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Environmental Analysis



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CONTENTS

SUMMARY	3
ACKNOWLEDGEMENTS	4
1 INTRODUCTION	5
1.1 Circumstances of the Project	5
2 METHODOLOGY	7
2.1 Wood.....	7
2.2 Charred and Waterlogged Plant Remains	7
2.3 Pollen	8
3 RESULTS.....	11
3.1 Wood.....	11
3.2 Charred and Waterlogged Plant Remains	13
3.3 Pollen	15
4 DISCUSSION	16
4.1 Conclusions	16
BIBLIOGRAPHY	18
APPENDIX 1: RADIOCARBON DATES.....	20
Scottish Universities Environmental Research Centre.....	21
Laboratory Code.....	21
Radiocarbon Age BP	22
Scottish Universities Environmental Research Centre.....	23
Laboratory Code.....	23
Radiocarbon Age BP	24
APPENDIX 2: WOOD DATA.....	25
FIGURES.....
Figure 1 Pollen diagram of material from the fills of the defensive ditch	9
Figure 2 Age frequency plot for the wooden stems from fills <i>113</i> , <i>114</i> , <i>115</i> , and <i>118</i> : all pieces	11
Figure 3 Age frequency plot for the wooden stems with cut ends from fills <i>113</i> , <i>114</i> , <i>115</i> , and <i>118</i>	12
Figure 4 Diameter frequency plot for the wooden stems from fills <i>113</i> , <i>114</i> , <i>115</i> , and <i>118</i> : all pieces	13

TABLES

Table 1 Analysis of charred and waterlogged plant remains from the fills of the defensive ditch of the earthwork enclosure 14

Table 2 Age (number of rings) of wooden stems per species from fill **113**..... 25

Table 3 Age (number of rings) of wooden stems per species from fill **114**..... 25

Table 4 Age (number of rings) of wooden stems per species from fill **115**..... 26

Table 5 Age (number of rings) of wooden stems per species from fill **118**..... 26

Table 6 Diameter of wooden stems per species from fills **131, 114, 115** and **118** 27

SUMMARY

An ongoing programme of archaeological investigation is being undertaken at the multi-period Scheduled Monument (CH 25) at Heronbridge (SJ 411 651), by the River Dee, Chester, by the Chester Archaeological Society under the direction of David Mason. Following an environmental assessment in 2005, which established that a section of the defensive ditch of the earthwork enclosure had been converted into an *ad hoc* retting tank, Oxford Archaeology North (OA North) was commissioned by Chester Archaeological Society in September 2008 to undertake a programme of environmental analysis of 84 pieces of wood and four bulk samples, and the assessment of the pollen from a series of four overlapping monolith samples from the fills of what is considered to be the defensive ditch of a curvilinear enclosure that overlies part of the Roman settlement. Plant remains were also to be selected that were suitable for radiocarbon dating.

The 84 pieces of wood were identified, and the sizes and ages recorded. The data were used to establish the age frequency, frequency of cut ends, and the size frequency of the various taxa. It was concluded that there was no evidence for woodland management in this material.

The four bulk samples contained abundant well-preserved waterlogged plant remains, including large amounts of herbaceous plant stems, flax seeds and capsules. This suggested that flax was being used to ret plant fibres. They also contained seeds from plants of cultivated, open or waste ground, and amongst these there are plants that are more usually associated with arable cultivation, whilst others are more likely to have been found growing on open or waste ground or beside tracks. The upper fill also contained some charred plant remains, including wheat grains.

The pollen assessment suggests that the landscape was largely cleared, though perhaps contained some secondary woodland. The landscape was probably a mosaic of cultivated, open or waste ground, grassland and woodland. It also suggests that hemp was not being retted with the flax in the ditch.

Flax seeds were selected from two fills of the defensive ditch (**114** and **118**) in 2004 and were submitted to Dr Gordon Cook at the Scottish Universities Environmental Research Centre, East Kilbride, for AMS radiocarbon dating. The results of the AMS dating gave an averaged mean date of cal AD 680-890 (1238±28BP), suggesting that the fills were accumulating in the early medieval period, and that the ditch had a secondary use for retting plant fibres.

The results of the analysis of the wood and plant remains, and of the pollen assessment of the fills of the defensive ditch of the curvilinear enclosure at Heronbridge make a significant contribution to our understanding of the local environment, the secondary usage of the defensive ditch, and the way in which local woodland was being used.

ACKNOWLEDGEMENTS

OA North would like to thank Dr David Mason, formerly of Chester Archaeology, and the Chester Archaeological Society for commissioning the work. We would also like to thank the Geography Department of the University of Lancaster for use of their laboratories. We would also like to thank Dr Allan Hall for assisting with the identification of the plant remains.

The environmental bulk samples were processed by Frances Graham, formerly of Oxford Archaeology North, under the supervision of Elizabeth Huckerby. Sandra Bonsall and Elizabeth Huckerby analysed the waterlogged plant remains and Denise Druce identified the wood. The pollen samples were prepared by Sandra Bonsall and the pollen was assessed by Elizabeth Huckerby. The report was written by Elizabeth Huckerby and Denise Druce, and edited by Rachel Newman.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

- 1.1.1 The site at Heronbridge, situated south of Chester by the River Dee (SJ 411 651), is a multi-period site and has been designated a Scheduled Monument (CH 25). Overlying part of the Roman settlement identified, there is a large curvilinear earthwork, which had been thought to belong to the general period *c* AD 400-*c* 1300, although there was no firm dating of the monument (D Mason *pers comm*). However, excavation in the 1930s recorded that organic material was preserved in the fills of the defensive ditch, and Dr David Mason and the members of the Chester Archaeological Society decided to excavate a section of the ditch surrounding this enclosure in order to retrieve organic material for radiocarbon dating. Four environmental bulk samples, 84 wood samples, and a series of four monolith samples were taken through the fills of this ditch.
- 1.1.2 An environmental assessment of the potential for charred and waterlogged plant and insect remains was undertaken in 2005 by Oxford Archaeology North (OA North) of four environmental bulk samples from the ditch fills (OA North, 2005). As part of this assessment, flax seeds, retrieved from the samples assessed, were submitted to Dr Gordon Cook at the Scottish Universities and Research Centre at East Kilbride for AMS dating; these returned dates calibrated to the early medieval period. Fifteen wood fragments were selected and assessed, to establish the potential of the wood remains to be identified to species. Four monolith samples were also taken by the OA North environmental archaeologist from the exposed section of the ditch fills, but these were not assessed at that stage.
- 1.1.3 The results from this assessment demonstrated the excellent preservation of waterlogged plant remains and identified the secondary usage of the defensive ditch for retting flax (OA North 2005). The report recommended that full analysis should be undertaken on the environmental bulk samples and the wood samples. The assessment report also recommended that the monolith samples should be assessed to establish their potential for the presence of pollen, and whether analysis was justified, to confirm whether flax alone was being retted, or if other plant taxa, such as hemp and nettles, were also being used.
- 1.1.4 Following the assessment of several of the wooden roundwood 'rods' from fills **113** and **114** from the defensive ditch (OA North 2005), recommendations were made for analysis of the material in order to determine the types of wood species used and whether there was any evidence for woodland management. Some 84 wooden 'rods' were analysed, which included the identification of wood species, whether there was evidence for woodworking (*ie* cut ends), the number of growth rings, and the diameter of each piece. Although the pieces came from four different fills of the ditch (**113**, **114**, **115** and **118**), given the homogeneous nature of these fills and the likelihood of the reworking of the

stratigraphy (D Mason *pers comm*), the results of the data are discussed as a whole unit. Without the dating of individual pieces, it is unclear whether the stems formed part of the same structure, perhaps a fence panel, hurdle or wattle structure, which was either constructed or dumped in the ditch. It is possible, though, that individual pieces were thrown into the ditch over a period of time.

- 1.1.5 Chester Archaeological Society commissioned OA North in September 2008 to undertake both the analysis of the waterlogged plant remains, including the wood, and the assessment of the pollen from the monoliths.

2. METHODOLOGY

2.1 WOOD

- 2.1.1 A slice from each piece of roundwood was initially examined using a Leica MZ6 binocular microscope at up to x40 magnification in order to determine its cellular make-up (*ie* ring, semi-ring, or diffuse porous wood) and to count the number of growth rings. The diameter of each piece was also recorded at this stage. Then, radial and tangential sections of each slice were mounted on a slide in water, sealed with a cover slip, and observed under transmitted light using an Olympus BH-2 microscope at up to x400 magnification. Identifications were made with reference to Schweingruber (1990), Hather (2000), and modern reference material.
- 2.1.2 The taxonomic level of identification varied according to the observed genera/family. In some cases, the level of identification was limited as a result of the similarities of species within a family or sub-group, such as *Prunus* sp (blackthorn-type in text), which includes *Prunus spinosa* (sloe/blackthorn) *Prunus avium* (wild cherry) and *Prunus padus* (bird cherry), and Salicaceae (willow-type in text), which includes *Salix* sp (willow) and *Populus* sp (poplar).
- 2.1.3 The data were used to create plots showing the age (ring counts) and size (diameter in millimetres) frequency distributions of all the pieces analysed, as the examination of these two variables may give an indication of woodland management techniques (Murphy 2001). There are problems with this technique, however, as it has been recognised that any pieces within an assemblage may originate from the same stem as part of construction (*ibid*), or as a result of breakage during the period post-deposition. In order to limit the chances of reproducing measurements from the same stem, any Heronbridge stems sampled together and exhibiting the same measurements were treated as a single piece. This reduced the number of stems used in the calculations from 84 to 74. The data used to reproduce the plots are shown in *Appendix 2*.

2.2 CHARRED AND WATERLOGGED PLANT REMAINS

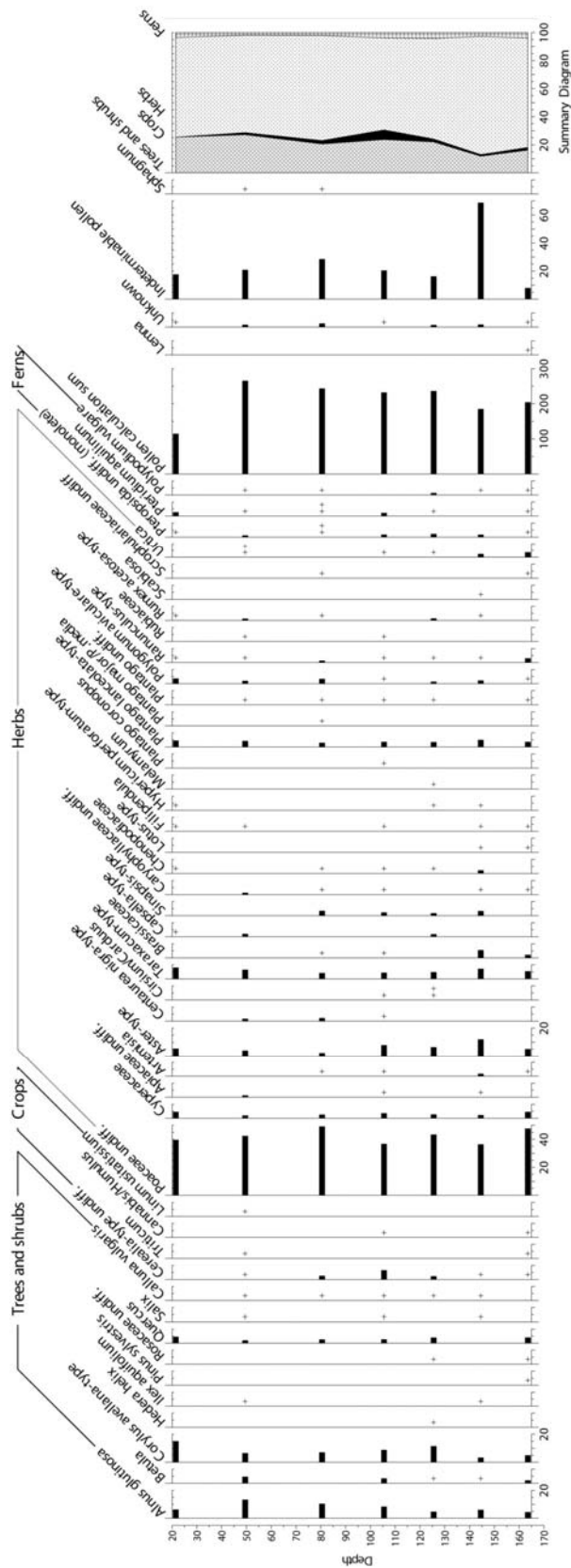
- 2.2.1 Four samples were selected by the excavators from fills *113*, *114*, *115*, and *118* of the defensive ditch of the curvilinear enclosure and assessed to establish their potential for analysis of charred and waterlogged plant remains (OA North 2005). The four samples were all judged to be suitable for analysis.
- 2.2.2 The samples, which were 6-10 litres in volume, were hand floated; the flots were collected on 250 micron mesh and retained in water. All flots (the larger ones were first subdivided) were sieved through a series of mesh sizes (2mm, 250mm, and 500mm). A decision was taken not to count each individual waterlogged plant remain but to record them on a scale of 1–5, where 1 is rare (less than five items in the sample) and 5 is abundant (more than 100 items in the sample). This strategy was adopted because it was judged that the benefit of any additional information concerning the plant assemblages from

individual contexts was greatly outweighed by the time required to process the waterlogged remains fully. A selection of each waterlogged type was extracted from the flots, and where possible identified. Identification was aided by Katz *et al* (1965), Cappers *et al* (2006), and Stace (1997), and by comparison with modern reference collections held at OA North (some modern seeds were supplied by the Hohenheim Botanic Gardens, Stuttgart) and the Biolaboratory of the Department of Archaeology, Durham University. Plant nomenclature follows Stace (1997).

- 2.2.3 Charcoal fragments, greater than 2mm, were recorded on the same scale of abundance as the waterlogged plant remains. Other material in the flot was noted.

2.3 POLLEN

- 2.3.1 Four overlapping monoliths were taken by an OA North environmental archaeologist in 2005 through the fills (**112**, **113** and **114**) of the defensive ditch. The samples were taken from 0.20m below a position marked by Dr David Mason and extended to a depth of 1.65m below this mark, the uppermost horizon of **115**, a layer of heavy rubble. The surface of each sample was cleaned and eight sub-samples were taken at known depths for the assessment of pollen (see Fig 1).



Percentage values of pollen sum, which includes all land pollen and fern spores. Values less than 1% are shown as +. Depths are shown in mm.

Figure 1: Pollen diagram of material from the fills of the defensive ditch

- 2.3.2 **Preparation:** volumetric samples were taken from the eight samples, and two tablets containing a known number of *Lycopodium* spores were added so that pollen concentrations could be calculated if required (Stockmarr 1972). The samples were prepared using a standard chemical procedure (method B of Berglund and Ralska-Jasiewiczowa (1986)), using HCl, NaOH, sieving, HF, and Erdtman's acetolysis, to remove carbonates, humic acids, particles greater than 170 microns, silicates, and cellulose, respectively. The samples were then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000cs silicone oil. Slides were examined at a magnification of x400 (x1000 for critical examination) by ten equally spaced traverses across at least two slides to reduce the possible effects of differential dispersal on the slides (Brooks and Thomas 1967). Pollen identification was made following the keys of Moore *et al* (1991), Faegri and Iversen (1989), and a small modern reference collection. Andersen (1979) was followed for the identification of cereal grains. Indeterminable pollen was also recorded as an indication of the state of pollen preservation. Plant nomenclature follows Stace (1997). The preservation of the pollen was noted and charcoal particles greater than 5 microns were recorded also (Peglar 1993).
- 2.3.3 **Calculations and Presentation of Results:** calculations were made and the pollen diagram drawn using the spreadsheet TILIA and TILIA.GRAPH in TILIA.View 2.0.2 (Grimm (1990)). The results are presented as pollen diagrams of pollen and spore taxa as percentages of the total land pollen sum, SumP (trees + shrubs + cultivated plants + herbs + ferns and fern allies). Obligate aquatics, indeterminable and unknown grains and spores of fern and fern allies, and microcharcoal particles greater than 5 microns are presented as percentages of the SumP + the sum of the particular category. All percentages less than 1% are shown as +.

3. RESULTS

3.1 WOOD

3.1.1 Six taxa/families were identified: *Alnus glutinosa* (alder), *Corylus avellana* (hazel), *Fraxinus excelsior* (ash), Salicaceae, *Prunus* sp, and *Betula* sp (birch). The age frequency plot using all 74 pieces (Fig 2) shows that all the taxa are clustered between two and seven years in age, and by far the most dominant taxa is hazel, which produced a few pieces older than seven years. Twenty pieces showed evidence of working, in the form of diagonally cut ends. Although the creation of an age frequency plot is of limited value with such a small dataset, the results (Fig 3) are consistent with the plot of all the pieces, in that the ages are clustered between three and seven years. Hazel is, again, the most dominant taxa, although, interestingly, the data show that seven out of ten ash stems had cut ends.

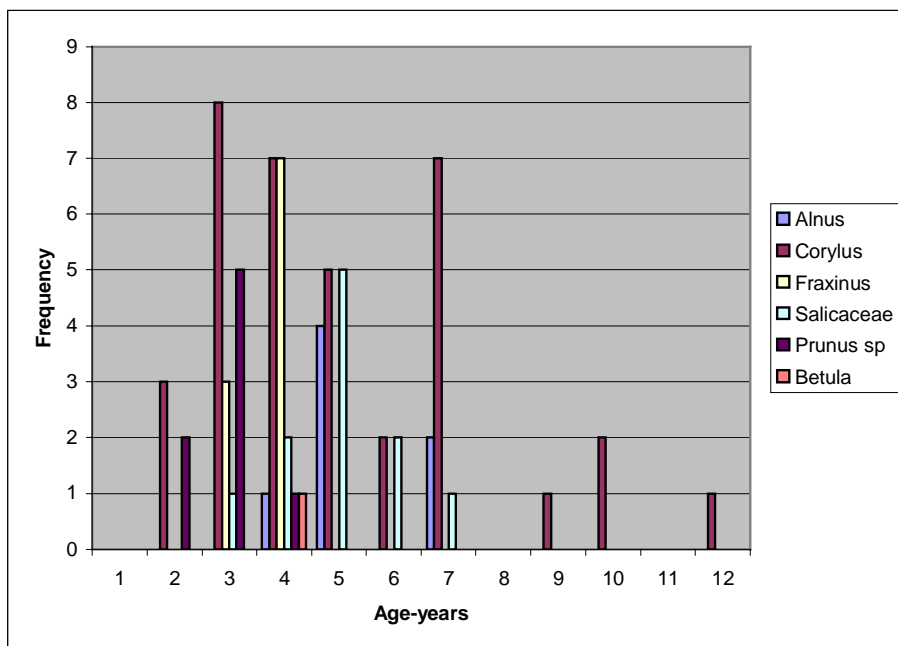


Figure 2: Age frequency plot for the wooden stems from fills 113, 114, 115 and 118: all pieces

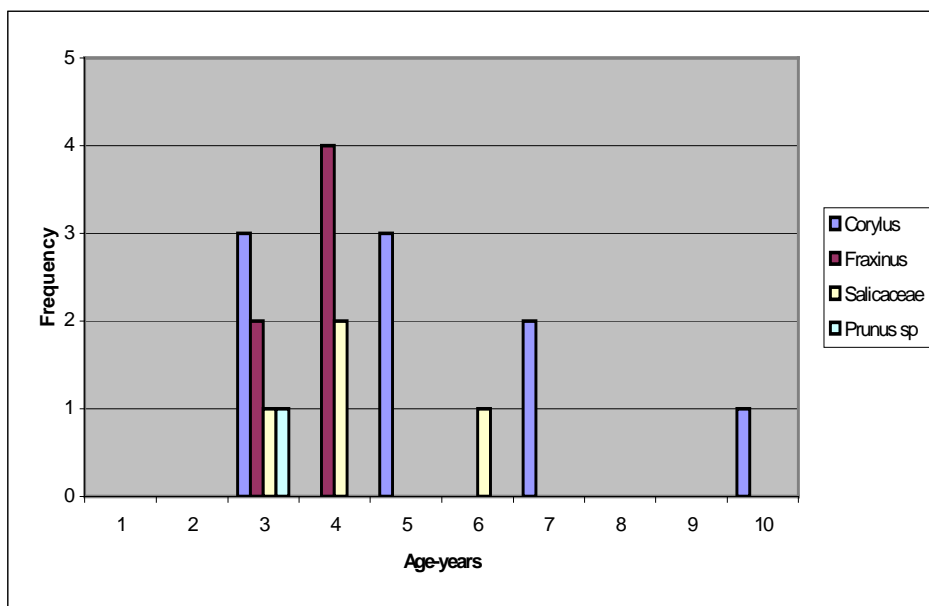


Figure 3: Age frequency plot for the wooden stems with cut ends from fills 113, 114, 115 and 118

3.1.2 Hazel and alder, and, indeed, most of the taxa present, were common medieval and post-medieval coppice trees, although, most can self-coppice and are able to rejuvenate by sending out suckers, which, if left to grow, can produce long straight rods (Edlin 1949). This makes the identification of ‘active’ woodland management through coppicing often hard to identify, especially with a relatively small dataset. What is certain, however, is that coppiced woods were cut at intervals of years (commonly seven, but this could vary between four and thirty years), which was sometimes regular, but often irregular (Rackham 2003). The age frequency plot (Fig 2) shows no obvious coppice cycle and suggests that although the age range is fairly limited, stem selection was probably based on other factors, such as size.

3.1.3 The diameter frequency plot (Fig 4) shows that the preferred size for hazel was 18mm, although the size distribution was 7-25mm. The size range of all taxa was 7-28mm, in which willow-type and blackthorn-type are notable as being in the lower half of the age bracket, and ash in the upper half. This broad pattern probably reflects the selection of smaller- and larger radius rods for different parts of a structure, or for different uses. If the remains originate from the same structure or type of structure, then it is possible that a connection exists between ash exhibiting the most cut ends and also being, generally, a larger size. It is possible, for example, that it was utilised, along with hazel, to form the larger uprights for a wattle hurdle or panel, which was staked into the ground.

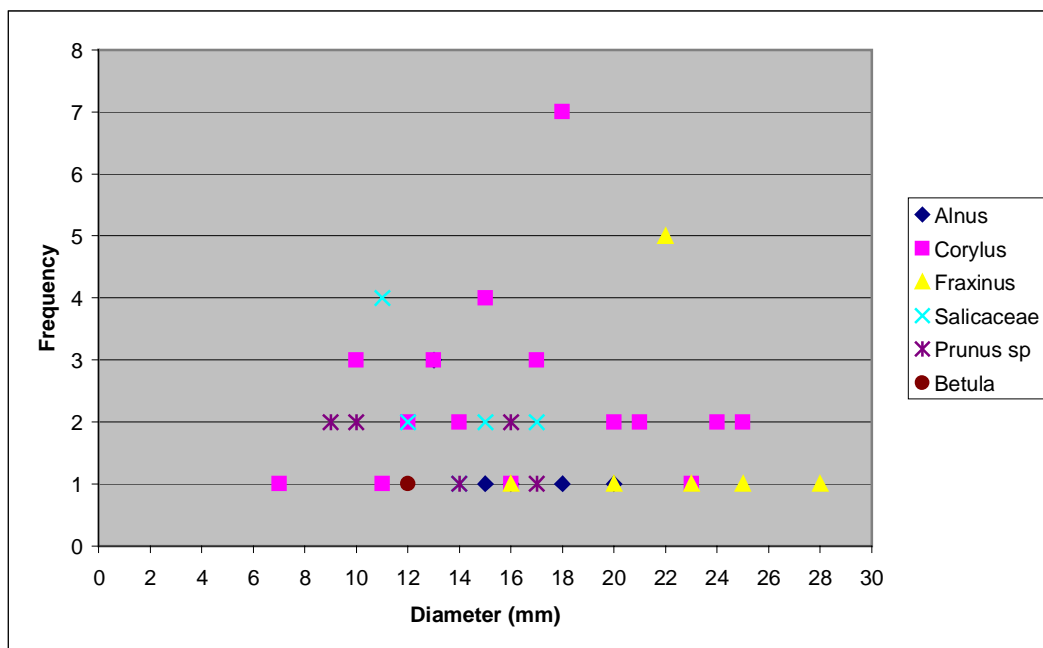


Figure 4: Diameter frequency plot for the wooden stems from fills **113**, **114**, **115** and **118**: all pieces

3.2 CHARRED AND WATERLOGGED PLANT REMAINS

- 3.2.1 Waterlogged plant remains were recorded in all the four samples (Table 1). Occasional charred plant remains were identified in two of the fills (**113** and **118**), with a single emmer/spelt wheat (*Triticum dicoccum/spelta*) grain in the lowest layer.
- 3.2.2 The most striking feature of the analysis of the waterlogged plant remains from the defensive ditch fills (**113**, **114**, **115**, and **118**) is the very high frequency of *Linum usitatissimum* (flax) seeds and capsule fragments, together with very abundant short sections of plant stems (only a few centimetres long), which are likely to be from flax. Excluding the flax seeds, capsules and stem fragments, seeds from plants of cultivated, open or waste ground dominated the plant assemblage in the four fills, and amongst these are several plants that are more usually associated with arable cultivation, such as corn chamomile (*Anthemis cotula*), corn spurrey (*Spergula arvensis*) and wild radish (*Raphanus raphanistrum*). Others, for example knotgrass (*Polygonum aviculare*), common mallow (*Malva sylvestris*) and stinging nettle (*Urtica dioica*), are more likely to have been found growing on open or waste ground, or beside tracks.
- 3.2.3 Seeds from plants indicative of grassland were also identified in the two upper fills examined (**113** and **114**), but none was recognised in either fill **115** or **118**. There were some plants of wet ground recorded in the samples, but these were rare, although there was a reasonable number in upper fill **113**.

Fill number	113	114	115	118
Volume processed (l)	6	10	6	10
Flot size (l)	2	3	1	9
Size of flot examined (l)	0.25	0.25	0.125	0.10
Amorphous plant remains	5	5		4
Stems	1	5	5	5
Wood	2	2	1	
Charcoal fragments >4mm	4	4	2	1
Bryophyte fragments - moss	1	1		
Insect remains	2	2	4	1
Coal		2		
Silt or clay	5	3		
Coarse sand/gravel			5	3
Waterlogged seeds				
Plants of cultivated, open or waste ground				
<i>Anagalis arvensis</i> - scarlet pimpernel		2		
<i>Anthemis cotula</i> - corn chamomile	3	3	2	2
<i>Aethusa cynapium</i> - fool's parsley	2			
<i>Brassica</i> sp - mustard/cabbage				1
<i>Chenopodium album</i> - fat hen	1		2	1
<i>Euphorbia</i> sp - spurge	1			
<i>Fallopia convolvulus</i> - black bindweed				1
<i>Fumaria</i> sp - fumitory	1			
<i>Malva sylvestris.</i> - common mallow	1	1	1	1
<i>Persicaria lapathifolia</i> - pale persicaria	2	2	2	
<i>Persicaria maculosa</i> - redshank		1		
<i>Polygonum aviculare</i> - knotgrass	3	5	4	2
<i>Raphanus raphanistrum</i> - wild radish pods	2	4		1
<i>Raphanus raphanistrum</i> - wild radish seeds	2	2	2	2
<i>Solanum nigrum</i> - black nightshade		1		
<i>Sonchus asper</i> - prickly sow thistle	2	4	3	2
<i>Spergula arvensis</i> - corn spurrey	1	4	3	5
<i>Stellaria media</i> - common chickweed	1	2		
<i>Thlaspi arvense</i> - field pennycress	1			1
<i>Urtica urens</i> - small nettle				3
Plants of grassland				
Poaceae 2-4mm - grasses with seeds 2-4mm	3	2		
<i>Leontodon saxatilis</i> - cf lesser hawkbit	1	1		
<i>Rumex acetosa</i> - common sorrel	2			
<i>Rumex acetosella</i> - sheep's sorrel		1		
<i>Prunella vulgaris</i> - selfheal	1	2		
Plants of wet ground				
<i>Alisma</i> sp - water plantains	3			
<i>Bidens tripartita</i> - trifold bur-marigold			1	
<i>Carex trigynous</i> -type - sedges	2			
<i>Isolepis setacea</i> - bristle club-rush		1		
<i>Juncus</i> sp - rushes	1			1
Broad ecological categories				
<i>Anthriscus caucalis</i> - bur-parsley	1	1		
Asteraceae - daisy family		1		
Chenopodiaceae undifferentiated - goosefoot/orache		2		
<i>Cirsium vulgare</i> - spear thistle		1		
<i>Cirsium</i> sp - thistle	1	2		
<i>Conium maculatum</i> - hemlock		2		
<i>Galeopsis tetrahit</i> - common hemp-nettle		1		

<i>Luzula</i> sp - woodrush		1		
<i>Plantago</i> sp - plantain sp	1			
<i>Ranunculus repens</i> -type - creeping buttercup-type	1	1	2	1
<i>Ranunculus sardous</i> - hairy buttercup		2		
<i>Rumex obtusifolius</i> – broad-leaved dock				1
<i>Rumex</i> sp stamens - sorrel stamens				2
<i>Torilis japonica</i> - upright hedge parsley			2	
<i>Veronica</i> sp - speedwell sp		1		
<i>Urtica dioica</i> - stinging nettle	5	5	4	
Indeterminate	1			
Food and economic taxa				
<i>Corylus avellana</i> - hazelnut fragments				1
<i>Linum usitatissimum</i> seed - flax	5	5	5	5
<i>Linum usitatissimum</i> capsule - flax	5	5	3	5
<i>Rubus fruticosus</i> agg - blackberries	1	1		
Number of charred Plant Remains				
<i>Triticum aestivum</i> - bread wheat	1			
<i>Triticum dicoccum/spelta</i> - emmer/spelt wheat	1			1
<i>Triticum</i> - wheat	1			
<i>Corylus avellana</i> - hazelnut fragments	2			
<i>Fumaria</i> sp - fumitory	1			

Waterlogged plant remains are recorded on a scale of 1-5 where 1 = 1-5 items and 5 = more than 100 items. Charred plant remains are actual counts

Table 1: Analysis of charred and waterlogged plant remains from the fills of the defensive ditch of the earthwork enclosure

3.3 POLLEN

- 3.3.1 Pollen was recorded in all the samples except that from a depth of 0.65-0.66m, and the pollen assemblage suggests an open landscape with some hazel and alder woodland (Fig 1).
- 3.3.2 The pollen assemblage was dominated throughout by grass (Poaceae) pollen, but there was a rich assemblage of other herbaceous plants. Several of the taxa recorded suggest cultivated or waste ground, for example mustard-type (*Sinapsis*-type), dandelion-type (*Taraxacum*-type), daisy-type (*Aster*-type), and goosefoots and oraches (Chenopodiaceae), whilst others are indicative of grassland, for example common sorrel-type (*Rumex acetosa*-type), common knapweed (*Centaurea nigra*) and ribwort plantain (*Plantago lanceolata*).
- 3.3.3 Cereal pollen was recorded throughout the sequence, but there is a peak at a depth of 1.05-1.06m, which is 0.58-0.59m above fill **115**, the heavy rubble layer. Despite the large amount of flax remains in the bulk samples, only a single grain of pollen was identified. Nettle pollen was identified in five of the samples, and occasional grains of cannabis/hop (*Cannabis/Humulus*) pollen were recorded at depths of 1.05-1.06m and 1.63-1.64m.
- 3.3.4 No pollen from obligate aquatics was identified, except for a single grain of duckweed (*Lemna*) pollen. Bracken (*Pteridium aquilinum*) and other fern spores were recorded in all the samples, but were never more than 5% of the pollen sum.

4. DISCUSSION

4.1 CONCLUSIONS

- 4.1.1 The results of the analysis of the wood and plant remains, and of the pollen assessment, from the fills of the defensive ditch at Heronbridge make a significant contribution to our understanding of the local environment, the secondary usage of the defensive ditch, and the way in which local woodland was being used.
- 4.1.2 The pollen assessment suggests that the landscape was largely cleared, although it perhaps contained some secondary woodland. The landscape was probably a mosaic of cultivated, open or waste ground, grassland and woodland.
- 4.1.3 There is very little pollen evidence to suggest that either flax or hemp were being cultivated in the environs of the site. Flax plants produce very small quantities of pollen and therefore its absence in the pollen record is unsurprising, but if hemp was being retted, the pollen of that species should have been abundant. Large numbers of nettle seeds were recorded in fills **113**, **114** and **115**, and some nettle pollen was identified in the pollen assessment. These are commonly identified from many archaeological sites, and in the past, the stems were a valuable source of fine fibres (Dimpleby 1978, 47). Today, nettles are a very common plant and are indicative of nitrogen-rich soils associated with animal or human activity.
- 4.1.4 Retting is a process whereby plant stems are soaked in shallow water for two weeks to separate out the plant fibres for the production of linen cloth (Higham 1998). The identification of the type and quantity of the flax seeds, capsules, and stems and sections of plant stems which were only a few centimetres long from the fills suggests that the feature was being used to rett the stems for fibres. The remains suggest that nettles may also have been processed. Hall *et al* (2000) recorded a similar assemblage of plant remains at Layerthorpe Bridge, York, which they interpreted as debris from retting, and as evidence for fibre processing in the early medieval or medieval period in York.
- 4.1.5 The two radiocarbon dates obtained from flax seeds from fills **114** and **118** provide a timeframe for this activity (OA North 2005). They were dated to cal AD 680-890 (1238±28BP), an averaged mean of the two dates from fills **114** (cal AD 650-830 (1285±40BP; SUERC-3764)) and **118** (cal AD 760-980 (1190±40BP; SUERC-3765)). The relative stratigraphy of the fills was homogeneous and therefore a Chi square test was applied to the results. This gave a value of 2.8, with one degree of freedom, and as this was less than 3.8, it was considered statistically reliable to take an averaged mean of the two dates (A Bayliss *pers comm*).
- 4.1.6 In Eastern England, medieval processing of hemp for plant fibres has been summarised in Geary *et al* (2005). The secondary usage of ditches, moats and existing water bodies for retting plant fibres, such as flax, hemp and nettles,

has been recorded at a number of medieval sites (Hall and Huntley 2007, 235-6), including Hall Garth, Beverley (Dobney *et al* 1994), Old Abbey Farm, Risley (Kenward *et al* 2004), and Higher Lane, Fazakerley (Hall *et al* 1996). Sites where the natural environment has been used include Askham Bog, near York (Bradshaw *et al* 1981), Layerthorpe Bridge, York (Hall *et al* 2000), Littlewater in Cumbria (LUAU 2000) and Glasson Moss (Cox *et al* 2001).

- 4.1.7 A pattern is emerging in north-west England of the extensive use of water bodies for the production of plant fibres in the early medieval period, for example at Glasson Moss, on the Solway Plain in north Cumbria (Cox *et al* 2001) and Littlewater, near Haweswater in east Cumbria (LUAU 2000), and now at Heronbridge. At Glasson Moss and Littlewater, the major plant being utilised, from pollen evidence, was *Cannabis* (hemp), although at Littlewater some *Linum* and abundant *Urtica* (nettle) pollen was identified. Both at Glasson Moss and Littlewater, natural water-bodies were being used, the former using pools on the surface of the raised mire and the latter a small lake.
- 4.1.8 A history of linen production in the North West is to be found in Roberts (1998). The practice of flax retting continued in Cumbria throughout the medieval and post-medieval periods until about 1750. Higham (1998, 8-10) describes how, at Grindleton, Lancashire, on the River Ribble, water was diverted into pools in the medieval period for the purpose of flax retting. At Heronbridge, it is possible that a similar system was being used, but utilising an existing defensive ditch.
- 4.1.9 Few pre-Conquest records dealing with woodland management exist (Rackham 2003), and in the medieval period, most relate to parts of eastern and southern England. Records after AD 1250 show the earliest coppice cycles (to AD 1400) to be between four and eight years (Rackham 2003, fig 10.3). However, these appear to be extended to between ten and twenty years after the 1500s. The wooden rods from Heronbridge, which cluster between two and seven years in age, are certainly in keeping with the smaller sizes more commonly found on earlier medieval sites. However, the fairly diverse spread, and the lack of obvious peaks in the dataset, means that evidence for active woodland management is lacking. Instead, it appears that the stems, which may represent naturally occurring or randomly chopped coppice, were selected for their size in relation to species type/properties and function.

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APPENDIX 1: RADIOCARBON DATES



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RADIOCARBON DATING CERTIFICATE

26 October 2004

LABORATORY CODE	SUERC-3764 (GU-12275)
Submitter	Dr. David Mason Ochr Cottage, Porch Lane Hope Mountain Caergwrle Flintshire LL12 9HG
Site Reference Sample Reference	Heronbridge Context 114
Material	Uncharred Seeds : <i>Linum usitatissimum</i>
$\delta^{13}\text{C}$ relative to VPDB	-23.9 ‰
RADIOCARBON AGE BP	1285 \pm 40

- N.B** 1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.
2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).
3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

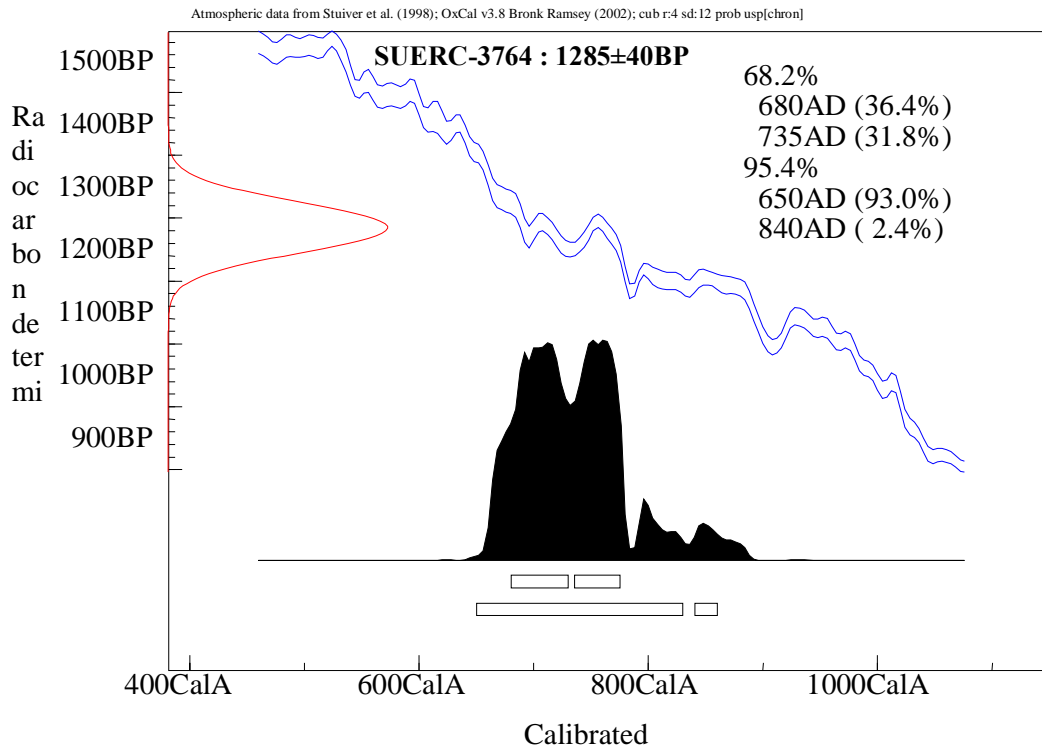
Conventional age and calibration age ranges calculated by :-

Date :-

Checked and signed off by :-

Date :-

Calibration Plot





Director: *Professor A E Fallick*

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RADIOCARBON DATING CERTIFICATE

26 October 2004

LABORATORY CODE	SUERC-3765 (GU-12276)
Submitter	Dr. David Mason Ochr Cottage, Porch Lane Hope Mountain Caergwrle Flintshire LL12 9HG
Site Reference Sample Reference	Heronbridge Context 118
Material	Uncharred Seeds : <i>Linum usitatissimum</i>
$\delta^{13}\text{C}$ relative to VPDB	-26.2 ‰
RADIOCARBON AGE BP	1190 \pm 40

N.B. 1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

- 2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).
- 3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

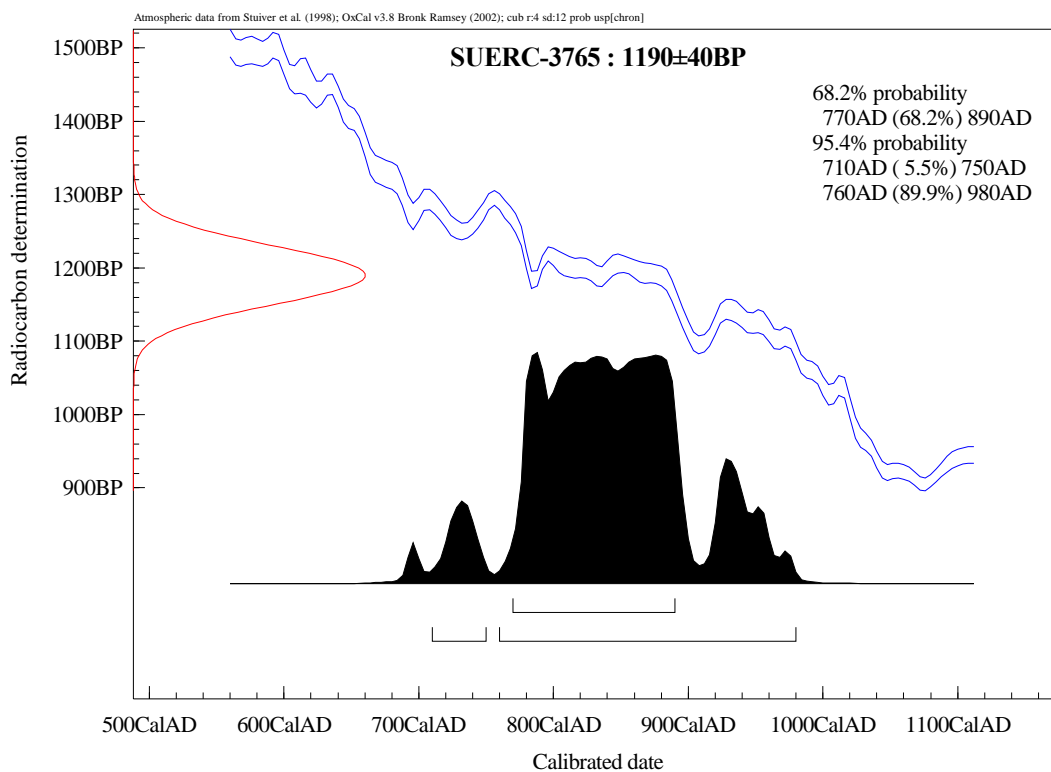
Conventional age and calibration age ranges calculated by :-

Date :-

Checked and signed off by :-

Date :-

Calibration Plot



APPENDIX 2: WOOD DATA

A2.1 The age of the wooden stems from Heronbridge (fills **113**, **114**, **115** and **118**) are shown in relation to their wood species in Tables 2-5. The numbers of worked pieces within each category are shown in brackets, for instance, (3w). The data were used to produce Figures 2 and 3 (*Section 3.1*). The diameters of the wooden stems from each of the four fills are shown in Table 6. The information shown in this table was used to produce Figure 4 in *Section 3.1*.

No of rings	<i>Alnus</i>	<i>Corylus</i>
2	-	-
3	-	5 (3w)
4	1	2
5	-	1
Total	1	8

Table 2: Age (number of rings) of wooden stems per species from fill 113

No of rings	<i>Corylus</i>	<i>Fraxinus</i>	<i>Salicaceae</i>	<i>Prunus sp</i>
1	-	-	-	-
2	-	-	-	2
3	1	2 (2w)	1 (1w)	2 (1w)
4	2	6 (3w)	2 (2w)	-
5	3 (3w)	-	5	-
6	2	-	1	-
7	3 (2w)	-	1	-
8	-	-	-	-
9	1	-	-	-
Total	12	8	10	4

Table 3: Age (number of rings) of wooden stems per species from fill 114

No of rings	<i>Corylus</i>	<i>Prunus</i> sp	<i>Betula</i>
1	-	-	-
2	2	-	-
3	2	3	-
4	2	1	1
5	1	-	-
6	-	-	-
7	4	-	
Total	11	4	1

Table 4: Age (number of rings) of wooden stems per species from fill 115

No of rings	<i>Alnus</i>	<i>Corylus</i>	<i>Fraxinus</i>	Salicaceae
1	-	-	-	-
2	-	1	-	-
3	-	-	1	-
4	-	1	1 (1w)	-
5	4	-	-	-
6	-	-	-	1 (1w)
7	2	-	-	-
8	-	-	-	-
9	-	-	-	-
10	-	2 (1w)	-	-
11	-	-	-	-
12	-	1	-	-
Total	6	5	2	1

Table 5: Age (number of rings) of wooden stems per species from fill 118

Diameter mm	<i>Alnus</i>	<i>Corylus</i>	<i>Fraxinus</i>	<i>Salicaceae</i>	<i>Prunus</i> sp	<i>Betula</i>
7	-	1	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	2	-
10	-	3	-	-	2	-
11	-	1	-	4	-	-
12	-	2	-	2	-	1
13	3	3	-	-	-	-
14	-	2	-	1	1	-
15	1	4	-	2	-	-
16	1	1	1	-	2	-
17	-	3	-	2	1	-
18	1	7	-	-	-	-
19	-	-	-	-	-	-
20	1	2	1	-	-	-
21	-	2	-	-	-	-
22	-	-	5	-	-	-
23	-	1	1	-	-	-
24	-	2	-	-	-	-
25	-	2	1	-	-	-
26	-	-	-	-	-	-
27	-	-	-	-	-	-
28	-	-	1	-	-	-
Total	7	36	10	11	8	1

Table 6: Diameter of wooden stems per species from fills 113, 114, 115 and 118