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Archaeological Report

Pilot Project:

Environmental Assessment Project for the central Vale of Pickering

English Heritage Project 3038

Dominic Powlesland: The Landscape Research Centre
James Rackham: Environmental Archaeology Consultancy

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Appendix A: Landkeeper Dossiers

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Summary

During 2002 and 2003 a pilot project was commissioned by English Heritage to determine the potential for the recovery of environmental evidence from ditches and other features identified through remote sensing within the Heslerton Parish Project research area. A series of 29 ditch sections were examined in small trenches cut with a JCB in 23 locations within the lower Vale of Pickering, to the north of the dense areas of settlement identified on the chalky sands and gravels in East and West Heslerton parishes. Four auger transects and a single auger sample located over palaeochannels relating to the River Derwent were examined.

The survival of environmental evidence that could be used for chronologically linked landscape reconstruction was variable, the results indicating that the long term survival of suitable material is unlikely beyond the next decade. Drainage, intensive root crop farming, coupled with irrigation are contributing towards desiccation leading to loss of the pollen and plant macro-fossil evidence which forms the basis of environmental reconstruction. In the short term the potential remains for the recovery of high quality evidence that could greatly enhance our comprehension of the prehistoric and later landscape in the central Vale of Pickering and the environmental context of the intensive settlement observed through excavation and remote sensing on the southern margins of the valley.

The results of the sampling, subsequent assessment and dating programme indicate that the central Vale and its southern margins were cleared of woodland by the Late Mesolithic or Early Neolithic (c.5000BC) and that the landscape remained essentially open grassland from this period onwards. This is an unanticipated result and requires further work to confirm whether this really is the case as it has important implications with regard to the regional and national picture.

The sampling and associated dating programme have confirmed a Roman date for an enclosure, possibly associated with a kiln complex, lying on the edge of the marsh and to the north of the key settlement complex following the wetland edge (Field 108). In field 76 a rectangular enclosure, showing faintly in geophysical survey results and some cropmarks appears to be Early Bronze Age, indicating use and management of areas within the wetland during this period contemporary with the construction and use of major monuments a few hundred metres to the south which are oriented towards the valley centre.

The auger transects provide the basis for the identification and reconstruction of a prehistoric sequence of river channels associated with the River Derwent but also reveal areas of lake muds and sediments indicating that more intensive survey should allow us to map the extent of Lake Pickering during the later Prehistoric period resolving a major issue with regard to the late phases of Lake Pickering and the associated Lake Flixton.

This pilot project has successfully fulfilled its objectives and demonstrated the potential for a more detailed and extensive project to develop the assessment and gain more comprehensive results filling the chronological gaps and extending the level of detailed environmental evidence.

Introduction

The Vale of Pickering has been the setting for major archaeological excavations for more than twenty five years both at Seamer/Flixton Carrs and at West Heslerton (Powlesland 2000a, 2000b). In both cases the long-term research projects have grown out of necessary excavations undertaken as part of the rescue archaeology programme funded by English Heritage (formerly the DOE) during the late 1970's & 1980's

Only a small part of this landscape has been investigated; initially work was concentrated on a 1km transect covering multi-period burial and settlement complexes from the Late Mesolithic to Early Anglo-Saxon periods (Powlesland *et al* 1986), more recently the main focus has been on the Early Anglo-Saxon cemetery and settlement at West Heslerton (Haughton and Powlesland 1999) and the Late Palaeolithic and Early Mesolithic research at Seamer and Flixton (Schadla-Hall and Cloutman 1985; Schadla-Hall 1989; Mellars and Dark 1998).

Following the chance discovery of an Early Anglo-Saxon cemetery at Cook's Quarry, West Heslerton, in 1977, excavations covering more than 20Ha have been undertaken ahead of mineral extraction and on sites threatened with agricultural damage. Remote sensing, designed to set the excavations within a landscape context, combining repeated air photography, multi-spectral imaging, LIDAR and ground based geophysics have revealed an archaeological landscape reflecting an exceptional density of activity from the Prehistoric to Medieval periods. The geophysical survey, covering a contiguous area of nearly 1000Ha, has shown that the sand and chalk gravels, which extend up to 1.5km from the foot of the Yorkshire Wolds to the edge of the ancient wetland that once dominated the centre of the valley, was densely utilized for agriculture, settlement, burial and ritual from the Neolithic period onwards. Further out into the centre of the valley, where geophysical survey is less effective, airborne surveys have revealed field systems, trackways, cemeteries and settlements showing that within the wetlands shallow spurs and islands were very extensively utilized and linked to the drier margins by ditched trackways traversing areas of peat and palaeochannels.

The wetlands comprising fens and swamps and shallow islands would have covered large areas of the Vale of Pickering prior to the large-scale drainage schemes following the passing of the Drainage Act of 1800. The extensive areas of peat that once dominated much of the valley floor have now been lost as a consequence of drainage works and the resulting desiccation; this has compromised the potential for the recovery of palaeoenvironmental data which can be used for landscape reconstruction so that the only areas where one could hope to recover the necessary evidence are now likely to be restricted to filled ditches and other cultural features and some of the network of relict palaeochannels associated with the River Derwent in the centre of the valley.

Research Objectives

This project was initiated as a pilot exercise to assess the potential of archaeological and natural features on the valley floor to the north of East and West Heslerton, to yield palaeoenvironmental data from which the valley floor environment, and the impact of man upon it, could be reconstructed. The sandy conditions prevailing at most of the excavation sites in Heslerton were not conducive to the survival of either waterlogged plant remains or pollen which could be used to interpret the broader environmental setting of these sites. However, the exceptional aerial photographic cover of the Vale and very extensive geophysical surveys have revealed a detailed and extensive crop mark landscape which clearly shows a wide variety of field systems (Fig. 1), settlements and cemeteries across this part of the Vale with the potential for the recovery of material from wet or even waterlogged deposits (Powlesland *et al* 1997). Archaeology of all periods from the Late Palaeolithic is known to exist and the extensive field systems in the Heslerton area are presumed to be of Iron Age, Roman and later date.

The continuing drainage regime for agricultural purposes means that any remaining waterlogged deposits within the archaeological features and palaeochannels within this landscape have a limited lifespan. The inevitable loss of these important deposits will compromise our ability to recover environmental reconstructive evidence related both directly and indirectly to the extensive archaeological data for this project area. The recent floods in the Vale may well be an incentive to extend and enlarge the drainage dykes of the Vale leading to even more rapid loss.

The project proposed:

- **A re-evaluation of the palynological work undertaken by Evans (1992) on seven sites in the valley**
- **A pilot programme to test the potential for the recovery of well preserved organic remains relating to the vast quantity of crop-mark and geophysical evidence that has since been compiled as a part of the Heslerton Parish Project.**

The start of the project was severely delayed as a result of the onset of foot and mouth disease, and the field work for the project was delayed until autumn 2003. We should note at this point our considerable thanks to the farmers of the area who very kindly permitted our access across their land and the excavation of a large number of trenches for the investigation of the archaeological ditches.

Methods

The project targeted three types of deposit, each of which offered the potential for the recovery of preserved waterlogged remains. The primary focus was on the ancient field systems where organic deposits may still be surviving within their fills, the secondary area was the investigation of the known palaeochannels using auger borehole transects, the deposits from some of which have been studied by Evans (1992), and the third area was an extensive peat deposit underlying blown sands that had been revealed in a previous preliminary auger survey, the extensive auger survey carried out by Landscape Research, and two trenches opened up in connection with field work being conducted in the summer of 2003.

The aerial photographic and geophysical cover of the valley floor in West Heslerton parish is so exceptional that it was possible for the project to consider a large number of potential locations for investigative trenches through the archaeological ditches. It was considered important to assess the survival potential of ditches in different parts of the valley and on different sub-soils to pinpoint the areas of greatest potential. As a preliminary to the excavation and sampling of the ditches selected for the project a JCB was used to clean the sides of drainage dykes at the locations where archaeological ditches appeared to intersect. This gave the project the opportunity to observe several of the ditches in section in the sides of the dykes and assess their potential, and also more accurately plot their location. On the basis of the aerial photographic data, the geophysics and this period of prospection a final selection of twenty six ditches in eighteen fields was made for trenching (Fig. 1), and additionally two trenches were opened up in fields 132 and 134 in connection with another programme of work from which samples of the extensive peat horizon were collected. The selected locations were surveyed in using the GPS and machine stripped at right angles to the direction of the crop mark. Since much of the aerial photographic data has not been fully rectified the accuracy of the plotting was not always particularly good and several trenches had to be extended some distance to find the ditches. When the ditches were located they were machined out, and overcut to expose the whole profile in section.

Recording of these trenches was fairly minimal, since the project was not geared to detailed cleaning, drawing and recording of the features. The plan of each ditch was photographed when first exposed. The corner of each stripped trench was surveyed in using the GPS, also the four corners of each ditch cut, and any other features, and the base of the ditch profile at its deepest point. This data has been included in the landscape database for the Heslerton Parish Project so that all trenches and features are 3 dimensionally located. Subsequently one of the two exposed sections of each ditch was cleaned and photographed, and this section was chosen for sampling. This photographic record is included in the landscape dossiers. The deposit sequence was recorded and a bulk sample was taken from any organic fills in the base of the ditch. Between one and nine pollen samples were taken up through the profile of the ditch at 0/1, 4, 8, 12, 16, 20 cm, etc, above the floor of the ditch, the number depending upon the quality of the deposits. In some ditches a short column of bulk samples was collected to assess the fall off in preservation of organics or to recover a series from deposits with snails.

In total 29 ditches were located, sectioned and photographed; 27 of these were sampled for pollen, bulk samples were collected from 17, radiocarbon samples were submitted from six. The reports, supporting plots and photographs relating to each field where work took place are to be found in Appendix A, the Landkeepers Dossiers relating to each field; these bring together all the evidence known from fieldwork carried out by the LRC on a field by field basis. The term 'Site' when used in the dossiers refers to an individual field rather than any particular feature within the field, site numbers being issued as and when work takes place in any particular field. The Landkeepers Dossiers provide a narrative record with supporting illustrations referencing all work undertaken, which in some cases encompasses geophysical and auger surveys or excavation sampling in addition to environmental assessment.

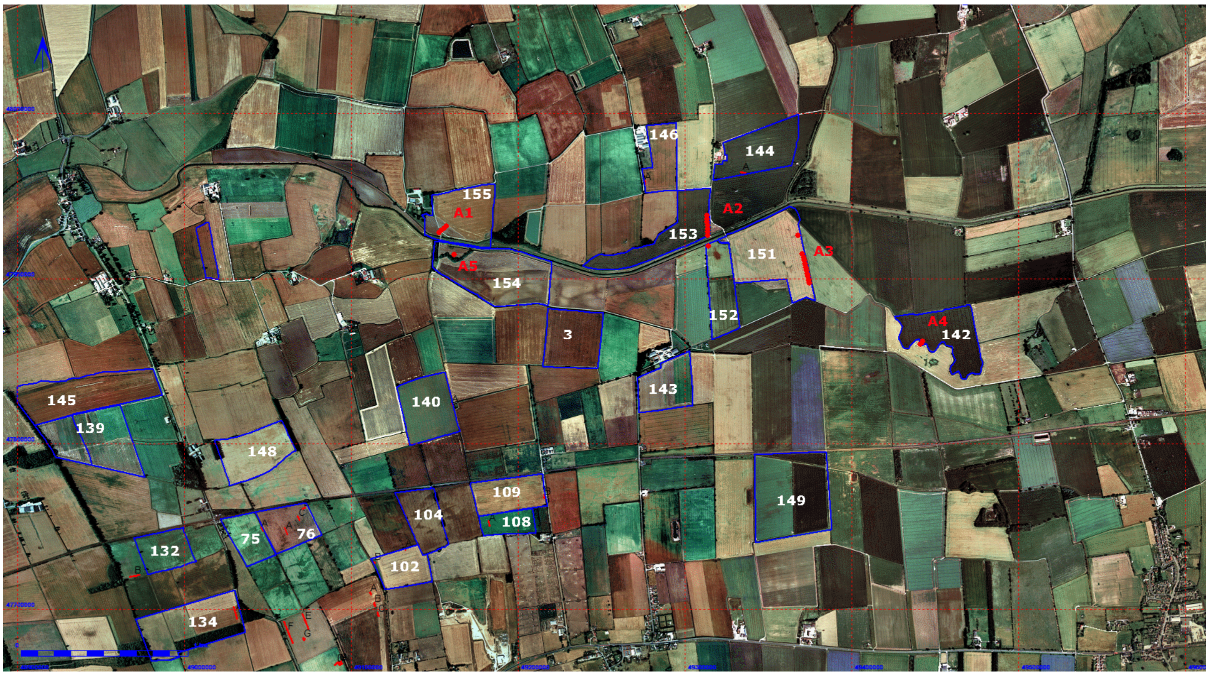


Figure 1: The lower Vale of Pickering to the north of East and West Heslerton. Fields where samples were recovered numbered and outlined in blue, auger transects marked A1-A5 in red.

The selection of palaeochannels for sampling was based upon a walkover of the terrain and the identification of channel features on the basis of the topography. Four locations were selected (Fig. 1, A1-A4), and at each location a transect of auger holes was laid across the palaeochannel, and the augered deposits described. After augering the whole transect a borehole was selected for sampling and a new bore made adjacent from which samples for radiocarbon and pollen analysis were collected. In addition to these four transects a single auger hole was located at point A5 (Fig. 1) to investigate a fifth palaeochannel, but time did not permit any more boreholes at this location.

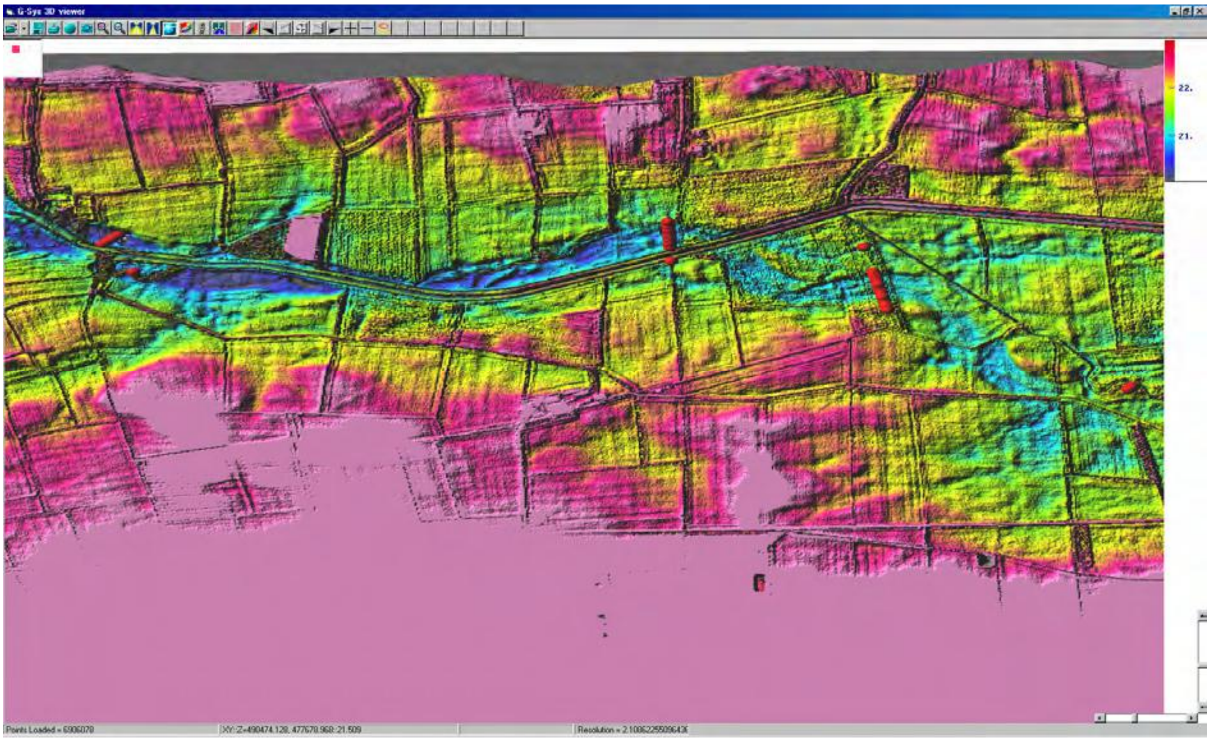


Figure 2: Auger locations marked in red on Lidar elevation data gathered in 2005. The data has been constrained between 20m and 23m AOD and colour mapped to show the ancient course of the River Derwent.

Palaeochannel investigations

Five palaeochannels were investigated by auger, four of these by a transect of between three and twelve boreholes and one due to time constraints by a single borehole. The locations were chosen on the basis of aerial photographic evidence and a walk over survey during which topographic features related to former channels of the river were noted. Transects were laid across palaeochannels at locations A1-4 on the map (Fig. 1) and a single borehole (A5) was sunk in a channel on the south side of the river approximately 150 metres south east of transect A1 (Figs. 2 & 4).

The deposits in the cores were described and then specific locations were then selected for an additional sampling core from which pollen and radiocarbon samples were selected.

Transect A1

This transect lies south of Foulbridge farm immediately north of the river and is characterised by a terrace edge on its north bank. A series of four boreholes was sunk in a SW-NE line across the channel feature. This channel drops down and under the present river channel but rises sharply to a bank on the north side (Fig. 3). No pollen or radiocarbon samples were submitted from this channel. The lower sediments are quite suitable for pollen analysis but a sequence of banded silts and sands at the base of the sequence suggests that this channel is of late glacial/early holocene age, at least in its primary fills.

Time permitted only a single borehole (A5) at the location of the Pheasant feeder south of Transect A1 but the core shows a series of dark grey brown peaty silts in its basal half and was not bottomed at 2.0m depth. This core was taken adjacent to what may have been the old course of the river prior to canalisation of this stretch and a transect is likely to reveal a good profile of the channel and a series of sediments suitable for pollen analysis. The age of the whole sequence cannot be estimated but a historic component is likely in this channel. Samples were collected for pollen analysis and dating at 154-160, 160-164, 164-170, 170-180 and 180-190* in this core, but only 180-190 has been considered in this assessment.

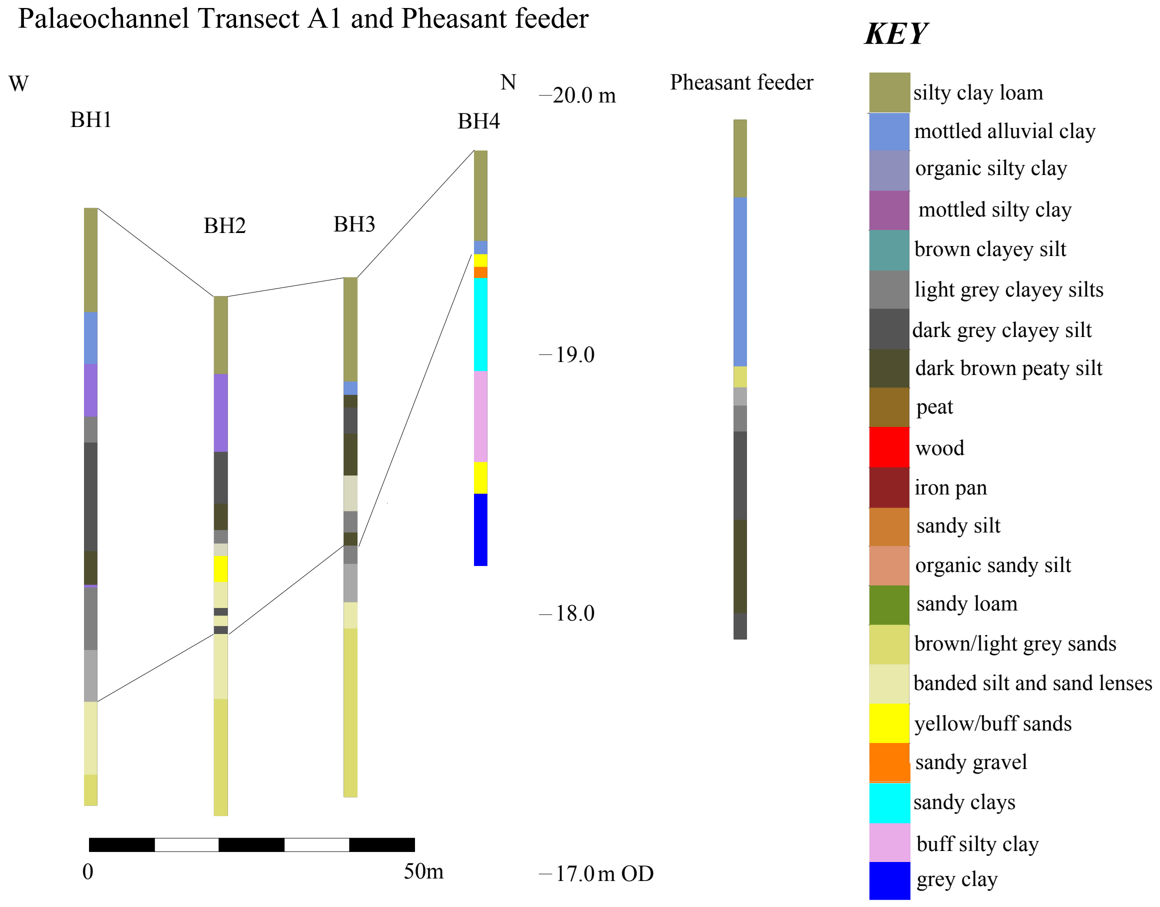


Figure 3. Reconstructed profile of the palaeochannel at Transect A1 and the nearby Pheasant feeder borehole A5.

Transect A2

This transect sectioned a palaeochannel north of the river, visible as a topographic feature. Seven boreholes were sunk on the north side of the present river and single borehole on the south side. The transect identified a major channel with a maximum depth of 2.25m and an exceptional series of organic sediments and peats (Fig. 5). This channel represents at least two major time episodes in the history of the river. The radiocarbon dates and pollen evidence indicate that the lower fills of the channel represent an early holocene river, although the peats in the channel base suggest movement of the active river to a new channel at this time. This channel was later cut by the late Bronze Age river and organic silts were laid down in this channel before it too became redundant. The upper fills appear to reflect alluvial clay sediments although their oxidised character may have lead to the loss of any organic component. The upper alluvial sediments are likely to be poor for pollen but the lower sediments have produced rich assemblages and show great potential for the palaeoenvironmental reconstructions. On the basis of the initial series of boreholes two additional boreholes, BH7a and BH2a, were placed adjacent to BH7 and BH2. These were sampled for pollen in BH2a at 65-75*, 75-80, 80-85, 100-110*, 120-130, 130-140 and 140-145* and three samples have been assessed (marked with *****). In BH7a samples were taken at 80-90, 90-100, 150-160, 160-165*, 165-170, 170-180, 180-190, 190-200, 200-208, 208-213*, 215-220 and 220-225* of which four were assessed within this project.

Transect A3

Transect A3 was located across a visible topographic feature south of the river. A series of eleven boreholes were sunk across the feature and identified a palaeochannel some 100-110 metres wide with a maximum augered depth of 2.34m (Fig. 6). The basal sediments are organic rich silts and peat with an alluvial clay upper fill. In contrast to Transect A2 this appears to be a single channel of Mesolithic date, possibly the successor to the early holocene channel in Transect A2, that infilled over at least two thousand years with no clear evidence of any hiatuses. A final borehole, BH8a, was sunk adjacent to BH8 and samples for pollen and radiocarbon dating collected at 95-100, 100-105*, 105-115, 115-125, 125-135, 135-145, 145-150, 150-160*, 160-170, 170-180, 180-190, 190-199, 200-210 and 215-220. Of these only two were assessed within the project (marked with *****).

At the north end of the transect a second area of low lying ground was investigated with a single borehole, BH11. In this case the topography did not hide a channel but the core suggested that alluvial clays had buried an old ground surface which might itself have some palaeoenvironmental potential.

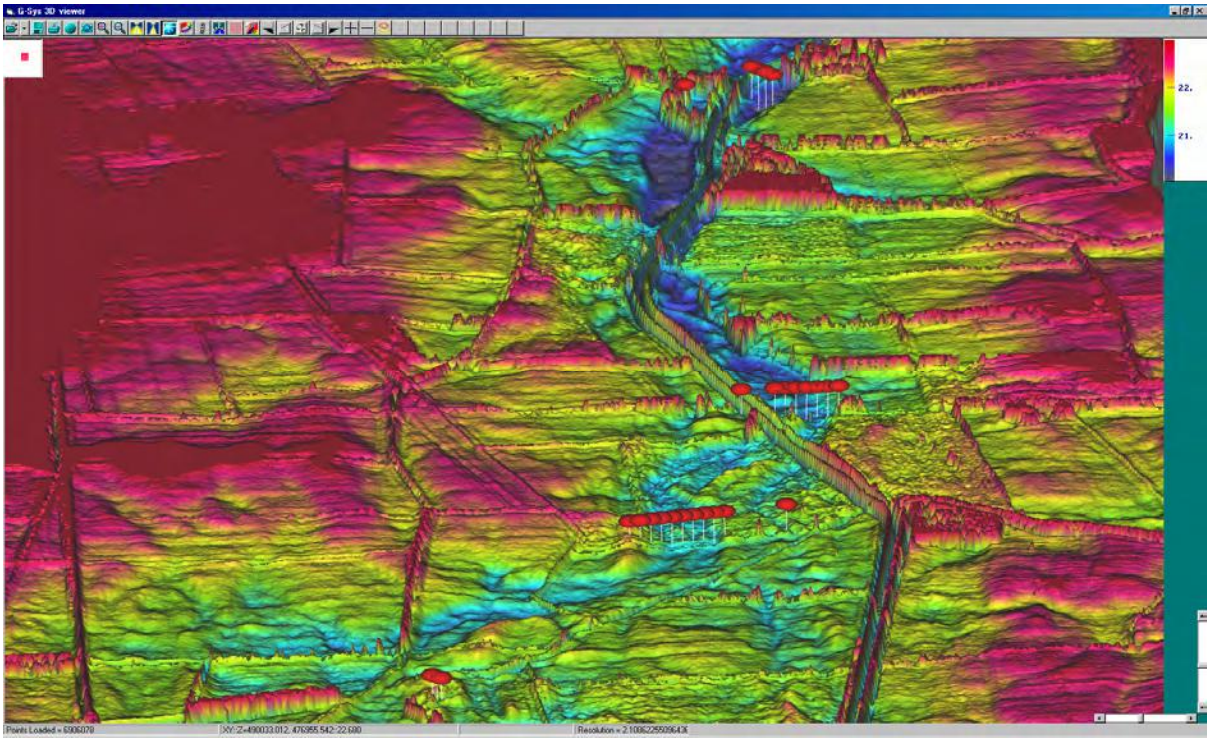


Figure 4. Perspective view from the East over the Vale of Piockering Lidar elevation data constrained between 20m and 23m, colour coded and exaggerated in the Z axis, with the auger locations shown as red topped pins. The main channel of the River Derwent is shown in blue with the man made drain the Hertford Cut shown by its flood banks cutting across the river channel.

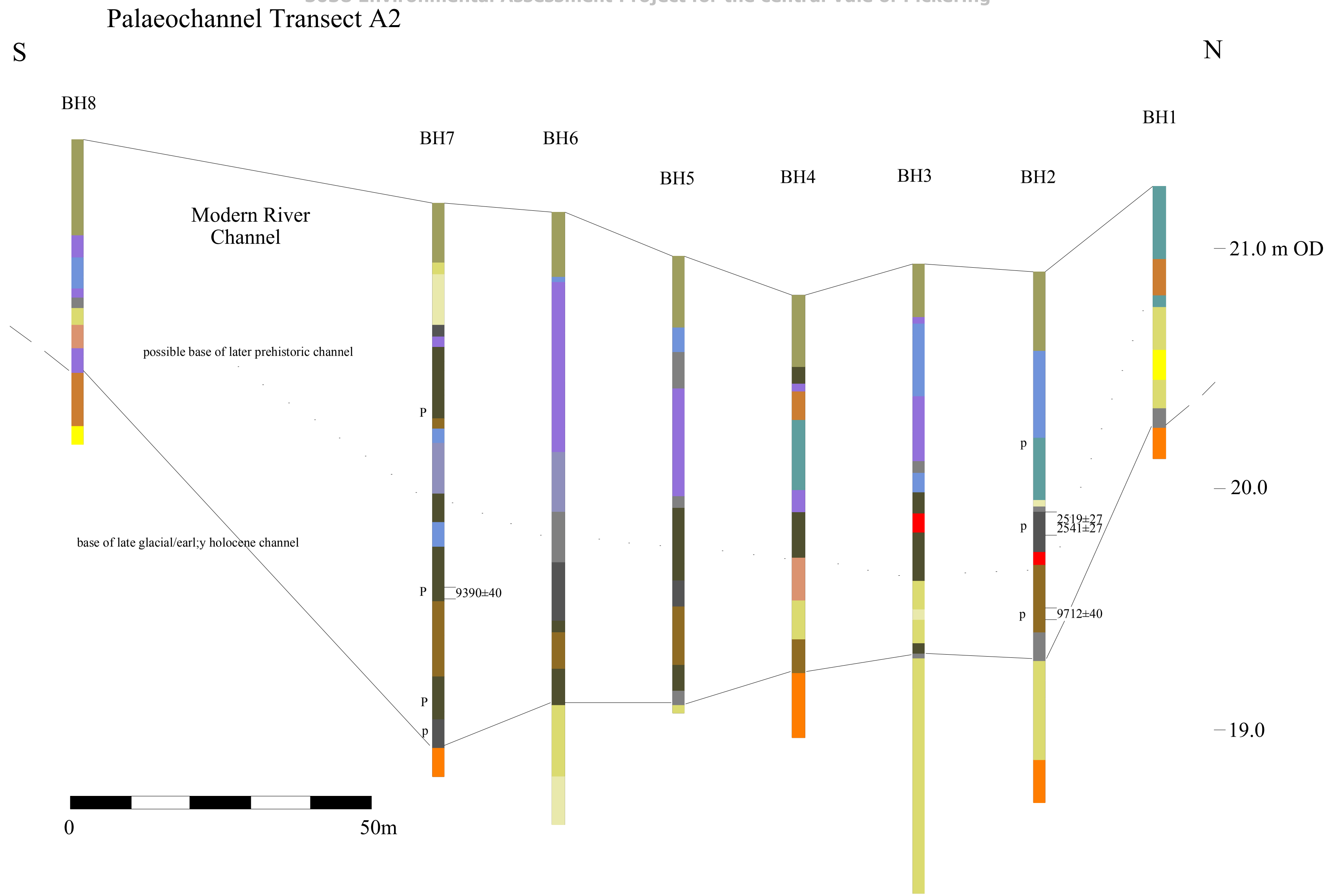


Figure 5. Diagrammatic section of the palaeochannel profile at Transect A2. (Key as for Fig. 3. Pollen assessment samples marked by a 'p' and radiocarbon samples indicated).

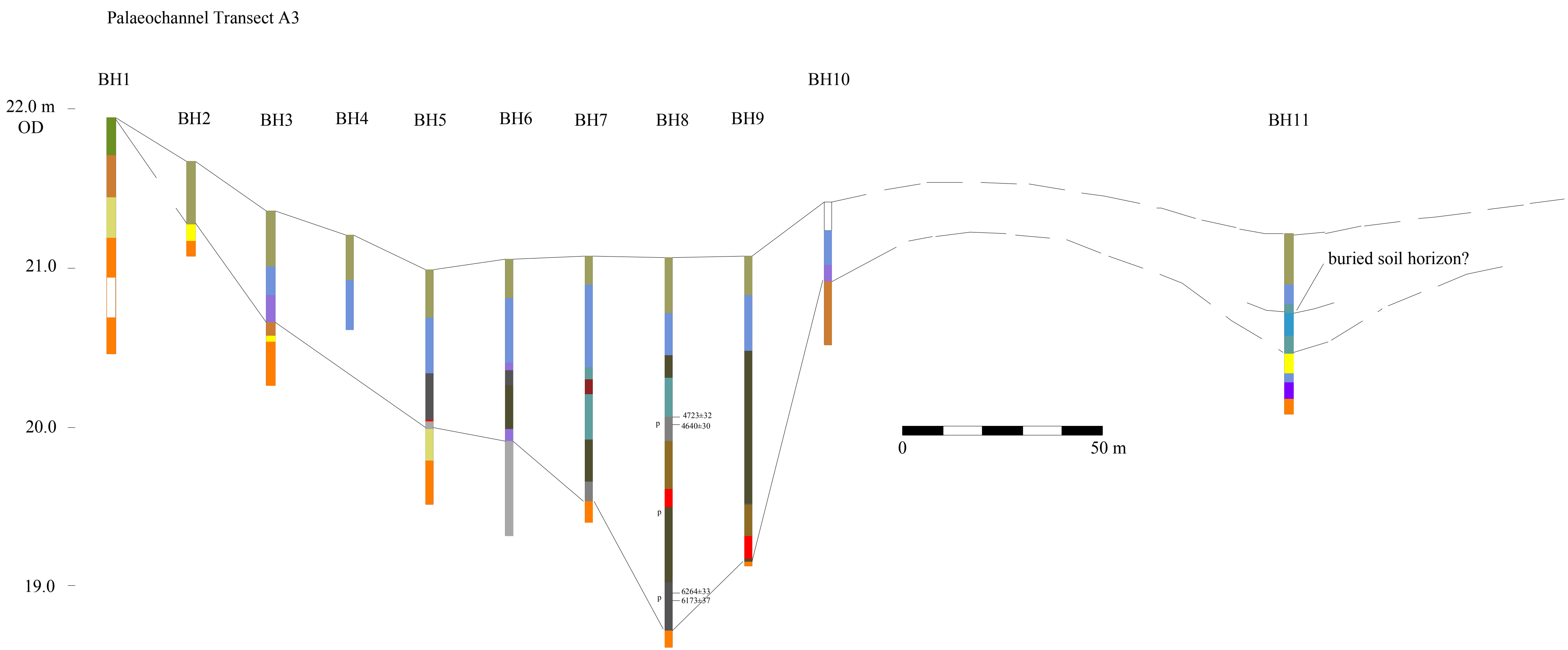


Figure 6. Diagrammatic section of the palaeochannel profile at Transect A3. (Key as for Fig. 3. Pollen assessment samples marked by a 'p' and radiocarbon samples indicated).

Transect A4

Transect A4 was located on the northern edge of what appears to be a former historic course of the river. Three auger holes were sunk and illustrated the northern edge of the channel (Fig. 7), but the south side was not investigated. The deposits were very sandy, and although they contain some organic components they were not sampled on this occasion. Future work should consider augering the other side of the field boundary.

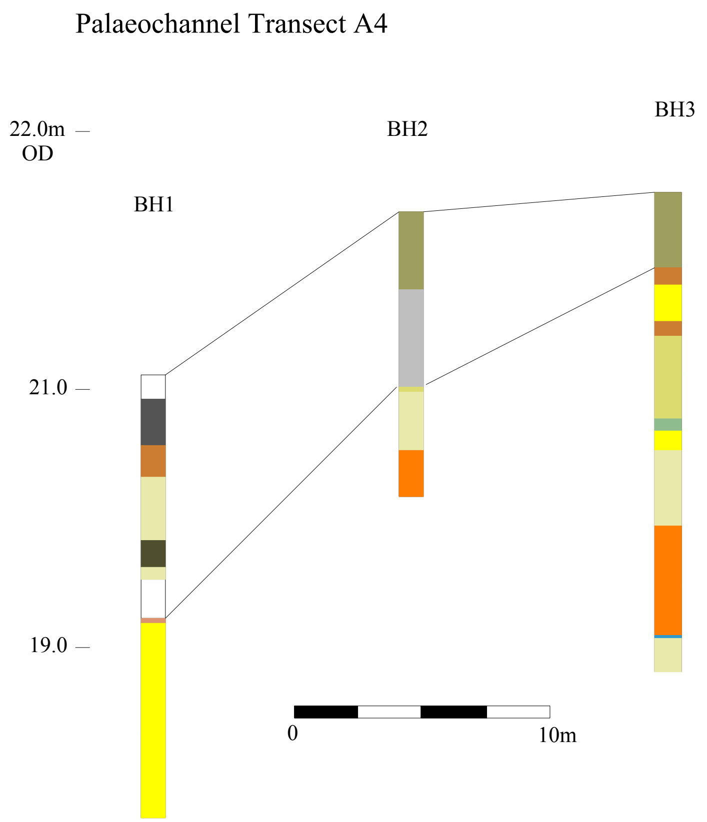


Figure 7. Diagrammatic section of the palaeochannel profile at Transect A4

Sampling

In total 29 ditches were sectioned photographed and located; 27 of these were sampled for pollen, bulk samples were collected from 17, radiocarbon samples were submitted from six. The detailed notes, plans and photographs relating to these features are to be found in the Site Dossiers, Appendix A. The buried peat deposits were sampled in three locations, in field 132, 134 and 76. In field 132 a series of 24 pollen samples were collected up through the organic sequence from three overlapping monoliths taken from the section; seven bulk samples were also collected and radiocarbon samples from the base and top of the organic deposits. In field 134 one monolith sample was collected from the north end of the trench. A series of six pollen samples were taken from the northern monolith. Two radiocarbon samples were taken from the top and bottom of the organic sediments in the northern sample column but were not subsequently submitted for analysis. Four bulk samples were collected from the same sequence. These extensive peats were also sampled by auger below the west ditch in trench 76AB and below the east central ditch in trench 76 AD. One sample from the former was collected for pollen, while a series was taken from the deposits below 76 AD and included material submitted for radiocarbon dating.

Field	trench	context	Description	Vol (l)	wt. kg.	date
132	AA	3409	10-15cms	1	2	6390 BP 933 BP*
132	AA	3409	18-23 cms	1.5	2.5	
132	AA	3409	20-25 cms	1.5	2.5	
132	AA	3409	23-27 cms	1	2	
132	AA	3409	30-35 cms	1	2	
132	AA	3409	38-43 cms	1	2	
132	AA	3409	44-48 cm	1	2	10,830 BP 11,080 BP
134	AA	3409	Long trench, north sample column-5cm below top C14 sample	0.75	1	
134	AA	3409	Long trench, north sample column-5cm above bottom C14 sample	1	2	
134	AA	3409	Long trench, north sample column-top of peat for C14	0.5	1	
134	AA	3409	Long trench, north sample column-basal 1cm of peat for C14	0.3	0.5	
76	AB		North section, centre ditch- 0-10 cms	9	9	
76	AB		North section, west ditch- 0-10 cms	9	9	315 BP 314 BP
76	AC		20-30 cms	6	6	
76	AC		30-40 cms	9	9	
76	AC		40-50 cms	8	8	
76	AD		East section, centre ditch- 0-10 cms	9	9	3600 BP 3704 BP
76	AD		East section, centre ditch- 10-20 cms	8	8.5	
76	AD		North ditch, west section- 10-20 cms	7	8	
76	AD		North ditch, west section- 20-30 cms	9	10	
76	AD		North ditch, west section- 40-50 cms	9	9	
102	AA		0-10 cms	1.5	2.5	
102	AA		10-20 cms	9	9	
102	AA		20-30 cms	8	8	
102	AA		30-40 cms	8	8	
102	AA		40-50 cms	8	8	
102	AB		0-10 cms	9	9.5	77 BP 103 BP
108	AA		South- 0-10 cms	6	7	
108	AA		10-20 cms	8	9	
108	AA		North- 0-10 cms	6	7	1820 BP 1873 BP
109	AB		Rectangular feature	15	15	
139	AA		0-5 cms	3	3.5	5673 BP** 5189 BP
139	AB		0-5 cms	3.5	4.5	
143	AA		0-10 cms	6	7	
143	AA		South- 10-15 cms	3	4	347 BP 319 BP
143	AA		North- 0-10 cms	8	9	
144	AA		30-40 cms	6	6.5	
144	AA		60-70 cms	6	6	
147	AA		10-20 cms	7	7	

* This is clearly an anomalous date. It was obtained from an unidentified epidermal cylinder now assumed to be root material.
** This date was unexpectedly early and is inconsistent with the pollen evidence (see below). It is assumed that the bark fragments dated have been reworked from early peat deposits in this area.

Table 1: West Heslerton Dyke Survey. Bulk samples taken for environmental assessment

All the collected bulk samples (Table 1) were processed and assessed at two levels. Eight of the samples from radiocarbon dated deposits were individually assessed for their waterlogged plant macrofossils and insects (see below). The remaining bulk samples were superficially assessed for this evidence and its state of preservation.

Sample processing

The pollen analytical methods are presented below. The bulk soil samples were processed in the following manner. Sample volume and weight was measured prior to processing. The samples were washed in a bowl using the wash over method with a flotation sieve with a 0.3mm mesh. The residue left in the bowl was then washed through a 0.5mm mesh and dried. The material washed over and caught on the 0.3mm mesh was kept wet and stored in jars. The wet volume of the flots was measured and the volume and weight of the dried residue recorded. A total of 708 litres of soil was processed in this way.

The dried residue of each sample was sorted by eye, and environmental and archaeological finds picked out, noted on the assessment sheet and bagged independently. A magnet was run through each residue in order to recover magnetised material such as hammerscale and prill and a count was made of the number of flakes or spheroids of hammerscale recovered. The residue was then discarded. The flot of each sample was studied using up to x30 magnification and the presence of environmental finds (i.e. snails, charcoal, carbonised seeds, bones etc) was noted and their abundance and species diversity recorded on the assessment sheet. The flots were then bagged and, along with the finds from the sorted residue, constitute the material archive of the samples.

The individual components of the samples were then preliminarily identified and the results are summarised below in Tables 2 and 3. Selected material was taken forward for full assessment by a specialist archaeobotanist and entomologist and the results are presented in Tables 4, 6 and 7.

The records, plans and photographs documenting each of the sampling trenches are presented in the individual field dossiers (Appendix A)

Pollen samples from the field ditch excavations

27 of the ditches were sampled for pollen analysis. In most cases the samples were taken from the base of the ditch fill (0 cm) and at 4, 8, and 12 cms above the base, with additional samples in some sequences taken at 16, 20, 24, 28 and 32. In three of the ditches further samples were taken above this basal sequence.

A total of 143 samples were taken for pollen from the field ditches and peat deposits sampled. These were taken since the opportunity was available but it was never envisaged that this number would be assessed within the project. Those that were assessed are highlighted in red in the list (Table 3).

The pollen samples from the palaeochannels are detailed above.

Field	**trench**	**Description**	**Vol (l)**	**residue vol. ml**	**wet flot vol. ml**	**dry flot vol. ml**	**water-logged**	**wood**	**seeds**	**insects**	**char-coal**	**charr'd grain**	**charr'd seed**	**snails**	**bone wt**	**pot**	**others**	**date**
132	AA	10-15cms	1	50	200	-	Yes											6390 BP 933 BP*
132	AA	18-23 cms	1.5	5	750	-	Yes	5	4/2	4/2								
132	AA	20-25 cms	1.5	-	?		Yes											
132	AA	23-27 cms	1	-	750	-	Yes	2	4/2	3/2								
132	AA	30-35 cms	1	-	1000	-	Yes	2	3/2	2/2								
132	AA	38-43 cms	1	-	750	-	Yes		4/2	3/2								
132	AA	44-48 cm	1	-	1150	-	Yes	2	4/2	3/2								10,830 BP 11,080 BP
134	AA	north sample column-5cm below top C14 sample	0.75	25	300	25	Yes	5	4/3	3/2								
134	AA	north sample column-5cm above bottom C14 sample	1	30	230	30	Yes	5	3/2	2/2								
134	AA	north sample column-top of peat for C14	0.5	-	150	-	Yes	4	2/2	3/2								
134	A	north sample column-basal 1cm of peat for C14	0.3	-	40	-	Yes		3/2									
76	AB	North section, centre ditch- 0-10 cms	9	150	.		Yes											
76	AB	North section, west ditch-0-10 cms	9	300	100	-	Yes	5	5/3	5/3	1				<1		Caddis, Daphnia	315 BP 314 BP
76	AC	20-30 cms	6	-	550	-	Yes	5	5/3	5/3							Caddis	
76	AC	30-40 cms	9	150	-	12	Okay	2	5/3	2/2				1/2	<1		Caddis	
76	AC	40-50 cms	8	50	-	1	Poor	1	4/2	2/2	1			1/1				
76	AD	East section, centre ditch-0-10 cms	9	200	200	-	Yes										Caddis	3600 BP 3704 BP
76	AD	East section, centre ditch-10-20 cms	8	40	-	10	Okay	4	5/3	3/3	1				<1			
76	AD	North ditch, west section-10-20 cms	7	10	-	4	Okay	1	4/2	2/2								
76	AD	North ditch, west section-20-30 cms	9	20	-	1	Poor	1	3/2					1/1	<1			
76	AD	North ditch, west section-40-50 cms	9	40	-	1	No		2/1	1/1*	1	1	1	1/1	<1			
102	AA	0-10 cms	1.5	-	-	12	Poor		3/2	2/2	1			5/3			Ostracods	
Field	trench	Description	Vol (l)	residue vol. ml	wet flot vol.	dry flot vol.	water-logged	wood *	seeds */#	Insects */#	char-coal *	charr'd grain *	charr'd seed *	snails */#	bone wt g	pot no/wt		date
102	AA	10-20 cms	9	700	-	10	No		2/1			1		4/3	<1		Barley, frog/toad	

102	AA	20-30 cms	8	600	-	5	No		2/1		1	1		4/3				
102	AA	30-40 cms	8	500	-	12	No		2/1			1		5/3				
102	AA	40-50 cms	8	300	-	9	No		5/1		1			5/3	<1		Wood mouse	
102	AB	0-10 cms	9	-	350		Yes											77 BP 103 BP
108	AA	South- 0-10 cms	6	300	80	-	Yes	4	5/3	4/3	1	1	1		<1		Caddis	
108	AA	10-20 cms	8	200	110	-	Yes	3	5/3	5/2	1				<1		Caddis, Daphnia	
108	AA	North- 0-10 cms	6	300	200		Yes									1/35		1820 BP 1873 BP
109	AB	Rectangular feature	15	300	-	2	Poor	1	3/2		2	1					Hammerscale, clinker	
139	AA	0-5 cms	3	-	50		Yes											5673 BP 5189 BP
139	AB	0-5 cms	3.5	100		2	Okay		4/1			1		1/1	<1			
143	AA	0-10 cms	6	-	40		Yes							2/1			Daphnia	
143	AA	South- 10-15 cms	3	250	2	1	Yes		4/2	3/3				2/2	<1		Caddis, Daphnia	347 BP 319 BP
143	AA	North- 0-10 cms	8	200	-	2	Poor		2/1		2			1/2	<1		Water vole?	
144	AA	30-40 cms	6	500	-	7	Poor	1	2/1		1			4/3	1		Field vole, shrew, small bird	
144	AA	60-70 cms	6	50	50	2	Poor	3	5/3	3/2	1			2/2	<1		Field vole, brick/tile (<1g)	
147	AA	10-20 cms	7	300	-	<1	No		2/1		1			1/1				

* frequency – 1=1-10; 2=11-50; 3=51=150; 4=151-250; 5=>250 items
# diversity – 1=1-3; 2=4-10; 3=11-25 taxa

Table 2. Summary of the finds from the samples

Field	Trench	Ditch	samples (centimetre readings from the basal fill upwards)
75	AA*		sample from the basal fill (post-medieval?)
76	AB	east ditch	0, 4, 8, 12
76	AB	central ditch	0, 4, 8, 12, 16
76	AB*	west ditch	-4, 0, 4, 8, 12, 16
76	AB*		organic sample from 0.68m below the base of the west ditch
76	AC*		0, 5, 9, 15, 20, 24, 28, 32, 36
76	AD*	south west d.	0, 4, 8, 12
76	AD*	east central d.	0, 4, 8, 12
76	AD	north west d.	0, 4, 8, 12, 16, 20, 24, 28, 32, 40
76	AD*		deposits below EC ditch - 0-5 (top of core), 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-45 (base of core)
102	AA*	west ditch	?0, 4, 8, 12, 16
102	AA	south ditch	basal fill only
102	AB*		0, 4, 8, 12, 16
104	AA*		sample taken from sediments in base of fill beside land drain (post- medieval?)
108	AA*	north ditch	0, 4, 8, 12, 16, 20, 24, 28 (Roman)
108	AA	south ditch	0, 4, 8, 12, 16 (Roman)
109	AB		rectangular ditch, basal fill only
132	AA*		sequence through peat deposits – 8, 11, 15, 19, 22, 26, 30, 34, 38, 42, 45, 48, 51, 55, 60, 65, 70, 73, 78, 84, 90, 96, 100, 110
134	AA		sequence through peat deposits – 4, 8, 12, 16, 20, 24
139	AA*		0, 4, 8, 12, 16
139	AB		0, 4, 8, 12
140	AA		clay lens only
143	AA*	north ditch	0, 4, 8, 12
143	AA*	south ditch	0, 4, 8, 12
144	AA*		0, 4, 8, 12, 16, 25, 30, 60
145	AA		band of clay in coarse fills
146	AA		basal fill
147	AA	east ditch	4, 8, 20
147	AA	west ditch	4
148	AA	west ditch	basal grey clay
148	AA	east ditch	basal grey clay

143 samples in total.

Table 3. Pollen sample list (samples assessed are highlighted in red)

Radiocarbon analyses

By Alex Bayliss

The samples were processed by the Oxford Radiocarbon Accelerator Unit, and were prepared using the methods outlined in Hedges *et al* (1989) and measured using Accelerator Mass Spectrometry (Bronk Ramsey *et al* forthcoming). Samples dated at Glasgow University were processed and dated as described by Stenhouse and Baxter (1983).

The results are conventional radiocarbon ages (Stuiver and Polach 1977), and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986, Table 1). The calibrated date ranges for the samples have been calculated using the maximum intercept method of Stuiver and Reimer (1986), and are quoted in the form recommended by Mook (1986) with endpoints rounded outwards to 10 years. The probability distributions have been calculated using OxCal (v3.5)(Bronk Ramsey 1995; 1998; 2001) and the usual probability method (Stuiver and Reimer 1993, Fig 6). The results have been calibrated using data from Stuiver *et al* (1998) (Fig. 8).

The homogeneity of the organic samples has been investigated by submitting replicate single-entity plant macrofossils for dating. The consistency of these results has been tested using the method of Ward and Wilson (1978). Bulk organic fractions were dated from sample HPP/DS/132/50-52cm. These are consistent, and so a weighted mean has been taken of the measurements on this material before calibration.

The two pairs of macrofossils from different levels within borehole BH8A are each statistically consistent (OxA-13357-8, T′=3.6; T′(5%)=3.8; v=1; and OxA-13359-60; T′=3.4; T′(5%)=3.8; v=1). This suggests that the deposits may be undisturbed and the dated sequence falls in the fifth and fourth millennia cal BC.

The two samples from the 100-110cm in borehole BH2A produced consistent radiocarbon measurements falling in the early Iron Age (OxA-13353-4; T′=0.3; T′(5%)=3.8; v=1). The single sample from 140-145cm in this sequence dates to around 9200 cal BC (OxA-13355). The consistency of the results from the Iron Age level suggests that this material may be undisturbed, although the difference in age between the two samples may hint that the sequence is not continuous.

Unfortunately only a single result is currently available from borehole 7A, which dates 160-165cm in this core to c. 8650 cal BC (OxA-13356). The result from 210-213cm is awaited.

HPP/DS/102/AB/0-10cm produced two consistent radiocarbon measurements (OxA-13361-2; T′=0.6; T′(5%)=3.8; v=1) which date the ditch to the nineteenth century AD. HPP/DS/143/AA/SOUTH/0-10cm produced two consistent radiocarbon measurements (OxA-13365-6; T′=0.7; T′(5%)=3.8; v=1), as did HPP/DS/76/AB/WEST (OxA-13052 and OxA-13117; T′=0.0; T′(5%)=3.8; v=1), which date these ditches to the sixteenth century AD. Two consistent measurements from HPP/DA/108/AA/NORTH (OxA-13038 and OxA-13223; T′=1.4; T′(5%)=3.8; v=1) date this ditch to the second century AD. The consistency of these pairs of results suggests that the organic deposits from which they were derived may be undisturbed.

Field 139 produced two radiocarbon dates. The two measurements from bark recovered in the basal 5cms of the fills of the sectioned ditch in Trench AA, and are not statistically consistent (OxA-13363-4; T′=113.7; T′(5%)=3.8; v=1), suggesting that this material has been disturbed.

Field 132 produced four radiocarbon dates. The two measurements from the upper peat horizon (at 50-52cm) are statistically consistent (GU-5996-7; T′=2.5; T′(5%)=3.8; v=1), and date this event to 11450 – 10700 cal BC. However, the two macrofossils from 10-15cm produced highly inconsistent measurements (OxA-13053 and OxA-13118; T′=14979.6; T′(5%)=3.8; v=1), suggesting that this material has been disturbed.

Field 76 also produced a potentially problematic sequence. The peat beneath the ditches excavated in this trench produced a single result which calibrates to 5480-5310 cal BC (OxA-13034). The other macrofossil from this deposit failed in chemistry. The sample above this in the same auger core (0-5cm) produced two consistent results (OxA-13035-6; T′=1.0; T′(5%)=3.8; v=1), which fall in the sixteenth-century AD. This is problematic as this auger core was taken from beneath sample HPP/DS/76/AD/CENTRE. This produced two slightly inconsistent measurements from separate macrofossils (OxA-13049-50; T′=5.8; T′(5%)=3.8; v=1), although this difference is sufficiently small to suggest that it may be a statistical outlier. These results may suggest that this ditch dates to around 2000 cal BC. The adjacent ditch, HPP/DS/76/AD/SOUTH produced two consistent results (OxA-13051 and OxA-13116; T′=0.7; T′(5%)=3.8; v=1), falling around 1700 cal BC.

Table 4: Radiocarbon dates for Vale of Pickering Environmental assessment pilot project.

Sample	Laboratory Code	Material	δ 13C (‰)	Radiocarbon Age (BP)	Calibrated date range (95% confidence)
HPP/DS/76/AD/35-40cm(a)	OxA-13034	alder (Alnus glutinosa), roundwood	-28.4	6414±38	cal BC 5480-5310
HPP/DS/76/AD/35-40cm(b)	P15165	Alnus glutinosa, roundwood		failed	
HPP/DS/76/AD/0-5cm(a)	OxA-13035	alder (Alnus glutinosa), roundwood	-28.1	371±27	1440-1640 cal AD
HPP/DS/76/AD/0-5cm(b)	OxA-13036	alder (Alnus glutinosa), roundwood	-27.8	408±26	1430-1620 cal AD
HPP/DS/108/AA/NORTH(a)	OxA-13223	willow (Salix sp.) or poplar (Populus sp.), roundwood	-26.6	1873±32	70-240 cal AD
HPP/DS/108/AA/NORTH(b)	OxA-13038	willow (Salix sp.) or poplar (Populus sp.), roundwood	-26.3	1820±31	90-320 cal AD
HPP/DS/76/AD/CENTRE(a)	OxA-13049	willow (Salix sp.) or poplar (Populus sp.), roundwood	-28.7	3600±31	cal BC 2040-1820
HPP/DS/76/AD/CENTRE(b)	OxA-13050	willow (Salix sp.) or poplar (Populus sp.), roundwood	-29.1	3704±30	cal BC 2200-1970
HPP/DS/76/AD/SOUTH(a)	OxA-13051	alder (Alnus glutinosa), roundwood	-27.6	3353±28	cal BC 1740-1520
HPP/DS/76/AD/SOUTH(b)	OxA-13116	alder (Alnus glutinosa), roundwood	-27.2	3391±34	cal BC 1860-1530
HPP/DS/76/AB/WEST(a)	OxA-13117	cf. blackthorn (Prunus spinosa), roundwood	-26.1	314±26	1490-1650 cal AD
HPP/DS/76/AB/WEST(b)	OxA-13052	blackthorn (Prunus spinosa), roundwood	-25.9	315±24	1490-1650 cal AD
HPP/DS/102/AB/0-10A	OxA-13361	hawthorn/Sorbus group (Pomoideae) stem	-27.6	77±25	1690-1960 cal AD
HPP/DS/102/AB/0-10B	OxA-13362	gorse (Ulex sp.) or broom (Cytisus sp.) stem	-27.7	103±24	1680-1960 cal AD
HPP/DS/139/AA/0-5A	OxA-13363	unidentified bark	-26.7	5673±31	cal BC 4600-4400
HPP/DS/139/AA/0-5B	OxA-13364	unidentified bark	-29.7	5189±33	cal BC 4220-3940
HPP/DS/143/AA/SOUTH/0-10A	OxA-13365	blackthorn (Prunus spinosa) stem	-26.8	347±24	1470-1640 cal AD
HPP/DS/143/AA/SOUTH/0-10B	OxA-13366	gorse (Ulex sp.) or broom (Cytisus sp.) stem	-27.1	319±23	1490-1650 cal AD
HPP/A2/BH2A/100-110A	OxA-13353	cf. alder (Alnus glutinosa)	-28.3	2519±27	cal BC 800-520
HPP/A2/BH2A/100-110B	OxA-13354	cf. alder (Alnus glutinosa)	-27.5	2541±27	cal BC 800-540
HPP/A2/BH2A/140-145A	OxA-13355	willow (Salix sp.) or poplar (Populus sp.)	-28.4	9712±40	cal BC 9260-8910
HPP/A2/BH7A/160-165A	OxA-13356	willow (Salix sp.) or poplar (Populus sp.)	-27.9	9390±40	cal BC 8790-8540
HPP/A2/BH7A/210-213A	P15262	alder (Alnus glutinosa)/hazel (Corylus avellana) stems		result awaited	
HPP/A3/BH8A/100-105A	OxA-13357	alder (Alnus glutinosa) stem	-28.9	4723±32	cal BC 3640-3370
HPP/A3/BH8A/100-105B	OxA-13358	alder (Alnus glutinosa) stem	-29.8	4640±30	cal BC 3520-3350
HPP/A3/BH8A/210-215A	OxA-13359	alder (Alnus glutinosa)	-28.9	6264±33	cal BC 5320-5070
HPP/A3/BH8A/210-215B	OxA-13360	alder (Alnus glutinosa)	-27.0	6173±37	cal BC 5260-4990
HPP/DS/132/10-15cm(b)	OxA-13053	alder (Alnus glutinosa), roundwood fragment	-27.7	6390±32	cal BC 5470-5300
HPP/DS/132/10-15cm(a)	OxA-13118	unidentified epidermal cylinder from herbaceous stem/root	-26.1	933±28	1020-1190 cal AD
HPP/DS/132/50-52cm	GU-5996	peat: humic acid	-29.0	10830±1201	
HPP/DS/132/50-52cm	GU-5997	peat: humin	-30.0	11080±100	cal BC 11220-11710

[1] 10980±77BP; T'=2.5; T'(5%)=3.8; v=1.

Figure 8: Calibrated Radiocarbon Dates from the West Heslerton Environmental Series

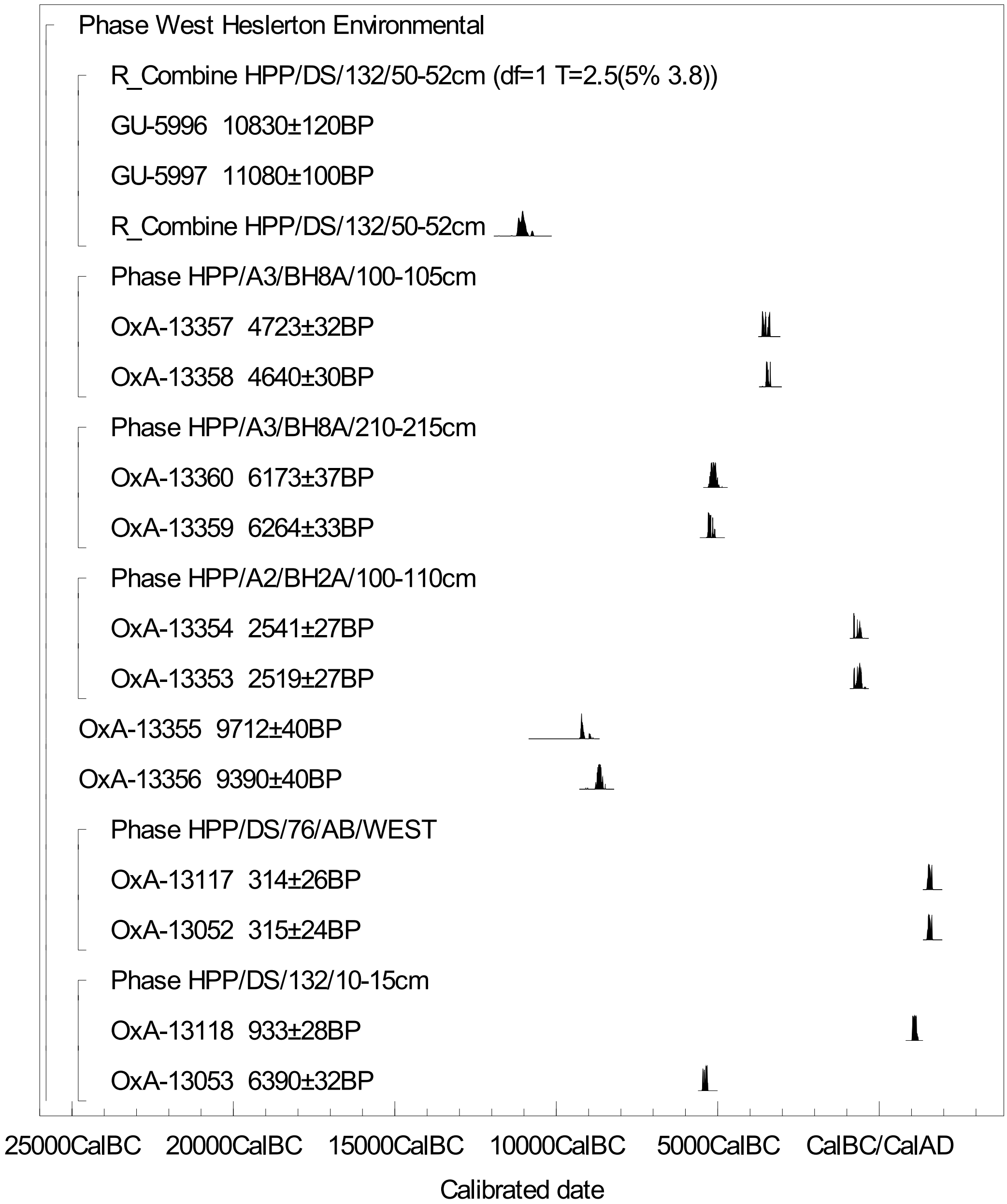
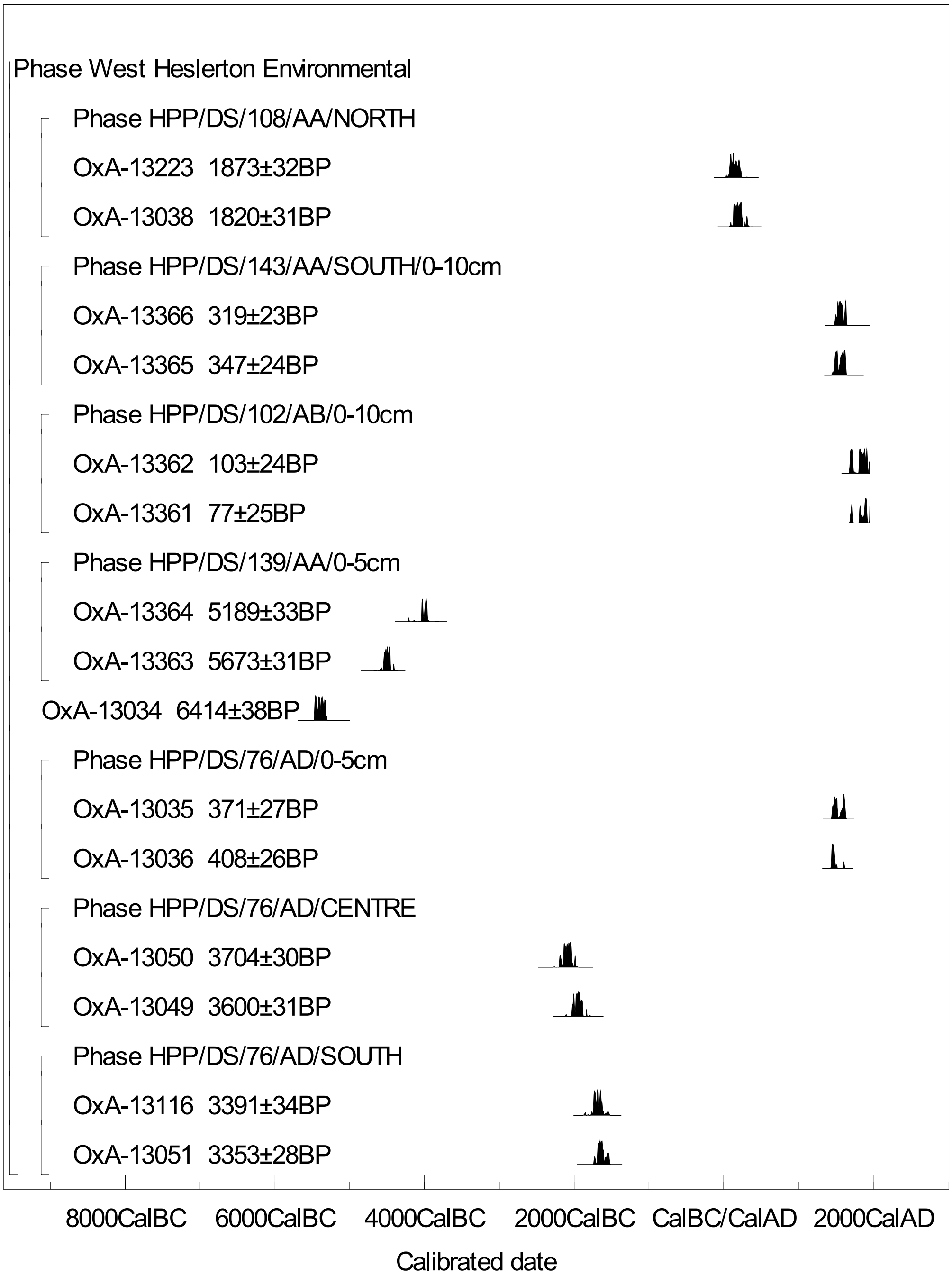


Figure 8 (continued): Calibrated Radiocarbon Dates from the West Heslerton Environmental Series



Pollen Analysis of the Multi-period Contexts and peat deposits

By Rob Scaife

Introduction

As part of the Environmental strategy adopted by the West Heslerton project, samples for pollen analysis were taken from the fills of field boundary ditches and other linear features of different ages. A total of 27 ditches and peat deposits were sampled of which 48 samples taken from 16 of these features have been examined in this first study. The principal aims of this assessment were primarily to establish if sub-fossil pollen and spores are present in the fills, and if present, their quantity and potential for reconstructing the local vegetation and environment and especially the land use of the adjacent fields. Pollen has been obtained from all of the samples examined and, as a result, some useful preliminary data on the past vegetation and local environments of the ditches and peat beds has been obtained. These data are presented here.

Pollen Procedures

A total of 48 samples from 16 different profiles have been examined. Pollen sub-samples of 1ml (for peat) to 3ml (for humic sands) volume were processed using standard techniques for the extraction of the sub-fossil pollen and spores (Moore and Webb 1978; Moore *et al.* 1992). Micromesh sieving (10u) was also used to aid with removal of the clay fraction in these sediments. The absolute pollen numbers/frequencies in the samples were calculated using added exotics to known volumes of sample (Stockmarr 1971). The sub-fossil pollen and spores were identified and counted using an Olympus biological research microscope fitted with Leitz optics. Assessment pollen sums adopted depended on the levels of abundance and preservation found in these widely differing sediment types. Totals ranged from 50 to ***ca.***200 grains per level plus fern spores, algal ***Pediastrum*** and miscellaneous pre-Quaternary palynomorphs. All pollen data from the 16 contexts are presented in Table 6, below, giving the raw pollen count data. Where sufficient levels have been examined, pollen diagrams (Section 76AD SW; 132AA basal peat; 132 AA North Ditch) have been plotted using Tilia and Tilia Graph (figures 1 and 2). Percentages have been calculated in a standard way as follows:

Sum =	% total dry land pollen (tdlp) (excluding ***Alnus*** and ***Salix***)
Marsh/aquatic =	% tdlp+sum of marsh/aquatics (incl. ***Alnus*** and ***Salix***)
Spores =	**% tdlp+sum of spores**
Misc. =	% tdlp+sum of misc. taxa.

Taxonomy, in general, follows that of Moore and Webb (1978) modified according to Bennett *et al.* (1994) for pollen types and Stace (1991) for plant descriptions. These procedures were carried out in the Palaeoecology Laboratory of the Department of Geography, University of Southampton.

The Pollen Data

A total of 16 profiles have been examined and a brief description of the pollen in each is given in the dossiers pertaining to each field (Appendix A). For the purposes of this assessment, where percentages are given, these are for the total pollen count unless otherwise stated (for example percentages calculated excluding the often substantial numbers of autochthonous Cyperaceae). The tabulated results of the pollen analysis from all the ditch samples examined are contained in Table 5 below. The analysis of the pollen samples derived from the auger borehole transects are discussed below and also recorded in the individual site dossiers.

Discussion. The Vegetation and Environment

There have been few attempts at reconstructing landscape history through the study of multi-period ditches and other deposits. There has been a justifiable uncertainty regarding the quality of the pollen data which can be obtained from these contexts due largely to the taphonomic problems. Such problems include the possibility of reworked older pollen being deposited with the sediments infilling the ditch (quite probably a problem with 139AA), pollen coming from other secondary sources such as human and animal waste products and in some cases domestic refuse. Furthermore, the pollen catchment of ditch profiles (and also pits) is in general restricted to the vegetation of the ditch itself and the very near surrounds. However, the fact that pollen can be extremely well preserved and does relate to the near environment has enormous potential for reconstructing the environment. This is especially the case for study of the land use of fields adjacent to the boundary ditches even though caution must be taken in interpreting the pollen data. Where ditches are within an agricultural landscape which spans several periods, it is possible to examine changes in land-use. This technique has been utilised at Rectory farm, West Deeping (Scaife in Hunn and Rackham in press.). This study in its present form attempts to examine the potential of the ditch complexes at West Heslerton for a similar landscape reconstruction avoiding the inherent problems associated with more usual study of peat mires and lake basins (too broad a catchment). It is, however, emphasised that this is a preliminary study and further more detailed analysis is required which will resolve some of the taphonomic problems addressed above

From the radiocarbon dating and inferred dating from archaeological contexts, five broad periods are represented in the sediments examined at West Heslerton

Late-Devensian-Early Holocene: 76AB, 76AC, 132AA, 139AA:

These profiles in general demonstrate typical open conditions with a diverse range of herbaceous communities with scattered birch and possibly pine trees. The mineral character of the sediments and use of Hydrofluoric acid clearly does have an effect on pollen size. However, a number of *Betula* pollen grains described as 'small *Betula'* are tentatively assigned to dwarf birch (*Betula nana*). This would be expected for this period and should additional work be carried out, a range of morphometric measurements will be made for pollen of tree and dwarf birch. Certain herbs are also diagnostic. Section 76AB contains *Polemonium caeruleum* (Jacob's ladder) which is a typical late-Devensian indicator (although it still remains in some refugia in Yorkshire). *Dryas octopetala* (mountain avens) is identified in section 139AA (although dating of this profile is anomalous). Apart from these taxa such as A*rtemisia, Thalictrum, Plantago* spp. and Asteraceae types are typical of the diverse herb environments. In these profiles, trees are represented by small numbers of tree birch and pine. Section 132AA appears to show changes from birch to pine. This profile should be highlighted for additional work.

From the above discussion, it is clear that all of the ditch sequences dating from the Neolithic to post medieval period appear to show herbaceous communities dominated by grassland and wet fen vegetation. The latter, which in some cases contain pollen of aquatic plants, derive from the on-site, ditch vegetation and in some cases from fen encroachment. The dominance of grassland is due to the location of the sites within the very wide valley and floodplain. Thus, we can envisage a large expanse of damp or wet floodplain grassland. This may have been used as pasture during the late-prehistoric and historic periods and possibly only seasonally. In the case of the late Devensian and early Holocene profiles coming from the expanse of basal peat, the site was also a low-lying fen giving dominance of grass-sedge and aquatic taxa. There is, therefore, evidence for a continuously open habitat during the Holocene. Even though the taphonomic factors noted earlier need to be considered, that is, very local pollen input from a restricted catchment, any significant tree growth locally would be seen in the pollen spectra.

The paucity of trees and shrubs in the pollen assemblages reflects i.) their absence in the broad low lying expanse of valley and ii.) the restricted pollen catchment offered by ditches. At this present stage of analysis, it is not clear to what extent woodland was of greater importance on nearby higher ground. The presence of small numbers of cereal pollen and of other herbs from drier grassland and pasture in the profiles shows that pollen was arriving from the interfluve areas. The question of continuity of open herb communities will be addressed and it is expected that pollen contained within palaeochannels will give some indications of vegetation in a wider catchment. The concept of open Holocene vegetation in this region has already caused a degree of controversy. Bush (1988) and Bush and Flenley (1986) from data obtained in the small mire in the Yorkshire Wolds suggested that there was such a continuity of open herb (grass) communities from the close of the Devensian which was strongly contested by Thomas (1989) but without resolution of the dating problems we cannot advance this further.

Middle Holocene: 76AD below east Central Ditch; bottom samples of 132AA ?

A single profile for this period. Similar characteristics to all later profiles being open grassland with no local woodland adjacent to the site. This is completely out of character with the usually heavily wooded characteristics of the middle Holocene and it is clear that there may be problems with the dating of these deposits. These profiles may sit better in the assemblages discussed below.

The late prehistoric period (76AD, 76D EC)

Two profiles date to the late Neolithic to Bronze Age. The environment, as in later periods was one of grassland/pasture in proximity to the site and wet sedge and grass habitat probably growing in the ditch. There are surprisingly few trees and shrubs, especially in profile 76AD East Central Ditch but this may be due to disturbance of the underlying late glacial/early holocene peats.

The Romano-British Period (108 AA, ?102AA*)*

There was only one definitely dated Roman context at 70-240 cal AD. There is a diverse range of trees present but in only small numbers. With the exception of willow which was probably growing in or adjacent to the ditch at the sample site, these arboreal elements probably relate to the drier areas of the interfluve/high ground. As discussed for the medieval period, the environment appears to have been largely open grassland probably pasture. Small quantities of cereal pollen suggest that drier areas also had arable cultivation.

The medieval and post medieval

Seven contexts cover this period. As might be expected, the environment depicted is one which is largely open agricultural with a minor tree and shrub element probably derived from regional (managed?) woodland of oak and hazel while there are also other wind pollinated taxa including birch, pine and alder. Single grains of beech and walnut have also been recorded. Overall numbers of trees and shrubs are, however, small and do not represent locally significant woodland. Herb assemblages are important being dominant and in contexts where preservation is good, these are diverse. The assemblages suggest a predominantly pastoral land use in proximity to the sample sites. This is based on the large quantities of grass, ribwort plantain and dandelion types plus other typical pastoral indicators (buttercups). Similarly high values of Cyperaceae in many contexts clearly relate to growth in wet ditches and in local fen. However, pasture may also be wet floodplain pasture.

Occasional cereal pollen including ***Secale cereale*** in 102AA (and ***Centaurea cyanus***) must derive from cultivation on interfluve areas. Because of the distances involved the representation would be limited if the sample site is within the flood plain/lower part of the valley.

Summary and Conclusions

A preliminary pollen assessment was undertaken to established whether sub-fossil pollen and spores are present in samples obtained from the fills of prehistoric and historic ditches and some associated natural (peat) deposits. If present it was anticipated that evidence of the local vegetation and land use in adjacent fields would be forthcoming. Pollen was recovered from all of the 48 samples taken from the 16 sequences. The age of the samples span the late-Devensian to historic periods. The overwhelming aspect of this study is the dominance of herbaceous communities and relative paucity of trees and shrubs in all sequences. Grassland is predominant with only small representation of arable land use in later periods. This is attributed to taphonomic aspects of local input into small (here ditch) contexts and the position of the contexts at some distance from the interfluves. This is not, however, wholly the case and the real possibility of continued largely open landscape is considered.

Further analysis should select the most representative sequence from each of the periods represented by good pollen preservation and radiocarbon dating. Closer interval sampling and standard pollen counts of 400 grains minimum (where preservation permits) should be made. Examination of local peat/palaeochannel sequences will be undertaken as a comparison to data obtained here.

Table 5. Pollen counts on the pilot samples

Depth cm.	75AA	76AB W 4	76AB W 0	76AB W -4	76AB	76AC 9	76AC 5	76AC 0	76AD sw 12	76AD sw 8	76AD sw 4	76AD sw 0	76AD ec 4	76AD ec 0
Trees and Shrubs														
Betula	8				26	2	1	8		1	1			
small *Betula*					5	1		2						
Pinus	8		1		8	1	1	2			1			1
Quercus	1								2		1			
Alnus	3				1				1		1	3		
Fagus sylvatica			1											
cf Juniperus communis							1	1						
Salix								1						
Corylus avellana type											4			1
Sorbus type												1		
cf Hippophae rhamnoides						1								
Myrica gale		1												
Erica			1					1					1	1
Calluna						1			1		1			
Empetrum nigrum		1												
Herbs														
Ranunculus type		10	5								1		14	2
Brassicaceae												3		
Sinapsis type	1								1	2			1	
Dianthus type				2									1	
Polygala												1		
Rosaceae												1	1	1
Sanguisorba minor									1			1		
Fabaceae Undiff.		1												
Ononis type							1							
Filipendula								1						
Trifolium type		1	1	1										
Lotus type			1											
Potentilla type		1	1					1						
Urtica type				2										
Apiaceae				1							1			
Rumex conglomeratus type			1											
Rumex							1							1
Hypericum				1										
cf Anagaliis														1
Caltha type					1									
Cerastium type					1									
Polemonium caeruleum					1									
Pedicularis		1			1									
Polygonum sp.										1	1			
Plantago media		1												

Plantago media/major		1							1		1	1		
Plantago lanceolata	5	20	15	23				4	7	5	7	8	1	
Rubiaceae		1						1						
Succisa pratensis		1		1									22	3
Scabiosa									1					
Bidens type		25	12	20					3		7			
Anthemis type		1												
Cirsium type			1			1						1		
Artemisia					1	1							1	
Centaurea scabiosa		1		2					1					1
Centaurea nigra type			5							1				
Lactucoideae	11	42	42	17		9			74	44	85	42	29	19
Poaceae	25	46	48	34	15			9	25	4	22	24	48	150
Poaceae (large)						30	10	1				1	1	1
Cereal type				3										
Unidentified/degraded				1	1			2		2		3		1
Marsh														
Cyperaceae	39	10	18	42	90	107	87	67	33	43	17	54	25	15
Menyanthes trifoliata						1								
Typha angustifolia/ Sparganium type														1
Spores														
Equisetum	1						1					1		
Selaginella selaginoides	1	1			4	3			5	1	5	4		1
Monolete Pteropsida	5			3	7	4	3	3	7		2	2		1
Pteridium aquilinum	1	4	1	5	3				2	3	7	3	1	2
Botrychium lunaria				1										
Polypodium vulgare	1	1							1		2			
Sphagnum	1										1	1		
Liverworts												2		
Pre-Quaternary Palynom.				1				1	5	30	21	20		3
Misc.														
Pediastrum					31		1	1						
Abs. Poll. Freq. Grains/ml.	28,667	68,187	62,846	22,250	67,640	46,567	13,617	20,173	16,798	15,942	13,350	21,805	49,192	237,333
Total Pollen Count	102	166	153	150	152	157	102	102	151	103	150	147	152	200

Table 5 continued.

Depth cm.	76AD und 0-5	76AD und 20-25	76AD und 30-35	76AD und 40-45	102AB 12	10AB 4	102AB 0	102A A w	104A A	108A A 12	108A A 8	108A A 4	108A A 0
Trees and Shrubs													
Betula	5				1						2	3	1
small *Betula*											1		
Pinus	3		2	1	1		1		6	3	1	2	3
Quercus				3	3	2	1			3	1		1
Ulmus	1									1			
Alnus				3		1				4		3	
Salix										1	7		2
cf Cornus						1							
Corylus avellana type		1	1	3		3				1		2	1
cf Buxus					1								
Erica											1	1	
Calluna					1	1					3		1
Herbs													
Thalictrum							1						
Ranunculus type				5	1	2			1		1	1	
Sinapsis type	1				1					11	1	1	3
Spergula type	1						1		1				
Rosaceae	1					3	1		1				
Sanguisorba minor													
Myosotis	1												
Lycnis type										1			
Trifolium type							1				1		
Chenopodiaceae					1		1		1			1	
Potentilla type						3						3	
Apiaceae												1	
Rumex					1	1	7		1	1			1
Mentha type						1						1	
Caltha type	1												
Scrophulariaceae					5	1							
Odontites type						3	1						
Polygonum aviculare type										1		1	
Plantago media/major				1									
Plantago lanceolata				7	11	23			13	8	8	5	12
Rubiaceae				2						1		1	
Scabiosa						1							
Bidens type				1			1		3				
Cirsium type							1		1				
Artemisia	1											3	
Centaurea cyanus								1					
Centaurea scabiosa						1	1						

Centaurea nigra type									1				
Lactucoideae				60	15		9	29	24	10	15	19	
Poaceae	13	3	12	32	85	86	80	10	39	71	50	35	29
Poaceae (large)										4			2
Cereal type				3	6	10	10	1	1	1	1	2	2
Secale cereale					1	1		1					
Poaceae (*Glyceria* type)						1	9						
Unidentified/degraded	1		1		1	1				1			
Marsh													
Potamogeton type										3	1	1	
Littorella uniflora						1					1		
Littorella litorina				2									
Myriophyllum alternifolium				1									
Cyperaceae	114	47	87	31	18	2		9	63	25	50	58	37
Typha angustifolia/ Sparganium type				4		1				1		1	
Spores													
Equisetum					1					4		1	1
Selaginella selaginoides							1		6			1	
Monolete Pteropsida	4	2				1	1	1	3	2	9	5	6
Pteridium aquilinum		2	1				4	2		3	6	6	6
Polypodium vulgare		3							1				
Sphagnum		1										1	
Liverworts								1		3		1	1
Pre-Quaternary Palynom.								3	5				
Misc.													
Pediastrum	1			1					1		1		
Abs. Poll. Freq. Grains/ml.	38,181	4,464	77,811	31,842	208,260	117,480	216,270	4,034	41,624	113,665	177,999	43,289	22,472
Total Pollen Count	143	51	102	161	156	154	162	51	152	149	150	152	101

Table 5 continued.

	132AA	132AA	132AA	132AA	132AA	132AA	139AA	139AA	139AA	143AA s	143AA s	143AA s	143AA s
Depth cm.	**15**	**26**	**30**	**42**	**51**	**70**	**8**	**4**	**0**	**12**	**8**	**4**	**0**
Trees and Shrubs													
Betula		5	11	25		1	14	13	16				
small *Betula*					1		1	6	2				
Pinus				7	2	1	9	4	8	2		1	4
Pinus type		1											
cf Juniperus communis								1				1	
Quercus										5			
Fraxinus excelsior										1			
Alnus												1	
cf Populus							1						
cf Cornus													1
Corylus avellana type							1						
cf Buxus											1	2	
Erica				1				1					
Calluna	1											1	1
Herbs													
Thalictrum							2						
Ranunculus type	1	1					1	1		1		1	1
Sinapsis type						1				1		2	1
Hornungia type										1			
Dianthus type								1		1		1	
Cerastium type							1						
Spergula type									1				
cf Dryas octopetala							1	8					
Rosaceae	1										1		
Filipendula								1	1				
Lycnis type													1
Lotus type										1		1	
Chenopodium type	1				1	1							
Potentilla type				5									
Apiaceae								1			1		
Rumex				1						1			
Cannabis sativa type												1	
Epilobium type					1								
Mentha type												1	
Scrophulariaceae		1								1			
Rhinanthus type										1	1		
Plantago media/major		1											
Rubiaceae					1								

Bidens type	1									1			
Anthemis type		1											
Artemisia				1		1	3	1					
Centaurea nigra type											1		
Lactucoideae	5		1				1			36	12	37	67
Poaceae	6	13	15	22	20	6	32	27	31	50	20	35	41
Poaceae (large)											1		1
Cereal type					1						7	7	
Unidentified/degraded	3			2		1					1		2
Marsh													
cf Littorella uniflora												1	
Menyanthes trifoliata	4	8					1						
Alisma type							1		1				
Myriophyllum alternifolium	1									5		3	5
Cyperaceae	63	70	173	129	75	48	79	88	91	26	10	34	23
Sagittaria													1
Typha angustifolia/ Sparganium type						1				1		1	
Spores													
Equisetum							1						
Selaginella selaginoides							1						
Monolete Pteropsida		1	1				7		1	1		7	1
Pteridium aquilinum	1					3	2			8	3	3	4
Lycopodium selago					1								
Polypodium vulgare												1	1
Sphagnum					1		1			1	1	1	3
Pre-Quaternary Palynom.					1	6	1	1			4	2	8
Misc.													
Pediastrum							108	179	144	8	1	1	10
Abs. Poll. Freq. Grains/ml.	6,793	23,970	118,666	25,267	12,104	9,580	80,634	49,516	67,194	81,702	8,899	49,061	32,467
Total Pollen Count	187	101	200	194	102	61	151	153	151	153	50	147	152

***Table 5** continued.*

	143AAn	**143AAn**	**143AAn**	**143AAn**	**144AA**	**144AA**	**144AA**	**144AA**
Depth cm.	**12**	**8**	**4**	**0**	**60**	**8**	**4**	**0**
Trees and Shrubs								
Betula		3						1
Pinus	1	7	4	2	4		2	
Juglans regia		1						
cf Juniperus communis					1			1
Quercus							1	
Alnus	3			1				
Salix								1
Corylus avellana type		6		3		1		
Erica				1				
Calluna	1			1	1		1	
Herbs								
Ranunculus type	1	1	1					
Sinapsis type		5	1		1			
Chenopodiaceae			1		1	1	1	
Agrimonia							1	
Apiaceae	3		1					
Polgonum aviculare	1	1						
Persicaria maculosa type	1							
Rumex				1				
Cannabis sativa type			1					
Lamiaceae			1					
Caltha type			3					
Scrophulariaceae	1							
Plantago media/major	1	1		1			1	
Plantago lanceolata	8	1	8		1			
Rubiaceae			1					
Bidens type	1			1				
Cirsium type				1				
Artemisia		3	1					
Centaurea nigra type		3				1	2	
Lactucoideae	64	37	24	11	14	18	17	
Liliaceae					1			
Poaceae	43	20	41	33	20	14	33	1
Poaceae (large)	1		1				1	
Cereal type		2		3				
Unidentified/degraded	1	1			4			
Marsh								
cf Callitriche	1							
Myriophyllum alternifolium		1						
Cyperaceae	18	11	26	36	6	14	39	45
Iris			1					
Typha angustifolia/ Sparganium type		1	1					
Spores								
Selaginella selaginoides			3					
Monolete Pteropsida	32	69	53	8	5	8	4	
Pteridium aquilinum	8	18	11	5	2	2	2	
Polypodium vulgare	3	10	7					
Sphagnum	1	7		1		1		
Liverworts	3			1				
Pre-Quaternary Palynom.	1	1	4	8		1	6	1
Misc.								
Pediastrum	10	8	15	10				
Abs. Poll. Freq. Grains/ml.	35,552	22,797	16,761	41,076	7,504	3,361	10,075	3,379
Total Pollen Count	153	111	113	100	52	51	100	50

Pollen analysis of the Borehole Sequences

(BH2A; BH7A; BH8A).

In addition to the pollen analysis of the on-site archaeological contexts (see above), a series of auger transects has also been studied. This preliminary pollen analysis was undertaken with the aim of examining the near regional, off-site environment. Selected samples from palaeochannels at West Heslerton all produced pollen and the preliminary findings are detailed here (Fig 9).

Pollen Method

Samples of 1ml were prepared using standard techniques for the extraction of sub-fossil pollen and spores and calculations as given in the section above.

Transect A2- Borehole 2A:

Three samples have been examined. The basal/lowest sample (3) at 140-145cm is dominated by herbs with ***Filipendula*** (meadow-sweet; 32%), Poaceae (grasses; 27%) and Cyperaceae (sedges; 69%). Trees comprise largely ***Pinus*** (pine; 19%) with ***Juniperis communis*** (juniper; 3%) and ***Salix*** (willow; 9%).

There appears to have been a generally open herb dominated environment and it is likely that this is an early Holocene assemblage and possibly at the Devensian/Holocene transition as evidenced by diagnostic peaks of juniper and meadow-sweet. The radiocarbon date of 9712±40 BP confirms this. Pine may have been present although this may have derived from extra-regional sources (long distance transport of this anemophilous taxon).

Subsequently, at 100-75cm values ***Pinus*** percentages are reduced and ***Alnus*** (alder; 27%) becomes relatively more important. Herbs include high values of ***Plantago lanceolata*** (ribwort plantain; 19%) with Poaceae (30%) and Cyperaceae (26%). Cereal pollen is also present. In the upper sample (75cm) trees are further diminished and herbs become of still greater importance dominated by Poaceae (66%)

These sample are clearly of much later Holocene age with evidence of Neolithic or later agriculture (cereal pollen and ribwort plantain). Although alder is present, the values do not suggest dominance on-site but probably localised growth on the banks of the floodplain or river. The radiocarbon date for a sample at the same level as the middle pollen sample in a late Bronze Age early Iron Age date for the sediments at this level.

Transect A2 - Borehole 7A:

4 samples. ***Betula*** is the dominant arboreal taxon (to 48%) with a single high value of ***Pinus*** at 160-165cm (29%). ***Corylus avellana*** type is incoming from sample from this depth. ***Juniperus*** is present at the same level as ***Filipendula ulmaria***. Herbs are important dominated by Poaceae (70% in the lowest level) with Cyperaceae (to 36%) and peaks of ***Filipendula*** (42% at 208-213cm).

The lower samples (160-225cm) are of early Holocene age and possibly late Devensian cold stage below the ***Filipendula*** and ***Juniperus*** at 208-213cm. This is suggested on the basis of the high birch values which represent the pre-boreal expansion of this pioneer tree after climatic amelioration at ***c.***10Ka BP. This is supported by the date of 9390±40 BP at 160-165cm. This latter event is evidenced by the combined expansion of juniper and meadow-sweet. There also appears a typical change from open herbaceous, grass dominated communities to this pre-boreal woodland. The uppermost sample at 80-90cm is more enigmatic since this contains ribwort plantain and cereal pollen which suggest a much later Holocene (Neolithic or post-Neolithic) age. Consequently, there may be a sedimentary hiatus in the stratigraphy (see below).

Borehole 8A:

3 samples. In this samples series, ***Alnus*** is the dominant taxon (48-51%) with ***Corylus avellana*** type (hazel and possibly sweet gale; 13-27%). There are also small numbers of ***Quercus*** (oak; 3-14%) and ***Tilia*** (lime; to 3%). There are fewer herbs than seen in the other borehole profiles. Poaceae are most important (to14%) and occasional ***Plantago lanceolata***.

This profile differs from the other borehole sequences in age and floristic content. Alder (?flood plain carr woodland) was dominant on or in closely adjacent wetter areas of the floodplain. The vegetation of the interfluves was oak and hazel but with lime. The latter is markedly under-represented in pollen assemblages and thus, its importance may be under estimated from the low percentages present.

The age of the samples in this sequence is conjectural. They are clearly of middle (late Mesolithic; Atlantic) or later Holocene age (sub-Boreal). Cereal pollen not present, however, ribwort plantain is. If a middle Holocene age is confirmed, this suggests localised disturbances (human and/or animal). It is, however, possible that the sequence is of Neolithic age similarly showing such activity. The latter may be evidenced by small values and absence of elm pollen suggesting a post-elm decline date (i.e. post ***c.*** 5.5-5Ka BP.).

The Pheasant Feeder: 1 sample at 190-200cm. This single sample is dominated by Poaceae (70%) with Cyperaceae (31%) and other reed-swamp taxa including ***Typha angustifolia/Sparganium*** (bur-reed and reed-mace). ***Plantago lanceolata*** (7%) and cereal pollen (1%) are also present.

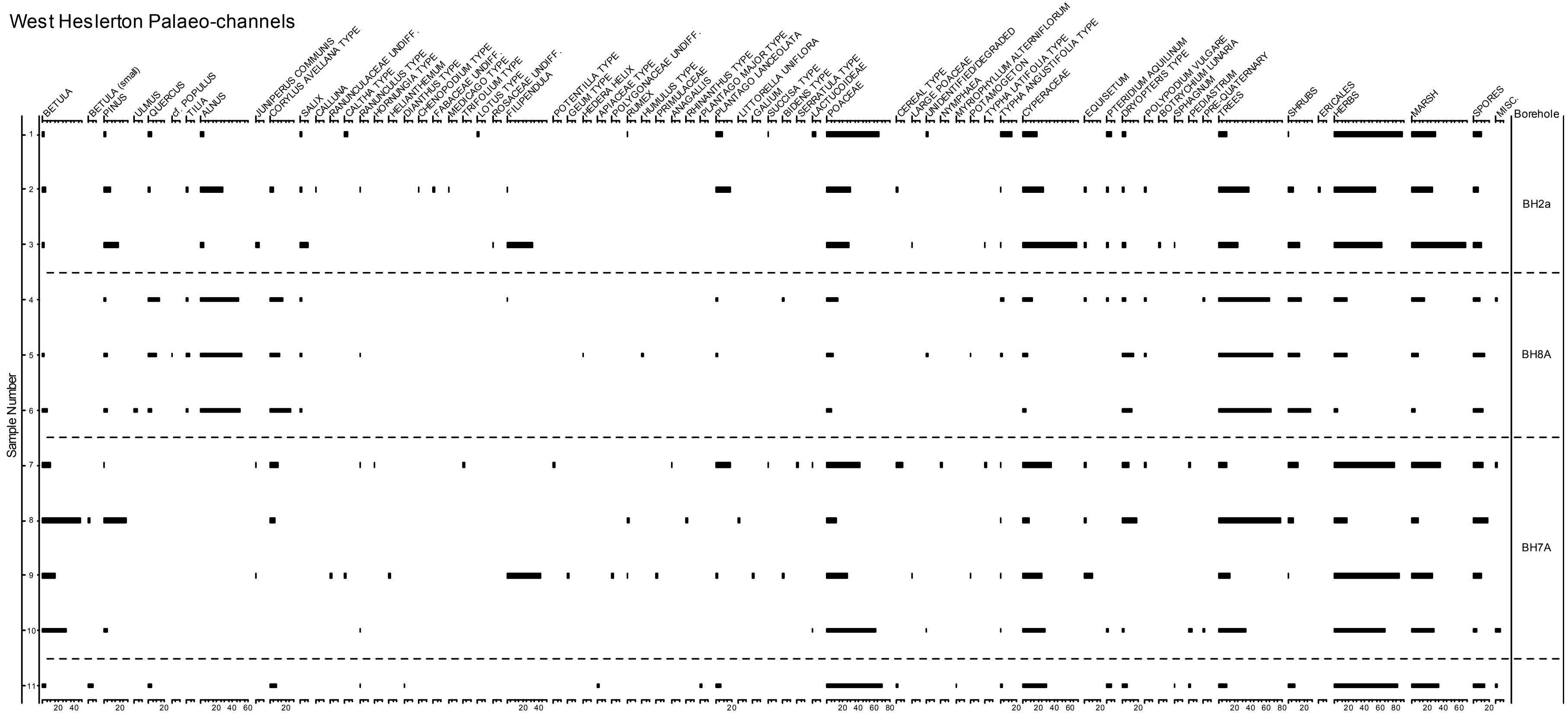
This single sample demonstrates an open, tree-less environment at least local to the site. Grassland (?pasture) is most important but with some evidence of arable cultivation. The sequence as suggested by J. Rackham is probably recent (?historic).

Summary and Conclusions

Test samples from four borehole profiles have been examined. These appear to be of widely differing ages within and between profiles. Boreholes BH2 and BH7 clearly have a late-Devensian and early Holocene component in their lower levels containing birch, pine and juniper pollen. The upper levels of these (?sediments overlying the palaeochannels) are of later Holocene age having evidence of human activity with ribwort plantain and cereals. Borehole 8 differs in showing dominance of alder on the floodplain with oak, lime and hazel on nearby drier ground. As noted the date of this profile is conjectural on pollen grounds but may be of middle Holocene (late Mesolithic) or Neolithic. If the former, it is possible that areas of open ground rather than the normally seen dominance of woodland may be evidenced. The 'Pheasant Feeder' sample shows a locally open largely grassland environment with some possible arable cultivation.

It is difficult to make such conclusions from the small number of samples examined from these borehole sequences. However, this analysis demonstrates that there is potential for a more detailed pollen analysis which, along with radiocarbon dating, would provide a vegetational history of the region which may be compared with the on-site analyses previously undertaken. Such a study would require sampling at standard 4 or 8cm intervals and detailed description of the stratigraphy especially to ascertain levels of possible hiatus.

Figure 9. Pollen diagram for the assessed samples from the palaechannels



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Assessment of the plant macrofossils

by Wendy Carruthers

Introduction

This report is part of an assessment project undertaken in the central area of the Vale of Pickering during 2003. In order to assess the survival and potential of anaerobically preserved environmental remains in the area, ditches and palaeo-channels were surveyed and sampled, as described above.

Methods

Soil samples were processed in the manner described above and the details of sample size are given in Table 6.

For the purposes of this assessment, the flots from eight radiocarbon dated samples were sent to the author, as listed in Table 1. Several petri dishes from each flot were rapidly scanned under a stereo microscope, with further dishes being examined until the character of the plant macrofossil assemblage could be roughly described. Care was taken to examine material from both the top and bottom of the sample bag, in case settling out had occurred.

Results

The results of the assessment are presented in Table 6. It should be noted that full identifications and quantifications will be undertaken at the analysis stage. For the purposes of the assessment rough estimates were made, so as to compare factors such as state of preservation and diversity. It is likely that many more plant taxa would be recorded during full analysis. Since precise identifications were not required at this stage, common names have been used in Table 6 to make it brief and accessible to non-botanists.

Nomenclature follows Stace (1997), and habitat information was taken from Stace (*ibid*), Hill *et al* (1999) and Haslam *et al* (1976).

Discussion

State of Preservation

The results of the assessment demonstrate that there was a great deal of variation in the state of preservation between the samples. The author does not have enough information to determine whether this is related to the geographic location of the samples, but it is notable that the four earliest samples did show the greatest signs of organic decay, as might be expected. It should be remembered that scarcity of fruits and seeds can be due to dense woodland cover and lack of human disturbance, but in these cases decay of other organic remains in the early samples such as wood and rootlets indicated that some drying out of the deposits had probably occurred at some time. Of the more recent samples, 143AA (347BP) was also poorly preserved.

The Character of the Assemblages

In most cases some information about the local habitat was recovered, even if this was only the immediate habitat of the ditch or peat bed. The presence of aquatic or semi-aquatic plants such as bogbean (***Menyanthes trifoliata***), water-plantain (***Alisma plantago-aquatica***), aquatic buttercups (***Ranunculus*** subg. ***Batrachium***) and sedges (***Carex*** spp.) indicated that the features had contained sufficient water for long-enough periods of time for these plants to produce seeds. More detailed comparisons of the ditch flora and fauna, including Characeae (aquatic stonewort algae) and Cladoceran ephyppia (drought-resistant eggs of ***Daphnia***), might provide information about nutrient status, since some aquatic taxa are more tolerant of nutrient-enrichment than others. Bogbean, for example, which was only present in the early samples Field 132AA (44-48cm) and 139AA is more characteristic of nutrient-poor (oligotrophic) peaty habitats, whilst water-plantain, found only in later samples 108AA and 143AA, is typical of nutrient-rich (eutrophic) water bodies.

Other plant groups represented include grassland plants, disturbed ground weeds and possibly woodland or hedgerow taxa. Grassland was not well represented in these samples, although grass seeds themselves are often too delicate to survive. Terrestrial buttercups (***Ranunculus repens/acris/bulbosus***) and daisy (***Bellis perennis***) are two indicators of grassland. A few other grassland plants such as self-heal (***Prunella vulgaris***) grow in a wider range of habitats. Of course, where grazing pressures are heavy, fewer seeds are likely to be produced. Thistles (***Cirsium/Carduus*** sp.) often become dominant in over-grazed pastures, so their occurrence in ditches 102AB and 76AB North could be significant. Pollen and insect results will be particularly important when the arable/pastoral balance is investigated in detail.

Disturbed/cultivated ground weeds were fairly common and diverse in the better-preserved samples, including several indicators of nutrient-rich soils such as stinging nettles (***Urtica dioica***), docks (***Rumex*** sp.) and henbane (***Hyoscyamus niger***). These were present in samples 76AD peats centre ditch (3600 BP) and later samples. It is unfortunate that many of the weeds of cultivated soils have a wide habitat range, so their presence does not necessarily indicate that cultivation was taking place nearby. Weeds such as common chickweed (***Stellaria media***) can grow as garden and arable weeds, but are equally common in disturbed, often nutrient-enriched soils around settlements and farm gateways. In total, none of the taxa observed were specifically arable weeds. Full analysis will produce a wider range of taxa which could include some arable weeds. In addition, pollen analysis may help to answer the question of what was being grown in the fields.

The only sample to produce evidence for the possible survival of woodland, scrub or hedgerows was sample 76 AD east centre ditch (3600 BP). Fragments of wood and twigs were frequent in the sample and willow (***Salix*** sp.) bud scales were common. Hawthorn (***Crataegus monogyna***) and possible field maple (cf. ***Acer campestre***) seed fragments were observed, amongst aquatic and disturbed ground taxa. Insects from this sample were well-preserved, and these should be invaluable in determining the source of the woody remains. The other sample to produce woody material was the sample from the recent ditch 102AB, which contained abundant gorse (***Ulex*** sp.) stem, spine and pod fragments (leguminous seeds rarely survive waterlogging). Gorse is typical of nutrient-poor grassland, particularly on acidic sands and peat and the soils around this ditch are sandy.

Conclusions

Some of the samples have the potential for providing a useful amount of information about the local environment, both in and around the ditches and peaty areas, and these samples have been indicated as A or B in Table 6. Samples graded C contained a little information, and if they are particularly important due to their date they could be added to the list of samples to be fully analysed.

Because preservation was found to be very variable from ditch to ditch, it is not possible to determine whether additional, as-yet undated samples would be useful without rapidly scanning the flots first. However, this takes very little time, so a selection process would be worthwhile if further dates were going to be obtained.

If sufficient well-preserved samples are available for study it should be possible to look at changes in the landscape through time. This would require more than one sample being examined per period wherever possible and the greater the number of samples per period, the more confident the interpretation will be. If multiple samples are unavailable, the analysis of pollen and insects from the same samples may help to substantiate the plant macrofossil interpretations.

Samples from the palaeochannels have not yet been examined since only auger samples were taken. Although the origin of material in palaeochannels is less certain and the sample size is, small, it would be worth rapidly scanning samples from levels that were due to be dated, since even the presence of a few taxa can be informative when examined in conjunction with pollen and insect remains.

Table 6: Assessment of the plant macrofossils

Sample	Feature information	Flot size (14cm x 14cm bag)	Flot description	Plant remains	Potential
102 AB 0-10cm	Ditch, 103 BP (recent)	¾ bag	Very twiggy with needles & pod frags, fibrous, some charred, insects ++	++ seeds, low diversity. Gorse needles & pod fragments +++; sedge , thistle; buttercup; grasses; cf. field maple seed	B/C – mainly gorse debris, though some more local habitat info may be recovered.
76 AB north section west ditch 0-10cm	Ditch 314 BP	¼ bag	Occ. rootlets, woody frags, stems, reasonable preservation but some seed decay. Caddis, insects ++, ephyppia +	+++ seeds, high diversity. Freq nutrient-enriched disturbed ground (nettles, dock, henbane), some grassland (buttercup, daisy, self-heal); freq aquatic ditch flora (aquatic buttercups, rushes, water-pepper)	B – good diversity & preservation. Info about local environment (grassy, nutrient-enriched - ?grazing) & ditch flora. More worthwhile including (as with all samples) if pollen & insects examined
143 AA south 0-10cm	Ditch 347 BP	1/8 bag	Roots, decayed woody frags, decayed seeds, poor preservation, ephppia +, insects +	++ seeds, low diversity. A few decayed aquatic & disturbed ground taxa (Apiaceae NFI, water-plantain embryos, chickweed, sedges)	C – a little information about local disturbance but low diversity & poor preservation
108 AA north 0-10cm	Ditch 1850 BP	½ bag	Silty, twigs, ++ wood, good preservation, ephyppia +, characeae ++, charcoal ++, insects ++	+++ seeds, high diversity. Freq ditch flora (aquatic buttercups, water-plantain, cress, pondweed, blinks), several disturbed ground plants (stinging nettle, dock, chickweed), elderberry	B – good diversity will enable more info about local environment to be obtained.
76 AD east section centre ditch 0-10cm	Ditch 3600 BP	¼ bag	Freq woody & decayed wood frag, ephyppia +, insects +++	+++ seeds, high diversity. Ditch flora mainly aquatic buttercups, blinks, rushes, sedges. A range of disturbed ground weeds (nettle, chickweed, dock), some grassland taxa (buttercup, thistles). Some woody taxa (hawthorn, cf. maple, willow bud scales)	A – possible evidence for woodland survival or hedges. Important to examine in conjunction with pollen & insects.
139 AA 0-5cm	Ditch 5200 BP	1/8 bag	Freq rootlets, occ twig, decayed organics, poor preservation, insects +	+ seeds, low diversity. Crushed bogbean seed+	D – too few remains.
132 3409 10-15cm	Peat bed 6390 BP	1/3 bag	Decayed rooty frags freq, occ twigs, occ ?Phragmites roots., poor preservation. charcoal +	+ seeds, low diversity. Occ sedges, spike-rush. NFI small buds?	C – limited information about aquatic environment
132 3409 44-48cm	Peat bed 10830 BP	1 bag	Abundant fine rootlet frags, some decay visible, occ woody frags	++ seeds, low diversity. Mainly aquatics (bogbean, sedges), grasses, moss frags	B/C – a little information about local environment. Maybe worthwhile in view of early date and large flot, partic. in conjunction with pollen? A little better preserved than 10-15cm sample.

KEY:
+ = occasional ++ = several; +++ = frequent

A = good potential on archaeobotanical merits alone; B = reasonable potential; C = some potential, but probably only worth analysing if important context or particular questions need answering; D = poor assemblage (few seeds/low diversity), not worth analysing

An Assessment of the Insect Remains

By David Smith and Emma Tetlow

Introduction

This report presents the results of an assessment of the insects from eight of the samples that have been radiocarbon dated. The first series came from early to mid-Mesolithic peat beds (samples 7 and 8), the second series from a series of ditches which range in date from the mid-Mesolithic to the present (samples 1-6).

It was hoped that an assessment of the insect remains from these samples would provide information on the following:

1. Were insects present? And if so, are the faunas of interpretative value?
2. Are these insect remains informative about the nature of the environment in the area at the time of the deposits formation?
3. Is there evidence for the nature of human activity and land use in the area?

To aid discussion, the samples have been renamed samples 1 to 8, (the correspondence between these and the original sample numbers are shown in Table 7). The environmental implications of the insect assemblages from these samples are discussed in chronological order.

Methods

Eight flots were received. Insect remains were sorted and identified where possible under a binocular microscope. The system for “scanning” faunas as outlined by Kenward *et al.* (1985) was followed in this assessment.

When discussing the faunas recovered, two considerations should be taken into account:

1) The identifications of the insects present are provisional. In addition, many of the taxa present could be identified to species level during a full analysis, producing more detailed information. As a result, these faunas should be regarded as incomplete and possibly biased.

2) The various proportions of insects suggested are very notional and subjective.

Results

The insect taxa recovered from the flots are listed in Table 7. The taxonomy used for the Coleoptera (beetles) follows that of Lucht (1987). A number of Dipterous (fly) puparia and Trichopteran (Caddis) remains were found.

The numbers of individuals present is estimated using the following scale: * = 1-2 individuals ** = 2-5 individuals *** = 5-10 individuals **** = 10+ individuals.

Discussion

1. Are insects present and are the faunas interpretable?

Samples 1 and 2 from the Mesolithic peat beds produced poorly preserved and restricted assemblages of insects and it is difficult to give these any meaningful interpretation. Certainly nothing was recovered which is indicative of glacial climates.

Moderately sized, diverse and well-preserved assemblages were recovered from the ditch samples 4-8. No insect material was recovered from sample 3.

2. Environmental setting and Land use during deposit formation:

Samples 4 and 5:

The presence of grassland vegetation, probably used as pasture is suggested by the insects recovered from these samples. Primarily the evidence for this is the large numbers of the Scarabaeidae or 'dung beetles', such as *Geotrupes* spp. and *Aphodius* spp., recovered from both samples. This may suggest large, ruminant animals grazed nearby. The Hydrophilidae *Cercyon haemorrhoidalis* and Staphylinidae *Oxytelus rugosus* and *Platystethus arenarius* are also often associated with manure and animal dung (Koch 1989, Hall and Kenward 1990).

Grassland indicators include the elaterids *Athous* spp. and *Agriotes* spp. and the curculionid *Sitona* spp. commonly associated with the Fabaceae and Leguminosae families which include vetches (*Vicia* spp.), clovers (*Trifolium* spp.) and gorse (*Ulex* spp.) (Koch 1992). The larval stage of the scarabaeid *Phylopertha horticola* is also associated with turf and grassland (Koch 1989). Several other species indicate disturbed grassland such as *Apion* spp, which is associated with docks (*Rumex* spp.), and *Mecinus pyraster*, which is found on ribwort plantain (*Plantago lanceolata*) (Bullock 1993).

Sample 6
This assemblage was considerably more restricted that those discussed previously. Conditions appear to be damper with a semi-permanent water body with riparian vegetation composed of tall reeds. The latter is suggested by the Carabidae *Bembidion guttula* lives on clay based soils amongst sedges (*Carex* spp.) and other wetland vegetation, whilst *Agonum thoreyi* is found amongst tall reeds at the margins of standing waters (Lindroth 1985).

An increase in aquatic and semi-aquatic species occurs in this sample, many are associated with muddy substrates and ephemeral pools. This is accompanied by an abundance of caddis fly remains (*Tricoptera* spp.) which strongly suggests this deposit was lain in still water.

Sample 7
Several species suggest that the environment remains relatively damp. Once again dung beetles suggest pasture. Grassland indicators also reappear, with small numbers of the curculionids ***Apion*** spp, and ***Sitona*** spp. present. A single indicator of rotting and decaying wood also appears in this sample, the histerid ***Abraeus golobsus*** is found in the moist and decaying wood of a variety of deciduous trees (Koch 1989).

Sample 8
The insect assemblages recovered from this sample see a return to grassland, probably used as pasture. The assemblage closely mirrors those of samples 4 and 5. Wet ground conditions also appear to continue. The Hydrophilidae *Hydrobius fuscipes* and *Coelostoma orbiculare* are both associated with shallow, slow moving water bodies (Hansen 1987).

Conclusion

These samples have produced readily interpretable and useful information about the environment surrounding these ditches and peats during deposit formation. It seems that during the earlier period (*c*. 5200-3600BP) and later period (*c.* 3174-103BP) of deposit formation, the area contained a ditch, which experienced episodic inflows of water and was surrounded by grassland used as pasture with clear evidence animals were kept nearby. The exception to this is sample 6, in which the assemblage suggests a slow moving stream, pond or pool surrounded by reeds and other tall emergent vegetation.

The lack of identifiable insect remains from the early to mid Mesolithic peat beds is disappointing, however, this paucity may be a result of small sample size. Samples 7 and 8 did contain some unidentifiable insect fragments and it is quite plausible that a larger sample would produce a larger assemblage. Should greater quantities of material be available from these contexts, further analysis of this material should be considered.

Table 7: Insect taxa recovered from the West Heslerton Dyke Survey

Sample no*	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Context	**132 44-48**	**132 10-15**	**139 AA 0-5**	**76 AD 0-10**	**108 AA 0-10**	**143 AA south**	**76 AB 0-10**	**102 AB 0-10**
Radiocarbon dates BP (approx) **COLEOPTERA**	**10,830**	**6390**	**5200**	**3600**	**1850**	**347**	**314**	**103**
Carabidae								
Notiophilus spp.	*							
Dyschirius globosus (Hbst.)					*			**
Bembidion guttula (F.)						*		
Bembidion spp.								**
Amara spp.				*			**	
Pterostichus spp.				*	*		*	
Agonum thoreyi Dej.						*		
Hydraenidae								
Hydraena spp.								*
Octhebius spp.					*	**	**	
Limnebius spp.					*		*	
Helophorus spp.				*		**	*	**
Hydrophilidae								
Coelostoma orbiculare (F.)								**
Cercyon haemorrhoidalis (F.)				*				
Aquatic *Cercyon* spp.				**	**		**	***
Hydrobius fuscipes Leach								**
Laccobius spp.								*
Histeridae								
Abraeus globosus (Hoffm.)							*	
Silphidae								
Silphidae spp.								*
Staphylinidae								
Micropeplus spp.								**
Omalium spp.				***				***
Lesteva longelytrata (Goeze)				*	*			**
Lesteva spp.								***
Oxytelus rugosus (F.)				**	*			*
Oxytelus spp.							*	
Platystethus arenarius (Fourcr.)					**			*
Platystethus spp.				*	*			*
Stenus spp.					**			**
Paederus spp.				*				
Lathrobium spp.	*							
Xantholinus spp.				*				*
Philonthus spp.				**	*		**	
Quedius spp.				*				
Tachyporus spp.				**		**	**	*
Tachinus spp.							*	
Aleocharinae gen. & spp. Indet.								**
Elateridae								
Athous spp.				**				
Agriotes spp.					*			
Helodidae								
Helodidae gen & spp. indet	**	*			*			
Byrrhidae								
Cytilus sericeus(Hbst.)	*							

Nitidulidae								
Brachyterus urticae (F.)					*			*
Cucujidae								
Monotoma spp.				**				
Cryptophagidae								
Cryptophagus spp.						*		
Lathridiidae								
Corticaria spp.				**	*			
Chrysomelidae								
Plateumaris braccata (Scop.)	*							
Plateumaris/Donacia spp.	**	*						
Phylodecta spp.							*	
Phyllotraeta spp.								*
Scarabaeidae								
Geotrupes spp.				*	*			
Oxyomous				*				
Aphodius granarius (L.)							*	
Aphodius spp.				***	**		**	**
Phyllopertha horticola (L.)				*	*			*
Curculionidae								
Apion urticarium (Hbst.)								**
Apion spp.	*			*	**		*	****
Phyllobius spp.				*		*		
Sitona spp				**				***
Ceutorhynchus contractus (Marsh.)							*	
Ceutorhynchus spp.		*					*	*
Mecinus pyraster (Hbst.)				*				*
DIPTERA				*	*	*		
TRICOPTERA				*		****		

Molluscs

Terrestrial and freshwater molluscs were recovered from several of the samples (table 8). In general they were not abundant, except where the deposits were calcareous such as the ditches in Trench 102AA and Trenches 143 AA and 144AA. They do however occur where preserved organic remains are lacking and form some picture of the local environment. The assemblages from the large ditch in Trench 102AA are significant. This ditch has been interpreted as a flood defence and all the bulk samples are dominated by aquatic snails. Samples were not collected above 50cm in the ditch fills but the abundance of aquatics at this level indicates that the ditch was still wet probably indicating a much higher ground water level that that of the present day. This ditch is believed to be contemporary with the Roman ladder field system and the less abundant terrestrial snail fauna is suggestive of open dry pasture around the ditch with probably little shade or cover other than local to the ditch. Most of the species that might be typically associated with shaded or woodland habitats in these assemblages are fairly catholic and can occur in damp or marshy environments.

The ditch 143AA south also shows a major aquatic component but the presence of Valvata piscinalis and Bithynia tentaculata suggests that this ditch may have carried running water. With a radiocarbon result which suggests a late/post medieval date for this fill this implies quite a high water table at this time. Finally the assemblages from ditch 144AA contrast with the others in that they are dominated by terrestrial taxa with only occasional shells of aquatic gastropods. A marsh element is still present, presumably reflecting the ditch environment, and the shade loving taxa are more abundant than in the other assemblages. These latter could be explained by the ditch being hedged. Quantification of these faunas would be needed to extract there full potential but in those ditches where organic preservation is poor and the fills are calcareous, or slightly so, the snails may reflect the character of the land use on either side of the ditch, and would certainly indicate the general ground water level. Ditch 144AA is presumed to be medieval or later and the relative absence of aquatic taxa despite its depth suggests that the land was already being drained.

Sample	**76AC**	**76AC**		**76AD west**	**76AD west**		**102 AA**	**102 AA**	**102 AA**	**102 AA**	**102 AA**		**139 AB**		**143 AA**	**143 AAs**		**143 AAn**		**144 AA**	**144 AA**		**147 AA**
Context	**30-40**	**40-50**		**20-30**	**40-50**		**0-10**	**10-20**	**20-30**	**30-40**	**40-50**		**0-5**		**0-10**	**10-15**		**0-10**		**30-40**	**60-70**		**0-10**
Open country																							
Cecilioides acicula								+												+			
Helicella sp.											+							+			+		
Vertigo pygmaea								+	+	+	+												
Verigo geyeri											+												
Vertigo sp.																+							
Pupilla muscorum							+	+	+	+	+												
Vallonia costata							+	+												+			
Vallonia excentrica								+	+	+	+		+							+			
Vallonia pulchella										+													
Vallonia sp.				+					+														
Catholic																		+		+	+		
Trichia hispida							+	+	+	+	+												
Hygromia sp.							+																
Helix hortensis/nemoralis																							
Helix sp.								+	+	+										+			
Cochlicopa sp.	+						+	+	+	+	+									+			
Shade loving																							
Retinella nitidula										+	+									+	+		
Nesovitrea hammonis											+					+				+			
Retinella. Pura							+	+	+	+	+									+			
Oxychilus sp.	+										+									+			
Shade or marsh																							
Punctum pygmaeum																				+			
Vitrea	+	+							+		+										+		
Euconulus fulvus											+												
Marsh																							
Carychium sp.	+				+		+	+	+	+	+++									+	+		+
Vertigo antivertigo				+			+	+		+													
Succinea sp.							+	+	+	+	+									+	+		
Lymnaea truncatula		+					+	+	+	+	+									+	+		
Aquatic																							
Lymnaea glabra																+							
Bithynia tentaculata																+		+					
Planorbis laevis								+	+++	+++	+									+			
Planorbis contortus									+	+	+												

Planorbis leucostoma									+	+				+	+					+		
Planorbis planorbis							+	+	+	+	+					+							
Valvata piscinalis																+							
Valvata cristata							+	+								+							
Valvata macrostoma									+	+	+												+
Pisidium sp.	+						+		+		+					+							

Table 8. Molluscan taxa identified from the samples. All other samples produced no shells

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Conclusions and discussion

It should be stated again at the start of this final discussion that the primary object of this project was to establish whether deposits survived in the valley that would allow the reconstruction of the environment of the valley through its history with particularly reference to how the land was utilised, and the condition of these deposits and their potential.

We can answer that quite simply. There are numerous deposits with a potential for informing on the contemporary environment on the valley floor. Two of the palaeochannels investigated have well preserved organic deposits rich in pollen, and probably other plant and insect macroscopic remains, and span extended time periods. Two of the others have potentially equal potential but were not fully investigated. The two dated sequences alone cover the early Holocene, the late mesolithic and neolithic and part of the first millennium BC, while Evan's earlier work (Evans 1992) at Foulbridge indicates deposits of late mesolithic through to the Bronze Age. The LIDAR data for the valley should allow us to identify further potential channels which could extend this coverage, particularly into the historic period. These deposits have an advantage in that three of the four channels augered produced sequences over two metres deep with the lower parts of these extremely well preserved. The peat beds have yielded good pollen assemblages and adequate macrofossil assemblages although the density of identifiable items other than moss is very low. Several of the ditch deposits still retain some organic remains and the pollen samples studied from these show that in most cases the pollen survives in a condition suitable for detailed analysis. It is clear however that many ditches do not contain deposits suitable for this study.

Preservation is very much a problem with deposits other than those in the palaeochannels. The impact of the land drainage is very evident in Trench 76AD where the land drain actually lies in the early holocene peats. The extremely compressed nature of these peats in many of the preliminary boreholes and excavated trenches is apparent and is well illustrated by Robert Tindall's (one of the landowners) account of when he was a young lad the ground above the buried peats moved when the tractors or trucks travelled over them. This is no longer the case despite much bigger tractors and the loss of water from the peats has led to their compression and gradual drying out, and their further destruction is only a matter of time. The preservation of the peats in the best preserved sequence in Trench 132AA is recorded as of reasonable/some potential, but some decay is already visible, and this was the best exposure of these deposits. In two of the excavated archaeological ditches worms are actively breaking down the organic sediments in the base of them indicating that this is a relatively recent impact. It does not take these worms very long to reduce a buried peat or organic deposit to an amorphous structureless mush and they move horizontally following the deposit along the feature.

The depth and location of the deposits is clearly also important. All the shallowest features, except that in Trench 102AB which lay adjacent to a stream on low lying ground and 108AA where peats still survive although degraded, lacked any deposits with potential for palaeoenvironmental analysis. Even in deeper features such as the ditch in Trench 144AA which was over 1m deep there was little or no organic survival and the pollen was poor by comparison to the other samples. Geographically the trenches down the centre of the valley floor, in fields 145, 147, 148, 140 and 003 produced shallow ditches completely unsuitable for study. Even the deeper ditches in Field 147 were poor although some snail assemblages may be recoverable. The deposits with the greatest potential appear to be aligned along the railway line and the fields either side of this line may warrant a focus for further work. Several areas could not be explored in this initial project and two areas of field system north and north-east of Field 148, and across the railway line from Field 076 may repay investigation. The other area with potential lies either side of the present river but this is an area with limited existing crop mark evidence, possibly due to alluvial coverage.

The ditches investigated produced the poorest results, perhaps not surprisingly since they are shallower than the palaeochannels and the peat beds. Of the 28 bulk samples collected from ditches nearly 50% contained no or very little organic survival and several of the ditches revealed during the excavations were deemed so poor that they were not even sampled. Nevertheless most of the pollen samples studied during the assessment produced reasonable assemblages of pollen with only limited evidence of differential preservation. This was not the case for the plant and insect remains although reasonably well preserved assemblages were present in ditches of Bronze Age, Roman and late/post-medieval, and recent date. While it is most useful when considering the land use of adjacent fields to be able to use the plant macrofossil and insect evidence to compliment that of pollen, as long as the ditches can be dated the pollen affords a good window on the local vegetation surrounding the ditch.

For future work dating appears to be one of the most problematic aspects. There have been some problems with the radiocarbon results on this project. The date of the peat beds is unresolved. The pollen work would assign several of the deposits studied to the late Glacial or very early holocene. Previous dates obtained by Evans (1992) on his work would agree with this and the upper date in Field 132AA is also consistent, but the lower 6390BP date in 132AA is clearly wrong. The pollen sample from 139AA, supposedly a ditch fill, is consistent with a late glacial date and at odds with the 5673BP date on bark from this fill. The feature is clearly a ditch and it appears that the pollen may be derived from reworked earlier peats and conceivably also the bark from some other deposit. It is not clear why several of the dates are suspect since all the samples were apparently taken from secure contexts with no evidence of contamination, and as far as possible single pieces of identified wood were used for the analysis. A decision was made not to use animal bone or sediment (except in one case) but this limits the study to only those ditches that still retain wood fragments within their sediments. The pollen may well survive in a studiable condition in sediments where the organic macrofossils no longer do and the selection of bone and snail opercula may extend the number of features that could be studied.

Two things emerge quite clearly from this assessment. Firstly that there are suitable deposits on the valley floor for the reconstruction of the vegetational history and land use in the valley and that in some areas the archaeological ditches still retain deposits that would allow the more detailed study of field use and farming practice. Secondly that these deposits, particularly those relating to the late glacial and early holocene environment, and the field systems are actively degrading and many can be expected to have been lost in no more than a decade or two. The worm activity particularly will destroy these deposits where they remain above the present ground water table.

Any future development of this project can be seen as a three stage exercise, the first two being the detailed study of the late glacial and early holocene deposits buried beneath the blown sands and a programme of analysis and dating of field ditches in selected areas to understand the agricultural landscape. The extensive geophysical data for the valley now considerably enhances the process of ditch selection and may assist in selecting ditches of suitable size and depth such that the success rate improves. These deposits are those likely to be lost first and are under the greatest threat. The third stage relates to the palaeochannels, which may collectively allow a considerable span of the prehistoric and historic periods to be represented in the deposit sequence. The LIDAR data for the valley now allows remote prospection of likely sites on the valley floor which can be readily tested through trial augering. This very limited assessment has identified five palaeochannels, all of which may represent different periods and we know two of which cover perhaps some three to four thousand years of prehistory in some three to four metres of deposit. A study of the differences between contemporary pollen assemblages from the peat beds and ditches, which receive a rain, and those from the palaeochannels which include an influx of waterborne material would be an important taphonomic study and could contribute to the way in which these pollen assemblages are interpreted.

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References

Bennett, K.D., Whittington, G. and Edwards, K.J. 1994 'Recent plant nomenclatural changes and pollen morphology in the British Isles'. ***Quaternary Newsletter*** 73,1-6

Bronk Ramsey, C, 1995 Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program, ***Radiocarbon,*** 37, 425-30

Bronk Ramsey, C, 1998 Probability and dating, ***Radiocarbon***, 40, 461–74

Bronk Ramsey, C, 2001 Development of the radiocarbon calibration program, ***Radiocarbon***, 43, 355-63

Bronk Ramsey, C, Higham, T, and Leach, P, forthcoming Towards high precision AMS: progress and limitations, ***Radiocarbon***

Bullock, J. A. 1993. *Host Plants of British Beetles: A List of Recorded Associations.* **(*Amateur Entomologist* 11a). Royal Entomological Society: London.**

Bush, M. B. 1988 'Early Mesolithic disturbance: a force on the landscape'. ***Journal of Archaeological Science*** 15,453-462.

Bush, M. B. and Flenley, J.R. 1986 'The age of the British chalk grasslands'. ***Nature*** 395,484-485.

Evans, A.T. 1992 Pollen studies in the West Heslerton area, North Yorkshire. **Ancient Monuments Laboratory Report 54/92**

Hall A. R. and Kenward H. K. 1990. ***Environmental Evidence from the Collonia***. (The Archaeology of York. 14/6). Council for British Archaeology, London.

Hansen, M. 1987. ***The Hydrophilidae (Coleoptera) of Fennoscandia and Denmark* (*Fauna Entomologyca Scandinavica 18*). Leiden: Scandinavian Science Press.**

Haslam, Sylvia, Sinker, Charles & Wolseley, Pat (1976) ***British Water Plants***. Field Studies, 4, 243-351.

Haughton, C. and Powlesland, D. 1999 ***West Heslerton – The Anglian Cemetery*.** Landscape Research Centre Monograph

Hedges, R E M, Bronk, C R and Housley, R A 1989 The Oxford Accelerator Mass Spectrometry facility: technical developments in routine dating, ***Archaeometry*,** 31, 99–113

Hill, M.O., Mountford, J.O., Roy, D.B. & Bunce, R.G.H. (1999) ***Ellenberg's indicator values for British plants.*** ECOFACT Volume 2: Technical Annex. HMSO.

Kenward H.K., Engleman C., Robertson A. and Large F. 1985. Rapid scanning of urban archaeological deposits for insect remains. ***Circaea*** 3, 163-72.

Koch, K. 1989. ***Die Kafer Mitteleuropas:*** **(Ökologie Band 2*)*. Krefeld: Goecke & Evers.**

Koch, K. 1992. ***Die Kafer Mitteleuropas:*** **(Ökologie Band 3). Krefeld: Goecke & Evers.**

Lucht, W.H. 1987. ***Die Käfer Mitteleuropas.*** (Katalog). Krefeld**: Goecke & Evers.**

Mellars, P. and Dark, P. 1998 ***Starr Carr in Context: new archaeological and palaeoecological investigations at the Early Mesolithic site of Star Carr, North Yorkshire.*** McDonald Institute Monographs

Mook, W G, 1986 Business meeting: Recommendations/Resolutions adopted by the Twelfth International Radiocarbon Conference, ***Radiocarbon***, 28, 799

Moore, P.D. and Webb, J.A. 1978 ***An illustrated guide to pollen analysis***. London: Hodder and Stoughton.

Moore, P.D., Webb, J.A. and Collinson, M.E. 1991 ***Pollen analysis*** Second edition. Oxford: Blackwell Scientific.

Powlesland D, 2000 a *The Heslerton Parish Project: An integrated multi-sensor approach to the archaeological study of Eastern Yorkshire, England* A paper presented at the international school in archaeology, University of Siena, 6-11 December 1999.

Powlesland D, 2000 b *The Heslerton Parish Project: 20 years of archaeological research in the Vale of Pickering*, Yorkshire Archaeological Research Frameworks.

Powlesland, D., Haughton, C. and Hanson, J. 1986 Excavations at Heslerton, North Yorkshire 1978-82. ***Arch. J.*** 143 (1986) 53-173

Powlesland, D., Lyall, J. and Donoghue, D. 1997 Enhancing the record through remote sensing: the application and integration of multi-sensor, non-invasive remote sensing techniques for the enhancement of the Sites and Monuments Record. Heslerton Parish Project, N. Yorkshire, England ***Internet Archaeology 2*** (http://intarch.ac.uk/journal/issue2/pld/index.html)

Powlesand, D. & Rackham, J. 2001. Environmental Assessment Project for the central Vale of Pckering: Pilot Project Design.

Scaife, R in Hunn, J. and Rackham, D.J. in press ***A Multi period landscape at Rectory Farm West Deeping, Lincolnshire*.** BAR.

Schadla-Hall, R.T. 1989 The Vale of Pickering in the Early Mesolithic in context. In C.Bonsall (ed). ***The Mesolithic in Europe*.** Edinburgh: John Donald.

Schadla-Hall, R.T. and Cloutman, E.W. 1985 'One cannot dig at random in peat bog'. The eastern Vale of Pickering and the archaeology of a buried landscape. In C.C.Haselgrove, M.Milett and I.M.Smith (eds*)* ***Archaeology from the Ploughsoil,*** Sheffield, Department of Archaeology and Prehistory, 77-86

Stace, C. 1991 ***New flora of the British Isles***. Cambridge: Cambridge University Press

Stace, C. 1997. ***New Flora of the British Isles***. Second Edition. C.U.P.

Stenhouse, M J, and Baxter, M S, 1983 ^{14}C dating reproducibility: evidence from routine dating of archaeological samples, **PACT,** 8, 147–61

Stockmarr, J. 1971 'Tablets with spores used in absolute pollen analysis'. ***Pollen et Spores*** 13,614-621.

Stuiver, M, and Kra, R S, 1986 Editorial comment, ***Radiocarbon***, 28(2B), ii

Stuiver, M, and Polach, H A, 1977 Reporting of ^{14}C data, ***Radiocarbon***, 19, 355-63

Stuiver, M, and Reimer, P J, 1986 A computer program for radiocarbon age calculation, ***Radiocarbon***, 28, 1022-30
Stuiver, M, and Reimer, P J, 1993 Extended ^{14}C data base and revised CALIB 3.0 ^{14}C age calibration program, ***Radiocarbon***, 35, 215-30
Stuiver, M, Reimer, P J, Bard, E, Beck, J W, Burr, G S, Hughen K A, Kromer, B, McCormac, G, van der Plicht, J, and Spurk, M, 1998 INTCAL98 Radiocarbon age calibration, 24,000-0 cal BP, ***Radiocarbon***, 40, 1041-83
Thomas, K.D. 1989 'Vegetation of the British Chalklands in the Flandrian period: A response to Bush'. Journal of Archaeological Science 16,5
Ward, G K, and Wilson, S R, 1978 Procedures for comparing and combining radiocarbon age determinations: a critique, ***Archaeometery***, 20, 19-31