Ancient Monuments Laboratory
Report 9/2000

WARDY HILL, COVENEY, CAMBRIDGESHIRE (TL 478820: COY 1: EXCAVATIONS 1991-2). CHARRED AND UNCHARRED PLANT MACROFOSSILS AND MOLLUSCS FROM AN IRON AGE RINGWORK ON THE FEN-EDGE.

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Summary

Ninety four bulk samples including charred material were analysed. Pre-ringwork contexts produced very little evidence for crop production or processing, but contexts of 1st century BC/AD date produced abundant remains of emmer and spelt, with some bread wheat, six-row hulled barley, wild or cultivated oats, and probably flax and a pulse crop. Local cultivation on poorly-drained clay soils is inferred from the weed flora. There was also evidence for collection of Cladium (sedge), probably for use as fuel, thatching or litter, and for some small-scale wild plant food foraging. The samples were largely composed of crop waste- or by-products, probably including both sieving and winnowing waste. Spatial patterning of charred macrofossils was interpreted as indicating that crop processing was confined within the defended enclosure, and that cereal waste had been used as a fuel on domestic hearths. A concentration of material in the south-east part of the enclosure implied a focus of crop cleaning. Two column samples were examined from the lower organic fills of the Outer Enclosure Ditch. Macrofossils of thorny shrubs were common, and this is thought to indicate that a hedgerow or encouraged zone of scrub on the bank formed part of the defences or, more prosaically, a barrier to exclude or confine stock. Samples from the ?fen' side of this circuit indicated standing water from the beginning of the infilling, whereas on the ?landward side', at a higher elevation, there was evidence for increasingly wet conditions and flooding.

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Introduction

The Iron Age Ringwork at Wardy Hill is located on a spur of Ampthill Clay projecting into the peat fen, to the north of an embayment on the north side of the Isle of Ely. The area excavated in 1991-2 by Christopher Evans (Cambridge Archaeological Unit) forms part of a more extensive system of ditched enclosures. The Ringwork itself comprised an Inner and Outer ditched circuit, with Outwork ditches, enclosing at least six circular buildings with associated pits, ditches and gullies, overlying earlier archaeological features. The site phases are as follows:

Period I: Pre-ringwork
I.1 Burnt flint mound, dating to the 2nd millennium BC
I.2 Later Bronze Age/Early Iron Age 'dyke' system.

Period II: Ringwork (provisional dating early/middle 1st century BC - mid 1st century AD).
II.1 Early phase of Iron Age settlement, including five circular buildings
II.2 Main ringwork ditches. One circular building definitely attributable to this phase.

Some isolated discrete cut features could not be attributed to a definite phase within Period II, and are listed here as Period II.1/2 (Evans 1997).

This report presents results from studies of charred and uncharred plant macrofossils, and molluscs. Although the clay soil at the site was poorly drained, organic (but now de-watered) sediments formed in wet conditions, were present *only* in the base of the Outer Ringwork ditch. Uncharred plant macrofossils from these deposits are discussed below. The majority of contexts sampled contained only charred plant macrofossils, sometimes associated with a few durable seeds, such as *Sambucus nigra* (elder) and *Lemna* sp (duckweed), which survive well in de-watered fills.

Charred plant macrofossils

Methods

Ninety four bulk samples were collected from features of all phases. The heavy clay matrix of the samples posed problems of disaggregation, so that conventional processing in a flotation tank was found to be ineffective. Pre-treatment, involving thorough air-drying followed by soaking in hot water, was found to be necessary to disaggregate the samples. For practical reasons, this necessitated a reduction in sample size to about 7 litres. Plant material was then separated from the disaggregated sediment by manual flotation/washover, collecting the flots in a 0.5mm mesh. The dried flots (or sub-samples of them) were sorted under a binocular microscope at low power. Charred plant macrofossils were identified by comparison with modern reference material. All samples included some intrusive modern plant material, principally fibrous roots and weed seeds, but also some modern bread wheat chaff and straw. The non-floating residues were checked for any non-floating charred macrofossils. It was found that manual flotation had resulted in good retrieval, with few residual macrofossils in these residues. The results are tabulated in Tables 1 - 8. Nomenclature follows Stace (1991).

Tables 1 - 8. Charred plant macrofossils

All taxa are represented by fruits or seeds unless otherwise indicated

Abbreviations

a - awn; ca - caryopsis; cn - culm node; fr - fragment; gb - glume base; s - seed; spb - spikelet base; spf - spikelet fork; rn - rachis node

Period	I.1	I.2		
Feature no.		73	83	99
Fill no.		345	406	562
Feature type	Burnt flint mound	Ditch	Pit	Gulley
Sample no.	90	91	92	93
Cereal grains				
Cereal indet (ca)				
Triticum sp (ca)				
Triticum aestivum s.l. (ca)				
Hordeum sp (ca)				
Hordeum vulgare L (ca)				
Avena sp (ca)				
Cereal chaff				
Triticum sp (gb)				
Triticum sp (spb)				
Triticum sp (rt)				
Triticum dicoccum Schubl (gb)				
Triticum dicoccum Schubl (spf)				
Triticum spelta L (gb)				
Triticum spelta L (spb/spf)				
Triticum aestivum s.l. (rn)				
Hordeum sp (rn)				
Cereal awns				
Triticum sp (a. fr)				
Hordeum sp (a.fr)				
Avena sp (a. fr)			x	
Culm fragments				
Cereal/large grass (cn)				
Cereal/large grass (culm frags)				
Other crops				
Linum c.f. usitatissimum (s.fr)				
Fabaceae indet (large cotyledon frag)				
Herbs (weeds/grassland spp)				
cf Agrostemma githago L (fragment)				
Anagallis-type				
Anthemis cotula L				
Apiaceae indet				
Atriplex sp				
Brassica sp				
Bromus mollis/secalinus				
Caryophyllaceae indet				
Cerastium sp				
Chenopodiaceae indet				
Chenopodium album L				
Chenopodium ficifolium Smith				
Euphrasia/Odontites sp				
Fallopia convolvulus (L) A. Love				
Galium aparine L				
Galium sp				
Hyoscyamus niger L				
Lamiaceae indet				
Leontodon sp				
Malva sylvestris L				
Medicago/Lotus/Trifolium-type				
Montia fontana subsp minor Hayw				
Persicaria lapathifolia (L) Gray				
Persicaria maculosa Gray				
Persicaria sp				
Plantago lanceolata L				
Poaceae indet (large)				
Poaceae indet (medium)				
Poaceae indet (small)				
Polygonaceae indet				
Polygonum aviculare L				
Ranunculus acris/repens/bulbosus				
Raphanus raphanistrum L				
Rumex acetosella L				
Rumex sp				
Stellaria graminea/palustris				
Stellaria media-type				
Tripleurospermum inodorum (L) Schultz-Bip				
Vicia/Lathyrus sp				
Wetland plants				
Carex spp				
Cladium mariscus L			4	
Eleocharis sp				
Trees/shrubs				
Corylus avellana L				
Crataegus monogyna Jacq				
Prunus spinosa L				
Rosa sp				
Sambucus nigra L				
Charred fruit fragment cf Rosaceae				
Vegetative plant material				
Charcoal <2mm	xxx	xx	xxx	xxx
Charcoal >2mm	x			
Thorns				
Buds				
Stem/rhizome fragments	xx	x		
Unidentified seeds etc.		3	1	
Sample volume (litres)	7	7	7	7
Flot volume (litres)	0.2	<0.1	0.1	0.1
% flot sorted	100	100	100	100

Table 1: Charred plant macrofossils from contexts of Periods I.1 (2nd millennium BC) and I.2 (Later Bronze Age/EIA 'dyke' system).

Feature no.	27	37	37	37	37	52	52	57	57	60	107
Fill no.	229	238	239	320	630	?227	230	272	285	414	550
Feature type	Ditch		Ditch			Ditch		Ditch			Pit
Sample no.	87	47	48	49	88	9	89	57	58	63	94
Cereal grains											
Cereal indet (ca)		1				1				1	
Triticum sp (ca)						1					
Triticum aestivum s.l. (ca)											
Hordeum sp (ca)											
Hordeum vulgare L (ca)											
Avena sp (ca)											
Cereal chaff											
Triticum sp (gb)		1		2	1						1
Triticum sp (spb)										1	
Triticum sp (ri)											1
Triticum dicoccum Schubl (gb)		1			2						
Triticum dicoccum Schubl (spf)						2				1	
Triticum spelta L (gb)						1					
Triticum spelta L (spb/spf)											
Triticum aestivum s.l. (rn)											
Hordeum sp (rn)					1					1	
Cereal awns											
Triticum sp (a. fr)											
Hordeum sp (a.fr)											
Avena sp (a. fr)											
Culm fragments											
Cereal/large grass (cn)				1						1	
Cereal/large grass (culm frags)											
Other crops											
Linum c.f. usitatissimum (s.fr)											
Fabaceae indet (large cotyledon frag)											
Herbs (weeds/grassland spp)											
cf Agrostemma githago L (fragment)											
Anagallis-type											
Anthemis cotula L				1							
Apiaceae indet											
Atriplex sp											
Brassica sp											
Bromus mollis/secalinus		1				1					
Caryophyllaceae indet											
Cerastium sp					2						
Chenopodiaceae indet		1		1		4					
Chenopodium album L				2							
Chenopodium ficifolium Smith											
Euphrasia/Odontites sp											
Fallopia convolvulus (L) A. Love											
Galium aparine L											
Galium sp											
Hyoscyamus niger L											
Lamiaceae indet											
Leontodon sp											
Malva sylvestris L											
Medicago/Lotus/Trifolium-type		3			1			1		2	
Montia fontana subsp minor Hayw											
Persicaria lapathifolia (L) Gray											
Persicaria maculosa Gray											
Persicaria sp											1
Plantago lanceolata L											
Poaceae indet (large)							1				
Poaceae indet (medium)	1			1							
Poaceae indet (small)							1	1			
Polygonaceae indet				1				1			
Polygonum aviculare L											
Ranunculus acris/repens/bulbosus											
Raphanus raphanistrum L											
Rumex acetosella L											
Rumex sp										1	
Stellaria graminea/palustris		1									
Stellaria media-type										2	
Tripleurospermum inodorum (L) Schultz-Bip											
Vicia/Lathyrus sp			1	1					1		
Wetland plants											
Carex spp											
Cladium mariscus L									1		
Eleocharis sp				1						3	
Trees/shrubs											
Corylus avellana L											
Crataegus monogyna Jacq											
Prunus spinosa L											
Rosa sp											
Sambucus nigra L											
Charred fruit fragment cf Rosaceae											
Vegetative plant material											
Charcoal <2mm	xx	xx	xx	xx	xx	xx	xx	xx	xx	xxx	xx
Charcoal >2mm						x				x	
Thorns											
Buds											
Stem/rhizome fragments	x					x					
Unidentified seeds etc.				1	1					2	2
Sample volume (litres)	7	7	6.5	6	7	6.5	7	6.5	6	7	7
Flot volume (litres)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1
% flot sorted	100	100	100	100	100	100	100	100	100	100	100

Table 2: Charred plant macrofossils from contexts of Period II.1 (early form).

Feature no.	6	6	6	6	6	6	6	6	6	6	6/67	61	61
Fill no.	202	206	209	213	221	225	236	398	420	425	218	268	325
Feature type	Ring gulley											Gulley	
Sample no.	11	12	13	74	14	15	16	17	76	75	18	59	60
Cereal grains													
Cereal indet (ca)	4	1		1		2	1	3	2	1	4	4	
Triticum sp (ca)											3	3	2
Triticum aestivum s.l. (ca)													
Hordeum sp (ca)						1						1	
Hordeum vulgare L (ca)													
Avena sp (ca)													
Cereal chaff													
Triticum sp (gb)	1	9	1			8	3				1	8	1
Triticum sp (spb)		1				1						1	
Triticum sp (ri)					2						1	1	
Triticum dicoccum Schubl (gb)	2	3		1		2				1	3	12	5
Triticum dicoccum Schubl (spf)		2				1						1	
Triticum spelta L (gb)		1				2						2	1
Triticum spelta L (spb/spf)													
Triticum aestivum s.l. (rn)						1							
Hordeum sp (rn)	1	1									1	1	
Cereal awns													
Triticum sp (a. fr)													
Hordeum sp (a.fr)													
Avena sp (a. fr)					x						x	x	
Culm fragments													
Cereal/large grass (cn)													
Cereal/large grass (culm frags)					x								x
Other crops													
Linum c.f. usitatissimum (s.fr)													
Fabaceae indet (large cotyledon frag)													
Herbs (weeds/grassland spp)													
cf Agrostemma githago L (fragment)													
Anagallis-type													
Anthemis cotula L													
Apiaceae indet													
Atriplex sp		2			1	1					1	2	1
Brassica sp													
Bromus mollis/secalinus		4			1	5				1	3	2	4
Caryophyllaceae indet											1		
Cerastium sp						1							
Chenopodiaceae indet	3	1			1	2			1		2	9	1
Chenopodium album L	2	2		1		1		1				6	1
Chenopodium ficifolium Smith	1				4							2	
Euphrasia/Odontites sp													
Fallopia convolvulus (L) A. Love													
Galium aparine L		1											
Galium sp					1								
Hyoscyamus niger L							1						
Lamiaceae indet													
Leontodon sp													
Malva sylvestris L													
Medicago/Lotus/Trifolium-type	11	3	1		1	4	1				3	1	3
Montia fontana subsp minor Hayw													
Persicaria lapathifolia (L) Gray													
Persicaria maculosa Gray													
Persicaria sp		1			1							2	1
Plantago lanceolata L													
Poaceae indet (large)	1	1	1									1	
Poaceae indet (medium)						1							
Poaceae indet (small)		2	1		2	2	1			1	1	2	
Polygonaceae indet													
Polygonum aviculare L				1		1						1	
Ranunculus acris/repens/bulbosus													
Raphanus raphanistrum L													
Rumex acetosella L													
Rumex sp		1			3						3	2	
Stellaria graminea/palustris													
Stellaria media-type			1		60	4		1				125	8
Tripleurospermum inodorum (L) Schultz-Bip												1	
Vicia/Lathyrus sp											1		1
Wetland plants													
Carex spp													
Cladium mariscus L													
Eleocharis sp	2	5			6	2				1	2	9	
Trees/shrubs													
Corylus avellana L													
Crataegus monogyna Jacq			1										
Prunus spinosa L													
Rosa sp													
Sambucus nigra L													
Charred fruit fragment cf Rosaceae													
Vegetative plant material													
Charcoal <2mm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xx	xx	xxx	xxx	xxx	xx
Charcoal >2mm	xx	xx	x	x	x	xx					xx		
Thorns	1												
Buds												1	
Stem/rhizome													
Unidentified seeds etc.	6	1	2		17	2		1		2	2	4	3
Sample volume (litres)	6.5	6	7	7	7	6.5	7	6.5	7	7	7	7	7
Flot volume (litres)	0.2	0.1	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.2	0.1	<0.1
% flot sorted	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 3: Charred plant macrofossils from ring-gulley, Structure 1

Feature no.	23	24	21	21	21	21	53	54
Fill no.	360	364	161	166	169	174	196	197
Feature type	Structure II		Structure III				Pit (Str. III)	
Sample no.	32	33	25	26	27	28	54	55
Cereal grains								
Cereal indet (ca)			1			2	4	2
Triticum sp (ca)	2		2	3		2	1	
Triticum aestivum s.l. (ca)								
Hordeum sp (ca)					1			1
Hordeum vulgare L (ca)								
Avena sp (ca)				1		1		2
Cereal chaff								
Triticum sp (gb)	1	6	5	5	5	11	4	6
Triticum sp (spb)				1		1		1
Triticum sp (rn)					1			1
Triticum dicoccum Schubl (gb)	1	5	5	3	7	19	15	14
Triticum dicoccum Schubl (spf)	1		1			4	3	3
Triticum spelta L (gb)	8	2	1		2		2	1
Triticum spelta L (spb/spf)	1	1						
Triticum aestivum s.l. (rn)				1				
Hordeum sp (rn)								
Cereal awns								
Triticum sp (a. fr)								
Hordeum sp (a.fr)								
Avena sp (a. fr)		x				x	x	
Culm fragments								
Cereal/large grass (cn)	1							
Cereal/large grass (culm frags)		x						
Other crops								
Linum c.f. usitatissimum (s.fr)								
Fabaceae indet (large cotyledon frag)								
Herbs (weeds/grassland spp)								
cf Agrostemma githago L (fragment)								
Anagallis-type								
Anthemis cotula L								
Apiaceae indet								
Atriplex sp								
Brassica sp				1				
Bromus mollis/secalinus			1				1	1
Caryophyllaceae indet								
Cerastium sp		1						
Chenopodiaceae indet			2	2	1		1	
Chenopodium album L			2		1		3	2
Chenopodium ficifolium Smith	1			2		1		
Euphrasia/Odontites sp								
Fallopia convolvulus (L) A. Love							1	
Galium aparine L								
Galium sp								
Hyoscyamus niger L								
Lamiaceae indet								
Leontodon sp								
Malva sylvestris L		1						
Medicago/Lotus/Trifolium-type			1		6		3	4
Montia fontana subsp minor Hayw								
Persicaria lapathifolia (L) Gray					1			
Persicaria maculosa Gray								
Persicaria sp				1	1		3	1
Plantago lanceolata L								
Poaceae indet (large)							2	
Poaceae indet (medium)						1		
Poaceae indet (small)		1			2		2	3
Polygonaceae indet								
Polygonum aviculare L								1
Ranunculus acris/repens/bulbosus								
Raphanus raphanistrum L								
Rumex acetosella L								
Rumex sp								1
Stellaria graminea/palustris								
Stellaria media-type							1	
Tripleurospermum inodorum (L) Schultz-Bip					1			
Vicia/Lathyrus sp			1		1			1
Wetland plants								
Carex spp					1			
Cladium mariscus L			1	1	1	2	1	2
Eleocharis sp		4			2		3	6
Trees/shrubs								
Corylus avellana L								
Crataegus monogyna Jacq						1		
Prunus spinosa L								
Rosa sp								
Sambucus nigra L								
Charred fruit fragment cf Rosaceae								
Vegetative plant material								
Charcoal <2mm	xx	xx	xxx	xxx	xxx	xxx	xxx	xx
Charcoal >2mm							x	
Thorns							1	
Buds								
Stem/rhizome							x	
Unidentified seeds etc.	1	1	1	3	1		5	2
Sample volume (litres)	6.5	7	7	7	7	7	6.5	7
Flot volume (litres)	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1	0.2
% flot sorted	100	100	100	100	100	100	100	100

Table 4: Charred plant macrofossils from ring gulley Structures II and III, Period II.1 (probably retained into II.2).

Feature no.	20	20	20	20	81	81	81	81	81	102	102	102	102	22	22	22	48	49
Fill no.	432	436	440	444	446	449	453	454	458	508	509/10	511	512/3/4	128	137	141	177	179
Feature type	Structure V									Pit associated with Str. V				Structure VI			Pits	(Str. VI)
Sample no.	21	22	23	24	64	65	66	67	68	69	70	71	72	29	30	31	52	53
Cereal grains																		
Cereal indet (ca)	1	1	1	4	8		1	2	3	1			7					
Triticum sp (ca)				2	3				3			1	4					1
Triticum aestivum s.l. (ca)														1				
Hordeum sp (ca)		2	1	10	2				1	4								1
Hordeum vulgare L (ca)			1															
Avena sp (ca)				1		1												
Cereal chaff																		
Triticum sp (gb)		2	1	21	11				5	1			8		1	4		1
Triticum sp (spb)				4			2		2	1			2					
Triticum sp (ri)			1	7	1				1				1		1			
Triticum dicoccum Schubl (gb)		1	1	16	7		1	1		1			1		1	2		
Triticum dicoccum Schubl (spf)				4	1		2											
Triticum spelta L (gb)				10	2		1	1	2				1					
Triticum spelta L (spb/spf)									1									
Triticum aestivum s.l. (rn)			1		1													
Hordeum sp (rn)				6	1													
Cereal awns																		
Triticum sp (a. fr)																		
Hordeum sp (a.fr)																		
Avena sp (a. fr)				x						x								
Culm fragments																		
Cereal/large grass (cn)													1			1		
Cereal/large grass (culm frags)																		
Other crops																		
Linum c.f. usitatissimum (s.fr)	1																	
Fabaceae indet (large cotyledon frag)										1								
Herbs (weeds/grassland spp)																		
cf Agrostemma githago L (fragment)							1											
Anagallis-type			1															
Anthemis cotula L																		
Apiaceae indet																		
Atriplex sp	1		1	14					2	3					1			
Brassica sp																		
Bromus mollis/secalinus			1		4	2	2		3									
Caryophyllaceae indet										1								
Cerastium sp																		
Chenopodiaceae indet		4		13	4			1		1	2	2	2					
Chenopodium album L	1		1	17	1				3	1			1					1
Chenopodium ficifolium Smith			1	5									1					
Euphrasia/Odontites sp													1					
Fallopia convolvulus (L) A. Love																		
Galium aparine L													1					
Galium sp																		
Hyoscyamus niger L																		
Lamiaceae indet															2			
Leontodon sp																		
Malva sylvestris L		1																
Medicago/Lotus/Trifolium-type		1		2	2				1				2					
Montia fontana subsp minor Hayw				1														
Persicaria lapathifolia (L) Gray									1									
Persicaria maculosa Gray								1										
Persicaria sp		1		1					2	1								
Plantago lanceolata L					1								1					
Poaceae indet (large)					4				1					1				
Poaceae indet (medium)													1					
Poaceae indet (small)		1			2				2				1	1				
Polygonaceae indet																		
Polygonum aviculare L																		
Ranunculus acris/repens/bulbosus												1						
Raphanus raphanistrum L										2			1					
Rumex acetosella L		1																
Rumex sp					2				2					1	1	1		
Stellaria graminea/palustris																		
Stellaria media-type																1		
Tripleurospermum inodorum (L) Schultz-Bip													1					
Vicia/Lathyrus sp				4										1				
Wetland plants																		
Carex spp		1				1						1				1		
Cladium mariscus L					2													
Eleocharis sp	1		2	1	6				1	1		2	2			1		1
Trees/shrubs																		
Corylus avellana L											x		x					
Crataegus monogyna Jacq													1					
Prunus spinosa L													1					
Rosa sp																		
Sambucus nigra L																		
Charred fruit fragment cf Rosaceae													x					
Vegetative plant material																		
Charcoal <2mm	xx	xx	xxx	xxx	xxx	xx	xx	xxx	xxx	xxx	xxx	xxx	xxx	xx	xx	xx	xx	xxx
Charcoal >2mm		x		xx	x	x				x			x			x		xx
Thorns										1								
Buds													1					
Stem/rhizome fragments														x	x	x		
Unidentified seeds etc.	1	1	1		2		2			3	1	1	8	2			1	
Sample volume (litres)	7	7	7	7	7	6.5	7	6.5	7	7	2	7	8.5	6	6	6.5	6	6
Flot volume (litres)	<0.1	<0.1	0.1	0.1	0.2	<0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.3	0.1	<0.1	<0.1	<0.1	0.1
% flot sorted	100	100	100	100	100	100	100	100	100	100	100	100	50	100	100	100	100	100

Table 5: Charred plant macrofossils from ring gulleys, Structures V and VI.

Feature no.	31	32	33	34	36	47	55	65	65
Fill no.	71	100	95	97	99	175	240	303	304
Feature type	Pits							Ditch/pit	
Sample no.	42	44	43	45	46	51	56	61	62
Cereal grains									
Cereal indet (ca)	2	5	2		1		1	1	6
Triticum sp (ca)	5	2	2		3	1	1	1	5
Triticum aestivum s.l. (ca)							1		
Hordeum sp (ca)		2	3	1		3			1
Hordeum vulgare L (ca)								2	
Avena sp (ca)									
Cereal chaff									
Triticum sp (gb)	7	8	7			7		1	9
Triticum sp (spb)	3		3		1			1	2
Triticum sp (n)	4			2				1	2
Triticum dicoccum Schubl (gb)	23	17	8	7		3			6
Triticum dicoccum Schubl (spf)	3	2	3	3	1			2	6
Triticum spelta L (gb)						4			5
Triticum spelta L (spb/spf)						1			
Triticum aestivum s.l. (rn)									
Hordeum sp (rn)	1	1		1		2		1	
Cereal awns									
Triticum sp (a. fr)									
Hordeum sp (a.fr)									
Avena sp (a. fr)	x		x	x		x		x	x
Culm fragments									
Cereal/large grass (cn)						1			
Cereal/large grass (culm frags)									
Other crops									
Linum c.f. usitatissimum (s.fr)									
Fabaceae indet (large cotyledon frag)									
Herbs (weeds/grassland spp)									
cf Agrostemma githago L (fragment)									
Anagallis-type									
Anthemis cotula L									
Apiaceae indet								1	
Atriplex sp	1	1	1		1	1		1	
Brassica sp									
Bromus mollis/secalinus	7	2	5					3	4
Caryophyllaceae indet									
Cerastium sp									
Chenopodiaceae indet	3	11	10	3		3		1	1
Chenopodium album L	10	6	9	2	1	1			1
Chenopodium ficifolium Smith	3	2	1						
Euphrasia/Odontites sp									
Fallopia convolvulus (L) A. Love	1	1	1			1		1	
Galium aparine L		1							
Galium sp			1						
Hyoscyamus niger L									
Lamiaceae indet									
Leontodon sp									
Malva sylvestris L			1	1					
Medicago/Lotus/Trifolium-type	7	5	6	1	1	1		1	1
Montia fontana subsp minor Hayw					1				1
Persicaria lapathifolia (L) Gray		1							
Persicaria maculosa Gray									
Persicaria sp	1	2		1	2			1	
Plantago lanceolata L	1		1						
Poaceae indet (large)		3	1						
Poaceae indet (medium)								1	
Poaceae indet (small)	2	3	3	1		1			
Polygonaceae indet			1						
Polygonum aviculare L		1	4						
Ranunculus acris/repens/bulbosus			1	1					
Raphanus raphanistrum L									
Rumex acetosella L									
Rumex sp		1	5						
Stellaria graminea/palustris		1							
Stellaria media-type	42			1	1				
Tripleurospermum inodorum (L) Schultz-Bip									
Vicia/Lathyrus sp		1	2		2				
Wetland plants									
Carex spp	1	2							
Cladium mariscus L	1	8	4			1		1	
Eleocharis sp	14	6	22	1	2			2	1
Trees/shrubs									
Corylus avellana L									
Crataegus monogyna Jacq									
Prunus spinosa L						1			
Rosa sp				1					
Sambucus nigra L	1	1							
Charred fruit fragment cf Rosaceae									
Vegetative plant material									
Charcoal <2mm	xx	xxx	xx	xxx	xxx	xx	xx	xxx	xxx
Charcoal >2mm	x	x	x	xxx		xx		x	x
Thorns									
Buds	1								
Stem/rhizome fragments			x	x		x		x	
Unidentified seeds etc.	7	5	5	6	2	2			3
Sample volume (litres)	6.5	7	7	3	7	6	6.5	7	7
Flot volume (litres)	0.1	0.1	0.1	1	0.1	0.1	<0.1	0.1	0.1
% flot sorted	100	100	100	12.5	100	100	100	100	100

Table 6: Charred plant macrofossils from pits and other contexts of Period II.1/2 (general ringwork attribution only).

Feature no.	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	10	12	12
Fill no.	62	63	65	245	246	249	606	20	21	22	23	24B	26B	34	35	83	385	278	146	276
Feature type	Outer enclosure ditch							Inner enclosure ditch										Outwork ditches		
Sample no.	80	81	82	83	84	85	86	73	1	2	3	4	5	6	7	8	10	77	19	20
Cereal grains																				
Cereal indet (ca)											1	1		1	4		3			1
Triticum sp (ca)								1		2	9		5		2		11			
Triticum aestivum s.l. (ca)																				
Hordeum sp (ca)										2							2			
Hordeum vulgare L (ca)																				
Avena sp (ca)															2					
Cereal chaff																				
Triticum sp (gb)								3		26	31		22	3	6		17			
Triticum sp (spb)										6	5		2	1	4					
Triticum sp (ri)										21	6		6	2	3		7			1
Triticum dicoccum Schubl (gb)										19	21		14	8	11		36			
Triticum dicoccum Schubl (spf)										1	3		1	2	6		2			
Triticum spelta L (gb)								4		6	16		7		3		12			
Triticum spelta L (spb/spf)																1				
Triticum aestivum s.l. (rn)																				
Hordeum sp (rn)						1				4					1					
Cereal awns																				
Triticum sp (a. fr)										x							x			
Hordeum sp (a.fr)										x										
Avena sp (a. fr)										x	x			x	x		x			
Culm fragments																				
Cereal/large grass (cn)						1					1									
Cereal/large grass (culm frags)												x	x		x					
Other crops																				
Linum c.f. usitatissimum (s.fr)																				
Fabaceae indet (large cotyledon frag)																				
Herbs (weeds/grassland spp)																				
cf Agrostemma githago L (fragment)																				
Anagallis-type																				
Anthemis cotula L																				
Apiaceae indet																				
Atriplex sp										2	1				1		1			
Brassica sp																				
Bromus mollis/secalinus									2	21	20	1	7	3	4		22			
Caryophyllaceae indet																			1	
Cerastium sp																				
Chenopodiaceae indet								1	3	14	3	1	2	1	8		18			
Chenopodium album L										1	1			1	2		2			
Chenopodium ficifolium Smith													1		2		3			
Euphrasia/Odontites sp																				
Fallopia convolvulus (L) A. Love														2	1					
Galium aparine L															1					
Galium sp																				
Hyoscyamus niger L																				
Lamiaceae indet																				
Leontodon sp																				
Malva sylvestris L																				
Medicago/Lotus/Trifolium-type								6	1	6	2		1	1	1		6			
Montia fontana subsp minor Hayw										1										
Persicaria lapathifolia (L) Gray											1						1			
Persicaria maculosa Gray																				
Persicaria sp										2	1									
Plantago lanceolata L																		1		
Poaceae indet (large)										1	1		2	3					1	
Poaceae indet (medium)						1								1						
Poaceae indet (small)										147	3				1		3			1
Polygonaceae indet																	1			1
Polygonum aviculare L													1							
Ranunculus acris/repens/bulbosus										2										
Raphanus raphanistrum L										1				1						
Rumex acetosella L																				
Rumex sp																				
Stellaria graminea/palustris																				
Stellaria media-type																	14			
Tripleurospermum inodorum (L) Schultz-Bip										18	1		3				2			
Vicia/Lathyrus sp																				
Wetland plants																				
Carex spp													1	2						
Cladium mariscus L										6	9		1	1	2					
Eleocharis sp								2	2	3			1	3			8			
Trees/shrubs																				
Corylus avellana L																				
Crataegus monogyna Jacq																				
Prunus spinosa L																				
Rosa sp																				
Sambucus nigra L																				
Charred fruit fragment cf Rosaceae										x				1						
Vegetative plant material																				
Charcoal <2mm	x	xx	xx			xx		x	xx	xxx	xxx	x	xx	xxx	xx	xx	xxx	x	x	x
Charcoal >2mm	x	x	x			x	x	xxx			xx	x		xx			x			
Thorns																				
Buds																				
Stem/rhizome										x			x					x		
Unidentified seeds etc.								4		7	3		3	2	2		9	1		
Sample volume (litres)	7	7	7	7	7	7	7	7	7	7	7	7	7	6.5	7	7	7	7.8	6	7
Flot volume (litres)	0.1	0.2	0.2	1	1.5	0.2	0.5	0.1	<0.1	<0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	0.1
% flot sorted	100	50	50	<10	<10	100	50	100	100	50	100	100	100	100	100	100	100	100	100	100

Table 7: Charred plant macrofossils from the Outer Ringwork Circuit (F1) and Inner Circuit (F2), and Outwork Ditches, Period II.2.

Feature no.	25	25	25	25	25/6	25/6	26	26	26	26	39
Fill no.	306	310	315	332	329	336	348	352	355	359	124
Feature type	Structure IV										Pit
Sample no.	34	35	36	37	79	78	38	39	40	41	50
Cereal grains											
Cereal indet (ca)		1		1		2		1	1	6	
Triticum sp (ca)	2							1		3	
Triticum aestivum s.l. (ca)											
Hordeum sp (ca)										2	
Hordeum vulgare L (ca)											
Avena sp (ca)	1					1					
Cereal chaff											
Triticum sp (gb)	9	1			14	1			10	11	
Triticum sp (spb)	1				4				1	2	5
Triticum sp (n)		1			4				2	6	
Triticum dicoccum Schubl (gb)	5	3			11	2	1	1	1	18	
Triticum dicoccum Schubl (spf)				1	7	1				3	
Triticum spelta L (gb)					5	1			1	3	2
Triticum spelta L (spb/spf)											
Triticum aestivum s.l. (rn)											
Hordeum sp (rn)									3	4	
Cereal awns											
Triticum sp (a. fr)											
Hordeum sp (a.fr)											
Avena sp (a. fr)								x	x	x	x
Culm fragments											
Cereal/large grass (cn)	2										
Cereal/large grass (culm frags)											
Other crops											
Linum c.f. usitatissimum (s.fr)											
Fabaceae indet (large cotyledon frag)											
Herbs (weeds/grassland spp)											
cf Agrostemma githago L (fragment)											
Anagallis-type											
Anthemis cotula L											
Apiaceae indet											
Atriplex sp				1						1	1
Brassica sp											
Bromus mollis/secalinus		1			14				4		
Caryophyllaceae indet									2		
Cerastium sp											
Chenopodiaceae indet	3	1			1					4	1
Chenopodium album L		1		2						2	
Chenopodium ficifolium Smith				1						1	
Euphrasia/Odontites sp											
Fallopia convolvulus (L) A. Love											
Galium aparine L	2										
Galium sp											
Hyoscyamus niger L											
Lamiaceae indet											
Leontodon sp											
Malva sylvestris L											
Medicago/Lotus/Trifolium-type			1						3		2
Montia fontana subsp minor Hayw											
Persicaria lapathifolia (L) Gray						1					
Persicaria maculosa Gray											
Persicaria sp			1	1					1		
Plantago lanceolata L											
Poaceae indet (large)	1										
Poaceae indet (medium)											
Poaceae indet (small)											
Polygonaceae indet	1										
Polygonum aviculare L											
Ranunculus acris/repens/bulbosus									1		
Raphanus raphanistrum L											
Rumex acetosella L									1		
Rumex sp						2				1	
Stellaria graminea/palustris										1	
Stellaria media-type	1		1	1						1	1
Tripleurospermum inodorum (L) Schultz-Bip	1									2	
Vicia/Lathyrus sp					1						
Wetland plants											
Carex spp				1							
Cladium mariscus L			1	1					6	4	
Eleocharis sp	1		1	2	3			1	1	1	
Trees/shrubs											
Corylus avellana L				x							
Crataegus monogyna Jacq									1		
Prunus spinosa L											
Rosa sp											
Sambucus nigra L											
Charred fruit fragment cf Rosaceae											
Vegetative plant material											
Charcoal <2mm	xx	xx	xx	xxx	xx	xxx	xx	xxx	xxx	xxx	xx
Charcoal >2mm				x							xx
Thorns											
Buds											
Stem/rhizome										x	
Unidentified seeds etc.	3	2		1		6			6	11	3
Sample volume (litres)	6.5	6.5	7	7	7	7	7	6	7	7	6.5
Flot volume (litres)	<0.1	0.1	<0.1	0.2	0.2	0.1	<0.1	0.1	0.1	0.1	0.1
% flot sorted	100	100	100	100	100	100	100	100	100	100	100

Table 8: Charred plant macrofossils from Structure IV, Period II.2.

Context Group	Period II.1 ditches and pits	Period II.1 Structures I, II, III, V, VI	Period II.1/2 ditches and pits	Period II.2 Ringwork ditches	Period II.2 Structure IV	Total frequencies
Cereal grains						
Cereal indet	3	24	7	6	6	46
Triticum sp (wheat)	1	14	8	6	3	32
Triticum aestivum (bread wheat)		1	1			2
Hordeum sp (barley)		11	5	2	2	20
Hordeum vulgare L (six-row hulled barley)		1	1			2
Avena sp (wild/cultivated oats)		5		1	2	9
Cereal chaff						
Triticum sp (wheat glume bases)	4	26	6	7	6	49
Triticum sp (wheat spikelet bases)	1	11	5	5	5	27
Triticum sp (wheat rachis internodes)	1	11	4	7	4	27
Triticum dicoccum (emmer glume bases)	2	26	6	6	8	48
Triticum dicoccum (emmer spikelet forks)	2	11	7	6	4	30
Triticum spelta L (spelt glume bases)	1	16	2	6	5	30
Triticum spelta L (spelt spikelet forks)		3	1	1		5
Triticum aestivum (bread wheat rachis nodes)		4				4
Hordeum sp (barley rachis nodes)		6	5	2	2	15
Cereal awns						
Triticum sp (wheat)				2		2
Hordeum sp (barley)				1		1
Avena sp (wild/cultivated oats)		8	6	5	4	23
Culm fragments						
Cereal/large grass (nodes)	2	2	1	2		7
Cereal/large grass (fragments)		2		3		5
Other crops						
Linum c.f. usitatissimum (?flax, seed fragment)		1				1
Fabaceae indet (pulse cotyledon fragment)		1				1
Trees/shrubs						
Corylus avellana (hazel nutshell)		2			1	3
Crataegus monogyna (hawthorn fruitstone)		3			1	4
Prunus spinosa (sloe fruitstone)		1	1			2
Rosa sp (rose fruitstone)			1			1
Sambucus nigra (elder seed)			2			2
Charred fruit fragment (cf Rosaceae)		1		2		3
Total number of samples	11	39	9	20	11	90

Table 9: Summary of frequencies (numbers of samples in which each taxon or plant part was present) for charred cereal remains and other economic plants (Period II, all contexts: 90 samples)

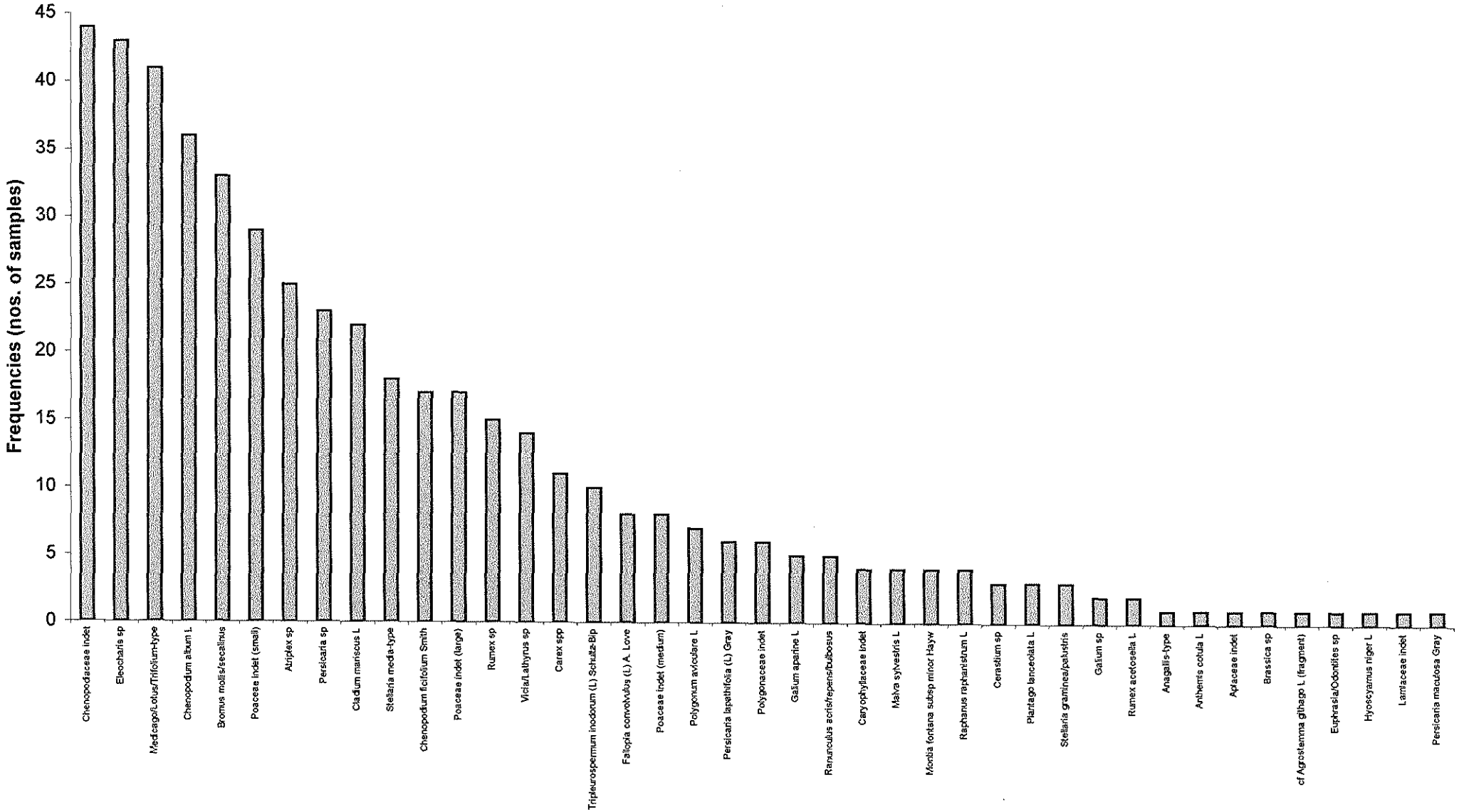


Figure 1: Herb taxa in rank order of frequency (Period II, all contexts; 90 samples).

Period I (Table 1)

A single bulk sample was taken from the Period 1.1 burnt flint mound. Heat-shattered flint fragments were common, but the 7 litre bulk sample produced a relatively small flot (0.2 litres) composed of charcoal (mostly < 2mm) and charred fragments of indeterminate stems and rhizomes. No other macrofossils were noted, and no interpretation for the function of this feature can be proposed.

Three samples came from features relating to Later Bronze Age/Early Iron Age activity (Period 1.2). The flot volumes obtained were again small (up to 0.1 litres), and consisted mainly of small charcoal fragments < 2mm. Apart from this, one sample included a scrap of *Avena* (oat) awn, with nutlets of *Cladium mariscus* (saw-sedge). Such very sparse assemblages are strictly uninterpretable and, given later activity at the site, the possibility of some intrusive material being present cannot be dismissed.

Period II (Tables 2 - 8)

Cereals and other crops

Frequencies of charred crop remains and those of other economic plants in the ninety samples from contexts of Period II are summarised in Table 9. The cereal crops represented were *Triticum dicoccum* (emmer), *Triticum spelta* (spelt), *Hordeum* sp (barley, including *H.vulgare*, six-row hulled barley) and *Triticum aestivum* (bread wheat), with *Avena* sp (wild or cultivated oat). Most of the wheat grains were not identified to species, though two samples included short *T. aestivum*-type grains. The barley grains were mostly badly deformed, though a few asymmetrical specimens from lateral spikelets of *H. vulgare* were present. A high proportion of the wheat chaff was very fragmentary or deformed. However, chaff fragments of emmer were well-represented, followed by spelt and barley, with a very few rachis nodes of bread wheat. Awn fragments of *Avena* were frequent, with some of *Triticum* and *Hordeum*. Culm nodes and fragments of cereals and/or large grasses were moderately frequent, but never numerically abundant. Other probable crop remains comprised a seed fragment probably of *Linum usitatissimum* (flax) and a cotyledon fragment from a large pulse seed.

The wild flora

Charred nutshell fragments of *Corylus avellana* (hazel), fruitstones of *Crataegus monogyna* (hawthorn), *Prunus spinosa* (sloe) and *Rosa* sp (rose), and seeds of *Sambucus nigra* (elder) occurred sporadically (Table 9); but the sparse charred macrofossils of edible wild plants do not suggest substantial reliance on wild fruit and nut collection.

Frequencies of charred macrofossils of herbaceous species are summarised in Figure 1. The more frequent taxa (those present in >10% of samples) included common arable weeds: Chenopodiaceae, predominantly *Chenopodium album* (fat hen) and *Atriplex* sp (orache), with *C. ficifolium* (fig-leaved goosefoot), *Bromus mollis/secalinus* (brome grass), *Stellaria media*-type (chickweed), *Rumex* spp (docks), *Vicia/Lathyrus* spp (vetches) and *Tripleurospermum inodorum* (scentless mayweed).

Small and large Poaceae (grasses) and *Medicago/Lotus/Trifolium*-type (small-seeded leguminous species including medicks, trefoils, clovers etc), were also common. Close identification of these taxa was not possible, but they commonly occur in grassland, as do some other taxa represented at lower frequencies: *Ranunculus acris/repens/bulbosus* (buttercups), *Plantago lanceolata* (ribwort plantain). Damp-ground species, particularly *Eleocharis* spp (spike-rush), but also *Persicaria* spp (redshank, pale persicaria) and *Carex* spp (sedges), were also frequent.

High frequencies of charred macrofossils of grassland and damp-ground plants in association with cereals are often taken as an indication that tillage was incomplete, so that grassland plants were able to persist in the arable fields (following Hillman 1981), and that cultivation extended onto poorly-drained land (as first suggested by M. Jones 1978). Following the latter interpretation, the abundance of *Eleocharis* and *Persicaria* could well indicate that the cereals from Wardy Hill had been grown on wet soils, and probably locally, as suggested by G. Jones (unpublished) for the cereal remains from Haddenham. However, caution must be exercised in such interpretation for it is likely that the taphonomy of charred assemblages from ditches, gullies and pits is likely to have been complex: they could easily include charred material from more than one source including, for example, hay, litter and thatching materials, besides cereal crops and their contaminants.

One common species from Wardy Hill - *Cladium mariscus* (saw-sedge) - definitely could not have occurred as a crop weed. It grows, usually in pure dense stands, in reedswamp and fen. It has traditionally been used for thatching and as kindling for fires, and these activities no doubt account for its abundance in the samples.

Crop processing activities

Bearing in mind the above *caveats* regarding the taphonomic complexity of the samples, assemblage composition can be used to provide information on crop processing activities on-site. Figures 2 and 3 summarise total counts of grains, chaff fragments and fruits/seeds of herbaceous taxa from all contexts of Period II. It is plain that in many samples, grains made up a relatively minor component, (though obviously the smallest assemblages are not informative). Chaff fragments and, in some samples, fruits/seeds of herbaceous taxa were much more abundant. It is suggested that crop processing waste- or by-products are generally represented, rather than material derived from prime grain charred by such accidental processes as granary fires or poor temperature control during grain drying or malting. The samples probably relate to disposal by fire of waste products from the cleaning of small batches of cereals taken from bulk stores and/or from the use of such products as fuel. Cereal by-products used as fuel would have been partly generated by on-site crop cleaning, though Van der Veen (in press) has suggested that such material was also an actively-traded resource in later prehistory. However, at Wardy Hill the composition of the weed flora gives no support for any large-scale importation of by-products grown elsewhere.

Assemblage composition for samples including more than 100 macrofossils is summarised in Table 10. In almost all these samples small weed seeds predominate (*Stellaria media*-type, Chenopodiaceae, small Poaceae), and crop cleaning by sieving is probably represented. One sample (BS 3, Inner Enclosure Ditch, Fill 23) consisted largely of chaff and large caryopses of *Bromus mollis/secalinus*: this is more likely to be a winnowing residue.

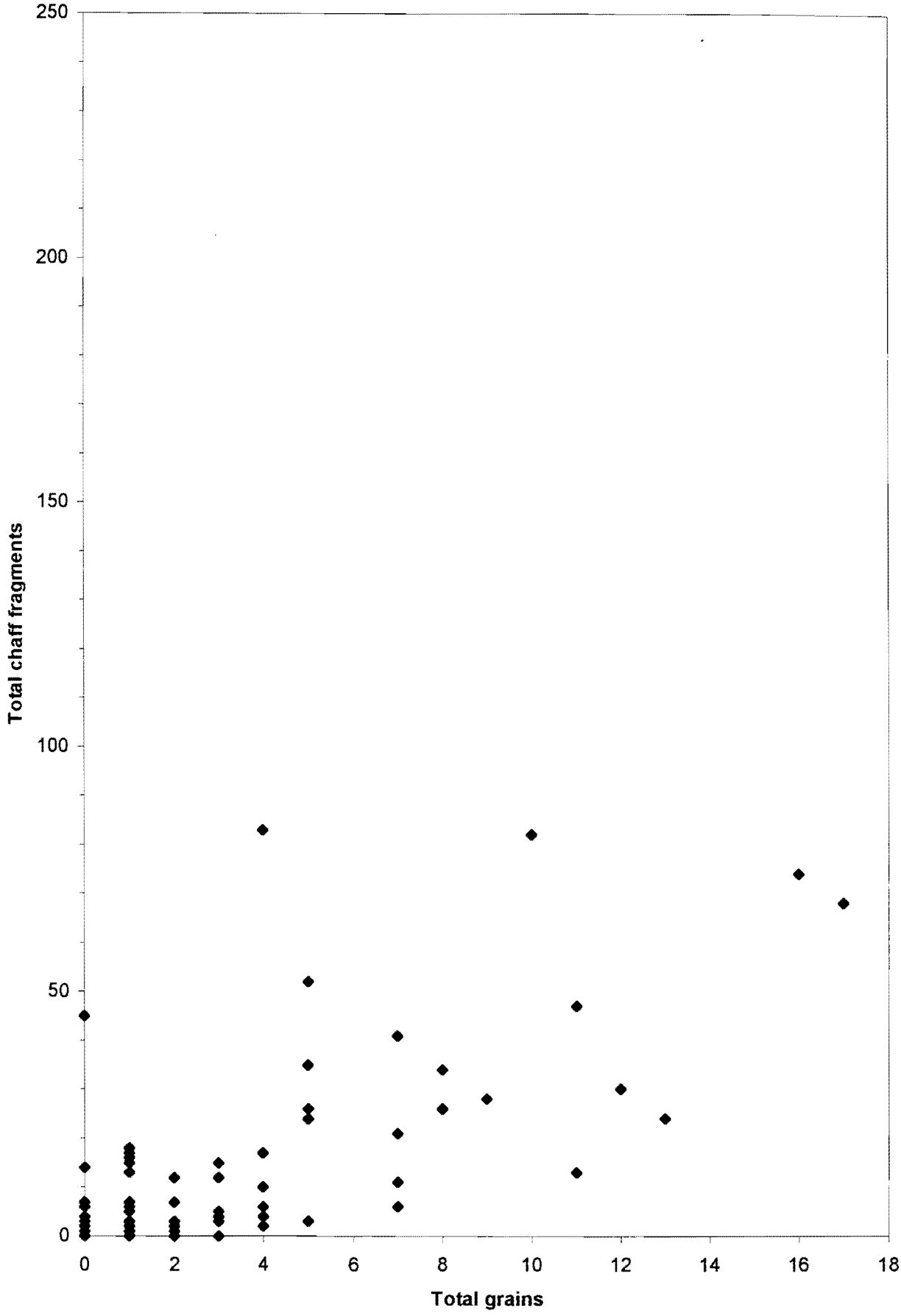


Figure 2: Scattergram showing total counts of grains and chaff fragments from Period II contexts

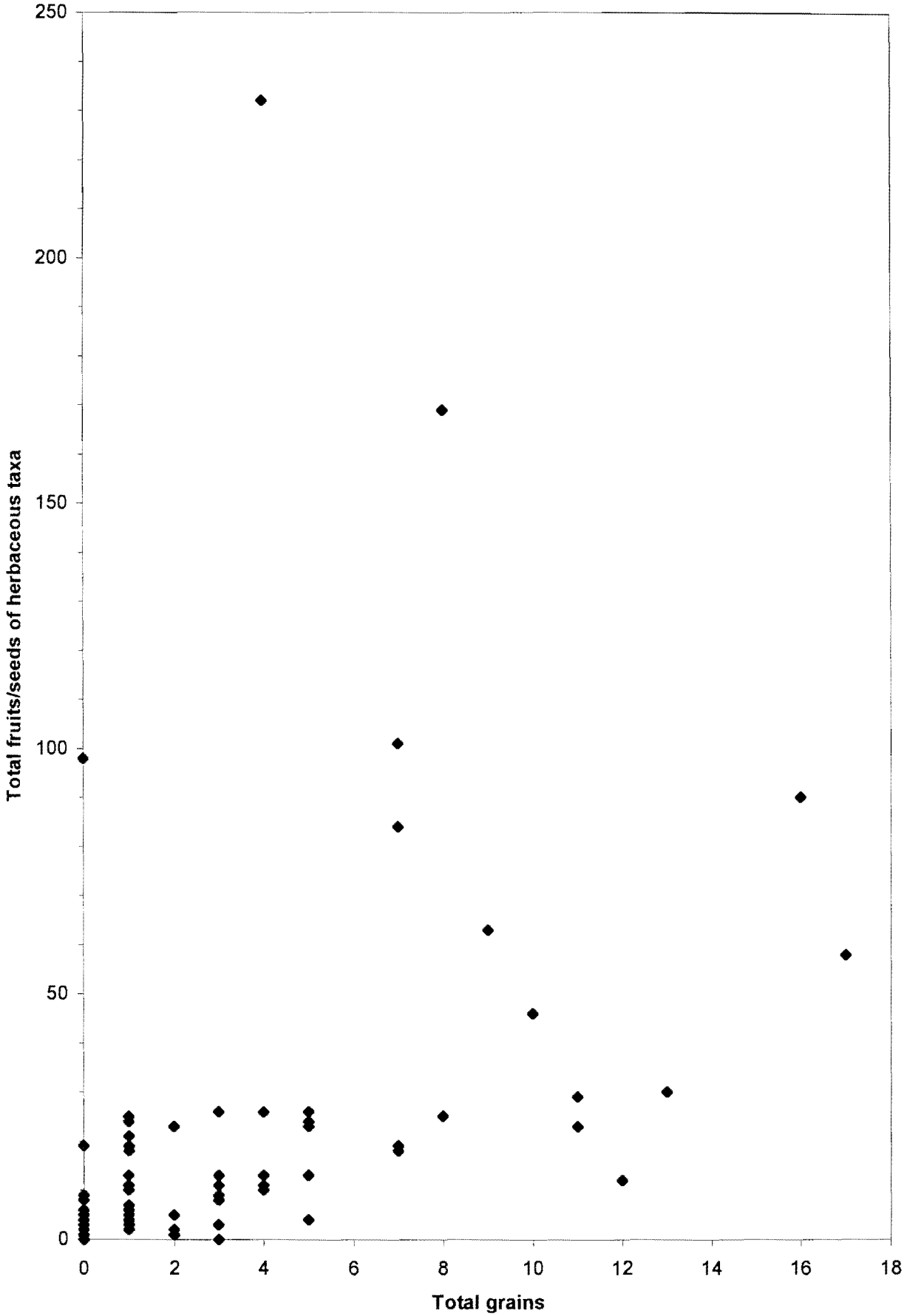


Figure 3: Scattergram showing total counts of grains and fruits/seeds of herbaceous taxa from Period II contexts

Context and Bulk Sample number	% grains	% chaff	% herbaceous taxa	Principal herb taxon	Total count
Structure 1, Fill 221, BS 14	0	2	98	Stellaria media-type	100
Structure 1, Fill 268, BS 59	3.9	12.8	83.3	Stellaria media-type	203
Structure V, Fill 444, BS 24	11.9	47.5	40.6	Chenopodiaceae	143
Pit 31, Fill 71, BS 42	4.6	27.6	67.8	Stellaria media-type	149
Pit 33, Fill 95, BS 43	6.2	18.8	75	Chenopodiaceae	112
Pit 33, Fill 100, BS 44	9	28	63	Chenopodiaceae	100
Inner Enclosure Ditch, Fill 22, BS 2	1.3	26	72.7	Poaceae(small)	319
Inner Enclosure Ditch, Fill 23, BS 3	7.2	59.5	33.3	Bromus	138
Inner Enclosure Ditch, Fill 385, BS 10	8.9	41.1	50	None predominant	180

Table 10: Summary of assemblage composition for all samples with > 100 macrofossils

Structure number	I	II	III	IV	V	VI
Mean density of cereal grains (nos. per litre)	0.37	0.24	0.58	0.29	0.79	0.1
Mean density of cereal chaff (fragments/litre)	0.94	1.85	3.19	1.95	1.63	0.33
Mean density of 'weed seeds' (nos. per litre)	4.58	0.93	2.41	1.68	2.25	0.56

Table 11: Mean densities of charred cereal grains, chaff fragments and 'weed seeds' from contexts associated with Structures I - VI

Spatial patterning of charred macrofossil discard

The spatial distribution of charred plant macrofossils from the site (Period II) is presented in Figure 4, in terms of numbers of charred macrofossils (grains, chaff fragments and fruits/seeds of herbaceous species only) per litre of soil processed.

The first, and most obvious, point is that densities were very low outside the F2 ditch circuit, though admittedly this is based on a rather small number of samples. No sample from F1, the Outwork Ditches or associated features contained more than one macrofossil/litre, even in the vicinity of the entrances. It seems that the bank between F1 and F2 prevented large-scale dispersal of charred material beyond F2, (except, presumably, by wind-blow.

Three samples from the south-eastern part of F2 produced some of the highest densities of material from the site: Fill 22 (91 macrofossils/litre), 23 (20/litre) and 385 (26/litre). It was suggested above that both sieving waste and coarser winnowing waste was represented. These contexts did not produce particularly high densities of artefacts, and fieldwalking before excavation showed that that this part of the site was not where the main middens were located (C. Evans, pers. comm.). A plausible interpretation is that crop cleaning took place in this south-eastern part of the enclosure, the waste products were burnt on bonfires, and the charred residues found their way into the adjacent fills of F2.

There are several points worth noting, so far as the fills of ring-ditches of buildings I - VI, and contexts directly associated with them, are concerned. Mean densities of charred grains, chaff fragments and 'weed seeds' for the structures are summarised in Table 11 and Figure 5. The fills of ring-ditches associated with structures II and VI included the lowest mean densities overall, and this correlates with the interpretation of these structures as 'ancillary' (C. Evans, pers. comm.).

Apart from this, it is probably unwise to place too much emphasis on *mean* densities for the entire structures, for these can be biased by particularly rich samples. For example, one sample from a gully associated with Structure I (Fill 268, BS 59) contained 29 macrofossils/litre, the highest density of material in any context associated with the structures. This sample, composed predominantly of small weed seeds, has biased the mean density for the Structure 1 as a whole. It is would therefore be unreliable to attempt to differentiate types of activities taking place in each structure. However, interpretation in general terms can be offered. It seems reasonable to infer that the charred material from the gully fills represented charred residues swept out from internal domestic hearths on which cereal processing by-products had been burnt: either deliberately as fuel or incidentally as waste. Structures I and IV included relatively high densities on the southern side of their doorway entrances, just where such sweepings might be expected to accumulate. The low densities of charred material in the fills of II and VI could imply that these structures lacked internal hearths.

Wardy Hill Ringwork

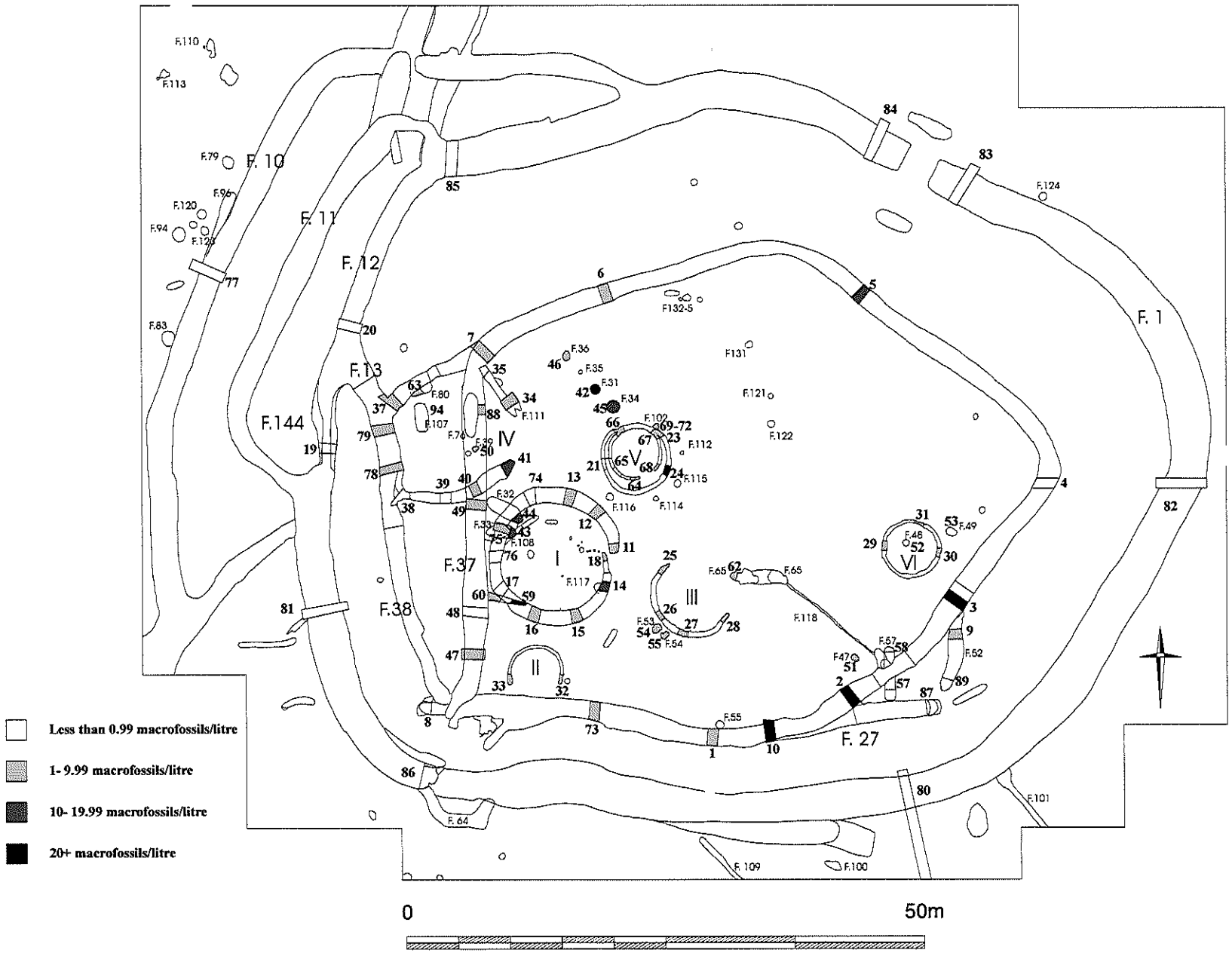
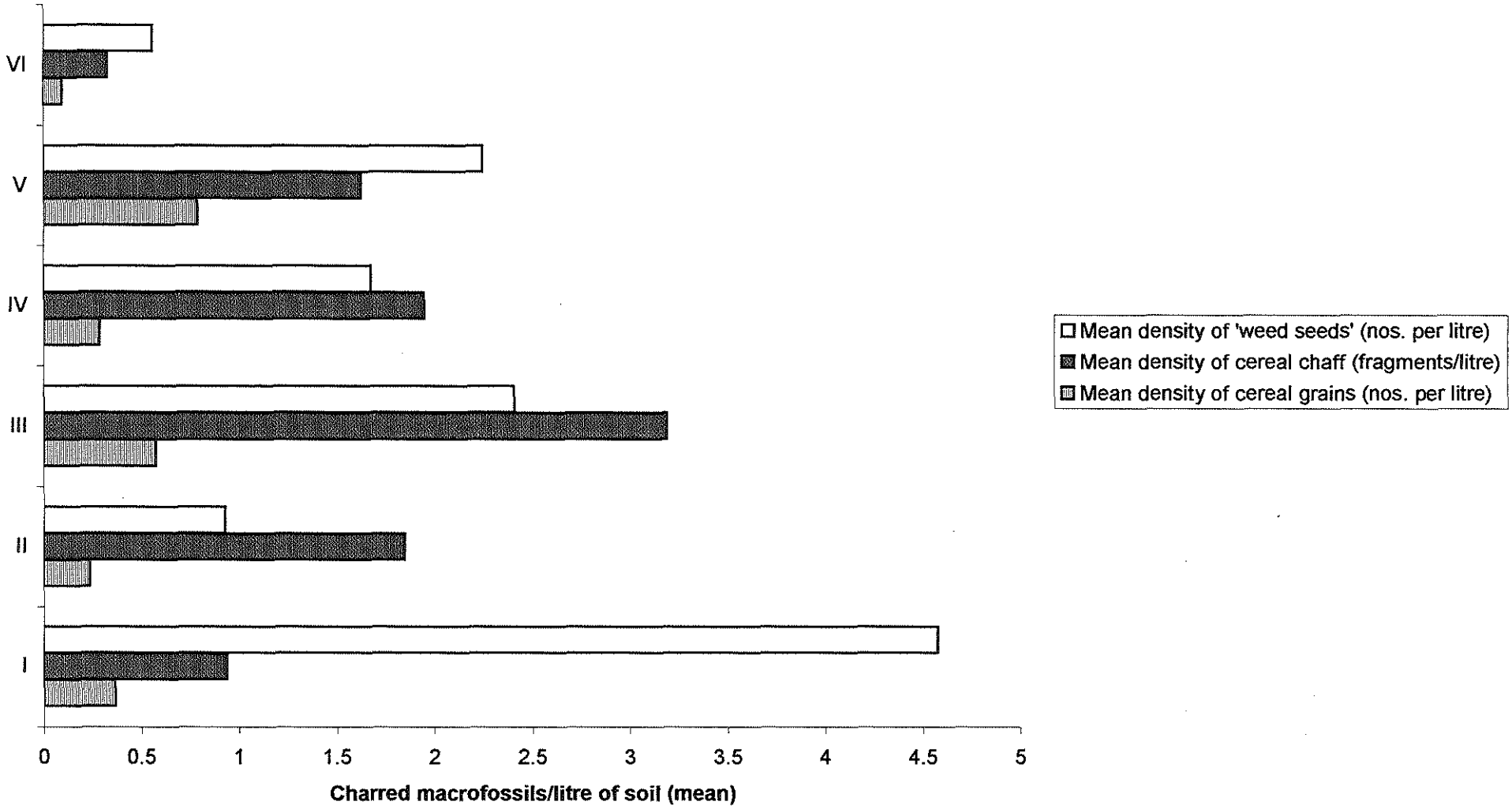


Figure 4

Figure 5: Densities of selected charred plant macrofossils in the fills of ring-gulley structures I - VI.



Uncharred plant macrofossils from F1, the Outer Enclosure Ditch

Introduction

As noted above, an extensive series of bulk samples was collected. The vast majority of contexts sampled were shallow, and their fills, though wet or moist when excavated, had not provided permanently anoxic conditions. Consequently, though charred plant macrofossils were common, survival of uncharred plant material was minimal, apart from a few durable propagules in some samples. These included seeds of *Lemna* (duckweed), which survive surprisingly well in de-watered fenland clays.

However, organic deposits were present in the basal fills of the Outer Enclosure Ditch, F1 (Period II). Samples were taken at two locations. Section 37 was on the higher part of the site, whilst section 63 was on low ground adjacent to the fen. The upper fills (not sampled) comprised topsoil, 20th century bank-levelling deposits and dark clays ramified by modern roots.

In addition, some macrofossils were recorded from a monolith, taken primarily for pollen assessment from a Period I.2 (Later Bronze Age/Early Iron Age) ditch, F73 [345], Laboratory Sample 5. There was insufficient material from this sample for analysis to be profitable.

The sediments

Section 37

At this point the ditch was cut through very stiff, impervious clay. The lower fills were as follows (depths from top of section):

100-120cm	Extremely firm brown to greyish-brown clay; virtually stoneless; well-developed columnar peds; mollusc shells locally common; fibrous roots (52)
120-135cm	Firm brown clay; virtually stoneless; some dark brown organic inclusions; large orange-brown mottles; fibrous roots (52)
135-170cm	Slightly firm dark greyish-brown organic clay; some marl fragments; orange-brown mottles; visible leaf impressions; poorly preserved twigs and seeds; mollusc shells; becoming moist towards base, but essentially de-watered. (68).

Laboratory sample 2 (LS2) was a column sample taken for macrofossil analyses, vertically sub-divided at 100-110, 110-120, 120-135, 135-150, 150-160 and 160-170cm.

Section 63

This part of the ditch was dug through clay and marl, and was more free-draining although at a lower elevation. All deposits dry (de-watered).

70-80cm	Very firm dark greyish-brown clay; virtually stoneless; well-developed columnar peds; fibrous roots abundant (58)

80-112cm Very firm greyish-brown clay; virtually stoneless; prominent orange-brown mottles; off-white marl inclusions; vertical off-white streaks of gypsum; degraded mollusc shell fragments (58)

112-125cm Very firm dark greyish-brown organic clay; virtually stoneless; some orange-brown mottles; off-white marl inclusions; white laminations; mollusc shells throughout, but particularly common at base; fibrous roots.

Laboratory sample 4 (LS4) was a column sample taken for macrofossil assessment, vertically sub-divided at 70-80, 80-90, 90-100, 100-112, 112-125cm.

Processing

Small sub-samples were initially disaggregated, washed out over a 0.5mm mesh, and the retents assessed to establish where there was preservation of uncharred plant macrofossils. On the basis of assessment, samples from 120-170cm in LS2 (Section 37) and the sample at 112-125cm in LS4 (Section 63) were analysed. Samples were initially disaggregated by pre-soaking in dilute NaOH solution, and macrofossils were then separated using the methods of Kenward *et al* (1980). The sample weights processed, and the proportions of the organic fraction sorted, are given in Table 11. All identifications were verified by comparison with modern reference material.

Discussion (Table 12)

The plant macrofossil assemblages from these five samples are listed in Table 12, and summarised in Table 13 and Figure 6. Macrofossils derived from four main ecological groups of plants were recorded: aquatics/reedswamp species, plants of wet soils, terrestrial herbs and trees/shrubs. In addition of few pinnules of *Pteridium aquilinum* (bracken) were noted in the basal samples from both sections. Bracken is unlikely to have been growing locally, on-site, given the predominately poorly-drained clay soils in the vicinity. It may have been intentionally imported for use as flooring material or animal bedding.

Aquatic and reedswamp plants were common in the basal fill of F1, section 63 (112-125cm): 54.2% of total seeds. The predominant taxa were Alismataceae, including *Alisma plantago-aquatica* (water plantain), charophytes (stoneworts) and *Potamogeton* spp (pondweeds). This section was on the lower-lying 'fen' side of the enclosure, and plainly the ditch held standing water in this area whilst the basal sediment accumulated. In the basal three samples from Section 37 (135-170cm), however, macrofossils from these plants were sparser (maximum 11%). Whilst conditions must plainly have been wet *within* the sediment, (otherwise macrofossils would not have been preserved), these lower frequencies of aquatics and reedswamp plants, suggest either that areas of standing water over the sediment surface were more restricted, or else that the ditch was only intermittently flooded at this point. The assemblage from 120-135cm in Section 37 was quite different in character, dominated by macrofossils of aquatic plants (81.5% of total macrofossils), and in particular by *Lemna* sp (duckweed). It was also at this level that significant numbers of freshwater mollusc shells first occurred, and these increased in abundance in sediments above, though these were too de-watered for plant macrofossil preservation. Much wetter conditions are indicated.

Section no.	37	37	37	37	63
Depth(cm)	120 - 135	135 - 150	150 - 160	160 - 170	112 - 125
Laboratory sample no.	LS 2	LS 2	LS 2	LS 2	LS 4
Trees and shrubs					
Crataegus monogyna Jacq.			31	25	
Crataegus-type (thorns)		1	3	3	
Quercus sp (leaf frags)			x	x	
Rosa sp					3
Rubus sect. Glandulosus Wimmer and Grab.	7	38	21	15	22
Rubus-type (thorns)		8	17	18	12
Sambucus nigra L. (see note below)	120	238	31	14	1
Solanum dulcamara L.	2	9	4	2	
Viscum album L. (epidermis: leaf, stem, inflorescence) *		xxx			
Terrrestrial herbs					
Apiaceae indet.		1	5		2
Asteraceae indet.		1		3	
Atriplex sp		1			
Caryophyllaceae indet.	1				
Chenopodiaceae indet.		2		1	1
Cirsium/Carduus sp		8	10		4
Conium maculatum L.		1			
Dipsacus fullonum L.					2
Lamiaceae indet.		1			
Lapsana communis L.		3	3	1	
Mentha sp	1		1	1	5
Moehringia trinervia (L.) Clairv.			1	1	
Myosotis sp					1
Poaceae indet.		2			
Polygonaceae indet.		2			2
Potentilla anserina L.		1			
Rumex sp		4	1	2	
Sonchus asper (L.) Hill			4	1	
Sonchus sp		3		1	
Stachys sp	2				
Stellaria media-type		10	7	9	
Urtica dioica L.	10	108	22	6	4
Urtica urens L.					1
Plants of wet soils					
Bidens sp					5
Carex sp		1			1
Eleocharis sp					7
Eupatorium cannabinum L.					1
Filipendula ulmaria (L.) Maxim			1		
Juncus sp					x
Lycopus europaeus L.	1	6	3	2	20
Menyanthes trifoliata L.		1			
Aquatics/reedswamp plants					
Alisma plantago-aquatica L.					21
Alismataceae indet.	1	4			36
Apiaceae cf O. aquatica	22				
Characeae indet.					17
Cladium mariscus L.		5			
Lemna sp (see note below)	616	2	3	1	2
Oenanthe aquatica (L.) Poiret	5	1	2		1
Potamogeton sp			7	1	47
Ranunculus sceleratus L.	1				
Ranunculus subg. Batrachium (DC.) A. Gray	11	1	4	5	3
Sparganium sp					1
Typha sp			6		6
Zannichellia palustris L.					1
Heathland					
Pteridium aquilinum (L.) Kuhn (pinnules)				x	x
Other plant macrofossils					
Buds/budscales		x	x	x	x
Charcoal	x	x			x
Leaf fragments		x	xx	xx	
Mosses		x	x	x	
Twig fragments			x	x	x
Unidentified seeds etc.	5	6	11	8	20
Sample weight (kg)	1	1	3	3	3
% sorted	100	25	12.5	25	25

N.B. Counts given for Sambucus and Lemna are estimated from sub-samples

Table 12: Plant macrofossils from two sections through the Outer Enclosure Ditch, F1. Taxa were represented by fruits or seeds, except where specified. * The remains of Viscum album were identified by Dr. Mark Robinson.

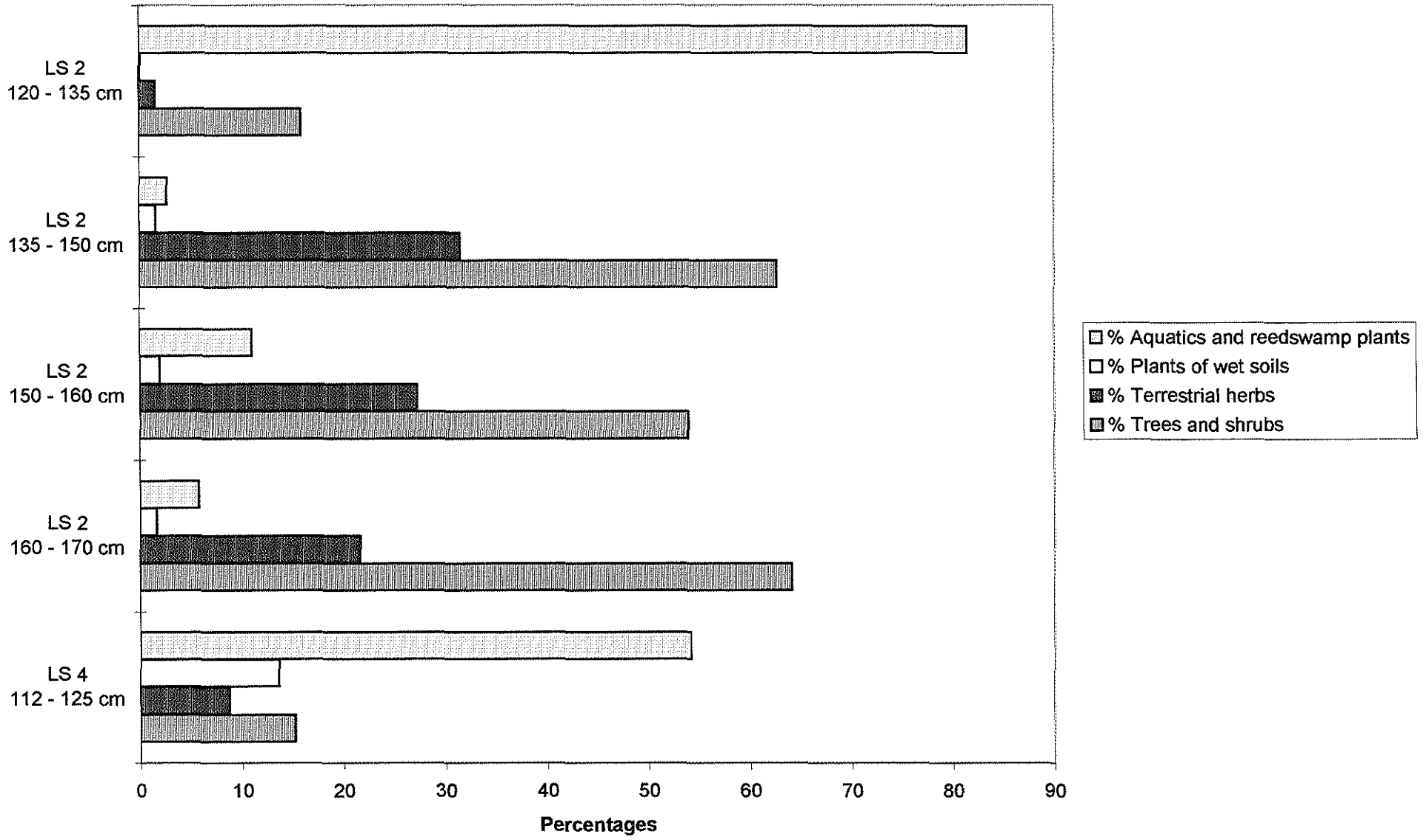


Figure 6: Summary of plant macrofossil assemblages from F1.

Section no.	63	37	37	37	37
Depth (cm)	112 - 125	160 - 170	150 - 160	135 - 150	120 - 135
Laboratory sample no.	LS 4	LS 2	LS 2	LS 2	LS 2
% Trees and shrubs	15.3	64.2	54	62.7	16
% Terrestrial herbs	8.8	21.7	27.3	31.6	1.7
% Plants of wet soils	13.7	1.7	2	1.7	0.2
% Aquatics and reedswamp plants	54.2	5.8	11.1	2.8	81.5
Total seeds	249	120	198	469	805

Table 13: Summary of plant macrofossil assemblages from F1.

There was, again, a contrast between Sections 37 and 63 in terms of the percentages of macrofossils from trees and shrubs. Taxa identified from fruits, seeds and leaves included *Crataegus monogyna* (hawthorn), *Quercus* sp (oak), *Rosa* sp (rose), *Rubus* section *Glandulosus* (bramble), *Sambucus nigra* (elder) and *Solanum dulcamara* (woody nightshade), whilst *Crataegus*-type and *Rubus*-type thorns were also present. In the basal sample from Section 63, macrofossils of trees and shrubs comprised 15.3% of the total count, though this percentage has been depressed to some extent by the abundance of aquatics. In the base of section 37, below 150cm, percentages of 64.2-54% were recorded. At 135-150cm, the overall percentage for trees and shrubs was 62.7%, but by this level the main taxon was *Sambucus*, which was comparatively rare below. *Sambucus* was also common at 120-135cm, but its percentage representation was again depressed by the abundance of *Lemna* seeds in the sample. In two samples from section 37, the woodland herb *Moehringia trinervia* (three-veined sandwort) was associated.

It is suggested that these macrofossils represent woody plants growing directly adjacent to the ditch, most likely on the internal bank. The unusual abundance of thorny species, in the basal fills of these two sections, especially 37, is thought to indicate at least that growth of such plants locally was permitted by excluding grazing animals, and it is even possible that they were intentionally planted. Either way, a belt of thorny vegetation on the bank, would have made an effective barrier, not easily penetrated. Whether this vegetation was no more than an untidy zone of scrub, or a managed hedgerow is impossible to say, for there was virtually no preservation of woody stems from which growth forms could be inferred. Characteristic hedging features on roundwood including right-angle bends in stems, (which may be generated by hedge-laying and management), have been noted in Iron Age contexts from Fisherwick, Staffordshire (Williams 1979) and St Ives, Cambridgeshire (Taylor 1996).

The increased abundance of *Sambucus* seeds in section 37 above 150cm is not simply a consequence of the well-known durability of these seeds in aerated deposits: though represented in the lower fills they were not common. A real local expansion of elder scrub may be inferred, perhaps relating to abandonment of the site whilst these upper fills accumulated.

One very unusual identification, of *Viscum album* (mistletoe), was made by Dr Mark Robinson, who comments:

"The paraffin flotation of a 1.0kg sample from Section 37, 135-150cm, to recover insect remains also resulted in a large quantity of plant epidermal tissue floating. It had the khaki, translucent appearance which is often characteristic of the remains of evergreen shrubs, and was eventually identified as *Viscum album*. The remains included epidermis of leaves, stems and inflorescences. The leaf fragments had a coarse cell pattern with scattered stomata that on the rounded leaf margin gave way to rows of cells and no stomata. Indistinct fragments of the venation adhered to the epidermis. The stem fragments had a more regular pattern of quadrate cells which gave a tuberculate surface. Stomata were present at intervals. The inflorescences comprised the characteristic united bracts with setaceous margins. The coarse pattern of equilateral cells gave a reticulate, tuberculate surface to the bracts.

The concentration of mistletoe remains was such that the deposit might have contained an entire plant. It is possible that the mistletoe had been deliberately placed in the ditch".

Dr Robinson's suggestion of intentional placing of the mistletoe is intriguing. However, it must be noted that samples from this ditch section included remains of rosaceous shrubs and oak, which can be parasitised by mistletoe. The plant may have been growing locally on scrub and trees, and could have been incorporated into the ditch fill by entirely natural processes.

The rather low frequencies of plants characteristic of wet soils in Section 37 (only up to 2%), though 13.7% in Section 63, seem at first sight surprising at a fen-edge site. This probably relates to the nature of the 'seed' catchments in the two sections, and to shading out of some open fen species by scrub growth. In 37, the ditch seems to have been an isolated wet feature bounded by scrub in an otherwise *comparatively* well-drained area, so that habitats for open fen species were restricted. In 63, by contrast the ditch was adjacent to the fen. The remaining group of terrestrial herbs comprises mainly weeds, with *Urtica dioica* (stinging nettle) predominating. These are uninformative.

Mollusca from F1, the Outer Enclosure Ditch

Introduction

Mollusc shells were present in the basal fill of Section 63 (LS 4: 112-125cm), and in most samples from Section 37 (LS 2: 100-170cm). Sediment descriptions for these two sections have been given in the report on uncharred plant macrofossils. A significant characteristic of the clayey sediments in these sections was the presence of gypsum and probably of re-precipitated calcite as white laminations and vertical streaks. In de-watered fenland clays, sulphur acids (H_2SO_3 and H_2SO_4), produced by oxidation of pyrite, commonly react with the calcium carbonate component of shell to produce gypsum ($CaSO_4.2H_2O$). It is therefore evident that some shell destruction has occurred, and this is particularly evident in the lower fills: some samples from Section 37 included no shells, and in the sample from Section 63, the main items surviving were the dense opercula of *Bithynia* sp, with a few shells of large *Lymnaea* spp and *Planorbarius corneus*. A few decalcified crushed periostraca were also noted.

Processing

Shells were extracted, together with plant macrofossils, from the samples using the methods of Kenward *et al* 1980. Meshes of 0.5mm were used throughout.

Discussion

Mollusc shells from Sections 37 and 63 are listed in Table 14.

In section 37, there was virtually no preservation below 135cm. Shelly clays at 100-135cm, however, included relatively abundant shells. The assemblages included a small component of terrestrial species, but there were too few shells to provide any information on dry-land habitats around the ditch. Freshwater slum taxa, characteristic of stagnant conditions and intermittent desiccation, were present: *Anisus leucostoma* and *Lymnaea truncatula*. These two snails, particularly *A. leucostoma*, are commonly reported from ditches and other wet archaeological features, and generally seem to represent the fauna resident in the feature (O'Connor 1988). However, the assemblages from this section were dominated by more typically freshwater species, including some snails such as *Planorbarius corneus*, which are not tolerant of poor, enclosed habitats, but are largely confined to large bodies of well-oxygenated water (Boycott 1936). Consequently, the assemblages are thought to have been emplaced as a result of widespread flooding from the fen, rather than representing a resident ditch fauna.

The sample from the base of section 63 was plainly differentially preserved, consisting of large shells and durable elements, but *P. corneus* was again present. Flooding again seems to be indicated.

Section no.	**37**	**37**	**37**	**37**	**37**	**37**	**63**
Depth(cm)	**100 - 110**	**110 - 120**	**120 - 135**	**135 - 150**	**150 - 160**	**160 - 170**	**112 - 125**
Laboratory sample no.	**LS 2**	**LS 2**	**LS 2**	**LS 2**	**LS 2**	**LS 2**	**LS 4**
Freshwater molluscs							
Acroloxus lacustris Linnaeus	1						
Armiger crista (Linnaeus)	11	47	14				
Bathyomphalus contortus (Linnaeus)	7	4	1				
Bithynia sp.	12	39	7				
Bithynia sp. (opercula)	41	116	1		1		17
Bithynia tentaculata (Linnaeus)							
Gyraulus albus (Mueller)							
Hippeutis complanatus (Linnaeus)	1	2	2				
Lymnaea cf stagnalis (Linnaeus)							3
Lymnaea sp(p).	1	1					
Physa fontinalis (Linnaeus)	1						
Planorbarius corneus (Linnaeus)	7	9					4
Planorbidae indet.	7	18	4				
Planorbis planorbis (Linnaeus)	14	21	1				
Sphaeriacea indet.	5	3					
Valvata cristata Mueller	2	15				1	
Freshwater 'slum' molluscs							
Anisus leucostoma (Millet)	1	3	1				
Lymnaea truncatula (Mueller)	5	24	8				
Land/marsh molluscs							
Aegopinella sp.	1						
Cepaea/Arianta sp.					1		
Limacidae indet.		1					
Succinea sp.							1
Vallonia sp	2						
Zonitidae indet.		5					
Indeterminate (apices)	1	2	1				
Other taxa							
Ostracods						x	x
Fish bones (including stickleback)			x				
Amphibian bones					x	x	x
Vole cheek tooth						x	
Sample weight (kg)	1	1	1	1	3	3	3
% sorted	100	100	100	25	12.5	25	25

Table 14: Molluscs and other macrofossils from two sections through the Outer Enclosure Ditch, F1.

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Wardy Hill Ringwork

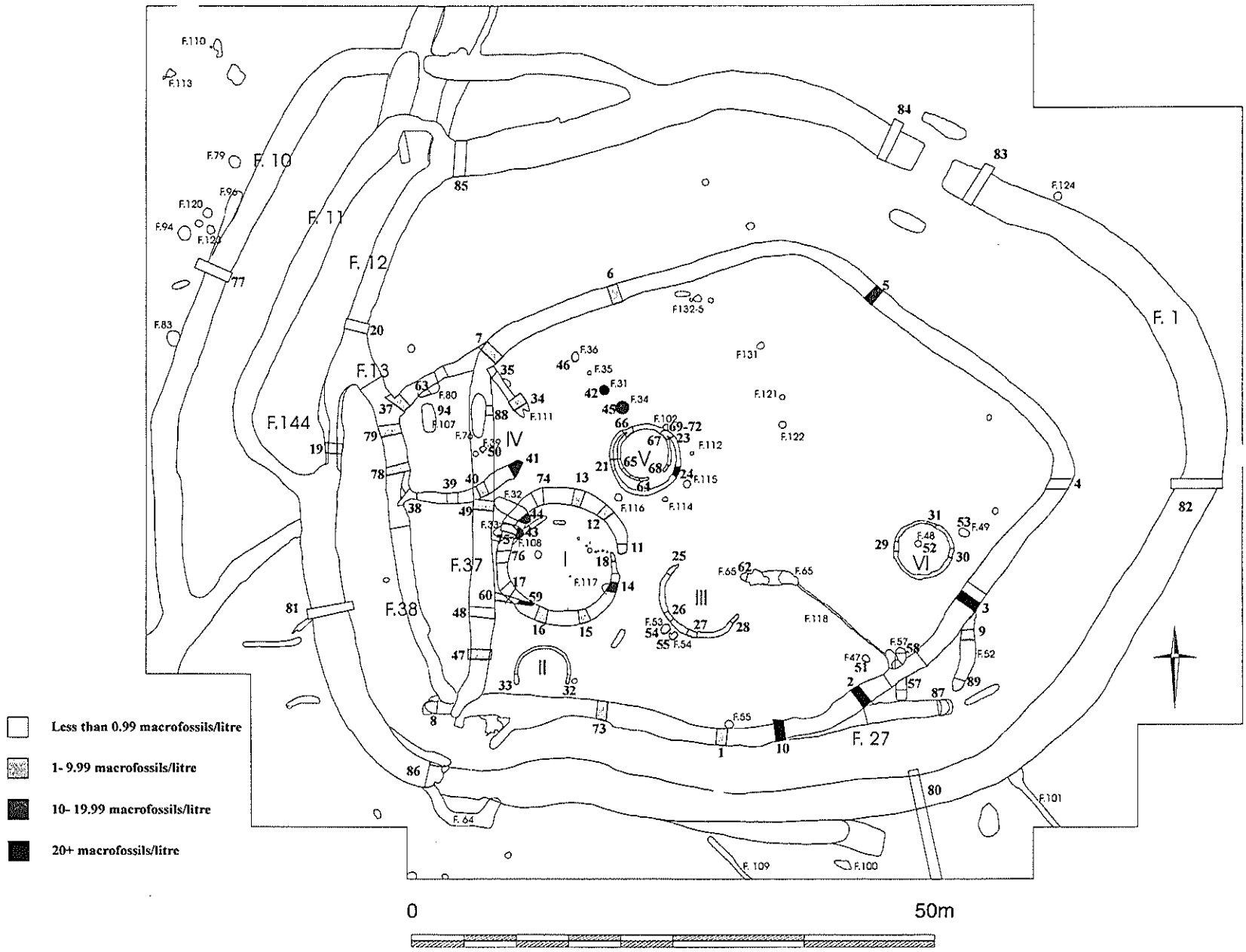
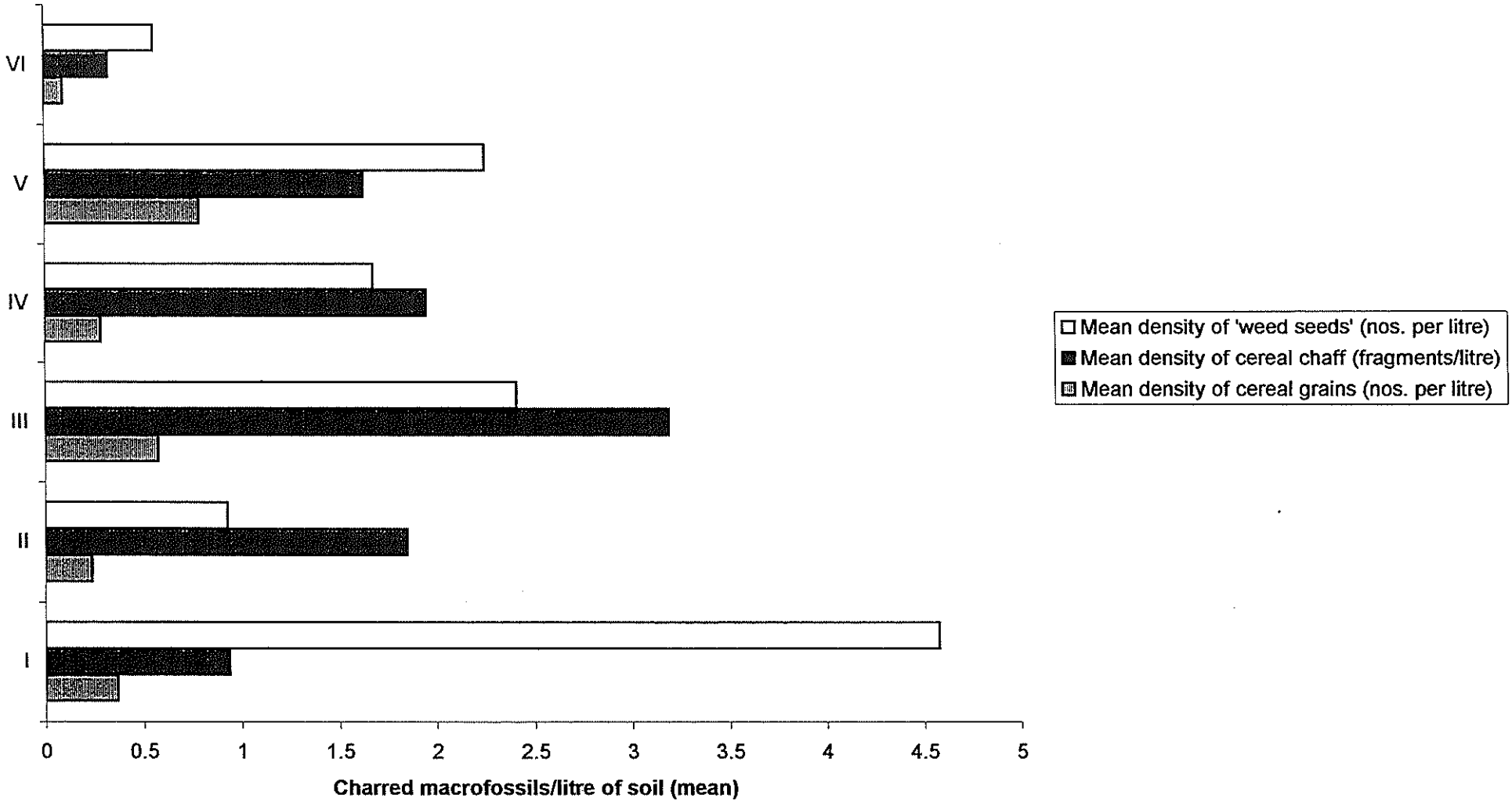


Figure 4

Figure 5: Densities of selected charred plant macrofossils in the fills of ring-gulley structures I - VI.



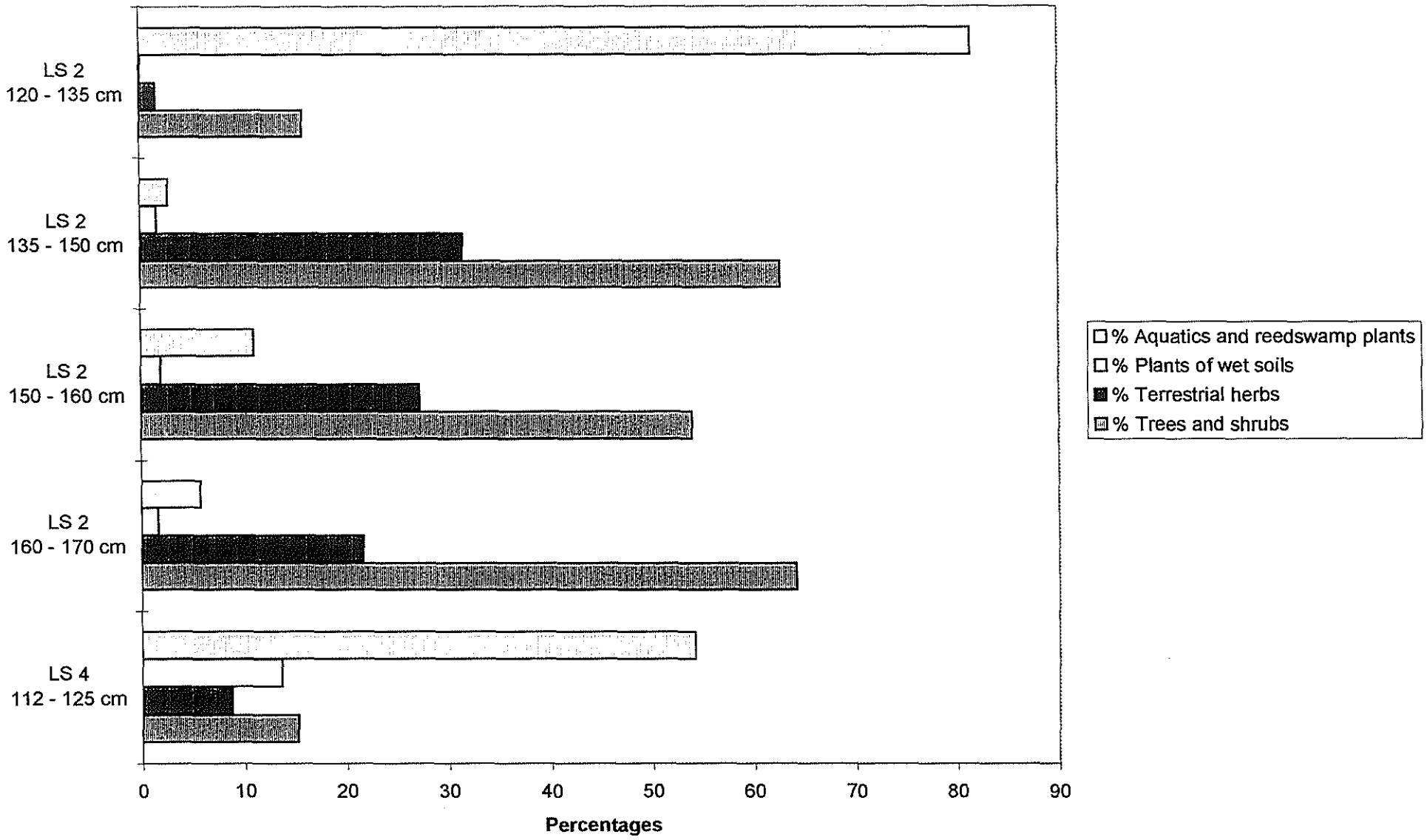


Figure 6: Summary of plant macrofossil assemblages from F1.