Chapter 5: Environmental evidence

ANIMAL BONE *by Lena Strid*

Introduction

The analysis included a total of 10639 bones (125kg), comprising all hand-collected bones from securely dated features and a selection of bones from sieved samples. The majority of the bones came from Sites 2, 3, 4 (Trench 54) and 7, with only small quantities from the other sites. Bones recovered from evaluation trenches in areas that went on to excavation have been included in the quantification and analysis for the corresponding site. Small assemblages of faunal remains were also recovered from a Roman posthole in Evaluation Trench 60 and a late Iron Age/early Roman ditch in Evaluation Trench 100, as well as an assemblage of 25 bones from Evaluation Trench 31, from features associated with the deserted medieval village at Lower End.

Methodology

The bones were identified using comparative skeletal reference collections, in addition to osteological identification manuals. All animal remains were counted and weighed, and where possible identified to species, element, side and zone (Serjeantson 1996). Sheep and goat were identified to species, where possible, using Boessneck *et al.* (1964) and Prummel and Frisch (1986). They were otherwise classified as 'sheep/goat'. Ribs and vertebrae, with the exception of atlas and axis, were classified by size: 'large mammal' representing cattle, horse and deer; 'medium mammal' representing sheep/goat, pig and large dog; 'small mammal' representing small dog, cat and hare; and 'microfauna' representing animals such as frog, rat and mice.

The condition of the bone was graded on a 6-point system (0-5). Grade 0 equating to very well-preserved bone, and grade 5 indicating that the bone had suffered such structural and attritional damage as to make it unrecognisable. The minimum number of individuals (MNI) was calculated based on the most frequently occurring bone for each species, using Serjeantson's (1996) and Worley's (forthcoming) zoning guides and taking into account left and right sides, as well as epiphyseal fusion. For the calculation of the number of identified fragments per species (NISP) all identifiable fragments were counted, although bones with modern breaks were refitted. The weight of bone fragments has been recorded in order to give an idea of their size and to provide an alternative means of quantification.

For ageing, Habermehl's (1975) data on epiphyseal fusion was used. Three fusion stages were recorded: 'unfused', 'in fusion', and 'fused'. 'In fusion' indicates that the epiphyseal line is still visible. Cattle horn cores were aged according to Armitage (1982), using texture and appearance of the horn core surface. Tooth wear was recorded using Grant's tooth wear stages (Grant 1982), and correlated with tooth eruption (Habermehl 1975). In order to estimate an age for the animals, the methods of Halstead (1985), Payne (1973) and O'Connor (1988) were used for cattle, sheep/goat and pig respectively.

Sex estimation was carried out on morphological traits on cattle and sheep/goat pelves, sheep and goat horn cores, and pig mandibular canine teeth, using data from Boessneck *et al*. (1964), Hatting (1983), Prummel and Frisch (1986), Schmid (1972) and Vretemark (1997). Mennerich's index for cattle metacarpals were also used for sexing this element (Mennerich 1968). The presence or absence of spurs on fowl tarsometatarsi and medullary bone in bird bones were used to sex avian remains.

Measurements were taken according to von den Driesch (1976), using digital callipers with an accuracy of 0.01 mm. Large bones were measured using an osteometric board, with an accuracy of 1 mm. Withers height of dog and horse were calculated using Harcourt (1974) and May (1985).

Sieved samples were scanned and bones from bird and fish extracted, as well as mammal bones suitable for ageing and sexing. The extracted bones amounted to 78 fragments (3.8% of the total fragment count from the sieved samples). The remaining bones mostly consisted of unidentifiable fragments.

Preservation

The bones were generally well or fairly well preserved, regardless of phase. Poorly preserved bone was mostly found in Site 5 and in the middle Roman features from Site 7. Burnt bones were only numerous in the middle Iron Age assemblage from Site 4 (Trench 54). With the exception of one rodent-gnawed bone from Site 4 (Trench 54), all gnawed bones had been gnawed by carnivores, probably dogs. The general scarcity of gnaw marks in the assemblages suggest that butchery and kitchen waste had been disposed of rapidly and securely.

Results

Site 2

The faunal assemblage from Site 2 comprised a total of 2096 fragments (22108g), dating from the late Iron Age and Roman period. The species present include cattle (*Bos taurus*), sheep/goat (*Ovis aries* / *Capra hircus*), pig (*Sus domesticus*), horse (*Equus caballus*), dog (*Canis familiaris*), red deer (*Cervus elaphus*), domestic fowl (*Gallus gallus domesticus*) and crow/rook (*Corvus corone* / *Corvus frugilegus*; Table 5.1). A single herring (*Clupea harengus*) vertebra from the uppermost fill (2267) of pit 2240 is extremely unusual for an inland site of this period and is likely to be intrusive (R Nicholson pers. comm.). While the majority of the assemblage derives from the early Roman features in the north-eastern part of the site, the middle Roman assemblage from the south-western area contained the greatest species diversity, including wild mammals, birds and dog. These taxa were represented by only a few bones each, with the exception of domestic fowl, of which a substantially complete individual was recovered from oven 20143.

Table 5.1: Site 2, Number of identified bones (NISP)/taxon by phase (MNI in parentheses)

	North-eastern complex		*South-western complex*	
	Late Iron Age	*Early Roman*	*Middle Roman*	*Late Roman*
Cattle	26 (2)	118 (5)	70 (2)	16 (2)
Sheep/goat	9 (2)	106 (5)	28 (2)	6 (1)
Sheep		4		
Pig		20 (2)	9 (1)	
Horse	7 (1)	18 (2)	12 (1)	1 (1)
Dog	1 (1)	4 (1)	2 (1)	
Red deer	1 (1)		2 (1)	
Deer sp.			3	
Domestic fowl			26 (1)	
Crow/rook			1 (1)	
Indet. bird			5	
Medium mammals	4	103	19	1
Large mammals	26	88	51	44
Indeterminate	259	512	97	97
Total	333	973	625	165
Identified to species	44	270	153	23
Weight (g)	2845	11253	5565	2445

Livestock

In the early Roman assemblage, cattle is the most numerous species (51.0%) followed by sheep/goat (40.1%). A predominance of cattle to sheep/goat is consistent with contemporary sites in the Milton Keynes area as well as sites south and south-west of Bedford (Dobney and Jaques 1996, 206; Hamilton-Dyer 2004, 296; Holmes and Dobney 1994, 207; Holmes and Rielly 1994, 517; Roberts 2004, 305; Strid forthcoming). Contrastingly, sites north and north-east of Bedford are dominated by sheep/goat (Chaplin and McCormick 1986, 397; Holmes 2007, 331). The middle and late Roman assemblages were too small for an analysis of the interspecies frequency to be considered reliable (Hambleton 1999, 39-40), although the relative scarcity of pig may be accurate, considering that a low representation of pig is common in contemporary assemblages in the region (Dobney and Jaques 1996, 206; Hamilton-Dyer 2004, 296; Holmes 1993, 136; Holmes 2007, 331; Holmes and Dobney 1994, 207; Holmes and Rielly 1994, 517; Roberts 2004, 305; Strid forthcoming).

There were only a small number of ageable livestock teeth from each phase (Tables 5.2-3). While both young and senile cattle were present, the sheep/goat mandibles were focussed on the 2-4 years age range. Bones with ageable epiphyses were also few in number, the only sizeable sample being from the early Roman phase, where both cattle and sheep/goat seem to have been mostly slaughtered as adults or subadults (Table 5.4). A small number of neonatal/juvenile bones of cattle, sheep/goat and pig were present in the early Roman and middle Roman assemblages. Butchery marks are absent, but as the bones are disarticulated they probably represent kitchen waste. The total number of sexed bones was too small for analysis. The few measurable bones are within the same size range as bones

Table 5.2: Dental ageing of sheep/goat

Site	*Phase*	*No.*	*<6 months*	*6-12 months*	*1-2 years*	*2-3 years*	*3-4 years*	*4-6 years*	*6-8 years*
2									
	Late Iron Age	1				1			
	Early Roman	2				2			
	Middle Roman	3		1		1	1		
	Late Roman	1					1		
3	Late Iron Age	6		3	2		1		
	Early Roman	1							1
4 (Tr 54)	Middle Iron Age	6			1	1	1	2	1
7	Middle Roman	2			1		1		
	Late Roman	3				1	2		

from contemporary sites in Britain. Withers heights of 0.53m and 1.31m respectively could be calculated on one early Roman sheep metacarpal and one middle Roman horse tibia.

Other species

Horse and dog were found in small numbers in most phases. The fusion data and surface structure of the bones suggest that these animals were fully mature when they died. Horses were not normally bred for meat in the Iron Age or Roman periods, but were mainly utilised as riding animals or beasts of burden. None of the dog bones are characteristic of the more extreme dog types that occurred during the Roman period (Harcourt 1974, 164), and they probably represent dogs of medium size, used for guarding and/or herding. No cut marks or chop marks were observed on any of the horse or dog bones.

The deer remains comprise a sawn-off red deer antler tine in Iron Age pit 2151 and five bones from middle Roman features: an articulated red deer distal radius and ulna in pit 20071 and articulated phalanges in waterhole 20167. The phalanges could not be identified to species, but would be either the native red deer or the introduced fallow deer, most likely the former. Fallow deer have been identified on Roman sites (Sykes 2007a, 77-78), but are very rarely found compared to red deer. As the antler lack burr or pedicle it is not possible to tell whether the fragment derives from a shed antler or from an animal that had been hunted, but the bones clearly derive from hunting. Marks from butchery or bone/antler working could not be observed on any of the Roman deer fragments.

The avian remains include 26 bones of domestic fowl, all from the fill of oven 20143 and possibly representing a single bird, and one humerus from a crow or rook from pit/waterhole 20167. It is unclear whether the bones from oven 20143 were deposited in an articulated state or whether they represent kitchen and table waste. With the exception of one tarsometatarsus, all the bones came from meat-rich parts of the carcass, including legs, wings and axial

Table 5.3: Dental ageing of cattle

Site	*Phase*	*N*	*<8 months*	*8-18 months*	*18-30 months*	*30-36 months*	*Young adult*	*Adult*	*Old adult*	*Senile*
2	LIA	1								1
2	ER	4					1			3
2	MR	2				1				1
2	LR	1				1				
3	LIA	2				1				1
3	ER	1						1		
4 (Tr 54)	MIA	19			1	5	2	5	3	3
7	MR	8		1	1	2		2	2	
7	LR	10			1	3		4		2

Table 5.4: Site 2, epiphyseal closure of cattle, sheep/goat, pig and horse by phase

	Late Iron Age		*Early Roman*		*Middle Roman*		*Late Roman*	
CATTLE	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion	1	0	10	10	6	0	1	0
Mid fusion	3	0	15	27	4	0	1	0
Late fusion			2	50				
SHEEP/ GOAT	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion			10	30	4	0		
Mid fusion	1	0	9	44	1	100		
Late fusion			5	80				
PIG	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion			3	0	1	100		
Mid fusion			1	100	1	0		
Late fusion								
HORSE	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion	3	0	2	0	1	0	1	0
Mid fusion			1	0	1	0		
Late fusion	2	0	2	0	1	0		

skeleton. The origin of the crow/rook bone is less clear; while it may be kitchen waste, it may also come from a natural mortality or a deliberate killing.

Butchery

Almost all butchery marks in the assemblage comprise cut marks from disarticulation or filleting. They are most frequent on cattle, but also occur on sheep/goat, pig, and large mammal. Cut marks that are very likely to derive from disarticulation occurred on the distal humerus of single examples of early Roman cattle, sheep/goat and pig, one early Roman cattle distal tibia and on the vertical ramus of one early Roman and two late Roman cattle mandibles. Cut marks from skinning were found on only a single cattle proximal metatarsal from an Iron Age context. It is possible that the cut marks on one early Roman cattle proximal metacarpal and one early Roman cattle scapula also came from skinning, but as they were located at the joints they may have been caused during disarticulation. Only two bones, both from early Roman contexts, display chop marks from cleavers. These comprised one sheep/goat astragalus and one pig mandible, which had chop marks on the vertical ramus. Cut marks from filleting were recorded on four bones from the early Roman period: one cattle maxilla, one pig and one large mammal humerus shaft and on the horizontal ramus on one pig mandible. One early Roman sheep/goat tibia had a crude hole pierced through its distal metaphysis, possibly to extract marrow or to facilitate hanging of the joint for smoking (Hamilton-Dyer 2010, 17).

Pathology

Pathological conditions were recorded on one cattle and three sheep/goat bones in the early Roman assemblage and on one fowl bone in the middle Roman assemblage. The distal joint on one cattle femur was slightly deformed and also displayed lipping and eburnation, which may suggest muscle stress, wear and minor trauma from the use of the animal for traction. One sheep/goat metacarpal had raised parallel ridges posteriorly on the upper half of the shaft. The aetiology is uncertain, but similar pathologies have been observed on sheep/goat metatarsal shafts from Lincoln, York and Winchester, where they have been interpreted as possibly associated with infection or repeated minor trauma (Brothwell *et al*. 2005; Strid 2011). One sheep horn core had a depression at its base, which may be linked to malnutrition (Albarella 1995). Oral pathology was present as a very large swelling lingually on the horizontal ramus on a sheep/goat mandible; the fourth premolar had been lost pre-mortem, indeed the alveole had been completely eroded on the lingual side, probably due to the infection. The middle Roman fowl scapula displayed a widening of the bone from the joint to mid-shaft. As the scapula was broken off mid-shaft it is not known whether the widening continued. The aetiology of this pathology is not known.

Table 5.5: Site 3, Number of identified bones (NISP)/taxon by phase (MNI in parentheses)

	Late Iron Age	*Early Roman*
Cattle	68 (3)	29 (3)
Sheep/goat	56 (5)	17 (2)
Sheep	2	
Pig	13 (2)	4 (1)
Horse	83* (3)	27 (2)
Dog	6 (2)	
Indet. bird	1	
Small mammals	3	
Medium mammals	33	22
Large mammals	153	9
Indeterminate	680	110
Total	1098	218
Identified to species	228*	77
Weight (g)	10526	3021

* including 60 fragments from a semiarticulated horse skeleton

Site 3

The excavation at Site 3 produced a total of 1316 bones (13.6kg). The majority of the assemblage (1098 fragments) dated from the late Iron Age and was dominated by cattle, sheep/goat and horse, with a small number of bones from pig, dog and bird (Table 5.5). Only two bones could be identified as sheep and none as goat, and considering the general rarity of goat bones on Iron Age sites (King 1991, 16), it is likely that most if not all of the sheep/goat bones are sheep. The smaller early Roman assemblage comprised 218 bones and was dominated by cattle and horse.

Livestock

Although the assemblage is too small to permit a full interspecies comparison, the low representation of pig in relation to cattle and sheep/goat has also been observed at several nearby sites (Dobney and Jaques 1996, 206; Hamilton-Dyer 2004, 296; Holmes 1993, 136; Holmes 2007, 331; Holmes and Dobney 1994, 207; Holmes and Rielly 1994, 517; Roberts 2004, 305; Strid forthcoming).

Dental ageing data for six late Iron Age sheep/goats indicate a range of slaughter ages, from 6-12 months to 3-4 years (Table 5.2). Two loose molars that could not be aged within Payne's age categories indicate an age at death of 4-8 years. The dental data suggest that sheep/goat were used for a multiple products, such as meat, dairy products, wool and manure. The sample sizes for epiphyseal fusion were small for all taxa in both the late Iron Age and early Roman periods (Table 5.6). Cattle and sheep/goat seem to have been slaughtered mostly as subadults or adults, whereas pigs were mostly slaughtered as subadults. A single late Iron Age sheep/goat metatarsal represents neonatal/juvenile mortality.

Table 5.6: Epiphyseal closure of cattle, sheep/goat, pig and horse

	Site 3 Late Iron Age		Site 3 Early Roman		Site 4 (Tr 54) Middle Iron Age		Site 7 Middle Roman		Site 7 Late Roman	
CATTLE	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion	4	0	2	0	7	0	6	33.3	15	0
Mid fusion	8	0	3	0	26	30.8	23	26.1	27	48.1
Late fusion			1	100	8	37.5	8	50	21	47.6
SHEEP/ GOAT	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	% unfused
Early fusion	4	25	2	50	3	0	4	50	3	0
Mid fusion			2	50	9	66.7			2	50
Late fusion					4	100	1	0	1	100
PIG	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion	5	60			2	0				
Mid fusion	1	0			1	0			4	100
Late fusion									1	100
HORSE	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*	*N*	*% unfused*
Early fusion	3	0	4	0	4	0	2	0	11	0
Mid fusion	1	0	1	0	2	0	1	0	1	0
Late fusion	1	0	1	0	1	0	3	0	2	50

Only three bones could be sexed, which is too small a sample for an analysis of the sex ratio of the herds.

The number of bones that could be measured and/or sexed was too small to yield any useful information regarding animal size, sex ratio and breed.

Other species

All horse bones came from skeletally mature animals, which is consistent with other sites in the area. Horses were not generally bred for meat, although occasionally their flesh was utilised. Horizontal cut marks on the medial side of a distal humerus from a late Iron Age ditch (3358) indicates disarticulation of the elbow joint. It is, however, not possible to tell whether this represents processing for consumption or was done in order to facilitate disposal of the carcass. The horse assemblage also included one semi-articulated horse (below), for which a withers height of 1.20m was calculated on the metacarpal.

The majority of the dog remains come from skeletally mature animals. Due to fragmentation, it was not possible to estimate the size of these dogs, but most dog remains prior to the Roman period displayed no extreme form either in withers height or robusticity (Clark 1995; Harcourt 1974). They were probably bred for herding and guarding, although it is not certain to what extent they were specialists or all-round dogs.

Butchery

Butchery marks were recorded on five bones from late Iron Age cattle, one pig and one horse, and from two early Roman cattle and one sheep/goat. All butchery marks were made by knives. In addition to this there were several fragmented bones, but it was not possible to be certain whether these represent butchery or post-depositional damage. Cut marks suggesting disarticulation were found on two cattle mandibular joints and one cattle proximal radius, as well as on one distal horse humerus. Two cattle tarsal bones had cut marks from either disarticulation or skinning. Cut marks from filleting were noted midshaft on one cattle humerus and on the transverse process on one large mammal vertebra. One late Roman sheep/goat humerus had diagonal cutmarks supradistally and midshaft, which could be from either filleting or disarticulation.

Pathology

Pathologies were only present in the late Iron Age assemblage, where they affected bones from horse, dog and large mammal. One horse skull had patches of pathological bone growth internally and externally on the premaxilla, suggesting an infection of the periosteum. One dog tibia displayed small areas of smooth but lumpy bone growth on the lower third of the shaft on all sides. The aetiology for this is unclear, but it may be the remains of healed infections of the periosteum. Five thoracic vertebrae from a large mammal, possibly horse, displayed different pathologies associated with degenerative joint disease and muscle stress: eburnation on the cranial articulate surface were recorded on two of these vertebrae, one of which also had porosities on the polished surface. Another two vertebrae displayed eburnation on the caudal articulate surface and one vertebra had exostoses on the vertebral body.

Articulated remains

A semi-articulated skeleton of an adult horse was recovered from the fill of ditch 3360. Most post-cranial bones were present but the skull and mandible were missing, although some maxillary and mandibular teeth were present in the fill. The ditch was very shallow and the skull and mandible may have been removed by truncation although diagenesis cannot be discounted as a factor. The posture in which the animal lay within the ditch suggests that it was partially dismembered prior to deposition, although no butchery marks were observed. Such marks may, however, have been missed due to fragmentation of the bone during recovery. Articulated skeletons of horses and dogs form a distinct category of faunal remains: on one hand, these animals were generally not eaten and their remains were disposed of more or less intact. On the other hand, they could symbolise power and protection, and were on occasion deliberately sacrificed (Grant 1984, 223; Monikander 2010, 62-65; Smith 2006, 12-13).

Animal bones from cremation burial 104802

Two burnt bones, one a carpal/tarsal from a large mammal and the other a fragment of a medium mammal long bone, were found in cremation burial 104802. They may have been part of cuts of meat that were included in the cremation or they may represent waste from a funeral feast that was included in the pyre, whether accidentally or deliberately.

Site 4 (Trench 54)

Site 4 (Trench 54) produced 3594 bones from middle Iron Age enclosure ditches and associated pits (Table 5.7). Cattle (*Bos taurus*), sheep (*Ovis aries*), goat (*Capra hircus*), pig (*Sus domesticus*), horse (*Equus caballus*), dog (*Canis familiaris*), red deer (*Cervus elaphus*) and field vole (*Microtus agrestis*) were identified. The assemblage is dominated by domestic animals, typical for rural Iron Age assemblages. Deer remains were represented exclusively by antler fragments, one of which shows evidence of working, but since no burrs or pedicles were present it is not possible to establish whether they result from hunting or from gathering of shed antlers.

Livestock

Cattle is the most common species, regardless of quantification method. However, the difference between cattle and sheep/goat is less pronounced when using MNI. Since MNI tends to promote less numerical species in favour of more frequently occurring species (Hambleton 1999, 34-35), the increased representation of sheep/goat when using MNI is not entirely surprising. The local environment would, however, have favoured cattle rather than sheep/goat, suggesting that the number of identified specimens may be the more accurate quantification method for comparing livestock abundance in this instance.

There is little difference in species frequency between the different phases of the enclosure system. The earliest enclosure, represented by ditches 17715 and 17716, contains relatively more sheep/goat compared to cattle than the later enclosures, but the sample size is small and the species ratio must therefore be interpreted with caution. The remaining enclosure ditches have a similar species ratio to the assemblage as a whole: cattle bones are much more numerous than sheep/goat

Table 5.7: Site 4 (Trench 54), Number of identified bones (NISP)/taxon by feature type (MNI in parentheses)

	Total	*Inner ditch circuit*	*Outer ditch circuits*	*Ditches 17719 and 17496*	*Pits*
Cattle	441 (10)	71 (2)	140 (5)	128 (5)	28 (2)
Sheep/goat	202 (8)	66 (3)	49 (2)	49 (4)	20 (3)
Sheep	3	1			1
Goat	1				
Pig	46 (4)	7 (2)	23 (3)	10 (1)	1 (1)
Horse	76 (3)	11 (1)	21 (1)	29 (1)	6 (1)
Dog	15 (1)	5 (1)	6 (1)	2 (1)	
Red deer	13	1		2	8
Indet. bird	2				
Field vole	1	1			
Small mammals	1		1		
Medium mammals	178	30	57	51	21
Large mammals	693	121	197	195	40
Indeterminate	1922	366	639	514	108
Total	3594	680	1133	980	233
Total identified to species	798	163	239	220	64
Weight (g)	39932	4540	10900	15460	2480

bones, although when using MNI, the difference between the two taxa is not so large. The difference may also be due to taphonomic factors: the larger cattle bones may have had a better chance of survival than the sheep/goat bones, or the cattle bones may have fragmented more during butchery. However, if the difference were solely taphonomic, it should apply equally throughout the assemblage.

The dental ageing data for cattle and sheep/goat showed a range of slaughter ages from young, probably surplus animals, to very old animals past their prime (Table 5.6). The epiphyseal fusion indicates that cattle were slaughtered as subadults and adults, whereas the sheep/goat data suggested a predominance of subadult animals (Table 5.7). The sample size for pig was too small for interpretation but considering the great fecundity and rapid maturation of pigs, most were probably slaughtered before or at the time they reached their full growth. All horse bones belonged to adult animals, indicating that horses were normally slaughtered when they were past their prime as work animals.

Sexing could only be carried out on cattle and pig, but the sample size was too small to produce meaningful results. Measurable bones were scarce for most species other than cattle. The cattle bones are mostly within the same size range as bones from contemporary sites in Britain with the exception of one metacarpal that was taller than all contemporary bones, but not wider. Surprisingly, it does not belong to a bull or oxen; Mennerich's index indicates that it was female. Withers heights of 1.18m and 1.22m respectively could be calculated on two horse metacarpals.

Butchery

Butchery marks were recorded on 17 bones from cattle, three sheep/goat, two pig and one horse. The butchery marks consisted mainly of cut marks at the ends of long bones, indicating disarticulation. Cut marks from filleting were recorded on one cattle and one pig humerus. One cattle first phalanx displayed cut marks on the proximal end, which may have derived from either disarticulation of the foot or from skinning. Indication of marrow extraction was found on one cattle tibia, which had been split in half axially. Portioning of large mammal ribs and axial splitting of carcasses occurred on three ribs and three vertebrae. The butchery marks on horse consisted of a pelvis with transverse cut marks between ilium and pubis. This suggests that the femur was disarticulated from the pelvis, either to facilitate disposal of the carcass or to facilitate meat removal for human or canine consumption.

Indications of antler and horn working were also found in the assemblage. One deer antler fragment had been sawn off and one goat horn core had been chopped off mid-horn core. It is not clear from the faunal assemblage whether antler and horn working actually took place on site or whether these remains represent preparations of raw material which were finished elsewhere.

Pathology

The pathological conditions observed in the assemblage mainly derive from infections and the use of animals as beasts of burden. Eburnation occurred on one cattle femoral head and exostoses and lipping were found on one first and one second cattle phalanx, as well as on one large mammal vertebra. Thin layers of bone growth, indicating active or healed infection, occurred on two cattle mandibles and one large mammal rib. The aetiology is uncertain regarding a bone ridge on the posterior side of a sheep metacarpal shaft, although similar pathologies has been noted in other assemblages (below).

Articulated remains

Deposits of articulated animal bone groups (ABGs), possibly connected to ritual deposition, are commonly found at Iron Age settlements. Hill (1995, 27-28) has divided these deposits into three categories: complete skeletons, skulls with or without associated mandibles and articulated limbs. Five deposits at Site 4 (Trench 54) may represent instances of the second category. These comprise three cattle skulls in the latest circuit of enclosure ditches (17496 and 17719) and one in the adjacent ditch (17718), as well as one male horse skull in enclosure ditch 17496. Mandibles were absent in all cases. The horse skull and one cattle skull were placed on the base of ditch 17496, whereas the remaining skulls were found in the secondary or tertiary fills. The structure of the bone surface indicates that the cattle skulls came from adult or subadult individuals. The skull in ditch 17719 could be aged to 3-7 years on the basis of the horn core surface (Armitage 1982). The wear on the horse incisors match mandibular incisor wear for 4-7 year old horses (Habermehl 1975, 51). All skulls were very fragmented after recovery and neither butchery marks nor pathologies could be observed. It is debatable whether skulls in mid-fills of features are likely to represent ritual deposits rather than normal butchery waste. Initial and final deposits are more likely to be ritual, signifying beginnings and closure. It is therefore probable that only the horse and cattle skull in ditch 17496 represent ritual activity. The absence of mandibles suggests that some modification of the remains took place before deposition. While the skulls are fragmentary, no gnaw marks could be observed, indicating that they were rapidly covered after deposition.

Animal bone from ditch 17343

Burnt bone was found in a variety of features but was only frequent in ditch 17343, where it comprised 16.7% of all bones (from this feature). The entire ditch, including the unrecorded sieved samples, contained 93 burnt bones and 299 unburnt bones. Perhaps surprisingly, the burnt clay layer that extends throughout this ditch produced only seven burnt bones, as well as 22 unburnt bones. If the unidentified bones from the unrecorded sieved samples are included, this is increased to a total of 149 bones, 35 of which are burnt. The burnt bone may derive from burning of rubbish, although since unburnt bone dominates the assemblage, either the rubbish burning was incomplete, or the burnt material was mixed with dumps of unburnt rubbish.

Site 4 (Trench 61)

The assemblage from Site 4 (Trench 61) comprises a total of nine fragments from a ring gully (5092) and two pits (5029 and 5046), all from the Iron Age. The only speciable fragments were two cattle teeth and one horse tooth.

Site 5

The assemblage from Site 5 contained a total of 74 animal bones, the majority of which were fragments of large mammal long bones from ring gully (6021). The only bones that could be identified to species were a tooth and an ulna, both from cattle.

Site 6 (Trenches 97-99)

The animal bones from Site 6 (Trenches 97-99) included one cattle tibia, seven bones from large mammals and one unidentifiable fragment, all from a 18th-19th-century ditch.

Site 6 (Trench 105)

The middle-late Iron Age pits (7512 and 7525) from Site 6 (Trench 105) contained a fragment of a cattle tooth and one unidentifiable fragment.

Site 7

The faunal remains from Site 7 comprise 3404 fragments from middle and late Roman contexts (Table 5.8). A further four bone fragments came from a medieval furrow (15696), but this small sample will not be discussed further. Animals present include cattle (*Bos taurus*), sheep/goat (*Ovis aries*/*Capra hircus*), pig (*Sus domesticus*), horse (*Equus caballus*), dog (*Canis familiaris*), unidentified deer, probably red deer (*Cervus elaphus*) and goose (*Anser anser*/*Anser domesticus*), the latter two taxa were only present in the late Roman phase. The scarcity of wild fauna follows the general trend for rural Roman settlements (Grant 1989, 144). Hunting cannot be proved, since the only wild faunal remains are two fragments of deer antler, which could have been collected as shed antlers during late winter. The middle Roman assemblage derives primarily from ditches, whereas the late Roman assemblage is dominated by bones from waterholes.

Table 5.8: Site 7, Number of identified bones (NISP)/taxon by phase (MNI in parentheses)

	Middle Roman	*Late Roman*
Cattle	146 (4)	256 (6)
Sheep/goat	40 (2)	41 (3)
Pig	2 (1)	13 (1)
Horse	36* (2)	24 (3)
Dog	164** (2)	50*** (2)
Deer sp.		2 (1)
Goose		1 (1)
Medium mammals	51	37
Large mammals	265	241
Indeterminate	1101	932
Total	1807	1597
Total identified to species	388	385
Weight (g)	15833	32016

*including 15 articulated fragments
**including 160 articulated fragments
***including 44 articulated fragments

Livestock

Regardless of quantification method, cattle are the most frequent animal in both phases, followed by sheep/goat. Only the late Roman assemblage is large enough for an interspecies comparison (Hambleton 1999, 39-40), but the predominance of cattle is consistent with Roman assemblages elsewhere in Marston Vale and its surroundings (Maltby 2008, 282-283; Maltby 2011, 125; Roberts 2004, 305), suggesting that the cattle dominance in the mid-Roman assemblage is accurate.

The relatively small sample of 18 ageable cattle teeth shows two concentrations of wear stages: subadult animals and adult/older adult animals (Table 5.2). The even smaller sample of five sheep/goat teeth are all in the 1-4 year range (Table 5.6). Epiphyseal fusion data for cattle show an increase in younger animals in the late Roman period (Table 5.7), which may indicate an increase in beef production or increase in trade of older animals to urban markets.

Sexable cattle remains were too few to permit an analysis of differences in sex ratios between the middle and late Roman periods, but overall males were somewhat more common than females.

Other species

The commonness of horse and dog remains is over-represented in the assemblage due to the presence of four semi-articulated skeletons (below), comprising 15, 67, 93 and 44 fragments. When these are excluded, the horse and dog remains from the site are of a similar frequency as those from other sites in the area. Dog is consistently less frequent than horse, but whether this is related to the actual ratio of live animals or whether it reflects different disposal patterns is unknown.

With the exception of one distal radius in the late Roman assemblage, all horse remains belonged to adult animals. The three long bones that could be measured show a range of withers heights: 1.29m (metacarpal, late Roman), 1.40m (metacarpal, late Roman) and 1.55m (metatarsal, mid-Roman). Calculations on horse metapodials in the ABMAP database show withers heights ranging from 1.14m to 1.65m, the average being *c* 1.33m (University of Southampton 2003). This indicates that the horses from Site 7 are of average to upper average height in comparison to horses of that period.

The remains of dogs from middle Roman contexts are dominated by bones from adult dogs, whereas the late Roman assemblage is dominated by subadult and juvenile remains. Due to the small sample size when excluding the articulated remains this difference is most likely incidental. A withers height of 393mm could be calculated on the tibia from one articulated middle Roman dog.

The two fragments of deer antler, probably red deer, showed signs of sawing and cutting, which suggests that antler working took place on the settlement. Since neither burr nor pedicle were present it is not possibly to tell whether they came from hunted animals or were collected as shed antlers.

The presence of a single goose bone indicates that poultry formed a very small part of the diet. Since domestic goose and its wild counterpart, the greylag goose, can interbreed, it is not possible to distinguish between them osteologically. However, while the Romans in continental Europe practised goose breeding, there is scant evidence for this in Britain. Due to the general scarcity of goose remains in Roman assemblages is is more likely that they come from wild populations (Albarella 2005).

Butchery

Butchery marks on bones in the middle Roman assemblage come from disarticulation, portioning and filleting. Blade marks from stripping the flesh from the carcass, a method which has been associated with professional butchers in Romano-British period (Maltby 2007), were found on the neck and the beginning of the spine on one cattle scapula. Another cattle scapula had its glenoid process chopped off, indicating disarticulation or portioning of the shoulder joint, and had longitudinal cut marks on the medial side of the blade from filleting. One cattle metatarsal had horizontal chop marks on the lower third of the shaft. This skeletal element is covered only in skin and tendons, so these marks do not derive from the portioning of a meat cut. The bone is almost complete, although lacking the unfused distal epiphyses, but it is possible that these cuts were a failed attempt to sever the toe bones from the metatarsal, perhaps in order to render the toe bones for glue.

One middle Roman cattle metatarsal exhibited marks that were difficult to interpret. The bone had several small cut marks on the top of the proximal joint surface on the anterior edge. Since this part of the bone is covered by tarsal bones, these would have to have been removed or moved out of the way before the cuts could be made. The location and the direction of the cuts would not suggest skinning or disarticulation, the more common reasons for cut marks on the tarsal joint.

A cut mark deriving from disarticulation or skinning was found on the medial side of a middle Roman horse calcaneus. Horses were not normally eaten in the Roman period, although it cannot be excluded that the flesh was used for ritual or medicinal purposes.

One middle Roman large mammal long bone splinter was split twice longitudinally, and another chop had occurred at an angle off one of the longitudinal splits. This seems excessive for marrow extraction, but has similarities with waste from medieval bone workshops (Erath 2002) and could therefore suggest that small scale bone working took place at the settlement during the middle Roman period.

The majority of the bones with butchery marks in the late Roman assemblage were cattle. Skinning was evidenced by transverse cut marks mid-shaft on a first phalanx. Cut marks on the diastema on two mandibles suggest skinning or filleting, and cut marks from skinning or disarticulation of the lower legs were found on one carpal bone, one tarsal bone, and just below the proximal joint surface on one metatarsal. Disarticulation of the joints was carried out with knives and cleavers in almost equal amounts. Blade marks were found on the beginning of the spine on one scapula. Chop marks from disarticulation were found on one calcaneus, the neck of one scapula, below the articulate process on a mandible – thereby severing the jaw from the skull – the rear-most part of a mandible and on an axis – the latter two examples indicating severing of the head. Cut marks near the glenoid articulation on one scapula indicate disarticulation of the shoulder, whereas a cut mark identified below the articulate process on a mandible would have facilitated severing of the jaw. Further evidence for portioning of meat cuts was indicated by longitudinal splitting of one scapula through the glenoid and neck. Cut marks from filleting were recorded on the shafts of two femora and one tibia, as well as on the neck of two scapulae. Cut marks on the diastema on two mandibles suggest skinning or filleting. One metacarpal was split longitudinally, possibly to facilitate marrow extraction.

Other butchery marks in the late Roman assemblage include disarticulating chop marks on the olecranon on a pig ulna and cut marks from skinning on a proximal sheep/goat metatarsal.

Pathology

The middle Roman assemblage included three bones with pathological conditions. A sheep/goat pelvis had small patches of smooth woven bone growth on the ilium – possibly a healed infection. A horse tarsal joint displayed a number of pathologies: the tarsal III bone was fused to the metatarsal, the metatarsal joint surface to tarsal IV displayed coarse pitting, and the tarsal III joint surface to tarsicentrale displayed small pitting. These pathologies suggest that the joint was affected by spavin, a condition that is associated with traction, heavy load carrying, repeated impact on hard surfaces and/or old age (Daugnora and Thomas 2005, 69; Grimm 2008, 52). Ossification of the attachments of the *infraspinatus* muscle occurred on a proximal dog humerus, possibly caused by muscle strain or an inflammation.

Pathological conditions in the late Roman assemblage were most common on cattle bones, which probably reflects the general older age of the cattle population in comparison to other animals. If a herd is mainly slaughtered at a young age, there is little chance of diseases developing to such a stage that they affect the skeleton.

Most late Roman cattle pathologies were associated with wear and tear from the use of cattle for traction. One carpal joint (carpal II+III, carpal IV, metacarpal) showed minor porosities and large erosion of the joint surface between carpals and metacarpal. A disarticulated tarsal bone (centrotarsal) had osteophytes anteriorly on its distal side. The joint surface that articulated with the metatarsal displayed coarse pitting and deformation, and the largest of the osteophytes were at this part of the bone. Both these pathologies are examples of degenerative joint disease, the tarsal deformation probably representing *chronica deformans tarsi* (ie severe deformation of the tarsal bones; Daugnora and Thomas 2005). Such deformation may be one of the first stages of spavin, a disease where the tarsal bones fuse to each other and to the metatarsal (Baker and Brothwell 1980, 117-120). As has just been mentioned, spavin is associated with the use of animals for traction, but also with old age (Daugnora and Thomas 2005) and lack of exercise (von den Driesch 1975). The latter possibility is, however, less likely to have occurred on an agricultural settlement like Site 7. Two calcanei had smooth exostoses at the medial *sulcus tendini*, along which a muscle connecting the distal tibia and the third phalanx runs. This condition is known from faunal assemblages from medieval Germany and mid 1st-century Sweden, where it has been interpreted as being connected to the use of cattle for traction (Grimm 2008, 52; Telldahl 2005, 65).

Thin patches of porous bone growth, suggesting infection, were found on one horse frontal bone near the orbit and on one sheep/goat mandible on the buccal side at the unerupted third premolar. Healed fractures occurred on one dog metatarsal 4, which had been broken at mid-shaft, and possibly on the neck of one cattle scapula, which had a small transverse bony ridge medially along the metaphysis. Above the ridge there was a 440x580mm area of smooth but 'bubbly' bone growth. The bubbly bone growth was also present on the lateral side, but only near the glenoid joint surface.

One cattle and one sheep/goat incisor displayed smooth wedges on the crown/root lateral border. The aetiology is uncertain, but may be connected to the eating of long abrasive grass (Miles and Grigson 1990, 494-495).

Articulated remains

The articulated remains from Site 7 comprise two mid-Roman and one late Roman dogs, as well as the hind leg of a horse from a middle Roman context and a cattle skull from a late Roman waterhole.

The dog in mid-Roman quarry pit 15580 was found in the upper part of the fill, which suggests that the deposit may not be ritual, but mere disposal of a dog carcass. Partial or complete dog skeletons are a common type of ABG in Roman Britain, particularly in urban assemblages, but became increasingly common on rural sites during the middle Roman period (Morris 2008, 207). The skeletally mature dog skeleton from ditch 15750 includes most of the hind limbs as well as the axial skeleton. A single ulna represents the fore limb. The remains are very fragmented and while many bones were difficult to side, both left and right sides are present in the deposit. While the ulna may represent a different animal, the presence of vertebrae and ribs suggest that the remains represent a whole dog that has suffered great post-depositional taphonomic loss, perhaps associated with plough truncation of this shallow feature. The dog from late roman waterhole 15735 was subadult (as indicated by fusing distal femur and tibia). Most body parts were present. Significant absences include skull and foot bones. As with the dog from ditch 15750, it is highly likely that the dog was complete upon deposition and suffered post-depositional taphonomic loss. An estimated greatest length of the humerus gave a withers height of 327mm. No butchery marks or pathological conditions were noted on either dog.

A cattle skull, an associated right mandible and a pottery vessel were recovered from the base of waterhole 15185 (Fig. 2.125). The fill also contained a left mandible with the same tooth wear pattern, suggesting that a complete head may have been originally deposited in the waterhole. Skulls are commonly associated with ritual activity (cf. Hill 1995; Morris 2008), and while it cannot be excluded that this skull and mandibles represent disposal of butchery waste, particularly as the remaining fill contained many bones from butchery and kitchen waste, the possibility of a ritual deposit must be considered.

The articulated horse leg in middle Roman ditch 15750 included femur, tibia, the tarsal joint and the metatarsal. All bones were fused, indicating that the animal was over 3.5 years old when it died. A deep diagonal cut mark was found on the medial side of the calcaneus. This is a common location for disarticulating cut marks, although skinning cannot be entirely ruled out. A withers height of 1.55m was calculated on the metatarsal. Limb bones are the second-most common type of horse ABG in the Roman period after axial elements (Morris 2008, 197), which suggests that this may be a deliberate deposit, although this is by no means certain.

Three bone fragments were recovered from grave 15230, but since they comprise one very small unidentifiable fragment and two cattle teeth it is likely that they were accidental inclusions.

Discussion

The animal bone assemblage from the A421 Improvements suggests that a mixed subsistence economy was practised throughout the Iron Age and Roman periods, as do those from sites elsewhere in Marston Vale and the surrounding area (Holmes 2007; Maltby 2011). With the exception of the assemblages from Site 2 and Site 8 at Great Barford Bypass (Holmes 2007), cattle are the predominant species on all Iron Age and Roman sites in the area. This differs from the more typical pattern at Iron Age sites in southern England, which are generally dominated by sheep, with a slowly changes in the Roman period when cattle and pig become more important (King 1991). Iron Age sites in the Milton Keynes area are also generally dominated by cattle, and it has been argued that since the wet pastures on the Ouse flood plain rendered the area highly suitable for cattle grazing, the region may have been a centre for cattle breeding in the Iron Age, as well as in later periods (Holmes and Rielly 1994, 531).

Viewing the sites individually, only the middle Iron assemblage from Site 4 (Trench 54) and the late Roman assemblage from Site 7 are substantial enough for comparison. It is, however, clear that all sites show great similarity regarding species representation and general abundancy: domestic mammals dominate the assemblages, and cattle, sheep/goat and horse are generally the most common taxa. Soil conditions are similar across the area of the A421 Improvements, which would add further support to what appear to be the general similarities between the faunal assemblages.

Changes in animal husbandry are apparent when the assemblages are considered as a group (Table 5.9). The abundance of cattle is shown to decrease in the early Roman period and then increase through the subsequent Roman periods. However, the majority of the late Roman assemblage comes from from Site 7, so it is possible that the apparent increase in cattle during this period merely indicates that this particular settlement was more cattle-reliant. The pattern of cattle exploitation at other sites in the region varies. The Great Barford sites and Marsh Leys show no change in species frequency over time. At Broughton Manor Farm cattle increase from the mid Roman to the late Roman period and at Wavendon Gate there is a minor decrease in cattle and a corresponding increase in sheep/goat during the same period (Dobney and Jaques 1996; Holmes 2007; Maltby 2011; Strid forthcoming). The frequency of pig on the A421 Improvements is consistently low and is further reduced in the mid-Roman period. This suggests that while woodland would have been present in the area to provide pannage for pigs, the local environment was dominated by arable land and fields for pasture. The decreasing frequency of pig in the mid-Roman period may be a sign of reducing woodland, possibly a consequence of an increase in arable land during the middle and late Roman periods.

The greater prevalence of sheep/goat remains during the early Roman period may actually reflect a reduction of cattle rather than an increase in sheep. Livestock from the Marston Vale settlements may have been sold on the hoof to the market at the nearby small towns at *Magiovinium*, near Milton Keynes. While the information regarding animal bones from *Magiovinium* is somewhat limited, it is clear that cattle dominate the assemblage (Locker 1987, 109). The early Roman phase of Broughton Manor Farm, a rural settlement situated between the M1 and *Magiovinium*, had a similar frequency of sheep/goat, which changed to a predominance of cattle in the later Roman periods (Strid forthcoming). In contrast, Wavendon Gate, a rural settlement which lies near *Magiovinium*, had a consistently high frequency of cattle throughout the Iron Age and Roman periods (Dobney and Jaques 1996, 206).

Ageing data is overall scant, even when the sites are viewed together. Cattle husbandry seem to focus on 30-36 month old cattle and adult/elderly cattle, whereas the sheep data suggest a range of slaughter ages from 6-12 months to 3-4 years. Some older sheep are also present, particularly in the

Table 5.9: Number of identified bones (NISP)/taxon from the A421 Improvements by phase

Phase	*n*	*sp. id.*	*cattle*	*sheep/goat*	*pig*
Iron Age	19	8	3		
Middle Iron Age	3594	798	441 (63.6%)	206 (29.7%)	46 (6.6%)
Late Iron Age	1532	228	102 (44.7%)	70 (30.7%)	18 (7.9%)
Late Iron Age/early Roman	57	16	10	4	1
Early Roman	1189	347	147 (49.3%)	127 (42.6%)	24 (8.1%)
Middle Roman	2432	541	216 (73.2%)	68 (23.1%)	11 (3.7%)
Late Roman	1762	408	272 (81.9%)	47 (14.2%)	13 (3.9%)

middle Iron Age at Site 4 (Trench 54), probably representing breeding animals. Cattle epiphyseal data suggests that more cattle were culled prior to 2–2$^{1}/_{2}$ years of age in the later period, perhaps a reaction to shortage of pastures caused by an increase in arable, or an increased preference for prime beef.

The ageing data suggest that cattle and sheep/goat were kept for a variety of products. Cattle were mainly kept for secondary products such as milk and traction, the surplus animals being slaughtered for meat in their third year. Sheep were probably kept mainly for wool, but this was not an intense focus and the sheep would have yielded a few clips of wool before being slaughtered. Since sheep usually have 1-2 lambs and can be bred before they are one year old, it would be possible to keep the herd young and still have enough wool, milk and meat for household use. Goat was only identified at the middle Iron Age settlement at Site 4 (Trench 54) and it is assumed that goat were, if not entirely absent in the other settlements, very rare. Goats may have been used for their meat, milk, horn, coat and leather. Pigs were kept for meat and mainly slaughtered at a young age. Pigs have a high fecundity and grow quickly and so it is not necessary to wait until they are fully grown before slaughtering them. The presence of neonatal and juvenile animals indicates that breeding of cattle, sheep/goat and pig took place at the settlements. It is not clear whether these remains represent deliberate slaughter for consumption or are natural mortalities. In extensive sheep keeping natural losses may range from 10-30% of the newborn lambs (Noddle 1990, 34).

Horses were kept for their use as riding and pack animals, and were normally not slaughtered until they were either past their prime or had debilitating injuries or illnesses. Evidence for consumption of horse meat was only found in the middle Iron Age at Site 4 (Trench 54) and in the early Roman period at Site 3. The scarcity of skeletally immature remains in Iron Age assemblages has been interpreted as a lack of horse breeding, and Harcourt (1979) has argued that horses were kept in feral herds and caught and broken in when needed. There are, however, Iron Age sites in the region that contain a small number of juvenile horse bones (Dobney and Jaques 1996, 224-225; Holmes 1993, 141; Strid forthcoming), which suggests that horse breeding did occasionally occur on settlements. Horses at the A421 Improvements increased in size from the Iron Age to the Roman period, a pattern that has also been observed in nearby assemblages (Holmes 2007, 345, 358). Most horses were pony sized, with the exception of one middle Roman horse from Site 7, that stood at 15.3 hands. A middle Iron Age horse and cattle skull on the base of an enclosure ditch at Site 4 (Trench 54), are likely to represent ritual activity. The depositions of a late Iron Age semiarticulated horse at Site 3 and a late Roman horse leg at Site 7 may also have had ritual significance.

Dogs were kept for guarding, herding and hunting. Particularly small or large dogs, which started to occur in the Roman period (Harcourt 1974, 164), were not found at the A421 Improvements. One middle Roman dog from Site 7 had a withers height of 393mm, about the size of a modern bullterrier. Utilisation of dog flesh occurred occasionally in Britain during the Iron Age and Roman periods (Maltby 1996, 23-24; Sykes 2007b) but evidence for this practice was not found in any of the A421 assemblages. Two dogs at the base of a middle Roman ditch and a late Roman waterhole in Site 7 were probably deliberately deposited when the features went out of use, possibly as a closure ritual.

Domestic fowl was only found in the middle Roman phase at Site 2. The remains come from a single oven and may represent a single bird. Domestic fowl was introduced to Britain in the late Iron Age and is often found in small numbers on Roman settlements (Grant 1989, 143). Fowl was probably kept for eggs and feathers, with meat as a byproduct.

Game comprised a very small number of fragments in the assemblage, and was absent from most sites. This is also the case in the nearby sites, where game only occurred at Great Barford, Biddenham Loop, Ruxox, Salford and Stagsden (Hamilton-Dyer 2004; Holmes 2007; Maltby 2008; Roberts 2000; 2005). Red and roe deer were the most commonly found species on these sites, but roe deer could not be identified at any of the A421 Improvements sites. It is not clear whether the scarcity of game in the assemblages reflect the absence of a tradition of hunting or restriction of hunting rights. Roman villas usually contain a relatively large number of bones from wild fauna (King 1991, 18), suggesting that the owners may have controlled hunting in the local area. The majority of the wild mammal remains in the assemblage were deer antler, with no evidence of whether they represent hunted animals or naturally shed antlers. Post-cranial elements were only found in the middle Roman assemblage from Site 2. Wild birds only occurred at Site 2 and Site 7, where one fragment each of crow/rook and goose were found.

The measurable bones showed that very little change in animal size could be discerned. It is generally held that the Romans introduced breeding stock from the continent and changes in animal size have been evidenced from several sites (Dobney 2001, 38-9). Data from sites in the Milton Keynes region agree that an increase in cattle withers height occurred between the early and late Roman period (Dobney and Jaques 1996, 219). This has not been evidenced from any of the A421 Improvements sites, although this may be due to the small number of measurements. Of note is the very large middle Iron Age cattle metacarpal from Site 4 (Trench 54), which was larger than the largest bone in the comparative sites. One would assume that such a large specimen came from a bull or an ox, but the biometrics indicate that it was female. The bone is not wider than other cattle metacarpals from Site 4 (Trench 54), and suggests that this is an unusually tall cow. Whether the bone represents a direct import from larger stock or a close descendant of an imported large animal is not certain.

The main difference between butchery methods in the Iron Age and the Roman period is the increasing use of heavy cleavers. Cleavers are closely associated with military and urban settings and probably represent professional butchers with a large turn-over of carcasses (Seetah 2006). During the Iron Age at the A421 Improvements knives were exclusively used for disarticulating the carcasses of cattle, sheep/goat, pig and horse and removing meat from them. In the Roman assemblages the use of cleavers was introduced on a small scale, but cut marks from knives continued to dominate. One cattle scapula from Site 7 had a blade mark near its spine, indicating removal of meat by cleaver, and one cattle metatarsal had been split axially, both methods characteristic of professional Roman butchery (Maltby 2007). The number of butchery marks per site and period were not of sufficient size to discern any changes in butchery practices in terms of placement of butchery marks or changes between different taxa. Contrastingly, the butchery at Great Barford and Marsh Leys Farm was mainly carried out with cleavers during all periods (Holmes 2007, 336, 342, 349, 353; Maltby 2011, 123, 127). This suggests that there was some very early influence from Roman military or civilian butchers – perhaps local men returning to settle after serving in the Roman army.

Evidence for bone, horn and antler working was scant – represented by one middle Iron Age sawn-off antler tine at Site 4 (Trench 54), a similar late Iron Age piece at Site 2, a middle Iron Age chopped-off goat horn core at Site 4 (Trench 54) and a middle Roman large mammal long bone at Site 7. Due to an absence of large build-ups of waste products the evidence for such crafts is likely to be unrepresentative of the scale of their actual occurrence, which are likely to have occurred on all sites regardless of period, albeit on a small scale.

Animal bone groups that were interpreted as ritual deposits occurred at Site 3, Site 4 (Trench 54) and Site 7, dating from the middle Iron Age to the late Roman period. The animals represented in these deposits were cattle, dog and horse. There is a great variety in deposit type: burials of articulated carcasses occurred at Site 3 (horse) and Site 7 (two dogs). At Site 4 (Trench 54) there was a deposit of one cattle skull and one horse skull on the base of an enclosure ditch. One articulated horse leg was found at Site 7, as well as a cattle skull at the base of a late Roman waterhole. It is difficult to compare ritual deposits from one site to another as there is a great variety of species, deposit types and feature types represented. In general most animal bone group deposits in Britain during the Iron Age are sheep, followed by dog but this is reversed in the Roman period (Morris 2008, 117, 153). In southern England, whether Iron Age or Roman, articulated burials of domestic mammals are rather scarce, and instead most animal bone groups consist of partial remains, such as the axial skeleton, limbs and heads (Morris 2008, 39, 117, 196-197).

CHARRED AND WATERLOGGED PLANT REMAINS *by Kathryn Hunter*

Introduction

A total of 170 bulk samples were collected for the extraction of charred plant remains. Following assessment of all samples (OA 2010), 32 samples from Site 2, Site 4 (Trench 54) and Site 7 were selected for sorting and analysis on the basis of the quantity and range of plant remains noted (Tables 5.10-11). These comprised 16 samples from Site 2, nine samples from Site 4 (Trench 54) and seven samples from Site 7. Although 46 samples were collected from Site 3, four samples from Site 4 (Trench 61), six samples from Site 5 and a single sample from Site 6 (Trench 105), none of these produced sufficient remains at the assessment stage to warrant full analysis. Three samples collected from Roman features at Berry Farm Borrow Area contained charred cereal remains, but were found to include a very high proportion of well-preserved modern, uncharred, hexaploid wheat chaff, including rachis fragments, as well as a relatively large number of modern weed seeds and roots. These may result from stubble burning from a modern crop, a common agricultural practice in Britain until 1993.

In addition to the samples processed for charred plant remains a single sample from late Roman waterhole 15735 at Site 7 was analysed for waterlogged plant remains.

Methodology

Samples were processed using a standard flotation technique (Siraf-style flotation tank), with 1mm and 0.5mm meshes used for the recovery of the residue and flot respectively. For the waterlogged sample 1 litre of soil was washed through a 0.25mm mesh. Where the quantity of fragmentary charred material, particularly chaff in the finer fractions, was particularly large the flots were riffled and only a proportion was examined. Some of the samples still contained considerable quantities of fragmentary chaff and this was not extracted where it was obvious that it would not facilitate a more in depth identification. In these instances partial counts were carried out and then estimates were made as to the quantity of this material. This is denoted by + following a number in the taxa tables. This practice was carried out with all oat (*Avena* sp.) awn and non-diagnostic floret fragments, and in some cases with glume base fragments. The identification of the plant remains was carried out using modern refer-

Table 5.10: Samples analysed for charred plant remains

Site	*Sample. no.*	*Context*	*Feature*	*Phase*
2	2009	2292	Ditch 2476	Early Roman
2	2010	2337	Ditch 2454	Early Roman
2	2014	2433	Pit 2430	Early Roman
2	2017	2436	Hollow 2435	Early Roman
2	2018	2437	Hollow 2426	Early Roman
2	2019	2427	Hollow 2426	Early Roman
2	2020	2428	Hollow 2426	Early Roman
2	2023	2461	Pit 2430/2460	Early Roman
2	2024	2754	Ditch 2766	Early Roman
2	2025	2967	Ditch 2732	Early Roman
2	2031	20020	Ditch 20224	Middle Roman
2	2032	20050	Working hollow 20049	Middle Roman
2	2037	20134	Oven 20139	Middle Roman
2	2041	20165	Pit/water-hole 20167	Middle Roman
2	2042	20168	Oven 20143	Middle Roman
2	2045	20051	Working hollow 20049	Middle Roman
2	2047	20186	Ditch 20236	Middle Roman
2	2060	2398	Ring gully 2709	Early Roman
4 (Trench 54)	17003	17029	Ditch 17714	Middle Iron Age
4 (Trench 54)	17010	17090	Ditch 17717	Middle Iron Age
4 (Trench 54)	17012	17725	Ditch 17725	Middle Iron Age
4 (Trench 54)	17013	17187	Ditch 17716	Middle Iron Age
4 (Trench 54)	17014	17180	Ditch 17716	Middle Iron Age
4 (Trench 54)	17015	17181	Ditch 17716	Middle Iron Age
4 (Trench 54)	17018	17255	Ditch 17343	Middle Iron Age
4 (Trench 54)	17019	17200	Ditch 17343	Middle Iron Age
4 (Trench 54)	17021	17191	Ditch 17343	Middle Iron Age
7	15036	15408	Ditch 15753	Middle Roman
7	15040	15503	Quarry pit 15500	Middle Roman
7	15042	15594	Quarry pit 15588	Middle Roman
7	15043	15604	Ditch 15753	Middle Roman
7	15044	15605	Ditch 15753	Middle Roman
7	15045	15606	Ditch 15753	Middle Roman
7	15057	15830	Waterhole 15375	Late Roman

ence material and standard reference texts (Beijerinck 1947; Berggren 1981; Jacomet 2006; Schoch *et al*. 1988; Capper *et al.* 2006). The nomenclature for the identification of the cereals follows Jacomet (2006) and for the rest of the plant remains follow Stace (2010).

Preservation

The preservation of charred and waterlogged remains was variable, with identification of some plant remains possible to subspecies while in others it could not be taken beyond family level. The generally vacuolated appearance of many of the cereal grains and fragments from all of the sites suggests that prior to burning they may have been 'green', that is containing too high a moisture content to be stored successfully.

Many of the analysed samples from the A421 sites were from enclosure ditches and pits and appear to be the result of secondary or tertiary dumping, so the absence of more fragile remains is not unexpected. However, even the samples from the ovens at Site 2 produced only relatively robust remains. This of course may also be due to factors such as the condition of the material prior to burning, the temperature of the fire, and the length of time for which the material was in contact with the high temperatures. No identifiable silicified or mineralised remains were noted in any of the samples, although some of the charred glume bases from sample 2042 at Site 2 had sandy concretions on the surface of some of the grains.

The robustness of remains can vary between species, particularly in waterlogged assemblages, and this may have affected waterhole sample 15057 from Site 7, as plants and insect remains associated with arable crops were found but not the cereals themselves.

Results

Site 2

Early Roman

Material from nine samples from features attributed to the early Roman period was fully analysed and material from a further two samples (2018 and 2020) was scanned (Fig. 5.1; Table 5.12).

Hollow 2426 contained three fills that were particularly rich in charred plant remains (samples 2018, 2019 and 2020). Since the assessment results indicated that these samples were of similar composition a decision was taken to fully sort and analyse sample 2019 and to scan the other two. The general characteristics of the three samples were indeed similar, with a dominance of wheat chaff over grain. Where identification was possible spelt wheat (*Triticum spelta*) predominated. Possible barley (cf. *Hordeum* sp.) was noted in sample 2018 and oat (*Avena* sp.) in sample 2020. Both barley and oat were represented in sample 2019. Overall the early Roman samples from this site had lower numbers of wheat chaff and grain than the samples from middle Roman features, with the highest number of chaff fragments per litre being 17.5 in sample 2019 from hollow 2426 (Table 5.11). On the whole the ratio of grain to chaff was also lower. This might suggest that spelt was being processed on a smaller scale than in the middle Roman period. The increase in incidence of spelt remains and cereals in general for this period appears to be a characteristic of Roman Britain, as are the lower counts for emmer (*Triticum dicoccum*), barley (*Hordeum* sp.), oat (*Avena* sp.), rye (*Secale cereale*), flax (*Linum* sp.) and various

Table 5.11: Intact cereal grain, wheat and wheat glume base fragments per litre of soil processed

Site 2 early Roman									
Sample no.	*2009*	*2010*	*2014*	*2017*	*2019*	*2023*	*2024*	*2025*	*2060*
Context no.	*2292*	*2337*	*2433*	*2436*	*2427*	*2461*	*2754*	*2697*	*2398*
Sample Vol (l)	*25*	*35*	*25*	*13*	*34*	*15*	*22*	*32*	*15*
% flot sorted	*100*	*100*	*50*	*100*	*100*	*100*	*100*	*100*	*100*
Cereal/l	0.12	1.1	4.7	5	4.8	0.4	0.5	1.1	1
Wheat/l	0.4	0.7	4.3	3.9	4.6	0.3	0.45	1	1
W Chaff/l	0.2	1.9	4.4	4.3	17.5	1.7	3	7.5	0.1
Site 2 middle Roman									
Sample no.	*2031*	*2032*	*2037*	*2041*	*2042*	*2045*	*2047*		
Context no.	*20020*	*22050*	*20134*	*20165*	*20168*	*20051*	*20186*		
Sample Vol (l)	*12*	*19*	*6*	*18*	*10*	*39*	*36*		
% flot sorted	*12.5*	*100*	*100*	*25*	*100*	*50*	*50*		
Cereal/l	42	5	0.16	57	10.2	4.4	2.9		
Wheat/l	31.3	3.8	0.16	56	8.8	4.2	2.5		
W Chaff/l	2360	147	15.6	386.6	300+	89.7	68.8		
Site 4 (Trench 54) middle Iron Age									
Sample no.	*17003*	*17010*	*17012*	*17013*	*17015*	*17018*	*17019*	*17021*	*17014*
Context no.	*17029*	*17090*	*17725*	*17187*	*17181*	*17255*	*1720*	*17191/17121*	*17180*
Sample Vol (l)	*40*	*37*	*37*	*38*	*40*	*37*	*25*	*6*	
% flot sorted	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Cerea/l	0.25	0.02	0	0	0	0	0	0	0
Wheat/l	0.25	0.02	0	0	0	0	0	0	0
W Chaff/l	0	0	0.05	0	0	0	0	0	0
Site 7 middle Roman									
Sample no.	*15036*	*15040*	*15042*	*15043*	*15044*	*15045*			
Context no.	*15408*	*15503*		*15604*	*15605*	*15606*			
Sample Vol (l)	*10*	*20*	*10*	*30*	*30*	*30*			
% flot sorted	*100*	*50*	*100*	*50*	*25*	*100*			
Cereal/l	6.8	2.3	0.4	21.3	43.6	1.6			
Wheat/l	5.9	21.8	0.2	12.9	24.8	0.5			
W Chaff/l	100+	244.6	20.8	200+	139.8	128			

legumes. Legumes, including garden pea (*Pisum sativum*) and possibly common vetch (*Vicia* cf. *sativa*), are present in small quantities, which are not large enough to suggest large scale cultivation. However, they may be underrepresented, as the charring that is required in order to preserve such material is not a normal part of the processing of these species. Common vetch, though a weed of arable crops, may also have been utilised as a fodder crop. The garden pea might have be grown on a small scale for local consumption.

Middle Roman

Seven samples from middle Roman contexts from the south-western enclosure complex were analysed (Fig. 5.2; Table 5.13).

Samples 2037 and 2042 came from ovens 20139 and 20143. Sample 2037, from oven 20139, produced a relatively poor assemblage of charred plant remains compared with the other samples from this site and the other sites in this project. Only one possible wheat grain was identified, together with 94 glume bases and a few other weed seeds. Though this might suggest that the oven was being fuelled by something other than cereal remains, it is also possible that it had been cleaned out prior to going out of use. Sample 2042, from oven 20143, produced an assemblage rich in cereal chaff, dominated by spelt wheat (*Triticum spelta*). As with the assemblage from Site 7 (below), a number of well-developed detached coleoptiles were present, though in smaller numbers here than for the Site 7 samples. A few glume bases in sample 2042 and enclosure ditch sample 2047 have been tentatively identified as emmer wheat (*Triticum* cf. *dicoccum*). These are likely to be weeds of the spelt or relics of a previous crop. An individual example of a large legume fragment may hint at the presence of either garden pea (cf. *Pisum sativum*) or broad bean (*Vicia faba*). Oven sample 2042 also produced a rich assemblage of weed seeds, including 62 seeds from stinking chamomile (*Anthemis cotula*), an arable weed which prefers heavier, base-rich soils. The remaining samples were taken either from enclosure ditches (2031 and 2047) or from working hollow 20049 (2032 and 2045), with a single sample (2014) from

Table 5.12: Site 2, summary of charred plant remains from early Roman contexts

Key to habitat and relative quantity: B: Bankside; C: Cultivated; D: Disturbed ground; Da: Disturbed ground inc. Arable; Dc: Disturbed cultivated; G: Grassland; H: Hedge bank; M: Marsh; S: Scrub; W: Woodland; WM: Woodland margin.
: Rare 1-5; **: Occasional 6-20; *: Frequent 21-100; ****: Abundant 100+; 3000+: Estimated quantity; #: ?modern.*

Sample no.
Context no.
Sample vol/l
% flot sorted

Family	*Taxa*	*Common name*	*Component*	*Habitat*
	Triticum cf. *spelta*	possible spelt	grain	C
	Triticum sp.	wheat nfi	grain (sprouted)	C
	Triticum cf. *spelta/dicoccum*	spelt/emmer glume wheat type (sprouted)	grain	C
	Triticum sp.	glume wheat type	grain (sprouted)	C
	Triticum sp.	wheat	grain (sprouted)	C
	cf. *Triticum* sp.	possible wheat	grain (sprouted)	C
	cf. *Hordeum* sp	possible barley	grain (sprouted)	C
	Avena sp.	oat	grain	C
	cf. *Avena* sp.	possible oat	grain	C/G
	Avena /Bromus sp.	oat/brome	grain	C/G
	cf. *Secale cereale*	rye type	grain	C
	Cereal NFI	unidentified cereal	grain fragments (charred)	C
	Triticum spelta	spelt	spikelet fork	C
	Triticum spelta/dicoccum	spelt/emmer	spikelet fork	C
	Triticum spelta	spelt	glume base	C
	Triticum cf. *spelta*	possible spelt	glume base	C
	Triticum spelta/dicoccum	spelt/emmer	glume base	C
	Hordeum sp.	barley	rachis fragment	C
	Avena sp.	oat	floret base	
	Avena sp.	oat	awn fragments	C, Da
	Cereal NFI	unidentified cereal	detached embryo	C
	Cereal NFI	unidentified cereal	detached coleoptile bases (other frags)	C
	Cereal NFI	unidentified cereal	straw internode	
	Cereal NFI	unidentified cereal	straw culm node	
Ranunculaceae	*Ranunculus* sp.	buttercup type	achene	
Fabaceae		legume	pod fragments	
	cf. *Lotus* sp.	birdsfoot trefoil	seed	
	Vicia cf. *Sativa*	possible common vetch	seed	C
	Vicia/Lathyrus sp. (4mm)	vetch/pea	seed	Da, C
	Vicia/Lathyrus sp. (2mm)	vetch/pea	seed	Da, C
	cf. *Lathyrus* sp.	pea	seed	
	Pisum sativum L.	garden pea	seed	Da, C
	cf. *Pisum sativum* L.	possible garden pea	seed	
	large legume fragment		seed fragment	
	legume		seed fragment	
	Trifolium/Lotus sp. L	clover/birdsfoot trefoil	seed	
	Trifolium/melilotus sp. L	clover/medick	seed	
Rosaceae	*Prunus spinosa* L.	blackthorn	stone (fragments)	WS
	cf. *Prunus spinosa* L.	possible blackthorn	stone (fragments)	
	Crataegus monogyna Jacq.	hawthorn	stone	WM, S, H
	cf. *Crataegus monogyna*	hawthorn	stone	
	cf. *potentilla* sp.	possible cinquefoils	achene	
	cf. *Aphanes arvensis*	parsley-piert	achene	C
Urticaceae	*Urtica dioica*	common nettle	achene	W, nitrogen rich
Betulaceae	*Corylus avellana* L.	hazelnut	shell frags	SW

2009	2010	2014	2017	2018	2019	2020	2023	2024	2025	2060
2292	2337	2433	2436	2427	2427	2427	2461	2754	2697	2398
25	35	25	13	12	34	33	15	22	32	15
100	100	50	100	scan	100	scan	100	100	100	100
	1		2			*		3		
2				**						15
					2					
									5(1)	
	9	53	22		14	***	5	4	12	
	13	-1	27		141			3	15	
	1	1	7	*	2					
			2			**	1			
			4			**		1		
1	12	4			4				2	
			1							
200+	1000+	300+	500+	****	1619	****	100+	100+	500+	35
					7					
1	4	5	6	*	13	*		3	11	1
				*	16	*	26		5	
	1	4	4						2	
4	64	47	47	***	561	***		64	402	1
			1							1
								1	5	
		*			**			**		
		1	2		3	*			2	
							1		2	
2	2								6	
										1
		1	1							
					4					1
	3	4	7			*			2	
2	1	9	5	*	4	*	1		2	
	6		3	*	1	**		3		
							2	1		
		1								
						*				
	1	7								
			12						5	
							1			
7		1				*		1	3	
										1
	1(2)									
						*				
		1								
1		1							1	
									1	
									2	
				*		*				

Table 5.12: Site 2, summary of charred plant remains from early Roman contexts (continued)

Family	*Taxa*	*Common name*	*Component*	*Habitat*
Violaceae	*Viola* sp.	violet type	seed	
	Viola tricolor L.	wild pansy	seed	Waste, marginal, cultivated land
Brassicaceae			seed	
	Brassica rapaspp. Campestris (L.) A R Clapham	wild turnip	seed	B
	Raphanus raphanistrum spp. *raphanistrum* L.	wild radish	mericarp fragment	C, Da
Polygonaceae	*Persicaria maculosa* Gray/ *Persicaria lapathifolia* (L.) Delarbre	redshank/pale persicaria	achene (frags)	Da
	Persicaria sp.	knotweeds	achene	
	Fallopia convolvulus (L.) Love	black bindweed.	achene	Da
	cf. *Fallopia convolvulus* (L.) Love	possibleblack bindweed.	achene	
	cf. *Persicaria* sp.	persicaria type	achene	
	Polygonum sp.	knotweed type	achene	
	Rumex sp.	dock type	achene	Da, G, M, S, W
	Rumex cf. *palustris* Smith	marsh dock	achene	B ditches marshy
Caryophyllaceae	*Stellaria media* (L.) vill	common stitchwort	seed	Da, open ground
	cf. *Stellaria* sp.	stichworts	seed	
	Agrostemma githago L.	corn cockle	seed capsule fragment	Da
	cf. *Silene* sp.	campion type	seed	
Amaranthaceae	*Chenopodium* sp.	goosefoots	seed	n
	Atriplex sp.	orache	seed	n
Montiaceae	*Montia fontana* spp. *chronrosperma* (Fenzl) Walters	blinks	seed	many kinds of damp places
Rubiaceae	*Galium aperine* L.	cleavers	nutlet	Da, H, S, other open land
Veronicaceae	*Veronica beccabunga*	brooklime	seed	Streams, ditches, marshes, pond/river sides
Plantaginaceae	*Plantago lanceolata* L.	ribwort plantain	seed	G short or grazed. Da
Scrophulariaceae	cf. *Scrophularia* sp.			
Laminaceae	*Prunella vulgaris* L.	self heal	seed	G, W (clearings)
	Lycopus europaeus L.	gypsywort	seed	B
	Mentha cf. *aquatica* L.	water mint	seed	M, P, wet fields
Orobanchaceae	*Euphrasia/Odontites* sp.	euphrasia/bartsias	seed	
Asteraceae			achene	
	cf. *Anthemis cotula* L.	Stinking chamomile	achene	Da
	cf. *Tripleurospermum inodorum*		achene	
Caprifoliaceae	*Sambucus nigra* L.	elder	seed	W, H
Apiaceae	*Anthriscus sylvestris* (L.) Hoff.	cow parsley	mericarp	G, WM
Juncaceae	*Juncus* sp.	rush	capsule/seeds	
	Juncus sp.	rush	fused seeds	
Cyperaceae	*Eleocharis palustris* (L.) Roemer & Schultes	common spike rush	nut	P (shallow). M, G (wet)
	Eleocharis sp.		nut	
	Carex sp. (Trigonus)	sedge	nut	M, B, W, G esp. damp/wet soils
	Carex sp. (bi-convex)	sedge	nut	M, B, W, G esp. damp/wet soils
poaceae		grass	caryopsis	
		grass	internode	
	cf. *Lolium* sp.	possible rye grass	caryopsis	
		moss stem		
	Unident		seed	
	Unident		rhizome/ tuber fragments	
	Unident		amorphous charred fragments	

		1								
								3		
				*	1					
					3					
									1	
	1							2		
		1						1		
									1	
		1								
	1								3	
	3	1	2						5	
								36	11	
									8	
			1						1	
		1					1	1		
1								2		
1	3		1		2			4	7	
	1				1					
									1	
1									1	
					1					
					1					
1	17	13	2		15	**	2		4	
									2	
										1
									7	
									1	
									1	
									16	
	1	15			6	*	3			
4									2	
1										
3	8	1		*		**	3	4	13	
									3	
1						*		1	4	
		1								
4								22	15	4
	1					1				
									1	

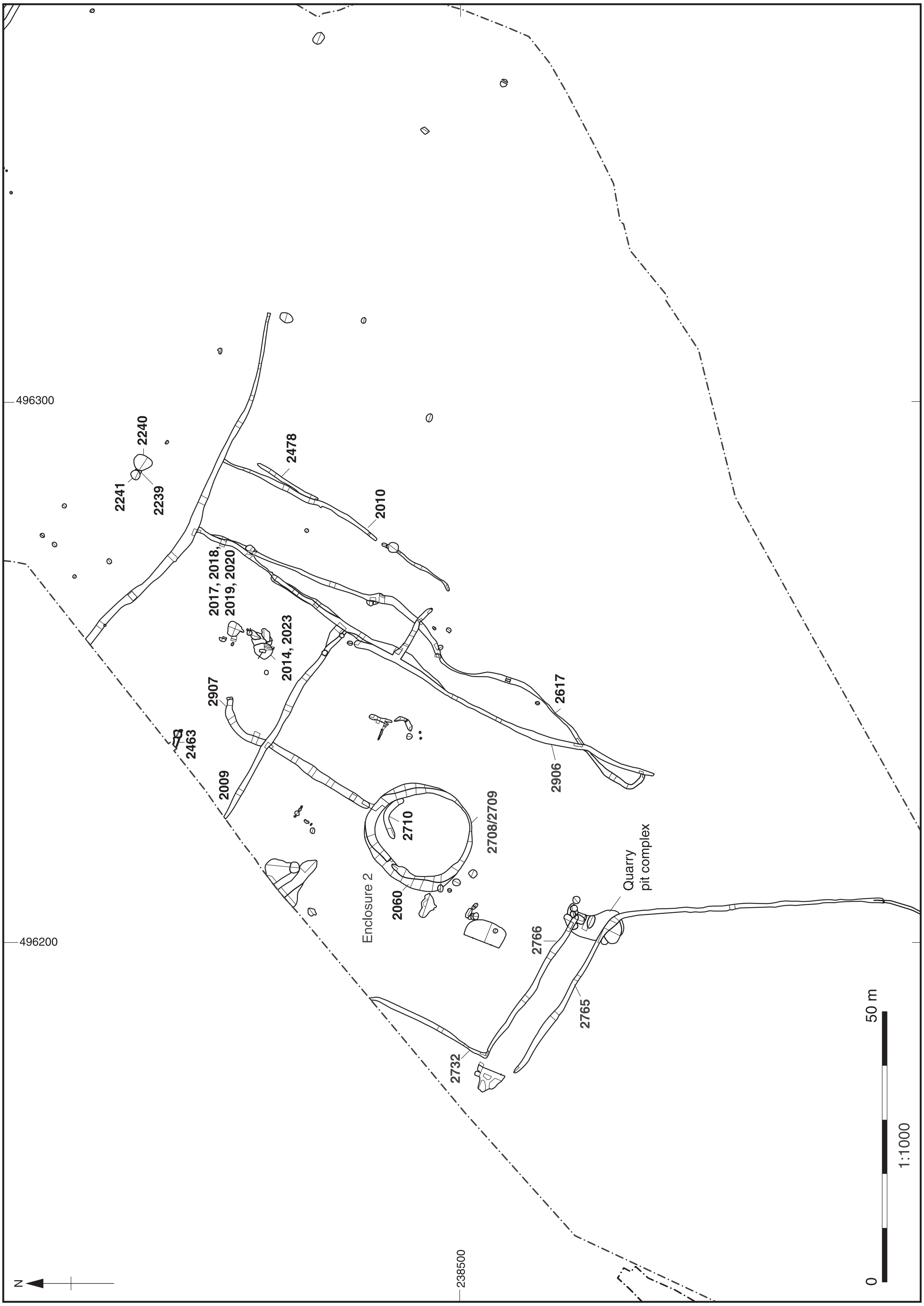


Fig. 5.1 Site 2, north-eastern enclosure complex, location of environmental samples

pit/waterhole 20167. Sample 2031, from enclosure ditch 20224, produced an extremely large quantity of wheat glume bases. The 12 litre sample contained approximately 28,000 fragments of wheat chaff, which equates to approximately 3000 fragments per litre of soil compared with only 386 fragments per litre from the next richest sample (2041; Table 5.11). This may indicate that this feature had been used for a prolonged period for dumping waste. The presence of rich counts of wheat chaff in all of the samples taken from close to the ovens may suggest that large quantities of material were being deposited and that there was probably a large spread of this waste material across the area which accumulated in the sunken features either deliberately or incidentally. As with the assemblages from Site 7 (below) there were significantly smaller numbers of cereal grains compared to chaff in all of the samples. Again, the dominant grain was wheat, with oat also present, but based on grain morphology alone it is not possible to identify which species of either crops the grains represent. One sprouted grain from sample 2032 exhibited characteristics that suggested it might be barley. A single degraded seed (sample 2045) has been attributed to flax (cf. *Linum* sp.). As with the naked varieties of

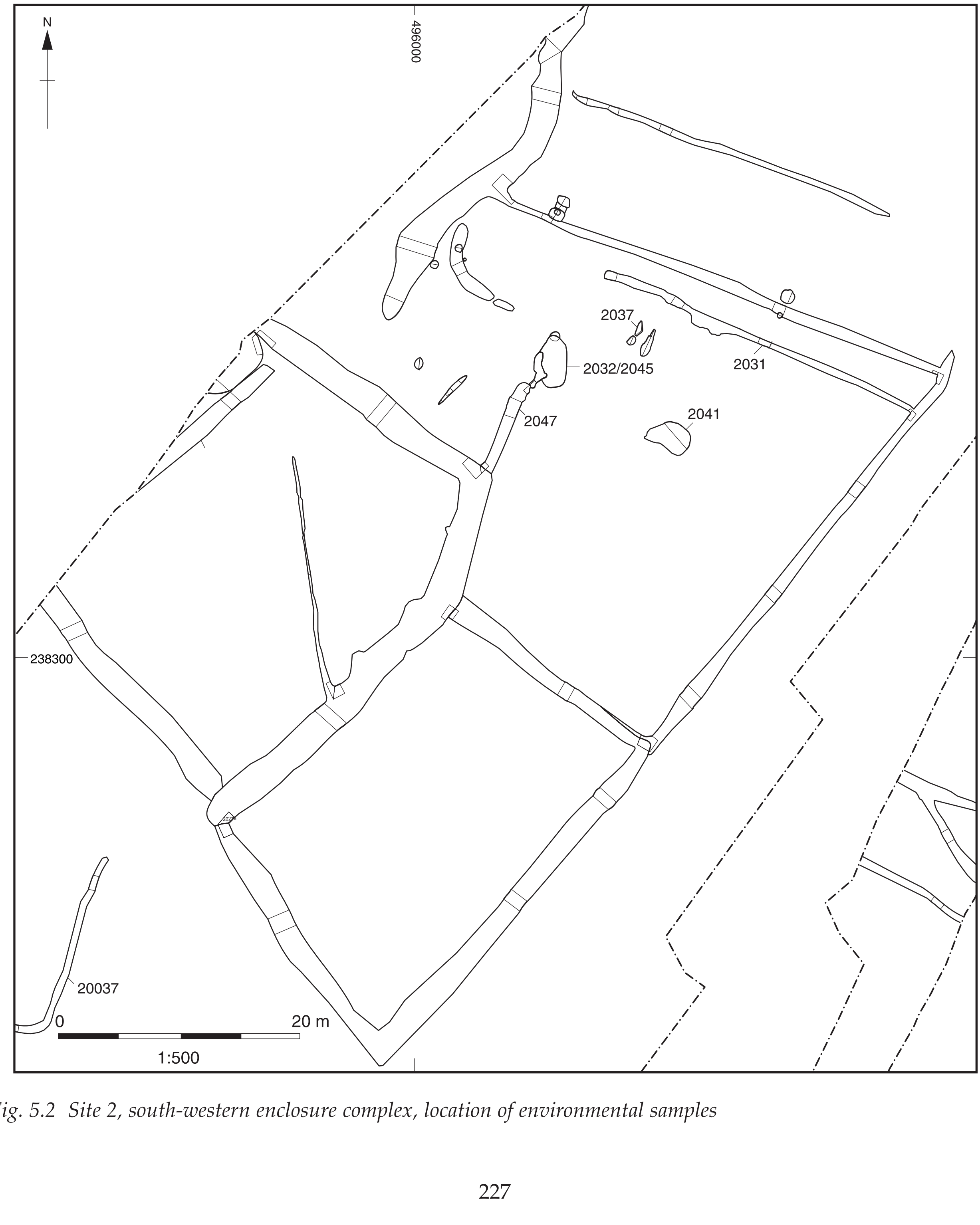


Fig. 5.2 Site 2, south-western enclosure complex, location of environmental samples

Table 5.13: Site 2, summary of charred plant remains from middle Roman contexts

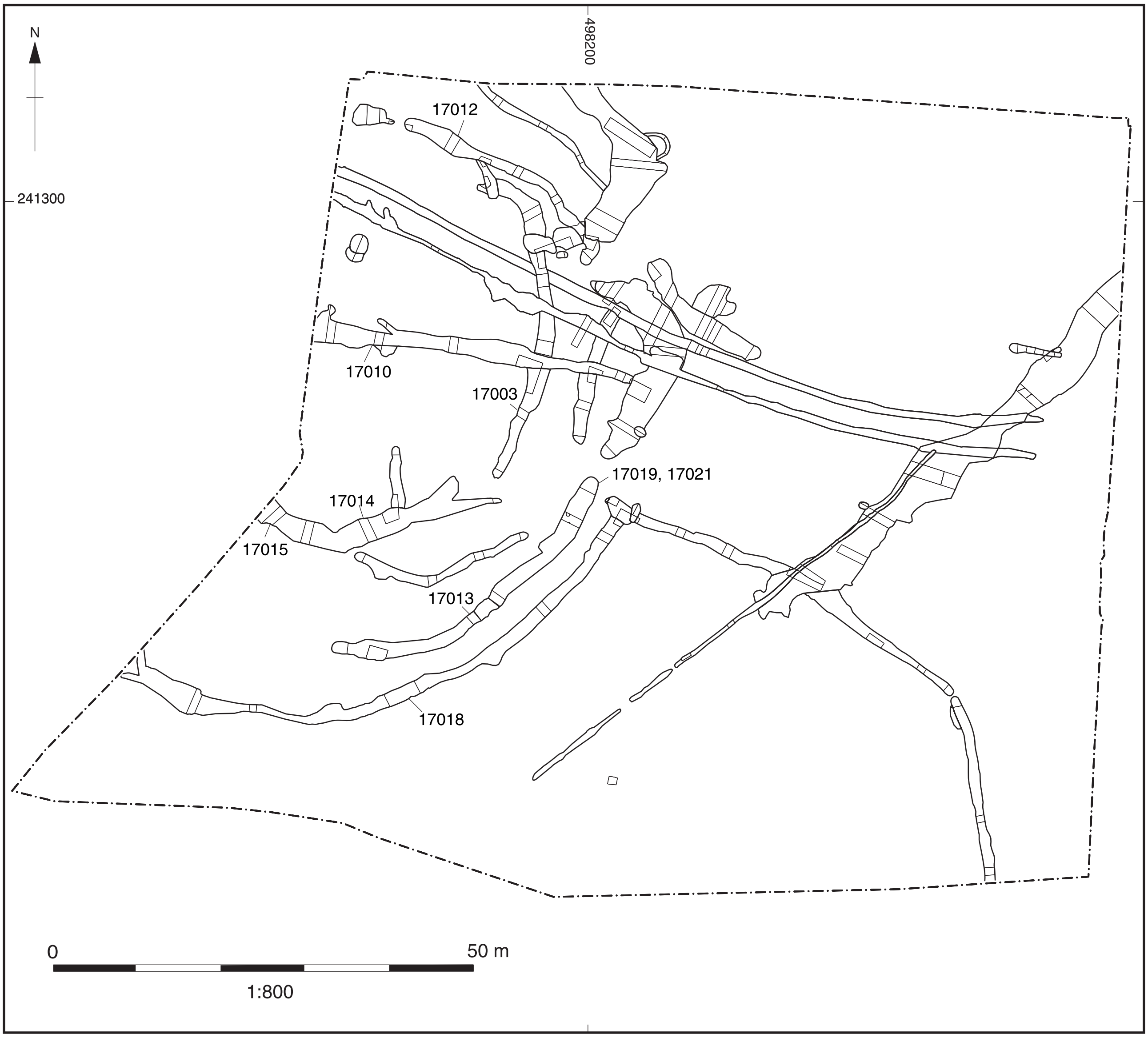
Sample no.
Context no.
Sample vol/l
% flot sorted

Family	*Taxa*	*Common name*	*Component*	*Habitat*
	Triticum sp.	free threshing wheat type	grain	C
	Triticum sp.	glume wheat type	grain(sprouted)	C
	Triticum sp.	wheat	grain (sprouted)	C
	cf. *Triticum* sp.	possible wheat	grain (sprouted)	C
	cf. *Hordeum* sp.	possible barley	grain(Sprouted)	C
	Avena sp.	oat	grain	C, Da
	cf. *Avena* sp.	possible oat	grain	C, Da
	Avena /Bromus sp.	oat/brome	grain	C/G
	Cereal NFI	Unidentified cereal	grain fragments (charred)	
	Triticum cf. *dicoccum*	possible emmer	spikelet fork	
	Triticum cf. *dicoccum*	possible emmer	glume base	
	Triticum spelta	spelt	spikelet fork	
	Triticum cf. *spelta*	possible spelt	spikelet fork	
	Triticum spelta/dicoccum	spelt/emmer	spikelet fork	
	Triticum spelta	spelt	glume base	
	Triticum cf. *spelta*	possible spelt	glume base	
	Triticum spelta/*dicoccum*	spelt/emmer	glume base	
	Triticum sp./*Secale cereale*	wheat/rye	rachis fragment	
	cf. *Hordeum* sp.	barley	rachis fragment	
	Avena cf. *sativa* L.	oat	floret base	
	Avena fatua L.	wild oat	floret base	
	Avena sp.	oat	floret base	C, Da
	Avena sp.	oat	awn fragments	C, Da
	Cereal NFI	unidentified cereal	detached embryo	
	Cereal NFI	unidentified cereal	detached coleoptile bases (other frags)	
	Cereal NFI	unidentified cereal	straw internode	
	Cereal NFI	unidentified cereal	straw culm node	
Ranunculaceae	*Ranunculus acris* L./*repens* L.	Buttercup meadow/creeping	achene	
	Ranunculus sp.	buttercup type	achene	
Fabaceae		legume	seed	
	cf. *Lathyrus* sp.	pea	seed	
	large legume fragment		seed fragment	
	legume		seed fragment absision scar	
	Trifolium/Lotus sp. L	clover/birdsfoot trefoil	Seed	
	Trifolium/melilotus sp. L	clover/medick	Seed	
Rosaceae	cf. *Crataegus monogyna*	hawthorn	stone	
	cf. *potentilla* sp.	possible cinquefoils	achene	
Linaceae	cf. *Linum usitatissium* L.	Flax	Seed	
Malvaceae	*Malva* sp.	mallow	nutlet	
Brassicaceae			seed	
	Raphanus raphanistrum spp. *raphanistrum* L.	wild radish	mericarp fragment	
	cf. *Raphanus raphanistrum* L.	wild radish	seed	
Polygonaceae			achene	
	cf. *Persicaria lapathifolia* (L.) Delarbre	pale persicaria	achene	
	Fallopia convolvulus (L.) Love.	black bindweed.	achene	
	Persicaria/Polygonum sp.	persicaria/ knotweed type	achene	
	Rumex sp.	dock type	achene	
	cf. *Rumex* sp.	dock type	achene	
Amaranthaceae	*Chenopodium* sp.	goosefoots	seed	
	Atriplex sp.	orache	seed	
	cf. *Atriplex* sp.	orache type	seed	
	Chenopodium/Atriplex sp.		seed	
Primulaceae	cf. *Anagalis* sp.	pimpernel	seed	

2031	2032	2037	2041	2042	2045	2047
20020	20050	20134	20165	20168	20051	20186
12	19	6	18	10	39	36
12.5	100	100	25	100	50	50
			1			
			99(37)			
34(1)	57(1)		103	65	82	24
12	16	1	12	23		22
	(1)					1
3	9			14		4
1	12				1	2
13			7		4	
100+	1218	13	143	265	665	84
				2		
				14		1
20			9	5	3	12
21	11			6		
9	30	5	62	11	52	81
490			81	30	13	61
	124					
3000+	2634	76	575	3000+ (est)	1017	1000+
2						
		1	3	2		1
					2	
				1		
1		1	3	3	1	
****	***	**	*	***	*	
5	7			3	45	3
27(29)	11(16)		148		9	7(10)
			3			
			3		1	
				1		
				1		
				1		
				1		
				1		
					1	
				1		
						1
						1
					1	
					1	
	1					
	1					
				1		
	1					
				1		
4	17		6	58	4	6
	3	1				2
			1			
2						
			1			
				4		
				1		

Table 5.13: Site 2, summary of charred plant remains from middle Roman contexts

Family	*Taxa*	*Common name*	*Component*	*Habitat*
Orobanchaceae	*Euphrasia/Odontites* sp.	euphrasia/bartsias	seed	
Asteraceae			achene	
	Cirsium sp.	thistle	achene	
	centaurea sp.	knapweed	achene	
	Anthemis cotula L.	stinking chamomile	achene	
	Glebionis segetum (L.) Fourr.	corn marigold	achene	
	Tripleurospermum inodorum (L.) Scultz-Bip	scentless mayweed	achene	
Caprifoliaceae	*Sambucus nigra* L.	elder	seed	
Apiaceae	*Anthriscus sylvestris* (L.) Hoff.	cow parsley	fruit	
Cyperaceae				
	Eleocharis sp.		nut	
	Carex sp. (Trigonus)	sedge	nut	
	Carex sp. (biconvex)	sedge	nut	
poaceae		grass	caryopsis	
	Unident		seed	
	Unident		amorphous charred fragments	
	bone fragments			



	3			2		2
	2					
	1					
				1		
	4			62	5	6
					2	
					3	
			1			
			1			
				2		
				2		
1		1		2		
				2		
2		1	1	1	3	2
		1			4	
		**				
		*	*			

cereal and the legumes, fire is not commonly used during flax processing so this plant would potentially also be underrepresented. Flax was commonly grown during the Roman period for the production of oil and for fibres for linen (Tomlinson and Hall 1996).

Site 4 (Trench 54)

While the recommendation made at assessment (OA 2010) was to not analyse any of the samples from this site due to the paucity of the remains, additional material was processed from some samples in the hope that even sparse plant remains would provide some level of information pertaining to agriculture at this middle Iron Age site. As a result nine of the 27 original sample flots were considered for this report (Fig. 5.3; Table 5.14). Several of the ditch samples (17021, 17013 and 17019) contained modern uncharred cereal chaff, and a sample from enclosure ditch 17717 included a wheat grain that has produced a modern C14 date (SUERC-30628 (GU-21950)), indicating a high risk of contamination. Given this evidence of modern contamination, any interpretation of the material should be treated with caution.

Charred cereal remains were present, albeit only in small quantities, in six of the nine samples (17003, 17010, 17012, 17015, 17019 and 17014). Four grains from pit sample 17003 were of a rounded shape suggesting a bread wheat type. However, given the difficulty of distinguishing wheat species by grain morphology alone and the absence of any diagnostic chaff, the identification must remain tentative. One sample (17014) contained oat grains, but again no diagnostic chaff was present and so it is not possible to distinguish whether this was a cultivated or weed type. Though present in small quantities in a few samples, the wheat chaff was not sufficiently well preserved to identify it beyond genus. Legume seeds were present in some samples but again it was not possible to identify them to genus or species and they were present in such small numbers that it is difficult to interpret them as a potential cultivated crop. All the samples contained a few weed seeds and they were on the whole species represented in the assemblages of the other sites in this report. One charred seed of henbane (*Hyoscyamus niger*) was present in sample 17013. This plant is often associated with manured ground and middens, so its presence hints at cultivation-related activity.

The four samples analysed from the burnt layer in enclosure ditch 17343 (17013, 17017, 17018 and 17021) contained very few identifiable charred remains.

Site 7

Middle Roman

Six samples were selected for analysis from the 31 assessed (Fig. 5.4; Table 5.15).

Very large quantities of glume wheat chaff were present in enclosure ditch samples 15036, 15040, 15044 and 15045 and quarry pit sample 15043, almost all of it consisting of glume bases. Where the preservation allowed detailed identification the assemblages were dominated by spelt wheat (*Triticum spelta*), with only a few emmer (*Triticum dicoccum*) spikelets being identified in sample 15040. The large quantities of glume wheat chaff compared with the quantities of cereal grains suggest that these assemblages are the result of the accumulation of crop processing waste on an industrial scale rather

Fig. 5.3 (opposite) Site 4 (Trench 54), location of environmental samples

Table 5.14: Site 4 (Trench 54), summary of charred plant remains

Sample no.
Context no.
Sample vol/l
% Flot Sorted

Family	*Taxa*	*Common name*	*Component*	*Habitat*
	Triticum cf. *aestivum*	bread wheat type (sprouted)	grain	C
	Triticum sp.	wheat	grain	C
	cf. *Triticum* sp.	possible wheat	grain	C
	Avena sp.	oat	grain	C
	Cereal NFI	unidentified cereal	grain fragments (charred)	C
	Triticum spelta/dicoccum	spelt/emmer	spikelet fork	C
	Triticum spelta/dicoccum	spelt/emmer	glume base	C
Fabaceae	cf. *Lotus* sp.	birdsfoot trefoil	seed	
	Vicia/Lathyrus sp. (4mm)	vetch/pea	seed	Da, C
	Vicia/Lathyrus sp. (2mm)	vetch/pea	seed	Da, C
	cf. *Lathyrus* sp.	pea	seed	
	Trifolium/Lotus sp. L	clover/birdsfoot trefoil	seed	
	Trifolium/melilotus sp. L	clover/medick	seed	
Urticaceae	*Urtica dioica* L.	common nettle	achene	N, D, C, Fens
Betulaceae	*Corylus avellana* L.	hazelnut	shell frags	SW
Polygonaceae	cf. *Polygonaceae*		achene	
	Persicaria maculosa/persicaria	redshank/pale persicaria	achene (frags)	Da
	Fallopia convolvulus (L.) Love.	black bindweed.	achene	Da
Amaranthaceae	*Chenopodium album* L.	fat hen	seed	Da, n
	Atriplex sp.	orache	seed	n
	Chenopodium/Atriplex sp.		seed	n
Montiaceae	*Montia fontana* spp. *chronrosperma* (Fenzl) Walters	blinks	seed	Many kinds of damp places
Rubiaceae	*Galium aperine* L.	cleavers	nutlet	Da, H, S, other open land
Solanceae	*Hyoscyamus niger*	henbane	seed	Rough, waste ground particularly manured
Laminaceae	cf. *Prunella vulgaris* L.	possible self heal	seed	G, W(clearings)
Orobanchaceae	*Euphrasia/Odontites* sp.	euphrasia/bartsias	seed	
Cyperaceae	*Eleocharis* sp.		nut	
	cf. *Bromus* sp.	brome type	caryopsis	
poaceae	Poaceae	grass	caryopsis	
	Unident		seed	
	Unident		amorphous charred fragments	

than small scale crop processing for domestic consumption. Even with the relatively small assemblage from sample 15042, there is still over twenty times as much chaff as wheat grains present. None of the samples analysed appear to be primary deposits and they are likely to be either the product of general accumulation of waste or deliberate dumping of spent fuel. The presence of cereal coleoptiles and detached embryos indicates that germination of at least some of the grain had occurred. It is not possible to discern which species the coleoptiles originated from and there is evidence of germination of wheat, barley and oat grains in the assemblage. The presence of grooves along the backs of the grain and of completely collapsed grain is indicative of germination. The fact that grooves were present on a relatively small number of the grains suggests that in these cases germination occurred while the grains were still contained within the glume or floret (W Carruthers pers. comm.). Although the coleoptiles were on the whole fragmentary, some were over 3mm in length and in a couple of cases over 5mm. For effective malting the process needs to be halted when the developing coleoptiles are relatively small and so these long coleoptiles, some with secondary root development, may well be evidence of spoilt grain being burnt along with the chaff rather than being evidence of malting. The presence of completely collapsed grain also suggests uncontrolled germination. Evidence for other crops is quite sparse, with cultivated oat (*Avena sativa*) and the possibility of barley (cf. *Hordeum* sp.) being present as grain and chaff in relatively small numbers. This may be because

17003	17010	17012	17013	17015	17018	17019	17021	117014	
17029	17090	17725	17187	17181	17255	17200	17191/92	17180	
40	37	37	38	40	37	25	6		
100	100	100	100	100	100	100	100	100	
4									
6	1								
								6	
17	10	***		4		4		10	
								1	
		2						4	
				1					
							1#		
	2				1				
						1			
	5	2							
			8						
	1								
		1	17						
						2			
						1			
2									
								3	
				2		3			
	2			2					
								1	
			1						
				1					
								2	
						1		1	
				1					
	2		1			1		1	
1		1	2	4					
					8				2

neither requires heat to process them beyond possibly drying a damp or 'green' crop. The weed assemblage from this site is generally consistent with the other sites in the area. The presence of corn cockle (*Agrostemma githago*) seed capsule fragments suggests that the weed was probably a contaminant of the crop, but the absence of the seeds suggest that either it was a minor weed or that the large poisonous seeds had been cleaned by hand from the crop at an earlier stage. Sample 15043 produced a richer weed assemblage than all the other samples apart from waterlogged sample 15057 (below) and contained the greatest number of corncockle capsule fragments, along with scentless mayweed (*Tripleurospermum inodorum*), and rye grass (*lolium* sp.). The latter two species are both cereal weeds, rye grass being particularly a weed of wheat. Single seeds of field/pot marigold (*Calendula arvensis/officinalis*) and mallow (*Malva* sp.) were also present.

Late Roman

Several waterlogged deposits were assessed (four samples) and one (sample 15057, context 15830) was selected for full analysis based on its stratigraphic position at the bottom of waterhole 15735 as well as the richness of material. The insect component from this deposit has also been analysed (Allison, below). The waterlogged assemblage consisted of the remains of plants representing several habitats, all probably local (Table 5.16). The relatively large number of duckweed (*Lemna* sp.) seeds would probably have originated from plants growing within the water, whilst other species such as common spike rush (*Eleocharis* cf. *Palustris*) and bog

Table 5.15: Site 7, summary of charred plant remains

Sample no.
Context no.
Sample vol/l
% flot sorted

	Taxa	*Common name*	*Component*	*Habitat*
	Triticum cf. *spelta*	possible spelt	grain (sprouted)	C
	Triticum sp.	wheat nfi	grain (sprouted)	C
	Triticum cf. *spelta/dicoccum*	Spelt/emmer glume wheat type (sprouted)	grain	C
	Triticum cf. *aestivum*	bread wheat type (sprouted)	grain	C
	Triticum sp.	wheat	grain (sprouted)	C
	cf. *Triticum* sp.	possible wheat	grain	C
	cf. *Hordeum vulgare*	barley, six row	tail grain (sprouted)	C
	cf. *Hordeum* sp.	possible barley	grain (sprouted)	C
	Avena sp.	oat	grain	C
	cf. *Avena* sp.	possible oat	grain	C/G
	Avena/Bromus sp.	oat/brome	grain (sprouted)	C/G
	cf. *Avena/Bromus* sp.	possible oat/brome	grain	C/G
	Cereal NFI	unidentified cereal	grain fragments	C
	Triticum dicoccum Schubl	emmer	spikelet fork	C
	Triticum cf. *dicoccum*	possible emmer	spikelet fork	C
	Triticum cf. *dicoccum*	possible emmer	glume base	C
	Triticum spelta	spelt	glume base	C
	Triticum cf. *spelta*	possible spelt	glume base	C
	Triticum spelta	spelt	spikelet fork	C
	Triticum cf. *spelta*	possible spelt	spikelet fork	C
	Triticum spelta/dicoccum	spelt/emmer	spikelet fork	C
	Triticum spelta/dicoccum	spelt/emmer	glume base	C
	Triticum cf. *Aestivum*	bread wheat	rachis fragment	C
	Triticum sp.	wheat	rachis fragment	C
	Avena i L.	oat	floret base	C
	Avena cf. *sativa* L.	oat	possible floret base	C
	Avena sp.	oat	awn fragments	C, Da
	Avena sp.	oat	floret fragment	C, Da
	Avena fatua L.	wild oat	floret base	C, Da
	Avena sp.	oat	floret base	C, Da
	cf. *Avena* sp.	oat	peduncle fragmenht	
	Cereal NFI	unidentified cereal	detached embryo	C
	Cereal NFI	unidentified cereal	detached coleoptile base fragments (otherfragments)	C
	Cereal NFI	unidentified cereal	straw internode	
Fabaceae	cf. *Lotus* sp.	birdsfoot trefoil	seed	
	Vicia/Lathyrus sp. (4mm)	vetch/pea	seed	Da, C
	Vicia/Lathyrus sp. (2mm)	vetch/pea	seed	Da, C
	Vicia cf. *Sativa*	possible common vetch	seed	?C
	Trifolium/melilotus sp. L	clover/medick	seed	
Rosaceae	cf. *Crataegus monogyna* Jacq.	hawthorn	stone	
	Potentilla sp.	cinquefoils	achene	
	cf. *Potentilla* sp.	cinquefoil type	achene	
Malvaceae	*Malva* sp.	mallow	nutlet	DG
Brassicaceae	*Raphanus raphanistrum* spp. *raphanistrum* L.	wild radish	mericarp fragment	C, Da
Polygonaceae	*Fallopia convolvulus* (L.) Love.	black bindweed	achene	Da
	Polygonum aviculare L.	knotweed	achene	all sorts of open ground
	Rumex sp.	dock type	achene	DaGMSW
	cf. *Rumex* sp.	dock type	achene	
	cf. *Rumex* sp.	dock type	tepal/perianth fragment	
Amaranthaceae	*Chenopodium* sp.	goosefoots	seed	n
	Chenopodium/Atriplex sp.		seed	n

15036	15040	15042	15043	15044	15045
15408	15503	15594	15604	15605	15606
10	20	10	30	30	30
100	50	100	50	25	100
			11	86(7)	
56				97	16(1)
3			81(2)		
				2	
	23	1(1)	4(1)		
			106		
	2				
	30(1)		2(1)	2	
	71		66(2)	131	
	91		54(1)	8	
6		2	10		11(2)
3					20
200+	300+	33	1000+	363	710
	6				
	1				
	2				
41	342	63	881	518	411
9	6		230		
	25		24	19	10
20	29		161		
7	31		6	247	27
1000+	2446	208	3000+	1049	3842
	2			1	
				6	6
					2
	1				
*	***		*****	*	***
	***		***	**	***
1	3		4		3
	2		7		8
			1		2
8	49	1	28	2	43
14(6)	43(132)	4(4)	131(184)	25(12)	90(162)
			2		
			1	1	
			2		
			1		
			1		
	2				
			1		
	2				
2					
			1		
			1		
		1	4	1	1
	27	1	36		4
	1				
	1				
			18		
2				7	1

stitchwort (*Stellaria alsine*) could have been growing around the edge of the water hole. Other plants in the assemblage such as lesser skullcap (*Scutellaria* cf. *minor*) and greater chickweed (*Stellaria neglecta*) prefer damp and shady conditions; this may indicate that shading from trees or shrubs occurred although there is no direct evidence for this in the plant assemblage (as is also indicated by the insect assemblage; Allison, below). Blinks (*Montia fontana* cf. *chronrosperma*) will also grow in many kinds of damp conditions. A number of seeds from plants associated with arable crops, in particular scentless mayweed (*Tripleurospermum inodorum*) and wild radish (*Raphanus raphanistrum*) were noted in the sample and there are also seeds from plants of disturbed or waste ground, in particular swine cress (*Lepidium coronopus*), nettle (*Urtica dioica*) and the oraches (*Atriplex* spp.), the last two preferring nitrogen rich soils, which are often associated with human activity. A single achene of a possible tansy (cf. *Tanacetum vulgare*) may represent a drier grassy environment such as a field margin or open grassland near by. Though no cereal remains or other agricultural crops were noted in the sample the presence of a grain weevil (a pest of stored grain) noted by Allison (below) together with the presence of arable weeds, suggests that cereals may have been growing and stored near by. It should be noted that cereal remains and other grasses are rarely preserved by waterlogging and so their absence in the waterhole fill is to be expected.

Discussion

The charred plant remains from Site 4 (Trench 54) were on the whole few in number and poorly preserved. This coupled with the evidence of modern contamination in a number of the samples has meant that any interpretation of these remains needs to be treated with caution. Other Iron Age sites in Bedfordshire have produced differing assemblages, with Salford (Robinson 2005) having low quantities of glume wheat chaff and grain while Marsh Leys (Robinson 2011) produced a relatively rich cereal assemblage.

The assemblages from Site 2 are suggestive of an increase in the processing of glume wheats from the early to the middle Roman periods, which may reflect a move from a more subsistence based economy to the larger scale production of spelt wheat. This large-scale processing of spelt is also reflected in the middle Roman samples from Site 7. Sites at Haynes Park (Robinson 2004), Yelnow villa (Pelling 2009) and possibly Ruxox (Scaife 2004) have similarly produced assemblages that are dominated by large quantities of glume wheat chaff, in particular spelt, suggesting that there too spelt may also have been grown and processed on an industrial scale. Roman sites near Stansted Airport, Essex, have also produced similar types of assemblage (Carruthers 2007; 2008). The dominance of spelt and/or glume wheat seems to be prevalent from the

Table 5.15: Site 7, summary of charred plant remains

	Taxa	*Common name*	*Component*	*Habitat*
Caryophyllaceae	*Agrostemma githago* L.	corn cockle	seed capsule fragment	Da
Montiaceae	*Montia fontana* spp. *chronrosperma* (Fenzl) Walters	blinks	seed	many kinds of damp places
Primulaceae	*Anagalis* sp.	pimpernel	seed	
Laminaceae	*Mentha* sp.	mint type	seed	
Orobanchaceae	*Euphrasia/Odontites* sp.	euphrasia/bartsias	seed	
Asteraceae			achene	
	Cirsium sp.	thistle	achene	
	Tripleurospermum inodorum (L.) Scultz-Bip	scentless mayweed	achene	Da
	Calendula arvensis/officinalis	field/pot marigold	achene	
Apiaceae	*Apium* cf. *Repens*	creeping marshwort	mericarp	open wet places
	cf. *Daucus carota*	carrot	mericarp	
Juncaceae	*Juncus* sp.	rush	(capsule)/seeds	
Cyperaceae	*Carex* sp. (Trigonus)	sedge	nut	M, B, W, G esp. damp/wet soils
poaceae	Poaceae	grass	caryopsis	
	Lolium sp.	rye grass	caryopsis	
	cf. *Lolium* sp.	rye grass type	caryopsis	
	cf. *Danthoniadecumbens* (L.) DC.	heath-grass	caryopsis	sandy or peaty soils
		?grass	rachis fragment	

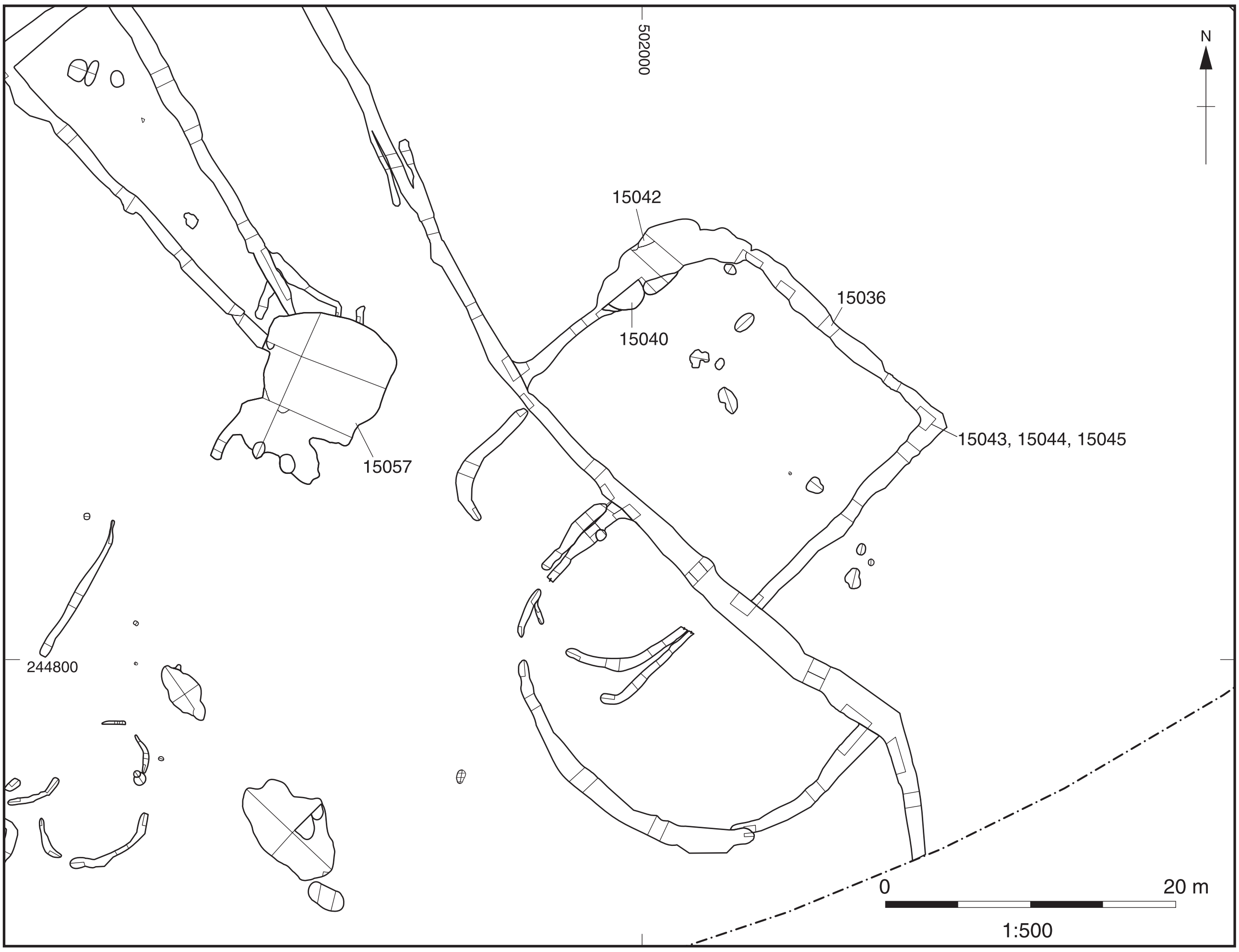


Fig. 5.4 Site 7, location of environmental samples

1	8		16		
			1		
			1		
			1		
1			1		
	1		2		
	1				
1	1	2	11	5	14
			1		
1	2		2		
	1				
			1		
			2		
1	108		194		66
	70		101		
21		4		80	60
	1				
	1				

middle Iron Age onwards in the area from the north west round to the east of modern Bedford. Sites such as Stagsden (Scaife 2000a), Fairfield Park (Pelling 2007) and Renhold Water End East and Roxton Road West on the Great Barford Bypass (Druce 2007), for example, all produced assemblages rich in glume wheat. A group of farmsteads within the area of the Biddenham Loop, to the north-east of the A421 Improvements, that were occupied continuously from the Iron Age into the Roman period have produced samples from kilns and ovens that are rich in spelt chaff. Particularly well-preserved samples containing glume bases were recovered from special deposit G125 at Farmstead 14, which was sealed by clay and would appear to have thus been protected from physical weathering (Pelling 2008, 285).

The appearance of stinking mayweed (*Anthemis cotula*) in the middle Roman samples may also be an indication of the move to cultivate the heavier clay soils that characterise the area. One of the indications of the stage of crop processing is the presence or absence of particular weed species. Corncockle (*Agrostemma githago*) is a large-seeded weed that is often retained beyond the initial processing stages, as the seed is of similar size to the grain. It is, however, toxic and should therefore have been removed by hand before the grain was used. If the spelt was initially being stored in the glume it is possible that the corncockle seeds would not have been removed until immediately prior to the drying process. The presence of the rigid tips of the seed capsule of this plant in some of the samples suggests the presence of the weed, which may have been removed. The capsule fragments might not have been so obvious, and therefore remained with the stored glumes. The larger seeds from plants such as black bindweed (*Fallopia convolvulus*) and cleavers (*Galium aperine*) may also have been retained during processing. There appears to be an increase in the production of spelt chaff from the early to the middle Roman period at Site 2, but the number of samples examined is relatively small and as such may not represent the whole picture.

The practice of storing spelt grains still encased within the glume – to protect them from damage from pests and the unpredictability of the British climate – is suggested by Robinson (2004) at Haynes Park and discussed by Campbell and Straker (2005), who suggest that spelt in the glume shows much less insect damage and is less susceptible to uncontrolled germination than the stored naked spelt grain. Evidence of this appears to be the case for a large deposit of stored hulled spelt that was burnt and preserved *in situ* in a reused bath house from Gloucestershire (OA 2011). This deposit showed no sign of insect damage or premature germination (OA 2011).

The other crops present in the assemblage do not need this secondary processing and their chaff may be considered to be a valuable resource for fodder, for example. The chaff from these crops was therefore less likely to have been burnt and incorporated into the archaeological record. Chaff from barley and oats and some legumes is more palatable to livestock and has a higher nutritional value than the wheat equivalent and so may be utilised as animal fodder. This may go some way to explaining why other crop waste appears only sparingly in the assemblages. If there was an increase in the production of spelt wheat for trade then there would have been a concomitant increase in the production of byproducts such as chaff, which could be utilised elsewhere. It is likely that the burnt chaff had been used to fuel ovens or hearths. The ovens at Site 2 clearly provide a focus for such activity, but none of the features from Site 7 represented by this analysis contained evidence for the actual charring of the chaff and so in this case it is likely that the focus of activity is located elsewhere, though probably not far away. The presence of completely collapsed grain and detached embryos and coleoptiles in many of the samples from Site 7 suggests the burning of spoilt grain.

The activity of malting on the site is difficult to identify as the characteristic detached embryos and coleoptiles are also indicative of accidental sprouting. Due to the fragmentary nature of the coleoptiles it is not possible to gauge whether the germination process was controlled, but the presence of secondary roots in some cases suggests that the germination was well advanced, and the occurrence of completely collapsed grains suggests that the germination process had gone beyond a stage that would be useful for malting. The spoilt grain might have been added back into the chaff for burning. If the high incidence of spelt chaff was a product of

Table 5.16: Site 7, summary of waterlogged plant remains from waterhole 15735

Sample No.			
Context No.			
Family	*Taxa*	*Common name*	
Ranunculaceae	*Ranunculus acris* L./*repens* L.	buttercup meadow/creeping	achene
	Ranunculus sp. *subgen batrachium*	water crowfoots	achene
	Ranunculus sp.	buttercup type	achene
Urticaceae	*Urtica dioica* L.	common nettle	achene
Brassicaceae			seed
	Lepidium coronopus (L.) Al-Sahbaz	swine-cress	fruit
	Brassica rapa spp. *Campestris* (L.) A R Clapham	wild turnip	seed
	Raphanus raphanistrum spp. *raphanistrum* L.	wild radish	mericarp fragment
	cf. *Raphanus raphanistrum* L.	wild radish	seed
Polygonaceae	*Polygonum aviculare* L.	knotweed	achene
	Rumex sp.	dock	achene
	Rumex sp.	dock	tepal
	Rumex acetosella spp *pyrenaicus* (Pourr.) Ackeroyd	sheep's sorrel	achene with tepal
	Rumex cf. *crispus* spp. *crispus* L.	curled dock	tepal
	Rumex cf. *Palustris* Sm.	marsh dock	tepal
Caryophyllaceae	*Stellaria neglecta* Weihe	greater chickweed	seed
	Stellaria alsine Grimm	bog stichwort	seed
Amaranthaceae	*Atriplex patula* Boucher ex DC./*prostrata* L.	spear-leaved/common orache	seed
	Atriplex sp.	orache	seed
Montiaceae	*Montia fontana* cf. spp *.chronrosperma* (Fenzl) Walters	blinks	seed
Laminaceae	*Scutellaria* cf. *minor* Huds	lesser skullcap	seed
Asteraceae			
	cf. *Soncus* sp.	sowthistle type	achene
	cf. *Tanacetum vulgare* L.	tansy	achene
	Tripleurospermum inodoum	scentless mayweed	achene
Apiaceae	cf. *Sium latifolium* L./*Apium inundatum* (L.) Rchb. f.	greater water-parsnip/ lesser marshwort	fruit
	cf. *Apium graveolens* L.	wild celery	fruit
Lemnaceae	*Lemna* sp.	duckweed	seed
Cyperaceae			nut
	Eleocharis cf. *Palustris* (L.) Roem.& Schult.	common spike-rush	nut
	Eleocharis sp.	spike-rush	nut
	Carex sp.		nutlet (trigonous)
	indet.		
	Moss	moss	leaf/stem
		dicotyledon	leaf frag.
		monocotlydon	leaf/stem frags
		charcoal	
		wood	

fuel utilisation rather than material falling in to a drying fire then the accompanying grain may either have simply fallen into the fire during whatever process was being carried out or be spoilt grain burnt deliberately.

The presence of emmer in several of the samples suggests that it may still have been grown as a crop in the middle Roman period; however, as the quantity of grain is small, it may be a relic of an earlier crop regime. Low quantities of barley and possibly oats, rye and legumes may represent other crops being grown or utilised in the area.

WOOD CHARCOAL by *Denise Druce*

Introduction

The assessment of 80 bulk samples taken during the excavations demonstrated the presence of abundant charcoal in samples from a number of Iron Age features from Site 3, Site 4 (Trench 54) and Site 5 (OA 2010). Ten samples from these sites were selected for full analysis in order to determine the taxonomic composition of the material and provide information about possible wood fuel selection and the

	15057 15830
Habitat	
G (damp), B	5
P, R	4
	3
D, W	6
	1
W, (paths, around trodden gateways)	9
by streams and rivers	2
cultivated, rough ground, waste places	2
	1
all sorts of open ground	10
	7
	1
heathy open ground, acid soils	2
maritime and inland	1
edges of ponds, ditches, marshy fields	1
shady, usually damp places	2
streamside, ditches. Often on acis soils	4
waste, cultivated ground/disturbed, waste ground	24
	2
many kinds of damp places	1
wet heaths open woodland on acid soils	1
	5
	1
grassy places, waysides, rough ground.	1
waste, cultivated ground	7
ditches and fens/ usually shallow water and on bare mud near by	10
brackish	1
aquatic	100+
	3
in or by water, marshes, ditches , riversides	1
Wet, damp places	1
	1
	11
	*
	*
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	**
	*

nature of the woody environment surrounding the three sites. They comprised four samples from late Iron Age enclosure ditches at Site 3, three from a middle Iron Age pit and ditched enclosure at Site 4 (Trench 54) and two from an early Iron Age cremation and a single fill from a late Iron Age pit from Site 5. The nature of the features, certainly from Site 3 and perhaps also Site 4 (Trench 54), plus a lack of charred cereal remains from these sites (Hunter, above), suggests that they may have formed part of an agricultural rather than a domestic setting. In addition to the cremation, Site 5 contained two possible roundhouses and associated features indicative of a probable late Iron Age settlement, but even this site produced very few charred cereal remains.

Methodology

The samples were processed using a modified Siraf flotation machine where flots were retained in a 0.25mm mesh sieve, and the residue on a 0.5mm mesh. Both the flots and residue were air-dried. Analysis of the samples followed standard procedure where *c* 100-150 fragments (or the entire sample if fewer than this were present) >2mm in size were extracted and identified. The charcoal was initially sorted into groups based on the features visible in transverse section using a Leica MZ6 binocular microscope at up to x40 magnification. Representative fragments of each group were then fractured to reveal both radial and tangential sections, which were examined under a Meiji incident-light microscope at up to x400 magnification. Identifications were made with reference to Schweingruber (1990), Hather (2000), and modern reference material.

Results

The charcoal results for the ten samples are shown by fragment count in Table 5.17. Seven taxa/wood types were positively identified, including two to species level.

The taxonomic level of identification varied according to the observed genera/family and/or the state of preservation. In many cases the key diagnostic features that are needed to distinguish species were not observed and so the fragments could only be identified to subfamily level (eg *Alnus glutinosa*/*Corylus avellana,* alder/hazel, both in Betulaceae). In other cases the level of identification was limited due to the similarities of species within a family or genus (eg Maloideae, referred to as hawthorn-type in the text, which could be hawthorn, apple, pear or one of the whitebeams, and cannot be separated anatomically). The fragments identified as *Prunus* sp. (referred to as blackthorn-type in text) could include sloe/blackthorn and/or wild cherry, although the site is probably out of the geographical range of bird cherry (Gale 1996; Hather 2000). Some of the fragments exhibited the wide rays typical of sloe/blackthorn, but in most instances the intermediate size of many of the observed rays means that either sloe/blackthorn or wild cherry could be represented. In general, the preservation was good. The fragments categorised as indeterminate come from distorted knotty wood.

Site 3

The upper fills from enclosure ditches 3358, 3361 and 3362 contained similar assemblages, dominated by *Prunus* sp. (blackthorn-type) wood charcoal

Table 5.17: Summary of the charcoal analysis. Numbers given are actual counts

Period		LIA	LIA	LIA	LIA	MIA
Feature		Enclosure ditch (upper fill)	Enclosure ditch (upper fill)	Enclosure ditch (upper fill)	Enclosure ditch (lower fill)	Pit (intermediate fill)
Feature number		3358	3362	3361	3361	17007
Sample number		3010	3013	3015	3016	17000
Context number		3107	3227	3272	3273	17006
Site		3	3	3	3	4 (Trench 54)
Acer campestre	field maple			5r		
Alnus glutinosa/Corylus avellana	alder/hazel					2r
Fraxinus excelsior	ash	7hr	11r	cf 2r		
Maloideae	hawthorn type	8r	1r			4r
Prunus sp	sloe/blackthorn or wild cherry	57r	101r	32r	4r	28r
Maloideae/*Prunus* sp	hawthorn/blackthorn type	4r	8r	5r		
Quercus sp	oak	35hr	12hr	13r	61r	45hr
Salix sp/*Populus* sp	willow/poplar					
Indeterminate		4	9	5		26
Total		115	142	62	65	105

h = heartwood present, r = roundwood present

(Table 5.17). *Quercus* sp. (oak) was also well represented, especially in fill 3107 of ditch 3358, as was *Fraxinus excelsior* (ash). Other taxa include Maloideae (hawthorn type) in fill 3107 of ditch 3358 and fill 3227 of ditch 3362, and *Acer campestre* (field maple) in fill 3272 of ditch 3361. The lower fill (3273) from enclosure ditch 3361 differed from the upper fill (3272) in that it was dominated by oak, and it is therefore likely to represent a separate episode of dumping.

Site 4 (Trench 54)

The two samples from pit 17007, which was situated outside the confines of the ditched enclosure, were very similar and were both dominated by *Quercus* sp. (oak), with lesser amounts of *Prunus* sp.(blackthorn type). Like the assemblages from Site 3, Maloideae (hawthorn type) was also recorded. Fragments of *Alnus glutinosa/Corylus avellana* (alder/hazel), and *Salix* sp. /*Populus* sp. (willow/poplar) were also present in fill 17005. The dump (17112) from enclosure ditch cut 17176 differed in that it contained solely *Prunus* sp. charcoal.

Site 5

The samples (6000 and 6001) from cremation deposit 6068/6071 were dominated by *Quercus* sp. (oak) charcoal. Sample 6001 also contained one fragment of *Alnus glutinosa/Corylus avellana* (alder/hazel). The assemblage from fill 6010 of pit 6009, was similar to the charcoal assemblages from Site 3 and Site 4 (Trench 54), in that it contained abundant oak and blackthorn-type (*Prunus* sp.) wood charcoal.

Discussion

The charcoal assemblages were very similar in content and were dominated by blackthorn-type and/or oak. No distinction could be made between sloe/blackthorn or wild cherry, and either variety could be represented. The dominance of small roundwood or branchwood in many of the fills suggests that some of the material is likely to represent the burnt debris from hearths or bonfires, probably of locally collected material either from woodland floors or after land clearance or hedge trimming. Those features dominated by oak, including obvious oak heartwood, such as the lower enclosure ditch fill 3275 at Site 3, the fills of pit 17007 at Site 4 (Trench 54), and the fill of pit 6010 at Site 5 may, in part, represent the waste generated by a specific activity that required a more robust or longer burning wood, such as construction or smithing.

The dominance of oak in the cremation deposit at Site 5 is consistent with other Iron Age and Roman cremations in Britain, which are often dominated by a single taxon, usually oak or ash (Campbell and Robinson 2008; Challinor 2007a; 2007b; Challinor 2010; Druce 2010 and forthcoming a). It has been suggested that specific wood taxa, or even a specific tree, may have been selected for the cremation pyre, with the specific selection possibly linked to gender, age, or status (Challinor 2007a; Campbell and Robinson 2008).

The woody environment

The abundance of blackthorn-type wood charcoal, especially from Site 3 and Site 4 (Trench 54), and the presence of hawthorn-type wood and field maple,

MIA	MIA	EIA		LIA
Pit (upper fill)	Dump (in enclosure ditch?)	Cremation burial		Pit (single fill)
17007	17176	6067/6070		6009
17001	17009	6000	6001	6003
17005	17112	6071	6068	6010
4 (Trench 54)	4 (Trench 54)	5	5	5
1r			1r	
5r				12r
33r	81r			11r
				7r
80hr		103h	104hr	83hr
2r				3r
20	5	1	4	6r
141	86	104	109	12

suggest that some of the area surrounding the sites during the middle and late Iron Age consisted of open woodland or scrub. The equally abundant oak in many of the samples, however, suggests that mature oak woodland was also present and perhaps in plentiful supply. The sole presence in the late Iron Age deposits from Site 3 of ash, a light-demanding tree and coloniser of secondary woodland, may reflect a spatial/temporal pattern in woodland composition. However, this can only be a tentative suggestion given the limited dataset. The occasional fragments of willow/poplar suggest collection of wood from damp areas, and hence that some of the areas surrounding the sites may have been prone to waterlogging.

Many other Iron Age sites in the region have produced similar assemblages dominated by sloe/blackthorn, wild cherry, hawthorn-type, maple, ash and oak, including Oxley Park and Brooklands, both in the Milton Keynes area (Druce 2009 and forthcoming b), the A421 at Great Barford (Challinor 2007c), Shillington (Cartwright 2004), and Fairfield Park (Thompson and Francis 2007). It is possible that the taxa formed mixed deciduous woodland; oak, ash, maple and blackthorn type certainly form the usual woodland of most of the Midlands today (Rackham 2003). Sloe/blackthorn, wild cherry, maple and ash are, however, common in hedgerows and other non-woodland areas, the latter two being the commonest hedgerow trees in the east Midlands and the Chilterns (Rackham 2003).

In general, a fairly limited variety of woody taxa appear to have been growing locally and to have been cleared/utilised, and greater emphasis/reliance is shown towards blackthorn-type wood and/or oak. The dominance of oak over blackthorn-type in some of the features is interesting and may

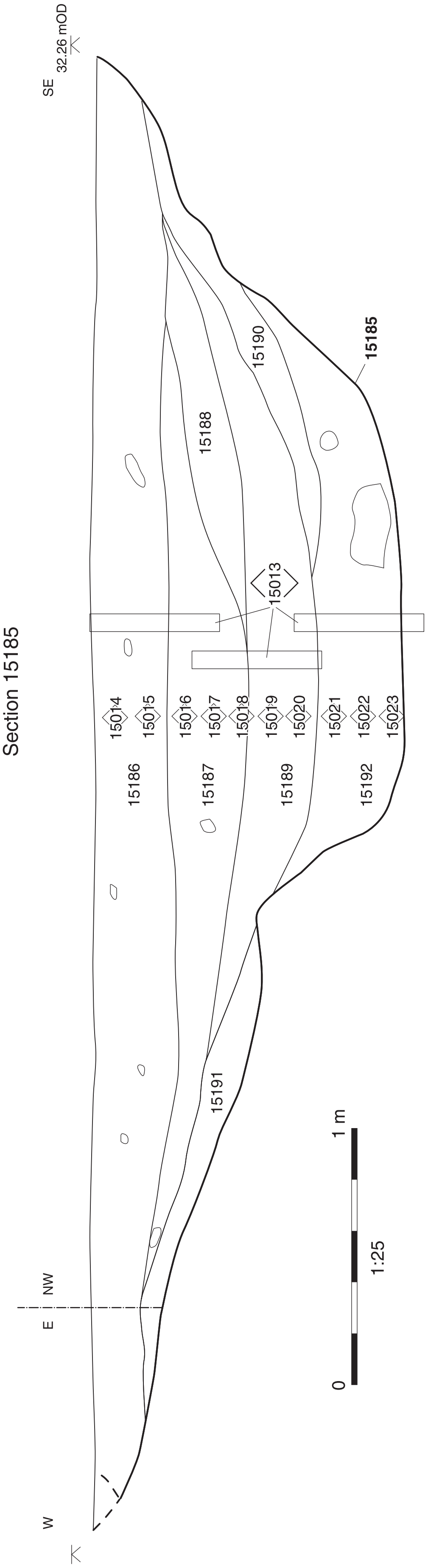

Fig. 5.5 Site 7, section through late Roman waterhole 15185 showing the locations of monoliths taken for palynological analysis

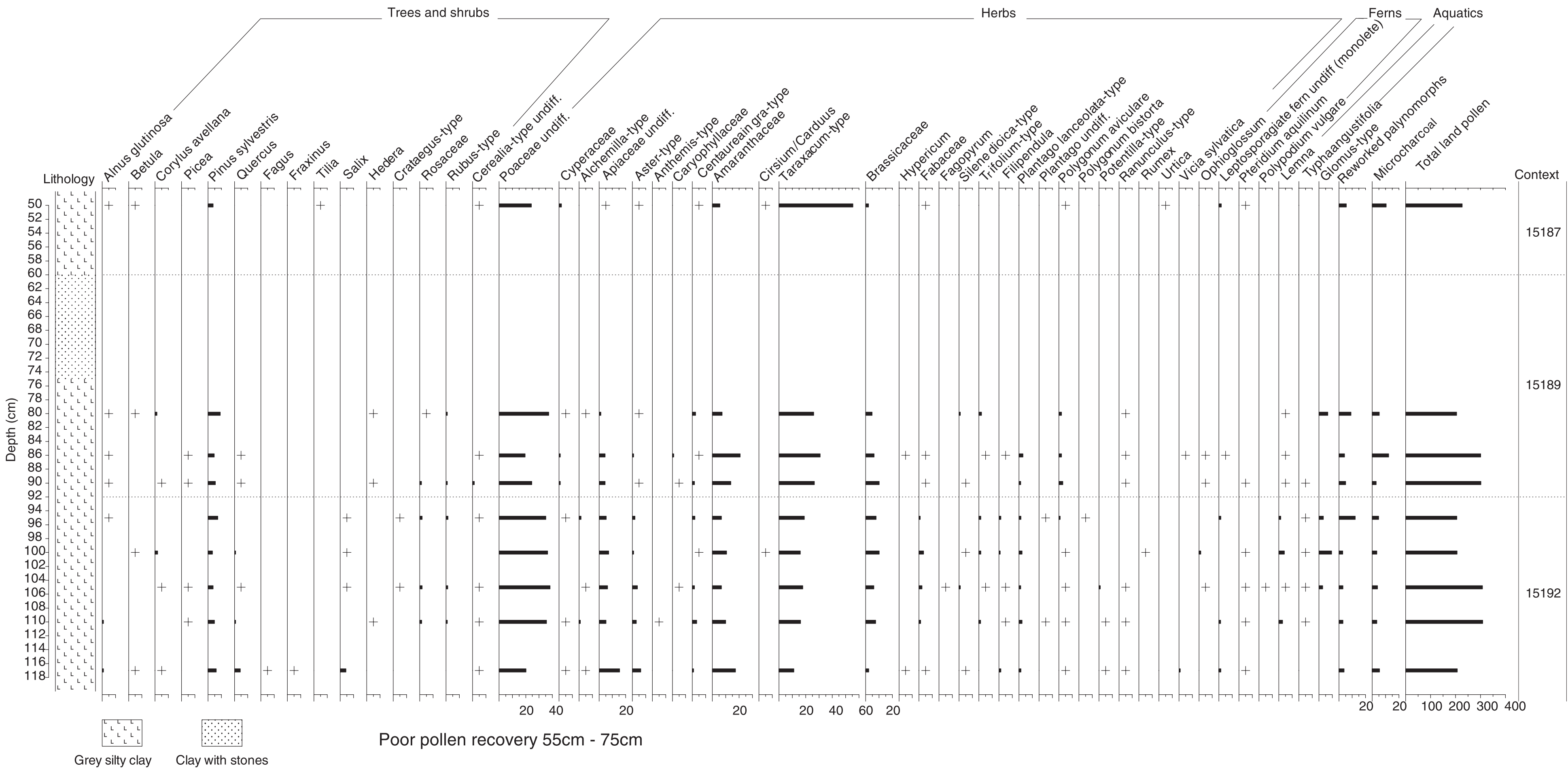

Fig. 5.6 Site 7, pollen diagram for late Roman waterhole 15185

Table 5.18: Summary of monoliths and subsamples taken for palynological analysis from waterhole 15185

Sample number	*Context number*	*Context boundaries (m)*	*Depth of pollen subsamples (m)*	*Lithology*
15013	15187	0.4-0.6	0.5, 0.6	Grey silt clay; stones
15013	15189	0.6-0.9	0.7, 0.8, 0.86, 0.9	Grey silt clay; stones
15013	15192	0.9-1.3	0.95, 1.0, 1.05, 1.10, 1.17	Grey silt clay with common chalk fragments and stones

indicate deliberate selection for construction or for activities that required oak's strength or sustained burning properties. Its presence in the assemblage and at other sites nearby suggests that oak was not in short supply in the region.

The abundant blackthorn-type wood and other typical hedgerow taxa in the samples, along and with the evidence from many other sites in the Bedfordshire area, indicate a well-managed agricultural landscape. The presence of hedged boundaries would also be consistent with the contexts of the features from which the assemblages came, namely nondomestic, agricultural enclosures, into which the debris from hearths or bonfires may have been dumped. It is possible that, like Cambridgeshire (Murphy 2001), the region was undergoing a process of agricultural intensification during the later prehistoric period, which involved the construction of ditched and hedged boundaries for the management of livestock.

POLLEN FROM LATE ROMAN WATERHOLE 15185 *by Mairead Rutherford*

Introduction

The preservation of pollen in monoliths taken through the sediments of a pit (20167) from Site 2 and three waterholes (15185, 15735 and 15958) from Site 7 was assessed. Only waterhole 15185 yielded sufficient pollen to be taken to full analysis (OA 2010), the pollen from the other features occurring at low concentrations and being poorly preserved.

Methodology

Three overlapping monoliths were taken from waterhole 15185 (Fig. 5.5). The pollen from eleven subsamples from the lower fills within the waterhole were analysed. These included three subsamples which had been shown to be productive for pollen during the assessment phase and eight new subsamples taken from three contexts within the lower part of the waterhole (Table 5.18). Closely spaced sampling of the two lower monoliths was targeted on depths where the results of the assessment had indicated that pollen recovery was good.

Volumetric samples (1cc) were taken from eight samples (Table 5.18) and two tablets containing a known number of *Lycopodium* spores were added so that pollen concentrations could be calculated (Stockmarr 1971). The samples were prepared using a standard chemical procedure (method B of Berglund and Ralska-Jasiewiczowa 1986), using hydrogen chloride, sodium hydroxide, sieving, hydrogen fluoride, and Erdtman's acetolysis, to remove carbonates, humic acids, particles >170 microns, silicates, and cellulose respectively. The samples were then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000cs silicone oil. Slides were examined at a magnification of x400 by counting pollen along equally-spaced traverses until a total of between 200-300 total land pollen grains (trees, shrubs and herbs) was counted. Pollen identification was made following the keys of Moore *et al.* (1991), Faegri and Iversen (1989), and a small modern reference collection. Andersen (1979) was followed for the identification of cereal grains. Plant nomenclature follows Stace (2010). Charcoal particles greater than 5μm were recorded (Peglar 1993). Fungal spore identification and interpretation followed Blackford *et al*. (in press).

Pollen data has been presented as a percentage diagram using the computer programs TILIA and TILIA-GRAPH (Grimm 1990; Fig. 5.6). The percentage values are based on a pollen sum of all land pollen but excludes fern spores, aquatic taxa and indeterminate grains. All palynomorphs excluded from the pollen sum are expressed as a percentage of the pollen sum plus the group sum in which they belong. Micro-charcoal values are expressed as a percentage of the pollen sum plus the charcoal counts. Fungal spore values are expressed as a percentage of the pollen sum plus the fungal counts.

Results

Pollen from the lowest context (15192) suggests a largely cleared landscape. Grasses (Poaceae) dominate the assemblage, with records of commonly occurring herbs associated with meadows, hedgerows and waste ground: for example, *Taraxacum*-types (dandelions), *Aster*-types (including daisies and thistles), *Centaurea nigra* (Common Knapweed), *Polygonum aviculare*-type (Knotgrass) and *Alchemilla*-type (Lady's Mantles).

Low counts of cereal-type pollen were recorded in all subsamples analysed from this context. This may indicate small-scale cereal cultivation nearby, which is additionally supported by records of pollen of weeds of cultivation. However, this interpretation is tentative because of the similarity of pollen grains from cultivated cereals and some wild varieties of grass such as wild barley (eg *Hordeum murinum*) and sweetgrass (*Glyceria* sp.; Andersen 1979). There is also evidence for some arable landuse, supported by records of consistent quantities of pollen of Brassicaceae (cabbage family) and weeds associated with arable landuse and/or disturbed ground, such as *Plantago lanceolata* (Ribwort Plantain). Plant taxa represented by Apicaeae (carrot family) are known to occur in a wide variety of habitats.

Tree and shrub pollen account for 18% of the total land pollen counted in the deepest sample from context 15192. This value decreases upward through the deposit to around 10%. Counts for *Pinus* (pine) are higher than for other tree/shrub pollen counts, reflecting preferential dispersal by wind of pine pollen grains over long distances. Relatively common counts for *Quercus* (oak) in the deepest sample may indicate regional stands of oak woodland or woodland pasture. The oak values appear to diminish upwards through fill 15192 to the lower part of context 15189. There are no records of oak pollen above this.

Small quantities of aquatic pollen were also recorded throughout fill 15192, indicating that sufficient water was still present in the waterhole for growth of these plants. Spores of the fungus *Glomus* may provide evidence for soils being incorporated into the fill. Of interest is the record of a single specimen of *Fagopyrum* (Buckwheats). This plant type grows on waste ground, possibly escaped from cultivation. Buckwheat is cultivated for edible seeds and leaves.

The lower half of context 15189 contained similar pollen assemblages to context 15192, with minor fluctuations in the quantities of grasses, Amaranthaceae (goosefoots, formerly Chenopodiaceae) and dandelions. A relative peak in charcoal values was recorded in this context.

The uppermost fill (15187) was distinguished by an abundance of dandelion pollen which, in association with other herb taxa indicates an open, possibly disturbed area, for example, meadow land surrounded by hedges. This may, however, reflect the over-representation of the more robust dandelion pollen in a context in which pollen preservation was generally poor.

Discussion

The pollen profile from the fills of waterhole 15185 provides good evidence for grassland/pasture, open waste ground environments and possible arable environments. The aquatic flora observed mainly in the lowest fill indicates that the water was not kept clear of weeds, perhaps signalling that by the time the feature began to silt up the waterhole was no longer in use as a source of fresh water. The general absence of fungal spores of the types associated with animals may indicate that grazing animals were not present in the vicinity of the waterhole during the period of silting.

The micro-charcoal record provides evidence for fires in the surrounding area. Most microscopic charcoal pieces observed were small enough to have accumulated through windblown deposition. The diminishing values for tree pollen, in particular oak, coupled with steady and then rising values for micro-charcoal, may be interpreted as possible indicators of tree clearance, resulting in an almost treeless landscape. It is possible that there was some management of oak, aimed at conserving it, while the wood of other tree types was used more extensively, as suggested by Wiltshire (2005, 152) for a late Iron Age pollen sequence at Salford. Wiltshire (1994) has recorded similar events – the selective conservation and subsequent demise of oak – during the late Iron Age/early Roman period at Scole, in Suffolk.

Reworked palynomorphs of Jurassic (Oxford Clay) age including pollen, spores and dinoflagellate cysts occur throughout the fills of the waterhole. This shows that material from the substrate into which the feature was cut became incorporated into its fills.

Although pollen was only present at low concentrations in waterholes 15735 and 15958, the results of the assessment similarly indicated a very open landscape with ruderal communities as found around habitation sites and footpaths, together with some grassland, probably used for pasture, and, from waterhole 15958, possibly some growth of cereals. Pollen from the basal context (15765) of waterhole 15735 provided tentative evidence that there were more trees and shrubs, or hedges, growing in the vicinity when the waterhole was first dug, although the landscape was still predominantly open. There also appeared to be no pollen from aquatic taxa in either of these waterholes or evidence of faecal contents, suggesting that these waterholes were kept clean and clear of water plants. The lack of evidence for grazing animals from all these waterholes is, however, in contrast to the evidence provided by analysis of the Coleoptera from waterhole 15735 (Allison, below), which included a number of beetles primarily associated with herbivore dung, suggesting that grazing animals were present in the area.

INSECT REMAINS FROM LATE ROMAN WATERHOLE 15735 *by Enid Allison*

Introduction

The samples examined for insect remains were from waterlogged deposits from the lower part of waterhole 15735 at Site 7. Sample 15057 was taken from the earliest fill of the feature, context 15830, and sample 15056 from context 15757, a silting deposit that may date from after the feature ceased to be used as a water source (Fig. 5.7).

Methodology

Sediment samples with volumes of 5litres were wet-sieved with flotation by Oxford Archaeology staff. Residues and flots were collected on 0.25mm mesh and both fractions were submitted for insect analysis. Paraffin flotation was carried out to extract insect remains following the methods of Kenward *et al*. (1980) with remains recovered on 0.3mm mesh.

For analysis, beetles (Coleoptera) and bugs (Hemiptera) were removed from the paraffin flots onto moist filter paper for identification using a low-power microscope (x10 – x45). Identification was by comparison with modern insect material and reference to standard published works. Numbers of individuals and taxa of beetles and bugs were recorded, and taxa were divided into broad ecological groups for interpretation following Kenward *et al.* (1986) and Kenward (1997). The state of preservation of remains was recorded using the system of Kenward and Large (1998), where fragmentation (F) and erosion (E) are scored on a scale from 0.5 (superb) to 5.5 (extremely decayed or fragmented). The abundance of other invertebrates in the flots was recorded on a three point scale as present, common or abundant. Nomenclature follows Duff (2008) for Coleoptera, and Nau (2006) for Hemiptera.

Results

Context 15830, sample 15057

A large assemblage of over 300 beetles and bugs of 136 taxa was recovered in the paraffin flot (Tables 5.19 and 5.20). Preservation of insect sclerites was rather varied, with some well preserved and others showing greater or lesser degrees of erosion.

Water beetles accounted for a quarter of the beetle and bug assemblage, water flea ephippia (Cladocera: resting eggs) were very abundant and ostracod carapaces common, all indicating that the feature had contained water and could have functioned as a waterhole. Ephippia are produced at certain times of the year, particularly in the autumn or at times of environmental stress such as seasonal reductions in water level (Scourfield and Harding 1966, 3) so their presence does not necessarily indicate permanently standing water, although it was probably present for much of the time. The condition of the insect material may reflect fluctuating water levels and periods when parts of the fill were incompletely waterlogged. Several species of water fleas were represented by the ephippia and many were *Daphnia magna* group. *D. magna* occurs in small relatively warm water bodies or restricted bays of larger waters (Scourfield and Harding 1966, 10).

Helophorus species were by far the most common water beetles, making up 72% of the aquatic component, and because of their fragmented state this may well be an underestimate of their abundance. They

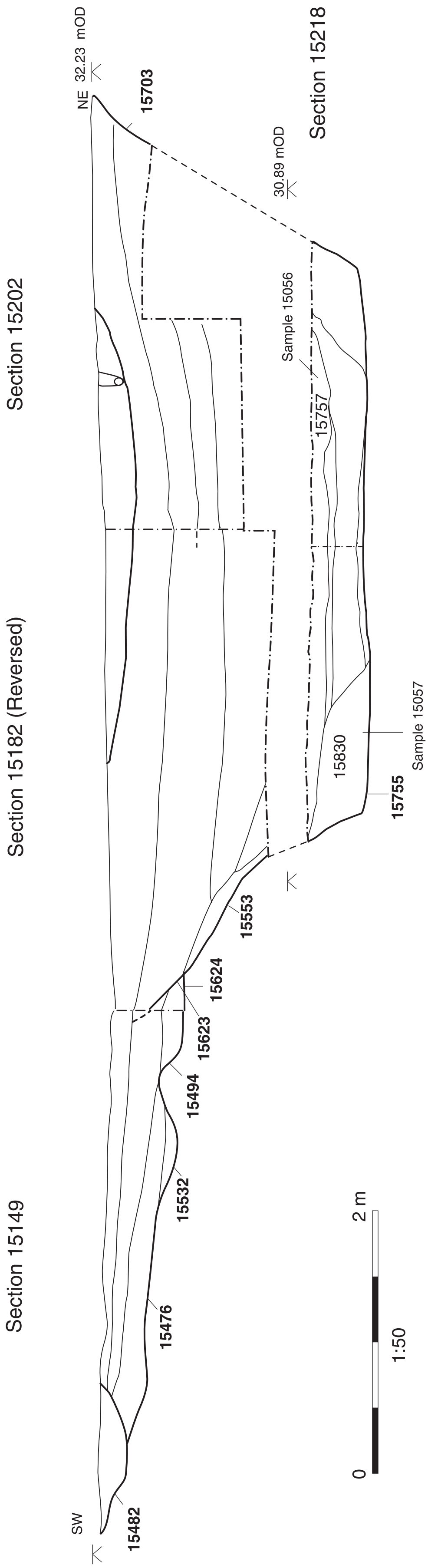

Fig. 5.7 Site 7, section through late Roman waterhole 15735 showing location of the deposits from which insect samples were taken

Table 5.19: Details of samples from late Roman waterhole 15735 examined for insect remains. Scores for fragmentation and erosion follow Kenward and Large (1998), using a scale ranging from 0.5 (superb) to 5.5 (extremely decayed or fragmented)

Ctx	*Sample*	*Sample volume (l)*	*Volume paraffin flot (ml)*	*MNI beetles and bugs*	*Fragmentation of insect sclerites*	*Erosion of insect sclerites*
15830	15057	5	20	308	3-4.5	3-4.5
15757	15056	5	25	610	2-4 (mode 3)	2- 5 (modes 2 (weak), 4.5)

are attracted to various water bodies even if small and temporary, often in considerable numbers. *Ochthebius minimus*, usually found in mud in shallow water, was quite common, with five individuals, and *O. dilatatus* is found in muddy water (Friday 1988, 149). Other water beetles included two *Hydrobius fuscipes*, *Agabus bipustulatus* and *Berosus*. The presence of several *Tanysphyrus lemnae* indicates that duckweed (*Lemna*) grew on the water surface.

Taxa characteristic of damp ground and waterside environments accounted for 30% of the terrestrial taxa and indicated that conditions around the feature were wet and muddy. The most numerous beetles in this component were *Platysthethus nitens* and *P. cornutus* group which are likely to have exploited organic-rich waterside mud. *Bembidion lunulatum*, which are found on damp bare ground near water (Luff 2007, 102), was common, with seven individuals. There was an indication of vegetation on damp ground from the weevil *Notaris acridulus*, which is found on reed sweet-grass (*Glyceria*) and perhaps other semi-aquatic grasses. One specimen was unexpanded, indicating an unemerged or newly emerged beetle.

The nettle ground bug *Heterogaster urticae* and *Brachypterus* indicated that there were stands of nettles (*Urtica*) growing close to the feature, and another ground bug, *Scolopostethus affinis*, is also often associated with nettles (Southwood and Leston 1959, 110). Other weedy vegetation was suggested by *Chaetocnema concinna*, which is found chiefly on *Polygonum*, and *Psylliodes* and *Ceutorhynchus*, which are found on cruciferous plants. The ground surrounding the feature was probably rather open. *Bembidion illigeri*, for example, is found in open, sunny sites near water (Luff 2007, 93) and a range of other insects were generally indicative of open and rather dry conditions nearby. Two bombardier beetles (*Brachinus crepitans*), which currently have a very local distribution on chalky and occasionally clayey soils in southern England and Wales in grassland, quarries and on waste ground (Luff 2007, 33; 1998, 82), are worthy of note. The beetles take their name from their ability to fire a defensive liquid from their anus which explodes audibly on contact with air (Harde 1984, 108). *Harpalus affinis* is also indicative of dry open situations such as waste or cultivated ground (Luff 2007, 153). *Drymus sylvaticus* is a very common lygaeid bug found in grass, moss or litter on relatively dry soils, feeding on mosses and fungal hyphae and possibly other foods (Southwood and Leston 1959, 107). There was a slight hint of the presence of shrubs and/or trees nearby, but perhaps not particularly close to the waterhole; the small longhorn beetle *Tetrops praeusta* is associated with recently dead or slightly decayed twigs and slender branches of various deciduous trees.

A number of bugs and beetles were indicative of dry grassland. *Paradromius linearis* is found in dry grassland and arable fields (Luff 2007, 191) and *Berytinus hirticornis*, a stilt bug, is a dry grassland species found among oat-grass and couch-grass. Until recently it was thought to be confined to Devon (Southwood and Leston 1959, 123) but there have been recent records from south-east England, suggesting that it is associated with grass vetchling (*Lathyrus nissolia*) (Essex Field Club 2011). Evidence for specific plants was provided by *Ceratapion carduorum*, which feeds on thistles (*Cirsium* and *Carduus*), and *Mecinis ?labilis*, which feeds on plantain (*Plantago*).

Shed skins from nymphs of the jumping plant louse *Craspedolepta nervosa* were very common (estimated 50+ individuals). These tiny insects are found chiefly on yarrow (*Achillea millefolium*) a common plant of dry grassland, but also occur on sneezewort (*A. ptarmica*) and mugwort (*Artemesia vulgaris*; Hodkinson and White 1979). The shed nymphal skins are commonly recorded from some occupation sites in association with a fauna from within buildings, where it has been suggested that they may have arrived in cut vegetation, in many cases probably as hay (eg Allison 1991a, 1991b; Kenward *et al*. 2011). Remains of the much more mobile adults might be expected if host plants were growing as close to the feature as the numbers of nymphs suggests. More likely alternatives are that the nymphs originated in dung from animals that grazed on local grassland, in stable manure brought to the site, or possibly even from a residue of a hay stack close to the feature.

There was evidence from a group of other insects that material derived from buildings had been introduced into the feature. Beetles associated with decomposing organic material made up 31% of the terrestrial assemblage and they included a group found in relatively dry mouldering material that are typical members of a fauna that would have formed within ancient buildings (Hall and Kenward 1990; Kenward and Hall 1995). This group accounted for 18% of the decomposers and comprised *Latridius minutus* group, *Enicmus*, *Atomaria*, *Cryptophagus*, *Typhaea stercorea* and a spider beetle (*Ptininae*). *Xylodromus concinnus*, a decomposer with more general feeding habits, is also often associated with a building fauna, and woodworm beetle (*Anobium punctatum*), probably from structural timber, and a grain weevil (*Sitophilus granarius*) may also have formed part of the same group. Grain weevils are found in stored grain, not in cereals growing in the fields, and many of those seen in assemblages from archaeological deposits are thought to have originated in stable litter or manure, having been introduced in low-grade cereals used as fodder (Kenward 2009, 281). Beetles found in moist, open-textured, nutrient-rich decomposing material and often typical of stable manure (Kenward and Hall 1997) were not particularly well-represented in the sample, although *Acritus nigricornis* was present and fly puparia were common. The range of decomposer species represented is sufficiently distinctive to suggest that waste from buildings had been dumped into the feature or very close to it, perhaps relating to episodes of manuring.

About a third of the decomposers in the assemblage (10% of the terrestrial insects) were taxa associated with foul matter, many of them primarily associated with herbivore dung. Six species of *Aphodius* were represented together with Geotrupes. Other taxa attracted to foul organic matter including dung were *Cryptopleurum minutum*, *Cercyon haemorrhoidalis*, *Cercyon pygmaeus* and *Platystethus arenarius*. Some of these species may have come from stable manure, but the relative abundance of scarabaeids probably indicates the presence of fresh dung locally.

Context 15757, sample 15056

A very large assemblage of over 600 beetles and bugs was recovered, with individual sclerites rather variably preserved and a greater proportion of eroded material than in context 15830. Water beetles and an occasional water boatman (Corixidae) accounted for 29% of the assemblage and, together with freshwater snails, abundant water flea ephippia and ostracods, indicated aquatic conditions. Several nautilus ram's horn snails (*Gyraulus crista* (Linnaeus)), which do not appear to occur in habitats susceptible to drying (Davies 2008, 168), were noted among the freshwater molluscs, suggesting that water may have been present in the feature more or less permanently, perhaps with seasonal reductions in water level at least partly accounting for the varied preservation of insect remains. *Helophorus* species were by far the most numerous water beetles (67% of the aquatic assemblage). Both *Ochthebius dilatatus* and *O. minimus* were quite common (each with six individuals), the former in particular indicating that the water was quite muddy, with the remaining taxa each represented by up to four individuals. *Hygrotus confluens* is typical of open silt ponds with sparse vegetation (Nilsson and Holmen 1995, 38) and both it and *Helochares lividus* are efficient colonisers of sparsely vegetated ponds, dying out as aquatic plant and animal communities develop (Denton 2007, 108, 129). There were indications of some aquatic vegetation from *Bagous*, and *Tanysphyrus lemnae*, which is found on duckweed (*Lemna*), was common with thirteen individuals.

Taxa found on damp ground and waterside environments were also common, accounting for 30% of the terrestrial assemblage. As with context 15830, *Platysthethus nitens* and *P. cornutus* group were abundant and are likely to have exploited organic-rich waterside mud. The ground beetles *Bembidion* lunulatum, represented by eight individuals, and *Bembidion articulatum* also indicated bare damp ground. The latter is found in cracks in bare sand or mud near water (Luff 2007, 99). The weevil *Notaris acridulus*, found on reed sweet-grass (*Glyceria*), a leafhopper *Conomelus anceps*, found on rushes (*Juncus*), and *Prasocuris phellandrii*, a leaf beetle usually associated with waterside *Ranunculaceae* especially marsh marigold (*Caltha palustris*), all provided indications of vegetation on damp ground.

Plant-feeding insects from a variety of other habitats were also recorded. Nettles were indicated by the nettle ground bug *Heterogaster urticae*, a nymph of the nettle psyllid *Trioza urticae*, and *Brachypterus*. There was good evidence for cruciferous plants, *Polygonum*, and generally for herbaceous vegetation from *Phyllotreta* and *Ceutorhynchus* species, *Chaetocnema concinna*, *Longitarsus* and *Apion* species. Relatively dry, open habitats were indicated by a range of ground beetles including *Ophonus ?ardosiacus*, *Bradycellus harpalinus*, *Paradromius linearis* and *Syntomus truncatellus*. *Bembidion obtusum*, found on open ground and cultivated land (Luff 2007, 99), was represented by five individuals. Grassland vegetation was indicated by *Ceratapion carduorum*, which feeds on thistles (*Cirsium* and *Carduus*), and by *Mecinus pascuorum*, which is found on plantain (*Plantago*). Although conditions appear generally to have been rather open there were definite indications of the presence of trees or shrubs nearby, perhaps in hedgerows, from two species of bark beetle (*Scolytinae*). One was identified as *Scolytus rugulosus*, which usually attacks trees and shrubs of the Rosaceae family. Two unidentified Anobiidae species are also likely to have been associated with trees or shrubs.

Woodworm beetle (*Anobium punctatum*) can be found in natural situations but could have come from structural timber nearby. It may alternatively have entered the feature with material from within buildings, for which there were distinct suggestions. Dry decomposer beetles typically associated with ancient buildings made up 20% of the decomposer taxa (6% of terrestrial insects) and included *Latridius minutus* group, *Enicmus*, *Ephistemus globulus*, spider beetles (*Ptininae*), *Cryptophagus* and

Atomaria species. Shed skins of *Craspedolepta nervosa* nymphs were common and are more likely to have arrived in the deposit with material from within buildings than from plants growing in the vicinity, probably with either hay or dung. Two poorly preserved biting lice (Mallophaga) which infest various birds and mammals but not humans were recovered, but unfortunately because of their poor condition could not be identified to species. Again this group as a whole could represent dumping of waste from buildings into or close to the waterhole, and may include an element from manuring.

Beetles associated with foul organic material made up 34% of the decomposers in the sample (10% of the whole assemblage). Scarabeid dung beetles accounted for almost three quarters of the foul group with *Aphodius contaminatus*, *A. granarius* and *A. prodromus* or *sphacelatus* the most common species (each represented by 8-10 individuals). *Cryptopleurum minutum* and several *Cercyon* species that are associated with foul matter (*C. haemorrhoidalis*, *C. pygmaeus*, *C. ?quisquilius*) made up the rest of this group. Again this group may include some beetles from stable manure, but the abundance of scarabaeids is suggestive of some fresh dung locally.

Discussion

Insect remains from waterlogged features associated with ancient field systems have a considerable potential to provide information about land use, occupation and ecological conditions in rural areas (Kenward 2009, 251-3). The potential in some cases is limited by a lack of taxa representing terrestrial habitats, since a water-filled feature would, by its nature, often be dominated by aquatics, which would provide little clear indication of the character of the surrounding landscape. This was not the case for the samples from waterhole 15735 however, in which a considerable terrestrial component has been identified.

The two samples examined were from the lower fills of the feature. The insect assemblages recovered were very similar in most respects, although a greater concentration of remains was present in the upper fill. Both assemblages indicated that the feature contained standing water more or less permanently, although there were probably seasonal fluctuations in water level. Aquatic beetles recovered suggest that it was an open silt pond, with numerous waterside taxa indicating areas of bare damp ground with organic-rich mud immediately around it. The presence of several plant-feeding insect species indicated that vegetation on damp ground included reed sweet-grass (*Glyceria*), rushes (*Juncus*), and Ranunculaceae species. There was also insect evidence for nettles (*Urtica*) and vegetation typically found on disturbed or cultivated ground such as crucifers and *Polygonum*. Generally, much of the rest of the insect assemblage indicated an open, sunny site and in particular dry grassland habitats with vegetation that included thistles (*Cirsium* and *Carduus*) and plantain (*Plantago*). Shed skins (exuviae) of nymphs of a jumping plant louse *Craspedolepta nervosa*, usually associated with yarrow (*Achillea millefolium*), were common in both samples, but these are considered likely to have had a different origin to some of the other plant-feeders. There was some evidence for the presence of trees or shrubs, including members of the Rosaceae in the later sample. Since the ground appears to have been largely open this may have been in the form of a hedgerow.

A distinctive suite of insects typical of litter from buildings was represented in both samples, indicating dumping of such material either directly into or very close to the waterhole. Some species within the group suggest that the material deposited may have been, or included, stable manure, raising the possibility of manuring of the surrounding enclosures. Manuring using a variety of materials and domestic waste as well as dung appears to have been practised from the late Neolithic onwards in western Europe (Bakels 1997). The introduction of litter from buildings complicates the interpretation of plant-associated insects in the assemblage in particular, since some of them could originally have come from hay or other cut vegetation used in buildings rather than from vegetation growing around the waterhole. On some sites *Craspedolepta nervosa* exuviae are a frequent inclusion in deposits within buildings, often probably derived from hay. Here, an origin in fresh dung from grazing animals is also a possibility. Despite the possibility that some of the plant-associated insects could have arrived with litter from buildings, various ground beetles recovered are very likely to represent conditions in the vicinity of the waterhole and they provide considerable evidence for rather dry, open ground, with grassland or cultivated habitats nearby.

Taxa associated with foul organic matter, the majority of which were scarabaeid dung beetles, accounted for 10% of the terrestrial taxa in both samples. A recent modern study has suggested that the proportion of dung beetle remains in insect assemblages from small bodies of water have the potential to reflect the intensity of grazing (Smith *et al*. 2010). Dung beetles may make up more than 10% of the terrestrial fauna when large or dense populations of grazing animals are present nearby, and less than 5% when there are natural populations of grazing animals or 'naturalistic' grazing by domestic animals. The situation here is complicated by the introduction of material from within buildings but the size of the foul decomposer assemblages, and particularly the abundance of scarabaeid dung beetles, probably indicate a significant population of grazing animals in the area. It should be borne in mind, however, that the size of herbivore populations could be overestimated if they were congregating around a waterhole.

Finally, it is interesting to note that although the

Table 5.20: Insects and other invertebrates recorded from late Roman waterhole 15735

	Abundance		Species group
Context	15830	15757	
Sample	15057	15056	
Sample volume	5 litres	5 litres	
Oligochaeta sp. (earthworm egg capsules)	-	+	
Cladocera spp. (ephippia)	++++	++++	
Ostracoda spp.	++	++	
Dermaptera sp.	+	+	u
Mallophaga sp.	-	+	
Heterogaster urticae (Fabricius)	1	2	oa-p
Stygnocoris sp.	-	3	oa-p
Drymus sylvaticus (Fabricius)	1	-	oa-p
Scolopostethus affinis (Schilling)	1	-	oa-p
Lygaeidae spp.	1	-	oa-p
Berytinus hirticornis (Brulle)	1	-	oa-p
Corixidae spp.	-	1	oa-w
Heteroptera sp.	-	1	
Conmelus anceps Germar	-	1	oa-p
Delphacidae sp(p).	1	1	oa-p
Auchenorhyncha spp.	3	5	oa-p
Craspedolepta nervosa (Forster) (nymphs)	+++	++	oa-p
Trioza urticae (Linnaeus) (nymphs)	-	+	oa-p
Aphidoidea sp.	+	++	
Coccoidea sp.	+	-	
Trichoptera sp. (adult wing fragments)	-	+	
Trichoptera sp. (larval cases)	+	+	
Diptera spp. (puparia)	++	+	
Formicidae spp.	+	+	
Hymenoptera Parasitica spp.	+	+	
Haliplus spp.	-	1	
Agabus bipustulatus (Linnaeus)	1	1	oa-w
Agabus or *Ilybius* spp.	-	3	oa-w
Colymbetes fuscus (Linnaeus)	-	1	oa-w
Hygrotus confluens (Fabricius)	-	2	oa-w
Hydroporinae spp.	2	4	oa-w
Brachinus crepitans (Linnaeus)	2	1	oa
Carabus spp.	-	2	oa
Nebria brevicollis (Fabricius)	-	1	oa
Notiophilus sp.	-	1	oa
Trechus obtusus or *quadristriatus*	-	2	oa
Bembidion (Metallina) lampros or *properans*	-	3	oa
Bembidion (Nepha) illigeri Netolitzky	1	-	oa
Bembidion (Trepanes) articulatum (Panzer)	-	1	oa-d
Bembidion (Phyla) *obtusum* Audinet-Serville	-	5	oa
Bembidion (Philochthus) guttula or *mannerheimi*	2	2	oa
Bembidion (Philochthus) lunulatum (Geoffroy in Fourcroy)	7	8	oa-d
Bembidion spp.	1	1	oa
Poecilus sp.	1	-	oa
Pterostichus ?melanarius (Illiger)	1	-	ob
Pterostichus sp.	-	1	oa
Amara sp.	-	1	oa
Harpalus affinis (Schrank)	1	-	oa
?*Harpalus* sp.	-	1	oa
Ophonus ardosiacus Lutshnik	-	1	oa
Ophonus sp.	-	1	oa
Bradycellus harpalinus (Audinet-Serville)	-	1	oa
Acupalpus sp.	-	3	oa-d
Paradromius linearis (Olivier)	1	2	oa
Syntomus truncatellus	-	3	oa
Carabidae spp.	2	4	ob
Helophorus spp.	56	117	oa-w
Berosus affinis or *luridus*	-	1	oa-w
Berosus sp.	1	-	oa-w
Helochares lividus (Forster)	-	1	oa-w
Hydrobius fuscipes (Linnaeus)	2	2	oa-w
Laccobius sp.	-	1	oa-w
Hydrophilinae spp.	1	2	oa-w
Cercyon haemorrhoidalis (Fabricius)	3	3	rf-sf
Cercyon nigriceps (Marsham)	-	2	rf-st
Cercyon pygmaeus (Illiger)	1	1	rf-sf
Cercyon ?quisquilius (Linnaeus)	-	1	rf-sf
Cercyon ustulatus (Preyssler)	-	1	oa-d
Cercyon sp(p).	1	1	u
Megasternum concinnum (Marsham)	4	4	rt
Cryptopleurum minutum (Fabricius)	1	-	rf-st
Acritus nigricornis (Hoffman)	1	1	rt-st
Atholus bimaculatus (Linnaeus)	-	1	rt
Histerinae sp.	-	1	rt
Hydraena sp.	1	1	oa-w
Limnebius spp.	1	2	oa-w
Ochthebius dilatatus Stephens	1	6	oa-w
Ochthebius minimus (Fabricius)	2	6	oa-w
Ochthebius c.f. *Minimus*	5	7	oa-w
Ochthebius sp(p).	1	1	oa-w
Acrotrichis spp.	-	1	rt
Leiodidae sp.	-	1	u
Lesteva longoelytrata (Goeze)	5	3	oa-d
Lesteva ?longoelytrata	1	-	oa-d
Xylodromus concinnus (Marsham)	1	1	rt-st
Omaliinae or *Proteininae* sp.	1	1	u
Micropeplus fulvus Erichson	-	1	rt
Pselaphinae spp.	1	1	u
Tachinus sp.	1	1	u
Tachyporus spp.	1	6	u
Tachyporinae sp.	1	-	u
Cordalia obscura (Gravenhorst)	2	4	rt-sf
Falagria sp.	2	1	rt-sf
Aleochariinae spp.	16	31	u
Anotylus nitidulus (Gravenhorst)	4	11	rt-d
Anotylus rugosus (Fabricius)	4	4	rt
Anotylus sculpturatus group	1	2	rt
Oxytelus sculptus	-	1	rt-st
Platystethus cornutus group	14	39	oa-d
Platystethus nitens (Sahlberg)	31	57	oa-d
Platystethus ?nodifrons Mannerheim	1	1	oa-d
Platystethus arenarius (Fourcroy)	6	4	rf
Carpelimus ?bilineatus	-	7	rt
Carpelimus spp.	8	7	u
Stenus spp.	-	5	u
Euaesthetus sp.	1	1	oa

Table 5.20: Insects and other invertebrates recorded from late Roman waterhole 15735

	Abundance		*Species group*
Lathrobium spp.	1	1	u
Lithocharis sp.	-	1	rt
Rugilus sp.	1	1	rt
Paederinae spp.	-	2	u
?Philonthus sp.	-	1	u
Gyrohypnus angustatus Stephens	-	1	rt-st
Gyrohypnus fracticornis (Müller)	1	1	rt-st
Gyrohypnus sp.	-	1	rt
Xantholinus linearis or *longiventris*	1	-	rt-sf
Staphylininae spp.	6	16	u
Geotrupes sp.	1	-	oa-rf
Aphodius rufipes (Linnaeus)	-	1	oa-rf
Aphodius granarius (Linnaeus)	5	8	ob-rf
Aphodius prodromus or *sphacelatus*	-	8	ob-rf
Aphodius contaminatus (Herbst)	1	10	ob-rf
Aphodius spp.	5	3	ob-rf
Oxyomus sylvestris (Scopoli)	2	3	rt
Onthophagus sp.	-	1	oa-rf
Cyphon sp.	1	-	oa-d
Dryops sp.	1	2	oa-d
Heterocerus sp.	-	1	oa-d
Elateridae spp.	2	2	ob
Cantharidae sp(p).	1	1	ob
Ptinus sp.	-	1	rd-sf
Ptininae sp.	1	1	rd
Anobium punctatum (de Geer)	-	2	l-sf
Anobium ?punctatum (de Geer)	1	-	l-sf
Anobiidae sp.	1	1	l
?Anobiidae sp.	-	2	l
Brachypterus sp.	1	1	oa-p
Nitidulidae sp.	-	1	u
Monotoma sp.	1	-	rt-sf
Cryptophagus spp.	1	2	rd-sf
Atomaria spp.	1	9	rd
Ephistemus globulus (Paykull)	-	1	rd-sf
Coccinellidae sp.	-	1	oa-p
Corylophidae sp.	-	2	rt
Latridius minutus group	7	7	rd-st
Enicmus sp.	2	3	rd-sf
Corticaria sp.	5	2	rd-st
Corticariinae spp.	5	4	rt
Typhaea stercorea (Linnaeus)	1	-	rd-ss
Anthicidae sp.	-	1	u
Tetrops praeustus (Linnaeus)	1	-	l
Bruchinae sp.	-	1	u
Prasocuris phellandrii (Linnaeus)	-	1	oa-p-d
Chrysomelinae sp.	-	1	oa-p
Phyllotreta nemorum group	-	1	oa-p
Phyllotreta nigripes (Fabricius)	-	1	oa-p
Phyllotreta sp.	-	2	oa-p
Longitarsus spp.	2	9	oa-p
Chaetocnema concinna (Marsham)	3	3	oa-p
Psylliodes sp.	1	-	oa-p
Alticini spp.	5	15	oa-p
Ceratapion carduorum	2	2	oa-p
Apionidae spp.	4	9	oa-p
Sitophilus granarius (Linnaeus)	1	-	g-ss
Notaris acridulus (Linnaeus)	3	2	oa-p-d
Mecinus labilis (Herbst)	1	-	oa-p
Mecinus pascuorum (Gyllenhal)	-	3	oa-p
Bagous sp.	-	1	oa-p-w
Ceutorhynchus spp.	1	2	oa-p
Ceutorhynchinae spp.	-	2	oa-p
Phyllobius or *Polydrusus* sp.	1	1	oa-p
Sitona spp.	-	1	oa-p
Scolytus rugulosus (Müller)	-	1	l
Scolytinae sp.	-	1	l
Tanysphyrus lemnae (Paykull)	4	13	oa-p-w
Curculionidae spp.	5	2	oa-p
Coleoptera spp.	3	5	u
Insecta spp. indet. larval fragments	++	+++	
Acarina spp.	+++	+++	
Aranae sp.	+	+	
Mollusca spp. (freshwater snails)	+	++	
Total individuals beetles and bugs	308	610	

A minimum number of individuals was estimated for adult beetles (Coleoptera) and bugs (Hemiptera) and the abundance of other invertebrates was recorded on a four-point scale as + present, ++ common, +++ abundant, ++++ very abundant

Key to species groups:

d	Damp ground or waterside taxa
l	Wood-associated taxa
g	Grain-associated taxa
m	Moorland taxa
oa	Certain outdoor taxa (unable to live and breed within buildings or in accumulations of organic material)
ob	Probable outdoor taxa
rt	Generalized decomposers
rd	Dry decomposers
rf	Foul decomposers
p	Strongly plant-associated taxa
S	Total synanthropes, i.e. taxa favoured by human activity (ss+st+sf)
ss	Strong synanthropes (very rare in natural habitats)
st	Typical synanthropes (typically present in man-made habitats but capable of living in natural situations)
sf	Facultative synanthropes (found in man-made and natural habitats)
u	Uncoded taxa
w	Aquatics

proportions of the assemblage made up by the main ecological groups were very similar in both samples, insects that can be regarded as synanthropic to some degree were less well represented in the later sample, where they accounted for 8% of the terrestrial assemblage, whereas in the earlier sample the proportion was 14%. Although these proportions are based only on two samples it is tempting to suggest that there may have been a decline in human influence during the later part of the period represented.

PHYTOLITHS *by Adrian G Parker*

Introduction

Phytoliths (plant silica) preserve well under oxidising conditions and may be used as a tool for environmental reconstruction, especially in the absence of pollen. They may be used to differentiate different tribes of Poaceae (Grasses), generic woody taxa, and can, in certain instances, be used to differentiate cereals and crop processing sites (Hodson 2002).

Phytolith analysis was carried out on deposits from enclosure ditches at Site 4 (Trench 54) (Figs 5.8 and 5.9). Initially a total of five fills of the north-eastern terminal (17189) of enclosure ditch 17343 were assessed for phytoliths, the results of which demonstrated the success of this technique for identifying plant materials that had been deposited in this feature. Since charred plant remains were generally sparse in the middle Iron Age features excavated in Site 4 (Trench 54), three additional samples from middle Iron Age ditch fills were submitted for phytolith work. These comprised samples 17014 (context 17180) and 17027 (context 17179), a secondary and upper fill within ditch cut 17178, and sample 17022 (context 17217), which represents a tertiary fill within ditch cut 17206. Both ditch cuts were part of ditch 17716, part of the innermost circuit of enclosure ditches.

Methods

Phytolith preparation and extraction was undertaken using 3g of sediment from each context. Each sample was sieved using a 1mm mesh to remove the coarse sands and gravel prior to chemical analysis. All samples were first treated with 5% HCl to remove carbonates followed by the removal of organics using 6% hydrogen peroxide (H_2O_2). This was followed by deflocculation using 50ml 2% Calgon in 250ml distilled water and shaking continuously for 30 minutes. The samples were then

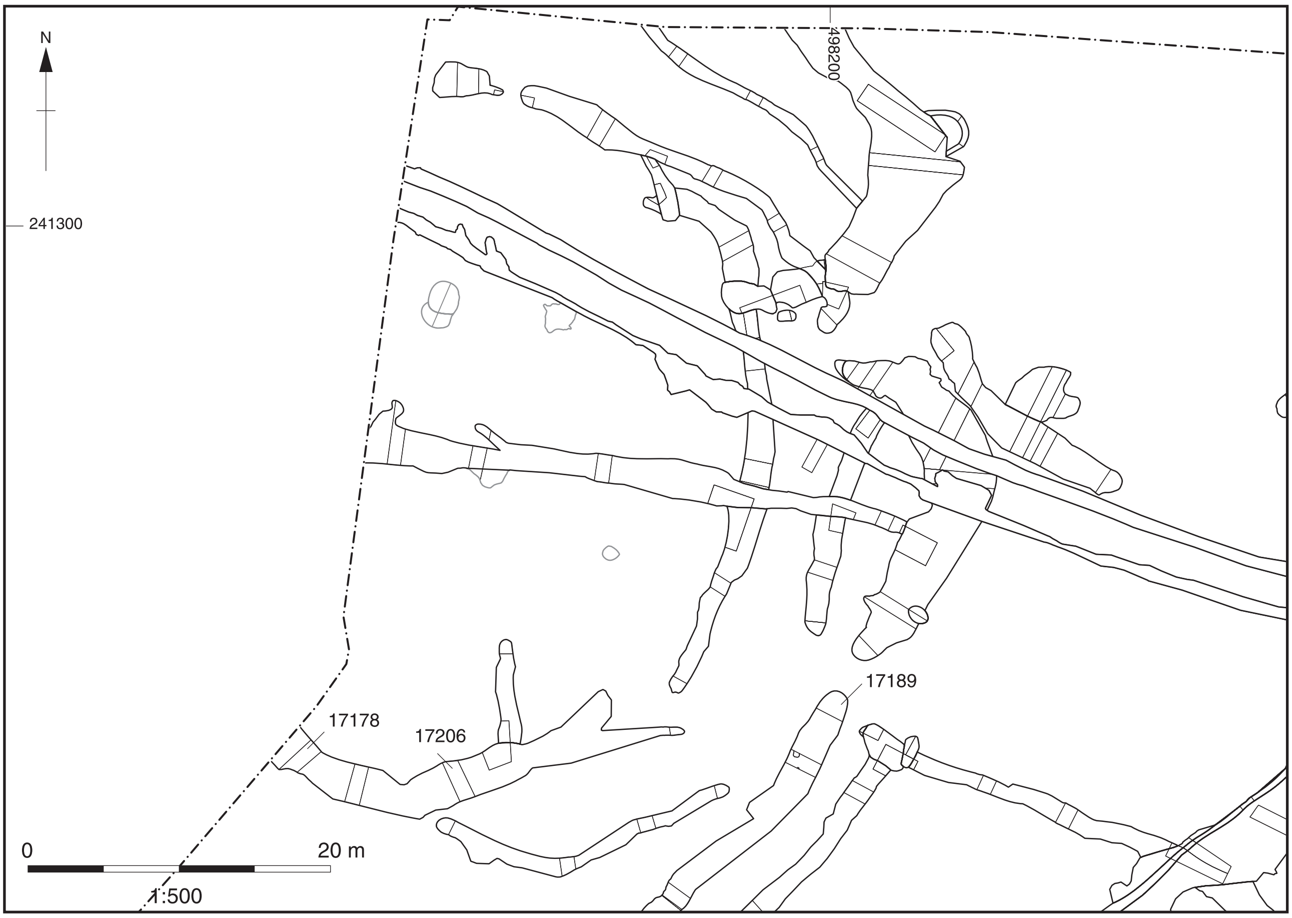

Fig. 5.8 Site 4 (Trench 54), location of phytolith samples

passed through a 212μm sieve, and the residues rinsed with distilled water and centrifuged. A floatation method using sodium polytungstate (2.35 s.g.) was implemented to extract the phytoliths from the denser, minerogenic fraction. Material less than 5μm in size was removed using the vacuum filtration method of Theunissen (1994). The residues were rinsed several times in distilled, de-ionised water and mounted onto microscope slides using Canada Balsam. Phytoliths from the same samples were identified at x400 and x1000 magnifications using a Nikon Eclipse E400 light microscope. The slides were first scanned to evaluate the level and nature of phytolith preservation. The phytolith morphotypes

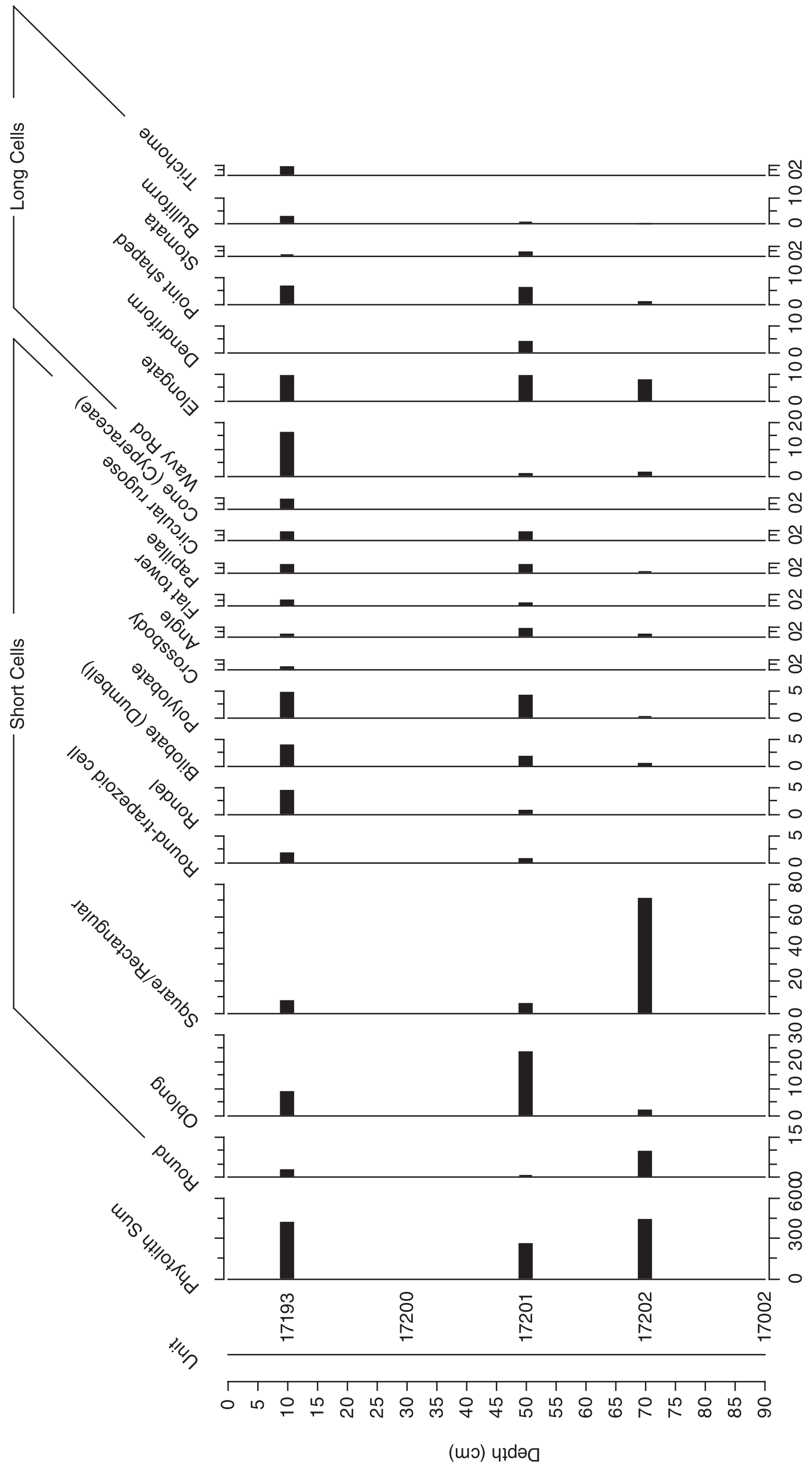

Fig. 5.9 Site 4 (Trench 54), percentage phytolith diagram from terminal 17189, ditch 17343

were compared with modern reference materials collected by the author and by comparison with phytolith keys including Cummings (1992), Mulholland and Rapp (1992), Piperno (1988) and Rosen (1993). Phytolith preservation varied in the samples from poor to excellent and counts ranged from 0-451 per sample.

The organic content of the five units was determined using loss-on-ignition (LOI; *sensu* Heiri *et al*. 2001). Samples were oven dried at 105°C, weighed and then placed into a muffle furnace at 550°C. The percentage loss was calculated and is used as a proxy measure for organic carbon.

Results

Ditch cut 17189, ditch 17343

A sample from the basal fill (17002) yielded no phytoliths and had a very low organic content (2%). This sample was from the natural bed into which the ditch feature had been cut.

The bottom fill of the ditch (17202) contained moderately well-preserved phytoliths. It should be noted that pitting and etching of phytoliths was noted in this sample, caused by partial dissolution of the plant silica bodies. Phytoliths are more susceptible to corrosion (pitting, etching and fragmentation) at pH levels greater than 8.5 (Piperno 2006). It was not sufficient, however, to affect identification or distort the results. The sample contained evidence for charring, with many microscopic charcoal fragments. A number of phytoliths also showed signs of charring. The burning of material with low oxygen availability will cause charring and the formation of inert carbon. This can be difficult to remove from samples during preparation but can provide useful insight into the depositional history of samples. The sample was dominated by Pooid short-cell grass morphotypes. Notably the square/rectangular forms comprised approximately 70% of the total phytolith sum. There morphotypes are predominantly found in the culms of grasses, especially cereals. It should be noted that they can be found in other plant organs including leaf sheaths, leaf blades and inflorescences, but these tend to be in low quantities compared to other morphotypes (eg long cell elongate forms). Another line of evidence that supports the notion of cereal culm material is the lack of long cell forms and in particular of dendriforms. These are formed in the inflorescence of grasses/cereals. The phytolith evidence from sample 17202 suggests the incorporation of cereal culm material, perhaps as waste. The presence of microscopic charcoal suggests the material had either been burnt *in situ* or had been burnt and then placed/tipped into the ditch. The lack of dendriform types indicates that any crop processing had been undertaken away from this feature. The organic content of this sample was relatively high at 14%.

Context 17201 contained a lower quantity of phytoliths when compared to the previous sample, but was still dominated by grass types. The sample contained a greater diversity of phytolith morphotypes. The presence of long cell elongate and dendriforms suggests mature grasses/cereals were present. The presence of circular rugose cells shows that woody taxa were also present in addition to grasses, although the genus or family could not be ascertained. The organic content was 10%.

The sample from secondary fill 17200 yielded very few phytoliths and a statistically reliable count was not feasible. This sample was rich in carbonates and liberated hydrogen sulphide on contact with HCl (acrid, rotten egg smell). The samples contained 5% organic material.

The uppermost fill (17193) yielded phytoliths that were in an excellent state of preservation. No edge abrasion or breakages were apparent, indicating that the sample was *in situ*, or at least it had not travelled far via colluvial processes. The sample comprised 30% organic matter and was dominated by grass/cereal short-cell and long-cell morphotypes. The sample contained no dendriforms, implying that no inflorescence materials were present, but it did contain a high number of wavy-rod long cells. The type found in this sample was very similar in size, shape and form to those contained in leaf sheath and leaf blade reference material from hulled barley. Whilst this evidence is not conclusive it does suggest that barley is a likely candidate for the source of these phytoliths. A small quantity of Cyperaceae cone phytoliths was also noted, indicating the presence of sedges. It is probable that the sample contains straw material from processed barley, largely derived from culm and leaf blade/sheath materials. The presence of circular rugose cells was also noted, suggesting the incorporation of woody taxa. Whether this was via deliberate burning or from decomposition is not known.

Ditch cuts 17178 and 17206, ditch 17716

The additional three samples analysed for this project, from samples 117014, 17027 and 17014 all contained well-preserved phytoliths with little evidence for edge abrasion and little sign of chemical pitting or etching. Woody taxa phytoliths comprise 1-2% of the total phytolith sums, suggesting that some tree/shrub material was incorporated into the sediments. Pooid C3 grass morphotypes (round, oblong short cells) dominate these samples (55% in 117014, 36% in 17027, and 43% in 17014). Panicoid short-cells account for 9-13% of the sums. Wavy-rod long cells vary between 3% (17027), 8% (17014) and 11% (117014). Dendriform phytoliths from grass inflorescence are high in sample 17014 (8%) with lower amounts in 17027 (3%) and 117014 (1%). Conversely, Cyperaceae (sedges) phytoliths were highest in 117014 (4%) and lowest in 17014 (0.5%).

Discussion

In the absence of other botanical indicators such as pollen and plant macrofossils the presence of phytoliths in some of the samples gives valuable insight into the flora and depositional history of the NE face of ditch terminus 17189. Whilst phytoliths were present in some contexts it is equally valuable to note contexts in which they were absent (17002 and 17200). This yields important taphonomic information. The phytolith analysis suggests that straw was discarded periodically in the middle Iron Age ditches and in at least one instance had been burnt. Sedge and woody ligneous dicotyledon material was also found in several samples. While sedges may be found growing in a variety of locations, may of them are typically found in damp areas or wetlands.

LAND AND FRESHWATER SNAILS

by Elizabeth Stafford

Introduction

A total of 26 samples from Site 2, Site 3 and Site 7 was submitted for the assessment of land and freshwater snails. The samples derived from a variety of settlement feature types: pits, waterholes and ditches, the majority dating from the late Iron Age to Roman period. The assessment outlined the broad character of the assemblages, the results of which a presented below. However, the generally low species diversity and abundance, together with the overall similarity between features and sites, indicated that further detailed analysis in the form of absolute shell counts would not provide a substantial amount of additional information and so such detailed analysis was not undertaken.

Method

A series of six incremental samples from middle Roman ditch 2891 at the south-western complex at Site 2 and a sequence of ten incremental samples from late Roman waterhole 15185 at Site 7 had been retrieved specifically for molluscan analysis. The samples were weighed out to between 1-2 litres, disaggregated in water, floated onto 0.5mm nylon mesh and air-dried. The residues were also retained to 0.5mm. For the purpose of assessment the flots were then scanned under a binocular microscope at magnifications of x10 and x20 and an estimate of abundance recorded. The flots from a selection of ten bulk samples (10-40 litres) from other features, primarily allocated for the retrieval of charred plant remains, were also examined in order to provide a more comprehensive assessment. The abundance of taxa was recorded. An estimate was also made of the total number of individuals in each flot. The identifications are divided into species groups in the table of results (Tables 5.21-22). Nomenclature follows Kerney (1999). For the freshwater molluscs, slum species are those able to live in water subject to stagnation, drying up and large temperature variations, catholic or intermediate species tolerate a wide range of conditions except the worst slums, and the ditch species require clean, slowly moving water, often with abundant aquatic plants. For the terrestrial fauna, habitat preferences consist of open-country, shade-loving, catholic or intermediate species tolerating a wide range of conditions, and marsh species. There are also some designated dry ground species that can tolerate a little dampness.

Results

The results of the assessment are presented in Tables 5.21 and 5.22. Overall preservation and abundance of molluscan remains was variable, although generally of low diversity with only a few species dominating. Preservation was poor to moderate within the incremental samples. A number of the bulk samples provided larger assemblages, although those from Site 7 clearly included large quantities of what appeared to be relatively recent shells (identified in Table 5.21 in parentheses).

Overall the assemblages were very similar in species composition. Dry ground open-country species were most abundant, mainly Vallonidae (*Vallonia excentrica* dominated). *Vertigo pygmaea* was also consistently present along with the catholic species *Trichia hispida*. Shade-demanding species were very sparsely represented; occasional specimens of *Aegopinella* cf. *nitidula* were noted in the middle and upper fills of the ditches at Site 2 and Site 3. Overall this suggests that the local environment of the features prior and during infilling was very open short-turfed grassland that had been established for quite some time. The association of *V. excentrica* and *T. hispida* in numbers perhaps suggests impoverished, heavily grazed grassland. The small number of shade-demanding species may be a reflection of slightly more mesic conditions prevailing within the base of the features, although this component would not suggest the growth of scrub or long grass. With reference to the ditches this may point to the base of the features being grazed as well as the immediate surroundings.

The exception to this is late Iron Age ditch 3324 at Site 3, and perhaps the middle to late Iron Age ditch at Site 4 (Trench 54). At Site 3 the assemblage is more diverse. The shade-demanding component included *Carychium* cf. *tridentatum*, *Ena obscura*, cf. *Clausilia bidentata* and *Vitrea contracta*, suggesting there may have been scrub or rank grass within or adjacent to the feature, perhaps a hedgerow or stand of trees. At Site 4 (Trench 54) this component is confined to *C. tridentatum*, which perhaps suggests long grass within the feature. It is possible that these shells represent residual components from a formerly more shaded environment. The sample, however, comes from an upper fill, which makes this less likely than if they were present in the primary fills.

It is notable that freshwater shells are consistently present in most of the features. Although this is mostly confined to a single slum species, *Lymnaea truncatula*, *Anisus leucostoma* is also occasionally present. This would suggest that the features held standing water, although the predominance of *L. truncatula* would suggest this was seasonal and liable to drying in the summer months. The exception to this are samples from contexts 15172, 15580, 15588 and 15958 at Site 7, which produced assemblages of a very different character. Here, freshwater species dominated with virtually no terrestrial species. Most abundant were *Gyraulus crista* and *A. leucostoma* suggesting more permanently wet conditions. In 15958 *Lymnaea peregra* and the pea mussel *Pisidium* sp. are also present in large numbers. On a cautionary note, however, all of the shells from these features were very well preserved; many were translucent with periostracum intact and many of the *Pisidium* sp. still had the valves attached, which suggests that these shells may well have been of relatively recent origin and may indicate substantial contamination of the samples.

Table 5.21: Results of snail assessment, Site 2, Site 3 and Site 4 (Trench 54)

Site		Site 2						Site 3				Site 4 (Tr 54)
Phase		Roman						Roman	LIA	Roman	LIA	MIA
Feature type		Ditch						Ditch	Ditch	Ditch	Ditch	Ditch
Feature								3081	3124	3211	3324	17176
Sample		2051	2052	2053	2054	2055	2056	3007	3008	3012	3017	17008
Context		2892	2892	2892	2892	2892	2892	3082	3125	3210	3334	17093
Vol. Processed (L)		1.5	1.5	1.5	2	1.5	2	36	37	35	36	32
Taxa												
FRESHWATER												
Valvata cristata (Müller)	D											
Lymnaea truncatula (Müller)	Sl M		++	+++	++	++	++	+		++	+	++
Lymnaea peregra (Müller)	C							+				
Lymnaea sp.	Sl C											
Anisus leucostoma (Millet)	Sl											
Gyraulus crista (Linnaeus)	C											
Pisidium sp.												
TERRESTRIAL												
Open-country												
Vertigo pygmaea (Draparnaud)	(M)		+	+	++	+	++		(+)	+	+	(++)
Pupilla muscorum (Linné)				+				+		+		
Vallonia costata (Müller)		+	+	++	++	+++	+	+++		+	++	+
Vallonia excentrica (Sterki)		+	+	++	+++	+++	+++			++++	+++	+++++
Vallonia pulchella (Müller)	(M)	+										(+)
Vallonia sp.	(M)	++	+	+++	++++	++++	+++		(+)			
Catholic												
Cochlicopa sp.	(M)			+	+	+	+		(+)		++	
Puntum pygmaea (Draparnaud)									+			
Vitrina pellucida (Müller)								+				
Nesovitrea hammonis (Ström)									+			
Trichia hispida (Linné)	(M)	+	+	+++	++++	++++	+++	++	++	+	+	+++
Cepaea/Arianta sp.	(M)											
Cepaea sp.	(M)											++
Shade-demanding												
Carychium cf. *tridentatum* (Risso)												+++
++												
Ena obscura (Müller)											+	
Vitrea sp.	(M)							+			+	
Aegopinella cf. *nitidula* (Draparnaud)					+	+		+	++			+
cf. *Clausillia bidentata* (Ström)										+		
Estimated min. no. individuals/sample		11	23	100	150	100	80	30	11	50	50	250
Estimated min. no. individuals/litre		7	15	67	75	67	40	1	0	1	1	8

Table 5.22: Results of snail assessment, Site 7

Phase		*Late Roman*									
Feature type		Waterhole									
Feature		15185									
Sample		15014	15015	15016	15017	15018	15019	15020	15021	15022	15023
Context		15186	15186	15187	15187	15187	15189	15189	15192	15192	15192
Vol. Processed (L)		1.5	1.4	1.7	1.5	2	1.5	1.5	1.4	1.5	1
Taxa											
FRESHWATER											
Valvata cristata (Müller)	D										+
Lymnaea truncatula (Müller)	Sl M	+		+++	++++	+++		+		+	
Lymnaea peregra (Müller)	C										
Lymnaea sp.	Sl C										
Anisus leucostoma (Millet)	Sl			+		+				+	
Gyraulus crista (Linnaeus)	C								+		
Pisidium sp.											
TERRESTRIAL											
Open-country											
Vertigo pygmaea (Draparnaud)	(M)	+		++	++	+	+		+		
Pupilla muscorum (Linné)											
Vallonia costata (Müller)				+	+	+	+	++		+	
Vallonia excentrica (Sterki)				+++	++	++	++	++	+		
Vallonia pulchella (Müller)	(M)			++	+	+				+	
Vallonia sp.	(M)	++		+++	+++	++	++	+++	++	++	+
Catholic											
Cochlicopa sp.	(M)			+	+	+		+	+		
Puntum pygmaea (Draparnaud)											
Vitrina pellucida (Müller)								+			
Nesovitrea hammonis (Ström)											
Trichia hispida (Linné)	(M)			+++	+++	++	++	++	++	++	+
Cepaea/Arianta sp.	(M)										
Cepaea sp.	(M)										
Shade-demanding											
Carychium cf. *tridentatum* (Risso)											
Ena obscura (Müller)											
Vitrea sp.	(M)										
Aegopinella cf. *nitidula* (Draparnaud)											
cf. *Clausillia bidentata* (Ström)											
Estimated min. no. individuals/sample		8	0	100	100	70	19	40	20	25	5
Estimated min. no. individuals/litre		5	0	59	67	35	13	27	14	17	5

Late Roman	*Roman*	*Roman*	*Roman*	*Late Roman*
Grave	Ditch	Pit	Pit	Waterhole
15230	15172	15580	15588	15958
15012	15037	15041	15042	15063
15231	15170	15585	15594	15974
10	10	10	10	10
	+			
	++			(+++++)
		(+)		
	++	(+++++)	++	(+++++)
	++	(+++++)		(+++++)
				(+++++)
	++			(+)
(+)	++			
(+)	++	(+)		
	++	(+)		
++	+++			
15	70	550	4	1000
2	7	55	0	100