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

This is a pre print version of the following article:

Original Citation:

Availability:

This version is available <http://hdl.handle.net/2318/1689349> since 2019-02-04T10:42:40Z

Published version:

DOI:10.1016/j.jasrep.2017.09.013

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(Article begins on next page)

Manuscript Details

Manuscript number	JASREP_2017_199
Title	Counting Roman Chickens: Multidisciplinary Approaches to Human-Chicken Interactions in Roman Britain
Short title	Counting Chickens in Roman Britain
Article type	Research Paper

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.

Keywords	Zooarchaeology; Chickens; Roman Britain; Eggshell; Medullary bone; Pathology
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Suggested reviewers	Dale Serjeantson, Tony King, Pam Crabtree, James Morris, Bea De Cupere

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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

1 **Counting Roman Chickens: Multidisciplinary Approaches to Human-Chicken**
2 **Interactions in Roman Britain**

3
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12
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21 that there were significant variations in the abundance of chicken bones found on different
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24 only a rare commodity. However, they continued to be frequently represented in graves,
25 shrines and other ritual deposits. The paper also discusses evidence of egg production and
26 avian osteopetrosis, demonstrating that when traditional zooarchaeological research is
27 integrated with scientific analyses, a deeper understanding of past human diet can be
28 acquired.

29
30 **1. Introduction**

31
32 The history of the domestication and westward spread of the chicken or domestic fowl
33 (*Gallus gallus domesticus*) out of Asia is currently the focus of much debate (Xiang et al.
34 2014, 2015; Perry-Gal et al. 2015; Peters et al. 2015; Eda et al. 2016; Pitt et al. 2016).
35 However, the species does not appear to have spread across Europe prior to the late
36 prehistoric period. The earliest confirmed record for the presence of chickens in Britain is

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

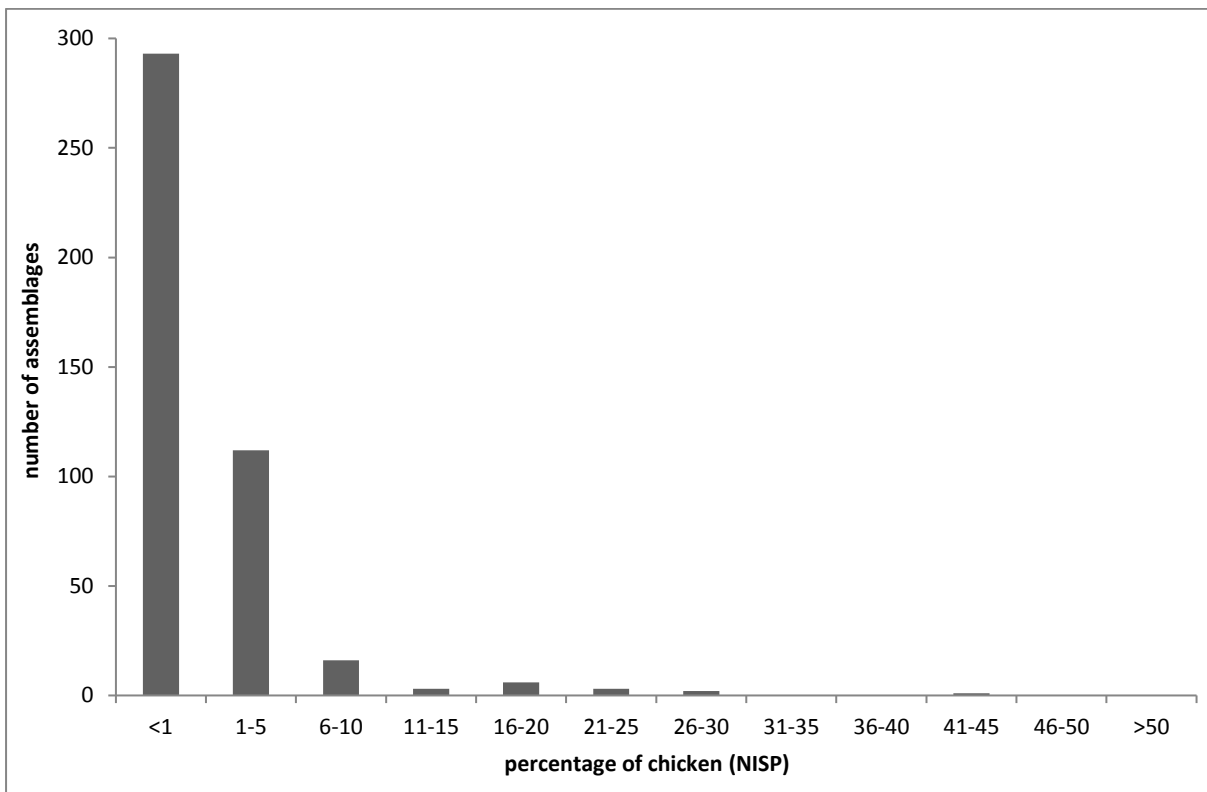
127 Data for the rural settlements, including nucleated sites, were obtained from the Roman Rural
128 project website (Allen et al 2015). Data for the assemblages from the major urban sites were
129 obtained from Maltby (2010a, 276) and supplemented by data obtained from more recently
130 reported assemblages.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

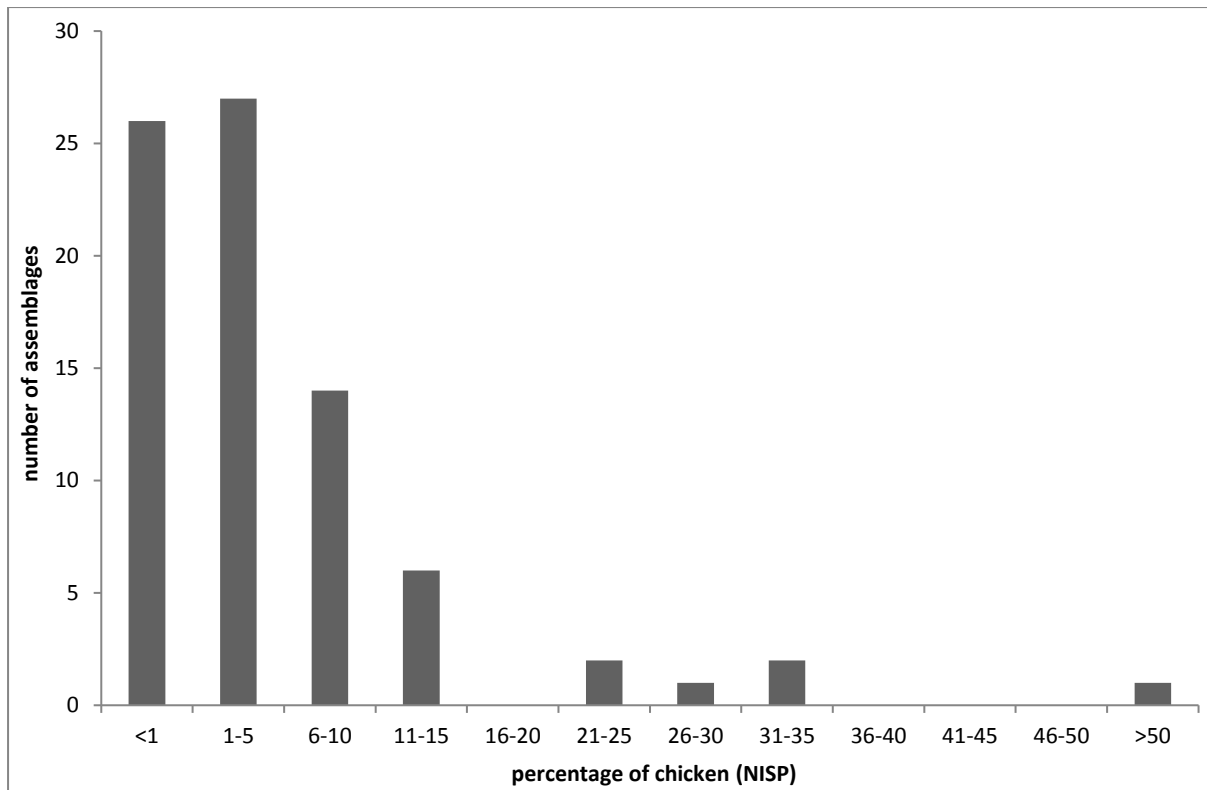
158 assemblage with over 15% chicken (Table 1). Generally, however, chicken bones were very
159 uncommon components of faunal assemblages from all types of farmsteads and villages.

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

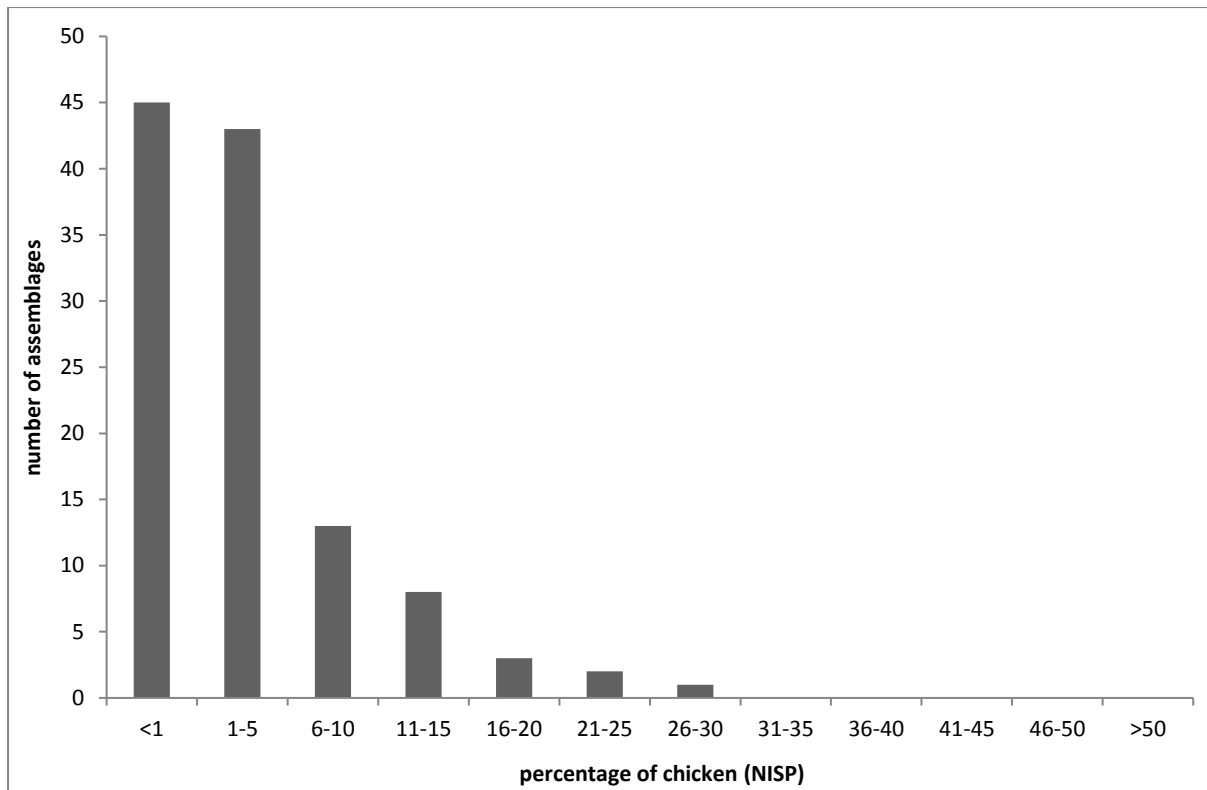
181 Figure 2: Percentage of chicken of total sheep/goat and chicken NISP counts from villas
 182 (n=79)

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

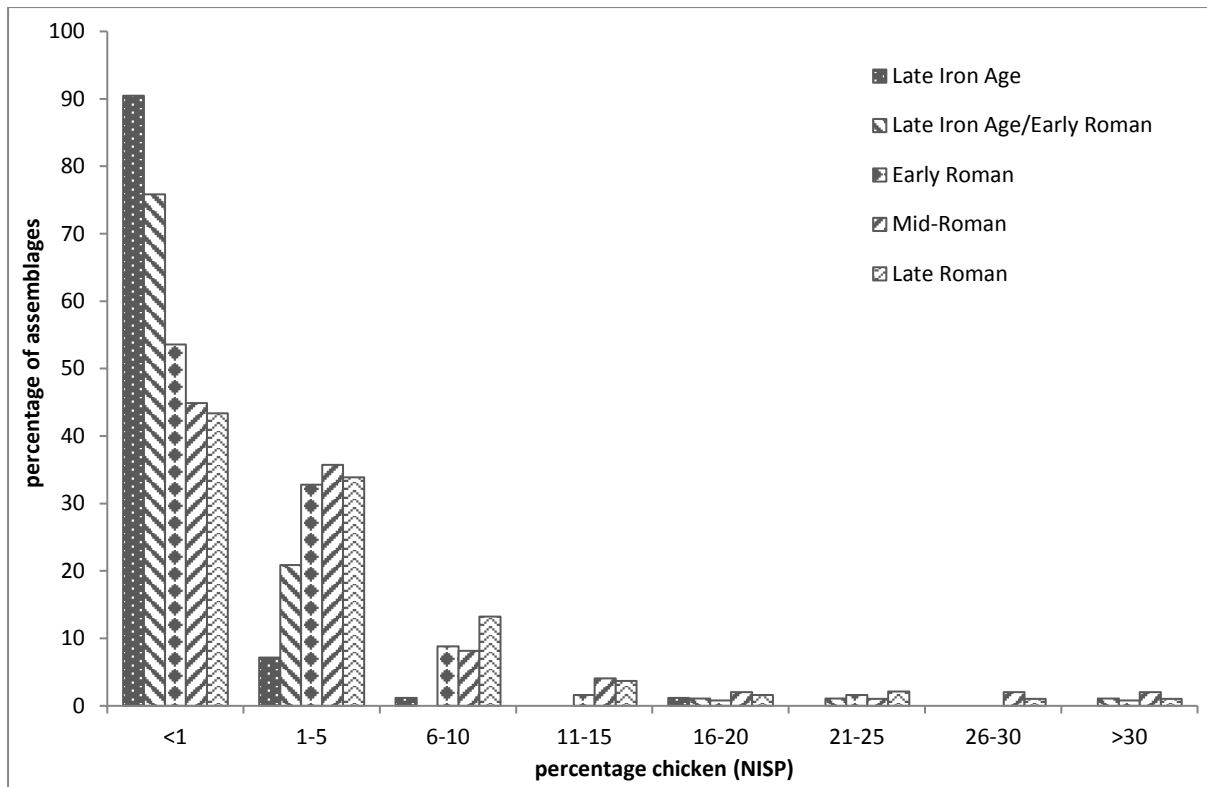
200 Figure 3: Percentage of chicken of total sheep/goat and chicken NISP counts from roadside
 201 settlements (n=115)

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

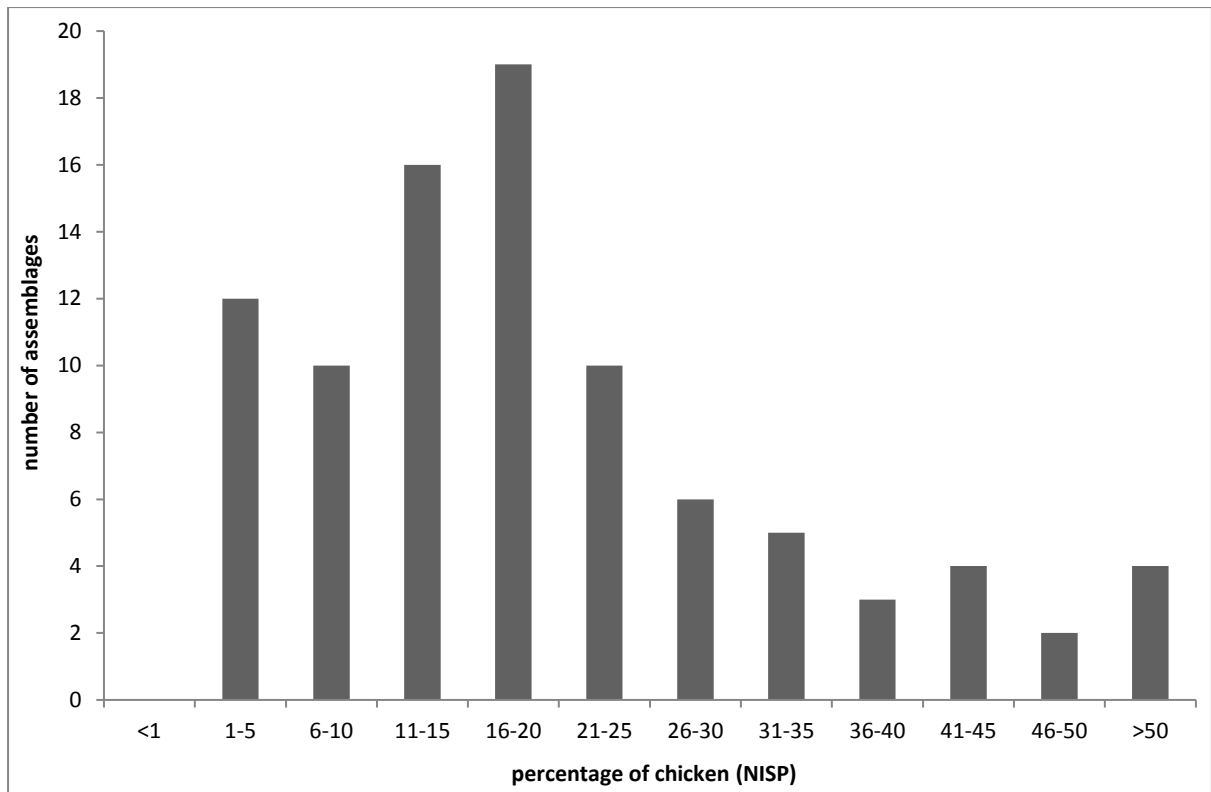
215 Figure 4: Percentage of chicken of total sheep/goat and chicken NISP counts from rural
 216 settlements by period (n=587)

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

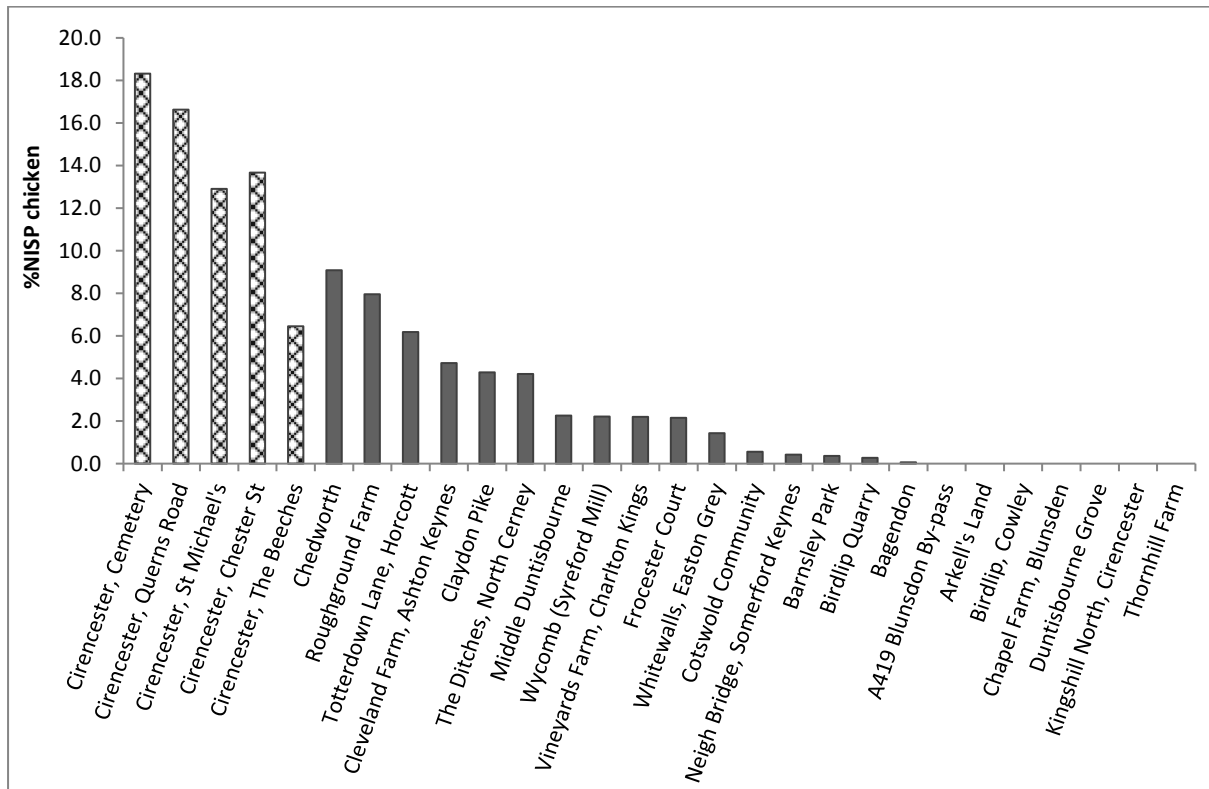
237 Figure 6: Chicken tibiotarsus from Exeter Princesshay showing diagonal knife-cuts on the
 238 distal condyles characteristic of disarticulating the lower leg (Photo J. Best).

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



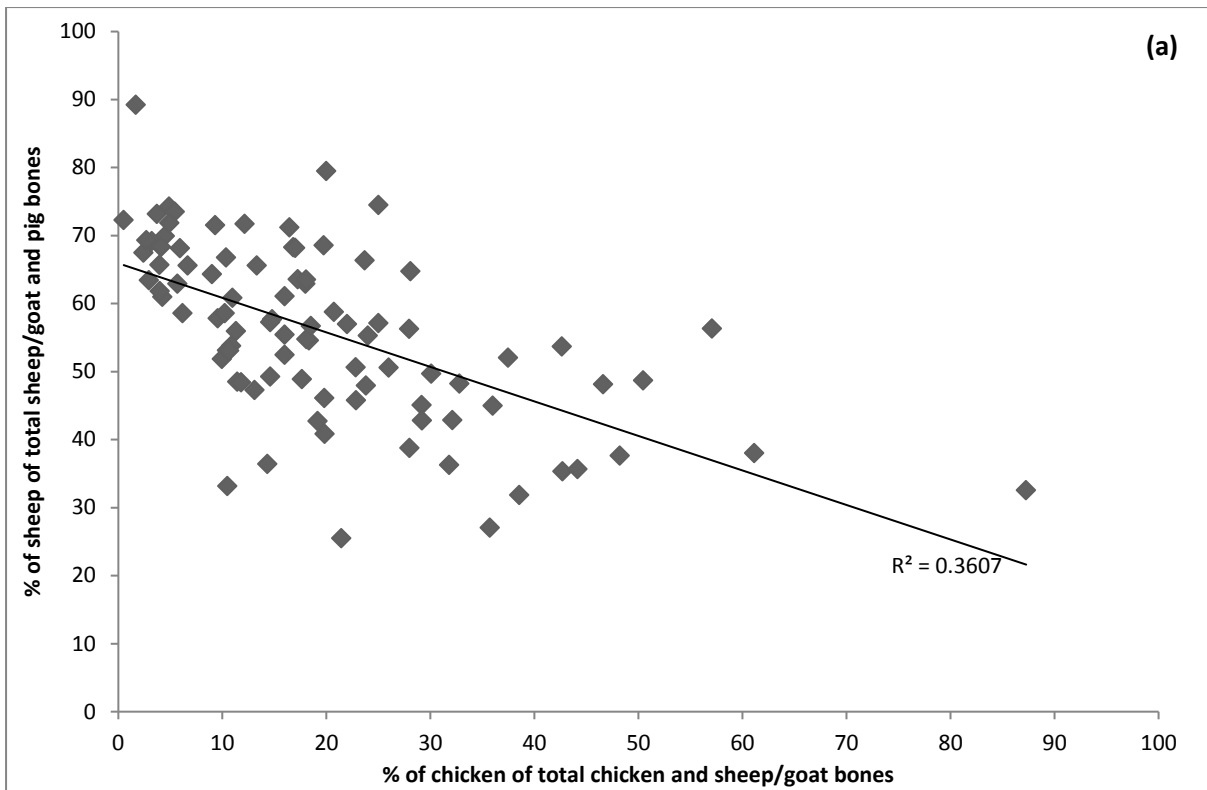
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251 Figure 7: Percentage of chicken of total sheep/goat and chicken NISP counts from sites in
 252 Cirencester (checked pattern) and its hinterland (grey)

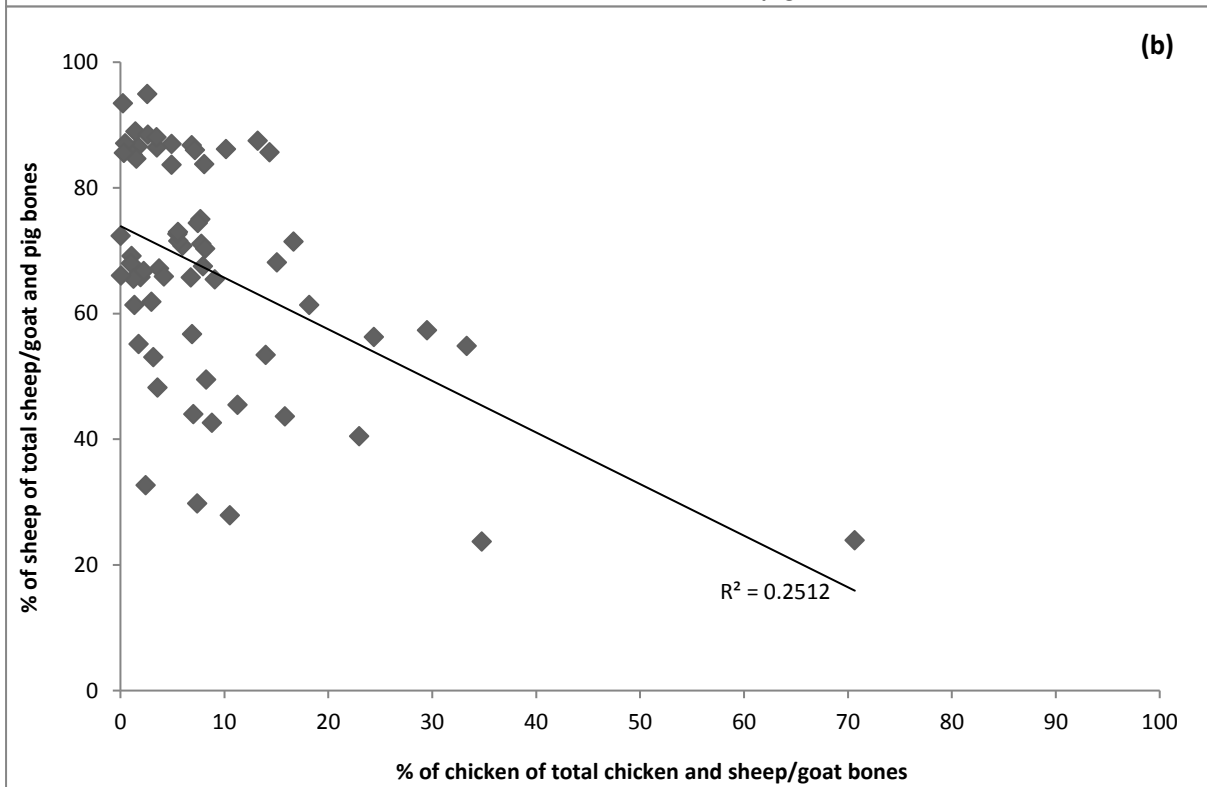
253

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



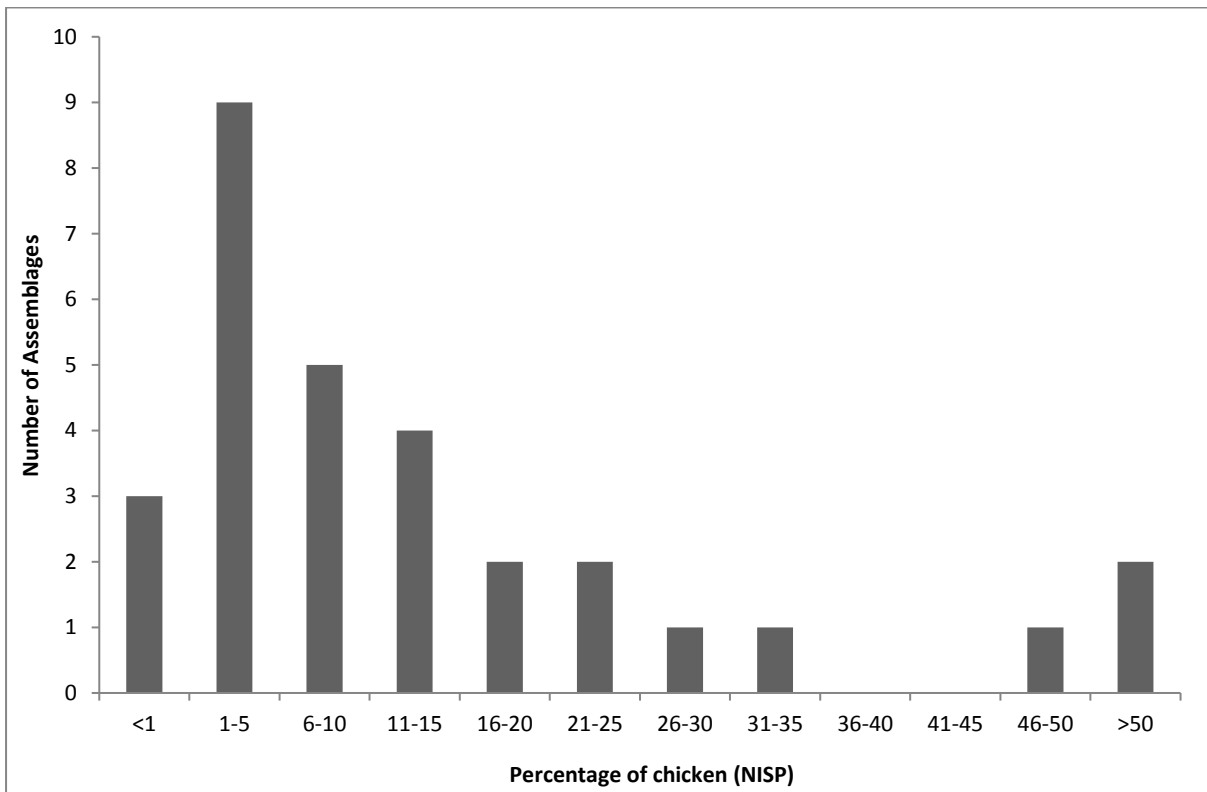
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262 Figure 8: Comparisons of chicken/sheep and pig/sheep ratios in (a) urban (n=91) and (b) villa
 263 (n=63) assemblages in Britain

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.

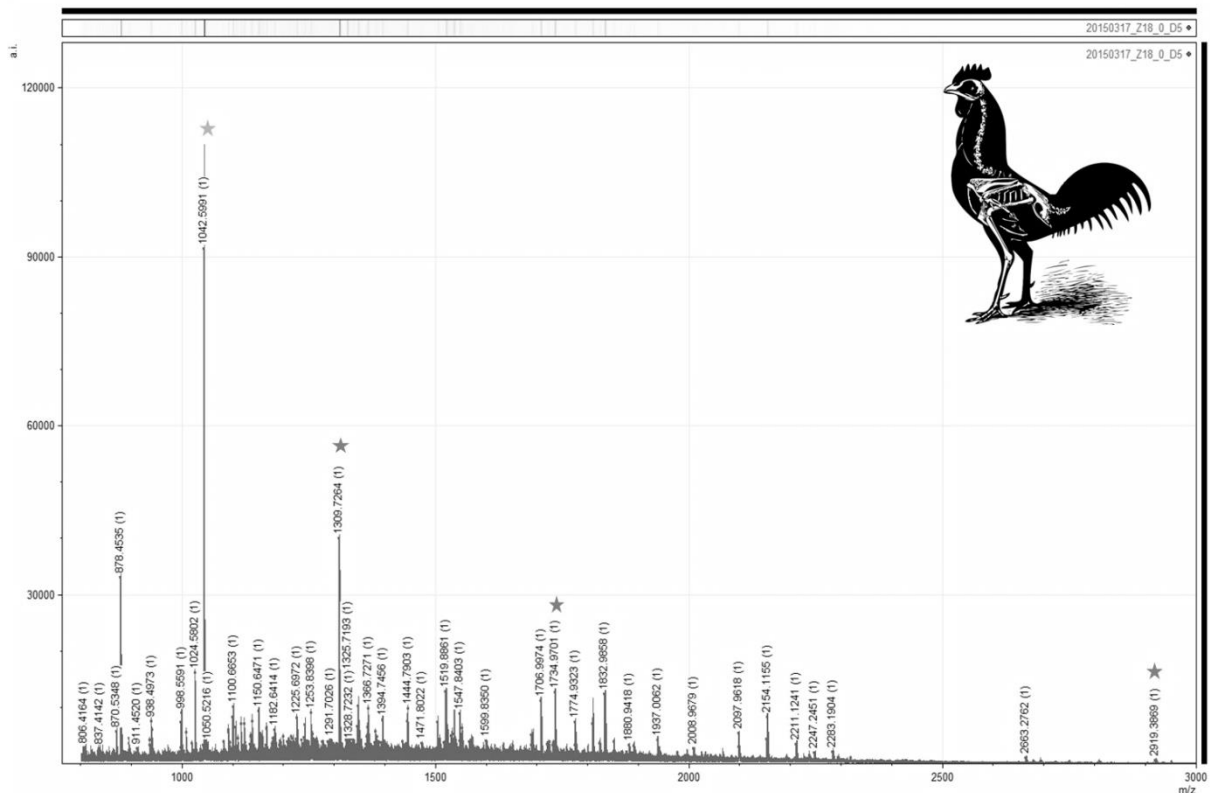
335 3.2 Eggshell

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 1st 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

479 **Acknowledgements:**

480

481 This work was supported by the Arts and Humanities Research Council as part of the project
482 “Cultural and Scientific Perspectives of Human-Chicken Interactions” (Grant No
483 AH/L006979/1) and by the Leverhulme Trust as part of the project “The Rural Settlement of
484 Roman Britain”. The funders had no role in study design, data collection and analysis,
485 decision to publish, or preparation of the manuscript. The authors also wish to thank the
486 following people for their help and collaboration: Tony Wilmott, Alice Forward, Robert
487 Symmons, the Intergemeentelijke Archeologische Dienst PORTIVA, Anton Eryvynck, An
488 Lentacker, Wim van Neer and Charlotte Coles. We are very grateful to Samantha Presslee
489 and Matthew Collins for providing information and discussion in relation to ZooMS.

490

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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)