. In 33% of the 79  
163 assemblages, chickens contributed <1% of the total number of sheep/goat and chicken  
164 elements (Figure 2). However, chicken bones did quite commonly form higher percentages in  
165 villa assemblages, providing 1%-5% of sheep/goat and chicken elements in 34% of the  
166 assemblages and between 6%-10% in a further 18%. However, in only six cases did chickens  
167 provide over 20% of the sheep/goat and chicken elements (Table 1). Unsurprisingly, these  
168 included an assemblage from the spectacular Fishbourne Palace in West Sussex, a site which  
169 also produced exceptionally high percentages in the earlier Late Iron Age and Flavian  
170 deposits and continued to produce quite large quantities in the later Roman period (Allen  
171 2011). In two cases (Bancroft and Yarford), percentages of chicken bones increased  
172 significantly from assemblages that accumulated prior to the construction of the villas. The  
173 Castle Copse (Wiltshire) assemblage was the only one to produce more chicken than  
174 sheep/goat bones. This was partly due to their increased abundance in sieved deposits, but the  
175 assemblage was also remarkable for the dominance of pig bones (Payne 1997). None of these  
176 six assemblages had evidence for biases created by the presence of associated bone groups.  
177 There is therefore some evidence that chickens made a significantly greater contribution to  
178 the diet at some high status villa sites.

179



180

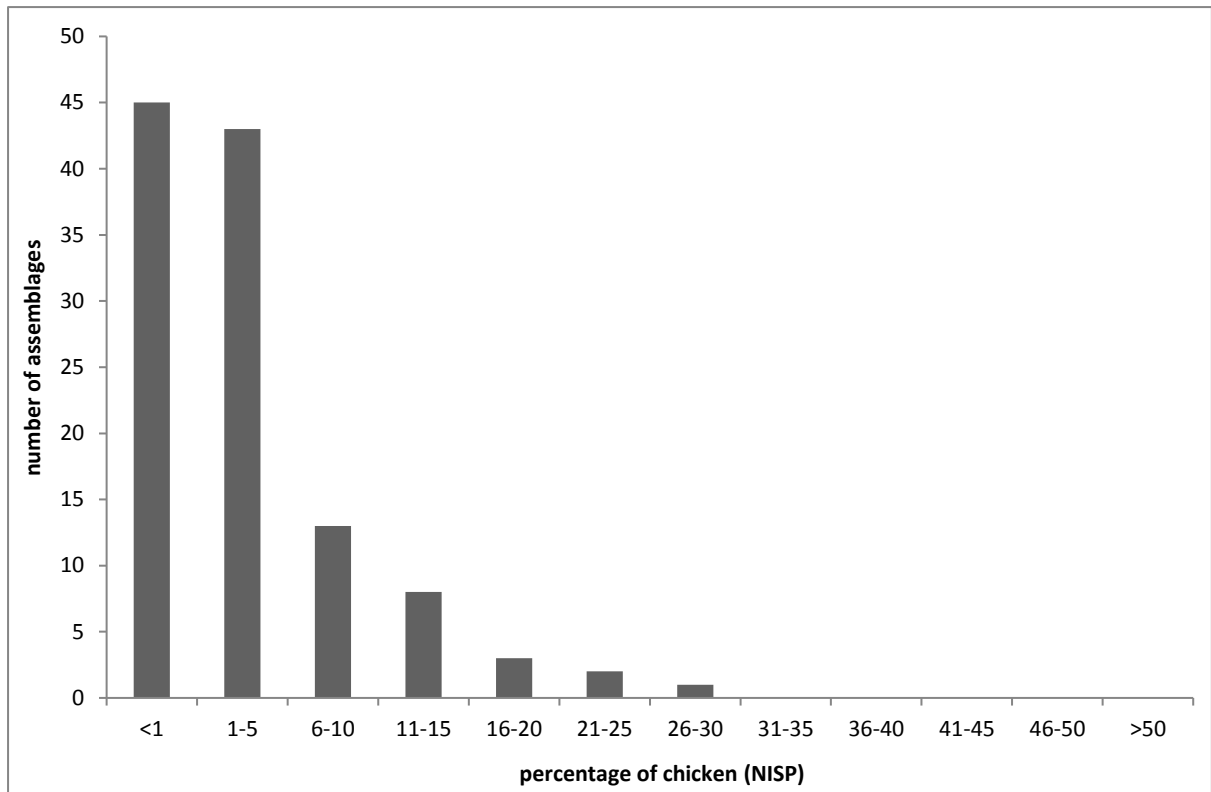
181 Figure 2: Percentage of chicken of total sheep/goat and chicken NISP counts from villas  
 182 (n=79)

183

184 *2.4 Roadside settlements*

185 These produced results similar to those obtained from villas (Figure 3). In 40% of the 115  
 186 assemblages, chickens provided <1% of the total number of sheep/goat and chicken elements,  
 187 and in a further 37% of the assemblages this figure lay between 1% and 5%. Chicken bones  
 188 contributed 6%-10% in a further 11% of the assemblages. In only six assemblages did  
 189 chickens provide over 15% of the sheep/goat and chicken elements (Table 1). Of these, the  
 190 assemblage from Skeleton Green (Ashdown and Evans 1981) is better characterised as a late  
 191 Iron Age oppidum displaying significant evidence of continental influence. It also produced  
 192 unusually large percentages of pig bones (Maltby 1997; Hambleton 2008). The two  
 193 assemblages from Staines, Surrey, are from a settlement where several excavations have  
 194 revealed evidence that indicates that the settlement had many urban characteristics, including  
 195 dumps of specialist butchery waste (Chapman 1984; 2010). The same case could be argued  
 196 for the settlements of Elms Farm, Heybridge, Essex (Johnstone and Albarella 2002) and  
 197 Shadwell, Greater London (Douglas et al. 2011).

198



199

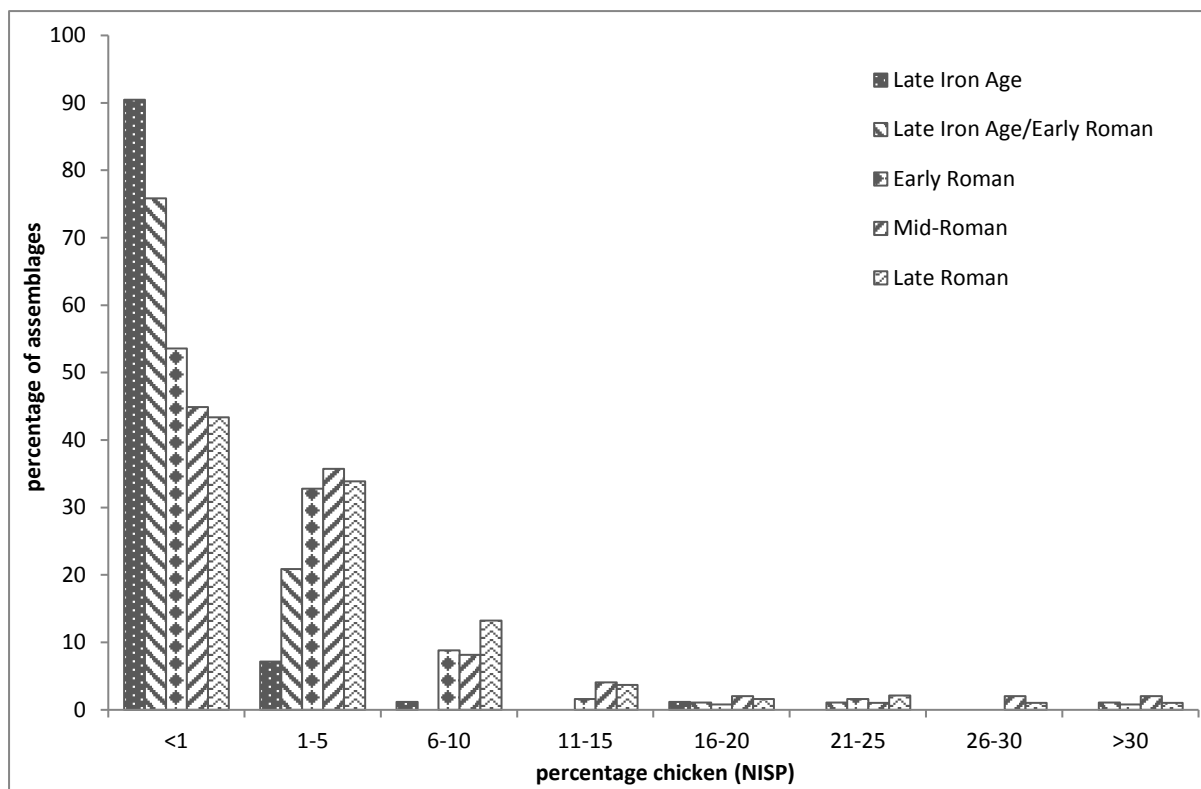
200 Figure 3: Percentage of chicken of total sheep/goat and chicken NISP counts from roadside  
 201 settlements (n=115)

202

203 *2.5. Chronological Variations.*

204 Rural assemblages (n=587) were sub-divided where possible into five broad periods ranging  
 205 from the late Iron Age through to the late Roman period (Figure 4). These confirmed that the  
 206 great majority had <1% chicken in the total sheep/goat NISP counts. However, the  
 207 percentage of assemblages in this category fell in each period from >90% in the Late Iron  
 208 Age down to 43% in the Late Roman period. Assemblages with 1%-5% chicken increased  
 209 from 7% in the late Iron Age sample to over 30% in the early Roman and later periods.  
 210 Assemblages with 6%-10% chicken bones formed over 8% of the early Roman sample, rising  
 211 to over 13% in the assemblages from the late Roman period. Chickens gradually became a  
 212 more consistent, albeit still minor component, of rural assemblages.

213



214

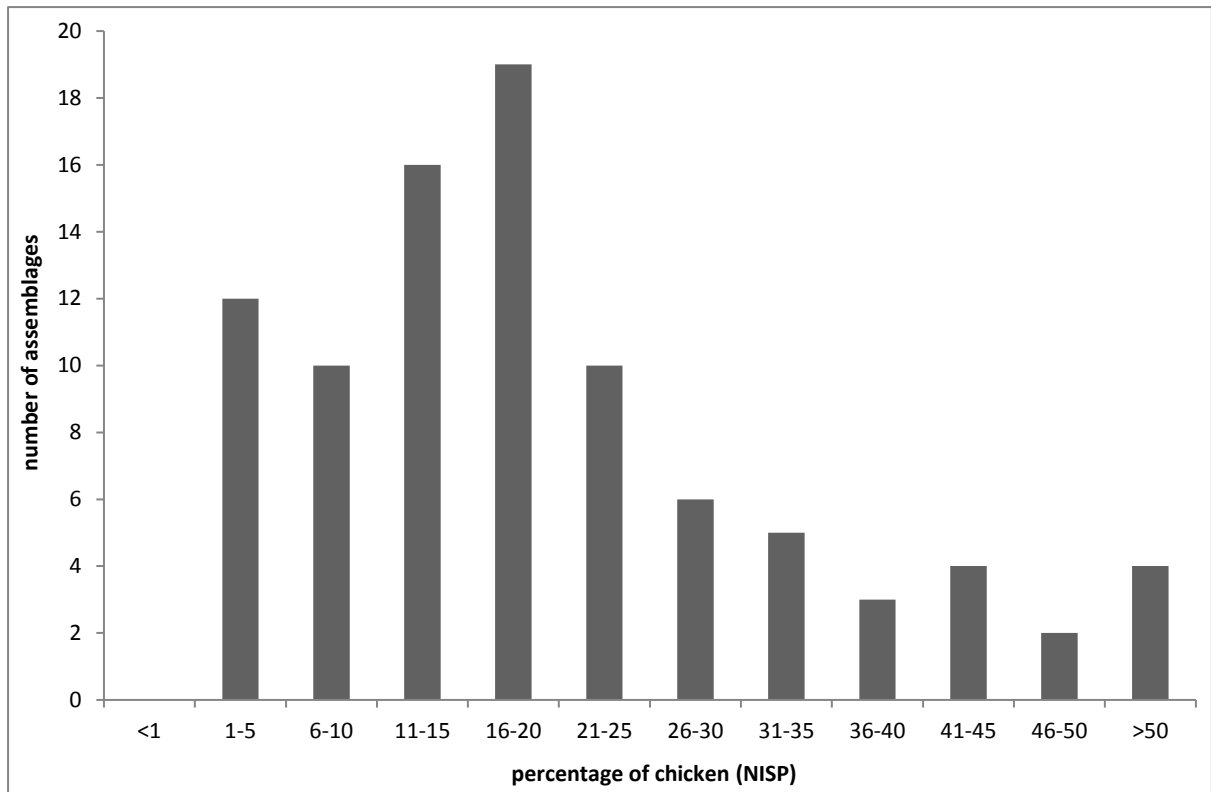
215 Figure 4: Percentage of chicken of total sheep/goat and chicken NISP counts from rural  
 216 settlements by period (n=587)

217

## 218 2.6. Urban assemblages

219 A total of 91 assemblages were obtained from 16 *civitas* capitals and *colonia* from Britain.  
 220 These showed a marked contrast with those from rural settlements (Figure 5). None of the  
 221 assemblages produced <1% chicken of the total sheep/goat and chicken NISP counts and  
 222 only 13% fell into the second lowest category (1%-5%). In contrast, 58% of the assemblages  
 223 included >15% chicken and the mode (21%) lay between 16%-20% chicken. Most of these  
 224 counts excluded bones in associated bone groups and bones from sieved assemblages were  
 225 not included. Although urban sites tend to produce better preserved assemblages than those  
 226 from rural settlements, it is very unlikely that this could account for all of the urban-rural  
 227 contrasts. Put simply, people living in towns were much more likely to eat chickens than  
 228 those living in the countryside. There is abundant butchery evidence (Figure 6) that supports  
 229 the increased use of chickens for meat in both the urban context, such as Exeter (e.g. Coles in  
 230 press). Similar evidence has been found on some rural sites including Fishbourne (Allen  
 231 2011, 223) and Shefford, Bedfordshire (Maltby 2010b).

232



233

234 Figure 5: Percentage of chicken of total sheep/goat and chicken NISP counts from urban  
 235 settlements (n=91)



236

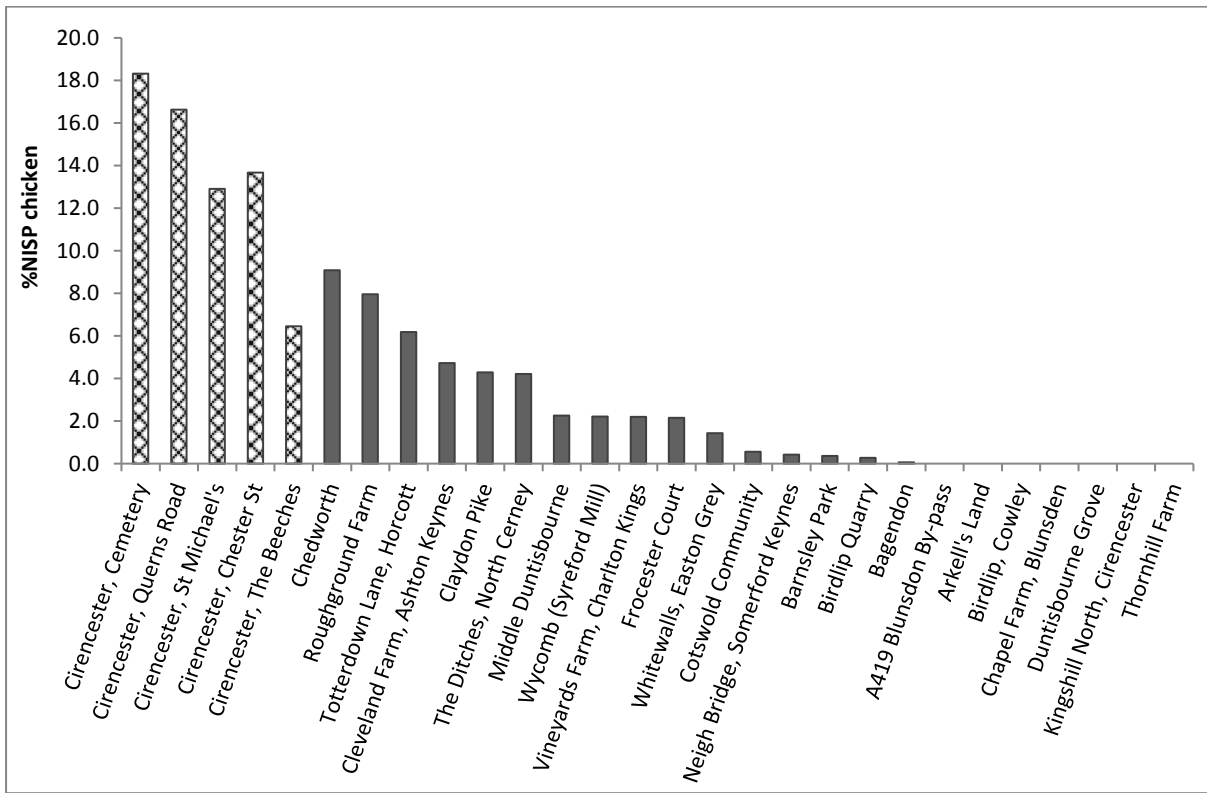
237 Figure 6: Chicken tibiotarsus from Exeter Princesshay showing diagonal knife-cuts on the  
 238 distal condyles characteristic of disarticulating the lower leg (Photo J. Best).

239

240 The contrast between urban and rural chicken abundance can be seen at a regional level, as  
 241 demonstrated by comparing sites from within the *civitas* capital of Cirencester and rural sites  
 242 in the local hinterland (Figure 7). This is not to say that the pattern is totally consistent. Sites

243 from Winchester have consistently produced assemblages in the 1%-5% chicken category,  
 244 whereas those from Dorchester, Exeter and Caerwent have nearly all produced over 15%  
 245 chickens (Maltby 2010a). The fact that most of the Winchester assemblages are from extra-  
 246 mural sites, whereas most of the assemblages from the other towns are from sites from central  
 247 areas of the towns may be significant, perhaps reflecting socio-cultural variations of diet in  
 248 different areas of the towns.

249



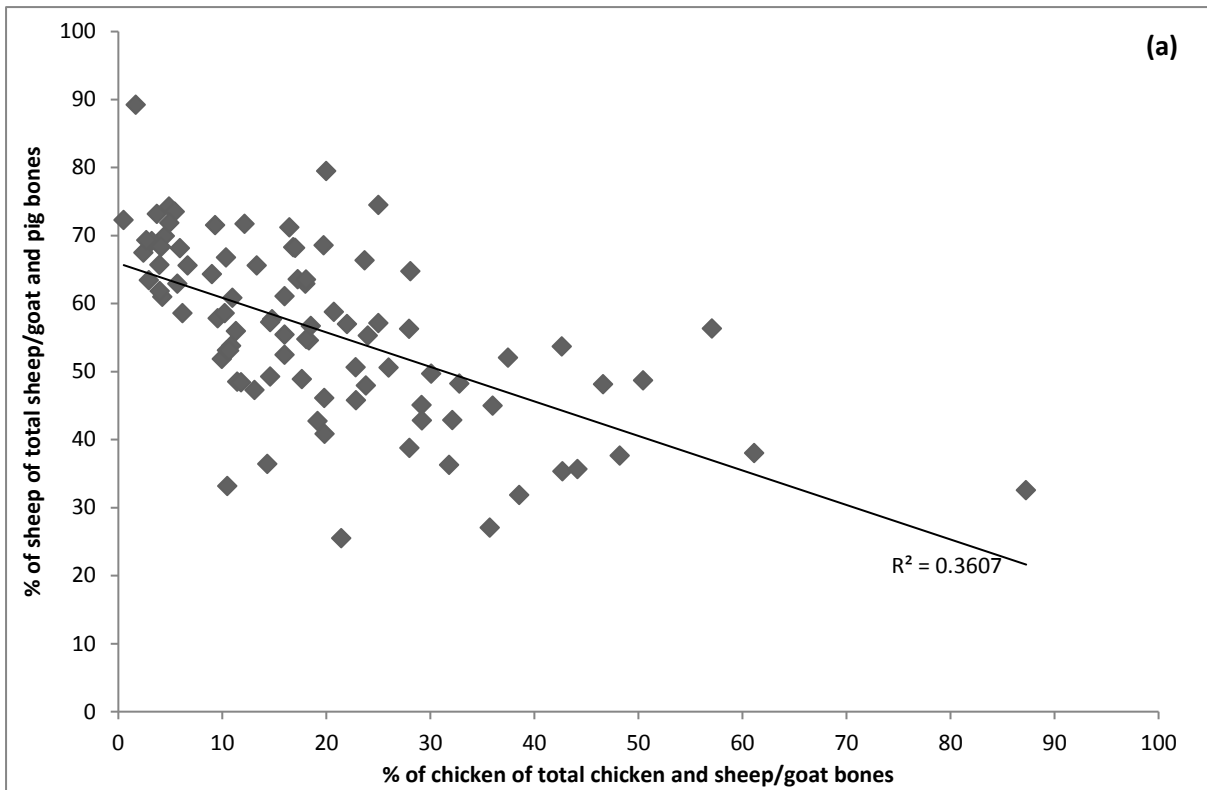
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251 Figure 7: Percentage of chicken of total sheep/goat and chicken NISP counts from sites in  
 252 Cirencester (checked pattern) and its hinterland (grey)

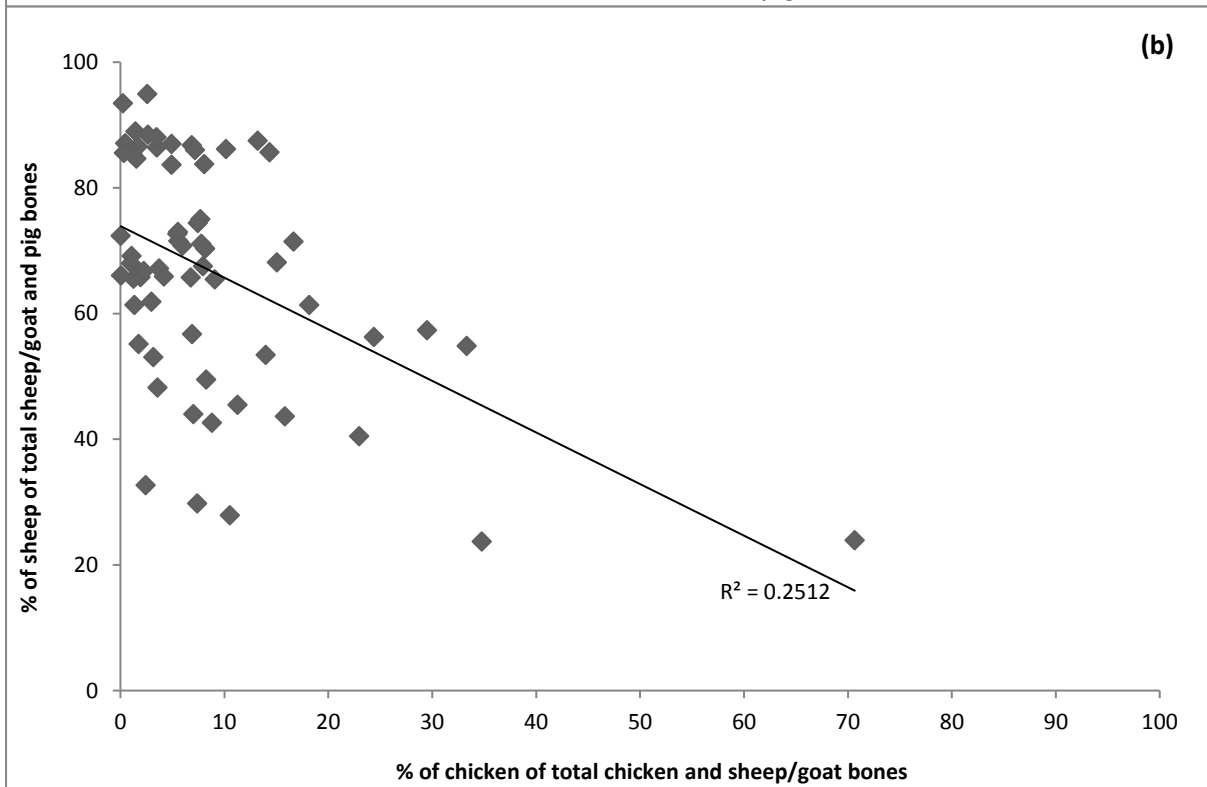
253

254 King (1984) observed that pigs often are more prominent in more Romanised settlements in  
 255 Britain. This updated review generally supports this interpretation, with assemblages from  
 256 both villas and towns that had higher percentages of chickens to sheep/goat also having  
 257 higher percentages of pig in relation to sheep/goat, although there is substantial variation  
 258 (Figure 8).

259



260



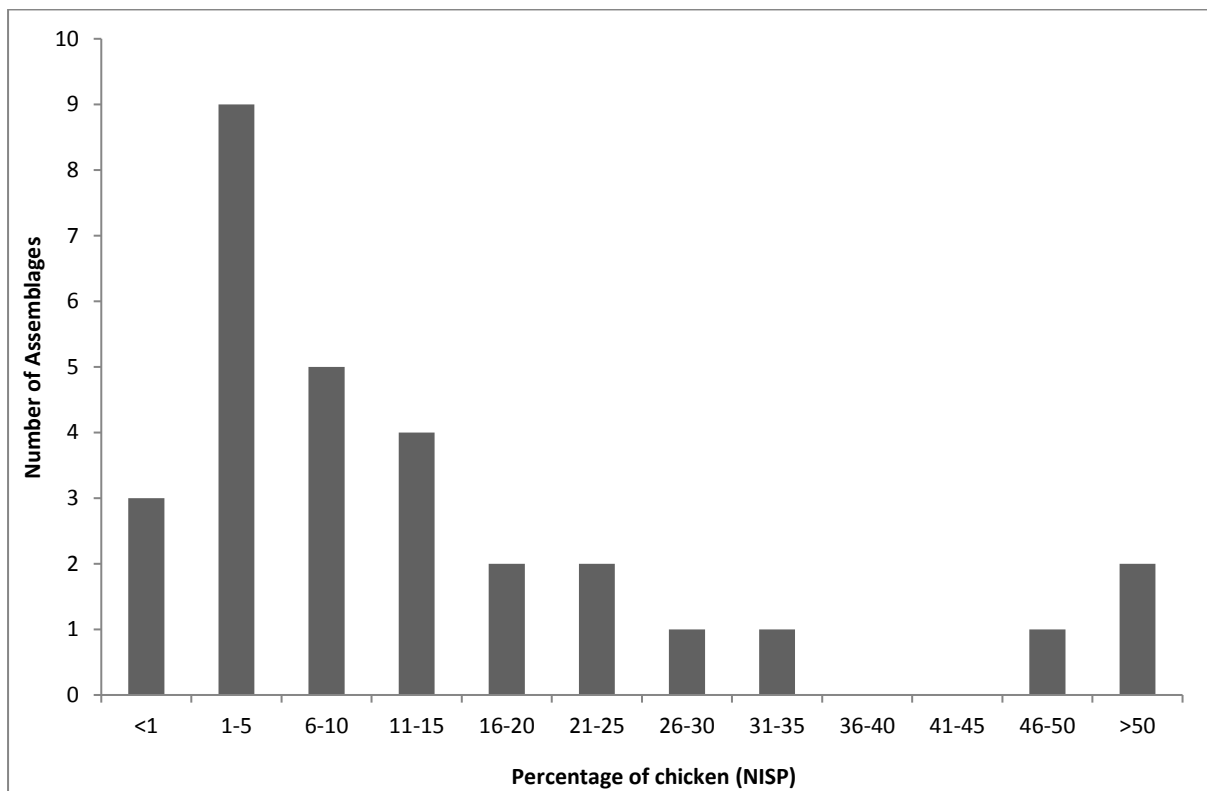
261

262 Figure 8: Comparisons of chicken/sheep and pig/sheep ratios in (a) urban (n=91) and (b) villa  
 263 (n=63) assemblages in Britain

264

265 2.7 Military Sites

266 Excluding vici, 30 assemblages from military sites were considered (Figure 9). Nine (30%) of  
 267 these fell within the 1%-5% chicken bracket but a similar number produced >15% chicken. A  
 268 wide range of variability is to be expected as this category covers a wide range of sites  
 269 ranging from large fortresses to small auxiliary forts in different parts and periods in Roman  
 270 Britain. However, the tendency was for chickens to be better represented than on rural  
 271 settlements, but not as consistently as well represented as in towns. There are also indications  
 272 that chicken meat may have been more available to high-ranking officers at the supply  
 273 fortress at South Shields (Stokes 2000) and the legionary fort in Caerleon (Hamilton-Dyer  
 274 1993). At the latter, chicken bones were particularly prominent in the drains of the baths,  
 275 (O'Connor 1986), indicating that chickens were commonly eaten by the bathers.  
 276



277  
 278 Figure 9: Percentage of chicken of total sheep/goat and chicken NISP counts from military  
 279 sites (n=30)

280  
 281 *2.8 Religious and Burial Sites and other Depositions*

282 King (2005) demonstrated that chickens were sometimes very well represented at temples  
 283 and shrines in Roman Britain. The best known example comes from Uley, Gloucestershire,  
 284 where goat and chickens were sacrificed in large numbers at a temple dedicated to Mercury  
 285 (Levitan 1993; Brothwell 1997). Substantial amounts of chicken bones have also been



286 reported from other temple sites at Brigstock, Northamptonshire, and Folly Lane, St Albans,  
287 Hertfordshire (King 2005). The highest percentage of chickens (87%) from the 91 urban  
288 assemblages discussed above came from near the Temple of Mithras in London (Macready  
289 and Sidell 1998). Continental examples are also well known, including amongst many others,  
290 the temple associated with Mithras at Tienen, Belgium (Lentacker et al. 2003a; 2003b) and  
291 the temple at Carnuntum–Mühläcker, Austria dedicated to Jupiter (Gál and Kunst 2010). It  
292 should be noted, however that by no means every temple and shrine has evidence of votive  
293 offerings of chickens, even where the sacrifice of other animals is prominent (King 2005). On  
294 the other hand, in Roman Britain chicken bones have quite commonly been found in  
295 association with inhumations and cremations in both urban and rural cemeteries, showing that  
296 they had multiple roles, including food for the dead and votive offerings (Morris 2011). As  
297 discussed above, they quite often feature much more prominently in grave deposits than in  
298 other contexts.

299

### 300 **3. The exploitation of chicken eggs**

301

302 When considering chickens in Roman diet, it is also important to recognise the secondary  
303 products that they can provide, particularly eggs. Chicken eggs become increasingly  
304 prominent as food items in Roman and Roman-influenced contexts. Their production and use  
305 can be traced by integrating multiple lines of evidence and analytical techniques including  
306 historical sources, archaeological eggshell and medullary bone.

307

#### 308 *3.1 Documentary evidence*

309 Documentary sources can provide insights into productivity, use and trade. On Hadrian's  
310 Wall, tablets from the fort of Vindolanda written in the 1st and 2nd centuries AD indicate that  
311 eggs as well as chickens were valuable resources to be acquired:

312 "... bruised beans, two modii, **chickens, twenty**, a hundred apples, if you can find nice ones,  
313 **a hundred or two hundred eggs, if they are for sale there at a fair price**. ... 8 sextarii of  
314 fish-sauce ... a modius of olives ... (Back) To ... slave (?) of Verecundus" (Tablet 302,  
315 Translation: Bowman and Thomas 1983).

316 This particular statement does not indicate specifically that these were chicken eggs, but  
317 given the reference to chickens earlier in the tablet, it is a fair assumption to make,  
318 particularly given the quantity requested. No eggshell has yet been recovered from

319 excavations at Vindolanda, and whilst this may result from preservation conditions, it could  
320 be that eggs were not locally available. The desire to obtain them as a special order probably  
321 reflects their high value.

322 Columella's *Res Rustica* is one of several agricultural works that provide instructions for the  
323 care of egg-laying chickens, including housing requirements and modifying feed to make  
324 hens lay sooner, more often and with larger eggs. He also describes aspects of productivity  
325 and preservation, such as transferring eggs for hatching to capable broody hens, and using  
326 chaff, bran and salt for egg storage. Columella and other ancient sources such as Varro even  
327 suggest that certain types of chicken, including those with five toes, were the best for egg  
328 laying and brooding.

329 Although rare, recipes can demonstrate how eggs could contribute to diet. Apicius' *De Re*  
330 *Coquinaria* a collection of recipes, compiled in the late 4th or early 5th AD, shows that they  
331 had a wide range of culinary uses, including clarifying muddy wine, and an ingredient in  
332 brain sausages and many sauces. Of course, it is unknown how widespread these recipes and  
333 agricultural guides were practised beyond Italy, as documentary sources are often limited in  
334 applicability by being restricted in period and place.

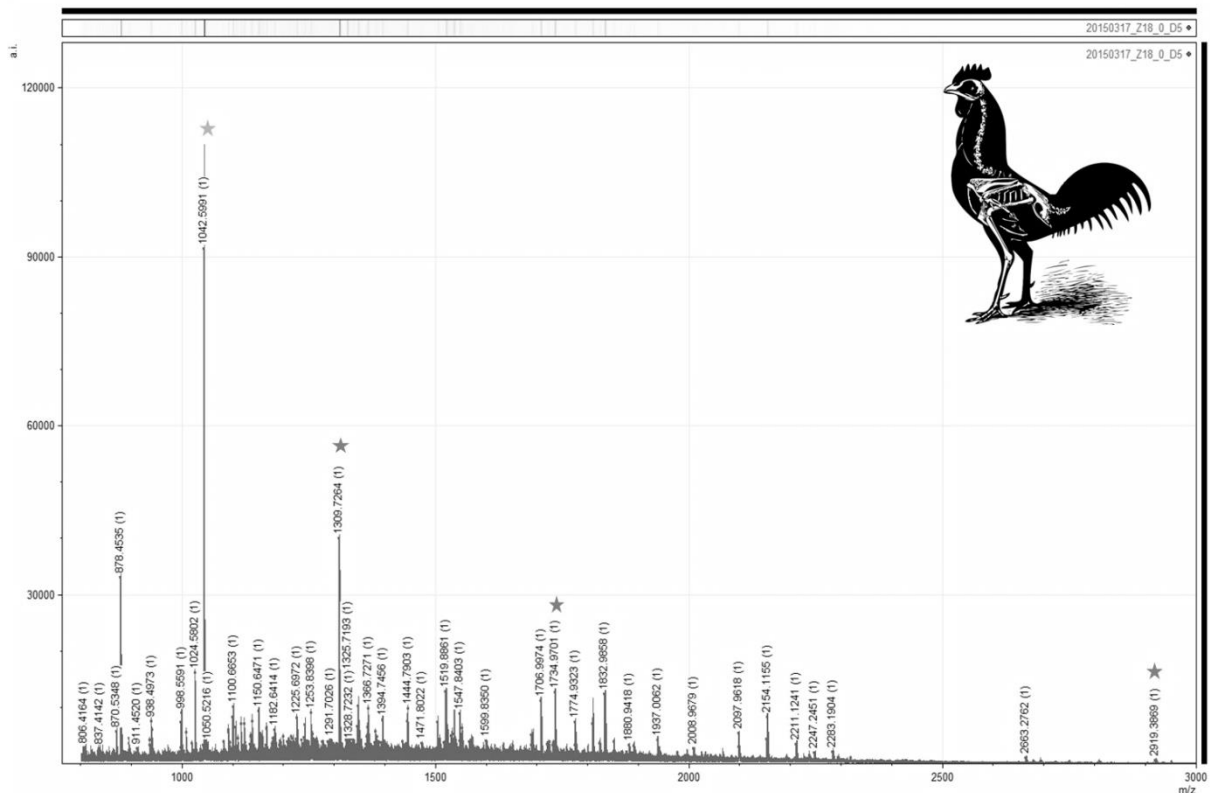
### 335 3.2 Eggshell

336 Eggshell is found fairly regularly on archaeological sites, although thorough soil processing  
337 is generally needed for its recovery. Eggshells were recorded on 38 sites collated by the  
338 Romano-British rural settlement project (Allen et al. 2015), although rarely were the  
339 eggshells further identified. Eggshell can be identified to species via microscopy (Sidell  
340 1993), although this has significant limitations (Best et al. in prep), and more recently by  
341 ZooMS (Zooarchaeology by Mass Spectrometry) which identifies taxa-specific peptide mass  
342 markers (Demarchi et al. 2016; Stewart et al. 2013; Presslee et al. in prep.). These two  
343 methods can be combined: using ZooMS for species identification and microscopy to identify  
344 the stage of chick development within the egg (since the developing chick takes calcium from  
345 the eggshell to aid bone formation, causing changes to the interior surface of the eggshell)  
346 (Beacham and Durand 2007; Best et al. in prep).

347 One of the first archaeological eggshell assemblages to be analysed using both techniques  
348 came from the military amphitheatre at Chester, Cheshire, where substantial amounts of  
349 eggshell were found. The bulk of this material came from two deposits: a well-stratified early  
350 assemblage from AD70-80, which correlates with the first phase of amphitheatre use, and a

351 second dating to AD100 from substantial deposits underneath the seating banks (Wilmott  
 352 pers. comm.). The ZooMS results indicate that all analysed fragments were from chicken  
 353 eggs (a representative ZooMS spectrum is shown in Figure 10). Microscopy revealed that  
 354 *c.*90% of the analysed fragments from the AD100 deposits showed no signs of reabsorption  
 355 associated with chick development. Therefore almost all of the eggs were freshly laid, halted  
 356 early in their incubation sequence, or infertile. In this instance the assemblage appears to  
 357 represent food consumed by spectators watching events at the amphitheatre. Such snacks  
 358 foods may have been on sale outside the amphitheatre as appears to be depicted in a fresco of  
 359 the Pompeii amphitheatre (Ellis 2004). This evidence suggests that chicken eggs were traded  
 360 from a relatively early period of Roman occupation in Britain, at least on military and  
 361 associated sites.

362 The eggshells from the AD70-80 phase at the Chester amphitheatre, whilst all identified as  
 363 chickens, had more varied stages of development, potentially indicating that not all of the  
 364 eggs were consumed fresh.



365  
 366 Figure 10: Annotated mass spectrum (ZooMS) of Chester Amphitheatre AD70-80 chicken  
 367 eggshell from context 625. Species and family specific markers are represented by star  
 368 symbols (following Presslee et al. in prep.).

369

### 370 3.3 Medullary Bone

371 The analysis of medullary bone, a calcium deposit for egg production laid down on the  
372 endosteal surface of the medullary cavity, is a useful method for identifying the presence of  
373 laying hens in the archaeological record (van Neer et al. 2002, 129-132). It can be used to can  
374 give an indirect insight into breeding and egg production on sites where eggshell is not  
375 recovered. It can be identified by macroscopic assessment of fragmented bones. However, by  
376 employing non-destructive x-ray analysis its presence or absence can also be determined for  
377 complete bones. This combined approach allows broad sex profiles to be identified for whole  
378 assemblages (Best in prep.). For example, no eggshell was available for identification at  
379 Fishbourne Palace, but observations of medullary bone in the fragmented bone assemblage  
380 (Allen 2011) indicated that laying hens were present at the site, either as live birds or dead  
381 meat resources. The femur is the best element for examining medullary bone in chickens  
382 since the fill is most substantial and enduring in this bone. X-ray analysis of the Fishbourne  
383 assemblage increased the overall recorded occurrence of medullary bone from 8% to 20% of  
384 the femora. The majority of the deposits only occupied a small proportion of the bone cavity,  
385 perhaps indicating that these birds were killed for meat at the end of lay, either permanently  
386 or temporarily as a result of moulting, illness or dietary deficiencies. This suggests that these  
387 birds were kept for egg production, with meat being a secondary consideration. The hens at  
388 Fishbourne may have been kept on site, but the possibility that some were traded from  
389 elsewhere, such as the nearby town of Chichester, should not be ruled out.

390 Absence of medullary bone can also be valuable for profiling the birds that were contributing  
391 to Roman diet and life. Bones without medullary deposits can belong to males, but also to  
392 females not in lay, or with no deposit in that specific skeletal element. At the temple site of  
393 Uley, medullary bone was scarce. When combined with spur evidence and metrics, these data  
394 support the interpretation that a large proportion of the birds sacrificed were male (Brothwell  
395 1997; Fothergill and Best in prep.). These birds would probably have been consumed in  
396 multiple ways: as meat, but also psychologically and metaphorically as spiritual offerings. A  
397 similar pattern can also be seen on the continent at sites such as Tienen in Belgium where  
398 over 7,600 chicken bones were found, representing at least 238 individuals (155 adults; 83  
399 subadults) which were deposited in a pit after what appears to have been a single very large  
400 ritual feasting event (Lentacker *et al.* 2004a, 77-81; 2004b). This site was associated with the  
401 god Mithras, who in turn was often connected with the cockerel. Again, several lines of  
402 evidence indicate that these birds were primarily males and no medullary bone was identified

403 in the fragmented material or in x-rayed whole bones. This demonstrates that several  
404 elements of ritual consumption in the Roman world are found in multiple geographic  
405 locations.

406

#### 407 **4. Pathology**

408

409 One palaeopathological hallmark of Roman-era avian bone assemblages is the presence of  
410 avian osteopetrosis, a pathology which is routinely identified in material from sites across  
411 Europe. These lesions are caused by a range of avian leucosis viruses, spread through contact  
412 as well as from hen to chick and through genomic transmission (Pruková et al., 2007). Avian  
413 osteopetrosis lesions are distinctive in appearance, consisting of hypermineralised endosteal  
414 and periosteal new bone formation in the diaphyses of affected elements (Figure 11), which  
415 can be differentially diagnosed through radiography (O'Connor and O'Connor 2005). Avian  
416 leucosis viruses affect various species of domestic poultry and cause a number of detrimental  
417 physical and behavioural symptoms which negatively impact vivacity, egg-laying, and weight  
418 gain (Holmes, 1961; Payne 1992; Uzunova et al. 2014; Vogt, 1977).

419



420

421 Figure 11: Tibiotarsus with avian osteopetrosis lesions from Uley, shown with a modern  
422 comparative element

423

424 Although it is possible that avian leucosis viruses affected poultry flocks in earlier periods  
425 (particularly as infection does not always result in bony lesion formation), the earliest  
426 archaeological evidence of avian osteopetrosis originates from Tiberian contexts at Roman  
427 military sites: the fort and naval base at Velsen in the Netherlands and the fort at Aulnay in  
428 France (Prummel, 1987; Lignereux and Peters, 1997). The Roman assemblage from Carlisle  
429 (Old Grapes Lane), also dating to the 1<sup>st</sup> century AD, contained two elements described as  
430 osteopetrotic (Allison 2010). The proportional frequency of avian osteopetrosis lesions  
431 identified in archaeological assemblages increases in the first and second centuries AD, and  
432 the initial geographic spread of avian leucosis viruses is likely to be linked to the movement  
433 of people and their animals around the Empire (Fothergill in press). Since animal husbandry  
434 plays a key role in pathogenesis, it is possible that Roman chicken-keeping methods and the  
435 environments in which these birds were kept fostered the transmission of avian leucosis  
436 viruses. These husbandry techniques have a direct link to human diet in terms of the quantity  
437 and quality of chicken resources available. These data also provide insights into how the diet-  
438 related cycle of production, distribution and consumption affected many aspects of animal  
439 health and avian-human interactions.

440

## 441 **5. Discussion**

442

443 Although there is evidence that the consumption of chicken meat and eggs increased during  
444 the Romano-British period, they were still nevertheless a rare commodity. The  
445 zooarchaeological data has shown that meat supply was heavily dependent upon the provision  
446 of beef, particularly in towns (King 1999; Hesse 2011; Maltby 2015). This is supported by  
447 lipid residue analysis. In Silchester, for example, most residues were composed of ruminant  
448 fats (Marshall et al 2008; Colonese et al. in press). In Britain, chicken meat and eggs would  
449 have been regarded as luxury foods obtained from an exotic, recently introduced, species. It  
450 is no surprise that they were consumed more readily on settlements where Roman and other  
451 continental influences were more prominent, reflecting the greater cultural and culinary  
452 diversity of the inhabitants. The greater dominance of chicken in Romano-British urban  
453 deposits is mirrored in other parts of the western Roman Empire, including northern France  
454 (Lepetz 1996) and Switzerland (Groot and Deschler-Erb 2015), as well as across much of  
455 North Africa (Fothergill and Sterry in press; Fothergill et al. in press). Given their special  
456 status combined with their convenient small size, it is understandable that chickens continued

457 to be sacrificed as votive offerings, linked with a number of deities and buried with humans  
458 even on settlements where they were probably rarely eaten. The supply of chickens may  
459 sometimes have been challenging, as indicated by the Vindolanda tablet and this challenge  
460 would have been heightened by the need to supply birds for sacrifice some of the temple  
461 sites. It is also likely that many chickens were raised in towns, where there was, at least  
462 initially, a greater demand for their products. Bones of very young chicks have been found in  
463 Winchester, Hampshire indicating at least some of the birds were being bred in the town  
464 (Maltby 2010a). The appearance of avian osteopetrosis lesions may also be linked to keeping  
465 chickens in more confined environments (Fothergill in press).

466

467 However, whilst all strands of evidence examined here indicate that the Roman period in  
468 Britain sees an increased use of chicken meat and eggs for food, these animals continued to  
469 hold multiple other roles within society and culture; from deity companions to luxury goods.  
470 Therefore, whilst frequently the archaeology of chickens, and particularly their  
471 zooarchaeological record, is seen primarily in terms of diet, this is not the only avian-human  
472 interaction that needs to be considered.

473

474 As such, this integrated approach incorporating traditional zooarchaeological methods  
475 alongside historical sources and a suite of scientific analyses shows that the investigation of  
476 avian demography can provide insights into their complex relationships with humans and  
477 resultantly inform upon and beyond human diet.

478

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Region	Site	Type	Assemblage Date	NISP	S/G	Chicken	%Chicken	Comments and original source
Central Belt	Broughton Manor Farm	unenclosed farmstead	1st C BC-mid 1st C AD	97	78	19	19.59	Chicken bones from cremations (Atkins et al 2014)
Central Belt	Wavendon Gate, Milton Keynes	enclosed farmstead	1st C BC/AD	209	171	38	18.18	Chicken bones from cremations (Dobney and Jaques 1996)
Central Belt	Pasture Lodge Farm, Long Bennington	farmstead (unclassified)	3rd-4th C AD	412	342	70	16.99	Includes chicken ABG (Harman 1994)
Central Belt	Woolram Wygate, Spalding	farmstead (unclassified)	3rd-4th C AD	72	55	17	23.61	Includes chicken ABG (Wood 2006)
South	Maiden Castle Road	farmstead (unclassified)	1st-4th C AD	224	186	38	16.96	Chicken bones from inhumation (Bullock and Allen 1997)
East Anglia	Foxton	complex farmstead	1st-4th C AD	366	297	69	18.85	Chicken bones from inhumation (Maynard et al 1997)
Central Belt	Empingham	enclosed farmstead	3rd-4th C AD	273	221	52	19.05	Most chicken bones from a well (Morrison 2000)
South	St Georges Road, Dorchester By-pass	field system	3rd-4th C AD	135	106	29	21.48	Chicken bones all from one pit (Bullock and Allen 1997)
Central Belt	Brogborough Hill (A421 Site 2)	complex farmstead	2nd-3rd C AD	60	34	26	43.33	All chicken bones from one oven (Barker et al 2006)
Central Belt	Langdale Hale, Earith, Colne Fen	complex farmstead	2nd-3rd C AD	250	182	68	27.20	Site includes specialist butchery deposits (Higbee 2004)
West Midlands	Grimstock Hill, Coleshill	enclosed farmstead	1st-2nd C AD	84	64	20	23.81	All chicken bones from one context (Magilton 2006)
North-East	Burnby Lane, Hayton	farmstead (unclassified)	3rd-4th C AD	185	131	54	29.19	Many bones from well (Halkon et al. 2017)
Central Belt	Abingdon, The Vineyard	village	1st-4th C AD	50	42	8	16.00	(Wilson 1993)
South	Fishbourne	palace	1st-2nd C AD	1035	797	238	23.00	34% in 1st C BC/AD deposits; 15% n 3rd-4th C AD (Allen 2011)
Central Belt	Latimer	villa	2nd-3rd C AD	61	43	18	29.51	(Branigan 1971)
Central Belt	Bancroft	villa	2nd-3rd C AD	111	74	37	33.33	1% in 1st-2nd C AD; 5% in 3rd-4th C AD (Levitan 1994)
South	Liss	villa	3rd-4th C AD	115	75	40	34.78	(Hamilton-Dyer 2008)
Central Belt	Yarford, Kingston St Mary	villa	3rd-4th C AD	291	220	71	24.40	7% in 1st C BC/AD farmstead (Allen 2006)
Central Belt	Castle Copse, Great Bedwyn	villa	3rd-4th C AD	1251	367	884	70.66	Very high % of pig; sieved (Payne 1997)
East Anglia	Braughing, Skeleton Green	roadside settlement	Late 1st C BC-mid 1st C AD	586	449	137	23.38	LIA oppidum (Ashdown and Evans 1981)
South	Heybridge, Elms Farm	roadside settlement	2nd-3rd C AD	302	247	55	18.21	2% in 1st-2nd C AD; 7% in 3rd-4th C AD (Johnstone & Alberella 2002)
South	Staines, Friends' Burial Ground site	roadside settlement	2nd-3rd C AD	432	342	90	20.83	9% in 1st-2nd C AD; 0% in 3rd-4th C AD (Chapman 1984)
South	Staines, Elmsleigh Centre 1975-78	roadside settlement	3rd-4th C AD	318	260	58	18.24	5% in 1st-2nd C AD (Chapman 2010)
Central Belt	Wimpole	roadside settlement	3rd-4th C AD	92	70	22	23.91	(Horton et al 1994)
South	Shadwell, Tobacco Dock	roadside settlement	3rd-4th C AD	292	211	81	27.74	Sieved; dominated by cattle (Douglas et al. 2011)