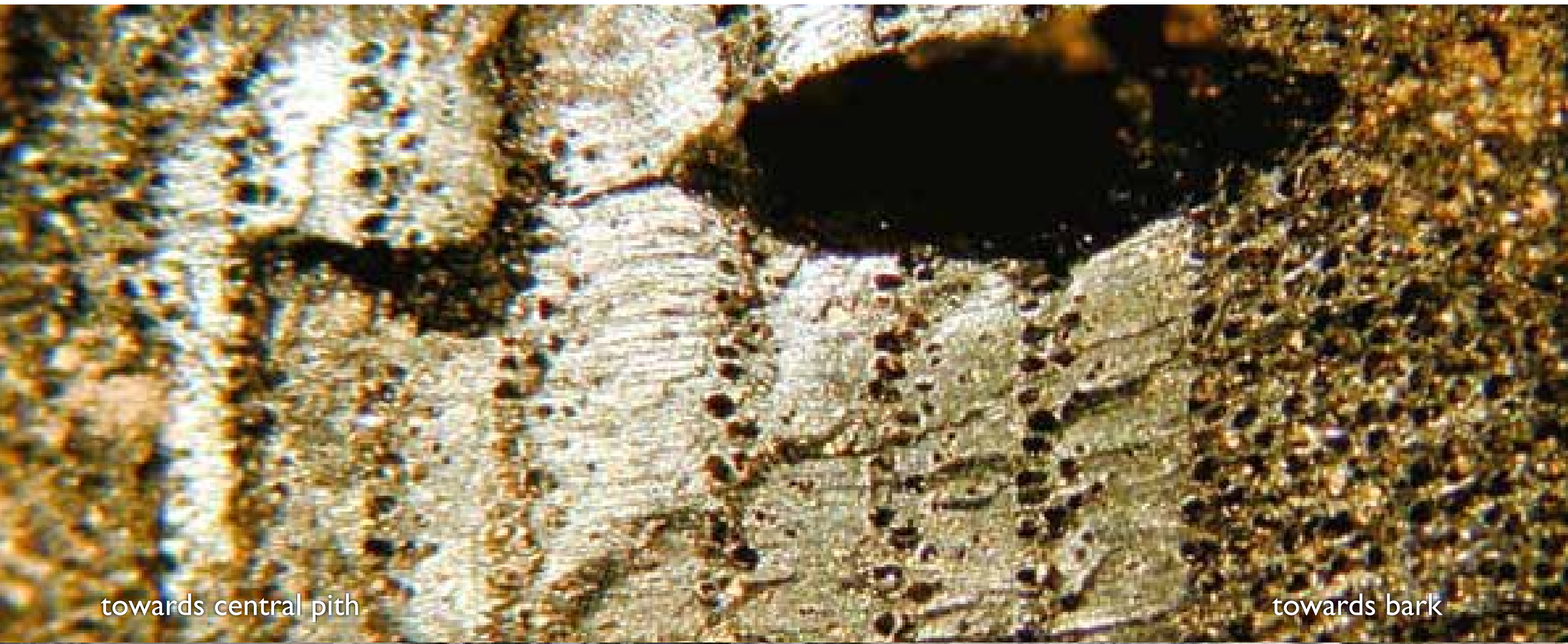
RESEARCH DEPARTMENT REPORT SERIES no. 68-2010 ISSN 1749-8775

NORTHERN ENGLAND

A REVIEW OF WOOD AND CHARCOAL RECOVERED FROM ARCHAEOLOGICAL EXCAVATIONS IN NORTHERN ENGLAND

ENVIRONMENTAL STUDIES REPORT

Jacqui Huntley



ARCHAEOLOGICAL SCIENCE

ENGLISH HERITAGE

This report has been prepared for use on the internet and the images within it have been down-sampled to optimise downloading and printing speeds.

Please note that as a result of this down-sampling the images are not of the highest quality and some of the fine detail may be lost. Any person wishing to obtain a high resolution copy of this report should refer to the ordering information on the following page.

Research Department Report Series 68-2010

Northern England
A review of wood and charcoal recovered from archaeological excavations in northern England

Jacqui Huntley

ISSN 1749-8775

SUMMARY

The evidence for wood and charcoal remains, excluding mineral replaced wood, submerged forests and wooden finds, from archaeological deposits in the northern counties of England is reviewed. The quality and quantity of the data are considered and some recommendations for future approaches to work in the region presented. Some of the recommendations, such as those regarding sampling, terminology and integration are of relevance to anyone studying these materials irrespective of their geographical area. In any excavation the questions must relate to the aims and objectives of the project and be 'fit for purpose'. Overall, the questions most relevant to ask of planning-lead interventions in the northern counties are likely to be based upon investigations of fuel used in specific features such as hearths and ovens.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the helpful comments provided on earlier drafts of the text by Eleni Asouti (Liverpool University), Gill Campbell (English Heritage) and Allan Hall (York University), and to Ruth Pelling (English Heritage) go thanks for final 'tweaks' and house-style editing.

COVER PHOTO Above: *Fraxinus* charcoal, from a medieval charcoal pitstead in the Lake District, showing rapid cessation in growth. This may have been caused by a catastrophic disease but could reflect the process of shredding in order to provide winter fodder for animals. Below: waterlogged planks and hurdling lining/covering a drain in Roman deposits at Carlisle.

CONTACT DETAILS

English Heritage North East Regional Office, Bessie Surtees house, 41-44 Sandhill, Newcastle upon Tyne NE1 3JF
Email: Jacqui.Huntley@english-heritage.org.uk

CONTENTS

AIMS OF THE REVIEW

Wood, and its partially burnt form charcoal, has been fundamental to the comfort, if not survival, of past societies – timber for building, transport, fuel and even some food and medicine, as well as fun – musical instruments, games. It is unusual in that it is a renewable resource. In view of this cultural importance it is a wonder that, even in the 21st century, it is not necessarily given more thought during the archaeological process.

The aims of this work are:

1. to present a resource assessment of waterlogged and charred wood recovered from archaeological excavations in the northern counties of England over the last 25 years or so. It complements both Huntley and Stallibrass' (Huntley and Stallibrass 1995) Regional Review of plant macrofossils and vertebrate remains from the English Heritage (EH) North-East and North-West Regions, and Hall and Huntley's (Hall and Huntley 2007) update of botanical aspects of that volume . The latter now includes Yorkshire Region and thus covers the whole of the EH Northern Territory.
2. to initiate the development of a research agenda for the region although the topics proposed are neither exclusive nor unique.
3. to address some methodological and analytical issues related to charcoal, particularly of relevance in planning led interventions.

INTRODUCTION AND BACKGROUND

Wood is typically preserved in three ways – waterlogged, carbonised to charcoal or mineral replaced. The recovery of wood *per se* from an archaeological site almost always depends upon anoxic waterlogged conditions in Britain and, as such, is most common in deeply stratified urban excavations or in sites buried under or within peat. Quantities of large timbers are routinely recorded and analysed in respect of their dendrochronological potential as well as providing information about timber conversion and wood working techniques. Sampling and recording methodologies are well established and readily available (Brunning 1995; English-Heritage 2010; Morris 1990b). Waterlogged roundwood and smaller material is less rigorously sampled but nonetheless samples generally are taken and investigated when large deposits are uncovered. Timber in submerged forests, as a naturally occurring material, is not considered in this review.

Wood is turned to charcoal when it is burnt in a low oxygen atmosphere at temperatures of the order of 250–500°C. Below 250°C incomplete conversion to carbon occurs and the material can then be subject to aerobic degradation the same as non altered wood. Above 500°C the wood turns to ash and is much less likely to survive. Charcoal can be recovered in quantity from almost any archaeological site thus making it an ideal comparative material, at least in theory. Unfortunately, however, its origin and interpretation are far less straightforward and, perhaps as a result of this, it is not often studied systematically from even moderate numbers of samples and/or stratigraphic sequences in British archaeology. The most common use of it here is probably still in providing material suitable, or not, for radiocarbon dating although this aspect has not been considered in detail in the resource assessment below. Many reports that do provide dates do not indicate what was used other than 'charcoal' and even some of the more recent ones do not indicate the laboratory number or any intimation of what was used to calibrate the date. Where specific dates are used in this review they have all been re-calibrated using OxCal 3 (Stuiver *et al* 1998).

At times, however, there have been recurrences of interest in British charcoal and lists of species and fragment counts appear in site monographs, although invariably little interpretation is offered, as can be seen from the regional resource assessment below. There are sometimes indications that a few archive reports do include more data, for example Taylor (1998), and even, very rarely, where those archive reports are stored. In most instances, however, samples seem to be taken almost on a whim of the excavator with no clear reasoning behind the process. This is an inefficient use of resources. As Murphy (2001) says, other Europeans use charcoal far more often in attempts to reconstruct woodland as can be seen in the papers on early prehistoric charcoal from French, Italian, Irish and Austrian sites (Heiss and Oeggl 2008; Marguerie and Hunot 2007; Newman *et al* 2007; Thiébault 1988; Thiébault 1997). The British reluctance to use charcoal in this way may well reflect the widespread availability of suitable deposits for preservation of pollen and our consequent long tradition of studying pollen from such contexts for reconstruction of landscapes and vegetation, especially in the north. Whilst pollen clearly brings with it its own suite of factors affecting interpretation, such as differential production and preservation (Jacobson and Bradshaw 1981), pollen distribution through the landscape tends to reflect largely natural factors rather than deliberate human intervention. Except in the case of crop or insect pollinated plants, where pollen travels minimal distances from source, pollen from an archaeological site will reflect something of the vegetation surrounding that site. On the other hand charcoal is only on site because of people, with all of the accompanying issues relating to social, ritual or practical choice of available material. Lack of charcoal work may also reflect the fact that many British excavations these days are development-led small-scale pieces of work with neither the on-site nor financial/time-scale suitable for a mainland European style investigation. In the latter, typically many thousands of pieces are identified from some considerable numbers of contexts – Asouti asserts that "recovery from twenty-five to fifty samples on average may be considered as a reasonable minimum" (Asouti and Austin 2005) with anything from 100-400 pieces, depending upon the author, identified per context (*see* below, Methodological section). Lack of charcoal work may, however, simply reflect a British scepticism that human intervention has just been too great to allow any meaningful interpretation or even a British reluctance to read critically a wide, although sometimes obscure, literature in languages other than English. Thus can, or even should, charcoal have a serious role to play in British archaeology? If so, what is that role and how do we achieve it as well as providing data that are comparable between sites or even across the English Channel?

The third type of preservation, mineral-replacement, is as its name suggests, and typically survives in association with metalwork. Examples would include coffins, chariot or boat burials and some structural elements. Its presence therefore indicates a specific combination of materials and, as such, is neither predictable nor that common. Wood preserved in this way was included in the initial searches but the results, as noted in the section below, were too limited and it will not be considered in this review. However, investigation of such material when it does survive should be undertaken by an appropriate specialist.

RESOURCE ASSESSMENT

The starting point for obtaining information about wood and charcoal reports was the web-based Environmental Archaeology Database (EAB) hosted by the Archaeology Data Service (http://ads.ahds.ac.uk). Querying this database results in bibliographic lists of published as well as Ancient Monuments Laboratory (AML) / Centre for Field Archaeology (CFA) reports that include environmental archaeological material. Data from unpublished reports, especially those produced for planning-lead interventions, have not been included exhaustively in this assessment although a trawl was made through the Environmental Archaeology Unit reports from York University and the Durham Environmental Archaeology Reports from Durham University as these deal with the majority of such cases within the region from the 1980s through to the late 1990s. Experience with these suggests that few detailed data relating to wood or charcoal are likely to be available in other similar reports – they either represent evaluations where wood or charcoal might be noted as present (and even important) but no further work took place, or they represent the analytical phases of the material and will eventually be published in local journals.

The EAB was queried for the counties/former counties of Cleveland, Cheshire, Cumbria, Durham, Greater Manchester, Humberside, Lancashire, Merseyside, Northumberland, North Lincolnshire, North Yorkshire, South Yorkshire, Tyne and Wear and West Yorkshire, and for types of material that included 'wood'. This produced some reports that dealt with purely artefactual remains and these are considered to be outside the remit of this paper. Likewise dendrochronological investigations have not been included unless additional wood-related topics were discussed. Mineral-replaced material was included in this query but, upon examination of the reports, none is more than the occasional identification, sometimes tentative, of a few fragments of wood. As far as the region is concerned, therefore, little may be said of wood surviving as a result of this kind of preservation.

Based upon the results of the query original reports or papers were obtained wherever possible and used for data extraction into an Access (Office 2000 version) database. Information extracted included location of site, identifications and quantification/qualification of material, types of context and material, and period represented. In many instances, there are considerable gaps in the information provided and this will be discussed in later sections. As much of the work was done through English Heritage (EH) and its predecessors, Historic Buildings and Monuments Commission (England) and Department of the Environment (HBMC), many of the reports are in the AML series although some of this material has been published subsequently. Both, where known, are given in the bibliography as, only too often, the published report provides a succinct summary only, usually as an Appendix or, in the earlier works, on fiche. During the literature search other papers that examined wood and/or charcoal were found and have been included in this review.

Figure 1 shows the distribution of relevant reports in the region by decade and Table 1 presents a breakdown by grouped county and decade of publication for the 180 reports. Data to the end of 2008 are included.

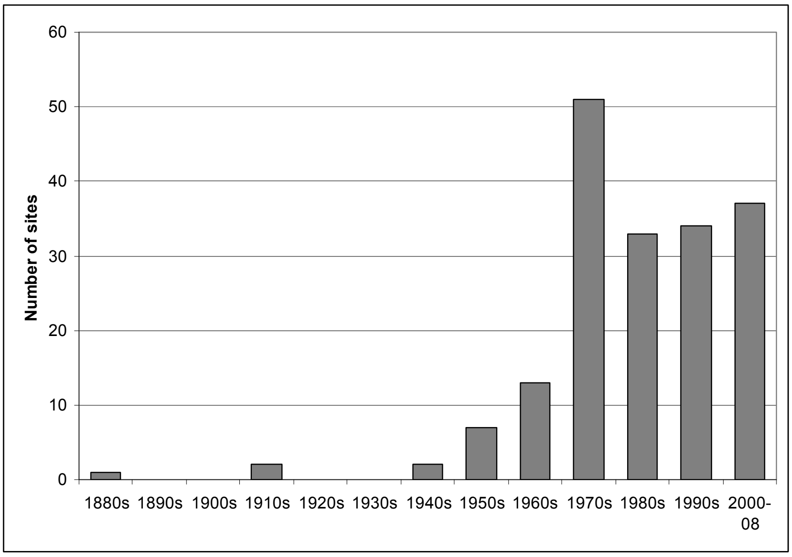


Figure 1: Numbers of reports by decade

This breakdown takes no account of size or details of the reports; neither does it recognise the fact that some sites, such as Wharram Percy, have multiple reports (thus the inflated values for 1970s North Yorkshire). Neither does it take into account quality (or not) of dating or useful information about the site type. It does show the 'boom' during the 1970s and 1980s when rescue excavations provided material and the EH/HBMC contractors undertook at least identifications.

The numbers dropped through the 1990s probably as a result of the shift in focus from large scale excavations to smaller planning-led interventions, where size of trenches excavated and nature of timing and funding have almost certainly led to wood and charcoal being under-represented in the archaeological sampling record. Indications for the first decade of the 21st century suggest that this material is gaining in at least consideration although many of these reports reflect a research interest of the present author.

Decade	Cheshire	Cumbria	Durham	East Yorkshire	Humberside	Lancashire	Merseyside	North Lincolnshire	North Yorkshire	Northumberland	South Yorkshire	Tyne and Wear	West Yorkshire	Grand Total
1880s		1												1
1910s					2									2
1940s						1				1				2
1950s		1	1						3	2				7
1960s			1		4				6	1		1		13
1970s	4	6	7		9	1			7	11		6		51
1980s	2	6	5		1	1			9	5		3	1	33
1990s		3	3	1	11	1		1	7	1	2	1	3	34
2000-08	1	20	1	1	1	2	1		2	6	1		1	37
Grand Total	7	37	18	2	28	6	1	1	34	27	3	11	5	180

Table 1: Reports with wood and/or charcoal by county and by decade

No records were returned for Greater Manchester.

What is clear is that by the time that the reports are separated into wood versus charcoal and then into broad period groups no single category will have many records. The baseline data for the whole of the northern territory are therefore very low and any reasonable-sized modern datasets are likely to make a real contribution to our understanding of woodland utilisation.

Irrespective of the limited data, the somewhat more extensive reports were summarised by broad archaeological period, and these summaries are presented below. For consistency, nomenclature in this section presents English names either as in the original papers or an equivalent translation, where possible, from original Latin. As far as possible, equivalent Latin names are used in the database. A general discussion of the taxa recorded and issues of nomenclature is presented below. The period-based dot maps presented show the distribution of groups of sites rather than all individual sites in order to show patterns more clearly, hence, for example there is one dot for the Roman period for Carlisle whereas there are at least a dozen reports. The names for such amalgamated groups have been simplified accordingly.

Figure 2 presents the location of the region under review and the distribution of the sites for which reports exist. While there is a reasonable spread of sites across most of the region, the southern central parts are rather poorly represented. This might well reflect at least in part the generally high levels of agriculture and more heavily urbanised centres as well as the presence of the gritstone moorlands of the Dark Peak where development-led archaeology is rare. Otherwise there are few large areas devoid of reports.

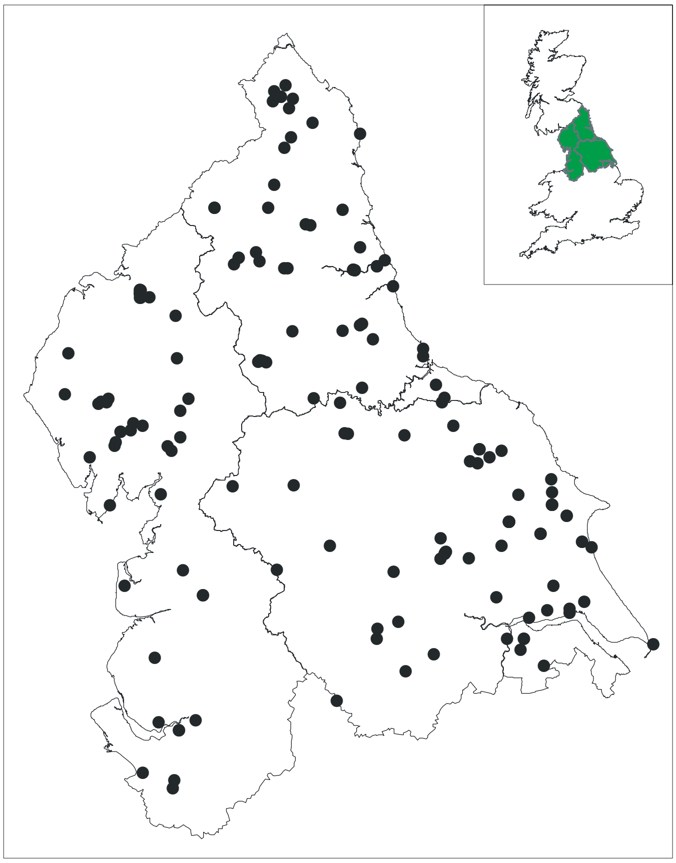


Figure 2: Location of region and of all sites with wood or charcoal reports.

Mesolithic (8500 – 4000 BC)

Given the long history in the region of traditional palaeoenvironmental and palynological analyses there is no shortage of evidence for the Mesolithic landscape. However, there are few sites with wood or charcoal records, as can be seen in Figure 3.

This period was essentially one of woodland with the tree line probably high in the Pennines (Turner and Hodgson 1979; 1983). Woodland types no doubt varied with the more thermophilous genera – oak (*Quercus*), ash (*Fraxinus*), elm (*Ulmus*), lime (*Tilia*) – favouring the lowlands and genera such as birch (*Betula*) and probably pine (*Pinus*) being more common in the uplands. Charcoal particles present in pollen samples have been investigated from peats in the eroding streamside at White Gill in the North York Moors showing that people at the time did manipulate the vegetation to some degree (Simmons and Innes 1987; 1988). This is widely interpreted as a measure to encourage grazing animals that could then be caught. Bulk charcoal from the Mesolithic site at

White Gill was identified from four samples although there is no quantification or information regarding contexts other than that one sample, consisting only of alder (*Alnus*), was from a pile of charcoal on an eroded surface. The other three samples contained oak, some hazel (*Corylus*) and small amounts of alder and birch (Dimbleby 1988). This is in line with the pollen taxa from Simmons and Innes' palaeoecological work at the site (Simmons and Innes 1988).

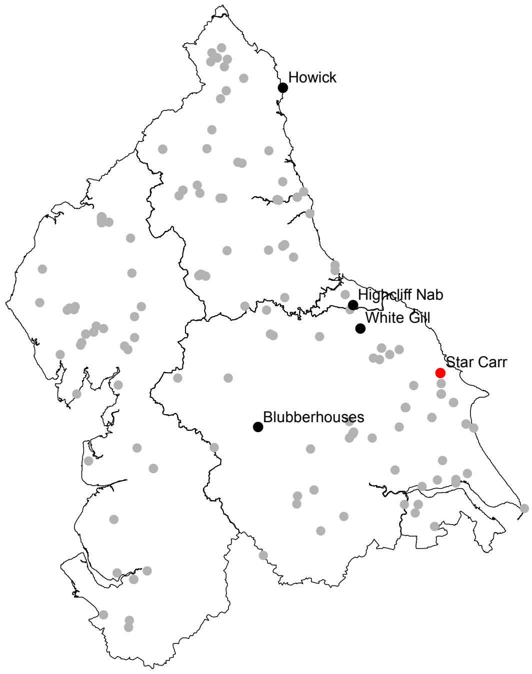


Figure 3: Mesolithic sites

black = charred; red = waterlogged

A major site of this period in the region, clearly, is that at ***Star Carr*** where excavations in the 1950s uncovered a timber platform that consisted entirely of birch. Rolls of birch bark and birch resin were also recorded (Clark 1954). Work in the 1990s involved further excavation but also concentrated upon palaeoenvironmental aspects of the site (Mellars *et al* 1998). More timber was found but it consisted entirely of willow (*Salix)* and poplar or aspen (*Populus)*. There was clear evidence for working as the wood was variously split longitudinally, tangentially and across the grain. No bark was present. The authors concluded that the arrangement of the material and the total absence of birch suggest that the feature bore no relationship to the central area of Clark's 1954 excavation which lay only some 30m to the east of the 1998 trenches. They concluded that the 1998 material was perhaps a segment of deliberately laid track consolidating access to the water's edge (Mellars *et al* 1998).

Excavations at ***Highcliff Nab***, near Guisborough, on the northern side of the North York Moors, produced a flint scatter and limited charcoal eroding from peat. A few fragments each of oak and birch/hazel/alder (the fragments were too small to determine genus with any confidence but were diffuse porous with scattered pores) were identified from one context (Huntley 1996). Excavations at *Blubberhouses Moor* (Davies 1996), near Skipton, likewise produced a flint scatter with a small amount of associated charred and non-charred wood. Oak and probably hazel were identified.

Most recently the extensive and internationally important Mesolithic site at *Howick*, Northumberland, has been investigated by Clive Waddington. Clear evidence for timber structures and shelters, and hundreds of thousands of charred hazelnut shell fragments were recovered. Charcoal *per se* was present in many of the bulk samples although typically in very small and fragile fragments thus precluding detailed analysis (Cotton, in prep.). Only three contexts produced 'moderate' amounts of charcoal, from which only two pieces were identifiable; both of these were of hazel and Cotton noted that these were soft and poorly preserved.

Summary:

The few sites of this period show that various taxa were being exploited by the Mesolithic population. The material is largely from genera that produce smallish trees but oak is present at four sites. For the majority of sites there is no information regarding the type of material represented so it is not clear whether only small trees/branches were being used – these might have been cut fresh or from fallen trees. Much of the material representative of this period had been collected primarily for dating purposes and experience shows that it is likely to have been small fragments only (irrespective of the fact that these could reflect centres of stems and hence older material) and therefore it was probably not possible to have said anything of this kind even if a wood specialist had examined it in the first instance. The types of site are, not surprisingly, ephemeral and tend to consist of charcoal scatters amongst flint scatters.

Neolithic (4000 – 2000 BC)

The Neolithic is characterised by definite woodland clearance, seen in pollen diagrams from throughout the region, and a concomitant increase in grasses and herbaceous taxa. The pollen data, however, are not spread evenly across the region but tend to cluster in some of the upland areas and the lowlands of County Durham (Pratt 1996).

Figure 4 shows the locations of sites with wood or charcoal records, and it is clear that they are sparsely distributed throughout the eastern part of the region with only one site in the west. Sites studied for palaeoecological reasons, mainly pollen and peat bogs/mires, are likely to produce further records of wood but these have not been considered in the current study unless there is clear and associated evidence for local human activity.

Figure 4: Neolithic sites
▲ Late Neolithic to Early Bronze Age
black = charred; red = waterlogged

The ***Milfield Basin*** in Northumberland has seen many excavations relating to its Neolithic past as well as to more recent periods. Charcoal from Harding's (1981) excavations consisted more or less of only oak from Milfield North, but mostly hazel from Milfield South (Donaldson 1981). In the archive AML report elm (*Ulmus)* is also noted as present but this is not presented in the publication. There is no indication of quantities for any taxon in any of the samples (Donaldson 1977e). Unidentified charcoal was used to produce three radiocarbon dates for the site.

South of the Milfield Basin, excavations by Waddington and Davies (2002) at ***Bolam Lake*** produced evidence for a transient Neolithic shelter cum settlement as well as Early Bronze Age cremation burials. Analysis of only about 50 charcoal fragments, mostly small roundwood, from the Neolithic post-holes concluded that the inhabitants of the site used wood from a variety of species of smaller trees for their constructions – taxa included alder, birch, willow/poplar (*Salix/Populus)* and Pomoideae (an anatomically similarly group of taxa which includes apple, (*Malus*), pear (*Pyrus*), hawthorn (*Crataegus*) and whitebeams (*Sorbus*)); oak was rare and it was suggested that, during that period, local trees would have been large and thus offered technological difficulties in felling for such transient occupation (Huntley 2002). As most of the contexts examined were post holes, and any one contained charcoal predominantly from only one taxon, it was also reasonable to suggest that the remains were from the original poles or stakes.

Excavations at *Thirlings* produced a small charcoal assemblage analysed by Donaldson (1976g) although the report provides no information about the type of site or range of contexts. All of the material from the 'north door' was hazel whereas that in a 'foundation trench' was all oak. Five 'pits' each produced fragments of oak; one also produced a fragment of ash and another a fragment of hazel. A second report itemises charcoal from five pits and the data are so similar that the two reports may refer to the same material (Donaldson 1977f). Unfortunately neither report gives dates for the site but it is assumed that it refers to the Neolithic site from which charred plants were recovered and dated (van der Veen 1982a). The context types in the first report are somewhat unusual for a Neolithic site in northern England however. Hazel charcoal was recovered amongst moderate numbers of hazelnut shell fragments from nine contexts at Neolithic Thirlings (Donaldson, 1976f)

Sampling from excavations at *Skipsea Withow Mere* in Holderness produced some quantities of worked waterlogged wood that were suggested as representing trackways or platforms. The *in situ* rods and pegs were either alder or hazel, and elbow shapes on the ends of some of them were considered to possibly represent coppicing (Gilbertson 1984). One pointed end stake of 40-year-old alder produced a radiocarbon date of 4770±70 bp (HAR-3378) which calibrates to 3670–3370BC at the 2σ level using OxCal 3 calibration programme with the IntCal 1998 data (Stuiver *et al* 1998). However, more recent work (McAvoy 1995) demonstrated clear evidence for the presence of beaver with trees that they felled forming a log jam, presumably part of their lodge and associated pond.

The nearby site of *West Furze* saw the earliest excavations where waterlogged timbers were recorded. It was excavated by Thomas Boynton in the 1880s when he described it as a structure, at the edge of a lake, consisting of a two-layer platform upon which buildings were erected, although detailed records were not apparently made (van der Noort and Ellis 1995). Boynton's work was compiled and published by Smith (1911) who left the interpretation as a platform with huts. The wood record is sketchy but notes that the trees consisted of oak, willow, birch, ash, hazel and alder with some having trunks of 15–18 inches (380–460mm) in diameter. It does note that the trunks were largely left round and not squared off. Recent work plus a critical re-evaluation of that of Smith by van der Noort (van der Noort and Ellis 1995) and colleagues leads them to conclude that the lower floor was probably Late Neolithic to Early Bronze Age whilst the upper floor was Late Bronze Age or later. They re-interpret the lower floor as representing a trackway across the mire but have less confidence in the upper floor other than it might be a secondary context.

Timbers preserved within peat at *Storrs Moss*, Lancashire, showed evidence for working although the arrangements of these timbers were not defined in any clear way. The evidence included the remains of a tenon, some planks and possible mortice sockets, as well as roundwood associated with post holes. Several of the oak fragments were noted as being hard and black but not charred – it seems reasonable to assume that they were 'bog oak' where iron and humic acids from the peats had coloured the wood as well as making it extremely hard. 'Bog oak' describes the preservation process but does not necessarily have to be oak – instances of pine and yew survive in this manner. Most of the material was identified as alder, but oak, willow, pine and buckthorn (*Frangula)* were all identified (Aldridge *et al* 1971). Material from the artefact level was dated but identification was not noted, although penetration by modern roots was. It returned a date quoted as 2640±90 BC (GaK-853). The interpretation then offered was that the episode of human activity was earlier than suggested at first from the results from associated pollen analyses and that the wood was, perhaps, material discarded from working or collection on site.

Street House Wossit, on the north side of the Yorkshire Moors, was another ritual palisaded enclosure – 58 fragments of charcoal were identified from three contexts (Turner and Nye 1988). These consisted of an old ground surface, topsoil and re-deposited topsoil; the first showed a wider variety of taxa than the other two with examples from alder, birch, hazel, ash, oak and hawthorn (presumably 'Pomoideae'). Otherwise ash, oak and alder/hazel only were recorded. Two charcoal samples from palisade posts were used for radiocarbon dating although details of the material are not presented. They returned dates of 3740±60 BP (BM 2566) and 3700±50 BP (BM 2567). Using the current OxCal program, with the 2004 calibration data, these calibrate to 2340–1950 BC and 2210–1940 BC, respectively, at 2σ.

Samples from hearths at *South Haw, Nidd*, situated at *c* 500m OD, had associated lithics' assemblages considered to be Mesolithic in form. Charcoal from two features was simply identified by the present author prior to being used for radiocarbon dating purposes. The lower fill of hearth RA1 produced numerous pieces of small birchwood and the upper fill a mixture of birch and hazel. Preservation of hazel was very different from that of birch, being extremely soft and friable whereas that of birch was much harder and tarry/glassy. Hearth TP1 produced mostly oak and all except one piece was extremely slow grown material such that annual rings were not distinguishable at all. One fragment of birch also was present and this was used for dating (Huntley 2005a). Although the flint typology suggested a broadly Mesolithic culture the calibrated dates, spanning 4230–3700 BC, indicated rather early Neolithic activity (Richard Chatterton pers comm).

Willerby Wold, Yorkshire, consists of ritual pits and mortuary enclosures dating to the Late Neolithic or Early Bronze Age (Manby 1963). Eleven samples of charcoal from the cremation burials themselves were analysed and all consisted only of oak (Dimbleby 1963). The author notes that the material was a mixture of fast- and slow-grown wood and that the parallel rings suggest it derived from large trees.

Excavations at *Carr House Sands*, in advance of sea defence work, produced a waterlogged hurdle from which 57 rods and 4 sails were identified. With the exception of one alder rod and one unidentifiable rod all of the material was hazel. The wood was mostly from two-year old stems and there were indications of some being cut in the spring. Although the function of the structure is not known, given its delicate nature and tidal location, it may well have been some kind of fish trap (Huntley 2005c). Material from it was radiocarbon dated to between 3932–3665 BC at the 2σ level (GU-5435 and GU-5436 weighted mean uncalibrated 4980±42 BP (Waughman, 2005).

Reports with small lists of taxa only recorded: ***Callis Wold*** (Keepax 1975b) – no details about the location or the site provided.

Summary

As with the previous period, charcoal from Neolithic sites has been collected primarily for dating purposes and little other information has been recorded in most instances. Where noted, the material seems to reflect collection of smaller stems or branches and this might, again, reflect technological limitations of the time. The one example of waterlogged material, from a hurdle, does, however, demonstrate skilful application of wood technology even during these early times.

Bronze Age (2200 – 750 BC)

Pollen evidence suggests that further woodland clearance occurred during the Bronze Age as people became more settled and agriculture more established. Evidence from the settlements themselves remains poor and little has progressed in that respect since the Huntley and Stallibrass review in 1995. Figure 5 shows the distribution of Bronze Age sites with wood or charcoal reports. These tend to be distributed on the fringes, at least, of the higher ground and probably reflect the fact that many of the reports are associated with excavations of ritual or funerary sites.

Charcoal was analysed from seven contexts associated with the Early Bronze Age funerary landscape at ***Broomrigg***, near Croglin in the Eden Valley, Cumbria (Orr 1986). Oak was the most commonly occurring taxon but willow and hazel were also present.

Material from a funeral pyre near ***Alnham*** in Northumberland produced two fragments of hazel and otherwise equal (but unknown) amounts of oak and birch charcoal (Clarke 1966).

Excavations of an Early Bronze Age cist burial at ***Allerwash***, Northumberland produced oak along with stems and leaves of rush (*Juncus*) (Clarke 1973) – presumably all of these were charred.

Figure 5: Bronze Age sites
▲ = Late Neolithic-BA ★= Late BA-Early Iron Age
black = charred; red = waterlogged

By comparison, analysis of charcoal from excavations near a rock shelter cemetery site at *Goats Crag*, also in Northumberland, produced rather more information. A sample from what was described as a 'firepit' produced mostly birch with a little oak whereas two samples directly associated with burials produced only oak. Charcoal from three other pits was also dominated by oak although birch was present in all and possibly heather in one (Esslemont 1972). The author noted that most of the charcoal derived from twigs or branches up to 18mm diameter.

Three soil samples were collected during excavation of cairns at Blawearie in Northumberland. These all contained some oak charcoal but no quantities or other details were provided (Turner and Nye 1996).

Charcoal from excavations of a burial cairn at *Crawley Edge* was only identified prior to being used for radiocarbon determination (Donaldson 1992). Two samples of oak were taken and were noted as being from small branches. One from under the basal layer of the cairn produced a date quoted as 1400±90 BC (HAR-3323) and the other from within the funerary urn a date of 1420±80 BC (HAR-3322). The excavator also states that the presence of charcoal spreads under upland cairns has been noted by other authors from throughout the region. At least some of this material is highly vitrified so it might indicate pyre material (Young & Welfare 1992).

Charcoal recovered from a Bronze Age urn and grave at Haugh Head, near Wooler, included oak, cherry and hazel (Blackburn 1948).

The Bronze Age settlement of Bracken Rigg in Teesdale produced 45 identified fragments of charcoal (Donaldson 1980b; 1984). Hazel and willow/poplar comprised over 80 per cent of the assemblage with small amounts each of oak, birch and sloe/cherry type (*Prunus* sp.). A piece of unspecified charcoal gave a date of 3180±60 bp (HAR-2414) – calibrating to 1610–1310 BC at 2σ. The author noted that most pieces were from 10–20mm diameter twigs and suggested that they probably represented brushwood collected for fuel.

During excavation of a sub-rectangular ditched enclosure, dating from the Late Bronze Age to Early Iron Age, at *West Brandon* in County Durham, several samples of charcoal taken from a selection of features relating either to House A or various smelting hearths. The hearth contexts only contained oak charcoal. The assemblages from the house contexts were a mixture of oak, hazel and birch (Clarke 1962).

Bronze Age material from the multiperiod site at *Thwing* produced a reasonable assemblage of charcoal from five samples (Gale 1991; *see* Early Medieval). For once, information about the nature of the material is included as well as fragment counts although, unfortunately, no interpretation or comments on the assemblage are offered. Ash was the most commonly recorded taxon and most of this material was from stems; oak was next and included a mixture of sapwood and heartwood. Other taxa included maple/apple type (*Acer*/Pomoideae), hazel and willow/poplar.

The Bronze Age burial cairn at *Oddendale* in the Shap Fells dated from 2400–2800 BC produced only oak charcoal from five post pits (Jones 1997).

Further Bronze Age material was recovered during excavations of a burnt mound at *Sparrowmire Farm* where a partially plank-lined trough produced several pieces of wood including one of tangentially converted oak (Heawood and Huckerby 2002). Although these were not suitable for dendro-dating they were used for radiocarbon analysis, producing calibrated dates of 1500–1400 BC. There seem to have been two phases of activity although it is not clear whether there were any differences in the charcoal taxa recovered from each of these phases – the charcoal was predominantly oak but with some birch, alder and hazel. No other details are provided. Bulk samples from excavations of another burnt mound, at *Aldingham*, Cumbria, produced fragments of what was 'thought to be birch or hazel' and two of which were used for radiocarbon dating. Both produced very early Bronze Age dates (Society 2006).

Material dated to the Late Bronze Age was recovered from excavations in advance of development at *Briarfield Nurseries*, Poulton-le-Fylde, Lancashire. Peat there contained wood layers comprising alder, birch and hazel. The most interesting fact about the site was that some of this wood had been worked by beavers (Wells *et al* 2000). This is one of the few reports from the region that notes such activity despite the large number of lowland wetland habitats that could certainly have sustained a beaver population throughout much of the Holocene.

One of the oldest reports for the region deals with timbers preserved within the ditches of the ***Bleasdale Circle,*** Lancashire. Oak posts formed an outer palisade with the central post from a tree reported to be more than 3 feet (0.9m) in diameter. The inner ditch was lined with birch poles (Varley 1938).

Perhaps some of the more spectacular features of the Bronze Age are the several finds of log boats, especially from around the River Humber. Those from the ***Ferriby*** area are probably the best-known and studied primarily in relation to boat technology and function and the methods of construction, namely whether single log or plank-lined. Several papers discuss the function of the boats, and their role in local or long-distance trade, and the possible means of their steerage and navigation (Chapman 2005; Coates 2005). Ferriby 5 survived as a single piece of oak although the presence of clear axe marks allowed detailed investigation of technological aspects (Wright and Switsur 1993). Fragments of the others were mostly oak planks with at least one boat made from an alder trunk. A major sequence of radiocarbon dates was obtained from all of the boats confirming that most of them were from the Bronze Age but that at least Ferriby 4 was dateable to the Early Iron Age (Wright *et al* 2001). However, the practice of building boats from single, hollowed-out logs is not constrained to the prehistoric period as will be seen in the medieval and post-medieval sections below.

Recent work on material from ***Brigg*** in North Lincolnshire (Mitchell and Bell 2002) is a good example of the potential within the developer-funded system. Stakes of various taxa were driven into alluvial deposits and provided dates for the activity on site. The central area contained an unstructured scatter of hazel rods. These were mostly 13mm diameter but of various lengths and their side branches had been removed. The interpretation was that they were probably the by-product of hurdle or basket manufacture. There was also an area of oak woodworking chips, the style of which suggested adze working. It was suggested that these might have even been debris from the manufacture of log boats, several of which have been found in this area of North Lincolnshire as noted above. Whereas only summary data are presented in the publication this does say that the full reports will be available in the site archive and where that archive will be lodged.

Although wood as such was not identified from Bronze Age deposits in Durham City there was much evidence for woodland in the form of tree buds and fruits, and the richness of the assemblage warrants a mention here. Besides the typical oak, ash, hazel, birch and alder, fruits of small-leaved lime (*Tilia cordata)* and yew (*Taxus baccata)* were both recorded (van der Veen 1985). Although the layers were immediately under a 13th century deposit, subsequent radiocarbon dating placed the sequence within the Early Bronze Age at 3350±70 BP (HAR-8365 addendum to AML report 4674) which calibrates to 1780–1490 BC at 90% confidence, thus providing evidence for species-rich woodlands on the flood plain of the River Wear at that time.

Samples from 16 contexts were collected from two excavations along the Yorkshire Water pipeline (*Rawcliffe Moor and Stockton West Moor*) where deposits dating from Bronze Age to Iron Age were found (although note that dates are only given in the EAB and not in the archive report itself). Charcoal was noted as present, occasionally abundant, in most of these samples and identifications undertaken on fragments from seven contexts. The authors noted that much of the material was from abraded branches or twigs up to approximately 15mm diameter. Oak was recorded in five of these contexts, ?willow in four, ?hazel in two and alder/hazel, alder and ?oak in one each (Carrott *et al* 1996a).

Summary

Bronze Age material is typically from sites related to burial or cremation and, presumably, reflects use of wood in the funeral pyre and associated hearths for ritual feasting. Many of the older reports simply identified material for the purpose of radiocarbon dating such sites and therefore are of little interpretative value. The low numbers of samples from the small number of settlement sites investigated show use of smaller trees and shrubs as well as of oak. It is interesting that oak has been recorded from most sites from this period. Whether this reflects technological advances through the use of metal tools or simply the specific types of sites analysed is not clear. The fact that many are funerary sites might suggest that the long burning time afforded by oak might be significant. In terms of preservation moderate amounts of waterlogged wood are recorded as well as charcoal.

Iron Age (750 BC – AD 50)

Pollen evidence for the Iron Age demonstrates further woodland clearance and agricultural expansion particularly in the east of the region (Pratt 1996). Whilst some clearance did occur in the west it was neither as extensive or intensive as in the east and this is also reflected in the rather few excavated sites of the period in the west – see McCarthy (2005), although the recent English Heritage mapping programme has demonstrated the survival of many enclosures and land boundaries from Carlisle through to Bowness-on-Solway (Boutwood 2005). The sites with charcoal or wood reports are therefore also clustered in the east (Figure 6).

Excavation at ***Salter's Nick*** in Northumberland investigated deposits in, and adjacent to, a rock shelter with various layers and a possible hearth being found. Flint fragments indicative of Neolithic occupation were recovered from several of these features and there was clear interest in dating the material. Fifty seven fragments of charcoal from the hearth deposit demonstrated the presence of ash mostly but also some hazel, oak and willow/poplar (Huntley 2005b). Whilst much of the material was small stem some of the ash clearly came from larger timbers given the almost complete lack of curvature in a few pieces. Hazel roundwood was sent for dating. This produced an Early Iron Age date (2445±30 BP (Poz-11763), calibrating to 600–400 BC at 2σ) although the lithics were clearly earlier. It does establish that the rock shelters were occupied, or at least used, over a considerable length of time. More recently, birch charcoal from this site produced an early Bronze Age date (3675±30 BP (Poz-29808), calibrating to 2140–1950 BC at 2σ) (Huntley 2008) thus confirming longevity of use, although not necessarily continuity.

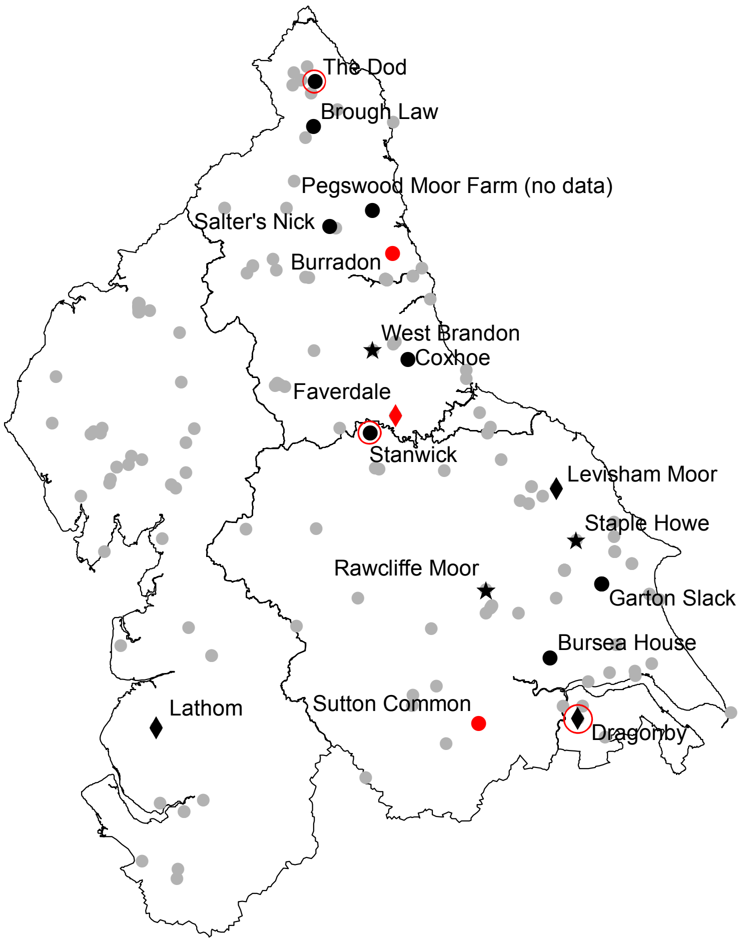


Figure 6 Iron Age sites.
★ = Late Bronze Age-IA ♦ = IA-Romano-British
black = charred; red = waterlogged

Excavations on Iron Age and medieval earthworks at *The Dod* in Northumberland produced both charcoal and waterlogged wood assemblages that were analysed. Twenty four charcoal samples, weighing a total of only 154g, consisted mostly of small diameter branch wood or twigs. Thirty seven percent of the material was unidentifiable through being mineral-encrusted and much of the rest was fragile thus precluding longitudinal fracturing; identifications were therefore considered not necessarily reliable (McCullagh 2000). Contexts and dates are not provided in the published report alongside this material other than two samples from columns through ditches. In total, seven taxa and 82 fragments were identified, with half of the fragments being hazel.

Three taxa – alder, oak and willow – comprised about 12 per cent each with birch, ash and heather (*Calluna)* making up the rest. The author suggested that the material might be the waste-product of on-site activity. Eighty four samples, from eight contexts, of waterlogged wood were also analysed. Those chosen included all with any evidence for working plus the larger ones from bulk samples (Crone 2000). One-hundred and ninety three pieces from 12 taxa were identified. This time hazel accounted for 30 per cent, alder and willow 15 per cent each, Ericaceae and gean or wild cherry (*Prunus avium)* 8 per cent each with the other taxa in the assemblage only present in small amounts. Oak consisted of only three pieces. Again, no context and date information associated with the wood/charcoal results were presented. It would probably be possible to match the two upon a prolonged reading. As a result it could, indeed, be that any or all of this material relates to the medieval occupation of the site.

At ***Burradon***, Northumberland, an Iron Age settlement and homestead was excavated by Jobey (1970). Charcoal samples from the base of the inner enclosure ditch consisted of oak, ash and alder. The oak consisted of fragments from branches that could have been up to 60mm diameter, the ash from twigs up to 8mm and 10 years old and the alder in the form of stems and roots (Clarke 1970).

An extensive Iron-Age farmstead was excavated at ***Pegswood Moor Farm*** in Northumberland in advance of opencast coal mining. The site was heavily truncated by recent ploughing and the bulk samples produced only degraded and unidentifiable fragments of charcoal (ASUD 2000).

Charred wood samples from a bivallate hill fort at ***Brough Law***, Northumberland produced 19 fragments of birch and one of alder (Clarke 1971)

Excavations at ***Staple Howe*** produced 23 fragments of charcoal of oak, willow/poplar, hazel, birch, alder, elm and ash (Metcalfe, 1963). Charred wheat (*Triticum)* provided a date of 2400±150 bp (no lab number given) (Brewster 1963).

The Late Iron Age through to Romano-British site at ***Levisham Moor*** produced charcoal from the bottom of a ditch that consisted mostly of willow but with some each of birch, oak and hazel. Charcoal from the upper layers, immediately pre-dating the levelling of that ditch, was, however, only from hazel and birch (Dimbleby 1983). The samples were taken primarily for analysis of pollen and give no indication of the quantities of charcoal recovered although they were presumably macroscopic material rather than tiny fragments on the pollen slides.

Excavations within the major Iron Age settlement at ***Stanwick*** in North Yorkshire produced some limited assemblages of wood in the 1950s (Metcalfe 1954). Taxa recovered from ditch layers included oak, ash, hazel, hawthorn, cherry, willow but also elder (*Sambucus nigra*) and probably blackthorn (*Prunus spinosa*).

Sutton Common, near Doncaster, consists of a pair of Iron Age enclosures lying in at least seasonally wet ground. The site is the subject of a major research programme because it is drying out as a result of past management but nonetheless waterlogged, anoxic conditions of preservation do survive. The area is now managed to retain a high water-table and environmental monitoring is ongoing. Some waterlogged wood was analysed during an initial phase of assessment (Taylor 1997) and further detailed work is in progress. Taylor determined that more than three-quarters of the material was alder and that some derived from immature coppice. The rest was willow/poplar with small amounts of hazel and oak. Clearly wet-tolerant taxa are the most abundant and they probably reflect clearance and use of local woodland. Taylor noted that there was plenty of evidence for wood working in the form of trimmed ends and coppiced heels, thus suggesting on-site working.

Material recovered from excavations at *Lathom*, Lancashire, comprised seven spot samples of charcoal and 28 bulk samples taken for general environmental assessment (Hall *et al* 2004). The site was dated broadly from 200BC–150AD. Almost all of the samples produced some charcoal but, as the authors noted, much was crumbly, brittle or vitrified, and this precluded detailed identifications in many cases. Most of the charcoal from the bulk samples was unidentifiable (161 fragments) but oak, willow/poplar, alder/hazel and hazel identified, and were present in approximately the same amounts (10–20 fragments each).

Excavations at *Faverdale* in County Durham demonstrated the presence of an extensive late Iron-Age settlement that continued, with modifications, into Romano-British times. Sixteen waterlogged wood samples were recovered from a well, 14 of which were from the lining of the well itself. Two of these pieces were identified as hazel. The report is not clear as to whether the rest was examined or not. Three rods from the fill of the well were identified as willow with a single large timber being from oak (Akeret *et al* 2005).

Reports that present simple lists of taxa: *Garton Slack* Iron Age grain silo (Keepax 1975d) and Garton Slack Iron Age settlement (Keepax 1978a). Hazel/alder, oak, elderberry, ash, oak and hawthorn were recorded. An Iron Age enclosure ditch at *Coxhoe* produced oak charcoal (Donaldson 1982b).

Summary

Charcoal evidence for the Iron Age is disappointingly sparse even for the east of the region where there are many tens of recent excavations, especially of small settlements or farmsteads. This is probably a reflection of their being developer-funded and charcoal being seen as of little value, except as possible dating material even though, in some instances, hearths and other charcoal-rich deposits have been recorded. Nonetheless, evidence suggests that woodland was still available locally for several sites and that at least oaks were well and rapidly grown. The pollen evidence indicates fairly widespread clearance throughout the east of the region so it may be that the patches of woodland being used were quite small in extent. There is limited evidence for wood working although this is the first period for which this aspect has been recorded in the region –

excluding the planks and boats recorded from the Bronze Age. Waterlogged preservation is rare, especially compared with the previous period.

Roman (AD 50 – 400)

Excavation of Roman sites has almost always concentrated upon military forts and, occasionally, associated *vici*, but excavations of a few villas or farmsteads have produced charcoal reports. Given the numbers of excavations it is disappointing how few have had wood or charcoal analyses undertaken (Figure 7). Pollen evidence suggests that the landscape was probably similar to that of today in terms of woodland to agricultural land proportions, although there remained some variability between the east and west of the Pennines with the west retaining considerably more woodland (Huntley 1999).

The villa site at ***Old Durham*** produced records of "hawthorn and gymnospermous wood, probably juniper" from a pit sealed under flag stones (Chalkin 1953). The fragments were generally only 1–2mm diameter although one was 17mm diameter. The author considered that the material might have been thrown into the pit in the form of thin chippings.

About 700 pieces of unworked wood and charcoal were analysed from deposits dating from Late Iron Age/early Romano-British through to the 4th century AD at the settlement of ***Dragonby*** (Hayes and May 1996) even though the excavations were undertaken from 1964–1973, thus making this an early analysis of wood and charcoal remains. The earliest material from the Late Iron Age was all charcoal and mostly oak although hazel and ash were both recorded. Most of the material came from Romano-British deposits and, again, was largely oak although a wider variety of taxa was present. This could simply be the result of identifying more fragments. Late Romano-British material was almost entirely oak although only about 60 fragments were identified. 'Much' charred oak was the only material from the 4th century. Other than a note to say that the material consisted of unworked wood and timber with branches and twigs present the publication consists essentially of a table of identifications by phase and context number with more or less no discussion.

Nine samples from the Roman fort at ***South Shields*** produced two occurrences each of birch and hazel charcoal (Donaldson 1977b).

Twenty two contexts from a Romano-British stone hut at the upland site of ***Forcegarth Pasture North*** were sampled. Unusually, part of the site was waterlogged hence the survival of wood and considerable amounts of birch bark. The author considered that this probably represented the remains of roofing material. This certainly is a tradition in northern Scandinavia where it is laid over the timbers but under the outer covering of grass sods – in much the same role as modern roofing felt. Much of the charcoal recovered was birch with a little hazel and willow/poplar. The wood also was mainly birch but oak and juniper (*Juniperus)* also were recorded. Juniper still grows abundantly in parts of Teesdale and is therefore not that unexpected. Oak is perhaps less expected given the altitude and exposure but it was only recorded in one context as twigs and thus could have derived from local scrub.

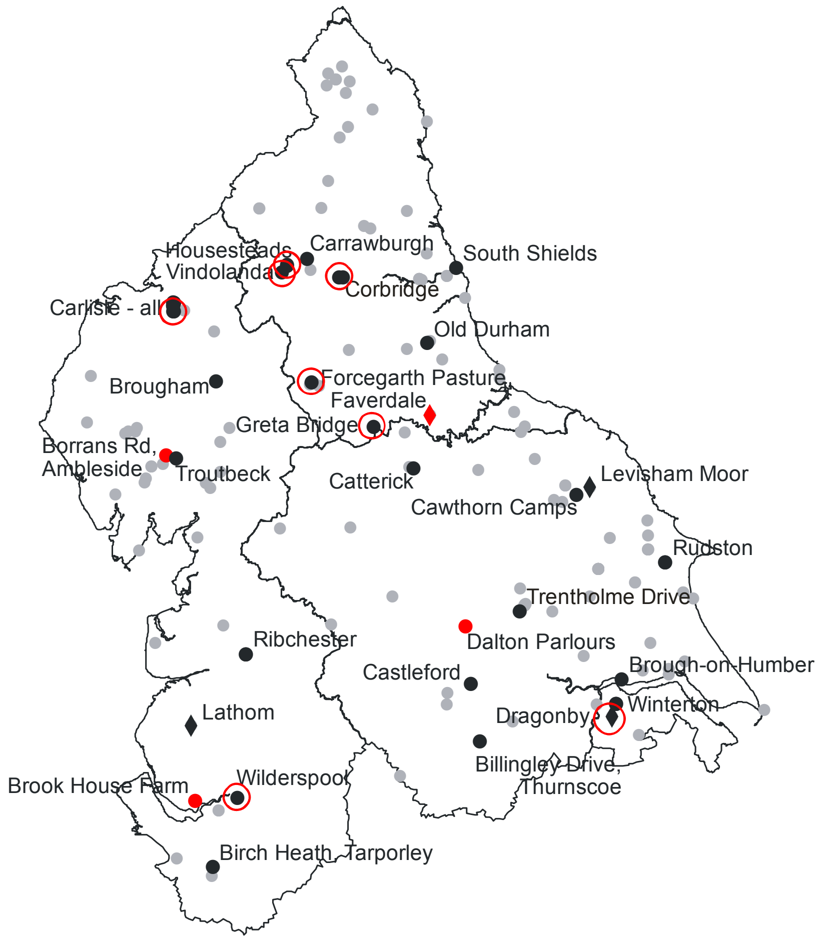


Figure 7: Roman and Romano-British sites
♦ IA-Romano British
black = charred; red = waterlogged

Several fragments of wood were recovered from the well in the Headquarters Buildings at *Vindolanda* behind Hadrian's Wall (Blackburn 1970). The large pieces were all from oak and included stakes and half a pipe. The bulk of the material however consisted of twiggy fragments with most being from hazel, but with birch, oak, cherry, willow and ivy all recorded. A yew twig had "evidentally once been a very amateurish bow" and there was a tiny fragment of sycamore from a chopping block. Pine was represented by two pieces from the sides of a wooden bucket. The sycamore, if correctly identified, represents an imported species as it is not native to Britain and is generally considered to have been brought here during the 16th century. As it was noted to be a fragment of an artefact this does not cause a problem here but probably reflects import of ready manufactured goods. Recent work by the author on plant remains from bulk samples has also demonstrated the presence of abundant charcoal in hearth or oven deposits (Huntley 2003). There are clear differences between these ovens with the largest number having more or less only heather wood in them. These features tended to be later in date than the ovens that produced a mixed assemblage of hazel, birch and oak on the whole (Huntley 2007), and this will be further investigated in the future.

At *Corbridge* Roman fort, buildings to the north of the granaries dating to the first and second centuries AD produced some wood. It was noted that it "was remarkable in that the sandy sub soil had preserved not only its [partition] main uprights but the wattles between them (pl. XXXVI, 1). They had been woven vertically round horizontal rods and form an interesting variant of the more usual horizontal weaving round vertical rods" (Richmond and Gillam 1953). Unfortunately taxa were not identified. Also from Corbridge, but this time from contexts associated with the bath-house at the *Red House* excavations, charcoal and wood were identified from a range of contexts including stoke holes, fuel stores, rubbish dumps, cooking fires and latrines (Clarke 1959). Nine samples were analysed with no indication of quantities of charcoal or, indeed, which was charcoal and which wood. Oak was present in seven, birch in five and elm in one. There are suggestions that samples from the fuel store and stoke holes produced only, or largely, oak whereas the pits and cooking fires had birch as well. Given the contexts, it would be worth checking the archive to see if this material survived and whether there was potential for some analysis of type of material. Further work on material from the supply base at *Red House* indicated that all of the structural timbers sampled were oak but that other samples produced a mixture of taxa (Donaldson and Hanson 1979). Oak charcoal alone was recovered from demolition layers and defences, presumably reflecting structural timbers to a large extent. Material from pits, furnaces and other structures included oak, ash, birch and hazel. Numbers of occurrences are provided with a total of 45. First century constructional material from excavations at *Corbridge by-pass* produced an oak sill beam or similar (Donaldson 1975).

Excavations at *Housesteads* fort on Hadrian's Wall have produced two wood assemblages from the north side of the north curtain wall and directly attributed to human activity (Whittaker 1988). Taxa identifications and numbers of fragments are given, but no contextual information is provided. The author does, however, note that much of the material consisted of fine branches or twigs and that some had cut ends. At least some of the material had had shallow chips removed. Just over 200 fragments were identified. Oak formed almost half the total assemblage, hazel and willow/poplar a sixth each followed by alder and birch, and with seven other taxa only represented by one to three fragments each. Charcoal from cultivation terraces associated with the fort at *Housesteads 189/88* included twig/small branch material of oak, birch, alder, willow and hawthorn-type (Clapham 1988)

The temple of Mithraeus at ***Carrawburgh*** on Hadrian's Wall produced charred cones of stone pine *(Pinus pinea)*, along with iron-stained charcoal containing hazel and further fragments of pine cones (Smythe 1951).

A small collection of charcoal from constructional phases of the fort at ***Greta Bridge*** produced a charred 'chair leg' of Pomoideae, three records of ash, two of oak and one each of birch and hazel although fragment numbers are not recorded (Donaldson 1976d; 1998).

Carlisle has had a large amount of wood analysed in various reports and to various levels. Early reports are little more than lists of a few items but will be summarised here for consistency. Keepax (1979) identified an oak handle and two fragments of conifer, probably not of native origin, from the late 1st century AD (site = ***Carlisle #2860*** in database using the AML report number as an identifier). Donaldson (1976b) identified five structural timbers as oak from ***Carlisle Lanes #2157***, an urban area outside the fort. ***Carlisle 72*** itemises various identifications from wattle features (all hazel), some pegs (oak and hawthorn-type (*Crataegus*-type)), some brushwood (all alder), two shoes (alder) and 18 other identifications of unknown origin. Oak was the most common identification but ash and ?field maple (*Acer* cf. *campestre)* were both recorded (Keepax and others 1977). ***Carlisle 78*** produced larch/spruce (*Larix/Picea)* and cedar (*Cedrus)* amongst the more usual Pomoideae (as a mallet head), oak (three artefacts) and ash (Keepax and Watson 1980). The conifers are not native and cedar, if correctly identified, is certainly unusual. They may have been artefacts, or fragments of artefacts, although this is not stated whereas other identifications were noted as such. ***Carlisle #3743*** produced oak, alder and hazel (van der Veen 1982c) whilst ***Carlisle: Blackfriars*** produced one identification of ash as well as these three taxa. One fragment of silver fir (*Abies alba)* was also recorded (van der Veen 1982b) and it is assumed that this was a fragment of a barrel or similar article.

The first of three major reports on waterlogged wood from Roman deposits at Carlisle deals with material from the ***Carlisle: Castle Street*** excavations (Huntley 1987) where about 400 fragments were identified. The trenches investigated an area adjunct to the fort and that was generally felt to be a place for stock holding. The buildings associated with the first and second timber forts (late 1st to mid-2nd century) were timber sill-beam structures with much wattling remaining *in situ*. Oak and alder were the dominant taxa in the late 1st century material with hazel becoming much more important, although still at values of about half those for oak and alder, during the early 2nd century. Oak and hazel were equally important in the mid-2nd century with alder being rather uncommon; alder again became more used in the 3rd century but never as much as in the initial phase. The suggestion was that strategic clearance of the area around the fort produced much alder which was then used rather than wasted but that by the early 2nd century the occupants had to go further afield for their timber supplies. The increase in alder during the 3rd century might reflect use of naturally re-grown alder in the flood plain, once again requiring clearing for strategic reasons. Few other taxa were recorded at all. Both the oak and the hazel exhibited two age classes but with, interestingly, a single narrow diameter range. Therefore two areas of woodland may have been exploited – one showing much faster growth than the other. The alder produced one age class, equivalent to the younger of the oak/hazel ones, but a broader diameter span.

Carlisle: Annetwell Street had over 2000 pieces of wood analysed of which about 1400 related to roundwood as opposed to wood working debris or off-cuts (Huntley 1989b). They came predominantly from two main periods of activity – the late 1st (period 3) and early-mid 2nd centuries (period 5) AD during both of which the timber fort was variously built, extended and generally modified. Building upon the Castle Street database, more rigorous attempts were made to categorise material into roundwood and worked fragments/debris and both ageing and metrical data were collected where possible. Table 2 below presents a summary by period:

PERIOD	3 (late 1st C)	4	5 (early-mid 2nd C)
TOTAL FRAGMENTS ROUNDWOOD IDENTIFIED	735	65	676
percentage			
Alnus	65.6	71.8	28.6
Betula	5.6	-	8.9
Corylus	7.6	7.7	28.9
Quercus	17.0	12.8	33.0
Ilex	1.0	2.6	0.4
Salix	0.1	-	0.7
Fraxinus	1.9	-	0.2
Ulmus	0.3	-	-
Pinus	0.3	-	-
Prunus	0.7	-	-
cf. *Prunus padus*	-	5.1	-
Crataegus-type	-	-	0.3

Table 2: Carlisle Annetwell St. summary wood data

Period 3 had large amounts of alder present with some oak and a small amount of both birch and hazel. The other taxa occurred only in very low numbers. Period 4 generally followed this pattern although considerably fewer pieces in total were identified. The relatively high values of cf. *Prunus padus* (bird cherry) were accounted for by wattles from one feature, the wood probably originating from one thicket. Approximately the same numbers of identifications were made from period 5 as from period 3 and therefore more realistic comparisons may be made between these two. The taxa themselves are similar although period 3 shows greater diversity – whether this is significant or not is debatable – but the proportions of taxa vary. In period 5 alder, hazel and oak are equally common with smaller amounts of birch, whereas alder dominates Period 3. The change in emphasis was suggested to reflect the differing areas of woodland that were being exploited. Initially the local river plain would have been cleared for strategic and defensive reasons hence the use of mostly alder. Later, when the region was, perhaps, more stable in political terms, and the local alder depleted, more distant woodland would be safe to exploit. Although data from the later 2nd century are few there are suggestions of a return to use of more alder suggesting that the trees on the river plain had re-grown. The report also discusses the material within the individual structures from which >30 fragments were analysed – wattles, fence lines, drains, ovens – although does not compare these to any extent. From the age and diameter plots it was clear that the selection of wood was mainly on size during both Periods 3 and 5 but that in the earlier stage the material was from a wide range of ages. This indicates collection from a variety of areas of woodland with a natural age structure, ie not managed. During Period 5 selection was still principally size-based but the corresponding age curves were much narrower, suggesting management or at least that woodland was becoming more uniform through natural regeneration after cutting. Huntley also noted that, although the absolute dates were not the same, she had seen this same sequence of events at Castle Street

The area outside the fort in Carlisle also had well-preserved assemblages of wood and these were analysed from excavations in a number of ginnels, the excavations from the southernmost of which were called 'Lanes-1' (Huntley 1992b; 2000b). Table 3 below presents the summary data from Lanes-1.

Taxon Trench	CAL-A	CAL-B	LEL-A	OBL-B	OGL-A	OGL-B	OGL-C	OGL-J
TOTAL IDENTIFIED	182	28	285	167	468	238	43	12
Percentage								
Alnus	15.9		10.9	22.2	12.6	13.0	4.7	
cf. *Alnus*			1.4		0.4	1.3		
Betula	4.9		0.7		7.1	1.3		
Corylus	7.7		11.2	2.4	6.4	0.4	9.3	8.3
cf. *Corylus*	0.5				0.2		2.3	
Betula/Corylus/Alnus	1.6				0.9	0.4		
cf. *Carpinus*			0.4				2.3	
Fraxinus	0.5		0.7	5.4				
Ilex				0.6				
Crataegus-type	1.6			0.6	0.2			
Pomoideae	0.5				0.2			
Prunus avium/P. padus types	0.5			0.6	0.6			
Quercus	58.2	100.0	73.7	58.7	67.1	77.8	81.4	91.7
Salix	3.8				0.9	4.6		
Populus				0.6				
Salix/Populus	2.7		0.4	0.6	1.9	1.3		
Abies				6.6	0.9			
Picea/Larix	1.1							
Pinus				0.6	0.2			
Taxus			0.7	1.2	0.0			
Calluna					0.2			
conifer unspecified					0.2			

Table 3: summary data from Carlisle: Lanes-1

Although some of the totals are rather low, in all trenches oak was the most frequently recorded taxon. Unfortunately it is not possible to separate out the roundwood from wood working debris in the tables themselves (although the archive database would allow this separation) and thus the data are not comparable with those in table 2. However, the text in the report does note that the oak was mostly such debris.

Alder was the next most common taxon with hazel and birch rather infrequent. Other taxa were the usual expected types but there were also moderate numbers of atypical taxa – for example yew and larch/spruce. The latter clearly is not native and probably reflects deposition of artefactual debris. The yew took the form of small blocks and may well also reflect manufacture of artefacts. In this case it would probably indicate high value goods given the attractive figure and nature of the wood.

The large numbers of trenches excavated make it rather more difficult to acquire adequate-sized datasets for specific periods, let alone contexts, and thus many of the analyses were undertaken at a rather broader level than initially anticipated. Again, categories of material were used and some patterns were observed this time. In Lanes-1 'roundwood', including whole and part sections, consisted of a wide variety of species with oak being most common. The 'bases and boles' were from willow/poplar, alder and oak, although the total number recovered was low. In general these pieces were from linear features between buildings or yards and probably reflect the remains of hedges or boundary features. Further evidence for this came from analyses of bulk samples in which twiggy material and fruits/seeds from woody taxa were abundant. The presence of faecal material and some numbers of small denomination coins in the associated ditches lends another dimension to the interpretation (Huntley 1992b).

'Off-cuts' were also dominated by oak as were the 'planks' – some of the latter were quite thin and may have been more of a shingle type material for covering walls of buildings. 'Miscellaneous' gave little information other than they were mainly oak or bark category. Although oak bark was extensively used in the tanning industry there were no concentrations of bark in any context sufficient to suggest deliberate usage in the Lanes area. It was considered that most of the bark was simply waste from dressing large timbers, or pieces having become detached from the roundwood following deposition, although this in itself might well indicate primary conversion work on-site. Oak was clearly the most commonly worked timber with many waste pieces being deposited throughout the contexts. The debris was classified as consisting of tangential or radial chips but nothing further was discussed at the time. The roundwood, used more or less as cut from the woodland, was from a wider range of species. As with the fort material, size was the over-riding character suggesting selection for use. Lanes-1 produced very few stakes (and all of the material was scanned) so most of the roundwood reflected small wattling and generally did produce narrow peaks in age although probably not sufficiently narrow to suggest restricted supply or formal coppicing. The main conclusion was that the wood from Lanes-1 represented local wood-working debris, including craft waste from the presence of yew off-cuts, and the use/discard or possible manufacture of wattling.

Time constraints upon analyses of material from trenches in the adjacent Lanes-2 excavations meant that little of the wood was examined in detail. Superficially the material was similar to that from Lanes-1 although with rather more contexts producing wood working debris, very little in the way of stakes, and a few contexts with large amounts of small wattling. With hindsight, more probably should have been done with the wood working debris especially in relation to whether the material was being trimmed and fitted to a particular construction job on site or whether there was more major on-site conversion from whole trunks. Nonetheless, nearly 500 records from eight of these large contexts were obtained. These produced almost exclusively oak working debris largely as off-cuts, while chippings were also common although not quantified. The data were not presented as a formal report and remain in note form and sketches only.

At *Dalton Parlours*, a Roman villa, the wood identifications were predominantly of artefacts and artefact fragments especially the remains of buckets. Oak, silver fir, pine, ash, alder and *Acer* (this could have been the native field maple or the exotic sycamore, with the latter perhaps slightly more likely given the artefactual nature of the material) were all present. The author noted that the staves were tangentially sawn or split which is in contrast to many Saxon and Medieval sites where radial sections were more commonly used (Morris 1990a).

Wilderspool – the wood report is simply one identification of a coffin timber as oak (Keepax 1978b).

The Romano-British settlement at *Brook House Farm* on Merseyside had a certain amount of waterlogged twigs and wood fragments analysed from the bulk samples (Shimwell 2000) in which willow, hazel, alder, birch and sloe (*Prunus spinosa)* were identified. Some structural timbers were formed from oak.

Charcoal from 12 bulk samples from Romano-British round-houses and associated features at *Birch Heath, Tarporley*, was analysed (Gale 2004). Although the material was not that well preserved the author identified almost 750 fragments, over 700 of which were oak. Much of this oak was heartwood. The other taxa recorded included alder, birch, hazel, Ericaceae, ash, Pomoideae and *Prunus* but the largest number of fragments of any of these was 14. The contexts included features associated with round-houses, pits, a ditch and two metalworking areas. The metalworking areas produced, with one exception – an ash fragment – only oak charcoal. The author suggests that the oak charcoal was probably fuel for high temperature processes such as metal working but that some may reflect the catastrophic burning of a round-house where it probably formed some of the structural elements. She also notes that the other taxa tended to be recorded from features within the round-houses, possibly reflecting domestic fuel debris. This is certainly one of the few reports from the region under discussion where quite detailed interpretations of the charcoal are offered and in conjunction with context information.

One fragment of oak charcoal was identified from *Troutbeck* Fort (Keepax 1974).

Samples from the excavations at ***Ribchester*** produced a large assemblage of wood, mostly waterlogged but with quite a few pieces showing signs of some charring (Huntley 2000a). Over 950 pieces were identified with almost half being of oak. Hazel, then alder, accounted for a further 30 per cent, with smaller numbers of ash, various Rosaceous taxa and a few of the imported silver fir. The latter probably reflects remains of artefacts such as barrels but the fragments were small and this was not clear. Much of the oak came from the phase of demolition and re-building of the fort presumably reflecting structural timber; indeed the majority of pieces were offcuts or working debris rather than roundwood. The ash, too, was principally from the same phase although mostly roundwood. Alder and hazel were more common in the earlier phases as was the case for Carlisle. It was suggested that the other taxa were simply cut opportunistically when the woodland was being felled. The author categorised material into sections and these were then grouped into primarily roundwood or working debris. She now feels that the large number of initial categories was probably excessive and based on size/shape rather than production methods. She also feels that more work remains to be done with this sort of material. Looking at the age/diameter plots there were two groups present in both alder and hazel, one representing a four-year cut and another a seven–eight year cut. Statistical manipulation suggested that alder was more likely to represent a single population with the size differences reflecting choice of material for the job. On the other hand the hazel was more likely to represent two distinct areas of woodland and this could well indicate formal management. It was also possible to say that moderate numbers of stems had been cut in the winter to early spring. Also two nit combs, complete with remains of nits, were identified as being made from boxwood (*Buxus)* (Fell 1991).

Winterton Roman Villa, North Lincolnshire, has produced two reports on wood and charcoal. The first (Morgan 1969a) identified 17 *Quercus robur*-type and a few each of poplar, ash, hazel, field maple, birch and common lime (*Tilia vulgaris)*. The wood of *Tilia* spp. is not separable therefore this level of identification is unlikely to have been possible. In addition, the common lime is not native to Britain and the charcoal is more likely to have been the native small-leaved lime – *T. cordata*. Charcoal from 41 samples was identified by Keepax (1978c) the bulk of which, other than oak, was twigs. Oak consisted of more or less equal amounts of twig (defined as up to 3cm), branch and large (no curvature in the rings) pieces. Hazel was more or less all twiggy material. Context types and interpretations were not offered. Other taxa identified included cf sloe, hawthorn-type, willow/poplar, *Acer*, *Prunus spinosa/Acer*, ash, *Prunus* and alder, although never more than three occurrences in any taxon.

Rudston Roman Villa samples produced oak, ash and ash/*Acer* charcoal (Morgan 1973) and 6 pieces of oak from a well (Keepax 1975g).

The Roman cemetery at ***Trentholme Drive*** near York produced a small assemblage of wood and charcoal (Blackburn and Metcalfe 1968). Of the 11 fragments identified by Blackburn one was from an oak coffin with the rest from debris in the *ustrina* and said to represent wood fuel used on the pyres. It included some quantities of pine bark and a little wood as well as oak, ash, hawthorn and hazel charcoal. Metcalfe identified some charcoal from blackened debris around the cinerary urns and determined that 60 per cent was ash, approximately 20 per cent oak and 10 per cent hawthorn. The rest was either hornbeam (*Carpinus)* or hazel. No criteria were presented regarding the identification of the hornbeam. This would be an unusual record for the region.

Two samples of charcoal were analysed by Rowena Gale from the annexe of the Roman Fort at ***Castleford*** (Gale 1998). In the specialist report the context numbers are given but it is not possible to integrate these with context types or the archaeology itself. The general discussion within the main body of the paper indicates some association with metal working – but also comments on waterlogged wood not charcoal. A range of species is present, including oak, *Acer* and Pomoideae. The larger of the two samples produced 58 fragments of mainly oak sapwood although a few fragments of heartwood were recorded along with 74 fragments of the Pomoideae taxa. These were predominately narrow branches/stems. Gale suggested that since heartwood was present this indicates that it was not coppiced material. The presence of mixed species, she also suggests, reflects collection from local wild wood and the relatively low amounts of oak more likely reflect domestic fuel rather than smelting as the latter requires high temperatures best achieved through burning oak.

Charcoal was recovered from 24 bulk samples taken from charcoal-rich deposits/layers during excavations at ***Cawthorn Camps*** with oak, ash and hazel being recovered. Assessment suggested that further work was not necessary upon this material (Hall and Kenward 2000).

Twenty one fragments of charcoal were identified from metalworking contexts at Catterick where they were found to be mostly oak with some hazel and single occurrences each of alder and birch (Bayley *et al* 2000). Campbell noted that the oak was a mixture of fast and slow grown material and that three of the hazel roundwood fragments were 5–6 years old. These were initially fast grown but then slowed considerably. This pattern is typical of simple biological growth however.

Brough-on-Humber produced some wood and charcoal assemblages (Morgan 1969b). Both oak and ash charcoal consisted of >4" (*c* 100mm) diameter and other taxa recorded included willow, alder, poplar and hazel. Worked softwood, larch/spruce, was also recorded. The published report is in the form of lists by code number but nothing else.

Charcoal from the Roman cemetery at ***Brougham*** in Cumbria has recently been re-analysed with the particular aim of looking for correlations between taxa and gender/status of cremations and to see if grave-goods and wood taxa showed any patterns of distribution (Campbell 2004). Birch and alder dominated the assemblages overall and were considered to reflect the main fuel for the pyres. Willow or poplar was also commonly used for this. The strong correlation of ash, charcoal and decorated bone veneers might well indicate derivation from pyre goods. Campbell determined that alder was more common in male cremations whilst birch was more so in burials of females and juveniles and she suggested that this could reflect the greater mass of a male body requiring longer burn time with a slower burning fuel. Such a study demonstrates the sorts of questions that nonetheless can be addressed even with, as Campbell says, limited material from previous excavations.

Summary

Charcoal and wood from the Roman period are generally better recorded than from earlier periods although this is, in part, biased by the large assemblages from Carlisle. More taxa have been recorded and more attention paid to types of material generally although, even here, there are discrepancies between sites. This period probably raises methodological questions as much as anything and it may be that this aspect should become a focus for the Roman agenda. Clearly old material could be re-analysed in some instances although how much the original material was fractured needs consideration. However, material preserved through waterlogging is unlikely to remain available. For several of the larger reports it is also clear that the excavator and charcoal/wood specialist did not discuss interpretation together to any degree.

Early Medieval (AD 400 – 1000)

Following the cessation of Roman administration the pollen evidence varies across the region in terms of whether there is woodland regeneration or further woodland clearance. The former seems to be typical of the area immediately around Hadrian's Wall – perhaps less surprising since this was a focal linear boundary for the Roman military as, for example, around Crag Lough in the central section of the wall (Dark 2005). On the contrary, in the upper reaches of the Durham Dales there is equally strong evidence for continuation of woodland clearance and it is not until the Norman Conquest that woodland regenerates to any degree (Roberts *et al* 1973). This effect is probably a result of the development of hunting areas in Weardale by the Prince Bishops of Durham.

Very few sites have had any charcoal or wood analysed (Figure 8), partly reflecting the lack of archaeological sites in the region as a whole for this period.

The majority of the wood analysed from *Lurk Lane Beverley* was considered to represent disposal of rubbish and, as a result, there were plenty of fragments of artefacts. However a boundary dating from late 9th/early 10th centuries produced off-cuts from carpentry such as planks, boards, pegs and stakes as well as unworked wood. Where identified the off-cuts were all of oak. Stakes were common and variously shaped. The taxa identified included sloe, willow, hazel, alder and birch (Foreman and Hall 1991).

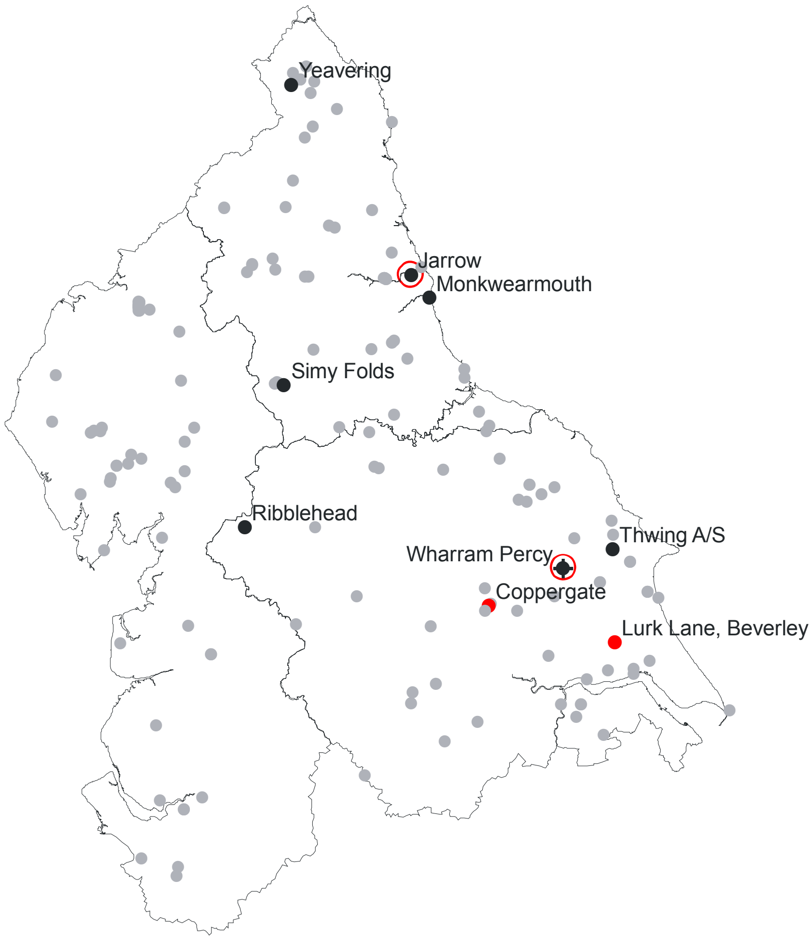


Figure 8: Early medieval sites. Wharram Percy includes early medieval-medieval
black = charred; red = waterlogged

An early medieval settlement at *Simy Folds* in Teesdale was excavated (Coggins *et al* 1983). Charcoal from three contexts associated with a house and floors produced a mixture of birch, willow/poplar, hazel and *Prunus* with the two floors producing predominantly birch (Donaldson 1977a).

At the upland site of *Ribblehead*, a 9th century farmstead, charred remains of birch, Pomoideae, hazel, ash and *Prunus* (total 6 fragments) were identified (Donaldson 1977d). She interpreted these as suggesting the presence of more woodland than at present and that it was open, and possible secondary, woodland.

Charcoal from the constructional phases of Saxon monastic site at *Jarrow* produced both oak and ash with a little willow/poplar wood (Donaldson 1976c).

Charcoal from 8th/9th century deposits at *Thwing* was mostly from oak but with some hazel and willow/poplar. More than half of the 40 oak fragments were from timber, wide stem or branchwood with 17 from heartwood and 5 from sapwood (Gale, 1991).

Yeavering dates to the early medieval period (Hope-Taylor 1977) and charcoal from 21 features is therefore probably also of this date. Thirteen construction features and 9 probable hearths were sampled (Anonymous 1977). Oak was the most frequently occurring taxon in both context types but there were slight hints of a wider range of taxa in the hearths. The author notes that the construction material, oak and one occurrence of ash, suggested that the local woodlands had big straight-trunked trees although the material might have been imported.

An extremely large assemblage of charcoal has been analysed by Isabel Figueiral from the Anglo-Saxon settlement at *West Heslerton* although not yet published (D. Powlesland pers comm). Over 3500 fragments have been recorded and thus there must be good potential for some spatial and temporal analyses of this assemblage.

The Anglian (mid-9th to late 11th century AD) site at *Coppergate* in York produced mostly roundwood of hazel with some willow and a small selection of other taxa; all of the structural timbers were oak. Over 1000 fragments were identified and measured with the conclusion that there was no organised coppice system. The authors also noted that much of the material was rather poorly sampled in respect of noting positions of wood pieces within features such as hurdles and wattling thus reducing the interpretative possibilities (Hall and Kenward 2004; Kenward and Hall 1995). Subsequently more work upon the waterlogged wood was undertaken by Allan Hall (Hall 1997) when he analysed over 3300 pieces of wood. He categorised these into 'small finds', 'timbers' and 'others'. Not surprisingly oak was the most frequent timber which included much of the plank-built structures on the site. Alder and maple (assumed to be probably *Acer campestre* by the author) were the two most common species in the 'small finds' category and comprised many fragments of lathe-turned bowls. The range of taxa in this category was also the largest with some taxa largely or wholly represented only in this category – silver fir, box, spindle (*Euonymous*), yew and elm for example. The 'other' category included high frequency (presumably in terms of numbers of contexts from which they were recorded) of alder, birch, hazel, ash and willow where they had been used in fences, hurdles and wickerwork. Hall noted that lime was the only major post-glacial forest taxon not recorded. Note that the records in the database for this report exclude those classed as 'small finds'.

The deserted medieval village site at *Wharram Percy* has had numerous charcoal reports produced over the years. As such these are discussed below in the medieval section although one set of radiocarbon dates puts some material into the 11th century – see details below.

Reports with simple lists of taxa recorded: wood samples from *Monkwearmouth* were determined as elder, holly and conifer (Turner and Hewetson 1971).

Summary

The early medieval period is fraught with difficulties over dating, with several sites spanning through to the first centuries of the medieval period, and it is therefore not a surprise that many reports on charcoal are simply using it as a dating material. The single large assemblage of charcoal from West Heslerton should, however, make a considerable difference to our understanding of woodland utilisation in the Vale of Pickering. Waterlogged material from York provides no strong evidence for formal woodland management despite moderate numbers of pieces sampled.

Medieval (AD 1000 – 1500)

From this period onwards there is strong documentary evidence for the formal management of woodlands whether for timber and roundwood, as hunting reserves or for wood pasture (Bond 2004). However, it is almost certain to have been rare for total clearance of any surviving woodland to have taken place at this time in view of the large number of products derived from it. Up until the Black Death in the mid 14th century large populations would have required these products in one form or another. Following the Black Death it might reasonably be assumed that woodland cover increased. Clearly radiocarbon-dated pollen diagrams could demonstrate this, or not, but the region is probably too diverse for any simple conclusion to be drawn. Equally many pollen diagrams are missing the top layers of peat through erosion or deliberate cutting for fuel in the past and many concentrate upon questions relating to earlier periods of peat development. Few diagrams have set out to address questions relating to the last 1000 years or so and the uppermost radiocarbon date in many is broadly Roman thus leading to interpolation from that level to the uppermost ones with the associated issues of constant sediment accumulation or not. Examples of the wide-ranging variation in tree pollen include Rusland Moss in the southern Lake District where a short but active phase of clearance during the 10th/11th centuries was followed by woodland regeneration until 'late Tudor times to the present day' (Dickinson 1975). By contrast at Rishworth Moor in West Yorkshire tree pollen percentages remained reasonably stable at *c* 30 per cent from the arrival of the Romans until well into the post-medieval period, after which they fell drastically (Bartley 1975). Nonetheless wood should still have been widely available, even if highly controlled, from the region throughout this period.

Figure 9 presents the medieval sites with wood or charcoal reports and the concentration in the southern Lake District can be noted. These relate to charcoal production and a special research interest of the author.

Newcastle: Carmelite Friary produced a wattle-lined trench dating to the 13th century. The lining consisted of a row of small upright stakes with horizontal branches woven around them. The wood consisted of a mixture of alder and birch. A plank of oak exhibited a tenon and had a slot and round hole cut in one face (Clarke 1968). It is not clear whether this was part of the structure or a discarded piece of clearly worked oak. Two coffin fragments were identified as being from oak at *Newcastle: Blackfriars* (Donaldson 1976a) and in the same report was a record of a single fragment of oak from *Newcastle: Blackgate*. Also in that report, although not from within Newcastle itself, assorted wood, charcoal and some bark, recorded from seven contexts from

Belling Mill were all identified as birch. Huntley (1992a) analysed further material from old excavations at *Blackgate BG84*. Although much of the wood had dried out since being excavated and was of little use beyond taxon identification there remained evidence for hazel, alder and oak being used as roundwood and some moderate amounts of oak wood-working debris. Limited though the data are, they do indicate high potential in respect of wood survival in this part of the city.

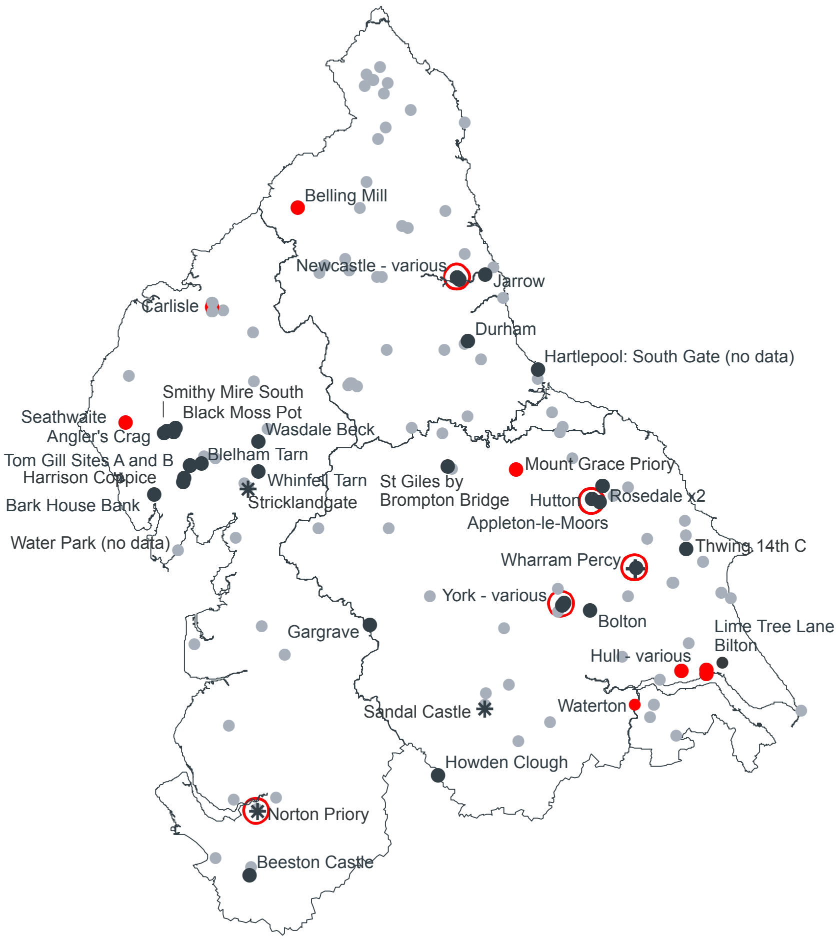


Figure 9: Medieval sites. +=early med–med; ✱=med–postmed
black = charred; red = waterlogged

Excavations at *Back Silver Street, Durham City* produced one charcoal sample that was more or less entirely ash and another of ash and hazel. Both were from the lower fill of a 13th century oven or kiln (Donaldson 1976e; 1980a).

The defences of medieval *Newcastle Town Ditch* produced a variety of waterlogged wood identified by Nye and Turner (1989). Willow was the most commonly recorded of the total 40 fragments, followed by oak, alder, ash and *Prunus*.

Sixteenth century glass-making furnaces in the North Yorkshire Moors had some charcoal investigated in the 1970s (Merton 1972). Those at *Hutton* produced largely birch and alder with the mention of only occasional fragments of oak whereas those at *Rosedale* produced ash in the preparation area and mostly oak from 'black soil'. The oak consisted of branch wood and twigs complete with bark.

In the lower Yorkshire Dales, the medieval hospice of *St Giles by Brompton Bridge* produced a small charcoal assemblage from over 250 bulk samples. The charcoal was not identified systematically or completely, merely *en passant*. The assemblage was formed mainly from twigs or small roundwood of a variety of local taxa with oak, ash, hazel, alder, birch as well as heather and gorse recorded (Huntley 1991b; 1996 for 1995).

In South Yorkshire, a lead-working site at ***Howden Clough*** yielded a moderate-sized charcoal assemblage (Gale 1999). Three contexts from hearths were sampled with one context sampled in spits. Oak was abundant in all three and birch present in all three with a few pieces of hazel; Pomoideae and ***Prunus*** were also recorded. The latter were all smaller fragments demonstrating the necessity for taking bulk samples rather than exclusively hand-picking material. The author noted that the material was mostly slow-grown with few specimens suggesting growth in optimal conditions. She also noted that some cross-sections demonstrated a dramatic ring reduction lasting at least 19 years indicating some drastic decrease in local environmental conditions. It might be wondered if such a reduction could indicate dense coppice growth although the author states that there was no other evidence for the use of coppice wood. A second alternative could, obviously, be the effects of lead vapour suppressing growth for a period and may indicate time of use of the processing site. This is yet another instance where integration of the charcoal and archaeological data may have paid dividends. The presence of bark in all of the samples was used to suggest that the material being burnt was wood rather than charcoal.

Hungate, York produced 44 stakes variously of oak, birch, hazel, ash and alder. All were associated with Medieval ship-timbers although none of the latter was identified (Naish 1961).

Fairly large timbers from the excavation of probable medieval deposits in *Carlisle (Cumberland Building Society)* were identified as either oak or ash but no other details or quantities are given (Keepax 1978d). Roundwood recovered from excavations of medieval layers elsewhere in Carlisle has never been studied (personal observation).

Wharram Percy, a large deserted medieval village, had a selection of charcoal examined from 14th and 15th century deposits. Oak, ash, hazel, hawthorn-type, alder, willow/poplar, *Acer, Prunus* sp. and birch were recorded in approximate order of frequency. Most were represented by twigs or branches as well as fragments from larger trees (Keepax and Morgan 1979). Material from wattle structures was identified (Haddon-Reece and Ede 1985), where distinctions were made between the sails and rods, although no information regarding contexts, ages or sizes was given and no discussion at all offered. Just over 100 identifications are presented: oak, willow and hazel are most common, forming approximately 85 per cent of the assemblage.

Although there is no real distinction between sails and rods, the data from 'wattle posts' suggest that oak was most frequently used (figure 10).

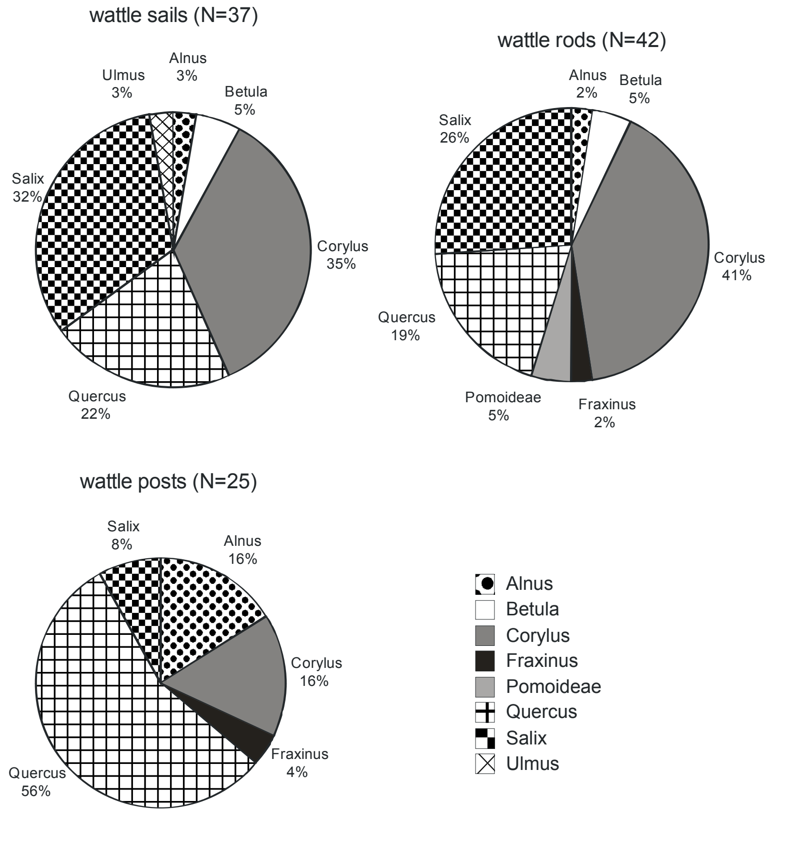


Figure 10: Wharram Percy. Data after Haddon-Reece and Ede (1985)

This greater use of oak as posts could indicate larger material being used for ends of structures but it is unlikely that the material remains in a state suitable for further work in order to confirm this, even if it has been archived, given the date of analysis and the fact that it was, presumably, waterlogged. A further report (#3720) simply indicates that a wattle fence consisted of a mixture of oak, hazel and willow, and there are identifications of seven other fragments of wood including two twigs (Haddon-Reece 1982). Morgan (1989) apparently analysed further wattling from Site 30. Her posts also included rather more oak than other taxa whilst the rods and small posts had slightly more hazel and willow than oak. She did determine ages and sizes of the material and concluded that the size appropriate to the function was chosen, *ie* smaller and younger material was selected for the rods. The smaller material ranged in age from 6 to 10 years with diameters 18–20mm whilst the larger material was 9–13 years and 28–36mm diameter. In fact, the taxa identification data from the two reports are so similar that Morgan must have returned to the original material and, in effect, simply added the size and age information.

Two samples of wattling were dated - 1090±70 (HAR-4651) and 1200±90 (HAR-4652); these calibrate (Stuiver and Kra 1986) to 770–1050 Cal AD and 660–1010 Cal AD at the 95 per cent confidence level, respectively, thus putting at least this feature into the early medieval period. *Wharram 1909* (Keepax 1975h) had a large but unspecified amount of both wood and charcoal analysed. The material was classified into twig, branch and timber based upon size classes. Oak was the most commonly recorded taxon and consisted of all types. Other taxa, although occurring frequently, tended to be more of the twig category but with alder, field maple, pine, *Prunus* and ash each also being represented by a few large timbers. Yet another report (Keepax 1975e) identified alder and *Prunus* type charcoal.

The moated medieval site at *Gargrave* produced some charcoal in the routine bulk soil samples (Hall 1983). The author notes that all of the tree species might well have grown locally and that most of the material was rather small – 10–20mm at most; he noted that they came mostly from trees of small stature suggesting that they were probably fuel from fires or the result of burning small structures such as fences or wattling.

Medieval hearths at *Jarrow* produced some oak charcoal although most of the material, presumably fuel debris, was coal and clinker; a similarly dated drain contained both oak and hazel charcoal (Donaldson 1976c).

Medieval material from *Beeston Castle* in Cheshire has produced, perhaps, the least helpful report for the whole of the region. The report simply states that four samples collected for charcoal contained ⋯ charcoal (Keepax *et al* 1978).

Smith and colleagues (Smith *et al* 1983) identified a considerable number of charcoal fragments from excavations at *Sandal Castle*. They note the high degree of carbonisation although it is not clear what they mean by this. They then go on to suggest that this indicates that "charcoal was purposely made in an oxygen deficient atmosphere. No uncarbonised wood was found amongst the samples and it would thus appear unlikely that the charcoal was the product of an accidental fire". This statement, especially the latter part, might suggest that the material derives from samples of *in situ* features reflecting charcoal production. However, the table notes that most samples are from the Barbican moat/ditch so why the charcoal should represent *deliberate* production is not clear. It seems more likely that it reflects ashes and remaining charcoal from probably domestic hearths or cooking areas simply being dumped into a convenient place. The data are presented as a table of percentage species by weight and by phase and this is used to discuss woodland composition. There are, however, some differences through time although these are not explored in the report (Table 4).

Date range	tot wgt - g	Quer-cus	Betula	Corylus	Sorbus	Cast-anea	Pop-ulus	coal	Ilex	others	# taxa
>1645	67	57	29							13 Acer	3
1485-1600	1488	37	25		3	1	0.3			1 Ulmus 1 Fraxinus	7
1484-5	728	40	51	1							3
1450-1484	311	62	12	8	3	3	4			2 Rosa	7
1400-1450	124	19	5		50				14		4
1240-1400	85	42		12				44			3
1130-1240	32	100									1
1104-1130	57	100									1

Table 4 after Smith *et al* (1983): percentage occurrence of taxa by broad period of activity

For example, the earliest deposits produced only oak but the samples were small. On the face of it, coal was as common as oak in the AD 1240–1400 group although recovery methods used may invalidate this. Might it, however, indicate a statement of status reflected in domestic fuel or that the incumbent was developing an industry on his land? The material dated AD 1400–1450 produced a very high proportion of rowan/whitebeam (*Sorbus)* with more or less equal amounts of oak and holly (*Ilex)* – it would be interesting to know the numbers of contexts represented here and whether the rowan/whitebeam and holly simply reflect the use of single trees (assuming that the identification as *Sorbus* is really that precise rather than the more usual Pomoideae given the problems of similarity within this group). Charcoal from AD 1450–1484 contexts produced the widest range of taxa with reasonable proportions of the less well represented taxa too – perhaps this was exploitation of a wide range of woodlands or a major clear-up on-site with material being dumped into the ditch from a much wider variety of contexts. This variety carries on into the AD 1485–1600 group although some of the minor taxa are different. The assemblage representing a single year, AD 1484/5, is a more or less equal mix of oak and birch and might be from a rather more specialist or restricted context(s) which was dumped into the ditch. The most recent group (>1645) is again rather small, and thus the low number of taxa might be a reflection of this. However, *Acer* is common and it is tempting to speculate whether this is, in fact, an early example of sycamore (*Acer pseudoplatanus)*. The identification of sweet chestnut (*Castanea)* is unusual for the region but further comment cannot be made as identification criteria are not presented in the report.

Samples from ***Mount Grace Priory*** excavations produced 43 identified pieces of wood that were also categorised into twigs (<50mm), branches and mature wood (Keepax, 1981). Most of the material was birch or hazel with even the mature category producing little oak.

Excavations at ***Norton Priory*** on The Wirral produced structural timbers purely of oak. A ditch running through the kitchen contained wattle and daub wall debris. The larger wattles were all hazel whilst the smaller material was willow, probably *Salix alba* (Keepax 1989). Identification to species level of willow is, however, highly unlikely and most material remains as willow/poplar rather than even willow. She also noted that coffins were made from oak planks with hazel binding material. Charcoal from the bell pit was from fairly large timbers of alder, oak and hazel. Alder also had been used in eleven bowls and a couple of platters that had been lathe-turned (Keepax ibid). The book also presents some interesting documentary evidence for the use of wood in that oak was used for boards and roof shingles and so forth. Oak and hazel were identified in a further report (Keepax 1975c).

All of the material identified from the 14th century iron works at ***Rosedale*** was oak charcoal (Hillam 1988). A 'twig' of 16 years and 11mm diameter was noted, as was larger material (up to 40 years and 20–50mm diameter). The very narrow rings were suggested as representing trees grown in dense woodland.

Two small samples of charcoal were retrieved from under a medieval oven at ***Appleton-le-Moors*** and from which oak, possibly ash and willow/poplar trunk/branchwood fragments were identified (Hall 1996). Hall noted that their preservation was poor and most fragments were either glassy or crumbly.

Two samples of timber and 17 sediment samples were analysed from the Jewish cemetery in ***Jewbury, York*** (Hall 1994). Much of the material was wood from *Pinus*, referable to coffins, although a little oak charcoal also was recovered from the samples. Preservation was generally poor. Hall notes that the pine is unusual and compares the data with others from his site at ***St Benet's Swinegate***, York, where he recorded mostly oak with only one fragment of pine from 11th/12th century contexts. Given that the Jewbury material was associated with a specifically Jewish cemetery there might be a religious influence on coffin material.

Erosion events in the ***Seathwaite*** Valley in Cumbria provided the opportunity to investigate a brushwood layer in context from pollen analyses of the associated peat deposits (Wild *et al* 2001). The pollen showed deforestation dated to the 14th/15th centuries. Of especial interest was a linear feature surviving within the peats and gravels. This consisted of vertically-driven and horizontally-laid worked stakes. One hundred and fifty seven timbers were investigated. They consisted of roundwood, complete with bark, with good toolmarks showing how the ends had been worked to a point (Panter in Wild *et al* 2001). Woodworking chippings were also present in the deposits, possibly suggesting local on-site working. It is a great disappointment that no identifications are presented, given the relatively large size of the assemblage studied. The feature was interpreted, initially, as a fenceline/boundary although the large quantity of rough brushwood present could indicate local manipulation of natural scrub, but still to form a stockproof boundary. Certainly the pollen suggests a transition from heavily-wooded ground to high-level grassland and there are good documentary sources for increased sheep grazing on local monastic lands from the 13th century. The combination of the three lines of evidence – wood, pollen and documents – certainly allows for more detailed interpretations to be offered.

Although not in the region, 30 samples of wood and charcoal were examined from a church site at ***Barhobble*** in Dumfries and Galloway (Dickson and Habeshaw 1995). The material dated from the 11th to 13th centuries and included charcoal from burials dating to the end of the 11th century. These burials always contained alder, often oak and sometimes ash and hazel. Although there are no details regarding the human bones in this part of the report it is interesting that alder is constant and compares well with the Roman Brougham material (Campbell 2004). The walls and roof contexts contained oak and alder. Dickson notes that some of the material was from twigs or branches, otherwise the report consists of a list of identifications only.

Four spot samples of charcoal, all alder, were retrieved from excavations at ***Lime Tree Lane, Bilton*** near Hull where deposits were of probable medieval date (Hall *et al* 1996).

One ditch fill from excavations of a medieval site at ***Waterton***, near Scunthorpe, produced a moderate number of twiggy fragments. Three were identified as ash and a further two as probably blackthorn or plum type (Carrott *et al* 1996b).

Reports that present simple lists of taxa: ***Thwing*** 14th century material (Keepax 1975a).

On-going work by the author, in conjunction with the Park Local Authority, is examining charcoal from pitsteads in the Lake District where charcoal was being produced and subsequently used in the iron industry. The dates so far obtained indicate that the pitsteads date from the 12th – 14th centuries and that they seem to reflect woodland in their immediate vicinity. As such the pitsteads might be of quite limited duration, perhaps even reflecting only a single firing. Given that the dates suggest that the pitsteads are contemporaneous and, given their close proximity plus pollen data are available from close by, this is one occasion when discussion of charcoal representing the composition of the local woodland may be possible.

Summary

Although the majority of medieval sites in Huntley and Stallibrass (1995) are from urban situations, reflecting modern re-development in town and city centres, there are surprising numbers of wood/charcoal reports from other site types but for which there are no associated seed data. Many of these have been opportunistic gathering of a few pieces of charcoal but several are from rural-based small industrial sites such as iron-working and charcoal production. The latter at least have some reasonable-sized assemblages and are ongoing projects so at least should be able to demonstrate the types of information valuable for site interpretation that can be obtained from wood/charcoal studies.

Post-Medieval (AD 1500 – present)

Woodland management continued throughout the post-medieval period and, with the needs of an increasingly industrialised region, imported timber became important – such as oaks and especially conifers from the Baltic (Groves 2002; 2005) and, later, probably from the eastern parts of the United States of America. Documentary sources survive better and can provide extremely useful insights into the demands and procurement of timber and wood – see for example Langton and Jones (2005) for proposals for a research programme. Although there is ample archaeological evidence for post-medieval activity in the region, reports with wood/charcoal are minimal (Figure 11).

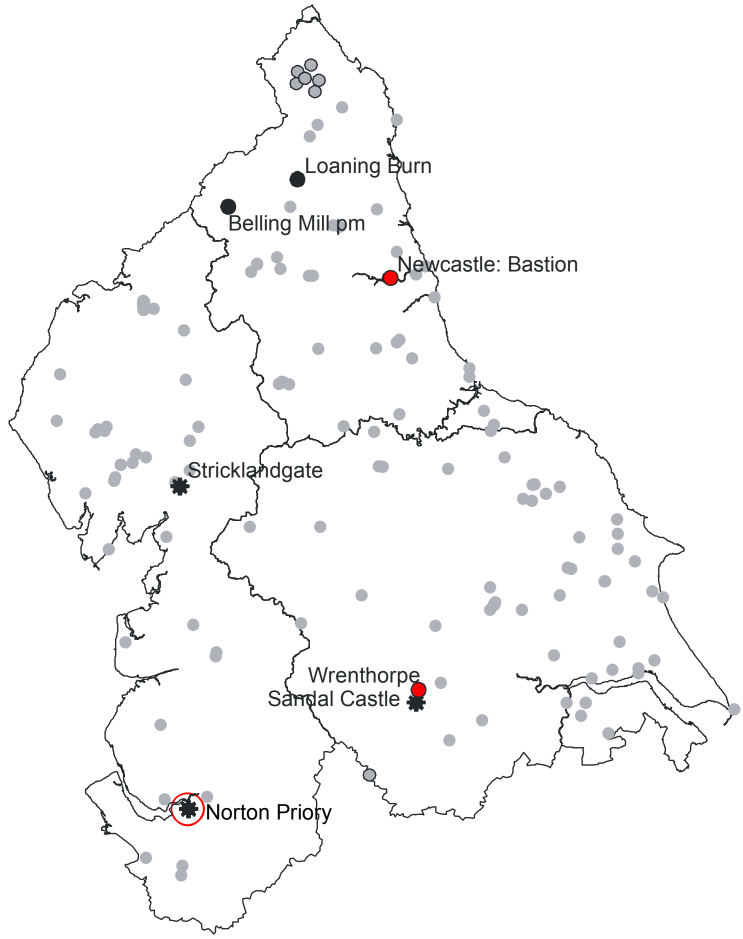


Figure 11: Post-medieval sites. ✱ med–post-medieval black = charred; red = waterlogged

At *Belling Mill*, Northumberland birch charcoal was identified from the entrance to the flue of a 17th century drying kiln (Donaldson 1976a; 1977h). At *Loaning Burn*, Northumberland, birch, oak and alder charcoal fragments were present amongst the thousands of charred oat grains in one sample from the floor of a 16th/17th century corn drying kiln (Donaldson 1982a).

The ditch of the 17th century *Newcastle Castle Bastion* produced a little oak and a fragment each of pine and spruce. The latter were suggested as being representative of imports of cheap Scandinavian softwoods (Donaldson 1983). Some remains of the wooden heels of platens were also recovered. Most of these were from alder but three were from poplar (ibid).

Decayed wood identified as being probably of oak came from one of the 16th–17th century kilns at the ***Wrenthorpe*** potteries site near Wakefield (Roberts 1992).

A very small assemblage of charcoal was produced from the urban burgage plot in *Stricklandgate,* Kendal where surfaces produced oak and hazel charcoal plus some other fragments simply left as birch/hazel/alder (diffuse porous, sparse scattered pores) (Huntley 1989a). Again the charcoal was not a specifically targeted piece of work but rather *ad hoc* from bulk samples.

Summary

Minimal evidence for use of either wood or charcoal is available for this period. Unfortunately this almost certainly reflects the interest, not only just historical, in earlier material with archaeology of this period almost seen as contamination.

Undated or very broad span dates

The possible smelting site at *Dry Beck* in Upper Teesdale produced, from one sample, 33 fragments of birch charcoal, eight of hazel and one of willow/poplar and ?poplar (Donaldson 1977c). The date of the site is not given in the archive report, nor is the context type, although it is most likely later prehistoric.

A second report on more than 400 fragments of charcoal from *Thwing (nd)* presents no dates and therefore the material could either represent Late Bronze Age or early medieval remains (Gale 1992). Context and feature types are, however, presented and two samples were, apparently, to be dated. No archaeological discussion is offered. Oak and ash were most frequent in terms of fragment numbers and frequency of occurrence in the samples. Hazel and *Prunus*-type were next. *Acer* was abundant in two samples and birch dominated one. Heather was recorded in two. Ironically, this is one of the larger reports for the region but through the lack of dates or integration with the archaeological information any interpretation possible becomes very limited.

Chester: Arrowcroft Scheme produced 10 identifications of oak from stakes and planks interpreted as a possible fence (Hillam 1979).

Bolton '73 produced large amounts oak charcoal, moderate amounts of ash charcoal and small amounts each of willow, pine, hawthorn-type and ?broom (?*Sarothamnus)* charcoal (Keepax 1975f). Otherwise nothing is noted of the site but it could relate to the medieval castle.

Ehenside Tarn in Cumbria produced a possible wooden platform and associated structures buried within peat (Walker 2001). This paper reviews various historical papers on pollen analyses from the peats as well as presenting a large number of radiocarbon dates. These range from Neolithic to Roman and possibly even Anglo-Saxon. The dates of the platform therefore remain enigmatic, as does its original function.

THE TAXA AND PRESERVATION

Although a resource assessment tells us what we have in terms of reports, other issues need some consideration before we can produce more than broad 'would like more' comments for the resource agenda. One question to ask of such a review is how widely the available taxa were used by past communities. Did people make very selective decisions or simply use whatever was available that would do the job in hand?

There are 40 woody tree/shrub genera (excluding woody lianes such as *Lonicera* and *Hedera*) with at least one species native in the British Isles today (Stace 1997). A further 40 are considered to have been introduced and some of these have subsequently become widespread – sycamore (*Acer pseudoplatanus)* and sweet chestnut (*Castanea sativa)* are two such species. Other introduced woody taxa such as *Buddleja*, *Cotoneaster*, *Escallonia* and *Mahonia* are moderately widespread in urban situations and may find their way into the archaeological record in the future. Some of the genera are monospecific in Britain eg *Alnus glutinosa* (although a European relative, *A. viridis*, is widely planted), others such as *Salix* have moderate numbers of species within them whilst the *Sorbus aria* and *S. intermedia* groups are apomictic with individual species having very narrow geographical ranges. It is generally acknowledged that identification of wood/charcoal, at best, is to the genus (Hather 2002) although, clearly, with monospecific genera this in fact means to species level. This then gives an indication of the range of taxa available to past people in the native woodlands (Appendix 1).

As part of the resource assessment, data were entered into the database by Latin name either as recorded in the original publication or translated if presented originally in English. This was principally in order to keep the range of taxa to a sensible and hopefully comparable level. Nonetheless it still produced a total of 93 taxa although these included 'indet', 'conifer', 'non-oak' and one instance of coal as well as the 'cf' categories. The data thus needed some 'tweaking' in order to be comparable with the taxa categorised in Appendix 2. For this comparison, the 'cf' categories were simply assumed to be the associated taxon. The densely diffuse-porous with multi-seriate ray taxa have been classed as either Pomoideae or Prunus-type. The former includes the various levels of identification of *Malus, Pyrus, Sorbus* and *Crataegus* fragments whilst *Prunus*-type includes all material described as various *Prunus* species. *Corylus, Betula* and *Alnus* categories were simply seen as the three genera. *Salix* and *Populus* categories were grouped as *Salix/Populus* because of the difficulties in identification of charred material from these two genera in most instances. With the exception of *Acer pseudoplatanus* the recently introduced taxa were omitted as many of them are modern naturalisations or garden escapes. This manipulation reduced the 93 taxa recorded to only 32. This represents 75 per cent of the similarly manipulated, ie recently introduced taxa again excluded, Appendix 2 data. The native taxa not recorded in the archaeological material were *Arbutus, Cornus, Daphne, Empetrum, Euonymus, Hippophäe, Lavatera, Ligustrum, Myrica, Potentilla* and *Ribes* none of which is a major component of native woodlands or scrub especially in the north and some are of very restricted geographical distribution – for example *Lavatera* and *Arbutus*. It therefore seems that at this broad level all of the trees and most of the shrubs that would have been commonly available at any period were used, although to greatly varying extents.

The numbers of occurrences for each of the broad taxa categories were tallied with a maximum of 180 (number of sites) for any one being possible. The coniferous taxa (Table 5) have some interesting occurrences although it might well be that some of the material represents broken artefacts, for example silver fir (*Abies)* is not native although numerous records of it have been made from barrels, especially from Roman deposits. These have not been comprehensively included in this review; indeed, where it was clear from the report that the origin was artefctual, such as planks or barrels, the data have not been entered here. Cedar (*Cedrus)* must have had a similar artefactual origin if the identification is secure, but no criteria are presented in the report (Keepax and Watson 1980). The same is probably true for the various combinations of spruce (*Picea)* and larch (*Larix)*. The record for stone pine (*Pinus pinea)* certainly includes charred fragments of the cones but it is not clear whether it also refers to charcoal of the wood itself. If the latter it would not be possible to distinguish its wood from that of other diploxylon pines such as the British native Scots pine (*P. sylvestris)*. The record for yew (*Taxus)* does refer to off-cuts from Roman wood working but yew is a native species and would almost certainly have been present in local woodlands especially on calcareous soils at the time. Indeed, seeds of *Taxus* were recovered from 'archaeological deposits' in Durham City (van der Veen 1985) and, more recently, from a site in Cumbria (E. Huckerby pers comm). Juniper (*Juniperus)* is interesting in that even today it remains a relatively common shrub in some areas such as Teesdale and parts of the Lake District. The single archaeological site with a record for it is indeed in Teesdale, at Forcegarth Pasture (Donaldson, 1977g). Pollen evidence from Teesdale has shown that the juniper is a long-standing scrub component there (Huntley 1991a) although major investigations of charcoal producing pits in the same area currently underway have produced no records for this species (T. Gledhill pers comm). *Pinus* likewise is a rare occurrence although, not surprisingly, the most commonly recorded conifer. A recent identification of small branchwood/twigs from dated deposits by the present author, however, suggests that it was growing around Coniston Water, in the western Lake District, during the 13th/14th centuries despite some opinion, based on pollen evidence, that pine was extinct in the region by then. It is assumed that all records of *Pinus* refer to the native *P. sylvestris* although the wood/charcoal of this is not distinct from other diploxylon European mainland species as noted above.

Many of the conifer records therefore relate to non-native taxa and/or artefacts/ritual use and thus an incomplete picture is present. This will be taken into account in the analysis of the data below.

Species-group		ch	ch/wl	wl	wl?
Abies	Fir			5	
Cedrus	Cedar				1
Conifer				4	
Juniperus	Juniper			2	
Larix/Picea	Larch/spruce			2	1
Picea	Spruce			1	
Pinus	Pine	7		9	
Pinus pinea (cones)	Stone pine	1			
Taxus	Yew	1		4	

Table 5: Number of sites with coniferous taxa by preservation type

The bulk of the material, over 96 per cent of the total 932 records, came from common, native deciduous trees and larger shrubs (Figure 12). The figure is at the taxon level irrespective of preservation type but, in fact, the major taxa are surprisingly mostly similar when seen at the charred versus waterlogged level. Alder (*Alnus),* birch *(Betula)* and hazel *(Corylus)* categories form almost 40 per cent of the assemblage. 'BCA' includes the nine occurrences where fragments were identified as *Betula/Corlyus* or *Alnus/Betula* and so forth, thus only representing a very low proportion of the total for these genera. By far the majority of the alder, birch and hazel occurrences are to the generic, as compared with 'cf', level as well. There is an overall split of approximately 40:60 waterlogged:charred within this group. In the waterlogged category the three genera are co-equal but for the charred material there is only half as much *Alnus* as either *Corylus* or *Betula*, the latter two being almost equal. This might reflect a greater use of *Corylus* and *Betula* as semi-structural roundwood timber with *Alnus* being used more opportunistically. Alder is also a poor fuel, burning quickly yet producing little heat, and may therefore have been deliberately avoided where possible. However, it makes excellent quick igniting charcoal, and thus in some specific contexts or site types may be expected to be present in abundance. Oak (*Quercus)* is next most frequent at almost a quarter of the assemblage. This relatively low frequency almost certainly reflects the exclusion of reports dealing only with major structural timbers. The two taxa – ash (*Fraxinus)* and willow/poplar (*Salix/Populus)* are next at about 10 per cent each. *Fraxinus* is straightforward and solely represents the ash, *Fraxinus excelsior*. *Salix* and *Populus* tend to be categorised as one because their uniseriate, diffuse-porous wood is not reliably distinct although well preserved material can be separated. The individual genera have been recorded in a few reports but the bulk of the records are at the bi-generic level.

Pomoideae and *Prunus*-types are next at 6.6 per cent and 4.4 per cent respectively. These groups cover a wide range of multi-seriate, diffuse-porous taxa including apple (*Malus*), pear (*Pyrus*), whitebeams (*Sorbus*) and hawthorn (*Crataegus*) as well as the various *Prunus* species. Again depending upon preservation, sub-groups can sometimes be defined but there is little consistency between reports in the present instance. As with many occurrences, diagnostic criteria are only very rarely presented. Likewise it is not clear whether preservation was sufficiently poor that no sub-groups could be determined, or whether time or skill was too short to attempt the grouping.

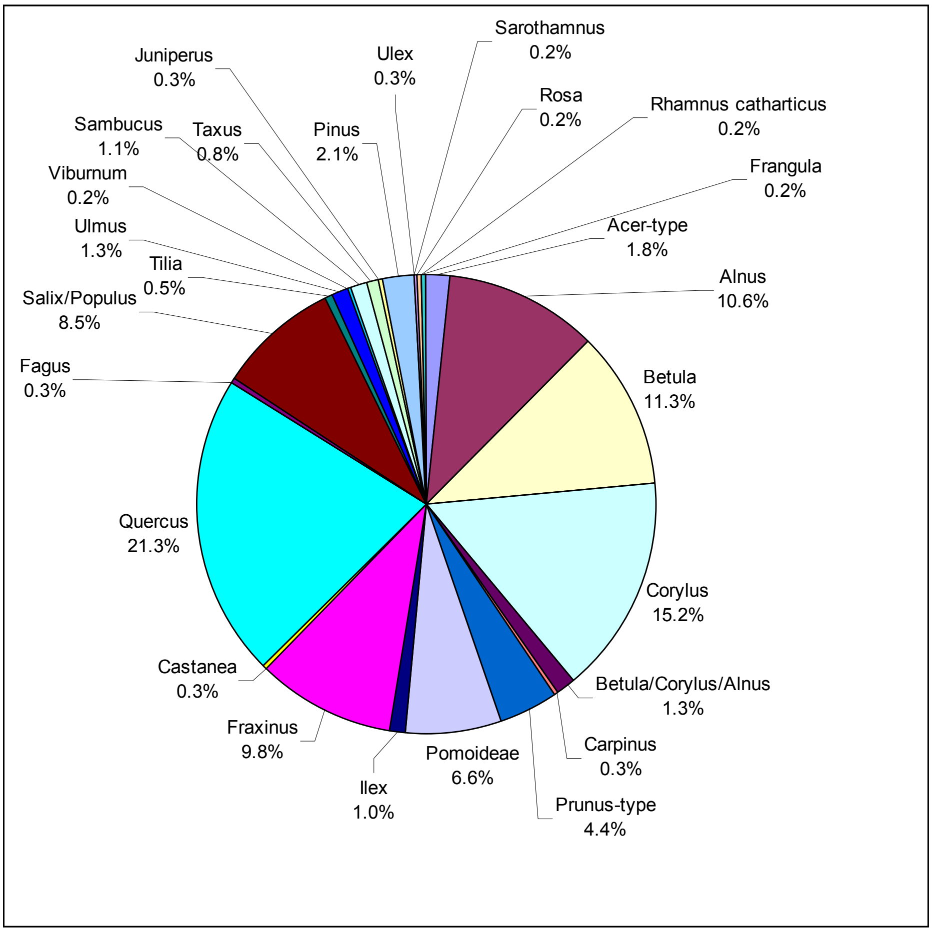


Figure 12: Proportions of the taxa recorded irrespective of preservation type

The remaining taxa represent up to 12 occurrences at most (elm (*Ulmus)*, maple (*Acer)* and elder (*Sambucus)*) but mainly rather fewer (including lime (*Tilia),* hornbeam *(Carpinus),* holly *(Ilex),* beech *(Fagus),* sweet chestnut (*Castanea)* and guelder rose (*Viburnum*)). *Viburnum opulus* was identified by the present author from medieval charcoal-producing sites in the western Lake District with detailed descriptions provided (Huntley in prep).

The *Acer* has mostly been identified to the native *A. campestre* but in one instance it was identified to *A. pseudoplatanus* (Blackburn 1970). As this was from a Roman context and the species is usually considered to be a 17th century introduction the identification may reflect an imported artefact. Hather (2000, 128) asserts that the two fall into separate groups based upon the numbers of cells in a typical ray but also notes that this is not necessarily consistent and may well not work on smaller diameter material, raising the possibility of mis-identification in this case. *Carpinus* and *Castanea* are two further taxa that may represent mis-identifications.

Smaller shrubs and lianes (Table 6) are not common. *Calluna* is certainly more common than appears here from experience of looking at bulk soil samples in which its frequent occurrence can reflect use as thatching, bedding and so on. The same holds true for other members of the Ericaceae. Buckthorn (*Frangula)* is somewhat unexpected as it tends to have a more southerly distribution but its occurrence at Storrs Moss would certainly be appropriate for its habitat requirements (Aldridge *et al* 1971) and it does show regular occurrence in the southern Lake District today (Preston *et al* 2002). *Buxus* is certainly southern although it is grown in the north and often planted around formal gardens or cemeteries. However, its single occurrence in this dataset reflects use as an artefact where its fine-grain clearly was used to advantage (Fell 1991). *Ulex, Sarothamnus* and *Rosa* are considered to reflect casual use of these taxa although *Cytisus* (*Sarothamnus)* is, again, more of a mainland European genus. Although it has widely naturalised throughout Scotland it is, nonetheless, considered a native of Great Britain.

Hedera	Ivy	2
Frangula	Buckthorn	1
Sarothamnus	Broom	1
Ulex	Gorse	3
Calluna	Heather	6
Buxus	Box	1
Rosa	Rose	1

Table 6: Occurrences of less common shrubs and lianes

The remaining few items are simply insecure or imprecise identifications (eg *Quercus/Fraxinus*, *Fagus/Quercus*, *Acer*/Pomoideae) and no further comment can be made.

In terms of preservation Figure 13 shows that over half of the occurrences are of charcoal – this does not take into account the size of any assemblage but rather the number of occurrences of each taxon in each preservation type. Bark is reflected by the single occurrence at Star Carr although a few other sites noted the presence of bark, generally unspecified, in some contexts. Bark has been recovered in abundance from some tanning pits but these assemblages are not included in this review. It is worth noting that bark, as well as charcoal and, indeed, wood is noted in many environmental reports even if it is not routinely identified. It must be reiterated that this review covers reports specifically dealing with wood or charcoal and is thus only a partial subset of the overall available information about these materials. Waterlogged wood *per se* accounts for almost 40 per cent of the occurrences but in terms of assemblage size is much less than the charcoal. Disappointingly, 7 per cent of the material cannot be categorised at all as nothing is stated in the reports about preservation, and a further 4.6 per cent is unclear.

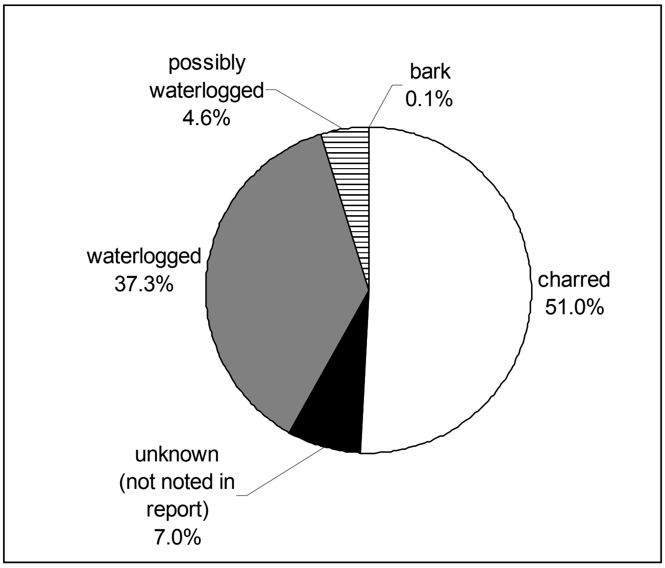


Figure 13: Preservation category by occurrence of taxa

Summary

Overall, most of the woody taxa available at any one time were used to a greater or lesser extent. The problems in discussing taxa level investigations further come from the quality of reports, however. What is abundantly clear is that there is little consistency between workers as to the taxonomy used and very little offered in the way of presentation of diagnostic criteria. The latter is crucial, especially when subsequently trying to evaluate any data – are they reliable identifications or simply assumptions in respect of level of identification, for example the ***Quercus robur*** in one report? Clearly the presentation of descriptions and more rigorous taxonomy must be one of the prime recommendations of this review. Even simple comments relating to the mode of preservation are lacking in rather too many reports and very few give any indication of the size of the fragments, even subjectively.

Distribution of taxa through time

In ecological terms it might be expected that more taxa would have been available during the mid-Holocene when pollen evidence suggests that mixed-species woodland dominated much of the region. As such the range of taxa in the earlier sites might be greater. Counter to this is the fact that past people may have chosen, or been forced to choose, specific taxa for technological or social/ritual reasons. Further to this there are few sites for the earlier periods that have had charcoal/wood examined and most were simply to recover material for dating purposes in any case. For later periods woodlands were far more restricted in extent and their use and management far more controlled. It might be expected that charcoal/wood would reflect a narrower range of taxa for this reason although if most of the charcoal was from material collected for firewood there might be an emphasis on small underwood with the larger species being used for timber and not generally then being recovered as charcoal.

Figure 14 shows the number of sites against number of taxa recovered by broad period excluding non-native taxa that might reflect artefacts ie *Abies, Picea, Larix, Cedrus, Pinus pinea, Acer pseudoplatanus* and *Buxus*. The two best represented periods, in terms of numbers of sites and for both types of preservation, are, not unexpectedly, the Roman and medieval. Both have considerably more sites than taxa.

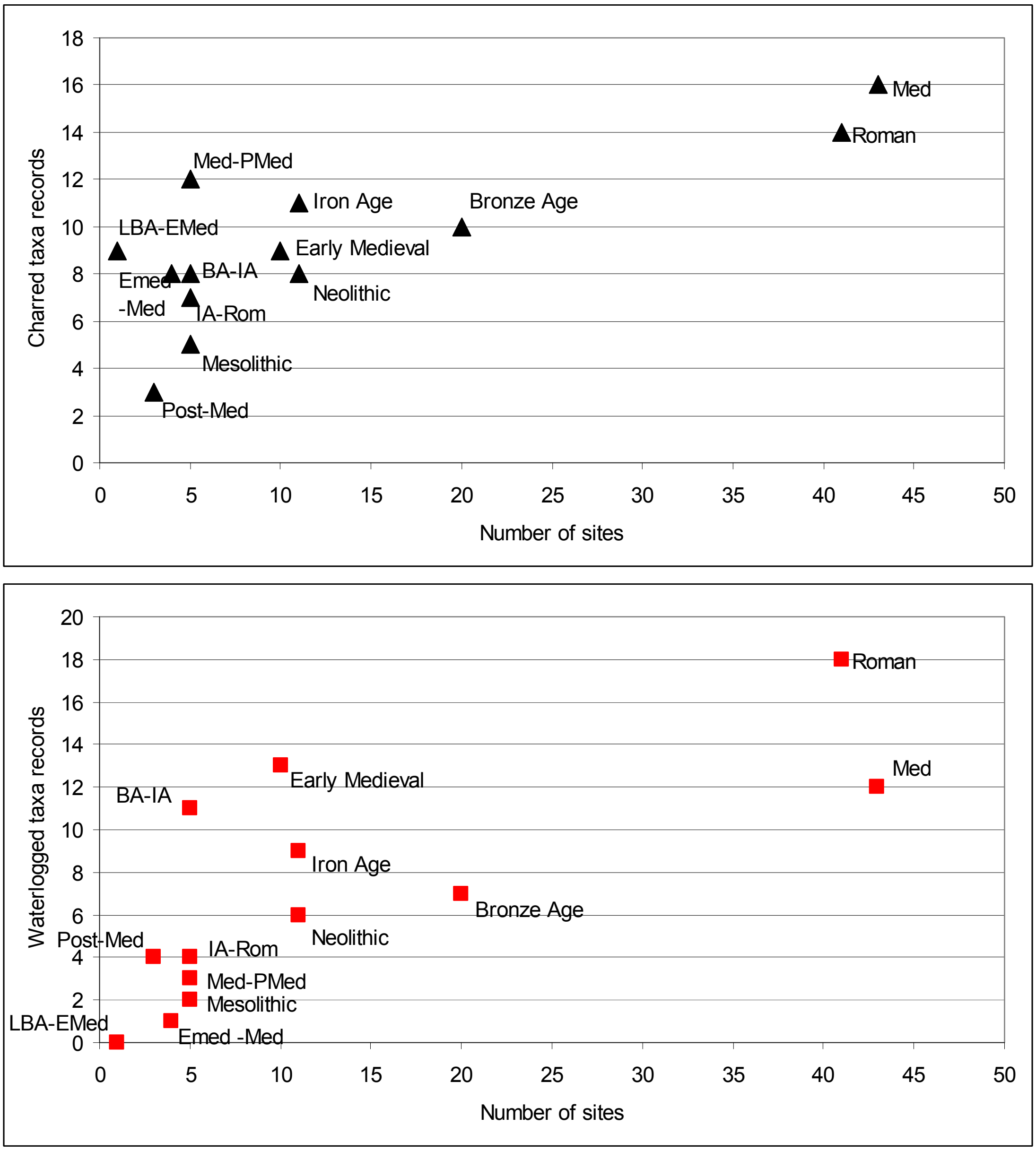


Figure 14: number of sites versus number of taxa (top plot charred data, lower plot waterlogged data)

The Bronze Age, Neolithic and early medieval periods also have more sites than charred taxa, perhaps reflecting that the assemblages mainly relate to material selected for radiocarbon dating. The other periods all have more charred taxa than sites indicating relatively rich assemblages. For the waterlogged material more periods are on the 'more sites than taxa' side of a 1:1 ratio, ie rather poor assemblages. This might reflect the limited (archaeological) nature of many of the assemblages or simply the low numbers of sites studied. It could also reflect technological practicalities at the time and which would have limited people perhaps to smaller trees. Certainly in the case of Bolam Lake (Huntley 2002), where there was discussion of the types of material present, there was a strong indication that only smaller material was present although this was a charred assemblage.

Distribution of taxa by type of site

Different woods have different properties in respect of working and resistance to decay. It is therefore certain that taxa suitable for the job in hand were chosen in the past, as indeed they are still today. For example, the timber on Georgian carriages and Morris 1000 Travellers was nearly always *Fraxinus* (ash), due to its large spring vessels and lack of compound rays which gave it the required flexibility. There might therefore be a correlation between site type and the taxa recovered.

Site type was extracted from the reports where possible; extraction at the level of context types would have been better but in many instances they were not presented either at all or certainly in such a way as to be able to correlate with the taxa data. Besides giving more precise data, the context type would allow a better interpretation regarding the primary or secondary, or indeed tertiary, nature of the deposition of charcoal. Charcoal/wood in a primary deposit, such as a kiln base or wattle structure, will have a higher potential for interpretation than that dumped in a ditch, where it is likely to be mixed with other materials from elsewhere on the site and maybe re-deposited anyway.

In an attempt to counteract the complications of mixed contexts in the first instance, the data were analysed at the site level using simple presence/absence of each taxon. The taxa were manipulated as discussed above and non-native taxa were omitted. As there are also likely to be differences in the taphonomy of wood versus charcoal the two types of preservation were also kept separate. The sites with only '?wl' category were assumed to be waterlogged whilst those that had unknown or both but indistinguishable preservation had to be omitted. This produced a charcoal matrix of 93 sites by 26 taxa and a waterlogged matrix of 72 sites by 24 taxa.

These matrices were then subject to multivariate analyses in order to see whether there were any patterns in the data that might be interpretable, or at least whether such analyses did have potential when a larger dataset becomes available in the future. Both a classification – TWINSPAN (Hill 1979b) – and an ordination – DECORANA (Hill 1979a) – were run on the two matrices.

Analytical results – charred data

The summary results are presented in tables 7 and 8 for charred and waterlogged data respectively. The data presented are simply the numbers of sites with that taxon in any one classification group, hence the maximum value for any cell in the table is the number of sites in that group.

Classification group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Number of sites in group	**1**	**7**	**8**	**21**	**15**	**9**	**16**	**13**	**3**
Prunus-type	1		3	1		8			
Quercus		4	5	16	14	8	15	13	2
Betula		6	5	12	13	8			
Alnus		4		8	10	6	1		
Corylus			8	21	13	9	9		
Salix/Populus			7	2	6	3	6	1	
Pomoideae					10	8	5		31
Fraxinus					13	6	15		
Acer-type					1	5			1
Pinus				2		1	1		
Alnus/Corylus				1	2		3		
Ulmus					3				
Viburnum					1				
Tilia					1				
Ulex					1				
Ilex					1				
Castanea					1				
Rosa					1				
Quercus/Fraxinus					1		1		
Sambucus						1	1		
Acer/Pomoideae						1	1		
Sarothamnus							1		
Carpinus							1		
Taxus							1		
Betula/Corylus/Alnus								1	
Juniperus									1

Table 7: Classification of charred data

Eight broad groups of samples were produced from the classification of charred data (table 7). The first division is between groups 1–5 with *Betula* as the diagnostic taxon and groups 6–8. Oak is a constant throughout all groups. Group 1 comprises a single site, one of the Wharram Percy assemblages, containing only *Prunus*-type. Group 2 comprises seven sites with character taxa of *Betula*, *Alnus* and *Quercus*. They are mostly medieval–post-medieval but do include earlier prehistoric sites too. Site types vary from flint scatters to glass furnaces with no discernible pattern. Group 3 has eight sites with *Betula*, *Corylus*, *Salix/Populus* and *Quercus* as constant taxa plus a little *Prunus*-type. Sites are mostly later prehistoric and include quite a few settlements. Group 4 has 21 sites with *Quercus*, *Betula* and *Alnus* constants. All periods and site types are represented and the group seems very much to represent the more casual collection of charcoal during excavation. Group 5 comprises 15 sites characterised by *Quercus*, *Betula*, *Alnus*, *Corylus*, *Pomoideae* and *Fraxinus* with a selection of other taxa scattered throughout. Sites are mostly medieval but with a few Roman or prehistoric ones as well; industrial sites and settlements, including military, predominate. The nine sites of group 6 have the same constants as group 5 sites but with *Prunus*-type and *Acer*-type in addition. They are Roman–medieval but cover a range of site types. Group 7 has sixteen sites with *Quercus*, *Fraxinus* and *Corylus* plus a scattering of other taxa and again span mostly Roman to medieval dates. Settlements/farmsteads dominate site types. Group 8 comprises thirteen samples with more or less only *Quercus*. They range from the Mesolithic to Medieval periods and a wide variety of site-types. They typically reflect samples only taken for radiocarbon dating. Finally, Group 9 comprises three samples with Pomoideae and some *Quercus* but little else. The sites are a Roman fort, villa and Iron Age grain silo.

Analytical results – waterlogged data

Table 8 presents the classification based upon the wood, as opposed to charcoal, data. Group 1 isolates Monkwearmouth from everything else as it contains only *Sambucus* and *Ilex*. The sixteen samples of group 2 have *Quercus*, *Salix/Populus*, *Corylus, Alnus, Betula, Prunus*-type, Pomoideae and *Fraxinus* as their constants as well as a few other taxa. Not surprisingly they include the larger assemblages analysed covering all periods up to and including the medieval and from a range of site-types. The large group 3 with 33 sites is similar but with less *Fraxinus* and little of the Pomoideae/*Prunus*-types and somewhat less *Salix/Populus*. They are too wide ranging in date or site-type to offer any interpretation. Group 4, seven sites, simply contains *Fraxinus* with, at times, *Quercus* or the occasional fragment of another taxon. Group 5 includes twelve sites from which only *Quercus* was recorded and group 6, three sites with *Pinus*. None of these offer any insight regarding periods or site-types.

The classifications derived for both datasets, but especially the wood, suggest that sampling factors in particular are determining the groups to a greater extent than either date of material or nature of site. There are few suggestions of site type being associated with specific taxa groups. Although disappointing this is not that surprising given the nature of most of the work. Charcoal/wood has rarely been sampled and analysed with specific questions in mind as yet, other than to provide material for dating. As a result the ordination data, which show an equally biassed result, are not discussed.

Classification group	1	2	3	4	5	6
Number of sites in group	**1**	**16**	**33**	**7**	**12**	**3**
Sambucus	1	4				
Ilex	1	3				
Quercus		12	27	3	12	1
Fraxinus		11	10	6	1	
Pomoideae		11	2	2		
Prunus-type		10	3	1		
Betula		15	11			
Alnus		12	25			
Corylus		13	21			
Salix/Populus		13	15			
Pinus		3	3			3
Taxus		3	1			
Acer-type		2	2			
Ulmus		4				
Ulex		1				
Betula/Corylus/Alnus		1				
Carpinus		1				
Quercus/Castanea		1				
Rhamnus catharticus		1				
Castanea		1				
Tilia		1	1			
Fagus			1			
Juniperus			1			
Frangula			1			

Table 8: Classification of waterlogged data

CHARCOAL METHODOLOGY AND BEST PRACTICE

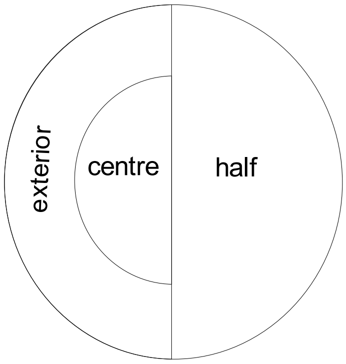
Charcoal may be produced at, or brought onto, a site as material for a specific purpose – industrial smelting of metallic ores for example (*see* Gale (2003) for a detailed review of industrial fuels in lowland Britain). Examination of this charcoal clearly will allow investigation of species used, of woodland management practices and technological production. However, and obvious though it may seem, by far the majority of charcoal will have been produced as a by-product of burning wood, either deliberately as in ovens, hearths, funeral pyres, bonfires, or accidentally as in disasters. It will, no doubt, then have been dispersed across a site, again accidentally and/or deliberately, and these processes may well have occurred several times. In addition, if the material is deposited in a ditch or other situation with flowing water then further processes of distribution take place – these can be related to different types and especially sizes of remain, as has been demonstrated by Nichols *et al* (2000) and may affect different charred taxa differentially. An understanding of the taphonomy of the specific contexts is therefore crucial to the interpretation of charcoal data as, indeed, is it crucial to our understanding of all materials on a site not just charcoal. In fact, the 'general' charcoal may be equated to general plant remains and thus should attract the same consideration as they do in respect of sampling and analysis. Too often, excavators collect charcoal by hand as if it was bone or pottery but without any thought as to why it was sampled – 'because it was there and might….' is often the answer received to such a question! Taphonomy of the contexts should always be considered prior to sampling for charcoal in order that appropriate questions may be asked in the first instance.

In terms of what analyses of charcoal from archaeological sites might tell us about the wood that was burnt in the first place, let alone taking several steps back to investigate the complex and dynamic relationship between people and the woodlands that were available for use, including cultural aspects of choice, we first need some fundamental experimental work to be both undertaken and published. There is a significant literature dealing with high temperature effects on wood – principally US Forestry results – see for example Rossen and Olsen (1985) and there are many anecdotes and much folk lore relating to uses of specific woods. However, we have little published information about the remains of fires that might be called 'usual' archaeological features – hearths, ovens and so on. Obviously there will always be unknowns as to how a fire was laid, how much it was stoked, poked and cleaned out. However, some simple experiments of burning known quantities (an emotive subject in itself) of different species of wood in a fire under conditions which could, at least subjectively, be repeated should give an indication of some relationships between fuel and debris. If there are no consistent relationships and, from the work of Zalucha (1982) and Scoulding (2008) (*see* box below), this seems true to a degree, we need to be very cautious in inferring anything about even this last stage in a process let alone an interpretation of local woodland types or selection by people for whatever reason. Such experiments would also allow us to investigate weight versus volume versus numbers of fragments of charcoal. How do these relations change with different sample processing or handling methods? Such data would feed into the discussion regarding quantification (or not) of charcoal (*see* below) and perhaps help to develop a standardised methodology.

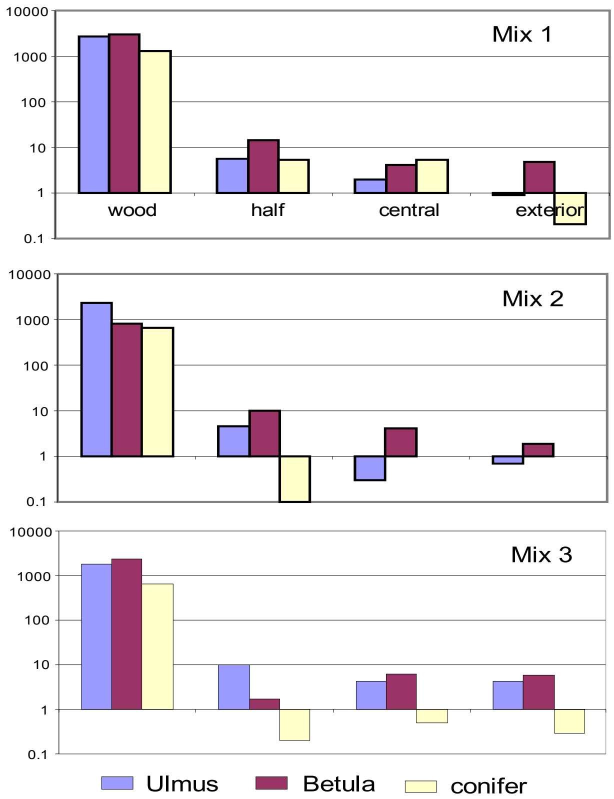
On both mainland Europe and in the USA there is more emphasis now upon frequency of occurrence of charcoal taxa either on a site or within phases of site activity. Clearly this removes fragmentation biases and so on but, again, requires 'reasonable' numbers of contexts to be studied; for example Zalucha identified over 3000 fragments from *c* 45 samples, totalling over 210 kg, at his Woodland site in Minnesota. How often can we 'reasonably' expect such information to be retrieved from developer-funded excavations unless we have very clear questions to ask of the sites in the first place? From the database created during the progress of this review the average number of samples per site is very low although such information is not available in quite a few of those reports. As a result it seems that most developer-funded charcoal work should, largely, target specific features with highly focussed questions for the time being.

Case study: burning wood in experimental hearths

Three brick-lined experimental hearths were constructed on a concrete base. For one experiment, three individual mixes of *Ulmus*, *Betula* and conifer logs were made and weights taken for the three taxa. The mixes were then burned concurrently in the three hearths. The wood was pushed to the centre of the fire as burning progressed. After cooling overnight each hearth was sampled. One half was removed as sample one. The other half was split into a central and exterior section as below to see if there were differences between material at the heart of the fire and that remaining at the edge. The charcoal was sieved and all fragments >1mm were sorted into the three taxa (these had been chosen as relatively easy to separate i.e. ring porous, diffuse porous and conifer) and weighed.



The plots (y axis is log scale weight) show that *Betula* is best represented as charcoal in nearly all cases with the greatest variation in the conifer with it being nearly all burnt away in two of the three hearths.



after Scoulding (2008)

Identification and reference material

The first attribute considered for charcoal is probably the identification to a plant type or taxon. Identification, for British native woody plants, remains mostly at the generic level although in a few cases only at Family level – eg Rosaceae (generally called 'Pomoideae' or '*Prunus*-type' in charcoal literature) within which groups may sometimes be distinguished. For single species genera in Britain, such as *Alnus*, there is the implication that the charcoal is from *Alnus glutinosa* but identifications still tend to be recorded as *Alnus*. This level of identification in itself will preclude some efforts at interpretation given the different ecological requirements/habitats of different species within a genus, e.g. between the birches, *Betula verrucosa* and *B. pubescens,* and between the numerous species of willow, *Salix*.

On a practical level, in the field only *Quercus* charcoal can reliably be identified from a simple transverse section across a fresh break and then only if mature wood is present. This is by the presence of clear compound rays producing a 'spoked' appearance out from the central pith. In all other cases microscopic examination on fresh breaks across three sections – transverse (TS), radial longitudinal (RLS) and tangential longitudinal (TLS) – is required, although with experience quite a lot can be achieved from TS alone. Identification is therefore a time-consuming practice with perhaps a rate of 100–200 fragments being achievable in a day by a reasonably experienced specialist. Obviously this also depends upon the quality, size and range of taxa within the assemblage, and up to 50 pieces a day can be considered a 'good day's work' for some sites; it gives an order of magnitude for resources required.

Whilst books such as those by Schweingruber (1978) and Hather (2000) provide good photographs and text to help to start the process of identification they cannot take the place of a reference collection. This author believes that artificially charred reference material is crucial and far more useful than prepared thin sections of non-charred wood, although these are of value too. There will inevitably, in both the archaeological and reference material, be variations due to original moisture content of the wood and the conditions under which charring took place, as well as taphonomically-induced post-depositional changes for the archaeological material, but comparisons of like with (near)-like are always easier. Preparation of such material can be undertaken in a normal laboratory 'muffle' furnace with the wood of known identification wrapped in foil packets, or buried in ash or sand, and then heated to *c* 300–350°C for 3–4–(8+) hours. Again, precise conditions vary considerably, especially moisture content of the wood, and occasionally a packet of ash or tarry residue will result. It would be useful if some experimental work on British woody taxa, using different known factors of time, temperature, moisture content, oxidising/reducing environment, were published, especially with detailed illustrations – such would be possible with a web-based publication these days (*see* McParland *et al* 2010 as an example of this type of experimental work). A less formal but still effective means of charring is to place the wood in a sealed tin that has been punctured with a few holes (golden syrup tins are ideal!) and place in the base of a wood burning stove, or the hottest AGA oven, for a few hours. The latter produces a temperature of *c* 250°C only and overnight 'cooking' is needed although complete charring is not always achieved even then. AGA ovens are, however, extremely good at producing charred cereal reference material – again wrapped in foil or buried in sand or ash for *c* 8 hours.

Examination of freshly fractured faces of the charcoal is required and this obviously results in reference material rapidly being used up if done every time a new site is investigated. As charcoal is relatively fragile the following method has proved of use in maintaining a reasonably stable set of charred reference material. The charred wood is fractured as normal and the three sections (transverse, tangential longitudinal and radial longitudinal) orientated carefully in sand. A small rectangular plastic box (lid discarded), the same as is commonly used for storage of reference seeds, is filled to just below the rim with plaster of Paris prepared to a 'double cream' consistency. The fractured pieces are then placed in this medium, again taking care with their orientation, so that their top surfaces are just above the rim of the box and as level with each other as possible. This ensures that microscope objectives are less likely to be damaged in subsequent examination of the material through removing the need to change focus to any great degree. It also produces a reference set with all three relevant sections side by side in one box. Once set, a matter of minutes only, the sections can be labelled appropriately. The whole box is then stored in another box of slightly larger dimensions and lidded – the type commonly available for storage of small items of jewellery, with a pop-on lid, is a good fit. In general, although the plaster sets very rapidly it needs to be left overnight in a warm place in order to set properly. With experience the author finds that 3–4 samples can be prepared and mounted with one batch of plaster of Paris. Excess charred material can be stored in suitable bags or boxes and used to make new plaster boxes as necessary, although the latter should last a considerable time with care. Even with student use the author has some which are now 5–6 years old – the greatest danger is in careless use of the microscope during examination.

Low power (up to about x50) incident light microscopy will allow investigation of the broad patterns of the vessels and associated cells. However, it is not adequate for distinguishing fine features of the rays or inter-vessel pits that are required for accurate diagnosis of taxon. Magnifications of up to x400 are necessary for this and these require a somewhat more sophisticated (expensive) epiluminescent microscope. Scanning electron microscopy is sometimes advocated but obviously is not a typical resource of even a well-funded contracting unit. Clearly any specialist must therefore be aware of the limitations of their equipment.

For any taxon that is unusual or infrequent the diagnostic criteria should always be presented. These days, it should also be possible to provide digital images at the microscopic level.

Nature of the material

Can we do more than identify the taxa present in a context? As seen in the resource assessment above, a few authors note 'types', such as whether the material was from twigs, small poles or large timber trees. However, there is no consistency between workers, for example as to what constitutes a 'twig'. Rather few reports have recorded metrical data and thus it is impossible to compare more than taxa lists except in a few instances.

Fragment size may well have a relationship with taxon if, for example, some types of wood fragment more easily than others when charred. It is therefore important to investigate the whole range of sizes recovered from a context and not just the larger fragments. If the material is sieved then sieve sizes and proportions of material analysed from each sieve should be presented.

It is suggested that charcoal should have attributes such as size (refer to sieve size perhaps) and nature routinely recorded. The fact that a large number of fragments are twigs, or other recognisable types, could well be useful in the interpretation of the context, and indeed the charcoal assemblage, and such information should not take excessive time to record. It is suggested that twig (diameter <10mm), roundwood (approximate size) and section (complete, half, radial, tangential), wood (heartwood or sapwood if possible to determine) and section if applicable and bark present or not, would be a minimum to record.

Thinking of interpretation, it is clear from the resource assessment above that all too often there is none. The wood/charcoal specialist produces a table of data (often only a list of taxa is published) and may make some suggestions as to the types of woodland represented by the assemblage. It is very rare, even in the most recent reports, that the charcoal is related to the context from which it came or that any attempt at interpretation from an archaeological perspective is offered. The charcoal is completely divorced from the archaeology, although it is that same archaeology that caused it be present in the first place. Of course, this may indicate that the published report contains a digest, often by the excavator, of the specialist report and that this information was present in the archive report. However, the location of the archive is generally not recorded so that any such details may not easily be determined.

Sampling – on-site and in the laboratory

In most of the reports used above, sampling appears to have been left to the excavator and material then sent to the wood/charcoal specialist. Best practice should include discussion with a charcoal/wood specialist at the outset. Sampling aims, methods, contexts to be sampled, sample size and processing methods should be discussed with the specialist at the outset. Whilst round-table meetings can be effective they are often neither necessary nor practical, especially where rapid turn-round is deemed essential. Telephones and e-mails are readily accessible however, and therefore there is no excuse for poor communication these days. The project officer, be they contract or research/academic archaeologist, has to implement this as the person producing the project design before tendering through either the planning process or for a Research Council grant.

Theoretically at least, the project design should be more prescriptive for a research excavation because, presumably, it is being conducted with specific and probably quite detailed questions already in mind. Planning-lead sites often have broader aims. At this stage, even broad questions in the project design concerning fuel use in domestic hearths or woodland resources that were used would raise the profile for charcoal analysis and allow some investigation into the comparison between charcoal and pollen data for example. Once an evaluation excavation has taken place there should be further opportunity for charcoal and other specialists to contribute to detailed project designs for either a full excavation phase or analysis from the evaluation trenches if required. Here more specific questions can be asked – this time from a known starting point – such as in regard for comparison of hearth debris for example.

Which contexts are sampled depends very much upon the questions being asked. One of the major comparisons made by mainland European charcoal specialists is between charcoal from discrete features such as hearths, where it is assumed to represent a short period of use, and charcoal from widespread layers or deposits that may well represent longer periods of time and almost certainly the full range of mixed processes. The latter is called 'dispersed' charcoal and in particular is used to infer local vegetation changes (see various papers in Thiébault (2002)). It seems unlikely at the present that such dispersed charcoal could become a viable option for most developer-funded sites in Britain simply because of the plentiful resources required, as discussed above. It could well be that, for the average planning-lead site, charcoal need only be collected from discrete features and investigated with respect to the function of those features. If in this way it can become accepted as a valuable and targeted tool then further research may become possible and momentum gained. What would be of great interest and value would be to excavate, and sample extensively for charcoal, archaeological sites in an area with well-dated and detailed pollen diagrams and to compare the two data types. Integration of such data types can only add to the interpretative value of a site.

Samples are probably best collected as bulk samples given the fragility of charcoal, especially when damp. Hand picked charcoal is usually of little value other than for specific dating purposes. The samples can be processed in the laboratory by flotation as with any other bulk sample. This needs to be done with care as further fragmentation is possible. Processing to 2mm is usually adequate – smaller pieces of charcoal are extremely difficult to fracture and examine. How much to process is another poorly-known factor as there is no real consensus on how many fragments should be quantified in order to produce a statistically valid representation of the taxa in any specific sample. In pollen this has been studied by tallying grains as counted and plotting percentage accumulation curves for each taxon. Where those curves flatten out is the total needed for that taxon. In general, counts of 500 pollen grains are typical for the most common taxa in the pollen diagrams but counts of 1000 are required for rare taxa such as the cereals. Similar work for charcoal suggests 300–600 pieces although this corresponded to the 18 most common taxa in the study as opposed to the 28 taxa recovered in total from over 3000 fragments (Dufraisse 2002). The author produced accumulation curves for a Neolithic assemblage of charcoal from Sewerby Cottage Farm (Huntley 2009). For the most common taxon, *Prunus*-type, the sum was only 50 fragments before the curve had flattened out. Other taxa were rare but included *Betula*, *Corylus* and *Alnus*. This is almost certainly an atypical site. Figueiral and Mossbruger (2000) quote figures of 200–250 fragments per layer which might be a good place to start but many of their sites are from the Mediterranean where there are considerably more taxa likely than in Britian. For the dispersed charcoal work investigating palaeoenvironmental reconstruction, various authors have counted 300–400 fragments per sample. They also use good stratigraphic sequences and often cross major cultural changes or periods (for example Uzquiano 2002). Judging from experience of working with well over a couple of thousand whole earth samples from northern England it is estimated that 50–60 litres of sediment from many contexts would be required to achieve even the low figures of 200–250 fragments unless effort was concentrated upon hearths and similar context types. There is therefore considerable resource needed, in time both to collect and analyse samples, and as a result the questions being addressed need to be considered carefully and in advance of field work. However, for features such as hearths or ovens then a normal bulk sample taken to investigate charred cereals and so on should also produce adequate amounts of charcoal – thus resources are not necessarily doubled.

Quantification: to count or to weigh?

If the total quantity of items to tally causes problems, then whether to count or weigh fragments requires even more consideration. All of the northern reports examined gave fragments counted while one or two also gave weights. Both fragmentation and weight can depend to some extent upon post-excavation and storage practices and thus have some drawbacks. It is probably easier to count than weigh fragments simply because a reasonably precise balance is needed for what are often small pieces of material. Current work by the author on material from charcoal pitsteads at Rusland in Cumbria includes both counting and weighing individual fragments (Huntley in prep). All taxa show the characteristic J-shaped curve with a high number of small pieces leading up to a few large pieces (very much the same as the J-shaped curves for seed concentrations in many bulk samples) and *Fraxinus* is heavily biased through the presence of one very large fragment. The weighing method heavily skews the results for this particular sample. Comparisons of the two datasets are ongoing and more work is needed since some of the individual pitsteads have produced rather small assemblages. Interestingly the *Fraxinus* pieces quite often show bands of exceedingly slow grown rings, starting abruptly, and might, therefore, reflect shredding the tree for animal fodder. It seems less likely to be due to shading by competing species given the extreme abrupt diminution in the rate of growth (Huntley ibid).

One way to avoid the counting versus weighing dilemma would be to categorise the material into broad size groups and then apportion these into representation indices as in Nelle's work on charcoal burning sites in Germany (Nelle 2002). This would certainly allow comparison between site assemblages as long as it was clear in all reports how the indices had been achieved, but is based upon stem diameters. As many fragments of charcoal are too small to produce any estimate of diameter this method would be limited to specific assemblages.

It is perhaps generally agreed within the small community of charcoal analysts that if sufficient samples are analysed then percentage occurrence of taxa by period or context type can be calculated and used for comparative purposes. However, most reports in this review, let alone the average developer-funded intervention, have had very few samples analysed, making this an impossible task.

One of the advantages of charcoal is its stability. As long as it forms part of the site archive it can still be accessible for re-analysis as can be seen in the case of the material from Brougham (Campbell 2004), and further information therefore can, at times, be gained. An issue in such a case is how to determine the original number of fragments assuming that they had been fragmented for identification the first time around! It might, therefore, be worth recommending that fragments from any single piece are kept together in separate bags or tubes, themselves all stored within the context bag, although clearly this would lead to more storage space being required. However, charcoal typically occupies relatively small volumes. There may be a few other regional sites with sufficient charcoal for such work to be attempted – for example Wharram Percy in particular where so many small reports have been written.

Summary

There are many questions relating to identification, sampling, quantification and analysis that require further work. In general sampling strategies need to be thought through at the planning stage of a project, and research agendas considered, with specialist involvement at this initial stage as well as throughout the analytical phases. Sample sizes need to be large enough to provide 200-300 fragments, although this is dependant upon the aims and objectives of the project. Both weights and fragment counts ideally should be recorded, while the fragments should also be quantified according to physical attributes such as twig wood, roundwood, diameter, growth pattern, presence or absence of bark and so on. The methodological section of the report should be precise and detailed. Although there may well be interpretations offered in terms of the wood/charcoal alone the data should always also be considered in conjunction with the archaeological nature of the site.

UNCHARRED WOOD

It is probably true to say that the survival of waterlogged wood, although maybe producing an initial response of panic from an archaeologist, will, at least, be considered as a potentially useful source of information about an archaeological site. There are guidelines for the collection and analysis of such material (English-Heritage 2010) and therefore little other than reiteration of some of the points in those Guidelines should be needed.

Probably most urban sites are likely to preserve wood to some degree or other and such material should therefore be *expected*. Rural archaeological sites are less likely to have waterlogged conditions although pits and ditches can always produce some. On the other hand, wood surviving in peatlands is potentially a vast archive and at least some will be related to human activity. Waterlogged wood can take the form of *in situ* structures, structural demolition debris, woodworking debris or more amorphous dumped material as well as the readily collected artefacts. Random, or ill considered, collection of any of these is not going to be highly productive in analytical terms and as a result, as with the charcoal, it is crucial that there is early discussion by all relevant specialists and relevant questions posed even prior to full excavation. These can be related to the species used, the technology, environmental analysis or to specific archaeological questions. The material may of course also be suitable for dendrochronological dating.

RESOURCE AGENDA

For the agenda it is probably more useful to determine specific questions rather than to go through each period, as many questions such as domestic fuel are relevant to all periods. Nonetheless, from the assessment above, some periods do have immediately obvious questions to ask.

Needless to say any reasonable quantity of wet wood has high potential for any period – but the odd piece is not likely to be that important unless clearly worked or vital for dating.

The few sites from the Mesolithic period show that various taxa were being exploited. The material is mostly from species that rarely make large trees although oak, potentially a very large tree, is present at three sites. For the majority of sites there is no information regarding the type of material represented so it is not clear whether only small trees/branches were being used – these might have been cut fresh or from fallen trees. Since much of the material had been collected primarily for dating purposes it is likely to have been small and therefore it was probably not possible to have said anything of this kind. Whilst the charcoal data are minimal from this period the region nonetheless has potential for both charcoal and waterlogged wood analysis. Eroding peat is becoming a more frequent issue, through both extreme weather events and increased visitor numbers to the moorland areas, and flint scatters are now being both looked for and investigated as a result. Where charcoal is also present, and this should always be sought from examination of bulk samples, it will almost certainly provide suitable material for radiocarbon dating. In addition, the residues from the bulk samples will themselves be useful to recover small flint fragments as for example at Salter's Nick in Northumberland (*see* under Neolithic below). Given the numerous rock shelter sites throughout the region that are often presumed to be Neolithic, such investigations might demonstrate that some are, in fact, Mesolithic. Equally, radiocarbon dating of material associated with Mesolithic lithic assemblages can also indicate apparent continuity of lithic technology into the early Neolithic, as at South Haw, Nidd (*see* below).

For the Neolithic the potential is similar to that of the Mesolithic. Rock shelters remained in use and, as at Salter's Nick, have been shown to be of long occupation. The pollen evidence suggests that much of the region remained reasonably well wooded and thus the Neolithic may be a period for which we could compare pollen and charcoal data to investigate how comparable they are. This would certainly contribute to the wider European use of charcoal as an indication of woodland types. Any settlement or funerary sites of this date and with well secured primary contexts, such as hearths, should therefore be well sampled in respect of their charcoal.

The Bronze Age remains a heavily biased period in terms of both charcoal and other archaeobotanical evidence, given that most of the sites are funerary in nature. Thus any well-dated site should be able to produce charcoal assemblages of adequate size for useful interpretation. Questions to address could include: Are there relationships between specific types of burial and species? What is the nature of the wood chosen for pyres? How does it compare with the debris from associated feasting hearths?

For periods for which more fuel-based industrial processes were developed there should be opportunities to investigate fuel types and use and these should be especially relevant for Roman, medieval and post-medieval sites. Domestic fires and hearths could provide material comparable to that of industrial processes although context and taphonomy will be crucial given the mixed nature of some deposits. However, when sampling what should be primary contexts – the hearths or ovens themselves – taphonomy should not be a major issue. It should also be remembered that wood and charcoal are not the only sources of fuel. Peat, turf, coal or even plant macrofossils such as cereal chaff have been used as fuel in the past. By examining only wood and charcoal an incomplete story would be told. This is yet another area where liaison between all team members should be routine.

As stated above, wood has a recognised and established set of procedures for its investigation. Charcoal does not and formal guidelines should be developed as a matter of importance. With clear guidelines it should be possible to get charcoal higher on the list of materials to be considered when projects are being developed. In the meantime it is essential that more detailed records are published with the site report and these must include identification criteria for at least the less frequently recovered taxa. How the charcoal pieces were chosen also needs detailing and raw data tabulated especially if indices or ratios are produced for comparative purposes. More information about the type of wood should be recorded – whether the wood is from twigs, small stems, heartwood and so on as this can all contribute to the interpretation of the assemblage. The charcoal data must be linked in an obvious and immediate way to the archaeological context from which it came, otherwise interpretation will be minimal and certainly not integral with the rest of the archaeology.

Another area where there is considerable inconsistency is the way in which radiocarbon dates are presented. In many cases a calibration has been performed but with no indication of the method or calibration data used, no laboratory number given and no indication of the uncalibrated BP date. These should always be given as a matter of routine, especially in order to recalibrate as and when more precise calibration curves become available.

Regarding the interpretation of charcoal assemblages there are still opportunities to undertake and publish some experimental work – to look at physical properties of charcoal produced under different regimes of moisture, air and temperature for example (*see* Braadbaart *et al* 2009). Reports note charcoal as being 'glassy' or 'soft and friable' but this author does not know whether this could be used to interpret conditions during burning at all although it seems likely to some extent. As noted above, experiments to investigate the relation between what went onto a fire and what remained afterwards were undertaken as an undergraduate dissertation at Durham University in 2008 and have taken us somewhat further in discussions of differential survival of taxa in a fire (Scoulding 2008). More recent work has looked at reflectance values of charcoal produced under different regimes, indicating that it is possible to estimate temperatures at which the wood was burnt in the first place (Ascough *et al* 2010; Braadbaart and Poole, 2008; McParland *et al* 2009; McParland *et al* 2010). Clearly this has high potential for interpretation of archaeological material

Charcoal and wood are fundamental to human society and certainly charcoal survives on probably nearly every site in England. They can contribute to our understanding of a range of activities and, by tackling some of the questions discussed above, it should be possible to include them in the suite of remains routinely studied even in developer-funded interventions although it is recognised that questions need to be focussed and answers achievable in this constrained world.

HOUSEKEEPING: FIGURES, TABLES AND FILES:

Text (with all in-text figures): The Review.doc Word2003

Figures

Figure 1: distribution of reports in the region by decade	Figure 1 data and plot.xls
Figure 2: location map of sites	Final site dot maps.mxd ArcGIS9
Figure 3: Mesolithic	- maps for all periods
Figure 4: Neolithic	- data files need to be in D: /Wood and charcoal review/ to work; region covers in ArcGIS dir as normal
Figure 5: Bronze Age	
Figure 6: Iron Age	
Figure 7: Roman and Romano-British	
Figure 8: early medieval	
Figure 9: medieval	
Figure 10: Wharram Percy. Data after Haddon-Reece	In text
Figure 11: post-medieval	
Figure 12: pie charts of proportions of most common taxa	Figure 12.xls
Figure 13: preservation category by occurrence of taxa	Figure 13.xls
Figure 14: scatter plot of number of sites against number of taxa	Figure 14.xls
Tables	
Table 1: reports by decade and county	Figure 1 data and plot.xls
Table 2: Annetwell Street: summary wood by period	Annetwell archive
Table 3: Lanes-1 summary data	Lanes-1 archive
Table 4: Sandal Castle data	In text
Table 5: conifer occurrences	In text
Table 6: small shrub and lianes occurrences	In text
Table 7: TWINSPAN table charred dataset	Tables 7 8.xls
Table 8: TWINSPAN table waterlogged dataset	Tables 7 8.xls
Appendix 1: tree and woody shrub taxa in British Isles	In text
Appendix 2: data tables by period – the archive	Final taxa wl vs ch.xls
Appendix 3: taxa by broad period	In text
Appendix 4: keys to tables 7 and 8 with respect to site names/codes and taxa names/codes	In text

REFERENCES

Akeret, Ö, Mant, J, Carrott, J, Jaques, D, Gardner, S, & Upex, B 2005 'Assessment of biological remains from excavations at Faverdale East Business Park, Darlington, County Durham (site code: FAV04)'. *Palaeoecology Research Services Report*, 2005/103.

Aldridge, C, Conolly, A, & Huckerby, E 1971 'Plant macrofossils', p. 129, *in* Powell, T G E, Oldfield, F and Corcoran J X W P, 'Excavations in Zone VII peat at Storrs Moss, Lancashire, England 1965-7'. *Proceedings of the Prehistoric Society* 37, 112-137

Anonymous 1977 'Charcoal', *in* Hope-Taylor, B (ed) *Yeavering an Anglo-British centre of early Northumbria* Vol. 7. London: HMSO, 333-4

Ascough, P L, Bird, M I, Scott, A C, Collinson, M E, Cohen-Ofri, I, Snape, C E, & Le Manquais, K 2010 'Charcoal reflectance measurements: implications for structural characterization and assessment of diagenetic alteration'. *Journal of Archaeological Science* 37, 1590-1599

Asouti, E and Austin, P 2005 'Reconstructing woodland vegetation and its exploitation by past societies, based on the analysis and interpretation of archaeological wood charcoal macro-remains'. *Environmental Archaeology* 10, 1-18

ASUD 2000 *Pegswood Moor Farm, Morpeth, Northumberland (PMF00): plant macrofossil and charcoal assessment, Rep. No. ASUD 686*. Durham: Archaeological Services, University of Durham

Bartley, D D 1975 'Pollen analytical evidence for prehistroic forest clearance in the upland area west of Rishworth, West Yorkshire'. *New Phytologist* 74, 375-381

Bayley, J, Campbell, G, Canti, M, & Dungworth, D 2000 'Metalworking at Catterick', *in* Wilson P R (ed) *Cataractorum. Roman Catterick and its hinterland. Excavations and Research, 1958-1997*. York: English Heritage and Council for British Archaeology, 164-166

Blackburn, K 1948 'Organic remains' p. 54 *in* Collingwood E F and Cowen, J D 'A prehistoric grave at Haugh Head, Wooler'. *Archaeologia Aeliana,* Fifth series 26, 47-54

Blackburn, K 1970 'Report on wood samples from the well in the HQB, 1933', p 145 *in* Birley. R 'Excavations at Chesterholm-Vindolanda 1967-1969'. *Archaeologia Aeliana (4th series)* 48, 97-155

Blackburn, K and Metcalfe, C R 1968 'Wood' p. 101 *in* Wenham, L P (ed) *The Romano-British cemetery at Trentholme Drive, York* Vol. 5, London: HMSO, p 101

Bond, J 2004 *Monastic landscapes,* Stroud: Tempus

Boutwood, Y 2005 'National Mapping Programme, Hadrian's Wall NMP Project: Bowness-on-Solway to Carlisle, Cumbria', English Heritage Document, Aerial Survey Report Series: AER/3/2005

Braadbaart, F and Poole, I 2008 'Morphological, chemical and physical changes during charcoalification of wood and its relevance to archaeological contexts'. *Journal of Archaeological Science* 35, 2434-2445

Braadbaart, F, Poole, I and van Brussel, A A 2009 'Preservation potential of charcoal in alkaline environments: an experimental approach and implications for the archaeological record'. *Journal of Archaeological Science* 36, 1672-1679

Brewster, T C M 1963 *The excavation of Staple Howe.* Malton: The East Riding Archaeological Research Committee, Wintringham

Brunning, R 1995 *Waterlogged wood: guidelines on the recording, sampling, curation and conservation of waterlogged wood.* Swindon: English Heritage

Campbell, G 2004 'Charcoal and other charred plant remains' *in* chapter 5 'The pyres and biers', *in* Cool H E M (ed) *The Roman cemetery at Brougham, Cumbria. Excavations 1966-67.* London: English Heritage and Society for the Promotion of Roman Studies, pp 267-271

Carrott, J, Hall, A R, Issitt, M, Jacques, D, Kenward, H, and Large, F 1996a 'Assessment of biological remains from excavations at Stockton West Moor and Rawcliffe Moor, York (site codes: YORYM 96.390 and 96.391)'. *Reports from the Environmental Archaeology Unit, York*, 96/27

Carrott, J, Hall, A R, Jacques, D, Kenward, H, & Large, F 1996b 'An assessment of biological remains from excavations at Waterton, North Lincolnshire (site code: WGF96)'. *Reports from the Environmental Archaeology Unit, York*, 96/40

Chalkin, K M 1953 'Report on an organic deposit from the rubbish pit'. p.124 *in* Wright, R P and Gillam, J P 'Third report on the Roman site at Old Durham'. *Archaeologica Aeliana (4th Series)* 31, 116-126

Chapman, H P 2005 'Seascapes and landscapes - the siting of the Ferriby boat finds in the context of prehistoric pilotage'. *The International Journal of Nautical Archaeology* 34, 43-50

Clapham, A 1988 'Housesteads Farm, Hadrian's Wall, Northumberland 1987, trenches C, D and E'. *Ancient Monuments Laboratory Report*, 189/88

Clark, J G D 1954 *Excavations at Star Carr* Cambridge: Cambridge University Press, Clarke, H H 1962 'Report on samples of burnt wood and charcoal' pp 30-31 *in* Jobey. G. 'An Iron Age homestead at West Brandon, Durham'. *Archaeologia Aeliana (4th Series)* 40, 1-34

Clarke, H H 1966 'Report on a sample of burnt wood from a cremation pyre' pp 47-48, *in* Jobey, G and Tait, J 'Excavations on palisaded settlements and cairnfields at Alnham, Northumberland'. *Archaeologia Aeliana (4th Series)* 44, 5-48

Clarke, H H 1968 'Wood' p 222 *in* Harbottle, B 'Excavations at the Carmelite Friary, Newcastle upon Tyne, 1965 and 1967'. *Archaeologia Aeliana (4th series)* 46, 163-223

Clarke, H H 1970 'Report on sample of wood' pp 85-86, *in* Jobey. G 'An Iron Age settlement and homestead at Burradon, Northumberland'. *Archaeologia Aeliana (4th Series)* 48, 51-95

Clarke, H H 1971 'Report on sample of charred wood' p. 85, *in* Jobey. G 'Excavations at Brough Law and Ingram Hill'. *Archaeologia Aeliana (4th Series)* 49, 71-93

Clarke, H H 1973 'Analysis of material from Bronze Age burial at Allerwash' pp 94-95 *in* Newman T G and Miket R F 'A dagger-grave at Allerwash, Newbough, Northumberland'. *Archaeologia Aeliana (5th Series)* 1, 87-95

Clarke, W A 1959 'Report on the charcoal and wood fragments from Red House' pp 173-174 *in* Daniels C M 'The Roman bath house at Red House, Beaufront, nr Corbridge'. *Archaeologia Aeliana (4th Series)* 37, 85-176

Coates, J 2005 'The Bronze Age Ferriby boats: seagoing ships or estuary ferry boats?' *The International Journal of Nautical Archaeology* 34, 38-42

Coggins, D, Fairless, K J, and Batey, C E 1983 'Simy Folds: an early medieval settlement site in Upper Teesdale, Co. Durham'. *Medieval Archaeology* 27, 1-26

Cotton, J in prep. 'Plant remains and charcoal' *in* Waddington C (ed) *Mesolithic settlement in the North Sea Basin: a case study from Howick, North-East England*, Oxford: English Heritage and Oxbow

Crone, B A 2000 'Waterlogged wood' p. 332 *in* Smith, I M and Taylor, J. 'Excavation on Iron Age and medieval earthworks at The Dod, Borders Region 1979-1981'. *Archaeological Journal* 157, 229-353

Dark, P 2005 'Mid- to late-Holocene vegetational and land-use change in the Hadrian's Wall region: a radiocarbon-dated pollen sequence from Crag Lough, Northumberland, England'. *Journal of Archaeological Science* 32, 601-618

Davies, J 1996 'A mesolithic site on Blubberhouses Moor, Wharfedale, West Riding of Yorkshire'. *Yorkshire Archaeological Journal* 41, 61-70

Dickinson, W 1975 'Recurrence surfaces in Rusland Moss, Cumbria (formerly North Lancashire)'. *Journal of Ecology* 63, 913-935

Dickson, C and Habeshaw, D 1995 'Plant identifications' p 99 *in* Cormack. W F 'Barhobble, Mochrum - excavations of a forgotten church site in Galloway'. *Transactions of the Dumfries and Galloway Natural History Society. Third series* 70, 5-106

Dimbleby, G W 1963 'Charcoal samples' p 204 *in* Manby, T G 'The excavation of the Willerby Wold long barrow, East Riding of Yorkshire'. *Proceedings of the Prehistoric Society* 29, 173-205

Dimbleby, G W 1983 'Pollen analysis of soil samples from enclosure 'A'', *in* Hayes R H (ed) *Levisham Moor archaeological investigations, 1957-1978* , Scarborough: North Yorkshire Moors National Park Committee and Scarborough Archaeological and Historical Society, 55-58

Dimbleby, G W 1988 'Charcoal' *in* Wilson, P R (ed) *North-East Yorkshire Studies: Archaeological papers by Raymond H. Hayes, MBE, FSA*, Leeds: Yorkshire Archaeological Society, Roman Antiquities Section, p 132

Donaldson, A M 1975 'Timber from Corbridge bypass'. *Ancient Monuments Laboratory Report*, Old Series 2154

Donaldson, A M 1976a 'Blackfriars, Newcastle; Blackgate 75; Belling Mill 73; Botanical reports'. *Ancient Monuments Laboratory Report*, Old Series 2161

Donaldson, A M 1976b 'Carlisle 1975: wood identification of structural timbers'. *Ancient Monuments Laboratory Report*, Old Series 2157

Donaldson, A M 1976c 'Charcoal and seed identifications from Jarrow 1965-76'. *Ancient Monuments Laboratory Report*, Old Series 2156

Donaldson, A M 1976d 'Greta Bridge: Identification of charcoal'. *Ancient Monuments Laboratory Report*, Old Series 2162

Donaldson, A M 1976e 'Identification of charcoal and seed: Back Silver Street 1975'. *Ancient Monuments Laboratory Report*, Old Series 2155

Donaldson, A M 1976f 'Identification of Neolithic nuts from Thirlings 1975'. *Ancient Monuments Laboratory Report*, Old Series 2159

Donaldson, A M 1976g 'Thirlings, 1976: identification of wood and charcoal'. *Ancient Monuments Laboratory Report*, Old Series 2158

Donaldson, A M 1977a 'Botanical report on material from Simy Folds, Upper Teesdale'. *Ancient Monuments Laboratory Report*, Old Series 2397

Donaldson, A M 1977b 'Botanical report on material from South Shields'. *Ancient Monuments Laboratory Report*, Old Series 2391

Donaldson, A M 1977c 'Charcoal from Dry Beck, Upper Teesdale'. *Ancient Monuments Laboratory Report*, Old Series 2396

Donaldson, A M 1977d 'Charcoal from the kitchen of a C9 farmstead at Ribblehead, N. Yorks'. *Ancient Monuments Laboratory Report*, Old Series 2398

Donaldson, A M 1977e 'Charcoal report. Milfield 1977'. *Ancient Monuments Laboratory Report*, Old Series 2395

Donaldson, A M 1977f 'Charcoal report. Thirlings 1977'. *Ancient Monuments Laboratory Report*, Old Series 2386

Donaldson, A M 1977g 'Report on bark, wood and charcoal from Forcegarth Pasture North, Upper Teesdale'. *Ancient Monuments Laboratory Report*, Old Series 2270

Donaldson, A M 1977h 'Soil samples and wood fragments', pp 138-139 *in* Harbottle B. and Newman, T G 'Excavation and survey in North Tynedale, 1973-1975'. *Archaeologia Aeliana (5th series)* 5, 121-154

Donaldson, A M 1980a 'Environmental report', pp 123-124 *in* ClipsonJ. 'Back Silver Street, Durham, 1975-6 excavations'. *Archaeologia Aeliana (5th series)* 8, 109-126

Donaldson, A M 1980b 'Final charcoal report Bracken Rigg 1977'. *Ancient Monuments Laboratory Report*, Old Series 3020

Donaldson, A M 1981 'Charcoal', p 133 *in* Harding, A F 'Excavations near Milfield, Northumberland'. *Proceedings of the Prehistoric Society of Scotland* 47, 87-135

Donaldson, A M 1982a 'Botanical report', p 163 *in* Charlton D B and J.C. Day. Excavation and field survey in Upper Redesdale: Part IV *Archaeologia Aeliana (5th series)* 10, 149-170

Donaldson, A M 1982b 'Organic material' p 43 *in* Haselgrove C C and Allon VL 'An Iron Age settlement at West House, Coxhoe, County Durham'. *Archaeologia Aeliana (5th series)* 10, 25-51

Donaldson, A M 1983 'Wood fragments recovered in the general samples', p 258 *in* Ellison M and HarbottleB 'The excavation of a 17th century Bastion in the castle of Newcastle upon Tyne, 1976-81'. *Archaeologia Aeliana (5th series)* 11, 135-263

Donaldson, A M 1984 'Charcoal identification', p 21 *in* Coggins D and Fairless K J 'The Bronze Age settlement at Bracken Rigg, Upper Teesdale, Co. Durham'. *Durham Archaeological Journal* 1, 5-21

Donaldson, A M 1992 'Charcoal from beneath Cairn A', p 44 *in* Young R and Welfare A T 'Fieldwork and excavation at the Crawley Edge cairnfield, Stanhope, Co. Durham'. *Durham Archaeological Journal* 8, 27-49

Donaldson, A M 1998 'The charcoal samples', pp 160-161 *in* Casey P J and Hoffmann B 'Rescue excavations in the vicus of the fort at Greta Bridge, Co. Durham, 1972-4'. *Britannia* 29, 111-183

Donaldson, A M and Hanson, W S 1979 'Charcoal identifications', pp 75-76 *in* Hanson W S, Daniels, C M, Dore J & Gillam J P 'The Agricolan supply base at Red House, Corbridge'. *Archaeologia Aeliana (5th series)* 7, 1-97

Dufraisse, A 2002 'Charcoal analysis in a lake dwelling site (Chalain 19, Jura, France): a sampling model for neolithic lacustrine contexts', *in* Thiébault S (ed) *Charcoal Analysis. Methodlogical ammproaches, palaeoecological results and wood uses.* BAR International Series 1063, 17-24.

English-Heritage 2010 *Waterlogged Wood: guidelines on the recording, sampling, conservation and curation of waterlogged wood*, 3rd edn. Swindon: English Heritage

Esslemont, B 1972 'The charcoal', pp 66-67 *in* Burgess C B 'Goatscrag: a Bronze Age rock shelter cemetery in Northumberland, with notes on other rock shelters and crag lines in the region'. *Archaeologia Aeliana (4th series)* 50, 15-69

Fell, V 1991 'Two Roman 'nit' combs from excavations at Ribchester (RBG80 and RB89), Lancashire'. *Ancient Monuments Laboratory Report*, 87/91

Figueiral, I and Mosbrugger, V 2000 'A review of charcoal analysis as a tool for assessing Quaternary and Tertiary environments: achievements and limits'. *Palaeogeography Palaeoclimatology Palaeoecology* 164, 397-407

Foreman, M and Hall, A R 1991 'The wood', *in* Armstrong, P, Tomlinson, D and Evans, D H (eds) *Excavations at Lurk Lane Beverley 1979-82,* Vol. 1. Sheffield: Univeristy of Sheffield, 174-82 and fiche 1/E6-7

Gale, R 1999 'Charcoal analysis', pp 46-49 *in* Bevan, B. 'Medieval leads: archaeological excavation and conservation of a lead working site, Howden Clough, Bradfield, South Yorkshire 1997'. *Transactions of the Hunter Archaeological Society* 20, 31-51

Gale, R 2003 'Wood-based industrial fuels and their environmental impact in lowland Britain' *in* Murphy, P and Wiltshire P E J (eds) *The Environmental Archaeology of Industry* Oxford: Oxbow

Gale, R 2004 'Charcoal' pp 96-103 *in* Fairburn N 'Birch Heath, Tarporley: Excavation of a rural Romano-British settlement'. *Journal Chester Archaeological Society,* new series 77, 59-114, Gale, R M O 1991 'Thwing, Yorkshire: charcoal identification'. *Ancient Monuments Laboratory Report* 23/91

Gale, R M O 1992 'Thwing: charcoal identification'. *Ancient Monuments Laboratory Report* 52/92

Gale, R M O 1998 'The charcoal', pp 53-4 *in* Crockett A and Fitzpatrick, A P 'Archaeological mitigation in the Flavian fort annexe and later Roman settlement at Bradley Street, Castleford, West Yorkshire'. *Yorkshire Archaeological Journal* 70, 35-60

Gilbertson, D D 1984 'Early Neolithic utilisation and management of alder carr at Skipsea Witthow Mere, Holderness'. *Yorkshire Archaeological Journal* 56, 17-22

Groves, C M 2002 'Dendrochronological Analysis of Conifer Timbers from Danson House and Danson Stables, Bexley, Kent' *Centre for Archaeology Reports* 69/2002

Groves, C M 2005 'Tree-Ring Analysis of Conifer Timbers from 107 Jermyn Street, City of Westminster, London'. *Centre for Archaeology Reports* 67/2005

Haddon-Reece, D E 1982 'The identification of wood samples from Wharram Percy 30, Yorkshire (A.M.Lab. site number 2)'. *Ancient Monuments Laboratory Report*, Old Series 3720

Haddon-Reece, D E and Ede, J 1985 'Identification of wood from Wharram Percy 1982'. *Ancient Monuments Laboratory Report* Old Series 4699

Hall, A R 1983 'Soil samples and charcoal', *in* Williams, D (ed) *Excavations at Gargrave (1977-1981).* Craven District Council, p 49

Hall, A R 1994 'Identifications of coffin wood', pp 384-5 *in* Lilley J M. Stroud, G, Brothwell, D and Williamson, M H (eds) *The Jewish burial ground at Jewbury* Vol. 12(3). York: Council for British Archaeology

Hall, A R 1996 'Appendix B: Charcoal from two samples associated with a medieval oven from a site at Appleton-le-Moors, N. Yorkshire', pp 10-11 *in* Allison, M & Rahtz, P 'A medieval oven at Appleton-le-Moors'. *The Ryedale Historian* 18, 6-11

Hall, A R 1997 'Anglo-Scandinavian 16-22 Coppergate: timber identifications'. *Reports from the Environmental Archaeology Unit, York* 97/23

Hall, A R, Carrott, J, and Johnson, K 2004 'Technical report: biological remains from an Iron Age farmstead at Lathom, West Lancashire (site code: DFL57). *Reports from the Palaeoecology Research Services,* PRS 2004/45'.

Hall, A R and Huntley, J P 2007 *A Review for macrofossil plant remains from archaeological deposits in northern England.* London: English Heritage

Hall, A R, Jacques, D, Kenward, H, and Large, F 1996 'Assessment of biological remains from Lime Tree Lane, Bilton, Hull (sitecode BIL93)'. *Reports from the Environmental Archaeology Unit, York* 96/29

Hall, A R and Kenward, H 2000 'Assessment of plant and invertebrate remains from excavations at Cawthorn Camps, N. Yorkshire (site 654)'. *Reports from the Environmental Archaeology Unit, York* 2000/9

Hall, A R and Kenward, H K 2004 'Setting people in their environment: plant and animal remains from Anglo-Scandinavian York', pp 372-426 *in* Hall R A, Rollason, D W. Blackburn, M, Parsons, D N, Fellows-Jensen, G, Hall A R, Kenward, H K, O'Connor T P, Tweddle, D, Mainman, A J and Rogers N S H (eds) *Aspects of Anglo-Scandinavian York* Vol. 8(4). York: Council for British Archaeology and York Archaeological Trust

Harding, A F 1981 'Excavations near Milfield, Northumberland'. *Proceedings of the Prehistoric Society* 47, 87-135

Hather, J G 2000 *The identification of the northern European woods: a guide for archaeologists and conservators*. London: Archetype Publications

Hayes, A J and May, J 1996 'Wood and wood charcoal', p 211-213 in chapter 9 'The plant remains' *in* May, J (ed) *Dragonby. Report on excavations at an Iron Age and Romano-British settlement in North Lincolnshire* Vol. 61. Oxford: Oxbow Books

Heawood, R and Huckerby, E 2002 'Excavation of a burnt mound at Sparrowmire Farm, Kendal'. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 3rd Series, 2, 29-49

Heiss, A G and Oeggl, K 2008 'Analysis of the fuel wood used in Late Bronze Age and Early Iron Age copper mining sites of the Schwaz and Brixlegg area (Tyrol, Austria)'. *Vegetation History and Archaeobotany* 17, 211-221

Hill, M O 1979a *DECORANA: detrended correspondence analysis*. Ithaca, NY: Cornell University Press

Hill, M O 1979b *TWINSPAN: a FORTRAN programme for multivariate anlaysis using two way indicator species analysis*. Ithaca, NY: Cornell University Press

Hillam, J 1979 'Wood identification and tree ring analysis 'Arrowcroft Scheme' 1978-79, Chester'. *Ancient Monuments Laboratory Report*, Old Series 3007

Hillam, J 1988 'Appendix 8: Identification of charcoal from Rosedale, North Yorkshire' *in* Wilson, P R (ed) *Hayes, R.H. North-East Yorkshire Studies: archaeological papers by Raymond H. Hayes, MBE, FSA* . Leeds: Yorkshire Archeological Society (Roman Antiquities Section), 134-5

Hope-Taylor, B 1977 *Yeavering. An Anglo-British centre of early Northumbria*. London: HMSO

Huntley, B 1991a 'Historical lessons for the future', *in* Spellerberg, I F, Goldsmith, F B and Morris, M G (eds) *The scientific managment of temperate communitieis for conservation.* Oxford: Blackwell Scientific Publications for The British Ecological Society, 473-503

Huntley, J P 1987 'Woodland management studies from Carlisle: Castle Street 1981'. *Ancient Monuments Laboratory Report* 119/87

Huntley, J P 1989a 'Plant remains from Stricklandgate, Kendal, Cumbria'. *Ancient Monuments Laboratory Report* 65/89

Huntley, J P 1989b 'Woodland management studies from Carlisle: Annetwell Street, 1983-4'. *Ancient Monuments Laboratory Report* 51/89

Huntley, J P 1991b 'The carbonised seeds, charcoal and pollen from Brough St. Giles, North Yorkshire: BSG88, BSG89 and BSG90'. *Ancient Monuments Laboratory Report* 90/91

Huntley, J P 1992a 'Analysis of wood from Blackgate, Newcastle upon Tyne'. Unpublished report for Newcastle City Archaeology Unit.

Huntley, J P 1992b 'Plant remains from excavations at The Lanes, Carlisle, Cumbria: part 1 - CAL, OGL, OBL and LEL'. *Ancient Monuments Laboratory Report* 51/92

Huntley, J P 1996 'Environmental evidence', pp. 11-12 *in* Waughman, M 'Excavations of a Mesolithic site at Highcliffe Nab, Guisborough'. *Durham Archaeological Journal* 12, 1-15

Huntley, J P 1996 (for 1995) 'Carbonized seeds and pollen', pp.225-233 *in* Cardwell, P. 'Excavation of the hospital of St. Giles by Brompton Bridge, North Yorkshire'. *Archaeological Journal* 152, 109-245

Huntley, J P 1999 'Environmental evidence from Hadrian's Wall', *in* Bidwell, P (ed) *Hadrian's Wall 1989-1999*. Cumberland and Westmorland Antiquarian and Archaeological Society *AND* the Society of Antiquaries of Newcastle upon Tyne, 224.

Huntley, J P 2000a 'Non-structural wood', *in* Buxton, K and Howard-Davis, C (eds) *Bremetenacum. Excavations at Roman Ribchetser 1980, 1989-1990* Vol. 9. Lancaster: Lancaster University Archaeology Unit, 359-366

Huntley, J P 2000b 'The plant and wood remains', in McCarthy, MR (ed) *Roman and Medieval Carlisle: the southern Lanes*. Carlise: Carlisle Archaeology Ltd, 71-79

Huntley, J P 2002 'Palaeoenvironmental samples' pp 42-43 and 'Charred wood' pp 43-44, *in* Waddington C & Davies J 'An Early Neolithic settlement and Late Bronze Age burial cairn near Bolam Lake, Northumberland: fieldwalking, excavation and reconstruction'. *Archaeologia Aeliana* 5th series 30, 1-47

Huntley, J P 2003 'Vindolanda: analysis of environmental samples. 1998-2002 excavations', *in* Birley, A (ed) *The Excavations of 2001-2002* Vol. 1. Vindolanda Trust Research Report, Bardon Mill, Hexham, Northumberland, 256-279

Huntley, J P in prep Rusland, Cumbria. Analysis of charcoal. Report for the Lake District National Park archaeologist

Huntley, J P 2005a 'Charcoal identifications from a potential Mesolithic site at South Haw, Nidderdale, Yorkshire'. *Durham Environmental Archaeology Report* 7/2005

Huntley, J P 2005b 'Salter's Nick, Northumberland. Charcoal for radiocarbon dating from context 33 - a possible hearth'. *Durham Environmental Archaeology Report* 3/2005

Huntley, J P 2005c 'Wood identifications', *in* Waughman, M (ed) *Archaeology and Environment of submerged landscapes in Hartlepool Bay, England* Vol. 2. Hartlepool: Tess Archaeology, 37-41

Huntley, J P 2007 'Vindolanda 2003-6: interim report on plant remains and charcoal from environmental samples'. *in* Birley, A and Blake, J (eds) *Vindolanda Excavations 2005 - 2006* Hexham: The Vindolanda Trust, 205-215

Huntley, J P 2008 'Salter's Nick, Northumberland (SN06): Charcoal and bulk samples from a rock shelter with a Neolithic lithics assemblage'. *Durham Environmental Archaeology Report* 1/2008

Huntley, J P 2009 'Charred plant remains and charcoal from Trench 17', *in* Fenton-Thomas, C (ed) *A Place by the Sea: excavations at Sewerby cottage Farm, Bridlington.* York: On-Site Archaeology Ltd, 288-291

Huntley, J P and Stallibrass, S M 1995 *Plant and vertebrate remains from archaeological sites in northern England: data reviews and future directions*, Research Report No. 4, Architectural and Archaeological Society of Durham and Northumberland, Durham

Jacobson, G L and Bradshaw, R H W 1981 'The selection of sites for palaeoecological studies'. *Quaternary Research* 16, 80-96

Jobey, G 1970 'An Iron Age settlement and honestead at Burradon, Northumberland'. *Archaeologia Aeliana, 4th Series* 48, 51-95

Jones, J A 1997 'Identification of charcoal samples', p 23 *in* Turnbull, P. & Walsh, D 'A prehistoric ritual sequence at Oddendale, near Shap'. *Transactions of the Cumberland and Westmorland Antiquaries and Archaeological Society* 97, 11-44

Keepax, C A 1974 'Wood identification from Troutbeck 'New Fort''. *Ancient Monuments Laboratory Report* Old Series 1510

Keepax, C A 1975a 'Charcoal identification for 14C Thwing'. *Ancient Monuments Laboratory Report* Old Series 1963

Keepax, C A 1975b 'Charcoal identification from Callis Wold (Neo)'. *Ancient Monuments Laboratory Report* Old Series 1970

Keepax, C A 1975c 'Wood identification from Norton Priory West'. *Ancient Monuments Laboratory Report* Old Series 1964

Keepax, C A 1975d 'Charcoal identification from Garton Slack'. *Ancient Monuments Laboratory Report* Old Series 1915

Keepax, C A 1975e 'Charcoal identification, Wharram Percy'. *Ancient Monuments Laboratory Report* Old Series 1969

Keepax, C A 1975f 'Charcoal identifications from Bolton, E. Yorkshire'. *Ancient Monuments Laboratory Report* Old Series 1898

Keepax, C A 1975g 'Identification of wood from Rudston Well'. *Ancient Monuments Laboratory Report* Old Series 1882

Keepax, C A 1975h 'Wood & charcoal identifications from Wharram Percy'. *Ancient Monuments Laboratory Report* Old Series 1909

Keepax, C A 1978a 'Charcoal identification: Garton Slack'. *Ancient Monuments Laboratory Report* Old Series 2495.

Keepax, C A 1978b 'Identification of wood from Wilderspool'. *Ancient Monuments Laboratory Report* Old Series 2598

Keepax, C A 1978c 'Winterton charcoal identification'. *Ancient Monuments Laboratory Report* Old Series 2502

Keepax, C A 1978d 'Wood id from Carlisle'. *Ancient Monuments Laboratory Report* Old Series 2499

Keepax, C A 1979 'Carlisle wood id'. *Ancient Monuments Laboratory Report* Old Series 2860

Keepax, C A 1981 'Charcoal samples from Mount Grace Priory'. *Ancient Monuments Laboratory Report* Old Series 3247

Keepax, C A 1989 'Identification of charcoal from bell pit' *in* Green, J P (ed) *Norton Priory.* Cambridge: Cambridge University Press, 56

Keepax, C A, Keeley, H C, O'Connor, T P and Jones, R T 1978 'Beeston Castle, Cheshire. Examination of biological remains'. *Ancient Monuments Laboratory Report* Old Series 2449

Keepax, C A and Morgan, G C 1979 'Charcoal', *in* Andrews D D and Milne, G (eds) *Wharram. A study of settlement on the Yorkshire Wolds 1. Domestic settlement, 1: Areas 10 and 6,* Vol. 8. London: Society for Medieval Archaeology, 133

Keepax, C A and others, a 1977 'Roman Carlisle: environmental investigations'. *Ancient Monuments Laboratory Report* Old Series 2402

Keepax, C A and Watson, J 1980 'Wood identification: Carlisle'. *Ancient Monuments Laboratory Report* Old Series 3174

Kenward, H and Hall, A R 1995 *Biological evidence from Anglo-Scandinavian deposits at 16-22 Coppergate.* York: Council for British Archaeology

Langton, J and Jones, G 2005 *Forests and Chases of England and Wales c.1500-c.1850. Towards a survey and analysis.* Oxford: St. John's College Research Centre

Manby, T G 1963 'The excavation of Willerby Wold Long Barrow, East Riding of Yorkshire'. *Proceedings of the Prehistoric Society* 29, 173-205

Marguerie, D and Hunot, J Y 2007 'Charcoal analysis and dendrology: data from archaeological sites in north-western France'. *Journal of Archaeological Science* 34, 1417-1433

McAvoy, F 1995 'Excavation at the Withow Gap, Skipsea (Holderness)'. First Annual Reportof the Humber Wetlands Survey (1994-95). Hull: Humber Wetlands Project, University of Hull

McCarthy, M R 2005 'Social Dynamics on the Northern Frontier of Roman Britain'. *Oxford Journal of Archaeology* 24, 47-71

McCullagh, R 2000 'Charcoal report', pp 328-332 *in* Smith, I M edited by Jeremy Taylor 'Excavation on Iron Age and Medieval earthworks at The Dod, Borders Region 1979-1981'. *Archaeological Journal* 157, 229-353

McParland, L C, Hazell, Z, Campbell, C, Collinson, M E, & Scott, A C 2009 'How the Romans got themselves into hot water: temperature and fuel types used in firing a hypocaust'. *Environmental Archaeology* 14, 176-183

McParland, L C, Collinson, M E, Scott, A C, Campbell, G, Veal, R 2010 'Is vitrification in charcoal a result of high temperature burning of wood?' Journal of Archaeological Science 37, 2679-2687

Mellars, P, Schadla-Hall, T, Lane, P, and Taylor, M 1998 'The wooden platform', In Mellars, P and Dark, P (eds) *Star Carr in context*. Cambridge: McDonald Institute Archaeological Research, 47-64

Merton, L F H 1972 'Samples of wood and charcoal', p 158 (Appendix 1) *in* Crossley, D W and Aberg, F A 'Sixteenth century glass-making in Yorkshire: excaations at furnaces at Hutton and Rosedale, North Riding, 1968-1971'. *Post-Medieval Archaeology* 6, 107-159

Metcalfe, C R 1954 'Botany', *in* Wheeler, M (ed) *The Stanwick fortifications, North Riding of Yorkshire,* Vol. 17. London: Society of Antiquaries of London, 59-60

Metcalfe, C R 1963 'Report on the charcoal samples from the site', *in* Brewster T C M (ed) *The excavation of Staple Howe*. Wintringham: The East Riding Archaeological Research Committee, 138-9

Mitchell, N and Bell, C 2002 'Evidence for late Bronze Age activity on the site of the former Stock Market at Brigg, N. Lincolnshire'. *Lincolnshire History and Archaeology* 37, 62-65

Morgan, G C 1969a 'Identification of wood, wood on iron and charcoal from Winterton'. *Ancient Monuments Laboratory Report* Old Series 1511

Morgan, G C 1969b 'Wood and charcoal', *in* Wacher, J (ed) *Excavations at Brough-on-Humber 1958-1961*, Vol. 25. London: Society of Antiquaries of London, 223

Morgan, G C 1973 'Identification of charcoal from Rudston Villa'. *Ancient Monuments Laboratory Report* Old Series 1523

Morgan, G C 1989 'Tree-ring analysis of wattling from the Mill Pond (Site 30) and graveyard (Site 71), Wharram Percy, N. Yorkshire'. *Ancient Monuments Laboratory Report* 91/89

Morris, C 1990a 'Identifications' . *in* Wrathmell, S and Nicholson, A (eds) *Dalton Parlours. Iron age settlement and Roman villa* , Vol. 3. Wakefield : West Yorkshire Archaeological Services, 206-30

Morris, C A 1990b 'Recording ancient timbers: the technologist's view' *in* Coles, J M, Coles, B J and Dobson, M J (eds) *Waterlogged Wood. The recording, sampling, conservation and curation of structural wood* . Exeter: WARP and English Heritage

Murphy, M 2001 'Review of wood and macroscopic charcoal from archaeological sites in the West and East Midlands regions and the East of England'. *Centre for Archaeology Reports* 23/2001

Naish, G B P 1961 'Report on the medieval ship-timbers' p 113 *in* Richardson, K M 'Excavations in Hungate'. York *Archaeological Journal* 116 (for 1959), 51-114

Nelle, O 2002 'Charcoal burning remains and forest stand structure - Examples from the Black Forest (south-west-Germany) and the Bavarian Forest (south-east-Germany)' *in* Thiébault, S (ed) *Charcoal analysis. Methodological approaches, palaeoecological results and wood uses.* BAR International Series 1063, 201-207.

Newman, C, O'Connell, M, Dillon, M and Molloy, K 2007 'Interpretation of charcoal and pollen data relating to a late Iron Age ritual site in eastern Ireland: a holistic approach'. *Vegetation History and Archaeobotany* 16(5), 349-365

Nichols, G J, Cripps, J A, Collinson, M E and Scott, A C 2000 'Experiments in waterlogging and sedimentology of charcoal: results and implications'. *Palaeogeography Palaeoclimatology Palaeoecology* 164, 43-56

Nye, S and Turner, J 1989 'Wood', p 66 *in* Nolan, R. Fraser, Harbottle B and Burton, F C 'The medieval town defences of Newcastle upon Tyne: excavation and survey 1986-87'. *Archaeologia Aeliana (5th series)* 17, 29-78

Orr, M Y 1986 'Report on the charcoal', p 41 *in* Hodgson, K S and Harper K 'The prehistoric site at Broomrigg near Ainstable: the excavations of 1948-49'. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 50, 30-42

Pratt, K E 1996 Development of methods for investigating settlement and land-use using pollen data: a case study from north-east England circa 8000 cal BC - cal AD 500. Ph.D. (unpublished), University of Durham

Preston, C D, Pearman, D A, and Dines, T D 2002 *New Atlas of the British and Irish Flora.* Oxford: Oxford University Press

Richmond, I A and Gillam, J 1953 'Buildings of the first and second centuries north of the granaries at Corbridge'. *Archaeologia Aeliana* 4th series, 31, 205-253

Roberts, B K, Turner, J, and Ward, P F 1973 'Recent forest history and land use in Weardale, Northern England', *in* Birks, H J B and West, R G (eds) *Quaternary Plant Ecology : the 14th symposium of the British Ecological Society, University of Cambridgem 28-39 March 1972*. Oxford: Blackwell Scientific Publications, 207-220.

Roberts, I 1992 'Wood identification', *in* Moorhouse, S and Roberts, I (eds) *Wrenthorpe pottereis. Excavatins of the 16th and 17th century potting tenements near Wakefiled* Yorkshire Archaeology 2. Wakefield: West Yorkshire Archaeology Service, pp 166-167

Rossen, J and Olson, J 1985 'The Controlled Carbonization and Archaeological Analysis of SE U.S. Wood Charcoals'. *Journal of Field Archaeology* 12, 445-456

Schweingruber, F H 1978 *Microscopic Wood Anatomy* . Zurich: Swiss Federal Institute of Forestry Research

Scoulding, M 2008 'Investigating charcoal produced in replica hearths: a critique of archaeological methods and interpretations'. Dissertation BA, Department of Archaeology, Durham University, Durham.

Shimwell, D W 2000 'Macro-botanic evidence', *in* R.W. Cowell, R W and Philpott, R (eds) *Prehistoric, Romano-British and Medieval settlement in lowland north west England.* Liverpool: National Museums and Galleries on Merseyside, 50-53.

Simmons, I G and Innes, J B 1987 'Mid-Holocene adaptations and later Mesolithic forest disturbance in northern England'. *Journal of Archaeological Science* 14, 385-403

Simmons, I G and Innes, J B 1988 'The later Mesolithic period (6000-5000bp) on Glaisdale Moor, North Yorkshire'. *The Archaeological Journal* 145, 1-12

Smith, M J, Hooper, A, and Bartley, D 1983 'An investigation of the charcoal samples', *in* Mayes, P and Butler, L (eds) *Sandal Castle excavations 1964-73.* Wakefield: Wakefield Historical Publications, 256-357

Smith, R A 1911 'Lake-dwellings in Holderness,Yorks., discovered by Thos. Boynton, Esq., F.S.A., 1880-1'. *Archaeologia* 1, 593-610

Smythe, J A 1951 'Report on pine-cone fuel from the Mithraeum at Carrawburgh', Appendix II, pages 86-87, *in* Richmond I A and Gillam, J P 'The temple of Mithras at Carrawburgh'. *Archaeologia Aeliana* 4th series, 29, 1-92

Society, M B A 2006 'Excavation of a burnt mound at Aldingham, Cumbria'. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 3rd Series, 6, 17-26

Stace, C 1997 *New Flora of the British Isles*, 2 edn. Cambridge: Cambridge University Press

Stuiver, M and Kra, R S 1986 'OxCal radiocarbon dating calibration program'. *Radiocarbon* 28, 805-1030

Stuiver, M, Reimer, P J, Bard, E, Beck, J W, Burr, G S, Hughen, K A, Kromer, B, McCormac, F G, van der Plicht, J and Spurk, M 1998 'INTCAL98 radiocarbon age calibration, 24,000-0 cal BP'. *Radiocarbon* 40, 1041-1084

Taylor, M 1997 'Waterlogged wood', pp 237-238 *in* Parker-Pearson, M and Sydes, R E 'The Iron Age enclosures and prehistoric landscape of Sutton Common, South Yorkshire'. *Proceedings of the Prehistoric Society* 63, 221-259

Taylor, M 1998 'The wood', pp 16-17 *in* Seagar Smith, R H 'Further excavations at the Iron Age enclosure at Tattershall Thorns, Lincolnshire by Peter Chowne, 1986'. *Lincolnshire History and Archaeology* 33, 7-19

Thiébault, S 1988 'L'évolution des relations homme/milieu végétal au Néolithique dans unde région périméditerranéenne: l'apport des charbon de bois', *in* Hackens, T, Munault, A and Till, C (eds) *Wood and Archaeology.* Strasbourg: PACT 22

Thiébault, S 1997 'Early-Holocene vegetation and the human impact in central Provence (Var, France): charcoal analysis of the Baume de Fontbregoua'. *Holocene* 7, 343-349

Thiébault, S 2002 *Charcoal Analysis. Methodological approaches, palaeoecological results and wood uses.* Oxford: Archaeopress

Turner, J and Hewetson, V P 1971 'A report on the wood and pollen samples from pit 1', p 59 *in* Cramp, R 'Excavations at the Saxon monastic sites of Wearmouth and Jarrow, Co. Durham: an interim report'. *Medieval Archaeology* 13, 21-66

Turner, J Hodgson, J 1979 'Studies in the vegetational history of the northern Pennines: I. Variation in the composition of the early Flandrian forests'. *Journal of Ecology* 67, 629-646

Turner, J and Hodgson, J 1983 'Studies in the vegetational history of the northern Pennines. III. Variations in the composition of the mid-Flandrian forests'. *New Phytologist* 71, 95-118

Turner, J and Nye, S 1988 'Palaeoenvironmental evidence', p 195-196 *in* Vyner, B 'The Street House Wossit: the excavation of a late Neolithic and early Bronze age palisaded ritual monument at Street House, Loftus, Cleveland'. *Proceedings of the Prehistoric Society* 54, 173-202

Turner, J and Nye, S 1996 'Environmental data', pp 268-9 *in* Hewitt, I. & Beckensall, S 'The excavation of cairns at Blawearie, Old Bewick, Northumberland'. *Proceedings of the Prehistoric Society* 62, 255-74

Uzquiano, P 2002 'Vegetation and firewood management at Cueva de la Vaquera (Segovia, Spain) between 6 and 3.7 kyr. BP: anthracological contribution to the landscape archaeology of the Spanish Central Mountains', *in* Thiébault, S (ed) *Charcoal Analysis. Methodological approaches, palaeoecological results and wood uses.* Oxford: Archaeopress, 109-112

van der Noort, R and Ellis, S 1995 *Wetland Heritage of Holderness: an archaeological survey* Kingston upon Hull : The Humber Wetlands Project van der Veen, M 1982a 'Carbonised plant remains from Neolithic Thirlings (Northumberland)'. *Ancient Monuments Laboratory Report*, 3831

van der Veen, M 1982b 'Wood identification, Carlisle 1978, Blackfriars'. *Ancient Monuments Laboratory Report*, 3742

van der Veen, M 1982c 'Wood identification, Carlisle 1982, Castle Street B'. *Ancient Monuments Laboratory Report*, 3743

van der Veen, M 1985 'The plant remains from Milburngate, Durham City'. *Ancient Monuments Laboratory Report*, Old Series 4674

Varley, W J 1938 'The Bleasdale Circle'. *Antiquaries Journal* 18, 154-168

Waddington, C and Davies, J 2002 'An Early Neolithic settlement and Late Bronze Age burial cairn near Bolam Lake, Northumberland: fieldwalking, excavation and reconstruction'. *Archaeologia Aeliana* 5th Series 30, 1-47

Walker, D 2001 'The dates of human impact on Ehenside Tarn, Cumbria'. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 3rd series 1, 1-20

Waughman, M 2005 *Archaeology and environment of submerged landscapes in Hartlepool Bay, England.* Hartlepool: Tees Archaeology

Wells, C E, Hodgkinson, D and Huckerby, E 2000 'Evidence for the possible role of beaver (*Castor fiber*) in the prehistoric ontogenesis of a mire in northwest England, UK'. *The Holocene* 10, 503-508

Whittaker, K M 1988 'The identification of waterlogged wood', p 110-112 *in* Crow, J G 'An excavation of the north curtain wall at Housesteads 1984'. *Archaeologia Aeliana (5th series)* 16, 61-124

Wild, C, Wells, C, Anderson, D, Boardman, J and Parker, A 2001 'Evidence for Medieval clearance in the Seathwaite Valley, Cumbria'. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 3rd series, 1, 54-68

Wright, E V, Hedges, R E M, Bayliss, A and Van de Noort, R 2001 'New AMS radiocarbon dates for the North Ferriby boats - a contribution to dating prehistoric seafaring in northwestern Europe'. *Antiquity* 75, 726-734

Wright, E V and Switsur, V R 1993 'The Ferriby 5 boat fragment'. *Yorkshire Archaeological Journal* 150, 46-56

Young, R and Welfare, A T 1992 'Fieldwork and excavation at the Crawley Edge cairnfield, Stanhope, Co. Durham'. *Durham Archaeological Journal* 8, 27-49

Zalucha, L A 1982 'Methodology in Paleoethnobotany: a Study in Vegetational Reconstruction Dealing with the Mill Creek Culture of North- western Iowa'. Ph.D. dissertation, University Microfilms, Ann Arbor, Michigan

APPENDIX 1: WOODY TAXA AND THEIR STATUS IN THE BRITISH ISLES

Grey shaded boxes indicate at least one species in the genus is native to the British Isles. First column: tick = taxon recorded in this review. ★part of the Pomoideae group. Species and status data largely extracted from Stace (1997).

	Genus	English	Species and status
✓	*Abies*	Firs	various species, trees, all introduced, mostly commercial planting
✓	*Acer*	Maples	• *campestre*: field maple, tall shrub-tree, native, widespread Co. Durham southwards. • *pseudoplatanus*: sycamore, introduced, widely naturalised and planted. • *platanoides*: Norway Maple, tree, widely planted lowland GB. • other species widely planted as amenity
	Aesculus	Horse chestnut	• *hippocastanum:* tree, introduced and widely planted as amenity • *A. carnea* and *A. indica* planted, south GB
✓	*Alnus*	Alder	• *glutinosa:* tall shrub—tree, native, widespread, wet places • *A. viridis:* introduced, widely planted as amenity
	Amelanchier	Juneberry	• *A. lamarckii:* shrub to small tree; planted and widely naturalised southern GB
	Arbutus	Strawberry tree	• *A. unedo:* small tree, native to Ireland, planted occasionally England.
	Aronia	Chokeberries	• 2 species, shrubs, introduced, restricted - naturalised Surrey, Dorset
	Berberis	Barberry	• *B. vulgaris:* tall shrub, introduced, widely naturalised. • other species: shrubs variously planted
✓	*Betula*	Birches	• *B. verrucosa:* tree, native, widespread • *B. pubescens:* tall shrub-small tree, native, damp to wet ground • other species amenity planting
	Buddleja	Butterfly bush	• *B. davidii* and other species: tall shrubs: introduced and widely naturalised
(✓)	*Buxus*	Box	• *B. sempervirens:* shrub, native, very local chalk southern GB. Widely planted in formal gardens as edging
✓	*Carpinus*	Hornbeam	• *C. betulus*: tree, native southern England
✓	*Castanea*	Sweet chestnut	• *C. sativa*: tree, introduced, planted especially southern England for coppice
✓	*Cedrus*	Cedars	• all species are trees, introduced, park and garden plantings
★	*Chaenomeles*	Japanese quinces	• *C. speciosa* and *C. japonica*: small shrubs, introduced especially in gardens; occasionally naturalised

	Genus	English	Species and status
	Cornus	Dogwood	• *C. sanguinea*: shrub, native, most common central and southern England, calcareous soils • *C. mas*: shrub to small tree, introduced, southern England
✓	*Corylus*	Hazels	• *C. avellana*: tall shrub, native, widespread • other species: introduced for nuts, sometimes naturalised
★	*Cotoneaster*	Cotoneasters	• large genus shrubs, introduced becoming widely naturalised through bird-dispersed seeds
★	*Crataegus*	hawthorns	• *C. monogyna*: shrub, native, widespread, traditional hedge species • *C. laevigata*: shrub, native, central and southern • other species: introduced, variously planted
	Cupressus and Chamaecyparis	Cypresses	• trees, introduced, commonly planted near coasts; some commercial forestry but mainly parks and gardens
★	*Cydonia*	Quinces	• *C. oblonga*: small tree, introduced
	Daphne	Mezereons	• *D. mezereum*: small shrub, probably native, very local north to Yorkshire • *D. laureola*: small shrub, native, local on calcareous soils
	Elaeagnus	Oleasters	• several species shrubs: introduced, naturalised southern GB
	Empetrum	Crowberry	• *E. nigrum*: dwarf shrub, native
	Ericaceae	Heath family	• includes *Calluna*, *Erica*, *Vaccinium* and *Andromeda* as native and widespread dwarf shrub genera; *Phyllodoce*, *Daboecia* and *Loiseleuria* native dwarf shrubs but geographically rather restricted. Taller shrubs include *Kalmia*, *Ledum* and *Gaultheria* all introduced with the latter naturalising.
	Escallonia	Escallonia	• *E. macrantha:* small shrub, garden plant
	Eucalyptus	Gums	• various species trees, introduced, planted as small-scale forestry, increasing
	Euonymus	Spindles	• *E. europaeus*: shrub to small tree, native especially on calcareous soils • other species introduced
✓	Fabaceae	Pea family	• several woody genera, small shrubs: • native species include *Ulex europaeus, U. gallii, U. minor, Genista tinctoria, G. pilosa, G. anglica, Cytisus scoparius* • introduced = *Robinia* (trees), *Lupinus arboreus* (shrub), *Laburnum anagyroides* (tree), *Spartium*
✓	*Fagus*	Beech	• *F. sylvatica:* tree, native southern England but naturalised/planted throughout
	Ficus	Figs	• *F. carica:* tall shrub, introduced, planted for fruit, central to southern England
	Forsythia	Forsythia	• various hybrids:tall shrubs-shrubs, introduced, some garden escapes
✓	*Frangula*	Alder buckthorn	• *F. alnus*: shrub, native, locally common

	Genus	English	Species and status
✓	*Fraxinus*	Ash	• *F. exelsior:* tree, native, widespread • other species: shrubs to trees planted and occasionally naturalised
	Fuchsia	Fuchsias	• shrubs, introduced, occasionally naturalised
✓	*Hedera*	Ivy	• *H. helix*: woodly climber, native, widespread and common • other species introduced and garden plants
	Hippophae	Sea buckthorn	• *H. rhamnoides*: shrub, native, coastal
	Hydrangeaceae	Mock orange family	• *Philadelphus*: several species and hybrids: introduced garden planting • *Deutzia*: shrubs, garden introductions • *Hydrangea*: small shrubs, garden introductions. All can naturalise especially when fly tipped
✓	*Ilex*	Holly	• *Ilex aquifolium*: shrub to tree, native, common throughout.
	Jasminum	Jasmine	• various species: shrubs to climbers, introduced, garden escapes, mostly southern England
	Juglans	Walnut	• *J. regia:* tree, introduced, commonly planted especially midlands southern England
✓	*Juniperus*	Junipers	• *J. communis*: shrub, native, local but common
	Lamiaceae	Dead nettle family	• contains some taxa with woody small shrubs – *Hyssopus officinalis*, *Lavandula* species and *Rosmarinus officinalis*. All introduced
✓	*Larix*	Larches	• all species trees, introduced, commercial forestry
	Laurus	Bay	• *L. nobilis:* shrub to tree, introduced for culinary use
	Lavatera	Tree mallows	• *L. arborea:* shrub, native but restricted to west coast • *L. cretica:* small shrub, native Cornwall and Scillies • other species: introduced, garden
	Ligustrum	Privet	• *L. vulgare:* shrub, native • *L. ovalifolium:* shrub, introduced, widely planted as hedging
	Mahonia	Oregon grapes	• *M. aquifolium:* small shrub, introduced, wid*ely planted as game cover and amenity.*
★	*Malus*	Apples	• *M. sylvestris*: tree, native, widespread • other species: domesticated apple cultivars introduced for fruit and or flowers.
	Mespilus	Medlars	• *M. germanica*: tall shrub to tree, introduced, well naturalised but local and southern
	Morus	Mulberry	• *M. nigra:* tree, introduced, planted for fruit, southern England, some escapes
	Myrica	Bog myrtle	• *M. gale:* dwarf shrub, native, throughout GB but especially north and west
✓	*Picea*	Spruces	• all species trees, introduced, commercial forestry
✓	*Pinus*	Pines	• *P. sylvestris:* tree, native but also widely planted for timber. • other species introduced, forestry timber

	Genus	English	Species and status
	Pittosporum	Pittosporums	• *P. crassifolium* and *P. tenuifolium*: tall shrubs, introduced especially south and coastal.
	Platanus	Plane	• *P. x hispanica:* tree, introduced and widely planted as street tree
✓	*Populus*	Poplars	• *P. tremula:* tree, native, widespread • *P. nigra:* tree, native but various sub-species and some introduced. • other species and large numbers of cultivars introduced
	Potentilla	Cinquefoils	• *P. fruticosa*: small shrub, native but very local (NE England and western Ireland); also widespread cultivation
	Prunus	Cherries	• *P. spinosa*: shrub, native, widespread • *P. avium*: tree, native throughout • *P. padus*: tall shrub to tree, native especially northern • other species introduced and planted for fruit – damsons, cherry etc
	Pseudotsuga	Douglas fir	• *P. menziesii:* tree, introduced, forestry timber
	Pterocarya	Wingnut	• *P. fraxinifolia:* tree, introduced, SE England
★	*Pyracantha*	Firethorns	• various species shrubs, introduced and becoming naturalised through bird-dispersed seeds
★	*Pyrus*	Pear	• *P. pyraster* and *P. communis*: trees, introduced; widely naturalised from garden escapes. • *P. cordata*: shrub, probably native, only near Plymouth
✓	*Quercus*		• *Q. petraea:* tree, native • *Q. robur:* tree, native • other species introduced, amenity planting
✓	*Rhamnus*	Buckthorn	• *R. catharticus*: tall shrub, native, locally common • *R. alertanus*: shrub, introduced, naturalised south Wales
	Rhododendron	Rhododendron	• *R. ponticum*: shrub, introduced but widely naturalised. • other species widely planted in gardens
	Ribes	Gooseberries and currants	• *R. uva-crispa:* small shrub, probably native, naturalised throughout • *R. alpinum:* small shrub, native but very restricted • *R. nigrum, rubrum, sanguineum, spicatum:* shrubs, introduced, naturalised throughout to various degrees.
✓	*Rosa*	Roses	• many species and hybrids: small shrubs native, also highly bred as cultivars,
✓	*Salix*	Willows	• many trees-shrubs to dwarf shrubs, native, widespread. Mostly totally amoral and hybridisation virulent.

	Genus	English	Species and status
✓	*Sambucus*	Elder	• *S. nigra*: shrub, native, widespread and common • *S. ebulus*: barely woody, possibly native, scattered • *S. racemosa*: shrub, introduced but well naturalised north from Derbyshire
★	*Sorbus*	Whitebeams	• *S. aucuparia*: tree, native • *S. domestica*: tree, probably native, very restricted • *S. aria* agg. and *S. intermedia* agg. tall shrubs to trees, native and very restricted each species
	Symphoriocarpus	Snowberries	• all introduced, various hybrids, naturalised throughout
	Syringa	Lilacs	• *S. vulgaris*: tall shrub to small tree; introduced, garden escape, naturalised, scattered throughout GB.
	Tamarix	Tamarisk	• *T. gallica* and *T. africana:* shrub to small trees, introduced, especially coastal
	Taxodiaceae	Redwood family	• all genera trees; introduced, mostly specimens in parks and gardens. Includes *Cryptomeria*, *Sequoia* and *Sequoiadendron*
✓	*Taxus*	Yew	• *T. baccata*: tree, native, widespread but rare in Scotland; also widely planted.
✓	*Tilia*	Limes	• *T. cordata:* tree, native • *T. platyphyllos:* tree, native • *T. x europaeus:* tree, hybrid between above two species, native but also widely planted
	Tsuga	Hemlock spruce	• *T. heterophylla:* tree, introduced, frequent mixed plantations
✓	*Ulmus*	Elms	• various species and hybrids: trees, native, widespread
✓	*Viburnum*	Viburnums	• *V. opulus*: shrub, native, frequent throughout. • *V. lantana*: tall shrub, native, common central and southern, scattered elsewhere. • other species introduced, garden planted, scattered naturalised to widespread naturalised

APPENDIX 2: DATA TABLES – SITE TYPES AND TAXA

The data tables below present summary data by period; they exclude one site of only "prehistoric" date and 2 sites of unknown date. The first table of each pair lists presence of each taxon recorded as charcoal by broad type of site whilst the second table presents the waterlogged data. Taxa have been grouped as in the discussion above.

Mesolithic

Table App2.1a: Mesolithic site types with charcoal
BCA = *Betula* or *Corylus* or *Alnus*, no distinction made in report

charred - 4 sites	flint scatter	settlement
Alnus	X	
Betula	X	
Betula/Corylus/Alnus	X	
Corylus	X	X
Quercus	X	

Table App2.1b: Mesolithic site types with waterlogged wood

waterlogged - 1 site	settlement
Betula	X
Salix/Populus	X

Neolithic

Table App2.2a: Neolithic site types with charcoal

charred - 8 sites	flint scatter	funerary	ritual	settlement
Alnus		X		X
Alnus/Corylus			X	X
Betula	X		X	X
Corylus	X	X	X	X
Fraxinus		X	X	X
Pomoideae		X	X	X
Quercus		X	X	X
Salix/Populus				X

Table App2.2b Neolithic site types with waterlogged wood

waterlogged - 3 sites	hurdle	trackways/platforms
Alnus	X	X
Corylus	X	X
Frangula		X
indet	X	
Pinus		X
Quercus		X
Salix/Populus		X

Neolithic-Early Bronze Age

Table App2.3a: Neolithic-Early Bronze Age site types with waterlogged wood

waterlogged - 2 sites	lake dwelling
Alnus	X
Betula	X
Corylus	X
Fraxinus	X
Pinus	X
Pomoideae	X
Prunus-type	X
Quercus	X
Salix/Populus	X
Ulex	X
Ulmus	X

Bronze Age

Table App2.4a: Bronze Age sites with charcoal

charred - 20 sites	burnt mound	cairnfield	funerary	settlement
Acer/Pomoideae				X
Alnus	X			
Alnus/Corylus				X
Betula	X		X	X
Corylus	X		X	X
Fraxinus				X
non *Quercus*				X
Pomoideae				X
Prunus-type	X		X	X
Quercus	X	X	X	X
Salix/Populus			X	X

Table App2.4b: Bronze Age sites with waterlogged wood

waterlogged - 7 sites	boats	burnt mound	Palaeo-environmental	ritual	settlement
Alnus	X	X			X
Betula			X	X	
Corylus			X		X
Fraxinus					X
Pomoideae					X
Prunus-type					X
Quercus	X	X		X	X

Late Bronze Age to Early Iron Age

Table App2.5a: Bronze Age to Early Iron Age types of site with charcoal

charred - 4 sites	settlement	unknown
Alnus	X	X
Alnus/Corylus		X
Betula	X	
Corylus	X	X
Fraxinus	X	
Quercus	X	X
Salix/Populus	X	X
Ulmus	X	

Iron Age

Table App2.6a: Iron Age types of site with charcoal

charred - 7 sites	earthworks	flint scatter	grain silo	hill fort	settlement
Alnus	X			X	X
Alnus/Corylus					X
Betula	X			X	X
Corylus	X	X			X
Fraxinus	X	X			X
Pinus					X
Pomoideae			X		X
Quercus	X	X	X		X
Quercus/Fraxinus		X			
Salix/Populus	X	X			X
Sambucus					X

Table App2.6b: Iron Age types of site with waterlogged wood

waterlogged - 4 sites	earthworks	settlement
Alnus	X	X
Betula	X	
Corylus	X	X
Fraxinus	X	X
Pomoideae	X	
Prunus-type	X	X
Quercus	X	X
Salix/Populus	X	X
Sambucus	X	X

Iron Age to Romano British

Table App2.7a: Iron Age to Romano British types of site with charcoal

charred - 3 sites	ditch	farmstead	settlement
Alnus/Betula			X
Alnus		X	
Alnus/Corylus		X	
Betula	X		
Corylus	X	X	X
Fraxinus			X
Quercus	X	X	X
Quercus/Fagus			X
Salix/Populus	X	X	

Table App2.7b: Iron Age to Romano British types of site with waterlogged wood

waterlogged - 1 site	*settlement*
Corylus	*X*
Quercus	*X*
Salix/Populus	*X*

Roman and Romano-British

Table App2.8a: Roman and Romano-British types of site with charcoal

charred - 18 sites	Ceme tery	Farm stead	fort	Fort urban settle ment	ritual	Settle ment	Un known	urban settle ment	vicus	villa
Acer-type			X				X			X
Alnus	X	X	X				X		X	X
Betula	X	X	X			X	X	X	X	
Carpinus	X									
Corylus	X	X	X		X	X	X	X	X	X
Fraxinus	X	X	X							X
Fraxinus/Acer										X
Pinus					X					
Pomoideae	X	X	X							X
Prunus/Acer										X
Prunus-type	X	X					X			X
Quercus	X	X	X	X			X	X	X	X
Salix/Populus	X		X	X		X				X
Ulmus			X							

Roman and Romano-British

Table App2.8b: Roman and Romano-British types of site with waterlogged wood

waterlogged – 23 sites	fort	fort and vicus	fort/urban settlement	settlement	unknown	urban settlement	vicus	villa
Acer-type	X	X						X
Alnus	X	X	X	X	X	X	X	X
Betula	X	X		X		X		
Betula/Corylus/Alnus						X		
Carpinus						X		
Castanea	X							
Corylus	X	X	X	X	X	X	X	
Fraxinus	X	X			X	X		X
Ilex	X					X		
Juniperus				X				
Larix/Populus			X					
Pinus	X					X		X
Pomoideae	X	X				X		
Prunus-type	X			X		X		
Quercus	X	X	X	X	X	X	X	X
Salix/Populus	X		X	X		X		
Sambucus	X							
Taxus	X					X		
Ulmus	X							

Late Bronze Age – Early Medieval

Table App2.9a: Late Bronze Age to early medieval type of site with charcoal

charred - 1 site	settlement
Acer-type	X
Alnus	X
Betula	X
Corylus	X
Fraxinus	X
Pomoideae	X
Prunus-type	X
Quercus	X
Sambucus	X

Early Medieval

Table App2.10a: Early medieval types of site with charcoal

charred - 5 sites	farmstead	religious	settlement
Alnus			X
Betula	X		X
Corylus	X		X
Fraxinus	X	X	X
Pomoideae	X		
Prunus-type	X		X
Quercus		X	X
Salix/Populus			X
Taxus			X

Table App2.10b: Early medieval types of site with waterlogged wood

waterlogged - 5 sites	religious	settlement	urban
Acer-type			X
Alnus		X	X
Betula		X	X
Corylus		X	X
Fraxinus		X	X
Ilex	X		X
Pomoideae		X	X
Prunus-type			X
Quercus		X	X
Quercus/Castanea			X
Rhamnus catharticus			X
Salix/Populus	X	X	X
Sambucus	X		X
Ulmus		X	

Early Medieval – Medieval

Table App2.11a: Early medieval to medieval types of site with charcoal

charred - 5 sites	settlement
Alnus	X
Prunus-type	X

Table App2.11b: Early medieval to medieval types of site with waterlogged wood

waterlogged - 3 sites	settlement
Alnus	X
Betula	X
Corylus	X
Fraxinus	X
Pomoideae	X
Quercus	X
Salix/Populus	X
Ulmus	X

Medieval

Table App2.12a: Medieval types of site with charcoal

charred - 22 sites	Ceme tery	glass furnaces	hospice and settle ment	industrial	moated site	oven	religious	Settle ment	urban (kiln/ oven)
Acer-type				X				X	
Alnus		X	X	X	X			X	
Betula		X	X	X	X			X	
Corylus			X	X	X		X	X	X
Fraxinus			X	X	X	X		X	X
Ilex				X					
Pinus				X					
Pomoideae				X	X			X	
Prunus-type				X				X	
Quercus	X	X	X	X	X	X	X	X	
Quercus/Fraxinus				X					
Salix/Populus				X	X	X		X	
Sarothamnus									
Tilia				X					
Ulex			X						
Viburnum				X					

Medieval

Table App2.12b: Medieval types of site with waterlogged wood

waterlogged - 19 sites	Cemetery	ditch fill	fence	glass furnaces	Industrial	mill	Palaeo-environmental	Religious	ship	urban	urban (town ditch)
Alnus								X	X	X	X
Betula				X		X		X	X	X	
Corylus								X	X	X	
Fagus								X			
Fraxinus		X						X	X	X	X
Pinus	X									X	
Pomoideae								X		X	
Prunus-type		X								X	
Quercus					X			X	X	X	X
Salix/Populus										X	X
Tilia								X			
Ulmus								X			

Medieval – post-medieval

Table App2.13a: Medieval to post-medieval types of site with charcoal

charred - 3 sites	castle ditch	religious	urban
Acer-type	X		
Alnus		X	
Betula	X		
Castanea	X		
Coal	X		
Corylus	X	X	X
Fraxinus	X		
Ilex	X		
Pomoideae	X		
Quercus	X	X	X
Rosa	X		
Salix/Populus	X		
Ulmus	X		

Table App2.13b: Medieval to post-medieval types of site with waterlogged wood

waterlogged - 2 sites	religious
Corylus	X
Quercus	X
Salix/Populus	X

Post-Medieval

Table App2.14a: Post-medieval types of site with charcoal

charred - 2 sites	drying kiln
Alnus	X
Betula	X
Quercus	X

Table App2.14b: Post-medieval types of site with waterlogged wood

waterlogged - 1 site	castle ditch
Alnus	X
Picea/Larix	X
Pinus	X
Quercus	X
Salix/Populus	X

APPENDIX 3: TAXA BY BROAD PERIOD

	Meso	Neo+ EBA	BA	LBA – EIA	IA	Rom	EMed	Emed-Med	Med	Med-PMed	PMed
Number of sites	5	13	15	2	11	36	9	5	40	4	3
Quercus	3	12	21	1	17	53	10	9	36	12	2
Alnus	1	7	2	1	7	22	6	7	15	2	2
Betula	3	5	8	2	9	28	7	4	22	5	2
Corylus	2	13	8	2	12	31	9	7	21	7	
Salix/*Populus*	1	2	2	1	1	8	5		5		
Fraxinus		8	2	1	8	20	7	5	17	1	
Ulmus		1		1	1	2	1	2	3	1	
Prunus-types		1	4		5	13	3	3	3		
Pomoideae		2	2		1	7	3	1	5		
BCA	1	2	1		2	1					
Salix		3	2		6	11	5	7	3	1	
Crataegus-type		2			5	10		1	8		
Sambucus					5	1	1	1			
Pinus		2			1	6		2	5		1
Acer						6		3	2	1	
Ilex						4	1		1	1	
Frangula		1									
Acer/ Pomoideae			1								
Ericaceae					1						
Calluna					1	1			1		
Populus					1	3			1	2	1
Tilia						1			3		
Carpinus						2		1			
Castanea						1				2	
Buxus						1					
Cedrus						1					
Abies						4					
Fagus/ *Quercus*					1						
Fraxinus/ *Acer*						1					
Hedera						2					
Juniperus						2					
Larix/ *Picea*						4					
Taxus						3	1				
Ulex		1							2		
Fagus									1		
Sarothamnus									1		
Quercus/ *Fraxinus*		1							1		
Viburnum									1		
Sorbus										3	
Rosa										1	
Picea											1

pale grey shading – non native taxa; cream shading to emphasise patterns between periods

APPENDIX 4: SITE CODES – NAMES, PERIODS AND TYPES OF SITES AND ASSOCIATED CLASSIFICATION GROUP; TAXA CODES

Sites with charcoal – ordered by classification results

Site code	Site name	Broad period	Type of site	TW-charc
203	Wharram Percy #1969	early med to medieval	settlement	1
138	Hutton	medieval	glass furnaces	2
67	Belling Mill pm	post medieval	drying kiln	2
74	Blubberhouses	Mesolithic	flint scatter	2
83	Brough Law	Iron Age	hill fort	2
123	Goats Crag	Bronze Age	funerary	2
145	Lime Tree Lane, Bilton	medieval	unknown	2
146	Loaning Burn	post medieval	drying kiln	2
118	Forcegarth Pasture	Roman	settlement	3
78	Bracken Rigg	Bronze Age	settlement	3
82	Broomrigg	Bronze Age	funerary	3
113	Dry Beck	Prehistoric	?smelting site	3
128	Haugh Head	Bronze Age	funerary	3
144	Levisham Moor	Iron Age to Roman	ditch	3
170	Simy Folds	early medieval	settlement	3
190	Thwing A/S	early medieval	settlement	3
120	Garlands Hopsital, Carlisle	Bronze Age	burnt mound	4
157	Norton Priory	medieval to p-med	religious	4
175	Sparrowmire Farm	Bronze Age	burnt mound	4
61	Alnham	Bronze Age	funerary	4
73	Blelham Tarn	medieval	industrial	4
87	Bursea House	Iron Age	settlement	4
101	Carrawburgh	Roman	ritual	4
103	Catterick	Roman	vicus	4
117	Fisher Street, Carlisle	Roman	urban settlement	4
126	Harrison Coppice	medieval	industrial	4
133	Howick	Mesolithic	settlement	4
140	Jarrow (Med)	medieval	religious	4
143	Lathom	Iron Age to Roman	farmstead	4
148	Milfield	Neolithic	ritual	4
173	South Haw, Nidd	Neolithic	flint scatter	4
174	South Shields	Roman	fort	4
182	Stricklandgate	medieval to p-med	urban	4
187	Thirlings 75 #2159	Neolithic	settlement	4
193	Tom Gill Site B	medieval	industrial	4
199	West Brandon	Bronze Age to Iron Age	settlement	4
209	White Gill	Mesolithic	flint scatter	4
185	The Dod	Iron Age	earthworks	5
124	Greta Bridge	Roman	fort	5
64	Barhobble	medieval	industrial	5

Site code	Site name	Broad period	Type of site	TW-charc
65	Bark House Bank	medieval	industrial	5
70	Black Moss Pot	medieval	industrial	5
75	Bolam Lake	Neolithic	settlement	5
88	Callis Wold	Neolithic	funerary	5
108	Corbridge Red House	Roman	fort	5
119	Gargrave	medieval	moated site	5
131	Housesteads 189/88	Roman	fort	5
169	Sandal Castle	medieval to p-med	castle ditch	5
172	Smithy Mire South	medieval	industrial	5
176	St Giles by Brompton Bridge	medieval	hospice and settlement	5
178	Staple Howe	Bronze Age to Iron Age	settlement	5
181	Street House Wossit	Neolithic	ritual	5
68	Billingley Drive, Thurnscoe	Roman	unknown	6
69	Birch Heath, Tarporley	Roman	farmstead	6
84	Brougham	Roman	cemetery	6
132	Howden Clough	medieval	industrial	6
162	Ribblehead	early medieval	farmstead	6
188	Thwing (nd)	Late BA to early med	settlement	6
192	Tom Gill Site A	medieval	industrial	6
202	Wharram Percy	medieval	settlement	6
212	Winterton #2502	Roman	villa	6
139	Jarrow	early medieval	religious	7
112	Dragonby	Iron Age to Roman	settlement	7
63	Appleton-le-Moors	medieval	oven	7
76	Bolton '73	medieval	?	7
104	Cawthorn Camps	Roman	fort	7
114	Durham: Back Silver Street	medieval	urban (kiln/oven)	7
121	Garton Slack	Iron Age	settlement	7
161	Rawcliffe Moor	Bronze Age to Iron Age	unknown	7
165	Rosedale (16th C)	medieval	industrial	7
166	Rudston	Roman	villa	7
168	Salter's Nick	Iron Age	flint scatter	7
186	Thirlings	Neolithic	settlement	7
189	Thwing 14th C	medieval	settlement	7
191	Thwing LBA	Bronze Age	settlement	7
194	Trentholme Drive	Roman	cemetery	7
215	Yeavering	early medieval	settlement	7
85	Brough-on-Humber	Roman	fort/urban settlement	8
141	Jewbury	medieval	cemetery	8
60	Allerwash	Bronze Age	funerary	8
62	Angler's Crag	medieval	industrial	8
71	Blawearie 84-8	Bronze Age	cairn	8
109	Coxhoe	Iron Age	settlement	8

Site code	Site name	Broad period	Type of site	TW-charc
110	Crawley Edge	Bronze Age	cairnfield	8
125	Hallshill	Bronze Age	settlement	8
129	Highcliff Nab	mesolithic	flint scatter	8
159	Oddendale	Bronze Age	funerary	8
164	Rosedale (14th C)	medieval	glass furnaces	8
195	Troutbeck	Roman	fort	8
211	Willerby Wold	Neolithic	funerary	8
102	Castleford	Roman	fort	9
122	Garton Slack (silo)	Iron Age	grain silo	9
160	Old Durham	Roman	villa	9

Sites with waterlogged wood ordered by classification order

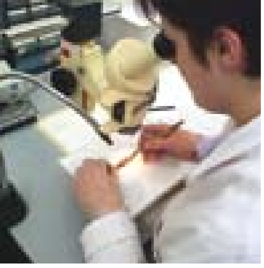
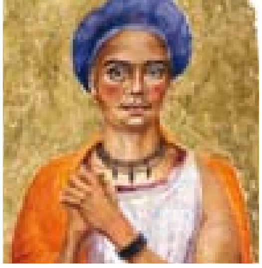
Site code	Site name	Broad period	Type of site	TW-wood
149	Monkwearmouth	early medieval	religious	1
138	Hutton	medieval	glass furnaces	2
185	The Dod	Iron Age	earthworks	2
66	Belling Mill med	medieval	mill	2
95	Carlisle: Annetwell Street	Roman	fort	2
98	Carlisle: Lanes-1	Roman	urban settlement	2
106	Coppergate	early medieval	urban	2
130	Housesteads	Roman	fort	2
150	Mount Grace Priory	medieval	religious	2
152	Newcastle: BG84	medieval	urban	2
163	Ribchester RB89	Roman	fort	2
177	Stanwick	Iron Age	settlement	2
179	Star Carr	Mesolithic	settlement	2
196	Vindolanda	Roman	fort	2
200	West Furze: Round Hill	Bronze Age to Iron Age	lake dwelling	2
205	Wharram Percy #4699	early med to medieval	settlement	2
206	Wharram Percy 30 A/S	early medieval	settlement	2
118	Forcegarth Pasture	Roman	settlement	3
120	Garlands Hopsital, Carlisle	Bronze Age	burnt mound	3
157	Norton Priory	medieval to p-med	religious	3
139	Jarrow	early medieval	religious	3
85	Brough-on-Humber	Roman	fort/urban settlement	3
72	Bleasdale	Bronze Age	ritual	3
77	Borrans Rd, Ambleside	Roman	vicus	3
79	Briarfiled Nurseries	Bronze Age	palaeoenvironmental	3
80	Brigg	Bronze Age	settlement	3
81	Brook House Farm	Roman	settlement	3
86	Burradon	Iron Age	settlement	3
89	Carlisle #2402	Roman	fort and vicus	3

Site code	Site name	Broad period	Type of site	TW-wood
92	Carlisle #3743	Roman	fort	3
96	Carlisle: Blackfriars	Roman	?	3
97	Carlisle: Castle Street	Roman	fort	3
100	Carr House Sands	Neolithic	hurdle	3
105	Cockermouth 1980 CLO2	not noted in report	not noted in report	3
111	Dalton Parlours	Roman	villa	3
115	Faverdale	Iron Age to Roman	settlement	3
116	Ferriby	Bronze Age	boats	3
135	Hull: Blackfriargate	medieval	religious	3
137	Hungate, York	medieval	ship	3
147	Lurk Lane, Beverley	early medieval	urban	3
151	Newcastle: Bastion	post-medieval	castle ditch	3
155	Newcastle: Carmelite Friary	medieval	religious house	3
156	Newcastle: Town Ditch	medieval	urban (town ditch)	3
158	Norton Priory West	medieval to p-med	religious	3
171	Skipsea Witthow Mere	Neolithic	trackways/platforms	3
180	Storrs Moss	Neolithic	unknown	3
183	Sutton Common	Iron Age	settlement	3
201	West Furze: Ulrome	Bronze Age to Iron Age	lake dwelling	3
204	Wharram Percy #3720	early med to medieval	settlement	3
207	Wharram Percy site 30	early med to medieval	settlement	3
124	Greta Bridge	Roman	fort	4
112	Dragonby	Iron Age to Roman	settlement	4
91	Carlisle #3174	Roman	fort and vicus	4
93	Carlisle Cumberland Building Society	medieval	urban	4
99	Carlisle: Lanes-2	Roman	urban settlement	4
198	Waterton	medieval	ditch fill	4
208	Whinfell Tarn	medieval	boat	4
175	Sparrowmire Farm	Bronze Age	burnt mound	5
90	Carlisle #2860	Roman	fort and vicus	5
94	Carlisle Lanes #2157	Roman	urban settlement	5
107	Corbridge by-pass	Roman	fort	5
136	Hull: Monkgate	medieval	religious	5
142	Kilnsea boat	Bronze Age	boat	5
153	Newcastle: Blackfriars	medieval	urban	5
154	Newcastle: Blackgate	medieval	urban	5
167	Rudston well	Roman	villa	5
197	Wasdale Beck	medieval	boat	5
210	Wilderspool	Roman	unknown	5
214	Wrenthorpe Potteries	medieval	industrial	5
141	Jewbury	medieval	cemetery	6
127	Hartlepool: Southgate	medieval	urban	6
134	Hull	medieval	urban	6

Codes for taxa

	tax-code	Taxa-group
waterlogged	128	*Pinus*
waterlogged	133	*Betula*
waterlogged	134	*Quercus*
waterlogged	141	*Corylus*
waterlogged	145	*Betula/ Corylus/ Alnus*
waterlogged	337	*Alnus*
waterlogged	464	*Fraxinus*
waterlogged	706	*Salix/ Populus*
waterlogged	707	*Juniperus*
waterlogged	711	Pomoideae
waterlogged	727	*Prunus*-type
waterlogged	728	*Rhamnus catharticus*
waterlogged	730	*Ulmus*
waterlogged	733	*Ilex*
waterlogged	796	*Frangula*
waterlogged	799	*Fagus*
waterlogged	846	*Ulex*
waterlogged	885	*Castanea*
waterlogged	891	*Tilia*
waterlogged	892	*Taxus*
waterlogged	893	*Acer*-type
waterlogged	894	*Carpinus*
waterlogged	895	*Sambucus*
waterlogged	999	*Quercus/ Castanea*
charcoal	2127	*Sarothamnus*
charcoal	2128	*Pinus*
charcoal	2132	*Viburnum opulus*
charcoal	2133	*Betula*
charcoal	2134	*Quercus*
charcoal	2141	*Corylus*
charcoal	2145	*Betula/ Corylus/ Alnus*
charcoal	2281	*Rosa*
charcoal	2307	*Quercus/ Fraxinus*
charcoal	2337	*Alnus*
charcoal	2464	*Fraxinus*
charcoal	2706	*Salix/ Populus*
charcoal	2707	*Juniperus*
charcoal	2711	Pomoideae
charcoal	2727	*Prunus*-type
charcoal	2730	*Ulmus*
charcoal	2733	*Ilex*
charcoal	2846	*Ulex*
charcoal	2885	*Castanea*
charcoal	2891	*Tilia*
charcoal	2892	*Taxus*

	tax-code	Taxa-group
charcoal	2893	*Acer*-type
charcoal	2894	*Carpinus*
charcoal	2895	*Sambucus*
charcoal	2897	*Acer*/Pomoideae
charcoal	2899	*Alnus*/*Corylus*



ENGLISH HERITAGE RESEARCH DEPARTMENT

English Heritage undertakes and commissions research into the historic environment, and the issues that affect its condition and survival, in order to provide the understanding necessary for informed policy and decision making, for sustainable management, and to promote the widest access, appreciation and enjoyment of our heritage.

The Research Department provides English Heritage with this capacity in the fields of buildings history, archaeology, and landscape history. It brings together seven teams with complementary investigative and analytical skills to provide integrated research expertise across the range of the historic environment. These are:

* *Aerial Survey and Investigation*
* *Archaeological Projects (excavation)*
* *Archaeological Science*
* *Archaeological Survey and Investigation (landscape analysis)*
* *Architectural Investigation*
* *Imaging, Graphics and Survey (including measured and metric survey, and photography)*
* *Survey of London*

The Research Department undertakes a wide range of investigative and analytical projects, and provides quality assurance and management support for externally-commissioned research. We aim for innovative work of the highest quality which will set agendas and standards for the historic environment sector. In support of this, and to build capacity and promote best practice in the sector, we also publish guidance and provide advice and training. We support outreach and education activities and build these in to our projects and programmes wherever possible.

We make the results of our work available through the Research Department Report Series, and through journal publications and monographs. Our publication Research News, which appears three times a year, aims to keep our partners within and outside English Heritage up-to-date with our projects and activities. A full list of Research Department Reports, with abstracts and information on how to obtain copies, may be found on www.english-heritage.org.uk/researchreports

For further information visit www.english-heritage.org.uk

ENGLISH HERITAGE