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To cite this article: Naomi Sykes, Gema Ayton, Frazer Bowen, Karis Baker, Polydora Baker, Ruth F. Carden, Craig Dicken, Jane Evans, A. Rus Hoelzel, Thomas F.G. Higham, Richard Jones, Angela Lamb, Robert Liddiard, Richard Madgwick, Holly Miller, Clare Rainsford, Peta Sawyer, Richard Thomas, Christopher Ward & Fay Worley (2016) Wild to domestic and back again: the dynamics of fallow deer management in medieval England (c. 11th-16th century AD), STAR: Science & Technology of Archaeological Research, 2:1, 113-126, DOI: [10.1080/20548923.2016.1208027](https://doi.org/10.1080/20548923.2016.1208027)

To link to this article: <http://dx.doi.org/10.1080/20548923.2016.1208027>



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Published online: 20 Jul 2016.



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Wild to domestic and back again: the dynamics of fallow deer management in medieval England (c. 11th-16th century AD)

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Abstract This paper presents the results of the first comprehensive scientific study of the fallow deer, a non-native species whose medieval-period introduction to Britain transformed the cultural landscape. It brings together data from traditional zooarchaeological analyses with those derived from new ageing techniques as well as the results of a programme of radiocarbon dating, multi-element isotope studies and genetic analyses. These new data are here integrated with historical and landscape evidence to examine changing patterns of fallow deer translocation and management in medieval England between the 11th and 16th century AD.

Keywords medieval; parks; fallow deer; genetics; isotope analysis; zooarchaeology

Received 10 January 2016; **accepted** 21 June 2016

1. Introduction

The medieval fashion for parks transformed the English landscape: it is estimated that by 1300 AD over 3000 had been established, covering about 2% of the total area of countryside (Rackham 1986, 123). Their clear social and environmental importance has seen medieval parks become the research focus for both landscape historians and archaeologists. Traditionally, analyses have focussed on mapping park size and shape (e.g. Cantor and Wilson 1961); however, more recently attention has been given to understanding their social

significance and function: in particular, whether they represented active hunting spaces (Gilchrist 1999, 145; Miles 2009), game larders (Birrell 1992) or socially divisive symbols of power (Creighton 2009; Herring 2003; Liddiard 2000, 2007).

Studies of the deer themselves have remained comparatively rare (although see Fletcher 2011) which seems bizarre given that these animals were central to the phenomenon of emparkment. This is particularly the case for the fallow deer (*Dama dama*) the non-native cervid species whose history is intimately tied

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to that of the park (Sykes 2007a). For instance, we know that an original introduction of fallow deer to Roman Britain can be viewed as a proxy for park establishment (Sykes et al. 2006, 2011) and, furthermore, that this initial establishment was short-lived, with both parks and fallow deer becoming extinct with the withdrawal of the Roman Empire (Baker et al. *in prep*). The connection between fallow deer and emparkment is reinforced by the coincidence of their reintroduction to medieval England, although the exact timing of this re-establishment – whether it occurred before or after the Norman Conquest – has been the subject of debate (Baker et al. *in prep*; Hough 2012; Liddiard 2003; Sykes 2007a; Sykes and Carden 2011). Based on this long-term link, understanding how fallow deer were managed and maintained must be central to unpicking the dynamics, function and meaning of parks. Furthermore, whilst it is often difficult to date the physical remains of parks (i.e. the pale) the same is not true for the remains of fallow deer, since these can be submitted for radiocarbon dating, with the potential to resolve when the concept of emparkment was reintroduced to medieval England.

To this end, this paper provides the first comprehensive, scientifically informed study of medieval fallow deer management. It brings together data from traditional zooarchaeological analyses with those derived from new ageing techniques as well as the results of a programme of radiocarbon dating, multi-element isotope studies and genetic analyses. These new data are here integrated with historical and landscape evidence to examine changing patterns of fallow deer translocation and management in medieval England.

2. Materials and methods

A previous review (Sykes and Carden 2011) highlighted a number of medieval assemblages reported to contain early examples of fallow deer remains. These assemblages were located and re-examined in detail, with several other collections being added to the study (Figure 1 and Table 1). Metrical data were already available for most of the *Dama* assemblages but antlers were re-analysed so that they could be aged using Billson's (2008) techniques. Published epiphyseal fusion data were collated to explore broad trends in fallow deer age. Dental ageing offers tighter resolution concerning herd demographics; however, for the medieval period, deer teeth are seldom recovered from occupation sites due to the rituals that surrounded the butchery of deer carcasses, which generally resulted in the deer heads being discarded off site (Sykes 2007b). Where available, mandibles were examined using Bowen et al.'s (2016) dental ageing system. Samples of cranial and post-cranial material were taken for isotope and genetic analysis, with a selected number of specimens being submitted for AMS radiocarbon dating. Full details of the analytical methods are provided in the supplementary information (S1) but can be summarised as follows.

2.1 Radiocarbon dating

Five specimens, from different sites, were submitted to the University of Oxford's Radiocarbon Accelerator Unit (ORAU). A further three samples, all from Carisbrooke Castle, were submitted to ORAU by English Heritage. These were processed and dated by Accelerator Mass Spectrometry using the protocols described by Brock et al. (2010); Bronk Ramsey et al. (2004a, 2004b) and Dee and Bronk Ramsey (2000). ORAU maintains a continual programme of quality assurance procedures, in addition to participation in international inter-comparisons (e.g. Scott, Cook, and Naysmith 2010) which indicate no laboratory offsets and demonstrate the validity of the precision quoted.

2.2 Genetic analysis

Genetic analysis was carried out at the School of Biological and Biomedical Sciences, Durham University. The resulting data provide an assessment of matrilineal diversity within and among sample sites, together with an indication of the demographic history of sampled populations. They also provide confirmation when species identification is equivocal.

2.2 Isotope analysis

In order to highlight temporal changes in human-fallow deer relationships, including movement and management strategies, multi-element isotope analyses were undertaken on the same specimens submitted for genetic analysis, to provide a suite of information at the level of the individual. All analyses were undertaken at the NERC Isotope Geosciences Facilities at the British Geological Survey, Keyworth.

Carbon and nitrogen isotopes are routinely measured in palaeodietary studies because they are assimilated in consumer tissues from dietary protein sources (Ambrose and Norr 1993; Tieszen and Fagre 1993). Gross variations in bone collagen $\delta^{13}\text{C}$ values are thought to be influenced by the consumption of marine versus terrestrial protein (Schoeninger, DeNiro, and Tauber 1983) or by the inclusion of arid C_4 plants in the diet (Vogel and Van der Merwe 1977); whereas $\delta^{15}\text{N}$ values reflect the proportion of plant and animal protein in the diet, becoming more enriched at each trophic level (Ambrose and Norr 1993; Richards and Hedges 1999). However, researchers are increasingly highlighting the complex range of variables – e.g. temperature (Stevens, Lister, and Hedges 2006), water availability (Schwarcz, Dupras, and Fairgrieve 1999), salinity and marine input (Guy, Reid, and Krouse 1986a, 1986b; van Groenigen and van Kessel 2002) and even underlying geology (Lynch, Hamilton, and Hedges 2008) – that can result in small scale variation in isotopic signatures.

Strontium isotope analysis is a widely adopted method for assessing animal movement and local versus non-local dietary patterns (e.g. Bentley 2006; Chenery, Eckardt, and Müldner 2011; Price, Burton, and Bentley 2002). This geochemical provenancing technique is based on the principle that different

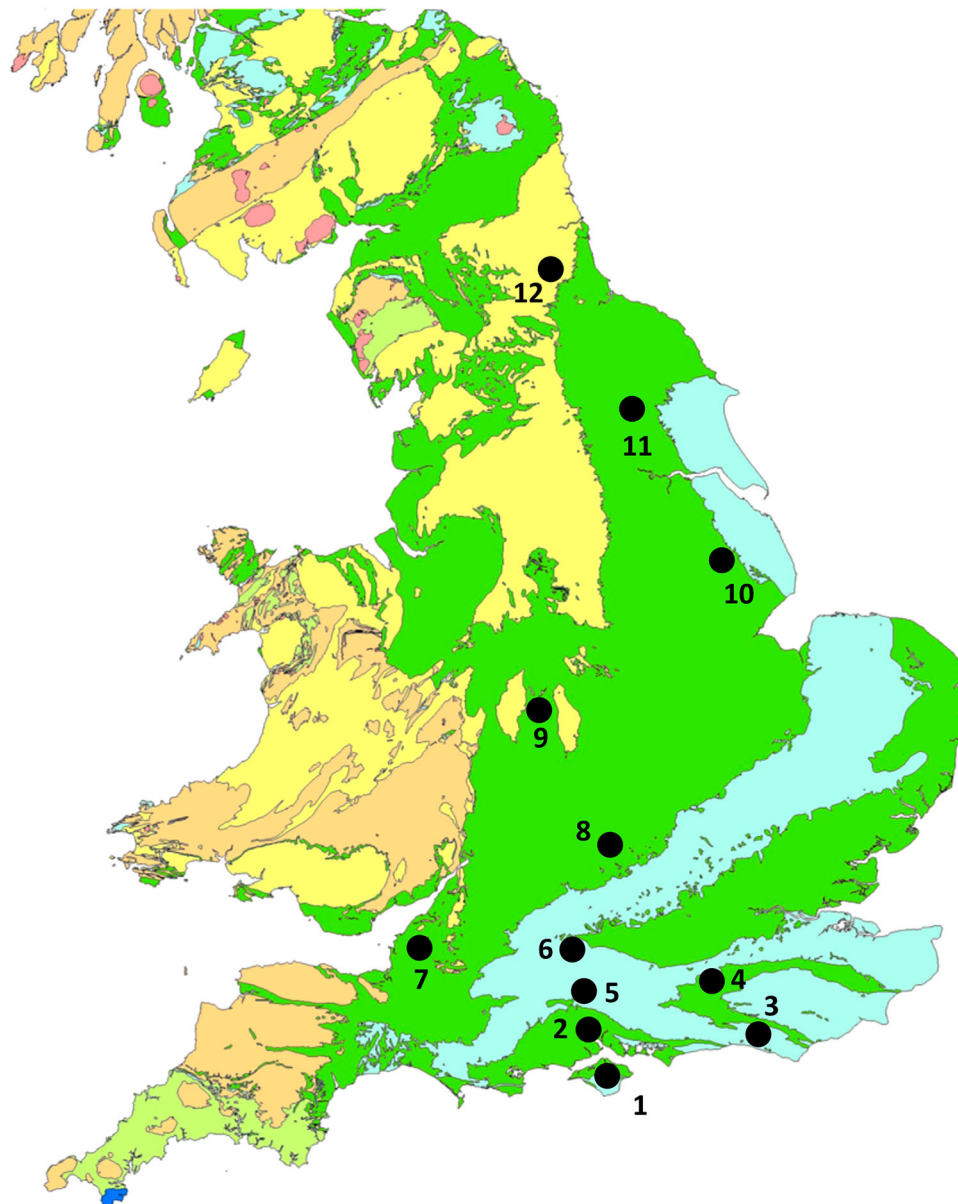


Figure 1 Sites for which new data are available – **Table 1** highlights which new datasets have been generated for each site (See Supplementary Table 1 for full details).

geological terrains have characteristic strontium isotope ratios ($^{87}\text{Sr}/^{86}\text{Sr}$) that transfers through the food-chain becoming reflected in skeletal material. Tooth enamel is resistant to diagenetic change and because it is not remodelled through life it preserves the signature of geographical origins, allowing migration to be assessed. Five fallow deer specimens from Facombe Netherton were available for Sr analysis. Two 11th/12th century maxilla from different individuals (specimens FN386, FN 387) had multiple samples taken to examine both their early and late-forming teeth (first and third molars). In addition, single teeth from three later-dated animals were also analysed: a first molar (M^1) from specimen FN385 (13th/14th century), a third molar (M^3) from specimen FN391 (13th/14th century) and an M^1 from FN384 (15th century). A single tooth (M^2) from an 11th/12th-century individual from Goltho (GO16) was also made available for Sr analysis.

To complement the Sr analysis, oxygen isotope data were also gathered from the same specimens from Facombe Netherton and Goltho, and a further tooth from the latter. The most worn tooth chosen for analysis had crown height along the growth of axis of 6 mm. To ensure that all samples covered similar time periods – producing comparable data in terms of mineralization and seasonal fluctuations – each tooth was sampled to a height of 6 mm along the axis of growth. The oxygen isotope composition ($\delta^{18}\text{O}_c$ values) of mammalian body tissue reflects the composition of local drinking water, allowing a further assessment of geographical origins (Longinelli 1984; Luz, Kolodny, and Horowitz 1984). A recent study has shown that oxygen isotope ratios in CO_3^{2-} and PO_4^{3-} ($\delta^{18}\text{O}_{\text{carbonate}}$ and $\delta^{18}\text{O}_{\text{phosphate}}$ values) of fallow deer are consistent with relative meteoric water trends across Europe (Miller et al. *in prep*).

Table 1 Sites for which new data are available – **Table 1** highlights which new datasets have been generated for each site (See Supplementary Table 1 for full details)

Map No	Site	C14 dates	Isotopes	Genetics	Ageing data
1	Carisbrooke Castle, Isle of Wight	✓	✓	✓	
2	Southampton (French Quarter), Hampshire		✓	✓	
3	Lewes, Sussex		✓	✓	
4	Guildford Castle and Woking Palace, Surrey				✓
5	Sparsholt, Hampshire	✓	✓	✓	
6	Facombe Netherton, Hampshire	✓	✓	✓	✓
7	Cheddar Palaces, Somerset	✓	✓	✓	
8	Eynsham Abbey, Oxfordshire		✓	✓	
9	Dudley Castle, West Midlands		✓	✓	✓
10	Goltho, Lincolnshire	✓	✓	✓	✓
11	Hungate (York), Yorkshire		✓	✓	
12	Binchester, County Durham	✓	✓	✓	

3. Results and discussion

New data were obtained for a total of 101 specimens from the sites under consideration. Full details are provided, by site and specimen, in Supplementary Table 1.

3.1 AMS radiocarbon dating

The radiocarbon dates are particularly important because, prior to this study, no medieval-focussed dating programme for fallow deer had been undertaken: previously, only Roman specimens had been targeted for analysis (Sykes et al. 2006, 2011). Indeed, several of the specimens in this study – those from Redlands Farm, Binchester Fort and Sparsholt Villa – were selected for dating because it was believed they were Roman. However, all returned medieval/post-medieval dates: the Sparsholt Villa specimen was dated to the 15th–17th century AD, that from Binchester to the 12th–13th century AD, whilst the Redlands Farm specimen returned an 11th/12th century date (Figure 2).

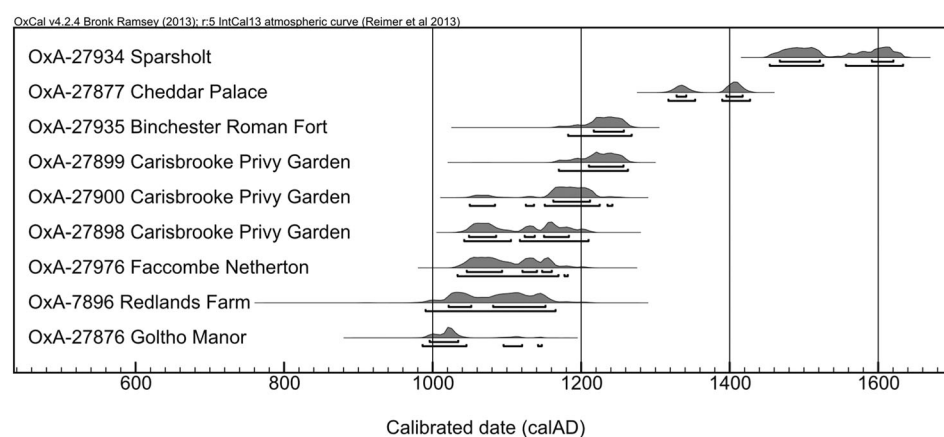
The specimen from Cheddar Palace also proved to be later than initially expected: whereas Sykes and Carden (2011) had suggested it might be Late Anglo-Saxon, the 14C calibration was more consistent with a 14th/15th century date. Three other sites that have always been strong candidates as early examples of fallow deer yielded radiocarbon results compatible with the spot dating: the Carisbrooke

Castle specimens all fell within the 11th to 13th centuries AD, whereas the specimens from Facombe Netherton and Goltho both returned 11th/12th-century dates. Whilst the 14C results provide a more solid chronological framework, the 'Saxo-Norman' span for the earliest specimens offers no resolution about whether fallow deer, and by association parks, were reintroduced before or after 1066. To some extent genetic analysis has been more helpful in this regard.

3.2 Genetic analysis

DNA analysis determined that some of the purportedly early fallow deer specimens were in fact red deer (*Cervus elaphus*). This included one 13th–16th century specimen from Cheddar Palace (CH221) and two from 10th/11th-century Southampton (OX09 and OX193). By striking these two Southampton specimens from the fallow deer record, the date range for the earliest-confirmed specimens is significantly tightened. After excluding these from the analysis we calculated that DNA was extracted and successfully amplified for 532 bp from 78% of the medieval samples collected in this study (78/99) (see Supplementary Table 1).

Figure 3 shows the median joining network, which depicts the relationship between the 16 haplotypes detected in medieval UK populations, labelled by

**Figure 2** AMS radiocarbon dates.

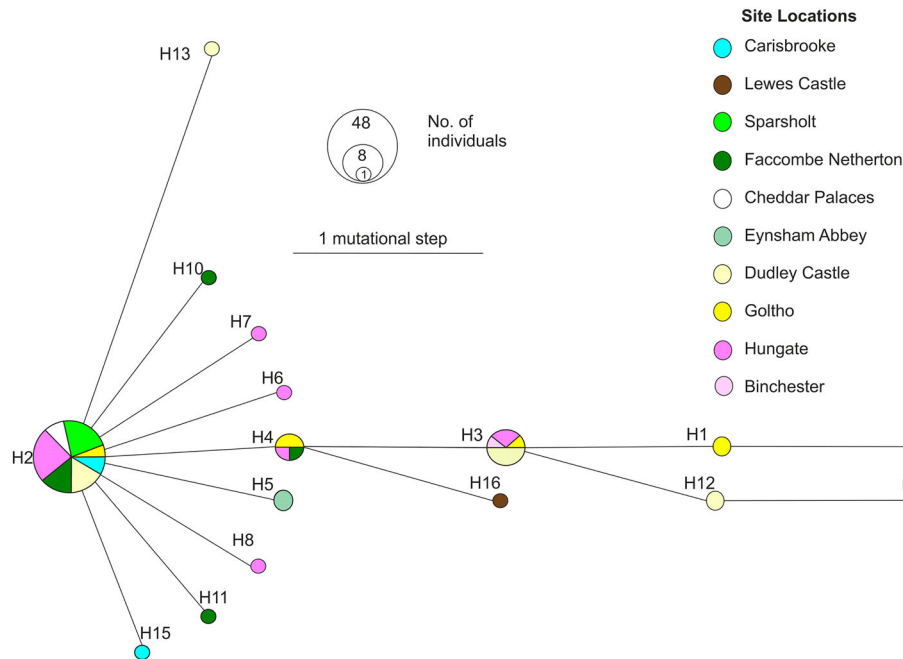


Figure 3 Median-joining network showing 16 haplotypes found from 78 UK medieval fallow deer samples at 10 sites.

site name. The resulting network cluster forms a star shape. Taken on its own, this is suggestive of a population expansion following a founder event. This would be consistent with the observed pattern of genetic diversity where mtDNA genetic variation (h) is high but nucleotide diversity (π) is low to moderate, since haplotypes will be lost due to random sampling during a founder event (Table 2; see Grant and Bowen 1998). There was also evidence for a post founder population expansion from Fu's F_s ($F_s = -11.1$; $P < 0.00001$), Tajima's D ($D = -1.8$ $P < 0.02$), and from the mismatch distribution. The goodness of fit tests comparing an expansion model to the observed mismatch distributions (Supplementary Figures 1a and 1b) revealed strong evidence for population expansion (demographic: $SSD = 0.005$ $P = 0.83$, $R = 0.05$, $P = 0.90$; spatial: $SSD = 0.001$ $P = 0.92$, $R = 0.05$, $P > 0.92$).

However, without reference to the source population or populations, and especially historical populations represented by ancient DNA, the observed

pattern cannot be precisely interpreted. While the dominance of the network by haplotype 2 (64%) suggests stochastic sampling during a founder event, diversity may have already been low in a single source population or amongst source populations. Therefore, the signal for expansion may primarily reflect earlier demographic events establishing post-glacial refugial populations (possibly reinforced by further bottlenecking in the UK population). Given the likely timeframe and the number of singleton haplotypes apparently derived from haplotype 2, some of this diversity likely predated the founding of the UK populations. The distribution of haplotypes through the network is not indicative of lineage sorting by geographic region, and so the available sample-set does not support regional subdivision (though larger local sample sizes would be required to confirm this). The simplicity of the network structure could be consistent with a single founder-expansion event; however this would depend on the diversity among potential

Table 2 Mitochondrial control region diversity indices for fallow deer from UK medieval sampling locations where: n , number of individuals; nh , number of haplotypes; hd , haplotypic diversity and π , nucleotide diversity.

Site	n	h	hd	π	Haplotype numbers present (in order of abundance)
Carisbrooke	5	2	0.20	0.0008	2,15
Lewes Castle	1	1	x	x	16
Sparsholt Villa	11	1	0	0.0000	2
Facombe Netherton	10	4	0.53	0.0011	2,4,10,11
Cheddar Palaces	4	1	0	0.0000	2
Eynsham Abbey	2	1	0	0.0000	5
Dudley Castle	17	5	0.71	0.0032	2,3,12,13,14
Goltho	8	4	0.81	0.0028	2,1,4,3
Hungate	19	7	0.66	0.0026	2,3,4,6,7,8,9
Binchester	1	1	x	x	3
Total across locations	78	16	0.62	0.0022	

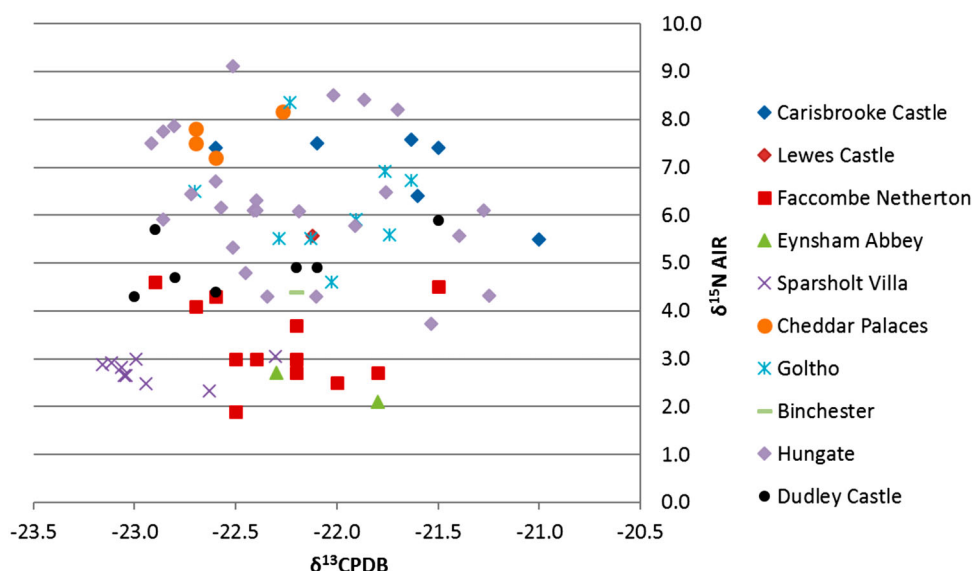


Figure 4 C/N data for all medieval sites in England.

source populations. Separate founder events from differentiated source populations would be expected to produce a more complex pattern.

3.3 Isotope analysis

If there was a single founder population and, by the 11th/12th century, populations were established across the country (e.g. from Carsbrooke on the Isle of Wight to as far north as Durham at Binchester) it suggests that fallow deer had been established in England for some time by the 'Saxon-Norman' period. This seems to be supported by the carbon and nitrogen isotope results, which show no evidence for the presence of first-generation imports (Figure 4). Whilst $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ data are generally not, for good reasons, used in provenancing studies, fallow deer stable isotope ratios, particularly carbon, do vary significantly across wide geographical ranges (Miller et al. 2014). A potential issue with using skeletal elements for such inferences is the bone turnover rate and its effect on how long the birth signal is preserved in the tissue. Unlike teeth, the collagen and bioapatite produced within bone will be re-absorbed and replaced by new material, the rate of which will depend on the specific bone, species, health, and age/life stage of the animal concerned. Quantification of the rate of bone turnover in mammal species has not been established. Studies that have discussed this assume that the bone turnover rates are within the order of a number of years for cancellous or trabecular bone (Cox and Sealy 1997) further work is needed to fully understand the effect of bone turnover in mammals. Despite this, we note that the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ results for the earliest-dated fallow deer of a range of ages included in this study are unlike those for any other area of Europe or the Near East, which have markedly higher carbon values (Miller et al. 2014). Instead, they plot with the data for Romano-British deer

(Madgwick et al. 2013; Miller et al. 2014) and sit comfortably within the range of the fallow deer from later/post-medieval England (e.g. Hungate in York, Cheddar Palaces, Sparsholt Villa) animals that we are confident were born and raised in Britain (Figure 4).

When examined more closely, Figure 4 shows that although the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ results for most sites have overlapping ranges and there are no obvious outliers in terms of $\delta^{13}\text{C}$, all of the Sparsholt Villa values cluster tightly towards the lower end of the $\delta^{15}\text{N}$ scale, as do seven of the twelve samples from Faccombe Netherton and the two from Eynsham Abbey. In a previous isotope study that included animal remains from Sparsholt, Lynch, Hamilton, and Hedges (2008) highlighted that specimens derived from areas of chalk geology (e.g. Sparsholt – see Figure 1) are depleted in ^{15}N relative to specimens from non-chalk areas. What Lynch, Hamilton, and Hedges (2008, 1031) were uncertain about was whether this ^{15}N depletion in chalky regions is due to the animals' life history or to diagenetic effects. The answer to this may lie in the Faccombe Netherton samples, which are presented in Figure 5 in more detail, alongside results for the other earliest medieval deer.

When the C/N results from Faccombe Netherton are considered in conjunction with the spot-dating, a temporal-related shift in the $\delta^{15}\text{N}$ values is observable: the three oldest individuals (FN386, FN387 and FN389, all 10th-12th century) have noticeably higher nitrogen isotope values than those from later phases (13th century onwards). The possibility that these differences relate to changes in management strategy or, in particular, to the geology upon which the deer were raised is something that can be tested through strontium isotope analysis.

The strontium results for the available teeth from Faccombe Netherton, as well as those for the early-

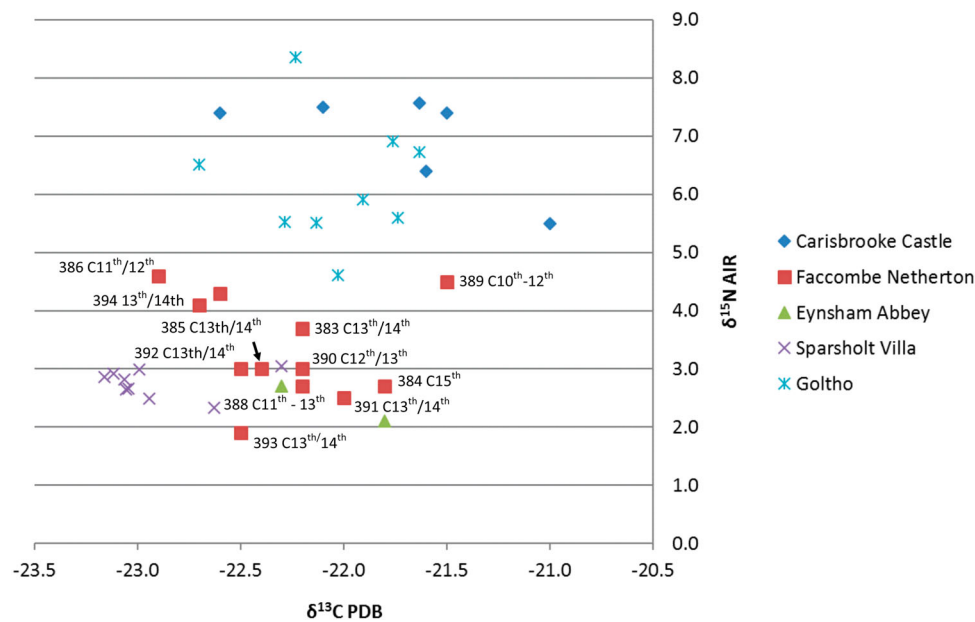


Figure 5 C/N data earliest medieval fallow deer with results from Faccombe Netherton by date/specimen.

dated fallow deer from Goltho (Lincolnshire) are shown in Figure 6, along with samples of bone and dentine, which are assumed to equilibrate with the local geology (Price, Burton, and Bentley 2002). The Goltho results for both the enamel and dentine are consistent with the Jurassic clay which typically produces $^{87}\text{Sr}/^{86}\text{Sr}$ biosphere values of 0.709–0.710 (Evans et al. 2010). Warham (2012) has shown that domesticated animals on this terrain give a slightly higher but overlapping range of 0.7103 ± 0.0004 (1SD, $n=47$) whereas the dentine value provides a measure of the composition of the burial area just below the predicted range. Given these constraints it is reasonable to suggest that sample GO116 is of local origin.

The site of Faccombe Netherton is underlain by chalk geology and this is reflected in the composition of the bone sample from specimen FN387, which was recovered from the bottom of a cess-pit dug into the bedrock and which provides a minimum value for

the site. The predicted biosphere range for chalk is 0.708–0.709 (Evans et al. 2010). Chalk-dwelling Iron Age cattle and sheep give values of 0.7088 ± 0.001 (1SD, $n=18$; Warham 2012) and Iron Age fauna from the local site of Rookdown in a similar geological setting give analogous Sr values of 0.7093–0.7100 (Bendrey, Hayes, and Palmer 2009). Using these factors as a guide, all the Faccombe Netherton enamel samples are consistent with a local origin, except those for FN387 which have values beyond those attributable to chalk terrain.

Whether there is sufficient natural local variation to accommodate FN387 through grazing specifically on the clay-with-flint horizons that are found within the chalk or whether it suggests a non-local origin is debatable but it seems possible that FN387 was imported to Faccombe Netherton from elsewhere. If it was an imported deer, transportation must have occurred after the animal's teeth had formed since the results for its M^1 and M^3 are consistent with each other, if

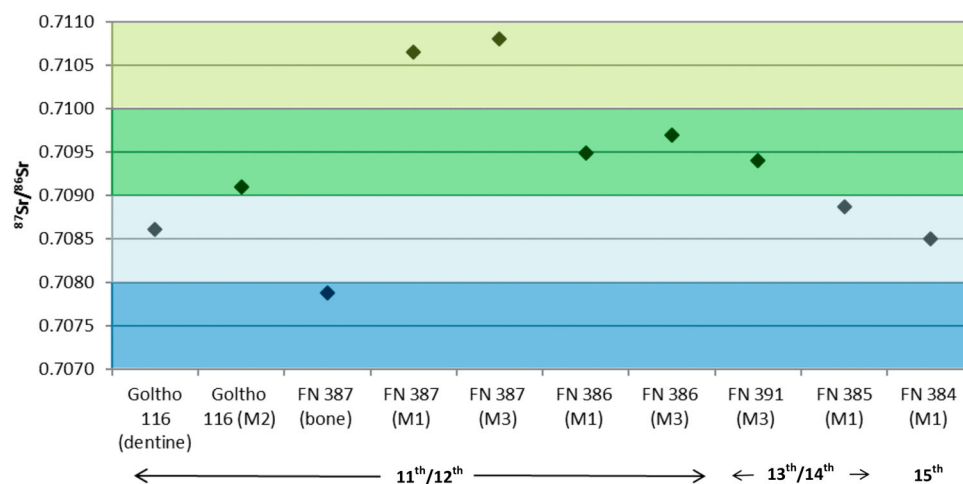


Figure 6 Sr for earliest medieval fallow deer.

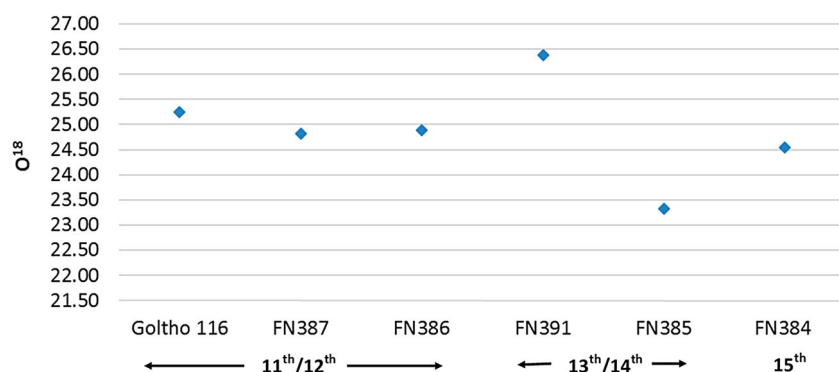


Figure 7 Oxygen results for earliest medieval fallow deer.

not the local geology. The M^1 forms and mineralizes *in utero*, while a fallow deer M^3 forms between 5 and 9 months, mineralizing between 9 and 11 months, therefore transportation is likely to have occurred after 11 months of age (Brown and Chapman 1991). By comparison, the results for specimen FN386 are in-line with the values for the local geology suggesting that this animal was born and raised at Faccombe Netherton, its early and late-forming teeth showing no evidence for movement.

The Sr results for two of the later medieval deer from Faccombe Netherton – FN385 (13th/14th century) and FN384 (15th century) – are noticeably different from the 11th/12th-century individuals. Figure 6 shows that their values are both indicative of chalk geology. When the nitrogen results for these same individuals are considered (FN385 returning a value of 3.0 ‰, and FN385, 2.7 ‰) it would seem to support the hypothesis that the relatively low $\delta^{15}\text{N}$ values are, indeed, the result of grazing on chalk-based soils, rather than post-mortem take up of this signature (Lynch, Hamilton, and Hedges 2008, 1031). The two 11th/12th-century deer had far higher nitrogen values (FN386 = 4.6 ‰ and FN387 = 4.3 ‰) compatible with their non-chalk Sr results and, again, strengthening the hypothesis that nitrogen values can correlate with geology.

The coherence of the Sr and $\delta^{15}\text{N}$ results for the 11th/12th century deer (FN386 and FN387) and the 13th-15th century individuals (FN386 and FN384) suggest that these early and later-dated fallow deer were raised in separate locations. Given the mixed geology of the area, it is feasible that both locations were proximate to Faccombe Netherton; however, they do appear to have been different environmentally.

Both the C/N and the Sr isotope data for Faccombe Netherton point to the 13th/14th century as the period when the fallow deer population shifted location. With this in mind, the results pertaining to 13th/14th-century specimen FN391 are interesting. The Sr value for this individual sits comfortably alongside non-chalk 11th/12th-century FN386, but its $\delta^{15}\text{N}$ result (2.5 ‰) is closer to the chalk-indicative results for FN385 and FN384. It seems possible that the bone/enamel chemistry of FN391 has captured the transition from the earlier to later location: its teeth being formed before the animal

was transferred to graze on the chalk-geology that is reflected in its bone collagen $\delta^{15}\text{N}$ value. Additional evidence that individual FN391 moved during its lifetime is provided by the oxygen data (Figure 7).

The results for the Goltho individual and for three of the Faccombe Netherton deer (FN387, FN386 and FN384) are all very similar and, based on Miller et al.'s (in prep) oxygen baseline study, are within the range of values that can be expected for central/central-southern England. This is important with regards to specimen FN387 since it suggests that, even if it was imported to Faccombe Netherton it remains consistent with values from relatively cold and wet England, rather than further afield e.g. a Mediterranean source population. The same is true for 13th/14th-century FN391; for although its $\delta^{18}\text{O}$ value is noticeably higher than all the other specimens, it is still well within the UK range (Miller et al. in prep). We might conjecture that this animal originated in south-west England, possibly Dorset, where warmer conditions prevail and the relative $\delta^{18}\text{O}$ would be in this range (Miller et al. in prep) and where the geology is consistent with the specimen's Sr results (Figure 1). By contrast, the $\delta^{18}\text{O}$ result for 13th-14th century FN385 is markedly lower, raising the possibility that this individual too may have been brought to Faccombe Netherton from another region of England, feasibly a more north-easterly area to accommodate the $\delta^{18}\text{O}$ values that suggest relatively wet conditions (Miller et al. in prep).

That Faccombe Netherton's deer show signs of within-England translocation, indicated by 11th/12th-century FN387 but also by the two 13th/14th-century specimens (FN391 and FN385) deserves comment given the historical evidence for the site. Faccombe Netherton has long been suggested as the location of one of the earliest medieval parks in England on the basis that its 'White Haga' (a landscape feature situated to the south of the manor and first recorded in AD 961) appears to have been an enclosure associated with deer keeping (Hooke 1989, 128). It seems possible that the 11th-12th century fallow deer were managed within this enclosure and that specimen FN387 was among the first animals to be brought to the site from elsewhere. In the early thirteenth century, however, the manor was divided up and between

1295 and 1297 its new owner, Oliver de Punchardon, is documented as having laid out new 50-acre deer enclosure around the settlement of Facombe Nether-ton itself (TNA: C 143/23/8; Page 1911, 314–318). Importantly, Facombe Nether-ton sits on a chalk outcrop and, were deer transported to this new enclosure in the late 13th century, it would certainly account for the nitrogen and strontium isotope results for the later-dated individuals from the site.

Medieval documents provide extensive evidence that fallow deer were moved regularly both in life (to stock parks) and in death, when cuts of venison were gifted as a symbol of lordly largess (Birrell 2006). The gifting of pre-butchered venison has been detected zooarchaeologically (Sykes 2007b) but additional information can, perhaps, be obtained from C/N isotope data (Figures 3 and 4). For instance, if it is accepted that low $\delta^{15}\text{N}$ values can be linked to chalk-grazing, the results from Eynsham Abbey in Oxfordshire are surprising. The site is not located on chalk (Figure 1) yet the two specimens from this site plot amongst those from Sparsholt and the chalk-indicative specimens from Facombe Nether-ton (Figure 4). Fallow deer are scarce in the Eynsham assemblage, making up just 0.06%–0.1% of the identifiable remains (compared with 3% for the 11th/12th century contexts at Facombe Nether-ton). Their low frequency can be attributed to the fact that, unlike Facombe Nether-ton, the Abbey did not own its own deer park. This means that the *Dama* remains from this site likely represent pre-butchered venison gifted from a park elsewhere, most probably one of the many examples located on the chalk down land of the Chilterns (Preece 1990).

The $\delta^{15}\text{N}$ data for the Carisbrooke Castle fallow deer are also at odds with the site's geology. Carisbrooke is situated on a chalk promontory and it might be expected that the deer from its assemblage would exhibit depleted $\delta^{15}\text{N}$ values; however, this is not the case (Figures 4 and 5). Whilst the disparity could again reflect the importation of pre-butchered venison to the castle, the fact that fallow deer are relatively well-represented in the assemblage (c. 1%) renders this less likely. Instead it seems more probable that a small breeding population was established on the island. Certainly the Isle of Wight was home to one of the earliest parks in Britain, The King's Park at Watchingwell being recorded in the Domesday Book (Williams and Martin 2003, 130). This would have been a suitably elite enclosure in which to maintain a herd of exotic fallow deer. Significantly, The King's Park is situated approximately two kilometres to north-west of the castle, in a locality where the chalk gives way to clays and sands, geology more consistent with the $\delta^{15}\text{N}$ values for the Carisbrooke specimens.

One site where we can be confident that fallow deer were not being raised is Hungate in York (Figure 1). As an urban centre, it is more likely that animals, or most probably cuts of (poached) venison, were imported from across the rural hinterland (Sykes 2007b). Such a scenario would explain the

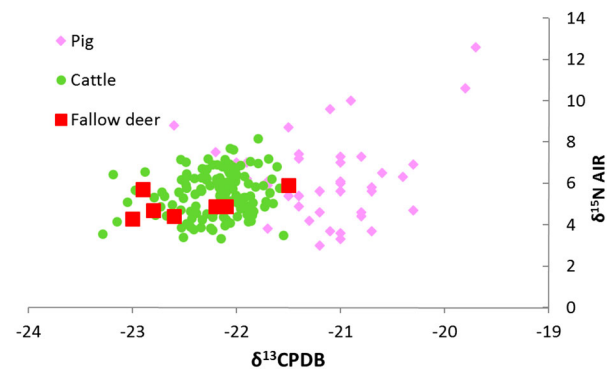


Figure 8 C/N data for Dudley Castle fallow deer, cattle (Fisher and Thomas 2012) and pigs (Hamilton and Thomas 2012).

large range in C/N data for the site, the distribution shown in Figure 4 being indicative of animals that fed in a wide variety of different environments. By contrast, the Dudley Castle fallow deer show a far more restricted range (Figure 4). When the Dudley Castle data are compared with Fisher and Thomas's (2012) results for other animals from the site (Figure 8), it would seem that fallow deer diet is broadly comparable with cattle, grazing animals that may have been raised alongside the deer in one of the many parks surrounding the castle. As Fisher and Thomas (2012) argued, patterns of cattle management do not appear to have changed through time, as the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values are largely static between the mid-13th and mid-18th centuries. The fallow deer are similarly conservative and, in this case, the isotope data provide insufficient resolution to elucidate the dynamics of deer management through time. Instead, we must look to more traditional sources of zooarchaeological evidence.

3.4 Demographics

Figure 9 presents results from the first application of Bowen et al.'s (2016) standardised system for fallow deer dental ageing. Although sample sizes are small, some temporal trends are apparent, and these are reflected by the broader, albeit more basic, synthesis of epiphyseal fusion data shown in Figure 10 and the age-profiles constructed from antler measurements (Figure 11).

Together, these datasets reveal that the earliest-dated fallow deer were kept to an older age than was seen in any subsequent period. The single tooth from 11th/12th-century Goltho (GO116) came from an animal that was at least 9–15 years old, and although no mandibles are available for 11th/12th century Facombe Nether-ton, the maxillary teeth of FN386 and FN387 are all heavily worn. Similarly, the three measureable antlers recovered from Facombe Nether-ton are comparable with modern animals aged 6–9 years old, whilst the Goltho specimen plots alongside 2–3-year-old deer. The post-cranial bones from both these sites, as well as those from 11th–13th century

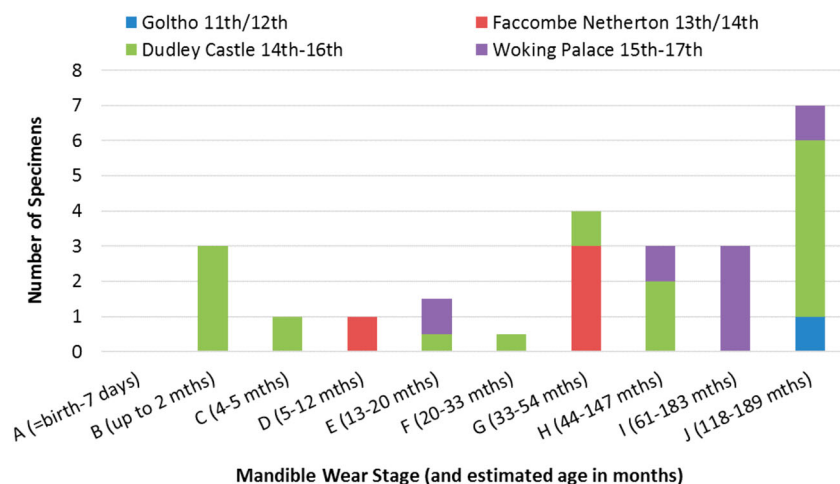


Figure 9 Dental ageing patterns for medieval sites of different dates.

Carisbrooke Castle derive, almost exclusively, from skeletally mature individuals. This age profile is to be expected given that fallow deer were clearly recent arrivals to Britain at this point and must have been deemed rare exotica, more important to be maintained and displayed in life than consumed in death. As such, the data support previous interpretations that early medieval parks (i.e. those of the 11th/12th century) were viewed more as menageries than hunting reserves (Sykes 2007a). Sykes and Carden (2011) argued that, within these early parks, emphasis was placed on the display of large adult bucks, their antlers rendering them a decorous addition to the landscape. This may be indicated by the sexing data for the Faccombe Netherton deer which show only males (Figure 12).

Through the course of the medieval period, however, the demographic profiles change, with an

increase in the culling of younger animals of both sexes. This is seen particularly between the 13th and 16th centuries, when the dental ageing data for Faccombe Netherton and, especially, Dudley Castle, show a significant representation of fallow deer aged under 20 months of age (Figure 9). The epiphyseal fusion data are similar, Figure 10 highlighting that many fallow deer assemblages contain more than 20% juveniles: indeed, at Faccombe Netherton the percentage of sub-adults is exceptionally high at over 40%.

This shift in age patterns probably reflects a number of linked phenomena. First is the growth of the British fallow deer population, which Baker et al. (in prep) have shown burgeoned between the 13th and 16th centuries. In part this was motivated by the elite's desire to demonstrate status through the ownership of densely populated parks that provided a ready

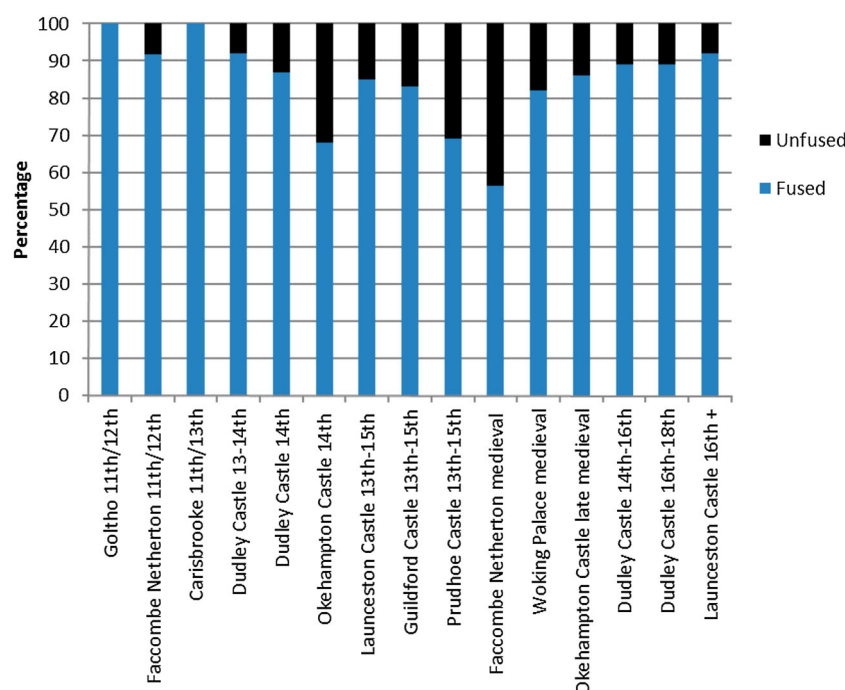


Figure 10 Broad trends in epiphyseal fusion data for fallow deer from medieval sites of different date.

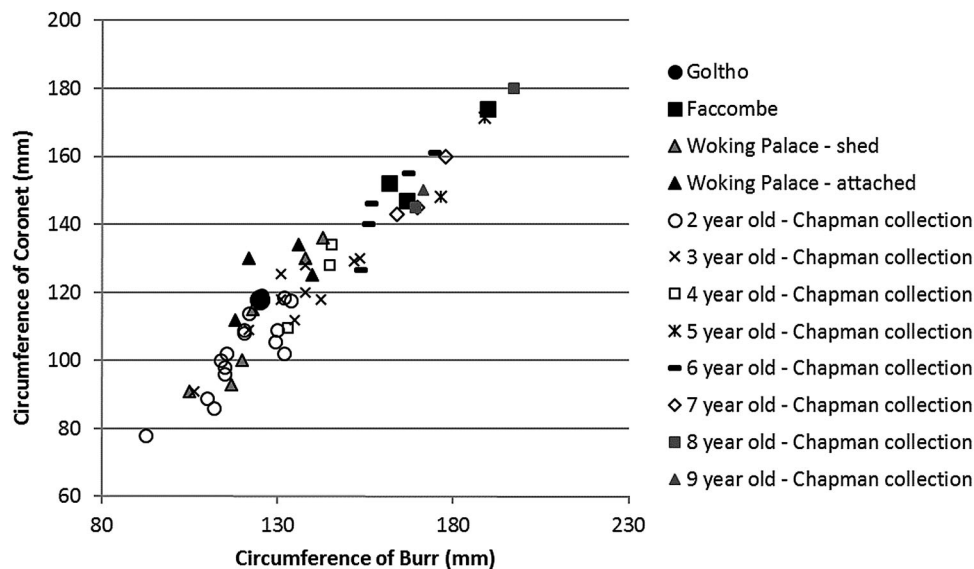


Figure 11 Ageing of antlers, shed and unshed, according to Billson (2008).

supply of venison for gift exchange (see Miles 2009, 128). Based on the documentary evidence Birrell (1992) has argued that, at this point, parks were essentially farms for the production of venison. The zooarchaeological data would appear to confirm this: the higher percentage of sub-adults indicates an emphasis on meat, produced through the culling of individuals that had reached their maximum carcass weight and were deemed unnecessary for herd sustainability.

At the same time, the culling of very young individuals, such as the high proportion of 2–5 month old animals seen at Dudley Castle (Figure 9) may point to over-hunting, something that Baker et al. (in prep) have argued impacted on later medieval fallow deer stock. It may be for issues of deer conservation that the age profiles change again into later/post-medieval period: Figure 9 shows that the dental ageing for

Woking Palace returns to a pattern skewed towards the older age range, the same being true of the epiphyseal fusion data for all sites of this date (Figure 10). While stock conservation is one possible reason the shift in age profiles, it may equally reflect broader changes in the perception and function of parks. By the end of the medieval period, parks were coming to be seen as more decorative and wild, as opposed to productive, landscapes with the deer taking a lead role in the construction of park aesthetics (Fletcher 2011; Williamson 1995, 22–24). This new concern manifested itself not only by the increased representation of fallow deer (notably adult bucks) in landscape painting but also in the new preoccupation with fallow deer coat colour: there is clear artistic and documentary evidence for the presence of both black and white deer as well as the common and menil



Figure 12 Sexual dimorphism as shown by measurements of the metatarsal (greatest length against smallest diameter).

variants (Shirley 1867, 5–10; Fletcher 2011). With so much emphasis being placed on the creation and management of herds with particular coat colours, it stands to reason that these deer were, once again, valued more in life than in death.

4. Conclusion

This paper has presented the results of the first comprehensive scientific study of the non-native fallow deer, whose introduction to medieval England transformed the cultural landscape. Detailed analysis has revealed that patterns of fallow deer management changed dramatically through the course of the medieval period, being far more dynamic than has hitherto been acknowledged.

Evidence from radiocarbon dating suggests that the earliest specimens within our medieval dataset derive from animals that lived in the 11th/12th century. However, the results of our isotope analyses point to the possibility that the initial introduction date may have been earlier still. The genetic data indicate a small founder population, and these early deer must have been viewed as very special animals. This is reflected by their age profiles, which show that these 11th/12th-century fallow deer were maintained for many years, presumably as prized exotica. With this information we can characterise the earliest medieval parks, such as The King's Park on the Isle of Wight and Facombe Netherton's 'White Haga', as menageries.

As fallow deer populations expanded rapidly, so too did the number of medieval parks. Both the genetic and isotope data reveal that animals were being moved around the country to stock these newly formed landscape features, such as the enclosure established by Oliver de Punchardon at Facombe Netherton in the late 13th century. Within these high-medieval parks, the management of fallow deer took on a different character: demographic profiles suggest a greater focus on venison production. This is perhaps unsurprising as during the high-medieval period venison became a social currency and was widely gifted as a symbol of aristocratic largesse. The historical and zooarchaeological evidence for this is clear but we have suggested here that the gifting of pre-butchered venison may also be detectable through stable isotope analysis, as has been argued for the fallow deer remains from Eynsham Abbey.

By the later/post-medieval period, the role of fallow deer had changed once more. Although still an important source of venison, the deer had become more significant in delineating park aesthetics. This is indicated not only by historical and iconographic evidence but also by deer demographics, which demonstrate a return to the maintenance of older animals. Stable isotope data are more limited for later and post-medieval settlements, as archaeological science tends to privilege earlier periods, but the evidence for Dudley Castle suggests that the fallow deer grazed within a similar environment to the cattle from the site.

Indeed, it may be that both were managed together within the castle's park, a scenario that would be consistent with the post-medieval emphasis on animal breeding as an expression of elite identity (Ritvo 1987). That fallow deer may also have been the subject of elite-driven breeding programmes is hinted at by the apparent emergence of coat-colour variation in the later/post-medieval period.

In many ways, the fallow deer data for the later/post medieval period indicate a return to the menagerie style management seen in the 11th/12th centuries and it may be no coincidence that both of these periods were characterised by imperialism: initially the Norman Empire, and later that of the British Empire. It has been shown repeatedly that menageries and zoos are traits of imperial societies, whereby wild animals are enclosed and maintained as metaphors for power and control (Ritvo 1987, 243–290). Certainly in both the earlier and post-medieval periods fallow deer were perceived as symbols of wilderness, rather than the 'livestock' of the high medieval period. Paradoxically, by the post-medieval period the increased attention given to coat colour – a well-known trait of domestication (e.g. Ludwig et al. 2009) – demonstrates that the fallow deer of this period were far removed from those first introduced to medieval England.

Funding

This research was funded by the Arts and Humanities Research Council (AH/I026456/1), supported by research leave funded by the University of Nottingham.

Supplemental data

Supplemental data for this article can be accessed at [10.1080/20548923.2016.1208027](https://doi.org/10.1080/20548923.2016.1208027)

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