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A Review of Macroscopic Plant Remains from the Midland Counties

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Incorporating contributions from Peter Murphy and Dominique de Moulins

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SUMMARY
Plant macrofossil evidence (primarily fruits and seeds) from archaeological deposits in the seventeen counties of the midlands region is reviewed. The evidence is discussed by period and thematically, and recommendations for future studies are presented. Accompanying dataset is available for download from the Archaeological Data Service https://doi.org/10.5284/1090383

COVER
Sprouted oats and barley grain from Freeschool Lane, Leicester LR26, by Anita Randini and Angela Monkton

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The authors are indebted to James Greig, Lisa Moffett and Peter Murphy for the many years of work in the Midlands and East Anglia that have formed the basis for archaeobotany in the region. In addition to their site reports, their reviews and research agenda have been invaluable to many workers in the field and archaeologists in general (for example Greig 1988, 1991b, 2007; Moffett 1991, 2006, Moffett *et al* 1989, Murphy 1984, 1992, 1997, 2000a, 2001, 2013).

We are very grateful to Peter Murphy and Dominique de Moulins for giving us access to their unpublished 2002 review and allowing us to use sections of their text, tables and data. Their draft review provided a solid basis from which to work and is an important resource in its own right. We are also especially grateful to our Historic England managers and reviewers, Ruth Pelling and Gill Campbell, and two external reviewers, Lisa Moffett and Angela Monckton for their very constructive comments and valuable contributions to the Review. We are grateful to Gary Jones (Oxford Archaeology South) for producing initial maps, and Andrew Lowerre (then Historic England) for producing the final maps included in the publication. Angela Monckton, Anita Radini and the University of Leicester Archaeology Service (ULAS) very kindly gave us permission to use their photograph of charred sprouted oats and barley grain from Freeschool Lane, Leicester.

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1. INTRODUCTION

1.1 The Purpose and Scope of the Review

This review forms part of three regional reviews of plant macrofossil data commissioned by English Heritage (now Historic England): northern counties, midland counties and southern counties. The first of these, 'A Review of the Evidence for Macrofossil Plant Remains from Archaeological Deposits in Northern England', was produced by Hall and Huntley (2007). The review for southern England is currently in progress (Campbell and Pelling forthcoming). This publication is an updated version of the draft Midlands Review produced by Peter Murphy and Dominique de Moulins in 2002 (henceforth referred to as Murphy and de Moulins 2002; available as an archive report from Environmental Studies, Fort Cumberland) incorporating parts of the original text where appropriate. The main focus of the updated review is based on work published between 2000 and 2010 although significant reports from earlier publications have been included.

The limits of this review

The definition of the 'Midlands region' follows Historic England's regional divisions, consisting of the following seventeen counties (see Figure 1). The codes used are given after each county (see also Section 1.2 'Links and references'):

Bedfordshire [BD], Buckinghamshire [BK], Cambridgeshire [CB], Derbyshire [DB] Essex [EX], Herefordshire [HF], Hertfordshire [HT], Leicestershire (including Rutland) [LR], Lincolnshire [LC], Norfolk [NK], Northamptonshire [NH], Nottinghamshire [NT], Shropshire [SP], Staffordshire [ST], Suffolk [SK], Warwickshire (including the former West Midlands County) [WR] and Worcestershire [WC].

The purpose of the review is to examine the quantity, quality and significance of the plant macrofossil evidence in order to produce a resource assessment and research agenda. For archaeobotanists working on sites in the region it serves as a source of comparative data. For curators and workers within education and research it draws attention to gaps in our knowledge and areas requiring further investigation. The subject area 'plant macrofossils' traditionally includes larger archaeobotanical remains (which excludes pollen and spores) i.e. fruits, seeds, wood and charcoal, as well as some other identifiable vegetative plant structures such as tubers/rhizomes and leaf buds. Wood and charcoal are not included in this review as they have been covered in separate publications (northern counties, Huntley 2010; midland counties, Murphy 2001; southern counties, Smith 2002) although pollen, charcoal/wood or insect evidence are discussed within the text where the results are pertinent. Because of a combination of factors related to taphonomy and survival under different preservation conditions, the principal categories of remains covered in the review are cereal grains and chaff, fruits/seeds from wild plants (mainly crop or garden weeds) and some other economically useful plant remains from fruits, nuts and fibre plants. Although it could be considered to be rather 'artificial' to study each category of environmental evidence in isolation, in most cases the original reports have been written taking other archaeological and environmental information into account, so that interpretations outlined below have been made with a full understanding of context and taphonomy.

As anyone working on a review paper will know, there are many problems in extracting information from published reports, including the frequent detachment of phasing and

stratigraphic information from archaeobotanical sections of the publication, as well as the omission of species lists from reports and failure to include enough taxonomic information within the specialist's report. In some cases, this type of editing has been carried out after reports have been submitted, and the severe cuts have made the information unusable for research purposes. However, this is not always the case and we send out a plea to archaeobotanists to try to make their data useable within a 'stand-alone' report wherever possible. Information which should always be included in the plant macrofossil report would be the location of the site, grid reference, excavating unit and project manager, sample sizes and phases with date ranges. The reference numbers and locations of archive reports should be included, and summaries or abstracts are very useful. A statement about sample selection, total number of samples taken and sample treatment, including mesh size, is desirable. Obviously, the publishing formats of different journals sometimes make this impossible, but in this case, authors should make sure that the archive report is freely available online, providing a web address within the published report.

The Archaeology Data Service (http://archaeologydataservice.ac.uk/) is an important repository for grey literature. It contains excavation and assessment reports produced since c 2004 and is open to all, although it takes some time for reports to become available and, specialist reports have tended to be poorly signposted, making them difficult to locate (the updated version of Oasis will include a specialist section enabling specialist reports to be uploaded to ADS more easily). The recovery of archive reports was found to be difficult in some counties, although many authors very generously provided copies of unpublished and published reports that were hard to track down (see Acknowledgements). Historic England's (previously English Heritage) Research Reports (incorporating the Ancient Monuments Laboratory Reports and Centre for Archaeology Reports) are now available on the Research Reports' Database at http://research.historicengland.org.uk/

Major contributions to our understanding of the archaeobotany of the region have been made by regional specialists funded by English Heritage (now Historic England) particularly in the decades up to 2000 when Lisa Moffett and James Greig covered the West Midlands from Birmingham University and Peter Murphy covered East Anglia and the East Midlands from the University of East Anglia. The authors are indebted to Lisa, James and Peter for carrying out the major proportion of archaeobotanical analyses taking place in the Midlands over past decades, for developing methodologies and research agenda, for providing training for new workers in the discipline and for ensuring that environmental archaeology is at the forefront of archaeological investigations in the region.

Large numbers of reports were read and summarised for this review, and there will inevitably still be many more reports that either could not be found, were missed, or fell beyond the limits of our resources in the search through seventeen counties-worth of publications and grey literature. Some summaries in the supporting summary data (available from Historic England Environmental Studies team) are fairly detailed whilst others consist of brief notes, depending on the needs of the authors and time available. Interpretations given in the summaries are those provided in the original reports, and if additional suggestions are made by Wendy Carruthers (WJC) or Kath Hunter Dowse (KHD) they are bracketed and initialled, for example '[or used for fuel WJC]'. The summaries provided throughout the Review are intended to highlight the presence of useful reports or specific content of interest rather than provide detailed summaries of

them. The reader is directed to the original reports for detailed information. Significant errors in the review can be revised by contacting the authors. The online supporting summary data is available for authors to update with new site summaries into the future, by sending them to the Review authors in the correct format as an Excel spreadsheet.

Use of the Murphy and de Moulins Draft Review

In many sections of this review extracts of the Murphy and de Moulins draft review have been used, sometimes as complete extracted paragraphs, for example where useful lists of sites of a particular type were given, and sometimes as summarised or paraphrased extracts where the information adds to the discussion. One table from Murphy and de Moulins has been updated and used in this report (*Table 2*), but unfortunately it was not possible to update the remaining tables and graphs that Murphy and de Moulins began, as the quantity of data from seventeen counties published since 2002 has greatly increased, making it impossible to cover so many topics in detail. Instead some of Murphy and de Moulins data is available on request from the Historic England Environmental Studies team archaeobotanists. We are extremely grateful to Peter and Dominique for giving us permission to use their data, and to reproduce sections of their draft report (Murphy and de Moulins 2002).

1.2 The Structure of the Review and Data Sources

An earlier draft review for the Midlands region produced by Peter Murphy and Dominique de Moulins in 2002 was taken as the starting point for the project. The aims of the current review were to:

- update the Murphy and de Moulins (2002) review by adding data from reports published from 2000 to 2010 (broadly speaking, though some significant later and earlier reports have been included in the site summaries and database)
- combine the evidence from both reports and analyse the resulting data
- produce a research agenda for future work in the Midlands region

Because it is part of a three-part plant macrofossil series, and for ease of use, the Midlands Review has been presented in a similar format to the first review published: the Northern Counties (Hall and Huntley 2007). The same Period divisions and basic layout have been used as in the Northern Counties Review but with some differences. The Midlands Review has incorporated information from Murphy and de Moulins (2002) which was presented in a slightly different form than Hall and Huntley (2007), and secondly because the data from each region is clearly not uniform in character.

The Murphy and de Moulins Midlands Review primarily referenced publications up to c 2000, although some new references and text were added in a second draft up to December 2002. Another important source of references was the Environmental Archaeology Bibliography compiled in the 1990s by Philippa Tomlinson and colleagues at the Environmental Archaeology Unit, University of York, funded by English Heritage (now Historic England; Tomlinson and Hall 1996; online EAB; see Hall and Huntley 2007, 17). The authors are very grateful to Allan Hall (formerly of the University of York) for providing them with references from all seventeen counties (years 2000 to 2010), from which to work. Unfortunately, funding has been too sporadic in recent years to ensure that a full coverage of publications was present in the EAB, so additional methods of searching had to be employed including:

- library searches through all county and period journals
- requests sent out to archaeobotanists for lists of publications
- following up references in a number of recently published sub-region reviews by archaeobotanists such as Angela Monckton and Elizabeth Pearson
- searches of grey literature using ADS and the more accessible of the county archives

Resources were not available for a full grey literature search involving HERs, so grey literature publications are used only if pertinent to particular themes. Although many assessment and evaluation reports were made available these have only been used occasionally because at the early stages of a project phasing is usually only preliminary, and re-interpretations often occur when full analysis is undertaken.

An Excel spreadsheet was set up for each county and the counties were shared between the two authors according to which county journals were available in the main libraries being used (KHD: Beds, Bucks, Here, Herts, Lincs, Staffs, Suffolk, Warwks and West Mids. WJC: Cambs, Derbys, Essex, Leics and Rutland, Norfolk, Northants, Notts, Shrops, Worcs). Major site reports were photocopied in the library in order to write a site summary for the spreadsheet which could be used as a basis for the Period Reviews (Section 5) and provide an overall understanding of the data for each county. Photocopies have been archived in box files for each county in the Historic England library, Fort Cumberland.

Because summaries were not available for the pre-2000 reports and there was not time to research all of the older reports, some sections of the Murphy and de Moulins have been incorporated into this updated review (for example, paragraphs containing lists of references for specific topics), as they were considered to be a useful source of information. Occasionally, where older sites were of particular importance to a period or theme, summaries were written into the spreadsheet so that the information could be included in more detail. Quite a few sites (mainly old ones, but sometimes newer ones that were found after the end of the data collection stage in November 2011) were entered into the spreadsheet without summaries but with a few notes to aid report writing. In some cases, this was done so that a 'Midlands Review Reference Number' (e.g. [NH44]) could be allocated and the site could be added to the maps. Summaries for these could be added at a later date if the Review is updated in the future.

Given the large number of archaeobotanical reports available from the region, not all have been included in the descriptive site summaries. Sites included in the review were chosen at the authors' discretion for a variety of reasons: because they were notable in some way - perhaps due to exceptional preservation, or because a site was particularly well-sampled enabling detailed interpretations to be made to illustrate a particular point in some cases, several summaries typical of a particular type of site might be given to demonstrate similarities across the period.

1.2.1 Terminology and the use of Latin binomials

In an attempt to make the review as easy to read as possible for a wide audience (and a little shorter) the use of Latin binomials has been reduced to a minimum. Although the use of common names can lead to a risk of confusing different taxa, this has been avoided by using the third edition of Stace (2010) for the nomenclature, apart from cereals which follow Zohary and Hopf (2000). In the report summaries cereal nomenclature has been

presented as published, such that if 'barley' is stated there is no assumption made as to whether this was hulled and six-row or not (*Hordeum* sp.). If 'oat' is mentioned and not specified as to species, or the species is said to be unknown, then it is followed by (*Avena* sp.) to show that this is the case. In the text preferred, standardised traditional binomial nomenclature for free-threshing wheat is used following Hillman et al (1996), which in the past has variously been referred to as 'bread wheat', 'rivet wheat', and so on. It is now accepted that the grain of free-threshing wheat cannot be reliably identified to ploidy level or species and is therefore referred to in the text as 'free-threshing wheat'. Where rachis was sufficiently well preserved to allow identification to ploidy level, this is recorded as hexaploid, bread wheat (*Triticum aestivum*) group, or tetraploid durum/rivet wheat (*Triticum durum/turgidum*) group. While Hillman et al (1996) warn against making assumptions on geographical grounds, it is assumed that tetraploid wheat present on medieval sites is rivet wheat (*Triticum turgidum*) rather than durum or pasta wheat (*Triticum durum*) on historical and ecological grounds, and is therefore recorded as rivet wheat for brevity. For practical reasons all weed taxa could not be listed in each report, but selected ecologically useful taxa such as stinking chamomile (*Anthemis cotula*, an indicator of heavy soils) are often listed. Original reports should be consulted before citing details from the review or from the spreadsheet.

Archaeological terminology used in the review follows the Forum on Information Standards in Heritage (FISH) vocabulary lists, with the exception of 'cesspit' which follows standard English useage as given in the Oxford English Dictionary. Archaeological feature types and site types use FISH vocabularies: monument thesaurus, while chronological periods use FISH vocabularies: chronology. Capitals are used for defined archaeological periods (Neolithic, Early Bronze Age, Late Iron Age), but only for real nouns for cultural periods (early Roman, medieval, post-medieval). Capitals are not used for early, middle or late if used as adjectives rather than archaeological period names.

1.2.2 Mapping

We are very grateful to Gary Jones at Oxford Archaeology South for producing first draft of the maps in Figures 1 and 3-9. Final maps were produced by Historic England. All sites mentioned in the text and listed in the supporting data spreadsheets (for access please contact Historic England Environmental Studies team) have been plotted on the period maps. It should be noted that, because this review has a starting point of the year 2000, only a few earlier, notable sites have been plotted. The addition of all of the sites in Murphy and de Moulins (2002) to the maps would have made some of the maps unusable, particularly the periods with large amounts of data, such as the Roman and Medieval periods.

1.2.3 Links and references

Codes have been given to each site in the review e.g. [CB1]. For sites mentioned in the text the codes act as a hyper-link to take the reader to the Appendix. The site codes can also be used when finding sites on the period maps (Figures 2 to 7). In some cases, more than one code is given to a site in the online supporting summary data (for example where more than one publication from the same site has been used to produce a summary, or where several sites were discussed within one publication. These have been cross referenced in the 'notes' column to avoid confusion. References to sites not in the spreadsheet (mainly sites published before 2000 or outside the Midlands region, with a

few reports written after data collection for the review was completed) can be found in the 'General References' bibliography.

1.2.4 Searching the supporting summary data

A supporting gazateer of summary data for all archaeobotanical reports from the region consulted is available as downloads on the Archaeology Data Sevice website https://doi.org/10.5284/1090383 (Hunter Dowse and Carruthers 2021)

Searching the spreadsheet can be done county by county, for example to filter the records for sites from a specific period: using the drop-down tab on the 'Period' column, select 'custom' from the list of options. Select 'contains' from the menu provided for the left-hand box and type in (or select) the code for the period required in the right-hand box. The 'or' option can be used to widen the search, for example to filter for both Anglo-Saxon (AS) and Saxo-Norman (Saxo-Norm) periods.

1.2.5 Radiocarbon dates

Where the information is provided in the published reports, radiocarbon dates have been provided in the following format:

9970-9220 cal BC (HAR-4260; 9920±100 BP)

These dates have not been re-calibrated, and the calibrations quoted are those given in the publications referenced.

1.2.6 Abbreviations

A number of abbreviations have been used in the text and in the online supporting summary data spreadsheets:

CPR	-	charred plant remains
HNS	-	hazelnut shell
SBT	-	smoke-blackened thatch (also called 'soot blackened thatch' in some publications)
SFB	-	sunken featured buildings
cf	-	from the Latin '***confer***' (read as 'compare'; botanically an uncertain identification)
fpl	-	items per litre (identifiable, countable items such as seeds, grain, chaff fragments)
frag	-	broken fragments
sl	-	***sensu lato*** (in the broadest sense)

Commonly used abbreviations for archaeological periods such as IA (Iron Age), LIA (Late Iron Age), MIA (Middle Iron Age) have been used. In the online supporting summary data tables, the following abbreviations have been used in the 'Date' column (these can be used to filter the data, together with E (early), M (mid) and L (late) where specified), with additional date ranges or cultural period (Belgic IA, or 12th to 14th C) where recorded:

Prehist	– unspecified prehistoric
Palaeo	– Period 1; Palaeolithic
Meso	– Period 2; Mesolithic
Neo	– Period 3; Neolithic
BA	– Periods 3 and 4; Bronze Age

IA	– Period 4; Iron Age
RB	– Period 5; Roman
AS	– Period 6; Anglo-Saxon
Saxo-Norm	– Periods 6 and 7; Saxo-Norman
Med	– Period 7; medieval
PM	– Period 8; post-medieval

2. THE STUDY OF PLANT MACROFOSSILS

2.1 History of Work in the Region

Macroscopic plant remains have been recorded and identified since the 19th century (in the UK notably by Reid (1899)), but the systematic study of material from archaeological sites has greatly expanded in the last forty years. The methodology for studying plant macrofossils is constantly developing, although issues such as the integration of bioarchaeological data and its publication in site reports are still causes for concern (see above).

Besides the ongoing recovery of plant macrofossils from excavations across the country, experimentation (Reynolds 1974; Boardman and Jones 1990; Carruthers and Straker 1996), autecological studies such as the functional interpretation of botanical surveys FIBS (Bogaard et al 1999; Jones et al 2000a; Bogaard et al 2001) and ethnographic investigations (Hillman 1981; Mears and Hillman 2007) have proved particularly valuable aids to analysis and interpretation. The growing body of information is disseminated through university courses on the subject, conference papers published in the proceedings of the three-yearly International Workgroup for Palaeoethnobotany, in journals such as Environmental Archaeology and Archaeobotany and Vegetation History, and in site reports. Specialist emailing lists and work groups such as the Archaeobotanical Work Group (AWG) provide further useful methods of dissemination and discussion.

Because each year more excavations are carried out, increased numbers of soil samples are taken, and greater numbers of plant macrofossil reports are produced (all of which are to be very much welcomed) it has become increasingly important that the access to the rapidly growing volume of grey literature is improved. Development of the Archaeology Data Service (ADS) through OASIS https://archaeologydataservice.ac.uk provides a useful resource, as do county/university grey literature sites such as the University of Leicester 'Leicester Research Archive' (https://lra.le.ac.uk) and Worcestershire County Council Archaeology Library (https://public.worcestershire.gov.uk/sites/archaeology) . The Leicester Research Archive, provided by the University of Leicester library service, contains some specialist reports and publications produced by the University of Leicester Archaeology Service with PDFs available by author. Other welcomed developments are open access, free online publications such as Internet Archaeology, archived by the ADS (https://intarch.ac.uk). However, the tendency to only publish site syntheses, leaving specialist reports in online archives (or on as archived hard copies) is a worrying trend, because it can be extremely difficult to accurately draw all aspects of specialist reports together and do justice to the data without the full involvement of all specialists, a near impossible task to organise within the budgets and timetables of the largest (and often most important) projects. The inclusion of CDs containing specialist reports is useful,

although these are not always accessible to all library users and are easily lost and rapidly becoming obsolete. The redevelopment of OASIS to include the facility to upload specialist reports and report information is eagerly anticipated and should improve the ease of grey literature search.

Within the Midlands region a number of well-established archaeological organisations based within County Councils and Universities provide environmental archaeology services, including archaeobotany. Coverage of all areas of the Midlands has generally been good (but see Section 6.3). Over the past few years the economic downturn has led to the reduction of some of these services, causing great concern and loss of expertise and local knowledge. It is to be hoped that the economic recovery will see the re-establishment of lost specialist jobs so that improvements that were made over the last decade continue.

2.2 Sampling and Preservation

2.2.1 Levels of sampling on site

Plant remains yield useful information in isolation, but give more informative results and enhanced interpretations when analysed in conjunction with other biological remains and artefacts. In this review, aspects of early agriculture and environmental change that can be investigated using plant macrofossils alone will be emphasised. Plant remains have the potential, in all periods, to provide information on the plant component of diet, collecting and foraging, agricultural practices (especially those related to cereal growing), the introduction or importation of various non-indigenous plants and plant products, the reconstruction of local environments and habitat change, and on the use of plants for medicines, textiles and in construction.

Where sufficient quantities of plant remains are recovered from a site, distributed amongst a wide range of features and through all phases of occupation/activity, the information recovered can inform on the disposal of waste (crop processing waste, domestic waste, industrial waste, sewage etc), changes through time (changes in crop husbandry practices, in diet, in trade links, in status) and activity areas (distribution of plant remains across the site). However, these types of analyses can only be carried out where an adequate level of sampling has been conducted and where plant remains are present in sufficient quantities and are well preserved. Smaller numbers of samples and even individual 'spot finds' can be useful where unusually well-preserved or rare plant remains are present, but in isolation they may be as significant as a single pot sherd would be. The quantity of plant data (number of samples and number of plant items) needs to be sufficient to determine whether the assemblages are typical of the site and specific phase before comparisons can be made with other sites in the area. Useful discussions as to the quantities of remains that ideally should be analysed have been presented in the Historic England Environmental Archaeology guidance document (Historic England 2011). In the field, the aims and objectives of project designs have to be taken into consideration when setting up sampling and processing programmes for the recovery of archaeobotanical material. It is important for environmental archaeologists to be able to make decisions that suit the period (e.g. increasing sample sizes for early prehistoric deposits where the number of items per litre are often low), suit the preservation type (charred, waterlogged, mineralised, silicified) and suit the constraints of a competitively tendered budget in the commercial sector (e.g. prioritise selected periods or feature types). For this to occur, either on-site environmental

supervisors need to be fully experienced in archaeobotany, or they must be in close contact with the project arhaeobotanist to enable rapid feedback on decisions concerning priorities to be made. Poor or inadequate sampling and inexperienced specialists are often not cost effective.

Sampling and processing methodology will not be discussed in detail here because they are presented in the recently updated Historic England guideline document noted above (Historic England 2011). A brief outline of sample sizes under each section is presented below, and some discussion of problems encountered during the recovery of plant material in Section 6.4.

Summary of sampling principles

As a general principal, environmental archaeologists and field archaeologists need to take into consideration the following requirements to ensure that adequate data is recovered from environmental samples:

- the need for samples to be as representative of a context as possible (the smaller the sample size the less true this will be unless a deposit is highly uniform with very limited diversity, but practicalities and economics have to be taken into consideration)
- the need for sufficient replicates of samples within a category (e.g. within a phase, within a feature type, within an area of the site) so that variation can be understood, and patterning can be detected
- the need for taphonomic changes to the assemblage, such as loss of material during charring and burial, or loss of material from waterlogged deposits, to be taken into consideration
- the need for there to be an adequate dating framework within which to place the environmental data (remembering that the plant remains themselves can be used to build that dating framework), as well as an understanding of the security of the dating evidence (how susceptible is the deposit to contamination and residuality?). Important findings, such as early records of crop species, should be directly radiometrically dated using Accelerator Mass Spectrometry (AMS) wherever possible so as to add credible data to the national records.

If no samples are taken or analysed, the reasons for this need to be explicitly stated. It is not sufficient to make a statement like 'No deposits suitable for palaeoenvironmental sampling were observed.'

2.2.2 Types of Preservation

2.2.2.1 Charred plant remains

The most common mode of preservation is by charring (also called 'carbonisation', particularly in older publications), the heating of material in a reduced-oxygen atmosphere so that full combustion does not occur and the item is reduced to a decay-resistant carbon form. Reduced oxygen combustion may occur in the centre or base of a fire, or in a container. Because charred remains are not subject to biological decay, they can be found in almost all sites where human activity takes place. However, charred material can suffer physical damage following deposition, in areas of trampling and compaction or after burial. Gravelly and sandy soils often cause surface abrasion, shallow chalk soils can be subject to frost damage and clayey soils can cause mineral encrustation that prevents material from floating during processing. In contrast, waterlogged deposits, destruction deposits that are rapidly buried (such as burnt-down buildings) and samples

from within vessels can contain extremely well-preserved charred plant remains by virtue of the added protection that these contexts afford.

Charring can occur deliberately when rubbish is burned in a hearth, or when tinder and fuel are burned, or spoilt grain destroyed. Much of the charred cereal grain found on sites was probably burned accidentally, through spilling food during preparation or over-heating it, or through the burning of accidentally dropped foods amongst floor sweepings. Floor sweepings might also contain plant material falling from thatch, or from other building materials (e.g. turves, see Hall 2003), floor coverings, bedding and animal bedding/fodder, as well as material brought or blown in accidentally. The vast majority of charred plant material recovered from sites of all ages probably derives from the day-to-day background waste that accumulates around a settlement, becomes burnt as waste and is either deposited in a pit as hearth sweepings or blows around as ash, eventually finding its way into open features. However, chaff-rich deposits, particularly from Iron Age and Roman sites, may be evidence of primary large-scale crop processing or evidence of the reuse of chaff for fuel. The taphonomy of waste deposits can, therefore, be complex, and the deposits can contain material of multiple origins including material re-worked from earlier deposits. Although difficult to interpret because of their varied sources, where primary deposits are lacking and re-deposition/contamination is not a major problem, these types of assemblage can provide information about the relative importance of different crop plants, providing that a large enough number of samples are taken to ensure that the results are representative. Radiocarbon dating of important finds from such deposits is strongly advised.

Sample size

Sample size largely depends on the date and type of deposit, with large samples (e.g. 40 to 60 litres of deposit or more) being required for early prehistoric deposits or rural settlements, due to the low concentrations of remains present, but smaller samples often being sufficient for urban Roman, urban Medieval or Post-Medieval samples (perhaps 20 litres). Where concentrated charred waste is present in thick dumps, a greater number of smaller samples (e.g. 500ml) taken in sequence down through the deposit would be more useful. Floor surfaces or large spreads of material can be sampled in grid squares (10 litre samples or entire grid squares are often taken) in order to detect discrete dumps of specific taxa. It is particularly important to process and assess the entire samples in most cases as it is not possible to assume smaller sub-samples will be representative of the whole deposit.

Recovery methods

Charred plant remains are recovered using the fact that the carbon remains usually float when the soil sample is mixed with water. Standard methods of using either a 'Siraf-type' tank (employing an up flow of water through the soil sample which is held in a nylon mesh (500 microns or 1mm mesh)) or buckets are used, with the flots usually being poured off through a fine mesh (often 250, 300 or 500 microns) in order to recover small seeds of wild plants and chaff fragments. Where mineral deposits (e.g. iron or clay particles) prevent a high proportion of the charred material from floating (residues should be routinely checked for this reason) 'double floatation' usually overcomes this problem, while pre-treatment with sodium carbonate assists the break-down of clay particles. The residues should be washed through a 500 micron mesh in these cases (e.g.

on clayey soils) to prevent loss of small encrusted charred remains. After the first floatation, the residues are fully dried before being re-floated, at which point the remaining charred material usually floats off into the fine-meshed flot sieve. Double floatation may be difficult to carry out on site because of the need for adequate drying space for both flots and residues, but different methods have been devised, for example using fine-meshed bags made of net curtain material hung on washing lines at Potterne, Wilts (Carruthers 2000a).

Plant remains rarely preserved by charring

The principal component of charred assemblages is nearly always cereal remains and associated weed seeds for taphonomic reasons. Some taxa are not favoured by charring, either because they are rapidly destroyed by fire, or they are not preserved in an unrecognisable form. Members of the pulse family often lose identifying features such as their seed coats and hila, while roots and tubers can rarely be identified to genus. Others have no reason to be burned, such as soft fruits or leafy vegetables, so are only occasionally found as charred remains. Items that do not preserve well include oil-rich seeds, such as hazel nut kernels (which become soft) and flax seeds (which are often distorted), and items with a high-water content. These can burst open and ooze sap (including cereals that are harvested at milk-ripe stage). Charred crab apples are quite often found in Neolithic pits, despite their fleshy fruits, but these can have signs of being deliberately cut open, prior to being dried over a fire (for example, Broom, Arrow Valley ([WR30a] Moffett and Ciaraldi, 2000, 32)).

2.2.2.2 Silicified plant remains

These are derived from very similar deposits as charred plant remains but the high-silica content of certain plant structures such as chaff and certain weed seed coats (for example poppy (*Papaver* sp.), spike-rush (*Eleocharis* subg. *Palustres*)) means that burning can reduce them to white silica skeletons (the white ash in bonfires) rather than carbon (see Robinson and Straker 1991). Silicified material is usually found in small, visibly-white patches within the ashy fills of ovens, hearths and oven rake-out deposits in pits and ditches. Processing methods for charred remains are detrimental to the recovery of silicified and less-robust charred plant remains such as leaves, seed pods/capsules and chaff, so their adequate recovery is reliant on the provision of specific measures provided in the sampling strategy, for example as employed for accidental house/building fires (James Street, Covent Garden (Hunter 2004) and St Mary's Stadium, Southampton (Hunter 2005)), and *in situ* burning deposits (Gloucester Pipeline, Hunter 2016).

Sample size and Recovery method

The material should be carefully lifted in a block and examined by the specialist. No processing is necessary.

2.2.2.3 Mineralised plant remains

Where concentrated organic waste such as dung and faeces accumulate in a moist environment (perhaps a pit or midden on a slow-draining soil, or a lined cesspit) mineral replacement can occur. This type of fossilisation involves the replacement of soft plant tissues by minerals, primarily calcium phosphate (Green, 1979; Carruthers 2000a; McCobb et al 2003). The range of features in which mineralisation occurs includes cesspits, garderobes, sewage rich fills in pits or ditches, middens and basal deposits in sunken feature buildings (SFB). Roman, Saxon, medieval and post-medieval sites have

produced the richest deposits to date, but occasionally earlier examples are found on specific soils, for example the Late Bronze Age 'midden' at Potterne, Wiltshire on greensand (Carruthers, 2000a) and the Bronze/Iron Age settlement at Battlesbury Bowl on chalk (Carruthers, 2008). Because mainly soft tissues take up the minerals in solution, seeds are often preserved without their seed coats and soft tissues such as the flesh of soft fruits can become preserved. Most of the seed/fruit remains preserved in this way are denser than charred material so they cannot be recovered by floatation (although a minority are hollow and float). It is essential, therefore, to recognise their presence prior to processing the soil sample as specific methods must be used (see below) to ensure the recovery of this very informative, direct evidence of diet and middening. Signs to look out for during excavation and processing are:

- greenish staining to the soil
- large buff-coloured concretions in the residue or a large number of smaller, pale brown lumps making the residue abnormally large
- large rounded 'pea-like' items in the flots and residues, often mistaken for peas or beans (unidentified 'nodules' described in Carruthers 1989)
- amber-coloured mineralised seeds in the flot.

Identification can be difficult for these remains because in many cases seed-coats are not preserved. However, by removing seed coats from reference material some level of identification is possible for many food items.

Sample size

Ten litres per sample is usually sufficient from cesspits contexts. Prehistoric midden-type deposits may require larger samples (30 litres was found sufficient at Potterne) but the time taken to microscopically sort the large residues can be prohibitive. Where important, well-preserved mineralised assemblages are found, 10 litre samples should be taken in addition to any taken for charred plant remains.

Recovery method

As most mineralised remains are too dense to float, a 500 micron mesh should be used to retain the residue in the sieving tank while floatation for charred remains is being carried out. The residue may need to be double-floated (see above), freeze-thaw treated, or chemicals such as sodium carbonate or hydrogen peroxide can be added to break up any soil lumps. It is essential that a soil-free, clean residue is obtained as the dried residues will need to be fully sorted under a microscope. Mineralised concretions and fragments can contain a wide range of identifiable food items, such as bran concretions, pulse hila and testa fragments, fruit and spice seeds and weed impressions and seeds. Mineralised fly puparia, arthropod fragments and worm cocoons can also be recovered, providing additional information about the environmental conditions (Smith 2009; 2013).

Plant remains rarely preserved by mineralisation

In contrast to charring, softer tissues preserve better by this method such that, in some cases the kernel of a sloe-stone and the flesh become mineralised but the woody fruit stone decay away. Items that are less often preserved are whole cereal grains and chaff, (although they can survive, and curled fragments of bran are common), and whole pulses, though fragmented pulses can be frequent. Leguminous weed seeds are also rarely found perhaps due to the nitrogen-rich nature of the seeds bringing about rapid decay (Pat Wiltshire pers. comm.), or possibly due to the specialised hygroscopically

activated valve mechanism in the hilum preventing uptake of the mineral-rich surrounding moisture (hypothesis put forward by WJC).

2.2.2.4 Waterlogged plant remains

Where deposits such as river sediments and well fills have remained waterlogged throughout their history a wide variety of plant remains can be preserved due to the anoxic conditions preventing organic decay. Waterlogged assemblages can provide detailed information about the local environment, and where waste or sewage have been deposited, they can also produce evidence of diet and processing activities such as flax retting. The preservation of plant remains in peat is similar, although additional chemical factors are involved.

Sample size

Smaller soil samples are usually required because plant remains are often present in much higher concentrations (e.g. 1 litre). In some cases (for example at urban waterfronts where occasional economic taxa are present amongst frequent wild taxa) two types of sample are taken: a small stack-sieved sample for the recovery of all items down to 250 microns in size, and a large bulk sample wet-sieved to 1mm to recover larger, rare items as well as bones and artefacts (see Kenward et al 1980).

Recovery method

The soil is usually disaggregated in water and then poured through a graduated stack of sieves of minimum mesh 250 microns (180 microns for mites). A wash-over method can also be used, whereby the floating organic material is poured off leaving the heavy residue in the bottom of the bucket/bowl.

Plant remains rarely preserved as waterlogged remains

Although seeds from members of the grass family (Poaceae) are often preserved, they quickly become reduced to a thin, transparent seed coat (caryopsis) which can be difficult to detect and identify, and easily damaged. Cereal grains, therefore, are not frequent in waterlogged deposits although cereal bran fragments are frequently recovered and charred cereal remains can be found in very good condition, being protected from weathering and compaction by the surrounding organic material and. Waterlogged cereal chaff can also be preserved, but large deposits are rare. As with mineralised assemblages, leguminous seeds are rare, perhaps for the same reasons (i.e. rapid decay of the nitrogen-rich cotyledons). Most other taxa, however, are preserved where waterlogging has been continuous throughout the deposit's history. Some leafy vegetables are readily identified, such as Allium species.

2.2.2.5 Plant impressions

Although less work on plant impressions is carried out than in the early days of archaeobotany (e.g. Helbaek 1952) now that soil processing is recovering larger amounts of data, there is still a place for this study, as shown by van der Veen at Mucking, Essex [EX21] and Murphy at Spong Hill [NK41]. Impressions appear to be providing a different type of evidence which can be compared to the charred evidence.

The study of plant impressions has not moved on significantly in recent years, but as Murphy and de Moulins discussed in their original review (2002), additional information

can be obtained from detailed studies. Prehistoric (mainly Neolithic) impressions reported in Murphy and de Moulins (2002) were all on pottery. The crops and wild fruits recorded had all been identified from charred material at other sites of this date, so in this sense the impressions added nothing. However, due to problems of contamination at Neolithic sites (discussed further in Section 5.3) impressions may be the only reliable source of information about crops at some sites (e.g. at Spong Hill, Norfolk; [NK41]). For the Roman period, published impressions relate to other types of fired clay, particularly briquetage associated with salt production. The abundance of impressions of cereal chaff and straw used to temper clay objects manufactured at some distance from the nearest farms and fields serves to reinforce van der Veen's contention (1999) that crop processing by-products were regarded as a resource in themselves, rather than just waste. Salt-marsh vegetation was readily available locally and could perfectly well have been used as vegetable tempering, yet crop by-products were preferred. Studies of impressions on early Anglo-Saxon pottery have produced very consistent results from geographically disparate areas. At the sites so far studied, the main crop represented as impressions is barley (apparently only *Hordeum vulgare*). So few charred assemblages of 5th-early 7th century AD date have been reported, that it is difficult to assess whether this represents a real emphasis on barley production, or whether the data are related to methods of consumption. It could be argued that, if barley grains were consumed as whole grain, in soups, stews etc, whereas other cereals were consumed mainly as flour or meal, there could have been accidental spillage of barley, rather than other cereals, around domestic hearths. Consequently, if pottery was made in domestic circumstances, barley grains would be more likely than other cereals to be accidentally mixed into the clay.

However, so far as pottery production is concerned, explanations of this type are questionable. Mixing chaff and chopped straw as temper with clay intended for use in crude structural materials, such as briquetage, makes practical sense, to avoid cracking during firing; but it is hard to understand why grains and sometimes whole spikelets should so often have become incorporated into clay intended for pottery, notably in the Neolithic and early Anglo-Saxon periods. After firing, the large voids left when grains burn out would inevitably have weakened the pot, making it more prone to fracture. In some cases, very large items were incorporated, such as an entire spikelet of emmer (*Triticum dicoccum*) with its internode, in a Neolithic sherd from Spong Hill, Norfolk [NK41]. It is hard to believe that potters would not have been aware of this structural weakness, or that they would have overlooked something as conspicuous as an emmer spikelet. Craftswomen and men generally take pains with their raw materials: could potters in the past really have been so careless? It seems far more likely that grains were intentionally incorporated, for reasons which we can only surmise, but which presumably fall in the 'ritual' category of human behaviour. It is interesting to note that cereal impressions have not been recorded in Late Neolithic Grooved Ware ceramics (Gibson, 2002; Mike Russell pers comm.).

In summary, there is still a role for the study of impressions, especially for periods where charred material is sparse and possibly contaminated; and for examining specific types of ceramic (such as briquetage), and structural materials such as daub and brick.

2.2.2.6 Desiccated plant remains

Although there would appear to be no likelihood of finding material preserved in this way on buried sites in Britain, standing buildings can contain well-preserved plant material that has effectively been preserved due to desiccation, being sealed into the clay matrix of

building materials such as daub. Where a wattle and daub wall or ceiling can be dated, the remains can provide information about the types of activities that were taking place nearby at the time of construction, since waste materials such as flax retting waste was often mixed into the clay (e.g. Althrey Hall, Wrexham, Carruthers 1991). It can also provide valuable evidence for the use of cereals, as identifiable chaff fragments were also often included in the mixed organic material used for tempering daub, or as stuffing or insulating materials. This is, as yet, a fairly untapped source of information which could be particularly useful for the later medieval and post-medieval periods, at times when different land races of cereals were developing. The information would be particularly useful in conjunction with evidence from smoke-blackened thatch (see below).

2.2.2.7 Smoke-Blackened Thatch

In some late medieval and post-medieval buildings areas of smoke-blackened thatch (SBT; also called soot-blackened thatch) provide a wealth of information about the crops being used for thatching, weed and insect remains mixed with the thatch and other types of materials used for base coats and ridges (Letts 1999, see Section 5.7.4.3). Preservation of the base layer of the thatch occurs due to the accumulation of soot from open fires and can be exceptional, with whole ears of cereals providing a wealth of information about cereal land races and varieties. This topic is discussed in more detail in the Medieval Period Section 5.7.4.3.

2.2.2.8 Preservation biases

In addition to the biases mentioned in each section, whole groups of food plants are missing from archaeobotanical assemblages, in particular leafy vegetables, root vegetables, (including tubers and rhizomes), plant foods imported already ground up or made into beverages, and wild food resources (which may be present but are often difficult to confirm as having been exploited). Even mineralised and waterlogged assemblages, although often richer in food plants than charred assemblage, are biased towards fruits/seeds because these organs are more often preserved in a recognisable form. Certain seeds simply do not preserve well or are not identifiable to species or genus, while others require identification of specimens mounted on slides at magnifications of x400. There is a need to look for less obvious plant material, such as possible leek (*Allium* sp.) epidermis (see Tomlinson (1987), Nantwich) in well-preserved waterlogged deposits containing faecal material. More in-depth investigations into plant foods that we know from documentary sources should be found, but have not yet been detected, might increase our range of food remains that can be recognised (see Greig 1996). We need to examine these at a cellular, but macroscopic level (i.e. looking for distinctive seed coats, leaf hairs, cell patterns etc) in order to see which can reasonably be detected using a low-power microscope. By far the largest volume of archaeobotanical work currently occurs in the commercial sector in the British Isles and it is not often practical to use expensive, time-consuming techniques (such as Scanning Electron Microscopy) under these circumstances.

2.2.2.9 Phytoliths

Although resources for the current review did not stretch to cover phytoliths, Murphy and de Moulins did discuss their potential in their original review (2002):

> Phytoliths are bodies composed of opaline silica, formed predominantly within plant cells, though intercellular silica depositions also occur. There have been very few studies from sites in the Midland region. Although classification of morphology is possible (Armitage 1975; Parry and Smithson 1964, 1966; Twiss

> et al 1969), definite identification to a particular plant species has proved elusive, though there are indications that some forms may be characteristic of particular groups of plants. This has discouraged extensive study. Very large, spiny, often dendriform phytoliths have been considered by the above authors to be characteristic of cereals, and dumb-bell phytoliths of the heath and/or bog grasses *Molinia caerulea* and *Danthonia decumbens*. However, without very extensive study of reference material it is impossible to assert with confidence that these forms do not occur in other species as well. A preparation method devised by Dr R. MacPhail is described in Murphy (1986) and a second method is given by Powers and Gilbertson (1987). Phytoliths may be extracted from coprolites by treatment with dilute HCl. This produces a brown suspension which may be mounted on microscope slides for high power examination (Murphy 1992).

Murphy and de Moulins provided two examples of useful phytolith studies from the Midlands:

> At Bowthorpe, Norwich an Early Bronze Age inhumation burial was examined. The burial was in acidic sand, so that the body survived only as a stain. There were also stains representing a coffin and a rectangular area of staining under the skull area which was thought to represent a pillow (Murphy 1986). Phytoliths were extracted from a sample of the latter and compared with phytolith assemblages from the surrounding natural sand in the Bowthorpe grave, from a Roman deposit from Somerton, Suffolk (Murphy, unpublished) composed of ash from combustion of cereals, and from modern heathland and neutral grassland soils at Mousehold Heath and Earlham Park, Norwich, respectively. The natural sand into which the Bowthorpe grave was cut proved to contain much lower densities of phytoliths than the 'pillow stain'. The cereal ash sample included no dumb-bells, but over 40% of large, elongate, spiny, dendriform phytoliths which confirmed previous observations that these forms are common in cereals. The two modern samples included a high percentage of wavy-edged costal rods (36.2 - 36.7%) and low percentages of dumbbells. The Bowthorpe sample contained more dumb-bells (9.6%) and few elongate spiny phytoliths (2.3%). From these results it was concluded that the Bowthorpe 'pillow stain' did represent a real concentration of phytolith-containing plant material, but it had not consisted of cereal straw or chaff. The high percentage of dumb-bell phytoliths was thought to indicate that heath grasses may have been used in making the pillow.
>
> At Culver Street, Colchester [EX10] coprolites from Roman deposits were examined for phytoliths and other microfossils. High power examination of HCl-insoluble material showed that microfossils from some forms of coprolite included abundant phytoliths, some of which remained aggregated as 'silica skeletons' of tissue from grass/cereal stems or leaves (Murphy 1992). The phytoliths were mainly of elongate spiny forms, though dumb-bell phytoliths were noted. Indeed, charred macrofossils of both cereals and *Danthonia decumbens* came from the same deposits. The abundance of phytoliths in these particular samples served to establish that herbivore coprolites were represented.

3. GEOLOGICAL AND TOPOGRAPHICAL BACKGROUND TO THE REGION

A detailed discussion of the Geoarchaeology of the Midlands region is provided in the Historic England (previously English Heritage) review by Matthew Canti (2009). It includes a useful range of figures showing the location of the major rivers (p.2), major mineral resources (p.11), major coastal sites, marine and estuarine sediments and peat deposits (p.15), Iron Age and Roman salterns in the fenland (p.28) and the Red Hills of Essex (p.35), all of which are relevant to the plant macrofossil review. The British Geological Society provide a useful, searchable, map of the geology and soils of the midland counties (http://mapapps.bgs.ac.uk/geologyofbritain/home.html).

3.1 Topography

The seventeen counties of the Midlands region (Figure 1) provided an extremely wide variety of landscapes and natural resources to early settlers. Beginning with landscapes that would have been the most accessible to early settlers, these include coasts, salt marshes and fenlands of East Anglia and Lincolnshire, and major river systems such as the Thames (forming the southern boundary to the region), Lea, Stour, Yare, Wensum, Great Ouse, Nene, Witham, Trent, Derwent, Avon, Severn and Wye.

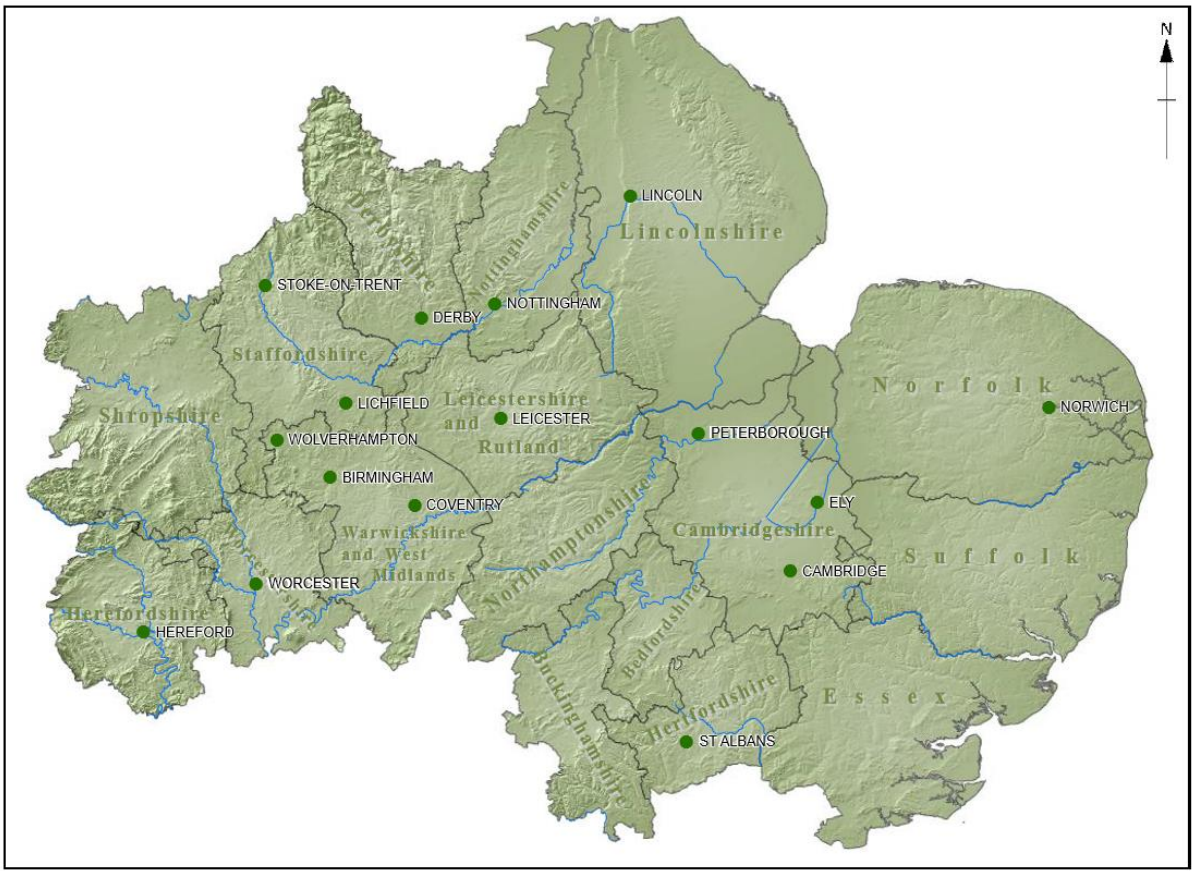

Figure 1: Map of the Midlands region included in the review showing major modern settlements and rivers

Topographically, the region rises to its highest point in the Black Mountains on the Herefordshire/Powys border (highest point at Black Mountain, 703m; Old Red Sandstone), with Kinder Scout in the Derbyshire Peak District in the north of the region (maximum height of 636m; Gritstone and limestone), and the Long Mynd in the Shropshire Hills to the west (516m; geologically ranging from igneous rhyolite to metamorphic schists to sedimentary Old Red Sandstone and limestone). To the south-west of the region the Malvern Hills are located in Herefordshire and Worcestershire (Worcestershire Beacon, 425m; Pre-Cambrian igneous and metamorphic rock). The more rounded chalk and limestone landscapes of the Chilterns in Bedfordshire, Buckinghamshire and Hertfordshire (highest point at Haddington Hill, 267m), the Cotswolds in Warwickshire and Worcestershire (Cleeve Hill, 330m; Oolitic limestone), and the Lincolnshire Wolds (Wolds Top, 168m) would have provided valuable arable and grazing, as well as strategic vantage points for ceremonial and funerary purposes, and in times of conflict. Agriculturally and in terms of woodland resources, some of the most important areas are the gently undulating lowlands and claylands of the Midlands, such as the Bedfordshire and west Cambridgeshire claylands, and the south Suffolk and north Essex claylands. The lowest lying land in England is found in the Midlands region, consisting of large expanses of fenland and coastal plains in the east that in places lie below the 0m OD contour. Following drainage of the fens in the nineteenth century leading to shrinkage of the peat, Holme Fen in Cambridgeshire is said to be the lowest point in Britain at nearly 3m below sea level.

Sea-level changes would have had major consequences for low-lying land in East Anglia and Lincolnshire, often resulting in the abandonment of sites such as Flag Fen. Although sea level change was rapid in the early post-glacial period, it had slowed down by c7.5 thousand years ago, and more or less reached the current sea levels by the Neolithic period (Canti 2009). Around six thousand years ago the East Anglian coastline would have appeared more undulating than today, but since then the silting up of estuaries and wetlands has created the current coastline.

3.2 Soils

The seventeen counties of the Midlands region lie almost entirely within the Lowland Zone, where the younger, softer Mesozoic and Tertiary bedrocks have eroded to produce more rounded, lower hills and plains than in the more ancient, hard rocks of the Highland Zone (Evans, 1975; Stamp and Beaver, 1971). The softer rocks of the Lowland Zone have, on the whole, produced deeper, more fertile soils making much of the region well-suited to arable farming. Soils range from highly fertile lime-rich chalky boulder clay with slightly impeded drainage in central and eastern counties such as Cambridgeshire, to moderately fertile shallow lime-rich soils over chalk or limestone in parts of Lincolnshire and East Anglia, and to poor, free-draining acidic Breckland sands and acid, loamy soils in parts of Norfolk and Suffolk (http://mapapps.bgs.ac.uk/geologyofbritain/home.html). Having such a range of soils to work with has enabled the farmers of the Midlands region to grow a wide variety of crops over the centuries. During the mid-Holocene a period of erosion, which has been primarily attributed to increased cultivation, led to the formation of the heavy clay soils of the Midland Plains (Canti 2009, 4). Although the period of increased sedimentation mainly dates to the Late Bronze Age/Early Iron Age it has been found to vary in different regions, for example in the upper Thames, Nene and Ouse valleys it is Iron Age or later (Robinson 1992). The availability of heavy, fertile soils in counties such as Essex and

Cambridgeshire was important in allowing for the expansion of arable agriculture during periods of population increase, such as the Romano-British period.

The contrast between the zones in terms of suitability for growing cereals increased during the period of climatic deterioration in the late second to early first millennium BC, when temperatures dropped and rainfall increased, with the loss of soil fertility made worse by increased land clearance around this time (Evans, 1975; Lamb, 1981). The formation of peat and heathland occurred in upland areas of both the highland and lowland zones, and on more marginal soils the appearance of the landscape was often permanently altered.

3.3 Natural resources and trade links

The occurrence of natural resources such as flint in Norfolk, iron in Northamptonshire, lead in Derbyshire and Shropshire and copper just over border in North Wales would have played a fundamental part in influencing settlement and trade patterns in the region. The Neolithic flint mines at Grimes Graves, Norfolk and Iron Age salterns at Droitwich, Worcs (Woodiwiss 2000) would have been major centres of activity in prehistoric times, spreading their influence across the region. Therefore, what some of the Midlands lacks in the west by way of coastal resources are more than made up for in its rich mineral resources and fertile soils. The East Anglian coastline, facing northern European ports in the Netherlands, Germany and Scandinavia would most likely have been the first region of the British Isles to receive new cereal introductions and food plants being brought in from fertile regions of central Europe. It is likely that river systems such as the Thames, the Great Ouse, Nene and Welland served as important trade routes into the Midlands. Further discussion of the introduction of new crops can be found in Section 6.7.

3.4 Climate

The Midland region is bordered by the Welsh Mountains to the west, which draw off most of the wettest weather coming in from the Atlantic, and by the many miles of North Sea coastline in East Anglia and Lincolnshire to the east. According to current climate data the wettest areas of the Midlands are along the Welsh border where the average rainfall exceeds 800mm a year. Upland areas such as the Derbyshire Peak District receive particularly high rainfall. In contrast eastern England contains some of the driest areas of England, with some parts receiving less than 500mm a year (http://www.metoffice.gov.uk).

The climatic effects of the geography are to provide mild, dry winters to the west, cold dry winters to the north-east and hot dry summers in the central and eastern areas (Shirlaw, 1966). It may be for reasons such as these that particular crops became established earlier in some areas than others, for example, it appears that frost-tender tetraploid free-threshing rivet-type wheat is found in the central and eastern part of the country from around the late Saxon period, spreading out to surrounding areas during the early and later medieval period. Topics such as this require further research.

4. THE ARCHAEOLOGICAL RECORD

Some of the background information prepared for the review by Murphy and de Moulins concerning archaeological coverage of the region is still relevant today, which could be seen as an interesting or worrying observation after more than ten years of further research and developer funded interventions. In some cases, this reflects the rural nature of particular counties and lack of development, but in others it may have more to do with the lack of active archaeological units or university-based research departments close-by. Murphy and de Moulins noted that the known archaeology of the western part of the area was very unevenly distributed. In contrast, some areas of central and eastern Midlands have been favoured by the creation of major surveys. The fenlands of eastern England were surveyed and excavated intensively during the 1980s and 1990s under the auspices of the Fenland Management Project (Crowson, et al 2000). Following a major programme of field-walking 41 of the 2500 sites discovered were excavated in order to assess their current state of preservation and devise a programme of management for the future. The wetlands of Shropshire, Staffordshire and Derbyshire were extensively surveyed within the North West Wetlands Project and assessments were made of the palaeoecology of the surveyed areas (Leah and Crowson 1994). Archaeological knowledge in Northamptonshire has been increased in recent years by the major excavation programme in the Raunds area (Harding and Healy 2008; Auduoy and Chapman 2009) which has provided an understanding of landscape change that is of national importance. In the last fifteen years many developer funded archaeological investigations have been carried out in the Midlands, particularly in Bedfordshire, Leicestershire, Warwickshire and Worcestershire. However, counties such as Derbyshire and Nottinghamshire have produced far fewer sites. Further discussion of the coverage by county can be found in Section 6.3.

5. PERIOD REVIEWS

The period reviews have been divided into the same seven sections that have been used for the Northern England and Southern England reviews, so that the data can be compared across the country. Inevitably, imposing arbitrary divisions on time has meant that difficulties arise in the transitions from one section to the next. It also means that multi-period sites are difficult to include without too much repetition. For this reason, sites have usually been included in the period of greatest interest in terms of the archaeobotany. Occasionally they have been divided between several period reports.

5.1 Early Hunter-Gatherers: the Palaeolithic (c950,000-10,000 BP)

The time frame for the majority of this Review begins as the last ice sheet (Devensian) retreated northwards from its maximum extent, having stretched across the Midlands from south-east Wales to the north Norfolk coast. Glacial activity left behind extensive deposits of till, or boulder clay, in West and East Midlands which influenced human settlement from the outset, particularly from the time that soils were brought under cultivation, but probably also during forest clearances.

However, the section below begins with some information obtained from plant macrofossils that pre-date this period, primarily to demonstrate that there is potential in the analysis of Pleistocene sites, even where the use of plants by humans cannot be demonstrated. It is important to investigate sites even where there is no direct evidence of human activity in order to obtain baseline environmental data from which to work. A number of recent reviews and projects have helped draw together information from this extensive and poorly understood period, including the Palaeolithic and Mesolithic section of 'Research and Archaeology Revisited: A revised framework for the East of England' (Medlycott 2011) which drew on an English Heritage/Prehistoric Society review (Pettitt et al 2008). A range of other projects contributed towards the 2011 review, such as the Suffolk River Valleys Project (commissioned in 2006) and the Fenland Rivers of Cambridgeshire Palaeolithic Project (initiated in 2007). The Environmental Archaeology section by Angela Monckton (2006) of the East Midlands Review was a valuable source of palaeoenvironmental data, as was James Greig's 'Priorities' paper in the West Midlands Review (Greig 2007).

5.1.1 Lower and Middle Palaeolithic (c700,000-c500,000 BP)

Waterlogged plant macrofossils are most commonly preserved on sites of this period, and these are often associated with fluvial and peat deposits. They can provide an insight into changes in the local environment, particularly when combined with other environmental evidence. Like insect evidence, plant macrofossils may help to identify the local environment at any given time which, when combined with pollen evidence, give a broader picture of the surrounding environment and how it changes through time. When associated with finds such as at Happisburgh [NK40] (see below), they can help to build a picture of the environment in which humans were living. However, because no human intervention is usually involved in waterlogged preservation, the mere presence of useful taxa such as nuts and berries cannot always be used to indicate human activity on a site. Another of the problems identified in sequences throughout Britain are the hiatuses created as successive periods of glaciation forced people further south and the evidence of past environments were scoured away by glacial erosion.

Excavations carried out in 2010 at Happisburgh, Norfolk (Parfitt et al 2010) [NK40], recovered well preserved plant remains associated with a butchery site dated to at least 700,000 BP. If older than this it will be the earliest site in Northern Europe. The evidence suggested that the site was occupied in a Boreal environment, similar to parts of modern Sweden. Although the plant macrofossils provided no direct evidence of plant utilisation they gave valuable information about the local environment, particularly in combination with the other palaeoenvironmental evidence of pollen and beetle remains. They also highlighted the potential for plant macrofossil survival alongside early human activity. Identifying the potential for plant macrofossil evidence is bound more strongly with other environmental research during the early prehistoric period, possibly more so than at any other period of archaeological research, at a time when human activity is difficult to detect, having less impact on the environment than in later periods. Although this volume is specifically looking at plant macrofossils, it is important that they are considered alongside all other available environmental tools. The pine (*Pinus sylvestris* L) cone found at Happisburgh (Parfitt et al 2010) is an extraordinary object and testament to the potential survival of biological remains. It is however of limited value if considered on its own. Its greatest value is as part of the complex data set of evidence gathered from the site.

Investigations at Pakefield Cliff, Gisleham, Suffolk (Parfitt et al 2005; Wymer and Robins 2006) [SK27], produced plant macrofossils, alongside animal bones and struck flints. The plant remains have helped to show that human activity took place in a Mediterranean-like climate around c700,000 BP (Stringer 2006). Both of these sites highlight the potential for further evidence of human exploitation of the area between periods of glaciation.

Plant macrofossil evidence and pollen recovered from pre-Anglian glaciation deposits at Brooksby, Leicestershire (Rice 1991; Monckton 2006, 263-65) [LR43], indicated a mild climate. A lower deposit produced evidence for woodland containing birch (*Betula*), pine, fir (*Abies*), hazel (*Corylus*) and oak (*Quercus*). Wetter ground and more open vegetation was indicated by waterside plants, heaths and heathers. An upper deposit produced a similar range of tree species without the evidence for oak. Herbaceous plants included violet (*Viola* spp), heather (*Calluna vulgaris*), mountain sorrel (*Oxyria digyna*) and crowberry (*Empetrum nigrum*). The deposits were dated to around 478,000 years ago (Graf 2002). More work on the site is currently being carried out by ULAS and Royal Holloway University of London (Angela Monckton pers. comm.). Recent geomorphological work at Brooksby suggests that the sediments may be derived from minor channels associated with the Bytham River. The ancient Bytham River with its wide sand and gravel banks is thought to have flowed through the Midlands until the Anglian glaciation around 450,000 years ago when it became buried beneath glacial deposits. It is likely to have provided an important route into more central parts of England in the first half of the Pleistocene (Rose et al 2001).

Other plant macrofossils have been studied from a number of Pleistocene sites in the study area such as the type-Cromerian sediments at West Runton, Norfolk and Late Devensian sediments in the Lea Valley, to the north of London and elsewhere (Bell 1970, Godwin 1975). A series of plant macrofossils were extracted from organic channel sediments at the Devensian mammoth-butchering site with associated Mousterian lithics at Lynford Quarry, Mundford, Norfolk (Field, 2012).

5.1.2 Upper Palaeolithic (c500,000 to 10,000 years BP)

Although nationally important cave sites such as Creswell Crags, Derbyshire have produced remarkable animal bone assemblages (Jenkinson and Bramwell 1984), river valleys and palaeochannels more often provide the conditions necessary to preserve waterlogged plant remains. A deep drift filled basin containing laminated clays and compressed peats at Wing, Rutland produced pollen and plant macrofossil evidence that was dated to the Ipswichian interglacial and start of the Devensian glacial, c110,000 years ago (Hall 1980). The vegetation changes over this period consisted of the establishment of mixed oak forest, a change to a more temperate hornbeam forest, followed by falling temperatures producing tundra-like conditions.

Quarries have also produced some remarkable finds. The partial skeleton of a woolly rhinoceros dating back to the middle Devensian (41-43k cal BP) was discovered at Whitemoor Haye Quarry, Staffordshire [ST29]. The associated pollen, plant macrofossil and arthropod remains provided evidence to show that the animal had been buried rapidly on a river floodplain surrounded by almost treeless herb-rich grassland. Plant macrofossils included indicators of tundra: dwarf birch (*Betula nana*), dwarf willow (*Salix herbacea*) and mountain avens (*Dryas octopetala*), open grassland: thrift (*Armeria* sp.), silverweed (*Potentilla anserine*), perennial flax (*Linum perenne*), grasses, and aquatic habitats: crowfoot, pondweed (*Potamogeton* spp) (Field in Schreve et al 2013). The overall palaeoenvironmental reconstruction indicated a river floodplain with a series of broad, shallow channels, surrounded by open vegetation dominated by grasses, sedges, arctic-alpine dwarf shrubs with areas of bare ground and pools at the margins of melting snow.

Willington, Derbyshire [DB5] Seven sample columns were examined for pollen and plant macrofossils. They included a late-glacial (c11,780 BP) to 2nd millennium peat, palaeochannels possibly dating from the prehistoric to Roman periods, and fills of a wooden trough and silted channel associated with a Bronze Age burnt mound. Preservation was good and the remains were abundant. The prehistoric palaeochannel (column 1) mainly contained birch and willow macrofossils, with pine, birch and hazel pollen and wetland plants (both pollen and plant macrofossils). The upper levels contained charcoal and ruderals, indicating signs of human activity (at around 50cm of a 98cm core; top dated to 11,405±45BP (SUERC-7350)). The bottom of the core was dated to 11780±45 BP (SUERC-7351).

5.2 Mesolithic (c10,000 to 6000 BP)

As the Devensian ice sheet retreated and sea levels rose around 10,000 BP, eventually cutting the British Isles off from the Continent of Europe, waterlogged and peaty deposits were formed, preserving evidence for climatic warming. The advance of thermophilous species of plants and insects can be observed in waterlogged sequences and peats.

The lack of direct evidence for plant exploitation in the Mesolithic across the Midland Counties is notable, though it is also scarce in other parts of the British Isles. Even in the Later Mesolithic, when there is a notable increase in the use of fire by humans to deliberately bring about vegetation change (Turner and Hodgson 1983; Williams 1985) there is little variety in the range of potential food plants preserved. Occasionally it is possible to be reasonably certain that the remains recovered had been collected for food, for example in burnt deposits at Mother Grundy's Parlour, Cresswell Crags, Derbyshire [DB27], where hazelnut shell but no hazel charcoal was present. Nevertheless, even

where no direct evidence for plant use is produced, environmental data can provide baseline vegetation descriptions against which human activities can be identified.

Waterlogged

There is a large number of studies of palaeochannels in river valleys such as the Trent, Nene and Welland, many of which date to the end of the last glaciation. A site at Austin Friars, West Bridge, Leicester [LR35], dated to 9970-9220 cal BC (HAR-4260; 9920±100 BP), produced plant macrofossil evidence for a shallow aquatic environment surrounded by muddy ground, which was consistent with insect evidence for a cold climate supporting tundra vegetation. Macrofossils from Late Glacial-Early Flandrian (early Holocene) sediments encountered during excavation of later sites have also been examined in recent years. At Stebbingford, Essex (Murphy and Wiltshire 1996), fills of a palaeochannel infilled from Zone IV onwards (following Godwin's (1975) pollen zones for the British Isles, c10500 to 9500 BP) produced sparse macrofossils including *Salix* cf. *retusa*, a creeping willow that currently grows in alpine regions of Europe (Murphy and Wiltshire 1996). At Boxmoor, Hertfordshire [HT25], the fills of a pingo spanning the Late Glacial to Early Flandrian were assessed: the basal fills included macrofossils of dwarf birch (*Betula nana*) and bearberry (*Arctostaphyllos uva-ursi*), both sub-Arctic species typical of late-glacial deposits, while overlying deposits provided macrofossil evidence for progressive colonisation by woodland of hairy birch (*Betula* cf. *pubescens*) and then by alder (*Alnus glutinosa*), with other thermophilous trees. At Fishergate, Norwich [NK37], macrofossils from the base of a peat sequence dated to 9160-8320 cal BC (HAR-7062; 9410±110 BP), indicated the presence of reedswamp of common club-rush (*Schoenoplectus* cf. *lacustris*), with other wetland and aquatic plants. Results of this type are of value in providing information on habitats available to Late Upper Palaeolithic and Mesolithic communities.

As part of the Raunds Area Project, Northants [NH34], a Late Devensian deposit from a river channel in the Nene Valley was investigated. Organic sediments from the base of the palaeochannel dated to 9220-8260 cal BC (HAR-9243; 9370±170 BP) showed that the landscape was still largely open when the channel was first functioning (pollen evidence), with meadowsweet (*Filipendula*) and willow indicating damp grassland with some scrub. Alder grew in the valley bottom prior to Neolithic clearance, and numerous tree throws were thought to have been at least partially caused by human activity, as some were burnt. Sediments from the channel produced plant macrofossils relating to the late-glacial flora, including a cf. dwarf birch seed (*Betula* cf. *nana*) and willow (*Salix* sp.) buds. It was suggested that 'in the harsh, cold conditions of the late Devensian the floodplain is likely to have presented an environment of a sparsely vegetated, unstable, gravel or sandy-loam surface with low clumps of dwarf birch and willow scrub' (Campbell and Robinson 2007, 19).

River Soar at Croft, Leics [LR29] Late glacial and Holocene deposits associated with Thurlston Brook at Croft, Leics, were investigated. The pattern of landscape change was seen to echo that found in the Trent Valley region. A multidisciplinary study was undertaken. Nine out of 21 samples were examined for plant macrofossils. A wide range of aquatic, marsh, waterside, woods/scrub, open ground, disturbed ground and grassland taxa were recorded. The environmental evidence as a whole demonstrated that in the Early Holocene conditions were open, with grassland, sedges and some birch and pine cover. In the Neolithic, alder dominated the valley with some willow. The valley slopes were cloaked in hazel/oak/lime forest (2 lime fruits and pollen recorded). Small

clearings are suggested during the Neolithic though their causes are unknown. Later clearances were more extensive with a largely open landscape in existence at the time that the upper channel levels were deposited.

Charred

Charred plant remains are rarely found during this period and linking them to direct human activity is problematic. Murphy and de Moulins (2002) suggest that this is partly because suitable deposits for sampling have not become available: cut features, for example, are rarely encountered. Increasingly, however, charred parenchyma (plant tissue) and other plant fragments have been recovered from sites in this country. Traces of roots and tubers, acorns, hazelnuts and fruit have also been found on European sites (Holden et al, 1995; Kubiak-Martens, 1996; Perry 2002; Zapata et al 2002). Specific identifications of charred *Ranunculus ficaria* tubers and bulbils are reported by Mason and Hather (2000) from a Mesolithic site in the Southern Hebrides, alongside vast quantities of charred hazelnut shell (HNS) in a large feature (Carruthers, 2000b). The evidence suggested that gathered high-protein and carbohydrate-rich foods were being prepared for long-term storage. If so, there is the potential for the recovery of this type of evidence in other areas of the country. An exceptionally well-preserved Mesolithic platform at Derragh Island, Co. Longford, Ireland may hold the clue to this process, since the large quantities of HNS recovered from the site were part-waterlogged and part-lightly charred. The dominance of cleanly-split (longitudinally) shells suggested that they had first been sprouted ('stratification') to cleanly split the shells, then lightly roasted to dry them prior to storage (Bunce 2018). This method would maximise the opening of nuts without crushing them and make them last longer in storage once dried. To investigate this further it would be worth recording the incidence of complete longitudinal halves of nut in well-preserved, large HNS deposits.

At Spong Hill, Norfolk [NK41], Caistor St Edmunds [NK42] and Bixley, Norfolk [NK12], periglacial features and ill-defined subsoil hollows in-filled with charcoal-rich sands, sometimes containing Mesolithic flints, were sampled. Pine charcoal fragments from the Spong Hill examples were dated to 7540-7070 cal BC (HAR-7063; 8280± 80 BP), 7540-7060 cal BC (HAR-7025; 8259±90 BP), and (associated with flints) 7520-6820 cal BC (HAR-2903; 8150±100 BP). Abundant pine charcoal in a natural feature at Bixley gave a date of 8430-7830 cal BC (GU-5186; 8990±100 BP). In addition, a sample from Caistor included charred hazelnut shell. Mesolithic activity in Boreal woodland is presumably indicated, although the precise type of activity could not be established. The charred material could be derived either from localised 'domestic' fires, or from extensive wildfires, perhaps deliberately initiated by Mesolithic people.

Differentiating between natural and deliberate burning episodes is an area worthy of further research, since some authors suggest that wildfires are extremely unlikely to catch hold of certain tree species and are unlikely to occur in many wetland situations (Dana Challinor, pers. comm.). The management of tall vegetation in marshlands, and of forests, by fire at specific times of year is known from ethnographic studies. Significant evidence for the management of forests in the Mesolithic Period has been provided by palynologists, such as Lismore Fields, Derbys (Wiltshire and Edwards 1993), where close-interval sampling enabled short-lived, localised clearings to be identified.

Notable plant macrofossil evidence for the use of plant resources was recovered from Lightmarsh Farm, Worcestershire [WC37]. Charcoal, charred stems and rhizomes of

Poaceae, and 170 charred hazelnut fragments dated to 8610-8230 cal BC (BIRM-974; 9160±80 BP), were found in two samples in association with flint artefacts at a Mesolithic hunting camp. Examples of charred hazelnut shell a date early in the Mesolithic of 8560-8290 cal BC (SUERC-4969; 9220±40 BP) have also been found at Taplow, Buckinghamshire [BK21]. Where there is evidence for *in situ* burning, such as the possible Palaeolithic hearth at Beeches Pit, West Stow, Suffolk (Preece et al 2006), human activity can be confirmed.

At the Madawg Rockshelter, Wye Valley, Herefordshire [HF10] charred hazelnut shell fragments and a sloe stone were dated to the Early to Late Mesolithic (HNS - 8290-7830 cal BC (8930±70; OxA-6113); sloe stone- 8170-7580 cal BC (8710±70; OxA-6081); HNS - 5680-5480 cal BC (6655±65; OxA-6082)), demonstrating that the site had offered protection to hunter-gatherers over thousands of years. Evidence from other sources, however, suggests that the consumption of plant foods may have varied greatly between populations. The following description is taken from the Historic England Updated East Midlands Research Agenda (https://historicengland.org.uk/images-books/publications/east-midlands-heritage/ Knight et al 2012,56):

> Mesolithic material is especially sparse, and is best represented in the region by the discovery of a female femur associated with animal bone preserving evidence of butchery in the fill of a palaeochannel at Staythorpe in Nottinghamshire. This remarkable find was dated by radiocarbon to 5740-5620 cal BC (Beta-14401; 95% probability) and was shown by stable isotope analysis to derive from an individual heavily reliant on animal protein, with a surprising dearth of plant foods and no influence of coastal food resources.

Although beyond the scope of this Review, phytolith studies of cave deposits could be profitable in at least establishing the categories of plant material present (e.g. wood, herbaceous material, mature grass panicles; see Madella et al (2002)). This type of site offers great potential for detailed plant macrofossil studies in general should suitable, undisturbed sites be discovered in the future. Areas such as the Magnesian limestones of Derbyshire where Cresswell Crags is located have produced evidence for Mesolithic activity in the past.

5.2.2 Summary and future prospects

Figure 2 shows the distribution of pre-Neolithic sites producing plant macrofossils across the Midlands region. This map primarily shows publications dated to the years 2000-2010, the period covered by the remit of this review, although efforts have been made to plot any site discussed in the review. Therefore, important pre-2000 sites noted in the Murphy and de Moulins draft review (2002) and notable unpublished sites brought to the authors' attention have been plotted. The sparse coverage across the Midlands demonstrates that there is still much to learn about the environment and plant-based economy of this period in all counties.

Although peat and waterlogged sediments have produced evidence of climate change and details of local environmental conditions, very few sites can be said to demonstrate the collection of wild plants for food. Occasional fragments of charred or waterlogged hazelnut shell are not sufficient to prove deliberate gathering, as they may have been present amongst fuel and water-borne debris. However, at a time where nuts would have been a highly valued source of protein it seems inconceivable that they would have been

thrown onto a fire un-noticed amongst firewood. It is more difficult to confirm that human activities were taking place when studying areas of burning (which could be due to natural forest fires) and palaeochannel sediments, so an integrated, multidisciplinary approach is vital in such cases.

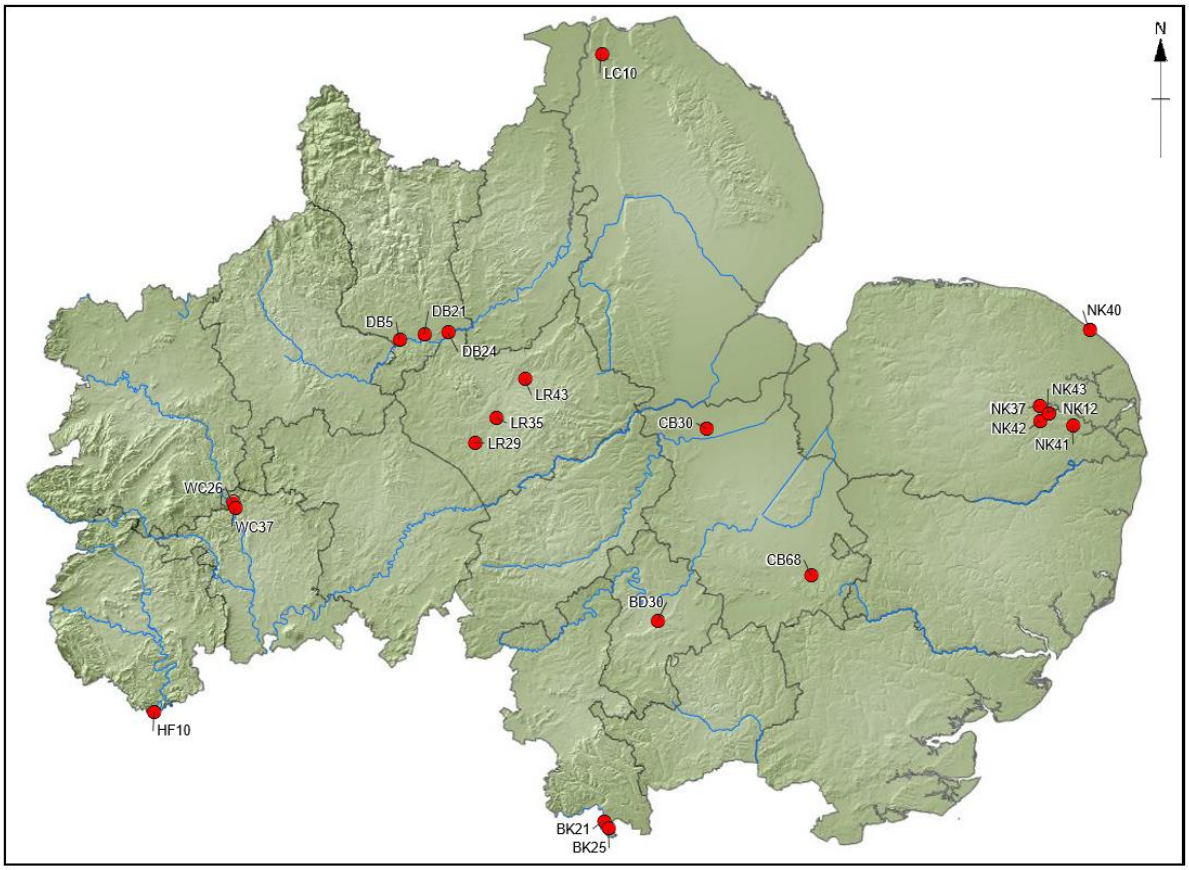

Figure 2: Palaeolithic and Mesolithic sites in the Midlands counties producing plant remains

BD44 Willington to Steppingley Pipeline; BK21 Taplow Hillfort; CB68 Rookery Farm, Great Wilbraham; CB77 Needingworth Quarry,Over; DB5 Willington Quarry; DB21 Swarkestone Lowes; DB27 Mother Grundy's Parlour, Creswell Craggs; EX20 Tank Hill Road, Purfleet; EX51 Stebbingford; HF10 Madawg Rockshelter, Wye Valley; HT25 Boxmoor; LC10 Conesbury Quarry Sidings; LR29 River Soar at Croft; LR35 Austin Friars; LR43 Brooksby; NH34 Raunds palaeochannel; NK12 Norwich Southern Bypass, Bixley; NK37 Fishergate, Norwich; NK41 Spong Hill; NK42 Caistor St Edmunds; SK28 Pakefield Cliff; ST29 Whitemoor Haye Quarry; WC26 Lightmarsh Farm

Although our knowledge of the pre-Neolithic period in the Midlands has improved over the last decade, sites of this period still need to be given top priority. Areas such as the East Anglian and Lincolnshire coast and river estuaries offer great potential, as do all peat deposits that began to accumulate in the early post-glacial period. Peat deposits (including coastal peats, buried basin peats, kettle holes, peat bogs and old river channels) continue to be under threat from activities that cause drainage and damage. They should continue to be closely monitored for sites being revealed due to shrinkage, commercial exploitation, coastal erosion and dredging. Geoarchaeological, macrofossil (plant remains and molluscs) and microfossil (pollen, diatoms, foraminifera and ostracods) research into off-shore peat deposits on the Dogger Bank in the North Sea (Doggerland) are currently being funded by a large offshore wind farm development (https://www.wessexarch.co.uk/news/secrets-doggerland#main-content). These

investigations are revealing important evidence for landscapes and human activity dating back to the Mesolithic period, and the deposits clearly hold great potential for future research. On dry land many Mesolithic sites have been detected by surface collection surveys, and where significant evidence is followed up by excavation there is the potential for charred plant remains to be recovered.

Murphy and de Moulins (2002) outlined that the top priority for future work was to obtain information on the plant economies of hunter-gatherer groups in the region, noting that in many cases palaeoecological information will aid site interpretation. The situation remains largely the same eleven years later, although recent and current projects, some of which are mentioned above, have helped to draw together research priorities and to increase data recovery. Recovery and analysis of charred plant assemblages from Mesolithic sites remains a top priority.

The lack of data from Late Mesolithic sites is particularly regrettable, not only in terms of understanding that period, but for defining a base-line for understanding the Mesolithic/ Neolithic transition. The first step is to find appropriate sites. Collaboration with field archaeologists attempting to locate wet sites is essential. On the whole there seem to be few published excavations of Upper Palaeolithic and Mesolithic sites which is unfortunate as they represent periods of increased incidence of the human population becoming more sedentary and therefore potentially having a greater impact on the environment. As outlined in the East Midland Framework, although sites such as in the Lea Valley and the Fen-edge have been identified as potentially informing on the pattern of Mesolithic occupation and exploitation, little excavation or survey work has been carried out.

The problem of lack of Palaeolithic and Mesolithic evidence may be due to the material not being preserved in the first place but it may also have been destroyed by subsequent glacial erosion through to modern coastal erosion /climatic change and/or human activity. The North Derbyshire Archaeological Survey published in 1984 (Hart) outlined the risk to deposits from mineral extraction, forestry and change of agricultural use, and particularly, the ploughing of previously uncultivated land. These risks are still relevant today to the whole region. Sites which are being exposed by active erosion, as at Happisburgh and Pakefield, highlight the fragility of some of these sites. With the threats to coastal areas due to climate change becoming better understood and fully accepted, it is important that sites are rapidly detected and investigated before the evidence is lost.

It is useful to repeat some of the research topics highlighted in 'Research and Archaeology Revisited' (Medlycott 2011) that are of particular relevance to the study of plant macrofossils:

- The diminishing coastal [archaeological] resources need to be monitored and recorded before they are lost. Particular attention should be paid to sieving for artefacts and environmental remains
- Channel deposits that are unusually deep-lying and so protected from disturbance should be investigated, incorporating sampling programmes for environmental remains, which have the potential to be well-preserved
- A fuller understanding of the Holocene environment is required, including the area now submerged beneath the North Sea

- The Greater Thames estuary is a key area for study of past environmental change and its relationship with human activity, including sea level change in the Mesolithic Period. A combined lithostratigraphic framework, dating programme and environmental study are required
- HERS should include geological and palaeoenvironmental data to help ensure that threats are met with the appropriate response
- Specialist input is required to educate archaeological professionals, to help improve evaluation and excavation methodologies and share best practise
- The lack of Mesolithic sites should be actively addressed by identifying areas with potential. Integrated research including palaeoenvironmental input needs to be employed.

Another reason why sites of this period may not be funded and or reach publication is that it may be very difficult to persuade archaeological consultants and therefore their clients to pay for anything which could be considered paleoenvironmental rather than archaeological, i.e. sites /deposits that have little or no evidence of direct human activity. In the Government's National Planning Policy Framework (NPPF 2012, 52) the Historic Environment is defined as:

> All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.' It depends on where curators and consultants draw the line as to whether or not sites are thought to fall into this category. Clearer guidance is required for the whole of the British Isles.

5.3 The Rise of Agriculture: the Neolithic and Earlier Bronze Age (c 6000-3250 BP)

The presence of cereal pollen in deposits dated to around 6000 BP marks the beginnings of arable cultivation in the British Isles. Unfortunately, the dating of early cereal pollen within peat and archaeological deposits is prone to a variety of problems such as precision sampling (the ability to sample at sufficiently high resolutions), contamination and the separation of cereal pollen from other members of the Poaceae such as *Glyceria* species. The pollen evidence for the beginnings of agriculture will be discussed in a future Historic England Review and is beyond the scope of this publication. Changes in woodland composition following the elm decline are also discussed in the pollen and charcoal/waterlogged wood reviews (Huntley 2010; Smith 2002; Murphy 2001). Since this review is focused on plant macrofossils the first clear evidence of agriculture begins with the recovery of charred cereal remains from archaeological deposits. Even where charred plant macrofossils are found the possibility of contamination is often high (see Section 6.5). Fortunately, the dating of plant macrofossils has greatly improved in recent years with advances in accelerator mass spectrometry (AMS) dating techniques meaning individual grains or chaff items can often be directly dated. A recent thought-provoking review of Neolithic agriculture by Stevens and Fuller (2012) has brought together the published AMS dates from cereals and wild food plants to suggest that the Early Neolithic arable revolution may have flagged or even failed in the later Neolithic, before recovering in the Bronze Age. The table of dates is freely available online (http://www.antiquity.acuk/projgall/stevens333/downloads/stevens333_Table1.pdf).

Radiocarbon dating of grain from early deposits is essential in understanding the spread of cereal cultivation, especially since contamination from animal and root activity has been shown to be a common problem in Neolithic deposits, following around five thousand years of burial (Pelling et al 2015). Since most excavated sites are multi-period, later activities frequently cause disturbance, truncation and contamination of early prehistoric deposits. For these reasons, well-sealed sites, such as The Stumble [EX37] (see below, p29) should be given high priority as these have the greatest potential for producing undisturbed, well-preserved plant assemblages.

Some of the earliest cereal dates come from sites in the Midlands including Lismore Fields, Derbyshire [DB13a][DB13b] (Jones, 2000); wheat grain (*Triticum* sp.) 3950-3530 cal BC (OxA-2434; 4930±70 BP); Lake End Road West, Dorney, Buckinghamshire [BK29] (Allen *et al* 2004) emmer grain (*Triticum dicoccum*) 3910-3640 cal BC (OxA-9819; 4955±40 BP) and The Stumble, Blackwater Site 28, Essex [EX37] emmer-type grains (*Triticum dicoccum*-type) 3605-3370 cal BC (OxA-2299; 4675±70 BP). Plant macrofossil results from these sites are outlined below. When compared to other regions of the British Isles, very similar early dates have been recorded from both the far southwest (Penhale Round, Cornwall (Carruthers 2011a); wheat grain (*Triticum* sp.) 3960-3650 cal BC (Wk-9839; 5001±75 BP) and the far north of the British Isles (Crathes, Aberdeenshire, Murray *et al* 2009; naked barley grain (*Hordeum vulgare* var. *nudum*) 3950-3700 cal BC (SUERC-4030; 5005±35), suggesting that arable cultivation spread rapidly across the country.

The most contentious issues of the period have been the relative importance of cereals in the Neolithic diet compared to gathered wild foods, and whether arable agriculture spread across the British Isles in a single wave or as a series of advancing and retreating ripples, perhaps influenced by climate change, changes to the soils and/or cultural factors. To add to this, the recent review of radiocarbon dated cereal and gathered food evidence by Stevens and Fuller (2012) has shown that the initial spread of cereals in the

Early Neolithic appears to have been followed by a "loss of interest" in arable agriculture, with greater emphasis on pastoral farming in the later Neolithic. The authors note that the possible abandonment of arable cultivation coincides with a population collapse and also with the main period of constructing megalithic monuments. A smaller, more mobile pastoralist population is postulated. Gathered wild foods continued to be collected, reducing in frequency more gradually into the Bronze Age. The eventual middle Bronze Age resurgence of arable cultivation may have been aided by the introduction of new crops such as spelt wheat and Celtic beans. Whether the apparent decline in the cultivation of cereals relates to climatic change or to cultural factors was open to debate.

Very similar findings were obtained from a major review of the evidence from Ireland. The recent study of "the boom and bust of early farming in Ireland" (Whitehouse et al 2012) illustrates how multi-disciplinary investigations can add more detail to the picture. The study used Bayesian methods of analysis of palaeoenvironmental and archaeological radiocarbon data, alongside plant macrofossil data from fifty-two sites across Ireland (McClatchie et al 2014). Settlement data, pollen data, zooarchaeological data and bog-oak dendrochronological data were also collated. A clear and abrupt transition to agriculture was identified from c3750 cal BC, characterised by a distinct 'house horizon' with longer-term fixed-plot arable agriculture as opposed to shifting, more transient settlements. Emmer wheat dominated but naked and hulled barley with occasional einkorn, naked wheat and flax were grown. This 'boom' phase, occurring between c3720-3620 cal BC, was followed by a period of changing settlement patterns, some re-afforestation, and reduced evidence for cereals, coupled with an increase in the recovery of wild food remains (3400-3100 cal BC). Although deteriorating climatic conditions were found to coincide with the reduction in cereal cultivation further work was said to be required in order to link the complex sequence of causes and effects.

From the plant macrofossil data collected for this review, it is notable that the deposits that produced the earliest cereal dates have almost all been associated with settlement structures/features such as longhouses, middens and pits, even though these types of sites and features are rare. The types of deposit most commonly excavated tend to be associated with ceremonial and funerary activities such as causewayed enclosures, long barrows and ring-ditches, perhaps because these are often more visible in the landscape and have frequently been curated to some extent throughout the past. Ritually placed food remains have occasionally been recovered from these types of sites (e.g. Deeping St Nicholas, Lincs, [LC22]) but in general very little information about arable agriculture has been recovered from them (Robinson 2000). This has resulted in a bias in the data and a lack of information about everyday diet, food preparation activities, and the disposal of domestic waste during the period of monument building. Developer funded excavation should go some way towards redressing this balance, although the detection of settlement sites and features remains poor.

Some of the factors that may have contributed to the difficulties in investigating early cereal cultivation include the scarcity of undisturbed settlement deposits, the probable low level, 'garden' scale of arable cultivation on many (but not all) sites, poor preservation over such an extended period of burial, and possible differences in methods of processing and storing small quantities of highly-valued cereals (Robinson 2000). With the exception of three sites in the whole of the Midlands area (see Lismore Fields, Derbys, The Stumble, Essex, and Clifton Quarry, Worcs, below), cereal remains tend to consist of poorly preserved grain recovered in low concentrations (grains per litre

sediment) from Neolithic sites. In addition, chaff fragments and weed seeds (the items that provide most of the information used for cereal identification and understanding crop husbandry) are notably scarce. Current Historic England Guidelines have recommended the taking of especially large volume soil samples from early prehistoric deposits for these reasons (Historic England 2011), and it is important that the highest priority continues to be put on Neolithic deposits in order to understand our long-term relationship with the cultivation of plants.

5.3.1 Settlements and pit groups

Sites with features more likely to be associated with settlement, albeit sometime seasonal or short-term are described below. Deeply stratified, well-sealed sites such as The Stumble and Lismore Fields are important in demonstrating how much information may have been lost from other sites. The following sites reflect Stevens and Fuller's (2012) findings to some extent, with The Stumble [EX37] and Lismore Fields [DB13a][DB13b] falling into the Early Neolithic cereal-rich settlements, and with Late Neolithic Broom [WR30a] producing abundant gathered hazelnut, apple and sloe remains but no cereals. There are, however, a number of sites that are intermediate between the two, such as the Early Neolithic pit groups at Kilverstone [NK21] and Wellington Quarry [HF7] that contained abundant HNS and a few cereals. Both Early and Late Neolithic Egginton and Willington [DB11] produced gathered foods but no identifiable cereal remains, despite the fact that hearths and pits were investigated, so the situation may be more complex than the current levels of evidence suggest.

The Stumble, Blackwater Site 28, Essex [EX37] In the Blackwater estuary, on an intertidal mudflat known as The Stumble, a site was found due to erosion of the thick estuarine clay that sealed it. The site had become submerged during the Thames III transgression, around 4000 BP, and was therefore protected from root action and burrowing animals, being conserved in a very constant depositional environment in terms of water content and temperature. As a result, the charred plant remains were generally well preserved and, it is thought, far fewer seeds have been lost by the processes of physical weathering (wetting/drying, freezing/thawing) prevalent at terrestrial sites, as well as truncation and later disturbance. It is probably for this reason, (as well as the apparent domestic status of the site) that samples from The Stumble produced more charred Neolithic crop remains than all other sites in eastern England put together. From the three main areas excavated 291 samples were collected using a sample size of around 5kg (dry weight) for the palaeosol samples. Cereals were present in 88-98% of samples amounting to at least two thousand grains in total. Emmer wheat was the main crop (*Triticum dicoccum*; present in 22-42% of samples). Single grains of einkorn (*Triticum monococcum*) occurred in two samples from Area A; free-threshing hexaploid wheat (*Triticum aestivum* s.l.) was recovered from four samples in Area C (4 grains in total); naked barley (*Hordeum* sp var *nudum*) in 5% of the samples (11 grains) and flax/linseed (*Linum usitatissimum*) in 3% (4 seeds/fragments). Although most of the samples consisted predominantly of grain, one sample from a post hole was composed largely of glume bases and appeared to represent crop processing waste – a scarce occurrence at this date and an insight into what might have been lost from less well-preserved sites. Associated weed seeds were mainly of *Vicia/Lathyrus* spp and *Galium aparine,* both of which are large-seeded climbing/scrambling plants which may have been collected with the crop during harvesting. Charred remains of woodland plant foods were almost as frequent as cereals at The Stumble, and in addition the samples produced abundant vegetative material (roots, rhizomes, tubers) which probably represented collected foods. Although four radiocarbon dates on emmer-type grains and hazelnut

shell demonstrated that occupation spanned the early-middle and later Neolithic, most of the crop and wild food remains were dated using associated ceramics and other artefacts. The repeated use of the area through the Neolithic meant that charred material in the palaeosol (the bulk of the samples) may have been derived from more than one phase of activity. These dating problems meant that possible dietary changes through the Neolithic could not be investigated in detail, though no obvious changes were observed using ceramic dating and samples from cut features. It is impossible to assess quantitatively and objectively the relative economic and dietary importance of crop production and wild plant food collection in the Neolithic, but clearly the latter was significant. A postscript in the Wilkinson *et al* 2012 report (p.90) refers to more recent publications that debate the issue of the relative importance of arable agriculture compared to gathered foods in the Neolithic. It concludes that cereals probably formed a significant and fundamental component of the diet at The Stumble, but this was likely to have been no different from other settlement sites of the period. The only difference was that inundation of the old land surface in the later Neolithic as sea levels rose ensured much better preservation than that found on dry land sites of Early Neolithic date.

Lismore Fields, Derbys [DB13a] [DB13b] Although this important site is still awaiting publication some information can be gleaned from publications concerning Early Neolithic agriculture in Britain, such as Jones and Rowley-Conwy (2007, pp.391-419). Table 23.1 in this article lists archaeobotanical finds from Neolithic sites in Britain, including Lismore Fields (divided into Lismore Fields 1, Lismore Fields 2 and Lismore Fields rest). A total of 582.8 litres of soil was sampled from the site. This produced 2779 grains of glume wheat, 79 grains of free-threshing wheat, 1 grain of barley, 2432 glume wheat glume bases, 21 weed seeds, 47 apple/pear remains, 124 flax seeds and many hazelnut shell fragments. Two adjacent buildings (Building 1) produced samples with different compositions, with the western building containing mostly chaff fragments and the eastern building mostly grain (both predominantly emmer). The highest concentration of material at Lismore was 200 grains per litre of deposit, though it was usually much lower. There is evidence of cereal processing having taken place in the western building if differential preservation due to charring is considered. Dates from '*Triticum* grain', a flax seed and a combined sample of *Triticum* grain and *Corylus* charcoal, have produced very similar results in the region of 3950-3530 cal BC (4930±70, OxA-2434; 4970±70, Ox-A2436; 4920±80, OxA-2438; Hedges *et al* 1991, 287-8). The grain-rich deposits in the eastern building could represent spikelets from which chaff had been lost during charring, or de-husked stored grain. This is one of the few Neolithic sites in England that is comparable to the substantial timber hall at Balbridie in Scotland (Fairweather and Ralston 1993). Palynological data are thought to indicate continuous arable activity since at least 6000 years before the present day, initially in a predominantly wooded landscape: this is the earliest evidence for farming in the study area (Wiltshire and Edwards 1993).

Kilverstone, Norfolk [NK21] One of the most remarkable sites excavated in the last decade was at Kilverstone, Norfolk, where 236 Early Neolithic pits were cut into the sandy, acidic Breckland soils. Forty-five of the pits and a tree throw were sampled for plant macrofossils. Although the abrasive sandy soils meant that preservation was poor, a surprisingly high proportion of pits contained charred plant remains. The pits produced frequent HNS (40 of 45 bulk samples, and >50% of the 217 pits including hand collected material). Charred cereals were found in 21 of the 46 samples, consisting of small numbers of emmer-type and indeterminate hulled wheat grains. Occasional barley grains were found but only a trace of chaff and weed seeds (sheep's sorrel (*Rumex*

acetosella), black nightshade (*Solanum nigrum*) and grasses). Black nightshade, the most frequent weed taxon, is a characteristic weed of European Neolithic cereal crops (Bakels, 2000). Small scale cultivation of cereals within localised woodland clearances was proposed. The mechanism by which the 236 pits were cut, then rapidly backfilled in clusters that may represent separate visits to the site was discussed in the report. It is possible that the materials placed in the pits were not of primary importance, but rather the act of backfilling itself. Two Late Neolithic Grooved Ware pits produced traces of HNS, free-threshing wheat and wheat/barley. Two of the three Beaker pits sampled also contained traces of HNS (2620-2460 cal BC). The Late Neolithic to Bronze Age buried soil produced a few grains of 6-row hulled barley and indeterminate grains.

Wellington Quarry, Herefordshire [HF7] Seven samples from an Early Neolithic pit group on the floodplain of the River Lugg were analysed, as well as a few from middle Neolithic pit fills and from a Beaker burial. Charred plant remains in the EN pits consisted of small numbers of cereal and grass grains and, in three contexts, large numbers of HNS fragments. Emmer, possible einkorn (one grain), barley, two oats and a free-threshing wheat grain were identified. Uncharred plant remains included numerous wild strawberry seeds and moss in a clayey fill. Stratigraphic information suggested that it was unlikely that these were contaminants and it was suggested that they may represent a particular activity. Sparse charred plant remains in the later samples included poorly preserved wheat (*Triticum* sp.), oat, sedge and grasses. It was suggested that wild plant foods played a significant part in the Early Neolithic diet alongside cereals. Cereals are likely to have been under-represented in the charred record. The level of cereal remains was comparable with occupation deposits on other sites, as was the presence of domestic artefacts, although ritual may have played a part. Therefore, occupation was probably domestic, transient and possibly seasonal. The relative importance of cereals is not possible to determine, and too few charred plant remains were present in the later samples to reveal changes through time (though the pollen record showed an opening up of the landscape).

Aston on Trent, Derbys [DB12] The report discusses an archive site excavated in the 1960's with plant remains analysed by Bob Alvey. A hearth/pit, ditch, gully and Neolithic land surface sealed below a Bronze Age burial mound were investigated. Nine samples were discussed in the archive report, and grain measurements were recorded. The features contained abundant emmer-type grains with some chaff (the latter mainly in the hearth), traces of possible barley and several HNS fragments. A bulk radiocarbon date of 3790-3020 cal BC (BM-271; 4700±150 BP) was obtained from around 400 cereal grains provisionally identified as emmer wheat in the vicinity of the hearth. Two additional samples from Derby Museum lacking in contextual information were examined by Angela Monckton. These produced frequent emmer-type grains, emmer chaff and HNS fragments. Radiocarbon dates from one sample matched the Neolithic date obtained by Alvey (early to mid-fourth millennium cal BC). Dates from the other sample were mixed, with some matching the earlier activity (HNS) but others possibly relating to the overlying mound. Grain sizes matched those given by Alvey. The Neolithic assemblage is remarkably rich in comparison with other sites in the area and perhaps relates to a possible settlement on the site. Although a small amount of chaff is present it appears to consist of cleaned emmer wheat and HNS food waste, so ritual activity is possible.

Egginton and Willington, Derbys [DB11] Out of 180 samples processed from Neolithic and Bronze Age deposits only 34 produced plant remains and no identifiable cereals were recovered, though occasional possible cereal grains were present. Earlier Neolithic

features (hearths and pits) produced mainly HNS and sloe stones, and two Late Neolithic/EBA features also produced a few sloe stones. Seasonal occupation of the floodplain and the gathering of wild foods were suggested. Because the site was well-sampled and settlement features such as hearths were present, it can be seen as an interesting example of continued reliance on gathered foods with very little movement towards cereal cultivation. In the late second millennium BC features associated with burnt mounds and a well-preserved rectangular wooden trough produced occasional HNS fragments, sloe stones and grass seeds. The trough contained charred alder cones with seeds, plus a charred and waterlogged damp grassland assemblage. The evidence suggested that the wooded, damp floodplain of the middle Trent Valley was being exploited in the middle Bronze Age, with the presence of alder cones before they had shed their seeds indicating activity in the late spring/early summer.

Arrow Valley, Warwicks [WR30a] [WR30b] [WR47] Excavations along the route of the Norton Lenchwick Bypass in 1993 revealed Late Neolithic, LBA, LIA, RB and AS sites along the Warwickshire Arrow Valley. Samples from four Late Neolithic pits excavated at Broom [WR30a] contained abundant HNS, crab apple seeds and cut and partly dried fragments of fruit flesh, and probable sloe stone frags. No cereal remains were present. Stored food or ritual deposition was indicated, using woodland resources. Comparisons with other sites in the area were made. In an EBA pit at Boteler's Castle, Warwicks [WR47] HNS was dominant but a few cereal grains including free-threshing wheat were found. The later sites are discussed in the relevant period discussions below.

Clifton Quarry, Severn Stoke, Worcs [WC33] One of the most important sequences of prehistoric to medieval deposits and palaeoenvironmental remains from the central Severn region, including an exceptional Late Neolithic grain deposit, was recovered from a site at Clifton Quarry. One of five Late Neolithic Grooved Ware pits (pit 2024) contained a collection of whole and fragmented polished axes, flint tools and debitage, Grooved Ware pottery, and abundant charred hulled barley grains (*Hordeum vulgare*; >9000 grains), and crab apple remains (equivalent to c33-41 whole apples). A small number of free-threshing wheat (*Triticum* sp.) and possible rye (cf. *Secale cereale*) grains were also identified, although re-examination of the grains by Ruth Pelling and Gill Campbell (pers comm) suggests them to be rounded barley grains or too poorly preserved for reliable identification. The only chaff present was one barley rachis internode and a couple of straw internodes and stem bases. Frequent indeterminate cereal grains were also present in other features but only very small amounts of gathered foods (HNS, sloe). The few weed/wild plants present in pit 2024 included stinking chamomile (*Anthemis cotula*), elder (*Sambucus nigra*), blinks (*Montia fontana*) and oat/brome (*Avena/Bromus* sp.). Six radiocarbon dates on barley grains, apple seeds and a possible rye grain (but see comments on identification) produced a date of 2900-2600 cal BC (including *Hordeum vulgare* grain 2910–2700 cal BC (OxA-18369; 4222 ±31); *Malus* sp. seed 2880–2580 cal BC (OxA-18250; 4146 ±28), and possible *Secale cereale* grain 2880–2580 cal BC (OxA-18370; 4148 ±31)). The presence of *Anthemis cotula* in the assemblage must warn of potential of some contamination in this assemblage however (see Pelling *et al* 2015).

A palaeochannel dated from the Late Mesolithic/Early Neolithic to early Bronze Age showed that Mesolithic communities made no significant impact on the local environment, as densely wooded alder carr with oak (*Quercus* sp.), elm (*Ulmus* sp.) and lime (*Tilia* sp.) existed beyond the floodplain. Few waterlogged aquatic and bankside plants were represented (hornwort (*Ceratophyllum demersum*), water-crowfoot

(*Ranunculus* subg. *Batrachium*), rush (*Juncus* sp.), nettle (*Urtica* sp.)). By the 2nd millennium BC permanent pasture and cultivated land had replaced significant areas of forest. A burnt mound produced only charcoal and a few waterlogged marshy/grassland seeds (parsley piert (*Aphanes arvensis*), sloe, marsh speedwell (*Veronica scutellata*), rush).

Willow Farm, Castle Donnington, Leics [LR28] A Late Neolithic/early Bronze Age pit, Bronze Age burnt mound and Saxon features were excavated in the north and south areas. The Late Neolithic/Early Bronze Age pit contained abundant whole and broken crab apple fragments representing around 50 apples, and HNS fragments, plus a few barley (*Hordeum vulgare*) and indeterminate glume wheat grains. A C14 date of 2140-1950 BC cal (Wk-10074; 3662±57BP) was obtained from one apple. Five Early to Mid-Bronze Age samples were analysed, including pits, hearths and a cremation. The cremation contained frequent grass-type tubers (including onion couch) and culm fragments (bases and nodes) plus a few grassland herbs, but no food remains. It is likely that these represent burnt turf from below the pyre, or kindling. Other features from this period contained sparse assemblages including occasional emmer/spelt and barley grains plus several HNS fragments from the hearth.

5.3.2 Ceremonial and burial sites

Although sometimes well-preserved, and occasionally waterlogged, samples from ditches, pits and buried soils related to ritual structures have mainly provided information about clearance, woodland regeneration and grassland management. It is primarily where evidence from charcoal, pollen and insect remains can be integrated with plant macrofossil data that a more detailed and reliable level of interpretation can be obtained, so waterlogged deposits are of prime importance. Waterlogging also affords some protection to charred plant remains so there is a greater chance of recovering identifiable chaff from these types of context.

Some of the more notable ceremonial/ritual sites are described below. It can be seen that, although sampling was sometimes extensive, quantities of identifiable plant macrofossils from cultivated species were predominantly low, with only the occasional exception. In addition, problems such as contamination and loss of information due to poor preservation were often encountered. The weathering, re-cutting, and animal trampling of monument ditches and banks makes the preservation of good plant assemblages a rare occurrence.

The Raunds Area Project, Northants [NH34] The Raunds Project, focused on a 10km stretch of the River Nene floodplain in Northamptonshire, has provided exceptional evidence of exploitation of the landscape over a long period, including the construction of a Long Mound within an already established grassland environment in the Neolithic Period. Two onion couch (*Arrhenatherum elatius*) tubers dated to the 6th millennium BP from the primary silt in the Segmented Ring Ditch demonstrated that human activities had enabled this grass to become established in the valley bottom at, or even before, the elm decline around 5200 BP. The Long Barrow ditches contained waterlogged plant remains in the primary silts including seeds of woodland plants such as greater celandine (*Chelidonium majus*), three-nerved sandwort (*Arenaria serpyllifolia*) and hedge woundwort (*Stachys sylvatica*), suggesting that some woody areas may have persisted, or have been cleared just prior to construction. A lightly-grazed grassland clearing within oak woodland was the most likely landscape in which the Early Neolithic Long Mound

was set, although it is difficult to know how large an area had been cleared. One notable record from the Long Barrow ditch was eight opium poppy seeds (*Papaver somniferum*), providing the earliest evidence of this potential crop plant in Britain. Opium poppy originates from the Mediterranean, and the find may be even more significant considering that no cereal remains were found. Some scrub regeneration appears to have occurred on the monument and on subsequent constructions and refurbishments in the area, although the fact that a Beaker burial and Bronze Age cremations were focused on the Long Barrow many centuries later suggests that it may have remained a focal point of ceremonial activities for over a thousand years. In the Late Neolithic pollen, insect and plant macrofossil evidence from a palaeochannel near West Cotton associated with a Neolithic timber platform indicated a much more closed, wooded environment, with small-leaved lime and ash being confirmed as part of the tree canopy from plant macrofossils, plus an under storey of cf. blackthorn/sloe (*Prunus spinosa*), dogwood (*Cornus sanguinea*) and purging buckthorn (*Rhamnus cathartica*). As the evidence from the palaeochannel was more regional in extent than that from the Long Barrow, linking the information from the sites was not straightforward. It was suggested that a patchwork of clearings, scrubby areas of regenerating vegetation, grazed park woodland and dense woodland probably existed in the valley bottom.

Rectory Farm, Godmanchester, Cambs [CB62] Samples of waterlogged sediment were obtained from the basal fills of the Early Neolithic cursus ditch and pit groups spanning the Late Neolithic to Middle Bronze Age. Two Late Neolithic/Early Bronze Age pit fills were radiocarbon dated to 2840-2340 cal BC (GU-5266); 4000 + 60 BP) and 2470-2040 cal BC (GU-5267; 3830 + 60 BP, both with 95% confidence) and a further pit was dated to the middle Bronze Age (1680-1410 cal BC (GU-5213; 3240 + 50 BP, 95% confidence).The Neolithic cursus ditch fill produced a waterlogged macrofossil assemblage dominated by *Stellaria media* (chickweed) and *Ranunculus sceleratus* (celery-leaved buttercup). However, macrofossils of obligate aquatic plants were very rare, so there may not have been permanent standing water in the ditch. Only a few macrofossils of scrub taxa and little twiggy detritus were present, pointing to locally open conditions maintained, presumably, by grazing. *R. sceleratus* is a plant particularly characteristic of nutrient-rich (often polluted) mud (Hall *et al* 1983, 215) and the high frequency of its achenes could well be related to deposition of excreta by grazing animals. There was certainly no evidence for eutrophication related to settlement activity and the sample produced no remains of cultivated plants and little charcoal. Combining the available dating from artefacts and radiocarbon determinations with the results from macrofossil analysis permitted the following outline reconstruction of habitat change over a prolonged period: The cursus was located in a cleared area of land, though pollen results (Wiltshire, forthcoming) suggested this was of restricted extent. The two Late Neolithic pits were infilled under woodland/scrub/hedgerow vegetation (48% and 19% woodland taxa), indicating subsequent woodland/scrub regeneration. Four Bronze Age pit fills produced plant macrofossil assemblages indicating locally open conditions of weedy grassland with the disposal of crop plant remains, suggesting that mixed agriculture was taking place.

Etton Causewayed Enclosure and Landscape, Cambs [CB40a] [CB40b] The causewayed enclosure was constructed following clearance in the second quarter of the fourth millennium cal BC (phase 1A) in an area subject to freshwater flooding from a stream channel. Within the wet fenland nearby the gravel deposits of Maxey offered a flood-free 'island'. Despite implementing a systematic sampling programme plant macrofossil evidence for cereal cultivation was scarce, consisting of 12 cereal grains (including 3

Triticum sp. grains) from the middle Neolithic enclosure ditch and 3 *Triticum* sp. grains from a later (phase 2) layer containing Grooved Ware pottery [CB40a]. Waterlogged plant remains were frequent in the lower enclosure ditch samples providing evidence for an established aquatic and marginal plant flora in the ditch but little evidence for disturbance. However, waterlogged plant remains from a middle Neolithic (phase 1A/1B) pit within the enclosure contained predominantly dry-ground taxa consisting mainly of ruderals including frequent stinging nettle achenes (*Urtica dioica*). Frequent hazelnut shell fragments in the pit may have represented food waste. Examining the plant macrofossil evidence together with insect evidence for dung and grasslands (Robinson 1998), and substantial cereal pollen evidence from the upper levels of the pre-enclosure stream channel and enclosure ditch fills (Scaife 1998) the following interpretation was presented. The assemblages indicated that following clearance of the land, cereal cultivation took place in the locality but possibly not on the wet soils adjacent to the enclosure. Higher ground such as the better drained soils on Maxey 'island' would have been more suitable. Cereal pollen within the enclosure ditch (5%-15% of total pollen) could have been derived from cereal processing activities as well as pollen blown in from further afield. Livestock was likely to have been grazing nearby in an open landscape in the middle Neolithic. An interior feature dated to the later Neolithic (phase 1C) again only produced waterlogged plant remains but these differed from the earlier samples in containing very few wetland taxa but a range of scrub species including rose (*Rosa* sp.), bramble (*Rubus* sp.) and elder (*Sambucus* sp.) suggesting some degree of abandonment. Late Neolithic pits containing Grooved Ware and Fengate pottery produced far fewer waterlogged plant remains with tentative evidence for a marginally damp environment. They differed from phase 1C samples however by containing fewer scrub taxa. The Fengate contexts contained evidence for disturbed ground with nutrient enrichment (including henbane (*Hyoscyamus niger*) and nettles). The Grooved Ware contexts also predominantly contained ruderals with one layer being one of the few samples to contain cereals (3 cf. *Triticum* sp. grains). Small numbers of waterlogged remains from scrubby taxa (*Corylus avellana, Rubus fruticosus*, *Sambucus* cf. *nigra*) were also present in this sample perhaps representing food remains.

The Etton Landscape project included relict river channels, floodplain and lower parts of the first gravel terrace of the River Welland. Later Neolithic and Bronze Age henges, enclosures, occupation features and barrows occur in this area. Flooding affected the area by the Romano-British period. Although bulk soil samples were taken from every Etton Landscape and A15 Bypass site, long-term drying out of the area exacerbated by gravel extraction at Maxey quarry meant that none of the Etton Landscape samples contained enough material for meaningful analysis [CB40b]. Eleven waterlogged contexts from the A15 Bypass site had remained damp enough to produce some anaerobically preserved material, though they were not rich. Three Neolithic features contained a few remains from wet woodland taxa, with a ground flora of stinging nettles. Sloe, elder, hazel and bramble were represented, with oak, alder and birch/hazel charcoal. By the Bronze Age the beetles and plant remains indicated more open conditions, with pasture and aquatic vegetation in the ditches. A piece of S-twisted linen twine of early/middle Neolithic date from the site provided early evidence for the use of flax in textile production (Pryor *et al* 1985, plate XL). In discussing the potential of plant remains for use in crafts, Hurcombe (2000, 172) points out that the abundant nettles from the Etton enclosure ditch and internal features would have been potentially useful for the manufacture of cordage and basketry products. This site is an important example of how drainage can cause the loss of information from waterlogged plant and insect remains and limit the level of interpretation possible. Low-lying sites in the East Midlands are particularly susceptible

to this type of destruction, and a number of other wetland sites (such as the Iron Age trackway at Fiskerton, Lincs; see Section 6.4.3) have also been affected by drainage and changes in land use.

Haddenham Causewayed Enclosure, Cambs [CB37] As with many long-term research projects, variations in sampling over the seven years of excavations made comparisons across this site difficult. Samples came from the probable Early Neolithic causewayed ditch, ditch re-cuts, palisade, pits, and buried soil. Barley (including 6-row hulled barley; *Hordeum vulgare*) was the main cereal present. Wheat, including grains of emmer, was also recovered. Wild fruits and nuts included HNS, and a possible apple pip. A single seed of cultivated flax confirmed that the crop had been grown in the Neolithic period. The apple pip and flax seed came from the main enclosure ditch. Few other remains were recovered from this feature or the palisade trench, but this may reflect sampling inconsistencies. HNS came from only three features, though the need to sort residues was mentioned in this context as not all residues had been retained. The barley deposit from a pit cut into the main enclosure ditch was "one of the largest 'caches' of charred barley grain from the British Neolithic" (354 *Hordeum* sp. grains; [CB37], 315). The barley deposit has not been radiocarbon dated to the authors' knowledge. Weed seeds and chaff were scarce at Haddenham and both wheat and barley were present, indicating the presence of cleaned grain. Overall, the quantity and quality of data recovered from the site was insufficient to determine how important cereals were to the economy in comparison with wild food sources. Useful methodological comments in the report include the need to take large numbers of samples from sites of this period in order to detect the rare productive deposits, and the importance of studying residues in addition to flots. Cereal remains and significant quantities of HNS fragments were recovered from some of the sample residues.

Potlock Cursus, Notts [DB14] Seven samples from the north and south cursus ditches and six samples from an EBA pit were examined. CPR were impregnated with minerals and eroded, so double floatation had to be employed. A useful examination of recovery methods and discussion was presented in the report. The southern ditch produced several charred scrub/woodland seeds, including raspberry/blackberry, hawthorn, elder, sloe and hazelnut remains. These may have become charred during clearance of the ditches, as a single burning event appears to have occurred. If so, this probably took place in late summer/early autumn. Alternatively, they could represent gathered foods brought to the site. Grassland and disturbed ground species, including some tuber/rhizome fragments, probably indicate the vegetation growing in the vicinity of the cursus. Fewer, similar remains were present in the northern ditch samples. The few poorly preserved cereals found in both ditches could only be identified as wheat (5 grains) and barley (3 grains, including one possible naked barley), as no chaff was preserved. Very little was found in the early Bronze Age pit (two wheat grains and several indeterminate cereals) despite the processing of 121 litres of soil. A sloe stone and a few grassland/disturbed ground weeds were also recorded.

Aston Cursus, Derbys [DB12] In order to resolve the question of function of cursuses (now dated to predominantly the early/middle Neolithic period; c4400-2900 cal BC), old land surfaces within them need to be examined, such as are found under Bronze Age barrows. The only surviving site of this type in the Midlands is the barrow at Aston cursus. In the 1960's Don Reaney excavated a quadrant of the barrow, finding sterile ring-gullies, one of which was cut by a shallow pit, scorched by fire, containing many charred cereals and sherds of an Early Neolithic bowl. A radiocarbon date centred on

3500 Cal BC was obtained from the grain. The storage of grain within a ritual centre for safety or ritual purposes was suggested by Loveday (2000). Monckton records the grain as being a 'large deposit of emmer' in her 2006 review of Environmental Archaeology in the East Midlands.

5.3.3 Early to Middle Bronze Age ritual and settlement sites

As in the Neolithic period, settlement sites of this date are rare across the Midlands, particularly the West Midlands. Aggregate extraction in Worcestershire, the Avon and Severn Valleys has led to the discovery of many sites. Where alluviation conceals deposits, for example in the Teme Valley and on the Severn floodplain, detection is difficult and less is known about the potential of the area (Jackson and Dalwood 2007).

The high occurrence of glacial till across the Midlands may also have influenced settlement patterns, as the heavy clay soils would have been difficult to work for early farmers and they did not suit the main cereals being cultivated in the earlier Bronze Age: barley and emmer wheat. The small amounts of charred plant remains recovered from these sites often point to the likelihood that pastoral agriculture was a dominant aspect of a site. On such a site all cereal remains, including processing by-products, would have been valued as winter fodder, so little cereal processing by-product would have been burnt as waste. Evidence for increases in pastoral activity can be derived from the excavation of ditches to form stock enclosures but from an archaeobotanical point of view these types of changes can be difficult to demonstrate. For this reason, there is the need for increased sampling in order to recover sufficient evidence from sparse plant assemblages.

Once spelt wheat, free-threshing wheats and oats became more readily available, from the mid to late Bronze Age onwards, a wider range of soils appears to have been cultivated, though the heaviest had to await the development of iron ploughshares, as described by Jones (1981). New suites of weed taxa are found in sites of MBA and later date, perhaps being brought into the area with new seed corn, or maybe being associated with different soils and crop husbandry methods.

Plant macrofossil evidence for the Early to Middle Bronze Age has come mainly from fen-edge and river terrace sites, particularly where deep pits of varied functions (including use as shallow wells) have been dug below the water-table resulting in preservation by waterlogging. Sites investigated in eastern England include West Row Fen, Suffolk [SK24], Rectory Farm, Godmanchester [CB62], Slough House and Chigborough Farms near Heybridge, Essex (Middle and Late Bronze Age; Wiltshire and Murphy 1998) and Chappell's Field, Deeping St James, Lincolnshire [LC21]. The wet basal fills of features at these sites have yielded charred and waterlogged cereal remains, mainly of emmer with some barley. Extensive sampling of shallow features with dry fills at West Row Fen also produced charred glume bases of spelt (*Triticum spelta*), an early record for the region, and waterlogged glume bases were tentatively identified as spelt at Godmanchester. The assemblages retrieved from these sites were small and could not be interpreted functionally, in terms of crop processing activities. Flax was present in all cases. The ubiquity of flax seeds and/or capsules suggests that this crop was widely cultivated at sites on poorly drained terrace and fen-edge soils. A pit at Godmanchester also produced seeds of opium poppy (*Papaver somniferum*) [CB62]. As shown by the recovery of this taxon from the Raunds long barrow ditch (described above), this introduced species has a very long history of use in the British Isles.

Holme-next-the-Sea, Norfolk [NK20] Exceptional conditions of preservation lead to the survival of two EBA timber circles on the Norfolk coast. The first circle excavated ('Seahenge') comprised 55 oak posts with an inverted tree at its centre, which was exposed and excavated in 1998. The monument had been sealed by peat which began to form around 1980-1780 cal BC (OxA-10207; lower contact of the peat with lower silts in borehole HDR 1), before sea water inundation and burial by sand (undated). Dendrochronological and radiocarbon determinations indicated that the central tree ceased growth in 2050 BC and the surrounding posts were felled in 2049 BC (Bayliss *et al* 1999). From 66 bulk samples, 21 were examined in detail. Erosion had removed any deposits that might have accumulated within the interior of the timber circle at the time of construction and use. Samples came from the basal clay/silt and backfills of the construction trenches. The waterlogged assemblages produced primarily saltmarsh/mudflat taxa: (*Salicornia* sp. (glasswort), *Spergularia media* (greater sea spurrey) and *Suaeda maritima* (annual seablite)), confirming (alongside insects, foraminifera and ostracods) that the timber circle had been constructed in a saltmarsh, with some areas of sparsely vegetated mud flat in the vicinity. Macrofossils from later peats at the site indicated the subsequent development of freshwater marsh conditions, presumably behind the protection of a sand/shingle barrier. One hazelnut was found under the central tree, perhaps having been placed there deliberately. A single barley rachis fragment (from the silt within construction trench, context 88) and a charred spelt glume base (from the undisturbed basal silt, context 68) were the only crop remains found. Unfortunately, the date of the spelt glume base could not be confirmed, as this would be an early date for spelt. Recent dendrochronological analyses have demonstrated that timbers used to build the second timber circle were also felled in the spring or summer of 2049 BC (http://www.heritage.norfolk.gov.uk/dating-the-second-timber-circle-on-holme-next-the-sea-beach-1).

North Fen, Sutton, Cambs [CB44] Two large waterholes on a small gravel island in the fen were excavated, one of which contained a timber platform dated to the EBA. A series of nine samples were examined down through the fills of a waterhole. A typical range of habitats was represented, including grasslands, disturbed ground (including frequent stinging nettle seeds), aquatics and waterside plants, and a few scrub/hedge/woodland remains (including bramble, dogwood, sloe and hazel). A predominantly open, pastoral landscape was suggested, with grazing only taking place at a low level. No cultivated plants were represented, although a single charred cf. barley grain and a few cereal fragments were found in a pit or hollow.

Perdiswell Park and Ride, Droitwich Road, Worcester [WC5] An EBA palisaded enclosure was excavated on the third gravel terrace of the River Severn. Out of 27 samples processed, only six produced small amounts of charred plant remains. The primary and upper fills of the ring ditch contained small amounts of emmer chaff, hulled barley, a wheat grain and an unidentified cereal grain. Traces of grass seeds and HNS were the only other charred remains present. No obvious signs of food offerings were found on this ceremonial site, though sites on gravel often produce poorly preserved charred plant assemblages.

Whitemoor Haye Quarry, Staffs [ST5] The northern area of the site is characterised by funerary monuments and associated features dating to the Neolithic and Bronze Age, whilst the southern area contains Iron Age and Romano-British domestic features. The most productive sample came from an early Bronze Age cremation deposit located in the

centre of one of the three ring-ditches. It contained primarily charred tuber and root fragments with some HNS and wild plant seeds characteristic of a damp grassland habitat. The HNS may have been the remnants of feasting, fuel or a burnt offering, whilst the remaining material may have come from beneath the pyre or result from use as tinder. Possible pignut (*Conopodium majus*) and onion couch tubers appear to have been deliberately gathered, since pignut is difficult to pull up intact. Pignut is likely to have been placed on the pyre as an offering, since it is too deeply buried to burn in *in situ* turf.

Northwold, Norfolk [NK24] The site contained a tightly dated early Bronze Age burnt mound in a damp woodland clearing on the fen-edge with associated waterlogged features. These included a well with a central alder wood-lined pit containing Bronze Age pottery. Dates from the planking suggested that use of the site covered a short time span of c35 to 165 years. Samples from the lower fills of two features produced waterlogged assemblages relating to the period of use of the burnt mound. The shaft-like pit which had probably supplied water for the activities associated with the burnt mound, mainly produced stinging nettles and other weeds of disturbed soils and open, grassy habitats. Woodland herbs (*Moehringia trinervia* and *Ajuga reptans*) with alder seeds and catkin fragments, birch seed, hazelnut shell, oak immature cupule, elder seeds and bramble seeds were present, indicating the proximity of woodland. Aquatics and alder remains were more frequent in the upper samples, perhaps indicating increased wetness and disuse. Bracken (*Pteridium aquilinum*) appears to have been brought to the site. A central pit with timber planks on its base produced seeds of mainly wetland herbs (mint (*Mentha* sp.), hemp-agrimony (*Eupatorium cannabinum*), gypsywort (*Lycopus europaeus*)), aquatics, woodland herbs and nettles. Open, wetland areas with some trees nearby were indicated. There appears to have been increased wetness in the Bronze Age and growth of alder wood peat in the features. Only a trace of charred cereal grain was found on the site, confirming the usual absence of food waste at burnt mound sites.

Watermead Country Park, Birstall, Leics [LR21] A Late Neolithic/early Bronze Age burnt mound and adjacent palaeochannel were investigated on the floodplain of the River Soar. The local environment was examined using plant (pollen and macrofossils) and invertebrate analyses from three columns: one close to human remains, one near the burnt mound and one within the palaeochannel. Radiocarbon dates spanned the early Holocene to early medieval periods. Samples from close to the burnt mound indicated an environment consisting of wildwood with mixed lime, oak and elm wood on drier land. Macrofossils included elder and wetland/marsh plants such as crowfoot (*Ranunculus* subgen *Batrachium*), ragged robin (*Lychnis flos-cuculi*) and spike-rush (*Eleocharis palustris*). Drier grassy vegetation grew around the mound which appears to have been located within a clearing. Charcoal representing fuel included alder, hazel, oak, elm, willow, hawthorn and blackthorn. Possible foods being consumed included hazelnuts, sloes, hawthorn berries and elderberries, although only small numbers of charred fragments were recovered so the fruits/seeds may have been present amongst the fuel. No cereals were found amongst the 21 samples studied. The fruits and nuts are all produced in the late summer and early autumn suggesting activity at the burnt mound around this time.

5.3.4 Summary and Future Prospects

The sparse and uneven coverage of this period across the Midlands (Figure 3) leaves much room for improvement, including targeting specific geographic areas and soil types to try to fill some of the gaps. Whilst East Anglia is rich in natural resources of great importance to this period, most significantly flint, but also open, less-densely forested

fen-edge sites, the river valleys of the West and East Midlands would have provided rich grazing once initial clearance of the valley floors had occurred. Lighter soils such as the Breckland sands may also have contained less dense vegetation that was more easily cleared, in close proximity to sources of flint such as Grimes Graves.

The sequence of clearance and settlement for each of the main valley systems needs to be investigated on the same scale as the Raunds Area Project in Northamptonshire before comparisons can be made across the region. In the early prehistoric period regional generalisations cannot be made, as clearance, occupation and cultivation are likely to have been small scale, short term and shifting in nature, and therefore difficult to detect. High definition, large-scale sampling, multi-disciplinary investigations (including, where available, pollen, charcoal, insects and bone) and the precision dating of cereal grains from many features (preferably as paired or triple dates) are essential to establish secure baseline information for each geographic area.

In the light of Stevens and Fuller's (2012) review of radiocarbon dated prehistoric charred plant remains the recovery of any cereal-rich Neolithic to Early Bronze Age deposits should be considered for dating. This should include possible Neolithic deposits (based on the character of cereal and associated weed assemblages) which lack other datable artefacts and are impossible to phase without direct dates. It is remarkable that so few Midlands counties sites appear in Stevens and Fuller's list of early cereal radiocarbon dates (29 sites producing 90 dates in total), though this could be due to the probability that small numbers of grains are less likely to be dated, so the list primarily represents the more productive sites. For the Neolithic period any occurrence of cereal remains is significant (if they can be shown to not be intrusive). If critical examination is to be made of Stevens and Fuller's suggestions of a return to primarily pastoral farming in the later Neolithic, it will be necessary to date a much larger number of cereal grains across the region.

Problems of contamination and poor preservation affect many deposits of this age, as noted above. In addition, the low density of cereal remains (items per litre deposit) from many of the Neolithic to Early Bronze Age sites means that contaminants are more likely to be present (Pelling *et al* 2015).

There is a case to be made for identifying areas that are well-sealed beneath protective deposits such as the estuarine clays at The Stumble and to survey them for early prehistoric sites. For example, where environmental surveys are being carried out by the Environment Agency looking at coastal erosion, attention should be drawn to the potential loss of archaeobotanical information and threatened deposits should be evaluated. Peat surveying projects such as the Lyonesse Project around the coast of the Scilly Isles which involves the local diving community are of great value (Charman *et al* 2015; cf. Ratcliffe and Straker 1997). The National Heritage Protection Plan (NHPP) identified submerged heritage and inundated prehistoric landscapes (Measure 3) as being important areas requiring survey and identification. Recent extreme weather events along the British coastline suggest that this measure should be given a high priority, especially since these events are likely to be linked to climate change.

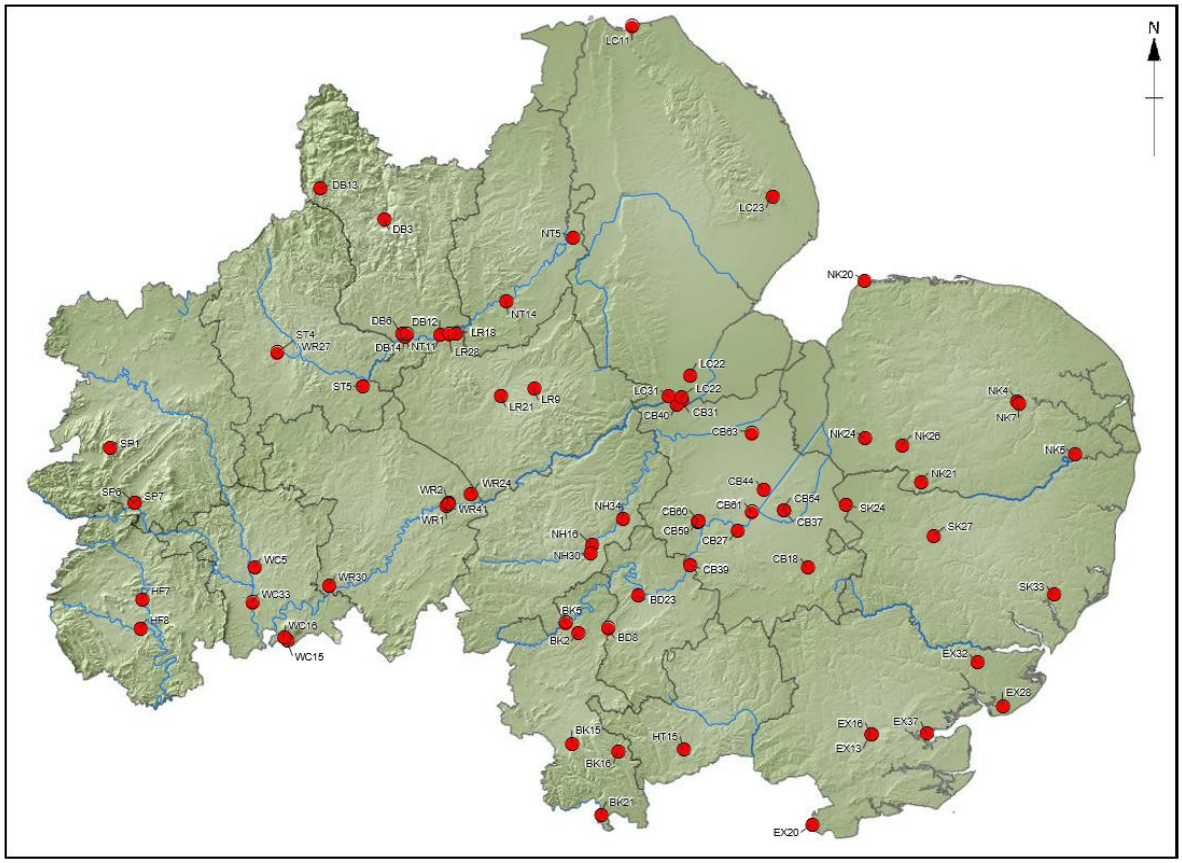

Figure 3: Neolithic to Middle Bronze Age sites in the Midlands counties producing plant remains

BD8 Salford; BD23 Biddenham Loop; BD30 Broom, Southill; BK5 Wolverton Turn, Stony Stratford; BK15 Whiteleaf Hill, Princes Risborough; BK16 Chessvale Bowling Club, Chesham; BK21 Taplow Hillfort; BK29 Lake End Road, Dorney; CB18 Great Wilbraham Causewayed Enclosure; CB27 Church Farm, Fenstanton; CB30 Parnwell, Peterborough; CB31 Northborough, Peterborough; CB37 Haddenham Causewayed Enclosure; CB39 Eynesbury, St Neots; CB40 Etton, Maxey; CB44 North Fen, Sutton; CB48 Lynton Way, Sawston; CB54 Haddenham; CB59 Brampton; CB60 Huntingdon Racecourse; CB61 Rectory Road, Blunitisham; CB63 Bradley Fen; CB62 Rectory Farm, Godmanchester; CB77 Needingworth Quarry, Over; DB3 Dale View Quarry; DB6 Mercia Marina, Findern Lane, Willington; DB11 Eggington and Willington; DB12 Aston Cursus, Aston on Trent; DB13 Lismore Fields, Buxton; DB14 Potlock Cursus; DB15 Big Lane,Hognaston; DB23 Shardlow Boat, Aston-on-Trent; EX13 Springfield Lyons, Chelmsford; EX18 Stansted Airport sites 2000-3; EX20 Tank Hill Road, Purfleet; EX25 Moverons Farm, Brightlingsea; EX28 Lodge Farm, St Osyth; EX37 The Stumble; EX49 West Thurrock; HF7 Wellington Quarry, Marden; HF8 Asda Site, Hereford; HF14 Hereford & District Sites; HT15 St Albans log boat; LC21 Chappell's Field, Deeping St. James; LC22 Deeping St Nicholas; LC23 Skendleby; LR9 Ashby Folville to Thurcaston Pipeline; LR21 Watermead Park, Birstall; LR23 Ridlington, Rutland; LR28 Willow Farm, Castle Donnington; LR40 Eye, Kettleby; NH16 Wilby Way, Great Doddington; NH30 Grendon, NH34 Raunds Project; NH43 Briar Hill; NK4 Three Score Road, Bowthorpe; NK5 Yarmouth Road, Broome; NK7 John Innes Centre, Colney; NK8 Grange Farm, Snetterton; NK12 Norwich Southern Bypass; NK20 Timber Circle, Holme-next-the -Sea; NK21 Kilverstone; NK24 Burnt Flint Mound, Northwold; NK26 Lynford Quarry, Mundford; NK32 Feltwell Anchor, nr. Brandon; NK46 Redgate Hill, Hunstanton; NT5 Langford; NT14 Holme Pierrepoint; NT15 Fosse Way; SK24 West Row Fen; SK27 Pakenham; SP1 Three Earthworks, Long Mynd; SP6 Bromfield; SP7 Meole Brace and Bromfield, Ludlow; ST5 Whiremoor Haye Quarry; ST20 Barton-under-Needwood; WC5 Perdiswell Park and Ride, Worcester; WC15 Aston Mill Farm, Kemerton; WC16 Huntsman's Quarry, Kemerton; WC33 Clifton Quarry, Severn Stoke; WR1 Churchover to Newbold Pacy gas pipeline, Church Lawford; WR2 Churchover to Newbold Pacy gas pipeline, Kings Newham; WR24 Churchover to Newbold Pacey gas pipeline, Churchover; WR26/WR27 M6 Toll; WR30 Arrow Valley; WR41 Kings Newnham 1990; WR42 Lodge Farm, Long Lawford; WR47 Boteler's Castle

5.4 Diversification and Intensification: The Mid to Late Bronze Age and Iron Age Periods (c3250-1900 BP)

From the Middle Bronze Age onwards the numbers of settlement sites excavated (Figure 4) and concentrations of charred cereal remains being recovered increase across most areas of the British Isles. As a result, meaningful comparisons between sites across the Midlands region are more easily made. In addition, settlement and economy can be examined in relation to geographical features, such as river valleys and upland areas.

Pollen evidence indicates that open, predominantly pastoral landscapes were widespread from the MBA onwards, particularly on lighter soils. Areas such as Breckland were substantially cleared by the IA and heath began to establish on the sandy, acidic soils (Bennett 1983a; 1983b). In contrast, the scarcity of Middle and Late Bronze Age sites in the West Midlands and the low occurrence of charred cereals remains on sites in this region suggest that heavier soils may have remained wooded for longer, with pastoral agriculture predominating where soils were difficult to work. Whilst spelt wheat began to enter the range of cereals being cultivated from around the MBA in south-east England, perhaps 'moving' along river valley systems such as the Thames valley towards the centre of the country (Pelling 2003a; Martin *et al* 2012), some areas in the West Midlands (see Kemerton, Worcs below) continued to grow primarily emmer wheat into the Iron Age. Investigations into the early cultivation of spelt in the Midlands and southern England are ongoing (see Section 6.6.2), the most important tool being AMS dating of spelt glume bases where early assemblages are found.

Non-cereal crop plants are found in increasing numbers on sites of this period. Celtic or broad beans (*Vicia faba*) start to be identified from the late Bronze Age onwards, while peas may be amongst less well-preserved pulses.

Large deposits of *Brassica nigra* (or *Brassica* cf. *nigra*) seeds have been recovered from several IA sites across the British Isles, including Biddenham Loop, Beds [BD23] from the Midlands region. In some cases, four-post features have produced large numbers of seeds possibly indicating storage (for example Truro College, Cornwall (Carruthers 2006a) and Chester (Pelling 2018)).

Other changes observed through this period of c1350 years are seen in the storage of cereals, which may reflect a number of factors, such as the amount of surplus each year, local environmental or soil conditions, cultural factors, the sense of threat from marauders, or amount of trade or exchange taking place. Evidence for storage is sparse in the Bronze Age, although occasionally pit storage within roundhouses has been demonstrated (for example, MBA naked barley and beans at Rowden, Dorset (Carruthers 1990)). The change from the storage of grain in characteristic 'beehive' or 'bell' shaped pits in the earlier Iron Age (e.g. Wandlebury [CB19a] [CB19a], see Section 5.3.5 below) to the occurrence of four-post structures on many sites in later periods may relate to harsher climatic conditions or "a changed storage requirement, i.e. from the long term (season-long curation) to short term storage enabled by an increase in trade" (Revised Framework for the East of England 2011). It may also reflect movement away from thin chalk soils towards clays, as spelt cultivation became increasingly important. There is very little evidence for storage in pits on the claylands, or from the Midlands region in general in comparison with the south of England. Storage within buildings or structures is much more likely. At Wandlebury some of the storage pits were examined at a micro-stratigraphic level and the evidence suggested that barley had probably been

stored in the ear whilst hulled wheats had been stored in spikelet form. At Elms Farm, Humberstone, Leics [LR7] (see below, Section 5.3.4), where both types of storage structure were present, a 'bell-shaped' pit showed signs of abandonment and reuse, whilst the four-post structure, contained fully cleaned, fairly pure spelt grain. It was suggested that the bell-shaped pits may have been used to store the crop in spikelet form for longer periods but, once opened, the grain may have required processing and storage in a different, more accessible form, in four-post structures. If so, the site provides evidence that grain was either being consumed in large enough quantities for it not to spoil in the damp British climate, or that it was being traded. However, there is little conclusive evidence for trade of cereals in the Iron Age except that given in Roman literature sources. An interesting area for further study would be the frequency and distribution of four-post structures across the Midlands and their relationship with extensive IA settlements such as Courteenhall [NH41] and Covert Farm, Crick [NH40], since they appear to be more common in Northamptonshire than the rest of the East Midlands (Angela Monckton pers. comm.).

5.4.1 Burnt Mounds

While MBA settlement sites are not frequent in the Midlands, Early to Middle Bronze Age burnt mounds are fairly common. These enigmatic features have often been sampled for charred plant remains and occasionally also produce waterlogged plant remains, as they are usually sited near watercourses. Although in most cases the only charred material present is charcoal (e.g. M6 Toll [WR26]), the following sites have provided a little more information about the local environment, and a glimpse into possible activities taking. For more information on burnt mounds see Historic England's introductory guidance document (https://historicengland.org.uk/advice/find/a-z-archived/ *Introductions to Heritage Assets: Burnt Mounds*).

Willington Quarry, Egginton and Willington, Derbys [DB11] Samples were taken from two burnt mounds of late second millennium date (M/LBA), as well as Neolithic hearths and pits (see section 5.3.1). Burnt Mound I produced HNS, sloe and a few burnt grass seeds. Burnt Mound II produced more charred material from a wooden trough, including alder cones, buttercup, sedge, vetch, bedstraw and HNS. Further aquatic/marsh vegetation and alder cone fragments were present in a secondary charred deposit. Food waste from gathering in the late summer to early autumn was therefore indicated, as it was by the Neolithic assemblage, while the wooded, damp floodplain of the middle Trent Valley was being exploited. The presence of alder cones which had not yet shed their seeds further indicated activity in the late spring/early summer. No cereal remains were found. Similarities to other burnt mound deposits from the area were given (Watermead Park, Birstall [LR21]; Willow Farm, Castle Donnington [LR28]). Waterlogged plant and insect remains indicate summer pasturing on the floodplain.

Willow Farm, Castle Donnington, Leics [LR28] In the south area of the site a Late Neolithic/EBA pit, Early to Middle Bronze Age pits, hearths and cremation deposit, LBA pits and a hearth, and Saxon features were excavated. Adjacent to a palaeochannel in the northern part of the site, a LBA burnt mound produced both charred and waterlogged plant remains. The LBA pits and hearth produced infrequent charred cereal grains, chaff and weed seeds. Crop plants included emmer wheat and hulled barley. The burnt mound contained a similar, small, assemblage with the addition of traces of charred elderberry and hawthorn seeds.

It was suggested that one of the functions of the hearth was the preparation of food for people using the burnt mound. A number of column sequences were sampled from different points within the palaeochannel and were examined for plant remains, insects and pollen. Aquatic plants of still to slow-flowing water were present, as were waterside plants. Plants of open disturbed ground were frequent, including taxa indicative of damp grasslands and pasture. Occasional wood/scrub remains included alder, elder, sloe, bramble, hazel and hawthorn. Since all except alder produce edible fruits/nuts these may represent food remains. The oldest (lowest) deposit within the palaeochannel was dated to 1705-1410 cal BC (95.4% probability, Beta-119653; 3280 ±70 BP). The presence of pasture remains suggests that the area was cleared before the burnt mound was created. A sample from a column adjacent to the edge of the burnt mound and edge of the palaeochannel (taken from immediately below the mound) was dated to 1210-840 cal BC (95.4% probability, Beta-119652; 2840 ±70 BP). It contained aquatic and waterside plants indicative of slow-flowing water and marsh. More aquatic plants were present in the burnt mound column and an increase in disturbed ground plants was seen perhaps including some weeds of cultivation. A sample from the mound trough contained a similar range of aquatic and waterside plants, with grassy and disturbed vegetation and silverweed indicating trampling. Insect evidence (discussed in the report, identified by Smith) indicated use of the area for pasture. No evidence was found for habitation existing close-by. Some differences in levels of activity could be seen between the columns with the column nearest the mound showing higher levels of disturbed ground taxa and the other column having a greater range of grassland and aquatic taxa.

M6 Toll Road, Warwicks to Staffs [WR26] Collet's Brook Burnt Mound (Keuper Marl and alluvium): 4 samples from a MBA burnt mound produced a poorly preserved cereal grain and a HNS fragment. Langley Brook (mudstone and alluvium): 7 samples associated with an EBA burnt mound were examined. Very poor material was found, including a trace of HNS.

Other burnt mound sites in the region include the EBA mound at Northwold, Norfolk [NK24] described in the Neolithic/EBA Period Report, and MBA mounds at Feltwell Anchor, Norfolk [NK32].

5.4.2 Middle Bronze Age settlements

Sites described below offer more substantial evidence for cereal cultivation, beginning in the MBA but often expanding significantly in later years. Many of the sites continued to be occupied through to the Iron Age and Roman periods, showing signs of expansion onto new soils as technological advances were made (Jones 1981).

Murphy and de Moulins (2002) found that macrofossil evidence for the early to middle Bronze Age in the east of the region had come mainly from fen-edge and river terrace sites, where deep pits of varied functions but including shallow wells had been dug below the water-table. Sites investigated include West Row Fen, Suffolk [SK24], (3420-3190 BP: HAR- 4629, 5634, 5635, 5638, 5639), Rectory Farm, Godmanchester [CB62], (3240±50 BP: GU-5213), Slough House and Chigborough Farms near Heybridge, Essex (middle and late Bronze Age, Wiltshire and Murphy 1998) and Chappell's Field Deeping St James, Lincolnshire [LC21]. The wet basal fills of these features yielded charred and waterlogged cereal remains, mainly of emmer with some barley. Extensive sampling of shallow features with dry fills at West Row Fen also produced charred glume bases of spelt (*Triticum spelta*), the earliest record of this crop from the region, while waterlogged glume bases were tentatively identified as spelt at Godmanchester. The assemblages

retrieved from these sites were small and could not be interpreted functionally, in terms of crop processing activities. Flax was present in all cases. The ubiquity of flax seeds and/or capsules suggests that this crop was widely cultivated at sites on poorly drained river terrace and fen-edge soils. A pit at Godmanchester also produced seeds of opium poppy (*Papaver somniferum*). Charred cereal remains have also come from cremation deposits, for example from the cremation cemetery at Moverons Farm, Brightlingsea, Essex [EX25], and from barrows at Bixley and Caistor St Edmund, Norfolk [NK12] [NK42]. At these sites, a few grains and/or chaff fragments were associated with seeds of grassland plants, monocotyledonous stem fragments, tubers, rhizomes and roots. The charred material is thought to represent residues from fuel or kindling, though intentional deposition of foodstuffs as an offering to the deceased is also possible.

The following are examples of more recently excavated settlement sites.

Stansted Airport and A120 Stanstead link road, Essex [EX17] [EX18] [EX19]
Excavations at Stansted Airport in 1986-91 [EX19] revealed sites dating from the late Bronze Age, Early to Middle Iron Age, Late Iron Age, Roman and medieval date. Although the results overall were unremarkable, the long-time span provided important data for an area not previously investigated in detail. The difficulties in processing samples of heavy boulder clay were discussed; soaking in Calgon and double floatation were used. Densities of charred material were very variable from site to site, the most productive of which were Duckend Farm (DFS, Roman) and Round Wood (RWS, medieval) which are discussed in the relevant sections of this review. The results from three Late Bronze Age to Late Iron Age/Roman sites were discussed in Volume 1 of the excavation publication ([EX17], 65-68). Other sites discussed included Bury Lodge (BLS: 10 late Bronze Age samples), Car Park 1 (CIS: 30 samples from a Middle Iron Age enclosure and Late Bronze Age/Early Iron Age pit), Social Club Site (SCS: 25 samples from Late Bronze Age/Early Iron Age droveway system and Late Iron Age/Romano-British features). Charred plant remains were poorly preserved and scarce in most samples from all three late Bronze Age to Late Iron Age/Roman sites, although a late Bronze Age fire pit and post hole at BLS produced reasonable numbers of hulled wheat grains and chaff (both emmer and spelt). A trace of barley and several weed seeds (including blinks, cleavers, brome grass) were recovered. Both emmer and spelt (and blinks) were present in small numbers on the other two sites.

A core through a palaeochannel at Stansted Brook was sampled for pollen and waterlogged plant macrofossils ([EX19], 68-78). Two radiocarbon dates from the base and middle of the core indicate that the columns span the early Bronze Age to middle Saxon periods (2560-2030 BC (cal 2 sigma, near base: HAR-9239; 3810±80BP) and AD 530-680 (cal 2 sigma - middle of core 2: HAR-9238; 1430±60BP)). Aquatic and marginal plant remains were present in low numbers towards the base and plants of still to slow waters, marsh, reed swamp and grassland were present around the middle. Charred cf. spelt glume bases were present in two samples, but it is difficult to extrapolate from just two dates.

The 797 samples from the later excavations [EX18] came from five sites, dating from the Neolithic to post-medieval period. The most productive phases were the LIA/ER and M-LRB periods, as in the neighbouring A120 road scheme sites [EX17], and these are discussed in the Roman section (Section 5.5) below. Charred and waterlogged samples from MBA contexts demonstrated that emmer and spelt were the main crops, with traces of barley and possible oat. Waterlogged fills of a ring ditch and a waterhole suggested

that the environment was primarily grassland with disturbed areas caused by grazing animals, while aquatic vegetation was recorded in both features. Some scrub or hedgerow taxa were also present. Levels of activity fell in the LBA and there was some woodland regeneration. Waterlogged plant remains in a LBA well indicated that woods/scrub or hedgerow existed nearby but cereals were not represented. Few features were dated to the E/MIA, but activity greatly increased in the LIA/ERB period. There was a ten-fold increase in concentrations of charred plant remains compared with the MBA (using charred fragments per litre deposit), indicating that arable agriculture was of greater importance at this time. These assemblages are described in Section 5.5.

Pode Hole Quarry, Cambs [CB42] The site was occupied throughout most of the 2nd millennium BC, until climatic changes caused it to become too wet in the early 1st millennium BC and peat grew across the site. Preservation of biological remains was good, and 216 bulk samples were processed from MBA and LBA features. Charred remains were poorly preserved and scarce, particularly in the waterholes. Uncharred remains in these samples were biased because of poor organic survival. Only four samples (from three contexts) produced over 50 charred items: a cremation deposit, a waterhole and refuse pit. Pits and post holes, and to a lesser extent waterholes and ponds, produced the most charred waste; ditches and cremation deposits were mostly unproductive. One cremation was dominated by flax seeds, with a few barley grains and a possible wheat grain, plus grass/disturbed ground weeds. The waterhole and refuse pits were dominated by cereal grains, with small amounts of chaff and weeds indicating waste from a late stage of cereal processing. Other pits and a midden were less productive, containing cereal grains and HNS. Spelt, emmer, free-threshing wheat, barley and possibly oats were present, with barley possibly dominating. *Prunus* sp. stones, HNS and flax were also present. Common disturbed and grassland weeds and wet-ground taxa were present. Waterlogged plant macrofossils were studied alongside pollen, insect, wood and vertebrates. Sparse charred cereals were present and occasional waterlogged flax seeds. *Prunus*, hawthorn, *Rubus*, elder, apple/pear/whitebeam and HNS may represent food plants. Several of the upper waterhole fills showed evidence for scrub development. In general, there was no clear evidence for crop processing or storage in the area, although flax may have been consumed and native fruits may have been important. Some waterholes contained aquatics indicating standing water but there was no evidence for retting taking place. The landscape was predominantly pastoral.

Ridlington, Rutland [LR23] A ring-post roundhouse and adjacent structure radiocarbon dated to the end of the 2nd millennium BC were investigated. Four samples from a pit and three post holes were examined. Cereal grains were frequent in one post hole and common in the other samples but chaff and weed seeds were generally scarce. Barley was the most frequent cereal with 6-row hulled barley being confirmed. A large deposit of barley (59 fragments per litre), dated to 1430-1040 cal BC (Wk10073; 3025±69 BP), was recovered from a post hole in a semi-circular structure, probably a building. Wheat grains were present in two samples and a single spelt glume base was found in one post -hole. Several of the wheat grains (19 grains) resembled free-threshing wheat and a few were emmer or emmer/spelt in form. It is possible that the spelt was intrusive from an adjacent Roman site, although E-MBA spelt was found at Lockington [LR18] (see Section 5.3). A modern radiocarbon date was recovered from grain in the structure containing the bread wheat -type grain, indicating that it was probably intrusive. The sparse weed seeds indicated that the crops may have grown locally. Small numbers of cereal grains occurred in some of the other features assessed. The predominance of grain indicated that small amounts of domestic waste had been distributed.

Broom, Beds [BD30] The middle-later Bronze Age settlement produced relatively few remains, mainly from ditch fills. Barley was dominant, with wheat and some oats. Samples associated with LBA features produced more charred remains with spelt chaff and emmer, but HNS was still significant. The Iron Age samples produced varying quantities of charred remains. Spelt dominated with some emmer wheat. Hulled barley was also present.

5.4.3 Late Bronze Age sites

Later Bronze Age settlement sites have been extensively sampled, mainly in southern and eastern counties such as Essex and Cambridge. Murphy and de Moulins (2002) described evidence from the eastern counties: At Lofts Farm, Heybridge, Essex [EX24] some large assemblages of charred cereals, including deposits of processing waste were recovered, mainly from a rectangular enclosure ditch. Spatial distribution of crop remains across the site implied either that the interior of the enclosure had been kept very clean, or that crop-processing took place outside it. As in earlier periods, emmer was the predominant crop but there was a significant proportion of spelt, as well as some barley, wild or cultivated oats and possibly Celtic bean (*Vicia faba* var. *minor*). In later Bronze Age pits at Springfield Lyons, Chelmsford, Essex [EX13] however, spelt chaff fragments were more abundant than those of emmer. Other crops at this site included free-threshing wheat, barley and Celtic bean.

Elsewhere, few sites of this period have been studied, though on the fen-edge at Chappell's Field, Deeping St James, Lincolnshire [LC21] very sparse assemblages of barley, emmer-type and free-threshing wheat type grains and chaff were recovered. The results do not suggest large-scale on-site cereal processing. Similar results came from Hagnaby Lock, Stickford, Lincs [LC37]. These sites were unusual in that charred hazelnut shell fragments were as, or more, frequent than charred cereals but in general the evidence for wild plant food collection in these periods is sparse, consisting of only occasional records of hazel, sloe, bramble and elder. Remains of wild fruits and nuts have been more frequently reported from the waterlogged fills of later Bronze Age wells, as are seeds and capsule fragments of flax.

The following site is an example of a Bronze Age ritual site, a barrow cemetery, with evidence for later Bronze Age activity nearby. It has provided the earliest date for the cultivation of spelt in Leicestershire.

Lockington Hoard, Leics [LR18] Samples were taken from an EBA barrow cemetery on the Trent floodplain. Very few charred plant remains were recovered from the mound, as is common in such contexts. Cereals consisted of a few emmer grains, a trace of hulled barley and glume wheat which may have been residual. The mound cremation pit contained a HNS fragment. Traces of grassy vegetation (culm base, seeds of blinks, rhizomes) were present in the charcoal spread under the mound, probably representing the vegetation present when the pyre was lit, or the remains of kindling. A pit group located away from the barrow (now thought to have been late Bronze Age in date; Angela Monckton pers. comm.) produced samples containing low quantities of cereal remains, though charcoal was sometimes abundant. The most productive pit contained 108 items, including both emmer and spelt glume bases. Chaff made up 62% of the remains and brome grass was the most frequent weed taxon. Barley and HNS were also present in some samples. Other taxa recorded were vetch, wild radish, possible pea or bean. A single possible free-threshing wheat grain was present. The chaff-rich deposit may

indicate that food preparation was taking place. Four spelt glume bases were dated to 980–810 cal BC (UBA-25298; 2737±38 BP) providing the earliest record for spelt in Leicestershire to date (Angela Monckton, pers. comm.). Charcoal from the pit was dated to 1425-1260 cal BC (at 68% probability, Beta-83722; 3039 ±80 BP) indicating that residual material was also present.

A few examples of LBA settlement sites are described below.

Frog Hall Farm, Fringringhoe, Essex [EX2] An oval post-built structure within a ring-ditch produced an unusual assemblage. One sample contained over 500 Celtic beans, some of which were sent for radiocarbon dating. A date of 1130-790 cal BC (HAR-2502; 2760 ± 80 BP) was obtained. The dimensions of 30 seeds were recorded and other finds of LBA beans in the area were cited, including Lofts Farm, Heybridge and Springfield Lyons, Chelmsford. The possibility of their use to help improve soil fertility and in crop rotations was noted.

Arrow Valley, Warwicks [WR30a] [WR30b] Excavations along the route of the Norton Lenchwick Bypass in 1993 revealed Late Neolithic, LBA, LIA, RB and AS sites along the Warwickshire Arrow Valley. Two sites produced late prehistoric plant remains [WR30a]. A LBA cremation pyre and ring ditch at Broom produced large amounts of charcoal but only one cereal grain, an onion couch tuber and a grass seed. Samples from pits produced a few cf. spelt glume bases, weed seeds and HNS. The ceremonial nature of the site probably resulted in sparse cereal remains. At Wixford two LIA samples from a ditch produced mainly barley with some spelt chaff and weeds.

Huntsman's Quarry, Kemerton, Worcs [WC16] Samples from a Beaker/EBA pit and a series of LBA features including two waterholes were analysed. The Beaker pit contained a few hulled barley (*Hordeum vulgare*) grains, a rachis fragment and brome grass, grasses and dock seeds. Most of the 70 LBA samples from dry contexts were fairly unproductive, producing poorly preserved charred plant remains that were typical of piecemeal processing. However, one sample from a small pit containing 64 pot sherds from a single vessel produced a fairly clean deposit of processed emmer wheat grain (a few glume bases of *Triticum dicoccum* confirming the identification) with smaller amounts of hulled barley, a few weed seeds (brome grass, large grasses) and occasional HNS fragments. Radiocarbon dates of 1260-920 cal BC (OxA-10791; 2885±40 BP) and 1260-930 cal BC (OxA-10792; 2891±36 BP) were obtained from two charred wheat grains (*Triticum* sp.). The assemblage may have been burnt and placed in the pit with the pot as a structured deposit. The other samples from the LBA contained small amounts of charred grain (mainly emmer-type with some hulled barley) with scarce chaff and weed seeds and occasional HNS. Oats and possibly rye (*Triticum/Secale* sp. grain plus one rye pollen grain) may have grown as weeds. Free-threshing wheat grain was recovered from the waterholes. A preservation bias may have skewed the assemblage towards grain and large weed seeds, as the pollen results demonstrated that cereals were being grown, stored or processed nearby (Greig 2015). Waterlogged plant remains from the base of the two waterholes and uncharred, possibly intrusive plant remains were discussed in the report. Twigs, leaves and thorns of woody taxa (bramble, elderberry, dogwood) were abundant but aquatic/marginal plant remains were scarce. Grassland or herbaceous woodland plants were present. Waste ground/nutrient-rich weeds (goosefoot/orache) were only abundant at the base of one waterhole. The pollen investigation also provided evidence for the use of flax.

Eye Kettleby, Melton Mowbray, Leics [LR40] This report concerns the prehistoric phases of a multi-period site (see the online supporting summary data for Mesolithic background vegetation and Late Neolithic and Early Bronze Age details). An Early to Middle Bronze Age D-shaped enclosure ditch produced a large amount of charcoal but just five cereal grains (emmer/spelt wheat and barley). It may have had a ceremonial function and in the MBA it was re-used as a focus for a cremation cemetery. A large boulder was placed over the infilled ditch at the east end. A group of urned cremation burials produced no cereal remains but several of the un-urned burials contained occasional grains of wheat and barley (including an emmer grain). The largest concentration was 16 grains in one un-urned burial. Grass stems and stem bases, onion couch tubers and grassland seeds were present in most of the cremation burials, sometimes in large numbers (20 tubers in one sample). HNS, elder seeds and sloe (including a complete fruit) may have been deposited or included with the fuel; grassy vegetation and onion couch tubers perhaps deriving from kindling or turf. None of the cremation burials within the northern ring ditch contained gathered fruits or nuts, perhaps indicating season of burial. Two LBA features were analysed including a pit containing mainly emmer chaff but with 4 spelt glume bases and some barley grains. Several weed species were represented (chickweed, scentless mayweed, brome grass). The assemblage represented domestic waste from de-husking.

5.4.4 The Iron Age

The following Iron Age sites range in size and complexity from farmsteads to hillforts. In contrast to the previous periods, it is surprising how uniform the findings are from these varied sites, with spelt wheat almost always being the dominant cereal cultivated by the LIA but emmer and hulled six-row barley usually also present. Occasionally, emmer continues to dominate over spelt, but often the level of sampling makes it difficult to know whether a few atypical emmer-rich samples have skewed the data. Brome grass is sometimes present in large enough numbers to question whether it was a tolerated contaminant (being almost as large a grain as oat), as has been suggested at Danebury (Campbell, 2000), or perhaps an early bite fodder crop. Other common weeds which increase at this time include cleavers, which is often said to indicate autumn sowing (Reynolds, 1981), and grassland taxa including small-seeded grasses, clover-type herbs (clover, medick, trefoil) and small-seeded vetches or tares. It is possible that the frequent occurrence of these contaminants indicates the use of a grass fallow, since they occur far too commonly to indicate recent ploughing up of pasture on every site. Because similar results are found across the country, for the first time this period has more in common with today's agricultural system than previous periods, perhaps suggesting that market forces, rather than suitability to local soil conditions, were beginning to influence the range of crops sown.

Manor Farm and Beaumont Leys, Humberstone, Leics [LR7] [LR8] Two Iron Age aggregated settlement sites of the later first millennium BC, located on boulder clay ridges, were examined. At Beaumont Leys [LR8] low densities of charred plant remains were recovered from roundhouses, pits and post holes. Barley, cf. spelt and spelt/emmer chaff and grains, grass seeds and small legume seeds were amongst the sparse remains. At Manor Farm a largescale sampling programme was used to add to the information from Elms Farm [LR7]. Although 172 samples were processed (from roundhouses, pits, ditches, 4-posters etc) only 22 samples produced moderate assemblages of 10-40 items. The maximum density was 1.6 fpl from a pit outside an enclosure. Small-scale de-husking of spelt was indicated, possibly with some emmer and barley. The small number of weed seeds included a seed of stinking chamomile (*Anthemis cotula*), one of the

earliest records in the county ([LR8], 131). Traces of waterlogged remains in the lower fill of an enclosure ditch included water crowfoot. Onion couch tubers were frequent in one roundhouse. Sloe stones and two hawthorn seeds were the only evidence for gathered foods. Samples from the hearth in a roundhouse and from the post holes of a four-post structure were slightly more productive, containing a few spelt grains, weed seeds and chaff fragments. A couple of fragments of large legume may represent a further crop. Wet-ground weeds were not present, though cleavers and brome grass were recorded. Compared to Elms Farm (see below), these sites may have differed in function, perhaps being more pastoral or craft-based.

Enderby and Huncote, Leics [LR15] Two contrasting clayland LIA enclosures were compared. At Enderby the maximum fpl was around 1. The total assemblage from 34 samples consisted of 46 cereal grains, 19 chaff fragments and 81 weed seeds. Spelt and hulled barley were recorded. HNS, sloe and hawthorn indicated that wild foods were being collected. Weeds included cleavers (*Galium aparine*), heath grass (*Danthonia decumbens*), brome grass, onion couch and vetch/tare, as is typical of Iron Age sites using ard cultivation on poor soils. The scarcity of cereal remains is typical of Iron Age sites in the area, perhaps because pastoral agriculture dominated. At Huncote eight of the samples produced fairly low amounts of spelt with barley and traces of emmer (<1.6 fpl). Three samples from the eaves drip gully of a roundhouse and from an enclosure ditch produced higher concentrations (14.3 to 19 fpl) which consisted primarily of crop processing waste. This may indicate more emphasis on arable agriculture or that this waste was not used for other purposes such as fodder. HNS, sloe and wild cherry/plum stones from roundhouse 1 were indicative of the collection of wild fruits and nuts.

Hurst Lane Reservoir, Ely, Cambs [CB11] Twenty samples were processed, 19 from middle/later Iron Age contexts and one from a Roman structure (structure 31). The predominant cereal in the IA samples was emmer (mainly chaff), with spelt and barley and a single grain of bread type wheat. Oats were present, but possibly not as a crop. Arable weeds were common and wetland plants such as blinks (*Montia fontana*), spike-rush (*Eleocharis palustris* type) and great fen-sedge (*Cladium mariscus*) may have also been growing as crop weeds on wetter soils. Crops were probably being processed piecemeal, and the high number of weeds suggests they were stored in a fairly unclean state, perhaps because organisation and labour was less available than at sites like West Fen Road. The author suggests that the absence of stinking chamomile, present on some IA sites in the region indicates that the local clay soils were not being cultivated. Chenopodiaceae were frequent, suggesting spring sowing predominated - not surprisingly with flooding likely to be occurring through the winter. Grass seeds were common as weeds perhaps indicating the ploughing up of grazed grasslands and poor tillage by ard. Crops were cut low on the stem, probably by sickle. Some cereal culm bases were present suggesting uprooting, but this may have been unintentional.

M6 Toll Road, Staffs to Warwicks [WR26] [WR28] Forty-one sites were investigated in this large project, five of which were analysed by Lisa Gray for Iron Age charred plant remains (and see 'Burnt Mounds' above). In his overview Stevens ([WR28], 457-527) noted that although there was more structural evidence for settlement in the Iron Age than in earlier periods, cereal remains were generally sparse. Spelt and emmer wheat and barley were the main cereals being cultivated. Stevens suggested that emmer continued to be cultivated mainly on the sandy, light soils around Birmingham, Cambridgeshire, Kent and N-E Britain. There was an increase in heathland in the area in the IA although the landscape was still quite wooded. There was no evidence for heathland exploitation

until the Roman period, when woodland was more limited. This surprising finding has been noted elsewhere, for example at Heathrow (Carruthers, 2010a), where heathland vegetation was clearly present from at least the Iron Age but was not used for fuel until the medieval period.

Saxon's Lode Farm, Ripple, Worcs [WC10] Six samples (out of 54 assessed) from LIA storage pits, were analysed. The flots were so rich in charred plant remains that they were subsampled. Well-preserved cereal grains and grass seeds were abundant. Densities of over 10 thousand items per litre of soil were obtained. Both emmer and spelt wheat were present, with the proportions of each varying between the pits: emmer was dominant in three pits, but spelt was dominant in two. Hulled 6-row barley was also abundant and variable in percentage, whilst oats were rare. Brome grass was common but small weed seeds were scarce and limited in range. The assemblages are thought to represent fully-processed grain, with the small amount of chaff and small weed seeds remaining as contaminants. Crop processing must have occurred elsewhere as no chaff-rich samples were found.

The following sites are notable in producing good charred plant evidence from more extensive Iron Age settlements:

Elms Farm, Humberstone, Leics [LR7] A rectangular BA ditch and an extensive Iron Age settlement (415 to 46 cal BC) were excavated. Three phases of IA structures existed, with an area of iron production located in the west of the site. Widespread trading links were indicated. A wide range of features was sampled (109 samples) but only nine were found to contain sufficient concentrations of remains to merit full analysis. Of the three BA samples from the enclosure ditch only one indeterminate cereal grain was recovered. Three of the 21 phase 1 IA samples assessed were fully analysed: a ditch fill and two samples from a post hole in a four-post structure. The ditch contained small numbers of emmer/spelt and barley grains and a chaff fragment with more frequent common weeds of cultivation and grassy places. The post hole contained abundant well-preserved spelt grains with occasional barley grains, very little chaff and very few weed seeds. Storage of fully-processed clean grain in the four-post structure was suggested. The M/LIA bell-shaped pits may have been used to store the crop in spikelet form for longer periods but, once opened, this may have required processing and storage in a different, more accessible form, in 4-posters. The 26 phase 2 samples only produced low levels of mixed grain (mainly spelt, barley) with occasional weed seeds and no chaff. The 30 phase 3 samples produced one ditch fill sample that was fully analysed, but this contained only traces of hulled wheat and barley with the main remains being nitrophilous weed seeds (chickweed, fat hen, small nettle, henbane). Other samples from this phase produced occasional possible food items including HNS, sloe stones, elderberry and pulse fragments. Five samples (out of 10 assessed) from Area 7 were analysed: a ditch, pits, a large bell-shaped pit and a layer. Four of the samples contained mixed, low-level processing and cooking waste, with grain slightly outnumbering the other items. The bell-shaped pit produced a chaff-dominated assemblage with spelt glume bases being identified although preservation was poor. Occasional barley rachis was also present. Weed seeds were fairly rare. This indicates the waste from de-husking spelt spikelets. The pit also contained abundant mineralised seeds from weeds such as Chenopodiaceae, Labiatae and Polygonaceae/Cyperaceae. The absence of edible taxa suggests that animal dung may have been stored in the feature following its use for storing crops. The charred weed taxa from the Iron Age samples as a whole suggested that cereal crops may have

been derived from more than one location (sheep's sorrel indicating acidic soils; red bartsia suggesting heavier, calcareous soils).

Grange Park, Courteenhall, Northants [NH41] Out of the 240 samples processed, seven E/MIA samples (phase 1; 400-200 BC) were discussed in the report (from a ring-ditch, pits, post holes). Spelt and hulled barley were the main cereals present, with smaller amounts of emmer and cf. free-threshing wheat grains. The distribution of chaff and weed seeds suggested that different types of waste were being deposited in different areas. A sample from a ring-ditch around a roundhouse contained almost exclusively barley grains. Charred fodder may be represented in the barley and chaff-rich samples. Weeds associated with damp, heavy soils were present in the spelt-rich samples. Cleavers indicated autumn sowing and brome may have been tolerated as a weed. Five phase 2 (late Middle/Late Iron Age; 200-1 BC) samples from pits, ditches and a possible pottery kiln were analysed. Spelt chaff was the most frequent category of material. Barley and wheat grains were present (including free-threshing wheat) but emmer chaff was infrequent. The samples were more uniform than in phase 1. The kiln fill contained several grassland taxa. Chaff and hay may have been used as fuel along with wood. LIA/ER samples (AD 1-100; 8 samples: pits, ditch, cremation) were more productive and diverse. Free-threshing wheat increased, and some samples contained greater numbers of barley grains. Industrial activities, such as the malting of barley, may have resulted in more diverse sample composition. Germinated grains and detached coleoptiles were frequent in an enclosure ditch, with both spelt and barley having sprouted. Chaff and frequent grassland seeds in this deposit probably represents fuel from the malting kiln. The cremation produced a few weed seeds including knapweed (*Centaurea* sp.) perhaps valued for its blue or purple flowers. Oat grains were common, particularly where barley was frequent. Vetch seeds were especially frequent in the samples, perhaps indicating some sort of crop rotation. Damp ground taxa were more common than before. Two possible onion seeds (cf. *Allium* sp.) and plum/sloe fragments were present.

Dragonby, Lincs [LC26] This backlog site, excavated in 1970, was dated to the LIA (100BC – 10AD) and Roman periods. Over ten thousand charred and waterlogged plant remains were identified, though some doubts over sample processing methods and preservation were noted. Two Iron Age pits produced a wide range of waterlogged remains comprising mainly of ruderal weeds but also containing several fragments of woad (*Isatis tinctoria*) fruits. This is the earliest, most substantial record of woad in Britain. Crop plants present in the charred assemblages included spelt wheat, free-threshing wheat, hulled barley, HNS and Celtic bean (*Vicia faba* var *minor*). Roman deposits are discussed in the Roman section and described in the online supporting summary data.

Covert Farm, Crick, Northants [NH40] Excavation of an extensive Iron Age settlement revealed that occupation dated from the Bronze Age to Roman times. The main evidence dated to the Middle and Late Iron Age. Three areas of gravel terrace and valley slopes were excavated and of the 209 samples taken 100 were fully analysed. Cereal cleaning waste was indicated from chaff to grain ratios and distributions were plotted. The main items recorded were spelt wheat chaff fragments, with emmer chaff present in small amounts. Hulled wheat grains were often poorly preserved and less frequent than chaff. A few possible free-threshing wheat grains were recorded. Hulled six-row barley was present as well as traces of oat awns. HNS, sloe stones and hawthorn stones were present. Large-seeded grasses (including brome grasses) were the most frequent

contaminants, particularly in the Middle/Late and Late Iron Age, and other weeds included cleavers, sedges and frequent leguminous weeds. Blinks and scentless mayweed (*Tripleurospermum inodorum*) were present but not stinking chamomile. No fibre crops were present, but henbane was recorded. The weeds indicated expansion or extensive cultivation rather than intensive garden cultivation. Grassy vegetation taxa were particularly numerous in the Middle/Late Iron Age (50 samples) and one sample contained abundant HNS. In the Late Iron Age (33 samples) one sample from a ditch contained abundant barley grains with signs of spoilage. Barley usage appears to have increased in this phase. Cleaned cereal grains (hulled wheat and barley) were recovered from the post holes of two four-post structures. The report includes a general discussion in which the results are compared to those from other MIA sites. Chaff was found to be more abundant than on sites in neighbouring Leicestershire but possibly less than the Thames Valley sites. In the LIA cereal remains increased and possible short-term storage of cleaned grain was observed in the four-post structures. Some of the wheat may have been stored in spikelet form and some fully processed (probably batches rather than whole crops). Barley was probably stored in the husk and used for a variety of purposes. The expansion of barley in the LIA may have been to make better use of poorly drained land. Cleavers was present indicating autumn sowing of wheat, which would have helped to spread the workload.

5.4.5 Hillforts/Ringworks

There is very little charred plant macrofossil evidence available from hillforts in the midland counties. Three hillforts are mentioned in Murphy and de Moulins (2002): Midsummer Hill in the Malverns, Herefordshire (Colledge 1981), The Wrekin, Shrops [SP10] and Asheldham Camp, Essex [EX50]. The evidence generally confirms that emmer and spelt with small amounts of barley were being stored at hillforts, and possibly smaller amounts of free-threshing wheat and oats, though whether these crops were grown locally or traded is more difficult to determine.

Asheldham Camp, Essex [EX50] The site was primarily pastoral prior to the construction of the hillfort in the early IA. Much of the interior of the fort had been destroyed by quarrying in the 19th and 20th centuries, but some pits and post holes survived, dating to the MIA. In two areas low levels of waste indicated that the by-products of domestic grain-drying or grain-roasting had been deposited. In a third area high concentrations of cereal remains demonstrated that the post holes and pit represented storage features. Emmer/spelt grains and both emmer and spelt chaff with some barley and several cultivated oat (*Avena sativa*) remains were recovered. The pit produced hulled wheats at ratios of roughly 1:1 grain to chaff indicating bulk storage in spikelet form. Post holes produced similar assemblages but with much higher barley proportions and with lower amounts of wheat chaff. Some de-husked grain might have been stored, or chaff had been destroyed on charring. Mixed batches of crops were probably represented. Free-threshing wheat grains and possible rye occurred sporadically. Weeds included frequent Chenopodiaceae, brome grass, Polygonaceae, wild raddish (*Raphanus raphanistrum*) and a possible cotton thistle (*Onopordum acanthium*) achene. Insufficient samples were available to determine whether crops had been grown locally or traded.

Wardy Hill Ringwork, Coveney, Ely, Cambs [CB15] A M/LIA bivallate ringwork arising from an enclosed farmstead was totally excavated in 1991-2. It fell out of use in the late 1st century AD. Ninety samples from the period of ringwork occupation contained evidence for the cultivation of emmer, spelt, 6-row hulled barley, and bread wheat with wild or cultivated oats. Emmer wheat remains were more frequent than spelt in all

phases and other cereals were infrequent. Other probable crop plants were flax and a large pulse (pea/bean). Wild taxa were also present: HNS, hawthorn, sloe, rose (*Rosa* sp.) and elder, though these remains were sparse. Herbaceous species were dominated by fat hen (*Chenopodium album*), brome grass, small grass seeds, clover-type legumes, vetch/tare. Damp ground taxa were also common. The presence of frequent great fen-sedge (saw-sedge *Cladium mariscus*) suggested that material from other sources, such as marsh hay used for kindling or thatching, was mixed with the cereal waste. The dominance of small weed seeds and chaff fragments in the richest assemblages indicated that crop cleaning by sieving was represented, though one *Bromus*-rich sample could be winnowing waste. Spatial patterning of the charred plant remains showed that very few remains occurred outside the ditches and that in the south-eastern area the ditches might have been used to dispose of crop cleaning waste with winnowing and sieving taking place in the vicinity. Some of the gully samples were rich in CPR perhaps having been swept out of the door from domestic hearths. Some of the structures with low densities may have lacked hearths and been used for other purposes. Only a few waterlogged plant macrofossils were present in the samples, including duckweed (*Lemna* sp.), but the preservation was too poor to be useful. Basal fills of the main circuit were sampled, producing evidence for a range of habitats. The ditch must have held standing water in some sections when the lower silts accumulated, as aquatics and reed swamp taxa were common. However, variation was seen in different sections of the ditch. The frequency of woody taxa and predominance of thorny shrubs such as hawthorn, blackberry and rose suggest that an area of scrub or managed hedge had existed on the internal bank acting as a thorny barrier to grazing animals and unwelcome visitors. Mistletoe (*Viscum album*) leaf, stem and inflorescence epidermis was identified by Mark Robinson, perhaps representing deliberately placed material or mistletoe parasitising the scrubby vegetation on the bank.

Wandlebury Ringwork, Cambs [CB19a] [CB19b] Forty-six pits dug into the chalk were sampled. A 15% sub-sample of the basal fills and a buried soil were selected for analysis. Charred cereal grain preservation was found to be much worse in the fills of pits from inside the ringwork. Greater temperatures or longer exposure to heat are suggested as the probable cause of the poor preservation. Hulled wheat (both spelt and emmer) with some barley were the cereal crops represented. The sample compositions varied in different features, indicating the presence of processing by-product and in some cases possibly stored whole cereal ears and spikelets. One feature produced an assemblage rich in grassland species, indicating the burning of hay or turf. Comparisons were made to other ringworks, primarily Danebury, Hampshire, since few others in the immediate area produced substantial evidence for arable cultivation. One pit, F77, was examined at a micro-stratigraphic level [CB19a]. Grain to chaff ratios suggested that hulled barley had been stored in the ear, while hulled wheats (mainly emmer) had been stored in spikelet form. This interesting observation is discussed further below. *Bromus* sp. was the most frequent weed contaminant. Detailed examination of the soils, phytoliths and state of preservation of the charred remains demonstrated that at least two events of *in situ* burning had occurred. In both cases the stored crops were very similar in composition, and no evidence of sprouting of grains was found. The grain had probably been held within a container in the pit.

Conderton Camp, Worcs [WC18] This hillfort (probably the earliest of 3 hillforts on Bredon Hill) dating to the late 6th to early-mid 2nd C cal BC was excavated in 1958/9. During the excavations soil samples of 450g were taken, air-dried and stored in calico bags in the Museum. Forty-six samples were processed and examined for this report.

One sample was rich and overall, charred cereal concentrations were unusually high. However, the small size of the samples meant that only a moderate amount of data was recovered. Glume wheats were the most frequent cereals represented. Emmer was identified from chaff in the earlier phases but both emmer and a few spelt glumes were found in the later phases. Occasional poorly preserved barley and some oat type awns were present. Weed seeds included docks (*Rumex* sp.), cleavers, corn gromwell (*Lithospermum arvense*) and brome grass, with none being particularly dominant. Grassland and damp ground taxa were also recorded. The composition suggested that waste from cereal processing had been incorporated into the pit fills, since chaff and weed seeds dominated the samples. Many of the rock-cut pits (140) among and beneath the houses were thought to be storage pits, but no grain-rich samples were recovered to provide supporting evidence. Weed ecology indicated autumn sowing and harvesting low on the straw, as at Danebury. Some damp areas were cultivated, but most of the weeds would have grown on a variety of soils.

Arbury Camp, Cambs [CB4] Waterlogged plant remains were examined from the five terminal ditch samples and one of the deeper post holes in the IA hillfort. The remains fell into 3 groups: aquatic plants living in or at the margins of the water, ruderals, and plants of damp, shady wooded and grassland environments. Nutrient-enrichment and disturbed ground weeds included henbane (*Hyoscyamus niger*), thistles (*Carduus/Cirsium* sp.), stinging nettle (*Urtica dioica*). Woody taxa included bramble and wood stitchwort (*Stellaria nemorum*). Human activities such as trampling, pasturing and cultivation are indicated. Unique leather-like remains were found to be abundant fragments of the fungus scaly earthball, *Scleroderma verucosum*, amounting to about 7 earthballs plus one puffball. The fungi appear to have been deliberately collected and placed in the ditch, though they were unlikely to have been eaten being too mature (puffball) or slightly toxic (earthballs). Medicinal use (e.g. styptic for wounds), or for tinder or packaging were suggested. A few other finds of puffballs were listed, though no earthballs. Three sub-samples from monoliths through the ringwork ditch taken from an earlier excavation [CB4] contained waterlogged plant macrofossils that were also indicative of grassland and weedy areas with no woody taxa to indicate a perimeter hedge.

5.4.6 Ritual / Funerary Deposits

Rushey Mead, Leicester, Leics [LR20] Samples from a LIA inhumation produced abundant charred cereal remains. A large deposit of charred spelt grains (identified from a few chaff fragments) was recovered from the inhumation burial. Small amounts of emmer and free-threshing wheat grains were present. Only a trace of barley was found. Since well-preserved grains were dominant and weed seeds and chaff were scarce, a cleaned prime product is indicated. Burnt antler and bone were also found in this deposit, so the cleaned grain may have been deposited in the grave as part of the backfill. There were no signs of *in situ* burning or much germination, so the feature was not likely to been a storage pit or rubbish pit. Therefore, the spelt was most likely to have been associated with the burial. Grain has also been found in IA graves at Danebury (Cunliffe 1986).

5.4.7 Summary and Future Prospects

Although sites of this period are patchy in distribution in the Midlands in comparison with southern England (Campbell and Straker 2003) the body of evidence is beginning to build up (Figure 4). Middle to late Bronze Age settlement sites have great plant macrofossil potential, since the scale of occupation has often reached a point where

domestic waste is being produced in larger quantities, making its way into a wide range of features. The change from cultivating mainly barley in the MBA to mainly emmer and spelt wheat may, in part be associated with the scarcity of sites in this region, since wheats, in particular spelt wheat, are better suited to the heavier soils that dominate the Midlands. However, spelt is not found simultaneously in all regions, and on some LBA sites (such as Kemerton, Worcs, [WC15], [WC16]) emmer continues to be dominant through to the Iron Age. These differences, together with increased data being recovered from the period, provide the potential for mapping the 'migration' of new food plants across the country. Such a study will need to be accompanied by the radiocarbon dating of notable cereal assemblages. This topic is discussed further in Section 6.6.2.

Both naked and hulled barley have been recovered in substantial quantities on sites in southern England, for example Bestwall Quarry, Dorset (Carruthers, 2009a) and Trethellan Farm, Cornwall (Straker, 1991). No sites in the Midlands have produced substantial quantities of naked barley, although it was relatively common in Neolithic samples from The Stumble [EX37]. Since naked barley is fairly common in early prehistoric samples from Scotland, it may be the proximity to the coast rather than latitude that is the limiting factor with this potentially useful cereal.

By the Iron Age most sites were growing spelt wheat, though a few (such as Silverstone 2, A43 Towcester to M40 project, above) on calcareous soils continued to be dominated by barley. Some sites (such as IA Hurst Lane Reservoir, Cambs, and LBA Kemerton, Worcs, above) still grew mainly emmer wheat. The majority were fairly similar in the composition of their charred cereal assemblages, perhaps indicating the success of spelt as a 'new' crop, or maybe suggesting that market forces were beginning to influence the economies of settlements, a factor that clearly became important by the Roman period.

The development of distinctive storage features in the Iron Age enables archaeobotanists to examine subjects such as the quality of the stored crop and the state in which different crops were stored. At Wandlebury Ringwork (see above, [CB19a] [CB19a]) it was suggested that hulled barley had probably been stored in the ear whilst hulled wheats were stored in spikelet form. The reasons behind this are worth studying further, since similar observations have been made at Poundbury, Dorset (Pelling 2011). It is possible that barley was being harvested in a semi-ripe state prior to shattering of the ears, as with oats. Alternatively, this could relate to the ease of transporting crops to large settlements from a range of locations, or the protection of viability in grain being used to produce malt. A well-preserved deposit of hulled barley, with some grains fused together as in the ear, was recovered from a LIA/ERB roundhouse at Middle Amble Farm, Cornwall (Carruthers, 2016). It appears that the grain, dated to cal. 50 BC to AD 70 (Beta-348526; 1990±30BP), may have been stored in a wooden box, adding further evidence for the storage of barley in the ear. Additional data may help to determine whether or not this was a widespread practice.

Because there is an apparent wealth of sites of Iron Age date it would be useful to target specific questions in future excavations, such as why the assemblages are so uniform and what the additional weed species (often dominated by grassland taxa) can tell us about changes in crop husbandry. The scarcity of Middle Bronze Age to Middle Iron Age sites leaves gaps in the understanding of settlement in the Midlands, in comparison with southern England and the reasons behind these differences need to be explored.

The gradual loss of environmental information, as well as the destruction of organic structures of all periods, such as trackways and platforms, is a continuing concern as a result of site drainage and changes in use of adjacent land. A number of monitoring projects have been set up, including investigations into methods of recording degradation such as the MARISP Project; 'Monuments At Risk In Somerset Peatland'(Jones *et al*, 2007). For this project Julie Jones has devised two scales of plant macrofossil degradation that can be used to monitor preservation over a period of time: seed/fruit surface erosion and seed/fruit fragmentation. Changes in land management at the Iron Age causeway at Fiskerton, Lincs [LC28b] in the Witham valley, have caused desiccation and potential loss of archaeological material over recent years, so the opportunity was taken to test the MARISP methodology on plant macrofossils from an area of trackway in 2007. Twelve samples of peat at various points and levels in relation to the trackway were assessed using MARISP methods, with 100 fruits/seeds from each sample being scored for erosion and fragmentation using Jones's scales (aided by both descriptions and photographs). Close correlation was found with other organic remains, suggesting that the methodology was useful and could be transferred to other sites and other workers. The trackway at Fiskerton was found to be in a poor state of preservation. Around 0.15m depth of organic deposits has been lost during a 26 year period, and deposits relating to the construction and use of the causeway have gone. Because many Late Bronze Age/Early Iron Age sites owe their survival to waterlogging resulting from climatic changes during the first millennium BC, sites of this period are particularly vulnerable to dehydration. A program of survey and targeted excavation is advisable, as has been undertaken in the East Anglian fens following on from the Fenland Survey.

River estuaries such as the Humber hold great potential for the recovery of trackways and log boats with associated waterlogged plant macrofossil evidence. In the Geoarchaeological Review for the Midlands Canti (2009, 18) discusses how the Humber Valley with its dominant flood tides provides ideal conditions for the preservation of organic remains through silt inundation. The three North Ferriby boats (Wright 1990; Wright and Churchill 1965) and the Brigg raft (McGrail 1981; averaged date of 2820-2860 cal BP) are evidence of this process. Intensive sampling for plant remains is recommended for such sites (see also section 5.2.2).

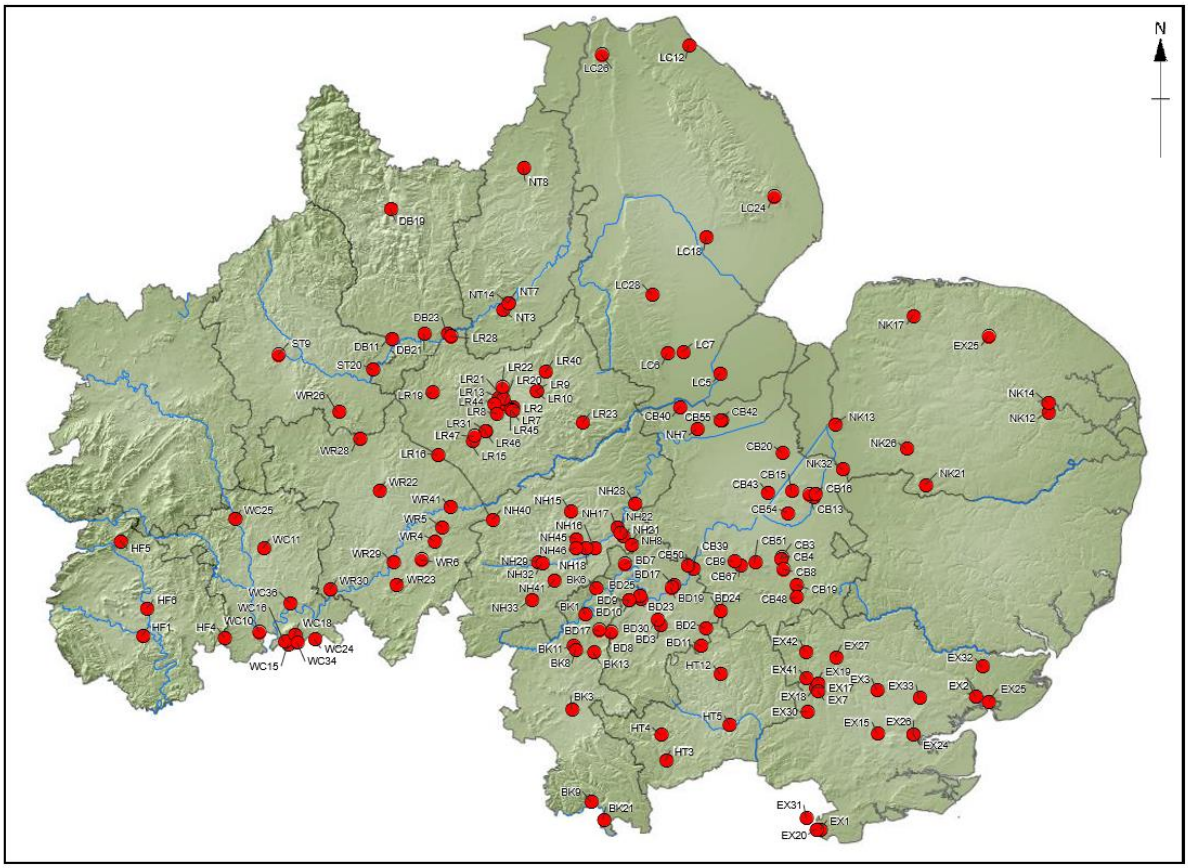

Figure 4: Middle to Late Bronze Age and Iron Age sites in the Midlands counties producing plant macrofossils

BD2 Topler's Hill; BD3 Haynes Park; BD7 Yelnow Villa, Colworth Science Park; BD8 Salford; BD9 East Stagsden; BD10 West Stagsden; BD11 Fairfield Park, Stotford; BD23 Biddenham Loop; BD24 Marsh Leys farm, Kempston; BD25 Gold Lane, Biddenham; BD30 Broom; BD40 Huntingdon to Willington Pipeline; BD44 Willington to Steppingley Pipeline; BK6 Aspreys, Olney; BK8 Kingsmead South, Milton Keynes; BK9 Little Marlow; BK10 Renny Lodge Hospital; BK11 Oxley Park; BK13 Water Eaton, Bletchley; BK17 Broughton Manor Farm and Brooklands, Milton Keynes; BK21 Taplow Hillfort; CB3 Arbury Camp 2002; CB4 Arbury Camp 2008; CB8 Grand Arcade and Bradwell's Court, Cambridge; CB9 A428 Caxton Common to Hardwick Improvement Scheme, Cambridge; CB11 Hurst Lane Reservoir, Ely; CB13 Ashwell Site, West Fen Road, Ely; CB15 Wardy Hill Ringwork, Coveney; CB16 Prickwillow Road, Ely; CB19 Wandlebury Ringwork; CB20 Stonea Camp and Stonea Grange; CB25 War Ditches, Cherry Hinton; CB39 Eynesbury, St Neots; CB42 Pode Hole Quarry; CB47 Lingford Wells, Cottenham; CB50 Bushmead Road, Eaton Socon; CB51 Dam Brook, Scotland Farm; CB54 Snows Farm, Haddenham; CB55 Pode Hole Farm, nr Thoney; CB63 Bradley Fen; CB64 Papworth Everard, Longstanton; CB67 New Settlement, Cambourne; CB79 Striplands Farm, West Longstanton; CB80 Loves Farm, St Neots; DB11 Eggington & Willington; DB19 Horse Pastures, Beeley; DB21 Swarkestone Lowes; EX2 Frog Hall Farm, Fringringhoe; EX3 Great Notley, Braintree; EX7 South of A120, Takeley; EX13 Springfield Lyons, Chelmsford; EX15 Springfield Park, Chelmsford; EX17 A120 Stansted linkroad; EX18 Stansted Airport sites 2000-3; EX19 Stansted Airport sites 1986-91; EX24 Lofts Farm, Heybridge; EX26 Elms Farm, Heybridge; EX27 Sampford Road, Thaxted; EX28 Lodge Farm, St Osyth; EX30 Hatfield Heath to Matching Tye; EX31 South Hornchurch; EX32 Elm Park, Ardleigh; EX33 Star & Fleece Hotel, Kelvedon; EX47 Colchester Garrison; EX50 Asheldham Camp; HF1 Bradbury Lines, Bullingham; HF4 Midsummer Hill; HF5 Croft Ambrey; HF6 Sutton Walls; HF9 Eaton Camp, Eaton Bishop; HF14 Hereford & District Sites; HT3 Leavesdon Aerodrome, Abbots Langley; HT4 Buncefield Lane, Hemel Hempstead; HT5 A414 Cole Green bypass, Hertford; HT12 Lobbs Hole, Stevenage; HT14 Jct 8 & 9, M1 Widening Scheme; HT28 Folly Lane, St Albans; LC6 Morton Fen, Bourne-Morton; LC12 Rosper Road / Conoco Humber Refinery, Immingham; LC18 Tattershall Thorpe; LC21 Chappell's Field, Deeping St James; LC26 Dragonby; LC28 Fiskerton; LC37 Hagnaby Lock, Stickford; LC40 Witham Quarry; LR2 Hamilton, Leicester; LR7 Elms Farm, Humberstone, Leicester; LR8 Beaumont Leys & Humberstone, Leicester;

LR9 Ashby Folville to Thurcaston Pipeline I; LR10 Ashby Folville to Thurcaston Pipeline II; LR13 Hallam Fields, Birstall; LR15 Enderby & Huncote; LR18 Lockington gold hoard; LR19 Normanton le Heath; LR20 Rushey Mead; LR21 Watermead Park, Birstall; LR22 Three Round Barrows, Cossington; LR23 Ridlington, Rutland; LR24 Wing to Whatborough Hill Trunk Main; LR25 Old Park House, Ashby de la Zouch; LR28 Willow Farm, Castle Donnington; LR30 Hamilton North, Leicester; LR31 Grove Farm, Enderby; LR40 Eye Kettleby, Melton Mowbray; LR41 Tixover, Kirby Muxloe; LR48 Whissendine, Rutland; LR50 Crown Hill, Leicester; LR51 Wanslip; NH7 Alma Road, Peterborough; NH8 Manor Farm, Newton Bromswold; NH15 Mawsley New Village; NH16 Wilby Way, Great Doddington; NH17 Lime Street, Irthlingborough; NH18 Mallard Close, Earls Barton; NH21 A6 Rushden and Higham Ferrers Bypass; NH22 Roman roadside settlement & shrine, Higham Ferrers; NH27 Sywell Aerodrome & Ecton; NH28 Thrapston; NH29 Upton, Northampton; NH31 Quinton House School, Upton; NH32 IA & Roman settlement, Upton, Northampton; NH33 A43 Towcester to M40; NH38 Stanwick Roman Villa, Raunds Project; NH40 Covert Farm, Crick; NH41 Grange Park, Courteenhall; NH43 Briar Hill; NK12 Norwich Southern Bypass; NK13 Crow Hall Park, Downham Market; NK17 Bloodgate Hill, South Creake; NK21 Kilverstone; NK24 Northwold; NK26 Lynford Quarry, Mundford; NK32 Feltwell Anchor, nr. Brandon; NT3 Gamston; NT8 Dunton's Clump; SK5 RAF Lakenheath; SK6 Lackford Bridge Quarry, West Stow; SK15 Game Farm, Brandon; SK19 West Stow; SK37 Barnham; SK38 Brandon; SK41 Chalkstone Way, Haverhill; SK42 Blofield, Trimley St Mary; ST18 Yoxall Bridge; ST20 Barton-under-Needwood; WC10 Saxon's Lode Farm, Ripple; WC11 Stonebridge Cross, Westwood; WC15 Aston Mill Farm, Kemerton; WC16 Huntsman's Quarry, Kemerton; WC18 Conderton Camp; WC24 Womington to Tirley Pipeline; WC25 Blackstone; WC34 Beckford; WC36 Upper Moor, Wyre Piddle bypass; WR4 Long Itchington, Churchover to Newbold Pacy gas pipeline; WR5 Frankton, Churchover to Newbold Pacy gas pipeline; WR23 Walton; WR26 M6 Toll, Wall; WR28 M6 Toll, Langley Brook; WR29 Park Farm, Barford

5.5 The Rise and Fall of the Roman Empire (1st - 4th centuries AD)

Following the Roman invasion in AD 43 social organisation increased in complexity in most parts of the Midlands region. Forts were built in strategically important locations, with major defensive sites constructed, for example on the site of the Late Iron Age *oppidum* at Colchester on the Essex coast, and Wroxeter close to the Welsh border. Wroxeter, the only major Roman town in the West Midlands, became the main focus of activity when a legionary fortress was constructed there in cAD 58. In some parts of the West Midlands, however, there is less evidence for change, perhaps because the main military front was located to the north and west (Esmonde Cleary, 2011). In the south of the region the presence of mineral resources, such as iron around Worcester and brine springs at Droitwich, meant that the area was important to the Roman incomers and became more strongly influenced by Roman cultural changes than the more agricultural counties of Shropshire, Staffordshire and Derbyshire and the north west of the region.

The increases in concentrations of charred plant macrofossils that began in settlement deposits dated to the later Iron Age continue into the Roman period in most areas of the Midlands. The archaeobotanical evidence suggests that arable agriculture entered a phase of expansion following the Roman invasion over much of England. The demand for spelt wheat, a robust, hulled cereal with a good storage life and broad sowing season (it can be sown as a winter or spring crop) greatly increased after the arrival of the Roman army (Manning 1975). On the surface a great deal on uniformity is found across the country, with spelt wheat being by far the most dominant cereal. This emphasis on spelt cultivation has been encountered in such diverse geographic and edaphic conditions as the fens (Stonea, Cambs, [CB20]), fen-edge (Maxey, Cambs, Green 1985), Boulder Clay plateau (Stansted, Essex, [EX19] [EX18]), greensand ridge (Haynes Park, Beds, [BD3]), and coastal sites (Canvey Island, Wilkinson and Murphy, 1995). However, where groups of corn driers are found and spelt processing waste occurs in large concentrations, indicating large-scale spelt production, the sites are usually located on clay plateaux or clayey floodplains. Since spelt wheat is particularly well-suited to these soils the location of high-output farms was, clearly, carefully considered in the Roman period. In the Midlands region such soils are found across the region, from the Welsh border to East Anglia. Although spelt became the dominant crop in most areas by the Late Iron Age, it is only in the Roman period that concentrations of virtually pure spelt chaff are found in ditches, ovens and kilns. In addition, documentary sources show that cereal processing waste was valued by the Romans as a useful by-product in its own right, so it was collected, stored, transported and sold for fodder and fuel at markets (van der Veen 1999). Abundant examples of this practice have been uncovered by excavations in Worcester (below), where spelt chaff was imported in large quantities for use in the smelting and smithing industries.

5.5.1 Major crop plants of the Roman Period

The site summaries below show that a remarkably uniform arable regime appears to have been in place during this period, with spelt wheat dominating almost every charred plant assemblage. Close examination of the evidence may indicate that taphonomy is partly responsible for the apparent uniformity of the arable regime in this period. Emmer wheat is always a very minor component, possibly only surviving as a relict crop in the Midlands. However, it should be remembered that if emmer continued to be grown but was only used as a fodder crop its chances of becoming charred en masse would have been reduced because grain for fodder would not need to have been de-husked. This is often thought to be the reason why hulled barley is present in many samples, but usually only in small amounts. Barley was considered by the Romans to be

greatly inferior as a food for humans (Manning 1975) but the charred evidence suggests that it was widely grown for fodder. It may also have been sometimes used for food for people as there is some evidence for processing (see Cawkwell, Lincs [LC25] and Ridlington, Rutland [LR24] below). Barley may also have been added to spelt in the production of malt, as found in four corn driers from East Anton and Finkley, Hants (Carruthers 2013c) where a ratio of 3 to 2 spelt to barley was indicated. Adding barley increases the malt yield as it is a much more efficient producer of the malting enzyme diastase than spelt (Katz and Voigt 1986). The dominance of spelt in corn drier assemblages (van der Veen 1989) is further confirmation that the crop most frequently being roasted or dried prior to de-husking or milling for human consumption was spelt. It is difficult to establish whether other crops recovered from these structures in small quantities were present as crops being dried or malted, or amongst fuel.

Additional crops that could similarly be under-estimated in the charred record because the use of fire was not involved in their processing are free-threshing wheat, rye, oats, peas and beans. Free-threshing wheat grains, generally assumed most likely to be bread wheat type (*Triticum aestivum* s.l.), have been recovered in high numbers from a few sites where catastrophic fires have preserved large quantities of plant remains *in situ*, for example the Boudiccan destruction layers in Colchester which included a granary (Murphy 1997, [EX10a] [EX10b]) and, in the north of England, South Shields granary (van der Veen 1994). Another type of context where it is possible that deliberate burning ensured preservation was grave fills in a late Roman inhumation cemetery at Jesus Lane, Cambridge [CB5]. The samples produced mainly clean free-threshing wheat grains and barley. At Langdale Hale, Colne Fen [CB65] the hexaploid bread wheat type chaff was frequent in the earlier phase but less so in later phases. Since bread wheat chaff is rare on sites of all periods the Langdale Hale record is particularly significant. Many Roman sites produce small numbers of free-threshing wheat grains, particularly sites on the claylands of Essex, Cambridgeshire, Bedfordshire and Northamptonshire. It is likely that the charred plant record greatly underestimates the importance of free-threshing wheat in the Roman period, although it may have been a cereal reserved for specific purposes, such as supplying the Roman army.

At sites such as Melford Meadows, Norfolk [NK27] and Bays Meadow Villa [WC14a], Droitwich, Worcs (see below) rye was frequent enough to suggest that it had been a minor crop rather than a weed. In the Midlands oats are rarely present in more than 'weed' quantities and confirmation of the cultivated species, common oat (*Avena sativa*) is extremely rare. Frequent *Avena* sp. grains were recovered from a 2nd- 3rd century pit at Old Park House, Ashby de la Zouch [LR25] along with rye grains and chaff (see below). However, the only pre-Saxon published record of *Avena sativa* from the Midlands known to the authors is E/MIA in date from Asheldam Camp, Essex [EX50]. In contrast, both cultivated and bristle oats (*Avena strigosa*) were grown on the poor, acid soils of Cornwall during the Roman period, and by the Later Roman period they were more frequent than hulled wheats on some sites (e.g. Penhale Round, Cornwall, Carruthers 2011a).

Peas (recorded more often as 'possible peas') were recovered from a variety of features on a large number of sites, but usually only one or two were recorded. However, their importance was confirmed by a deposit of stored peas recovered from a corner of the burnt Great Holt's Farm barn, Boreham, Essex ([EX8]; see below). Celtic beans are a little less frequent, even though they are large, robust and more easily identified because of their distinctive shape. A Roman post hole from Frogs Hall Borrow Pit, Takeley, Essex

([EX6] see below) contained frequent peas and beans, demonstrating that they were being grown in some areas. Interestingly, peas and beans appear to be much more commonly found in samples from eastern England, in particular Essex and Kent (Campbell forth), a phenomenon that deserves further investigation.

Flax is commonly recovered as one or two charred or waterlogged seeds and capsule fragments, but occasionally the seeds are found in larger numbers, perhaps indicating heating during oil extraction (see Renny Lodge, Bucks; Causeway Lane, Leicester; Earith, Cambs). It is possible that some other plants were also grown for oil, such as opium poppy, cotton thistle (*Onopordum acanthium*) and black mustard (*Brassica nigra*). Large deposits of *Brassica nigra* (or *Brassica* cf. *nigra*) seeds have been recovered from several IA sites across the British Isles (see previous section). There are a number of Roman archaeobotanical records from other parts of Europe (www.archaeobotany.de) so it is likely that black mustard was grown in the British Isles. Further discussion of this crop plant is given in section 6.6.7.1.

The earliest records of cotton thistle in the region, likely to be an Iron Age or Roman introduction to the British Isles (Preston *et al* 2004), were from two Roman wells: Glapthorn Road, Oundle [NH10] and Bays Meadow, Droitwich [WC14b]. Its association with waterlogged features and possible uses are discussed in section 6.6.7.1.

5.5.2 Imported or locally grown introduced foods and flavourings

In the Roman period there is a dramatic increase in the variety of economic plants recovered from archaeobotanical samples across the country (van der Veen *et al* 2007; 2008; Livarda 2011), as well as an increase in concentrations of charred cereal remains on settlement sites (see above). Clearly, the incorporation of Britain into a trading network which extended from the Mediterranean and beyond had a large part to play, as well as the adoption of a Romanised way of life by the native population. It is very difficult to determine how many of these 'exotic' plants were grown in Britain, as opposed to being imported. Some, such as olives (*Olea europaea*) and date (*Phoenix dactylifera*) can be excluded on climatic grounds, but most cannot. The recovery of 61 closed stone pine (*Pinus pinea*) cones from a 1st century BC shipwreck close to Toulon, southern France, provides evidence for the long distant trade of perishable and exotic plant goods within Roman Empire (Kislev 1988, 76). Stone pine cones and the seeds were used for both ritual and culinary purposes in the Roman world and have been recovered from a number of sites in Britain and Northern Europe, well outside the native distribution of the tree (Lodwick 2014; Kislev 1988). The possibility that stone pine was cultivated in Roman Britain as demand for the cones and seeds grew has been suggested due to increasing numbers of finds in southern Britain (Campbell 1999; Robinson 2007; Bateman *et al* 2008, 114; Pelling 2008) and the ability of stone pines to produce mature cones in Britain today (Lodwick, 2014).

Fragments of stone pine cone and/or nutshell have been recovered from a fairly large number of sites in southern Britain, particularly London where, no doubt, most finds related to the presence of a major port (for example, London Gateway [EX48]). In the Midlands region several sites in Essex have produced stone pine remains, including Colchester (Murphy 1984, 32), Mucking (Wilson 1973, 305) and Great Holts Farm [EX8]. The most northerly and inland find from the Midlands was from Ortons Pasture, Rocester [ST16] where a large number of pine nuts and two whole dates were recovered from an early Roman shrine. Other inland sites containing stone pine, such as

Verulamium (St Albans) and Bancroft Villa [BK24a] (see below) are high status settlements, where imported goods are much more likely to have been consumed.

Classical writers such as Tacitus (1st century BC) suggest that the British climate was too wet for viticulture, and the Emperor Domitian (AD 81-96) limited the planting of vines in the occupied provinces by edict (Roach, 1985, 247). However, around AD280 Emperor Probus issued an edict encouraging the planting of vines in Britain, and this may be the explanation for a series of trenches found at a large Roman site in North Thoresby in Lincolnshire, which are thought to have been part of an experimental vineyard. Although this interpretation is now contested, the presence of pollen, trenches and support posts at Woolaston, Northants [NH44] provides more convincing evidence, and experimental work on growing vines at the site is now underway. These types of sites are hard to identify with certainty, and it is primarily where substantial macrofossil and pollen identifications are made from the same deposits that local cultivation can be established. The abrupt decline in the range of economic plants recorded from Early Anglo-Saxon sites illustrates the extent to which the Roman presence affected the British economy.

The Roman cultural package seems to have affected many aspects of life-style in the Eastern counties, including the appearance of new foods of Mediterranean origin. The earliest evidence is from the military and early civilian phases at Colchester [EX10b], where a military latrine pit dated to 44 - c49 AD, produced opium poppy, grape (*Vitis vinifera*) and fig (*Ficus carica*). A wide range of charred imported foods were recovered from the Boudican destruction deposits of AD 60/1 including dates, stone-pine, figs, and herbs such as coriander (*Coriandrum sativum*) [EX10a] [EX10b]. Although imported foods are less often found at ritual sites, a late Roman well at Great Holts Farm, Boreham, Essex [EX8] produced, amongst other crops, walnut (*Juglans regia*), stone-pine, sweet chestnut pericarp (*Castanea sativa*) and olive (see also Murphy 1997). Exotic foods are a useful indicator of the affluence and economic connections of the site occupants.

A variety of garden vegetables, herbs and decorative plants are described in section 6.2.4 below, including the first appearance of beet at several sites (e.g. Earith, Cambs [CB65]; M6 Toll, Warks [ST4] [WR26]; New Cemetery, Rocester, Staffs [ST17a] [ST17b]). At Alcester [WR33] thirteen charred asparagus seeds (*Asparagus officinalis*) were recovered from a ditch and later hearth, dating to around the third century AD (although see Pelling *et al* 2015 on the importance of directly dating asparagus seeds). The presence of columbine (*Aquilegia* cf. *vulgaris*) and beet (*Beta vulgaris*) macrofossils indicated that garden waste had probably been burnt on the site ([WR33]). Herbs and spices such as coriander and fennel can be added to the list of possible garden plants, and the recovery of box leaves from sites such as Marsh Leys, Kempstone [BD24] and Rectory Farm, Godmanchester [CB62] (both described below) hints at the types of decorative garden features that may have been used. A number of papers have discussed the introduction and importation of plants and foods during the Roman period (such as Livarda 2011; Witcher 2013) drawing attention to the fact that the legacy of Roman Britain is still detectable in our diet and gardens today.

On a site by site basis the presence of evidence for other items characteristic of a Romanised way of life are frequently recovered, for example fragments of amphorae, fish remains, eggshell and shellfish. Where waterlogging and mineralisation has led to the preservation of food or faecal remains a much more detailed picture of the Roman

influence on diet may be obtained (see below; Great Holts Farm, Boreham, Essex [EX8]). As noted in section 4.8, most wells were located externally so the fills do not often contain as rich a variety of food remains as that at Great Holts Farm. Mineralised latrine deposits however can be very rewarding (see below; Newarke Street [LR3]; Castle Street, Leicester [LR1b]) but few examples have so far been investigated in the Midland region.

5.5.3 Romano-British site summaries

Examples are given below under settlement-type headings, although it is acknowledged that sites are sometimes difficult to categorise.

5.5.3.1 Roman military sites and major Roman settlements

The first large settlements established by the Romans served a military function. As populations grew up around forts in order to supply the needs of military personnel, many settlements gradually developed to become major towns. In addition, veteran soldiers settled around the places in which they had served. Some of the following major settlements in the Midland region have been investigated many times over the years, and have produced some well-preserved archaeobotanical assemblages. However, considering how much is known of the structural archaeology of some of these towns the archaeobotanical information appears to be very patchy and inadequate.

Colchester

A Roman legionary fortress was established at Colchester (*Camulodunum*) on the site of an Iron Age oppidum, shortly after the Roman invasion in AD 43. It served as a provincial capital of Roman Britain, but was destroyed during Boudicca's rebellion in AD 61. The town walls were built around 65-80 AD, during the post-Boudiccan rebuilding of the town. In 2004, Colchester Archaeological Trust discovered the remains of a Roman circus (chariot race track) underneath the Victorian Garrison in Colchester - a unique find in Britain ('News' in *British Archaeology* 92, 2007).

Excavations have been undertaken at a number of sites within Colchester over the years, including sites on Lion Walk and Balkerne Lane [EX10a], Culver Street, Cups Hotel and Gilberd School [EX10b]. The early evidence of imported foods in the town, including foods charred during the Boudican revolt, has been described above. At Culver Street, a deposit of charred sprouted wheat grains (spelt or emmer) associated with coarse textile fragments was thought to represent a sack of malt ([EX10b]). Extensive charred granary deposits containing spelt wheat, spelt malt, emmer and bread wheat had been stored as clean, processed grain with very little chaff or weed contamination and very little evidence of spoilage by damp or insect pests (Murphy, 1997). These types of major burning events, either accidental or deliberate, highlight the vast amount of information that is not preserved in day-to-day accidentally charred domestic waste, or in deliberately burnt waste deposits.

Leicester

The first recorded name of the city is the Roman label *Ratae Corieltauvorum*. The proceeding Iron Age oppidum was the capital of the Celtic Corieltauvi tribe ruling over roughly the same territory as what is now known as the East Midlands. *Ratae Corieltauvorum* was founded around AD 50 as a military settlement along the Fosse Way, a Roman road between Exeter and Lincoln. It grew into an important trading centre and became one of the largest towns in Roman Britain.

The archaeobotanical findings from several large-scale excavations in the town make an interesting contrast with those from Worcester (below). Unlike the more industrial town of Worcester, cereal processing waste appears not to have been brought into Leicester for fuel in notable quantities (Monckton 2006). However, a wider variety of imported exotic foods has been found in Leicester, suggesting that higher status occupants were found in this town, or at least in the areas investigated to date. Of course, the range of foods and preservation of material in no way compares to the extensive layers of burning found in Colchester resulting from the Boudican revolt (above).

Leicester Shires [LR5] Large scale sampling (>1000 samples) was carried out on Little Lane (Roman and medieval) and St Peter's Lane (mostly late medieval and post-medieval). Most of the Roman samples produced sparse, background 'noise' assemblages and no samples contained concentrated cereal processing waste. Three samples were more productive (from two ditches and a hearth). These samples were dominated by large-seeded grasses such as brome grass. Culm fragments and wetland taxa such as sedges were also frequent. Some cereal grains and weed seeds were also present. It is suggested that this may mainly have represented tinder and hand-picked cleanings thrown into fires. Spelt, free-threshing wheat (s.l.), six-row hulled barley and pea/bean were the main crop plants, with traces of naked barley, oat, rye, HNS, sloe and apple/pear.

Causeway Lane, Leicester [LR4] The site lies within the Roman and Medieval town walls of Leicester. Four insulae (housing blocks) were excavated revealing areas that were still being cultivated in the late first century, and features relating to the Roman occupation of the planned town. Insulae may have appeared as early as the late first century although division into plots, occupation and street metalling followed later. Timber buildings of the late C1st- early C2nd were followed by more substantial stone buildings in the mid-C2nd. Occupation reduced in the C3rd and C4th. Most of the buildings were constructed of timber in the Roman period. Evidence for long distance trade included marine fish and oysters, coriander, and imported pottery. Industries included tanning, soap-making, cupellation (the refining of alloyed metals and ores under high temperatures) and ironworking. Truncation by cultivation occurred at the end of the Roman period while quarrying occurred in other areas. During the earlier Roman period spelt wheat was the most frequent cereal, with traces of emmer and free-threshing wheat, though hulled barley grains were nearly as frequent. Oats and rye may have been present as weeds but were scarce. Barley became more abundant by the later phases. Bean, pea and lentil (*Lens culinaris*, late Roman) were present, and opium poppy, fig, flax (frequent charred seeds in one sample) and coriander were identified. Orchard and garden plants consisted of a seed of beet (*Beta vulgaris*), apple/pear seeds, bullace, HNS and sloe as well as columbine (*Aquilegia vulgaris*), an ornamental flower. Common weeds of disturbed, heavy clay (stinking chamomile, *Anthemis cotula*), nutrient-rich soils (henbane, *Hyoscyamus niger*) and grasslands (hay taxa including yellow rattle, *Rhinanthus minor* and ox-eye daisy, *Leucanthemum vulgare*) were recorded. Corncockle (*Agrostemma githago*) and cornflower (*Centaurea cyanus*) were present in both Roman and Medieval samples. Cornflower becomes much more common in cereal assemblages from the medieval period in the British Isles (Greig 1991a; 1988) as it does in the Netherlands (Bakels 2012), occurring as occasional seeds only previously (Preston *et al* 2004), which raises the possibility that Roman occurrences such as these are derived from later intrusive contamination. Some wet/damp ground taxa were present. Mineralised plant remains were common in many pit fills indicating the presence of sewage or faecal

material. There was no evidence for the use of cereal processing waste as fuel or for processing taking place in the town, though small amounts of chaff and weeds suggested that grain was brought to the town in spikelet form.

Castle Street, Leicester [LR1a] [LR1b] A second century colonnaded shop front was investigated. Pottery (amphorae, flagons and Samian) and the contents of a cesspit to the rear suggest that a delicatessen may have been located on this busy street. At this time the town was growing rapidly but was not yet walled. 17 samples from Roman pits, floors and a furnace or kiln and 13 medieval contexts (mainly pits) were examined. Very little chaff was found in the samples, as is common on sites within the town walls. Spelt and 6-row barley were present, while free-threshing wheat (including possible hexaploid bread wheat type), barley, rye and oats *s.l.* were also found. Peas or beans were present and HNS. Buried soils contained straw fragments, glume wheat grains and weeds (including cleavers). Samples from the mid-2nd century cesspit to the rear of the shop front contained evidence of imported goods including amphorae fragments, meat bones, fish remains and mineralised sloe stones, grape pips, small *Prunus* sp. stones, apple, strawberry (*Fragaria vesca*), possible figs, opium poppy and grass stems. Mineralised weeds included nettle, docks and possible Solanaceae. A few charred spelt glume bases were present. The imported, exotic fruits and fish recovered from this pit suggest that diet of the urban population was being shaped by Roman influences, in contrast to more rural sites where such finds are scarce. The phase 4 (3rd century) samples were poor in CPR and a few mineralised remains were found. The furnace/kiln contained a few incidental inclusions. The floor deposit, however, produced numerous HNS fragments, a few cereal grains and numerous weed seeds of a grassy vegetation type (heath grass (*Danthonia decumbens*), crested dog's tail (*Cynosurus cristatus*), knapweed (*Centaurea* sp.), clover-type, plantains, buttercup, sedges). This could be kindling or fodder, as found at the Shires ([LR5]).

Newarke Street, Leicester [LR3] This area of Leicester, lying south of the Roman and Medieval town defences, is known to have been used as a cemetery in the Roman period. A late C1st pit contained abundant charred plant remains comprising primarily weed seeds and cereal grains with a little chaff (including spelt). Flax seeds and a charred bean or pea fragment were also present. The assemblage appears to have originated as domestic waste, including cereal cleaning waste from the preparation of grain prior to cooking. A mid C2nd cesspit contained a few charred cereal grains and mineralised seeds of opium poppy and grass fragments.

Rocester

A fort was constructed midway along the road between Derby and Newcastle during the later part of the 1st century AD. After the Roman army abandoned the fort in the mid 2nd century civilians remained and Rocester continued to thrive as a trading centre.

New Cemetery, Rocester, Staffs [ST17a] Forty samples from 25 features were analysed including twelve samples from nine features associated with the barrack block. Primary contexts included two oven/hearth pits from the kitchen. Crop plants consisted of spelt, free-threshing wheat, possible emmer, hulled six-row barley and rye. A single fruit of beet was also recovered. Chaff and weed seeds were mostly few in number. Rye may have been a weed rather than a crop. The few identifiable oat grains were from *Avena fatua/ludoviciana*, so the remainder may all have been weeds too. Weeds and wild plants were primarily common weeds of disturbed and cultivated ground (including

heath grass and stinking chamomile). Sloes and HNS would have been collected; one mineralised sloe stone came from a latrine pit. Half of the samples appeared to contain fully processed wheat or barley and this might derive from small-scale accidents. Some grain may have been spoilt, though no signs of insect damage were noted, unlike in some Roman forts. Free-threshing wheat was the main wheat at Rocester, with some spelt and traces of emmer. The granary at the South Shields fort is the only other parallel (van der Veen 1994). Comparisons with rural farmsteads supplying the granaries shows that free-threshing wheat is rarely found in substantial numbers and rye is also a minor element, with spelt usually dominating these assemblages.

Worcester

The position of this settlement, commanding a ford on the river, gave it a strategic advantage when in the first century sites for forts were being sought by the Romans. Worcester was on the military route from *Glevum* (Gloucester) to *Viroconium* (Wroxeter) and it soon developed into an industrial town with its own pottery kilns and iron-smelting furnaces. Roman Worcester was a thriving trading and manufacturing centre for some three hundred years, though by the time of the Roman withdrawal from Britain in 410 it had dwindled considerably in size. A large number of sites in Worcester have been sampled for plant remains, such that a detailed picture of the development of the Roman town is starting to build up. It is clear that spelt processing waste was being burnt in considerable quantities in this town, either as fuel for metalworking industries (see below), or perhaps in some cases in the production of malt for brewing. However, the latter case has not yet been proven with confidence, and further work needs to be carried out to resolve this question, as it has important bearings on the diet and economy. Discussion concerning future research in Worcester, including the need to sample primary contexts (currently lacking), waterlogged deposits and more post-medieval deposits, was included in the Deansway reports [WC6].

Deansway, Worcester [WC6] Fifty samples from Roman deposits were examined. The main constituent of the flots was charred spelt, derived from the burning of fine sieving waste for fuel, and accidentally/deliberately burnt grain. Items per litre ranged from over 500 to less than one. Minor economic components were free-threshing wheat grains, rye grains, barley grain and chaff, and oat grains, plus a trace of pea/bean. Germinated grains and detached coleoptiles were common in the largest assemblages but occasional as a whole. Weed seeds were scarce, with various grasses (Poaceae) contributing by far the majority of seeds, as is common on a number of Roman sites. The grasses may have grown as crop weeds and been removed with the chaff, or may have been burnt as stable waste or kindling.

Worcester College of Technology [WC1] First to second century AD agricultural ditches were excavated. Samples were taken from three fills of the early Roman ditches. The primary fill contained frequent grassland taxa including indicators of damp soils with occasional cereal grains (free-threshing wheat, wheat, wheat/rye). This may represent hay that had been burnt as stable waste or tinder. The upper fill contained abundant spelt chaff with occasional grains (barley, free-threshing wheat, spelt). Detached embryos were common and brome grass and other grasses were frequent. This represents spelt processing waste, perhaps from a corn drier or chaff store. The sprouting could represent spoilage or malting.

Roman Suburbs, Worcester [WC21a] [WC21b] Four primarily Roman sites are included in this report: St Martin's Gate, 1 The Butts, 8-12 The Butts and 14-24 The Butts.
St Martin's Gate - [WC21a] Charred plant remains from 1st-3rd century pits and a ditch at this smelting and smithing site consisted primarily of spelt processing waste, with minor evidence for emmer, free-threshing wheat and barley. Sprouted grain and detached sprouts were frequent, possibly indicating use for malting or damp storage conditions. Wild plants were primarily large-seeded grasses (*Lolium, Bromus*), with some damp ground taxa and heath grass - a possible indicator of ard cultivation or the burning of turves. Comparisons with other Worcester sites indicate uniformity at this time.

14-24 The Butts - [WC21b] Charred and waterlogged plant remains were examined from 5 samples (2nd/3rd century pits and ditches). A Roman well fill was also examined using a corer. Spelt chaff was abundant in all five samples. Small amounts of detached sprouts and barley grains and rachis fragments were present. A similar range of weed taxa to St Martin's Gate was present (*Eleocharis,* scentless mayweed). The near total absence of grain and very uniform proportions of remains suggest that cereal processing waste was being used as fuel. Six samples from the well core revealed a dominance of nettles and henbane. The upper part of the deposits were not waterlogged. The assemblages indicated abandonment, though a little charred spelt chaff was also present. A single cotton thistle seed was also present, indicating a warmer climate.

Wroxeter

Wroxeter is on the site of the Roman city of *Viroconium Cornoviorum*, which was the fourth largest *civitas* capital in Roman Britain. The main section of the Watling Street Roman road runs across England between *Dubris* (Roman Dover) and Wroxeter.
Baths Basilica, Wroxeter, Shrops [SP16] Excavations on the site of the baths basilica were carried out over 25 years with a sampling program in effect from 1975. Deposits associated with the late Roman/early post-Roman use of the area were sampled for charred plant remains. Some 245 samples taken over the first 5 years were analysed by Monk. More than 600 samples were taken in 1981-5, 41 of which were analysed by Charles and Colledge. Although contamination was a problem on the site some rich samples were recovered and interpretable results were obtained. The dominant cereal was found to be spelt wheat, with occasional emmer (identified from chaff fragments). Free-threshing wheat grain was common, as was six-row barley, with occasional rye and oats (*Avena* sp.). Peas were present, as well as occasional wild fruits and nuts (sloe, blackberry, elder, HNS). Traces of walnut (*Juglans regia*) shell and a grape pip were the only exotic taxa. Weed seeds were generally scarce. Concentrations of CPR were mainly found at the western end of the baths basilica near two hearths. Hearths on the north portico and a midden also produced higher concentrations. Glume wheats were dominant in all but two samples, but in some barley was possibly frequent enough to suggest a mixed crop was grown. Perhaps barley was present as a tolerated weed or processing contaminant. In 50% of the samples no chaff was present and the remainder had > 10:1 grain to chaff indicating a partially cleaned crop. The barley-rich samples had also been processed or partially processed according to grain:rachis fragment ratios. Nine samples contained sprouting of 10 to 50% wheat grains, five of which were located in the north aisle but whether this was due to malting or damp storage is unclear. Crop processing stages were examined and the samples were placed in five categories according to their composition: (1) cleaned glume wheat grain, (2) glume wheat cleaning residues (high grain and chaff), (3) mixed clean cereals, probably mixed in storage rather

than mixed crops, (4) mixed clean glume wheat but unprocessed barley, probably mixed prior to charring, and (5) three miscellaneous, varied deposits. In conclusion, most of the CPR in the 1981-5 analysis originated from hearths or large-scale burning of storage deposits. Cleaned or semi-cleaned cereals were brought to the site where small-scale preparations took place in order to produce food. Corn driers were found by Bushe-Fox (1913) to the south of the forum demonstrating that in the later period Roman towns became adapted to subsistence-related activities, perhaps due to increased centralisation.

5.5.3.2 Small market towns, villas and farmsteads

No samples from small towns in Leicestershire and Rutland have been investigated in detail recently as projects have mainly consisted of field-walking pottery scatters or occasional test pits (Angela Monckton, pers.comm.). However, a number of farmsteads and villas have been sampled, including Empingham Villa, Rutland [LR17] (see corn drier section 5.5.3.3, below). A useful list of fifteen Roman rural sites in Leicestershire and Rutland was provided by Angela Monckton in her Beaumont Leys and Humberstone report ([LR8] 134). Examples of small rural settlements provided by Murphy and de Moulins (2002) include Leylandii Farm, Worcestershire (Jackson, Hurst, and Pearson 1996), Strensham, Worcestershire, (Jackson, Hurst, Pearson and Ratkai 1996). Small towns include Baldock, Herts [HT26] and Scole, Norfolk (Fryer and Murphy, 2014). Others are possibly represented by the pre-fort pit at Mancetter and Wasperton in Warwickshire (Bowker 1982; 1983). In the East Midlands and East of England, many rural Romano-British sites, ranging from farms to more extensive settlements, have been sampled. They include Maxey, Cambs (Green 1985), Duck End Farm, Stansted Airport, Essex [EX19] and Stonea, Cambs [CB20] and Pakenham, Suffolk [SK29]. Villa sites listed in Murphy and de Moulins (2002) include Norfolk Street, Leicestershire (Jones 1982) and Denton, Lincolnshire (Connolly and Biek 1971). Some examples of notable and/or more recent reports are given below:

Bancroft Roman Villa, Bucks [BK24a] [BK24b] Charred plant remains from the 'mausoleum' [BK24b] were consistent with general trends, increasing in density from the Iron Age, showing signs of nitrogen depletion in the early Roman period (high leguminous weeds) but showing no obvious signs of cultivation of heavier soils further away from the site. Blinks (*Montia fontana*) was present in the MIA and early Roman samples but stinking chamomile was not found. On the villa site, waterlogged and charred plant remains were recovered from features to the east of the farm buildings as well as the ornamental fish pond [BK24c]. Waterlogging increased in the late C4th AD leading to peat development in the valley bottom. The lowest third of the enclosures and corn drier were enveloped in organic sediments during the later Roman period. Samples were examined from the enclosure ditches, layers, pits and a hearth/corn drier. Samples from the valley bottom produced waterlogged and charred evidence from a ditch and overlying peat deposit. The ditch fill contained evidence for a very open environment with a strong element of disturbance (including hemlock (*Conium maculatum),* nettle etc). Abundant tussock rushes (*Juncus effusus* group) suggested wet pasture or grazed marshland. Charred spelt chaff was common, indicating crop processing nearby or rubbish disposal. A few seeds of wild celery (*Apium graveolens*), coriander (*Coriandrum sativum*), and summer savory (*Satureja hortensis*) represented cultivated herbs/flavourings. A waterlogged stone pine (*Pinus pinea*) cone was found in the ditch, possibly having grown locally, or imported for nuts or altar fuel. Plants and invertebrates of a shallow pond or lake were recovered from the peat deposit, with some well-preserved charred spelt chaff. The evidence suggested that this was a deliberately created pond, perhaps for a mill, or for fish or ornamental purposes. A pit group contained

aquatic plants, disturbed ground taxa, traces of crop plants including a flax seed, plus waterlogged seeds of garden cultivars. Two species/types of Brassica were identified in significant numbers: black mustard (*Brassica nigra*) and wild turnip (*B. rapa* ssp. *campestris*), providing probable evidence of cultivated crops. Coriander, wild celery, caper spurge (*Euphorbia lathyris*) and summer savory seeds were also recorded in the pits, all of which suggest a kitchen garden existed nearby (sewage was not indicated). A corn drier contained abundant chaff and detached coleoptiles (predominantly spelt with traces of barley and free-threshing wheat). The high evidence for sprouting in the few cereal grains present suggests the waste from rubbing malted spelt prior to grinding, though a spoilt crop could not be discounted. The charred evidence as a whole indicated the domination of spelt, but with small amounts of chaff of free-threshing hexaploid (*Triticum aestivum* type) wheat, emmer, hulled barley and oats (*Avena* sp.). Waterlogged flax was also present. Most of the waste derived from de-husking. The weeds included stinking chamomile (*Anthemis cotula*), sheep's sorrel (*Rumex acetosella*) and corncockle (*Agrostemma githago*). Bancroft was a palatial villa, at least in the 4th century, and the presence of two beetles that can become serious pests of stored grain (page 583) could indicate the large-scale storage of grain at more the substantial villas in the Ouse Valley, such as Bancroft. The presence of horticultural plants, malting debris and possible orchard cultivation is notable (stone pine, plum/bullace/damson).

Rowler Manor, Croughton, Northants [NH12] Twenty-two samples from different stages of the excavation of the Roman villa were examined. Grain-rich samples from immediately above the mosaic floor comprised pure spelt grain with some chaff, and no weed contaminants (though with a trace of emmer, barley and oat/brome). Clean, fully processed spelt grain was likely to have been present. It is possible that crops were being brought in from another farmstead in a fully processed state. It was suggested by Mark Robinson ([NH12] 85) that charring may have happened accidentally when grain stored in the roof-space was burnt during a fire at the villa. Samples from the demolition layer were similar to the grain-rich deposit, containing almost exclusively spelt with very little chaff. Other features, such as the hypocaust and pits, produced a few cereal remains. Grain dimensions were recorded for 100 spelt grains from the mosaic floor.

Colne Fen, Earith (Langdale Hale and Camp Ground), Cambs [CB65] Analyses of assemblages from two fen-edge sites, Langdale Hale and Camp Ground, form a large proportion of Rachel Ballantyne's thesis on Roman settlement and economy on the southern fen-edge of Cambridgeshire (Ballantyne 2009). At Langdale Hale two lower fills of a well were waterlogged, providing evidence of damp, disturbed ground and regenerating vegetation (nettles, blinks, hemlock etc). The deposits probably represent abandonment. The charred assemblages (92 samples) were generally rich (average of 37 fragments per litre (fpl)), deriving from middens, flues and wells. Chaff comprised 52% of the remains. Grain was often puffed indicating high charring temperatures. Spelt wheat (grain and chaff) was the dominant cereal, with some emmer and probable free-threshing wheat grain and chaff. The presence of unusual items such as single grained spikelets, infertile spikelets and immature spikelets within the spelt wheat crop was interpreted as possible evidence for harvesting the crop when green and/or physiological stress, or the expression of a genetic trait. These elements were also present at Camp Ground, indicating a possible link. Barley was less frequent except in some phase I (AD 70 to AD120) samples from Langdale Hale. No evidence for malting was found and rye was absent. All oats were probably wild, as indicated by a few floret bases recovered. The predominance of spelt chaff could demonstrate use for fuel. Bread wheat-type chaff was unusually frequent in phase I though spelt may have dominated in later phases. Flax,

pea, bean, HNS and sloe/cherry were present in low numbers. Distributions of chaff-rich and grain-rich samples were plotted, showing that settlement reorganisation differences in the charred plant remains (CPR). Spelt chaff was abundant from AD180 onwards and very few samples contained no CPR. Comparing the distribution of artefacts and bone it can be seen that concentrations of unburnt materials represent middening, the locations of which changed through the phases.

At Camp Ground 302 samples were analysed. Ditches, pits and middens produced the richest assemblages, rather than the interiors of buildings, and the average concentration of charred plant remains was lower than at Langdale Hale. Spelt chaff was the most abundant item, with smaller amounts of emmer and probable bread wheat-type free-threshing wheat. Hulled six-row barley was present in moderate frequencies, as has been found in other southern fen-edge sites. Rye was scarce (phase IV only; AD 325 to AD 410+) and only wild oat floret bases were recorded. Charred flax seeds were frequent in a beam slot, and pea, Celtic bean, wild plum (*Prunus domestica*) and HNS were recorded. A charred seed of beet (*Beta vulgaris*) was present in a well fill. Wetland taxa were more frequent than at Langdale Hale. A high frequency of *Phragmites* culm nodes occurred at this site and it is likely that fen plants and possibly peat were used as fuel along with spelt chaff. Because of the lower frequencies of charred plant remains spatial patterning was difficult for most phases except phase III (AD180 to AD 325). Nine samples were waterlogged though not all were productive. Aquatics and plants of nutrient-enriched disturbed ground were dominant. The base of a phase III ditch, however, contained fenland plants.

Papworth Everard, Longstanton, Cambs [CB64] A total of 45 samples dating from the LBA to Saxon periods were analysed including 22 of RB date, of which six produced rich assemblages. A spread of charred material in the area suggests that the samples may have had similar origins. Spelt wheat was the most frequent cereal, with traces of rye and hulled barley. Chaff was dominant, suggesting that waste from the later stages of processing was present. One feature contained a large amount of well-preserved silicified awns, rachis internodes and coleoptiles, and all but one sample contained germinated spelt grains. Malting, or possibly spoiled stored grain was suggested. Heavier soils were cultivated by the RB period (stinking chamomile was common). Whilst cereals were clearly important, by the RB period they may not have been growing enough for market at this site. However, they may have been making spelt beer. Similar weeds in the Saxon period suggest no changes in the location of arable fields. Other plants collected and used from the RB period onwards included flax (stem frags), hazelnuts, black mustard, lentils (*Lens culinaris*), and possibly peas, plus fruits and possible herbs.

Droitwich Spa, Worcs

The Roman town was known as *Salinae (Dobunnorum)* and was located at the crossroads of several Roman roads. Natural brine springs in the town were used to manufacture salt from the IA and through the Roman period. Railway construction in 1847 revealed Roman mosaic pavements, and later excavations unearthed a Roman villa or corridor house some 40 metres (130 ft) long.

Waterlogged and charred plant remains have been recovered from the following Droitwich sites listed in Murphy and de Moulins (2002): a saltworking site at Upwich [WC39]; Old Bowling Green [WC28] (IA to Post-Medieval features). Some examples of more recently published reports are given below.

Hanbury Street, Dodderhill Hillfort, Droitwich [WC13] A palisaded boundary ditch was excavated near the junction of two Roman roads at Hanbury Street. An extensive spread of 2nd century charred cereal remains was well-sampled. Five samples were analysed from three distinct areas of the spread. The deposit contained different types of waste from several stages of processing of one or several emmer and spelt crops. Some barley may have been grown nearby. The waste from the second sieving stage (Hillman's model, 1981), and the waste from the third sieving stage were probably represented. Brome-grass was abundant but as it had mainly been removed from the crop, it was presumably not valued as a 'fall back' crop. However, its concentration in one part of the spread may mean that it was deliberately recovered from the by-product of crop processing, or that it was abundant in one field and the crop from that field was processed in a particular area of the site. It may have been kept as famine food or fed to livestock. Alternatively, Pliny (Natural History 22:79) describes medicinal uses for 'bromos'. The highly concentrated, large deposit of spelt chaff might have been collected for fuel and then raked out of hearths and dumped outside the hut in a midden to be used on the fields at a later date. Chaff may have been used for fodder, to line storage pits, as temper or as animal litter. *Lolium, Festuca* and other grass seeds were abundant, possibly representing stored animal fodder, or accumulated waste. A calamitous fire consuming the waste from one season's cereal processing is suggested. Sprouted grains were common, and this suggests that the grain may have been burnt due to sprouting in storage. Apart from grasses, other weeds were scarce. This could be due to efficient processing, weeding of crops in the field or cutting high on the straw. Post holes near the deposits may have been from a structure covering or enclosing the threshing area.

Bays Meadow Villa, Droitwich, Worcs [WC14a] Four samples from a cesspit, oven, aisled building and pit dated to the late 3rd/4th century were analysed. The cesspit contained occasional charred spelt and emmer grains, frequent 6-row hulled barley, a trace of oat and a horse- or Celtic bean. Weed seeds and chaff were rare, suggesting that cleaned grain had been deposited. The oven sample contained abundant spelt chaff, frequent barley grains, barley chaff, and some spelt (with rare emmer) grain. Several rye and oat grains (probably wild) and frequent weed seeds (mainly brome with corncockle, sedges, grasses etc) were present. The use of cereal processing waste for fuel/kindling was suggested. Some of the spelt and barley grains had sprouted but it was not clear whether malting had been taking place or drying of a crop in which some grains had spoiled. The C4th annexe deposits contained abundant stored cereals consisting primarily of spelt wheat grain (90% of grain), with <1% of cf. emmer, 3% hulled barley grain and 4% rye. Oats (2%) were probably growing as crop weeds as one wild oat floret base was identified. A large number of spelt grains had sprouted and charred beetle remains were present, perhaps indicating that spoilage was the reason for burning this processed crop. The grain to glume base ratio was 79:1 suggesting that the spelt had been stored as processed grain, leaving it more vulnerable to pests and damp. The main weed contaminants were grain sized (brome grass), but some damp ground weed taxa (sedges) and nutrient-poor indicators (vetches) were also present. Very little was recovered from the C4th pit. It is uncertain whether the processed grain had been grown locally or imported, but the relatively high occurrence of rye (4%) is notable.

A large waterlogged assemblage was examined from a stone-lined C3rd/4th well [WC14b]. Perennial weeds of nutrient-rich soils were abundant (nettles, hemlock). Other waste ground weeds included burdock (*Arctium* sp), thistles, henbane and cotton thistle. Aquatics and wet ground plants were more limited and evidence of grassland was slight.

Hedgerow/scrub was represented by oak buds and sloe stones. The only crop plant was some charred wheat - no exotic taxa were present. A very weedy, possibly post-abandonment, vegetation appears to have existed, as is common in many well fills of this date.

Great Holts Farm, Boreham, Essex, [EX8] Samples from the large post-pits of a late 3rd/4th century granary produced charred grain and pea, representing stored crops. Spatial variation enabled the different storage zones to be identified. The cereal remains mainly consisted of hulled wheat grains, with the small amount of chaff indicating spelt as the principal crop (though a little emmer may have been present). Possible peas or cultivated vetch were present in some of the post holes and dominated a post hole in the north corner. The Roman building represents the only known example from the Midlands region of a farm granary that had been burnt down, preserving evidence of the stored crops. Spelt, barley and pulses were stored as separate, fully- processed crops (indicated by the scarcity of chaff and weed seeds), yet there were no signs of insect or fungal attacks. Six-row barley and pulses would have been mainly used for fodder. The main weeds were brome grass, stinking chamomile, small grassland taxa such as clovers, grasses and plantains. A late Roman well produced abundant waterlogged macrofossils. Evidence of edible plants was frequent and varied, including stone pine cone bracts and nutshell fragments, sweet chestnut pericarp, walnut shell, hazelnut shell, olive stones, a grape pip, sloe, cherry and bullace stones, apple endocarp, spelt chaff. Both calcicoles (requiring lime) and weeds of dry, sandy acidic conditions were present, as well as the clay soil indicator stinking chamomile. Hay was also probably present, with several types of grassland indicated. The material represents dumped flooring material from within the farmhouse along with other domestic debris, providing a rare picture of living conditions within a late Roman farmhouse. There was no evidence to suggest that animals had been housed in the building. In view of the frequency of imported foods, the occupants appear to have enjoyed a high standard of living. This may in part reflect the preservation at the site (waterlogged conditions and the burnt-down granary), providing some indication of the plant foods which are rarely found.

Stanwick Villa, Raunds, Northants [NH38] Although only assessed to date, the potential of these charred and waterlogged assemblages is notable, particularly those from the wells. Assessment reports covering primarily samples from Stanwick Roman Villa, but also a few samples from MCB'86 near Mallows Farm (assessed by Joy Ede) and Redlands Farm are presented in Volume 2 of the Raunds Area Project report on the LIA and RB sites. Volume 1 presents the findings of all specialist reports in a collated narrative. Charred plant remains were recovered from bulk sieved samples. 1021 samples out of 1843 have been processed, c10% of which were assessed along with all of the corn drier and four-poster samples (37 and 13 samples). Spelt wheat was dominant in most samples but occasional samples were dominated by hulled barley. Traces of emmer, free-threshing wheat, oats and rye were present, but there remains the possibility of contamination and residuality, and the final phasing had yet to be completed when the report was written. Recommendations were made that Iron Age samples (including 4-post structures) and IA/RB contexts should be studied (c23 samples). First to second century pit and ditch samples (c30 samples) were limited but contained emmer which was not found in the C3rd-C4th. The later RB samples were more productive, including corn driers and ash spreads, so comparisons can be made with regard to arable catchment areas. Little Saxon material was found. Waterlogged preservation was found in 120 samples which included 23 wells. Some of the well fills were very well preserved, but the deposition of mixed waste in many restricted their

value for providing information about the local environment. However, selected wells were recommended for full analysis, including one containing a diverse hay meadow flora which indicated that the flood plain was relatively well-drained, one containing a large amount of waterlogged spelt spikelets with flax and bracken and one containing frequent fruit stones (including sloe and bullace). The waterlogged ditch samples had the potential for providing information about the local environment, since little waste had been dumped. Few exotic species were present in the waterlogged features, the most notable being traces of coriander in several samples, opium poppy, box leaves in the later Roman samples and celery. Cotton thistle was present in three 3rd to 4th century samples.

Dragonby, Lincs [LC26] The remains of LIA roundhouses which were later replaced by Roman aisled timber buildings, courtyards and ovens were excavated in 1970. Charred and waterlogged plant remains were examined. Three waterlogged RB well fills produced both native and exotic food plant remains, including blackberry, sloe, hawthorn, elderberry, hazelnut shell, coriander, opium poppy and summer savory (*Satureja hortensis*). The charred plant assemblages contained primarily low concentrations of grain, with spelt wheat and hulled barley grains being roughly equal in number. Free-threshing wheat was present but no emmer was identified. A single seed of cultivated flax was recorded. The imported foods suggest a high-status dwelling.

Frogs Hall Borrow Pit, Takeley, Essex [EX6] Roman activity consisted of a villa/farm complex on the east bank of the River Roding and mid to late Roman craft and agricultural processing activities on the west bank. Charred plant remains were scarce and poorly preserved, but a Roman post hole produced frequent peas and beans. Wheat (*Triticum* sp. with spelt confirmed by a few glume bases) was found in three samples associated with a Roman hearth. Weed seeds were rare and were mostly found in the hearth, probably implying use as kindling (stinking chamomile, grassland taxa including buttercups (*Ranunculus*) and sheep's sorrel). Two LIA or RB cremation burials produced tuber fragments including one onion couch tuber.

Elms Farm, Heybridge, Essex [EX26] The report arises from the 1994-5 excavations, during which 790 samples were taken. Samples from the earlier 1993 excavations were unproductive. Recovery problems meant that relatively few samples were productive and refloating had to be employed wherever possible. Spelt wheat was by far the dominant cereal cultivated, although emmer was present in several samples until the later phases (later 2nd to late 4th century AD). Hulled barley was consistently present in low concentrations and possible free-threshing wheat grain was present in small amounts throughout. Small numbers of flax seeds were found in Late Iron Age/early Roman (mid 1st century BC to mid 1st century AD) and the early Roman (later 1st century to mid 2nd century AD) samples. In the LIA/ER (phase 2; mid-1st century BC – mid-1st century AD) charred plant remains were frequent (averaging 14.9 fpl) and most of the assemblages appeared to consist of cereal cleaning waste with frequent detached sprouts, as chaff and weed seeds were dominant. In the early Roman period the samples were at their most productive (16.6 fpl), particularly in a well that had been used for rubbish disposal. The abundant spelt chaff and detached, uniform sprouts suggests malting waste. Larger scale de-husking is also indicated in the same area of the site. In the mid to late Roman period (phases 4-6; later 2nd to late 4th century AD) fewer productive samples were found and the CPR concentration was only 3.5 fpl on average. Gathered fruits and nuts included frequent HNS, sloe, bramble, hawthorn, elder and wild or sour cherry (*Prunus avium/cerasus*), with HNS and sloes being present in all phases. Additional finds from the bulk samples from wells included frequent stones of wild/sour

cherry (*Prunus avium/cerasus*) and small plum or bullace, with grape and walnut representing imported or introduced foods (A. Monckton pers. comm.). A palaeochannel contained high concentrations of charred wheat chaff and evidence of malting spelt, and two later Roman corn driers were grain-rich. Activity appears to have moved to the periphery of the site in the later periods. The weed assemblages did not vary much between phases, indicating continuity of husbandry methods. Autumn sowing was suggested, and soils ranged from sandy to damp. Henbane, bryony (*Bryonia dioica*) and mallow (*Malva* sp) occurred in the later Roman, species typical of farmyard environments. In all phases, pits were most productive and post holes the least.

Renny Lodge, Bucks [BK10] Valley gravels overlying Oxford clay in the Great Ouse and Ouzel were occupied from c2000BC. Bronze Age barrows, Iron Age farmsteads, and 2nd to 4th century Romano-British settlement features were excavated. Four out of 34 were samples analysed from RB ditches and a spread, but scanning results were also incorporated in the table. The cereals consisted primarily of spelt remains with some emmer, several barley grains and occasional free-threshing wheat. The weeds were mainly large seeded, such as brome and oats. The de-husking of fairly clean spikelets was indicated. Frequent charred flax seeds, capsules and stem fragments were recovered from a ditch along with small weed seeds. Frequent weeds such as corn spurrey (*Spergula arvensis*) and field pennycress (*Thlaspi arvense*), suggested the cultivation of sandy soils, and the presence of onion couch indicated the uprooting of flax that had probably been grown for oil.

Great Barford by-pass, Beds [BD13] A large number of samples were assessed from this road scheme, leading to the analysis of Iron Age to medieval settlement assemblages. Amongst these, three early Roman samples were fully analysed. One sample produced abundant spelt glume bases, a possible ditch terminal (or oven/pyre?) contained abundant wheat grains (including spelt and free-threshing wheat) and barley. Three samples from beehive-shaped pits (LIA/ER) produced some grain-rich samples, some of which also were rich in vetches. Two samples from a kiln were rich in cereal grains and chaff fragments (mainly spelt, with some free-threshing wheat grains, barley, rye and oats) demonstrating that it had been used to dry grain. A flax seed and possible pea were present. The limited weeds included fat hen, vetches and chickweed (*Stellaria media*). Weeds in the other ER samples included common ruderals with frequent clover-type (*Trifolium* type) seeds and some wet ground taxa. One mid/late RB sample from a pit in Site 1 was examined. Wheat grains (*Triticum* sp.) with limited spelt chaff and frequent weeds were recorded (fat hen, vetches, Poaceae). As in earlier samples, wet ground weeds were frequent including club rush (*Isolepis* sp.) and spike-rush (*Eleocharis* sp.). On Site 8 samples from a mid/late Roman corn drier were dominated by wheat grains. The presence of detached coleoptiles suggested malting was taking place. Limited oats and barley were present. Hulled and free-threshing wheat was present and spelt glume bases were abundant. Weed seeds, however, were scarce, indicating cleaning/weed removal prior to de-husking. A deposit of concentrated spelt processing waste recovered from a hollow dated to the late Roman period also appeared to consist of malting waste, since detached coleoptiles were abundant. The waste had probably been cleaned out of a corn drier. It was notable that the same types of weeds continued to be dominant throughout the phases, suggesting continuity in the types of soils being cultivated.

Salford Priors, Arrow Valley, Warks [WR30a] [WR30b] Excavations along the route of the Norton Lenchwick Bypass in 1993 revealed Late Neolithic, LBA, LIA, RB and AS sites along the Warwickshire Arrow Valley. Charred plant remains from Later Roman

contexts at Salford Priors were better preserved and more abundant than on some of the Arrow Valley sites, and were concentrated in certain areas of the site. An area containing a corn drier, produced by far the most abundant material, which was predominantly spelt chaff. Emmer and weed seeds were scarce. Grass seeds and fat hen were the most common weeds.

Waterlogged remains were sampled from a late Roman-British ditch in a series consisting of 15 spits. Aquatic/wetland plants decreased up the profile as perennial weeds of nutrient-rich soils increased with the silting up of the ditch. Scrub or hedgerow taxa suggest the presence of a hedge along the ditch. Disturbed/cultivated ground weeds were dominant, especially nutrient-rich taxa. Annual weeds included stinking chamomile. Henbane, mallow and cotton thistle (warmth-demanding taxa) were also present. Grassland and trampled ground were represented. Some charred cereal remains were present, and opium poppy seeds and celery.

Tiddington, Warks [WR35] The site of a Romano-British village, located on the gravel terrace of the Warwickshire Avon, produced particularly rich charred plant assemblages. 120 samples were examined from mostly 1st and 2nd century contexts, including pits, ditches, post holes, wells, hearths ovens and corn driers. The main cereal recovered was spelt wheat (96% presence), grain and chaff. Emmer was present in all phases but in low amounts, tailing off to some extent through to the C4th. Barley was common (82% presence) but in small amounts, and free-threshing wheat (*Triticum aestivum s.l.* rachis; spelt/free-threshing wheat grain) was infrequent. Unusual forms of a possible tough-rachised spelt or non-disarticulated hexaploid free-threshing wheat internodes were recovered, as well as short compact grains resembling club wheat but with some spelt characteristics, identified in the report as *Triticum spelta/T. aestivocompactum*. This probably demonstrates the genetic diversity of the crops. Rye grains and chaff fragments were present in low numbers in several 2nd century samples and were more frequent in two corn driers and the well. Peas, hedgerow plants (sloe, hawthorn, hazel), grassland species (for example vetches and heath-grass, which may indicate fallowing) and arable weeds (including an early record of cornflower, which should be considered as potentially intrusive) were recovered. Four corn driers produced mainly chaff and some germinated grain. One drier produced abundant unevenly germinated spelt, probably germinated in the husk, and this is thought to have represented malting. Smaller amounts of sprouting seen in samples from the other three corn driers were more ambiguous. A sample of prime spelt wheat grain was recovered from the cross flue of one drier. Silicified awn and chaff conglomerations were present, as well as some that were at least partially mineralised. Most of the material derived from re-deposited fine sieving waste, though a few samples were dominated by prime grain or weed seeds. Weed ecology suggested that cereals were harvested low on the stem and at least some crops were autumn sown. Light, sandy soils and calcareous soils were indicated by the weeds. Occasional henbane seeds, sloe stones and heather flowers indicated that other types of waste were also deposited with the cereal processing waste, including food waste (peas, hazelnut shell). In conclusion, the settlement appears to have been processing cereals (primarily spelt wheat) in notable quantities from the C2nd onwards, some of which were used for malt production.

Old Park House, Ashby de la Zouch, Leics [LR 25] Second to third century AD features from a Late Iron Age to Romano-British site included a wide linear ditch and pits. A Romano-British pit produced abundant oats (*Avena* sp.; 145 grains) and evidence for rye cultivation (2 grains and 13 rachis fragments). Spelt wheat, free-threshing wheat and

barley were less frequent. Weeds included frequent stinking chamomile and some wild radish (*Raphanus raphanistrum*), suggesting that both heavy, and lightly, slightly acidic soils had been cultivated. The deposit is interpreted as probably representing charred mixed oat/rye/barley fodder and provides a rare example of a site of this period in which spelt wheat was not dominant

Raymoth Lane, Worksop, Notts [NT2] A typical Late Iron Age/Romano-British enclosure was investigated. The absence of formal land divisions was possibly explained by the dominance of animal husbandry over arable agriculture. There was some evidence for local smithing and pottery production. Fifty-one samples were processed from pits, ditches and a kiln. Only 15 of the 34 bulk samples from the features within the enclosure contained more than 10 items and 61% of the samples produced <1 fpl, particularly those from the enclosure ditch fills. Only the samples with more than 30 fragments per litre were listed in the table. Cereals identified include spelt-type and emmer-type wheat, possible occasional einkorn-type grains and some cf. free-threshing wheat grains. Most of the chaff recovered was from emmer or spelt. Hulled 6-row barley was also present and a pea/bean sized cotyledon indicated that pulses were cultivated. Wild species included HNS, corncockle, grasses, oat, elder and bramble. A mid 2nd C AD pit sample was dominated by spelt wheat, with emmer amounting to less than 5% of the wheat grain. Occasional free-threshing wheat, cf. einkorn-type (*Triticum* cf *monococcum*), hulled barley and oat grains amounted to 9% of the grain (with oat dominant). Grain was dominant, suggesting a cleaned crop ready for storage, consumption or milling. The 2nd century kiln produced mainly barley with frequent weed seeds and some barley chaff. This may represent cleaning residues being used for tinder and/or fuel. The enclosure ditch produced sparse remains (0-1.65 fpl) including poorly preserved wheat grains, emmer/spelt chaff, hulled barley grains and a few grassland/cultivated land weed seeds. Comparing the occurrence of edible species across the site, barley was the most widespread item though densities were low. Spelt wheat dominated the rich samples. Oat and brome were also widespread. Pulses, hazelnuts and wild fruits may also have been important but were under-represented. The overall impression was that, since stored processed crops were present with very little evidence for earlier stages of processing, the site may have been primarily pastoral with cereals brought to the site from further afield. There is also no crop mark evidence for arable fields in the immediate area.

Ely

The land around Ely was occupied through the later IA to end of the Roman period. Evidence from several sites demonstrates that the area was occupied intermittently from 5th to 3rd century BC and then continuously into the second half of the 4th century AD. Mixed arable and pastoral farming occurred in the IA and Roman periods at the following sites:

Prickwillow Road, Ely, Cambs [CB16] Middle Roman (mid 2nd-3rd century AD) samples produced primarily hulled wheat (with emmer confirmed from glume bases) with traces of barley, HNS and a possible half crab apple. Spelt chaff was not found prior to the later Roman period. Wetland taxa, including great fen-sedge, occurred from the earlier RB onwards and increased with time.

By the 4th century AD concentrations of charred plant remains had increased and spelt was the principal crop represented, with only traces of emmer, barley, oat and possible rye being found. Brome grass was by far the most common weed, and in one very rich

sample, a deposit of crop processing waste in an enclosure ditch, it accounted for 44% of the remains (439 grains). It is possible that brome grass was tolerated as an edible weed, particularly in fodder crops. Wetland taxa, including great fen-sedge, were more frequent in this phase, and were common in the oven sample, indicating that marsh hay was being used as fuel or tinder. Arable cultivation therefore appears to have increased and expanded in the mid 3rd-4th century AD in this area with the introduction of spelt and free-threshing wheat which would have been suited to the heavy, mineral-rich soils.

West Fen Road, Ely, Cambs [CB13] Five samples from Roman contexts produced spelt wheat de-husking waste, a few barley grains, free-threshing wheat rachis internodes, occasional oat grains and typical arable/disturbed ground weeds (Chenopodiaceae were frequent; sedges and brome grass were present). The occurrence of stinking chamomile for the first time on the site (Iron Age samples did not contain this species) was linked to a possible movement of cultivation on to clay soils during the Roman period, although the occurrence of this species is sporadic prior to the Roman period generally. Celtic bean was present in a Roman ditch. The evidence as a whole from this region suggests continuity of occupation from the Iron Age onwards, but changes in the range of soils being cultivated, with movement onto wetter and heavier soils occurring during the RB period.

Parnwell, Peterborough, Cambs [CB30] Sixteen Romano-British features, including a corn drier, were examined. Ten samples from the corn drier produced evidence for malting spelt wheat (abundant detached coleoptiles and a few sprouted grains). Small numbers of free-threshing wheat, barley and rye grains were present, perhaps representing other crops grown. The dominant weed taxa were *Bromus* and small leguminous (Fabaceae) seeds. Corncockle and stinking chamomile were present. Other features contained similar taxa but one pit was dominated by clean grain (perhaps stored) and another contained weeds of wet/damp ground.

Stansted Airport and the A120 Stansted Link Road, Essex [EX19] [EX17] [EX18] Around 1000 soil samples have been assessed from several sites in this area over the last two decades. Concentrations of charred plant remains up to the Late Iron Age/early Romano-British period were notably low, probably due to difficulties in cultivating the heavy clay soils. In the LIA/early Romano-British period there was a ten-fold increase in concentrations of charred plant remains in comparison with the MBA, indicating that arable cultivation had become a major component of the economy on the Essex clay (see LBA/IA Period Review section 5.4 for details of earlier settlement).

Stansted Volume 1 [EX19]: Late Iron Age and Roman charred plant remains. Sites investigated included the Airport Catering site (ACS - 50 samples from a LIA/early Roman enclosed settlement), Bury Lodge (BLS: 35 samples from LIA/Roman features), Car Park 1 (CIS) and Duckend Farm (DFS: 22 Roman cut features, floor levels and cremations). The LIA/Roman samples (ACS, BLS, CIS, DFS) produced poorly preserved, fragmented grains and chaff, with spelt wheat dominating the identifiable chaff. Charred plant remains densities were generally low in ACS and BLS (very little chaff present) but high in spelt chaff at DFS. A few emmer chaff fragments and free-threshing wheat grains, six-row hulled barley grains, oats (including one *Avena sativa*), cf. peas were recovered from most sites but there was no evidence for any distinctive clayland production. Site ACS, located on poorly drained soils, contained a background scatter of debris from semi-cleaned crop products with no evidence for the disposal of processing waste. Stinking chamomile was not present in these samples, though it was in BLS and DFS.

BLS produced more variable samples which may have resulted from more than one type of activity. The Roman samples from DFS were totally different from ACS, containing much higher densities of charred plant remains, dominated by glume wheat chaff. Cereal grain sprouts were frequent and some grains showed signs of sprouting. *Anthemis cotula* was frequent. DFS is located at the boundary between heavy clay and better-drained loamy clay soils. Large scale crop cleaning and possibly malting was taking place at farms such as DFS, indicating that specialisation and intensification occurred in the Roman period in Essex. Harvesting may have involved cutting high on the straw as most of the assemblages were largely sieving waste with limited ranges of weeds. *Vicia/Lathyrus* spp. and *Bromus* sp. were the main taxa. The presence of grassland taxa at ACS and BLS may relate to hay crops or plants on field margins. Damp habitat taxa were fairly common (*Montia fontana, Carex* spp.*, Eleocharis palustris*). Wild foods included hazelnut, sloe and possible strawberry.

[EX18] and [EX19]: Samples examined from the later excavations indicated that the arable economy was well developed by the Late Iron Age and early Romano-British period. Spelt wheat was probably the main cereal grown for human consumption, although emmer and hulled barley continued to be important. Free-threshing wheat grain made its first appearance in these samples and increased in occurrence as the Romano-British period progressed. Oats may have started to replace barley as a fodder crop to some extent in the early Romano-British period. A range of new weeds of cultivation occurred from the early Romano-British period, possibly having been introduced in imported spelt wheat, including corncockle, small-flowered buttercup (*Ranunculus parviflorus*) and perennial/Mediterranean rye-grass (*Lolium perenne/rigidum*). However, stinking chamomile, a weed of heavy, clay soils, did not occur prior to the mid Romano-British period (2nd/3rd century AD) suggesting that this was the point of expansion of arable onto the Boulder Clay. Perhaps enclosures on the plateau were primarily used for low-level livestock rearing in the Late Iron Age /early Romano-British, rather than for arable crops. Other damp ground weeds, such as spike-rush and sedges, were notably more frequent in the Late Iron Age/early Romano-British and early Romano-British samples than at any other time, indicating that most of the cultivation may still have been taking place on the lower lying ground near Stansted Brook at the Long Term Car Park (LTCP) site. Another significant category of weeds that was well-represented in the mid/late Iron Age samples discussed above (section 5.4), and in all of the Late Iron Age, Late Iron Age/early Romano-British and early Romano-British samples, was the small-seeded vetches (<2 mm diameter seeds of *Vicia/Lathyrus* sp.). These are characteristic of nutrient-depleted soils (Moss 2004), so their abundance suggests that, although arable cultivation appears to have been occurring on a greater scale, yields per unit area of land may have been dropping because manuring was not yet being practised or was insufficient to meet the needs of the cultivation regime. Using van der Veen's description of agricultural systems (2005, 158), the Late Iron Age/early Romano-British economy was probably operating along the lines of an extensive agricultural system (low input, large area of land).

By the M/LRB arable organisation and industry increased. Large scale production and processing of spelt occurred, as indicated by concentrations of processing waste around a corn drier and the presence of concentrated crop processing waste on two of the A120 sites [EX17]. Bread wheat (*Triticum aestivum* type), rye (confirmed by a rachis fragment at Bury Lodge [EX19]), traces of emmer, occasional barley, flax, possible peas and oats (not identified to species) were also being grown but the only indication of exotic foods was a trace of grape pollen. Some native fruits and nuts were consumed. Leguminous

weed seeds decreased perhaps indicating an increase in manuring. Detached coleoptiles were only present in the later Roman samples and it is possible that some sites in the Stansted area were malting spelt (Murphy 1997). However, in most cases the increase in sprouted grain was probably due to large scale handling of de-husked spelt which would have been more prone to spoilage.

Melford Meadows, Brettenham, Norfolk [NK27] Excavations at Melford Meadows, just outside Thetford, revealed part of a Romano-British settlement (probably a farmstead, mainly 3rd – 4th century) and an early Saxon settlement on a low sandy ridge on the left bank of the River Thet. Of the 30 samples assessed ten were analysed. The four samples from RB features included a waterhole (not waterlogged), a possible oven and a pit. The waterhole contained concentrations of charred chaff and grain from the de-husking of spelt and threshing of rye and barley. The few weed seeds recovered included some taxa of acidic, free-draining and wet ground. The 62 chaff fragments and 4 grains of rye were significant early evidence for cultivation of this crop. The other two features contained mainly poorly preserved grain, including wheat and barley.

M6 Toll, Warks to Staffs [WR25] Excavations carried out along the route of the M6 Toll motorway identified 41 sites spanning most archaeological periods. The Romano-British deposits that produced archaeobotanical remains are briefly outlined here.

Washbrook Lane, Norton Canes [WR25] (boulder clay): 3 of 6 samples from RB features contained charred plant remains but amounts were low. Crops included emmer/spelt, barley, pea and beet (*Beta vulgaris*).

West of Crane Brook Cottage, Hammerwich [WR25] (sandstone under clay/alluvium): Of a total of 44 samples, 17 were analysed, mainly from RB features. A little wheat, barley, HNS, and an onion couch tuber had been recovered from an Iron Age burnt stone feature. Moderate amounts of spelt, a little emmer, some barley (grain and chaff), and occasional rye rachis frags were present in samples from an aisled RB building. Corn spurrey, heath grass (*Danthonia* sp.) and rye suggest the cultivation of acid soils. The building may have been used to store and perhaps process grain. Other features produced sparse remains but a beet fruit was found in a ditch sample.

East of Birmingham Road Nurseries (Site 15), Shenstone [WR25] (silty sand and clay): A total of 129 samples were assessed, mainly from Romano-British features, of which 31 were analysed. Only a few from a Romano-British pottery kiln (feature 158022) were rich in charred plant remains. Enclosure and boundary ditches contained sparse spelt, barley, rye (2 grains), pea and flax. Some spelt crop processing waste was present in an enclosure ditch. Low concentrations of waste were present in gullies, a waterhole and pit, including occasional HNS, spelt, barley, rye chaff, oats and weeds. Cultivation of sandy and acid soils was indicated by the weeds. Spelt was the dominant crop but hulled barley and rye were also well represented. Traces of two-row barley (identified on the basis of five rachis internodes) were recovered from the stoke-hole of the pottery kiln (feature 158022). Emmer, peas and flax were also grown. The kiln deposits produced the most interesting material including a substantial assemblage of weed remains within which were over 1000 nutlets and 'flowers' of docks (*Rumex* sp.), stem fragments and a range of other taxa, interpreted as crop processing waste used as fuel. The rachis of rye was fairly common in the feature (35 rachis in total), and a number of seeds of weeds characteristic of sandy and acidic soils (*Scleranthus annuus*, *Spergula arvensis*, *Rumex acetosella* and *Danthonia decumbens*) were thought to be associated with the rye crop.

Unusual for this period were seeds of cornflower (*Centaurea cyanus*), rarely recorded in the British Isles prior to the medieval period (Greig 1991a; Preston *et al* 2004), and should be regarded as potentially intrusive.

5.5.3.3 Corn driers, malting and the use of chaff for fuel

The review paper by van der Veen (1989) summarised the types of charred plant assemblages found in Roman corn driers in Britain, and describes the range of functions that they might have served. *Table 1* summarises records from the Midlands sites, demonstrating that spelt was the dominant cereal being parched prior to de-husking or dried, although barley was also often common. Most corn driers come from later Roman sites (3rd/4th century), most are found in central and southern counties and many produced possible, and sometimes definite, signs of having been used to dry malt.

Malting can be difficult to prove where the percentage of sprouted grains appears to be low. It may be that malting took place earlier in the life of the corn drier (depositing frequent detached coleoptiles) even though the crops that more frequently became charred consisted of unsprouted grain being dried prior to de-husking. Alternatively, the thin sprouts from poorly stored grain may have accumulated over time by falling to the base of the oven, in the same way that small weed seeds often fall down though the ash. Where spelt was being processed on a large scale and marketed or transported in a fully processed state (as was likely when supplying the army) exposure to the damp climate of the British Isles would have caused considerable sprouting if processed, naked grains were stored for any length of time (e.g. Stanstead Airport, Essex [EX18]). Using spoilt grain as fuel in corn driers may also have been an effective and efficient way of destroying insect and fungal infestations.

A further difficulty in identifying malting is that it is not necessary to wait until the grain shows external sign of sprouting (Merryn Dinely, pers. comm.). Frequent 'half-grains', where the germinating embryo has mobilised starches close to the embryo end causing them to burn away during charring is a useful sign of malting which can be added to counts of grooved grains and detached sprouts to obtain a fuller picture (Helm and Carruthers 2011).

Differentiating between these various types of burnt deposit in corn driers can be very difficult, unless well-preserved examples are found, as described below.

Mucking corn drier, Essex [EX22] A 90ml sample of pure charred cereal remains from a 3rd/4th century L-shaped Roman corn drier was examined. Spelt was the main cereal present, with traces of barley, some oats (only wild oat identified), brome grass (*Bromus secalinus/mollis*) and a few weed seeds (corn spurrey, dock, fat hen, grasses). Over 1000 spelt grains had sprouted and detached coleoptiles were abundant. Spelt glume bases were also abundant (ratio 1:0.6 grain:glume bases). The sample contained almost no charcoal so a 'mixed fuel and crop' explanation was unlikely. Whole clean sprouted spelt spikelets in the process of roasting for malt was the most likely interpretation.

Table 1: Corn driers producing charred plant assemblages from the Midlands region

Site name	Site code/reference	Main crops	Date	Notes
Haynes Park	BD3	spelt, barley	1/2C	de-husking by-product
Renold Water, A421	BD21	spelt	RB	
Windmill and Heelands, Milton Keynes	Jones (1987); Murphy & de Moulins (2002)		RB	
Wavendon Gate, Milton Keynes	Letts (1996); Murphy & de Moulins (2002)	spelt	RB	frequent spelt chaff, fuel residue
Bancroft Roman Villa	BK24a	spelt	1/2C	20% germinated grain
Parnwell, Peterborough	CB30	spelt	RB	malting
Haddon	CB32	spelt	4C	possible malting, mostly chaff-probably fuel
Little Hay Grange Farm, Ockbrook	DB20			
Mucking	EX22	spelt	3C	95% germinated grain; malting
Colchester	van der Veen (1989)	bread wheat, barley, rye	4C	re-used in L Saxon period
Wendens Ambo	Jones et al (1982)	spelt, bread wheat	2/3C	
Foxholes Farm, Hertford	der Veen (1989)	emmer/spelt, barley	3/4C	
Boxfield Farm, Chells, Stevenage	HT18			
M1 Widening Scheme	HT14	spelt	2/3C	40-50% chaff
Roman Villa, Norfolk Street, Leicester	LR27 ; van der Veen (1989)	spelt	RB	
Rectory Lane, Appleby Magna	LR12	spelt, barley	3/4C	upper fill, low density waste, chaff-rich
Empingham, Gwash Valley	LR17	spelt	4C	2 condriers, some malting in one, de-husking in other
Hamilton North, Leicester	LR30	spelt	RB	fine sieved cereal cleanings used as fuel
Crown Hills, Leicester	LR50	spelt	late RB	1 corn drier. c.70% chaff, more weeds in upper fill, more grain in lower fill
Ridlington (Wing to Whatborough Hill Trunk Main)	LR24	spelt, barley	2C & 4C	8 corn driers, de-husking and possible malting

Site name	Site code/reference	Main crops	Date	Notes
Cawkwell	LC25 ; van der Veen (1989)	barley, spelt	2/3C	<1% germinated grain
Hibaldstow	van der Veen (1989)	spelt	4C	90% germinated grain, malting
Fengate Farm, Weeting	van der Veen (1989)	spelt	4C	
Stanwick Roman Villa	NH38	spelt, barley	later RB	2 corn driers dominated by barley
Tiddington	WR35	spelt	2-4C	33% germinated grain
Wasperton	WR46; van der Veen (1989)	spelt, barley	2-4C	
Billesley Manor, Stratford-upon-Avon	WR45	spelt,	RB	10-12% germination, some wheat, probably in spikelet form
Salford Priors, Arrow Valley	WR30	spelt	RB	large-scale processing, chaff used as fuel
Long Itchington	WR4	spelt (emmer, barley)	RB	some detached embryos

Wing to Whatborough Hill Trunk Main, Rutland, Ridlington corn driers [LR24] Sites along a c14km water pipeline were investigated. The pipeline cut through settlement activity near boundary ditches where cereal processing was taking place. Of the 58 contexts assessed, fourteen samples from three sites were fully analysed. At Ridlington (site 5) most of the deposits were Roman and agricultural in character. Occupation spanned c125 to 350 AD. Eight corn driers dating from the beginning and end of the 200 year occupation were found, all but one of which were of the bowl furnace or long hearth type, though one had traces of a cross flue surviving suggesting that some or all may have originally been T-shaped prior to truncation. De-husking of spelt wheat was indicated, with cleaning waste being used as fuel. One sample from a flue contained abundant silicified light chaff. Malting may have been carried out, although the presence of detached sprouts does not necessarily prove this. Drying prior to storage could also have occurred. Some de-husking of barley also took place. A small amount of emmer wheat was also present (identified from chaff) as were occasional rounded grains of possible free-threshing wheat. The cultivation of better drained soils than in Leicester and autumn sowing were indicated by the weed assemblage. Comparisons were made to other sites with corn driers in the area.

The following report also provides a useful summary of corn driers in Leicestershire and Rutland, including comparisons with the corn driers in Ridlington [LR24], Appleby Magna [LR12] and sites near Leicester at Norfolk Street [LR27] and Crown Hills [LR50].

Empingham Villa, Gwash Valley, Rutland [LR17] Four samples were examined from Roman features including two 4th century corn driers. The corn driers, located on different sites, produced small assemblages revealing possible different uses of these structures. One contained spelt grain with some chaff, perhaps representing de-husking or drying prior to grinding. The second contained 27 germinated wheat grains and a barley grain, suggesting that the corn drier had been used for malting. Dimensions of several spelt, emmer, oat, barley and brome grains were given.

Cawkwell, Lincs [LC25] This site provides an example of corn driers being used to process crops other than spelt. The large numbers of grain suggest primary deposits, charred and preserved *in situ*, are present. Excavations in 1988 revealed a Roman ditch complex and number of corn driers dating to the 2nd to late 3rd century AD. Soil samples were taken from 8 ditches and 5 corn driers for the recovery of charred plant remains. Although poorly preserved, charred remains were abundant, reaching a maximum of >4000 items per kg soil processed in one barley-rich corn drier. Two of the other four corn driers were dominated by spelt chaff and grains and two contained more barley grains (*Hordeum vulgare*) than hulled wheat. Oat grains (*Avena* sp.) were frequent in 3 of the corn driers to the extent that they could have been a crop plant in corn driers 70 and 157. However, the 7 florets that were identifiable to species level were all of the wild type (*Avena fatua*-type) suggesting that oats had been a tolerated contaminant of barley, perhaps because it was being used primarily for fodder. The close association of barley and oats in four of the five corn driers and in the ditch samples (either both high, or low in occurrence) suggests that they were growing together either as dredge or as very weedy barley crops. Seeds of brome grass (*Bromus* sp.), however, (another common large-seeded weed of this period) were infrequent. The ditches were less productive (78 items per kg) and contained very little barley or oats. Because the assemblages were of the same character as the corn driers (mainly spelt processing waste or possibly complete spikelets) it is likely that the corn driers were the source of the burnt waste in the ditches.

A range of weed taxa were represented in the 15 samples, including weeds of nutrient-rich and nutrient-poor soils, both large and small-seeded, tall and short growing, damp soils (sedges, *Carex* sp.,blinks, *Montia fontana* ssp. *chondrosperma)*, and autumn sown crops (*Galium aparine*). Clearly the crops had been grown on a range of soils, and some additional sources of wild plant remains such as hay used for kindling may have been present (indicated by yellow rattle, *Rhinanthus* sp. and fairy flax, *Linum catharticum*). A trace of stinking chamomile and possible free-threshing wheat were present, but no emmer wheat was confirmed. The corn driers appear to have been used to dry a range of crops grown on a variety of soils, but no obvious evidence for malting was found. Some of the remains may represent spelt processing waste used for fuel, but the high incidence of hulled wheat, barley and oat grains indicates that much of the charred material derives from accidentally burnt crops being dried prior to de-husking, milling or storage.

5.5.3.3.1 Use of chaff as fuel

As can be seen from many of the sites summarised in section 5.5.3, spelt wheat chaff was widely used as fuel during the Roman period. This occurred to such an extent that crop processing waste was considered to be a valuable commodity, according to documentary records (van der Veen 1999). Large deposits of almost pure charred spelt chaff have been recovered from a variety of features on Roman sites, especially those close to corn driers. The following report is an example from a county that has provided surprisingly few large-scale plant macrofossil studies.

M1 Widening Scheme, Junctions 8 and 9, Herts [HT14] Twelve samples of LIA to LR date were examined including a MR corn drier, LIA/RB pits, ditches, a waterhole, an organic layer. In some cases, charred plant remains were so abundant that riffled subsamples were used for quantification. Eight of the LIA/ER-LR samples were dominated by cereal chaff (primarily spelt), one was dominated by grain and four were mixed grain/chaff/weed seeds. The weed/wild component was often small, especially if brome grass and oats are excluded. Crop-processing by-products were indicated, apart from the grain-rich pit sample (55.2% grain) which comprised highly fragmented charred cereals. Use of crop processing waste for fuel was suggested, since these remains were common to both sites and all Roman phases. The corn drier also contained a substantial chaff component (49.9% and 39.2% chaff from 2 samples). Weed seeds were limited in diversity but included brome grass, oats (*Avena* sp.), orache (*Atriplex* spp), docks and small-seeded grasses. Oat and brome were dominant in some samples, perhaps being tolerated contaminants or minor crops. Similar results were obtained from a corn drier and well at Boxfield Farm, Chells, Stevenage, Herts [HT18].

5.5.3.4 Industrial deposits and assemblages

As noted above, in addition to a productive agricultural output, important industries of the Midlands region included iron and lead working, salt making and pottery and tile production, with notable centres for the latter being in the Nene Valley and Mancetter-Hartshill (Taylor, 2006).

5.5.3.4.1 Salt making

The Midlands has a number of sites that have been used for salt making, including brine springs at Droitwich [WC28] and a number of fenland sites in Cambridgeshire, Lincolnshire and Norfolk. The following examples show how the interpretation of cereal remains on these sites can be complicated by the question of whether or not cultivation was occurring locally, and whether or not the remains represent foods consumed or cereal processing waste imported as fuel. Chaff of spelt and other cereals was also

imported to saltern sites for use as temper in clay structures associated with brine evaporation on the Essex coast (Wilkinson and Murphy 1995; [EX48]. Other potential sources of fuel can also be preserved, such as saltmarsh vegetation. The identification of peat burning is not always easy, but radiocarbon dating can help to investigate this further.

London Gateway, Essex [EX48] Situated in the Thames estuary salt working was carried out at the site from the Iron Age, with the characteristic Red Hill deposits, into the Roman period. The charred remains of local saltmarsh vegetation including sea lavenders (*Limonium* sp), saltmarsh rush (*Juncus gerardii*), sea rush (*Juncus maritimus*), sea arrowgrass (*Triglochin maritima)* and sea plantain (*Plantago maritima*), were deposited in large quantities across the site throughout this period. It was potentially being used as a raw material in the production of a salt-rich ash which was mixed with sea water to increase its salinity prior to the salt extraction. The burning of these plants was also used to provide heat to aid the evaporation process. An increase in the use of cereal chaff (particularly spelt) over time, was noted in a small study of ceramics, including briquetage, from the site. A well-preserved deposit of charred spelt ears contained single and double spikelets suggesting that the plants might have been growing in marginal conditions. A waterlogged pit produced a rich assemblage of the remains of fruits including plum, cherry, apple/pear and rose (*Rosa* sp.) with possible cereal bran. Coriander and fig were also present. A single waterlogged stone-pine (*Pinus pinea*) cone scale was recovered from elsewhere on the site.

Parson Drove, Cambs [CB36] The site of Parson Drove was located in the Cambridgeshire fens on the edge of a roddon (a raised silt or clay bank or bed of a dried watercourse). Three phases of Romano-British settlement were excavated spanning the 1st-4th centuries AD. The economy was focused on salt making and animal rearing. The Roman charred plant assemblages contained both emmer and spelt chaff, with occasional grains of hulled wheat and barley. Some samples contained large numbers of chaff items. It was suggested that cereals had been brought to the sites and stored in spikelet form. Seeds from common arable weeds had probably mainly been brought onto site with the cereals. Hazelnut shell fragments in several samples provided evidence for the exploitation of hedgerow resources. Frequent culm nodes and high numbers of sedge seeds in most of the samples suggested that peat had been used for fuel. However, one sample produced abundant sedge seeds, in association with a relatively high occurrence of barley grains but no culm nodes. The author suggested that this sample could indicate that barley may have been grown locally, since it is the most salt-tolerant cereal. The presence of duckweed might be due to flooding, or the flow of brackish water through the ditch systems into the pits as part of the salt making process.

Blackborough End, Middleton, Norfolk [NK28] A late Roman saltern in the Nar valley was fully excavated. Sixteen bulk samples were examined from the flue and stoke-hole of a salt-evaporating hearth/oven, ditches, and buried soil overlapped by estuarine muds. Small amounts of charred plant remains were recovered when compared to the Lincolnshire saltern sites (Cowbit [LC5], Morton Fen and Bourne-Morton [LC6], and Bourne-Morton Canal [LC7]). Siliceous amorphous fused globules and flat concretions, however, were present in almost all of the samples, implying well-oxygenated combustion of the silica-rich saltmarsh vegetation. Crop processing waste (spelt, free-threshing wheat, barley), grass culm nodes (including some *Phragmites*) and *Cladium* fruit fragments indicated that fuel residues were represented, comprising cereal waste, reeds and sedge or sedge peat. Although cereal processing waste was rare its presence as

impressions on some briquetage suggests it may have been brought to the site for use as a temper.

Bourne-Morton Canal, Lincs [LC7] Briquetage and other deposits from a ditch next to the canal were examined. The charred remains differed from Blackborough End in that *Cladium* was not present. Cereal processing waste consisting mainly of spelt with occasional barley and oats was common. Saltmarsh plants including sea milkwort (*Glaux maritima*), sea plantain (*Plantago maritime*),sea club-rush (*Bolboschoenus maritimus*/*Scirpus maritimus*) and annual sea-blite (*Suaeda maritima*) were present, as was vegetative rush, sedge and *Phragmites* material. Fuel used in brine evaporation was indicated, with no evidence for burning peat but cereal processing waste being brought to the site and local vegetation being dried and burnt.

5.5.3.4.2 Pottery Production

As with the examination of domestic ovens/hearths and metalworking hearths, the analysis of pottery kiln residues can provide information about the types of fuels being used, in addition to indirectly providing evidence of cereal use. However, the possibility of 'buying in' cereal processing waste should be borne in mind, particularly in the Roman period when documentary sources provide evidence for the practice (van der Veen, 1999). Clearly, the results of these analyses need to be examined in conjunction with charcoal analyses in order to determine how the selection of fuels was carried out. Other macrofossils that can provide evidence for fuel sources include heathland material, such as heather shoots and seeds, and bracken frond fragments.

Ellingham, Postwick and Two Mile Bottom, Norfolk [NK19] Samples from a late 2nd – early 3rd century AD mortarium kiln at Ellingham produced sparse wheat grains and spike-rush nutlets, perhaps indicating the use of crop waste for kindling or fuel. Three 2nd century AD kilns from Postwick produced much larger amounts of cereal processing waste, with the main crop being spelt. Possible free-threshing wheat, emmer, oats and cultivated flax were present in small quantities. Four kilns from Two Mile Bottom also produced frequent spelt processing waste, with no emmer but occasional barley, cf. free-threshing wheat and oat. Brome grass and corncockle were amongst the weed taxa, and brome grass was sometimes frequent in the samples. Comparison with other kiln sites and salterns suggested that where fuel may have been scarce, or particular temperatures needed to be reached, cereal processing waste might have been purchased as a commodity for this specific use. The three sites varied in the types of waste represented; straw (culm nodes and culm internode segments) was frequent in one sample from Postwick, whilst at the other sites straw was absent and chaff (glume bases with some rachis internotes and spikely forks) was dominant. While this variation could be incidental, it was linked to the main pottery type (oxidised or reduced) as an indication of temperature of firing; the Postwick pottery was mainly reduced ([NK19] table 48, 93).

Snettisham, Norfolk [NK23] The site contains Roman pottery kilns and thirteen Roman ironstone quarry pits, one with a chalk access ramp and revetted timber steps. It was suggested that two other quarry pits had been re-used as wells. Most quarry pits were later used for the disposal of domestic waste. Evidence of a road and substantial buildings that had fallen out of use by the 4th century AD was found. Forty-three samples were examined, seven of which produced evidence of kindling or fuel. In addition to charred remains, occasional mineralised seeds were found. Cereal grains and/or chaff were found in all but one sample, with wheat being the dominant cereal. Spelt chaff was present in 17 samples and four samples contained sprouted grains. A possible pea, HNS,

elder, bramble and sloe stone were the other edible taxa present. A typical range of weeds (including frequent grassland species and onion couch tubers) was found. Wetland taxa were also well-represented. Heather remains were found in 30 samples and some bracken was recovered. Twelve RB pit fills contained spelt processing waste, grassland taxa and remains of heather. Fuel or kindling for the nearby kilns was indicated. One of the pits also contained sprouted grain and sprout fragments, suggesting some other types of waste had also been used. Other pits contained only low-density background waste. Nine ditches, including roadside ditches, were examined. Kindling/fuel residues and some domestic refuse were found. Burnt molluscs indicated that riverine clay had been brought from the river to line the kilns. One pit used as a well contained both charred and waterlogged remains, including abundant hemlock and nettles, perhaps indicating abandonment. In comparison to other contemporary industrial sites, spelt chaff was not as abundant as the grassland and heathland remains, perhaps reflecting the fuels that were most easily obtained, but also possibly relating to the temperatures required for specific pottery types.

5.5.3.5 Burial and ritual contexts

Few Romano-British sites serving a ceremonial function have produced notable plant macrofossil assemblages in the Midlands. Although samples from features such as graves often produce sparse, poorly preserved cereal remains at best (e.g. Watersmeet Mill Common, Huntingdon [CB35] and Upton, Northants [NH32]) and their provenance is often questioned, it is still important to investigate these features as the ritual burning of plant material may have taken place. In a review of plant remains (including charcoal) from Roman cremations across Europe (46 sites) Angela Kreuz (2000) revealed that 47.8% contained cereals, 13% charred foods such as bread, 37% pulses, 6.5% oil plants (e.g. poppy, gold-of-pleasure, flax), 41.3% wild fruits and nuts, 50% cultivated fruits and nuts, 8.7% spices and medicinal plants. This research demonstrates the potential for recovering important evidence from these types of contexts, although more data is needed before any patterning is likely to emerge. Kreuz (*ibid*.) recommends 100% sampling of grave fills and other ritual features. Examples of food remains from English sites are scarce, but grape pips, cf. fig, lentils and Celtic bean were recovered from cremation deposits at Pepper Hill, Kent (Allen *et al* 2012) and pulses were found in a *bustum* (a cremation burial where the pyre is constructed over a grave-shaped pit) from Nantwich, Cheshire (Pelling 2009). A recently excavated *bustum* (EF 62) on the garrison site (Area E) in Colchester, Essex, has produced dates, pulses, figs (including possible fragmetns of fruit) and grapes (assessment data only; Fryer 2013).

Orton's Pasture, Rocester, Staffs [ST16] Twelve samples were analysed from 2nd century AD features. Moderate amounts of cereal remains were recovered from pits and ditches (mainly spelt with traces of possible emmer and possible rye plus several hulled barley). A pit from the south enclosure contained fragments of stone pine (*Pinus pinea*) nutshell, some whole nuts, shrivelled kernels and cone scales. At least 77 pine nuts were represented in total. In addition, two whole charred dates and a date stone were found in the pit with some date fragments being recovered from a second pit. Other food plants included a grape pip, apple/pear pips, HNS and a cf. *Prunus spinosa* stone fragment. Arable/disturbed ground/grassland taxa were present in moderate numbers in the features. The occurrence of the exotic fruits and nuts may be related ritual activities since the pit producing the stone pine remains was located close to a small stone building that has been identified as a shrine.

The following two sites highlight the problem of uncertain origins for charred plant remains recovered from non-cremated inhumation grave fills. More detailed investigations into well-preserved grave fills, coupled with the taking of spot samples from specific points and radiocarbon dating, might help to determine whether the plant material is residual, intrusive or deliberately burnt and placed. It may also reveal whether other activities were taking places in cemeteries, such as crop processing or foddering animals.

Jesus Lane, Cambridge [CB5] A later Roman inhumation cemetery was excavated and five samples from grave fills were assessed. Wheat grains were dominant in the small charred plant assemblage, mainly consisting of free-threshing wheat with some hulled wheat (emmer/spelt). Smaller amounts of barley, occasional rye grains and pea were present, plus a few common weed seeds. The consistent presence of free-threshing wheat grains and scarcity of hulled wheat chaff fragments lead to the suggestion that either the material was intrusive, or the fills were unusual in containing cleaned grains of a new cereal crop.

Parnwell, Peterborough, Cambs [CB30] A Roman inhumation contained well preserved cereals and chaff mainly from spelt but also with free-threshing wheat, ten emmer-type grains (not found in other samples) and a single barley grain. Only traces of weeds were present. This could represent a deliberately burnt offering.

5.5.3.6 Roman Wells and Waterholes and evidence for Garden Plants

Wells are frequently encountered on Roman sites and can be valuable sources of evidence for foods not commonly preserved by charring, depending on the types of material falling into them during use, or deposited as backfill following abandonment. Occasionally deliberate 'ritual closure' deposits are placed in wells, as in other types of features. It is unknown if the rich deposit in the well at Great Holts farm ([EX8] (see above) falls into this category. Charred remains preserved in waterlogged deposits are also often important, as they tend to be well-preserved, being protected from crushing and weathering. Although waterlogged well assemblages are often dominated by weeds of nutrient-rich waste the occasional evidence of exotic foods makes detailed analysis worthwhile (see Great Holts Farm, Boreham, Essex, above). A review of Roman well fills in the Midlands by Greig (1988) discussed the evidence from early excavations, and he added to this in his Bays Meadow report [WC14b].

Marsh Leys Farm, Kempston, Beds (BD24] An assemblage from a farmstead well contained predominantly weeds of nutrient-rich soils such as hemlock and henbane, with the occasional flax seed, walnut shell, cotton thistle seed and box (*Buxus sempervirens*) leaf. Some of these remains hint at the decorative and productive nature of gardens that may have been cultivated in Roman Britain. A plant such as cotton thistle is highly decorative but is also useful as a vegetable, as a source of oil from the seed, for its downy fibres, and for medicinal use.

The well at Tiddington, Worcs [WR35] summarised in section 5.5.3.2 (mostly 2nd century AD), contained frequent charred remains, suggesting that material cleaned out from a corn drier had been incorporated into the fills. The macrofossils in the well indicated that the corn drier may have been used for malting since the grains had germinated and the number of coleoptiles present was very high. The 2nd century well from Causeway Lane, Leicester [LR4] (summarised in section 4.3.1) was very different, producing few charred remains but some mineral-replaced puparia and macrofossils of

fig and sloe. This suggests that the well was used for the disposal of sewage in the latter stages of its use, as has been found on other sites. It is also common for macrofossil assemblages from wells to be dominated by seeds of weeds and grassland plants, probably through being used to deposit animal bedding, dung, floor sweepings etc. A few reports describing well fills that produced probable garden plants are given below.

Rectory Farm, Godmanchester, Cambs [CB62] This site provides early evidence for the creation of formal gardens during the Roman Period. The fills of wells and of two ornamental ponds produced macrofossils of a range of garden plants: beet (*Beta vulgaris*), box (*Buxus sempervirens*), marigold (*Calendula* cf *officinalis*), fig (*Ficus carica*), possible fennel (cf *Foeniculum vulgare*), opium poppy (*Papaver somniferum*), spruce (*Picea abies*), yew (*Taxus baccata*) and grape (*Vitis vinifera*). In addition, there were remains of rose (*Rosa* sp), violet/pansy (*Viola* sp), celery (*Apium graveolens*) and carrot (*Daucus carota*) which could represent either wild or cultivated plants. It is not clear whether the box leaves came from standard trees or clipped hedges as most were fragmented. Yew, a native species, was represented only by a single twig. However, the leaves, shoots and cones of spruce, not a native British tree in the Holocene, clearly did come from standards. Evergreens of various sorts, including conifers, both clipped and as standards were characteristic features of Roman gardens in Italy, as described by Pliny (Zeepvat 1991, 53). It seems reasonable to suppose that the use of spruce and yew in the Godmanchester garden, replacing the bay and cypress of the Mediterranean, was an adaptation of the classical style to the British climate.

Roman roadside settlement and shrine, Higham Ferrers, Northants [NH23] Samples from the Roman shrine and settlement included both wet (5 samples from bottoms of wells/waterhole) and dry deposits (76 samples). All five well samples were analysed and four of the richest charred samples were examined. The charred samples included three ashy dumps in upper layers of wells. Charred and waterlogged evidence from the late C3rd-C4th samples, which included three wells, produced frequent seeds of disturbed, nutrient-enriched ground, including henbane and opium poppy. Herbs and spices present in the waterlogged samples included summer savoury, coriander, wild? celery and fennel (*Foeniculum vulgare*). Probable cultivated *Brassica* seeds (perhaps *B. oleracea* cultivars, cabbage or kale, *B. napus*-rape, swede or *B. rapa*-turnip) were present in one well (11 seeds). Black mustard (*B. nigra*), HNS and opium poppy were also found. No cultivated fruits were present. Garden cultivation is likely.

Glapthorn Road, Oundle, Northants [NH10] A wealthy and flourishing late-third century AD walled rectilinear enclosed settlement at Glapthorn Road was excavated. Three waterlogged deposits from a Roman well were examined. They primarily contained domestic waste and hay in the upper layer. The middle layer contained frequent thistle seeds suggesting that livestock had been grazing nearby. Flax, cherry/plum, spelt chaff, opium poppy, coriander, cotton thistle, and possible dill were included, as well as native hedgerow fruit and nut remains, providing evidence of a fairly varied, higher status diet.

Grange Park, Courteenhall, Northants [NH41] Samples from a well contained waterlogged remains in the lower fill and charred crop processing waste in the upper fill. Waterlogged remains included mainly hemlock and nettles and a range of ruderal weed seeds. In addition to cereals (mainly barley and free-threshing wheat), Celtic beans, lupin (4 seeds; *Lupinus* sp.) and radish *(Raphanus* cf. *sativum*) were present, perhaps indicating crop rotation. Lupin is a primarily Mediterranean genus which has been used

for food in the past, but toxic alkaloids first have to be soaked from the seeds. The plant is also ornamental and has been used for fodder or as a green manure.

5.5.4 Summary and future prospects

Although this period is well-represented in the Midlands (Figure 5) the increased complexities in areas such as social structure, trade, crop husbandry practices and diversity of plant foods consumed mean that there are still many research topics to pursue. Major changes in the landscape and in farming methods occurred during this period so it is important that sites spanning the transition periods at the beginning and end of the Roman occupation are fully investigated. In order to detect changes in crop husbandry, and expansion onto new soils, it is necessary to analyse enough samples to provide good weed ecology data. Primary deposits such as stored crops are important in order to be sure that seeds from wild plants were growing as arable weeds with a specific crop.

Charred assemblages from domestic waste deposits dated to the Roman Period are surprisingly uniform across the Midlands region and most are characterised by the following;

- Almost all are dominated by spelt wheat
- Most also produce smaller amounts of emmer (though some appear to contain none) and barley is usually present in low but constant amounts
- Brome grass (*Bromus* sp.) is usually the dominant weed taxon and at times the caryopses are abundant
- Small-seeded legumes such as clovers and trefoil are often frequent, as are small- and long-seeded grasses.

These characteristics are common elsewhere in the British Isles although there appear to be local variations, particularly in the earlier Roman period (Gill Campbell pers. comm.). Farming practices may have become more uniform across the country due to the Romanisation of the population, although more detailed studies are required (particularly of rural sites) in order to test this hypothesis. Since not all soils of the Midlands would have been best suited to the cultivation of spelt, the preference for this crop would have influenced where villas and farmsteads were located, and may also have brought changes to crop husbandry regimes in order to obtain good yields. For example, on lighter soils manuring would have been essential to obtain reasonable yields over several years. There is some evidence from weed ecology that manuring was taking place at this time and one of the explanations put forward for the increased occurrence of grassland remains is that crop rotation was in operation which included a fallow period. It is also possible that the deliberate sowing of grasses and small legumes (including clovers and vetches) was carried out in order to provide both nitrogen-fixing soil improvement and nutritious grazing for livestock.

The status of free-threshing wheat in the British Isles during the Roman period is an interesting area of study, as the grain has primarily been found in significant quantities on sites where calamitous fires have ensured its preservation, as is also often the case with luxury foods. Gradually, as more of these types of context are excavated, it is hoped that the evidence will help to clarify whether free-threshing wheat was primarily being imported in order to supply the Roman army, or whether some areas of the British Isles, such as the claylands of the south-east Midlands, were set aside to grow it. Targeted dating is required to confirm the presence of free-threshing wheat, particularly within

mixed assemblages from rural Romano-British settlements, as well as large primary deposits as discussed above. If it can be demonstrated that free-threshing wheat was being cultivated locally, the question that then needs addressing is what proportion of the population regularly consumed and perhaps developed a taste for it, leading to the virtual abandonment of hulled wheats by the Anglo-Saxon period?

The status of some of the minor crops is similarly uncertain, as oats and rye may have existed as weeds for some time before they were valued as crops. Peas and, to a lesser extent, beans, although obviously grossly under-represented in charred assemblages, have been recovered from many sites. Although taphonomic factors mean that the numbers of seeds were low, their presence on many sites suggested that they were important to the economy. Pulses have often been used for fodder in the past rather than for human consumption, but recipes in *Apicius* (Edwards 1985) using peas and beans demonstrate that they were used in the kitchen in Roman times. Flax has been recovered from a sufficient number of sites (again usually in small amounts of seed or seed capsule fragments) to suggest that it was commonly grown for fibre, and possibly for oil (see section 6.2.1.6) and medicinal/flavouring uses. A review of the artefactual evidence for Roman textile production in the British Isles suggests that it may have become a leading industry by the late third century AD (Wild 2002). Evidence from fragments of waterlogged or metal replaced textiles, such as coloured wool from a grave at Arrington, Cambs (cAD 130-160), or from Vindolanda, which appeared to have been dyed with madder or bedstraw, and woad demonstrate the potential for recovering more information for plant use should suitable conditions of preservation be found (Wild 2002, 7).

Some of the gaps in our knowledge in this generally productive period in terms of agriculture and trade have already been flagged up. The recent review by van der Veen *et al* (2007), as well as the East and West Midlands reviews (Watt 2011, Monckton 2006), have been useful sources of topics for this section. The following specific areas deserve further investigation:

a) Villas and rural sites

Considering that cereal cultivation was taking place on an increasingly large scale in Roman villas, surprisingly few sites in the Midlands region have produced diverse or abundant charred plant assemblages despite the fact that many of the sites outlined above have been fairly intensively sampled. Although sometimes structurally well-preserved, being spared the disturbance from later occupation that urban sites suffer, villas have often produced very little burnt waste. To some extent this is also a problem in medieval rural sites, so it seems likely that it is at least partly due to the efficient use or recycling of any waste produced in a rural setting. Cereal processing waste would probably have been fed to livestock rather than been burnt as fuel, since other fuels and tinder would have been available close at hand, such as wood, scrub, hedge trimmings, bracken, heath, hay and marsh hay. In addition, composting waste was probably an important activity on sites involved in agricultural production, particularly under intensive systems.

In the Roman period there is also evidence that processing waste was a valuable commodity which was traded (van der Veen 1999), with one of the uses being as fuel for corn driers, ovens and kilns. The paucity of deposits of 'fuel ash' therefore needs explaining. It was well known by the Romans that ash could be used to enrich the soil

(Columella in Leigh 2004, 51), so where waste was burnt in a rural setting the ash would have been added to middens or spread on the fields rather than being deposited in pits or scattered around settlement features. Other materials added to middens may have included culinary waste (though kitchen waste would also have been fed to livestock), floor sweepings, hearth sweepings, waste bedding and dung. Animal bedding is traditionally trampled down in middens to aid rotting, so conditions for preservation would not have been good. Once a midden has rotted down this valuable material would have been spread on the fields, so unless the midden itself is excavated the archaeobotanical evidence would have been widely dispersed. The higher levels of organisation and status of villas in comparison to native farmsteads would also mean that floor surfaces, ovens and yards were probably swept clean of debris on a regular basis, removing evidence of activities taking place.

Although little can be done to mitigate against the 'cleanliness' and recycling of waste, increased sampling to include a wide range of different types of context on rural sites would help, since negative evidence can then also be used where features are found to be 'clean' of burnt waste. In addition, sites showing evidence of waterlogged features such as wells or ponds, and sites with evidence of catastrophic burning incidents should be given the highest priority. The rich dietary evidence from sites such as Great Holts Farm (above) shows the type of information that is not being preserved on dry, well-maintained villas.

b) Corn driers and crop processing methods

Many of the larger sites of this period produce corn driers, particularly those dated to the later Roman period (*Table 1*). Central and south-eastern counties appear to contain the highest concentrations of corn driers, and clay soils are common in most of these counties. However, the clustering of corn driers in some counties may at least partly relate to the number of excavations being carried out. It is important that their true distribution continues to be investigated, as far as is possible, in order to assist in building up a better picture of areas of high cereal production. The presence of a corn drier is a useful indicator of larger-scale cereal processing, since a single small household would be able to dry small quantities of grain prior to de-husking or milling over a domestic hearth or in an oven. Where large concentrations of de-husking waste are found in the absence of a corn drier, as often occurs in ditches, geophysical survey methods could be used to try to locate corn driers in the wider area. Very few corn driers appear to be early Roman in date as most are found on 2nd to 4th century AD sites. By closely dating associated assemblages it may be possible to determine precisely when corn driers began to be used more widely and investigate how usage ties in with increased crop production across the British Isles. Corn drier functions and methods of operation still need to be investigated and this involves careful sampling in different areas of the structure in order to try to differentiate materials being used for fuel from crops being dried.

c) Imported fruits, nuts and spices, or orchard and garden luxury crops?

Indications of the wide range of foods being sold at Colchester during the Roman period, and occasional glimpses of the Roman diet recovered from sewage in cesspits and wells, suggest that there is still a lot to be learned about the importation of foods to Roman Britain. Of particular interest is the extent to which poorer, rural and native Romano-British populations had access to and taste for these foods and how much of a desirable

luxury they were. Targeting waterlogged and mineralised deposits and analysing these types of deposit in greater detail (including, where possible, fragments of seeds or vegetables) may help to fill in the blank spaces either with negative or positive information. Detailed anatomical studies such as Philippa Tomlinson's identification of possible leek *(Allium* cf. *porrum)* leaf epidermis from Coppergate, York would be very beneficial in this respect (Tomlinson 1991, 115; Kenward and Hall 1995, 469 and 525). Further investigations into the potential of DNA survival would be of great benefit to this period in order to help distinguish between cultivated species of difficult group such as apples (*Malus* sp.) and plums (*Prunus* sp.).The apparent rapid reduction in the availability of luxury goods at the end of the Roman period also deserves further study, since some of the imported herbs and fruits can be cultivated in Britain so could have been retained, if there was desire to do so. So far, however, there is little clear evidence to show that this was happening.

d) Radiocarbon dating of transition phase assemblages and atypical taxa

Although Roman period sites usually produce sufficient ceramic dating evidence there are specific cases where AMS dating of cereal grains would be valuable. As in all of the periods discussed, the transition phases need to be clarified by setting them within a tight time-frame, i.e. the late pre-Roman Iron Age (LPRIA) and the end of Roman occupation. In early post-Roman deposits destruction layers and abandonment debris often contain frequent charred grain but this can seldom be attached to a specific activity. Dating archaeobotanically significant deposits of this sort, for example assemblages rich in free-threshing wheat, or rich in rye or oats, can help to clarify whether the lack of charred evidence for these crops in the Roman period is due to taphonomy or is a true record of cereal usage.

Because Roman charred plant assemblages appear to be so uniform, with spelt wheat dominating on most sites, it is important to confirm that this is a fact (and not just an artefact of preservation) by dating 'atypical' assemblages. For example, where samples produce no evidence for hulled wheats but frequent free-threshing wheat, oats, rye or cultivated vetch, contamination is often suggested. In such cases this needs to be tested by radiocarbon dating.

e) Coverage across the midland counties

Van der Veen *et al*'s review (2007) suggested that coverage was not evenly spread across the region, with the West Midlands and East Anglia producing fewer sites in recent years. This may reflect the lower concentrations of charred plant remains recovered from agricultural areas as opposed to urban centres, since the selection of sites for statistical analysis required over 100 items per sample. It is important to balance information across the region by examining sites with more pastoral-based economies, particularly if there is the potential to find waterlogged and mineralised deposits. Smaller native settlements should be intensively sampled in order to compensate for the lower concentrations of charred plant remains and to provide a comparison with more highly Romanised regions. In order to investigate the arable/pastoral balance in a meaningful way a multidisciplinary approach is required, including, wherever possible, evidence from bones, charred plant remains, pollen, molluscs and insects. These types of undisturbed waterlogged features are unlikely to occur on many sites, although features such as waterholes and wells are worth assessing for potential.

f) Greater emphasis on large-scale sampling of burials and temple/shrine sites

Although these types of samples often appear to be unproductive, the European review by Kreuz (2000) demonstrated that there is great potential for these deposits if large-enough samples are taken. The ritual and spiritual significance of these contexts to the Romano-British people should mean that they are given a high priority for archaeobotanical sampling, even if in many cases charcoal is the only macrofossil found. Classical writers indicated that specific firewoods and other plants were used for symbolic purposes in cremations, such as opium poppy as the bringer of sleep and death or stone pine as a symbol of immortality (Kreuz 2000, 50), so more data is required to investigate these uses.

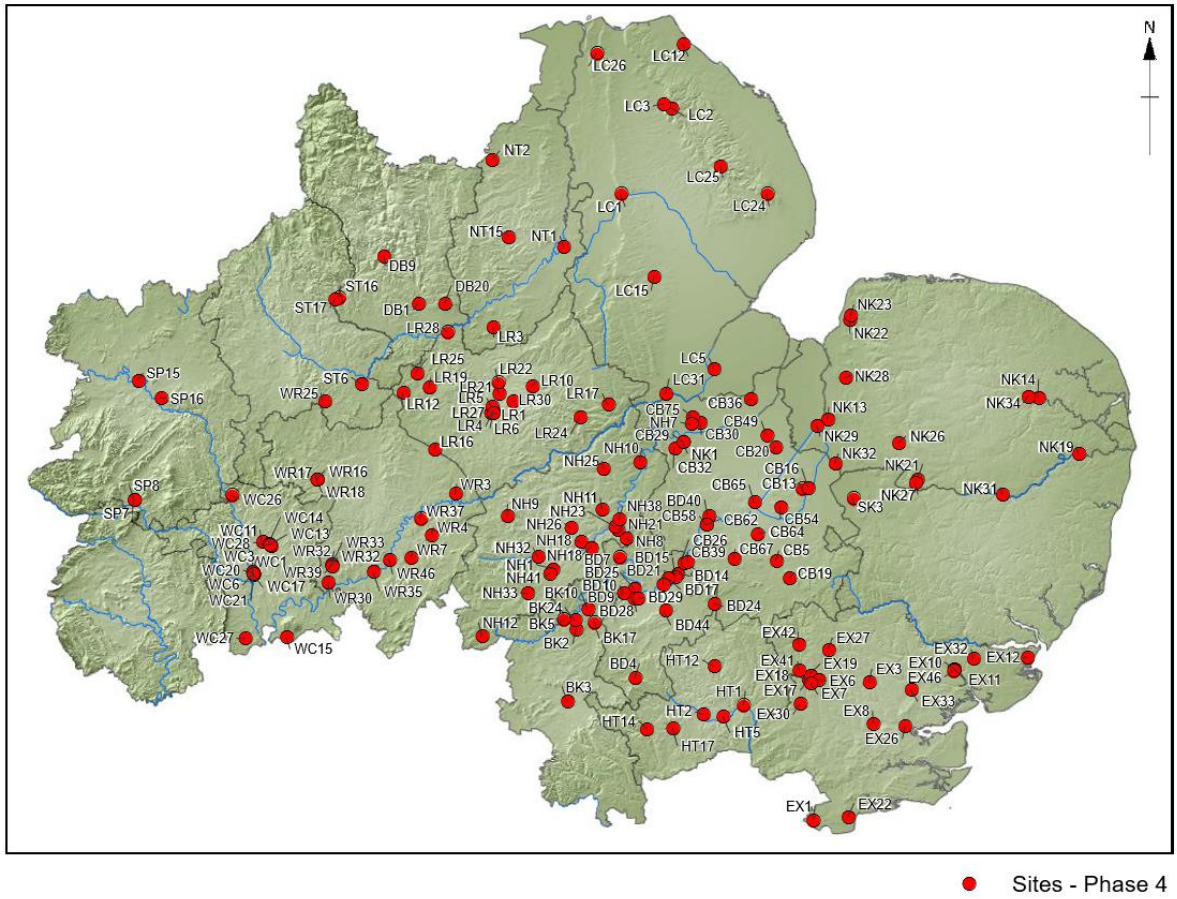

Figure 5: Romano-British sites in the Midland counties producing plant macrofossils

BD3 Haynes Park, Hanes Church End; BD4 Queensway Hall, Dunstable; BD7 Yelnow Villa, Colworth Science Park; BD8 Salford; BD9 East Stagsden; BD10 West Stagsden; BD14 Roxton Road West; BD17 Birchfield Rd, Great Barford bypass; BD21 Renold Water, Great Barford bypass; BD23 Biddenham Loop; BD24 Marsh Leys farm, Kempston; BD25 Gold Lane, Biddenham; BD28 Bedford Region, Kempston; BD29 RB cemetery, Kempston; BD40 Huntingdon to Willington Pipeline; BD44 Willington to Steppingley Pipeline; BK3 Weedon Hill, Aylesbury; BK4 Snellshall East, Milton Keynes; BK5 Wolverton Turn, Stony Stratford; BK10 Renny Lodge Hospital; BK17 Broughton Manor Farm & Brooklands; BK22 Tattenhoe & Westbury; BK24 Bancroft Villa; CB2 Park Street, Cambridge; CB5 Jesus Lane, Cambridge; CB9 A428 Caxton Common to Hardwick Improvemovement Scheme; CB13 Ashwell Site, West Fen Road, Ely; CB16 Prickwillow Road, Ely; CB19 Wandlebury Ringwork; CB20 Stonea Camp and Stonea Grange; CB26 Prior's Gate, Eaton Socon; CB29 Orton Longueville, Peterborough; CB30 Parnwell, Peterborough; CB32 Haddon, Peterborough; CB35 Watersmeet Mill Common, Huntingdon; CB36 Parson Drove; CB39 Eynesbury, St Neots; CB49 Cedar Close, March CB54 Snow's Farm, Haddenham; CB58 London Road, Godmanchester; CB62 Rectory Farm, Godmanchester; CB64 Papworth Everard, Longstanton; CB65 Colne Fen, Earith; CB66 Langdale Hale, Colne Fen; CB67 New Settlement, Cambourne; CB75 Paston; CB80 Loves Farm, St Neots; CB82 Tunbridge Lane, Bottisham; DB1 Little Chester, Derby; DB9 Brough Field, Carsington; DB10 Carsington; DB20 Little Hay Grange Farm, Ockbrook; EX1 Ship Lane, Aveley; EX3 Great Notley, Braintree; EX6 Frogs Hall Borrow Pit, Takeley; EX7 South of A120, Takeley; EX8 Great Holts Farm, Boreham; EX10 Boudiccan revolt, Colchester; EX12 Roman Villa & Saxon Settlement, Little Oakley; EX13 Springfield Lyons, Chelmsford; EX17 A120 Stansted Airport link road; EX18 Stansted Airport 2000-2; EX19 Stansted Airport 1986-91; EX22 Mucking; EX26 Elms Farm, Heybridge; EX27 Sampford Road, Thaxted; EX30 Hatfield Heath to Matching Tye; EX32 Elm Park, Ardleigh; EX33 Star and Fleece Hotel, Kelvedon; EX45 Churchyard of St Mary & All Saints, Rivenhall; EX46 29-39 Head Street, Colchester; EX47 Colchester Garrison; EX48 London Gateway, Standford le Hope; HF1 Bradbury Lines, Hereford; HF14 Hereford & District sites; HF18 Ledbury Trunk Main, Stretton Grandison; HT1 Glaxo Smith Kline restaurant, Ware; HT2 Stanborough School, Welwyn Garden City; HT5 A414 Cole Green By-Pass, Hertford; HT12 Lob Hole, Stevenage; HT14 Junction 8 and 9 of the

M1 Widening scheme, Hemel Hempstead; HT17 Verulamium; HT18 Boxfield farm, Chells; HT24 Solesbridge, Chorleywood; HT26 Baldock; HT28 Folly Lane, St Albans; HT29 Gorhambury; LC1 Lincoln Waterfront; LC2 North of Mount Pleasant House, Nettleton & Rothwell; LC5 Cowbit; LC6 Morton Fen & Bourne -Morton; LC7 Bourne-Morton canal; LC15 The New police station, Sleaford; LC25 Cawkwell; LC26 Dragonby; LC37 Hagnaby Lock and Outgang Road, Market Deeping; LC38 Cartergate, Grimsby; LR1 Castle Street, Leicester; LR3 Newarke Street, Leicester; LR4 Causeway Lane, Leicester; LR5 The Shires, Leicester; LR6 Bonners Lane, Leicester; LR10 Ashby Folville to Thurcaston Pipeline; LR12 Rectory Lane, Appleby Magna; LR16 Coventry Road, Hinckley; LR17 Gwash Valley, Empingham; LR19 Normanton le Heath; LR22 Three Round Barrows, Cossington; LR24 Wing to Whatborough Hill Trunk Main (Ridlington corn driers); LR25 Old Park House, Ashby de la Zouch; LR26 Freeschool Lane, Leicester; LR27 Norfolk Street villa, Leicester; LR30 Hamilton North, Leicester; LR41 Tixover, Kirby Muxloe; LR42 St Nicholas Place & Medieval Undercroft, Leicester; LR47 Vine Street; LR50 Crown Hills, Leicester; LR52 Vaughan Way, Leicester; NH1 Wootton Fields, Northampton; NH7 Alma Road, Peterborough; NH8 Manor Farm, Newton Bromswold; NH9 West Haddon; NH10 Glapthorn Road, Oundle; NH11 Burton Wold Farm, Burton Latimer; NH12 Rowler Manor, Croughton; NH18 Mallard Close, Earls Barton; NH21 A6 Rushden and Higham Ferrers bypass; NH23 Roman roadside settlement and shrine, Higham Ferrers; NH25 Brigstock Road, Stanion; NH26 Sywell Aerodrome runway; NH32 IA & Roman settlement, Upton, Northampton; NH33 A43 Towcester to M40; NH38 Stanwick Roman Villa, Raunds; NH41 Grange Park, Courteenhall; NH45 Belle Baulk, Towcester; NK1 NordelphNK13 Crow Hall Park, Downham Market; NK14 The Oaks, Thorpe St Andrew, Norwich; NK19 Pottery Kilns, Ellingham, Postwick & Two Mile Bottom; NK21 Kilverstone; NK22 Snettisham bypass; NK23 Strickland Avenue & Station Road, Snettisham; NK26 Lynford Quarry, Mundford; NK27 Melford Meadows, Brettenham; NK28 Blackborough End, Middleton; NK29 Nordelph; Downham West; NK31 Scole; NT1 Trent Lane, Newark; NT2 Raymoth Lane, Worksop; NT10 Bunny; SK19 West Stow, nr Bury St Edmunds; SK27 Pakenham; SK35 Somerton; SK40 Stowmarket; SP7 Bromfield, Ludlow; SP15 Ellesmere Road, Shrewsbury; SP16 The Baths Basilica, Wroxeter; ST6 Whiremoor Haye Quarry; ST16 Orton's Pasture, Rocester; ST17 Rocester; WC1 Worcester College of Technology; WC3 New Police Station, Worcester; WC6 Deansway, Worcester; WC11 Stonebridge Cross, Westwood; WC13 Hanbury Street, Dodderhill fort, Droitwich; WC14 Bays Meadow villa, Droitwich; WC15 Aston Mill Farm, Kemerton; WC17 Sidbury, Worcester; WC20 14-20 The Butts, Worcester; WC21 Roman Worcester; WC24 Wormington to Tirley Pipeline; WC26 Trimpley to Blackstone Aqueduct; WC27 Hill Court Farm, Longdon; WC28 Old Bowling Green & Friar Street, Droitwich; WC36 Wyre Piddle Bypass; WC39 Upwich, Droitwich; WR3 Churchover to Newbold Pacy gas pipeline, Harborough Magna; WR4 Churchover to Newbold Pacy gas pipeline, Long Itchington; WR7 Churchover to Newbold Pacy gas pipeline, Chesterton & Kingston; WR16 Metchley Roman Forts, Birmingham, Areas 7 & 8; WR17 Metchley Roman Forts, Birmingham, Area 8 WPR; WR18 Metchley Roman Forts, Birmingham, Area s 2&3; WR30 Salford Priors, Arrow Valley; WR32 Coulters Garage, Alcester; WR33 Tibbets Close, Alcester; WR35 Tiddington; WR37 Glebe Farm, Bubbenhall; WR39 Hockley Chemical Works, Alcester; WR42 Lodge Farm, Long Lawford; WR45 Billesley Manor; WR46 Wasperton

5.6 Anglo-Saxon: Immigrants from the East (5th century to 1066)

Even before the Roman occupation of Britain ended in cAD 410 Europe began to experience a period of movement of Germanic people known as the 'Migration Period'. Anglo-Saxons were first recruited to help defend England as the Romans withdrew, but they later mutinied around AD450-500. Whether the population increased due to further influxes along southern and eastern coasts, or whether there was a more peaceful co-existence and gradual migration is still debated. In the Midlands the kingdoms of Mercia, East Anglia and Essex became established, surviving until the 9th century. The distribution of sites of this period appears to be concentrated in the east of the region (Figure 6) although Late Saxon Stafford in the north-west produced notable charred plant assemblages, as described below.

5.6.1 The Roman / Anglo-Saxon transition period

Although traditionally the transition period was said to have been characterised by abandonment, scrub and forest regeneration and disorder, more recent investigations have shown that the situation was more complex. Dendrochronological evidence indicates widespread Saxon use of timber from trees which started growing in the early fifth century, perhaps originating from abandoned Roman short-cycle coppice or from seedlings colonising abandoned farmland (Tyers *et al* 1994). However, pollen, macrofossil and sedimentological evidence from some palaeochannels (e.g. Sandon Brook, Essex) and meres (e.g. Micklemere, Pakenham, Suffolk) indicate, to the contrary, that there was no large-scale woodland regeneration (Murphy 1994). At Micklemere, open landscapes were maintained by grazing, although cereal pollen was not detected on post-Roman sediments, reappearing only around 1290 BP [SK37]. Palynological studies of 7th century wells at Slough House Farm, Essex produced assemblages with tree pollen under 5% and cereals up to 14% (Wiltshire and Murphy 1998) showing that land use varied considerably from site to site at this time. It is likely that woodland expansion occurred in the immediate post-Roman period at some locations, presumably mainly at the periphery of existing woods where the trees would then have been the most accessible for felling, perhaps explaining the dendrochronological results.

It is difficult to investigate this period using palynological and waterlogged plant macrofossils as deposits that are reliably dated to the transition period are hard to find, particularly since in many wetland areas there has been a loss of surface peats due to de-watering and agricultural activity. Early Saxon sites (late 5th to mid 7th centuries) producing charred plant macrofossils are also scarce, particularly in the west of the region. A greater number of sites dated to the mid to late Saxon period have been excavated, some of which have produced well-preserved plant macrofossil assemblages, but in many cases these are multi-period sites with complex stratigraphy and problems of re-working and contamination. Urban sites with Saxon origins often fall into this category, so it is vital that where early records for specific taxa are found, such as tetraploid free-threshing wheats (as described below for Higham Ferrers) and cultivated vetch, radiocarbon dating is used to confirm significant findings.

5.6.2 Principal crop plants of the Anglo-Saxon period

One of the intriguing questions that remain to be answered is what drove the apparently abrupt change from the cultivation of primarily spelt wheat in the Roman period to the cultivation of mainly free-threshing wheat (initially likely to be the hexaploid bread wheat type, *Triticum aestivum s.l.* in the Anglo-Saxon Period. The emerging picture of a slightly more complex transition (Pelling and Robinson 2000) needs to be clarified by the

routine radiocarbon dating of 'late' hulled wheat finds in Saxon and medieval deposits where secure contexts are concerned. Too often these are dismissed as being 'probably intrusive', which may often be true but needs to be investigated. Section 6.6.5 discusses this subject in more detail and *Table 3* provides examples of post-Roman sites from the Midlands that have produced more than just single items of emmer or spelt wheat.

There was a greater range of cereals being grown across the country at this time, with more variation in which cereal was dominant on a site. It appears that cereals were being selected to suit the local conditions, for example the cultivation of rye (*Secale cereale*) on the Breckland sands at West Stow [SK19], and the cultivation of oats in wetter climates on the poor, acid soils of the south-west England and Wales and Scotland. In the eastern part of the Midlands, rye dominated samples from sites such as Brandon, Suffolk [SK38] indicating the tillage of droughty sands in the Breckland. The extensive root system of this crop would have encouraged its cultivation on free-draining, sandy soils in areas of deficient rainfall. Concentrations of rye chaff being brought into towns such as late Saxon Stafford [ST9/10/11], demonstrated that, like the spelt chaff in the Roman Period, this crop was now being grown in large enough quantities for the chaff to become a useful commodity.

Oats (*Avena* sp) are recovered in much greater quantities in this period and as a result, identifications to species level (based on the floret bases) can be made more often. Thus, it can be confirmed that two cultivated species were being grown; *A. sativa,* cultivated or common oat, and *A. strigosa,* bristle or black oat, were identified from the pedicels recovered from deposits at Stafford [ST9/10/11]. Samples composed largely of oats with abundant fruits of *Anthemis cotula* came from late Saxon contexts at Springfield Lyons, Essex suggesting an emphasis on oat cultivation on clay soils ([EX14]; Murphy 1994).

Hulled barley was clearly not just being grown for fodder as may have been the case in the Iron Age and Roman periods, since on some sites it was the dominant cereal. Barley dominates some of the samples at Salford Priors [WR30a] and Rocester [ST17b]. Many rachis fragments, as well as grains of two and six-row barley were recovered from late Saxon features in Stafford [ST9/10/11] (see below), comprising one of the few Saxon examples of two-row barley (*Hordeum distichum*) in the British Isles (see Section 6.6.3 for more information about two-row barley). The predominance of barley at sites on the silt fens is thought to be related to cultivation of saline soils. Middle to late Anglo-Saxon rural sites in the northern silt fens have been examined as part of the Fenland Management Project, at West Walton, Walpole St Andrew and Terrington St Clement, Norfolk and Gosberton, Lincolnshire (Murphy 1993). At all four sites the main crop represented was six-row hulled barley with some oats. Peas, horse/Celtic beans and flax occurred frequently. The assemblages closely resembled those from coastal sites in the Netherlands, where horse/Celtic bean, barley, oats and flax are usually the most common crops reported (Behre and Jacomet 1991, 91). It seems likely that, faced with common problems, Anglo-Saxon farmers on the fen siltlands developed similar agricultural systems to their Dutch contemporaries. Arable farming in both areas was hazardous due to marine flooding and it would have made sense to cultivate the highest available land, i.e. creek levees and roddons. Residual salinity and occasional flooding, even on the roddons, meant that there was a reliance on the most salt tolerant crops - mainly barley and oats. Barley-dominated samples, associated with some free-threshing wheat, beans and flax have also been reported from 8th century deposits at St Nicholas' School, Boston, Lincolnshire (Giorgi and Rackham 1996).

The first evidence was found that mixed crops or 'maslins' were being grown in order to insure against total crop failure, for example dredge (barley and oats) was recovered from a late Saxon dump on the riverbank adjacent to the mills at West Cotton, Raunds ([NH37]; see below). Mixed oat and barley deposits, thought to have been intended for malting, have also been recovered from late Saxon deposits in Norwich (Castle Mall, [NK44]), and a cellar at the Buttermarket, Ipswich ([SK39]; see section 5.6.4 below). By the late Saxon period a second type of free-threshing wheat, tetraploid rivet wheat (*Triticum turgidum*) wheat had been introduced, as confirmed by radiocarbon dating chaff at Higham Ferrers (770-1000 cal AD), providing the first evidence for pre-Conquest rivet from the region ([NH20] see below). Other late Saxon rivet records mentioned below come from Stansted Airport [EX17] and Raunds [NH37].

Pulses (peas and horse/Celtic beans) became very important sources of protein at this time, as demonstrated by the much larger number of site reports containing charred and mineralised evidence of these taxa. The fact that mineralised pea and bean remains have been recovered from cesspits (sometimes in large quantities, for example middle Saxon Southampton, Carruthers 2005) demonstrates that they were being used for human consumption, possibly in addition to use for fodder. The introduction of cultivated vetch around this time (for example late Saxon/Saxo-Norman Raunds [NH36]) is more likely to be associated with use as a fodder crop, although vetch may occasionally have been added to flours and pottages. On most sites (for example Higham Ferrers [NH20] and Stafford [ST9]) cultivated vetch is not confirmed as being present until the medieval period.

Fibre crops are well represented in this period, especially where waterlogged plant assemblages are preserved. At the middle Saxon settlement at Staunch Meadow, Brandon, Suffolk [SK26] rectangular clay platforms within peats on the floodplain of the Little Ouse, adjacent to the settlement area, were associated with stem waste, seeds and capsules of flax and fruits of hemp (*Cannabis sativa*). Large numbers of flax seeds and capsules dated to the middle Saxon period (620-890 cal AD; OxA-4079: 1295 ±70 BP) were recovered from the river palaeochannel at West Cotton, Raunds, [NH37] but no fibres or stems were present. Though it was clear that retting had taken place it was uncertain whether it occurred in the river itself, or whether the waste had been dumped ([NH34] p. 502). Seeds and capsule fragments of gold-of-pleasure (*Camelina sativa* sens. lat.), a weed of flax as well as an oil crop in its own right, were found associated with these remains.

5.6.3 Fruits, nuts and flavourings

Although arable crops diversified, the range of fruits, nuts and flavourings appears to have regressed to pre-Roman levels, with native species being fairly common (HNS, apple/pear, blackberry, elder) and just the occasional trace of imported foods, even following the establishment of *wics* in the Middle Saxon period. International trade appears to have only been taking place at a small scale in comparison with the Roman period. The few Saxon waterlogged deposits so far studied have produced only traces of imported (or possibly orchard grown) walnut (*Juglans regia*) from Brandon, Suffolk [SK26], and mineralised fig, grape, bullace and damsons from the town ditch in Hereford ([HF2], see below).

The scarcity of imported foods is even more obvious in this period because mineralised faecal deposits are much more commonly found than previously, particularly as urban centres grew. Without an organised method of disposal like the Roman garderobes,

faecal waste accumulates and becomes mineralised in semi-waterlogged soils. Examples of mineralised latrine deposits were found at Springfield Lyons, Chelmsford [EX14]; Deansway, Worcester [WC6]; Mill Lane, Thetford [NK25]; Stanstead Airport, Essex [EX18]; Bloodmoor Hill, Carlton Colville, Suffolk [SK29]; and West Fen Road, Ely, Cambs [CB13].

5.6.4 Malting

Although Finberg (1972, 422) writes that "the Anglo-Saxons consumed beer on an oceanic scale" this does not appear to be reflected in the archaeobotanical record. Ovens found at Rocester and Stafford may have been used for roasting malt as well as simply drying crops, but as no germinated grain was recovered, it is not possible to confirm this interpretation. Evidence for malting oat grains was retrieved at West Cotton, Raunds [NH35] [NH37]. At sites in Ipswich [SK22] [SK23], there was also definite evidence for malting and brewing. At the Buttermarket large deposits of charred barley and oats were found. Almost all grains had sprouted prior to charring and many had been fractured, again before charring. They were thought to represent coarsely-ground malt grist, stored ready for brewing. A large deposit of charred sprouted barley came from the middle Saxon pit, whilst another pit fill of late Saxon date at the ABC Cinema site produced fused charred masses of hops (*Humulus lupulus*) [SK23]. This implies that hopped ales may have been drunk at a much earlier date in the British Isles than has previously been suggested. Hops were an important preservative, without which beer would only have retained its qualities for a few days. The earliest evidence of the production of hopped beer is a documentary record from a 9th century Benedictine monastery in France discussing the gathering of hops for making beer (Oliver 2012). Hop cultivation appears to have been well established in central Europe by the 13th century (Simmonds 1976, 209) but the earliest evidence for cultivation in Britain is from the 16th century (see also Section 6.2.1.5).

Large samples of sprouted barley and oat grains, again thought to represent malt, came from pre-Castle (late 9th-11th century) contexts at Castle Mall, Norwich [NK44].

5.6.5 Evidence for fuel and burning

Although charcoal data is not within the remit of this review, the burning of vegetation and peat can also leave recognisable traces in the plant record. At Brandon, Suffolk, peats adjacent to the middle Saxon settlement produced macrofossils derived from valley floor fen, and charred layers in the peat containing the remains of heather or ling (Calluna vulgaris). Layers of charcoal in the peat were dated to 1350±70BP (HAR-4086) and 1330±80BP (HAR-6605) providing a calibrated date range for the burning of 605-660 AD [SK38]. Whether or not this relates to the management of vegetation for grazing is uncertain. Heathland vegetation was also being used in metalworking hearths at Mill Lane, Thetford [NK25]. Ovens at Stafford [ST9/ST10/ST11] and Raunds [NH36] were being fuelled by rye chaff (see below).

5.6.6 Site Summaries

The following site summaries have been provided as examples either of well-sampled, large projects such as the extensive landscape studies at Raunds, Northamptonshire, or sites with reasonably productive samples. However, in some cases less productive sites are included in order to demonstrate typical findings, for example in the case of sunken featured buildings (SFBs) (section 5.6.6.2), and the well-preserved but unproductive settlement at Bloodmore Hill, Suffolk (see below). To some extent this negative information, which often contrasts with preceding Roman contexts on the same site, is

part of the story, but this can only be demonstrated on sites that have been sampled sufficiently.

5.6.6.1 Early Saxon settlement sites

Murphy and de Moulins (2002) listed the following rural early Saxon sites that have produced plant macrofossil reports: Spong Hill, Norfolk [NK41], Redcastle Furze, Norfolk (Murphy 1995), Hinxton Hall, Cambs [CB78], Chadwell St Mary [EX44] and Slough House Farm, Essex (Wiltshire and Murphy 1998) and Nettleton Top, Lincs [LC3]. Examples of more recently published reports are given below:

Raunds Project, Northants [NH36] [NH37] Ten years of excavation at Raunds on the slopes of the River Nene examined the process of village formation from the early Saxon period to medieval desertion. Two sites produced early to middle Saxon material. (The late Saxon to medieval samples from Burystead, Furnells Manor, Gells Garage and West Cotton are described in section 5.6.6.3 below.)

At Langham Road preservation was poor and remains were sparse. Early to middle Saxon samples contained sparse remains including barley and a flax seed. Burystead also produced mixed assemblages but with better preservation. A well-dated middle Saxon well/waterhole (late 7th to mid-8th century) produced a rich charred cereal assemblage with free-threshing wheat grain and chaff, all the latter of which was from a hexaploid wheat, some of which was from a fairly compact-eared form. Some barley and traces of rye and oat were present, plus three hulled wheat remains. Possible peas and frequent weed seeds (including stinking chamomile and grasses) were identified.

Higham Ferrers, Northants [NH20] Higham Ferrers is located on a limestone ridge on the east bank of the River Nene. Forty-two samples from early Saxon to later medieval deposits were examined. Early Saxon SFBs a post hole and a pit produced reasonable quantities of charred plant remains. The SFB's probably contained redeposited material deposited in the features after they fell into disuse, but there is also the possibility that small items fell through the wooden floors while in use. Cereal remains were quite frequent, and free-threshing wheat, probably the hexaploid bread wheat type, was the most common. In one context, however, barley and flax were dominant suggesting a different activity was taking place. Smaller amounts of rye, oats and spelt wheat might have been crops, weeds or residual material. The composition of the assemblages suggested processed and fairly clean crops that had become charred during domestic activities.

Eye Kettleby, Leics [LR49] An early to middle Saxon settlement with SFBs and halls was excavated. Samples were examined from six SFBs, five pits and a fire pit. Barley (six-row hulled confirmed) was the dominant cereal, occurring in 36% of the samples compared with wheat in 26%. Wheat was mostly of the free-threshing form and a probable bread wheat rachis fragment was recovered (*Triticum* cf. *aestivum*). No tetraploid rivet-type wheat was identified. Very little chaff was recovered but a single spelt glume base could represent occasional growth amongst the bread wheat. Oat (*Avena* sp.) and rye were poorly represented. Other possible crops included flax (*Linum usitatissimum*), and large legumes (*Vicia/Lathyrus/Pisum* sp.). Collected foods included hazelnut, sloe and hawthorn. Weed seeds were quite diverse but not abundant and were mostly common weeds of arable and disturbed ground (including *Galium aparine, Anthemis cotula, Bromus hordeaceus/secalinus, Danthonia decumbens*). The association of a concentration of free-threshing wheat with the highest occurrence of *Anthemis cotula*

suggested that this cereal had been grown on heavy clay soil. The other five pits tabulated were all dominated by barley grains. The six SFBs produced variable concentrations of plant remains but only one produced over 10 items per litre. This sample was dominated by barley grains. Grassland taxa, sloe and larger legume fragments, together with the cereals, indicated the presence of domestic waste. Fire pits (including assessed samples) mainly contained abundant charcoal but also some domestic waste that had been burnt as kindling or fuel (such as cereal grains, sloe, HNS, straw). The main evidence from the site was from the final cleaning of grain in the preparation of food, that is, de-husking of hulled barley and the removal of weed seeds. Possible edible legumes, flax and gathered foods (sloe, hazelnuts, possible hawthorn) were the only other economically useful plants represented. There was some evidence of hay in one pit.

5.6.6.2 Sunken featured buildings (SFBs)

That most distinctive early to mid Anglo-Saxon feature-type, the Grubenhäus or SFB is often found to contain rather low densities of charred material. The assemblages do not appear to differ significantly from those in other 'refuse' contexts, suggesting that the fills largely relate to activities post-dating use of the structures, when they were being back-filled with soil and refuse. Mineralised plant remains are often also present in low quantities, perhaps reflecting the organic nature of the waste or the deposition of diluted sewage. However, there is still a need to investigate SFBs thoroughly on a structure-by-structure basis, since the possibility of *in situ* primary deposits does exist and variation can be found between structures. Some plant material may relate to use of the buildings, including hearth debris and the remains of building materials such as flooring, thatch and possibly turf walls (e.g. suggested at middle Saxon West Heslerton, Yorkshire, (Carruthers and Hunter in Hall and Huntley 2007, 99-103)).

Murphy and de Moulins (2002) listed the following early to middle-Saxon sites with SFBs that produced useful plant remains: Broome, Norfolk [NK5], Snetterton, Norfolk [NK8], Salford Priors, Arrow Valley, Warwicks [WR30a] (abundant weeds and grassland plants, mainly barley, West Cotton and Langham Road, Raunds, Northants [NH36] [NH37], Chadwell St Mary [EX44] and Slough House Farm, Essex (Wiltshire and Murphy 1998), Nettleton Top, Lincs [LC3], Spong Hill [NK41] and Redcastle Furze, Thetford, Norfolk (Murphy 1995). The following sites are described as examples, in addition to Higham Ferrers and Eye Kettleby discussed above). They include a study of plant impressions in pot sherds from SFB's at Mucking, because this work provides a useful reminder that taphonomic processes must be taken into account when determining the relative importance of the different cereals.

West Stow, Suffolk [SK19] Samples from IA, RB and early to middle AS contexts were examined, including the entire fill of one SFB (362 buckets of soil). This mid C5th feature contained a total of 219 cereal grains (wheat, rye, barley and oats), 62 hulled wheat spikelet fragments (including *Triticum spelta*), a possible pea and 1807 weed seeds. Spelt was the main type of wheat in the SFB (free-threshing wheat was also present) but no cereal dominated the mixed assemblage. It was suggested that the charred remains represented a gradual accumulation of material from a variety of sources. This can be compared to a small unphased AS pit fill sample (500g) that contained 290 rye grains, 11 indeterminate grains, 4 spikelet fragments and 191 weed seeds (corn cockle and grasses). In addition, a large 7th century deposit from an adjacent site produced a clean deposit of processed rye (385 grains). Spelt appears to have continued in cultivation into the 5th century, but it was not recovered from the large 7th century deposit or unphased AS pit. Impressions on AS ceramics consisted almost entirely of hulled barley, as found at

some other sites (e.g. Spong Hill [NK41], Mucking [EX21]). The possibility that barley was consumed as whole grain rather than milled flour was suggested.

Mucking, Essex [EX21] A total of 256 sherds of locally made Anglo-Saxon pottery, dated between cAD420-700, were analysed. The sherds came from 81 SFBs. Plant impressions were present in 244 of the sherds. Identification (using rubber casts) were as follows: 69% barley, 8% oats, 6% wheat and 12% indeterminate. Occasional peas, weed seeds and a fern impression made up the remainder. Six-row hulled barley was confirmed but two-row could not be ruled out. Bread wheat and spelt were confirmed (grains and chaff from both species), as were both wild and cultivated oat grains. Weeds included brome grass, vetches, black bindweed and orache. Grains were present on the inside, outside, and within the fabric of the pots, suggesting deliberate inclusion. Comparisons with pottery sherds from other Anglo-Saxon sites showed that barley always predominated, suggesting selective use. Comparing grain impressions with charred plant assemblages from other Anglo-Saxon sites it can be seen that although barley was the main cereal associated with pottery manufacture it was not always the dominant cereal being cultivated.

Bonners Lane, Leicester, Leics [LR6] Excavations revealed occupation deposits dating from the Roman to post-medieval periods. An Anglo-Saxon SFB produced low concentrations (c1 fpl) of cereal grains, weed seeds with traces of other possible foods (large legume) and just a trace of chaff. Redeposited material rather than dumped waste was indicated. As at Causeway Lane [LR4], barley outnumbered wheat, and rye was scarce.

Eynesbury, St. Neots, Cambs [CB39] Five samples from Saxon SFBs produced mainly free-threshing wheats including one tetraploid rachis fragment. Barley was common, with some rye, oat, peas, beans, corn cockle, stinking chamomile and darnel (*Lolium temulentum*). Mineralised concretions and some mineralised weed seeds were present. Given the early records for both tetraploid wheat and darnel it is possible that intrusive material was present in the samples.

Grange Farm, Snetterton, Norfolk [NK8] Fourteen samples from early Saxon SFBs, pits and medieval features produced variable amounts of charred plant remains. Cereal remains (mainly grains) included barley, oat, rye and wheat (*Triticum* sp.), with barley dominating the samples. Chaff was scarce (consisting of a few barley/rye rachis fragments) but sprouted grain and detached embryos were present in a SFB, as well as a medieval pit and an oven. HNS fragments, which were common in two LN/EBA pits, were present in two SFBs. Possible heather stem fragments and a bracken fragment were present in Saxon features. The SFBs appear to have contained domestic refuse. The cultivation of light acid sandy soils is indicated by the weeds. The sprouts may represent poorly stored grain.

5.6.6.3 Ritual and burial contexts

Only one cemetery site in the region has produced evidence for plant remains other than wood or charcoal. An early Saxon mixed cremation and inhumation cemetery of over 250 burials was investigated at Springfield Lyons, Chelmsford, Essex [EX14]. About half of the graves contained grave goods dated to AD450-700. The early Saxon cremations produced frequent charred plant remains but inhumations produced very little. Poorly preserved free-threshing and hulled wheat grains with occasional chaff (including mainly spelt with cf. emmer) were present in the cremation pits. A few hulled barley grains and

occasional poor oat and rye grains were found. A possible pea was present. Grassland taxa were the main wild plant remains and onion couch tubers were common. Weeds included stinking chamomile and Brome grass. How much was burnt accidentally or as offerings was unclear but cereal densities were generally low.

5.6.6.4 Mid to late Saxon rural settlement sites

Murphy and de Moulins (2002) listed the following rural sites from the middle Saxon period: Staunch Meadow, Brandon, Suffolk [SK26]. Middle to late Anglo-Saxon rural sites in the northern silt fens have also been examined as part of the Fenland Management Project, at West Walton, Walpole St Andrew and Terrington St Clement, Norfolk and Gosberton, Lincolnshire (Murphy 1993, 2000). The following sites have been given as examples of more recently published sites that produced evidence from the mid to late Saxon period.

Springfield Lyons, Chelmsford, Essex [EX14] A late Saxon settlement with at least 16 buildings was superimposed on an early Saxon cemetery (discussed below in section 5.6.6.5). Occupation dated to around AD 850-1200 (mainly C10th) and the buildings were probably mainly agricultural, though a bell tower and post-mill were also possibly present. Samples from 10th-11th century features including gullies, post holes, and hearths, produced only free-threshing wheat grains, though some hulled wheat chaff fragments were present (mainly spelt, a little emmer). Barley was frequent with six-row hulled barley being confirmed. Oats (including confirmed cultivated oat) were often the most frequent cereal present, particularly in post holes. Rye was less frequent and flax, bean and possible pea were occasional. Sloe stones and a plum/bullace-type *Prunus* stone were recorded. The charred plant remains were more concentrated than in the early Saxon cremations and inhumations (see section 5.6.6.5) The weeds included corn cockle and stinking chamomile. The relatively common occurrence of spelt and emmer chaff fragments in the samples was thought to most likely be due to these cereals persisting as weeds of free-threshing wheat. The high number of oat grains could be due to the burning of fodder, but they were also likely to have been eaten by humans. Cultivated fruits were rare in contrast to towns but wild fruits were quite diverse. A mixture of grassland, wetland, arable and waste ground weeds was present, and a mixture of soil types was indicated. However, clay soils were dominant (to the north and west of site, edges of chalky till) and acidic indicators (as would be found on de-calcified gravels) rare. The compositions of assemblages from six buildings were compared. A well-preserved possible granary, clay hearths/ovens and possible kitchen area were postulated. A latrine pit produced unidentified mineralised stem fragments and seeds. One sample may have been burnt midden material (high in fruit stones and nitrophilous plants). No concentrations of processing waste were found.

Raunds Project, Northants [NH36] [NH37]
The development of settlements along the Nene valley continued into the late Saxon and medieval periods (see above for the early to mid Saxon periods).

At Furnells Manor [NH36] samples from late Saxon to later medieval deposits were investigated, including three LS/Med cesspits. Both tetraploid and hexaploid free-threshing wheats were being cultivated from the late Saxon period, with barley and occasional rye and possibly oats. Large legumes including horse/ Celtic bean, peas and possibly cultivated vetch (*Vicia sativa* cf. subs *sativa*) were present, particularly in a hearth associated with the western manor. Ovens and hearths in a bakehouse and brewhouse produced frequent grain, though no sprouted grain was observed. An open

hearth contained frequent chaff that may have been used for fuel. No notable changes in crop plants were seen in the small number of samples examined. The cesspits contained mineralised remains but these were mostly *Brassica/Sinapis* sp. seeds and sewage fly puparia, with a single grape pip in the Eastern Manor being the only notable item. Nine cf. wheat nematode galls [amended ID post-publication, Campbell pers. comm.] were present in medieval samples.

At Gells Garage [NH36] a late Saxon/Saxo-Norman ditch fill contained both tetraploid and hexaploid free-threshing wheat with some barley and a few rye and oats. Weed seeds were frequent with some grassland taxa.

At West Cotton [NH37] most of the evidence came from the late Saxon onwards as the seven early Saxon samples were sparse and insecurely dated. Some rich samples were present in the late Saxon settlement. An oat-dominated sample from a ditch contained evidence for sprouting and most weeds were characteristic of winter-sown crops on calcareous soils. Large-seeded legumes were present and two pear pips (*Pyrus* sp.). The deposits were of mixed origin and the weeds included corn cockle, stinking chamomile, wild radish (*Raphanus raphanistrum*), and spike-rush. Other cereals included rivet-wheat and bread wheat-type, rye and barley (all represented by grain and rachis fragments). The timber buildings contained poorly preserved cereals and weeds. The mill, pond and bank contained evidence for dumped processing waste with some sprouted oat and barley but probably not malted. All four cereals were present, with the well-sealed tetraploid wheat remains comprising one of the earliest British records to date. Rivet wheat rachis fragments were recovered from a context dated (by association) to 1100 and 1100-1250 AD. A rich deposit of malted, fairly clean dredge (oats and barley mixed crop), was recovered with weed evidence for spring sowing.

Four waterlogged samples (middle Saxon to C12th) from a palaeochannel adjacent to West Cotton were analysed. Flax capsule and seeds were frequent in the middle Saxon period (dated to 620-890 cal AD (95% confidence, 1295±70 OxA-4079). Gold-of-pleasure (*Camelina sativa*) seeds and capsules were also present. Other taxa include grassland herbs of managed hay meadow, and of wetter floodplains. Disturbed ground, some trees/shrub vegetation (alder, willow) and aquatics were also represented. Three late Saxon mill deposits produced flax, grassland taxa, trampled and disturbed ground taxa and arable weeds (including opium poppy, which may have been grown for oil or spice).

Samples from late Saxon/Saxo-Norman ditches and a quarry at Burystead [NH36] contained both tetraploid and hexaploid free-threshing wheat, plus bean and cultivated vetch. Six-row hulled barley, rye, oat and flax, plus a gold of pleasure (*Camelina sativa*) pod fragment were all recorded. Bullace/plum and HNS were also present. A weed-dominated ditch sample contained cultivated oats (some sprouted), herbage, frequent legume pod fragments and rye chaff with a little grain. Other ditch samples contained mainly free-threshing wheat grain and chaff with tetraploid rachis fragments outnumbering hexaploid. A range of sources is indicated including perhaps spoiled oats, fuel debris and drying accidents.

To summarise the Raunds sites for the mid to late Saxon period, rye and oats may have taken the place of barley as the main fodder crops in later periods, or the emphasis on livestock might have been greater, as lower concentrations of charred plant remains and less processing debris were present in this period. By the late Saxon/SN period both

tetraploid and hexaploid free-threshing wheat were grown, plus barley, oats and rye. Wheat was by far the most important cereal, though which type dominated is uncertain as it varied by site, as did the types of context sampled making close comparisons difficult. Whilst at West Cotton [NH37] dredge was grown, the oat-dominated ditch sample at Burystead showed that pure oat crops were also valued. Rye may be under-represented as the Burystead ditch sample with 20 rachis fragments suggests. The greater occurrence of rye chaff than grain could indicate the use of rye chaff as fuel/kindling, as suggested at Stafford [ST9/ST10/ST11]. Rye and rivet straw may have been used in drying ovens with the chaff burned as fuel, as the oven from the Furnells bake/brewhouse suggested. Peas were visible in the record from the mid Saxon period on. Other occasional economic plant records include flax (all periods) and late Saxon/Saxo-Norman gold of pleasure. Occasional *Prunus* sp. occurred from the late Saxon period onwards. HNS was less common than on some other sites. The wide range of weed taxa reflects cultivation of a variety of soils by the late Saxon/Saxo-Norman period (*Anthemis cotula* frequent, *Bupleurum, Agrostemma, Lithospermum, Scandix* etc) and includes newly introduced taxa.

Higham Ferrers, Northants [NH20] Eighteen samples from the late 7th to early 9th century (phase 2) enclosure ditch, stone malting kiln and building features were examined. The enclosure ditch appears to have contained a dump of cereal-rich midden material, with free-threshing wheat grain the main crop, and some barley. The small amounts of glume wheats might have been residual. One dump of material contained primarily rye with some large legumes (cf. pea). Post pipes from one building contained abundant barley with some sprouting, and a post hole from a storage barn also produced some sprouted barley, though it is uncertain if this indicates malting or damp storage conditions. A few large legume fragments were present. The malting oven chamber contained predominantly (90%) barley with occasional oats and wheat. Roughly 25% of the barley had sprouted, providing clear evidence for malting. Weed seeds were infrequent indicating a cleaned crop, with *Brassica/Sinapis* sp. and stinking chamomile being most frequent. The oven flue contained evidence for the burning of wheat chaff as tinder.

Eleven samples from the late Saxon to medieval period (phases 3 and 4, mid 9th to early 14th century) were examined and similar results were found in both phases. Bread and rivet wheat chaff were present in a gully, and the rivet wheat chaff was radiocarbon dated to cal AD (OxA-10126; 1150±45 BP), providing the first evidence for pre-Conquest rivet wheat. Opium poppy (some mineralised) and a large vetch seed were recorded. Some samples contained frequent barley and wheat, suggesting a possible maslin crop. Weed seeds were much more frequent in the phase 3 samples suggesting changes in crop husbandry or crop-related activities from the previous phase. Cultivated vetch was not found until the medieval period (late 14th-late 15th century).

West Fen Road, Ely: Ashwell Site, Cambs [CB13] Eighty-nine samples from Iron Age, Roman, mid Saxon, late Saxon and medieval deposits were analysed. Preservation in the heavy clay soils was good, though extraction was difficult. The average density of charred plant remains was 13.07 fpl.

Six mid Saxon samples were examined. Free-threshing wheat grains were dominant and barley was a little more frequent than in previous periods. A few rye and oat grains were present. A large number of Celtic beans were found in a pit.

Forty late Saxon samples were examined. Similar cereal assemblages were present but the recovery of chaff enabled bread wheat (*Triticum aestivum s.l.*) to be identified as the principal free-threshing wheat with one tetraploid rachis fragment. As before, rye was usually present, but one ditch sample produced frequent rye chaff. Rye chaff-rich contexts have also been found at West Cotton [NH35], Stafford [ST9] and Cottenham [CB46]. The possible selective use of rye chaff was discussed (perhaps as bedding in drying kilns), as rye was the only cereal at West Fen Road where chaff fragments outnumbered grains. Only a trace of hulled wheat was present and this may have represented a weed or re-worked residual material. Flax seeds occurred in several contexts, and Celtic bean and possible pea were occasionally identified. *Cladium* leaves were frequent in one ditch context. Wild seeds often amounted to c20-30% of the assemblages, but one pit appeared to contain a clean deposit of stored grain (mainly barley, c1/3 free-threshing wheat). Possible black mustard (*Brassica nigra*) seeds were present in several samples, as well as charlock (*Sinapis arvensis*).

The charred plant assemblages were broadly unchanged through from the late 7th century to 14th century, with the most frequent weed taxon, stinking chamomile, reflecting the heavy, damp nature of the soils under cultivation. Frequent great fen-sedge (*Cladium mariscus*) seeds and leaf fragments indicated the presence of a collected resource, marsh hay. Other wetland plants were common (spike-rush, sedges, rushes) indicating that the cereals had been grown locally. Common vetch (*Vicia sativa* type, <4mm) was present in both phases but given the small size of the seeds it was uncertain if this was the cultivated form.

West Fen Road, Ely, Cambs [CB14] Sixteen middle Saxon samples produced very few uncharred remains but three contained mineralised material. Pits, ditches and a well were examined. Two pits contained evidence for faecal material but only one resembled concentrated sewage. Straw, cereal bran, apple seed fragments but no other fruits, spices or legumes were present, though fish remains were frequent. Traces of charred Celtic bean and flax indicated other foods/crops. Charred sloe and HNS were also present, as were all four cereals, with barley being most frequent. The distribution of small amounts of cereal processing waste allowed some suggestions to be made as to the possible location of fodder deposits.

Flixborough, Lincs [LC19] [LC20] Flixborough is a good example of how informative a large, detailed sampling strategy can be, even if the remains are sparsely distributed. This rural settlement was occupied in the Mid to Late Anglo-Saxon period, having six main phases of occupation that extended into the medieval period. Excavations between 1989 and 1991 revealed c40 buildings, other structures and middens. Detailed analysis showed that the character of occupation changed radically during the 2nd half of the first millennium. Whilst bone preservation and abundance were excellent, CPR were very poorly preserved and extremely sparse. They did, however, provide evidence for coastal saltmarsh exploitation. A total of 560 samples were analysed from 386 contexts (of 1759 samples taken). Of the few cereals (grain and chaff) recovered, the most commonly found grain was barley (15 contexts), followed by free-threshing wheat, rye and oats. Hemp, field (horse- or Celtic) bean, cf. pea, bullace-type plum and flax were other plants of economic importance present in small quantities. Saltmarsh flora was present (sea club rush, *Bolboschoenus maritimus,* annual sea-blite (*Suaeda maritima*), charred seaweed) and charred vegetative remains such as rhizomes were common. The environmental evidence as a whole indicated that a large, diverse wetland habitat stretched from the west and north, well-established reed beds grew along the Trent,

edged with some riverine woodland. Rich fenland probably existed near Flixborough. To the south and east rich lowland heath, unimproved pastures and deciduous woodland was present. Saltmarsh would not have been found close-by because of lower sea levels at the time, so material must have been brought some distance. The Lincolnshire fens and saltmarshes have, historically, been extremely important for providing high quality grazing for both sheep and cattle. Fish was mainly being caught in the Trent, and major changes were seen in the occurrences of cattle, sheep/goat and pig over the AS period. Major changes in consumption and disposal of meat occurred in the 9th century AD. The supply of cattle and sheep probably changed at this time. The character of the earlier economies was of high-status estate centres, whilst in the ninth century a new, possibly monastic component was introduced.

Bloodmoor Hill, Carlton Colville, Suffolk [SK29] A well-preserved, almost complete Anglo-Saxon settlement was excavated dating from 6th to the 8th century AD with a mid-7th century cemetery. A variety of structures were excavated including 38 SFBs, 9 post-buildings, 4 middens, 270 pits and 5 hearth/ovens. Metalworking was an important industry. Environmental sampling over four years produced 207 samples, 76 of which were unproductive and only three of which produced >50 items. The abrasive, sandy soils were probably partly, but not wholly, responsible for the poor preservation and low occurrence of charred plant remains. The SFBs and pit fills in Areas D and E were the most productive features, perhaps due to better survival. Hulled barley, free-threshing wheat and rye were the main cereals, as at West Stow and Kilverstone. Emmer and spelt were common enough in one pit to suggest continued use at this site. Weeds such as sheep's sorrel suggested local cultivation and the scarcity of weeds of grain-sized contaminants (brome, *Fallopia*) indicated that cleaned grain was mainly present. Oats were possibly just a weed (one *Avena fatua* identified). Two contexts (including a hearth) contained charred flax seeds, and a Celtic bean was recovered from a post hole. Wild foods included common HNS, crab apple and sloe. *Phragmites*-type nodes were present as charred and mineralised remains probably having been used for thatching.

Mill Lane, Thetford, Norfolk [NK25] Late Saxon activity included features dug into the well-drained sands and gravels. Pit fills, metalworking features and burnt primary fills of the buildings were sampled (18 samples). In addition, monoliths through the waterlogged river valley sediments were taken in order to obtain palaeoecological data concerning the Saxon phase of occupation. The charred plant remains from the features consisted primarily of oat grains (with cultivated oat confirmed) with frequent rye grains and chaff fragments, a few barley grains and several free-threshing wheat grains. Large legumes were present but not identifiable. Heathland vegetation was being used as fuel in the late Saxon metalworking hearths. Domestic refuse was represented in the pits, including HNS, sloe, bramble and elder. Weeds were fairly uncommon. One feature had probably been used as a latrine pit, as mineralised material was present. The valley sediments were analysed in order to recover information about land-use in the period leading up to the establishment of Thetford. The top of the peat appeared to date between the early Roman and late Saxon periods. Open conditions were consistently present with mire and swamp plant macrofossils dominating. Scrub species were rare, so abandonment leading to woodland regeneration does not seem to have occurred. Unusually for East Anglian valley peats, no alder or willow macrofossils were present. A trace of pot, charcoal and cf. spelt glume base at a level dated to AD 50-330 indicated the washing in of Roman material. The more minerogenic sediments above this may relate to the establishment of the town of Thetford. Although plant macrofossils were sparse, traces of flax capsule and seeds were present at one level, as was also found at Staunch

Meadow, Brandon [SK26]. Dates from either side of this level indicated that flax was being grown on the floodplain in the late Saxon period.

Southgate, Stansted Airport, Essex [EX18] Relatively little evidence for Saxon settlement has been found at the many sites excavated in the Stansted area over the last two decades, so it is likely that woodland regeneration occurred on much of the Boulder Clay after the Romans left. At Southgate late Saxon samples from a cob building contained primarily oats (*Avena* sp.). Hulled wheat grain (cf. spelt) was dated to the late Saxon period demonstrating continued use (900 - 1160 cal AD (NZA-23235; 1022±30)). Beans, bread wheat and rivet-type wheat (two good rachis fragments) and cultivated vetch were recovered. Charred flax seeds were frequent in a post hole and were radiocarbon dated to the late Saxon period. A late Saxon cesspit produced mineralised bramble and apple/pear remains, providing evidence for the consumption of either gathered wild, or orchard fruits.

Taplow Hillfort, Bucks [BK21] Excavations revealed a defended hilltop enclosure that was constructed in the late Bronze Age and then reoccupied in the Iron Age and Saxon periods. Seven samples were analysed for plant remains. The lower Iron Age ditch sediments produced no charred plant material but the upper Anglo-Saxon fills contained a rich mix of cereals, chaff, weeds and nutshell dated to 770-970 cal AD (SUERC-4971). Free-threshing wheat, hulled six-row barley, rye and oats (*Avena* sp.) were identified. A couple of hulled wheat glumes including emmer were present. About 6% of the assemblage was HNS. Weed seeds made up over half the assemblage, most of which were weeds of cultivation (dock, vetches, brome grass, corn cockle, stinking chamomile). Spike-rush and sedges indicated that some crops were grown on wetter ground, though the site was on the well-drained gravel terrace. The outer AS defensive ditch also contained evidence for the four cereals (wheat dated to 670-870 cal AD (Poz-12532; 1255±30)) plus HNS. None of the free-threshing wheat could be identified to species level, but it was probably bread wheat.

5.6.6.5 Examples of towns with Anglo-Saxon origins

Many of the towns in the Midlands region have their origins in the Anglo-Saxon and Saxo-Norman periods, although well-preserved, uncontaminated deposits of these periods are not always easy to find. Concentrations of both charred and mineralised plant remains can become high in urban back-yard rubbish pits and ditches. Notably substantial deposits of charred remains have been recovered from deposits in Foundation Street, School Street and Smart Street, Ipswich [SK22] and Greyfriars Road [SK39]. Cellars of 11th century buildings destroyed by fire at Ipswich have produced some rich charred remains of stored cereals. At the Buttermarket a cellar produced samples consisting mainly of barley and oats [SK39]. A similar deposit from Foundation Street ([SK22]; site IAS 4601) was composed almost entirely of oats with other cereals and flax/linseed as minor components. The presence of a horse-shoe and spur in the cellar fill hinted that this deposit represented horse fodder. Another cellar at the Buttermarket, Ipswich, produced 18 whole and fragmentary small charred loaves (Murphy 1990a). Scanning electron microscopic studies showed that these consisted largely of an amorphous vesicular matrix including scraps of wheat/rye pericarp (bran). Frances McLaren has examined samples using infra-red spectroscopy, concluding that in these examples bread wheat was the main cereal used for bread-making (in Murphy 1990a).

25 High Town, Hereford, Heref [HF2] Samples of Late Saxon deposits from the defensive ditch were examined. Mineralised remains from the bottom of the *burh* ditch included fly puparia, mosses and straw fragments and twenty-six seed taxa. The economic taxa (charred and mineralised) included hemp (*Cannabis sativa*), HNS, fig, bullace and damson type plum stones, sloes, apple/pear, blackberries, grape. Incidental plants included field pennycress (*Thlaspi arvense*) and dock. Naturally occurring taxa included sedges, bistort (*Persicaria bistorta*), elder, nettles. The foul nature of the local conditions was indicated by the deposition of faecal material and presence of wild taxa characteristic of nutrient-rich environments conditions.

Freeschool Lane, Leicester, Leics [LR26] Three samples from an early Saxon SFB produced charred plant remains in low concentrations, in contrast to Romano-British contexts from the same site. Free-threshing wheat (*Triticum* cf. *aestivum*) with some barley grains and possible rye were recorded, with no hulled wheat remains. Seventeen Saxo-Norman samples were analysed. Free-threshing wheat with bread wheat (confirmed from rachis fragments) was dominant with lesser quantities of barley, oat and traces of rye. Oat was dominant in a few samples and several grains had germinated. The presence of detached cereal sprouts and sprouted grains suggested that malting may have been taking place. A wider range of weed/wild plant seeds was present including grasses and some wetland plants, possibly representing flooring and/or roofing materials. Mineralised remains of bramble, sloe kernel and elder were present in some samples overlying the Roman *Macellum* (indoor market) wall, probably representing food remains. Bread wheat and barley chaff was also present in one of these samples indicating the dumping of processing waste. A probable cesspit contained mineralised sloe kernels and elder seeds demonstrating the use of native hedgerow fruits.

St John's Square, Daventry, Northants [NH24] The St John's Square area of Daventry has been occupied from the 6th century AD onwards, although there were periods of abandonment and the area was probably always marginal to the town. Large deposits of charred cereal remains were present in many samples, including frequent chaff fragments and weed seeds. It was thought that the area served as a cereal processing area, particularly in the period c900-1250 AD (phases 2 and 3). Twelve samples were examined from ditches, pits and hillwash. In samples from the most productive period (phases 2 and 3, c900-1250 AD), the proportions of cereals remained remarkably constant, at c50% bread wheat (no rivet chaff was identified), c5% barley, c2% rye and c5% oats (cultivated oat confirmed). This could represent refuse accumulated from repeated similar activities over a period of 125 years or more. Some increases in weed taxa indicate movement onto more acidic soils at the end of phase 2 (possible Saxo-Norman period), though calcareous soils were cultivated throughout. Clay soils (indicated by stinking chamomile) were also under cultivation. Weedy vetches were frequent but wet-ground taxa were only occasional. Other economic plants were scarce, including HNS, elder, wild strawberry (*Fragaria vesca*), cf. pea, cf. flax and horse beans. The scarcity of charred material other than cereal processing waste, such as charcoal and HNS, indicates that these deposits consisted of fairly pure cereal processing waste with grain percentages increased by differential preservation, without the mixing in of domestic waste as occurs on most sites.

Stafford, Staffs [ST9/ST10/ST11] Excavations at Bath Street, St Mary's Grove and Tipping Street produced rich charred and waterlogged plant assemblages dating from the Iron Age, late Saxon and medieval periods. At St Mary's Grove five late Saxon ovens/kilns were examined, in addition to a late Saxon pit, SFB and two wells. Large

numbers of cereal grains, chaff fragments and weed seeds were present in the ovens, representing both the crops being processed and also chaff being used for fuel. Rye chaff was dominant in two ovens, probably having been used for fuel. Rye grains were also frequent, while oats and barley were frequent in a third oven. Straw nodes, flower heads and large weed seeds indicated the use of coarse sieving and winnowing by-products for fuel. Free threshing wheat grain, hulled six- and two-row barley (identified on the basis of rachis), rye, common oat and bristle oat (*Avena strigosa*) were the crops represented. Most charred material came from the vicinity of the flues, suggesting rake-out deposits. Peas and beans and a seed of flax were also recorded in the SFB. A wide range of soil types was represented by the Saxon charred weed seeds. No evidence for malting was found, so cereals were probably mainly being dried prior to milling. The Late Saxon wells produced waterlogged dill, bullace/damson, cf. morello or dwarf cherry (*Prunus cerasus*) and apple pips, though ruderals and wet ground plants dominated. The main difference between the Saxon and medieval assemblages was the appearance of rivet wheat and cultivated vetch in the medieval period (see Section 5.7.3). A preference for rye chaff as a fuel is apparent on this site, as it was dominant in both in the Saxon and medieval periods.

Woolmonger Street, Northampton, Northants [NH4] Evidence for Early-Middle Saxon to late Saxon and medieval occupation was revealed during excavations around Woolmonger Street. Twenty-three soil samples were examined from the site dating from the Late Saxon and Late Saxon/early medieval periods. Abundant well-preserved charred grains with occasional chaff fragments and weed seeds were recovered from a Late Saxon destruction layer. This comprised primarily rye grain (c48%) with free-threshing wheat (c25%) and traces of barley and oats. Horse beans were frequent (>100 in total), but cf. peas were rare. A single possible flax seed was present. Small-seeded weed seeds and chaff fragments were scarce, but larger weed seeds, in particular corn cockle, were frequent, indicating processed crops were probably represented. A possible apple core fragment and traces of HNS indicated other foods that were being consumed.

Deansway, Worcester, Worcs [WC6] The Roman samples from this productive site are discussed in section 5.5.3.1. The post-Roman 'Dark Earth' (8 samples) produced sparse remains (<10 fpl) which may have been residual. Thirty-four Saxon and medieval samples were examined. Hulled wheats had been replaced by free-threshing wheats by this time. The six late Saxon (8th to 11th century) samples produced free threshing wheat grain, barley, rye and oats (with cultivated oat confirmed) in addition to horse beans, peas and flax. An 8th to 9th century cesspit contained abundant mineralised fruit remains, including over 1000 *Prunus* embryos, c60 apple/pear seed embryos and a few peas. Weed seeds were infrequent but included corn cockle, stinking chamomile and brome grass. The existence of orchards at this time is likely.

5.6.7 Summary and future prospects

A distribution plot of sites producing plant remains of this period is shown in Figure 6. There is great potential for plant remains to provide an insight into the farming of this period, when agriculture underwent fundamental transformations, initially from a system adapted to meet the requirements of the Roman Imperial economy to one directed towards indigenous and local needs. It is clear that any Anglo-Saxon site, especially early Saxon ones, deserves comprehensive sampling and dating. The Raunds Project shows us that the best information is obtained from large projects, as they

provide the best chance of recovering unusual and informative deposits, and of observing patterns of activities on site.

Cereal usage appears to have been much more diverse in this period, so assumptions cannot be made as to which cereals formed the basis of the human diet across the region as a whole. An important consideration is that the arrival of new cultures brought with them new dietary traditions. Evidence from Germany and Denmark suggests that rye and barley were usually the dominant crops on sites of this period (Knörzer 1991; Jensen 1991), so an increase in diversity of ethnic groups may have resulted in more varied arable agriculture. It may also reflect an extension onto land that had not been considered suitable for cultivation in previous periods, such as poor, acidic sands and gravels.

Some areas that require more in-depth investigation are:

- The continued cultivation of hulled wheats. Well-stratified, securely identified hulled wheat chaff (glume basis and spikelet forks) from Anglo-Saxon contexts should be radiocarbon dated on a regular basis to amass data that clarifies our understanding of arable change.
- Well-stratified, securely identified tetraploid free-threshing wheat rachis fragments from Anglo-Saxon contexts should be radiocarbon dated on a regular basis to increase our understanding of arable change.
- As with all periods, waterlogged and mineralised deposits are vital to the investigation of the non-cereal components of the diet. Since alternative sources of protein such as pulses are under-represented in the charred plant record, mineralised latrine deposit need to be studied in detail. The hila of pulses are often preserved in an identifiable condition in such contexts, but finding them amongst what are often large numbers of mineralised bran concretions in the residue requires experience, patience and resources.

Evidence for the disposal of crop processing waste is rare from this period onwards, because mainly free-threshing cereals were being grown. Samples from middle Saxon to early medieval sites in the Silt Fens were an exception [LC33]. These contained grains, but also relatively abundant chaff and weed seeds, implying local production and processing. Chaff-rich samples were also present at Stafford (above). Any deposits containing processing waste, or cereals from an early stage in the crop processing sequence (Hillman 1981), should be given the highest priority.

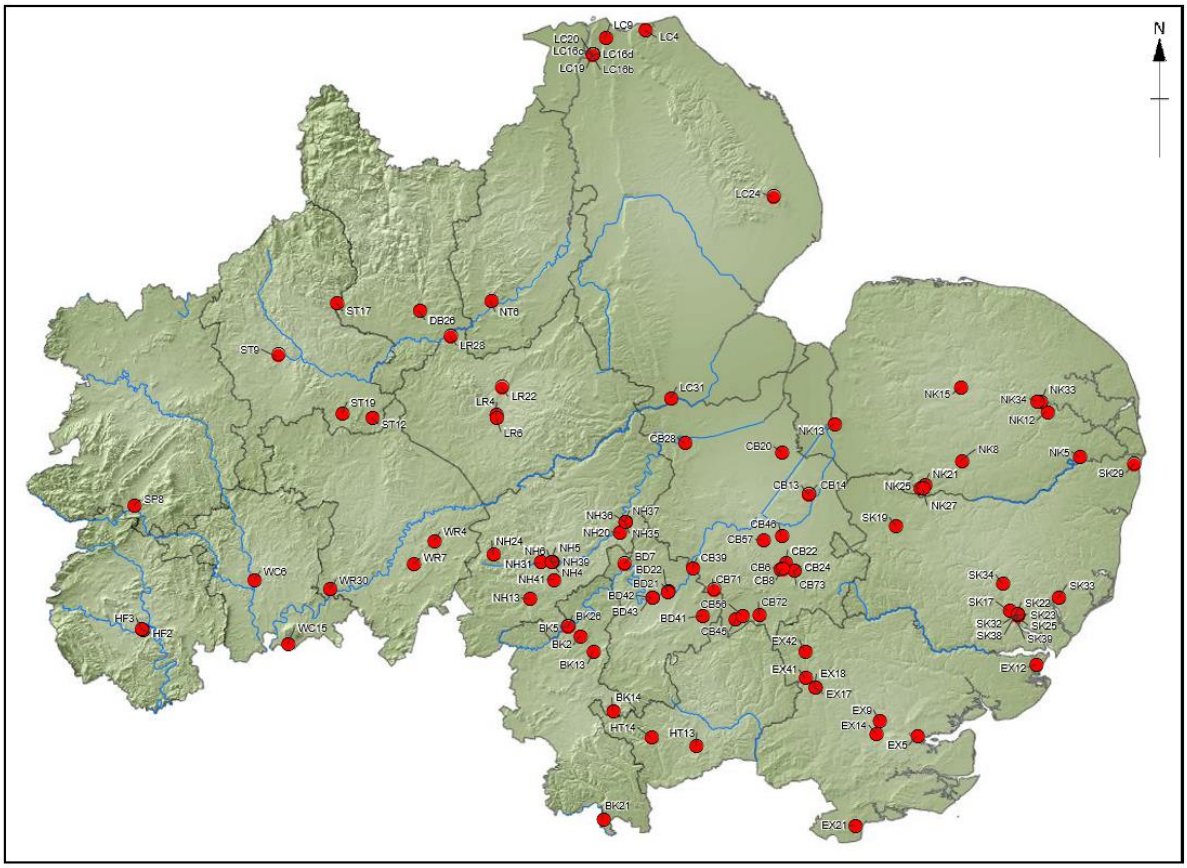

Figure 6: Anglo Saxon sites in the Midland counties producing plant macrofossils

BD3 Haynes Park; BD21 Renold Water End East; BD22 Renold Water End West; BD39 Stewartby Millennium Park; BD40 Huntingdon to Willington Pipeline; BD41 Stratton; BD42 Norse Road, Bedford; BD43 Castle Lane Bedford; BD44 Willington to Steppingley Pipeline; BK2 Loughton, Milton Keynes; BK5 Wolverton Turn, Stony Stratford; BK13 Water Eaton, Bletchley; BK14 Former Castle Cement Works, Pitstone; BK17 Broughton Manor Farm; BK21 Taplow Hillfort; BK22 Tattenhoe & Westbury; BK23 Olney; BK26 Wolverton Mill; CB6 Criminology settlement & King's Garden Hostel cemetery, Cambridge; CB8 Grand Arcade & Bradwell's Court, Cambridge; CB13 Ashwell Site, West Fen Road, Ely; CB14 West Fen Road, Ely; CB20 Stonea Camp and Stonea Grange; CB22 Scotland Road/Union Lane, Chesterton; CB24 Church End, Cherry Hinton; CB28 Cherry Orton Road, Orton Waterville; CB39 Eynesbury, St Neots; CB45 Oblic Engineering site, Litlington; CB46 Lordship Lane, Cottenham; CB56 Church Close, Bassingbourn; CB57 Longstanton; CB64 Papworth Everard; CB71 Station Road, Gamlingay; CB78 Hinxton Hall; DB2 King Street, Derby; DB26 St Mary's Gate, Derby; EX5 Chalet Site, Hall Road, Heybridge; EX14 Anglo-Saxon Cemetery & Settlment, Chelmsford; EX18 Stansted Airport 2008; EX21 Mucking; EX44 Chadwell St Mary; HF2 25 High Town, Hereford; HF11 Aubrey Street, Hereford; HF14 Hereford & District sites; LC3 Nettleton Top; LC4 Barrow Road, Barton-on-Humber; LC5/6/7 Cowbit, Middleton & Moreton; LC19 Flixborough; LC20 Flixborough; LC24 Fordington to Skendleby pipeline; LC27 8 Church Lane, South Witham; LC31 Flaxengate, Lincoln; LC36 Riby
LC41 Hall Farm, Baston; LR6 Bonners Lane, Leicester; LR22 Three Round Barrows, Cossington; LR26 Freeschool Lane, Leicester; LR28 Willow Farm, Castle Donnington; LR48 Whissendine, Rutland; LR49 Eye Kettleby, Melton Mowbray; LR52 Vaughan Way, Leicester; NH4 St Peter's Walk, Northampton; NH5 Sol Central, Marefair; NH6 Marefair, Northampton; NH13 Bury Mount, Towcester; NH20 Middle Saxon estate centre, Higham Ferrers; NH24 St John's Square, Daventry; NH36 Raunds Project; NH37 West Cotton, Raunds Project; NH39 St James' Square, Northampton; NH41 Grange Park, Courteenhall; NH42 Alderton Mount; NK5 Yarmouth Road, Broome; NK8 Grange Farm, Snetterton; NK13 Crow Hall Park, Downham Market; NK21 Kilverstone; NK25 Mill Lane, Thetford; NK27 Melford Meadows, Brettenham; NK33 Lower Close, Norwich; NK41 Spong Hill; NK44 Castle Mall, Norwich; SK17 Boss Hall cemetry, Ipswich; SK19 West Stow; SK22 Ipswich sites; SK23 Ipswich sites; SK26 Staunch Meadow, Brandon; SK29 Bloodmoor Hill, Carlton Colville; SK38 Brandon; SK39

Buttermarket, Ipswich; ST9/10/11 Stafford sites; ST12 Tamworth; ST17 Rocester; ST27 Tipping Street, Stafford; WC6 Deansway, Worcester; WC15 Aston Mill Farm, Kemerton; WC17 Sidbury, Worcester; WC24 Wormington to Tirley Pipeline; WC35 Beckford; WR4 Churchover to Newbold Pacy gas pipeline; WR30 Arrow Valley

5.7 After the Norman Conquest (AD 1066-1540) - The Medieval Period

5.7.1 The Saxon/ medieval transition period

During the 9th century the Midlands region was divided by Danelaw into English Mercia to the west and Danish Mercia to the east. By the 10th century the region became united under the rule of Wessex into the Kingdom of England. Anglo-Saxon rule ended at the Battle of Hastings in 1066 with the death of Harold Godwinson. Considering the long period of upheaval and greatly increased contact with the Continent it is inevitable that agricultural practices would have been affected. The spread of new arable weed taxa such as cornflower (*Centaurea cyanus*), shepherd's needle (*Scandix pectin-veneris*) and thorow-wax (*Bupleurum rotundifolium*) is likely to relate to increased trade and the movement of people from the continent, as all three examples are better suited to continental climates and all are now scarce in the British Isles. Greig (1991a, 106) suggests that in the case of cornflower the most important factor could be increased cultivation of light, sandy soils, though other factors suggested by authors have been its relationship with the cultivation of rye, and climatic improvement. Pinning down specific agricultural changes relating to cultural influences is difficult because the Saxon and medieval periods were quite diverse in terms of arable agriculture. It is likely that the suitability of local soils largely dictated which crops were grown at each location during this time, in contrast to the more rigid and limited crop regimes imposed by the Romans. Because of this diversity large amounts of data are needed in order to identify overall trends. However, one observation made by a number of authors is that the maintenance of soil fertility appears to have been a problem in some areas. This is discussed further below.

Sites spanning the Saxon and medieval periods show no clear break in agricultural tradition, as demonstrated by the charred plant assemblages recovered from St John's Square, Daventry, Northamptonshire [NH24]. The site was occupied in the 6th century AD onwards, although there were periods of abandonment and the area was probably always marginal to the town. Large deposits of charred cereal remains were present in many samples, including frequent chaff fragments and weed seeds. Twelve samples were analysed, from ditches, pits and hill-wash. It was thought that the area had served as a cereal processing area, particularly in the period c900-1250 AD (phases 2 and 3), during which the proportions of cereals were remarkably constant, at c50% free-threshing wheat (bread wheat chaff was identified), c5% barley, c2% rye and c5% oats (cultivated oat confirmed). This period could have lasted for at least 125 years. Some increases in weed taxa indicate movement onto more acidic soils over time, though calcareous soils were cultivated throughout. Clay soils (indicated by stinking chamomile) were also under cultivation. Weedy vetches were frequent but wet ground taxa were only occasional. Other economic plants were scarce, including HNS, elder, wild strawberry, possible pea, possible flax and Celtic beans. The scarcity of charred material other than cereal processing waste, such as charcoal and HNS, indicates that these deposits consisted of fairly pure processing waste with grain percentages probably increased by differential preservation (Boardman and Jones, 1990), and without the mixing in of domestic waste as occurs on most sites.

5.7.2 The Main Crop Plants

5.7.2.1 Cereals and pulses

All of the crops cultivated during the Saxon period continued in use into the medieval period and beyond, with evidence for tetraploid wheats greatly increasing in the Midlands during the 12th and 13th centuries (*Table 4*). Free threshing wheats (both hexaploid and tetraploid types), were the principal components of many assemblages but barley was also common and oats dominated some samples and even whole assemblages from several sites. At Riggs Hall, Shrewsbury, Shrops [SP9] cultivated oat was dominant in all of the samples. Hulled barley, free-threshing wheat, spelt and rye were present in smaller quantities. Similar oat-dominated samples with free-threshing wheat were found at 10th to 14th -14th century Flaxengate, Lincoln [LC31]. At City Arcade, High Street, Worcester, Worcs [WC2] post-Roman and early medieval (cc AD 5th to 12th century) samples contained frequent oats and free-threshing wheat grains. Although the identification could not be confirmed, the oats were thought to have probably been a crop. At Shenstone, one of the M6 Toll Road sites [WR27], evidence for rye cultivation increased in the medieval period. Cultivation was thought to have expanded onto heavier soils and there was increased exploitation of heathland vegetation for fuel. An increase in rye was also observed in the later medieval phase at Brooklands, Milton Keynes, Bucks ([BK17a] see below) along with evidence of deteriorating soil fertility.

Oats and rye were useful crops in areas with poor soils, the cultivation of which increased through the Saxon period and continued into the medieval period. The fact that small amounts of these crops are found on the majority of sites excavated, including fertile loams and clays, suggests that they were more commonly grown than the charred record suggests. It is likely that the reason why they seldom became charred in large quantities was because they were mainly used for fodder, and perhaps were also sometimes grazed from the fields. The use of oats for brewing is discussed below in the summary for Freeschool Lane, Leicester [LR26]. The recovery of primary fills from malting kilns and ovens provides substantial evidence for the use of oats, mixed with smaller amounts of wheat and barley, as well as dredge. Aside from these well-preserved deposits, the absence of identifiable floret bases from most charred oat deposits means that this useful, crop may be underestimated in the charred record, being dismissed as weedy oats on many sites.

Evidence for the cultivation of two-row barley (*Hordeum distichum*) is slightly more convincing in the early medieval period. Leicester Shires sites [LR5] produced rachis fragments in early medieval features (no date given but pre- 1200 AD). An early 12th century oven from West Cotton, Raunds [NH37] contained rachis fragments and possible grain. Three early medieval (11th to 13th century) features at Flaxengate, Lincoln [LC31] produced two-row barley rachis fragments. The topic is discussed further in Section 6.6.3. Since the presence of this species can only be confirmed using exceptionally well-preserved waterlogged or charred rachis fragments, the record for this useful malting barley is likely to be grossly underestimated in the archaeobotanical record.

Glume wheats continue to appear at some sites, possibly as a minor crop or as a persistent and tolerated 'residual' crop (*Table 3*). Routine radiocarbon dating of hulled wheat chaff when it is present in reasonable quantities is required in order to see how widespread the cultivation of hulled wheats was in this period. Both emmer and spelt wheats have their own specific places in the rather diverse cropping regimes of the Saxon

and medieval Periods, at a time when diversity was probably seen as insurance against total crop failure, poverty and starvation. A wide range of mixed crops or 'maslins' were grown which was at least partly an attempt to ensure that at least one of the two crops succeeded each year, no matter what the weather, pests or diseases had to offer. Some of the more common maslins that have been recorded (sometimes tentatively) in archaeobotanical samples include mixed bread wheat-type and rivet-type free-threshing wheats, and, perhaps more commonly, barley and oat dredge (e.g. West Cotton [NH37]). Others that have not yet been identified with certainty but that are known, either from other regions, periods or from documentary records, include bread wheat and cultivated vetch (Wharram Percy Barn, Carruthers, 2010b). Although not always easy to confirm in the mixed domestic waste deposits that are the mainstay of archaeobotanical analyses, the occasional primary deposit from a storage structure can sometimes provide good evidence for this practice. Local documentary sources, of course, are of vital importance in this period and should be included in analyses wherever possible.

Celtic beans (*Vicia faba*) are recorded more frequently in the medieval period and so are those of the cultivated vetch, (*Vicia sativa* var. *segetalis/sativa*) and pea (*Pisum sativum*). Commonly, seeds of the latter two pulse crops are tentatively identified, as the diagnostic hilum is rarely preserved, and large, round seeds occur in some wild species of vetch/vetchling. Though the presence of these crops might indicate the practice of crop rotation they may also represent elements from mixed crops such as Though the presence of these crops might indicate the practice of crop rotation they may also represent elements from mixed crops such as 'pulse' (beans and peas), 'bollymong' (oats, peas and vetches or buckwheat), and 'berevechicorn' (dredge (barley and oats) and vetch) (Hammond 2005, 3). However, distinguishing the preserved remains of a mixed crop as opposed to a mixed waste deposit from different origins is very difficult (van der Veen 1995). Mixed crops have both advantages and disadvantages: they provide insurance against crop failure, and the differing heights of cereals and twining nature of legumes help to protect against lodging (the large scale collapse of crops on to the ground before harvest that can lead to rotting or premature sprouting). Cereal straw provides a support for the legumes which in turn shade the ground, inhibiting weed growth and evaporation of soil moisture in dry weather. Unless used for fodder, the different elements may need to be harvested at different times which would appear to be a major disadvantage. However, the restoration of fertility by nitrogen-fixing bacteria in the root nodules of leguminous plants, or the ploughing in of plant material from the fallow periods, makes the use of crop rotation involving legumes worthwhile.

5.7.2.2 Fruits, nuts and flavourings, and fibre plants

As in the Saxon period, many fruit, nut and fibre crop remains have been recovered from mineralised or waterlogged deposits that contain sewage and/or domestic waste. A wide range of fruits, nuts and herbs has come from urban sites throughout the region and also from monastic sites (see Section 5.7.5 below). Mineral-replaced macrofossils from Grove Priory in Bedfordshire (Robinson 1984) provided evidence for the use of condiments such as fennel, and mustard seeds have also been reported from West Cotton and a cesspit at Furnells, Raunds ([NH36] [NH37]). Fennel, celery, black mustard and chicory were present in 12th to 14th century accumulated material in the moat of Shrewsbury Abbey [SP2]. These flavourings/ medicinal plants were thought to have been grown in the priory garden.

5.7.3 Site summaries

5.7.3.1 Towns and suburbs

Soil samples from urban sites can be very productive, often containing the remains of a diverse array of food plants (often including imported species), flavourings, fibre crops and weeds of waste ground. Charred, waterlogged and mineralised plant remains are often all preserved. Amongst the taxa it is very likely that at least some of the plants had been consumed or applied as poultices for medicinal purposes, but determining which species were used is much more difficult (but see Worcester Road below). The main problems with urban sites are the complex stratigraphy and possibilities of contamination and residuality. Samples need to be carefully selected during the assessment stage and unusual or very unlikely occurrences should be radiocarbon dated wherever possible.

Ely waterfront, Cambs [CB17] This report includes plant macrofossil studies from the Jewsons site, Broad Street. Features dating to the C12th/13th (a post hole), C14th/15th (15 samples associated with buildings and an oven and waterlogged samples from a ditch and two channels), and C16th (an oven, a kiln, two waterlogged channel fills) were investigated. The C12th/13th post hole contained mainly barley with some evidence for sprouting suggesting it may have been affected by post-depositional mixing with the later malting deposits. Great fen-sedge (*Cladium mariscus*) leaf fragments were present, perhaps representing use for fuel. The C14th/15th samples from layers and features associated with timber structures contained abundant barley, with evidence for rapid, high-temperature roasting of barley grain for malting. Two-row barley may have been used as twisted grains were absent, though no chaff was preserved to confirm this. Weed seeds and chaff were scarce and the large, cereal grain sized seeds of Italian rye-grass (*Lolium* cf. *multiflorum*) was the most frequent wild taxon. Non-malting waste included free-threshing wheat (mainly grains) and rye grains, weeds (stinking chamomile, corn cockle) and a Celtic bean. A bird cherry stone and HNS indicated food preparation waste. Great fen-sedge ash (containing silicified leaf fragments) was present in small amounts but its high burning temperature would have been unsuitable for malting. Possible evidence for burning peat included tiny burnt soil and iron-replaced wood fragments. Floor layers from the wooden hall contained only small amounts of possible food preparation waste (cereals, chaff) but abundant seeds from fenland taxa (primarily fen-sedge, spike-rush (*Eleocharis* cf. *palustris*), sedges and bogbean (*Menyanthes trifoliata*). No evidence for burning peat was present but flooring or thatch material might be represented. Two fills of an oven contained evidence for malting barley plus possible evidence for the use of peat as a fuel (burnt soil fragments and iron-replaced wood traces). Charred fenland seeds and stem fragments were numerous in one sample, with only a few cereal grains. A waterlogged ditch contained small amounts of grain and sedge ash, as well as uncharred remains indicative of a nutrient-rich and still or slow-flowing aquatic vegetation. Waterlogged channel fills contained little evidence of occupation debris but abundant nettle seeds, further aquatic species typical of still to slow-flowing water, as well as disturbed ground weeds. A 16th century kiln and oven samples contained contrasting assemblages. In the kiln charred cereal grains, wetland plants and molluscs were abundant. Barley was dominant and three rachis internodes confirmed that 2-row barley was present. In contrast, the kiln/oven layer contained scarce charred plant remains but abundant land molluscs. Two samples from a possible 16th century

waterlogged channel contained background levels of charred waste plus waterlogged remains from plants of damp, shady and nutrient-rich disturbed soils.

West Fen Road and the Ashwell Site, Ely, Cambs [CB12] [CB13] The main excavations were carried out in 1999 on the site of earthworks and crop marks (primarily ridge and furrow). A total of 89 bulk samples, from primarily mid 9th to 13th century deposits, were analysed for charred plant remains. In the early phases free-threshing wheat, hulled barley and rye were cultivated but the latter two cereals decreased to trace levels by the high medieval period (12th to 13th centuries). Oats (*Avena* sp.) were present in low numbers throughout. There was little evidence for the use of fen resources, such as wetland taxa, although waterlogged remains do not preserve well when charred (Smith 1990) so evidence of peat burning is unlikely to survive. Furthermore, peat tends to burn very slowly and thoroughly (Hunter, personal observation), reaching high temperatures reducing much of the plant content to ash; temperatures of over 700°C were estimated for peat ash in hearths from sites in the Western Isles of Scotland, while archaeobotanical assemblages were poorly preserved (Church 2004, 108). Ecologically great fen-sedge and black bog-rush (*Schoenus nigricans*) nutlets were unlikely to have been growing within arable fields (unlike spike-rush), so the increase in their occurrence through time suggests an increase in the use of fenland vegetation (as opposed to peat) as fuel in the high medieval period. Documentary sources and archaeobotanical evidence (Ballantyne 2001) show that fenland vegetation was used in ovens and kilns because of the high temperatures it produced. Bone evidence was included to show that in the earlier phases the subsistence strategy was broad, whilst more specialisation occurred in the later medieval period. At the Ashwell site links to the monastery at Ely may have existed, perhaps influencing the use of plant resources. Increased commerce and regional specialisation from the 12th century was a Europe-wide trend (Postan 1973; Miller and Hatcher 1995). In Roman and medieval times drainage and controlled use of wetlands was widespread. Changes in the later phases reflect these trends, with specialisation to free-threshing wheat and wool production being led by economic forces. The value of the fenland resources became more important, as demand for fuel and thatching, fishing, fowling and turf (peat-fuel) increased.

In an overview of medieval use of the East Anglian peat fens, using the Ashwell Site [CB10] as an example, Ballantyne (2004) discusses the relationship between the site and the use of fenland resources in the 8th to early 12th century. Charred plant remains and bone evidence were examined with respect to site formation processes. The occupants of the Ashwell site appear to have under-utilised the local fenland resources, and which she discusses in the context of historical evidence.

Forehill, Ely, Cambs [CB10] Fifty-five samples from features dating to the 11th to 12th centuries, up to the 15th/16th century produced waterlogged and charred plant remains. Free-threshing wheat, rye, barley, oats, peas and Celtic beans were present amongst the charred assemblage. The waterlogged samples produced evidence for the consumption of a range of fruits and nuts, primarily relating to the 14th century occupation of a building. These included a few exotic fruits and nuts such as fig, grape and walnut. Orchard fruits included cherry, plum/bullace, apple and hazelnut. The recovery of frequent vervain (*Verbena officinalis*) seeds in two 13th /14th century samples led to the suggestion that they may have been gathered for medicinal use, since the plant prefers lighter soils than those in the area and vervain was valued as a cure for plague in the medieval period ([CB10], 168).

St Mary's Gate, Derby, Derbys [DB26] During excavations on the site of the Magistrates Court samples were taken from five areas containing medieval pits, wells, ditches and gullies. The deposits dated from the Saxo-Norman to post-medieval period, but mainly to 12th-14th centuries. This was the first opportunity to investigate plant remains from medieval Derby. Although 111 samples were taken, and charred plant remains were frequent, only 30 were fully analysed because of recovery problems and the selection of productive samples.

A Saxo-Norman pit contained frequent free-threshing wheat grains and bread wheat-type chaff. Oats were almost as frequent as wheat and were probably grown as a separate crop (one *Avena sativa* spikelet was identified). Some 31% of the oats and 5% of the wheat had sprouted, raising malting as a possibility.

Four samples associated with an early medieval industrial structure contained probable food preparation waste, possible burnt fodder (mainly oats), and a charred layer containing frequent wheat grain with relatively high chaff ratios (perhaps including cleaning waste). In the latter sample weed seeds included stinking chamomile and leguminous weeds, and oats were again numerous. Domestic waste in a linear feature included pea or bean and hazel nutshell.

A hiatus phase contained mixed waste that included mineralised straw and moss fragments, probably redeposited from rubbish pits. Features pre-dating the main phase of industrial activity contained domestic waste from food preparation including wheat and oat grains, legumes and hazel nutshell fragments.

In the main industrial phase (phase 4B; 12th – 14th century), a well close to possible tanning pits produced charred cereal remains (wheat and oats), legumes, hazel nutshell and numerous weed seeds (mainly leguminous), plus probable waterlogged remains - but with mainly robust taxa such as elder surviving. Little evidence for tanning was found except for a few bark fragments, though it is possible that the frequent elder remains represent berries used for tanning. An oven built on top of the well after it had been backfilled contained mainly small oats with wheat and little chaff. Flax, peas/beans and hazel nutshell indicated domestic waste deposition, possibly after abandonment. Other samples contained evidence for cereal cleaning waste (wheat chaff) with frequent peas and beans from a pit, some samples containing numerous weed seeds and some with grassy taxa possibly representing kindling for a corn drier. A second well contained charred cereal cleaning waste and a wide variety of waterlogged remains of ruderal weeds suggesting a polluted environment. Other features from this phase included a corn drier containing possible charred grassy kindling and fuel, a gully containing abundant wheat-possibly representing a cereal crop with some contaminants, and a pit containing cereal cleaning waste with numerous peas and beans.

Reuse and abandonment features contained a similar range of charred grain (mainly oats with wheat) and weed seeds. Few post-medieval samples were recovered, but one feature contained possible latrine waste including uncharred fig, elder and bramble seeds.

Free-threshing wheat (with only bread wheat-type and no rivet rachis identified) and oats were the main cereals on this site in all phases. The high density of cereal remains in many samples from this site, including unusually large quantities of chaff in three samples, indicated more than domestic use of cereals. The frequent leguminous weeds

may suggest crop rotation including fallow. Fodder may have been present (oats and legumes) for working animals on the industrial site.

The Shires, Leicester, Leicestershire [LR5] Large scale sampling (more than 1000 samples) was carried out on Little Lane (Roman and medieval) and St Peter's Lane (mostly late medieval and post-medieval). The medieval samples produced a similar range of crop plants from the early to late medieval periods: rivet/macaroni wheat, bread wheat, rye, 2-row and 6-row hulled barley and cultivated oat. Celtic bean, pea and cf. cultivated vetch were also recorded. Collected or cultivated fruits and garden plants were limited in the early medieval period (sloe, HNS, apple, cf. raspberry). Charred seeds of possible pot marigold (*Calendula officinalis*; 1 fragment), possible leek (*Allium* cf. *porrum*) and flax (early to late medieval) were other cultivated species represented. In the late medieval period *Prunus* sp., figs, possible leek, possible grape, opium poppy, and possible sweet violet (*Viola odorata*) were present. A wide range of typical weeds were also represented including corncockle, shepherd's needle, thorow-wax (*Bupleurum rotundifolium*), stinking chamomile, and cornflower. Thorow-wax and cornflower are likely to be medieval introductions (Preston *et al* 2004 table 2; Greig 1988; 1991a). Grassland (grasses, fairy flax, daisy etc), wetland (sedges) and hedgerow (elder, yew, deadly nightshade etc) taxa were present, with the possibility that some were collected for medicinal use. In the early medieval period the assemblages may represent hay brought in as packaging or to feed animals, low-level background domestic waste and some deposits of more concentrated mixed waste. The middle medieval samples contained sparse charred remains, as did the late medieval samples, although cereals were more frequent at St Peter's Lane (mainly wheat and oats). Some sort of cereal-based activities were suggested, though most cereals would have been purchased as flour at this time. Similar charred plant remains from various deposits, and mineralised seeds and fruit stones from cesspits (together with fish remains, fly puparia and parasite ova), were recovered from Causeway Lane, Leicester [LR4], mainly from deposits dated 1100-1400.

Derngate, Northampton, Northamptonshire [NH3] Two samples from 13th to early 14th century pits were examined. One pit produced high concentrations of cereal grains (58.2%), chaff (7.8%) and weed seeds (33.9%). Free-threshing wheat and oats were the most abundant cereals, with some rye and a few barley grains. Rivet wheat was identified from rachis internodes. A small amount of sprouting was in evidence in both samples. Other food plants included large pulses (indeterminate), plum/bullace, apple/pear and HNS. Weed seeds were frequent, including a variety of arable and ruderal weeds (stinking chamomile, vetch/tare, clover/medick etc). Wet ground/marsh and grassland taxa were notably frequent, especially sedges, suggesting that hay from damp meadows was included in the assemblage from one pit. The pits appeared to contain burnt waste from a variety of sources including grain crops, possible thatching material, perhaps some brewing waste and burnt hay.

Bath Street, St Mary's Grove and Tipping Street, Stafford, Staffordshire [ST9/ST10/ST11] Two medieval quarries contained vast dumps of charred grain. All four cereal types were represented and chaff was frequent enough to suggest that the remains were not solely from fully processed crops. Some whole spikelets and ear fragments of rye were present. Rye rachis was again dominant in one sample suggesting use for fuel. Samples from a 12th – 14th century pit and kiln produced most of the rivet wheat from this site. The kiln produced no clear evidence for malting, and weed seeds were the main component of the sample. Rye chaff was again most frequent, but remains were generally infrequent suggesting the kiln had been cleaned out. An oven, however,

contained 30% germinated grain (mainly rye and oats), while weed seeds were dominant. Seed heads probably accounted for the frequency. A 13th/14th century pit contained mainly rye and oats with frequent rye rachis and weed seeds. A waterlogged medieval well contained no food plants except for fennel seeds, but mainly waste ground and wet ground weed seeds. A second well contained more evidence for dumped food waste, including flax, dill, sloe and heather flowers. Hay and rushes may also have derived from household waste. The main differences between the Saxon and medieval assemblages were the appearance of rivet wheat and cultivated vetch in the medieval period. A preference for rye chaff as a fuel is apparent on this site.

Norwich - Over the years a large number of sites in Norwich have been investigated (for example Alms Lane [NK38], St. Martin-at-Palace Plain (Murphy 1987a), Fishergate [NK3], Lower Close [NK33] and St Peter's Street [NK10]), which have effectively gradually added pieces to the puzzle. Charred, waterlogged and mineralised remains have provided information about crop husbandry, the local economy and diet. For example, at St Martin-at-Palace Plain, Norwich, a 12th/13th century gully included dense charred deposits of rye and probable two-row hulled barley (*Hordeum* cf *distichum*) with traces of bread wheat, flax and Celtic bean. Chaff, straw nodes and weed seeds were abundant. The small size of the grains and the high percentage of leguminous taxa amongst the weed seeds were thought to indicate rye cultivation on impoverished soils which were not receiving sufficient manure to maintain nitrogen levels (Murphy 1987a). An alternative explanation could be that the leguminous seeds represent evidence of crop rotation (Murphy and de Moulins, 2002).

A more recent but fairly typical example is provided by an assemblage from St Faith's Lane, Norwich, Norfolk [NK11]. Seven samples from the backfills of three medieval backyard pits (dated to the mid 11th-12th century) were analysed. Residuality was a problem on this site so these were the only deep features considered worth analysing. One pit contained frequent mineralised remains but little definite evidence of sewage (no bran, faecal concretions, fruit remains). The mineralised assemblage consisted of frequent whole corn cockle seeds, three apple/pear seeds and several *Brassica/Sinapis* sp. seeds that could have come from mustard or may have been weeds. A few weed seeds were also mineralised (dock, brome grass). Burnt domestic waste containing primarily charred oats and barley, with occasional rye, HNS, and three large beans was recovered. The pit may have contained midden material including seeds picked out by hand from the crop prior to cooking. The second pit produced frequent charred plant remains containing some cereal processing waste, with straw and frequent weed seeds but also frequent grains. Oats were again the most numerous cereal grain with frequent barley and occasional bread wheat-type grain and rye. This mix of cereals is often found in medieval Norwich, with oats having been commonly used for brewing prior to the 11th century (see Section 5.6), as well as fodder. Bread wheat may have been mainly brought into town as flour, so tends to be under-represented as macrofossils. Amongst the abundant weed seeds, stinking chamomile and darnel (*Lolium temulentum*) were most frequent, with sedge nutlets also being common. Heavy damp soils are to be found locally. The third pit was less productive but oat grains, followed by free-threshing wheat grain, were most frequent. Wetland and heathland plants were represented, as were occasional foods including charred apple pips and possible bean and pea fragments. Burnt domestic and industrial waste might be represented, with heather probably being collected from nearby Mousehold Heath for fuel for industrial purposes (Murphy, pers. comm.).

Worcester Road, Droitwich, Worcestershire [WC12] An 11th - 13th century cesspit from the back part of a plot possibly fronting onto Worcester Road was investigated. Charred cereal grains included free-threshing wheat, barley, oats and large grasses. These mainly came from the upper fill of the pit. Weed seeds were common in this fill (including vetch/vetchling/pea, sheep's sorrel, and sedge). Waterlogged remains included henbane, elder and bramble. Mineralised concretions and seeds were present in the lower fill, including numerous hemp seeds, apple/pear, cf. garden parsley (*Petroselinum crispum*), elder and white horehound (*Marrubium vulgare*).

5.7.3.2 Villages and farmsteads

Although rural medieval sites are not quite as rare as they once were with regard to archaeobotanical investigations there are still relatively few examples of well-sampled, well-preserved sites amongst the published reports. One of the problems for archaeobotanists is that the principal cereals at this time were free-threshing, so processing waste could easily be produced at the site of production, away from settlement features, and therefore not enter the archaeological record. In addition, cereal processing waste was a valued commodity, so it would only have become charred in specific situations, such as when burnt as fuel in hearths and ovens or in accidental fires.

The most intensively investigated area in the Midlands is the landscape along the River Nene, investigated as part of the Raunds Project, Northants [NH36] [NH37]. Ten years of excavation at Raunds on the slopes of the River Nene examined the process of village formation from the early Saxon to medieval desertion. A series of excavation sites around the medieval village have been reported on.

At Burystead [NH36] C12th quarry backfills contained grain-rich assemblages with frequent weed seeds and common chaff (mainly free-threshing wheat, hexaploid and tetraploid). Cultivated vetch and Celtic bean was present. Several new wild taxa were present, including frequent spike-rush, suggesting a wider range of sources of waste than the ditches. The recovery of a few mineralised remains may indicate the presence of some faecal waste, including mineralised henbane, forget-me-not (*Myosotis* sp.), and mayweed (*Tripleurospermum* sp.). Few other medieval samples were available and four late medieval/early post-medieval contexts, which included an oven, produced few remains. Wheat was dominant and oats and rye were less frequent than they had been in the late Saxon/Saxo-Norman period. The oven contained silicified, poorly preserved cereal remains including possible two-row barley (identified on the basis of grain shapes). However, *Brassica* seeds, including *B. nigra*, were frequent enough to suggest that they might have been a crop.

Nearly all of the features at Midland Road [NH36] frontage were medieval. Charring appears to have taken place at high temperatures. Legumes were present in 56% of the assessed samples, cereals in 85%. Five late medieval/early post-medieval samples (drains, pits, floor deposit) showed that both tetraploid and hexaploid free-threshing wheat continued to be cultivated, and barley, oats and rye were present in low numbers. Large pulses were poorly preserved (pea/vetch/bean). Weeds were common and varied with more diversity in the drain samples reflecting wider sources of waste. The main contrast with Burystead was the increased number of legumes at Midland Road.

At Gells Garage [NH36] the only sample was from a late Saxon/Saxo-Norman ditch fill and contained both tetraploid and hexaploid free-threshing wheat with some barley and a few rye and oats. Weed seeds were frequent with some grassland taxa.

At West Cotton [NH37] early Saxon features, a late Saxon (AD950-1100) pit, a medieval manor (AD 1100-1250) and later medieval yard layer (AD1250-1400) were sampled. Seven waterlogged deposits were also analysed. Later and post-medieval samples were too sparse and unreliable to be included. Most of the evidence came from the late Saxon onwards. *Summary of crops*: Both bread wheat and rivet wheat were grown from the late Saxon period and were probably grown together as an all-purpose maslin. Small amounts of spelt were present in the late Saxon mill leat, perhaps as a weed of rye. Barley and oats may have been grown as dredge or pure crops and were clearly important for malt production; a large proportion of oats and barley grain showed signs of germination. Rye was grown as a pure crop at least in 12th century (medieval manor phase). Small numbers of legumes were recovered with beans grown from the late Saxon/post-Conquest period onwards and peas from the 12th century onwards. The fodder crops cultivated vetch and possibly lentil were introduced in the early 12th century. Flax was grown and *Brassica* seed may have been cultivated in the 13th and 14th centuries. A total of 358 samples from the medieval manor were assessed and 144 were analysed. The western pit group comprised a number of demolished ovens and pits containing burnt debris. Some of the oven samples were very rich, containing cereal grains (mainly free-threshing tetraploid and hexaploid wheat) and frequent weed seeds, plus common chaff (as well as frequent fragments too small to count). Leguminous seeds (mostly weeds but also cultivated vetch and bean) and pod fragments were frequent. Bracken fragments and a flax seed were recovered. Weeds included seed heads of scarlet pimpernel and stinking chamomile, plus a wide range of taxa including cotton thistle (*Onopordum acanthium*), Venus's looking glass (*Legousia hybrida*) and grass vetchling (*Lathyrus nissolia*) - some of which may have been from fodder crops. Several different uses of the ovens were suggested including drying wheat crops, rye crops and malting dredge. The frequent cultivated vetches may have been used for fuel or been a weed of another crop. Some wet-ground plant remains could indicate the use of wet grassland hay for fuel/kindling. In one oven sprouted grains and detached sprouts were frequent, and while twisted barley grains were not observed, six-row barley rachis was present. It is likely that both two-row and six-row barley were grown with two-row favoured for brewing. The weeds suggested a range of light, heavy, calcareous and more acidic soils were used.

Nine samples associated with the mill contained similar charred assemblages, with wheat by far the dominant cereal. However, in samples from the pond, rye and rye chaff were frequent. Waste ground weeds were common (hemlock, henbane, cotton-thistle, thistle) some of which may have entered the fields in manure. Samples from the mill area sometimes contained more rye and sometimes were rich in oats (wild and cultivated) but sprouted grains were not present. The evidence suggested that rivet wheat and rye may have sometimes been grown as a maslin. A backfill layer contained a lump of burnt horse dung which showed that both oat grain and bread wheat chaff were being fed to livestock.

Samples from the ditch systems were variable but sometimes very productive, perhaps being closer to ovens or buildings. The samples suggested that sprouted oats and barley had been grown as separate crops, with the mixing occurring at a later stage. A wide range of weed seeds, some flax seeds and some possible edible shrubby seeds, in addition to wet-ground taxa growing in the ditch were all recorded. Some samples were richer in rye, particularly chaff. Some contained evidence for six- and two-row barley with no sprouted grains. Some contained several large legumes including cultivated vetch and

pea/bean. The presence of frequent charred oats with no signs of sprouting in one sample suggests that oats were being consumed as well as used for brewing.

Samples from the manor buildings, including a malthouse, contained sparse evidence though occasional sprouted grains confirming the interpretation. Mineralised and charred remains from a stone-lined garderobe consisting of coprolite was dissolved using dilute HCl to free the bran. Wheat, barley, corncockle, possible oat and rye fragments were observed, as well as a possible pea hilum and plum-type skin fragments. Straw-type fragments were frequent. Elder seeds were frequent but may not have been mineralised so could have entered later. The final phase of hall samples (AD1200-1250) were dominated by weed seeds and chaff was infrequent. No evidence of sprouting was observed. All four cereals were present as well as flax and large legumes, plus HNS and Prunus sp. The medieval tenements produced low-level waste dominated by wheat grains (116 samples analysed), with only 7 samples producing over 200 items, all from the malthouses. Three of the four malthouses produced occasional sprouted grains and *Brassica* seeds were common. Peas were present and large legume seeds were common. HNS, an apple/pear pip, flax and a *Prunus* sp. stone fragment were found. A similar range of weed seeds were recorded.

The high incidence of chaff at West Cotton could be due to use as a fuel for malting (important as the malt takes on flavour). Other possible reasons include few animals to consume chaff, low access to other fuels, high access to other fodders. Weed-crop associations noted were corn cockle-rye, black bindweed-dredge, and possibly corn gromwell-wheat and wheat/rye maslins. No obvious decrease in soil fertility was seen as leguminous weeds were frequent from the early medieval onwards. Increases can also be due to crop rotation but this is difficult to confirm. Wheat nematode galls (*Anguina tritici*) were present from the C11th onwards at West Cotton and at north Raunds.

In summary, across the Raunds sites both tetraploid and hexaploid free-threshing wheats were being grown by the late Saxon/Saxo-Norman period, alongside barley, oats and rye. Wheat was by far the most important cereal, though which type dominated is uncertain as it varied by site, but so did types of context. Whilst at West Cotton [NH37] dredge was grown, the oat-dominated ditch sample at Burystead showed that this was not always the case. Rye may be under-represented as the Burystead ditch sample with 20 rachis fragments suggests. The greater occurrence of rye chaff than grain could indicate the use of rye chaff as fuel/kindling, as suggested at Stafford [ST9]. Rye and rivet straw may have been used in drying ovens with the chaff burned as fuel, as the oven from the Furnells bake/brewhouse suggests. The same range of crops occurred in later periods with possible two-row barley added and possible decreases in wheat dominance. Peas were probably grown from the middle Saxon period and Celtic bean and cultivated vetch from at least 12th century. The increase in pulses at Midland Road could be due to higher chances of charring and horse fodder due to possible location of a smithy (also at Furnells). Other occasional economic plant records include flax (all periods) and late Saxon/Saxo-Norman gold of pleasure. Black mustard was grown in the late medieval period and occasional *Prunus* sp. occurred in late Saxon contexts onwards. HNS was less common than on some other sites such as Westbury, Bucks [BK22]. The wide range of weed taxa reflects cultivation of a variety of soils by the late Saxon/Saxo-Norman period (*Anthemis cotula* frequent, *Bupleurum, Agrostemma, Lithospermum, Scandix* etc). Increases in leguminous weeds and frequent grassland taxa in the Medieval period might suggest reduction in soil fertility or a grass/legume rotation. Wheat nematode galls

(*Anguina tritici*) were present from the C11th onwards at West Cotton and at north Raunds.

Boreham Airfield, Essex [EX9] A 12th -13th century house, granary, and a windmill within a large rectangular moat were excavated. Sixty-eight samples produced charred plant remains. Free-threshing wheat grains were dominant and small amounts of chaff showed that both bread wheat-type and rivet-type wheat (a few rachis fragments) were present. Poorly preserved barley (*Hordeum* sp.), oats (including some cultivated) and rye grains were found, with oats being frequent but barley and rye rare. Large pulse fragments were found in small quantities in 22% of the samples. Both pea and bean were probably represented. Weeds were common (mainly stinking chamomile and vetches/vetchlings/tares.), indicating the cultivation of clay, possibly depleted, soils, although crop cleaning may have biased the assemblages. Some wetland taxa may indicate damp soils or hay. HNS and a few other tree species may represent food waste. Differences in preservation and a study of grain distribution indicated that the granary had suffered a catastrophic fire leading to smouldering and better preservation than in the domestic debris burnt in hearths. The densest concentration of remains was in the granary area. Wheat dominated, but barley, oats, rye and pulses were also being stored. Peripheral areas contained poorly preserved bonfire waste. The building and domestic areas and mill were kept scrupulously clean.

Brooklands and Broughton Manor Farm, Bucks [BK17a] [BK17b] Located in the Vale of Aylesbury on clay soils, this multi-period site produced both charred and waterlogged plant remains. In the Medieval period both bread wheat-type and a trace of rivet-type wheat were recorded in a ditch that contained well-preserved straw and *Anthemis cotula* seed heads. Rye was frequent and barley and oats were occasional. Rye was the second most frequent cereal in the medieval samples and by the medieval/post-medieval wheat, rye and barley were present in similar quantities. Leguminous weed seeds were frequent in the medieval samples but abundant by the medieval/post-medieval period. Stinking chamomile was also frequent in all samples. It was suggested that a loss of soil fertility over the medieval period may have caused a change from cultivating mainly bread wheat to a wider variety of less demanding cereals as an insurance against failure. However, only six samples were examined so the suggestion was tentative. Other crops/foods included flax, bean, cultivated vetch, HNS, blackberries, sloe/plum/bullace, elder and cotton thistle (*Onopordum acanthium*; 11 charred seeds in a ditch). A medieval well contained dumped rubbish including straw, free-threshing wheat rachis, burdock, hemlock, a fig seed and a hop seed fragment, some of which could have come from traces of sewage. Comparisons between Brooklands, Broughton Manor Farm, Brooklands 4 (Smith, unpublished) and other Milton Keynes sites showed a similar pattern of change. Stinking chamomile was not present until the Medieval period suggesting a late movement onto the clays. Soil fertility decreased and cereal diversity increased over time and pulses may have been used in rotations.

Olney, Bucks [BK23] During excavations at Olney on the site of a recently demolished tannery, samples were taken from pits and ditches dating from the late Saxon to medieval period (mainly 12th /13th century). A possible 14th century malting kiln was also excavated and sampled. Seventeen samples were fully analysed. Five samples from Saxo-Norman pits and post holes contained mainly free-threshing wheat with bread wheat confirmed by the chaff. Smaller amounts of barley, rye and oats were present and possible rivet wheat. Stinking chamomile was the dominant weed species. About a quarter of the wheat had germinated. Peas and vetches were present. Eight 12th century

samples were examined, one of which (from a pit) contained concentrated, partially cleaned, grain (466 fpl). Wheat was dominant and about a quarter of the grains had sprouted or shrivelled, but the evidence suggested spoilage rather than malting. Other pit and ditch samples contained wheat-dominated domestic waste (rivet and bread wheat type) with peas/beans, HNS and flax, some barley, rye and oat. Three 13th century samples from a quarry, hearth and ditch were also wheat dominated but two of the samples (hearth and ditch) contained almost as many grains of oats and barley, with high levels of germination. Large legumes were recorded and domestic waste was indicated. A sample from the 14th century possible malting kiln was dominated by abraded wheat grains with some barley. Weeds were frequent, particularly taxa of grassland and large grass seeds. No obvious evidence for malting was present so the sample was probably a post-abandonment fill. To summarise, wheat was the dominant cereal in all phases with both rivet and bread wheat at least from the 12th century. Wheat chaff was relatively frequent in the samples, as found in some other suburbs such as Bonners Lane, Leicester [LR6] and St Mary's Gate Derby [DB26]. This material must have been brought into town, or possibly the wheat was brought in as partially cleaned grain. It is suggested that quantities of cereals were being brought into town for commercial purposes in the 11th to 13th century, with cereals being processed and sold on in the town as whole grain for use in pottages and for brewing. Evidence for brewing was inconclusive though germination of wheat grains was substantial. It was suggested that wheat can be added to improve the quality of malted oats, which was a cheap grain but with poorer keeping qualities. Other foods being consumed included peas, beans and hazel nuts. Grasses, vetches and possibly barley and oats may have been used for fodder. Stinking chamomile was the most abundant weed indicating the cultivation of heavy soils. Other weeds suggested light soils and the mixed nature of the samples made the recovery of information on specific crop regimes difficult. Weeds of autumn sown crops such as corn cockle and cleavers were probably associated with the wheat. Barley and oats increased in the 13th century but rivet and bread wheats were still dominant.

Cropston Road, Anstey, Leicestershire [LR14] Anstey is on a low boulder clay ridge between former Leicester Forest to the south-east and Charnwood Forest to the north-west. The site overlooks a flood meadow around Rothley Brook. The raised toft platform (the raised yard of a rural medieval house) is separated from a croft by a hollow way. The site was abandoned in the late 13th century, re-used in the 15th century but undeveloped since the enclosure of 1762. Small scale metalworking took place on the site. The charred plant remains showed clear differences in activities taking place on different parts of the site. Samples from the house platform contained domestic waste consisting of cereal grains, weed seeds and a few chaff fragments (including bread wheat type rachis). Smaller amounts of barley, oats and rye were present. Cereal grains and weed seeds were roughly equal in number and chaff was scarce, so this appears to represent waste from the preparation of food. The boundary ditch to the west contained larger quantities of bread wheat type chaff, arable weed seeds, legumes and HNS. This probably represented cereal processing waste and food debris. The weeds included indicators of autumn sowing (cleavers, corncockle) and of clay soils (*stinking chamomile*). Leguminous weeds were numerous, perhaps suggesting that the crops had followed fallow or fodder crops.

5.7.3.3 Monastic sites

Monastic sites offer great potential for recovering information about diet, orchard and physic garden cultivation and industries such as cloth working. This is partly because

they often contain latrine pits and drains, and also because they were usually sited close to rivers, from which mill races and lodes could be constructed to power industries such as cloth working. Mineralised and waterlogged features such as these, particularly ones containing human faeces, tend to produce the majority of evidence for fruits, flavourings and textile production. In addition, horticulture was at the core of their existence, and documentary sources show that abbey orchards and physic gardens were diverse and well tended. Non-native fruits, herbs, spices and medicinal plants (or at least potential medicinal plants, as proving their use is difficult) are most frequently found either at monastic establishments or at quaysides across the British Isles. Examples such as Shrewsbury Abbey (below) demonstrate that a wide range of foods were available to at least some establishments. Documentary sources, such as herbals, demonstrate that a wide range of cultivated and native plants could have also been used for medicinal purposes.

The 14th century abbey records mention a corn mill and malt mill at Ramsey Abbey, Cambs [CB41]. Grain was transported by river from fenland manors such as Ely and Ramsey, as well as fodder, lumber and wine. Basal fills of mid-12th to 13th century ditches were rich in CPR, including primarily free-threshing wheat grains and chaff, with rye, hulled barley and peas. Weed seeds included stinking chamomile and common weeds of grassy and disturbed places including clover-type, small nettle (*Urtica urens*) and cleavers. Scrubby plants were also represented (hawthorn, HNS, elder, apple). Waterlogged taxa included aquatics and marshland plants (*Cladium, Schoenoplectus, Carex echinata*). Flooring and roofing materials could be included in this group. Deposits dated from the 13th century to c1539 from the lode (artificial waterway) contained species of low velocity water flow such as water plantain and spike-rush. The lodes would have linked Ramsey Abbey to the main river network, allowing the passage of heavy building materials such as stone to the area. A building to the west of the lode may have been a storehouse. There is also documentary evidence from Ramsey for the transportation of grain, fodder, lumber and wine. Comparable lodes and wharfs are found at Castle Acre Priory (Norfolk) and Waltham Abbey (Essex).

Long Causeway, Peterborough, Cambs [CB34] During excavations near Peterborough Abbey charred and waterlogged plant remains were recovered from 13th-14th century and 16th century deposits. Samples for plant macrofossils, pollen and insects were taken from the Abbey boundary ditch, pits and wells, on the town side of the ditch. Nine samples were selected for analysis of waterlogged plant remains and five bulk flotation samples produced sufficient charred plant material for analysis. Charred cereals included both rivet and bread wheat-type, rye, and hulled barley (including 2-row barley). Small scale use of whole grains for pottage is suggested. Peas, possible beans and possible lentils were recovered. Other foods include beet, fig, HNS, blackberry, apple and plum/bullace. Other plants probably used for flavourings, for oil or medicinal use include black mustard, fennel, mint (*Mentha* sp.) and bog myrtle (*Myrica gale*). Flax and weld (*Reseda luteola*) records suggest a textile industry. Possible medicinal plants include vervain (*Verbena officinalis*), henbane and opium poppy. Arable weeds were varied (including corn cockle, cornflower, stinking chamomile, thorow-wax, shepherd's needle). Plants of damp grassland and wet ditches were also present.

In the earliest phase a waterlogged rubbish pit contained evidence for latrine waste with apple, hazelnut shell, bran and flax representing edible plants amongst weeds. The lowest boundary ditch layers contained abundant aquatic and waterside plants. Charred domestic waste contained free-threshing wheat and rye grains, pea and flax, plus weed

seeds. Nettle seeds were abundant and wayside weeds were present. Damp ground plants decreased as the ditch silted up but marsh plants were present and disturbed ground plants may have grown near the ditch. Domestic charred waste was sparse. A layer above the ditch on the North Plot contained domestic waste (free-threshing wheat, rye, hulled barley, apple, HNS, blackberry) with abundant weeds. This may represent a dump of flooring or sweepings from a nearby house. A well on the plot contained similar cereal evidence with the addition of rivet wheat, with abundant nettle and elder seeds suggesting backfilling with rubbish. A hearth produced the largest charred cereal assemblage, consisting of both wheats (with chaff), barley and rye. Weed seeds and grass seeds were abundant, perhaps representing cleaning waste. Less evidence for rubbish disposal was found on the South Plot. A sample from the waterlogged basal fill of a 16th century ditch produced evidence for standing water vegetation. Docks and hemlock were more abundant and insect evidence indicates conditions were cleaner with less dumping of waste. However, a little sewage was present (fig seeds and parasite eggs).

Shrewsbury Abbey, Shrops [SP2] Waterlogged accumulations abutting the precinct wall dated to c1150-1330 AD provided information about the aquatic environment and waste being deposited in the moat. Weeds of cultivation and disturbed ground were most frequent, including many crop weeds that may have been deposited as processing waste. Grassland herbs and tree/shrub seeds were sparse. A few charred wheat and oat grains, and oat and rye chaff were present. Waterlogged rivet wheat rachis was present and fragments of bran (indicating the presence of sewage or split flour) were noted. Wild and cultivated/imported fruits included strawberry and bilberry (*Vaccinium myrtillus*) and fig, bullace and damson, pear and apple. Almond (*Prunus dulcis*) shell and pine nut shell were present and HNS was frequent. Fennel, wild celery, chicory (*Cichorium intybus*), possible pennyroyal and possible black mustard indicate flavourings that were being used. The occupants of the abbey appear to have been enjoying a varied and high-status diet at this time. After the Dissolution, the abbey was taken into private ownership. Plant remains recovered from the post-medieval deposits are discussed in section 5.8.

Bordesley Abbey, Worcestershire [WC29] Forty-six waterlogged samples were examined from stream channels, the mill pond, mill races and by-pass channels. Pre-monastic old stream channels (pre-mid-12th century) contained evidence for oak/lime forest with hazel and birch understory (abundant twigs and leaves with a few fruits). Some herbs of disturbed/enriched soil and wetland habitats were present. Alder was noted to increase in the latter part of this period, along with an increase in the range of woods/scrub/hedgerow taxa. With the establishment of the mill in the later 12th century woodland taxa greatly decreased. Grassland taxa and wet-ground/aquatic taxa were dominant. Waterlogged cereal grains, fragments of corn cockle seeds and other arable weeds and some rye and barley rachis fragments were recovered from the tail race, perhaps representing spilt grain and flour relating to the use of the mill as a corn mill. Flax (seeds and capsule fragments), fuller's teasel (*Dipsacus sativus*) and hemp were recorded from all of the phases of mill operation, providing evidence that the mill had been used for textile working. No dye plants were recovered but many of the native plants could have been used for dyeing. The evidence for food plants was limited (wheat, barley, oats and rye, plus common native fruits and nuts) and very little evidence for imported foods was found. Fig seeds were occasionally recorded, whilst grape was only present in post-abandonment samples. After the abandonment of the mill in the late 14th/early 15th century (Period 7) woodland/scrub taxa increased to some extent but did not return to the pre-monastic levels. Some herbs of abandoned areas increased, such as

nettles, but it was thought that the continued frequency of grassland and similar wet-ground taxa suggested some areas continued to be grazed as before.

5.7.3.4 Moated Manors and Castles

As with monastic sites, moated manors and castles often contain evidence of imported foods for two reasons: waterlogged and mineralised preservation is often present (as well as charred), while the higher status dwellings clearly had greater access to luxury foods. Surprisingly few sites in this group have been intensively sampled and examined in detail however, despite their high potential.

A 14th century moated manor was excavated at Shackerley Mound, Shrops [SP4]. Five waterlogged samples were studied from the first (one sample) and second (four samples) moat. A wide range of taxa was recovered from aquatic/bankside vegetation, grassland, annual weeds, cornfield weeds, ruderal plants, woodland/scrub and crop plants. No trends were observed through the profile of the second moat to show that conditions changed over time. Annual weeds included corn spurrey and corn marigold, indicating acidic sandy soils. Weeds such as stinking chamomile and cornsalad conversely indicated heavier and more alkaline soils. This wide range of soil indicators is typical of medieval sites. The weeds may have derived from the remains of agricultural produce and waste products. Woods/scrub remains (including holly leaf spines) were fairly varied but not abundant, suggesting some scrubby areas existed nearby. Crop plants included flax (capsule fragments), charred wheat and barley grain and rye rachis. Comparisons were made to Cowick, Humberside (Greig 1986a) and a post-medieval moat in Birmingham (Greig, 1981). The Cowick moat showed a more expected progression of silting and eventual choking-up.

A medieval moated manor was excavated at the Former steel works at Normanby Park, Lincolnshire [LC13]. Charred plant remains from the moat platform and waterlogged remains from moat fill were examined. Cannabis/hemp (*Cannabis sativa*), flax, hazel and walnut were noted, as well as rye chaff and weeds (corncockle and corn marigold).

At Oak Street, Fakenham, Norfolk [NK16] a moated rectory was investigated. The moat was probably constructed in the 13th century and the residence was abandoned between 1677 and 1706. The moat produced a few poorly preserved charred cereal remains including oat, free-threshing wheat, and a spelt glume base. A garderobe contained no mineralised remains but a few charred free-threshing wheat grains. Make-up layers forming the moat building platform contained beans, pea, bread wheat, barley, rye and weed seeds. A pit contained bread wheat, peas, barley, and oats. The basal fill of the moat produced a wide range of waterlogged plant remains. The assemblage mainly reflected the local environment, with the only economic item being a single fig seed. Several weeds of cultivation and straw fragments were present (corn cockle, corn marigold, poppy). Woody taxa included elder, bramble and frequent alder cones and buds. Some aquatics and marginals were growing in and around the moat. Pollen results suggested that very little woodland existed in the area. Grasses were the dominant taxa.

A column sample was taken from a 12th century deposit filling the southern end of the castle keep at Castle Acre Castle, Norfolk [NK3]. Charred and mineralised plant remains were recovered, including 26 mineralised taxa. Barley and oats were the most frequent charred cereal, followed by wheat with just a trace of rye. Celtic bean and possible pea were also common, as were fragments of HNS. The mineralised plant remains were

mainly from weeds of cultivation or disturbed soils, including corn cockle, corn gromwell, elderberry, indeterminate Brassicaceae and a single apple seed. The deposit may have been a midden-type dump, perhaps containing more animal manure than human faeces since so few fruit remains were present.

5.7.4 Industrial uses of plants

5.7.4.1 Malting/Brewing

Despite the recovery of a fused mass of hops on the late Saxon ABC Cinema site, Ipswich [SK23] (see section 5.6.4), no conclusive evidence for brewing with hops has been found on medieval sites in the Midlands. A group of medieval to post-medieval pits thought to have been used for retting or tanning at Corpusty/Saxthorpe Link Road, Norfolk [NK6] contained traces of possible hop bracts, but it was not possible to confirm whether retting, tanning or brewing had taken place. Brewing is discussed further in section 6.2.1.5 including mention of several medieval sites.

Kilns thought to have been used for malt-drying have occasionally been reported (see Jewsons Yard [CB17] see below, 121). Small numbers of sprouted grains are regularly recorded, as at West Cotton, where dredge (oats and barley together) were thought to have been used for malting. In the west of the study area malting kilns have been reported from Burton Dassett [WR31], Boteler's Castle [WR47], and St Mary's Grove, Stafford [ST9] and malthouses were found at West Cotton [NH37]. At Boteler's Castle, a large part of the black layer found in the kiln was made up of grains, mainly oats with some wheat and a lesser proportion of rye and barley. Forty percent of the grains appeared to have sprouted but the germinated grains were probably under-represented as free-threshing grains do not show traces of germination as obviously as hulled grains. At Burton Dassett the malting kiln contained wheat, oats and barley grains. Half of the barley, the most abundant crop, had germinated while only a few of the oats showed signs of sprouting. One quarter of the assemblage, however, consisted of weed seeds and the wheat grains were not germinated, suggesting that the kiln may have been used for drying grain as well as for malting. Alternatively, it could have been backfilled with crop processing waste that had been used as fuel. At St Mary's Grove, Stafford a kiln produced no clear evidence for malting, and weed seeds were the main component of the sample. Rye was the most frequent chaff component, but remains were generally infrequent suggesting it had been cleaned out. An oven, however, contained 30% germinated grain (mainly rye and oats) and weed seeds were dominant. In the malthouse at West Cotton, both oats and barley found together (dredge) had sprouted.

Two medieval malt-drying sites have been excavated in Norfolk. In Norwich, the Alms Lane site [NK38] produced evidence for malting and brewing during the 13th century. Structural features included a clay-lined pit, clay floor and ovens, whilst a millstone was also recovered. One of the ovens and a nearby pit produced abundant charred sprouted barley, representing malt accidentally burnt during drying. Similar results came from a medieval kiln at Redcastle Furze, Thetford (Murphy 1995).

The following summaries come from more recent excavations.

Excavations at Freeschool Lane, the Highcross, Leicester [LR26] revealed large malting kilns built of stone. Sprouted cultivated oats in various mixtures with free-threshing wheat and barley were recovered from the kilns. The basal fill of one oven was rich in clean free-threshing wheat including bread wheat type (identified from rachis fragments)

with a few grains of oats and barley. Many sprouted grains were present suggesting that it had been used for malting. Some broad beans were present in another layer. Samples from the mouth of the flue of a malting kiln produced mainly sprouted hulled barley and sprouted oats (see Plate 1: the front cover of this review). The almost equal proportions of the two cereals and the abundance of detached sprouts and germinated grains indicated that malted dredge was present. What appeared to be a mat of rye straw was recovered from another sample, perhaps representing the matting on which germinated grains were roasted in the oven. Small amounts of chaff and several weed seeds were present including *Anthemis cotula*, indicating local cultivation on heavy soils. A large number of charred broad beans, field beans and peas were recovered from a feature associated with another oven, in addition to frequent weeds (especially Polygonaceae). Accidental charring during drying of the legumes was suggested, with the crops either used for animal or human consumption. Another malting oven produced a very clean deposit of hulled barley (possibly two-row) and cultivated oats with frequent indeterminate germinated grains. A deposit over a floor associated with an oven base used for heating during brewing produced frequent *Vicia faba* and weed seeds but there were no signs of sprouted grain. The industrial levels of drying grain and pulses and roasting malted grain in the ovens and kilns in the medieval period at this site are notable, particularly the high usage of oats which were the principal cereal used for brewing on the Continent (Kistemarker and Vilsteren 1994). A wheat/barley malt would have been prepared and sprouted oats would have been added to the mash to provide starch (ibid). There was no evidence for hops at the site but some of the other taxa (bramble, sloe, elderberry) could have been used to flavour the ale. Oats were less frequent in later medieval samples from intercutting pits and cesspits.

Castle Garage, Monk Street, Tutbury, Staffordshire [ST7] Three samples were assessed and two were taken to full analysis. A charcoal-rich deposit on the edge of a medieval (13th/14th century pot was present) ditch/fishpond produced an almost pure deposit of common oat (*Avena sativa*), a large proportion of which had sprouted (21%). Around a third of the grains were grooved, indicating sprouting. Malting may be the most likely explanation.

Jewsons Yard, Ely Waterfront, Cambs [CB17] - C14th/15th samples from layers and features associated with timber structures contained abundant barley, with evidence for rapid, high-temperature roasting of barley grain for malting. Two-row barley may have been used as twisted grains were absent, though no chaff was preserved to confirm this. Weed seeds and chaff were scarce and possible Italian rye grass (*Lolium* cf. *multiflorum*) was the most frequent wild taxon. Ballantyne writes:

"There is good evidence for malting, provided by 51 to 80% clearly germinated grain in the samples..... However, many grains were omitted from this calculation due to the loss of the embryo end of their dorsal side, despite perfect preservation of their ventral side by charring. This patterning may indicate rapid, high-temperature roasting for malt; crystal malt often has parts of the grain 'blown off' during roasting, and the area around the germinated embryo is very prone to loss due to the conversion of nearby starches into sugar. The percentage of germinated grain within the originally charred barley may thus have been much greater."

This site also produced interesting evidence for possible use of the local marsh hay (indicated by frequent great fen-sedge leaf fragments) and peat for fuel (see Section 6.2.3). In most other malting kilns and ovens cereal chaff was present in large quantities, suggesting that processing waste was often used for fuel. Markham (1668) also suggests

that cereal straw, in particular rye straw, was recommended for bedding the grain in a malting kiln (as referenced in the M6 Toll report by Smith [WR27]). In her West Cotton [NH37] report Campbell notes that the choice of fuel is very important in malting kilns, as it can flavour the malt. Chaff was a favoured fuel for this reason.

5.7.4.2 Fuel

Apart from deposits recovered in situ from ovens and kilns, it can be difficult to prove that specific plant materials were selectively used for fuel, rather than being part of general waste materials and floor sweepings thrown into household fires. Fuels such as peat and hay that are composed of a range of different plant species are also difficult to pin down once the remains have been burnt and mixed with other waste. The report on Jewson's Yard above is one example of the possible burning of peat and fen-sedge 'hay' for fuel in ovens. Ballantyne also discusses the use of fenland resources for a variety of purposes in her West Fen Road report ([CB12] see above). Charred heather/ling, gorse (*Ulex europeaus*) and bracken were present in a 14th century oven at St Peter's Street, Norwich [NK10] and charred remains of these taxa have been recovered from a variety of other medieval features in two other sites in Norfolk; Grange Farm, Snetterton [NK8] and Red Lion Street, Aylsham [NK9]. Gorse produces a fierce, fast heat which was traditionally particularly valued for bread ovens (Gale and Cutler 2000, 260).

The importance of cereal processing waste as a resource in its own right was appreciated by the Romans (see Roman Section 5.5.3.3) and in areas of the country where this valuable thatching/fodder/bedding material was in a surplus it also appears to have been used as a fuel during the medieval period. Rye straw in particular appears to have been used at some sites, including Raunds (see above), Stafford (see Anglo-Saxon Section 5.6.5) and below.

M6 Toll, Shenstone Linear Features, Staffordshire [WR27] A total of 28 of 67 samples taken from medieval pits and kilns/ovens (13th/14th century) were analysed. The samples were rich in cereal remains, in particular rye grains and chaff fragments (all samples). Traces of barley and spelt may have been contaminants/residual. Rye chaff and weed seeds were dominant in all but one pit sample, indicating the presence of crop-processing by-products. The similarity in assemblages from the pits and kiln/ovens is notable, suggesting the use of this material for fuel. Alternatively, rye straw was recommended as bedding for malting grain (Markham 1668), suggesting another possible route to charring. The wide range of weed taxa includes frequent acid indicators and some wet/damp ground weeds (including frequent corn spurrey, corn marigold, and stinking chamomile). Harvesting was probably low on the stem, allowing use of the straw.

5.7.4.3 Thatch

Thatch is underrepresented in the archaeobotanical record. Unless whole intact masses are preserved and recognised *in situ* in a deposit it can be difficult to demonstrate with certainty that the assorted plant remains in a sample represent thatch. Yet, its importance in the past has been considerable, using, especially in the medieval period, huge amounts of harvested crops. Other parts of the dwellings including bedding, flooring and walls also made use of plant material which is equally not often interpreted as such, perhaps with the exception of cob, although none so far has been recorded from the Midlands. A relatively new area of research, therefore, the study of smoke-blackened

thatch (SBT; Letts 1999) has provided a wealth of information about thatching materials used in different regions, the use of waste materials in thatching and the development of landraces in cereals.

Different plants can potentially be used for thatching such as reed, broom and heather as well as a variety of cereal straws. It is likely that crops were grown equally for thatching material as well as for grain production, and in years of poor grain harvest the population may have been able to salvage something from the crop by selling straw for thatching, bedding and fodder.

Although most of Letts' published work has been carried out on standing buildings in the south of Britain, seven buildings in the Midlands region were also included in his early studies, listed in Appendix 1 (four from Buckinghamshire, two from Northamptonshire, and from Cambridgeshire, all dating between the 13th and 15/16th century). All material examined derived from the base coats of roofs which had been exposed to the soot of open fires. The base coat of the roof of a cottage in Great Brington, Northamptonshire, dating from the 15th/16th century, included several specimens of rye (*Secale cereale)*. Much barley was recovered from the SBT assemblage of 22 Broughton Road in Milton Keynes as well as stubble and roots and crop weeds. The assemblage from 22 High Street, Stewkly, dating from the late 15th century, included whole plants of bread wheat, rivet wheat, 2-row barley, and a suite of crop weeds. The richest assemblage from the region was from Willow Vale Farm, Steeple Claydon, which included rye, 2-row hulled barley, bread wheat, rivet wheat, and cultivated oats (*Avena sativa*) and a suite of forty-seven species of other crop and weed seeds including bracken fronds, whole plants of *Sinapis alba*, pods of *Vicia* sp., perianths of *Rumex crispus*, many whole plants and heads of *Anthemis cotula* as well as seeds and flower heads of *Centaurea* sp. (the weeds were studied by de Moulins 2007). As Murphy and de Moulins stated (2002), this material is truly exceptional and allows a 'better representation of the actual composition of a medieval field than can be obtained from assemblages of charred remains'.

The range of the more resistant plant parts recovered from SBT assemblages resembles the usual medieval assemblage of charred remains, including tough chaff fragments, multiple species of cereal grain, weed seeds, seed heads or clusters and capsule fragments and bracken fronds. While such assemblages are usually interpreted as 'mixed', the recognition that thatch assemblages can be complex has resulted in increased awareness of the possibility of thatch in archaeological assemblages.

Samples found in ditches at Burystead, Raunds [NH36] were interpreted in the site report as mixed assemblages, but, may well represent a single event of dumped thatch. One sample from a gully at Boteler's Castle [WR47] also appeared to have a typical 'thatch' composition with a wide range of segetal weed seeds and rachis fragments of several cereals, although it also contained several hundred grains of free-threshing wheat which may be used to argue against this interpretation. Another sample from Nottingham found in an 11th-12th century ditch [NT6] also exhibited the same thatch characteristics. Two more assemblages from sites in the East of England could also belong to this category. On the Essex till plateau at Round Wood, Stansted ([EX19]: aa), a 13th century farmstead, charred crop remains were predominantly of wheats (bread wheat and rivet wheat, *Triticum* cf *turgidum*) with oats and some hulled barley, rye and flax/linseed. Seeds of pulses, including pea, Celtic bean and vetch, *Vicia sativa*, were frequent: markedly more so than at Roman sites in the same area. A 12th/13th century

gully at St Martin-at-Palace Plain, Norwich included dense charred deposits of rye and probable two-row hulled barley with traces of bread wheat, flax and Celtic bean. Chaff, straw nodes and weed seeds were abundant. The small size of the grains and the high percentage of leguminous taxa amongst the weed seeds were thought to indicate rye cultivation on impoverished soils which were not receiving sufficient manure to maintain nitrogen levels (Murphy 1987a). This type of assemblage, however, may also represent remains from thatch roofs. In addition, nutlets and leaf fragments of *Cladium mariscus* (great fen-sedge) from several sites, notably from an early medieval pit at St Nicholas' Street, Thetford [NK47], where charred *Cladium* remains were associated with burnt mollusc shells, mostly of floodplain species, are also likely to represent thatch.

So far documentary information specifically referring to the use of spent thatch has not been collected. Ethnographic evidence would also be useful. But where animal dung used as fuel is described, it is interesting to note that it needs preparation. Some of this preparation entails mixing straw from the byre with the dung and letting it dry (Fenton, 1985). It is possible that this could be a mechanism for using up spent thatch. Spent thatch could also have been burnt and disposed of in ditches and gullies.

5.7.4.4 Fibre crops, textile production and tanning

Because water bodies such as rivers and ponds were required for retting fibre crops such as flax (rotting down the stems to release bast fibres), most evidence for this important crop comes from waterlogged deposits. In charred assemblages this crop is likely to be under-represented, as the oily seeds often distort and become soft when burnt. However, occasional deposits of charred seeds and capsule fragments are recovered, and seeds can also become mineralised in nutrient-rich, moist places such as cesspits. In this case the presence of hemp or flax seeds might represent oil, flavouring/decorative or medicinal use if the seeds themselves had been consumed.

Despite the increased frequency of waterlogged rubbish deposits and cesspits in the medieval period, flax is more commonly found on Roman sites than medieval ones in the Midlands area. Whether this is a taphonomic phenomenon (for example, perhaps flowing water bodies such as rivers were used more in the medieval period so the evidence has been washed away) or not requires more research.

Sites at Biggleswade, (Dawson 1994) and St James' Square, Northampton [NH39] produced evidence for retting, with the latter site producing frequent waterlogged flax capsule fragments in 10th/11th century pits and layers. Flax has also been found at Brooklands (see Section 5.7.4 [BK17a]), West Cotton (see Section 5.7.4 [NH37]), Shackerley Mound (see Section 5.7.6 [SP4]) and A421 Beds (Druce 2008 [BD16]), but quantities of remains were not notable. Wells (e.g. Stafford, Section 5.7.3 [ST9/10/11]) often contain small amounts of flax seeds and capsule fragments, usually amongst other types of waste being dumped when the well is abandoned.

Corpusty/ Saxthorpe Link Road, Norfolk [NK6] Nine waterlogged samples from the fills of five possible retting or tanning pits were examined. No evidence for retting or tanning was recovered, suggesting that the deep pits had been cleaned out prior to the dumping of agricultural waste. Two pits contained evidence for the deposition of lime (calcareous and tufaceous concretions), which may be why scant waterlogged material was present. The other three pits contained fragments of corncockle seed coat and a reasonable range of waterlogged plant remains, mostly from common ruderal weeds. Traces of charred cereal (barley), flax and hop seeds were also present.

Four medieval to post-medieval sites were published together in a report on the industrial centre of Birmingham, theBull Ring. Rather than split these significant reports between the two periods they are presented together here, to demonstrate the continued use of the area for tanning, brewing, metalworking and retting.

The Bull Ring, Birmingham, West Midlands [WR8] [WR9] [WR10] [WR11]
Edgbaston Street [WR8] Biological material was mainly preserved by waterlogging and charred material was scarce, reflecting the non-domestic nature of the site. Eleven contexts are listed in the table, including three from organic layers, three from tanning pits and five from the primary fill of a water course. The watercourse assemblages (12th–14th century) consisted of taxa typically found in ditches and rivers (crowfoots, rushes, sweet grass etc), damp habitat plants (ragged robin, water pepper, bog stitchwort) and species of open/disturbed places (nettle, hemlock, elder). Willows were growing along the bank (bud scales). The tanning pits (15th-16th century and 17th-18th century) contained organic material almost exclusively made up of small wood fragments, thought to have been oak sawdust/shavings, rather than bark. This may have been used to cure already tanned leather. One sample contained a wider range of species including wet/damp habitat plants, foods (*Avena* sp., HNS) and weeds. Fragments of decayed leather, wood and bark sclereids provided evidence for tanning, and a hemp seed (also present in a 15/16th century tanning pit) may indicate retting. Some other 17th/18th century features contained heathland species such as gorse and cross-leaved heath (*Erica tetralix*), may have been used for packaging. Organic deposits of 12th to 14th century, 17/18th and 19th century contained small numbers of plant remains from wet/damp environments, similar to those found in the watercourse samples, such as coral necklace (*Illecebrum verticillatum*). Periodic flooding may have occurred and pollen evidence suggested woodland was present nearby.

Moor Street [WR9] Two (of 22 collected) 12th-14th century samples from the recut of the massive boundary ditch produced waterlogged (lower) and mainly charred (upper fills) remains. The lower fill contained wet ground and disturbed ground taxa, indicating vegetation growing locally. The upper charred assemblage contained a more diverse damp and disturbed ground assemblage, as well as grassland species, cereal grains and weeds of cultivation (*Anthemis cotula, Spergula arvensis*) indicating both heavy and sandy soils. Free-threshing wheat, barley, rye and possible cultivated oats (*Avena* cf. *sativa*) were present, with several wheat, barley and oat grains having germinated. This could indicate malting or the use of spoilt grain for fodder. Oats were most frequent, and the frequency of grassland taxa, pollen results and documentary information concerning the presence of barns or sheds all point to the presence of fodder.

Park Street [WR10] Medieval and post-medieval features across three excavation areas were sampled, 26 of which are described in the report (charred and waterlogged). A total of 15 samples from the medieval period (12th-14th century) included fills of the boundary ditch, water-lain layers and other ditches and pits. In Area A frequent charred cereal grains (free-threshing wheat, barley, oats and rye) were present, though not in the other two areas. Large numbers of charred culm bases and culm nodes of Poaceae plus grassland and weedy seeds were present indicating charred fodder, bedding or thatching materials (as at Moor Street). The waterlogged assemblages were smaller, containing aquatics in the basal fills of the boundary ditch demonstrating it had been water-filled. Damp/wet ground plants and remains from birch, alder and willow trees indicate other types of vegetation growing locally. The presence of small amounts of hemp (from

ditches in all three areas) and flax (Area A) remains may indicate retting taking place in ditches. Occasional seeds of beet (2 areas), lupin (Area C), fig (2 areas), and grape (Area A) reflect garden cultivation and the importation of foods into the area. Some other plants such as balm (*Melissa officinalis*) may also have been grown as herbs. A seed of thorn apple (*Datura stramonium*) in a pit may be the only English record of this poisonous, medicinal plant, introduced by the Spanish physician Francisco Hernandez (Stary 1998) in the 16th century. Other damp/disturbed ground and grassland taxa were recorded. Hazelnut and *Prunus* sp. represent other food remains. Three 15th-16th century samples from a rectangular tank and a clay-lined pit produced mainly waterlogged remains from wet/disturbed places similar to those found in earlier samples. It was suggested that the features had been used as watering holes for livestock. Eight samples from post-medieval pits in three areas produced evidence for domestic and industrial waste deposition. Rich metalworking deposits were found in a mid-18th century pit. A diverse waterlogged assemblage containing food and fibre plant remains (HNS, bramble, elder, fig, plum (*Prunus domestica*), grape, frequent hemp seeds, beet, rose, hops) was recovered, representing garden cultivation, domestic waste deposition and possibly retting and brewing waste. Two pits dating to the late 16th -early 18th century produced a few charred barley, oat and rye grains, abundant waterlogged figs and beet in one pit, abundant bramble and elder seeds in two samples and a range of common weed taxa. A late 18th century wood-lined tank and pond-like feature contained common wet ground/aquatic taxa. Samples from a 17th century waterlogged area containing domestic and industrial waste produced abundant chickweed and nettle seeds and assorted weeds, but also hemp seeds and parsnip seed.

The Row [WR11] Four medieval samples were taken from the Birmingham Moat, to examine state of preservation, refine dating and act as comparisons to earlier studies of the moat (Greig 1981). The results compared well to earlier studies. The lowest sample from the bottom fill contained aquatic and disturbed ground plant remains indicating a fairly clean water-filled moat. A large quantity of possible hemp stems was recovered from the next layer up, which, in addition to high Cannabacaea pollen (ibid.) suggests hemp retting was taking place. Weeds of damp, grassy and disturbed/cultivated ground (including corncockle, ragged robin and fairy flax) were identified, in addition to some *Erica* seeds. Ericaceae pollen (ibid.) was also present suggesting that heathland vegetation may have been collected for use as thatch.

Discussion for all four Bull Ring sites: Evidence for the industrial development of the centre of Birmingham was obtained, starting with the housing of livestock at Edgbaston Street in 12th to 14th centuries. In addition, tanning was taking place at Edgbaston Street, and in water-filled ditches at Park Street hemp retting was being carried out. At this time, however, some wooded areas and open disturbed ground still existed. The abundant supply of water in the area clearly met the needs of a number of industries over the centuries. Hemp seeds were present in Park Street from the 12th-14th century, and in Edgbaston Street from the 15th-16th century, and hops were present in both sites in the 15th –16th century. The presence of charred grain at Moor Street and Park Street as well as imported food and garden plant remains suggests that houses existed nearby from the medieval period onwards. Figs, grapes, hazelnuts, plums and beet suggest a varied diet, though the proximity of industries such as tanning and retting must have made the area fairly smelly and polluted.

5.7.5 Summary and future prospects

Figure 7 shows the distribution of medieval sites studied for this review. Although it is clear that there is a far greater archaeobotanical understanding of later, historical periods than prehistoric ones, there is a different set of challenges which must be faced in order to obtain useful and significant information from medieval assemblages.

- Primary fills of features such as pits, ovens and hearths are of paramount importance so as to avoid the problem of interpreting 'mixed waste deposits' that are so common in urban locations.
- A clear understanding of the formation processes and likelihood of contamination and residuality needs to be obtained by communicating with other specialists working on the site.
- Wherever possible, resources for documentary research should be included in a project so that the relationship between written records and what is recovered from the ground can be fully understood and taken into account in interpretations.
- There are still many opportunities for increasing knowledge of trade and agricultural developments by dating plant remains, for example, early records of imported taxa that do not agree with documentary lines of evidence should be dated to ensure that contamination has not occurred. In addition, late records of significant quantities of hulled wheats should also be dated so as to see whether these crops continued in use in some areas of the country (see Pelling 2003b). *Table 3* shows that, in addition to Saxon sites, several medieval sites have produced more than the occasional hulled wheat remains and these findings need to be investigated by dating, particularly on sites with little or no evidence of prehistoric occupation.
- During this period there is great potential for investigating industrial development and trade. Specific types of waste need to be fully characterised using historical and ethnographic models, in a similar way to the characterisation of cereal processing waste stages by Hillman (1981), so that archaeobotanists can try to recognise industrial waste within mixed urban deposits.

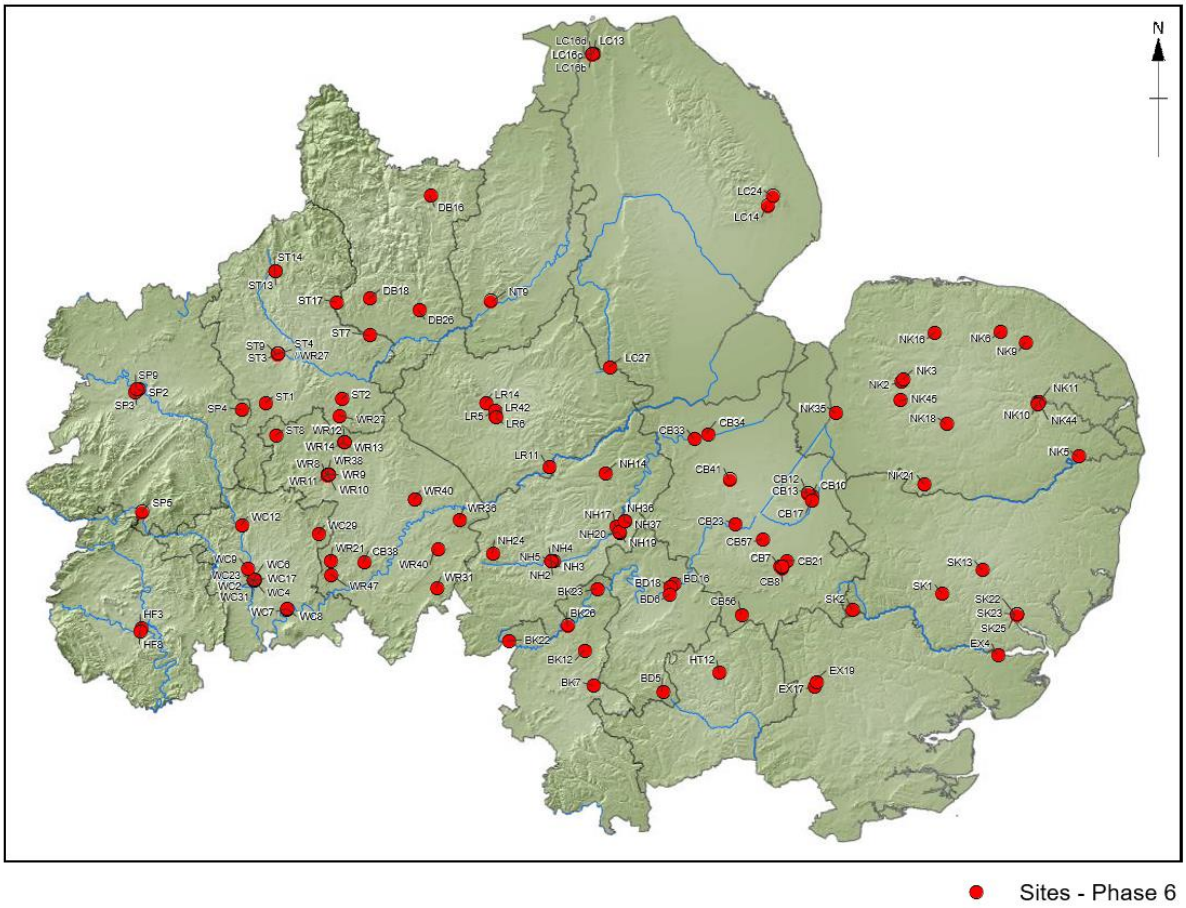

Figure 7: Medieval sites in the Midlands counties producing plant macrofossils

BD3 Haynes Park, Haynes, Church End; BD5 Castle Street, Luton; BD6 Danish Camp, Willington; BD10 West Stagsden; BD16 East End, Great Barford bypass; BD18 Barford Road, Great Barford bypass; BD35 University of Bedfordshire, Luton; BD41 Stratton; BK2 Loughton, Milton Keynes; BK7 Wing Church; BK12 Buckingham Road, Bletchley; BK17 Broughton Manor Farm/Brooklands, Milton Keynes; BK22 Westbury; BK23 Olney; BK26 Wolverton Mill; BK28 Chicheley Hall, Chicheley; CB7 Cambridge Castle Hill, Cambridge; CB8 Grand Arcade and Bradwell's Court, Cambridge; CB10 Forehill, Ely; CB12 Ashwell Site & West Fen Road, Ely; CB13 Ashwell Site, West Fen Road, Ely; CB17 Waterfront sites (Jewsons Yard, Broad Street), Ely; CB21 Chesterton; CB22 Scotland Road/Union Lane, Chesterton; CB23 cockpit at St Ives; CB33 The Walnuts, Oundle Road,Woodston CB34 Peterborough, Long Causeway; CB38 St Marys St, St Neots; CB41 Ramsey Abbey School; CB57 Longstanton; CB76 Botolph Bridge, Orton Longueville; CB78 Hinxton Hall; DB16 Magistrates Court, Chesterfield; DB18 Hemp Croft, Thurvaston; DB26 St Mary's Gate, Derby; EX4 The Old Slaughterhouse, Stour Street, Manningtree; EX9 Boreham Airfield; EX15 Springfield Park, Chelmsford; EX17 A120 Stansted Airport link road; EX18 Stansted Airport 2000-3; EX19 Stansted Airport 1986-91; EX30 Hatfield Heath/Matching Tye; EX35 Barking Abbey; EX36 St Mary & All Saints; EX41 North Shoebury; EX42 Hill Hall; EX45 Churchyard of St Marys & All Saints, Rivenhall; HF2 25 High Town, Hereford; HF3 Tesco, Hereford; HF8 Asda Site, Hereford; HF12 The Mead & Thomkinson Site, Hereford; HF14 Hereford & District sites; HF17 Hop Pole Inn, Leominster; HT12 Lob Hole, Stevenage; HT13 Tyttenhanger, Ridge; HT14 Jct 8 & 9, M1 Widening scheme, Hemel Hempstead; HT23 Hertford Castle; LC4 Barrow Road, Barton-on-Humber; LC13 Former Steel Works at Normandby Park, nr Scunthorpe; LC14 Hospital of St Mary Magdalen, Partney; LC27 8 Church Lane, South Witham; LC31 Flaxengate, Lincoln; LC38 Cartergate, Grimsby; LC41 Hill Farm, Baston; LR4 Causeway Lane, Leicester; LR5 The Shires, Leicester; LR6 Bonners Lane, Leicester; LR11 Sutton Road, Great Bowden; LR14 Cropston Road, Anstey; LR26 Freeschool Lane, Leicester; LR42 St Nicholas Place & Medieval Undercroft, Leicester; LR44 Sherrard Street, Melton Mowbray; LR46 Saxby Village; LR47 Vine Street, Leicester; LR48 Whissendine, Rutland; LR52 Vaughan Way, Leicester; NK15 High Street, Dereham; NK33 Lower Close, Norwich; NK34 Heigham, Norwich; NK36 Site 1020, Thetford; NK38 Alms Lane, Norwich; NK47 St Nicholas Street, Thetford; NH2 Kingswell Street & Woolmonger Street, Northampton; NH3 Derngate, Northampton; NH4 St Peter's Walk,

Northampton; NH5 Sol Central, Marefair; NH14 Corby Road, Stanion; NH17 Lime Street, Irthlingborough; NH19 College Street, Higham Ferrers; NH20 Middle Saxon estate centre, Higham Ferrers; NH24 St John's Square, Daventry; NH36 Raunds Project; NH37 West Cotton, Raunds Project; NH39 St James' Square, Northampton; NH42 Alderton Mount; NK2 Castle Acre Priory; NK3 Castle Acre Castle; NK5 Yarmouth Road, Broome; NK6 Corpusty/Saxthorpe link road; NK8 Grange Farm, Snetterton; NK9 Red Lion Street, Aylsham; NK10 St Peter's Street, Norwich; NK11 St Faith's Lane, Norwich; NK16 Oak Street, Fakenham; NK18 Preceptory of the Order of St John; of Jerusalem, Carbrooke; NK21 Kilverstone; NK35 Wimbotsham; NK44 Castle Mall, Norwich; NT6 Nottingham Castle; SK1 Priory Farm, Peston St Mary; SK13 Cedars Field, Stowmarket; SK22 Ipswich sites; SK23 Ipswich sites; SK36 Greater Gabbard Wind Farm, Leiston; SP2 Shrewsbury Abbey; SP3 Queen Anne House, Shrewsbury; SP4 Shackerley Mound, nr Tong; SP5 29 Corve Street, Ludlow; SP9 Riggs Hall, Shrewsbury; SP13 Stafford Street, Newport; ST1 Brewood; ST2 Sandford St, Litchfield; ST3 Stafford College, Broadeye; ST7 Castle Garage, Monk St, Tutbury; ST9/10/11 Stafford sites; ST14 Hulton Abbey; ST17 Rocester; ST27 Tipping Street, Stafford; WC2 City Arcade, High Street, Worcester; WC4 Warner Village Cinemas, Friar; Street, Worcester; WC6 Deansway, Worcester; WC7 34 High Street, Pershore; WC8 37 High Street, Pershore; WC9 Church Lane, Hallow; WC12 Worcester Road, Droitwich; WC17 Sidbury, Worcester; WC23 Fish Street, Worcester; WC24 Wormington to Tirley Pipeline; WC29 Bordesley Abbey; WC31 Worcester Cathedral; WC35 Beckford; WC39 Upwich, Droitwich; WC40 Corve Street, Ludlow; WR8/9/10/11 Bull Ring Sites, Birmingham; WR12 33 Coleshill Street, Sutton Coldfield; WR13 15-17 Coleshill Street, Sutton; Coldfield; WR14 Coleshill Street, Sutton Coldfield; WR20 Bascote,Southam Area Rationalisation Scheme; WR21 Coughton Court; WR27 M6 Toll, Shenstone; WR31 Burton Dassett; WR36 Cawston; WR40 Cathedral and Priory of St Marys, Coventry; WR47 Boteler's Castle, Oversley; WR48 School Road, Alcester; WR49 Bridge End, Warwick

5.8 The Post Medieval Period (1540-1901 AD)

"The post-medieval rural landscape of fields and farms, which was peopled by landlords and tenants, rich and poor, nobles and peasants, squatters and commercial farmers, is frequently ignored by those tackling the big archaeological themes of the period"
Newman (2005)

5.8.1 Introduction

Lack of interest in post-medieval environmental archaeology has long been a problem, and it is often thought that scarce resources would not stretch to the study of such 'recent' material. Murphy and de Moulins (2002) suggested that until recently, excavations specifically directed to investigating the post-medieval period were of very specific site types, such as industrial sites, gardens and shipwrecks. Furthermore, they stated that it was not uncommon for the post-medieval levels of urban sites to be excavated as speedily as possible in order to reach the main focus of attention, usually Roman to Medieval contexts, for which the construction of a research agenda (whether formally written or more conceptual), is relatively easy. Given the greater detail provided by written sources for the period after about 1550 AD it is often difficult to see ways in which archaeobotanical data can add more than to provide concrete illustrations of facts which are already known from documentary sources. Given the much greater focus on post-medieval archaeology since the introduction of NHPP (National Heritage Protection Plan), the inclusion of archaeobotanical studies and closer dialogue between historians and archaeobotanists should help to define those areas where archaeobotany can make a useful contribution.

Some of the rich assemblages given in this section illustrate just how much information can be recovered with regard to diet and trade in the post-medieval period. The ability to fill out, or put into context, the documentary information by examining the material found on a specific site, within a specific type of feature can be particularly rewarding (see Greig 1996). For example, comparing import records with plant material recovered from urban cesspits will show that some of the exotic fruits and spices were reaching the occupants of towns (such as figs and grapes or 'raisins') whilst other foods were probably only consumed by the elite (such as pomegranates, peaches and almonds). The post-medieval period provides the greatest potential for such studies.

5.8.2 Crop Plants and Imported Foods

The main changes to the cultivation of cereals are increased evidence for the use of rivet wheat, alongside bread wheat types, and for two-row hulled barley, alongside the six-row hulled variety. It is difficult to determine whether the 'newer' cereals were replacing the more ancient because so few post-medieval sites have been excavated and the data is too sparse. In addition, taphonomic factors could partly be responsible, as material buried for a shorter period of time might be better preserved and so retain more identifiable characteristics. Well-preserved rachis fragments are required for both of these taxa to be identified with confidence, so they stand a better chance of being identified in the most recent deposits. In order to increase the recovery of identifiable chaff, deposits of cereal cleaning waste or partly cleaned cereals need to be analysed. Areas with drying kilns and processing floors could be targeted in suburbs and rural locations. Other contexts that can produce well-preserved chaff include waterlogged deposits, and thatch and daub in standing buildings.

Some samples composed of cereal grains suggest storage before milling at Leicester Shires [LR5] and Bonners Lane [LR6]. In the latter case, the sample was thought to indicate the commercial use of cereals. Legumes continue to be fairly abundant on most sites where charred remains have been recovered. Chaff, however, generally appears to be less frequent except in the occasional instances of rye rachises being recovered to the exclusion of all other charred remains, as at Bolebridge, Tamworth, Staffs (Greig and Colledge 1989). Stone, Staffs [ST26] seems an exceptional site, with abundant chaff. At Castle Mall, Norwich [NK44], the latest post-medieval phases produced assemblages with a higher proportion of chaff and weed seeds than those from Anglo-Saxon and medieval contexts, implying use of cereal by-products in their own right..

The other major change is the increase in the variety of imported foods from a wider geographic range, including New World countries. Cucurbits such as melon and cucumber were brought from Africa and Asia. Melegueta pepper (*Aframomum melgueta*) or grains of paradise from West Africa and black pepper (*Piper nigrum*), from South-East Asia have been recovered from a few sites. Tomato and squash (*Cucurbita pepo*) were introduced from the Americas. Most of these taxa have been recovered from latrine deposits and redeposited sewage (see section 5.8.4 below).

Buckwheat is a food that arrived surprisingly late in Britain, even though it is found as early as the 12th century on the continent (Greig 1996, 213-4). Because it has distinctive pollen its arrival can be tracked using both pollen and macrofossils, although the precise dating of pollen grains can be difficult. As with millet (*Panicum miliaceum*), which seems to have been absent from the Midlands region in all periods, the British appear not to have acquired the taste for some foods, even though they were quite widely consumed on the European mainland.

The recording of exotic taxa on post-medieval sites is more than a 'stamp-collecting' exercise, as it provides information about trade with an increasingly wide range of countries, it informs archaeologists about diet and status on specific sites, and can be linked to historical documents to test the validity of other sources of information. It should be noted, however, that urban waste deposits have a high chance of containing residual material, so care must be taken in selecting suitable deposits for sampling.

5.8.3 Urban sites

Because of the mixed nature of most urban deposits, often including high proportions of sewage and food waste along with industrial/craft waste, a range of types of site have been grouped together. Some of the examples below contain evidence for the deposition of industrial waste containing hops, hemp, fuller's teasel (*Dipsacus sativus*) and flax, but unless primary deposits are encountered, detailed studies of industrial processes are difficult.

Grand Arcade and Bradwell's Court, Cambridge, Cambs [CB8] Samples from the two sites mainly dated to the 12th-16th centuries, provide information about the historical development of the City of Cambridge. Kings Ditch spanned the 11th to 16th century. Samples from 15th/ 16th century deposits contained a little charred material (barley, free-threshing wheat) and occasional sewage indicators. Waterlogged wild plant remains were not recovered from 15th century deposits but were present in the 16th century levels suggesting a period of dryness in the 15th century. Increased disturbance altered the vegetation to some extent and the aquatics were less diverse. The 16th century re-cut of the ditch showed increased use for sewage deposition, with frequent fig, black mustard

and strawberries. Corncockle fragments were also frequent. Damp grassland and ruderal weeds were present.

At St Andrews Street waterlogged remains were recovered from deeper wells and pits and 17th century sewage deposits contained a range of exotic foods. Both rivet wheat type and bread wheat type grains (with some rachis fragments) were the most frequent charred plant remains. Barley was probably mostly six-row but a two-row rachis fragment in the 16th century confirmed the presence of this taxon. Rye (mostly chaff) and oats (no species confirmed) were recorded. Other edible remains were present in two contexts were sloe, apple/pear, flax, Celtic bean and pea. *Cladium* and cereal straw were being used as fuel. The 16th century samples were rich in fen ash and an 18th century pit contained mineralised blackberry, *Brassica/Sinapis* and grape. Evidence of sewage (waterlogged and mineralised) included a 16th century pit deposit containing fig, black mustard, blackberry, strawberry, bullace/damson, pear/apple and grape. One early 17th century cess-pit contained a more exotic range of foods which in addition to those listed for the 16th century pit included cucumber, grains of paradise and hops. Three wells contained wild plants including nettles and chickweed. A barrel-lined well contained numerous fennel seeds and *Brassica/Sinapis* sp.

Samples from 16th century deposits at Bradwell's Court suggest a change to more intense use of space compared to the medieval (11th to 15th century) deposits (see section 5.7.3.1), formal sub-divisons and dumping of sewage in the Kings Ditch. However, oven ash, which had reached a peak in the 13th-14th century, was less frequent. A widespread, deep garden soil suggested small-scale cultivation occurred in the post-medieval period in the backland and some innerland areas, though evidence of garden plant remains was scarce.

Pembroke College Library, Cambridge [CB1] A square, clunch-lined pit thought to have been a cesspit was dated to the later 16th century. A sample from waterlogged deposits in the base of the pit produced plum, bullace/damson-type and dwarf cherry-type stones. Hazelnut shell and a fragment of walnut shell represented additional remains from economic plants. Holly (*Ilex aquifolium*) seeds may have come from garden plants, as may large seeds from *Brassica/Sinapis* sp. and a possible seed and tepal of patience dock (*Rumex patientia*) This species was introduced from the continent and grown as a pot-herb in the past. Cotton thistle, henbane and stinking chamomile were the most notable 'wild' taxa, indicating either a period of abandonment or an area of rough ground where nutrient-rich waste had accumulated. No mineralised remains were found, but the fruit remains could have originated in faecal waste, since stones were often eaten with the fruit.

Cockpit at St Ives, Cambs [CB23] Medieval pits produced uniform grain/chaff/weed seed assemblages including remains from oat, barley, rye and wheat. The arable weed stinking chamomile was dominant, indicating the cultivation of heavy, soils. Leguminous weeds were also present, suggesting that the soils may have been impoverished. The post-medieval samples produced very similar results, although both rivet and bread wheat were being cultivated at this time. Some faecal concretions and grassland taxa (possibly hay) were found in one pit, indicating the deposition of mixed waste.

King Street, Derby [DB2] Twelve Saxo-Norman charred assemblages and one 18th century AD pit fill containing charred and waterlogged plant material were examined by James Greig. Although the Saxon-Norman samples produced a fairly sparse assemblage

(wheat, oats, rye, possible barley, vetch and weed seeds characteristic of domestic waste), the post-medieval waterlogged assemblage was very diverse. Seeds from a wide range of economically useful plants were present, including hop, fig, grape, cherry, strawberry, sloe, celery, onion and black pepper. A few charred wheat and oat grains were also recorded. Weed seeds, bracken fragments and grassland taxa indicated that other materials had been deposited, including perhaps dung. Brewing waste and unviable old seeds may have been discarded in the pit, or perhaps faecal material was present. This unusual assemblage demonstrated the value of examining post-medieval waterlogged deposits.

Bonners Lane, Leicester [LR6] Early post-medieval samples contained abundant charred grain with some chaff and weed seeds. Mineralised plant remains were abundant in some pits and a feature associated with a stone-lined drain. They included abundant figs, brambles, occasional apple, sloe, apple/pear, grape, and flax. Possible medicinal taxa that were mineralised in quantity included henbane and hemlock, though they may have grown nearby on nutrient-enriched soils. Mineralised small weedy leguminous seeds were frequent, as were charred legumes including pea, bean and cultivated vetch. Stinking chamomile, corn spurrey and sheep's sorrel were abundant amongst the charred weeds but corn cockle was scarce. Barley (two- and six-row) and free-threshing wheat (with frequent rivet wheat, and bread wheat type rachis) were the dominant cereals; rye and oats (including cultivated oat) may have been under-represented. Barley may have been the dominant cereal in this period, as has been found in some medieval and post-medieval towns such as Norwich (Murphy, 1985). A post Civil War latrine pit contained frequent mineralised fig and bramble seeds. A charred thorn-apple (*Datura stramonium*) seed was also recorded. Cereals were being brought onto the site in large quantities at this time, some in a semi-cleaned state, with weeds indicating a range of soil types. There was no evidence for malting so the frequent barley could indicate fodder. However, the fact that the abundant barley had become charred suggests that this happened during processing which would not have been necessary for animal food. Since mills and bakeries would have been used at this time, the abundant charred cereals appear to represent the commercial selling of whole grain to the public.

The Shires, Leicester [LR5] Two sites were sampled in the north-east quarter of Leicester, a sparsely settled area presumed to have been heavily gardened. Grain was sparse in comparison with the earlier medieval periods but a wider range of garden plants was present. A mineralised hop seed was recovered from one site. Dill, opium poppy, columbine (*Aquilegia vulgaris*), pot marigold (*Calendula officinalis*), apple, strawberry and asparagus were probably all garden plants. Mineralised Brassicaceae seeds were also frequent in two features, either a *Brassica/Sinapis* species or possibly wild radish as a pod fragment was present. Henbane and bristly ox-tongue were other possible medicinal/potherb plants represented. Two layers in a pit produced most of the mineralised and uncharred fruit seeds (strawberry, fig, raspberry/bramble, apple, hop and grape) probably deriving from redeposited sewage.

Shrewsbury Abbey, Shrops [SP2] Plant remains from medieval deposits are described in Section 5.7.5. Early C18th-20th rubbish deposits contained scattered aquatics, grassland taxa that indicated the presence of hay, charred wheat and rye grain, flax and buckwheat capsule valves. Peach was a notable find amongst the frequent fruit remains. A seed fragment of cucumber or melon (*Cucumis* sp.) was also recorded, fennel, coriander and possible pennyroyal (*Mentha pulegium*), plus black pepper (*Piper* cf. *nigrum*) and Melegueta pepper (*Aframomum* sp.). Fuller's teasel was present in C17th/18th deposits

but there was no clear evidence for industrial activities from the plant remains. Comparisons were made with non-monastic urban sites and conclusions were drawn that there were probably no differences between wealthy non-monastic urban and monastic assemblages.

Deansway, Worcester [WC6] Medieval samples had produced fairly sparse, mixed assemblages containing mainly grain and possible garden plants and latrine waste. One late medieval sample contained abundant charred flax capsules. The later medieval and post-medieval samples (13 samples) produced similar results although one exceptional sample contained frequent chaff, including rivet wheat and bread wheat rachises (occurring in a ratio of 7:5) and frequent rye rachis fragments and straw nodes. Additional sporadic taxa (several uncharred; some sewage and some garden) included grape, pea, strawberry, *Prunus*, mineralised apple, abundant uncharred fig, tomato (*Lycopersicon esculentum*), yew (*Taxus baccata*), cultivated vetch, fennel (*Foeniculum vulgare*), possible caraway (*Carum carvi*) and vervian. Comments were made in the report about future research in Worcester included the need for primary contexts (lacking in these samples), waterlogged deposits and more post-Medieval deposits.

The Butts, Worcester [WC19] A 17th century waterlogged deposit from the medieval city ditch was investigated, producing abundant evidence that enabled reconstruction of the environment and industry in post Civil war Worcester. The Medieval ditch is believed to have been frequently cleaned out up to the preparations made for the Civil War in the 16th century. Some areas of ditch were backfilled during 17th century, but not on the north side. However, by the 18th century a building (spa) stood on the adjacent site excavated in 1992. The assemblage was dominated by seeds from plants that would have grown in the damp ditch soils (celery-leaved crowfoot (*Ranunculus sceleratus*), fool's watercress (*Apium nodiflorum*), watercress (*Nasturtium officinale*)) though corn cockle and straw were also quite common. Economic plants were well represented including cherry, plum, grape, apple, sorbus (*Sorbus aucuparia/domestica*), HNS, elder, coriander, fennel, black mustard, possible cabbage, flax, fuller's teasel and hemp. Textile working, cereal processing waste/bedding and domestic waste had been deposited. No evidence for sewage was observed, unlike other rich deposits from this period such as Dudley Castle [WR50], Worcester barrel latrine [WC22] and Worcester Cathedral [WC30].

Tipping Street, Stafford [ST27] An assessment was carried out on a single sample from a 19th century 'cesspit' near to the Turks' Head Pub. Seeds and bracts of hops and leaves of heather were noted. It was suggested that these could be the remains of beer flavourings.

Norwich, Norfolk Analysis of 15th century and later latrine pits at Castle Mall, Norwich (in Murphy and de Moulins 2002) [NK44] and St Martin-at-Palace Plain, Norwich (Murphy 1987a) produced records of a wide range of crops and imported foods preserved by calcium phosphate mineralisation, including a New World product, *Cucurbita* sp (pumpkin/marrow) from Castle Mall. The 15th century cess-pit from St. Martin-at-Palace Plain contained fennel, coriander, a range of *Prunus* sp. (plum, cherry etc), apple, strawberry, mulberry (*Morus nigra*), frequent fig seeds and grape pips, walnut and hazelnut shell, in addition to frequent cereal remains (bran or pericarp and some whole bread wheat type and common oat grains). The wide range of exotic foods available in Norwich demonstrates its importance as a centre for trade at this time.

Park Street, Bull Ring, Birmingham [WR10] Medieval and post-med features (phases 1-3; three areas) were sampled, 26 of which are described in the report (charred and waterlogged). Three 15th to 16th century samples from a rectangular tank and a clay-lined pit produced mainly waterlogged remains from wet/disturbed places similar to those found in earlier samples. It was suggested that the features had been used as watering holes for livestock. Eight samples from post-medieval pits in three areas produced evidence for domestic and industrial waste deposition. Rich metalworking deposits were found in a mid-18th century pit. A diverse waterlogged assemblage containing food and fibre plant remains (HNS, bramble, elder, fig, plum (*Prunus domestica*), grape, frequent hemp seeds, beet, rose, hop) was recovered, representing garden cultivation, domestic waste deposition and possibly retting and brewing waste. Two pits dating to the late 16th-early 18th century produced a few charred barley, oat and rye grains, abundant waterlogged fig seeds and beet in one pit, abundant bramble and elder seeds in two samples and a range of common weed taxa. A late 18th century wood-lined tank and pond-like feature contained common wet ground/aquatic taxa. Samples from a 17th century waterlogged area containing domestic and industrial waste produced abundant chickweed and nettle seeds and assorted weeds, but also hemp seeds and parsnip (*Pastinaca sativa)* seed. The proximity of industries such as tanning and retting in the Bull Ring area must have made it fairly smelly and polluted.

5.8.4 Latrine pits

Deposits containing human faecal material can be particularly rewarding from this period, since a wide range of exotic taxa were available, particularly to the urban population. In addition to sites such as Grand Arcade, Cambridge described above which produced a number of waterlogged and mineralised latrine pit fills (section 5.8.3) a number of other sites in the region have provided likely sewage deposits and associated dietary insights.

A post-medieval (17th-18th century) deposit from City Arcade, High Street, Worcester [WC2] was rich in sewage or faecal material, containing mineralised grape, cf. raspberry, fig, apple, *Prunus* kernels, elder and coriander. Other scanned post-medieval samples also contained sewage. Drainage of the deposits may have been too good to provide the optimal conditions for mineralisation to take place. The results are comparable to Deansway, Worcester [WC6] where preservation conditions were similar.

Sidbury, Worcester [WC17] Three adjacent tenements between Sidbury and the City Wall were excavated. Six pits were sampled, ranging in date from the Roman period to the 11th, 13th, 16th and 17th century. A 17th century pit containing the skeleton of a pony produced frequent wetland (sedges, rushes) and grassland taxa indicative of marsh hay. A second C17th pit contained scrub and wasteland weeds. A C16th stone-lined latrine pit contained a range of fruit seeds (grape, elder, frequent bramble, mineralised sloe, mineralised apple, frequent wild strawberry).

Latrines were also sampled at Dudley Castle [WR50] and Deansway [WC6]. The long list of taxa from the late medieval Worcester barrel [WC22], included macrofossils from edible plants such as mustard, linseed, grape, bramble, strawberry, sloe, damson, cherry, apple, gooseberry, coriander, fennel, fig, hazelnut, bilberry and oat. Comparable assemblages have also come from rubbish layers at Shrewsbury Abbey [SP2]. Although most of the remains for this period are preserved by waterlogging or occasionally by mineral-replacement, some of the fruit 'pips', especially those of figs, survived uncharred

at Deansway [WC6] and Leicester Shires [LR5] in contexts which were not obviously waterlogged.

Melegueta pepper (*Aframomum* sp. has been reported from 18th-20th century rubbish deposits at Shrewsbury Abbey [SP2] and an early 17th century cesspit at Grand Arcade, Cambridge [CB8]. Black pepper (*Piper nigrum*) was also found in the Shrewsbury Abbey rubbish dump and in an 18th century waterlogged pit at King Street, Derby [DB2]. Other exotic imports are represented by seeds of Cucurbitaceae, melon/cucumber (*Cucumis* sp.), found at Shrewsbury Abbey and an American species of squash (*Cucurbita pepo*) in a 17th century waterlogged and mineralised latrine shaft at Dudley Castle [WR50]. The only New World crop so far identified in the eastern part of the region is also *Cucurbita* sp (pumpkin/marrow/squash), a mineralised seed of which was recovered from a mid-17th century context at Castle Mall, Norwich [NK44] and presumably also derives from sewage.

The 'fruit salad' of this period does not necessarily indicate a high status, but may be more a reflection of the feature-types sampled and of the level of preservation. Latrine deposits characteristically contain abundant small seeded species ingested and passed through the gut (such as fig, strawberry), fragments of black, corn cockle seed ground up with grain as a contaminant of flour, and also larger stones which may be the remnants of rotten fruits or perhaps more likely the left-overs from food thrown as waste into the latrines or cesspits. Rarer reports of exotic spices and New World crops are more likely to be indicators of status. This is confirmed by their occurrence in sewage deposits on sites such as large urban centres, abbeys and castles.

5.8.5 Medicinal plants

Waltham Abbey, Essex [EX23] A waterlogged sample (200ml) was examined from a C16th post-dissolution pit at Waltham Abbey. Abundant henbane and several hemlock seeds were present, plus a few common weed seeds. Other sites producing these two taxa were listed, but none had produced more than around 20 seeds. Discussion of the possible medicinal uses of the plants and references to them in herbals and botanical publications was given. The evidence suggests that both species were cultivated at the Abbey, possibly for external use for pain relief. Seeds could have been steeped to remove the powerful alkaloids. The pit had probably received waste from this process.

5.8.6 Building materials

The study of smoke-blackened thatch (SBT) has already been discussed in the Medieval Period review, Section 5.7.4.3. Other plant materials were also used for the construction and furnishing of dwellings (bedding, flooring, walls) but use for specific purposes are difficult to prove unless *in situ* deposits are found. The exception may be plant remains from cob or daub (e.g. Althrey Hall, Clwyd, Carruthers 1991), but none have been investigated in the Midlands (Angela Monckton pers. comm.).

5.8.7 Summary and future prospects

There is great potential for increasing our understanding of this period since, at present, investigations have usually been limited to the occasional well-preserved deposit in isolation (Figure 8: site distribution map). Allowing for the fact that resources are often limited and earlier periods also offer great potential, a case can be made for targeted investigations focusing on the following topics:

- Specific industries/crafts, such as tanning, cloth-working and dying
- Rural farmsteads and manor houses

- Any deposits unaffected by redeposition, that is in areas where there has been little or no earlier activity
- Sites where documentary evidence is available to augment the data, particularly if it relates to agricultural practice or innovation
- Sites where deposits can be accurately dated
- Further investigations into plant remains recovered from standing buildings, including smoke-blackened thatch (SBT) and daub
- Garden archaeology: The data recovered can help to establish dates of introductions and provide an authentic basis for re-planting. Information from garden archaeology is readily accessible and comprehensible to the public and may be one area where archaeobotany can establish a public face (Murphy and de Moulins 2002).
- Uncharred plant remains: Studies have shown that plant material can survive in aerobic soils for a surprisingly long time, thus presenting new sources of information for the post-medieval period. Uncharred material of this type needs more investigation (Murphy and de Moulins 2002).
- Wreck sites are of interest for any period, though the high levels of trade in the late and post-medieval periods mean that shipwrecks often date to this time.
- Wreck sites

There is great potential for finding wrecks in river estuaries, and off the coast of ports such as Kings Lynn and Great Yarmouth that were very active at this time. These sites can produce important information concerning trade, the consumption of imported goods and life on board merchant ships. Wrecks such as the Newport Medieval ship (Carruthers 2013a) which sank in dry dock on the Usk estuary in the C15th and the C16th Mary Rose (Smith and Green 2005) have the potential to contain sewage and dunnage in the bilges of the ship, as well as food and drink being traded, and other plant-based evidence of bedding, fodder, cordage, and fibres used for repairs. Documentary evidence from customs records such as those published by Gras (1918) dating from the C13th to C16th, and Howlett (1883) provide comparative evidence which can aid interpretation.

- Evidence for agricultural improvements and innovation

An as-yet unexplored topic is the potential for post-medieval charred assemblages of crop processing waste and/or processed crops to provide us with evidence of the impact of agricultural improvements in the archaeobotanical record. Should these types of deposit become available it is likely that they would be relatively well-preserved, having suffered fewer centuries of burial. If so, they could assist us in the interpretation of older material by providing, for example, suites of indicator weeds associated with specific crops. In addition, by examining this type of deposit alongside the documentary evidence a deeper understanding of crop husbandry methods could be obtained. Information from studies of weed assemblages from thatch (de Moulins 2006) can be integrated into this type of investigation.

- The use of documentary studies to inform archaeobotanical investigation

Studies such as those carried out by Chris Dyer (2000) on mid-13th to mid-15th century harvest workers from Sedgeford, Norfolk, can be used to provide archaeobotanists with information that can aid interpretation, as well as changing our general approaches to medieval and post-medieval analyses. By analysing data from specific social groups (in this case manorial accounts concerning food and drink given to harvest workers) Dyer

has revealed detailed evidence for the way of life, social hierarchy and agricultural working practices. As well as revealing information about specific trades and occupations, these types of studies can provide evidence for changes through time and regional variations that can then be used by archaeobotanists in their interpretations of the data (Monckton, pers. comm.). This is similar to, but an inversion of, the point above concerning the examination of sites for which historic evidence is available, in that historical evidence can be used as the starting point for investigations, helping in the design of projects and in the targeting of research.

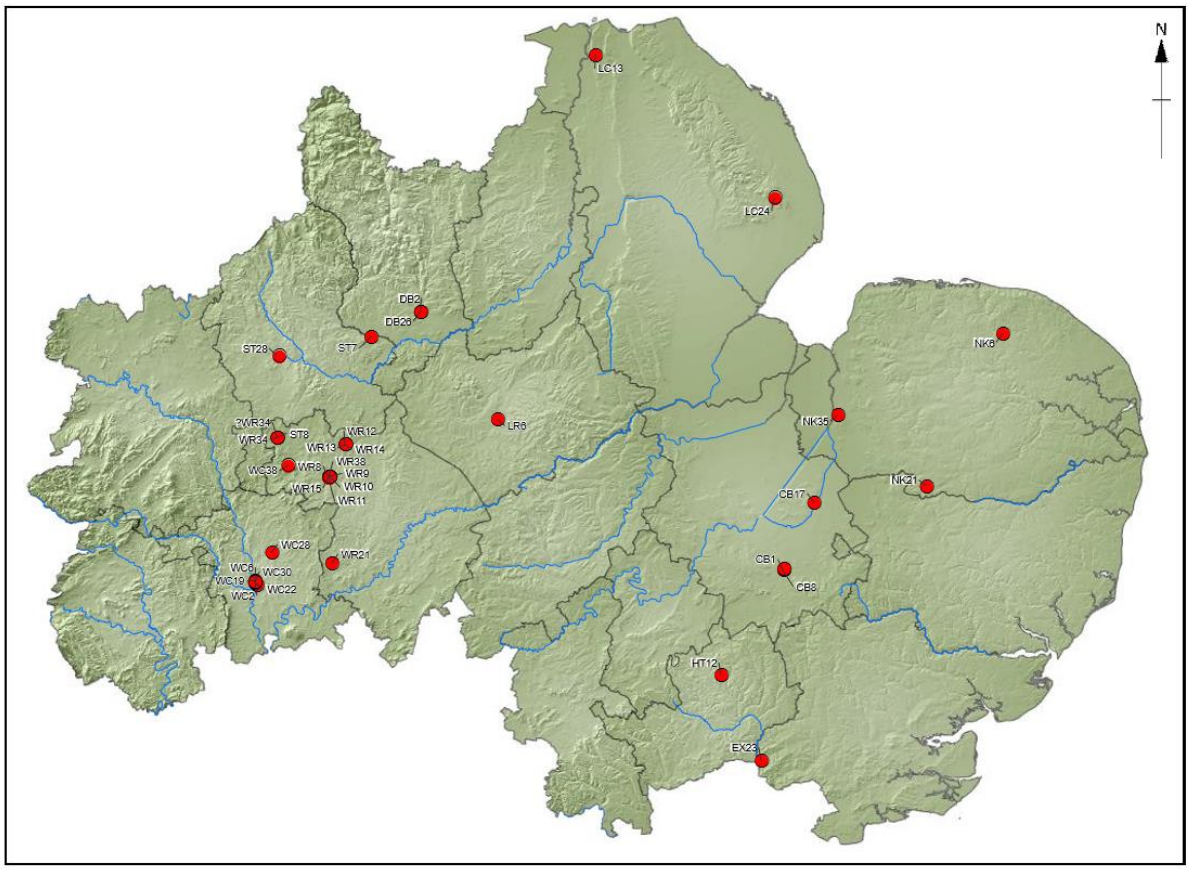

Figure 8: Post-medieval sites in the Midlands counties producing plant remains

BD35 University of Bedfordshire, Luton; BK17 Broughton Manor Farm/Brooklands, Milton Keynes; CB1 Pembroke College Library, Cambridge; CB8 Grand Arcade & Bradwell's Court, Cambridge; CB17 Waterfront sites (Jewsons Yard, Broad Street), Ely; CB23 cockpit at St Ives; CB34 Peterborough, Long Causeway; CB57 Longstanton; DB2 King Street, Derby; DB26 St Mary's Gate, Derby; EX18 Stansted Airport 2000-3; EX23 Waltham Abbey; EX45 Churchyard of St Marys & All Saints, Rivenhall; HF14 Hereford & District; HT12 Lob Hole, Stevenage; LC11 Chowder Ness, Barton upon Humber; LC38 Cartergate, Grimsby; LR5 The Shires, Leicester; LR6 Bonners Lane, Leicester; LR42 St Nicholas Place & Medieval Undercroft, Leicester; LR44 Sherrard Street, Melton Mowbray; LR45 Humberstone LR48 Whissendine, Rutland; LR52 Vaughan Way, Leicester; NH5 Sol Central, Marefair; NK6 Corpusty/Saxthorpe link road; NK21 Kilverstone; NK34 Heigham, Norwich; NK44 Castle Mall, Norwich; SP2 Shrewsbury Abbey; SP13 Stafford Street, Newport; ST7 Castle Garage, Monk Street, Tutbury; ST8 The Moat, Wolverhampton Old Hall; ST26 Tenement in Stone; ST27 Tipping Street, Stafford; WC2 City Arcade, High Street, Worcester; WC6 Deansway, Worcester; WC17 Sidbury, Worcester; WC19 3-5 The Butts, Worcester; WC22 Barrel latrine, Worcester; WC28 Old Bowling Green & Friar Street, Droitwich; WC30 Worcester Cathedral; WC39 Upwich, Droitwich; WR8/9/10/11 Edgebaston street, Bull Ring, Birmingham; WR12 33 Coleshill Street, Sutton Coldfield; WR13 15-17 Coleshill Street, Sutton Coldfield; WR14 Coleshill Street, Sutton Coldfield; WR15 Dean House, Birmingham; WR19 Longbridge; WR21 Coughton Court; WR40 Cathedral and Priory of St Marys, Coventry; WR50 Dudley Castle

6. THEMATIC REVIEW

6.1 Plants as Indicators of the Past Environment: problems of interpreting remains of wild plant taxa

The interpretation of wild plant remains from archaeobotanical samples presents a number of difficulties, depending on the type of deposit sampled and method of preservation. The remains may represent fruits, seeds and other identifiable structures produced by plants growing nearby, such as aquatic vegetation in water-filled features, dumped waste derived from vegetation growing elsewhere including deposits of hay or turf, plant remains in dung, plant materials used for packaging, native plants growing as contaminants of crop plants or they may derive from collected and utilised wild plants (leafy vegetables, oil-seed plants, medicinal plants). In many cases, particularly where mixed urban waste deposits are concerned, it can be impossible to unravel which of the interpretations applies to a particular native species with any certainty. Stinging nettle seeds, for example, are extremely common and sometimes abundant in waterlogged samples such as ditch fills and wells, as might be expected considering their association with soils where the nutrient status has been enriched due to human and livestock activities. They are also useful in a variety of ways, for example as a leaf vegetable, for medicinal purposes (see Pliny's Natural History (1855) Book 22 Chapter 15: 'The nettle: sixty-one remedies'), as a fibre crop, as a nutrient-rich compostable material, and when burnt, as a source of lye (which contains caustic soda, used for a variety of processes including making soap, paper and dying textiles). The chances of distinguishing between these uses or identifying any one of them is slight, with the possible exception of a charred, fairly pure deposit of nettle seeds which very likely (but not definitely) derived from the manufacture of lye found at Saxon West Heslerton, Yorkshire (Carruthers and Hunter 2001). However, with some types of deposit it is fairly clear that the local vegetation is represented, for example where there is little evidence for human activity in the immediate area, and where the assemblage as a whole is characteristic of a particular vegetation type (e.g. peat deposits).

The integrated study of a floodplain sedimentary sequence and palaeochannel at Biggleswade West, Bedfordshire (Dawson, 1994) provides a useful example of how particular sediments, such as floodplain deposits, can reveal evidence for human activities that result in changes to the landscape (Murphy and de Moulins 2002). Samples taken for insects and plants by M. Robinson at Warren Villas demonstrated that peat had begun to form extensively on the Ivel floodplain by the late Roman period. A fen meadow environment, seasonally flooded and (on the evidence of Coleoptera) grazed, existed, but it was not until the late Saxon to early medieval period that clay alluviation began. This is attributed to large-scale and intensive cultivation in the catchment (Robinson 1992). Analysis of plant macrofossils points to use of the floodplain as hay meadow. Alluviation appears to have largely ceased after the 14th century.

Studies of wild flora can be used to create a picture of the environment within which human activity is taking place, particularly for early Prehistoric sites where the environment may still be exerting a stronger impact on the human population than vice versa. In addition, waterlogged plant remains can help to flesh out the archaeological story, providing evidence of, for example, hay meadows, hedgerows, scrub or woodland.

6.2 The Use of Plants as a Resource

6.2.1 Plants as foods and flavourings

6.2.1.1 Gathered wild foods

As outlined above, assigning a function to the remains from native wild plant remains can be difficult. The key factor in confirming human exploitation of a plant resource is the association of large concentrations of remains with artefacts and/or other ecofacts within a specific dated context, for example the recovery of vast quantities of charred hazelnut shell fragments with lesser celandine tubers from the large Mesolithic hollow at Colonsay, Southern Hebrides (Carruthers 2000b; Mason and Hather 2000). Preservation by charring was an important factor in this case in assigning a possible purposeful activity to this deposit, that of large-scale collection and processing of wild foods in order to provide food for the winter. Accidental charring will only have resulted in the preservation of (presumably) a small proportion of the nuts and tubers being processed, so it should be remembered that the charred plant record only represents a small proportion of the gathered foods being processed. There are many foods that are extremely unlikely to become charred en-masse, or even to be preserved in a recognisable form by waterlogging, such as leaf and root vegetables. Leaves, roots and seeds of medicinal plants would probably have been used in small quantities, particularly the more toxic species such as henbane, so proving their use is likely to be extremely difficult on a macroscopic level. Clearly, this presents a great problem when investigating pre- and early agricultural economies, and archaeobotanists may need to resort to the use of more anatomical-based studies using Scanning Electron Microscopy, e.g. to refine tuber and root identification methodology (see Hather 1993), or involve specialists in phytoliths and chemical residues such as starch grains (e.g. Piperno and Holst 1998).

Examples of wild plant use from the Midlands mirror those from other areas of the British Isles, in that hazelnut shell fragments and crab apple seeds, endocarp and hypanthium (flesh) fragments are relatively common in Neolithic features, as demonstrated by Moffett *et al* (1989). Remains from around 50 crab apples were recovered from a Late Neolithic/EBA pit at Willow Farm, Castle Donnington, dated to around 2000 BC [LR28]. There is evidence from some sites suggesting that apples were deliberately cut in half in order to dry, preserve and improve their flavour (for example Late Neolithic pits at Broom [WR30a]). Hazelnut shell fragments are found through all periods in varying quantities, but the highest concentrations are usually Neolithic in date. Charred remains of apples are also much less common after the Neolithic/EBA period, and by the time apples begin to reappear from the Roman period onwards (usually represented by seeds preserved by waterlogging and mineralisation in faecal deposits and wells) it is likely that the cultivated species, *Malus domestica*, is represented rather than wild crab apples (*M. sylvestris;* see Robinson 2006, 217).

Records of charred roots, tubers and rhizomes have increased in recent years as archaeobotanists become more aware of their importance to early prehistoric people. Of the many sites in the Midlands producing evidence of onion couch, pignut (*Conopodium majus*), lesser celandine (*Ranunculus ficaria*) and other unidentified parenchymatous structures almost all are burial or ceremonial in nature (for example EBA cremations at Eynesbury, Cambs [CB39]; Roman cremations at Sampford Road, Thaxted, [EX27] and early Saxon cremations at Springfield Lyons, Chelmsford [EX14]). Only The Stumble [EX37] has produced substantial quantities of storage tissues that appear to represent food waste.

6.2.1.2 Staple foods: cereals and pulses

It is fortunate for archaeobotanists that cereals, the crop plants key to the development of agriculture in Europe and most of the world, are readily preserved by charring. To add to this, because the early hulled cereals needed to be de-husked prior to consumption, they were much more likely to become preserved by charring than foods such as fruits and nuts. In the prehistoric period de-husking is likely to have taken place regularly within settlement sites, so chaff would have been readily available for burning as fuel or tinder, while grain may be accidentally burnt during roasting or drying. Although charring causes some loss of more delicate elements of the chaff (Boardman and Jones 1990), identifiable structures such as the glume bases and grains are often reasonably well preserved. Pulses conversely, frequently lose their hila on charring (important structures used to distinguish between taxa), and are less likely to require contact with heat in the first place. Early evidence for the cultivation of pulses, therefore, is much less certain, consisting mainly of vague descriptions of 'large pulse fragments' which could be from wild or cultivated taxa. The earliest definite, radiocarbon dated example of large pulses in the Midlands region was the large deposit of horse/Celtic beans recovered from a pit at Frog Hall Farm, Frinringhoe [EX2] dated to the Late Bronze Age: 1130-790 cal BC (HAR-2502; two sigma: 2760 ± 80 BP) (see section 5.4.3). Possible peas/beans have been recovered from a few earlier sites, such as Lockington Early Bronze Age barrow cemetery [LR18], though sometimes doubts about the security of the context highlight the importance of dating (for example Eynesbury, St Neots [CB39] which produced pea, free-threshing wheat grain and rye rachis in Early and Late Neolithic pits).

The addition of mineralised evidence to the plant record has helped to fill in gaps in the record for later periods when this type of preservation is fairly frequently encountered, such as in the Roman, Saxon and medieval periods. Garderobes and cesspits often contain fragments of pulse which can include recognisable seed coat fragments and identifiable mineralised hila. Comparing the occurrence of these items with mineralised bran curls from well preserved middle Saxon cesspits in Southampton it was clear that pulses were consumed in similar quantities to bread, during this period at least (Carruthers 2005), probably mainly as pottages given evidence from documentary sources.

Detailed discussion of crop changes though the periods have been given above in the Period reviews (Section 5), and discussion of the evidence for early and late cereal records is given below (Section 6.7). In addition, *Table 2* provides a summary of economic plant records as a whole. The table was initially drawn up by Peter Murphy for the East of England and it has since been amended to take in more recent information, including some radiocarbon dates for the earliest records. Ideally, in time, all early records in this table will be accompanied by direct dates (i.e. not dates from associated finds such as charcoal). Since much more evidence of contamination has recently come to light now that AMS dating can be carried out on single seeds (see Section 6.6; Pelling *et al* 2015), some of the uncertain early records for crops such as free-threshing wheat have been queried in the table.

6.2.1.3 Fruits, nuts and flavourings including imported foods

Foods in this category are greatly under-represented in the archaeobotanical record, particularly in the charred plant record. Documentary sources can help to redress the balance in some periods and locations (e.g. taxes paid on imported goods at ports) and

higher status establishments such as monasteries and manor houses often have records concerning foods purchased and consumed. Lower status and rural sites require further research, since little is known about the diets of their inhabitants.

Table 2Table 4 illustrates the rate at which new foods were introduced into the economy, either by nurturing native plants (protecting, pruning, weeding, feeding, propagating, creating new cultivars by plant breeding), or by importing exotic foods from abroad. As might be expected, the Roman period stands out as a time when a wide range of exotic foods and flavourings were being consumed, followed by a lull. There was something of a resumption of a more diverse diet in the Saxo-Norman to early medieval periods, when the foundation of monastic establishments led to the provision a wider range of foods, with the creation of orchards, vineyards, physic gardens and ornamental gardens.

The precise uses of some plants, such as cotton thistle (*Onopordum acanthium*) and mallow (*Malva sylvestris*), are not fully understood but there is a clear rise in their occurrence during specific periods. For these two species this occurs in the Roman period. Classical writers make specific mention of cotton thistle and mallow with regards to cures (see Section 6.6.7 for further discussion of cotton thistle) and the making of poultices (mallow – Hippocrates Section 4). Mears and Hillman (2007) recommend eating the ripening fruits or 'cheeses' of mallow and making soups from the leaves, which is said to be similar to a soup made in Arab countries, 'melokhia' (Mabey 1972).

Table 2: Summary of occurrences of economically useful plants from the Midlands counties over time

	Periods	Neolithic- Beaker	Early-Mid Bronze Age	Late Bronze Age	Iron Age	Roman	Early Saxon	Middle Saxon	Late Saxon - Early Med	Later Medieval	Post-Medieval	early sites	late sites
Cereals													
Avena sativa L.	common oat				E/MIA			----------				EX50	
Avena strigosa L.	bristle oat											ST9/10/11	
Avena sp	wild/cultivated oat												
Hordeum sp	barley												
Hordeum vulgare L.	6-row barley												
Hordeum vulgare var *nudum*	naked 6-row barley		1690-1510calBC	+		+			+			BD23	
Hordeum distichon L.	2-row barley									?		ST10	CB17
Secale cereale L.	rye		?										
Triticum monococcum L.	einkorn wheat		?		?	?						EX37	
Triticum dicoccum L.	emmer wheat	3940-3540calBC							?			DB13; BK29	
Triticum spelta L.	spelt wheat	?	1410-1210calBC					C8th AD	?			EX49	
Triticum turgidum-type	Rivet wheat-type								770-1000 calAD			NH20	
Triticum aestivum-type	bread wheat-type		?	?									
Triticum aestivum/turgidum	free threshing wheat	E-LNeo										EX37	
Pulses													
Lens esculenta	lentil									?		CB20	CB34
Pisum sativum	pea	?	?EBA									?LR18	
Vicia faba	field/Celtic bean		MBA (Dorset)	1130-790 cal BC								(date-EX2)	
*Vicia sativa**	cultivated vetch/vetch									------- ------			
Wild/cultivated fruits													

	Periods	Neolithic- Beaker	Early-Mid Bronze Age	Late Bronze Age	Iron Age	Roman	Early Saxon	Middle Saxon	Late Saxon - Early Med	Later Medieval	Post-Medieval	early sites	late sites
Crataegus monogyna	hawthorn												
Curcurbita sp*	pumpkin/ marrow												
*Ficus carica**	fig											many	
Fragaria vesca	Strawberry												
Malus sylvestris/Malus sp.	crab apple/apple	2880-2580 calBC										date WC33	
*Mespilus germanica**	medlar								C11th			St Martin, Norwich[1]	SP2
*Morus nigra**	mulberry					ERB				C15th		EX10	St Martin, Norwich[1]
*Olea europaea**	olive					ERB						LR26	
*Phoenix dactylifera**	date					C2nd AD						ST16	
*Prunus avium**	sweet cherry											Several	
*Prunus domestica**	bullace/plum/ damson												
*Prunus spinosa**	sloe												
Pyrus communis	pear								L Saxon			NH37	SP2
Rosa sp	rose hip												
Rubus idaeus	raspberry											Several	
Rubus sect *Glandulosus*	bramble												
Sambucus nigra	elderberry												
Vaccinium myrtillus	bilberry											SP2	
*Vitis vinifera**	grape											Many	
Wild/cultivated nuts													
*Castanea sativa**	chestnut											EX8	
Corylus avellane	hazelnut												
*Juglans regia**	walnut											Several	
*Pinus pinea**	pine-nut											Several	SP2
Prunus dulcis	almond											SP2	

	Periods	Neolithic-Beaker	Early-Mid Bronze Age	Late Bronze Age	Iron Age	Roman	Early Saxon	Middle Saxon	Late Saxon - Early Med	Later Medieval	Post-Medieval	early sites	late sites
Fibre/oil/drug crops													
*Cannabis sativa**	hemp							Staunch Meadow			Hill Hall	EX42	
*Linum usitatissimum**	flax/linseed	3950-3640calBC										DB13	
*Onopordum acanthium**	cotton thistle				?MIA							EX50	
*Papaver somniferum**	opium poppy												
*Camelina sativa**	gold-of-pleasure												
Dye and textile-processing plants													
*Dipsacus sativus**	fuller's teasel									C12th-14th	C17/18th	WC29	SP2
*Isatis tinctoria**	woad				LIA							LC26	
Reseda luteola	dyer's rocket												
Herbs/vegetables/ornamentals													
Aframomum sp.*	melegueta pepper											CB8; SP2	
Allium sp.*	garlic, onion, leek												
*Anethum graveolens**	dill											Several	
Apium graveolens	celery											Several	
Aquilegia vulgaris	columbine												
*Beta vulgaris**	beet											Several	
*Buxus sepervirens**	box												
Brassica nigra	black mustard				E-MIA								
Brassica rapa	turnip/wild turnip												
*Calendula officinalis**	marigold												LR5
Coriandrum sativum*	coriander											Several	
*Euphorbia lathyris**	caper spurge											BK24	
Foeniculum	fennel											Several	

	Periods	Neolithic- Beaker	Early-Mid Bronze Age	Late Bronze Age	Iron Age	Roman	Early Saxon	Middle Saxon	Late Saxon - Early Med	Later Medieval	Post- Medieval	early sites	late sites
*vulgare**													
*Pastinaca sativa**	parsnip												
Pimpinella anisum	anise												
*Piper nigrum**	black pepper											DB2	
*Satureja hortensis**	summer savory					.						BK24	
Ale/beer flavourings													
Humulus lupulus	hop												
Myrica gale	sweet gale											CB20	

* not native to Britain, imported/introduced
? Uncertain identification or provenance
- - - continuation likely, records exist from other parts of Britain
+= trace only, may be natural mutation
1 Murphy 1987a

6.2.1.4 Evidence recovered from cesspits and other faecal deposits

Waterlogged and mineralised faecal deposits provide direct evidence of diet and can contain items that rarely survive in other types of deposit, either because they do not preserve well by charring and waterlogging (such as pulses, discussed above) or because they rarely come into contact with fire or enter waterlogged deposits (such as fruit remains and flavourings). In the process of mineralisation, soft tissues such as insect pupae, worm cocoons, seed embryos and fruit flesh can become preserved by the uptake of calcium phosphate in solution, followed by crystallisation, and the formation of amber-coloured 'fossils' or mineralised replicas (Green 1979; Carruthers 2000a; McCobb *et al* 2003). Mineralisation occurs in nutrient-rich, moist deposits such as middens, drains and cesspits. Where curled fragments of bran (sometimes present in larger fragments of coprolite), frequent fruit pips/seeds, indentations made by the spines of small fragments of corn cockle, and fragments of pulse testa with hila are observed the presence of human faecal waste can usually be confirmed. Although faecal deposits have been encountered at a wide range of sites of different periods, differentiating between human faeces and midden accumulations is much more difficult in periods when imported foods were not present, such as in the Late Bronze Age 'midden' at Potterne, Wilts (Carruthers 2000a).

The following sites provided useful waterlogged or mineralised plant assemblages derived from sewage deposits. They contain a range of food items that are unlikely to have been preserved by charring, primarily fruits, nuts and flavourings. It should be remembered that some staple foods, such as bread and pottages would have been mainly made from grain and pulse flours, containing only small fragments of seed which may not be preserved in a recognisable or quantifiable form. As might be expected, almost all sites are located in major towns, and the frequency of productive deposits increases as populations grow and problems of waste disposal increase.

Roman

[LR1a] [LR1b] Castle Street, Leicester– Mid 2nd century AD cesspit

Saxon

[CB14] West Fen Road, Ely – middle Saxon cesspits
[EX18] Stansted Airport – late Saxon and medieval cesspits
[HF2] High Town, Hereford – late Saxon defensive ditch
[WC6] Deansway, Worcester – late Saxon to post-medieval, rich mineralised and waterlogged sewage assemblages

Medieval and Post-Medieval

[CB1] Pembroke College, Cambridge – 16th century waterlogged cesspit
[CB8] Grand Arcade and Bradwells Court, Cambridge – medieval to post-medieval sewage deposits
[LR42] St Nicholas Place and Medieval Undercroft, Leicester – medieval and post-medieval cesspits and deposits (summarised below)
[ST2] Sandford Street, Litchfield – 13/14th century garderobe
[WC2] City Arcade, High Street, Worcester – 17/18th century sewage

[WC12] Worcester Road, Droitwich – 11-13th century cesspit

The following report is a good example of a medieval urban site that demonstrates the range of information that can be recovered from a combination of charred, waterlogged and mineralised remains:

St Nicholas Place and Medieval Undercroft, Leicester [LR42] - Selected Roman, medieval and post-medieval features were examined for charred and mineralised plant remains, together with a site previously excavated at the Undercroft, Guildhall Lane. Of 35 samples processed from St Nicholas Place (SNP), 11 were fully analysed. From the Undercroft (U) 21 samples out of 68 processed were fully analysed. The four Roman samples from St Nicholas Place contained small amounts of emmer/spelt grain, spelt chaff and weeds plus several HNS fragments. Charred hay meadow vegetation from a demolition layer represented fodder brought in to town as at Causeway Lane [LR4]. A waterlogged layer from the Undercroft may have received later seepage from a cesspit. Infrequent cereal grains in the medieval samples included hulled barley, free-threshing wheat (NFI), some rye and oat (*Avena* sp.). The samples were mainly from cesspits, accounting for the scarcity of cereals. The Undercroft samples contained numerous free-threshing wheat and oats in some samples, with some of the oats having germinated. Chaff was frequent in some samples. Other economic plants in the medieval period included peas and beans (SNP) and cultivated vetch (U), abundant mineralised fig seeds, and mineralised strawberry, opium poppy, sloe, apple, blackberry, Apiaceae and cf. flax (all SNP cesspits). Many of these same fruits occurred as waterlogged seeds in the Undercroft samples. The Saxo-Norman 'dark earth' and Undercroft spread contained dumps of cereal grains (free-threshing wheat and oats (*Avena* sp.)) and weed seeds suggesting midden deposits rather than cultivated soil. Waterlogged elder, fig and blackberry suggest the presence of sewage. Early medieval (1150-1300 AD) cesspits contained waterlogged fig seeds and evidence of small amounts of mineralised coprolite, fish remains and fly puparia. Samples from a drain and tank/oven dated to c.1250-1325 AD contained some domestic waste (charred cereal, peas, waterlogged fig and fish bone). The Undercroft contained a number of cesspits at this time which produced parasitic worm ova, frequent waterlogged economic plants (opium poppy, blackberry, fig, *Prunus*, apple, possible dill, mineralised cf. black mustard, abundant waterlogged henbane and waterlogged sedges, rushes and wild plants (flooring or toilet wipes). Charred cereals (including common chaff: rivet and bread wheat, rye, cultivated oats) were abundant in the middle layers, with oats being dominant and often sprouted. The 1275-1500 AD samples contain abundant charcoal (kiln deposits) and abundant mineralised fig, strawberry, apple, blackberry, elder, opium poppy etc. in stone-lined cesspits. Henbane, greater celandine and sun spurge (waterlogged) have been found in other late deposits in Leicester. A post-medieval drain contained a few mineralised and waterlogged remains, similar to earlier cesspit samples, and a demolition layer contained some domestic charred waste and waterlogged urban waste-ground taxa (hemlock, henbane, elder). The assemblage differed from Causeway Lane and the Shires, in having a large deposit of grain in the undercroft with equal wheat and 20% sprouted oats. This could be a commercial deposit of brewing waste, as found elsewhere in the Midlands, but the sprouting was too low to be certain. *Agrostemma githago* and *Anthemis cotula* were present in moderate numbers in all phases.

6.2.1.5 Brewing

The presence of frequent germinated grains with coleoptiles of similar dimensions, (often the length of the grains or slightly less) indicates that malting is likely to have taken place. Near uniformity of coleoptile length is significant, reflecting controlled germination and simultaneous cessation of development by parching, as in modern malting. Collapsed and distorted grains can also be found, and occasionally malted grain that has been coarsely crushed to a 'grist' in order to recover the malt (such as Stebbing Green, Essex (Murphy 1999)).

However, when smaller amounts of sprouted grain are recovered interpretation is less straight forward. In a successful malting procedure, the grain should never come in to contact with fire and therefore shouldn't survive as a charred assemblage. For this reason, any grain charred during the process must have been deliberately burned (if spoilt in some way), or accidentally charred. It may also be difficult to distinguish between deliberately sprouted grain and evidence of accidental germination of a stored crop, or even grain that has sprouted in the ear. Although the different stages of the malting process are very closely controlled, greater genetic diversity in ancient crops means that uniform sprouting is unlikely to have been achieved on a regular basis, so this is not a foolproof indicator of malting (Moffett 1986). Germinated coleoptiles are often destroyed on charring or become detached from the grain and fall into the ash, so they are not always found. Free-threshing cereals are less likely to show a clear groove to indicate sprouting, and since malt is produced at the very start of germination morphological signs can be difficult to spot (Merryn Dineley, pers. comm.). Depending on the stage and type of malting, 'half-grains' are sometimes abundant. This type of preservation occurs when the moist, sprouted embryo ends fall away ('popping') on contact with the heat due to inadequate drying prior to roasting (Rachel Ballantyne, pers. comm.). Popping leaves an oblique, hollowed out, melted scar across the half-grain that is distinctly recognisable (see Figure 9). It has been found in medieval malted barley as described below, and in Roman malted spelt (e.g. Northgate House, Winchester, Hants; Carruthers 2011b). A medieval example of this in the Midlands region was found at Jewsons Yard, Ely Waterfront [CB17] as described on page 124 (Section 5.7.4.1).

Figure 9: Germinated spelt-type grains including some 'half grains' from a Roman daub spread at Mill Cottage, Nonington, Kent (Helm and Carruthers 2011)

The earliest evidence for possible malting in the Midlands was found in a Middle Iron Age enclosure at Bushmead Road, Eaton Socon, Cambs [CB50]: This Middle Iron Age enclosure was situated on the first river terrace gravels of the Great Ouse. Of the six

samples assessed, only one, from a pit fill, contained useful quantities of charred plant remains. Spelt wheat appears to have been the dominant cereal present, possibly with some emmer and bread wheat. Hulled six-row barley was also frequent. Oats may have been a weed as one *A. fatua* floret base was observed. Grain was abundant but chaff (spelt chaff) and weeds (fat-hen, *Bromus* sp.) were sparse. Detached embryos were numerous, indicating malting or spoilt grain. The scarcity of chaff and weed seeds suggests fully processed grain had been burnt, perhaps having spoilt or having been malted. It would be worth radiocarbon dating material from this deposit.

Another example of possible early malting evidence is provided by a deposit from a Late Iron Age/early Romano-British enclosure at Grange Park, Courteenhall [NH41]. Frequent germinated spelt and barley, plus detached coleoptiles were recovered from an enclosure ditch suggesting the possible malting of mixed grain.

In the Roman period evidence for malting from Midlands sites is much more frequent, with spelt wheat being the principal grain sprouted, though this is occasionally mixed with barley, as at Courteenhall [NH41]. Substantial evidence has been found at Mucking [EX22], Elms Farm, Heybridge [EX26], Tiddington [WR35] and Bancroft Roman Villa [BK24], as well as several sites with more tentative evidence for malting (moderate amounts of sprouting, rather than abundant), such as Empingham Villa [LR17] (see *Table 1*). Several Roman sites, including some villas have produced dumps of malted grain, such as Bays Meadow Villa, Droitwich [WC14a], although no corn driers were excavated at Bays Meadow. Dumps of malted grain have been found in a variety of settlement types, including rural enclosures such as Weedon Hill, Aylesbury [BK3], in large fortified settlements such as Little Chester, Derby [DB1] (a rubbish dump), and towns such as Worcester [WC21a], suggesting the practice was widespread in a range of different types of location. The most complete example of a Roman malt-house is from Stebbing Green, Essex, where a combination of archaeobotanical, artefactual and structural evidence has been used to indicate the presence of a malting vat, malting floor, parching ovens and mill to grind the malt to a grist suitable for brewing (Murphy 1999).

By the medieval period barley had taken over as the preferred grain for malting, though this was often mixed with oats, or possibly the mixed crop of dredge, oats and barley, was used. Both two-row barley and six-row barley may have been malted, though the former is very difficult to confirm (see Section 6.6.3). At West Cotton some ovens/kilns were thought to have contained two-row barley, because very few twisted lateral grains of six-row barley were observed ([NH37]), for example oven 393 dated to AD1100-1250. In addition, some samples from late Saxon deposits at West Cotton indicated that dredge had been used for malting (for example an AD 950-1100 mill sample), whilst others suggested that separate crops were grown but mixed together later if rates of sprouting varied too much, perhaps once they had been malted. Malted dredge was also recovered from later deposits at West Cotton, including an AD 1250-1400 malthouse, as well as an oven fill (AD 1250-1400) at Freeschool Lane, Leicester [LR26]. In the middle Saxon period at Higham Ferrers [NH20] a malting oven produced abundant sprouted barley.

Other medieval malting records include several sites in Cambridgeshire (for example Jewson's Yard, Ely Waterfront [CB17], St Neots [CB38] and Ramsey Abbey [CB41]), a county that appears to have had a long history of brewing. At Ramsey Abbey a corn mill and malt mill were investigated. Jewson's Yard, Ely [CB17] is another site that may have been using two-row barley. More unusually, frequent sprouted oats were recovered from a 13/14th century fishpond at Castle Garage, Monk Street, Tutbury [ST7], perhaps

indicating malted grain that would have been later mixed with barley if it had not spoiled. More information concerning corn driers/kilns/ovens and malted grain deposits can be found in the Period Reviews in summaries of the more productive sites, such as West Cotton.

There is scant evidence for the use of flavourings in fermented beverages, particularly since it is difficult to assign the occasional find of a few hop (*Humulus lupulus*) seeds in a mixed waste deposit to a specific use. Indeed, because hop fruits (female 'cones') used for brewing should not be pollinated and produce seeds, the presence of hop seeds is more likely to represent wild plants or use for medicinal purposes, rather than brewing. Hops is a dioecious (having the two sexes on different plants) perennial that is native to most parts of Europe, scrambling through hedgerows, scrub and fen-carr. The first evidence for its use in the Midlands consisted of fused masses of hundreds of charred hop fruits from a late Saxon pit at the ABC Cinema site, Ipswich, [SK39] which must indicate use, presumably as a flavouring/preservative for beer. Apart from the ABC cinema evidence, archaeobotanical evidence for the use of hops in the Midlands region is scarce. A group of medieval to post-medieval pits thought to have been used for retting or tanning at Corpusty/Saxthorpe Link Road, Norfolk [NK6] contained traces of possible hop bracts, but neither retting, tanning nor brewing activities could be confirmed. A post-medieval waterlogged pit (King Street, Derby; [DB2]) and a well (Stansted Hunting Lodge; [EX18]) produced a few hop seeds but in both cases the remains were mixed with domestic waste so their association with brewing was unproven.

The first documentary association of hops and brewing dates from a 9th century Benedictine monastery in Picardy, Northern France (http://zythophile.co.uk/2009/11/20/a-short-history-of-hops/, recorded by Abbot Adalhard), although not necessary implying hopped beer. Specific mention of brewing hopped beer in monasteries dates from 12th century in Germany, as recommended by the Benedictine abbess Hildegard in her book on health and healing ('*Liber vitae meritorum*'). However, it is generally thought that hopped beer, with its better keeping qualities than ale, did not dominate the British market in until the later medieval period. Hopped 'beere' was being imported from the Low Countries by the 14th century but the first evidence for the cultivation of hops in Britain dates to the 16th century when Kent became an important hop growing county (www.zythophile.wordpress.com; www.breweryhistory.com).

Prior to using hops for flavouring and preserving, a variety of plants was added to ales, including sweet gale (or bog myrtle, *Myrica gale*), dandelions, marigolds, burdock root, horehound and ground ivy. Since some of these are common weeds of waste ground it is hard to demonstrate use. However, the presence of sweet gale at excavations near Peterborough Abbey [CB34] could suggest use of the plant as a flavouring, perhaps with other herbs such as fennel and mint. Other finds of sweet gale have come from waterlogged Roman pits at Stonea Grange [CB20] and Lincoln waterfront [LC1] (preliminary assessment), though use in brewing was not suggested in either case.

6.2.1.6 Seeds used as a source of oil

This topic is discussed in Section 6.6.7 under 'plants with economic uses deserving of further investigation'. Seeds that contained high percentages of oil, such as members of the Brassicaceae, flax (linseed), cotton thistle and nuts would have been highly valued. Plant oils have a variety of uses: for lighting, cooking, ritual and medicinal uses. Because many of the plants that produce oil are native to the British Isles it can be difficult to be

certain whether or not they have been collected or grown specifically for the extraction of oil. In addition, plants in the Brassica family are not always easy to identify to species level. In view of the importance of this topic it is clear that more research is required, perhaps by coupling the chemical analysis of residues on pot sherds with increased sampling from specific sites.

6.2.2 Medicinal uses of wild and cultivated plants

When classical texts and herbals are consulted it is clear that a wide range of native plants were being used for medicinal purposes, ranging from very common weeds such as nettles (*Urtica dioica*; see Pliny's Natural History Book 22. Chapter 15 'The nettle: sixty-one remedies') that would have grown in abundance around settlements, to less common and more toxic plants such as henbane (*Hyoscyamus niger*). The documentary evidence provides details of some of the plants that were valued for medicinal purposes (for example the 1st century BC *De Medicina*, by Carolus Celsus; Pliny the Elder's Natural History, AD77-79; Gerrard's Herbal including Johnson's 1633 revision), so there can be no doubt that some of the taxa represented within archaeobotanical assemblages would have been used medicinally when necessary. However, medicinal use of specific assemblages is very hard to prove, so the following examples are mainly described as 'possible' use of plants for medicinal purposes.

Arbury Camp, Cambs [CB4] Waterlogged plant remains were examined from five Iron Age hillfort ditch terminal samples and one of the deeper post holes. The remains fall into three groups: aquatic plants living in or at the margins of the water, ruderals and plants of damp, shady wooded and grassland environments. Nutrient-enrichment and disturbed ground weeds included henbane, thistles, nettles. Woody taxa included bramble and wood stitchwort. Human activities such as trampling, pasturing and cultivation are indicated. Unique leather-like remains were found to comprise abundant fragments of *Scleroderma verucosum*, scaly earthball, amounting to about seven earthballs plus one puffball. The fungi appear to have been deliberately collected and placed in the ditch, though they were unlikely to have been eaten, being too mature (puffball) or slightly toxic (earthballs). Medicinal use (e.g. styptic for wounds), for tinder or packaging were suggested. A few other finds of puffballs were listed, though no earthballs.

Forehill, Ely, Cambs [CB10] Fifty-five samples from features dating from the 11th-12th centuries, up to the 15/16th century produced waterlogged and charred plant remains. Free-threshing wheat, rye, barley, oats, peas and broad beans were present amongst the charred assemblage. The waterlogged samples produced evidence for the consumption of a range of fruits and nuts, primarily in the 14th century occupation of the building. These included a few exotic fruits and nuts including fig, grape and walnut. Orchard fruits included cherry, plum/bullace, apple and hazelnut. The recovery of frequent vervain seeds in two 13/14th century samples led to the suggestion that they may have been gathered for medicinal use, since the plant prefers lighter soils than those in the area and vervain was valued as a cure for the plague in the Middle Ages.

Long Causeway, Peterborough [CB34] During excavations near Peterborough Abbey charred and waterlogged plant remains were recovered from 13th-14th and 16th century deposits. The site summary has already been presented in Section 5.7.5 (Medieval monastic sites), but the possible medicinal taxa recovered included henbane, vervain and opium poppy.

Waltham Abbey, Essex [EX23] A waterlogged sample (200ml) was examined from a C16th post-dissolution pit at Waltham Abbey. Abundant henbane and several hemlock seeds were present, plus a few common weed seeds. Other sites producing these two taxa were listed, but none had produced more than around 20 seeds. Discussion of the possible medicinal uses of the plants and references to them in herbals and botanical publications were given. The evidence suggests that both species were cultivated at the Abbey, possibly for external use for pain relief. Seeds could have been steeped to remove the powerful alkaloids. The pit had probably received waste from this process.

6.2.3 Plants used in the home and for building: flooring, bedding and construction
Considering the frequency with which domestic buildings have been investigated, there is still very little secure evidence (aside from wood/charcoal evidence) for uses of plant materials in the home. One possible source of evidence for flooring material can be found in cesspits, such as the medieval barrel latrine from Worcester ([WC22], 278). Mineralised and waterlogged remains of materials such as hay, straw and sedge stems are commonly found in cesspits, and one explanation given is that it had first been used for flooring, and then swept up and deposited in latrine pits so as to soak up liquids and reduce foul odours. An additional suggestion is that it had been used as toilet wipes, though this could be alongside use as a floor cover. *In situ* recognisable lumps of charred and waterlogged materials such as thatch and flooring are required in order to provide clear evidence of use, and these would need to be hand-collected, rather than disaggregated and mixed during the processing of soil samples. Examples of roofing materials (sods from scallop-thatched roofs) have been found in anaerobically preserved deposits in the houses of Viking Dublin, Ireland (Geraghty 1996, 27). Conversely, no definite fragments of roofing materials were found in the equally well-preserved Viking deposits at Coppergate, York, (Hall and Huntley 2007, 113). As suggested in section 5.7.4.3 (Medieval Period, Smoke Blackened Thatch) old thatch may have been too useful a resource to waste, perhaps having been burnt for fuel and/or composted. In addition, old thatch was often left on roofs as a base coat, unless it had become badly infested with pests and moulds. There is the potential, therefore, for plant material deriving from thatch to become incorporated in archaeobotanical samples from features such as hearths, pits and floor layers. Having analysed the weed component of smoke blackened thatch from southern England, de Moulins (2007, 396) suggested that it may be possible to detect the presence of thatch in archaeological deposits in cases where rivet-type wheat or rye grain and straw, or legume pods and stems, were frequent, in addition to some of the weeds described in her paper. However, no specific indicator weed taxa were identified, so this methodology would need to be applied with caution.

As demonstrated by Letts (1999, 12-23) a range of plant materials have been used for thatching in the past, including water reed (*Phragmites australis*), great fen-sedge, reedmace (*Typha* sp.), bulrush (*Schoenoplectus lacustris*), broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), heather (*Calluna vulgaris*) as well as various cereal straws. Long-strawed cereals such as rivet-type wheat and rye were the principal cereals used for the main coats.

6.2.4 Horticulture and Gardens
The topic of identifying garden plants amongst assemblages was first brought to the attention of archaeobotanists by Lisa Moffett with her article on 'Gardening in Roman Alcester' (1988). Murphy and Scaife summarised the available biological evidence for Roman and later gardens in their review (1991). James Greig's comparisons between the archaeobotanical and historical records provided another valuable method of examining

the data which is particularly relevant to garden/horticultural archaeology (Greig 1996). Some notable records of garden plants recovered from archaeological sites are outlined below. Roman villas and medieval monastic sites, particularly those with waterlogged features, have great potential for providing evidence for both medicinal, orchard and horticultural plants, as shown in the summaries. Although it is not possible to tell which uses the various taxa were put to, or where exactly they had been grown, the wide variety of foods and flavourings recovered were very likely to have been locally grown in ornamental and herb gardens, physic gardens and orchards.

In addition to the more obvious cases, where a variety of taxa that are currently considered to be garden plants are found grouped together, it should be remembered that many other cultivated and native plants found in small quantities in assemblages may have been grown on a garden scale in the past, close to dwellings in both urban and rural locations. In particular, peas and beans, flax, hemp, leaf vegetables such as members of the Chenopodiaceae, Brassicaceae and mallow would have been suitable for garden cultivation. Unfortunately this important aspect of a household's economy is extremely difficult to recognise amongst mixed rubbish deposits, especially since in most cases vegetables would not have been left to run to seed, and charring was unlikely to take place where seeds were being retained for sowing.

Amongst the more easily recognised garden plants, fruits of beet *(Beta vulgaris)* have been found in Roman, medieval and post-medieval assemblages at a number of sites, suggesting widespread cultivation in the Midlands region. By comparison, records in the Northern region are virtually absent (Hall and Huntley, 2007). Midlands Roman records include Rocester, Staffordshire [ST17a] [ST17b], Alcester, Warwickshire [WR33], Causeway Lane, Leicester [LR4], Washbrook Lane, M6 Toll Road, Warwickshire [ST23] and Higham Ferrers, Northants [NH23]. Additional garden plants recovered from a Roman well at Higham Ferrers were opium poppy, summer savoury, coriander, celery, fennel, black mustard and at least three additional types of brassica (cabbage/kale, rape and turnip/swede). At Causeway Lane other potential garden plants recovered from features within the planned Roman town included pea, bean, lentil, opium poppy, fig, flax, coriander, apple/pear, bullace, hazelnut, sloe and, for decorative purposes (and possible medicinal use as an abortificant and labour inducer, Gerrard and Johnson 1633) columbine (*Aquilegia* sp.). Many of these possible garden plants were also found in medieval deposits at Causeway Lane, with the addition of a charred leek seed. Documentary records suggest that vegetables such as leeks, onions, garlic and cabbage were highly valued in the medieval period, judging from import records from the 13th to 16th centuries studied by Gras (1918).

From Bancroft Roman Villa, Bucks [BK24a], waterlogged macrofossils of coriander (*Coriandrum sativum*), celery (*Apium graveolens*), summer savory (*Satureja hortensis*), black mustard (*Brassica nigra*), caper spurge (*Euphorbia lathyrus*) and plum (*Prunus domestica*) were recovered. They were interpreted as representing horticultural activity at the villa in one particular enclosure

The earliest evidence for a formal garden in eastern England has come from the Roman site at Rectory Farm, Godmanchester, Cambridgeshire (Murphy unpublished). Here, the fills of wells and of two ornamental ponds produced macrofossils of a range of both ornamental and edible garden plants: beet (*Beta vulgaris*), box (*Buxus sempervirens*), pot marigold (*Calendula* cf. *officinalis*), fig (*Ficus carica*), cf. fennel (cf *Foeniculum vulgare*), opium poppy (*Papaver somniferum*), spruce (*Picea abies*), yew (*Taxus*

baccata) and grape (*Vitis vinifera*). In addition, there were remains of rose (*Rosa* sp), violet/pansy (*Viola* sp), celery (*Apium graveolens*) and carrot (*Daucus carota*) which could represent either wild or cultivated plants. It is not clear whether the box leaves came from standard trees or clipped hedges as most were fragmented. Yew was represented only by a single twig. However, the leaves, shoots and cones of spruce, not a native British tree in the Holocene, clearly did come from standards. Evergreens of various sorts, including conifers, both clipped and as standards were characteristic features of Roman gardens in Italy, as described by Pliny (Zeepvat 1991, 53). It seems reasonable to suppose that the use of spruce and yew in the Godmanchester garden, replacing the bay and cypress of the Mediterranean, was an adaptation of the classical style to the British climate. Although the assemblage from the villa at Stanwick, Northants, has only been assessed to date [NH38] a small number of possible garden plants were recovered from waterlogged features, including traces of coriander in several samples, opium poppy, box leaves in the later Roman samples and celery. Cotton thistle was present in three 3rd to 4th century samples.

A number of monastic sites have produced evidence for possible garden and horticultural plants. Waterlogged accumulations abutting the precinct wall of Shrewsbury Abbey, Shrops [SP2], dated to c.1150-1330 AD, produced the remains of fruits including strawberry and bilberry (*Vaccinium myrtillus*) and fig, bullace and damson, pear and apple. Almond shell and pine nut shell were present which are more likely to have been imported, while HNS was frequent. Fennel, celery, chicory, cf. pennyroyal and cf. black mustard indicate flavourings that were being used, all of which could have been cultivated in the abbey gardens.

During excavations at Peterborough Long Causeway, Peterborough Abbey, Cambs [CB34] charred and waterlogged plant remains were recovered from 13th-14th century and 16th century deposits. Possible garden or orchard crops included beet, fig, hazelnut shell, blackberry, apple and plum/bullace, black mustard, opium poppy, fennel, mint, flax and weld. Possible medicinal plants included henbane and opium poppy.

There is ample documentary evidence for late medieval gardens, and macrofossils of garden plants have been reported from a number of sites, as described in the review by Murphy and Scaife (1991). Gooseberry seeds *(Ribes uva-crispa*), found in the 15th century Worcester barrel latrine, may mark the first appearance into Britain of this plant in a cultivated form ([WC22], 182). Garden plants such as opium poppy, sweet violet, strawberries, mint and celery have been identified from macrofossils in urban latrine pits, at Deansway, Worcester, Worcestershire [WC6] for example. An 8th/9th century cesspit contained abundant mineralised fruit remains, including more than 1000 *Prunus* embryos (genus includes cherry, damson, plum etc.), c.60 apple/pear seed embryos and a few peas. The existence of orchards at this time was considered likely. A few garden plants (some uncharred) might have been represented and perhaps some latrine waste, since opium poppy, fig, sweet violet, mint, strawberries, blackberries, cf. raspberries and cf. cotton thistle were recorded.

The sporadic records of flax may also indicate local gardens, for late medieval and early modern writers identify it as the province of the "housewife" who is supposed to tend them in her garden and process them for textile manufacture (Markham 1668). Elsewhere, especially at rural sites, macroscopic remains of flax are more likely to have been grown on a field-scale production.

For the post-medieval period contemporary gardening books can provide a great deal of information (see sources cited in Fitzherbert 1882; Harvey 1981). Garden plants make a significant appearance in the archaeobotanical record at this time, with records reported for this period including columbine *(Aquilegia vulgaris),* pot marigold *(Calendula officinalis),* asparagus *(Asparagus officinalis),* dill, other condiments and many of the species from the "fruit salad", especially strawberries. However, only wild/Hautbois-type strawberries (*Fragaria vesca/moschata*) have been identified so far in the Midlands, according to the published record. Some weeds such as *Euphorbia* sp. are also considered to be associated with gardens. Such assemblages have been found at Deansway [WC6], the two sites of Leicester Shires [LR5], and Dudley Castle [WC38].

After dissolution Shrewsbury Abbey [SP2] was privately owned. Mid 15/16th century deposits which had accumulated outside the wall contained frequent fruit remains, including strawberry, fig, gooseberry and grape. Fruit stones and nuts of possible ornamental and orchard trees included various types of plum, sour cherry, medlar (*Mespilus germanica*), pear, apple and walnut. Vegetables and flavourings included mustard, dill, celery, coriander, hyssop (*Hyssopus officinalis*) and cf. pennyroyal (*Mentha* cf *pulegium*). Columbine may have been grown for medicinal or ornamental purposes. Early 18th-20th century rubbish deposits produced a range of aquatics andother debris, including frequent fruits, amongst which peach (*Prunus persica*) was a notable find. A seed fragment of cucumber or melon (*Cucumis* sp.) was also recorded, along with fennel, coriander and cf. pennyroyal, plus black pepper and Melegueta pepper.

Samples from Pembroke College, Cambridge [CB1] produced plant remains from a typical, useful range of garden plants. A square, clunch-lined pit thought to have been a cesspit was dated to the later 16th century. A sample from waterlogged deposits in the base of the pit produced plum (bullace/damson-type) and dwarf cherry-type stones. Hazelnut shell and a fragment of walnut shell represented additional remains from economic plants. Holly seeds may have come from garden plants, as may large seeds from *Brassica/Sinapis* sp. and a possible seed and tepal of patience dock (*Rumex patientia*). This species was introduced from the continent and grown as a pot-herb in the past. Cotton thistle (*Onopordum acanthium*), henbane and stinking chamomile were the most notable 'wild' taxa, indicating either a period of abandonment or an area of rough ground where nutrient-rich waste had accumulated. The first two taxa also have medicinal/economic uses. No mineralised remains were found, but the fruit remains could have originated in faecal waste, since stones were often eaten with the fruit.

Waterlogged fills of garden features, including ditches and ponds, sealed beneath layers associated with the construction of a 16th century building at Hill Hall, Essex have produced plant macrofossils (Murphy and Scaife 1991, 95-6). The features were evidently backfilled prior to construction work and most plant remains from their upper fills related to weed and scrub vegetation following abandonment of the garden. Samples from the lower fills included an unusually high proportion of *Plantago major* (up to 39%), implying the proximity of trampled ground, probably a well-used pathway. Above this, increases in the abundance of bramble and *Torilis japonica* implied tall herb and scrub development. The top fill included a mass of hedge trimmings dumped into the feature and a weed flora dominated by *Urtica dioica*. A range of garden plants and crops was recovered: celery (*Apium graveolens*), beet (*Beta vulgaris*), *Brassica* sp, marigold (*Calendula officinalis*), hemp (*Cannabis sativa*), teasel (*Dipsacus fullonum*), fig *(Ficus carica*), strawberry (*Fragaria vesca*), hops (*Humulus lupulus*), flax/linseed (*Linum usitatissimum*), cherry (*Prunus avium*), vervain (*Verbena officinalis*) and bread wheat

rachis (*Triticum aestivum*). Plainly, some of these are field crops and others, such as fig, could be derived from food waste or even sewage. Remains of some other plants including rose, mallow (*Malva sylvestris*) and agrimony (*Agrimonia eupatoria*) might represent either garden plants or wild species. Other trees and shrubs identified from wood, thorns, leaves, fruitstones and seeds were bullace (*Prunus domestica* ssp *insititia*), hazel (*Corylus avellana*), hornbeam (*Carpinus betulus*), holly (*Ilex aquifolium*) and oak (*Quercus* sp.). A mass of blackthorn (*Prunus spinosa*) stems showing transverse cuts may have come from a perimeter hedge.

At most garden sites, however, there are no waterlogged features and consequently conditions are less favourable for preservation of plant material. At Audley End, Essex, flower-beds of a 19th century parterre, partly sealed by a gravel path, were sampled. In the dry fills of these features there was much intrusive recent plant material; the only macrofossils possibly related to 19th century gardening were charophyte oospores (algal resting spores), perhaps introduced into the soil when watering (Murphy 1987b).

However, work by Chambers and de Rouffignac at Castle Bromwich Hall Gardens, West Midlands (Currie 1990; Currie and Locock 1991) has shown that uncharred seeds and pollen may survive in buried garden soils for at least a few hundreds of years, contrary to what one might expect in aerated soils of high nutrient status. With these results in mind samples from flowerbeds and bedding trenches in a 17th-18th century walled garden at Cressing Temple, Essex have been examined for uncharred plant material (Williams and Murphy 1991). Most fruits and seeds present were of weeds, grasses and shrubs (mainly elder) with some trees (including sycamore, *Acer pseudoplatanus*). However, seeds of a species of *Viola* (violet/pansy), nutlets of apple mint (*Mentha rotundifolia*) and a raspberry seed (*Rubus idaeus*) were present and probably represent plants growing in the garden.

6.2.5 Plants used in craft and industry: fuel, retting and cloth working

6.2.5.1 Fuel

One of the earliest pieces of evidence for the collection of vegetation (other than wood or charcoal) for possible use as fuel came from an early Bronze Age shaft-like pit associated with a burnt mound at Northwold [NK24]. The 98 waterlogged fragments of bracken in the lower fills of the 'well' were thought to have been brought to the site because the local soils would have been too wet to support this type of vegetation. However, no specific explanation could be found as to why the vegetation had been collected. The interpretation of 'collected for use as fuel or tinder' is also often applied to charred grassy vegetation and tubers (commonly including onion couch) found in cremation deposits, although other interpretations are possible, such as ritual use or the incidental burning of turves below pyres.

The use of cereal processing waste for fuel has been discussed elsewhere, particularly in the Romano-British Period Review (Section 5.5) where widespread evidence for the use of spelt processing waste to fuel corn driers was described (e.g. Haddon, Peterborough [CB32]; Godmanchester [CB58]; Mucking [EX22]; Deansway, Worcester [WC6])). In some cases there is evidence for other materials being combined with chaff in ovens/corn driers, such as heathers (e.g. Newark [NT1]; M6 Toll Road [WR28]). In later periods there is evidence for a wider variety of plant materials being used for drying grain, particularly in malting kilns. During the production of malt the fuel used to 'stop' the

malting process can affect the flavour of the final product, so choices may relate to local tastes and traditions, as well as cost and practicality. On some fen-edge sites, such as medieval malting ovens at Jewsons Yard, Ely waterfront [CB17], there is evidence to suggest that local fuel sources including peat may have been burnt (small fragments of burnt soil and iron-replaced wood were present). Charred great fen-sedge (*Cladium mariscus*) found in medieval features at Ely (increasing in the high medieval period on the Ashwell site, Ely [CB12]) was thought to have been used for fuel or tinder, as it would have burnt at too high a temperature for roasting malt. It was also being used for fuel alongside cereal straw in Cambridge [CB8] . Other uses of fen vegetation (fen-sedge, spike-rush, sedges, bogbean) may include flooring and thatching at the Ashwell site. At Cherry Hinton [CB24] cereal processing waste and sedge hay appears to have been used as a fuel for bread-making in the middle Saxon period. At Flixborough [LC19] the local saltmarsh vegetation had been used for fuel in the mid to late Saxon period, since charred sea club rush (*Bolboschoenus maritimus*), annual sea blight (*Suaeda maritima*) and seaweed fragments were recovered.

Evidence for large-scale peat burning in the East Midlands is more obvious if the landscape itself is used as a source of evidence. In addition, fruits and seeds of wild plants from sites in the east of the study area have provided some information on the exploitation of 'natural' plant communities and other economic activities. In the early medieval period vast quantities of peat ('turf') were extracted from the river valleys in east Norfolk and Suffolk, producing the peat pits which, from the late 13th century onwards, became flooded to form the modern Broads. Rackham (1986, 359) estimates total extraction at 900 x 106 cubic feet and considers that at this time Norwich was "a peat-burning city". The evidence for this very large-scale activity is elusive in soil samples from the city: the available evidence implies, to the contrary, that wood and charcoal were of greater importance than peat. At Castle Mall, charred remains of wetland plants, some of which are peat-formers were present, but at low frequencies. At least some of these (e.g. *Eleocharis palustris* (spike-rush), *Carex* spp (sedges)) may have arrived as crop contaminants or in animal fodder. The only samples interpretable with reasonable confidence as including peat-burning residues are those from medieval industrial/refuse pits. These produced abundant charred remains of *Carex* sp., *Eleocharis* sp., *Cladium mariscus* and *Phragmites*-type culm nodes, besides heat-discoloured oogonia of charophytes (stoneworts) and freshwater molluscs. These macrofossils point to the burning of base-rich *Cladium* and/or *Phragmites* peat. Overall, however, it is surprising that such a large-scale activity should be so archaeobotanically inconspicuous. Presumably peat is much less readily preserved by charring than wood, crumbling to a fine ash when burnt which would have been a useful addition to garden soils and composts.

The economic importance of fuels, in particular cereal processing waste, has been discussed by van der Veen (1999). In the Roman period spelt processing waste appears to have been transported to the Lincolnshire salterns to be used as fuel, alongside local vegetation that was first cut and dried as hay (Bourne/Morton canal [LC7]). There was no evidence for the use of peat at this site, but at a Roman saltern in Norfolk (London Lode Farm, Nordelph [NK29]) charred nutlets of *Cladium mariscus* (saw-sedge) from the debris of a Roman salt-producing site were dated to 400-170 cal BC and 820-510 cal BC (OxA-5437, 5438: 2 sigma date range). These nutlets significantly pre-dated the Roman site, and were obviously already sub-fossil when charred during peat-burning (ibid.). Chaff (mainly spelt) was also used as temper for the clay structures associated

with brine evaporation on the Essex coast (Wilkinson and Murphy 1995) and was used to fuel Roman pottery kilns in the region.

The trade in cereal processing waste as a product in its own right continued into the Anglo-Saxon and medieval periods, when the evidence shows that some towns were buying it in from the rural hinterland in large quantities. In late Saxon Stafford [ST9/ST10/ST11] ovens had been fuelled by rye coarse sieving and winnowing by-products. This particular fuel appears to have remained in demand through to the medieval period in the town, likely in part to be related to the suitability of the local soils for the cultivation of rye. Rye chaff was also used, often in combination with rivet/hard wheat processing waste, in late Saxon to medieval Raunds sites [NH36] [NH37], in the early medieval M6 Toll Road sites [WR27], in medieval Cambridge [CB8] and in later and post-medieval Worcester [WC6]. The fact that the two long-strawed cereals (rye and rivet) that were the most useful for thatching appear to dominate these ash deposits could suggest that old thatch was often used as fuel, or that demolition debris was being deposited in some of the features investigated. In addition, rye straw was said to be favoured for malting, imparting a good flavour to the malt (Markham 1668).

In contrast, Roman to medieval sites in Leicester (e.g. [LR4], [LR5], [LR6]) have not produced large concentrations of chaff, though some large clean and partly cleaned grain deposits have been found in the post-medieval period in the southern suburb [LR6]. Hay was being brought in as fodder for livestock being kept in the town in the Roman period ([LR4], [LR42]), possibly in preference to chaff. The evidence for rye, including rye chaff, is sparse, suggesting there was little demand for it. It is likely that while the demand for rye chaff may in part have been driven by certain activities, such as malting, other factors such as availability in the area and suitability of local soils were more significant.

In Cambridge and Ely de Vareilles and Ballantyne ([CB8]) have noted that there is a peak in the occurrence of oven ash around the 13th-14th century which declines from the 16th century. Perhaps this indicates a change to the use of other fuels that do not leave retrievable residues, changes in waste deposition or alternatively the introduction of tighter regulations controlling the use of ovens in urban areas following events such as the Great Fire of London in 1666.

Whilst ovens, corn driers and malting kilns would have required a controllable, gentle heat to achieve drying without scorching or charring, metalworking hearths would have been required to reach, and sustain, much higher temperatures. Late Saxon metalworking hearths at Thetford [NK25] made use of heathland vegetation to obtain high temperatures, and Roman pot kilns at Snettisham [NK23] probably used spelt processing waste, heathers and hay, judging from the nearby pit fills. Roman smelting and smithing deposits from two sites in the suburbs of Worcester [WC21a] produced frequent charred spelt processing waste, as has been found in other similar sites in the town. Pollen, charcoal and plant macrofossil evidence suggested that woodland resources may have been depleted by Roman metalworking activities leading to an increased dependence on other fuel sources such as crop processing waste. Spelt chaff was also used in metalworking hearths at Ruxox, Beds [BD27]. Pollen analysis from this site indicated that there was a significant reduction in woodland from the Iron Age onwards. By the Romano-British period there was much less evidence for the major fuel woods such as oak, lime and hazel. Chaff is unlikely to have provided a sustained heat but it may have been used to supplement scarce fuel resources and to assist in bringing poorer fuel woods to the correct temperature.

Waterlogged features such as wells and waterholes also sometimes produce heather- and bracken-rich deposits that are said to probably represent vegetation gathered for fuel (e.g. late Roman waterhole at Upton [NH32] – frequent heather stems; Roman quarry pits re-used as wells at Snettisham [NK23] – heather and some bracken; Roman stone-lined well at The Butts, Worcester [WC20] – bracken and waste materials). Later evidence for the use of heathland or rough ground vegetation including heathers, gorse, bracken and ling was found in a medieval oven at St Peter Street, Norwich [NK10]. In two other cases in Norfolk the dumps of charred heather and bracken remains in early Saxon to medieval features at Snetterton [NK8] and on a medieval floor at Aylsham [NK9] could represent fuel cleared out of hearths and ovens, or vegetation used for other purposes and later burnt as waste, such as bedding, flooring, thatching or fodder.

Another possible source of fuel was indicated at Haynes Park, Beds [BD3], where a mixed deposit of charred spelt de-husking waste and dung near to a Roman drying oven suggested that dung could also have been collected for use as fuel. Dung is often used in arid regions and where woodland resources are limited, so this evidence has implications regarding the use of dung as fertiliser and availability of other fuels.

6.2.5.2 Plants used in cloth-working

Evidence for the cultivation of fibre crops spans all periods, the earliest being flax from the two most important Neolithic settlements in the region: The Stumble [EX37] and Lismore Fields, Derbys (Jones 2000; [DB13a], [DB13b]). At Lismore Fields 124 flax seeds were recovered demonstrating the importance of this crop in the Neolithic. It must be remembered that the presence of flax seeds does not demonstrate the use of the fibre for textile production, merely the potential for it. In this respect it is interesting to note, however, that flax seeds are not found in ceremonial deposits, unlike foods such as hazelnuts, cereals and apple. This is discussed further in the next section. Bronze Age and Iron Age records for fibre crops are less frequent, but this could be due to fewer sites with waterlogged deposits from these periods being investigated. A possible flax seed fragment was found in a LBA/EIA context at Brooklands [BK17a] and flax was confirmed at EIA deposits from North Shoebury [EX41].

Roman records for flax are more numerous in the Midlands region, with notable quantities of charred remains present at Causeway Lane, Leicester [LR4], Earith, Cambs [CB65] and Tiddington, Worcs [WR35]. Flax has also been found on sites in Essex and Suffolk.

The occurrence of flax remains continues to increase into the Anglo-Saxon and medieval periods, possibly due to the increased occurrence of suitable contexts for waterlogged preservation at a time when towns were expanding along river banks and estuaries. In addition, the evidence for retting flax for fibre production is stronger in this period. Flax capsules were recovered from West Cotton and this was interpreted as evidence for retting, dated to the middle Saxon period (OxA 4079; 1295 ±70 BP, cal AD 660-780 (68% confidence) cal AD 620-900 (95% confidence)). Seeds and capsule fragments of gold-of-pleasure (*Camelina sativa*) were found associated with these remains – an archaeophyte thought to have been introduced as a weed of flax. In the middle Saxon settlement at Staunch Meadow, Brandon, Suffolk [SK26] within peats on the floodplain of the Little Ouse adjacent to the settlement area, rectangular clay platforms were associated with stem waste, seeds and capsules of flax and fruits of hemp (*Cannabis sativa*). By the medieval period flax remains are fairly common in waterlogged urban

waste deposits (for example Stafford [ST9/10/11], St James's Square, Northampton [NH39]).

Other indicators of cloth working include the presence of fullers' teasels (*Dipsacus sativus*) and hemp seeds in channel deposits at Bordesley Abbey Mill [WC29] and in a 17th century fill of the Worcester medieval city ditch [WC19] (see Sections 5.7.3.3 and 5.8.3 for summaries). A large range of other plants can be used for fibre production, including nettle (*Urtica dioica*), and for textile dyes, although demonstrating their use for such is extremely difficult. The recovery of several fragments of woad fruits (*Isatis tinctoria*) from two waterlogged Iron Age pits at Dragonby, Lincs [LC26] is one of the more convincing pieces of evidence to have been uncovered, particularly since the plant is not native to Britain or Northern Europe. Although the use of woad as body paint by the Britons, as described in Caesar's *De Bello Gallico* Book V, 14 has been questioned (Pyatt *et al* 1991), the recovery of woad fruits and impressions on pottery from other Iron Age sites in Northern Europe ([LC26], 211) demonstrates its importance during this period.

6.2.6 Plants possibly used in rituals (including feasting) and burials

Examples of the use of plants in rituals and burials have been given under the period sections (e.g. Section 5.3.2 Neolithic ceremonial and burial sites). In this section the evidence is reviewed as a whole.

One of the main problems still requiring research is which of the charred plant remains recovered from cremations and burials were deliberately burnt with the human remains, or deliberately placed as burnt offerings/tributes, and which were accidentally included or residual within the burial soil. Whilst radiocarbon dating might help to separate out residual remains if they are detectably older than dated bones, the other materials may prove to be more difficult to interpret. Large caches of food remains suggest that deliberate deposition was involved, but the presence of non-foods or questionable foods such as tubers remains problematic. Charred onion couch tubers (and sometimes other types of tuber) are characteristic of cremation deposits, but whether this represents deliberate burning due to ritual significance, deliberate burning due to use as tinder (Robinson 1988) or accidental charring due to their presence beneath cremation pyres is still often questioned in reports. Where assemblages also contain frequent grass-sized stems and Poaceae seeds but no (or scarce) food remains the latter two options are usually suggested, i.e. either deliberate pulling up of grasses for use as fuel/tinder or to create a fire break or incidental burning of turf below the pyre (e.g. Norwich Southern Bypass, Bronze Age cremations [NK12]). However, if, as at Whitemoor Haye Quarry [ST5], pignut tubers are present the deeply buried tubers could signify deliberate digging up of these items at least. Alternative suggestions where only a few pignut tubers are present are that turves could have been cut and dried for fuel, or removed from the pyre site exposing the tubers to fire. Pignut can become frequent enough in poor, unfertilised grasslands to be accidentally burnt in this way (according to the author's (WJC) unpublished experimental work). The frequency of onion couch tubers in some later burial contexts (1st 3rd century AD Thaxted [EX27]) as well as some non-burial deposits (IA roundhouse at Beaumont Leys and Humberstone, Leicester [LR8]; LN/EBA hearths at Lynford Quarry [NK26]) suggests that the presence of tubers is more likely to be related to the process of burning turves or grassy vegetation, rather than ritual behaviour.

Finds of occasional cereal grains in burial and cremation deposits are fairly common, but the poor states of preservation and sporadic occurrences often suggest that these are residual, or accidentally deposited. A large deposit of cereals (mainly spelt grains with occasional emmer and bread wheat type grains) recovered from a Late Iron Age inhumation at Rushey Mead, Leicester [LR20] was probably included with the burial as there was no evidence of in situ burning to suggest that the feature was a reused storage pit. At Parnwell, Peterborough [CB30] a Romano-British inhumation contained well preserved cereals and chaff mainly from spelt but also with bread wheat and ten emmer-type grains (not found in other samples from the site). Only traces of weeds and a barley grain were present. This may have represented a deliberately burned offering. Further evidence for the deliberate inclusion of foods within a Roman burial context was found at Jesus Lane, Cambridge, (see Section 5.5.3.5) [CB5] where late Roman graves contained 27 grains of free-threshing wheat with some hulled wheat, barley, pea and weed seeds but no chaff fragments.

It has been noted in the section above that flax seeds are rarely recovered from burial or cremation contexts (although see Pode Hole Quarry [CB42] where one BA cremation was dominated by flax seeds. This observation could suggest that the plant was primarily used for fibre rather than oil/food production, and so may have been less likely to be used for ritual purposes. If this were true, ritually burnt deposits at ceremonial sites are more likely to represent foods consumed during the ceremony, rather than materials that may be required in the next life, though of course this is all highly speculative. However, it is this type of comparison across a large number of examples in sites across the British Isles that may, eventually, clarify the selection of plant material for ritual purposes. The occurrence of food remains in Roman cremations across Europe has been reviewed by Kreuz (2000), as discussed in section 5.5.3.5. This study demonstrates that there is a lot of potential in ritual and burial contexts. Grape pips, possible fig, dates, lentils and Celtic bean have so far been recorded from cremation and *bustum* deposits from British sites (Section 5.5.3.5; Allen *et al* 2012; Pelling 2009; Fryer 2013). Further investigations may help to clarify which foods were being selected and what was their significance. At a different type of Roman site and context, over 500 fragments of HNS and over 200 poorly preserved cereal grains (mainly emmer and spelt wheat), plus some tubers, were recovered from a ring ditch at the Roman marching camp at Bromfield [SP7] and it was suggested that these remains might represent feasting or offerings. Finds of stone pine cone and seeds possibly burnt in Roman shrines have been recorded from Orton's Pasture, Rocester, Staffs [ST16].

Plant macrofossils can be an important source of information when investigating the function of some other types of enigmatic sites, such as cursus, pit groups and burnt mounds (see Section 5.3.1). At Aston Cursus, Aston on Trent [B12] a quadrant of the barrow situated between the cursus ditches was excavated in the 1960's revealing sterile ring-gullies, one of which was cut by a shallow pit. The pit produced 11 sherds of a carinated bowl and over a thousand emmer grains (*Triticum dicoccum*; see also Loveday 2011) with some HNS. The emmer was dated to around 3500 cal BC (based on 3 dated grains: 3800-3010 cal BC (BM-271; 4700±150); 3650-3370 cal BC (SUERC-25943); 3950-3700 cal BC (OxA-22081, 5024±35)). In his discussion of Neolithic pits in the Middle Trent Valley, Loveday (2011) suggested that, in order to produce large numbers of well-preserved charred grains around the sides of the pit near the upper rim, a superstructure of turf may have existed. Insufficient signs of burning were present to suggest that fires had been set within the pit, and this would not have provided the right conditions for such good grain preservation. Instead, heated stones could have been used

to slow-cook or smoke strips of meat, in the manner sometimes suggested as having taken place at burnt mounds. Charcoal-rich lenses with burnt flint were recorded in the pits at Kilverstone, Norfolk [NK21], and 21 of the 46 samples examined produced small quantities of charred cereals. Suggestions such as this need to be borne in mind when Neolithic/early Bronze Age pits are excavated in the future. With careful micro-excavation and detailed sampling for soil micromorphology and potentially phytoliths, well-preserved pits may provide sufficient evidence to investigate this hypothesis.

6.3 Regional Coverage

Although county boundaries are a relatively modern construct, subject to change over the centuries and of no significance to prehistoric settlers, almost all of the county towns in the region have medieval or earlier origins and many of the geographical boundaries had significance to earlier populations. It is useful to be able to briefly discuss the results of this review on a county level because of the structure of the planning process in relation to archaeological intervention. Previous reviews of the Midlands have been carried out for the sub-regions of West Midlands, East Midlands and East Anglia, so this division has initially been used below.

6.3.1 The West Midlands

The timely publication of 'The Archaeology of the West Midlands: A framework for research' (edited by Sarah Watt 2011), the culmination of over ten years of open meetings and discussions, has been a useful resource for this review. Environmental evidence was drawn together for the different periods by archaeobotanists such as James Greig (2007) and Liz Pearson (2003), and this has been integrated into the chapters by period. On the whole, research topics that are of interest for the West Midlands have also been highlighted in other areas of the country, such as understanding the relative importance of arable agriculture in the Neolithic period, and increasing research into early Bronze Age agricultural economies. The call for routine sampling for plant macrofossils on sites was once again made (p.120), showing that more still needs to be done to make sampling for environmental remains as integral a part of archaeology as recovering pot sherds. The curatorial chapter stressed that 'environmental work should be more prominent in briefs', ensuring that 'adequate time and funding' should be made for processing samples. The importance of off-site deposits with environmental potential was noted (p.248). Charred plant remains were said to be 'relatively sparse in the West Midlands', so sample sizes may need to be increased for prehistoric deposits. As well as increasing the chances of recovering sufficient data, it would also enable negative evidence to be recorded with confidence where pastoral farming was of greater importance than arable cultivation. The importance of AMS dating unusual and early plant records was also noted (p.249).

The solid geology of this area spans the late pre-Cambrian rocks in the west (Herefordshire) to Jurassic limestone, sandstones and clays in the south-east of the region (British Geological Survey, 2001). Quaternary deposits forming the basis for agricultural soils are dominated by slightly acid, reddish till with chalky till to the east.

6.3.1.1 Shropshire

This county has produced few major reports, particularly in recent years. The wetlands of Shropshire and Staffordshire were surveyed for North West Wetlands Survey Volume 5 (Leah *et al* 1998), amassing large amounts of data demonstrating the potential of the county. Pollen evidence from sites such as Top Moss indicated that there were two distinct lime declines in Shropshire; one decline occurred at around 3600 BP as well as a Bronze Age lime decline at 3220±50BP (OxA-6639; 1620-1410 cal BC). The burning of local mire vegetation appears to have been a regular feature in north-west England in prehistory (Leah ibid. p.180). Despite the frequent association of burnt mounds with wetlands, it was notable that none were found around any of the Shropshire meres (p.121). These features are more common in river valleys and by streams, rather than extensive peat deposits.

Possibly the most notable sites from the county include the long-term excavations at Wroxeter [SP16], where over 600 samples were taken during 1981-5 producing some useful Roman charred cereal data, and the recovery of waterlogged assemblages from dumped waste abutting the precinct wall of Shrewsbury Abbey [SP2] which provided information about monastic life in the 12th to 14th centuries.

The main priorities for this county are fairly straight forward – more data is required from all periods so every site that comes under threat should be intensively sampled. The most notable gaps are in the Bronze Age to Iron Age and the Anglo-Saxon period.

6.3.1.2 Staffordshire

The geography of Staffordshire provides upland moors in the north and south of the county with lower, undulating land in the central region. The clay soils that dominate the county would have favoured pastoral agriculture in early prehistory, which may account for the scarcity of early prehistoric charred cereal assemblages. At Whitemore Hay Quarry [ST5] only gathered foods including tubers were found amongst EBA funerary deposits. The earliest substantial records of cereal cultivation date from the Iron Age onwards in the Stafford town sites [ST9/ST10/ST11], where rye makes an early appearance in an Iron Age four-poster assemblage and remains prominent in the record throughout the Saxon and medieval periods due to use of the chaff for fuel. The importance of rye in the region might be due to the presence of acidic, sandy soils at Cannock Chase, south of Stafford. From the Saxon period onwards imported and/or garden and orchard foods and flavourings were present in Stafford, and in the medieval period tetraploid rivet wheat type free-threshing wheat and cultivated vetch were introduced. Both bristle oat (*Avena strigosa*) and common oat (*Avena sativa*) were being brought into town in the Late Saxon period. The presence of identifiable chaff fragments provided an early confirmation of the cultivation of these two types of oat in the region. Two samples from wooden barrels excavated at Brewood [ST1] provided useful plant evidence for local industries in the medieval period, consisting of wood, bark and sclereids indicating tanning and hemp seeds possibly suggesting that retting had taken place.

The gaps mainly lie in the early prehistory of this county, particularly for the Neolithic and Bronze Age periods. Whilst the urban medieval plant macrofossil evidence has been greatly increased by excavations in Stafford, rural sites including farmsteads and villages have been largely unexplored.

6.3.1.3 Herefordshire

This sparsely populated, agricultural county has seen few major excavations. The cathedral city of Hereford produced some important Late Saxon mineralised remains from the bottom of the burh ditch [HF2], including some imported foods. Further investigations in and around Hereford are likely to be valuable, particularly if waterlogged deposits along the Rivers Wye and Lugg are encountered. Recent assessments of twelve sites excavated from 1997 to 2005 in the Hereford area, dating from the Neolithic to medieval periods [HF14] will provide useful information when they are published, and demonstrate the potential of the county. Most sites date to the medieval period, but an Early Neolithic feature at the Hereford Asda site [HF8] produced emmer, frequent HNS and apple remains. This will make a useful comparison to the Early Neolithic pit group at Wellington Quarry [HF7]. The mostly free-draining, loamy soils would have been attractive to early farmers, particularly in the Wye Valley area, so survey work to assist the detection of sites in rural areas is to be recommended.

The priorities for this county are to generally increase the level of archaeobotanical investigation across the board. The analysis of the twelve sites mentioned above will be a useful first step. Evidence is most sparse for the Neolithic and Bronze Age, though Romano-British and Anglo-Saxon sites are also few and far between in this county.

6.3.1.4 Worcestershire

This region was part of Mercia in the 7th century AD, and was an important wool producing area for most of the Middle Ages. Pollen evidence from Cookley, Worcs suggests that the major decline in woodland did not start until the late Bronze Age (Greig 2004). Bronze Age dates for the start of cereal cultivation on a noticeable scale have been found elsewhere in Worcestershire (Greig 2007). However, there are a few sites which demonstrate that people were present in the county much earlier, including a Mesolithic hunting camp at Lightmarsh Farm [WC26] and a rich Late Neolithic cereal and gathered food assemblage from Clifton Quarry, Severn Stoke [WC33]. Because the towns of Worcester and Droitwich have been frequently investigated over the years prior to development, details about their Roman and Saxon origins are building up. The provision of an environmental archaeology service within this county at Worcestershire Archaeology, no doubt helps to increase the profile of this discipline at excavations in the region. However, evidence for crops dating from the Neolithic to late Bronze Age periods is still fairly scarce in this region. The Late Neolithic Grooved Ware pit recently excavated at Clifton Quarry, Severn Stoke [WC33], produced abundant hulled barley grain with apple remains and just a small amount of hazelnut shell. Six items, including barley grains, apple seeds and a possible rye grain (further possible rye grains have since been reidentified as indeterminate cereals, Pelling pers. comm.), were radiocarbon dated, producing a combined date of around 2900-2600 cal BC (see section 5.3.1). This charred plant material was associated with placed artefacts such as polished axes and pottery. Some of the other more important sites investigated in the last decade include Huntsman's Quarry, Kemerton [WC16] where a late Bronze Age structured deposit was dominated by emmer with no spelt present; Saxons Lode, Ripple [WC10] where Late Iron Age storage pits produced abundant charred cereal remains; Bays Meadow Villa, Droitwich [WC14a] included an annexe with abundant stored cereals; Deansway, Worcester [WC6] produced significant evidence from the Roman to post-medieval periods; Bordesley Abbey Mill [WC29] produced evidence for cloth working during the 12th/13th century.

Although this county has one of the best ranges of sites that have produced useful plant macrofossil samples, often containing both waterlogged and charred plant remains, there is inevitably a strong bias towards large urban centres such as Worcester and Droitwich. It would be useful to investigate additional rural multi-period sites like that at Kemerton so that the early development of the agricultural landscape is more fully understood. The Anglo-Saxon period also requires more work, particularly on more rural settlements.

6.3.1.5 Warwickshire and Birmingham

Although Lower and Middle Palaeolithic artefacts have been recovered from terrace deposits of the Rivers Avon and Severn, the fact that *in situ* archaeological deposits have yet to be found means that archaeobotanical information is scarce. The Avon Valley in Warwickshire has one of the greatest concentrations of Early Bronze Age sites in the country (Cracknell and Hingley 1994) and Greig (2007) highlights this as one of the areas requiring detailed environmental investigation. Sites such as Boteler's Castle [WR47], several sites from the M6 Toll Road project [WR27] [WR28] and the

Churchover to Newbold Pacey pipeline [WR24] have produced frequent gathered (hazelnut shell, apple) and cultivated (emmer wheat, barley) food remains, some of which has been dated to the Early Neolithic and others to the Early and Middle Bronze Age. Bronze Age burnt mounds have also been investigated. Later periods are reasonably well-represented by plant macrofossil evidence, particularly the Roman (for example Wasperton [WR46], Tiddington [WR35], Alcester [WR32] [WR33]), medieval (for example Burton Dassett [WR31]; Bull Ring sites [WR8/9/10/11]) and post-medieval periods (for example Bull Ring sites). Important evidence for the development of tanning and cloth-working industries was recovered from Birmingham city centre at the Bull Ring sites (ibid.).

The main gap in recent reports appears to be the Anglo-Saxon period, so this should be given a high priority. This is particularly important on multi-period urban sites where the Anglo-Saxon may be swamped by samples from other periods, particularly if there is a hiatus at this time. A reasonable range of types of sites has been investigated but, as always, further investigation needs to be done to understand the early development of arable agriculture.

In the past the Birmingham University Environmental Archaeology Unit has provided specialist services for much of the Midlands region, particularly the West Midlands. The recent loss of this resource will inevitably affect the provision of environmental expertise this county in the future.

6.3.2 The East Midlands

The publication of 'Archaeology of the East Midlands: An Archaeological Resource Assessment and Research Agenda (Cooper 2006) has provided a useful resource for this review, in particular Angela Monckton's chapter (Chapter 11, pp. 259-286) 'Environmental Archaeology in the East Midlands'. Research Agenda and priorities from this chapter have also been taken into account for Section 7 of this review.

6.3.2.1 Derbyshire

The county contains both northern upland characteristics and those of the midland lowlands, with the southern end of the Pennine gritstone penetrating the north-west of the county, whilst flatter, more fertile land characterises the majority of the landscape. Agriculturally, therefore, Derbyshire has offered a range of farming opportunities, with some lowland areas of highly fertile soils supporting arable, and with dairy farming, beef and sheep rearing on the Dales and Peak district. The Derwent and Trent are the major rivers of the county, flowing into the Humber estuary to the north-east. The rural nature of the county means that there have only been fairly low levels of development leading to archaeological investigations. However, one of the most important sites for the Neolithic period, Lismore Fields [DB13a][DB13b] is located in this county, as well as a number of other notable Neolithic and Bronze Age sites (Eggington and Willington [DB11], Aston Cursus [DB12] and Potlock Cursus [DB14]), suggesting that Derbyshire's fertile soils were attractive to settlers and farmers from an early date. The county town, Derby, has produced useful evidence of its Roman, Saxo-Norman and medieval past ([DB1], [DB2], [DB26]).

With regard to priorities, there is clearly a lot of potential for further, larger-scale archaeobotanical sampling in this county. The importance of Derbyshire in the Neolithic is notable, with the major settlement of Lismore Fields in addition to ceremonial sites such as Potlock Cursus and Aston Cursus. Ritual and ceremonial contexts continue to be

common into the Bronze Age, as seen by the excavation of several cremations, burials and a middle Bronze Age log boat. The following Roman and Anglo-Saxon periods, however, have provided very little information to date - the need for increased sampling in Derbyshire was noted in the Roman priorities section of Monckton's review (2006). These gaps in coverage need to be filled.

6.3.2.2 Nottinghamshire

The main river flowing diagonally through Nottinghamshire towards the north-east is the Trent. The slightly acid, loamy and clayey soils on the valley slopes are moderately fertile, but as a whole the slow-draining, often acidic soils in the county are low to moderate in terms of fertility. The production of wool and malt were important industries in the medieval period, with coal mining taking over in the 19th century. This is one of the least productive counties in terms of substantial plant macrofossil reports, particularly in the last decade. The assessment at Langford [NT5] demonstrates that settlement with arable agriculture occurred from at least the Late Neolithic/Early Bronze Age. The most notable sites are the Late Iron Age/early Roman enclosures at Gamston [NT3] and Worksop [NT2] which provided fairly typical evidence for the period consisting primarily of spelt, with some barley, emmer and pulses (probably pea and bean). Possible evidence to suggest that malting may also have occurred in the Roman period was found at Newark [NT1], since barley-dominated samples and sprouting was recorded, though this was thought to indicate poor storage conditions. Heather was being used to fuel ovens/kilns at this site, as well as cereal processing waste.

This county requires detailed environmental sampling programmes to be employed on all sites coming up for development in the future, since very little is known about the arable economy. It is not possible to set priorities or highlight gaps because all periods are so poorly understood.

6.3.2.3 Lincolnshire

Archaeobotanical investigation in the county benefited from the setting up of the Fenland Project which ran from 1982 to 1988. The threat to archaeological sites from peat desiccation, erosion and ploughing affected fenland in Norfolk, Suffolk, Cambridgeshire and Lincolnshire. Survey work identified sites dating from the Mesolithic period onwards, both dryland and some with wetland components (van der Noort 2002). Limited excavations were later undertaken by the Fenland Management Project, with integrated palaeoenvironmental and archaeological programmes researching the extent of loss of information and future methods of preservation.

Lincolnshire appears to have been a largely pastoral county for much of its early history if the general lack of charred cereal remains on many sites is an accurate reflection of arable activity. The most productive plant macrofossil assemblages investigated to date include the extensive IA and Roman settlement at Dragonby [LC26] that produced a unique record of waterlogged woad (*Isatis tinctoria*) fruits, as well as a diverse waterlogged and charred flora. Cereals were being grown at Dragonby, but the large number of samples taken from an Anglian site at Flixborough [LC19] produced very little evidence for arable cultivation. However, use was being made of local saltmarsh vegetation for fuel and grazing at Flixborough. The Iron Age causeway at Fiskerton [LC28a] [LC28b] (subject to monitoring programmes over the last few years due to threats from drainage), demonstrates that low-lying landscapes were being intensively used at this time, though perhaps only for subsistence level cereal cultivation on raised islands according to pollen evidence (Greig 1982, 1986b). By the Roman period, however, parts of the county grew

sufficient quantities of grain to merit the construction of five corn driers at Cawkwell (C2nd-C3rd [LC25]). Both hulled barley (dominating two of the corn driers) and spelt were being processed but there was no evidence for malting. There is some evidence that in Lincolnshire during the Roman period larger-scale barley cultivation may have been taking place than is found in most other counties. No doubt this relates to the fact that the county contains large areas of basic and lime-rich soils, as well as a long and wide area of coastal wet loamy soils. Barley is a very adaptable cereal that can cope with salt-affected areas, very free-drained shallow chalk soils and wet soils.

Rich Roman deposits at Lincoln Waterfront [LC1] containing exotic imports provided further indications that the region was important at this time. Because of the high potential for waterlogged deposits in the county, it is an area that deserves more detailed investigation. A rich deposit of rivet and bread wheat type chaff recovered from Grimsby [LC38] dated to the 12th to mid 14th century provides evidence that by this time arable agriculture was an important aspect of the economy. This is the most northerly record for rivet wheat in the East Midlands (Angela Monckton, pers. comm.). In her review of the East Midlands environmental archaeology Angela Monckton (2006) suggested that the evidence from this county needs to be reviewed, since it differs considerably from much of the central Midlands in its land-use history.

There is a marked scarcity of recently published, detailed archaeobotanical studies from this county. Although the Iron Age, Roman and Anglo-Saxon periods have produced a number of sites in the past, there is nothing known about the Neolithic period and very little from the Bronze Age. More detailed studies are required for the medieval period, particularly since the low-lying nature of much of Lincolnshire presents excellent opportunities for the recovery of waterlogged and mineralised food remains.

6.3.2.4 Leicestershire and Rutland

As in Cambridgeshire, the existence of an active Environmental Archaeology department at the University of Leicester has helped to ensure that plant macrofossil studies have been fully integrated into archaeological investigations in the region. Useful resources for this Review included reviews carried out by Angela Monckton: a review of work in Leicestershire and Rutland (Monckton 1995; 2004), and the Environmental Archaeology section of the East Midlands Review (completed in 2003, published in 2006). In addition, archive reports are available on the ADS (http://.archaeologydataservice.ac.uk/). Because of the consistency of coverage for the county over the last decade, archaeobotanical understanding is good, having built up a solid base of local information for all periods from which research agenda can develop. Of particular note is the fact that a high proportion of the sites have been well-sampled, enabling much more detailed interpretations to be made for the periods represented. Some of the more recent, productive sites investigated include Bonners Lane, Leicester [LR6], Castle Street, Leicester [LR1a], [LR1b] and Hamilton, Leicester [LR2], all multi-period sites producing good data sets.

Although the coverage for this county is good, particularly for the later Bronze Age, Iron Age and Roman periods, less is known about the Anglo-Saxon period. However, recent work at Highcross ([LR26], [LR52]) will help to fill the gap. A few productive Neolithic to early Bronze Age sites have been examined, but these have comprised pit groups and burial mounds, leaving the usual gap with regard to settlement features and structures.

6.3.2.5 Northamptonshire

Northamptonshire is a county of generally fertile, loamy /clayey soils which would have provided good arable and grazing over the centuries. The River Nene flows through the county in a north-easterly direction, towards the Wash. Because there has been a lot of development taking place in this county over the past few decades, and because environmental sampling has been seen as an integral part of excavations, this is one of the most productive Midlands counties in terms of plant macrofossil studies. In addition, a nationally important landscape study, the Raunds Project, was undertaken in the mid 1980s to early 1990s, providing a comprehensive insight into the development of the Nene valley east of Kettering and Wellingborough (see [NH34] to [NH38]). Both waterlogged and charred evidence were recovered in a large-scale sampling programme. A multidisciplinary approach was used on a variety of sites, providing a detailed narrative of changing landscape use over the past five millennia. This knowledge does not mean that there is no more to learn about the area, and the extensive excavation of the Roman villa and Saxon features at Stanwick next to West Cotton is still awaiting publication. The Raunds Project data adds value to further plant macrofossil studies in the area, as new evidence can be compared with the findings, enabling the data to be positioned within a reasonably well-understood framework. In addition, archaeobotanical questions arising from the Raunds project can be written into future projects in the area.

In terms of period coverage, priority should be given to Neolithic (particularly earlier Neolithic) through to Late Bronze Age/Early Iron Age sites. The Late Iron Age onwards is fairly well represented and there is evidence for the growth of a number of settlements starting from the Saxon period in this county. In addition, rural sites are better represented than in some regions, including Iron Age farmsteads and Roman villas.

6.3.3 East of England

The geography of East Anglia has enabled it to be treated as a distinct region in the past, facilitating the setting up of specific projects such as the Fenland Management Project (Murphy 2000) and Hullbridge Survey of the Essex coast (Wilkinson and Murphy 1995). East Anglia also has an exemplary publication record, thanks to the extensive work of Peter Murphy. In the last decade, however, fewer major studies have taken place. Historically, too, East Anglia was distinct, being one of the Anglo-Saxon heptarchy kingdoms in the 6th-7th centuries AD. With its long, east-facing coastline it has been vulnerable to Scandinavian and Germanic invaders. For much of its history parts of the region have been largely composed of marsh and bogs, although the Romans did create a sea barrier and undertake drainage. However, it was not until the 17th century that systematic drainage and the use of windmills created the largely arable, productive landscape that exists today. Salt-making, arable agriculture and wool production have been the most important industries in the past. The recent revision of the 'Framework for the East of England' (Medlycott 2011) has provided a useful resource with regards to current research frameworks for the area. The authors are also grateful to Kate Parks for giving us access to her PhD thesis 'Iron Age and Roman Arable Practice in the East of England' (Parks 2013).

6.3.3.1 Cambridgeshire

The fertile, low-lying land of this county has resulted in a long history of settlement. Iron Age and Roman farmsteads are particularly frequent, many of which have produced substantial charred plant assemblages. Evidence for malting is notably common in this county, with spelt having been malted in the Roman (and possibly even IA [CB50])

period, e.g. Parnwell [CB30], Papworth Everard [CB64] and Cambourne New Settlement [CB67], and with barley being malted in the medieval period (e.g. Jewsons Yard, Ely; [CB17]). At Jewson's Yard two-row barley may have been used. Settlement of the Cambridgeshire fen-edge in the Roman period has been studied by Rachel Ballantyne (2009), providing a valuable body of evidence against which to compare future investigations. The coverage of environmental archaeological sciences at the University of Cambridge has helped to ensure that the region is well provided with specialists to advise and carry out assessments and analyses.

Because the coverage of periods and settlement/site types is so wide in this county there are few obvious gaps to highlight. However, the usual priorities that apply to all counties should be noted, that is, any hunter-gatherer site with *in situ* deposits, all transition periods and any site with exceptional preservation, from any period. Neolithic sites are also of great importance, particularly where settlement features and buildings can be identified. Now that Cambridgeshire is one of the most archaeobotanically productive counties in the Midlands region, it should be possible to produce project designs and reports that are more targeted towards specific period-based questions.

6.3.3.2 Norfolk

In the revised framework for the East of England (Medlycott 2011) Norfolk stands out as being under-represented with regards to early prehistoric sites, perhaps suggesting that rising sea levels made most land uninhabitable for early settlers. In terms of material culture, too, differences between northern counties of East Anglia and southern regions have been noted, such as the distribution of particular early pottery styles and of metal objects in the Bronze Age (more frequent in Norfolk), and the occurrence of field systems in southern areas but not north of the Stour and east of the fens. Two notable exceptions to this observation include the Early Bronze Age timber circle at Holme-next-the-Sea [NK20], 'Seahenge', and the 45 Early Neolithic pit fills at Kilverstone [NK21]. It would be useful to collate and compare different sources of information from these areas and see if the archaeobotanical data throws any light on the situation with regards to suitability of the land for cultivation.

By the Iron Age Norfolk became more attractive to settlers (e.g. Norwich Southern Bypass [NK12]), and drainage in the Roman Period helped to increase the productivity of low-lying land. Farmsteads and villas are fairly common in the county although few have produced extensive, detailed information. At Kilverstone [NK21] occupation extended from the Iron Age, through to an industrial metalworking site in Roman times, continuing into the early Saxon. Another significant find in archaeobotanical terms was frequent rye chaff and some grain in a Roman waterhole at Melford Meadows [NK27]. Early records of rye tend to be sporadic and few in number, so this is useful confirmation that that rye was being grown as a crop in the Roman period, rather than occurring as a weedy contaminant.

The presence of the English Heritage (now Historic England) archaeobotanist for East Anglia (Peter Murphy) in the University of East Anglia, Norwich, over the past few decades has clearly helped to ensure that sites have been well-sampled for plant remains and analysed in detail. All periods have produced information and an interesting range of types of sites has been studied. As for all counties, Neolithic settlement contexts should be given the highest priority. The Bronze Age is also not well-represented, perhaps due to inundation of the landscape at this time. Multi-disciplinary studies of Bronze Age deposits may help to clarify this point.

6.3.3.3 Suffolk

In comparison with Norfolk this county has produced many more sites dating from the Palaeolithic to Bronze Age periods (Medlycott 2011), although few have produced useful plant macrofossil assemblages. The early Bronze Age site at West Row Fen is a notable exception [SK24], possibly producing the earliest evidence for the cultivation of spelt in the area. Waterlogged flax seeds, capsule fragments and possibly fibres from this site also provide early evidence for retting. Other important sites in Suffolk include Anglo-Saxon villages at West Stow [SK19] and at Bloodmoor Hill, Carlton Colville [SK29], which were excavated over 20 years apart but which produced similar results in terms of crop plants. These sites provided evidence that emmer and spelt wheat continued in cultivation well into the Anglo-Saxon period, and that rye was an important crop on the free-draining, Breckland sands.

One town in this county that has been investigated in some detail is Ipswich ([SK18], [SK22], [SK23], [SK39]), although many of the reports are still only available as Historic England Research Reports. At the ABC Cinema site the first evidence for the use of hops was found in a late Saxon pit. Fused masses of hundreds of charred hop fruits indicated use, presumably as a flavouring/preservative for beer (see [SK23], also section 6.2.1.7). Other remarkable finds that were preserved due to calamitous fires which destroyed stored foods in the cellars of 11th century buildings included stored barley and oats in a cellar at the Buttermarket. Another, similar, early medieval deposit from Foundation Street [SK22] was composed almost entirely of oats with other cereals and flax/linseed as minor components. The presence of a horseshoe and spur in the cellar fill was said to suggest that the deposit represented horse fodder. Another cellar at the Buttermarket produced 18 whole and fragmentary small charred loaves. Scanning electron microscopic studies showed that these consisted largely of an amorphous vesicular matrix including scraps of wheat/rye pericarp (bran) Frances McLaren has examined samples using infra-red spectroscopy, concluding that bread wheat was the main cereal used for making the bread (Murphy 1990a).

Although a number of sites dating from the Anglo-Saxon period have produced useful archaeobotanical information, no published sites dating to other periods have provided substantial evidence of arable agriculture, diet or environment. The prehistoric period through to the Roman period require more in-depth analyses, particularly the Neolithic and Bronze Age.

6.3.3.4 Buckinghamshire

Apart from frequent investigations in the Milton Keynes area, this county has not produced many important sites from an archaeobotanical aspect. One notable exception is Bancroft Villa [BK24b], which was said to have been palatial by the 4th century AD. A wide range of garden and orchard crops were grown, as described in Sections 5.5 and 6.2.3.1. There is some suggestion that woodland persisted until quite late in some areas. Stinking chamomile (*Anthemis cotula*) was late to arrive at some sites suggesting that clay soils had been left unploughed until the Saxon period (*Anthemis cotula* first occurred in the Saxon Period atT Taplow Hillfourt (Court) [BK21], medieval at Broughton Manor Farm [BK17b]). Hazelnut shell was abundant at some sites, perhaps reflecting the availability of woodland margin or hedgerow resources (Tattenhoe and Westbury deserted medieval village [BK22]). By the Medieval Period both bread-wheat and rivet-wheat type wheats were being grown on several sites in the county.

Priorities for this county are the detailed analysis of Neolithic deposits wherever they become available, and larger-scale sampling from future Roman and Medieval sites. The county as a whole has produced few notable archaeobotanical assemblages so deposits of all periods have the potential for improving our knowledge about the environment and arable economy.

6.3.3.5 Bedfordshire

Although areas such as Biddenham Loop [BD23] in the Great Ouse valley are rich in prehistoric monuments, the county as a whole has not produced a great deal of plant macrofossil evidence for this period. Biddenham Loop itself produced useful charred plant evidence dating from the Neolithic to Roman periods. The most productive periods in Bedfordshire in terms of evidence for agricultural development are the Iron Age and Roman periods. The rich variety of clay soils in this county no doubt suited the cultivation of hexaploid wheats, spelt and bread wheat, which were the mainstay of Iron Age and later periods. A few authors have noted that barley was totally absent from some Roman sites (Shillington Bury [BD26], Kempston Romano-British cemetery [BD29], Huntingdon to Willington Pipeline [BD40], Willington to Steppingley pipeline [BD44]) in this county, perhaps suggesting specialisation in the cultivation of spelt for the Roman market. However, these particular sites did not produce high concentrations of charred processing waste, as found on the Essex claylands, so it is unlikely that large-scale cultivation was taking place. Instead, the usual background levels of crop processing waste are usually present. In addition, some Roman sites in Bedfordshire produce the usual 'spelt-dominated with lesser amounts of barley' assemblages (Haynes Park [BD3], A421 Great Barford Bypass [BD13], A421: Roxton Road West (site 1) [BD14], A421: Renold Water End East (Site 8) [BD21]), so the situation is obviously more complex. Nevertheless, this is a subject worth investigating further.

Tetraploid rivet- wheat type wheat was probably introduced into the area around the time of the Norman Conquest and has been recovered from the Huntingdon to Willington Pipeline [BD40], Stratton [BD41], Norse Road, Bedford [BD42], and Castle Lane, Bedford [BD43] (see *Table 4*), following on from the Late Saxon introduction dates recovered from Northamptonshire.

Gaps in the coverage lie in the early and late periods: the Neolithic to late Bronze Age and the Anglo-Saxon period onwards. There are few detailed studies of either urban or rural settlements in Bedfordshire, although occasional pipeline excavations have provided tantalising windows revealing changes in the landscape. A major landscape project such as the Raunds project in Northamptonshire would be of value.

6.3.3.6 Hertfordshire

Considering this county's central location, with the Thames tributary, the River Lea, passing through it, it is surprising how few major plant macrofossil assemblages have been found, particularly from the prehistoric period.

One of the most intensively sampled recent sites is the M1 Widening scheme [HT14], which revealed deposits dating from the Late Iron Age/Romano-British, medieval and post-medieval periods, some of which were rich in charred plant remains. The Romans were clearly very active in the county throughout their occupation, establishing a municipium at Verulamium in AD50. Several major burning events occurred in the town, including Boudican destruction in AD 61 and recorded major fires in AD155 and AD250. The potential, therefore, for important deposits of charred plant evidence on a

par with the remarkable finds from Colchester (see below) is great, and efforts should be made to determine where such layers survive. Although some samples have been taken in the past, for example very late Roman deposits (5th century and perhaps later) collected during excavations necessitated by expansion of the Verulamium Museum at St Albans in the 1990s (in Murphy and de Moulins 2002), the fact that these have not been taken to publication is a major concern which needs to be remedied. Information on agricultural systems, and crop processing and storage activities associated with the terminal phases of Romano-British cities is exceedingly sparse, and this material is therefore of national importance.

There is the potential for early records of new crops, such as spelt in the Bronze Age, having spread along the Thames into the Lea valley, so the county should be given a high priority for future research projects. All periods require much more in-depth sampling to be carried out, but the major gaps lie in the Neolithic to late Bronze Age, and in the Anglo-Saxon period. The medieval period has also produced very little detailed information in comparison with most counties.

6.3.3.7 Essex

The geography and environmental background of Essex have been described by Allen and Sturdy (1980) in Buckley's Archaeology in Essex to AD 1500. This includes a presentation of the evidence for sea level rises that affected the coastline of south-east England. Sea levels rose rapidly during the early to middle Mesolithic, with a slower rate of rise through the Neolithic coming to a standstill in the late Neolithic and early Bronze Age. Levels rose again in the late Bronze Age and Iron Age but current levels were only attained by the medieval period. Sites such as The Stumble [EX37] in the Blackwater estuary need to be examined in relation to these changes, as what is now an intertidal site would have been around 1 km inland in the Neolithic Period. Factors affecting agriculture listed included the favourable climate, with Essex being one of the driest counties in the country. Winter wetness can limit growth due to waterlogging of the clay soils, and many of the soils are lime-deficient, requiring both liming and manuring. Sandier, gravelly soils can be affected by droughts.

As with Cambridgeshire, the boulder clays of Essex have been widely settled in the Iron Age and Roman periods. The spread of spelt wheat as the main crop plant across the region, together with the ability of farmers to work heavy clay soils, increased settlement in the county from the Iron Age onwards. However, worked flint and charcoal from Neolithic tree-throw holes at Stansted Airport (sites [EX17], [EX18], [EX19]) demonstrate that humans have been affecting inland areas of Essex from an early period, as well as coastal regions. Fewer sites have provided evidence for malting in the Roman period (e.g. Mucking [EX22], Elms Farm, Heybridge [EX26]) than in Cambridgeshire, but large-scale spelt production was clearly taking place in areas such as Stansted ([EX17] [EX18] [EX19]). In addition, Essex contains towns that were of major importance during the Roman period, such as Colchester and Chelmsford. The Boudican destruction layers in Colchester produced unparalleled charred evidence for imported foods being stored and sold in shops [EX10a] [EX10b] [EX11]. Continued study of these charred deposits is important, because 'calamitous' fires such as these can preserve materials rarely found on other sites, such as the sacks that foods were being stored in and whole figs. This is not just because they make impressive museum displays, but because they inform archaeobotanists about the range of foods about which we know little in the British Isles, providing evidence for importation, trade, status and the structure of societies within towns.

Essex has produced a reasonable amount of archaeobotanical evidence from late Bronze Age through to Roman sites, as well as the few exceptional sites noted above, but there are relatively few Neolithic to middle Bronze Age published reports and surprisingly few Anglo-Saxon and later detailed studies. Because this county is located at the gateway to England for settlers and traders travelling from mainland Europe it has the potential for providing important information about early introductions and trade links.

6.3.4 Conclusions

In a recent review of the plant macrofossil evidence for early agriculture by Stevens and Fuller (2012) Cambridgeshire and Essex were the two counties producing the most sites with radiocarbon dated plant macrofossils (not counting charcoal; 5 sites and 6 sites respectively). Most other counties produced one or two sites at best. Whether this is an accurate reflection of archaeobotanical investigations in the counties or not is open to debate, but the overall figure of 29 dated prehistoric sites for the whole region (17 counties) does not seem sufficient to provide crucial evidence for the beginnings of arable agriculture. With the price and accuracy of AMS dating improving over the years it is essential that the selection of grain and chaff for dating becomes a routine part of archaeobotanists work, particularly for critical contexts, such Neolithic deposits, transition periods, and times of agricultural innovation and change.

It is clear to see that counties with active environmental archaeology units can develop a deeper understanding of the local area and can therefore highlight topics that need further research. This needs to be backed up by free access to the research archive such as the ADS which is a huge resource with great potential if indexing could be improved. Archaeobotanists based in university departments have the advantage of involving undergraduates and post-graduates in projects, as well as having free access to reference collections and libraries. Freelance workers can build up a good understanding of particular areas over time but the deposition of archive reports to make them readily accessible is less straight forward in practice because of the way projects are timetabled. They can acquire useful experience of different regions allowing comparisons to be made across the country, but are less likely to be able to carry out more research-based investigations because of funding constraints within the commercial sector. They are also rarely in a position to direct where investigations should be focused, though they can (and should) present a strong case for radiocarbon dates to be carried out on important material. Commercial units and freelance workers are confined by deadlines and tight budgets which clearly affect decisions on where to concentrate resources. All of these constraints and variations have played a part in the levels of archaeobotanical work carried out in the Midland counties, but there are also other differences which relate to the geography, agriculture and levels of development of the region. Only targeted large-scale projects would make a significant inroad into these inequalities.

6.4 Methodology: Recovery, analysis and experimental methods and monitoring

6.4.1 Recovery

A number of issues concerning the recovery of plant macrofossils have been discussed in earlier sections, particularly in Section 2.2 'Sampling and preservation'. To summarise some of the important issues that have arisen over the last few decades:

- A range of soils (clay soils, acidic sands and gravels) cause silt encrustation of charred plant remains resulting in poor recovery using single floatation (on one site this amounted to a potential loss of c.50% charred plant remains). It is important that either double floatation is adopted as standard, or a proportion of residues are checked early on in the project in order to determine whether double floatation is required.
- The preservation of plant material by mineral replacement (see Section 2.2.2.3) is not always obvious at the sampling stage. Residues should be retained (discarding large stones only) until flots and some residues have been assessed. An additional reason for retaining and assessing the residues is that dense charred plant remains, such as hazelnut shell and pulse cotyledons, often fail to float, so would be under-represented if only flots were examined.
- Because in the above situations plant remains will be too dense to float, 500 micron meshes should be adopted as standard to retain the residues in floatation tanks.
- On silty soils the mesh of 250 micron flot sieves can easily become clogged with fine silt, so larger meshes are sometimes used (usually 500 microns or less). There is a danger of losing rare but ecologically significant seeds of taxa such as members of the Ericaceae family if larger meshes are used, so this will need to be taken into account and noted in reports.

Examples of Midlands Reports where recovery problems are discussed include Wardy Hill Ringwork [CB15], Potlock Cursus [DB14], St Marys Gate, Derby [DB26], Springfield Lyons [EX14], Elms Farm, Heybridge [EX26], Holme Pierrepoint [NT14] and Crick, Northants [NH40]. In most cases these problems relate to clayey soils, impregnated plant remains and the failure of charred material to float at the first floatation stage, necessitating the use of re-floatation.

6.4.2 Analysis

Although under the restrictive conditions of commercial archaeology it is not always possible to carry out detailed integrated studies, new methods such as those used by Rachel Ballantyne in her PhD thesis (Ballantyne 2009) and study of the Colne Fen, Earith plant remains [CB65] have the potential for greatly increasing our understanding of processes such as middening. It involves the analysis of both unburnt and burnt waste of all types (pottery, bone, charcoal etc.) and making comparisons between the distributions of different categories of materials. New GIS technology and the increased accuracy of finds recording should make this time-consuming task much easier in the future. Integrated studies of different types are essential to help overcome some of the 'chance' nature of archaeobotanical data (for example, the possible accidental charring of atypical material), as well as our reliance on relatively slender evidence in many cases (making it necessary to over-use words such as 'possibly' and 'perhaps' far too often). Other factors that should help to overcome these uncertainties as more studies are carried out over the next few decades are the use of widespread sampling across sites,

and the collation and comparison of data from large numbers of sites of the same date and type.

6.4.3 Experimental Methods and Site Monitoring

Much work has been carried out in the past with regards to site monitoring in the fenland areas of the East Midlands, as outlined in the Introduction (see the Fenland Management Project). One such site in Lincolnshire was investigated using methodology devised for the Somerset levels by the MARISP project (Monuments At Risk In Somerset Peatlands; Jones *et al* 2007):

The Iron Age Causeway at Fiskerton, Lincs [LC28b] Three small evaluation trenches were excavated in 2007 in order to provide information about the preservation of the causeway which could be compared to earlier excavations in 1981 (Field and Parker Pearson 2003). A multidisciplinary approach was taken with the emphasis being on the state of preservation of the environmental and artefactual remains rather than a detailed full analysis. For the plant macrofossils, a system of scoring was used that had been developed by Julie Jones for the Monuments at Risk in Somerset Peatlands (MARISP) project (Jones *et al* 2007). This was the first use of the system by another author on different peatlands, so comparisons and suggestions were made relating to the Somerset Levels results during the project. Bulk samples of peat were taken from columns down through two of the sample trenches, extending beneath the level of the trackway. After extraction from the samples, 100 fruits/seeds from each sample were scored for erosion/corrosion of the seed coat surface (E index) and fragmentation (F index). Photographs taken by Jones (*ibid.*) of specific taxa and detailed descriptions helped to establish how the scores had been set for the Somerset Levels project. Scores were averaged for each sample and comparisons were made through the profile and between two trenches. Comparisons were also made between the different classes of environmental remains, and many similarities in the findings were obtained. The results (including radiocarbon dates) demonstrated that the deposits identified in 1981 associated with the Iron Age causeway had now been lost due to drainage and conflation of the deposits. The upper layers of peat showed signs of degradation and contamination of the insect, seed and pollen assemblages, and the lower levels in Trench 2 also showed signs of deterioration due to fluctuating water levels. Monitoring for redox potential, water levels and pH over the years has shown that the water levels fluctuate over 1.4m, a range that includes all of the environmental samples and the causeway at c. 60cm below the current surface. The zone of maximum water level change was at 45-65cm, and zone 45-50cm showed the greatest evidence for erosion and fragmentation of plant remains in both trenches. Since most of the trackway has now been excavated, apart from the vertical timbers, loss of the palaeoenvironmental record is the most important consequence to be considered when devising future management strategies at Fiskerton. The MARISP method of scoring preservation, developed by Julie Jones, was found to be a valuable tool that should be developed further so that it can be more widely used in wetland situations.

6.5 The importance of detecting contamination and residuality

In this section the common occurrences of uncharred fruits/seeds and rootlets are not under discussion, since these remains can usually be discounted as being recenton British sites (though radiocarbon dated ancient uncharred seeds have been recorded from some sites such as The Shires, Leicester [LR5] where uncharred elder seeds were dated to 1190±60 bp (OxA-3067) and 1340 ±70 bp (OxA-3068)). However, these details should be noted in assessment reports because they do indicate that material of all sorts may have moved down through the soil profile, which could, of course, include charred and mineralised archaeological remains. With some black-coated seeds such as Chenopodiaceae it may be necessary to break open the seeds to determine whether or not they are charred. As long as these decisions are clearly explained in the report the loss of information can be taken into consideration, and may be a reasonable pay-off that enables more useful information to be recovered. Sometimes, such as at Springfield Lyons [EX13], a whole site is contaminated with sewage, either because of a nearby sewage works or because of materials used to fertilise the soil. In other cases, stubble burning can cause contamination, although modern burning can usually be detected because some partially-burnt brown/black material and very fresh-looking charred remains (often including frequent culm nodes) are present.

The problems of contamination in charred deposits, through both intrusion (later or modern material working down the soil profile, usually through the action of soil flora and fauna) and residuality (where material already in the soil from earlier periods becomes mixed with later remains when areas are re-worked) has already been highlighted in the Period sections. Contamination is particularly problematic in early prehistoric periods, where the sometimes low levels of survival of charred plant remains, as discussed in the Period sections, mean that the chances of adding contaminants to our sparse list of plant foods is much greater, and statistically false records are of greater significance. Murphy and de Moulins (2002) went so far as saying 'due to problems of contamination at Neolithic sites impressions may be the only reliable source of information about crops at some sites' (*e.g.* at Spong Hill, Norfolk [NK41]). For this reason, it is vital that unusual and notable records are backed up with AMS dates at all times, and resources need to be set aside at the project planning stage to cover this eventuality. In order to safeguard the integrity of the archaeobotanical record, archaeobotanists need to take on the responsibility of requesting that material is dated where notable remains are encountered. A case can also be made for this on archaeological grounds in that it can help to refine pottery typology and it can date features, at the same time as providing securely dated plant records. The feedback loop of a more secure understanding of cereal and weed chronology is that archaeobotanists can use this knowledge to draw attention to features that do not fit in with the expected pattern, leading to further investigations and dating programs. (See also Pelling *et al* 2015 for a general discussion on the problem of contamination in the archaeobotanical record).

Unfortunately, mineralised material may also suffer from residuality in intensively occupied urban areas, and this cannot be detected by AMS dating. This possibility needs to be taken into consideration, and when particularly notable assemblages are encountered ceramic dating evidence should be closely examined, and associated materials such as bone or charcoal may need to be dated to try to clarify how mixed the deposit has become.

Remarkably few plant remains have been AMS dated in the Midlands region if Stevens and Fullers' (2012) recent review of Neolithic farming is used as a rough guide. A total of 90 direct radiocarbon dates from 29 prehistoric sites (mainly Neolithic and Early Bronze Age) were collated from 12 of the 17 counties in central England. Since material from this early period is more likely to be radiocarbon dated than material from later periods, there is clearly scope for improvement in this area. It is notable how much evidence of contamination there was in Stevens and Fullers' list of dates. In this review, too, a number of site reports mention the possibility of contamination, particularly where the occasional unexpected item was present in a sample, e.g. Parnwell, Peterborough [CB30] a spelt glume base in an Early Neolithic pit; Eynesbury, St. Neots [CB39] rye grains in an Early Neolithic hengiform ditch, plus several rye rachis fragments and *Anthemis cotula* in Early and Late Neolithic pits; some indication of contamination was recovered from the Neolithic features at Grendon [NH30].

Although not from the Midlands region, the following examples demonstrate the importance of dating significant finds. A well-sealed, single-filled pit containing Neolithic pottery from Kings Stanley, Gloucestershire, recently produced three free-threshing wheat grains and an *Anthemis cotula* seed. Although an early Bronze Age date had been previously been obtained from HNS, the cereal assemblage was sufficiently suspicious to obtain funding for another date, this time on a well-preserved free-threshing wheat grain. An 11th/12th century AD date was obtained (Pelling *et al* 2015). The most likely explanation appears to be that an overlying 12th century dark soil (not sampled) must have contained frequent charred cereal remains, some of which had been carried down the profile by soil fauna, though it is surprising that as many as four items made this journey. Unexpected events of this kind have occurred in the past in apparently well-sealed, deeply buried contexts, including a grape pip from the Old Land Surface beneath Hazelton Neolithic long cairn which produced a modern date (Straker 1990, Appendix 18) and modern grape pips from the final silting of an enclosure ditch at Flagstones (Straker 1997; p.188). Earthworm activity was thought to be responsible in both cases (Vanessa Straker, pers. comm.). Because these items were sufficiently unusual to be submitted for dating they have provided importance evidence of contamination. How many less noteworthy contaminants have slipped through into the records it is difficult to tell, but they could be many. This subject requires further investigation (see Pelling et al, 2015).

6.6 The introduction, dispersal and survival of key crops in Central England

6.6.1 Free-threshing wheats in the Neolithic and Early Bronze Age

Although in the past it has been suggested that small amounts of free-threshing wheat were being cultivated in the Neolithic Period (Greig 1991b, 300; Campbell and Straker 2003, 15), on closer examination there is very little reliable evidence to support this in the Midlands region. None of the occasional finds of short, rounded, free-threshing wheat-type grains have been radiocarbon dated, so confirmation has yet to be produced. In fact, from Stevens and Fullers' (2012) list of 415 radiocarbon dated plant macrofossils only two free-threshing wheat grains were dated to the prehistoric period: one from Crathes, Aberdeenshire, Scotland dated to the Early Neolithic (*Triticum aestivum/turgidum* type, Murray and Murray 2005; 3940-3660 cal BC SUERC-4038) and one from Perceton, Irvine, North Ayrshire, Scotland dated to the Middle Bronze Age (residual on a Medieval site; Stronach 2004). The first of these records could be compared to three large assemblages of distinctive, short-grained, probably tetraploid

free-threshing wheat remains (*Triticum turgidum*-group) from Early Neolithic pits at Thanet Earth, Kent (Carruthers 2013b). Well-preserved grains and occasional chaff fragments with tetraploid characteristics were recovered (The author is indebted to Professor Stefanie Jacomet, University of Basel, Switzerland, for her assistance in identifying these important cereal remains). Three free-threshing wheat grains from the pits were securely dated to c. 3900 - 3600 cal BC. Photographs will be included in the forthcoming Thanet Earth publication. Most of the Kent free-threshing grains were distinctive in their short, rounded but blunt-ended appearance compared to free-threshing wheat usually encountered on medieval sites, but there was some variation in form which meant that a large proportion could not be differentiated from emmer wheat. The following criteria were used for distinguishing the free-threshing wheat from emmer wheat grains at Thanet Earth, as the presence of rachis fragments confirmed that tetraploid wheat was present. They cannot be used on their own to positively identify tetraploid wheat grains, but in well-preserved, large assemblages they may help to raise the possibility that tetraploid wheat might be present.

Free threshing tetraploid-type wheat grains:

- Mostly short-grained spheroid-type but with some variation: lengths x breadths ranged from 3.2mm x 2.6mm to 4.8mm x 3.5mm. Length/breadth indices ranged from 1.14 to 1.5.
- Mostly blunt apical ends and fairly rounded profiles but deeper backed than usually seen in charred free-threshing wheat grain (with some variation, a few tending towards more pointed emmer)
- Rounded convex ventral surfaces (and sometimes wide furrows) to differentiate them from the flat-faced hulled wheats that are held more tightly by the chaff
- Embryo depressions wider, deeper and more rounded than the shallow, narrow, tilted emmer depressions
- Absence of grooves along dorsal side which are found in hulled wheats

Rachis fragments:

A few, very poorly preserved rachis fragments were recovered from two samples.

- Rachis fragments with clear bulges at the base of the glumes, as is characteristic of tetraploid free-threshing wheats of the *turgidum*-group
- Stumps of glumes often surviving, always bending in an outward direction ('splayed'), indicating a free-threshing wheat which loosely holds its grains
- Rachis fragments broken close to the base of the bulges (probably due to poor preservation, breaking in the thinner part of the rachis)

It would be useful to compare the "short grains of free-threshing hexaploid type (*Triticum aestivum s.l.*)" wheat from The Stumble ([EX37], 84-5, figure 5.19 and tables 5.11, 5.13, 5.14, 5.16) with this material (and perhaps with the Crathes grain), to see whether a new type of wheat made a brief appearance in the south-east of England at the time when arable agriculture was still in its infancy, but did not spread to other areas of the British Isles or continue to be cultivated through to the later Neolithic. It is worth considering whether the short-lived cultivation of this crop could relate to Stevens and Fullers' (2012) initial 'failure' of arable agriculture in the later Neolithic period and the 'boom and bust' in Ireland (Whitehouse *et al* 2012).

Problems of contamination have been outlined above, with the Neolithic and early Bronze Age period being highlighted as specific areas of concern. Even into the Bronze Age, finds of free-threshing wheat should be considered to be worth dating: at Ridlington, Rutland [LR23], a modern date was obtained on free-threshing wheat grain (Wk-10072) from a MBA context. A nearby deposit containing numerous barley grains produced a good Bronze Age date, demonstrating that wherever possible productive deposits should be used for dating. However, this leaves the problem of sites with sparse remains not being dated, and taxa such as free-threshing wheat that are often only found in small numbers on prehistoric sites continuing to have uncertain provenances. A large assemblage of free-threshing wheat consisting of 80 grains was recovered from a Neolithic deposit at Woodham Walter, Essex (Boyd 1987, 41), but in this old report the state of preservation was said to be poor and radiocarbon dating was not carried out. The find of three early medieval free-threshing wheat grains in an early Bronze Age pit at Kings Stanley (mentioned in the above section and Pelling *et al* 2015), shows that contamination can occur even in apparently well-sealed single-fill features. The Neolithic settlement at Lismore Fields [DB13a] [DB13b] produced 79 grains of free-threshing wheat in addition to nearly three thousand hulled wheat grains. Although emmer grains and flax seeds have provided consistent Early Neolithic dates it would be useful to date some of the free-threshing wheat grains. At the Asda Site, Hereford [HF8] a possible Bronze Age pit was found to contain 46 free-threshing wheat grains and 4 bread wheat type rachis fragments. This material would also be worth radiocarbon dating.

Other records of free-threshing wheat from early sites in the Midlands region do not exceed six grains and chaff fragments are even more scarce. A total of eighteen Neolithic to later Bronze Age Midlands sites (four given in Murphy and de Moulins 2002; fourteen more recent sites) have produced small numbers of free-threshing wheat grains (usually single grains). Free-threshing wheat chaff has only been recovered from the Asda site mentioned above and LBA Hatfield Heath to Matching Tye [EX30] (a single rachis fragment). Considering the difficulties in identifying wheat grains (Jacomet 2006) and the fact that none have yet been directly AMS dated, the evidence is currently extremely tenuous.

As suggested in Campbell and Strakers' review of southern England (2003), the earliest dated, consistently occurring free-threshing bread-type wheat (*Triticum aestivum s.l.*) is not recorded until the Iron Age in the Midlands, and even then quantities of grain and chaff tend to be small and large scale cultivation is doubtful. Free-threshing wheat grains (and occasionally rachis fragments) found in Iron Age deposits have been primarily from areas of clay soils in central and eastern Midlands, such as Bedfordshire (e.g. East Stagsden [BD9], West Stagsden [BD10]. Shillington Bury [BD26]), Cambridgeshire (e.g. Wardy Hill ringwork, Coveney [CB15], Bushmead Road, Eaton Socon [CB50]), Essex (e.g. Stansted [EX18], Springfield Park – LBA [EX15]), Northamptonshire (Grendon [NH30], A43 [NH33]) and Nottinghamshire (Raymoth Lane [NT2], Gamston [NT3]). By the late Roman period larger numbers of grains are sometimes found (e.g. Stansted [EX18]), possibly because the scale of production and trade/grain transportation had increased to such a level by this time that even a free-threshing cereal was more frequently becoming preserved by charring. An additional factor is taphonomic, in that it has been shown that de-husked glume wheats can puff up to resemble free-threshing wheats, so mistaken identifications may become more frequent in this period (Braadbaart 2008).

Using data from the online supporting site summaries a total of 525 records produced the following results for the percentage of records where free-threshing wheat was present (**Error! Reference source not found.**; records given as, for example, LIA/ERB were counted as the later period);

Neolithic – 18% (of 63 records)
Bronze Age – 6% (of 104 records)
Iron Age – 12% (of 146 records)
Romano-British – 22% (of 212 records)

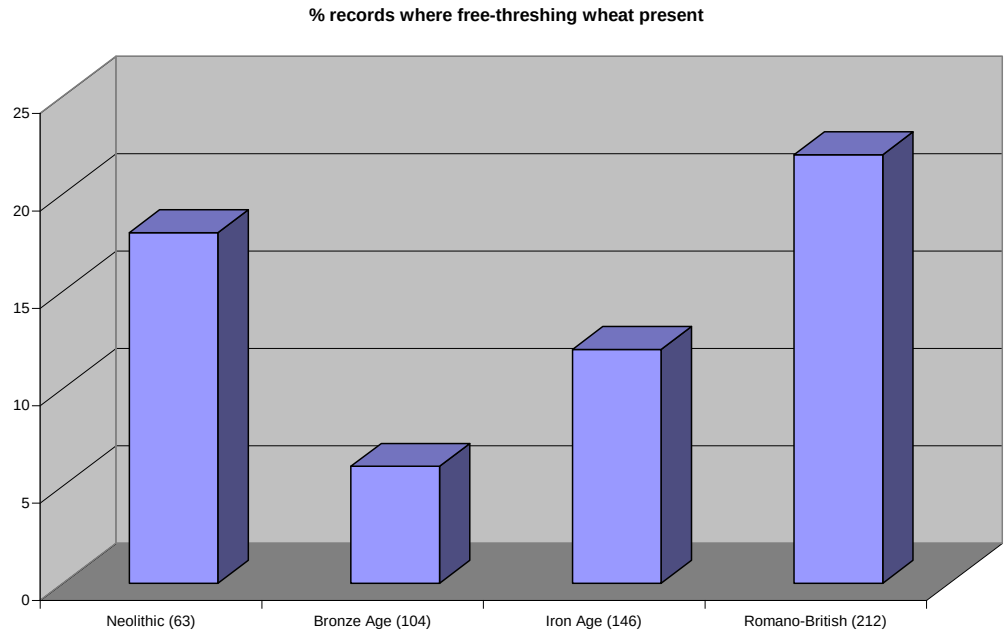

Figure 10: Presence of free-threshing wheat by period

This included records where there was a suggestion of possible contamination, because in some cases the presence of free-threshing wheat itself is taken as an indication of contamination so the argument can become circular. The fact that the percentage of Neolithic sites containing free-threshing wheat grains is almost as high as the percentage of Roman samples could be interpreted in several ways: either Neolithic deposits are more prone to contamination than Bronze Age samples (perhaps relating to factors such as the types of soils on which the sites are located or types of sites), or that free-threshing wheat was cultivated on a small scale, or that the genetic diversity of early crops meant that grains with both free-threshing and hulled characteristics could be found within a crop. As noted above, radiocarbon dating has shown that free-threshing wheat grains in prehistoric contexts often turn out to be medieval or later in date, so it is likely that at least some of the prehistoric remains are contaminants. By the Roman period, however, there is confirmation that free-threshing wheat was being consumed by the army from large grain deposits recovered from the military granary at South Shields, Tyneside, in Northern England (van der Veen 1994). The evidence for the use of free-threshing wheat by the general population and its local cultivation is less clear, and it is possible that the military supplies were being imported.

In view of the conflicting evidence, it would be worthwhile radiocarbon dating large deposits of grain from each of these periods, particularly where rachis fragments are also present, as at West Fen Road, Ely [CB14] where 487 grains and 29 rachis fragments of free-threshing wheat were recovered from the middle fill of an Iron Age enclosure ditch. Enclosure ditches can remain open for several centuries so there is the possibility of later dumping having taken place at this site. At Loves Farm, St. Neots [CB80] more than 500 grains and 90 rachis fragments were present in a late Romano-British rubbish pit, and Romano-British pits at Tattenhoe and Westbury [BK22] produced 174 grains of free-threshing wheat and 97 rachis fragments. If radiocarbon dated these samples would provide secure evidence of cultivation and use by the wider population.

Records of short 'spheroid' wheat grains in the Midlands (often mistakenly recorded in reports as a 'compact-type', possibly *Triticum aestivum* ssp. *compactum*, which produces a compact ear rather than grain), comprise late Saxon and medieval deposits at sites such as Marefair, Northampton [NH6], Friar Street Worcester [WC4], Worcester Road, Droitwich [WC12] and Riggs Hall, Shropshire [SP9]. In two 13th century rural sites within the earlier Stansted project [EX19] Murphy records 'very short hexaploid wheat grains' as being present at Roundwood and Molehill Green. This suggests that there may have been an introduction of spheroid grained wheat into the West Midlands, or perhaps sporadic importations from the continent.

6.6.2 Spelt wheat in the Bronze Age

As with the early free-threshing wheat evidence, the early occurrences of spelt wheat are frequently much less secure and less frequent when the data is examined critically, taking the possibility of contamination in to account. Although findings of one or two spelt glume bases or spikelet forks have been recorded for several Middle Bronze Age sites in the Midlands (e.g. Ridlington Rutland [LR23] – 1 spelt glume base in a Middle Bronze Age post hole; Stansted [EX18] – only 1 spelt glume base in each of 2 sites), and occasionally for earlier periods (e.g. one spelt glume base at the Early Bronze Age timber circle at Holme-next-the-Sea [NK20]; a tentatively identified uncharred spelt glume base at Godmanchester [CB62] dated to 1671-1420 cal BC; Parnwell [CB30] – 1 Early Bronze Age spelt glume base, 'probably a contaminant'), in all cases either the items were undated so were often said to be 'possibly intrusive', or in the case of Godmanchester the identification was uncertain. Waterlogged chaff is often crumpled, swollen or distorted so can be difficult to identify with certainty and at present a minimum of 2 good sized charred glume bases (or one spikelet fork) need to be present to guarantee enough carbon for dating (Ruth Pelling, pers. comm.). Middle Bronze Age sites that produce sufficient quantities of well-preserved spelt remains are, therefore, extremely rare, even in as large an area as the Midlands.

The following sites may be worth investigating to see whether the spelt remains can be submitted for dating:

[EX49] West Thurrock, Essex – A large mixed hulled wheat assemblage was dated on grains of emmer to 1410-1210 cal BC (NZA-29932; 3040±30BP). Spelt wheat remains present in the deposit consisted of 33 spelt glume bases, nine spikelet forks and 72 spelt-type grains.
[CB63] Bradley Fen –"features in a collared urn settlement (early-middle Bronze Age) produced spelt wheat remains"

[NT5] Langford – (assessment only so uncertain dating) two early Bronze Age samples produced frequent barley and spelt grain and two undated features produced barley and spelt.
[SK24] West Row Fen – this was said to be the earliest record of spelt in the region when Murphy and de Moulins wrote the draft Midlands Review (2002, 26). Two spelt spikelet forks and eight glume bases were recorded in early-middle Bronze Age settlement deposits.

Across southern England (from Kent to Somerset), five sites have so far produced Middle Bronze Age dates for spelt wheat (three direct dates), the earliest being Monkton Road, Minster, Isle of Thanet, Kent (Barclay *et al* 2011; Martin *et al* 2012) where a large mixed hulled wheat deposit was dated on spelt glume bases to 1896-1690 cal BC (3470±30BP, SUERC-32886). As with early records of free-threshing tetraploid wheat found on the Isle of Thanet, it is possible that close ties with continental Europe in south-east England facilitated the early importation of 'new' crops like spelt wheat to this area. The suggestion that agricultural advances might have spread along the Thames Valley and its tributaries (Hey and Robinson 2011) is one that might be answered in time by collecting a large number of direct radiocarbon dates on spelt assemblages.

Since the Late Bronze Age is not well-represented in the Midlands in comparison with southern England there are few good examples of assemblages of spelt wheat crops in this period. Two directly dated examples do confirm its presence by this period and are the earliest directly dated examples from the region:

[BK21] Taplow, Bucks – Two spelt-type grains (with 4 spelt glume bases being recorded) were dated to 910-800 cal BC (OxA-14359; 2687±27BP) and 930-790 cal BC (SUERC- 4968; 2800±40BP).
[LR18] Lockington Hoard, Leics – 5 spelt glume bases and 5 cf. spelt glume bases were recovered from a sample dated by charcoal to 1425-1260 cal BC. Four spelt glume bases were directly dated for this review to 980-810 cal BC (UBA-25298; 2737±38BP).

It is clear from the slight dominance of spelt over emmer at occasional sites such as Springfield Lyons, Chelmsford [EX13] (10 spelt spikelet forks and 23 glume bases) and from a single spelt-rich middle-late Bronze Age pit at Eynesbury [CB39] that spelt had become a valued crop by the Late Bronze Age, at least in the south-east of the region. At Taplow [BK21], cited above, the Middle Bronze Age features at the site had contained no spelt remains. At Park Farm, Barford [WR29] spelt chaff was recovered from later Bronze Age features, providing a Bronze Age record for this crop in the West Midlands. By the Iron Age spelt had become dominant on most sites in the area, demonstrating that, once introduced, its value as a high-yielding, robust cereal that could be autumn-sown (thus spreading the work over the farming year more evenly), was quickly recognised. For example, along the Wormington to Tirley pipeline [WC24] spelt was four times as frequent as emmer by the mid-late Iron Age and at Hallam Fields, Birstall [LR13] spelt was dominant over emmer by the same period. However, there is also evidence that in some areas, notably in Worcestershire, emmer retained its importance. At late Bronze Age Huntsman's Quarry, Kemerton [WC16] clean, processed emmer was identified but no spelt wheat. In Middle Iron Age pits at Aston Mill Farm, Kemerton [WC15] no spelt was found, only frequent barley with some emmer and oat. In Late Iron Age storage pits at Saxons Lode [WC10] spelt and emmer were present in similar quantities, with each crop dominating specific pits, indicating that the cereals were being cultivated as separate crops rather than as a maslin, as has sometimes been suggested.

Perhaps in this area the cultivation of separate crops prevented the gradual creep towards spelt dominance suggested by van der Veen (1992). Clearly, more data is needed to support this hypothesis, because factors such as settlement type, feature type and the nature of the waste being deposited can greatly skew the data, for example if emmer was primarily being used for fodder and spelt for human consumption. It is also possible that growing crops for the market/taxes versus domestic use will have an influence on the archaeobotanical record, so that if emmer was solely used for small-scale domestic use it may only have entered the charred plant record in small quantities, if at all (Ruth Pelling, pers. comm.). As always is the case with charred assemblages, accidental burning also has a large effect as to whether or not the data is representative of the economy as a whole.

6.6.3 Naked barley and two-row hulled barley

Evidence for the cultivation of naked barley (*Hordeum vulgare* var *nudum*) is very sparse in the Midlands, with most records consisting of 'one or two grains of possible naked barley' primarily from the Neolithic and earlier Bronze Age. No large assemblages similar to the middle Bronze Age sites in southern England such as Trethellan, Cornwall (Straker 1991), Rowden, Dorset (Carruthers 1990) and Bestwall Quarry, Dorset (Carruthers 2009a) have been found. The fact that these three are all coastal sites was no doubt important when the choice was made to grow naked barley as a crop. Barley is the most salt-tolerant of the cereals, but it does not grow well in soils that are deficient in lime (Beaven, 1947). Naked barley does not produce good yields in comparison with hulled barley and its straw is prone to lodging (Beaven, *ibid.*), so it would mainly have been useful in marginal areas where the other main cereal of the period, emmer wheat, is likely to have performed poorly. Poor yields may be one reason for the decline in cultivation by the end of the Bronze Age of what would appear to be a useful, free-threshing cereal. The increased wetness towards the end of the Bronze Age and into the Iron Age is unlikely to have suited naked barley (Bakels, 1991). Naked (or free-threshing) cereals are more prone to sprouting in the ear if grown in a wet climate because they are much more loosely held by the chaff. In addition, experimental work in Sweden has indicated that increased manuring favours hulled barley over the naked form so naked barley may have been out-competed (Joachell Regnell in Campbell and Straker, 2003). However, this hypothesis depends on the cultivation of the two cereals as a maslin. Campbell and Straker (*ibid.*) also suggest that the cultivation of naked barley continued longer in south-west England because conditions were more similar to the Highland Zone – another, more marginal region from which naked barley has often been recovered. The abandonment of naked barley is a topic that requires more research and experimental work of the kind undertaken by van der Veen and Palmer (1997) for emmer, spelt and free-threshing wheat.

Almost all of the minor records of naked barley (e.g. Biddenham Loop [BD23] – six grains) are early to middle Bronze Age in date, though occasional grains also occur in slightly earlier and later periods (for example Neolithic Church Lawford [WR1] or late Bronze Age Lofts Farm [EX24]). In addition, Roman deposits sometimes produce naked barley grains. These minor finds could simply represent sporadic mutated plants or relicts from earlier periods. Because naked barley can be difficult to identify with certainty, particularly in early prehistoric, eroded assemblages, it is likely that the crop is under-represented in the plant record. Being a free-threshing crop, it is also much less likely to become charred, as previously discussed with free-threshing wheats.

Two-row hulled barley *(Hordeum vulgare* subsp. *distichum)* is also difficult to identify with certainty unless well-preserved rachis fragments are recovered. Although the absence of the twisted lateral grains (only present in six-row barley) may provide a clue as to the presence of two-row barley, it is not a reliable indicator, since crop processing and the distortions of preservation by charring can make calculations of straight to twisted grains un-useable. In order to confirm the presence of two-row barley well-preserved rachis fragments are required, showing a range of characteristics such as; more slender rachis segments in front and side view, some persistence of infertile, narrow side florets, or small side floret scars. Identification criteria are have been drawn together by Mike Charles, Dragana Filipovic and Amy Bogaard and can be downloaded from Academia (Archaeobotany Work Group Meeting notes June 2011, Sheffield; https://www.academia.edu/1876893).

From the material evidence it appears that two-row barley was known to the Romans, since a British coin struck at Camulodunum (Colchester) dating to around 20 BC bears a clear impression of a two-row barley ear (Hunter 1952, figure 14). However, the earliest archaeobotanical evidence from the Midlands comes from late Saxon, medieval and late/post-medieval sites in the East Midlands. This should not be taken to suggest that it was not cultivated in the west of the region, or in an earlier period, as the necessity for excellent preservation outlined above means that chance plays too large a part to be certain.

[CB17] Jewsons Yard, Ely Waterfront – a 16th century kiln contained three rachis fragments
[CB34] Long Causeway, Peterborough – a 16th century ditch contained rachis fragments
[LC31] Flaxengate, Lincoln – three pits of 11th, 12th and 13th century date produced nine rachis fragments
[LR5] Shires, Leicester – rachis fragments present in early medieval features
[NH37] West Cotton, Raunds – early 12th century features produced rachis fragments and an oven produced predominantly straight grain
[ST9] St Marys Grove, Stafford – three rachis fragments in late Saxon SFB, two possible rachis fragments in a late Saxon pit; seven rachis fragments in medieval quarries and one rachis fragment in a medieval oven.

Two-row barley is the variety most wildely cultivated in the British Isles and includes the varieties most valued for malting due to a low proteid-content and the evenness of sprouting resisulting from consistent grain size (Percival 1942, 510-517). This would have become a more obvious advantage as genetic variability within crops gradually reduced over time, and also as barley became the favoured grain for malting in the medieval period. Of the cereals, barley is the best producer of diastase enzymes (produced at the root tip on germination) which are responsible for converting the cereal starches into sugar. In the Roman period it was mixed with wheat to improve the malt, and in the earlier medieval period it was sometimes mixed with oats to produce different flavoured beers (Bennet 1996; see examples from Middle Saxon Buttermarket, Ipswich [SK38] and West Cotton medieval manor, Northants [NH37]).

6.6.4 Early evidence for oats and rye

The problem facing the precise timing of introduction of oats is that although oat grains themselves are easily identified, important elements of the floret and rachilla are less often preserved, being brittle and easily fractured when charred. Useful publications

regarding the identification of oat species from intact chaff fragments and grains include Lisa Moffett's report on the late Saxon common (*Avena sativa*) and bristle (*A. strigosa*) oats identified in Stafford ([ST9/ST10/ST11]), and Stefanie Jacomet's revised cereal identification guide (2006). Jacomet's guide shows that the identification of bristle oat can only be confirmed where very narrow lemma bases are present on awned lemmas, since the secondary florets of common oat can look very similar but are un-awned. It is likely that bristle oat is grossly under-recorded in the Midlands because the small grains can easily be mistaken for wild oats. Fortunately, rye rachis is more easily recognised, although the grains can vary in shape and are not always found in their characteristic lop-sided bullet-shape.

Both oats and rye may have initially been introduced as crop weeds (Findlay 1956; Chambers and Jones 1984; Behre 1992) but by the Saxon Period both can be confirmed as crops in several Midlands counties. Cereal impressions in (420-700 AD) early Saxon pottery at Mucking included common and wild oats [EX21]. Late Saxon and Saxo-Norman records of confirmed common oat (i.e. chaff fragments preserved) include St Marys Gate, Derby [DB26], Mill Lane, Thetford [NK25], St John's Square, Daventry [NH24], Riggs Hall, Shrewsbury [SP9], The Shires, Leicester [LR5]. At Mill Lane, Thetford [NK25] rye grains were also frequent and at Woolmonger Street, Northampton [NH4] rye was dominant in late Saxon destruction layers. In a number of sites (e.g. West Cotton [NH37], Stafford [ST9/10/11], West Fen Road, Ely [CB13], Cottenham [CB46]) the abundance of rye chaff in ovens and ash pits has demonstrated that rye was being grown on a large enough scale to make the waste product a useful commodity. This is discussed in the West Fen Road, Ely report [CB13] by Rachel Ballantyne. The abrupt changes in arable agriculture that took place in the Saxon Period were clearly greatly influenced by incomers from north-west Europe, since rye became the dominant cereal on many continental sites at this time, and common oats were also frequent (Bakels 1991).

Prior to the Saxon Period, however, records are much more sporadic and uncertain in the Midlands. Occasional indeterminate oat grains have been found in Neolithic and Early Bronze Age samples (e.g. Wellington Quarry [HF7], Springfield Cursus [EX13] and Eynesbury [CB39]) but without direct dates these records must remain unconfirmed (in fact rye grains at Eynesbury were thought to be intrusive). A few early oat records have been directly dated e.g. Bestwall Quarry in the south of England (Carruthers 2009) an oat grain (*Avena* sp.) was dated to the middle Bronze Age (1410-1130 cal BC) and at Balbridie, Scotland, an *Avena* sp. grain was dated to 4820±80 (OxA-1767; Fairweather and Ralston 1993). However, the low level of oats until the Roman period at Bestwall Quarry suggested it was present as a weed in the Bronze Age. A similar measure of caution should be placed on the few Late Bronze Age sites that have produced occasional *Avena* sp. grains in the Midlands (e.g. [BD30], [EX24], [EX15]) until directly dated examples from larger assemblages are produced. By the Iron Age and Roman periods, however, the number of sites containing oat increases, although the quantities of grains at most sites are still very low. Reports from counties such as Cambridgeshire, Northamptonshire and Worcestershire usually mention oats as probably having been weeds, since they were infrequent and only identifiable as *Avena* sp. At Grange Park, Courteenhall [NH41], however, oats were said to be common in a LIA/ER sample. The earliest confirmed occurrence of a cultivated oat species, *Avena sativa* (common oat, floret base identified) in the Midlands region appears to be at Asheldam Camp [EX50] from an early/middle Iron Age context.

The large number of Romano-British reports containing mention of both oats and rye, albeit still usually in small amounts, suggests that these cereals had become either persistent weeds, occasional crops or fodder crops (and so possibly less likely to become charred in large quantities). Evidence to support the first suggestion was recovered from Bays Meadow Villa [WC14a] where a 4th century annexe was found to contain charred stored grain, including 4% rye and 2% oats. Only a single wild oat (*Avena fatua*) was identified to species level, and the low proportion of these cereals suggested that they had probably been growing as weeds. A similar suggestion was made for the fairly frequent oat grains found in two corn driers at Cawkwell [LC25], since only wild oat florets were identified. However, a large deposit of rye threshing waste (62 chaff fragments and 4 grains) was recovered from a Romano-British waterhole at Melford Meadows [NK27] and another substantial unpublished record exists from Ellesmere Road, Shrewsbury (Robinson 2002, quoted in Pelling 2003b, 103; [SP15]), confirming the cultivation of this cereal in both the east and west of the region. At Old Park House, Ashby de la Zouch [LR25] oats were common in a Late Iron Age pit and abundant in a Romano-British pit (almost 60% of cereal grains). Although no chaff fragments were recovered to confirm the identification, the recovery of 145 grains of oat showed that they were being grown as a crop. Rye chaff was also common in the Romano-British pit. Since local soils were seasonally wet, acidic and primarily of low fertility the Romans may have been adapting to local conditions in cultivating a different range of crops. It was suggested that the pit had contained burnt fodder. It is surprising that so little evidence for these crops has been recovered from other Roman sites in the Midlands, since in south-west England there is evidence that both common and bristle oats (*Avena strigosa*) were being grown, probably because other crops were failing on the poor, acidic soils (Penhale Round, Carruthers 2011). Oats are also more common in Scotland from the Iron Age onwards, with bristle oats being the principal cultivated species at this time (Boyd 1988). Once again, there is a need for the radiocarbon dating of oats and rye where a reasonable number of remains are found in Iron Age or Roman contexts in the Midlands, particularly where common or bristle oat chaff is preserved.

6.6.5 Late records of hulled wheats in the Saxon and Medieval Periods

Ever since the direct dating of substantial assemblages of emmer glume bases and grain from Lake End Road, Dorney, Berkshire and Yarnton, Oxfordshire (Pelling 2003b), there has been a growing awareness that hulled wheats should not always be discounted as being residual when found in early medieval and later contexts. Five glume bases (out of over at least 397 identified as *Triticum dicoccum*) from Dorney gave an early Saxon radiocarbon date of 1487±58BP (NZA-9206) (cal 543 AD to 642 AD at 1 sigma). At Yarnton, Oxfordshire (Pelling and Robinson 2000) emmer chaff from a post hole (found with grains) was dated to the middle Saxon period. Several other examples from southern England were provided by Pelling (2003a) and Pelling and Robinson (2000) but only two of these came from the Midlands region (see *Table 3*): Stewartby Millennium Park, Bedfordshire [BD39] where early to middle Saxon samples contained occasional emmer-type grains and a glume base, and Springfield Lyons, Essex ([EX13] [EX14]), where occasional emmer and spelt remains were found in an early Saxon cemetery and late Saxon settlement. A unpudated summary of occurrences of hulled wheats in the Saxon and medieval periods in the region is given in *Table 3*. Emmer wheat had not been recorded in notable numbers from Thames Valley sites since the Bronze Age, so its occurrence was interpreted as a reintroduction rather than persistent cultivation in the region. Because of the focus of these sites in the lowland zone along the Thames estuary, and because of continued cultivation of emmer in parts of Northern Germany from where Saxon immigrants to the Thames Valley are known to have

originated (Hawkes 1986, 77), it has been proposed that the Ems estuary in Germany could have been the origin of this re-introduced crop, rather than upland areas in the British Isles where it continued in cultivation for a longer period than in the south. The suitability of emmer to lighter soils, such as are found on the Thames gravel terraces would have made continued cultivation worthwhile, with cultural factors no doubt also playing a role.

Two additional sites are described in sections 5.6.6.2 and 5.6.6.3 of this review:

Bloodmoor Hill, Carlton Colville, Suffolk [SK29] Emmer and spelt were common enough in one pit on a 6th to 8th century AD settlement to suggest the continued use of hulled wheats.

West Stow, Suffolk [SK19] 62 hulled wheat spikelet fragments were recovered from a SFB, most of which were identified as spelt.

Table 3: Finds of emmer and spelt wheat in Saxon and medieval assemblags in the Midlands region

Site code	Site Name	County	Taxa	Date	Notes	Additional Reference
BD39	Stewartby Millennium Park	Beds	emmer	E-M Saxon	occasional grain and chaff	Pelling (2003b)
EX5	Heybridge	Essex	emmer & spelt	Anglo-Saxon	Anglo-Saxon cemetery	
EX14	Springfield Lyons, Chelmsford	Essex	emmer & spelt	E Saxon & L Saxon	early Saxon cemetery & L Saxon settlement – several spikelet forks	Murphy (1994)
EX18	Stansted Southgate	Essex	spelt	L Saxon	cob building - good spelt-type grain dated to AD 960-1040±30 (NZA 23235)	
EX21	Mucking	Essex	Spelt	AD420-700	impression (s) on pot sherds	
EX44	Chadwell St Mary	Essex	spelt	E Saxon	one emmer glume base	
NH5	Sol Central, Marefair, Northampton	Northants	spelt	later Med	traces of spelt chaff present in one sample	
NH20	Higham Fererrs	Northants	spelt; glume wheats	E Saxon	small amounts of spelt wheat in SFBs, small amounts of glume wheats in enclosure ditch, maybe residual	
NH37	West Cotton, Raunds	Northants	spelt	L Saxon	small amounts in mill leet, perhaps as weed of rye	
NK16	Old Street, Fakenham	Norfolk	spelt	C13th to post-med	a spelt glume base in moat	
NK27	Melford Meadows, Brettenham	Norfolk	spelt	E Saxon	a little spelt	
NK12	Norwich Southern Bypass	Norfolk	emmer	Saxon	grave fill, may be residual	
SK19	West Stow	Suffolk	spelt	C7th AD	dominant in one SFB	
SK29	Bloodmoor Hill	Suffolk	emmer & spelt	C6th-C8th	emmer and spelt were common enough in one pit to suggest continued use at this site.	
SP9	Riggs Hall, Shrewsbury	Shropshire	spelt	C10th & early C12th	some in pit	
WR27	M6 Toll	Warwicks	spelt	Med	traces of spelt may have been contaminant or residual	

It would be worthwhile obtaining radiocarbon dates from both of these assemblages. This is a topic that requires further confirmation by dating, in order to rule out residuality and look for regional differences.

6.6.6 Free-threshing tetraploid wheat (rivet-type) in the Anglo-Saxon to early medieval period

A detailed review of the evidence for rivet-type wheat is currently being prepared by Angela Monckton (pers. comm.) so the subject will only be briefly discussed here to accompany *Table 4*: a list of rivet wheat-producing sites. The authors are very grateful to Angela for providing data from her unpublished research, some of which has been used below.

The Midlands is a rich source of evidence for the cultivation of tetraploid free-threshing wheat (generally considered most likely to have been rivet wheat, *Triticum turgidum* on ecological and historical grounds, but referred to as rivet- wheat type in this Review; see Moffett 1991). The central counties of Warwickshire, Leicestershire, Northamptonshire, Buckinghamshire, Bedfordshire, Cambridgeshire and Essex appear to have favoured the cultivation of this useful free-threshing wheat. Some of the earliest dated records for rivet-wheat type wheat come from the centre of this region, in particular sites around the Nene Valley such as West Cotton, Raunds (AD 950-1100 [NH37]), and Higham Ferrers (770-1000 cal AD; OxA-10126; 1150±45 BP, [NH20]). The occurrence of rivet wheat type increases notably in the earlier high medieval period (c.1100-1250) and even more so in the later high medieval period (AD 1250-1400). In comparison with the south of England the Midlands has almost twice the number of sites on which it has been recorded, an observation that could relate to a preference for heavier soils as found in the Central Midlands. Only three sites have been recorded from Northern England, reflecting the fact that rivet wheat is less frost-hardy than bread wheat types. Further investigations coupled with radiocarbon dating will, hopefully, reveal how this cereal spread through the southern and central regions of Britain

There are several advantages to growing both types of free-threshing wheat. Whilst bread wheat types have high gluten content and so make a well-risen loaf of bread, rivet wheat is more suitable for making biscuits. Rivet wheat grows on a long, strong straw that was much in demand for thatching (Letts, 1999). It was late to ripen, and so needed to be planted early in the autumn, but was resistant to pests and diseases, and was useful on weed-infested land because its long straw meant it could out-compete many species (Percival, 1921). Both wheats produced good yields on heavy, fertile soils. They may often have been grown together as a maslin with bread wheat in order to 'hedge your bets' with regards to weather conditions, pests and diseases, since pure deposits of rivet wheat have yet to be found. Medieval bakers often mixed different cereals to make bread (Letts, 1999), so there may have been no need to grow the crops separately. Rivet wheat appears to have fallen out of favour in the 19th century in the British Isles when a lighter, whiter loaf of bread was required, and mechanisation demanded more even ripening of crops.

Table 4: Finds of tetraploid free-threshing wheat rachis in the Midlands region

Site Names	Site code/ reference	Date	Perservation	notes
Yelnow Villa, Colworth Science Park	BD7	presumed med	C	assessment only
Stratton	BD41	C9th-C11th	C	
Norse Road, Bedford	BD42	late Saxon to Saxo-Norman	C	info from A Monckton (pers.comm.)
Castle Lane, Bedford	BD43	? late Saxon/Saxo-Norman	C	info from A Monckton (pers.comm.)
Huntingdon to Willington pipeline	BD40	Saxo-Norman	C	
Wing Church	BK7	C13th	C	
Brooklands, Milton Keynes	BK17	C12th-C14th	C	trace of rachis
Olney	BK23	?Saxo-Norman, C12th >	C	
Chicheley Hall	BK28	C11th-C14th, ?Saxo-Norman	C	info from A Monckton (pers.comm.)
Grand Arcade and Bradwells Court, Cambridge	CB8	C15th-C16th	C	info from R Ballantyne (pers. comm.)
Cockpit at St Ives	CB23	post-med	C	
The Walnuts, Oundle Road, Woodston, Peterborough	CB33	early & late med	C	
Long Causeway, Peterborough	CB34	C13th-C14th	C	
St Marys Street, St Neots	CB38	Med	C	a few rachis frags
Hinxton Hall,	CB78	early med	C	6 rachis frags
Boreham Airfield	EX9	C12th-C13th	C	c12th-13th house, granary, windmill within large rectangular moat; 3 rachis frags
Stansted Airport	EX18	possible late Saxon	C	cob building, 2 good rachis fragments
Roundwood, Stansted	EX19	C13th	C	7 rachis frags
Molehill Green, Stansted	EX19	C13th	C	1 rachis frag
North Shoebury	EX41	early med (AD 1066-1300)	C	2 rachis frags
Hill Hall	EX42; Moffett 1991	C12th	C	
Hereford HE97B	HF12	?	C	info from A Monckton pers.comm.
Flaxengate, Lincoln	LC31	C13th	C	1 rachis frag

Site Names	Site code/ reference	Date	Perservation	notes
Grimsby	LC38	C12th-mid C14th	C	ID confirmed & info from A Monckton pers.comm. Most northerly site in East Mids region
Mornington House, Gosberton	LC33	mid-Saxon	C	1 rachis frag
Leicester Shires	LR5	e C12th- m C13th & C15th	C	
Causeway Lane	LR4	C11th-C13th	C	
Bonners Lane, Leicester	LR6	post-med	C	
St Nicholas Place, Leicester	LR42	early med	C	pit in undercroft
Vine Street, Leicester	LR47	Med	C	A Monckton pers.comm.
Sherrard Street, Melton Mowbray	LR44	post-med	C	ref in LR45 report & in ULAS Report 2005-146 by S Jones on ADS
Main Road, Old Dalby	LR45	post-med	C	In ULAS Report 2008-056 by A Hyam on ADS with discussion of Leicestershire sites
Saxby Village	ref in LR45		C	
Whissenden, Rutland	LR48; ref in LR45	early post-med	C	not in earlier phases, bread wheat only
Kingswell St & Woolmonger St, Northampton	NH2	Med	C	
Derngate, Northampton	NH3	C13th-C14th	C	
Woolmonger Street, Northampton	NH4	early med	C	
Higham Ferrers	NH20	dated AD 770-1000	C	Nene Valley
West Cotton, Raunds	NH37	dated AD 950-1100	C	Nene Valley. In ovens & ponds 1100-1250 AD, few in 1250-1400 (AM pers.com.)
Carbrook Preceptory	NK18	Med	C	bread wheat dominant to rivet by 27:1
Castle Mall, Norwich	NK44	C16th-C18th	C	
Nottingham General Hospital	NT6	C12th-C13th	C	abundant CPR in gully in outer bailey, one good sample amongst several v. poor (11 rachis frags)
Minster School, Southwell	NT17	med/post-med	C	upper layers channel fill (AM pers.comm)

Site Names	Site code/ reference	Date	Perservation	notes
Ipswich	SK37; Moffett 1991	C13th	C	
Shrewsbury Abbey	SP2	C12th-C14th	W	waste deposited in moat
Stafford	ST9/10/11; Moffett 1991	C12th	C	
Stone tenement	ST26	early post-med	C	
Deansway, Worcester	WC6	C16th/early C17th	C	
Upwich, Droitwich	WC39	C13th & late/post-med	C	
Corve Street, Ludlow	WC40	late C12th	C	
Burton Dassett	WR31	early C14th & mid/late C15th	C	AML 111/91
School Road, Alcester	WR48; Moffett 1991	C12th	C	
Cawston DMV, Dunchurch, Rugby	WR36	C12th-C13th	C	abundant chaff
Bridge End, Warwick	WR49; Moffett 1991	C14th	C	A Monckton pers.comm. from Moffett 1991
Boteler's Castle	WR47	C12th/C13th	C	
St Mary's Priory, Coventry	WR40	AD 1300-1400	C	7 rachis frags
Bascote, Southam	WR20	C11th/C12th & C12th/C13th	C	

W = waterlogged; C = charred

6.6.7 Early records of specific plants with economic uses deserving of further investigation

6.6.7.1 Possible oil seed plants

An important resource in the past would have been the oil that could be extracted from seeds such as several members of the brassica family (Brassicaceae, including mustards and *Camelina sativa*), flax or linseed (*Linum usitatissimum*) and poppies (*Papaver* spp.). Fatty vegetable oils (fixed oils) can be extracted from seeds and nuts by pressing. If heat is applied this process is made more efficient, although too much heat can change the quality and taste of the oil. The following taxa could all have been used for oil extraction, although they all have other uses in addition.

Charred evidence - Records of flax (*Linum usitatissimum*) have been discussed through the period sections and in Section 6.2.4.2, with the main interpretation being that retting waste was represented when capsule fragments, stems and seeds were recovered from waterlogged deposits. Finds of abundant charred seeds of any of these taxa, however, are more likely to indicate oil extraction, since heat was often used to make the oil flow from pressed seeds more effectively. Of course, this depends on the character of the assemblage as a whole; although charred flax seeds were frequent at Renny Lodge, Bucks [BK10] the presence of capsule and stem fragments as well as weed seeds suggested that in this example burnt flax processing waste was indicated.

The following examples from the Midlands *could* be seen as evidence of oil production, although the evidence is far from conclusive;

[BD23] Biddenham Loop, Beds - >2000 charred seeds *Brassica /Sinapis* sp. including *Brassica nigra* (probably dominant) in a Middle Iron Age pit.
[BD28] Kempston, Beds – frequent charred *Arabidopsis/Camelina* sp., 2nd century Roman
[CB13] West Fen Road, Ely – possible charred black mustard seeds in several late Saxon samples, and several samples contained flax seeds
[LR4] Causeway Lane, Leicester – frequent charred flax seeds in one Roman sample

Waterlogged evidence - The waterlogged assemblage of three species of brassica (*Brassica nigra*, *Brassica rapa* ssp. *campestre* and *Brassica/Sinapis* sp.), present in significant numbers at Bancroft Roman Villa, Bucks [BK24], could have derived from use as flavourings, use as garden seed or use for oil extraction. The possibility of accumulations of small-seeded weedy brassicas (including charlock, *Sinapis alba*) within storage pits and structures should also be borne in mind, since the small, rounded seeds would easily trickle down through stored grain and accumulate at the bottom if a storage area was re-used over a period of time.

Black mustard (*Brassica nigra*) is a tall (1 to 3 metres) annual that is probably native (Stace 2010) although some texts suggest that it may have been introduced to Britain by the Romans (Phillips, 1983). It was certainly used as a condiment by the Greeks and Romans, according to documentary sources, and its seeds are the

most pungent of the mustards. Seeds were steeped in wine and crushed by the Romans, and they were ground into a paste by the Anglo-Saxons or used whole (Phillips, *ibid.*). Oil from mustard seeds has been used medicinally and to make soap. Oil makes up around 30% of the seed, consisting mainly of the fatty acids linoleic acid and erucic acid. Mustard seed oil has the lowest saturated fat content of the edible oils. The high erucic acid content makes it less palatable to western tastes today, but in India it is heated at a high temperature during cooking to reduce the strong smell and taste. Mustard seed can also be used externally in poultices, as the oil has an antibacterial quality and is said to improve blood circulation. Black mustard was largely replaced by Asian/African brown mustard (*Brassica juncea*) in the 1950's because it was easier to harvest mechanically, being shorter and less likely to shed its seeds (de Rougemont 1989, 228).

The archaeophyte opium poppy (*Papaver somniferum*) is possibly the earliest non-cereal crop plant introduced to the British Isles. Samples from the Long Barrow ditch at Raunds dated to the early 4th millennium cal BC produced opium poppy seeds [NH34]. The seeds can be used as a flavouring and for oil, while medicinal opium (latex) can be extracted from the fruits. Occasional opium poppy seeds are quite common in later deposits. Other examples given below demonstrate the wide range of feature types and dates in which opium poppy seeds can be found;

[CB34] Long Causeway, Peterborough – 16th century ditch
[CB54] Haddenham – in flood deposits sealing an Iron Age enclosure ditch
[NH10] Glapthorn Road, Oundle – Roman well
[NH23] Higham Ferrers – Roman wells

While it is debatable whether cotton thistle (*Onopordum acanthium*), a weed of waste ground, should be included in this section, being a c.2.5 m tall introduced plant with an impressively tomentose appearance and several uses, it is likely to have been of economic value at least at some point in its history. Cotton thistle has been included here because its large seeds have been used to provide oil for lighting and cooking on the continent. Grieve (1931, 798) notes that twelve pounds of seeds can produce around 3lb of oil when heat is used to aid expression (it could also have been placed in Section 6.2.1.7 amongst the medicinal plants). Greig (1988, 370) points out that the weed community that includes cotton thistle, henbane and mallow, the 'Onopordietalia', is warmth-demanding and not currently found in the British Isles. Cotton thistle was introduced from continental Europe at least as far back as the Roman period and possibly in the Iron Age according to evidence from Heathrow waterholes (Carruthers 2006b) and a tentative identification from Middle Iron Age Asheldham Camp [EX50]. It is of interest because the plant has a variety of uses (oil from the large seeds, downy 'cotton' stuffing/padding material from the seed head, edible shoots and leaves) and it is strongly associated with waterlogged features such as wells, waterholes and ditches. In the Midlands there is waterlogged evidence of the seeds from a Roman well at Glapthorn Road, Oundle [NH10], a 3rd/4th century Roman well at Bays Meadow, Droitwich [WC14b], three Roman (1st/2nd to 3rd/4th century) wells at Tiddington [WR35], a later Roman ditch at Salford Priors, Arrow Valley [WR30b], a later medieval well at Scotland Road/Union Lane, Chesterton [CB22] and a post-medieval waterlogged clunch-

lined pit at Pembroke Colledge Library, Cambridge [CB1]. Charred seeds were also recovered from a medieval ditch at Brooklands [BK17a].

The relationship of this plant with waterlogged features suggests either that some type of retting or water-related processing was taking place, or that the large silvery-white plant had a symbolic association with water. Although it now grows as a casual on rough ground including river banks, it was obviously useful or important enough as far back as the Roman period (if not earlier) to have been brought to Britain. Classical texts such as Pliny the Elder suggest that cotton thistle could cure a number of ailments, ranging from a crick in the neck, to convulsions and rickets. Pliny, in his Natural History (1855, chapter 66), notes that:

> The seed of the white thorn is useful as a remedy for the sting of scorpions, and a chaplet made of it is good for headache. Similar to this plant is that known to the Greeks as the 'acanthion' [*Onopordum acanthium*] though it is much smaller in the leaf, which is pointed at the extremity, and covered with a down like a cobweb in appearance. This downy substance is gathered in the East and certain textures are made of it similar to those of silk. An infusion of the leaves or root of this plant is taken for the cure of opisthotony (muscular spasms).

Summary - This small amount of tentative evidence suggests that the main periods of use for seed-extracted oil could have been the Iron Age and Roman periods, a phenomenon that has been observed in other parts of the country. In Southern England a number of late Bronze Age and Iron Age sites have produced occasional samples from pits and post holes that are rich in seeds from the Brassicaceae family (late Bronze Age/early Iron Age Hartshill Copse, Berks – 150 seeds *Brassica* cf. *nigra* (Carruthers 2009b), Iron Age Thanet Earth, Kent - >600 *Lepidium* cf. *campestre* and cf. *Sisymbrium officinale* (Carruthers, 2013b)). Although several Anglo-Saxon and later sites also produce evidence of this nature it is likely that a wider range of oil-rich seeds and fruits came onto the market as trade routes expanded around the world.

6.6.7.2 Dye Plants

Unlike the Anglo-Scandinavian dye plant finds at Coppergate, York (Kenward and Hall 1995) or the early medieval records from Bristol waterfront (Jones and Watson 1987), the Midlands has not yet produced extensive waterlogged deposits containing evidence of dye plants such as madder (*Rubia tinctorum*) or dyer's greenweed (*Genista tinctoria*). Whilst woad (*Isatis tinctoria*) fruit fragments were recovered from two Iron Age pits at Dragonby, Lincs [LC26] there was no definite evidence as to their precise use. Hall and Huntley (2007, 236) point out that the recognition of dye plant waste is particularly difficult because fruits and seeds are not the main parts of the plants used to extract dyes. For madder and dyers greenweed the roots are used, and for woad the young leaves are most effective.

There is potential for finding this type of information in many of the Midland city centres, particularly at waterfront sites in cloth-working towns such as Lincoln (see

[LC1]). It is likely that dying activities were taking place at sites producing substantial evidence for cloth working, although no large concentrations of obvious dye plants were found (at Long Causeway, near Peterborough Abbey [CB34] weld and flax were recovered; at Bordesley Abbey [WC29] fullers teasel, flax and hemp were present). Many common native plants can be used for dying, including lichens, clubmoss, heather, blackberry, elderberry, bracken, nettle, horsetail and bark. Unless a concentration of these materials is found, perhaps amongst discarded waste, their use is unlikely to be recognised in archaeobotanical samples.

6.7 Evidence for Crop Pests and Diseases

Charring and mineralisation can preserve structures such as fungal sclerotia and cereal galls that provide valuable evidence about crop husbandry practices and the quality of harvested grain. Very little evidence of these has been recovered from the Midlands counties but the following examples demonstrate the types of information that can be recovered.

6.7.1 Ergot (Claviceps purpurea) sclerotia

Crops such as rye and some grasses are particularly susceptible to ergot because they are cross-pollinated, although wheat and barley can be affected to a lesser extent. Conditions favouring infection are a cold winter followed by soils that are wet for a long period in the spring. This may be why the free-draining sandy Breckland soils of East Anglia were favoured for growing rye, in addition to the long root systems coping better with dryness. Cool, moist weather also favours the disease, as do poor growing conditions (nutrient-poor soils, high levels of insect infestation spreading spores etc.).

An article by Jean and Hannah Nicholson (2010) concerning 17th century ergotism in Nottinghamshire demonstrates that this fungal disease of rye and grasses continued to be a serious problem in the Midlands until seed screening and crop spraying became widespread in modern times. Bad cases of infection in a cereal crop which is then made into bread can lead to miscarriages, still births, deaths, insomnia, hallucinations, convulsions and other psychotic behaviour in livestock and humans. Toxic alkaloids are present in the thick-walled sclerotia which remain active even after being baked into bread. The devastation caused by this disease was understood in the medieval period, and it no doubt affected decisions on which crops to sow and where to sow them. It may also have increased activities such as screening by hand-picking cereals in the home, since the brown/black sclerotia are easily seen amongst grain but not easily sieved out, being the same width as the grains they replace in the ear.

In Saxon cesspits in urban locations such as Winchester (Carruthers 2011b) the large number of intact corn cockle seeds is often noted (another large black seed easily, though laboriously, picked out by hand). Although corn cockle is also toxic it has a less devastating effect when made into bread, so perhaps the screening was aimed primarily at removing ergot sclerotia at this time. Mineralised sclerotia have been recovered from middens and cesspits at sites dating back to the Late Bronze Age (Potterne, Carruthers, 2000a) as well as probable sclerotia from mid to late Saxon cesspits at Barton Court School, Kent (Carruthers, 2010c).

Examples of evidence for ergot are scarce in the Midlands, but some sclerotia were found in the Leicester Shires sites [LR5] dating to the Roman and early medieval periods. A possible sclerotium of ergot was also recovered from a medieval sample at Rocester [ST17a] [ST17b].

6.7.2 Wheat nematode gall (*Anguina tritici*)

Figure 11 is an illustration of a wheat nematode gall from Wharram Percy in the Yorkshire Wolds (Carruthers, 2010b). At Wharram Percy the burnt-down 16th century barn, produced 275 galls amongst large quantities of stored wheat. In the Midlands ten galls were recovered from the medieval Raunds Project sites of Furnells Manor and Langham Road [NH36].

Figure 11: Wheat nematode gall (*Anguina tritici*), Wharram Percy Barn, by Kathryn Hunter Dowse (Carruthers 2010b)

Wheat nematode gall (*Anguina tritici)* or 'ear-cockles' was a considerable problem in the past and still causes economic losses in some parts of the world, such as India and Romania. Infestations can be controlled by using crop rotations of one to two years in moist soil conditions, but in areas of drought the nematodes within the galls can remain viable in the soil for many years (nematodes have been revived from galls stored up to 28 years (Southey 1972)). Modern mechanical seed screening has led to the elimination of this pest from crops in Britain today, and in the past floatation in brine or water was used (Southey, ibid.). Although in the past

there may not have been any understanding of the mechanism of infection by something as small as a nematode, the facts that the galls are brown or black in the ear and the plants become grossly distorted should have allowed for some degree of disease control, particularly if farmers had already experienced debilitating infections such as ergot. Diseased plants could have been pulled up by hand and the brown/black galls could have been handpicked from the harvested grain.

6.7.3 Grain pests (e.g. the granary weevil (*Sitophilus granarius*))

A recent review of evidence for grain pests in the British Isles highlights the fact that, even after many years of data collection, there are no pre-Roman records, no immediate post-Roman records and relatively low numbers of medieval records, despite the frequency of sampling from sites of these periods (Smith and Kenward 2011). Attempting to answer the question as to why records are so focused on the Roman Period (a question first examined by Buckland thirty-five years ago (1978)), they mapped the records across the country, demonstrating how the distribution related to the mass movement and storage of grain in military locations such as 3rd and 4th century AD Droitwich, Worcs (Osborne 1977), 4th century AD Alcester, Warwicks (Osborne 1971), ?1st century AD Dragonby, N. Lincs (Buckland 1996), and mid to late 3rd through to 4th century AD Lincoln, Lincs (Carrot *et al* 1995; Dobney *et al* 1998). Large-scale cereal cultivation was occurring in the late Iron Age, but it was not until the importation of grain occurred in the Roman period at a high and constant level that non-native pests such as granary weevil, saw-toothed granary beetle (*Oryzaephilus surinamensis*) and the rust-red grain beetle (*Laemophloeus ferrugineus*) from the Continent became established as storage pests. Their failure to persist in large numbers after the Roman withdrawal was suggested to be due to the demise of large open grain stores which can hold large quantities of grain, in combination with the frequent and large-scale importation of grain from across the Channel. To add to this, we suggest that the de-husking of spelt wheat on a large scale, as evidenced on sites with corn driers and large deposits of de-husking waste such as Stansted, Essex, suggesting that the grain was stored in a fully threshed state, may have made crops more vulnerable to attack and helped to spread pests between sites.

The recognition and recording of signs of pest attack, therefore, could not only increase knowledge about storage conditions but also may provide indirect evidence for the transportation and trade of grain – an activity that is hard to prove in other ways. Smith and Kenward (2011) suggest that 'the round holes left by the grain weevil should be readily observed.' In addition, larvae and adult beetles can sometimes be found amongst charred grain. Besides the grain pest records cited by Smith and Kenward, other finds of pests have come from the following sites:

Austin Friars, Leicester (Girling 1981, plates 13 and 14) – granary weevil and saw-toothed grain beetle), and bean beetle from waterlogged medieval deposits at Austin Friars, Leicester.
Bonners Lane, Leicester [LR6] – a bean showing signs of attack in a late medieval/post medieval pit containing charred peas, beans and cereals.

7. RESEARCH AGENDA AND PRIORITIES

The following section summarises the research agenda for plant macrofossil studies in the Midlands counties, drawing on agenda put forward in a number of regional reviews written over the last ten years (Murphy and de Moulins 2002; Greig 2007; Monckton 2006; Pearson in Watt 2011). Many themes have been repeated in successive review papers, with attention being drawn to the same gaps in our knowledge over the years. In some cases, progress in these areas may be a matter of time, for example, our better understanding of hunter-gatherer plant-based subsistence may largely be due to the chance findings of *in situ* well-preserved Mesolithic deposits with associated finds. A certain amount can be done with the help of survey projects to attempt to locate likely deposits and sites (for example The Doggerland Project, Bryony Coles, Exeter). Other topics, however, could be advanced if research funding was specifically targeted at particular settlement types or deposits.

The finding of notably well-preserved or unusual deposits and structures (and sometimes even sites) that have the potential for providing high quality data is frequently unpredictable and sufficient funding is consequently not always available to maximise the archaeobotanical potential. One solution would be to direct extra funding to high priority sites or deposits as they arise, so as to enable large-scale sampling and detailed analysis to be carried out where it would be most effective. This would be especially valuable for developer-funded sites and community excavations, where competitive tendering and low levels of funding limit the options for undertaking detailed archaeobotanical work. It would require a fast-track system of funding, with applicants having to meet a sufficient level of archaeobotanical competence. The fund should also be available at the post-excavation stage, so that archaeobotanists would be able to carry out more detailed analyses of deposits found to be of special interest during analysis, with particular emphasis on providing funds for the AMS dating of significant plant remains (a high priority noted in many sections of this review). Within the developer funded system it is vital that sufficient funding is protected at the excavation stage for full assessment of archaeobotanical samples.

The following research priorities have been put forward by most authors working in the Midlands region, as well as being noted by the authors of this review:

7.1 By Period

The period reports (Section 5) contain more specific priority points, but the following areas of interest have been noted by most authors of reviews covering the Midlands;

- Any *in situ* Palaeolithic or Mesolithic deposit with associated evidence for human activity should be sampled on a large scale (and in high definition) for all types of environmental evidence. Integrated specialist analyses are key to the understanding of very poorly understood periods and will provide

more reliable evidence for climate change. Organic deposits are of major importance, including palaeochannels.

- Areas now under the North Sea ("Doggerland") and in the Thames estuary have great potential for increasing our understanding of the Holocene environment and early human activity and settlement.
- Neolithic to Early Bronze Age sites should be intensively sampled (up to 60 litre soil samples or multiples of smaller samples from each context) in order to increase our understanding of the cereals versus wild food dietary balance and importance of arable cultivation. Charred cereal remains from these periods need to be directly dated where frequent in number or notable in character, with photographs of significant dated items published wherever possible. Particular note should be made of substantial free-threshing wheat assemblages, large deposits of naked barley and early Celtic bean, flax and other non-native economic plant finds.
- Sampling of Neolithic and Early Bronze Age sites should not be limited to deposits producing datable lithics/ceramics. Highly productive grain deposits with no associated finds have been demonstrated to be early Neolithic once grain has been directly dated (Poundbury, Dorset Pelling 2011; Westwood Cross, Kent, Stevens 2011).
- The Middle and Late Bronze Age periods are much less well-understood in the Midlands region than in Southern England or NE England. The introduction of new crop plants such as spelt wheat and Celtic beans needs to be tracked across the region more accurately, with AMS dates being carried out directly on spelt glumes bases wherever possible.
- There is renewed interest in the excavation of Iron Age hillforts, many of which were excavated several decades ago, prior to the development of archaeobotanical studies. Detailed studies at Danebury Hillfort and surrounding Environs (Jones 1995; Campbell 2000) have provided good comparative data, and the plant evidence has a lot to contribute towards the organisational aspects of these sites and the surrounding landscape.
- Although the Roman period is fairly well-represented in terms of numbers of sampled sites, there is still much to learn about the trade and importation of foods, the pressures leading to large-scale cultivation of spelt, and industries such as brewing, as well as the roles of free-threshing wheat, emmer wheat and rye within the native and military economies. Waterlogged and mineralised deposits, as well as catastrophic fire deposits have great potential to provide information about garden plants, imported goods and crafts involving plants. Roman villas continue to produce mostly poor assemblages (perhaps demonstrating their efficiency) so any rural settlements, especially villas, should be intensively sampled. Small towns are under-represented in some areas. With sufficient data from urban sites, Roman deposits in town centres and suburbs can be compared to see how crop-related activities, diet and living conditions differ for different sections of society. This type of comparison would also be valuable for later periods of occupation.
- The Anglo-Saxon period is still of particular interest, especially the Roman/AS transition period when the most abrupt and widespread changes affected farming practices and diet. The extent to which these changes were

experienced in different types of settlement is not clear, and the early Anglo-Saxon period is still poorly represented. Variations in the degree of abandonment occur from site to site, so more detailed investigations are required to see if patterns are emerging. Cereal crop changes, which need to be pinned down by direct AMS dating, include the possible early introduction of rivet wheat in the late Saxon period (particularly in Northamptonshire) and the possible continued cultivation (or re-introduction) of hulled wheats well into the Anglo-Saxonand medieval periods. For this latter topic AMS dates on identifiable chaff fragments (where reasonable numbers of chaff fragments are found) are essential to overcome confusion due to the redeposition of charred material.

- Rural medieval sites are still under-represented, and well-preserved examples are needed to provide information about cereal crop husbandry and the spread of crops such as rivet wheat across the region. Their relationships with small market towns and larger urban centres need to be better understood, comparing and contrasting the charred plant macrofossil evidence with the documentary evidence wherever possible. Because charred cereal processing waste is rarely found in large quantities on these sites (being too useful a resource to burn, and often not reaching settlements due to processing stages taking place elsewhere), sites affected by catastrophic fires, or waterlogging and mineralisation, are of particular interest. In addition, the piecing together of the results from samples, which individually do not provide limited information, from small-scale excavations in villages may gradually build up information about the rural economy.
- The value of post-medieval deposits is still rarely acknowledged, even though they are more likely to be supported by documentary evidence, increasing their interpretative contribution. In addition, deposits related to industrial activities such as tanning, cloth working and brewing can be of great interest, providing information which can be related back to the medieval and earlier periods, where such activities may be more difficult to identify. The availability of 'luxury' foods, including New World goods, to different sectors of the population needs investigating, as do the dietary differences in general in a society that had become much more diverse in terms of living conditions and status.
- Transition periods in general require more detailed examination, including the examination and publication of samples that may be less productive, so as to demonstrate changes in activity levels. Sampling across transition periods would need to be backed up by extensive Bayesian dating information in order to tie them in to a tight time frame.

7.2 High Priority Themes

Specific research areas are worthy of further investigation, benefiting archaeology as a whole.

- Intensive studies of a number of carefully selected individual sites (the value of which has been demonstrated by, for example, the Raunds project).
- Increase in the use of Bayesian modelling to refine chronologies.

- A more integrated approach for all finds categories so as to answer questions such as waste disposal and middening (as undertaken by Rachel Ballantyne 2009).
- A more consistent approach to data retrieval and publication (including making grey literature readily available on the ADS) to facilitate projects involving synthetic and regional studies. It is important that full data sets (species tables with sample volumes) linked to phasing information are provided in the grey literature.
- Further development of DNA analysis would be of great value to the understanding the origins of agriculture. Cereal taxonomy in the Neolithic period is complex and difficult to unravel due to the scarcity of identifiable chaff fragments and wide variation in grain morphology.
- Regional variations in the timing and extent of early human impacts on the landscape mean that very localised and detailed investigations need to be made. Targeted multi-disciplinary studies on river valley sediments, palaeochannels, lakes and inter-tidal zones should be undertaken.
- There is still a need for evidence of trade at regional, national and international levels. Even in the Roman period, there is little knowledge about the movement of grain around the country, or the trade in luxury goods in smaller towns. Communication networks across western Europe need to be investigated, perhaps by the tracing of suites of weed taxa.
- Any *in situ* deposits associated with specific activities and artefacts, such as industries and crafts, should be sampled in detail for plant macrofossils.
- Ceremonial and ritual contexts containing placed items can provide evidence of the status of different foods. Micro-excavation and close interval sampling may be worthwhile to enable 3-D re-construction of the feature.
- Many historic buildings were constructed to a large extent with plant materials, and there is ample scope for their investigation using methods routinely employed for buried deposits. Types of analyses that have been of value in the past include dendrochronology, the analysis of soot-blackened thatch (Letts 1999; see Sections 2.2.2.7 and 5.7.4.3), and plant macrofossils recovered from wattle and daub walls (Althrey Hall, Clwyd (Carruthers 1991)). The introduction of the National Planning Policy Framework (NPPF) in 2012 (updated in 2018) should now ensure that there is a more integrated approach to investigating all aspects of heritage assets (buildings, sites, monuments, landscapes) and the historic environment. This should improve the investigation of archaeobotanical remains from all types of historical context, including standing buildings.
- It is important for archaeobotanists to continue to find new ways to engage with the public and demonstrate how information from past societies and environments has relevance to cooking, diet, gardening, agriculture, climate change and conservation today. Integrated studies of foods using information from plant remains, bones, pottery and documentary sources (such as Cool 2006; Eating and Drinking in Roman Britain) can be of great interest to the public. In addition, the increased use of archaeobotanical evidence in museum displays, and by re-enactors at schools and for public events is to be encouraged.

As may be expected, many of these topics involve the input of higher levels of funding - something that can be difficult to carry out within the commercial sector, under the constraints of competitive tendering. A recent review of Medieval Archaeobotany in Britain by Marijke van der Veen, Alistair Hill and Alexandra Livarda (2013) highlights changes in the levels of archaeobotanical data being published. Concerns have been voiced about the reduced numbers of samples (taken for charred plant remains) brought to full analysis and publication, and about the variable quality of the accessible published data set. It is perhaps not surprising that excavations in medieval urban centres are by necessity keyhole operations with the potential for providing relatively few informative samples. On the other hand, a much larger number of sites have been excavated and sampled over the last two decades, some of which have been intensively sampled where the opportunity has arisen. It is important that experienced archaeobotanists are involved in assessments leading to the selection of samples for analysis, and that they are able to justify analysing sufficient numbers of samples which not only pick out the richer deposits, but also provide information on the background levels of waste present in a wide range of features. Rich deposits in isolation can produce misleading results, as they often arise from chance accidental fires and so may not be typical of the period. They need to be set in context by analysing a wider range of samples from different areas of the site, even if this involves including some poor, mixed waste deposits. This will provide sufficient data for archaeobotanists to investigate distributions across the site, activity areas and changes through time (on multi-period sites), none of which is possible when only rich samples are analysed. It is particularly important that all data from a site, including sites producing no or only limited plant remains, are published in some form to enable a more accurate understanding of finds distribution. This may simply mean a summary of assessment data but should include numbers of samples per phase and sample volumes.

7.3 Threats and Problematic Areas

- *Contamination* - The problems of contamination have been highlighted in Section 6.5. Until this is tackled by directly dating unexpected and unusual plant remains our overall understanding of the timing of crop introductions will be inaccurate and incomplete.
- *Identification* – Even after decades of sampling and analysis, new crop plants are coming to light, with published identification criteria and workshops enabling archaeobotanists to recognise them in British assemblages (such as tetraploid wheats in the 1990's (Moffett 1991), the new glume wheat in the 2000s (Jones *et al* 2000b; Kohler-Schneider 2003), current work on two-row barley (see Section 6.6.3) and Neolithic free-threshing wheat. Online discussion groups (for example Archaeobotany@jiscmail.ac.uk) can be a valuable way of exchanging information, and conferences such as the International Work Group for Palaeoethnobotany (IWGP) are important forums for advancing identification criteria.
- *Sampling* – With the current system of funding most excavations are small-scale (particularly in urban centres) leading to many excavations producing

and analysing relatively few productive samples (frequently too few to be of interpretative value; see van der Veen *et al* 2013). A few, much larger developments do continue to provide valuable well-sampled multi-period, multi-disciplinary investigations. However, it is important to make use of data from the smaller sites by drawing it together in publications and using it for comparative purposes so that the results from multiple interventions within the same urban area can be analysed as a whole. Any sampling strategy devised in such areas should refer to previous excavations, and research priorities should be identified for the urban area as a whole. It is also possible to include non-quantified assessment data from poorer samples to maximise the information published in reports.

- *Loss of information* – Threats such as land drainage, plough-damage, quarrying, coastal erosion and development have long been flagged up, particularly by projects such as the Fenland Management Project. As climate change remains at the top of the agenda, the need to monitor sea level rise and increases in coastal erosion should become more urgent. Other effects of climate change could be to increase the loss of wetlands and peat deposits through climate warming and increased water extraction as well as changing pH levels and water flow rates.
- *Publication* – Failure to publish work within a reasonable time frame means that the data from many sites remains inaccessible. The setting up of 'grey literature' archives such as OASIS are helpful, although work still needs to be done on making these sources more easily searchable from a specialist point of view.
- *Difficult but important topics* – A number of archaeobotanical questions continue to be difficult to answer, primarily because of the limitations of preservation. Often the only useful approach is a multi-disciplinary one, with each specialist adding to the overall interpretation. Larger scale sampling can also be beneficial, helping to clarify subjects such as which cereals were being used for fodder rather than human food. Other subjects in this category include arable / pastoral balance, distinguishing malting from germination due to poor storage conditions, recognising when plants have been used as building materials (thatch, flooring, daub walls, turf walls), recognising when peat has been burnt for fuel, unravelling mixed urban waste deposits, the precise parameters for preservation by mineralisation, the origin of mineralised 'nodules' (see Carruthers 1989). In some of these cases experimental archaeology could be worthwhile. In others a new approach, such as phytolith analysis or chemical analyses may provide new data. Workshops specifically organised to tackle each problem area could be one way forward.

7.4 Experimental, phytosociological and ethnobotanical work

There is a need for further studies into the cultivation of specific crops (e.g. naked barley, bristle oats), their weed associations and harvesting methods along the lines of Marijke van der Veen and Carol Palmer's wheat growing experiment (1997) and the University of Sheffield's ongoing weed ecology (FIBS) research (Bogaard *et al* 1999; 2001; Jones *et al* 2000a). Questions such as the extent of the affect on the taste of bread or beer caused by severe contamination of wheat with brome grass,

have occurred to the authors in the past, and simple experiments could answer them. Experimentation should also build on the useful charring work carried out by Boardman and Jones (1990) to cover additional taphonomic questions such as differential survival of charred plant remains following burial in a range of soil conditions. Despite many years of informal experimentation with the conditions required for mineralisation to take place, the author (WJC) has not yet succeeded in producing mineralised plant remains. More controlled, laboratory-based experiments may help to gradually narrow down the range of nutrient and water levels required to recreate mineralisation.

To conclude, the process of drawing together the vast amount of plant macrofossil information being published from the seventeen Midlands counties has highlighted the following general points which should be considered in future archaeobotanical investigations:

1. The importance of free and easy access to clear, stand-alone reports (with dates, context details and species tables wherever possible) whether this is in an online archive such as the ADS, on CD rom or in print.
2. The need for archaeobotanists to ensure that examples of important, unusual or chronologically surprising plant remains are submitted for AMS dating.
3. The need for more projects that extend the scope of current archaeobotanical methods of analysis, either through carrying our experimental work, by undertaking reviews of tightly defined subject areas or by investigating ethnobotanical and ecological parallels. Technological advances in the identification and analysis of plant remains also have the potential for breaking through the current blocks to advancement of the subject.

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APPENDIX: SITES MENTIONED IN THE TEXT

Site No.	Site	Reference
Bedfordshire		
BD3	Haynes Park	Robinson, M 2004 'Charred Plant Remains' in Luke, M and Shotliff, D (eds) 'Evidence for Iron Age, Roman, Early Medieval occupation on the Greensand Ridge at Haynes Park, Bedfordshire', *Bedfordshire Archaeology* **25**, 55-135
BD7	Yelnow Villa, Colworth Science Park	Pelling, R 2009 'Charred Plant Remains and charcoal' in Milward, J (ed) *Yelnow Villa, Colworth Science Park, Bedfordshire*, archive report for Wessex Archaeology
BD10	West Stagsden	Scaife, R 2000 'The Charred Botanical Remains', *in* Dawson, M (ed) *Iron Age and Roman Settlement on the Stagsden Bypass,* Bedfordshire Archaeology Monograph Series **3**, 107-15
BD13	Great Barford Bypass (A421) overview	Druce, D 2008 'Charred Plant Remains', *in* Timby, J, Brown, R, Hardy, A, Leech, S, Poole. C and Webley, L (eds) *Settlement on the Bedfordshire Claylands: Archaeology along the A421 Great Barford Bypas,* Bedfordshire Archaeology Monograph Series **8,** 365-382
BD14	Roxton Road West (site1), Great Barford Bypass	Druce, D 2008 'Charred Plant Remains', in Timby, J, Brown, R, Hardy, A, Leech, S, Poole. C and Webley, L (eds) *Settlement on the Bedfordshire Claylands: Archaeology along the A421 Great Barford Bypass*, Bedfordshire Archaeology Monograph Series **8**, 367-370
BD21	Renold Water End East (Site 8), Great Barford Bypass	Druce, D (2008) 'Charred Plant Remains', in Timby, J, Brown, R, Hardy, A, Leech, S, Poole, C and Webley, L (eds) *Settlement on the Bedfordshire Claylands: Archaeology along the A421 Great Barford Bypass*, Bedfordshire Archaeology Monograph Series **8**, 367-377
BD23	Biddenham Loop	Pelling, R 2008 'Charred Plant Remains' in Luke, M (ed) Life in the Loop: Investigation of a Prehistoric and Romano-British Landscape at Biddenham Loop, Bedfordshire, East Anglian Archaeology 125, 92, 119-120, 154-156, 192-193, 240-242, 285-287
BD26	Shillington Bury	Scaife, R G 2004 'Plant Macrofossils', *in* Dawson, M (ed) *Archaeology in the Bedford Region*. Bedfordshire Archaeology Monograph **4,** Oxford: BAR Brtish Series **373,** 267-268
BD27	Ruxox	Scaife, R G 2004 'Plant Macrofossils', in Dawson, M (ed) Archaeology in the Bedford Region. Bedfordshire Archaeology Monograph **4**, Oxford: BAR Brtish Series **373,** 269-271

Site No.	Site	Reference
BD30	Broom	Stevens, C J 2007 'Appendix 6: Charred and waterlogged plant remains', *in* Cooper, A A and Edmonds, M (ed) *Past and present: Excavations at Broom 1996-2005*. Oxford: Oxbow Books, 283-286
BD39	Stewartby Millennium Park	Pelling, R 2017 'The Saxon Plant Remains' *in* Wells, J and Edwards, E (eds) 'Early–middle Saxon settlement at the Millennium Country Park, Marston Moretaine', *Bedfordshire Archaeology,* **27**, 226-229
BD40	Huntingdon to Willington Pipeline	Carruthers, W J 2002 *The Huntingdon to Willington Pipeline (HUW 01), Bedfordshire,* Unpublished draft report for Network Archaeology
BD41	Stratton	Moffett L and Smith W 1998 'Crops and weeds from the Saxon and medieval settlements at Stratton, Bedfordshire, England', unpublished report for Bedfordshire Archaeology cited in Moffett, L 2007 'Crop Economy and other plant remains', 158-178 *in* Hardy, A, Charles, B M, Williams, R J 2007 (eds) *Death and Taxes. The Archaeology of a Middle Saxon Estate Centre at Higham Ferrers, Northamptonshire.* Oxford, Oxford Archaeology
BD42	Norse Road, Bedford	Monckton, A 2017 'Charred plant remains' *in* Meckseper, C, Abrams, J and Preece, T (eds) 'Late Saxon settlement evidence from Norse Road, Bedford', *Bedfordshire Archaeology,* **27,** 241-242
BD43	Castle Lane, Beford	Hill, A 2009 *Castle Lane, Bedford,* University of Leicester Archaeological Service Report **2009-025**
BD44	Willington to Steppingley pipeline	Carruthers, W J 2003 'Charred, mineralised and waterlogged plant remains', *in* Ward, M (ed) *Archaeological Evaluation, Excavation and Watching Brief 2002.* unpublished Network Archaeology Archive Report No. **182**
Buckinghamshire		
BK3	Weedon Hill, Aylesbury	Wessex Archaeology 2008 'Charred plant remains and charcoal in Archaeological investigations at Weedon Hill, Aylesbury, Buckinghamshire', unpublished archaeological assessment report and updated project design
BK7	Wing Church	Carruthers, W J 2008 'The charred plant remains from the 13th century building and associated features', in Holmes, M and Chapman, A (eds) 'A Middle-Late Saxon and Medieval Cemetery at Wing Church, Buckinghamshire', *Records of Buckinghamshire*, **48**, 99-103
BK10	Renny Lodge Hospital, Newport Pagnell	Stevens, C 2010 'Charred plant Remains', *in* Budd, C and Crockett, A (eds) 'The Archaeology and History of Renny Lodge: Romano-British farmstead, Workhouse, Hospital, Houses'*. Records of Buckinghamshire,* **49**, 118-120

Site No.	Site	Reference
BK17a	Broughton (including Brooklands), Milton Keynes	Carruthers, W 2014 'Charred and waterlogged plant remains; Brooklands', 'Plant macrofossils: Brooklands', and joint sections with Fryer, V, *in* Atkins, R, Popescu, E, Rees, G and Stansbie, D (eds) *Broughton, Milton Keynes, Buckinghamshire: The evolution of a South Midlands landscape'.* Oxford Archaeology Series: Oxford Archaeology Monograph Volume: **22,** 44-45, 115, 201, 348-352, 413-415, 431
BK17b	Broughton (including Brooklands), Milton Keynes	Fryer, V 2014 'Plant macrofossils; Broughton Manor Farm', and joint sections with Carruthers, W *in* Atkins, R, Popescu, E, Rees, G and Stansbie, D (eds) *Broughton, Milton Keynes, Buckinghamshire: The evolution of a South Midlands landscape.* Oxford Archaeology Series: Oxford Archaeology Monograph Volume: **22,** 114-115, 348-352, 431
BK21	Taplow Hillfort (Taplow Court)	Robinson, M 2009 'The Charred Plant remains (except charcoal)', *in* Allen, T, Hayden, C and Lamdin-Whymark, H (eds) *Archaeological excavations at Taplow hillfort, Buckinghamshire, 1999-2005.* Thames Valley Landscapes Monograph No.**30**, Oxford: Oxford Archaeology,149-153
BK22	Tattenhoe and Westbury	Letts, J B 1995 'Appendix XII: The charred plant remains', *in* Ivens,R, J (ed) *Tattenhoe and Westbury: Two Deserted Medieval Settlements.* Milton Keynes: The Buckinghamshire Archaeological Society Monograph Series No. **8**, 444-449
BK23	Olney	Monckton, A 2004 *Charred plant remains from a medieval suburb at Olney, Buckinghamshire (CTO.03)*, University of Leicester Archaeological Service Report **2004-140**
BK24a	Bancroft Roman Villa	Pearson, E and Robinson, M 1994 'Environmental evidence from the Villa', *in* Zeevpat, R J (ed) *Bancroft. The Roman Villa. Vol. II: finds and Environmental Evidence,* Milton Keynes: The Buckinghamshire Archaeological Society Monograph Series No. **7**, 565-584
BK24b	Bancroft Roman Villa, mausoleum	Nye, S and Jones, M 1994 'Plant remains ('mausoleum')' *in* Zeevpat, R J (ed) *Bancroft. The Roman Villa. Vol. II: finds and Environmental Evidence,* Milton Keynes: The Buckinghamshire Archaeological Society Monograph Series No. 7, 562-5
BK28	Chicheley Hall	Monckton, A 2012 'Plant Remains', in Phillips, M (ed) 'Medieval settlement remains, part of a medieval cemetery and later structural remains associated with Chicheley Hall, Bucks', *Records of Buckinghamshire*, **52**, 25-29
BK29	Lake End Road West, Dorney	Allen, T, Barclay, A and Lamdin-Whymark, H 2004 'Opening the wood, making the land. The study of a Neolithic landscape in the Dorney area of the Middle Thames Valley', *in* Cotton, J and Field, D (eds) *Towards a New Stone Age: aspects of the Neolithic in south-east England,* York: Council for British Archaeology Research Report **137**, 82-98

Site No.	Site	Reference
Cambridgeshire		
CB1	Pembroke College Library, Cambridge	Ballantyne, R M 2002 'Plant Remains', in Hall, A (ed) 'A Late Sixteenth Century Pit Group from Pembroke College Library, Cambridge', *Proceedings of the Cambridge Antiquarian Society* XCI, 98-99
CB4	Arbury Camp, Cambridge	Simmons, E 2008 'Environmental samples', in Evans, C and Knight, M (eds) 'Further Investigations at Arbury Camp, Cambridge: The Eastern Entrance- A Monumental Architecture', *Proceedings of the Cambridge Antiquarian Society* XCVII, 23-24
CB5	Jesus Lane, Cambridge	Alexander, M, Dodwell, N and Evans, C 2004 'A Roman Cemetery in Jesus Lane, Cambridge', *Proceedings of the Cambridge Antiquarian Society* XCIII, 67-94 (plant remains, page 89)
CB8	Grand Arcade and Bradwell's Court, Cambridge	Ballantyne R M and de Vareilles A K 2019 'Plant macrofossil remains from the Grand Arcade and Bradwell's Court, Cambridge', *in* Cessford, C and Dickens, A (eds) *Medieval to Modern suburban material culture and sequence at Grand Arcade, Cambridge: archaeological investigations of an eleventh–twentieth-century suburb and town ditch,* McDonald Institute for Archaeological Research, 199-205
CB10	Forehill, Ely	Stevens, C 2003 'Plant and fossil macros', in Alexander, M (ed) A' medieval and post-medieval street frontage: Investigations at Forehill, Ely', *Proceedings of the Cambridge Antiquarian Society* XCII, 166-168
CB11	Hurst Lane Reservoir, Ely	Stevens, C 2007 'Environmental remains', in Evans, C, Knight, M and Webley, L (eds) 'Iron Age settlement and Romanisation on the Isle of Ely: the Hurst Lane Reservoir site', *Proceedings of the Cambridge Antiquarian Society* XCVI, 60-62
CB12	West Fen Road & Fens, the Ashwell Site, Ely	Ballantyne, R M 2004 'Islands in wilderness: the changing Medieval use of the East Anglian peat fens, England', *in*.Whitehouse, N, Murphy, E M and Plunkett, G 'Worlds Apart? Human settlement and biota of islands: papers from the 2003 AEA conference at Belfast, N. Ireland', *Environmental Archaeology* **9**, 189-98
CB13	West Fen Road, the Ashwell Site, Ely	Ballantyne, R M 2005 'Plants and seeds' *in* Mortimer, R, Regan, R and Lucy, S (eds) *The Saxon and Medieval Settlement at West Fen Road, Ely: The Ashwell Site,* East Anglian Archaeology **110**, 100-112, 150-169
CB14	West Fen Road, Ely	Carruthers, W 2008 'The charred, mineralised and waterlogged plant remains', *in* Mudd, A (ed) *West Fen Road,* unpublished draft report for Northamptonshire Archaeology.

Site No.	Site	Reference
CB15	Wardy Hill Ringwork, Coveney, Ely	Murphy, P 2003 'Plant macrofossils and molluscs', *in* Evans, C *Power and Island Communities: excavations at the Wardy Hill Ringwork, Coveney, Ely,*East Anglian Archaeology **103**, 84-114.
CB16	Prickwillow Road, Ely	Carruthers, W 2003 'The charred plant remains', *in* Atkins, R and Mudd, A (eds) 'An Iron Age and Romano-British settlement at Prickwillow Road, Ely, Cambridgeshire: excavations 1999-2000', *Proceedings of the Cambridge Antiquarian Society* **XCII,** 44-8
CB17	Waterfront sites (Jewsons Yard, Broad Street), Ely	Ballantyne, R M 2006 'Plant Macrofossils', *in* Cessford, C, Alexander, M & Dickens, A (eds) *Between Broad Street and the Great Ouse: waterfront Archaeology in Ely,* East Anglian Archaeology **114,** 33-7, 101-6.
CB19a	Wandlebury Ringwork, Wandlebury	Cyganowski, C 2004 'The macro-botanical remains from a selection in exterior/interior pits' in Charles French, C (ed) 'Evaluation, survey and excavation at Waldlebury Ringwork, Cambridgeshire', *Proceedings of the Cambridge Antiquarian Society* XCIII, 49-53
CB19b	Wandlebury Ringwork, Wandlebury	Ballantyne, R 2004 'A cross-disciplinary investigation of Iron Age pit deposition'in Charles French, C (ed) 'Evaluation, survey and excavation at Waldlebury Ringwork, Cambridgeshire', Proceedings of the Cambridge Antiquarian SocietyXCIII, 53-57
CB20	Stonea Camp and Stonea Grange	van der Veen, M 1996 'Plant Remains', *in* Jackson, R P J and Potter, T W (ed) *Excavations at Stonea, Cambridgeshire 1980-85.* London: British Museum Press, 613-636
CB22	Scotland Road/Union Lane, Chesterton	de Vareilles, A 2009 'Environmental samples', in Mackay, D (ed) 'Excavations at Scotland Road/Union Lane, Chesterton', *Proceedings of the Cambridge Antiquarian Society* XCVIII, 84-5
CB23	Cockpit at St Ives	Fryer, V 2005 'Charred plant macrofossils and other remains', in Nicholson, K 'Medieval deposits and a cockpit at St Ives, Cambridgeshire', *Proceedings of the Cambridge Antiquarian Society* XCIV, 111
CB24	Church End, Cherry Hinton	Cessford, C and Dickens, A 2005 'The Manor of Hintona: the Origins and Development of Church End, Cherry Hinton', *Proceedings of the Cambridge Antiquarian Society* XCIV, 51-72 ('Agriculture and diet', 61)
CB30	Parnwell, Peterborough	Druce, D 2007 'Charred plant remains', *in* Webley, L (ed) 'Prehistoric, Roman and Saxon activity on the Fen hinterland at Parnwell, Peterborough', *Proceedings of the Cambridge Antiquarian Society* **XCVI,** 101-104
CB32	Haddon, Peterborough	Fryer, V 2003 'Charred plant macrofossils and other remains', *in* Hinman, M (ed) *A Late Iron Age farmstead and Romano-British site at Haddon, Peterborough.* Oxford: BAR British Series **358** /Cambridgeshire County Council Archaeology Field Unit Mono **2**, 133-5

Site No.	Site	Reference
CB33	The Walnuts, Woodston	Monckton, A 2006 *The Walnuts, Oundle Road, Woodston, Peterborough: Charred Plant Remains from a Medieval Village*, University of Leicester Archaeological Service Archive Report **2006-051**
CB34	Peterborough, Long Causeway	Monckton, A and Grinter, P 1997 *Peterborough, Long Causeway (LCW 95): Plant Macrofossils from medieval deposits from an archaeological excavation*, University of Leicester Archaeological Service Archive Report **2381/10344**
CB35	Watersmeet, Mill Common, Huntingdon	Fryer, V 2006 'Environmental samples', in Nicholson, K 'A late Roman cemetery at Watersmeet, Mill Common, Huntingdon', *Proceedings of the Cambridge Antiquarian Society* XCV, 82
CB36	Parson Drove	Stevens, C 2006 'Charred plant remains and charcoal', in Andrews, P (ed) 'Romano-British and medieval saltmaking and settlement in Parson Drove, Cambridgeshire', *Proceedings of the Cambridge Antiquarian Society* XCV, 40-41
CB37	Haddenham	Jones, G 2006 'Charred plant remains', *in* Evans, C and Hodder, I (eds) *A woodland archaeology. Neolithic sites at Haddenham. Haddenham Project Volume 1.* McDonald Institute for Archaeological Research, 312-316
CB38	St Marys St, St Neots	Moffett, L 2000 'Charred plant remains', *in* Jones, A E (ed) *St Marys Street, St Neots, Cambridgeshire; archaeological investigations 1994-5*, East Anglian Archaeology Occasional Papers **7,** 20-2
CB39	Eynesbury, St Neots	Clapham, A J 2004 'Evidence for the economy and environment: Charred plant remains' and 'Waterlogged plant macrofossils' *in* Ellis, CJ (ed) *A prehistoric ritual complex at Eynesbury, Cambridgeshire. Excavation of a multiperiod site in the great Ouse Valley, 2000-2001,* East Anglian Archaeology Occasional Paper **17**, 70-9; 81-3
CB40a	Etton causewayed enclosure, Maxey	Nye, S and Scaife, R 1998 'Plant macrofossil remains', *in* Pryor, F (ed) *Etton, Excavations at a Neolithic causewayed enclosure near Maxey, Cambridgeshire, 1982-7,* London: English Heritage Arch Rep **18**, 289-298.
CB40b	Etton landscape project, Maxey	Nye, S 2005 'The plant remains', *in* French, C and Pryor, F (eds) *Archaeology and Environment of the Etton Landscape,* East Anglian Archaeology **109,** 152-153.
CB41	Ramsey Abbey School, Ramsey	Clapham, A and Fryer, V 2008 'Plant remains', In Sperry, P, Atkins, R, Macauley, S and Popescu, E S (eds) 'Ramsey Abbey, Cambridgeshire: excavations at the site of a fenland monastery', *Med Arch* **52,** 171-206
CB42	Pode Hole Quarry	Martin, G with Giorgi, J and Snelling, A 2009 'The Charred Plant Remains & Waterlogged Plant Remains' *in* Daniel, P (ed) *Archaeological Excavations at Pode Hole Quarry. Bronze Age occupation on the Cambridgeshire Fen-edge*. Oxford: BAR BS **484**, 94-102

Site No.	Site	Reference
CB44	North Fen, Sutton	Smith, W 2009 'Waterlogged plant macrofossils' in Webley, L & Jonathan Hiller, H (eds) 'A fen island in the Neolithic and Bronze Age: excavations at North Fen, Sutton, Cambridgeshire', *Proceedings of the Cambridge Antiquarian Society* XCVIII, 28-30
CB46	Lordship Lane, Cottenham	Stevens, C 1998 'The charred plant remains' *in* Mortimer, R (ed) *Excavation of the Middle Saxon to Medieval village at Lordship Lane, Cottenham, Cambs,* unpublished report for Cambridge Archaeological Unit, Rep **254**
		Mortimer, R 2000 'Village development and ceramic sequence: the middle to late Saxon village at Lordship Lane, Cottenham, Cambridgeshire', *Proc. Cambs Antiq Soc* **LXXXIX,** 5-33
CB50	Bushmead Road, Eaton Socon	Druce, D 2008 'Charred plant remains', in Stansbie, D (ed) 'Excavation of a Middle Iron Age enclosure at Bushmead Road, Eaton Socon, Cambridgeshire', *Proceedings of the Cambridge Antiquarian Society* XCVII, 48-9
CB54	Haddenham	Campbell, G (nee Hunt) 2006 'Waterlogged plant remains', *in* Evans, C and Hodder, I (eds) *Marshland Communities and Cultural Landscapes: The Haddenham Project Vol 2,* McDonald Institute for Archaeological Research, 255-60
		Jones, G 2006 'Cereal processing, household space and crop husbandry' *in* Evans, C and Hodder, I (eds) *Marshland Communities and Cultural Landscapes: The Haddenham Project Vol 2,* McDonald Institute for Archaeological Research, 248-54
CB58	London Road, Godmanchester	Smith, W 2003 'Charred plant remains', *in*Jones, A (ed) *Settlement, burial and industry in Roman Godmanchester. Excavations in the extra-mural area: The Parks 1998, London Road 1997-8, and other investigations*. Oxford: BAR British Series **346**/ University of Birmingham Field Archaeology Unit Monograph Series **6**, 160-8
CB62	Rectory Farm, Godmanchester	Murphy, P in press 'Plant Remains', *in* Lyons, A (ed), *Godmanchester, Cambridgeshire: Excavations at Rectory Farm, 1988-1995,* East Anglian Archaeology
CB63	Bradley Fen, nr. Peterborough	de Vareilles, A forthcoming 'Charred assemblages, *in* Bradley Fen & King's Dyke', forthcoming report for the *Proceedings of the Cambridge Antiquarian Society*
CB64	Papworth Everard, Longstanton	de Vareilles,2012 'The plant remains' *in* Patten, R (ed) 'An Iron Age and Roman Settlement at Summersfield, Papworth Everard' *Proceedings of the Cambridge Antiquarian Society* **101** *132-4*
CB65	Colne Fen, Earith	Ballantyne, R 2013 'The plant remains', *in* Evans, C, Appleby, G, Lucy, S and Regan, R (eds) *Romano-British Communities at Colne Fen, Earith, (*Cambridge Archaeological Unit Landscape Archives Series: The Archaeology of the Lower Ouse Valley, Volume II), Cambridge: Cambridge Archaeological Unit, 143-61

Site No.	Site	Reference
CB67	Cambourne New Settlement	Wright, J, Leivers, M, Seager, R, Smith, W and Stevens, C 2009 *Cambourne New Settlement: Iron Age and Romano-British Settlement on the Clay Uplands of West Cambridgeshire.* Salisbury: Wessex Arch Rep 23
CB77	Needingworth Quarry, Over	Vander Linden, M and Evans, C 2008 'Archaeological Evaluation in Hanson's Over/Needingworth Quarry: The Oven Lowland Investigations (III) - The 2007 Evaluation', Cambridge Arch Unit, University of Cambridge, Report **813/HER no. ECB2884**
CB78	Hinxton Hall	Fryer, V and Murphy, P in prep 'Plant macrofossils' *in* Clarke, R (ed) 'Hinxton, Cambridgeshire: Part 2: Excavations at Hinxton Hall and the Genome Campus 1993-2014. Anglo-Saxon to Medieval (working title)', *East Anglian Archaeology.*
CB80	Loves Farm, St Neots	Monkton, A 2008 'The environmental evidence' in Wilson, N (ed) *Archaeological evaluation and excavations at land north of Loves Farm, St Neots, Cambridgeshire*, Archaeological Services and Consultancy Ltd **1009/LSN/2** , 31-3 and 4
Derbyshire		
DB1	Little Chester, Derby	Alvey, R, revised by Wendy, S 2002 'Archaeobotanical Evidence for Roman Thatch and Malt', *in* Sparey-Green, C (ed) 'Excavations on the south-eastern defences and extramural settlement of Little Chester, Derby 1971-2', *Derbyshire Archaeological Journal* **122,** 300-308
DB2	King Street, Derby	Greig, J 2006 'Charred plant remains', *in* Bain, K (ed) 'Excavations at King Street Derby, 2004', *Derbyshire Archaeological Journal* **126,** 71-76
DB5	Willington Quarry	Greig, J 2009 'Pollen and plant macrofossils' in Beamish, M G (ed) 'Island Visits: Neolithic and Bronze Age Activity on the Trent Valley Floor. Excavations at Egginton and Willington, Derbyshire, 1998-1999', in *Derbyshire Archaeological Journal,* **129**, 128-34 and on-line specialist report
DB11	Egginton & Willington	Monckton, A 2009 'Charred plant remains', *in* Beamish, M, G (ed) 'Island visits: Neolithic and Bronze Age Activity on the Trent Valley Floor. Excavations at Egginton and Willington, Derbyshire, 1998-1999', *Derbyshire Archaeological Journal* **129,** 116-119 and on-line specialist report http://archaeologydataservice.ac.uk/archives/view/willington_eh_2008/downloads.cfm

Site No.	Site	Reference
DB12	Aston Cursus, Aston on Trent	Monckton, A and Alvey, R 2012 'Charred Plant Remains', *in* Loveday, R (ed) 'Aston on Trent 1, Derbyshire - Excavation of a round barrow and protected cursus land surface', *Derbyshire Archaeological Journal* **132**, 103-107 Alvey, R and Monckton, A 2010 *Charred cereals from Aston on Trent, Derbyshire,* University of Leicester Archaeological Service Report 2010-000 Reaney, D 1968 'Beaker burials in South Derbyshire', *Derbyshire Archaeological Journal* **88,** 68-81 (carbonised grain, page 77) Loveday, R 2000 'Aston Cursus, Derbyshire', Current Archaeology **167**, 438-9
DB13a	Lismore Fields, Buxton	Jones, G and Rowley-Conwy, P 2007 'On the importance of cereal cultivation in the British Neolithic', *in*Colledge, S and Conolly, J (eds) *The Origins and Spread of Domestic Plants in Southwest Asia and Europe.* London: UCL Institute of Archaeology, 391-419.
DB13b	Lismore Fields, Buckton	Jones, G and Bogaard, A 2017 'Integration of cereal cultivation and animal husbandry in the British Neolithic: the evidence of charred plant remains from timber buildings at Lismore Fields', in Rowley-Conwy P, Serjeantson, D and Halstead P (eds) *Economic Zooarchaeology. Studies in Hunting, Herding and Early Agriculture,* Oxford: Oxbow Books, 221-6
DB14	Potlock Cursus, Potlock	Monckton, A and Moffett, L 1994 'Charred Plant Remains from Potlock, Derbyshire', *in* Guilbert, G. and Malone, S., (eds) *An Excavation Across the Potlock Cursus. Nottingham: Trent & Peak Archaeology.*Unpublished archive report for Trent and Peak Archaeology https://doi.org/10.5284/1024102 Monckton, A and Moffett, L forthcoming 'Charred plant remains', in Guilbert, G and Malone, S (eds) 'An excavation across the Potlock cursus, 1994', Transactions of the Thoroton Society of Northamptonshire
DB14	Potlock Cursus, Potlock	Moffett, L 1990 *Preliminary results from the trial excavation of the cursus ditches at Potlock, Derbyshire,* Ancient Monuments Laboratory Report **19/90,** London: English Heritage
DB20	Little Hay Grange Farm, Ockbrook	Wagner, P 2001 'Plant remains', in Palfreyman A (ed) 'Report on the excavation of a Romano-British aisled building at Little Hay Grange Farm, Ockbrook, Derbyshire 1994-97', *Derbyshire Archaeological Journal* **121**, 158-50
DB26	St Mary's Gate, Derby	Monckton, A 2003 *Charred plant remains from a medieval suburb at St. Mary's Gate, Derby: the Magistrates Courts Redevelopment (2001.59),* University of Leicester Archaeological Service Report **2003-048**
DB27	Mother Grundy's Parlour, Cresswell Craggs	Campbell, J B 1977 *The Upper Palaeolithic of Britain. A Study of Man and Nature in the Late Ice Age.* Oxford: Clarendon Press.

Site No.	Site	Reference
Essex		
EX2	Frog Hall Farm, Fingringhoe	Murphy, P 2002 'Charred beans from feature 11', in Brooks, H (ed) 'A Bronze Age and Saxon occupation site at Frog Hall Farm, Fingringhoe', *Essex Archrchaeology and History* **33**, 60-61
EX5	Chalet Site, Hall Road, Heybridge	Pelling, R 2008 'The Charred Plant Remains', in Newton, A A S (ed) 'A Late Bronze Age to Early Iron Age enclosure and an early Anglo-Saxon cremation cemetery at the Chalet Site, Hall Road, Heybridge, Essex', Essex Archrchaeology and History, 39 111-113
EX6	Frogs Hall Borrow Pit, Takeley	Fryer, V 2006 'Charred plant macrofossils and other remains', in Ennis, T (ed) 'Roman and Medieval land-use in the upper Roding valley: excavations at Frogs Hall Borrow Pit, Takeley 2002', *Essex Archrchaeology and History* **37**, 85-86
EX8	Great Holts Farm, Boreham	Murphy, P 2003 'Plant macrofossils', *in* Germany, M (ed) *Excavations at Great Holts Farm, Boreham, Essex, 1992-94,* East Anglian Archaeology **105**, 204-213
EX9	Boreham Airfield, Boreham	Fryer, V and Murphy, P 2003 'Charred plant macrofossils and other remains' inClarke, R (ed) *A medieval moated site and windmill: excavations at Boreham Airfield, Essex, 1996*. East Anglian Archaeology Occasional Paper No. **11**, 56-66
EX10a	Lion Walk & Balkerne Lane & Middleborough, Colchester	Murphy, P 1984 'Carbonised fruits from building 5', 'Carbonised cereals and crop weeds from buildings 38, 41 and 45', 'Soil monolith through the cultivated soil of period 5 at Balkerne Lane', 'Miscellaneous samples (Middleborough)', *in* Crummy, P *Excavations at Lion Walk, Balkerne Lane and Middleborough*, Colchester: Colchester Archaeological Report **3,** 40, 105, 108, 110 & microfiche
EX10b	Culver Street, Gilberd School, Colchester	Murphy, P 1992 'Environmental studies: Culver Street',, 'Environmental studies: Gilberd School', 'The carbonised cereals and flax', *in* Crummy, P (ed) *Excavations at Culver Street, the Gilberd School, and other sites in Colchester 1971-85,* Colchester: Colchester Archaeological Report **6,** 273-289 and 330-2
EX13	Springfield Lyons, Chelmsford	Murphy, P 2001 'Plant remains from Neolithic and Bronze Age contexts', *in* Buckley, D G, Hedges, J D and Brown, N (eds) Excavation at a Neolithic cursus at Springfield, Essex 1979-85. *Proceedings of the Prehistoric Society* **67**, 147-9
EX14	Springfield Lyons, Chelmsford	Murphy P 2005 'Environmental Evidence', *in* Tylor, S and Major, H (eds) *The Early Anglo-Saxon Cemetery and Later Saxon Settlement at Springfield Lyons, Essex,* East Anglian Archaeology **111,** 149-163

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EX15	Springfield Park, Chelmsford	Carruthers, W 2004 'Charred plant remains' in Manning A and Moore, C (eds) 'A Late Bronze Age site at Springfield Park, Chelmsford', *Essex Archrchaeology and History* **34**, 28
EX17	Stansted Airport, A120	Carruthers, W 2007 'Environmental overview', *in* Timby, J, Brown, R, Biddulph, E, Hardy, A and Powell, A (eds) *A Slice of Rural Essex. Archaeological discoveries from the A120 between Stansted Airport and Braintree. Oxford:* Oxford Wessex Monograph **1**, 187-193 and CD-Rom.
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EX21	Mucking	van der Veen, M 1993 'Grain impressions in early Anglo-Saxon pottery from Mucking', *in* Hamerow, H (ed) *Excavations at Mucking Volume 2: The Anglo-Saxon settlement (*English Heritage Archaeological Report **21**), London: English Heritage**,** 80-81
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EX24	Lofts Farm, Heybridge	Murphy, P 1988 'Plant macrofossils', *in* Brown, N (ed) 'A late Bronze Age enclosure at Lofts Farm, Essex, *Proceedings of the Prehistoric Society* **54**, 281-293
EX25	Moverons Farm, Brightlingsea	Murphy, P 2008 'Carbonised plant remains' *in* Clarke, C P and Lavender, N J (eds) *An early Neolithic ring-ditch and Middle Bronze Age cemetery: excavation and survey at Brightlingsea, Essex,*East Anglian Archaeology **126,** 51-54

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EX27	Sampford Road, Thaxted	Challinor, D 2007 'The wood charcoal and charred plant remains' in Stansbie, D, Brady, K, Biddulph, E and Norton, A (eds) 'A Roman cemetery ay Stampford Road, Thaxted', *Essex Archrchaeology and History* **38**, 84-85
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EX37	The Stumble	Murphy, P 1989 'Carbonised Neolithic plant remains from The Stumble, an intertidal site in the Blackwater Estuary, Essex, England', *Circaea* **6(1)**, 21-38
		Wilkinson, T J, Murphy, P L, Brown, N and Heppell, E M 2012 *The Archaeology of the Essex Coast, Volume II: Excavations at the Prehistoric Site of the Stumble,* East Anglian Archaeology **144**, (Charred plant remains and palaeocology, pages 71-114)
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EX42	Hill Hall	Murphy, P 2009 'Plant macrofossils and molluscs', in Drury, P (ed) *Hill Hall: A singular house devised by a Tudor intellectual*, London: Society of Antiquaries of London, 353-362
EX44	Chadwell St Mary	Fryer, V and Murphy, P 1999 *Charred plant macrofossils and other remains from Chadwell St Mary County Primary School Site, Chadwell St Mary, Essex,* unpublished report for Essex County Council, Field Archaeology Unit
EX48	London Gateway	Hunter, K L 2012 'Plant Macrofossils', *in* Biddulph, E, Forman, S, Stafford, E, Stansbie, D and Nicholson R (eds) *London Gateway: Iron Age and Roman Salt Making in the Thames Estuary. Excavations at Stanford Wharf Nature Reserve, Essex,* Oxford: Oxford Archaeology Monograph No.**18.** Digital Volume htts://library.thehumanjourney.net/909, report 19
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HF7	Wellington Quarry, Marden	Pearson, E 2010 'Plant macrofossils', *in* Jackson, R and Miller, D (eds) *Wellington Quarry, Herefordshire. Investigations of a landscape in the Lower Lugg Valley,* Oxford: Oxbow Books
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HF10	Madawg Rockshelter, Wye Valley	Barton, R N E 1997 'Third Interim Report on the Survey and Excavations in the Wye Valley, 1995', *Proceedings of the Univiversity of Bristol Spelaeological Society* **20 (2)**, 153-159
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HF14	Hereford & District: various sites	Monckton, A 2005 *Hereford and District: plant remains from excavations of Neolithic to medieval date,* University of Leicester Archaeology Service Reports **1997-2005** on behalf of Archaeological Investigations Ltd. Hereford 1997 http://lra.le.ac.uk/handle/2381/10357
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LR5	The Shires, Leicester	Moffett L C 1993 *Macrofossil plant remains from Leicester Shires* Ancient Monuments Laboratory Repoirt **31/93** London: English Heritage
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LR18	Lockington Gold hoard, Lockington	Moffett, L and Monckton, A 2000 'Charred plant remains', *in* Hughes, G (ed) *The Lockington Gold Hoard: An Early Bronze Age Barrow Cemetery at Lockington, Leicestershire,* Oxford: Oxbow Books, 78-81
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LR27	Norfolk Street villa, Leicester	Jones, G 1982 *Plant remains from the Roman villa at Norfolk Street, Leicester,* (Acient Monulments Laboratory Report **4973)**, London: English Heritage
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LR35	West Bridge, Austin Friars, Leicester	Greig, J 1985 'Pollen', *in* Shackley, M and Hunt, S A (eds) 'Palaeoenvironment of a Mesolithic peat bed from the Austin Friars, Leicester', *Transactions of the Leicestershire Archeological and Historical Society* **59**, 1-12
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LR52	Vaughan Way, Highcross Excavations, Leicester	Monckton, A 2003 'Charred plant remains', in Way, V (ed) *Leicester, St Margarets Baths site (A2.2003), Highcross Excavations,* University of Leicester Archaeology Service Report **2009-158**
Lincolnshire		
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LC3	Nettleton Top	Carruthers, W J 1993 'The carbonised plant remains', *in* Field, N and Leahy, K (eds) 'Prehistoric and Anglo-Saxon Remains at Nettleton Top, Nettleton', *Lincolnshire History and Archaeology* **28**, 34-5

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LC6	Morton	Murphy, P 2001 'Impressions and other plant material in briquetage' and 'Plant macrofossils' *in* Lane, T and Morris, E L (eds) *A Millennium of Salt Making: Prehistoric and Romano-British Salt Production in the Fenland,* (Lincolnshire Archaeology and Heritage Reports **4**), Sleaford: Heritage Trust for Lincolnshire 110-111, 151-155 (environmental summary, page 156)
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LC21	Chappell's Field, Deeping St James	Murphy, P 1997 *Fenland Management Project. Plant macrofossils from Chappell's Field, Deeping St James, Lincolnshire,* Ancient Monuments Laboratory Repoirt **1/97** London: English Heritage
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LC26	Dragonby	van der Veen, M 1996 'The Plant Macrofossils from Dragonbury', *in* May, J (ed) *Dragonby: Report on Excavations at an Iron Age and Romano-British Settlement in North Lincolnshire,*(Oxbow Monograph **61**), Oxford: Oxbow Books, 197-211

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LC31	Flaxengate, Lincoln	Moffett, L C 1996 *Plant remains from Flaxengate, Lincoln,* Ancient Monuments Laboratory Report **50/96**, London: English Heritage
LC33	Mornington House, Gosberton	Murphy, P 1993 'Anglo-Saxon arable farming on the silt fens - preliminary results', *Fenland Research* **8**, 75-8
LC37	Hagnaby Lock & Outgang Road, Stickford & Market Deeping	Murphy, P 2010 'Charred plant macrofossils' and ' Wood, plant macrofossils and molluscs from an Iron Age and Roman fen-edge site', *in* Lane, T and Trimble, D (eds) *Fluid Landscapes and Human Adaptations: Excavations on Prehistoric sites on the Lincolnshire Fen Edge 1991-1994,* (Lincolnshire Archaeology and Heritage Report Series **9**), Sleaford: Heritage Trust for Lincolnshire
LC38	Cartergate, Grimsby	O'Brien, C 2011 *Palaeoenvironmental analysis; Cartergate, Grimsby, Lincolnshire,* Archaeological Services Durham University Report **2579** on behalf of Pre-Construct Archaeological Services Ltd.
Norfolk		
NK5	Yarmouth Road, Broome	Fryer, V 2002 'Environmental material', *in* Robertson, D (ed) 'A Neolithic enclosure and Early Saxon settlement: excavations at Yarmouth Road, Broome, 2001', *Norfolk Archaeology* **44**, 240-241
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NK10	St Peter's Street, Norwich	Fryer, V 2005 'Plant macrofossils and other remains', *in* Shelley, A and Tremlett, S (eds) 'Excavations at St Peter's Street, Norwich, 2001', *Norfolk Archaeology* **44**, 671
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NK19	Ellingham, Postwick & Two Mile Bottom Pottery Kilns	Murphy, P 2003 'Charred plant remains' and 'Environmental Evidence', *in* Bates, S and Lyons, A (eds) *The Excavation of Romano-British Pottery Kilns at Ellingham, Postwick and Two Mile Bottom, Norfolk, 1995*-7, East Anglian Archaeology Occasional Papers **13**, 26, 54, 91
NK20	Holme-next-the-Sea timber circle	Fryer, V and Murphy, P 2003 'Plant macrofossils', *in* Brennand, M and Taylor, M (eds) 'The Survey and Excavation of a Bronze Age Timber Circle at Holme-next-the-Sea, Norfolk, 1998-9', *Proceedings of the Prehistoric Society* **69**, 44-46
NK21	Kilverstone	Ballantyne, R 2006 'Environmental and faunal remains', *in* Garrow, D, Lucy, S and Gibson, D (eds) *Excavations at Kilverstone, Norfolk: an Episodic Landscape History,* East Anglian Archaeology **113,** 88, 89, 94, 160-162, 198-9, 206, 230-240
NK23	Strickland Avenue & Station Road, Snettisham	Fryer, V 2004 'Charred Plant Macrofossils and Other Remains', *in* Lyons, A (ed) *Romano-British industrial activity at Snettisham, Norfolk. Archaeological investigations at Strickland Avenue and Station Road,* East Anglian Archaeology Occasional Papers **18,** 55-57

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NK24	Burnt flint mound, Northwold	Murphy, P 2004 'Plant macrofossils', *in* Crowson, A (ed) *Hot rocks in the Norfolk Fens: the excavation of a burnt flint mound at Northwold, 1994-5,* East Anglian Archaeology Occasional Papers **16**, 21-22, 41
NK25	Mill Lane, Thetford	Murphy, P 2004 'Plant macrofossils and molluscs', *in* Wallis, H (ed) *Excavations at Mill Lane, Thetford, 1995, Deneham:* East Anglian Archaeology Repoirts **108,** 100-104
NK26	Lynford Quarry, Mundford	Fryer, V 2005 'Plant macrofossils', *in* Birks, C and Robertson, D (eds) 'Prehistoric settlement at Stanford: Excavations at Lynford Quarry, Norfolk 2000-2001', *Norfolk Arch* **45**, 693-4
NK27	Melford Meadows, Brettenham nr.Thetford	Robinson, M 2002 'Plant Remains', *in* Mudd, M (ed) *Excavations at Melford Meadows, Brettenham, 1994:: Romano-British and Early Saxon occupations,* East Anglian Archaeology **99**, 108-110
NK28	Blackborough End, Middleton	Murphy, P 2000 'Environmental archaeology: an overview', *in* Crowson, A, Lane, T and Reeve, J (eds) *Fenland Management Project Excavations 1991-1995.* (Lincolnshire Archaeology and Heritage Reports Series **3)**, Sleaford: Heritage Trust of Lincolnshire, 10 (environmental summary, pages 210-11)
NK29	Nordelph; Downham West	Murphy, P 2002 'Plant macrofossils', *in* Wallis, H and Ayers, B (eds) *Roman routeways across the fens: excavations at Morton, Tilney St Lawrence, Nordelph and Downham West,*East Anglian Archaeology Occasional Papers **10**, 15-17, 26-7
NK32	Feltwell Anchor, nr. Brandon	Murphy, P 2000 'Seeds and vegetative remains from pit 44', *in* Bates, S and Wiltshire, P (eds) *Excavation of a burnt mound at Feltwell Anchor, Norfolk, 1992.* Norfolk Archaeology **43 (3)**, 395, table 2 and passim
NK33	Lower Close, Norwich	Murphy, P 2002 'The plant remains', *in* Atkin, M (ed) 'Excavations on the Lower Close (Site 300N)', *in* Atkin, M and Evans, D H (eds) 'Excavations in Northern Conesford, in and around the Cathedral Close' in Atkin M (ed) *Excavations in Norwich 1971-1978. Part III,* East Anglian Archaeology **100**, 64, microfiche 1
NK37	Fishergate, Norwich	Murphy, P 1994 'The environmental evidence: Introduction, mollusca, miscellaneous faunal remains, plant macrofossils, wood, summary and discussion', *in* Ayers, BS (ed) *Excavations at Fishergate, Norwich, 1985,*East Anglian Archaeology **68**, 34- 61
NK38	Alms Lane, Norwich	Murphy, P 1985 'The marine mollusca; The plant remains', *in* Atkin, M (ed) *Excavations at Alms Lane, Norwich,* East Anglian Archaeology **26,** 228-234

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NK40	Happisburgh	Parfitt, S A, Ashton N M, Lewis S G, Abel R L, Coope, R G, Field M H, Gale, R, Hoare P G, Larkin N R, Lewis M D, Karioukovski V, Maher B A, Peglar S M, Preece R C, Whittaker J E and Stringer C B 2010 'Early Pleistocene human occupation at the edge of the boreal zone in northwest Europe', *Nature* **466** (7303), 229-233
NK41	Spong Hill	Healy, F 1988 *The Anglo-Saxon cemetery at Spong Hill, North Elmham, Part VI: Occupation during the seventh to second millennia BC,* East Anglian Archaeology **39**, 104
NK42	Caistor St Edmunds	Murphy, P 2000 'Environmental and botanical evidence', *in*Ashwin, T and Bates, S (eds) *Excavations on the Norwich Southern By-Pass, 1989-91. Part 1: Excavations at Bixley, Caistor St Edmund, Trowse, Cringleford and Little Melton,* East Anglian Archaeology **91**, 217-227
NK44	Castle Mall, Norwich	Murphy, P 2009 'Plant remains', *in* Shepherd Popescu, E 2009. *Norwich Castle: Excavations and Historical Survey 1987–98 (in four parts).Part II c.1345 to Modern,* East Anglian Archaeology 132, 1015-1020
NK46	Redgate Hill, Hunstanton	Murphy, P 1993 'Mollusca; Plant macrofossils', *in*Healy, F, Cleal, R M J and Kinnes, I (eds) *Excavations at Redgate Hill, Hunstanton, 1970 and 1971,* East Anglian Archaeology **57**, 65-69
NK47	St Nicholas Street, Thetford	Fryer V and Murphy P 1999 'Plant macrofossils and molluscs', *in* Andrews, P (ed) 'Excavations at St Nicholas' Street, 1990, Site 1134', *in* Andrews, P and Penn, K (eds) *Excavations in Thetford, north of the river, 1989-90,* East Anglian Archaeology **87**, 60-5

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NH2	Kingswell St & Woolmonger St, Northampton	Fryer, V 2008 'Plant Remains', in Brown, J (ed) 'Excavations at the corner of Kingswell Street and Woolmonger Street, Northampton', *Northamptonshire Archaeology* **35**, 209
NH3	Derngate, Northampton	Pelling, R 2002 'The charred plant remains', *in* Hiller, J, Hardy, A and Blinkhorn, P (eds) 'Excavations at Derngate, Northampton, 1997-2000', *Northamptonshire Archaeology* **30**, 53-56
NH4	St Peter's Walk (Woolmonger Street), Northampton	Carruthers, W J 1999 'Charred plant remains and the arable environment', *in*Soden, I (ed) 'A story of urban regeneration:excavations in advance of development off St Peter's Walk, Northampton', *Northamptonshire Archaeology* **28** (for 1998-9) 108-12
NH5	Sol Central, Marefair	Giorgi, J 2005 'The plant remains', in Miller, P, Wilson, T and Harward, C (eds) *Saxon, medieval and post-medieval settlement at Sol Central, Marefair, Northampton Archaeological excavations 1998-2002*. (MoLAS Monoograph 27) London: MoLAS, CD Rom, 16-25

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NH6	Marefair, Northampton	Straker, V 1979 *Late Saxon and late Medieval plant remains from Marefair, Northampton,* Ancient Monuments Laboratory Report **2867**, London: English Heritage
NH10	Glapthorn Road, Oundle	Carruthers, W J 2005 'The charred and waterlogged plant remains', *in* Maull A and Masters P (eds) 'A Roman farmstead and Anglo-Saxon cemetery at Glapthorn Road, Oundle', *Northamptonshire Archaeology* **33**, 66
NH12	Rowler Manor, Croughton	Scaife, R 2008 'Plant macrofossils', *in* Dawson, M (ed) 'Excavation of the Roman Villa and Mosaic at Rowler Manor, Croughton, Northamptonshire', *Northamptonshire Archaeology* **35**, 83-88
NH20	Middle Saxon estate centre, Higham Ferrers	Moffett, L 2007 'Crop economy and other plant remains', *in* Hardy, A, Charles, B M and Williams, R J (eds) *Death and taxes: the archaeology of a Middle Saxon estate centre at Higham Ferrers, Northamptonshire,* (Oxford Archaeology Monographs **4**), Oxford: Oxford Archaeology, 158-178
NH23	Roman roadside settlement and shrine, Higham Ferrers	Robinson, M 2009 'Macroscopic plant remains (excluding charcoal) and insects' *in* Lawrence, S and Smith, A (eds) *Between Villa and Town. Excavations of a Roman roadside settlement and shrine at Higham Ferrers, Northamptonshire,*(Oxford Archaeology Monographs **7**), Oxford: Oxford Archaeology, 300-309
NH24	St John's Square, Daventry	Carruthers, W J 1997 'Charred plant remains', *in* Soden, I (ed) 'Saxon and Medieval Settlement Remains at St John's Square, Daventry, Northamptonshire, (July 1994-February 1995)', *Northamptonshire Archaeology* **27**, 85-91
NH30	Grendon	Last, J, Baxter, I, Brown, T, Crummy, N, Dodwell, N, Fryer, V, Gale, R, Gardner, R, Hatton, J, Henry, K, McDonald, T, McSloy, E 2005 'Life by the River: a Prehistoric Landscape at Grendon, Northamptonshire', *Proceedings of the Prehistoric Society* **71**, 333-360 (plant remains, page 354)
NH32	IA & Roman settlement, Upton, Northampton	Fryer, V 2010 'The charred plant remains', *in* Walker, C and Maull, A (eds) 'Excavation of Iron Age and Roman settlement at Upton, Northampton', *Northamptonshire Archaeology* **36**, 45-46
NH33	A43 Towcester to M40, Northamptonshire Uplands	Carruthers, W J 2007 'Charred plant remains', *in* Mudd, A (ed) *Iron Age and Roman settlement on the Northamptonshire uplands; Archaeological work on the A43 Towcester to M40 Road Improvement scheme in Northamptonshire and Oxfordshire,*Northamptonshire Archaeology Monograph **1**, 147-157
NH34	Raunds Project: Neolithic & BA	Campbell, G and Robinson, M 2007 'Environment and land use in the valley bottom', *in* Harding, J and Healy, F (eds) *The Raunds Area Project: A Neolithic and Bronze Age Landscape in Northamptonshire,* London: English Heritage, 18-36

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NH35	Raunds Project	Campbell, G 1994 'The preliminary results from Anglo-Saxon West Cotton and Raunds', *in* Rackham, J (ed) *Environment and Economy in Anglo-Saxon England,* York: Council for British Archaeology Research Report **89**, 65-82
NH36	Raunds Project: Saxon to Med	Campbell, G and Robinson, M 2009 'Plant and invertebrate remains', *in* Audouy, M and Chapman, A (eds) *Raunds: the origin and growth of a midland village AD 450-1500,* Oxford: Oxbow Books, 222-244
NH37	Raunds Project: West Cotton	Campbell, G and Robinson, M 2010 'The environmental evidence', *in* Chapman, A (ed) *West Cotton, Raunds: a study of medieval settlement dynamics AD450-1450,* Oxford: Oxbow Books, 427-515
NH38	Raunds Project: Stanwick Roman Villa	Campbell, G 1995, updated 2013 'Charred plant remains, including charcoal' and 'Waterlogged macroscopic plant remains', in Perrin, R (ed) *Raunds Area Project, Volume 2: The A*ssessments, unpublished assessment report for English Heritage, Appendix 4A and Appendix 4C
NH39	St James' Square, Northampton	Robinson, M 1983 'The Late Saxon Environment', *in W*illiams, J H and Farwell, D (eds) 'Excavations on a Saxon site in St James' Square, Northampton', *Northamtonshire Archaeology* **18**, 150 and microfiche 30-38
NH40	Covert Farm, Crick	Monckton, A 2000 *Charred plant remains from an Iron Age settlement site at Dirft East, Covert Farm, Crick, Northamptonshire, (DRE 97),* University of Leicester Archaeology Service Rep **2000/107**
NH41	Grange Park, Courteenhall	Ciaraldi, M 2006 'The plant economy', *in*Jones, L, Woodward, A and Buteux, S (eds) *Iron Age, Roman and Saxon Occupation at Grange Park,* Oxford: BAR British Series **425**, 194-212
NH44	Roman vineyards, Wollaston	Brown, A G and Meadows, I 2000 'Roman vineyards in Britain: finds from the Nene Valley and new research', *Antiquity* **74**, 491-2

Nottinghamshire

NT1	Trent Lane, Newark	Fryer, V 2005 'The plant remains', *in*Cuttler, R and Ramsey, E (eds) 'The Excavation of Roman, Medieval and Civil War remains at Trent Lane, Newark, Nottinghamshire', *Transactions of the Thoroton Society of Northamptonshire* **109**, 61-63
NT2	Raymoth Lane, Worksop	Rackham, J and Martin, G 2004 'The Botanical Remains', *in* Palmer-Brown, C and Munford, W (eds) 'Romano-British life in North Nottinghamshire: fresh evidence from Raymouth Lane, Worksop', *Transactions of the Thoroton Society of Northamptonshire* **108,** 56-75

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NT3	Gamston	Moffett, L 1992 'Charred plant material', *in* Knight D (ed) 'Excavations of an Iron Age settlement at Gamston, Nottinghamshire', *Transactions of the Thoroton Society of Northamptonshire* **96**, 79-82
NT5	Langford	Snelling, A and Rackham, J 2001 'Environmental Archaeology Assessment' *in* Holt, R, Jones, H, and Knight, D, 2001 *Evaluation excavations on the Fosse Way, Langford, Nottinghamshire,* Trent and Peak Archaeological Unit, 20-23
NT6	General Hospital (Nottingham Castle)	Monckton, A 1998 *Charred Plant Remains from Excavations on the site of Nottingham General Hopsital 1994-8 (NCM 1994-764)* University of Leicester Archaeology Service Report **2000-09** Monkton, A forthcoming 'The charred plant remains' in Gnanaratnam, A and Connor, A (eds) 'Excavations in the North Bailey of Nottingham Castle', *Transactions of the Thoroton Society of Northamptonshire*
NT14	Holme Pierrepont	Moffett, L 1990 *Holme Pierrepont site 5 (Great Briggs ring-ditch): some problems in flotation recovery at a Bronze Age ring-ditch in the Trent valley, Nottinghamshire,* Ancient Monuments Laboratory Report **20/90**, London: English Heritage
NT17	Minster School, Southwell	O'Brien, C 2012 'Roman and medieval plant remains, assessment' Archaeological Services Durham University, Palaeoenvironmental Report No. **2243** for Pre-Construct Archaeological Services.

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SP2	Shrewsbury Abbey	Greig, J 2002 'The 13th - 18th century plant remains', *in* Baker, N J (ed) *Shrewsbury Abbey; studies in the archaeology and history of an urban abbey,* (Shropshire Archaeological and Historical Society Monograph **2**), Shrewsbury: Shropshire Archaeological and Historical Society, 161-175
SP4	Shackerley Mound	Greig, J 1987 'Plant remains', *in* Andrews, D D (ed) 'Shackeley Mound: A Medieval Moated Site and it's Bridge', *Transactions of the Shropshire Archaeological and Historical Society* **65**, 29-32
SP7	Meole Brace & Bromfield, Ludlow	de Rouffignac, C 1995 'The plant remains from B9', *in* Hughes, G, Leach, P and Stanford, S C (eds) 'Excavations at Meole Brace,1990 and at Bromfield 1981-1991', *Transactions of the Shropshire Archaeological and Historical Society* **70**, 58-60
SP9	Riggs Hall, Shrewsbury	Colledge, S M 1983 'The plant remains', *in*Carver, M O H (ed) 'Two town houses in Medieval Shrewsbury', *Transactions of the Shropshire Archaeological and Historical Society* **61**, 62-3

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SP10	The Wrekin	Colledge, S M 1984 'The charred grain and other seeds', *in* Stanford S C (ed) 'The Wrekin hillfort excavations 1973', *Archaeology Journal*, **141**, 80-3
SP15	Ellesmere Road, Shrewsbury	Robinson, M 2002 'Plant remains', *in* Mudd, A (ed) *Excavations at Melford Meadows, Brettenham, 1994: Romano-British and early Saxon occupations.* East Anglian Archaeology **99**, 108-110
SP16	The Baths Basilica, Wroxeter	Monk, M, Charles, M & Colledge, S 1997 'Plant remains', *in* Barker, P, White, R, Pretty, K, Bird, H and Corbishley, M (eds) *The Baths Basilica, Wroxeter. Excavations 1966-90,* (English Heritage Archaeology Report **8**), London: English Heritage, 324-345
Staffordshire		
ST1	Brewood	Ciaraldi, M 2004 'Plant macroremains from the barrels', *in* Ciaraldi, M, Cuttler, R, Dingwall, L and Dyer, C C (eds) Medieval tanning and retting at Brewood, Staffordshire: Archaeological Excavations 1999-2000. *Staffordshire Archaeology and History Society Transactions* **XL**, 19-24 Greig, J 2004 'Pollen and seeds from peat deposits', *in* Ciaraldi, M, Cuttler, R, Dingwall, L and Dyer, C C (eds) Medieval tanning and retting at Brewood, Staffordshire: Archaeological Excavations 1999-2000, *Staffordshire Archaeology and History Society Transactions* **XL,** 24-31 Allan, H 2004 'Bark sclereids', *in* Ciaraldi, M, Cuttler, R, Dingwall, L and Dyer, C C (eds) Medieval tanning and retting at Brewood, Staffordshire: Archaeological Excavations 1999-2000, *Staffordshire Archaeology and History Society Transactions* **XL**, 24
ST2	North side of Sandford Street, Litchfield	Ciaraldi, M 2004 'The Mineralised plant remains from the cess pit, *in* Nichols, K and Ratkai, S (eds) 'Excavations on the north side of Sandford Street, Litchfield, Staffordshire, 2000', *Staffordshire Archaeology and History Society Transactions* **40**, 105-109
ST4 /WR27	M6 Toll	Smith, W 2008 'Charred plant remains', in Chapter 15, Powell, A. B., 'Shenstone Linear Features (Site 13)', *in* Powell, A.B., Booth, P., Fitzpatrick, A.P. and Crockett, A.D. (eds) *The Archaeology of the M6 Toll 2000-2003.* Oxford Wessex Archaeology Monograph **2**, Salisbury: Wessex Archaeology, 207-218.
ST5	Whitemoor Haye Quarry	Smith, W 2006 'Plant macro-remains from a Late Neolithic/ Early Bronze Age cremation deposit', *in* Hewson, M (ed) *Excavations at Whitemoor Haye Quarry, Staffordshire 2000- 2004: A prehistoric and Romano-British landscape,* Oxford: BAR British Series **428 /** University of Birmingham Field Archaeology Unit Monograph Series **2**, 96-99

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ST7	Castle Garage, Monk Street, Tutbury	Smith,W 2005 *Medieval plant Macrofossils and insects from a ditch/fishpond at Castle Garage, Monk Street, Tutbury, Staffordshire,* University of Birmingham Environmental Arcaeology Services Report **117**
ST9	St Mary's Grove, Stafford	Moffett, L 2010 ''Plant macrofossils, FR 10.1', *in* Carver M O H (ed) Stafford Field Reports 1975-1990. Field Reports On-line (ADS), FR10 (written 1987) http://archaeologydataservice.ac.uk/archives/view/stafford_eh_2009/
ST10	Tipping Street, Stafford	Moffett, L 2010 ''Plant macrofossils, FR 10.1', *in* Carver M O H (ed) Stafford Field Reports 1975-1990. Field Reports On-line (ADS), FR10 (written 1987) http://archaeologydataservice.ac.uk/archives/view/stafford_eh_2009/
ST11	Bath Street, Stafford	Moffett, L 2010 ''Plant macrofossils, FR 10.1', *in* Carver M O H (ed) Stafford Field Reports 1975-1990. Field Reports On-line (ADS), FR10 (written 1987) http://archaeologydataservice.ac.uk/archives/view/stafford_eh_2009/
ST16	Orton's Pasture,	Monckton A 2000 'Charred plant remains', *in* Ferris, I M, Bevan, L and Cuttler, R (eds) *The excavation of a Romano-British Shrine at Orton's Pasture, Rocester, Staffordshire,* Oxford: BAR British Series **314/** University of Birmingham Field Archaeology Unit Mononograph Series **3**, 67-71
ST17a	Rocester	Moffett, L 1996 'Charred plant remains', *in* Cleary, A S and Ferris, I M (eds) 'Excavations at the new cemetery, Rocester, Staffordshire, 1985-1987', *Staffordshire Archaeology and History Society Transactions* (for 1993-1994), **XXXV**, 206-218
ST17b	Rocester	Moffett L 1989 *Economic activities at Rocester, Staffordshire, in the Roman, Saxon and medieval periods: the evidence from the charred plant remains,* Ancient Monuments Laboratory Report New Series **15/89**, London: English Heritage
ST26	Stone tenement	Moffett L and Smith D 1996 'Insects and plants from a late medieval and early post-medieval tenement in Stone, Staffordshire', *Circaea* **12**, 157- 175
ST27	Tipping Street, Stafford	Smith, W and Hunter, K (unpublished) *Assessment of charred and waterlogged plant remains from Anglo-Norman, Medieval and Post-Medieval deposits at Tipping Street, Stafford.* Unpublished assessment report for Oxford Archaeology.

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ST29	Whitemoor Haye Quarry	Schreve, D, Howard, A, Currant, A, Brooks, S, Buteux, S, Coope, R, Crocker, B, Field, M, Greenwood, M, Greig, J and Toms, P 2013 'A Middle Devensian woolly rhinoceros (Coelodonta antiquitatis) from Whitemoor Haye Quarry, Staffordshire (UK): palaeoenvironmental context and significance', *Journal of Quarternary Science* **28(2)**, 118-130
Suffolk		
SK18	The St Stephens Lane/Buttermarket cemetry, Ipswich	Turner-Walker, G 2009 'Mineral preserved insect and plant evidence' and 'Plant remains' *in* Scull, C (ed) *Early Medieval (late 5th-early 8th centuries AD) cemetries at Boss Hall and Buttermarket, Ipswich, Suffolk,* (Society for Medieval Archaeology Monograph **27**) Abingdon: Routledge, 226-228, 278
SK19	West Stow	Murphy, P 1985 'The cereals and crop weeds', *in* West S (ed) *West Stow: The Anglo-Saxon village. Volume 1,* Deneham: East Anglian Archaeology Reports **24**, 100-108
SK22	Turret Lane, Ipswich	Murphy, P 1987 *Ipswich, Suffolk: plant macrofossils from Middle Saxon to early Medieval contexts at sites IAS 4201, 4601, 4801 and 5701,* Ancient Monuments Laboratory Report **225/87**, London: English Heritage
SK23	Ipswich	Murphy, P 1991 *Ipswich, Suffolk: plant macrofossils from sites 3201 (ABC Cinema) and IAS 5203 (Greyfriars Road),* Ancient Monuments Laboratory Report **33/91**, London: English Heritage
SK24	West Row Fen, Mildenhall	Murphy, P 1988 *Palaeoecological studies of three Bronze Age 'burnt flint' sites near West Row, Mildenhall, Suffolk,* Ancient Monuments Laboratory Report **165/88**, London: English Heritage
SK26	Staunch Meadow, Brandon	Carr R D, Tester A and Murphy P 1988 'The Middle Saxon settlement at Staunch Meadow, Brandon', *Antiquity* **62,** 371-7
SK27	Pakenham, nr Bury St Edmunds	Murphy, P and Wiltshire, P 1989 *Pakenham, Suffolk (PKM 027): environmental and economic studies,* Ancient Monuments Laboratory Report New Ser. **99/89**, London: English Heritage
SK29	Bloodmoor Hill, Carlton Colville	Ballantyne, R M 2009 'Botanical evidence', *in* Lucy, S, Tipper, J and Dickens, A (eds) *The Anglo-Saxon Settlement and Cemetery at Boodmoor Hill, Carlton Colville, Suffolk,* East Anglian Archaeology **131**, 305-316
SK37	Barnham	Murphy, P 1993 'Botanical remains', *in* Martin, E J (ed) *The Iron Age enclosure at Barnham,*East Anglian Archaeology **65**, 16-20

Site No.	Site	Reference
SK38	Brandon	Murphy, P 1982 *Mollusca, Peat section, Charred Crop Plants and Weed Seeds. Brandon, Suffolk,* Ancient Monuments Laboratory Report (Old Series) **3637**, London: English Heritage
SK39	Buttermarket (site IAS 3104), Ipswich	Murphy, P 1991 *Ipswich, Suffolk: plant macrofossils from sites IAS 3104 (Buttermarket), IAS 3201 (ABC cinema) and IAS 5203 (Greyfriars Road),* Ancient Monuments Laboratory Report **33/91**, London: English Heritage

Warwickshire

WR1	Churchover to Newbold Pacy gas pipeline, Area D Church Lawford	Monckton, A 2010 'Charred plant remains', *in* Palmer, S C (ed) 'Neolithic, Bronze Age, Romano-British and Anglo-Saxon sites excavated on the Transco Churchover to Newbold Pacey gas pipeline in 1999', *Transactions of the Birmingham and Warwickshire Archaeological Society* **113** for 2009, 156-159
WR4	Churchover to Newbold Pacy gas pipeline, Area B. Long Itchington	Monckton, A 2009 'Charred plant remains', in Palmer, S C (ed) 'Neolithic, Bronze Age, Romano-British and Anglo-Saxon sites excavated on the Transco Churchover to Newbold Pacey gas pipeline in 1999', Transactions of the Birmingham and Warwickshire Archaeological Society **113** for 2009, 49-53
WR8	Edgbaston street, Bull Ring, Birmingham	Ciaraldi, M 2006 'The plant macroremains-Evidence of domestic and industrial activities at Edgebaston Street, Moor Street, Park Street and the Row', in Patrick, C and Rátkai, S (eds) *The Bull Ring uncovered: Excavations at Edgebaston Street, Moor Street, Park Street and the Row, Birmingham,1997-2001,* Oxford: Oxbow Books, 240-243
WR9	Moor Street	Ciaraldi, Marina (2006) The plant macroremains-Evidence of domestic and industrial activities at Edgebaston Street, Moor Street, Park Street and the Row. In Catherine Patrick and Stephanie Rátkai. The Bull Ring uncovered: Excavations at Edgebaston Street, Moor Street, Park Street and the Row, Birmingham, 1997-2001. pp. 243-245. Oxbow Books
WR10	Park street, Bull ring, Birmingham	Ciaraldi, M 2006 'The plant macroremains-Evidence of domestic and industrial activities at Edgebaston Street, Moor Street, Park Street and the Row', in Patrick, C and Rátkai, S (eds) *The Bull Ring uncovered: Excavations at Edgebaston Street, Moor Street, Park Street and the Row, Birmingham,1997-2001,* Oxford: Oxbow Books, 246-256

Site No.	Site	Reference
WR11	The Row, Bullring, Birmingham	Ciaraldi, M 2006 'The plant macroremains-Evidence of domestic and industrial activities at Edgebaston Street, Moor Street, Park Street and the Row', in Patrick, C and Rátkai, S (eds) *The Bull Ring uncovered: Excavations at Edgebaston Street, Moor Street, Park Street and the Row, Birmingham,1997-2001*, Oxford: Oxbow Books, 256-258
WR20	Bascote,Southam Area Rationalisation Scheme	Monkton, A 2008 'Charred plant macrofossils', in Litherland, S, Ramsay, E and Ellis, P (eds) 'The archaeology of the Severn Trent: Southam Area Rationalisation Scheme, Warwickshire', *Transactions of the Birmingham and Warwickshire Archaeological Society* **112**, 109-115
WR24	Transco Churchover to Newbold Pacey gas pipeline	Monckton, A 2009 'Charred plant remains', *in* Palmer, S C (ed) 'Neolithic, Bronze Age, Iron Age, Romano-British and Anglo-Saxon sites excavated on the Transco Churchover to Newbold Pacey gas pipeline in 1999', *Transactions of the Birmingham and Warwickshire Archaeological Society* **113**, 49-54
WR25	M6 Toll	Clapham, A 2008 'Charred plant remains' (various sections) *in* Powell, A, Booth, P, Fitzpatrick, A P and Crockett, A D (eds) *The Archaeology of the M6 Toll 2000-2003,* (Oxford Wessex Archaeology Monograph **2**), Salibsury: Wessex Archaeology, 41-44, 72-75, 275-285, 297
WR26	M6 Toll	Gray, L 2008 'Charred plant remains' (various sections), in Powell, A, Booth, P, Fitzpatrick, A P and Crockett, A D (eds) *The Archaeology of the M6 Toll 2000-2003,* (Oxford Wessex Archaeology Monograph **2**), Salisbury: Wessex Archaeology, 85-86; 173-176; 225-227; 304-305; 326-330; 347-350; 353-354; 391-393; 415-417.
WR27	M6 Toll	Smith, W 2008 'Charred plant remains', *in* Powell, A, Booth, P, Fitzpatrick, A P and Crockett, A D (eds) The Archaeology of the M6 Toll 2000-2003, (Oxford Wessex Archaeology Monograph **2**), Salisbury: Wessex Archaeology, 207-218
WR28	M6 Toll	Stevens, C 2008 'Waterlogged plant remains' and 'Environment and agricultural economy (overview)', *in* Powell, A, Booth, P, Fitzpatrick, A P and Crockett, A D (eds) *The Archaeology of the M6 Toll 2000-2003,(*Oxford Wessex Archaeology Monograph **2**), Salisbury: Wessex Archaeology, 354-355, 418, 457-527
WR29	Park Farm, Barford	Moffett L 1994 'Charred plant remains', *in* Cracknell, S and Hingley, R (eds) 'Park Farm, Barford:excavation of a prehistoric settlement site, 1988', *Transactions of the Birmingham and Warwickshire Archaeological Society* **98**, 1-30 and microfiche, 22-24.

Site No.	Site	Reference
WR30a	Arrow Valley: Broom, Salford Priors, Wixford	Moffett, L and Ciaraldi, M 2000 'Charred plant remains', *in* Palmer, S C (ed) 'Archaeological Excavations in the Arrow Valley, Warwickshire', *Transactions of the Birmingham and Warwickshire Archaeological Society* **103**, 8-19, 32-34; 52-53; 59; 162-171; 211-216
WR30b	Arrow Valley: Broom, Salford Priors, Wixford	Monckton, A 2000 'Waterlogged plant macrofossils', *in* Palmer, S C (ed) 'Archaeological Excavations in the Arrow Valley, Warwickshire', *Transactions of the Birmingham and Warwickshire Archaeological Society* **103**, 171-173
WR31	Burton Dassett	Moffett, L 1991 *Plant economy at Burton Dassett, a deserted medieval village in south Warwickshire,* Ancient Monuments Laboratory Reports, **111/91**, London: English Heritage
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