Assessment of the animal bone assemblage from the 2009 and 2010 excavations at Lyminge, Kent

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The animal bones assessed in this report are from two main periods of occupation at the Anglo-Saxon settlement of Lyminge, Kent. Archaeological excavations in 2009 revealed a number of features which probably relate to monastic settlement in the 8th-9th c. (middle Saxon period). At this time, Lyminge is thought to have been the site of a monastic community, possibly one of a number of "double-houses founded by the Kentish royal dynasty" (Thomas 2011a)." The features include pits, boundary ditches and possible evidence for cells and structures, and internal and external spaces. Pits constitute c. 95 of contexts excavated (Thomas 2011b). The 2010 excavations revealed an underlying early Saxon settlement, possibly related to a royal tribute centre or royal vill, with evidence for timber halls and sunken-featured buildings (SFBs) and which may represent part of the earliest phase of monastic settlement (Thomas 2011a, 2011b). Animal bones were recovered in varying quantities from SFBs 1-4. The chronology and characteristics of the SFBs are summarised below (after Thomas 2011b):

- SFB1: late 6th-AD 700. Cuts a classic timber hall. The assemblage is small, and from cut features (postholes) and structural or use features.
- SFB2: late 5th/6th-late 6th/7th c (the artefacts suggest a 6th-7th c. date but may include waste accumulated elsewhere 50-100 years earlier, as suggested by the finds (Scull 2011)). Some of the bone is highly fragmented and looks like crushed midden waste (Thomas 2011b)
- SFB3: late 7th/8th (or 8th-9th c., Scull 2011)
- SFB4: 6th-7th c.

Storage of the assemblages

The 2009 assemblages is stored in 13 plastic crates, of *c.* 30cmx40cmx60cm (9 crates) and c. 23cmx35cmx48cm (4 crates). The material is temporarily stored in the Zooarchaeology Laboratory, English Heritage, Fort Cumberland (Fort Cumberland Rd., Portsmouth, Hants. P04 9LD). The 2010 assemblage is stored in six plastic crates, approximately 30cmx40cmx60cm, which are housed at the University of Reading.

Aims and objectives of the assessment

The aim of this assessment is to establish the potential of the assemblage to inform on diet, food production and procurement, husbandry, as well as cultural identity and status variation in time and space. Of particular interest is the potential for identifying religious taboos and regulations. In addition, waste disposal and use of space may be explored by full analysis.

Potential research questions include;

- Is there any evidence for chronological change in the species distribution which may reflect a shift in culture or faith of the inhabitants?
- Is there evidence for consumption of high status food, eg. wild animals, symbolic animals, juvenile domestic animals, relating to elite status/religious faith?
- Is there any evidence for introduced species or new husbandry techniques (eg. fallow deer, rabbit, pigeon)?
- Is there evidence for spatial variation in bodypart distribution, between areas/SFBs, including evidence for consumption versus butchery and food preparation, or craft activities?
- Is there evidence for special treatment of animal carcasses (eg. foundation/termination deposits)?
- Can the age at death data potentially inform on husbandry systems and diet quality?
- Is there enough metric data to inform on livestock size and conformation?

Recovery of the assemblages

The 2009 (8^{th}-9^{th} c.) animal bone assemblage was recovered by dry-sieving and hand-collection during excavation, as well as from the sample heavy residues and flots. For the coarse-sieving, a 4mm mesh was used. All pit fills were dry-sieved and most of the ditch fills were sieved also, though towards the end of the excavation, some fills were hand-collected only (Thomas 2011b), which may have resulted in recovery bias against smaller specimens. It is not possible to differentiate the coarse-sieved and hand-collected materials from the bag labels, but of 136 bags of bones examined, it is possible that 40 include hand-collected bone only (based on general impression of fragment size). For the flotation samples, a 250µm mesh was used to collect the flots and the heavy residues were retained on a 1mm mesh. The residues are unsorted but most have been scanned by Gill Campbell, who provides notes regarding abundance of animal remains in her assessment archive (Campbell 2012). Bone fragmentation in the samples is noted as heavy for all residues examined.

The 2010 animal bone assemblage was recovered primarily by dry-sieving over a 4mm mesh. The bones were washed and the washing water was sieved through a c.1mm sieve (Harrington 2011). Some clusters of bones were recovered by hand, with grid coordinates recorded. Animal bones were recovered also from the sample heavy residues and flots; the flots were recovered on a 250µm mesh and the heavy residue retained on a 1mm mesh.

Methods

The assessment follows English Heritage MAP2 (1991) and Environmental Guidelines (2011). Numbers of identifiable, ageable and measurable specimens, but not the detail of individual bones, was recorded to allow assessment of quantity, quality and information potential of the recovered material. It also provides a task-list for analysis. Limited interpretation or synthesis is attempted at this juncture. The methods follow closely those applied by Rebecca Reynolds (2008) in her assessment of the 2007-8 material, so that comparison between the assessment results is possible.

Due to time limitations, the assemblages could not be assessed in their entirety. Instead, approximately 30% of both the 2009 and 2010 assemblages was examined. For the 2009 assemblage, assessment focused on material from priority contexts (Thomas 2011b), including mainly the early boundary ditch and pits and, to a much lesser extent, the secondary timber palisades. Approximately 27% of the total coarse-sieved/hand-collected assemblage was examined and the total recordable data was extrapolated from this figure based on box size and volume of material. A small number of residues were assessed also. Residue samples were selected from those contexts for which the coarse-sieved/hand-collected bone was assessed. The assessed residues include:

Pit fills

- 1508 (sample 69), bags,1, 2, 4, 5, 6, 7, 8 of 8 bags
- 1095 (sample 78), bag 6 of 8
- 1545 (sample 79), bag 1 of 8
- 1672 (sample 126), bag 2 of 2
- 1698 (sample 138), bag 2 of 4

Early boundary ditch fills

- 1711 (sample 137), bags 1 and 2 of 2
- 1689 (sample 142), bag 5 of 8
- 1751 (sample 143), bag 1 of 8

For the 2010 assemblages, a portion of the material from SFB1 and SFB2 was assessed and the total recordable data extrapolated from this for the respective SFBs, based on box size, volume of material and an impression of fragmentation. Almost all of the SFB3 and SFB4 material was assessed, with unexamined bags including few if any additional recordable bones:

- SFB1: Boxes 2 and 3 assessed; Box 5 contains similar type and amount of material as Box 3
- SFB2: Box 1 assessed; Box 4 contains similar type and c. 75% of the quantity of material examined from Box 1

- SFB3: Box 6 assessed
- SFB4: Box 6 assessed
- General (not assigned to SFB, not assessed): Box 6; includes c. 75 recordable bones

Preservation and taphonomic traces were recorded. The state of preservation (condition) was scored using the five stage system applied by Reynolds (2008), with stage 1 indicating the worst preservation and stage 5 the best. The presence of gnawing and of other modifications, such as weathering, erosion/abrasion, and root etching was recorded also. The presence of butchery traces was noted but not quantified. The presence of animal bone groups or articulated/associated specimens was recorded. The evidence for articulating/associated bones, condition and taphonomic traces can be used to address questions of deposit formation and burial or exposure of bone waste. For the 2010 assemblage, this is of particular interest with regards to the origin of the SFB2 assemblage.

As in Reynolds (2008), the total number of identifiable bones (excluding sesamoids) and teeth (NISP) was recorded for each context examined. A zone recording system was not adopted. In order to assess the potential for spatial analysis, quantification by bodypart was undertaken (modified after Reynolds 2008) system: the elements of each taxon are divided into cranial-teeth; cranial other (including mandibles and maxillae with teeth and horncores); atlas/axis; meat-limbs (scapula, humerus, radius, ulna, pelvis, femur, tibia); meat-ribs/vertebrae; feet (carpals, tarsals, metapodials, phalanges). This may assist in identifying intra-site spatial variation in consumption versus butchery, craft activity, and special treatment of part/whole animals. In addition, the number of unidentifiable fragments was estimated very approximately for all examined material (except for some samples)l.

For the assessment, no attempt was made to distinguish between certain taxonomic groups, horse, donkey or mule, or medium size Galliformes for instance. Where goat elements were observed this was noted in the archive, but species distinction was not undertaken for all elements of sheep/goat at this juncture. Full speciation should be carried out during analysis, using modern comparative reference material and published criteria for morphological and biometrical separation.

Mandibles were considered ‘ageable’ if they had one or more cheek teeth (fourth deciduous premolar/fourth premolar – third molar) in-situ with recognisable wear (attributable to a wear stage) on the occlusal surface, following Grant (1982) for cattle and pigs, and Payne (1973, 1987) for sheep/goat. Isolated teeth were considered ageable if they consist of the fourth deciduous premolar, fourth premolar or a first, second or third molar with recognisable wear (attributable to a wear stage) on the occlusal surface (references as above). Bones were considered ageable if the state of epiphyseal fusion could be ascertained or if they consisted of foetal/perinatal remains including where bone ends were too damaged or unformed to show epiphyseal surface.

Von den Driesch (1976) defines the majority of measurements that would be taken for full analysis. Pig measurements would follow the definitions of Payne & Bull (1988). Humerus ‘HTC’ and ‘BT’ would be taken for all species, as defined by Payne & Bull (1988). Additional metapodial measurements (BatF, 1, 2, 3, 4, 5, 6, a & b) would also be taken for cattle, sheep/goat and deer, according to Davis (1992). Mandibular equid teeth would be measured using Davis (1987). For this assessment the number of measurable specimens includes bones in which fusion of the latest fusing epiphysis could not be ascertained but excludes unfused bones and obviously immature or juvenile specimens. On average, c. 2-3 measurements may be estimated for each measurable specimen.

Results

Description of the assemblages is provided in chronological order of settlement occupation rather than excavation date, in order to allow a sense of change or continuity in the data through time.

Preservation

Condition and gnawing

In general the preservation of the 5th-7th c. and 8th-9th c. assemblages is good, with condition scores varying between 3 and 4 (see methods above and Reynolds 2008). For all SFBs the bones in most of the bags that were examined show condition scores 3 (moderately-well preserved, some edges abraded - this is a slight modification of Reynolds (2008) who defines score 3 as "edges mainly abraded") and 4 (well preserved, edges mainly spiky) (Table 1). There is some variation between SFBs. The preservation in SFB1 is not as good as in SFB2 or SFB3, with a higher proportion of the lower condition scores. The colour of the specimens in SFB1 appeared more mottled than the material in SFB2. Though gnawing was observed on few specimens, dog gnawing was observed more frequently in SFB1, with 33 gnawed specimens compared to only nine observed in SFB2 (based on number of specimens, not bags). The condition scores and gnawing evidence suggest that the assemblage from SFB1 may have been exposed for a slightly longer period of time prior to burial than the waste deposited in SFB2 and/or that it originates from a different depositional environment (the colour is more varied in SFB1). The preservation data does not agree with the artefactual evidence which suggests that SFB2 may include residual material; this may indicate that the bone and artefacts have different depositional histories.

In the 8th-9th c. assemblage poorly preserved material was rarely noted (Table 1). Gnawing by carnivores, mainly dog, was observed on c. 5% of the assessed material, and was more than twice as common on material from the early boundary ditch compared to the pits. It was also much more common on the few bones assessed for the North-South secondary ditch palisade. This may indicate that waste from pits was buried more rapidly following discard, compared to material from ditches/boundary features which may have been exposed for a longer period either prior to, or following disposal within these features. A few contexts yielded possible residual fragments including pit fills (1667, 1018 and 1026) and an early boundary ditch fill (1690). Specimens showing an ivoried or greasy appearance were present throughout the assemblage. While the assemblage is highly fragmented, the "high degree of erosion" and "numerous occurrences of acid etching" noted by Reynolds (2008, 1) in the 2007 and 2008 assemblages, were not observed. At least some of the pits (pit 1633, fill 1672; pit 1321, fill 1619; pit 1064, fill 1506; pit 1165, fill 1566) functioned as cess pits at one time as indicated by the presence of coprolites (probably human) and/or typical cess type encrustations on the bones. Pit fill 1672, clearly a cesspit fill, contained an almost complete skeleton of a perinatal human (see below).

Fragmentation

Dry-sieving in the SFBs resulted in the recovery of many thousands of small unidentifiable fragments (Tables 2, 6 and Archive). Fragmentation of the assemblages in all the SFBs is marked, though at this stage it is not possible to say if the waste was deliberately crushed or fragmented through other processes, or if processes differ between buildings. The high fragmentation of the 5th-7th c. material was not observed in the 8th-9th c. assemblage; the potential causes of intersite variation and appropriate methods for quantifying this should be considered at analysis stage.

Burning

Burning was noted on c. 1% (8th-9th c.) to 2-3% (5th-7th c.) of unidentifiable bones and teeth, and a few of the recordable specimens (see Archive). Many of the burnt specimens show partial burning, suggestive of roasting; alternatively it may be due to uneven exposure of discarded waste to fire, though this would probably have resulted in a greater proportion of burnt specimens overall. In the 8th-9th c., burning is most common in the pits. This may indicate that waste from cooking and/or burned in hearths was more commonly disposed of in the pits, or that a greater mix of materials was discarded in the ditch/palisade features. There is no concentration of burnt bones that might indicate the use of bone for fuel.

Butchery

Butchery marks were observed on the bones of cattle, sheep/goat and pig, and on the ribs and vertebrae of large and medium size mammals in both periods (Archive). The horn cores of both male sheep and goats were observed throughout the 8th-9th c. assemblage, many of which show evidence of having been deliberately removed from the skulls, probably for horn working. Small concentrations of horn cores were observed in ditch fills 1616, 1676 and 1690. Two worked items were noted:
-pit fill 1672: solid piece of bone (1cm wide x c. 7cm long), worked to chisel-like end
-early boundary ditch fill 1751: bone pin

Articulating elements and associated bone groups (ABGs)

Some associated bone groups were noted during excavation but a number of ABGs and occasional articulating bones, have been recognised only at assessment stage. The following description is based on assessment data. Articulating bones (limb bones and epiphyses, foot bones, etc) were recognised in a number of contexts, suggesting that once deposited, little further disturbance occurred to the bone waste. In the 5th-7th c. assemblage, articulating bones were observed in SFB2-five bags, SFB1-12 bags, SFB3-1 bag, but many more may be present (see Archive). Some associated or isolated bones (for example skulls) may represent deliberate deposits although only one partial skeleton (neonatal pig) was observed:
-2293b (SFB2): neonatal pig, possible part skeleton
-2609C (SFB2): possible associated pig scapula, humerus and radius
-2541D (SFB1): cattle skull, cattle radii
-bone cluster at 1.35 (SFB1, no context information): possible pig's feet
-2043C (SFB4): sheep/goat lower hind limb: tibia, calcaneum, astragalus, navicul-cuboid, metatarsal, two proximal phalanges, two middle phalanges and one distal phalanx

In the later assemblage, articulating elements were observed in 11 bags and associated bone groups in seven pit fills and a secondary timber palisade feature (see Archive). Some of these may represent deliberate deposits or consist of discarded carcasses in cesspits while the status of others is uncertain:
-pit fill 1667: subadult cattle partial skeleton
-pit fill 1672 (possible cess pit, within EW ditch): perinatal human, probably single individual, almost complete skeleton. Small bones and teeth are absent and were not observed in the sample residues (see Archive); they were probably lost during excavation rather than through truncation as many skull, both jawbones and a few foot bones are present. It is impossible to know if the individual was still-born or live at birth; if still-born, the baby would have been close to full-term. It may be possible to determine gestation stage, if still-born, from bone lengths (Mays 2011).
-pit fill 1566: possible part skeleton of a juvenile domestic fowl
-pit fill 1506: juvenile corvid part skeleton; distal limbs of at least five juvenile birds, possibly domestic fowl; foetal/neonatal bird, possible domestic fowl; foetal/neonatal dog/cat; roe deer radius and ulna
-pit fill 1508 part skeleton of an adult corvid, jay size, with tibiotarsus showing healed trauma; possible part skeleton (possibly three associated bones) of a juvenile domestic fowl
-pit fill 1552: two juvenile tarsometatarsi of domestic fowl
-pit fill 1571: calf skeleton
-secondary timber palisade (E-W) 1590: equid mandibles, atlas and axis, vertebrae and ribs

Assemblage size and recordable bones

The assemblages from the 5th-7th c. and 8th-9th c. will yield moderate to large assemblages, allowing comparison of taxonomic distributions between periods, and between structures or features within each period of settlement, for example between SFB1 and SFB2, and between groups of pits and pits and ditches, in the later period.

The assessed remains from the 5th-7th c. assemblage includes *c.* 1400 mammal, bird and amphibian remains and c. 40 fish bones that may be identifiable to species, genus or family level. The total assemblage, including assessed and estimated counts includes *c.* 16000

fragments of which *c.* 2400 recordable bones may be identifiable to species, genus or family level (Table 2). The total counts for SFB1 and SFB2 indicate that just over 1000 specimens will be recordable in each, with SFB3 and SFB4 yielding *c.* 100 recordable bones respectively. Mammals constitute by far the most abundant class in the assessed material, with fewer bird, amphibian and fish remains in the sieved/hand-collected assemblage. The heavy residues are dominated by small mammal (28%) and fish (39%) bones (Table 3).

The assessed remains from the 8th-9th c. coarse-sieving/hand-collected assemblage include c. 10000 fragments of mammal, bird, amphibian and fish bones, of which c. 3450 may be recordable to species, genus or family level (Table 4). The potential total fragments is c. 36600, of which just under 13000 may be recordable, including *c.* 8250 mammal, bird and amphibian remains and *c.* 4500 fish bones (cranial bones and vertebrae) (Table 4). For assessment of the sample residues, 22 bags of unsorted residues from 8 samples (8 contexts) were examined (total assessed sample volume 750 litres of total). This represents just over a tenth of the total volume of recovered samples, *c.* 6770 litres, see sample list LYM09-T1.xls). These yielded few identifiable remains (58) other than fish bones which are present in huge numbers (Table 5). As a crude estimate, the sample residues may include *c.* 500 identifiable bones, excluding fish. Where fish bones were particularly numerous, these were not quantified but a general indication of abundance is provided (see Archive). Large numbers of scales are present in some of the flots also (see 2012).

Taxonomic distribution

In both periods, the assemblages are dominated by domestic animals but the proportions of mammals and birds and of the main domestic mammals vary markedly between phases.

Cattle, sheep/goat and pig

In the dry-sieved/hand-collected assemblages from the SFBs, the domestic taxa, cattle, sheep/goat and pig make up cc. 80% of estimated total recordable bones, with pig being the most abundant in all except SFB3 (Table 2). The assemblage from the heavy residues from SFB2 shows the predominance of pig over cattle and sheep also (Table 3). The predominance of pig is undoubtedly due to the greater number of metapodia and phalanges and presence of upper incisor teeth in the pig skeleton (see methods) (Tables 6-7). Nonetheless, when proportions are based on discrete skeletal element groups, the abundance of pig is evident (Table 4; the few cattle and sheep/goat horncores included in the bone counts are unlikely to bias taxonomic representation). In the 8th-9th c. coarse-sieved/hand-collected assemblage cattle, sheep/goat and pig make up a smaller proportion of the total assemblage (c. 56% of estimated total recordable bones, excluding fish), with sheep/goat being the most abundant in all feature types (Table 6). This is echoed in the heavy residues (Table 7) and in the distribution of taxa by bodypart (Table 8). There does not appear to be a biasing effect from any particular skeletal element group, though it is possible that the cranial element count for sheep/goat and, to a lesser extent cattle is biased by horncores, as these were noted throughout the assemblage (Table 9 and Archive). The pattern is very similar to that observed by Reynolds (2010) for the contemporary assemblage excavated in 2007 (test pits) and 2008 (two large trenches) near the present church of St. Mary's (Table 10).

Other domestic mammals

Other domestic mammals include equid, dog and cat, but these are relatively uncommon in both phases, representing less than 2% of combined mammals (excluding small mammals) and birds. Nonetheless, the presence of gnawed specimens indicates the presence of dogs (and cats) throughout the periods of occupation.

Wild mammals (excluding microfauna)

Wild mammals are rare, representing less than 1% of combined mammals (excluding small mammals) and birds in the 5th-7th c. and 8th-9th c. Red and roe deer are present in the earlier phase, with two of the three recorded red deer specimens consisting of antler (of which two

are sawn). In the later phase red deer is absent, but a number of cranial and postcranial remains of roe deer were recorded. Fallow deer was not noted. Wild mammals other than deer include small carnivores and lagomorpha (hare/rabbit).

Birds

In the 5th-7th c. dry-sieved/hand-collected assemblage, birds represent *c.* 10% of the combined mammal (excluding small mammals) and bird bones in the assessed assemblages, varying between 8% and 13.5% in individual SFBs (Table 2). Domestic fowl make up approximately two thirds of the bird bones.). In the assessed sieved residues from SFB2, birds represent c. 14% of combined mammal (excluding small mammals) and bird bones. Birds are much more common in the 8th-9th c dry-sieved/hand-collected assemblage, representing c. 33% of the combined mammal (excluding small mammals) and bird bones in the assessed assemblages; this varies between c. 28% in ditches and c. 36% in pits (see also Table 10 for Reynolds' data (2008)). Most of the bird bones derive from domestic fowl, with other taxa representing only one fifth of bird bones compared to one third in the earlier phase (Table 4). In the ditch and pit assemblages, domestic fowl are more common than either cattle or pig. Birds represent *c.* 6% and *c.* 44% of combined mammal (excluding small mammals) and bird bones in the assessed assemblages from pits and ditches respectively.

Bones of large goose and duck were noted in the 5th-7th and 8th-9th c. assemblages and may derive from domesticated or wild birds (greylag, mallard). Greylag size bird bones are present throughout SFB1 and other wild species include Turdidae (blackbird/thrushes) and a possible medium size diver/aquatic bird. In SFB 2, small goose species, small duck (teal size), plover or related species, Turdidae, a medium-large size raptor, black throated diver and crane were noted. There seems to be some variation between SFBs, with birds other than domestic fowl being twice as numerous in SFB2 compared to SFB1, which may explain in part the greater number of bird taxa noted in SFB2. The relative frequency of bird bones in the assessed heavy residues from SFB2 (14% of combined mammal (excluding small mammals) and bird bones) is similar to that in the dry-sieved/hand-collected assemblage (13.5%) (Table 3). Two of the four recordable bird bones are from Turdidae or similar size birds (eg. plover, pigeon), and it is probable that such small species are underrepresented in the dry-sieved/hand-collected assemblage. In the 8th-9th c. assemblage, taxa other than domestic fowl are less common than in the earlier phase, despite the greater assemblage size. These include domestic/wild geese and ducks, small wild ducks, a large wader (heron/egret size), possible plover, possible rail species (Rallidae) and crow/rook, magpie and jay size corvids. Bird bones represent *c.* 14% of combined mammal (excluding small mammals) and bird bones in the sieved residues (Table 5). The sieved residues also include bird vertebrae, ribs and unidentifiable bird bones. Five of the six identifiable bird bones are from domestic fowl.

Fish

Fish bones represent *c.* 3% of the recordable dry-sieved/hand-collected assemblage in individual SFBs and in the 5th-7th c. assemblage as a whole. In contrast, in the heavy residues (SFB2) they are the most abundant taxonomic group (35%) (Table 3). A total of 60 head elements and vertebrae were recovered as well as c. 59 undiagnostic ribs/rays. Eel and ray (dermal denticles) were noted amongst the fish bones. In the 8th-9th c. assemblage, fish bones represent approximately one third of the total recordable coarse-sieved/hand-collected assemblage and are much more abundant in heavy residues, present in their hundreds in ditch samples and thousands in the pit residues (Tables 4 and 5; see also Reynolds n.d.). A range of taxa are present, with very large fish remains in the coarse-sieved/hand-collected assemblage and very small fish bones much more abundant in the residues. There is some evidence that fish species may differ between contexts. Eel bones are present in pit fill 1048 (pit 1698), whereas other contexts more commonly yielded gadids and possibly herring. Cranial remains appear to be approximately three times as common as vertebrae, which may indicate that for the most part fish arrived whole on site; this is suggested also by the abundance of all elements, including undiagnostic ribs, rays and vertebral spines in the residues.

Microfauna

Microfaunal remains are scarce in the dry-sieved/hand-collected assemblages but abundant in the flotation heavy residues. Small mammal remains represent 25-28% and amphibia from *c.* 15% to 30% of the assessed heavy residue assemblages (Tables 3 and 5). These small taxa will inform on environmental conditions within and around the settlements and possibly on deposit formation (eg. pit traps). The amphibian remains may be useful for exploring the biogeography of particular species, such as the reintroduced pool frog.

Skeletal element representation

The assemblages will allow exploration of skeletal element representation of the main domestic taxa. In Tables 6-7 and 8-9, a preliminary assessment of bodypart distribution is provided. As noted above pig feet are abundant in the 5th-7th c. assemblage though this may be biased by the assessment method. Other bodyparts appear to be more evenly represented suggesting that whole carcasses or live animals were brought to the settlement throughout occupation. Analysis of carcass processing may provide insight into use of space. Sheep (mainly ram) and, in particular, male goat horncores were commonly observed in the 8th-9th c. assemblage, and full analysis may reveal areas or dumps of craft waste. Skeletal element distribution of bird and fish remains can also be explored, in particular in the later period given the large assemblage size and good preservation of the remains

Ageable specimens

The number of ageable and measurable specimens of the main domestic taxa is provided in Table 11 (5th-7th c.), Table 12 (8th-9th c.) and Table 13 (summary of both assemblages). The data for other domestic and wild mammals is presented in Table 14 and for domestic and wild birds in Table 15.

For the 5th-7th c., few mandibles will be available for cattle, sheep/goat or pig limiting the potential to construct mortality profiles. Isolated teeth are slightly more abundant and will provide useful additional mortality data (eg. mortality profiles of sheep/goat based on dP4, P4 and M3 after Payne 1988). For the 8th-9th c., approximately 30 cattle, 63 sheep/goat mandibles (and possibly up to 10 from residues) and 80 pig mandibles will be available. This data is invaluable for the 8th-9th c. as few mandibles are available from the 2007 and 2008 excavations (Reynolds 2008). The epiphyseal fusion data is abundant for both assemblages, though for the 5th-7th c. the pig data is provided in large part by phalanges. It may be possible to combine the 8th-9th c. data with the abundant data reported for the 2007-2008 (Table 13).

The datasets will allow comparison of mortality profiles between periods, to inform on animal husbandry, production, slaughter patterns and animal use. The remains of foetal/neonatal and very juvenile pigs and sheep/goat were observed throughout both assemblages (see Archive), suggesting that some livestock was raised locally. In the 8th-9th c. foetal and perinatal animals were observed in a range of contexts including pit fills 1606, 1619, 1667, 1672, 1687 and early boundary ditch fill 1690. Juvenile and subadult cattle were observed also, and some very old cattle are evident in the 8th-9th c. assemblage. The age data may also inform on diet quality and status, potentially spatially between SFBs in the 5th-7th c., and temporally between broader periods. In conjunction with taxonomic and element identification, the age data may also inform on symbolic deposition of animals in both periods.

Other species, including equid, dog, cat and roe deer yield far less, but potentially useful age data (Table 14). In the case of roe deer, subadult and adult animals were observed in the 8th-9th c. assemblage and a consideration of age profiles may inform on hunting practice.

Few juvenile domestic fowl bones were noted in the 6th-7th c. assemblage. In contrast, they were recorded throughout the 8th-9th c. assemblage, with the presence of very juvenile specimens and part skeletons recorded in some pits (see above). A tarsometatarsus of a juvenile goose (?) was observed in the 8th-9th c. (pit 1619) (see Reynolds 2008 on the presence of juvenile goose bones in the 2007-2008 assemblages).

Sex indicators

The analysis of sex criteria provides insight into animal management as well as dietary choices. The sex of pigs is indicated by the canines and canine alveoli. For the 6th-7th c., of 26 sexed specimens, at least 19 are male and 7 are female, suggesting a predominance of males. In the 8th-9th c. assemblage, male and female elements are evenly represented, though these may derive from few animals (Table 15). At analysis, the calculation of minimum number of elements (MNE) or individuals (MNI) will be essential for examining sex ratios based on skeletal elements/morphological traits. The distribution differs from that observed for the contemporary assemblage from the 2007 and 2008 assemblages in which there is a predominance of male elements (Reynolds 2008).

The sex of domestic fowl is provided by the presence/absence of spurs on the metatarsals (usually male, occasionally female) and medullary bone (females). In the 6th-7th c. assemblage, one tarsometatarsal has a spur and medullary bone is present in one unidentified bird bone and one domestic fowl bone (Table 16). In the 8th-9th c. assemblage, approximately 148 specimens will provide sex information. These include many fragments with medullary bone and tarsometatarsals with and without spurs. Female elements appear to be predominant. Measurements may also inform on the proportion of male and female fowl (see below).

Measurable specimens

The measurable specimens of the main domestic mammals are listed in Tables 11-13, of other domestic and wild mammals in Table 14 and for domestic and wild birds in Table 16. If we estimate that on average the measurable specimens will yield two to three times as many measurements, the potential of the dataset becomes clear, in particular for the 8th-9th c. animals.

In both assemblages, most of the recordable bone measurements of the main domestic mammals are breadth and depth measurements, as few complete bones were recovered. Many of the measurements can be combined, using the log-ratio technique, to explore chronological variation in livestock size and shape. For some taxa, the measurements will allow identification of distinct species (eg. sheep vs goat, after Payne 1969). It may be possible also to explore sex distributions where datasets are large enough. The 8th-9th c. metric data will add substantially to that available from the 2007 and 2008 assemblages (Reynolds 2008).

The bones and teeth of dogs in the 5th-7th c. and 8th-9th c. assemblage are mainly from medium-large animals (border collie to Alsatian size), while smaller bones belonging to fox/small dog are less common. The measurable and more fragmented remains of dogs will provide an idea of the types of dog present, and from this their possible role. The possible presence of wolf should be considered at the analysis stage.

For roe deer, an estimated 30 measurable specimens may be available, which may allow some characterisation for deer size in the Saxon period.

The metric database for domestic fowl is very large, with c. 80 specimens (160-240 measurements) available for the 5th-7th c., and a huge number of potentially measurable specimen in the 8th-9th c. (885 measurable bones equal to 1700-2400 measurements) (Table 16). A dataset of this size will allow examination of population distribution (males, females) and potentially of different types of fowl present (size and shape). Other bird remains (corvids, goose, duck, other waterfowl) include c. 50 and 130 measurable bones for the 5th-7th and 8th-9th c. respectively. The measurements, in particular of goose and duck may assist with species distinction.

Pathology and non-metric traits

Pathological specimens were noted in both periods, though not in great abundance (see Archive). These include possible linear enamel hypoplasia in a pig M3, and extra bony

growth on a sheep/goat humerus, pig middle phalange and dog proximal phalanx in the 6th-7th c. A sheep/goat radius with extra bone on the shaft, healed fractures in a domestic fowl tibiotarsus and a jay size tibiotarsus (8th-9th c.), and healed fractures on other identified and unidentified elements are evident in the 8th-9th c.

Non-metric/congenital traits were not recorded at assessment but should be fully documented at analysis stage.

Discussion

The animal bone assemblages from the sunken featured buildings and later monastic settlement at Lyminge are amongst the largest available for the Saxon period in Southeast England. They will make invaluable contributions to defining lifeways at the site itself and more widely to our understanding of rural/elite life and monastic traditions in Saxon England.

The assemblages from both the 5th-7th c. and 8th-9th c. settlements are well-preserved, with a low incidence of carnivore gnawing, suggesting rapid burial, prior to and following deposition in the SFBs, and in the later pits and ditches. The presence of associated bones and epiphyses, and some articulating groups supports this. The ABGs and articulating elements may provide excellent radio-carbon samples where required. The good condition overall of the assemblages suggests that natural taphonomic alteration is not a main cause of variation between the assemblages, however the intrasite variation observed between SFBs and between later context types should be taken into consideration when comparing taxonomic and age distributions as the predominance of material from a particular context type or structure may bias spatial and temporal patterns.

Both assemblages hold considerable potential for understanding diet, pastoral husbandry and agrarian activities, social status and animal symbolism, within and between periods. A total of *c.* 2200 and 4500 identifiable bones, excluding fish is estimated for the 5th-7th and 8th-9th c. dry-sieved/hand-collected assemblages respectively, with a further 1800 and 4000 fragments respectively recordable to size class. A few hundred additional identifiable mammal, bird and amphibian specimens will be available in the sample residues. The data will provide information on the proportions of the main livestock, of the ratio of domestic versus wild mammals, and of the relative abundance and diversity of avian taxa, as well as providing moderate to very large numbers of ageable and measurable specimens of the main mammals and domestic fowl. Fish bones number in their 100s in the 5th-7th c. assemblage (dry-sieved/hand-collected and samples), and in their thousands in the later assemblage.

In summary, the assemblages are dominated by domestic animals, cattle, sheep/goat and pig as well as domestic fowl, but there are marked differences between phases, with pig predominant in the 5th-7th c. and sheep/goat and domestic fowl in the monastic phase. Both NISP and quantification by bodypart (to avoid biasing for interspecific element frequency) suggest that this represents a real change in site diet, economy or husbandry practice. For example, the abundance of pig in the early Saxon period may support other evidence for high status at the site, while the later focus on sheep/goat may reflect monastic involvement in wool production (Reynolds 2008; Sykes 2006). Wild mammals are scarce throughout the assemblages, suggesting that hunting was not engaged in on a large or perhaps legitimate scale. Roe deer are the more common of the deer species in both periods, and appear to have been hunted for meat, as indicated by the presence of all bodyparts. The saw marks on some red deer antler fragments suggests that antler was worked at the site and a single red deer limb bone from SFB 3 suggests that red deer was hunted in the early Saxon period. Studies of deer symbolism may throw some light on taxonomic distributions. For example, roe deer may have been considered suitable quarry for ecclesiasts (Poole 2011; Sykes 2007).

The assessment suggests that bird taxa and abundance change through time also, potentially reflecting site function and status. The assessment has shown that although bird bones are not nearly as common in the SFBs as in the 8th-9th c. features, up to one third-one half of identifiable bird bones come from a wide range of taxa other than domestic fowl, including some potentially high status species, for example crane and raptor (see discussion of falconry in the Saxon period in Dobney and Jacques 2002, Poole 2011). The abundance of bird

bones in the later phase echoes that observed by Reynolds (2008) for the contemporary assemblage from the 2007 and 2008 excavations. The chronological variation does not appear to be due to preservation differences, though context type must be taken into consideration (SFBs versus pits for example); it is possible then that the increased representation of domestic fowl reflects requirements of the monastic diet (avoidance of meat from quadrupeds, see Sykes 2007, Poole 2011). The difference in the abundance of fish may best illustrate changes in dietary traditions or proscriptions (in the monastic phase), as well as shifts in fishing activity and intensification of marine fisheries (Reynolds 2008, 2010. n.d.). How early this intensification began and how it operated is an active area of research (eg. Barrett *et al.* 2011); the data from Lyminge will provide insight into fish sources and fishing methods in particular in the 8th-9th c. The presence and taxonomic diversity of small mammal and amphibians may inform on deposit formation (eg. pit falls) and on ecological conditions within the settlement and its surrounds, aspects that will help to contextualise and elucidate wider assemblage characteristics from stock raising, hunting and wild fowling activities to waste disposal and feature use.

The assemblage will yield information on skeletal element representation for the main mammal and bird taxa. The assessment data suggests that whole animals/carcasses were brought to the site. In the 5th-7th c. phase there appears to be a predominance of pig foot bones, though more detailed quantification of skeletal abundance will clarify if this represents variation in processing methods or if due to inter-specific anatomical differences. Analysis of butchery marks, observed throughout the assemblages, will provide information about methods of carcass processing, jointing and meat distribution. The splitting of vertebrae of the medium and large size livestock was observed infrequently. Though present in many periods, it is thought that axial splitting of large carcasses was dependent on structural capabilities for hoisting and hanging them, and may thus be a sign of a standardised approach to butchery. The evidence of burning should be examined closely as it may inform on cooking methods; the presence of part charred specimens suggests that some roasting may have occurred (see Sykes 2006 on roasting and elite diet). Craft activity is evidenced by antler cut-offs in the early Saxon assemblage, while numerous horncores of male sheep and goats in the monastic phase may indicate some level of organised horn working (Albarella 2003 on goats and hornworking). There was no obvious evidence for leather working, though the possibility of vellum production in the monastic phase should be kept in mind at the analysis stage.

The age data will inform on husbandry practices and the use of animals for different purposes and products, from which site function (producer versus consumer), consumption practices (meat quality) and social status may be interpreted. The estimated age data will allow analysis of kill-off patterns for sheep/goat and pig and provide somewhat more limited information for cattle. Poultry keeping will be elucidated also, in particular for the monastic phase. At present, it seems that different age groups are present for cattle, sheep/goat and pig, with juvenile pig particularly common in the early phase. The presence of subadult pigs is the usual pattern throughout historical periods in England, though in much later periods an abundance of juvenile pigs is a mark of high status (eg. Dobney *et al*. 2007; Sykes 2006; Albarella and Davis 1996, for medieval period). The pig data from the monastic settlement may reveal more nuanced differences in pig husbandry and consumption at Lyminge. The sex data of pigs will inform on pig management; in the early phase of occupation males appear to be more common than females while in the later phase there is a more even representation of males and females (though this contrasts with Reynolds 2008 nd needs to be analysed based on MNE/MNI). The variation may suggest differences in procurement and production; for example there may have been a greater emphasis on breeding females in the later phase. The presence of foetal, neonatal, juvenile through to adult animals in both phases strongly suggests that livestock-raising occurred in the site vicinity in both periods. Juvenile/subadult Galliformes (probably domestic fowl) were noted much more frequently in the 8th-9th c. assemblage than in the earlier phase, which may indicate a shift in consumption patterns (though to some extent it may be a biased impression due to assemblage size and recovery). The presence of medullary bone indicates the presence of laying hens and is most abundant in the monastic phase.

The biometrical data from Lyminge is invaluable for characterising livestock size and shape in the Saxon period, in particular for the 8th-9th c., given the scarcity of large Saxon datasets for Southeast England. Comparison to Roman datasets may provide some insight into "continuity" or change in livestock husbandry. Domestic fowl bones will yield a very large metric dataset with which, for the first time, it will also be possible to explore size change/continuity from the Late Roman period (Poole 2011), demographic structure as well as potentially the presence of different types of fowl. Breeding and manipulation of domestic fowl have received little systematic zooarchaeological attention (Slavin 2009 for the late medieval period). There may also be sufficient information to explore the potential presence of domestic geese and ducks.

The presence of articulating elements, as well as associated bone groups is invaluable for assessing deposit formation and disturbance. The associated bone groups (ABGs) will also provide an opportunity to examine evidence and arguments for the discard of carcasses and/or symbolic deposition of animals in the Saxon period (eg. Hamerow 2006; Morris and Jervis 2011). Partial and/or complete carcasses of cattle, pig as well as domestic fowl and corvids are present in the assemblage. While non-human animals are the main concern for the zooarchaeological analysis, the presence of a late-term human foetus/newborn human baby in one of the 8th-9th cess-pits is a poignant find and should be considered in the light of other Saxon evidence for social *moeurs* and treatment of still-born/neonate infants. The remains should be examined by a human bone specialist

Potential and comparative data

On a regional scale, the assemblages can be compared to the few large faunal datasets for Kent, and nearby counties. Most Saxon assemblages in the Southeast include fewer than 500 identifiable bones and few were recovered systematically through sieving. Assemblages with over 1000 mammal and bird bones or an abundance of fish include:
-Early Saxon: Northfleet, Kent (Grimm and Worley 2011, mammal and bird NISP c.1100)
-Middle Saxon: Sandtun, Kent (Murray 2001, mammal NISP 298, Bird NISP 76; fish NISP 1278, Hamilton-Dyer 2001)
-Middle Saxon: Lyminge, Kent (Reynolds 2008, assessment, mammal and bird NISP c. 6300)
-Late Saxon: Bishopstone, Sussex (Poole 2010, mammal and bird NISP 6541; Reynolds 2010, fish NISP 2448)
-Late Saxon: Steyning, Sussex (Gardiner 1993; O'Shea 1993, mammal and bird NISP c. 3360)

The Lyminge assemblage represents a nationally important dataset for the 5th-7th and 8th-9th c. (and Reynolds 2008) and can be compared to large assemblages from individual rural, urban and ecclesiastical Saxon sites, in Southern England (see synthesis of regional and national data in Holmes 2011, forthcoming; Poole 2011), the Midlands (Albarella and Pirnie 2008, forthcoming) and the North (eg. Dobney *et al*. 2007). The syntheses of Saxon animal bone assemblages, including Poole (2011), Holmes (2011) and Albarella and Pirnie (forthcoming) will provide essential references for this analysis. In addition, much work has focused on the use and symbolism of particular groups of animals in Saxon-Medieval England, providing chronological, spatial and socio-economic models against which to consider and interpret the Lyminge data (eg. Dobney and Jacques 2002; Sykes, 2004, 2006, 2007; Poole 2011; Hamerow 2006; Holmes 2011; Morris and Jervis 2011). In addition, the assemblages will inform and be informed by the recent syntheses of animal biogeography in Britain (various chapters in O'Connor and Sykes 2010). To provide a broader chronological perspective, the assemblage may be viewed against the evidence for settlement, landscape, diet and economy in Southeast England in the Anglo-Saxon period and more widely in the late Roman period (Allen 2012, forthcoming; Albarella and Pirnie 2008, forthcoming), as well as in the subsequent medieval period (see Albarella and Pirnie forthcoming; Holmes forthcoming). The data will make an invaluable contribution to and should be included in future regional research agendas (e.g. Thomas forthcoming).

Recommendations

A number of bags contain unwashed bones. This material needs to be washed so that taphonomic traces, including butchery, and age at death data can be recorded.

Samples from the 2009 excavations need to be sorted. The English Heritage guidelines (2011) advise that 100% of the >4mm residues and 25% of the 2-4mm fractions be sorted. Further sorting of the 2-4mm fractions should be undertaken with the advice of specialists, and advice regarding scanning or sorting of <2mm residues should be sought from relevant specialists (fish, microfauna).

Potential variation in recovery methods needs to be resolved if possible, so that comparison of assemblages from different periods and features is meaningful.

Assessment by relevant specialists is required for amphibian, fish and the perinatal human remains. Sorting of the fish and amphibian bones from the 2009 and 2010 dry-sieved/hand-collected and flotation residues needs to be undertaken/completed. Guidance should be sought regarding sorting of fish bones (identifiable/recordable elements) prior to sending the material for assessment and regarding the selection of recordable elements at analysis stage.

Full analysis of the assemblages is recommended. A full methods section is not provided here, but some essential criteria and procedures are recommended. The total number of recordable bones will depend on the recording system adopted. In this assessment the assemblage was scanned for complete or fragmented bones with diagnostic form or features but a zone system was not applied. During analysis, a zone system should be used in addition to or as the defining recording method, so that estimation of minimum number of elements and minimum number of individuals is possible. The methods used in published reports should be checked prior to adoption of a zone method, so as to facilitate comparability of published works. For example, the systems of Serjeantson (1996) and Serjeantson and Cohen (1996) are widely used. Skeletal representation should be analysed for domesticates, wild mammals and birds, and fish, as this will inform on carcass processing and meat distribution, food preparation and presentation, types and organisation of craft activity, and waste disposal. Taphonomic traces and fragmentation should also be recorded in order to assess intensity of processing, waste disposal and deposit formation.

Speciation of identifiable bones should be attempted for closely related species using published guides where available. In addition to the use of reference collections and standard guides, recent publications include Halstead *et al* (2002) for speciating sheep and goat mandibles and mandibular teeth, Davis 1987 and Johnstone 2004 (and references within) for speciating horse, donkey and mule, Callou (1997) for lagomorpha, Tomek and Bochenski (2009) for medium galliformes and columbiformes, and Tomek and Bochenski (2000) for corvids. For deer species, Lister (1996) provides criteria for differentiating red and fallow deer. While current understanding of the biogeography of fallow deer is that viable herds were not re-established in England until the medieval period (Sykes 2010), the possible presence of fallow deer should be kept in mind and appropriate criteria recorded so that their absence or presence is fully documented. Recording and speciation of small mammals should be undertaken with the advice of a specialist. Measurements of mammals (and birds) should follow standard guides, including for sheep the Sheep/goat Working Party recommendations and recent research and new measurements proposed in Popkin *et al*. (2012).

Tasks:

Washing unwashed bones: tba
Sample sorting: tba
Assessment of human bones: tba
Assessment of amphibian remains: tba
Assessment of fish remains: tba

Recording and analysis of identifiable mammal and bird specimens (@200 mammal identifications/day and 100 bird bone identifications/day):

Period	Recovery	Class	#specimens estimate	Recording Time
5th-7th c.	Dry-sieved/hand-collected	Mammal	1900	10
5th-7th c.	Dry-sieved/hand-collected	Bird	240	2.5 days
5th-7th c.	Samples	Mammal	150*	1 day
5th-7th c.	Samples	Bird	10*	<0.5 day
8th-9th c.	Dry-sieved/hand-collected	Mammal	5860	30 days
8th-9th c.	Dry-sieved/hand-collected	Bird	2385	24 days
8th-9th c.	Samples	Mammal	420	2.5 days
8th-9th c.	Samples	Bird	60	1 day
Total				71.2 days

* not estimated but c. half of sorted residues examined for assessment

Analysis of mammal and bird bones and report writing: 71 days

Total (recording, analysis and reporting for mammal and bird bones): *c.* **142 days**

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Context type	Condition score (number of bags)								Gnawing		Burning	
	1	2	2-3	3	3-4	4	4-5	5	N	%*	N	%
5th-7th c.												
SFB1	1	4	2	46	2	39		6	33	5.0	89	2.9
SFB2		1		16		33			9	1.6	156	4.6
SFB3		1		7	1	27		1	14	14.9	18	2.7
SFB4		2		10	3				0		8	4.8
Total	**1**	**8**	**2**	**79**	**6**	**99**		**7**	**56**	**4.2**	**271**	**3.7**
8th-9th c.												
Early boundary ditch			1	5	13	18			43	10.1	4	0.3
Pit				18	32	19	4	7	56	3.8	59	1.6
Sec. timber pall (E-W)				3	2	5			2	2.8	1	0.4
Sec. timber pall (N-S)					3				2	8.0	0	0.0
Total	**0**	**0**	**1**	**26**	**50**	**42**	**4**	**7**	**103**	**5.2**	**64**	**1.2**

Table 1: Preservation of sieved and hand-collected bones based on condition score (scale ranges from 1-worst to 5-best, after Reynolds 2010). Condition counts refer to number of bags examined; *Gnawing is based on assessed NISP, excluding microfauna and fish; **Burning is based on assessed unidentifiable specimens

Taxa	SFB1 NISP assess.	*SFB1 NISP est.*	SFB1 Total est.	SFB2 NISP assess.	*SFB2 NISP est.*	SFB2 Total est.	SFB3 NISP assess.	SFB4 NISP assess.	*General NISP est.*	**Total assess** **NISP**	**%**	***Total est.*** ***NISP***
Cattle	133	*47*	180	85	*85*	170	38	2	*na*	**258**	**18.7**	***390***
Sheep/goat	116	*59*	175	75	*75*	150	15	12	*na*	**218**	**15.8**	***352***
Pig	334	*119*	453	307	*307*	614	33	14	*na*	**688**	**49.8**	***1114***
Horse	1	*1*	2	2	*2*	4	1	0	*na*	**4**	**0.3**	***7***
Dog	10	*6*	16	0	*0*	0	2	0	*na*	**12**	**0.9**	***18***
Cat	2	*1*	3	0	*0*	0	0	0	*na*	**2**	**0.1**	***3***
Red deer	0	*0*	0	2a	*2a*	0	1	0	*na*	**1**	**0.1**	***1***
Roe deer	1	*0*	1	1	*1*	2	0	1	*na*	**3**	**0.2**	***4***
Other mammal	2	*0*	2	3	*3*	6	0	0	*na*	**5**	**0.4**	***8***
Small mammals	3	*2*	5	1	*1*	2	0	0	*na*	**4**	**0.3**	***7***
Domestic fowl	45	*22*	67	46	*46*	92	2	4	*na*	**97**	**7.0**	***165***
Other bird	13	*5*	18	28	*28*	56	2	0	*na*	**43**	**3.1**	***76***
Amphibia	40	*16*	56	5	*5*	10	2	0	*na*	**47**	**3.4**	***68***
Total	700	278	978	553	553	1106	96	33	*75*	**1382**		***2213***
Fish	22	*11*	33	17	*17*	34	2	1	*na*	**42**		***70***
Ribs, vertebrae and sternum												
Large mammal	97	*37*	134	82	*82*	164	43	7	*na*	**229**		***348***
Medium mammal	329	*136*	465	427	*427*	854	28	7	*na*	**791**		***1354***
Hare/cat size mammal	9	*3*	12	15	*15*	30	0	0	*na*	**24**		***42***
Unidentified fragments	3030	*1530*	4560	3418	*3418*	6836	675	167	*na*	**7290**		***12238***
Total	4187	1995	6182	4512	4512	9024	844	215	75	**9758**	**0**	***16265***

Table 2: Number of identifiable specimens by taxon/taxonomic group, with estimates of total identifiable bones in the individual SFBs (in italics) and the assemblage as a whole (for dry-sieved/hand-collected assemblage). SFB1 NISP-est=estimate for Box 5, SFB2 NISP-est=estimate for Box 4 and General NISP-est=estimate for Box 6. est-estimate; na-not assessed; Total-est includes assessed and estimated counts

Taxon	SFB2 NISP assess.	%
Cattle	3	1.8
Sheep/goat	3	1.8
Pig	19	11.7
Red deer	2a	
Other mammal	3	1.8
Small mammals	46	28.2
Domestic fowl	2	1.2
Other bird	2	1.2
Amphibia	25	15.3
Fish	60(+59r/r)	36.8
Total	163	

Table 3: Number of identifiablee specimens by taxon/taxonomic group in the heavy residues from SFB2. More than half of the bags were examined but the data is not extrapolated to potential total. A-antler; r/r undiagnostic ribs, rays and vertebral spines

Context type	Early boundary ditch		Pit fills		Sec. timber palisade (E-W)		Sec. timber palisade (N-S)	**Total assess.**		***Total est.***
	NISP assess.	%	NISP assess.	%	NISP assess.	%	NISP Assess.	**NISP**	**%**	***NISP***
Human			42(97)					**42**		
Cattle	78	18.3	194	11.4	12	16.7	7	**291**	**13.1**	***1078***
Sheep/goat	137	32.1	469	27.6	20	27.8	9	**635**	**28.5**	***2352***
Pig	83	19.4	206	12.1	12	16.7	6	**307**	**13.8**	***1137***
Horse	2	0.5	0	0	14	19.4	1	**17**	**0.8**	***63***
Dog	1	0.2	14	0.8	1	1.4	0	**16**	**0.7**	***59***
Cat	0	0	7	0.4	0	0	0	**7**	**0.3**	***26***
Red deer	0	0	0	0	0	0	0	**0**	**0**	***0***
Roe deer	3	0.7	9	0.5	0	0	0	**12**	**0.5**	***44***
Other mammal	2	0.5	6	0.4	0	0	0	**11**	**0.5**	***41***
Small mammals	0	0	51	3.0	0	0	0	**48**	**2.2**	***178***
Domestic fowl	103	24.1	397	23.3	11	15.3	2	**513**	**23.0**	***1900***
Other bird	16	3.7	113	6.6	2	2.8	0	**131**	**5.9**	***485***
Amphibia	2	0.5	235	13.8	0	0.0	1	**238**	**10.7**	***881***
Total	427		1701		72		26	**2226**	**100**	**8244**
Fish	117		1079		8		6	**1210**		***4481***
Fish (rib/ray/vert spine)	108		521		10		3			
Ribs, vertebrae and sternum										
Large mammal	71		118		21		3	**213**		***789***
Medium mammal	146		613		23		4	**786**		***2911***
Hare/cat size mammal	4		36		0		0	**40**		***148***
								0		
Unidentified fragments	1210		3751		254		90	**5305**		***19648***
Total	1975		7298		378		129	**9780**	**100**	**36222**

Table 4: Number of identifiable specimens by taxon/taxonomic group, with estimates of total identifiable bones for the assemblage as a whole. Approximately 27% of the total assemblage was assessed. The potential total (Total est.) is extrapolated from this figure. * a skeleton of a perinatal human is present in pit fill 1672-the figure in ( ) includes ribs, vertebrae and cranial fragments but the count is probably higher; r/r – fish rib/rays/vertebral spines

Heavy residues	Early boundary ditch		Pit fills	
	NISP assess.	%	NISP assess.	%
Cattle	0		9	23.7
Sheep/goat	4	20.0	15	39.5
Pig	1	5.0	6	15.8
Cat			1	2.6
Small mammals	4	20.0	2	5.3
Domestic fowl	4	20.0	1	2.6
Other bird			1	2.6
Amphibia	6	30.0	3	7.9
Reptile	1	5.0		
Total	20	100	38	100
Fish	100s		1000s	
Ribs, vertebrae and sternum				
Large mammal			3	
Medium mammal	7		8	
Unidentified fragments	not fully quantified		not fully quantified	

Table 5: Number of identifiable specimens by taxon/taxonomic group in the sample heavy residues from a few pit and early boundary ditch deposits. The potential total is much higher and more varied as only a small number of unsorted residues, representing c. one tenth of total sample volume, were examined

SFB	Taxon	Skeletal element group											
		Teeth		Cranium		Atlas/axis		Meat-limbs		Feet		Total	
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
SFB1	Cattle	41	25.6	44	42.3	2	14.3	24	24.2	22	10.7	133	22.8
SFB1	Sheep/goat	52	32.5	17	16.3	4	28.6	20	20.2	23	11.2	116	19.9
SFB1	Pig	67	41.9	43	41.3	8	57.1	55	55.6	161	78.2	334	57.3
	Total	160	100	104	100	14	100	99	100	206	100	583	100
SFB2	Cattle	31	25.4	14	23.7	0		19	18.6	21	11.5	85	18.2
SFB2	Sheep/goat	19	15.6	4	6.8	0		25	24.5	27	14.8	75	16.1
SFB2	Pig	72	59.0	41	69.5	2		58	56.9	134	73.6	307	65.7
	Total	122	100	59	100	2		102	100	182	100	467	100
SFB3	Cattle	9		3		0		11		15		38	44.2
SFB3	Sheep/goat	4		1		0		8		2		15	17.4
SFB3	Pig	14		1		0		14		4		33	38.4
	Total	27		5		0		33		21		86	100
SFB4	Cattle	0		0		0		2		0		2	7.1
SFB4	Sheep/goat	1		0		0		2		9		12	42.9
SFB4	Pig	1		2		0		1		10		14	50.0
	Total	2		2		0		5		19		28	100
All	Cattle	81	26.0	61	35.9	2		56	23.4	58	13.6	258	22.2
All	Sheep/goat	76	24.4	22	12.9	4		55	23.0	61	14.3	218	18.7
All	Pig	154	49.5	87	51.2	10		128	53.6	309	72.2	688	59.1
All	total	311	100	170	100	16		239	100	428	100	1164	100

Table 6: Relative frequency of main domestic taxa in the SFBs, based on skeletal element groups in assessed material only (number of recordable bones in dry-sieved assemblages and bone clusters). Teeth-isolated teeth; Cranium includes mandible; Feet include carpals, tarsals, metapodials, phalanges

SFB	Taxon	Skeletal element group										
		Isolated teeth		Cranium&mandible		Atlas/axis		Limbs		Feet (c/t, mtps, ph)		**Total**
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	**NISP**
SFB1	Cattle	41	30.8	44	33.1	2	1.5	24	18.0	22	16.5	**133**
SFB1	Sheep/goat	52	44.8	17	14.7	4	3.4	20	17.2	23	19.8	**116**
SFB1	Pig	67	20.1	43	12.9	8	2.4	55	16.5	161	48.2	**334**
	Total	160	95.7	104	60.6	14	7.3	99	51.8	206	84.6	**583**
SFB2	Cattle	31	36.5	14	16.5	0	0.0	19	22.4	21	24.7	**85**
SFB2	Sheep/goat	19	25.3	4	5.3	0	0.0	25	33.3	27	36.0	**75**
SFB2	Pig	72	23.5	41	13.4	2	0.7	58	18.9	134	43.6	**307**
	Total	122	85.3	59	35.2	2	0.7	102	74.6	182	104.4	**467**
SFB3	Cattle	9	23.7	3	7.9	0	0.0	11	28.9	15	39.5	**38**
SFB3	Sheep/goat	4	26.7	1	6.7	0	0.0	8	53.3	2	13.3	**15**
SFB3	Pig	14	42.4	1	3.0	0	0.0	14	42.4	4	12.1	**33**
	Total	27		5		0		33		21		**86**
SFB4	Cattle	0		0		0		2		0		**2**
SFB4	Sheep/goat	1	8.3	0	0.0	0	0.0	2	16.7	9	75.0	**12**
SFB4	Pig	1	7.1	2	14.3	0	0.0	1	7.1	10	71.4	**14**
	Total	2		2		0		5		19		**28**

Table 7: Relative abundance of skeletal element groups in each SFB by main domestic taxon, assessed material only (number of identifiable bones in dry-sieved/hand-collected assemblages). Teeth-isolated teeth; Cranium includes mandible; Feet include carpals, tarsals, metapodials, phalanges

Context type	Taxon	Skeletal element group										
		Isolated teeth		Cran&mandible		Atlas/axis	Limbs		Feet		**Total**	
		NISP	%	NISP	%	NISP	NISP	%	NISP	%	**NISP**	%
Early boundary ditch	Cattle	17	30.9	20	21.7	1	19	21.3	21	34.4	78	26.2
	Sheep/goat	29	52.7	54	58.7	0	41	46.1	13	21.3	137	46.0
	Pig	9	16.4	18	19.6	0	29	32.6	27	44.3	83	27.9
	Total	55		92		1	89		61		298	
Pits	Cattle	51	26.3	30	14.2	3	37	15.8	73	34.4	194	22.3
	Sheep/goat	101	52.1	110	52.1	12	151	64.5	95	44.8	469	54.0
	Pig	42	21.6	71	33.6	3	46	19.7	44	20.8	206	23.7
	Total	194		211		18	234		212		869	
Sec. timber palisade (E-W)	Cattle	3		1		1	2		5		12	27.3
	Sheep/goat	4		3		0	10		3		20	45.5
	Pig	3		3		0	2		4		12	27.3
	Total	10		7		1	14		12		44	
Sec. timber palisade (N-S)	Cattle	2		3		0	2		0		7	31.8
	Sheep/goat	4		1		0	3		1		9	40.9
	Pig	3		1		0	2		0		6	27.3
	Total	9		5		0	7		1		22	

Table 8: Relative frequency of main domestic taxa in the different features and the assemblage as a whole, based on skeletal element groups in assessed material only (number of identifiable bones in dry-sieved/hand-collected assemblages). Teeth-isolated teeth; Cranium includes mandible; Feet include carpals, tarsals, metapodials, phalanges

Context type	Taxon	Skeletal element group										
		Isolated teeth		Cranium&mandible		Atlas/axis		Limbs		Feet (c/t, mtps, ph)		**Total**
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	**NISP**
Early boundary ditch	Cattle	17	21.8	20	25.6	1	1.3	19	24.4	21	26.9	78
	Sheep/goat	29	21.2	54	39.4	0	0.0	41	29.9	13	9.5	137
	Pig	9	10.8	18	21.7	0	0.0	29	34.9	27	32.5	83
	Total	55	18.5	92	30.9	1	0.3	89	29.9	61	20.5	298
Pits	Cattle	51	26.3	30	15.5	3	1.5	37	19.1	73	37.6	194
	Sheep/goat	101	21.5	110	23.5	12	2.6	151	32.2	95	20.3	469
	Pig	42	20.4	71	34.5	3	1.5	46	22.3	44	21.4	206
	Total	194	22.3	211	24.3	18	2.1	234	26.9	212	24.4	869
Sec. timber palisade (E-W)	Cattle	3	25.0	1	8.3	1	8.3	2	16.7	5	41.7	12
	Sheep/goat	4	20.0	3	15.0	0	0.0	10	50.0	3	15.0	20
	Pig	3	25.0	3	25.0	0	0.0	2	16.7	4	33.3	12
	Total	10	22.7	7	15.9	1	2.3	14	31.8	12	27.3	44
Sec. timber pallisade (N-S)	Cattle	2	28.6	3	42.9	0	0.0	2	28.6	0	0.0	7
	Sheep/goat	4	44.4	1	11.1	0	0.0	3	33.3	1	11.1	9
	Pig	3	50.0	1	16.7	0	0.0	2	33.3	0	0.0	6
	Total	9	40.9	5	22.7	0	0.0	7	31.8	1	4.5	22

Table 9: Relative frequency of bodyparts of the main domestic taxa in the different feature and the assemblage as a whole, based on skeletal element groups in assessed material only (number of identifiable bones in dry-sieved/hand-collected assemblages). Teeth-isolated teeth; Cranium includes mandible; Feet include carpals, tarsals, metapodials, phalanges.

Species	NISP	%
Sheep	2238	35.5
Cow	1327	21.1
Pig	746	11.8
Horse	7	0.1
Dog	224	3.6
Cat	192	3.0
Roe Deer	7	0.1
Rodent	719	11.4
Bird	842	13.4
Total	6302	

Table 10: Distribution of the main recorded species by NISP (after Reynolds 2010)

5th-7th c.	Measureable specimens				Ageable specimen			
	Teeth	Limbbones	Phalanges	Total	Mandibles	Teeth	Bones*	Total
Cow								
SFB1 assess.	3	6	9	18	1	8	21	30
SFB1estimate	2	2	5	8	1	4	9	14
SFB2 assess.	3	6	3	12		6	11	17
SFB2estimate	3	6	3	12		6	11	17
SFB3 assess.	1	3	3	7		2	11	13
SFB4 assess.								
Total estimate	**12**	**23**	**23**	**57**	**2**	**26**	**63**	**91**
Sheep/goat								
SFB1 assess.	17	7	9	33	4	19	33	56
SFB1estimate	8	2	5	15	2	11	14	26
SFB2 assess.	3	14	1	18	1	5	24	30
SFB2 estimate	3	14	1	18	1	5	24	30
SFB3 assess.	1	2	1	4		1	4	5
SFB4 assess.		5	5	10			7	7
Total estimate	**32**	**44**	**22**	**98**	**8**	**41**	**106**	**154**
Pig								
SFB1 assess.	11	18	37	66	7	8	141	156
SFB1estimate	3	8	17	28	2	2	44	48
SFB2 assess.	12	16	21	49	5	14	122	141
SFB2 estimate	12	16	21	49	5	14	122	141
SFB3 assess.	2	5	1	8	1	2	10	13
SFB4 assess.	1	1	3	5	0	1	9	10
Total estimate	**41**	**64**	**100**	**205**	**20**	**41**	**448**	**509**

Table 11: Number of ageable and measurable specimens of cattle, sheep/goat and pig in dry-sieved/hand-collected assemblages. *includes phalanges. SFB1 estimate=estimate for Box 5, SFB2 estimate=estimate for Box 4; Total estimate includes assessed and estimated counts

8th-9th c.	Measurable specimens				Ageable specimens			
	Teeth	Bones	Phalanges	Total	Mandible	Teeth	Bones*	Total
Cattle								
Early boundary ditch	6	1	4	11	4	6	12	22
Pit	2	14	12	28	4	8	32	44
Sec. timber pall. (E-W)	0	0	1	1	0	1	2	3
Sec. timber pall. (N-S)	0	1	0	1	0	0	1	1
Total assess	**8**	**16**	**17**	**41**	**8**	**15**	**47**	**70**
Total estimate	**30**	**59**	**63**	**152**	**30**	**56**	**174**	**259**
Sheep/goat								
Early boundary ditch	9	11	2	22	3	12	20	35
Pit	10	47	10	67	14	14	107	135
Sec. timber pall. (E-W)	0	0	0	0	0	0	4	4
Sec. timber pall. (N-S)	1	0	0	1	0	3	1	4
Total assess	**20**	**58**	**12**	**90**	**17**	**29**	**132**	**178**
Total estimate	**74**	**215**	**44**	**333**	**63**	**107**	**489**	**659**
Pig								
Early boundary ditch	2	7	5	14	2	1	29	32
Pit	24	4	2	30	21	5	45	71
Sec. timber pall. (E-W)	0	1	0	1	1	1	4	6
Sec. timber pall. (N-S)	0	1	0	1	0	1	1	2
Total assess	**26**	**13**	**7**	**46**	**24**	**8**	**79**	**111**
Total estimate	**96**	**48**	**26**	**170**	**89**	**30**	**293**	**411**

Table 12: Number of ageable and measurable specimens of cattle, sheep/goat and pig by feature type, in the dry-sieved/hand-collected assemblages. Total estimate includes assessed and estimated counts. *includes phalanges

	Measureable specimens				Ageable specimens			
	Teeth	Bones	Phalanges	Total	Mandible	Teeth	Bones*	Total
Cattle								
5th-7th c.	30	59	63	**152**	30	56	174	**259**
8th-9th c.	12	23	23	**57**	2	26	63	**91**
Reynolds2008				*159*				*101*
Sheep/goat								
5th-7th c.	74	215	44	**333**	63	107	489	**659**
8th-9th c.	32	44	22	**98**	8	41	106	**154**
Reynolds 2008				*409*				*415*
Pig								
5th-7th c.	41	64	100	**205**	20	41	448	**509**
8th-9th c.	96	48	26	**170**	89	30	293	**411**
Reynolds 2008				*157*				*171*

Table 13: Summary of estimated total number of ageable and measurable specimens of cattle, sheep/goat and pig in the dry-sieved/hand-collected 6th-7th c., 8th-9th c. and 2007-2008 (middle Saxon) assemblages (Reynolds 2008). *includes phalanges

	Equid				Dog		Cat		Roe		Other mammal	
	Meas	Age mand.	Age teeth	Age bone	Meas	Age	Meas	Age	Meas	Age	Meas	Age
5th-7th c.												
SFB1 assess.	1		1		9	6	2	2		1		
SFB1estimate	1		1		5	4	1	1				
SFB2 assess.	1		1						1	1	1	1
SFB2 estimate	1		1						1	1	1	1
SFB3 assess.				1	4	1						
SFB4assess.												
Total	**2**	**0**	**2**	**1**	**13**	**7**	**2**	**2**	**1**	**2**	**1**	**1**
Total estimate	**4**		**4**	**1**	**18**	**11**	**3**	**3**	**2**	**3**	**2**	**2**
8th-9th c.												
Early boundary ditch	0	0	1	1	0	1	0	0	0	3	0	0
Pit	0	0	0	0	1	12	7	7	8	9	1	2
Sec. timber pall (E-W)	3	2	2	1	1	1	0	0	0	0	0	0
Sec. timber pall (N-S)	1	0	0	1	0	0	0	0	0	0	0	0
Total	**4**	**2**	**3**	**3**	**2**	**14**	**7**	**7**	**8**	**12**	**1**	**2**
Total estimate	**15**	**7**	**11**	**11**	**7**	**52**	**26**	**26**	**30**	**44**	**4**	**7**

Table 14: Number of ageable and measurable specimens of other domestic and wild mammals in the 5th-7th c. and 8th-9th c. dry-sieved/hand-collected assemblages (8th-9th c. includes foetal/neonate dog/cat in pit 1506, recorded as dog). Total estimate includes assessed and estimated counts

Context type	Male	Female	Total	Total est.
5th-7th c.				
SFB1	8	4	12	21
SFB2	9	2	11	22
SFB3	2		2	2
SFB4		1	1	1
Total	**19**	**7**	**26**	**46**
8th-9th c.				
Early boundary ditch	2		2	7
Pit	3	5	8	30
Sec. timber pal (E-W)	1		1	4
Sec. timber pal. (N-S)				
Total	**6**	**5**	**11**	**41**
Reynolds 2008				*36*

Table 15: Distribution of male and female pig canines, maxillae and mandibles by feature type, in the assessed assemblage and for the estimated total assemblage (Total est.). Reynolds' (2008) estimate included in italics.

	Domestic fowl		Other bird
	Meas	Sex	Meas
5th-7th c.			
SFB1 assess.	20	[1 f]*	5
SFB1estimate	11		2
SFB2 assess.	21	3	21
SFB2 estimate	21	3	21
SFB3 assess.	2	1	1
SFB4 assess.	4		
Total assess.	47	4(3f,1m)	27
Total estimate	**79**	**7**	**50**
8th-9th c.			
Early boundary ditch	49	3	7
Pit	186	37	27
Sec. timber pall (E-W)	3	0	1
Sec. timber pall (N-S)	1	0	0
Total	239	40	35
Total (est)	**885**	**148**	**130**

Table 16: Number of ageable and sexable specimens of domestic and wild birds in dry-sieved/hand-collected assemblages. NB. In the 6^{th}-7^{th} c. assemblage, the number of measurable bones assessed is the same for domestic fowl (21) and other birds (21) and is not an error in transcription. *unidentifiable medium bird bone. Total estimate includes assessed and estimated counts