Changing plant subsistence in Prehistoric Southwest Britain: archaeobotanical and anthracological evidence from the South Cadbury Environs Project

Volume I

Danielle Elizabeth de Carle

Thesis submitted in fulfilment of the Degree of Doctor of Philosophy

Department of Archaeology, University of Sheffield

January 2014

Abstract/Summary

The thesis investigates changing agricultural practices and wood use across a landscape from the Neolithic to Romano-British period, through charred archaeobotanical remains: crops, weeds, wild herbaceous plants and wood charcoal, recovered during survey test-pitting and excavation as part of the multi-site, South Cadbury Environs Project (SCEP), South Somerset, England.

Alongside abundant barley grain, the major wheat crop shifts from emmer to spelt in the Late Bronze Age, with the appearance of free threshing wheat towards the end of the Romano-British period. The quantity of crop remains increase in the Middle Iron Age contexts accompanied by new crop types including pulses. The crop composition is investigated through consideration of both the crops themselves and the physical and ecological characteristics of the accompanying weeds and wild taxa. The majority of crop-rich SCEP samples represent waste from the later stages of crop processing. Ecological assessment of the crop weeds from the fine sieving by-products of glume wheats points to differences between localities which are suggested to indicate a shift from Bronze Age spring sowing of glume wheat to autumn sowing in the Middle Iron Age, particularly at the limestone-scarp site of Sheepslait.

The majority of the wood charcoal recovered from the SCEP samples seem to represent waste from fuel use. Across the landscape as a whole, the wood taxa utilised remained relatively stable throughout the periods, representing oak and ash lowland mixed deciduous woodland, woodland edge and hedgerow species. Ecological investigation of the wood taxa shows differences related to location. A marked temporal change in the taxa from the Sigwells area may indicate the sourcing of wood for particular tasks.

Acknowledgements

The current work would not have been possible without NERC studentship funding. Many heartfelt thanks go to: Prof. Glynis Jones for a huge amount of time, knowledge and support; the volunteers, staff and students linked to the South Cadbury Environs Project/South Somerset Archaeological Research Group, in particularly Dr Richard Tabor, Dr Clare Randall, Liz Cadwell and Peter Wright; Valerie Wall for some the unenviable battles of the prose and pizza; Lee Broderick and members of the Archaeobotany Laboratory University of Sheffield (Catherine Longford, Dr Mike Wallace, Dr Emily Forster, Angela Walker, Dr Alexandra Livarda, Tudur Davis and Ellen Simmons) for companionship and tea; Dr Mike Charles and Dr Gianna Ayala for comments on chapters and analysis.

Volume I

Volume II

List of Tables: Volume II

2 Study area background

3 General site descriptions

4 Methods

5 The crop and weed results

6 Wood charcoal results

Appendix : crop/weed/wild herbaceous plant counts

List of figures: Volume II

1 Introduction

2 Study area background

3 General site descriptions

4 Methods

5 The crop and weed results

6 Wood charcoal results

1 Introduction

The modern British landscape is a largely humanly managed construct. It contains a palimpsest tracing the overlying marks of interventions on the 'natural' environment. Within the landscape some locations have acted as central places, attracting people over an extended period of time, and these have been the focus of much archaeological investigation. However, they were part of a wider network and larger landscape that has changed drastically over the last ten thousand years. The timing, extent, and the very character of changes, periods of development and continuity in any one area, are a particular response by the people that once lived there to the prevailing habitat as well as social, cultural influences and conceptual frameworks. Archaeological approaches to characterising the past nature of such functioning landscapes employ evidence of the physical remains such as settlement and wider landscape features including boundaries, burials and artefact distributions (Tabor 2004). Within this, archaeobotany may be considered an aspect of the archaeology of material culture, all-be-it based on botanical remains (de Hingh 2000: 15). Plants add to the rich understanding of the past, prosaic reminders of the 'stage of action' and everyday subsistence, at its very base, food, warmth and shelter. That they survive at all is remarkable.

The following thesis investigates the changing agricultural practice and wood use across a selected landscape from the Early Neolithic to Romano-British period, through study of the charred archaeobotanical remains: the crops, weeds, wild herbaceous plants and wood charcoal, recovered during the programme of survey, test-pitting and excavation undertaken as part of the South Cadbury Environs Project (SCEP), South Somerset, England.

1.1 The mechanisms of burning, charring and preservation

In temperate Britain, charring is the most common form of preservation of both crop items and wood. Other means by which plant remains can be preserved include desiccation, waterlogging, freezing or fossilisation (mineral replacement) but these require particular burial conditions that may, nonetheless, occur naturally. Excluding natural fire events burnt plant material is likely to be closely related to human actions and decisions and is indeed commonplace; black flecks litter most archaeological sites. Although archaeobotanists consider charring important in terms of preserving plant material, there is only a narrow window of temperatures and associated conditions that allow plant remains to persist in a recognisable state (Boardman & Jones 1990, Wright 2003). What remains can represent only a small proportion of the total material deposited in the past. Consequently the archaeobotanical record is biased by differences in what was subjected to fire as well as what survives burning, be it species or particular plant parts (Boardman & Jones 1990).

Charcoal is created when the combustion of plant material is incomplete due to a lack of oxygen for certain durations and across a range of temperatures. The events by which plant material can become charred may be accidental, catastrophes such as the destruction of a whole building or small mishaps such as dropping an object into a domestic fire. Other instances involve more intentional actions such as the burning of fuels and disposal of waste. There may be deliberate reasons for larger scale burning such as the cleansing of a house after a death, infestation, or clearance of an area for a new activity. Since the charred material can persist within sediments, there continue to be problems of residuality with many opportunities for the material to be redeposited and reworked over long periods.

Many interdependent factors are involved in the process of pyrolosis. The main variables relate to heating, including the time of exposure, temperature and rate of heating. These are also dependent on factors such as the water content of the material, the presence of resins, gums, oils, sugars and starches (Gale & Cutler 2000). For wood, in particular, the major controlling influence on burning is thought to be species morphology (Braadbaart & Poole 2008, Zicherman & Williamson 1981), vessel pattern and density of the cells. This can also be dependent on the zone of the plant exposed to heat, for example heartwood, sapwood or roots. As wood has a three-dimensional structure, even the direction in relation to the source of heat has an effect, the morphology controlling the flow of reactants and products within the area of burning. External variations must also be considered, such as the position of the material in the fire, the air-flow and the possibility of burial within the ashes. Generally, as plant material is heated, water is driven off causing the tissues to shrink with a loss of mass. In wood, at increased temperatures the constituents start to decompose, hemicellulose at 170-240°C, cellulose around 240-310°C and lignin at 320-400°C. However, the heating rate also significantly affects the point at which these changes take place (Kwon et al 2009). The constituents are usually released as gases causing further material to be lost. In the absence of oxygen, carbonisation of wood can take place at just 300°C. If there is a pilot flame, the gases can ignite at around 350°C, or the gases will spontaneously combust at temperatures of around 600°C (Braadbaart & Poole 2008). The reduction in mass and size may represent some 40% (Gale & Cutler 2000). Charring creates visible fragmentation, with areas of powdery char, and causes stress that can manifest as cracks or splits.

Plant parts such as seeds tend not to survive such high, direct, temperatures. Experiments such as those by Wright (2003) showed that temperatures of around 300°C, when exposed for a period of just under an hour, produced material likely to survive archaeologically in a recognisable state. Most items tested were destroyed at 700°C. Again there are many individual factors that affect the optimum charring and ultimate survival of particular species (Märkle and Rösch 2008) or the part of the plant represented (Boardman and Jones 1990). Survival may also be influenced by factors such as the volume, density and combination of materials. Laboratory experiments do not fully reproduce the varied and changing conditions of prehistoric domestic and industrial fires. It is difficult to measure and define the particular conditions in more 'natural' situations. In many cases the original shape of plant material may become distorted as, for example, in cereal grains and pulses where puffing is a common change (Kislev & Rosenzeig 1991).

The resulting, persistent charred material is resistant to biological and some chemical attack. However, it may be destroyed by further burning. Charred material is generally brittle and vulnerable to fragmentation from mechanical stresses. The action of wetting, drying and freeze-thaw found in many burial environments, especially those present in Britain, has been shown to cause further cracking and degradation (Smart & Hoffman 1988). Movement and abrasion, whether caused by physical processes such as bioturbation, alluvial transportation, colluviation or crushing by the overburden of deposits, will also cause degradation (Keepax 1988) providing an opportunity for the charred material to be moved away from the original position of deposition and potentially into other archaeological contexts. Mineral deposits in the burial environment, whether from the sediments or from materials such as metals (Keepax 1988) can enter the vessels and structure of the charcoal or charred material creating surface crusts that obscure the original form and may apparently increase weight.

Due to their different growth needs it must be assumed that wood from trees and shrubby plants requiring relatively long, stable periods of growth, for example medieval coppice cycles of 7-14 years (Rackham 1990), would be collected separately and, according to historical documents, traditionally at different points of the year to the crop and associated weed/wild species which may represent growing plots with higher disturbance levels. Such 'zones' may have been physically close or intermixed in the landscape. The act of burning, and the physical and chemical transformation that takes place in both seeds and wood, however, is a point of similar taphonomy (figure 1.1). After burning, the waste char and ash from both types of material is likely to have been treated and disposed of in the same manner. Yet despite many researchers having the skills to deal with both classes of material, archaeobotanical seed and wood charcoal are generally studied and discussed separately by different practitioners. This is largely due to the nature of the material, methods of identification and the different focus of the research questions asked of the material.

1.2 Recognising the importance of, and filters on, patterning within crops and weeds

Archaeobotanists frequently identify evidence relating to staple crops, the very base of some agricultural economies. Until relatively recently, much of the population would have been directly involved in agricultural production. It is likely that it took up a significant percentage of the year. Feeding first the household, then community and, through surplus production, wider markets is likely to have been a priority. The consumption of crops is not restricted to humans, as both the products and waste can be fed to animals either as a necessity or in good years or seasons, as a form, or in some cases the impetus, for surplus production and storage (Halstead 1989, 1993, Halstead & G. Jones 1989).

Prior to burning, one of the most significant factors acting as a filter on the composition of archaeobotanical samples, both crop remains and the accompanying seeds of weed and wild species, is crop processing. Ethnographic work on traditional arable producers outside Britain by researchers such as Hillman (1981, 1984) and G. Jones (1984, 1987) indicates that, within certain technological limitations, there is relatively little variation in the basic sequence of processes before consumption of the crop. The simplified processing sequence for free threshing cereals such as barley and free threshing wheats and many of the pulses is summarised in figure 1.2 along with additional stages required for the glume wheats. Depending on the eventual use, stages such as coarse sieving may be omitted. The crops can potentially be transported, stored or used at various points between processing stages. The eventual 'product' is the cleaned grain, though there may be different tolerances of contaminants and limitations on the efficacy of the processing. At each of the stages different products and by-products are created which may be identified by the varying proportions of grain, chaff, straw and weeds, as well as the types of weeds. Although the materials from some stages are short lived or ultimately become mixed, others are more persistent or the process takes place closer to habitation and therefore the residues are more likely to come into contact with fire giving the opportunity for preservation by carbonisation and eventual archaeological recovery. These include the winnowing by-product, coarse sieving by-product, and fine sieving by-product and product (Hillman 1984, G. Jones 1984).

Both different crop plant elements and weed seeds with specific physical attributes are removed or retained by each of the processing techniques (Hillman

1981, G. Jones 1992). It is only after these filters have been identified that questions can be asked about crop husbandry.

1.3 The potential role of wood charcoal analysis in the interpretation of prehistoric farming landscapes

Trees and other woody plants are integral, often highly visible, elements of the British landscape. Within the modern, western, industrial mindset, and when concentrating on the nature of farming in the past, it is easy to dismiss woody species as occupying areas of merely ‘liminal’, ‘wasted’ spaces, wild untamed areas that must be cleared, between the productive areas of pasture and those parcels of land used to cultivate domesticated crops. However, trees and shrubs have been important natural or managed resources and prominent elements in the landscape for most human societies, sometimes gaining social and spiritual importance well beyond the merely functional (Bevan-Jones 2002, Austin 2000, Newman *et al* 2007).

Despite the traditional focus of archaeologists on more durable elements of the archaeological record such as stone, pottery and metals, a large proportion of past material culture was made from organic, perishable materials, with wood being especially important (Darvill 2010, Rackham 1990, 36). Wood can be used as the raw material in a range of artefacts, such as tools, furniture and decorative objects, in means of transportation such as boats, carts and sledges, in structures including shelters, buildings, barriers, fences, trackways or traps. Wood is also a source of chemicals, including tannins, alkalis, medicines, as well as fibres for rope and textiles.

Through their edible parts, woody plants provide a source of energy for animals and humans. However, a significant energy use is as fuel, whether sourced specifically to be burned or utilised after serving another function. The combustion of wood provides both light and heat. The ability to cook and process foods is essential in transformations allowing storage of perishables such as the processing of milk into cheeses and yogurts. Wood and charcoal have been important fuels in the kilns and furnaces for industries that produced many of the durable archaeological artefact types (Gale 2003). Fuel waste is likely to be the source of much archaeologically recovered charcoal (Keepax 1988).

In addition to thinking directly about how past people used trees and other woody species, the analysis of wood charcoal (anthracology) has been used by both archaeobotanists and palaeoecologists as a tool for reconstructing past vegetation and climate change (Badal *et al* 1994, Asouti & Austin 2005). Such charcoal studies have been most frequently used in regions with limited palynological records. Some practitioners have argued that 'on-site' charcoal evidence provides a more contemporaneous and direct record of the plants present in the surrounding landscape of a site than the 'off-site' techniques which often represent a conflated record (Asouti & Austin 2005). Nevertheless, this faces the criticism that the charcoal record is too heavily influenced by human actions (Asouti & Austin 2005, Keepax 1988, 335, Delhon et al 2009). It could be argued that it is the opportunity to identify elements of human action and influence that make such a study archaeologically useful. By using the material evidence to infer processes of wood use, woodland management and the effects of both deforestation and regeneration, it is possible to discuss past landscape use, elucidating the choices and actions of people. Evidence of fuel selection along with contexts of waste deposition add to our understanding of the everyday use of wood (Dufraisse 2006, 2008, Heizer 1963), while the exchange of valuable timbers from outside a region may indicate wider social contact and networks (Asouti 2003a, Asouti & Austin 2005).

1.4 Studying seeds: crops and weeds in the southwest of Britain

Within lowland Britain, before wide-scale flotation of bulk soil samples, Helbaek's classic paper (1952) principally used impressions of cereals from pottery fragments and the limited evidence of charred concentrations from sites including the Mear and Glastonbury lake villages, Somerset, to investigate prehistoric crop cultivation in southern England. He identified the shift from emmer as the principal wheat and the introduction of spelt, highlighting similarities with developments identified on the continent. The conclusions of

Helbaek's paper were reappraised by Dennell (1976a) almost a quarter of a century later. Little data could be added but Dennell's interpretation of the data suggested that the patterning in barley and wheat may owe more to regional differences based on the soils available for cultivation than period-wide trends.

In the following decades the more frequent application of bulk soil flotation, alongside rescue and developer funded archaeology, have meant that archaeobotanical studies became much more common. To date, a lot of botanical data has been published within individual site reports and other 'grey literature'. Regional surveys of environmental archaeology were produced under the Directorate of Ancient Monuments and Historic Buildings (Keeley 1984). As with many of the others, the review covering the southwest of England (Bell et al. 1984) provides a list of the work undertaken up to the early 1980s. This was updated with a more specific review of both plant micro- and macrofossils by English Heritage (Scaife 1987). The macrofossil element was again updated in the 1990s as summarised in Campbell and Straker (2003). The publication of the review of macrofossil plant remains from Northern England (Hall and Huntley 2007) is more easily accessible in full, and provides interesting thematic and general information relevant to the southern material. Summaries of environmental archaeology within the southwest region are also provided within the regional research framework, resource assessment and agenda (Fitzpatrick et al 2007, Hosfield et al 2007, Straker 2007 a,b,c, Straker et al a, & b 2007, Wilkinson & Straker 2007). However, a new round of specialist reviews is currently underway (R. Pelling pers comm).

Martin Jones, often in partnership with others, is a recurring name in the archaeobotany of southern central England. His assessment of sites in the Thames Valley was important in demonstrating that archaeobotanical material could be used to answer questions relevant to wider themes in archaeology, with a model that suggested a hierarchy of sites in the landscape by attempting to identify arable 'producers' and 'consumers' (M. Jones1981). Relating to the Iron Age, M. Jones' archaeobotanical study of the remains from the extensive, long running excavations of the chalk downland hillfort, Danebury, Hampshire, represents one of the largest sets of data available (M. Jones 1984, 1995; M. Jones & Nye 1991).

His interpretations and model developed as further material became available. M. Jones was also involved with another major Wessex developed hillfort as part of Sharples' 1985-6 investigations of Maiden Castle, Dorset (Palmer and M. Jones 1991 in Sharples 1991). These studies effectively look outwards from the hillfort to arable production in the catchment, across a range of soils, aspects and land organisation. Alongside such ostensibly large, but effectively single site-based investigations, M. Jones has also been called on to synthesise the wider data available for southern Britain across various areas and periods (M. Jones 1981, 1985, 1991 & 1996).

Campbell and Straker's (2003: 26) interpretation of the expanded archaeobotanical material available suggested that general patterns of husbandry and change, such as those provided by M. Jones (1981) and Greig (1991), and even patterns for large regions such as Wessex (Green 1981), could be shown to be more locally complex. They called for greater focus on examination of assemblages at a local level. Sites, and samples, that might normally be considered typical of a period, and therefore of limited interest, may represent considerable potential for study when taken into consideration with a number of closely related sites.

Looking at developments in a relatively large region of Northeast of Britain, van der Veen's (1992) regional study of the archaeobotanical remains of prehistoric and Roman sites around the Tyne was significant as it brought together, and directly compared, material from a number of the sites studied by the author. Looking towards southern and southwest lowland Britain, key, but by no means exhaustive, regional attempts at studying the information from multiple sites within the landscape include the treatment of a string of multi-period sites along the line of the improved A30 in Devon (Clapham 1999, Clapham & Stevens 1999). Building on M. Jones' long running work on the charred material from within the Danebury hillfort, another highly relevant set of results and interpretations comes from Gill Campbell's work on the archaeobotanical remains recovered from the sites investigated as part of the environs project around Danebury. Again investigations included both prehistoric and Roman archaeobotanical material. Campbell's interpretations included a Late Iron Age shift from mixed crops towards greater purity in separate spelt and barley over time and alongside a change from autumn only to autumn and spring sowing. Considered with the animal bone data this was used to inform possible organisation of the wider agricultural year (Campbell 2000a & associated volumes, 2008).

In their recommendations for the priorities for future work, Campbell and Straker (2003), alongside increasing geographic coverage and quantity of sampling taking place, called for more direct dating of plant material itself rather than reliance on dates from other material found within the same context. This is of particular importance when looking at the sequence and extent of introduction, establishment and widespread adoption of new crops such as spelt in the Middle Bronze Age and pre-Roman free threshing wheat, as well as the timing of innovations such as changes in sowing time or plough technology.

The key themes that come out of such archaeobotanical studies relate to the timing of introduction, and increasing use of crop varieties, particularly in the wheats an expected shift from emmer to spelt glume and then to free threshing varieties, perhaps in conjunction with different husbandry regimes. Another is the recognition that these changes took place at different times and rates in specific regions, potentially at a very localised scale. Ultimately this is of importance as what and how people farm has implications for organisation of the landscape and social structures. The direct dating of crops themselves would help in identifying the timings of introductions.

1.5 The development of wood charcoal studies in southern Britain

Initial explorations of wood charcoal from archaeological sites began in continental Europe in the second half of the 19th century AD. In most cases the focus was on material recovered from hearths with the aim of determining the wood species that were selected as fuel (Asouti 2001, 65). The examination of British archaeological wood charcoals started with a publication by Salisbury and Jane (1940) of charcoal from the excavation of Maiden Castle, Dorset. Elements of their work were promptly criticised in an article by Godwin and Tansley (1941, Gale 1991) who argued that the frequency of species in the assemblage could not accurately reflect their proportions in the vegetation local to the site. They argued that careful consideration of the various sources of bias in the selection of wood were needed before wood charcoal could be used in environmental reconstruction, a criticism still valid today (Asouti & Austin 2005).

Throughout the 20th century, technical advances played a crucial role in the viability and implementation of charcoal analysis. The innovation of radiocarbon dating after the Second World War (Trigger 1989) resulted in greater interest in charcoal deposits in general. The practice of identifying fragments of wood intended for dating highlighted the possibility of wider analysis. As with the evidence for charred crop and weed species, the introduction and increasing standardisation of systematic bulk soil sampling and processing by flotation was another important development, increasing both the amount and the size range of charcoal recovered from a variety of contexts beyond that possible when using only hand collection (Keepax 1988, Smart & Hoffman 1988). The use of scanning electron microscopes (SEM) has provided detailed images of wood morphology, aiding identification. The greater depth of field allows clear, high magnification photography of uneven surfaces. However, it was the introduction of less detailed, but faster and more economical reflected light microscopes, coupled with the observation of freshly fractured surfaces made by hand, that made possible the study of the increased number of charcoal pieces recovered. These later techniques allow fragments to be quickly assessed and often identified without lengthy preparations (Leney & Casteel 1975).

An important piece of British charcoal work to have emerged in the last thirty years was a doctoral thesis by Carole Keepax (1988) which assessed the methodology and underlying theory used in charcoal studies. The thesis drew together previous Mesolithic to Post-Medieval studies from across southern Britain and made use of material sent for analysis to the Ancient Monuments Laboratory (AML). There was a heavy bias towards sites in southern England. Quantified results were available for 17 of the sites which were looked at using the statistical method of polar ordination. Many of the sites included in the thesis were only represented by low numbers of sampled contexts and similarly low numbers of individual fragments, due to the remit of the AML, and the varying recovery methodologies used. This meant that Keepax's synthesis had to rely on presence/absence data. The study produced a picture of wood use over time that was relatively stable and conservative. Where variation was present, it could be most directly attributed to the availability of particular plants in broad geological areas.

As part of a more recent study of charcoal from Maiden Castle, Gale (1991, 125), a dominant figure in Southern British wood charcoal studies for many decades, called for development from what she referred to as opportunistic, piecemeal charcoal identifications towards the assessment of larger collections of wood charcoal from contexts of known age and character. She advocated synthesis, both spatially and temporally, at a range of scales from the individual site to countrywide. Despite this, and certainly up until the end of the 20th Century, British archaeological wood research can be accused of still working at the basic stage of data accumulation (Murphy 2001). An assessment of the frequency of wood charcoal reports in local archaeology society journals of Southwest Britain indicates that it was not until the 1990s, and perhaps even later, that the analysis of wood charcoal became a relatively standard practice in post-excavation study. It was even later that charcoal identifications were integrated into the general discussion of sites as opposed to being relegated to specialist reports hidden in appendices and microfiche. Nevertheless, the majority of reports are based on a single site, a notable exception being Gale's (1999) analysis of the string of sites along the course of the A30 road improvements.

Wendy Smith (2002) undertook a review for English Heritage of wood and charcoal remains from the southern region. She discusses identification and wood use in terms of the results at specific sites, but again due to the volume of data, the scope is largely limited to a list of available studies and key points of interest. A significant problem that the review highlights is that, across Britain, following the general trend in the available archaeology, the type of contexts providing charcoal for analysis changes from a focus on what can lazily be described as 'ritual' contexts such as burials, pits and monuments in the Neolithic and Early

Bronze Age, moving towards increased domestic sources in later periods (Smith 2002). It is debatable whether charcoals from such different contexts are directly comparable. Another problem, also highlighted in the Midlands review, is the tendency of wood to be studied in isolation from other archaeobotanical remains (Murphy 2001, Smith 2002).

Extrapolating results from Smith's (2002) review and some of the original reports contained therein, wood remains across Southern Britain from the Neolithic into the Middle Bronze Age are expected to show a progressive reduction in 'true' woodland species due to clearance of so called 'wild wood', as a result of the expansion of both arable and pastoral farming, alongside an increase in 'secondary wood' species from regeneration. Moving into the Iron Age there is a notable expansion in the number of wood species used. At this period it is thought that much of the clearance of woodland was complete and fewer woodland trees were available. This expansion in the number of wood species utilised might be explained by well-established hedges, containing a variety of different species, becoming an attractive additional source of wood (Cunliffe 2005). In contrast, the following Romano-British period is described as showing a retraction in species. The accepted explanation for this, and the concentration on a few key species, is also said to be a response to the reduction in woodland. If this is so, the pressure on woodland is being cited as the cause of very distinct and opposite outcomes in these two adjacent periods, and so is an unsatisfactory explanation. Within these overarching trends, there is also the possibility of many episodes of clearance and regenerative growth on a small, more local scale.

Key points from the previous wood studies is that looking at the regional level tends to provide a conservative pattern of wood use. Clearance is expected to be shown through greater numbers of light demanding species suggestive of woodland edge and hedges but in later periods the focus on larger woodland types is also suggested as indicative of species pressure. Looking forward from both the previous archaeobotanical and wood charcoal studies there is a need for consideration and awareness of charred remains at the level of the individual context, to ensure comparability of samples in later analysis. Working from this understanding is important on a relatively localised basis to identify variation not available or hidden at the scale of the wider region.

1.6 The current study

Charred remains recovered from archaeological sites within a landscape are most useful for addressing the aspects of the past plant economy in terms of 'food and fuel'. Using those charred plant remains the aim of this thesis is to look for, and characterise, patterns of change over time and differences across a landscape.

The basic questions within this study are:

- From what period are the archaeological contexts and what is the date of the plant material?
- What crops were people growing?
- How were the crops processed?
- What other types of plant resources were gathered?
- Where in the landscape were people growing the crops?
- What husbandry techniques did they choose to employ?

Building on the principal questions:

- Did these factors change discernibly over time and at what points?
- Do the archaeological feature types have distinct archaeobotanical signatures?
- Can differences be discerned between sites across a small but varied region?
- What vegetation types were present and accessible in the landscape?
- How did the arable economy fit into what is interpreted in some periods as a principally animal based economy?
- Were non-arable plant resources actively managed and conserved?
- What were the environmental and social impetuses and consequences of such changes and differences?

The South Cadbury region of South Somerset is of interest as it represents a region for which there is relatively little published prehistoric archaeobotanical data available. However, it is located at the interface of two well investigated regions of southern Britain, the low lying wetlands of the Somerset levels and moors and the region of Wessex.

The light fraction (flots) of bulk soil sampling, undertaken as an aspect of the South Cadbury Environs Project (SCEP), 1994 to 2007, were made available for study by the current author. The regional focus of the newly studied botanical material used in this study is relatively compact. The sites are located in smaller survey localities within the region dictated by the SCEP project, a 64km^2 area centred on the developed hillfort of South Cadbury. A number of the archaeological sites are adjacent or inter-visible. The material studied relates to archaeologically determined periods from the Early Neolithic to the end of Romano-British period, though the majority of those available for study were thought to relate to the Bronze and Iron Age. The chronological emphasis was partially dictated by the focus of the original Environs Project (Tabor 2008a), the restricted number of samples and the paucity of material from the earliest periods.

1.6.1 Outline of the chapters

This thesis is structured as follows: Chapter 2 lays out the background of the study area, the history of research around the hillfort of South Cadbury, a central feature of the landscape and its organisation but also a significant missing element of the study. It then goes on to introduce the landscape surveys and excavations that took place as part of the South Cadbury Environs Project (SCEP). Chapter 3 contains brief descriptions of the individual SCEP excavation sites from which the archaeobotanical samples were selected for study, relevant archaeological context details and results of dating the samples themselves. Chapter 4 introduce the archaeobotanical methods and methods of analysis used in the study. Chapter 5 moves on to assess presence/absence results for the identified crops, their frequency across the available periods and sites, and the density of charred material. Analysis is then focused on the crop-rich samples, those with at least 50 cereal items. Covering mostly the Middle Bronze Age to Romano-British periods, the greatest numbers come from Middle and Late Iron Age contexts. The samples are considered in terms of the crop processing stages that they are likely to represent. Correspondence analysis is used to look at the patterning of crop items across the wider landscape, within the study localities, and at certain key sites. Comparison is then made across the largest crop processing group identified, the glume wheat fine-sieving by-products, looking at the weed species present and the differences in husbandry suggested by the ecology of the weeds. Chapter 6 lays out the wood charcoal identifications and the general results. It then uses correspondence analysis to compare the patterning of taxa between samples. The frequency of non-taxa related observations, indicating preservation, size of wood and burning conditions for the charcoal fragments are also briefly presented. Chapter 7 discusses key themes relating to the crop/weed and wood charcoal results, in particular sowing time and the relationship of the environment to what was collected (and eventually preserved) through carbonisation. It then attempts to set the changes in crop and wood use that took place over time in the SCEP landscape in the context of the archaeological information and archaeobotanical research from the wider region and beyond. Finally, in Chapter 8, the results are summarised and general conclusions drawn.

2 Study area background

This chapter introduces the South Cadbury Study region. Section 2.1 lays out the background to the location of sites, topography, geology, climate, water availability, soils and land use. Section 2.2 introduces the vegetation history of the region based on previously conducted palaeoenvironmental studies from the lowland Somerset and Avon Levels wetlands and uplands such as Exmoor and Dartmoor. Section 2.3 summarises the antiquarian and archaeological investigations of South Cadbury hillfort, a major focus in the landscape. Section 2.4 introduces the work of the South Cadbury Environs Project (SCEP); the project aims and research, including previous doctoral projects, the chronology used and earlier archaeobotanical investigations.

2.1 The area under study: location and environment

2.1.1 Location, physical features and boundaries

The study area is situated within the lowland zone of Britain, at the neck of the south western peninsular of England. The specific region of interest is located 12 km northeast of Yeovil, a square area 8 by 8 km centred on the hillfort of South Cadbury, one of the most westerly of the Wessex developed hillforts (Cunliffe 2005). The study area lies mainly within South East Somerset extending just over the border into North Dorset. It covers all, or at least part, of 19 modern parishes (figure 2.1).

The region straddles the interface between two contrasting landscapes: a Jurassic limestone ridge to the south and east and low-lying Lias clays to the north and west (Tabor 2002:1). The navigable river Yeo flows within 7 km of south Cadbury giving access to the Bristol Channel despite South Cadbury being around 38 km inland. The position of South Cadbury Hill, and some of the other sites within the project, on the edge of higher, broken ground, coupled with the flat nature of the Somerset basin, allows extensive views including Glastonbury

Tor. In clear weather this extends to the Mendip Hills and at their western end the peninsular of Brean Down, islands in the Bristol Channel and even the high ground of South Wales. Other hillforts visible from the study area include Ham Hill and Brent Knoll. Dundon Hill is closer but concealed by a ridge. Looking south and east the view is much more restricted. The scarp hides a series of ridges (see topography, section 2.1.2) that rise to the western-most part of the Wessex chalk just 19 km to the east and the Dorset chalk-lands to the south with important hillforts such as Hod Hill, Hambledon Hill and further afield Maiden Castle with their own environs investigations.

A major, modern, artificial feature in the landscape is the dual carriageway of the A303 which now bisects the SCEP study region. Running between the villages of North and South Cadbury, the road disrupts movement along the minor routes between settlements which follow the topography, dividing what would have been a more unified landscape.

2.1.2 Geology and topography

The underlying solid geology of South Somerset is relatively complex (figure 2.2); comprising a landscape of rolling countryside disjointed by limestone hills and ridges (figure 2.3) (Havinden 1981:229). This forms a crescent around the southern and eastern edges of the low lying area of central Somerset. This area, running from the Mendips in the east around the southern edge of the Somerset Levels to the Blackdown Hills in the west is often referred to as the Southern Arc or the Yeovil Scarplands and includes both low, sheltered, clay vales and higher steep scarps and ridges (CQC 2010).

West of South Cadbury hillfort is a region of low-lying land bounded by a low extension of the Polden Hills to the west and by the River Brue to the north. The basin is divided by a low, narrow limestone ridge known as Camel Hill. To the south of this ridge the Vale of Ilchester is drained by the rivers Cam and Yeo which eventually flow into the Parrett. To the north, the Vale of Sparkford drains into the Rivers Cary and Brue. Various tributaries rise in the surrounding hills. The rivers then drain through the Somerset Levels into the Severn Estuary. The gently undulating, low-lying vales and flood plains are based on a geology of clays and shales of the Lower Lias (Davey 2005).

At the centre of the specific study area, the multivallate hillfort of South Cadbury sits on an outlier of the Middle Jurassic limestone or inferior Oolite scarp, which runs north-south from Castle Cary to Sanford Orcas where it then curves in an arc southwest towards Bradford Abbas. Other outliers of note are visible across the wider open Somerset basin. These include Brent Knoll and Glastonbury Tor. Like Cadbury, other outliers such as South Petherton and Creech Hill are found closer to the main outcrop. The limestone forms a cap on Cadbury Hill helping to give it distinctive steep slopes (Torrens et al 2000). The South Cadbury Hill is actually part of an escarpment of what used to be called the Yeovil Sands (also Ham Stone) extending from Yeovil, westwards (Torrens et al 2000). The rock forms are siltier at the base leading to harder sand towards their upper boundary. These are part of a much larger formation of progressively younger, but similar sands, that run from the Malverns and the Worcester basin in the north, where they were known as the Cotswold Sands, down to the south coast at Bridport which now gives the formation its current name, Bridport Sands (Cope 2006:340).

To the east of the SCEP region, a continuation of the north-south banding of geology that runs into North Dorset appears as clays and shale bands of Fuller's earth. This is succeeded by tilted beds of Forest Marble followed by Cornbrash. The harder nature of the two limestones forms another high, north-south ridge sloping to the east into the Blackmore Vale and Upper Cale Valley where the Cretaceous rocks rise at the border with Wiltshire (Davey 2005).

The specific localities and sites that provided suitable samples that make up the principal part of this thesis are limited to areas of relatively raised ground towards a central band of the SCEP study region. This bias could be due to sampling decisions and the choice of priorities by project staff to concentrate resources in such areas. The underlying geology of these localities includes areas of the

Middle Lias clays, the Upper Lias sands and small areas of the Inferior Oolitic limestone. The Lower Lias lies at around 20m, while most of the included SCEP sites are located on land above 60m aOD. Even the limestone ridges reach elevations of less than 200m aOD. Here altitude is not a particularly strong limiting factor on agriculture, therefore giving greater weight to soil quality, drainage and the gradient of the land in the dictation of land-use (Davey 2005).

2.1.3 Climate

Lacking the maritime influences of the far southwestern peninsula, the Cadbury region falls within a climatic zone of mild, dry winters and hot, dry summers (Shirlaw 1966). Values recorded by the British Meteorological Office between 1971 and 2000 give summer temperatures averaging a maximum of 20.5-21.5°C, a mean of 15.5-16°C, and a minimum of 10-11°C. Winter maximum temperatures were 8-9°C, with a mean of 4.5-5°C and a minimum of 2-0°C. Ground frosts occurred on around 100 to 120 days per year (Met Office 2010). This leads to the region enjoying a growing season, the period of time when soil temperatures at a depth of 30cm are consistently above 6°C, of around 250 days per year (Findlay et al 1984: figure 6). These are recent figures and how they compare to those in the past can be difficult to assess. Climate change and its effects on plants, animals and human communities is a highly visible and sometimes emotive topic in current research and the popular media. The prospect of catastrophic changes linked to a variation of just a few degrees centigrade or a seasonal shift in the pattern of precipitation may have a significant effect on growing conditions and therefore the economy.

During the Neolithic in Central Somerset, study of insects associated with the Sweet Track has been used to suggest that summers may have been around 2-3°C warmer, certainly no colder, while winters may have been 2-4°C cooler than present (Girling 1979, Robinson 2002, Wilkinson & Straker 2007). Using insects to infer climate is seen as more difficult from the Neolithic onwards as, in addition to climatic conditions, indicator species would also be affected by the increased human modifications to habitats (Robinson 2002). The Later

Bronze/Early Iron Age is frequently associated with climate deterioration, including the resumption of peat growth in bogs across Great Britain; this would suggest a wetter climate in such areas. However, Robinson's (2002) review of the insect data is ambiguous. The changes seen could not be shown to relate solely to climate and in some cases it may have even suggested higher mean temperatures than today.

2.1.4 Water presence, access and effect

The 1971-2000 data suggest average annual rainfall figures in the region of 600 to 900mm (Met Office 2010). Yet, as with the characterisation of landscape, the underlying geology has a significant effect on the availability and location of water within the SCEP region. Water percolating through the raised topography, especially the limestones, creates aquifers. The study region has many springs where the water appears at the surface. Around the hillfort, St Ann's Well and King Arthur's Spring have been the focus of attention (Torrens et al. 2000). Other springs rise in the Cadbury Valley and around the slopes of the hillfort. Another important Oolitic spring is the Seven Sisters Well, the source of the River Yeo, at the base of Sheepslait Hill (see section 3.4 below). Generally water is plentiful on the lower ground and in the valleys but the free draining nature of the soils and rocks on the plateaux can make them very dry (Tabor 2008a:19). In both the South Cadbury Valley and on Seven Wells Down, Early Bronze Age holloways and tracks, suitable for livestock, lead down to water from the hilltops and downland. Access routes to water have also been identified across the lower clay lands. At Worthy, Western-Bampfylde, a double ditched trackway leads south from the field system to an ancient palaeochannel (Randal 2010a: 143, 154).

Shifting palaeochannels with alluvial build-up have also been identified on the gradiometry surveys of the land south of Milsom's Corner suggesting wet meadowland (see section 3.2.1). The drainage ditches, brooks and streams flow from the higher ground of the study region, out on to the lower lying clays into the major rivers described within the topography section above (2.1.2). The rivers make their way through Central Somerset, the Somerset Levels and peat moors, wetlands of national importance and much archaeological investigation. In earlier periods changes in the nature of the rivers is thought to have been most strongly influenced by changes in sea level (Straker et al 2007a, Hosfield et al 2007). In the Neolithic, rivers of the southwest developed meandering, anastomosing forms but in the Bronze Age increased mineral and silt sediment, released due to instability caused by deforestation, clearing land for agriculture in up-river areas such as the SCEP landscape, is thought to have caused further wetness and flooding further downstream (Straker et al 2007a: 104/5). Starting in the Roman period much reclamation and drainage has taken place out on the Levels (Straker et al 2007b). However, it is suggested that up until the 19th Century less effort was put into the drainage of the southern Somerset moors, closer to the SCEP region, in comparison to the north. What had been rough marshland and overgrown thickets of trees was replaced by what is now pasture divided by neat grids of drainage ditches and willow lined roads (Havinden 1981; Smith 1993: 55). Nonetheless, in winter, even now, there can be flooding over large areas.

2.1.5 Soils and land-use

Somerset has long been associated with having a high percentage of land under pasture. At the beginning of the 20th century pasture accounted for over 67% of land use with only Yorkshire and Devon having higher figures (Davey 2005).

Across the individual fields, sites and even trenches, immediate soil conditions can vary. Figure (2.4) provides a simplified view of the general soilscape of the study region and beyond. One of the most noticeable aspects is the concentration of the study sites on, or at the edges of, the freely draining, slightly acid soils. Across Britain, and away from the uplands, such soils tend to be typified by habitats of neutral to acidic pasture and deciduous woodlands. Freely draining, these soils are not considered to be particularly fertile. The nearby shallow, lime-rich, loamy soils are more associated with arable, and in particular the more clayey soils to the west are, by modern standards, considered more fertile (Crandfield/DEFRA 2010).

In the clay vales the soils are often slightly acidic, heavy and generally poorly drained. Settlement and pasture have tended to be concentrated on low rises created by gravel terraces or close to the alluvial deposits of the rivers (Davey 2005, Smith 1993). The largely broad valley north of the wooded Sparkford ridge is now predominantly pasture, although this has not always been the case, as is evidenced by preserved examples of ridge and furrow. The southern Ilchester Vale is typified by mixed farming with arable situated on the drier clay islands. The landscape is open with established hedges and oak-lined lanes. Water courses are defined by alder and willow trees (Smith 1993:58-9).

In the hilly areas of the study region, there is evidence that in historic periods arable farming was of relatively greater importance on the raised ground. This was the region of Somerset where the open-field system was most established and widespread (Havinden 1981: 229). Medieval ridge and furrow is visible on the slopes of the hillfort with sheep grazing and woodland concentrated on steeper slopes and heavier soils (Davey 2005: 22).

Around the hillfort the soils are broadly brown earths, mostly free draining, slightly acidic silt loams. In depressions and valley bottoms there are patches of gleyed colluvium where drainage is poor. Such areas are generally under grass. Though variable, the surface layers remain dry for most of the year while the subsoil has a permanently waterlogged zone (Avery 1955), confirmed by the current author while taking part in the excavation of test pits.

The limestone ridges carry shallow, lime-rich soils overlying limestone rubble above solid limestone. Largely used as pasture, the free draining nature of these soils can make them unproductive in drier years, causing ‘burning’, and their clay content can make them sticky when wet. The weathering of the underlying rock creates relatively neutral to alkaline soils but under ‘old grassland’ the soils can become acidic (Avery 1955).

Areas of thicker, calcareous soils occur on shelf-like structures such as that at Sutton Montis. These soil types, sometimes derived from limestones inter-bedded with the grey marly clays, can be associated with perched water tables, and have a greater silt content derived from the Upper Lias. The soils are described as unfavourable for fruit trees because of the fluctuating water levels and presence of rock bands, but some orchards are planted. In the 1930s most of the land on these soils was under pasture but high proportions were ploughed after the Second World War. The cultivated soils tend to contain large amounts of limestone, although those under grass can again be slightly acidic. In wetter areas, iron mottles are common and there is sometimes panning in the lower horizons (Avery 1955).

Since the Second World War, the number of individual farmers in the area has fallen; dairy herds have decreased and those farmers still involved work larger areas of land. The trend for creating large arable fields by the removal of hedges has to some extent been reversed with the encouragement of subsidies. Boundaries have been replaced and a growing number of woodlands planted (Tabor 2008a). Tabor, as a resident with strong family ties to farming in the area, sees such rapid changes as testament to the versatility of the underlying resources.

2.2 Vegetation

2.2.1 'It's all about the trees'

Reviews such as those of Keeley (1984), Scaife (1987) and Wilkinson and Straker (2007) indicate that South Somerset is generally very poorly covered by paleoenvironmental studies. Aside from the particularly local information gained from mollusc studies from non-acidic soils (for an example from within the study area section 2.3.3 below), the major limiting factor is the lack of suitable contexts for palynological studies. A single sediment core was taken by the current author from a wet 'pond area' during the Castle Farm rescue excavations (see below) but a preliminary extraction for pollen at the University of Sheffield, with the kind help of Tudur Davis, provided very low numbers of pollen grains and the context was not considered secure enough to warrant further work.

Within the wider region, interpretations of vegetation cover are often inferred from pollen profiles taken from the extensively studied Somerset Levels where it is assumed that species that favour drier habitats would most likely relate to the vegetation on the islands and surrounding hills which, based on shared geology and topography, might be expected to show similarities with the Cadbury region.

Very generally, following the last Glacial Period, the initial colonising tree species were thought to be birch, pine and hazel. These were followed by various other species moving to a mid-Holocene dryland 'wild wood' dominated by lime, hazel, elm and oak alongside the fen woodlands of birch and alder on the Levels themselves. This vegetative cover is thought to have been relatively long-lived and stable over all but the wettest parts of Somerset, although there is debate as to how contiguous such tree cover may have naturally been (cf. Vera 2000). Certainly it is no longer considered to be completely devoid of human influence, although clearings are generally thought to have been small and relatively short-lived. Largely based on the geology, South Cadbury lies within the region thought to be dominated by a climax woodland, at the Boreal-Atlantic transition circa 3750 BC, typified by extensive lime woodlands (Bennett 1989, Rackham 1986, 1988, 2003:109). Nevertheless models of pollen production hint at the presence of patches of woodland with no lime to shade the smaller hazel trees and bushes. When growing as a densely shaded under-storey plant, with a limited amount of direct sunlight, hazel tends to produce much lower amounts of pollen and therefore ultimately fewer nuts, which are of importance in the following thesis.

Across Britain the arrival of Neolithic artefacts tends to be closely associated with the 'elm decline' and increases in the proportions of non-woodland pollens such as grasses and *Plantago*. This is often interpreted as being due to the increased clearance of trees for arable and grazing of animals. Basing calculations on five sites studied by Godwin including data from Mere Pool and the Glastonbury Lake village (Godwin 1956), Rackham (1988:17) suggested the 'expected' general proportions of species within Neolithic dry woodland of Somerset. A modified summary of his estimations consists of 33% hazel, 25% each of oak and lime, 10% elm and 4% ash with traces of other species. However, this provides a hugely simplified and uniform picture of the woodland composition across a varied pollen catchment region. Neolithic waterlogged wooden trackways within the Levels, such as the Sweet Track, give some of the first direct evidence of systematic management of the woodlands, through both species selection and the consistent pole and wattle sizes in use.

In later prehistory the pollen profiles generally indicate continuing decline in lime. Rackham suggests (2003:239) that the soils associated with this species may have been those preferentially selected for cultivation (1988: 18) reducing the habitat available to the limes. However, the apparent increase in hazel pollen may be a side effect of the active management of the woodland through coppicing. Hazel has been shown to produce pollen just two years after felling while many other species may take around eight years to regenerate to the point of flowering. In addition, coppicing of an area would mean that there was less competition for light, which also increases hazel pollen production.

It is generally felt that by the Iron Age, and particularly the Romano-British period, the progression of clearance and the wood requirements for domestic and industrial fuel would have meant that the remaining woodland and trees were a resource that required active management and conservation. In the Anglo-Saxon period Somerset was not considered a particularly wooded county (around 11% of the available land) although information taken from the 1086 Domesday Book suggests that the Cadbury area may have had more than the average (Rackham 1988:19, 2003).

2.3 South Cadbury hillfort ('is that Camelot?'): the elephant in the room

The multivallate hillfort of South Cadbury Castle (figure 2.5 & 2.6) is a medium to large Iron Age hillfort similar to those of Wessex and the Welsh Marches (Alcock et al 1995). The importance of the hill, which led to it being investigated, was the reuse and refortifications that took place in Early Historic periods. The northeast entrance to the hillfort has a series of in-turning banks. To the southwest the entrance is made up of overlapping banks and to the east there is a small break in the defences. Four, and in places five, ramparts encircle the central plateau of the steep hill now obscured by 19th century tree plantation.

The hillfort is an impressive central feature of both the region under investigation and the research frameworks which have led, and feed into, this current research. However, investigations within the hillfort provided no samples of charred material that could be included in this current piece of work. Bulk soil sampling and flotation was not considered standard practice and was therefore not undertaken as part of Alcock's original excavations within the hillfort, 1966-70. Sadly this leaves an archaeobotanical 'blank' at the centre of the investigation of the SCEP Landscape. Some charred material was recovered by hand for radiocarbon dating, and concentrations of charred remains or charcoal-rich layers are noted in context descriptions (Alcock 1972) but were not available for study. Previous interpretations of the arable economy linked to the hillfort have depended solely on associated artefacts such as sickles and querns (Barrett et al. 2000) and information from outside the study region from Brean Down which is much closer to the Bristol Channel.

2.3.1 South Cadbury: Antiquarian interest

The earliest antiquarian account of South Cadbury Castle comes from John Leyland, Antiquary to Henry VIII. In 1542 he associated the impressive earthworks and the local place-names containing 'Camel' with King Arthur's Camelot (Alcock 1972: 11). This was followed by a series of scholarly accounts and references through the 16th to 19th centuries AD including William Stukeley's visit to 'Camalet Castle' in 1723 (for details see Freeman 2000 and Alcock 1972). These sources record buildings on the summit of the hill, the fact that it had been ploughed, and the finds, including Roman coins, rounded sling stones and worked stone. Bennett, a former rector of South Cadbury, is acknowledged as the first person to realise the pre-Roman date of the hillfort. Alongside excavation he assessed the relationship of Cadbury to other sites and ancient roadways (Bennett 1890 cited in Freeman 2000).

2.3.2 South Cadbury hillfort: 20th century excavations

The first systematic excavations were carried out by St George Gray (1913) who directed the investigation of five trenches around the south-west gate, across the inner defences and at the highest part of the interior. These explorations identified Roman material, pre-Roman 'Celtic' pottery and finds comparable with those from the Somerset lake villages. Gray also reviewed evidence for occupation in the area of the hillfort. In the 1950s the finds recovered through surface collections within the hillfort were published by Radford and Stevens Cox (1954-55). These included Neolithic flints, pottery demonstrating a long Iron Age occupation, and also included sherds of imported Mediterranean pottery, similar to some found at Tintagel and a 6th century glass rim which were used to suggest high status post-Roman occupation of the hill, in the 5th, 6th and 7th centuries AD.

After his success with Welsh hillforts, the Camelot Research Committee invited Leslie Alcock to direct a series of excavations of Cadbury, which took place from 1966 to 1970. Alcock repeatedly asserted that questions relating to the legendary Arthur are redundant (for example Alcock 1995: 6) but the topic is never far away in his chosen titles and introductions. An innovative aspect of the Cadbury investigations was the interest in the interior occupation as opposed to the military defences and the use of geophysical survey in the hillfort interior to select areas for excavation. Trenches were opened across the ramparts, in the area of the southwest gate and large open areas in the interior (see Barrett et al 2000: 16 figure 7). Alcock published a series of excavation reports, reflective overviews and a popular summary of the hillfort excavations (1967-75). However, it took until 1995 to publish the Early Medieval results (Alcock 1995). Later a team led by John Barrett, Alcock's ex-student at Glasgow, was funded by English Heritage to address the later prehistoric and early historic elements (Barrett et al 2000). The Neolithic material has not yet been disseminated in a final report (Randal 2010a: 132).

In the Barrett et al (2000) report the decision was made to 'blur' traditional chronological periods together (Barrett et al 2000, Tabor 2008a). This was due, in part, to difficulties encountered in differentiating contexts and phases during excavation. The authors of the 2000 report call for the need for absolute dates to be associated with the phases and express caution regarding the problems of residuality. Trying to enforce an episodic outline of activity at Cadbury goes against Barrett's call for thinking of the complex site as developing organically, as opposed to a series of overlaid individual sites (Barrett et al 2000: 22). However, it seems necessary to produce a summary sequence, however imperfect, of the nature of activity on the South Cadbury hill (table 2.1) that can, at some level, be compared and reconciled with wider frameworks, SCEP and the periods used in this thesis (table 2.2).

2.3.3 Molluscs

Sampling for land molluscs was undertaken during excavations of the outer earthworks at South Cadbury Castle by John Evans in 1967. His results and further work unsurprisingly indicate that the early Cadbury hill was typified by open grassland species. The ditch fills contained species that suggest broken or bare limestone, most probably reflecting the direct surroundings within the banks, while others pointed to stable grassland. From the snail evidence these open conditions appear to persist well into the 1st century AD (Rouse 2000). In most of the Cadbury area preservation of snails is considered to be poor. However, small land molluscs were collected from all of the flots in the hope that analysis will be undertaken in the future.

2.4 The South Cadbury Environs Project (SCEP)

2.4.1 Researching and investigating the hillfort environs

Instigated by the imminent formal publication of Alcock's hillfort excavations (Alcock 1995 & Barrett et al 2000) the South Cadbury Environs Project (SCEP) was established to look at the changing relationship between the hillfort and the surrounding hinterland through its use. The aims, methodologies and background of the wider landscape survey are laid out by Tabor (2002, 2003, 2004). Tabor's popular account, interpreting the SCEP landscape results and linked role of South Cadbury Castle, was published in 2008. An academic publication of the investigations and fieldwork up to 2007, when funding ended, is currently underway.

Briefly, the SCEP narrative objectives are to look at the status of the Cadbury Castle hill as a central place within the wider landscape through the Neolithic to Late Saxon periods; at how shifts in the nature of the central place affected access and movement patterns in the landscape, leading to attempts to establish how this was reflected in the resource zones defined by the topography and ancient soils. Other aspects include an investigation of the apparent increase of settlement nucleation in the Late Bronze/Early Iron Age, the influence of the Late Bronze Age pre-hillfort on land division and, during the Iron Age, the nature of the local, social and productive conditions that allowed the high input of resources required firstly to construct, and then to maintain, the hillfort as reflected in the more intensive subdivision of landscape. It was hoped that, by working in core localities, the Roman impact and changes in the Late Romano-British landscape leading to the reuse of the hillfort could also be addressed (Tabor 2002: 8).

Recognising that it was only possible to cover a proportion of the area, the project was designed as a regional, continuous, multilocal survey (Tabor 2003) across an 8 by 8km area centred on the hillfort. It has produced a series of maps based on extensive geophysical survey and the recovery of artefacts. The series of test pits and excavations, from which the bulk soil samples used for archaeobotanical investigation included here were taken, were principally designed to 'ground-truth' and date the interpretations of the geophysical surveys (Tabor 2002 8-13, Tabor & Johnson 2000).

Periods of funding by the Leverhulme Trust followed by the Arts and Humanities Research Council (AHRC) allowed the employment of Richard Tabor and further staff on the project. However, it has been the long-term focus of regular training excavations in the area as well as longer placements for students from universities including Glasgow, Birmingham, Bristol and Bournemouth, alongside a highly skilled team of volunteers that has allowed such a large percentage of the landscape to be investigated. Since 2007 volunteers have continued post-excavation processing and analysis under what became the South Somerset Archaeological Research Group (SSARG). While expanding their areas of interest and activity, SSARG has also undertaken new archaeological investigations within the area including further geophysics, test pitting and an emergency rescue excavation forced by building on the Castle Farm field in 2009.

2.4.2 Chronology

As introduced above SCEP excavations were integral in the dating of the geophysical features of settlement and landscape organisation observed through the wider survey. Dating of individual features and contexts is largely based on the pottery/artefact sequence which continues to be refined. The SCEP sequence draws heavily on the South Cadbury hillfort pottery series which in turn was linked by Woodward (2000) into schemes developed at Hengistbury Head, Dorset, and refined at Danebury and Houghton Down.

Refining the dating schemes, and providing direct dating of organic artefacts from the excavations, a series of 33 SCEP radiocarbon dates were secured and funded through the NERC-AHRC National Radiocarbon Facility (NRCF) and run at the Oxford Radiocarbon Accelerator Unit (applications NF/2009/2/3 and NF/2012/1/21). A Further six dates were undertaken as part of the current thesis in order to date material or sites of particular archaeobotanical interest, not already covered by the other applications. These were run by the ^{14}CHRONO Centre, Queens University Belfast, and funded through a NERC studentship. Where dated material came from the same contexts as the studied charred remains, calibrated dates are shown with the site and context descriptions (Chapter 3). Many of these are direct ‘single season’ dates on hazel nutshell fragments or cereal grains.

As is the case for the stages relating to the hillfort, splitting prehistory into meaningful units is notoriously difficult. Especially when looking for changes over time, the periods are not of equal length and the rate and adoption of change can be variable. Changes may take place across the period not necessarily at boundaries convenient for the artificially imposed divisions. What is more, the technologies used to define the period may not have changed in tandem with those under investigation. Nevertheless, meaningful division is needed. Relevant chronological periods and their approximate dates used to roughly group the archaeobotanical material are outlined in table 2.2.

2.4.3 Landscape history

John Davey (2005) used a largely landscape history approach to look at the evidence for the transition in the region from the Roman through to the Medieval periods, the 5th to 10th centuries AD. Although he maintains that his work was limited by the prehistoric focus of the wider SCEP project and the occurrence of foot and mouth disease in 2004, Davey was able to trace strong continuity in the organisation of the landscape, which he suggests has roots in prehistoric field systems, as well as ultimately the underlying basic geography of the area.

2.4.4 Modelling hillwash: colluviation/alluviation

Geomorphological processes, as well as ultimately affecting choices of past people about the areas of the landscape used, have a large impact on the archaeological record. This can be physical, through the erosion, movement and eventual deposition of material which may denude some areas leading to loss or truncation of the archaeological record. Elsewhere the build up and possible mixing of material may cover and hide *in situ* archaeological remains (Waters & Kuehn 1996). Evidence of these processes can also provide information about past land-use practices. Early examples include work on the dry chalk valley bottoms (Bell 1983, 1992). Although affected by a wide range of events such as the activities of animals, storm events and diseases, in northwest Europe human activity is often thought of as the most important factor transforming environments, reducing the natural vegetation cover particularly through deforestation and, even more so, the creation of arable land which increases erosion (Bell 1992).

Drawing on results from the SCEP test-pitting campaign, around 170 of over 300 test pits considered contained colluvial deposits. Some of the test pits contained evidence of up to seven episodes of colluviation with maximum cumulative depths of 1.68m. While over half of the independently dated colluvial deposits were associated with modern colluviation (Lock & Pouncett 2011), this still leaves many historic and prehistoric episodes. Localities at high points in the landscape, such as the Sigwells plateau show no, or very little, colluviation. In test pits from areas such as the Central sites on the slopes around the hillfort and lower points in the combe of Woolston, such deposits are widespread. Comparing the test pit results with digital elevation models based on calculations of slope and aspect, Lock and Pouncett (2011) modelled the likely zones of colluviation. It was expected that evidence of colluviation would most likely be found at points of topographic lows, channels, pits and passes. Instead it was more commonly associated with sloping areas, probably due to the increased potential for erosion and deposition on these surfaces at either the top or bottom depending on the convex or concave shape of the slope itself. Further work based on flow models, hydrology and refined phases of colluviation is planned for the future.

2.4.5 Domestic animal economy

Analysis of the major Bronze and Iron Age animal bone assemblages from the SCEP region, including a reassessment and expansion of those from the hillfort, was undertaken by Clare Randall (2010a). Her aim was to put the data within a wider consideration of the landscape features including field systems associated with the organisation of mixed farming economies. Wishing to move away from the concept of 'fields as indicators of social discourse', Randall's insight focuses on the functional importance of the physical barriers and delineations of landscape in the context of practicality in handling and managing stock. The strong visibility of these features, alongside what she suggests as rare evidence of arable remains, suggest that the domestic animal economy was of primary importance in many of the periods under consideration (Randall 2010a).

2.4.6 Previous SCEP archaeobotanical work

The excavations of South Cadbury hillfort 1966-70 and 1973 took place at a time when bulk soil sampling and archaeobotanical investigations were not standard practice. Subsequently the arable economy was inferred from artefacts associated with cultivation such as sickles, querns, pottery used for consumption and the large numbers of supposed grain storage pits (Barrett et al. 2000:203).

Following high ideals, but not always implemented consistently across information types, recovery of bulk soil samples from excavations and test pitting in the environs project became an important aspect of the research strategy (Tabor 2003, 2004). What was considered to be a more systematic approach was introduced in 2005 (Randall 2010a: 136). However, this happened in tandem with average sample volumes being reduced to 10 litres.

Limited work was carried out on the charred plant remains from two Early Medieval graves from Hicknoll Slait, a hilltop east of the hillfort. These relate to contexts later than the current investigations (Davey 2002). The work was carried out by Davey himself, with limited advice. He measured the density of charcoals and identified the presence of wheat (*Triticum sp*.) and barley (*Hordeum sp*.). The only wild species identified were the tubers of false wheat grass (*Arrhenatherum elatius*). The rest of the material was recorded as unidentified plant fragments. The somewhat generic interpretation was that they were offerings made as part of a pagan funeral rite, tinder, or residual evidence of activity. There have also been four unpublished, University of Bristol undergraduate archaeobotanical projects, including one by the current author (de Carle 2006). These covered a range of samples and periods dictated by the non-specialist project staff. In the present thesis previously studied but unpublished samples have been reassessed, sorted, re-identified and previous interpretations largely disregarded to ensure a consistent approach.

2.5 Summary

The SCEP landscape straddles the transition between very different landscape types, geologically and topographically, between the Wessex chalks and the Somerset Levels. The surrounding area of South Somerset and the Yeovil scarplands have traditionally not been the focus of large environmental archaeology studies. Yet the area around South Cadbury has been extensively investigated archaeologically through survey and excavations. The hillfort of South Cadbury has traditionally been the focus of attention but the South Cadbury Environs Project helps to set it within a wider landscape and ‘community’. Due to the dates of the hillfort excavations, little direct botanical information is available relating to the arable economy and wider plant use. The samples collected from outside the hillfort therefore provide an important opportunity to investigate the arable economy and wider use of the landscape that can be compared with other lines of evidence.

3 General site descriptions

Five localities within the study region were selected by SCEP for detailed survey in order to represent the various landscape types present in the area/region (see Figure 3.1). The following chapter introduces each of these areas, summarising the relevant work undertaken by SCEP in its various forms, and lays out the key archaeological findings as well as listing the archaeobotanical samples studied for each site and period. Within each of the localities the site names, and therefore codes used for sites and samples, are derived from the respective field names from the 19th Century Tithe maps (for example Cooper 2002) and from modern usage.

3.1 Locality 1: out on the clays, the vales (Clay)

Locality 1 and 1a (figure 3.2, table 3.1) represent a survey area west of South Cadbury hillfort. They cover two areas of the Lower Lias clays of the Sparkford and Ilchester Vales, divided by a section of raised ground, the Sparkford ridge. Activity in relevant periods has been recorded from the regular test pits within this area (for example Tabor 2003: 75). However, due to the generally low numbers of samples and limited numbers of charred remains recovered, only a single sample from Nine Acres (NA) was selected as suitable for analysis. The sample from test pit 90 comes from a Mid-Roman industrial site supposedly uninhabited but thought to be related to brick making (Tabor pers com).

3.2 Locality 2: around the hillfort, hill slopes and valley bottom (Central area)

Early in the Environs Project, work was carried out in the immediate area around the hillfort, looking for evidence of activity in the fields on and adjoining the slopes of Cadbury Hill (figure 3.3). Using geophysical survey and the project sampling techniques for artefact collection, almost a complete circuit has been investigated. This covers the spur of land looking out over the clays to the west of the hillfort, round through the modern village of South Cadbury to the north east of the hill, along the South Cadbury valley and round towards the village to the south of the hill, Sutton Montis.

3.2.1 Milsoms Corner (MC)

The field known as Milsoms Corner (figure 3.3, 3.7, table 3.2) lies below the southwestern gate of the hillfort curving round the hill on a spur of land and looking out over the low lying ground to the Somerset Levels. The slight rise slopes down to the north and west and has suffered from heavy ploughing. Excavated 1995-7, the multi-period site discovered in Trench 1 and its extensions represent the greatest span of periods within the current study of plant remains. These excavations were conducted early in the project when an *ad hoc* or selective judgement sampling method was used concentrating on contexts perceived as ‘interesting’ or where charred remains were visible (see section 4.1.1 for SCEP sampling criteria and Randall & Cadwell forthcoming).

A geophysical survey across the field shows a succession of land divisions. The disused, fragmentary Early Bronze Age linear field boundaries were cut by a new layout of fields in the Middle Bronze Age. The new field system contained around 12ha of enclosures and features suitable for stock handling. The series of enclosures were laid out along a spinal, linear feature which, for at least part of its length, formed a trackway. Houses within the field system tended to be situated close to the trackways, were well spaced and lacked individual enclosing ditches. Ditches at the south eastern end of the system of enclosures created a funnel out on to the lower, wetter ground which could have been meadows used for grazing livestock (Tabor 2008a Randall 2010a: chapter 4).

Archaeological excavation of test pits and a larger trench in this field uncovered a complex sequence of human activity from the Early Neolithic into the Late Iron Age. A line of Early Neolithic pits (figure 3.4), possibly orientated towards the top of Cadbury Hill, provided a rare opportunity to look at early activity in the region.

The next evidence of activity is an Early Bronze Age burial truncated in the Middle Bronze Age by a ditch. Middle Bronze Age excavated features included a house and an associated enclosure tying into the patterns previously indicated by the geophysical survey. In the Late Bronze Age some of the ditches went out of use and in some cases silted up to a third of their original depth. During this period a circular structure with a sunken floor was in use. Later there was a brief phase of increased activity and deposition especially in the enclosure ditch incorporating large amounts of burnt material (Tabor 2008a). Of national note was a beautiful Late Bronze Age Shield (figure 3.4) ceremonially deposited in the silted settlement enclosure ditch (Coles *et al.* 1999). A roundhouse was subsequently built over the filled ditch.

The Early, Middle and Late Iron Age activity seen in the excavation is less well defined. These periods are represented by ditches, pits, postholes and horizontal deposits, some possibly floors. This terminated in the 1st Century AD with a sterile layer of hillwash (Randall 2010a appendix 3).

3.2.2 Homeground (HG)

Moving clockwise around the flanks of the hillfort, adjacent to Milsoms Corner, is the field Homeground (figure 3.3, 3.8 table 3.3), a narrow field 70m from the base of the northern slopes and to the south of Folly Lane. The Homeground field slopes fairly steeply northwards becoming shallower towards the bottom. During wet periods the spring head in the middle of the field causes waterlogging further down slope (Tabor 2002).

In 2004 two trenches were opened in Homeground as a result of previous test pitting. The smaller trench (Tr2, 2x2m) covered the terminals of an enclosing ditch. Large quantities of Late Iron Age pottery were found at the entrance to the enclosure. The larger trench (Tr1, 6x4m) uncovered the northeastern section of a roundhouse floor. The combination of extremely poorly preserved bone recovered from the floor layer, made up of a non-sandy soil, and high quantities of heavily abraded pottery led to the suggestion that this did not represent the original house floor or an abandonment layer. The original house may have been reused for housing stock or the retaining walls for a manure heap (Randall 2010a: Appendix 3, 581). A shallow ditch that cuts across the floor surface and earlier deposits contains pottery suggesting a *tempus post quem* of Medieval date, 12th Century. Running west out of the village of South Cadbury the eastern section of Folly Lane, marking the northern boundary of the field, is believed to be a partly Iron Age route which continues as a double ditched track to enclosed areas in Milsoms Corner. Although the excavators are relatively happy with Late Iron Age pottery dates for the house structure radiocarbon dates from cereal grains of free threshing wheat, identified and highlighted as unusual in previous work (de Carle 2006), and re-identified for the current study, provided date ranges from the mid 1st Century AD up to the modern period (figure 3.8, table 3.13). These dates call into question the secure source of the charred material, both seeds and wood. Consequently the majority of Homeground samples containing grains of this type of wheat were excluded from some summary sections.

3.2.3 Castle Farm (CF)

Castle Farm, and to the south a field with the same name (figure 3.3, 3.5 top, table 3.4), are situated in the bottom of the South Cadbury valley to the east of the hillfort. In 1996, prior to the construction of a new barn, a small excavation took place east of the paddock and the hillfort visitor car park, down slope of what was thought to be a north-south aligned lynchet. The lynchet was later found to represent the course of the former main road through the village, probably Romano-British in origin. A late Romano-British midden sealed by a cobbled surface and cut by stone and clay ovens was uncovered (Tabor 2003: 61). Another excavation took place in 1998 and further excavations were conducted by Davey in 2003 (Davey 2005). The excavations, including previous work that took place within the village of South Cadbury, and geophysics, show Castle Farm at the northernmost limit of a substantial settlement of rectilinear enclosures and buildings aligned on the road spreading through the adjacent fields of Blacklands and The Moor. No samples from the 1998 excavations onwards were presented for archaeobotanical analysis.

It is unfortunate that in the summer of 2009 the greater part of the Castle Farm field was excavated to a considerable depth by heavy machinery in order to prepare the sloping ground for the construction of a new milking parlour. The archaeological importance of the area had not been taken into account and no provisions made under the then current advisory guidelines PPG16 (Planning Policy Guideline 16). Access was granted to the SCEP volunteers and emergency measures put in place. Features discovered, and where possible recorded, included Romano-British ditches running east-west, a raised terrace covered in structures including rubble floors, further midden layers, burials, a number of kilns and furnace structures, perhaps including a corn dryer. Some soil samples were taken and it is hoped that these will contribute to future studies but important information on the sub-Roman activity around the hillfort has been irrevocably lost.

3.2.4 The Moor (MO)

The field called 'The Moor' adjoins Castle Farm field directly to the south (figure 3.2, 3.9 table 3.5). In 2005 three trenches were located at the crossing points of a series of field boundaries. These were planned to look at the phasing of the Iron Age field systems with scattered houses that are spread through the valley and across the watercourse. The modern level of the water table meant it was not possible to excavate the full depth of all features in the trenches. Randall (2010a) suggests that there has been an alteration in the hydrology of the area though it was probably always damp and in need of drainage. The deep ditch-fills in the trenches represent deposits accumulated towards the end of the Middle and into the Late Iron Age when the ditches went out of use. They include large pottery dumps and an uncharacteristically high number of cattle bones, particularly cranium, with evidence of possible exposure. The ditches were overlain by Romano-British and Saxon layers of abandonment, hillwashes and cultivation horizons indicated by cross ploughing marks (Randall 2010a:575 & appendix 3 566-580).

3.2.5 Crissells Green (CG)

Crissells Green is also located in the Cadbury valley on a slightly raised terrace above the original valley floor (figure 3.2, 3.6, table 3.6). It faces the hillfort at the base of Littleton Hill. In 2002 a slot was excavated through a box profile ring-ditch of around 20-25m diameter. The ditch cut into the gravels and through an earlier linear boundary ditch (Tabor 2002: 55, 2008a: 52-3). No suitable diagnostic material to date the feature was recovered so a further excavation took place in 2008 which established the feature as the ring-ditch of a levelled Bronze Age Barrow. Some of the sparse, highly abraded pottery from the outer ditch has been identified as Middle Bronze Age. At some point a crouch burial was added to the ditch. After the ditch was deliberately filled with material from the surroundings and the original mound, a series of ashy scoops were made. These were then overlain by a plough soil containing Romano-British pottery (Randall 2010a: appendix 3, 510-2). Samples from the second 2008 excavation have not been submitted for archaeobotanical analysis.

3.3 Locality 3: Sigwells Field (Sigwells)

Sigwells, Charlton Horethorne, represents most of Locality 3 (figure 3.1), an 18ha (45 acre) field, about 1.5km to the south-east and in part overlooking the hillfort. On a plateau, it is at the head of an east running V-shaped valley and part of the limestone scarp underlain by the Yeovil Sands which creates light free draining soils. The field, especially large for the region, is broken by two steep sided ravines which act as routes to the modern farm located on the site of the Deserted Medieval Village (DMV) of Whitecomb. Three round barrows in the field were excavated in the 19th Century and the area has yielded various Roman artefacts to metal detectorists including coins and a stone altar (Tabor & Johnson 2000, Tabor 2002, 2008a).

Following intensive field walking in 1993/4, in 1998 Sigwells was selected as the pilot study area for assessing the effectiveness of geophysical survey (figure 3.10) combined with various methods of artefact recovery (Tabor 2002: 57). Interpretation of the results led to a simplified sequence of landscape change which to some extent has been modified and extrapolated out to the other areas of the region (Tabor & Johnson 2000: 324).

- In the Early Bronze Age (2nd Millennium BC) the largely undivided landscape was broken up by long linear boundaries probably relating to territories associated with the round barrows.
- In the Middle Bronze Age (1st Millennium BC) a similar boundary system was in place but this time relating to the D-shape enclosure. These integrated small rectangular enclosures suggest a more varied agriculture but both probably relate to stock rearing as the principal means of subsistence.
- By the end of the Bronze Age (1st Millennium BC), though some old features remain significant, the boundary pattern saw realignment and revision including a wider variety of enclosure forms suggesting a more mixed cultivation-orientated subsistence.
- This pattern was sustained into the Romano-British period till the 2nd century AD when it was re-cast. However, the range of enclosures suggests broadly similar agricultural processes.

3.3.1 The Bronze Age enclosure (SGBA) and boundaries (SG16)

Trial Trenches 8/9 (Tabor 2002: 57-79) were positioned to investigate a Middle or Late Bronze Age enclosure (30x60m), rectangular except for the northern boundary which respected an Early Bronze Age linear ditch. More extensive excavations on the enclosure were undertaken in Trench 10, in 2002 (Tabor 2004: 27) and later Trench 19 (table 3.7), excavated in 2005. The east ditch suggested three phases. In the first the ditch silted up slowly; in the second phase the ditch was open only for a short length of time allowing no silting before it was re-filled with rubble from inside the enclosure. The third phase saw shallow cylindrical pits dug about 2m apart along at least 20m of the inside edge of the ditch. Other parts of the enclosure show subtly different actions. The site has been interpreted as a short term metal working/crafting camp, in use for perhaps only a few weeks. High numbers of fine sand, clay casting mould fragments were recovered.

Skowanek (2008) suggests that the high fragmentation of the ceramic metal moulds goes well beyond that needed to extract the metalwork and indicates deliberate destruction to prevent copies. In the Northwest of the area, Trench 19, there is evidence of an oval structure with internal screens which was associated with burnt rocks, wet-stones and hammer-stones. Other parts of the enclosure appear to have been relatively open. Concentrations of scrapers and bone points suggest the working of skins.

Five saddle querns from at least three different sources, some quite distant from Sigwells, point to the processing of cereals (Tabor 2008a: 61-9). Access to water at the temporary site would have been limited requiring it to be transported up to the camp. There are several features suggested as suitable for cisterns. Close by, a feature of particular interest is the rock cut 'cooking pit' in Trench 10 (figure 3.11). Lined with clay it was possibly used to boil meat with hot rocks. Material from around the site has been deposited in the cooking pit along with the remains of a large number of individual animals, decorated pottery and layers of charcoal. The preservation of the animal bones and pottery suggest incorporation was rapid (Randall 2010a: appendix 3 504). Across the enclosure features seem to show the deliberate removal and careful positioning of objects in acts of closure.

Also relating to the Bronze Age activity in the area three samples were studied from Sigwells Trench 16 (table 3.7, figure 3.13), a small trench targeted to investigate the intersection of the ring ditch of what was thought to be a Late Bronze Age round barrow. The barrow ditch overlay older landscape divisions represented by the linear ditch system where dates had been suggested using Geographical Information Systems (GIS) methods including the use of network analysis (Lock & Pouncett 2008).

3.3.2 West Sigwells (SGW)

Trenches 12-15 (table 3.8, figure 3.14) were located to investigate a square enclosure identified by the geophysics but also uncovered a group of intercutting straight sided pits covering an area some 200m by 20-30m aligned on the edge of a double ditched trackway. A Bronze or Early Iron Age holloway was cut by some of the Middle Iron Age pit activity and followed by the digging of the enclosure. In the Late Iron Age further pits were dug and the enclosure ditch remodelled with a new, realigned, more complex entrance. Extrapolating from the number of pits uncovered by excavation, it is estimated that there may be over 5000 pits across the total area suggested by the geophysical survey (Randall 2006). Iron Age pits are often thought of in practical terms as being dug for the storage of grain, the disposal of rubbish, or some more esoteric activity. The final archaeologically recovered contents of pits are potentially completely divorced from the original function. Detailed scrutiny of the fills and finds in the Sigwells pits (Randall 2010b) highlights the variety of their contents. Yet Randall identifies similarities in the way many of the pits were filled, at least in their final use. This includes being left open at the beginning of the fill sequence; repeated acts of deliberate deposition with pauses allowing the associated bone groups, metalwork or other 'structured deposits', including a burial (figure 3.12), to silt over undisturbed; the location being visually marked and remembered in the landscape. The later internal enclosure space also included a round structure and other unrelated post-holes. It is suggested that this area continued in similar use into the Romano-British period but with continuity of indigenous artefact types. Although the ditched trackway was Iron Age, Roman activity included the replacement of the ditches with banks (Randall 2010a: Appendix 3 529).

3.3.3 South Sigwells (SGS) and Roman buildings (SGRB)

Excavated in 2005, South Sigwells is around 150m to the south of the West Sigwells area. Trenches 21-23 (figure 3.10, 3.14, table 3.9) were set to investigate a square ditched enclosure at the edge of the field systems. Pottery from these trenches suggests a 1st century AD date. About a third of the internal area was separated off by a ditch and a line of pits dug in the smaller part. In comparison with the Bronze Age enclosure and West Sigwells, the faunal remains from both the pits and ditches of South Sigwells, though showing good preservation, were relatively scarce. Roman features were also found but suggest there was a break in activity for around a century (Randall 2010a: Appendix 3 564).

The first trenches dug at Sigwells in the northeastern quarter mainly related to Roman features including a 3rd century AD building which showed similarities to the rural structures of Catsgore (Leech 1982). Sample flots are included from two contexts in Trench 7 (table 3.9) but overall very few were available from the 1994-2000 Sigwells excavations.

3.4 Locality 4: Over the border, Downland (Sheepslait)

Locality 4 (figure 3.1, 3.15) is located in the far southeast of the study area over the current county boundary in North Dorset. Sometimes called Poyntington Down, within the text it is referred to generally as Sheepslait, the field name of the major site which provided all but one of the archaeobotanical samples.

3.4.1 Sheepslait (SS)

The field Sheepslait (figure 3.15, 3.16, 3.17, table 3.10) is about 4km south of the hillfort on a spur of limestone separated from the rest of the plateau by a large ditch of unknown date. It overlooks three steep valleys, two dry and one containing a spring which is the source of the River Yeo. Heavy ploughing of what had previously been medieval ridge and furrow has damaged the remains on top of the hill making the relationship with fragmentary linear field boundary ditches difficult to clarify. Situated on the false crest of the hill is a Late Bronze/Early Iron Age ringwork 50m in diameter. The core area for ringworks is southeastern England in the Lower Thames Valley. Such monuments are commonly thought of as an aggrandising statement for elites (Yates 2007). Examples are spread across the east of England as far north as Yorkshire. Previously the most westerly known example of a ringwork was in Oxfordshire, 160km to the northeast. A rhyolite quern and quartz crystal in the rubble of the ditch terminal also affirms long distance contacts with the west, either Dartmoor or Cornwall.

Partially excavated in 2006, after test pitting in 2005, the sequence at Sheepslait begins with a shallow flat bottomed ditch. The eastern entrance was divided by a line of posts, probably a fence, orientated with the field system. In the second phase the ditch was re-cut, around 5m wide and almost 2m deep, with a concentric palisade concealing the enclosure centre. Silts built up fairly slowly until the ditch was again re-cut to the base. It was then more rapidly refilled with rubble thought to come from the internal bank. In the central area pits indicate a rectilinear building probably contemporary with the earliest phase and refurbished over several generations. This was succeeded by a circular structure which would have taken up much of the central area. Burnt stones, many displaying a striking blue colour from being burnt in an environment of reduced oxygen, were used deliberately to close some of the post-holes and the palisade. Stones on the top show signs of weathering suggesting that they were left visible for a period (Tabor 2008a).

Bronze Age finds were sparse across the site in comparison to those deposited in the outer ditch (figure 3.16). The alternating concave layers of rubble and lenses of soil indicate a period of settling between repeated, but discrete, deposits into the ditch. Finds in the ditch were considered to be in fairly good condition. The faunal assemblage almost all comes from this final re-cutting of the ringwork. Unusually high quantities of pig, including neonates, is interpreted by Randall (2010a) to reflect specific consumption practice as opposed to the livestock rearing at the site (Randall 2010a: appendix 3 513).

Subsequent Iron Age activity obscures what was taking place within the building at the centre of the ringwork. This includes a group of pits alongside floor layers and gullies associated with a roundhouse that reoccupied the enclosure, perhaps after a break, when the original associated field system had gone out of use. A thick, ashy layer that sealed a stone floor and large hearth or furnace associated with slag-like material has been used to suggest pyrotechnical industry taking place in the enclosure, perhaps akin to Sigwells (Tabor 2008a).

3.4.2 Down Close (DC)

The field Down Close, Seven Wells Down, lies on the opposite side of the valley northwest from Sheepslait (figure 3.15, table 3.11). Here a regular test pit bisected the ditch of a previously unknown Early Bronze Age barrow dated by ‘scraps’ of pottery. Geophysics has located a further three possible barrows and Beaker pottery was reportedly seen when pillow mounds were levelled at the southern side of the field (Tabor 2008a: 52). Only a single sample from the upper silting layers of the barrow ditch contained enough charred material to be selected for study.

3.5 Locality 5: Woolston Combe (Woolston)

Locality 5 to the north of the SCEP region was originally sited to cover an area of Middle Lias clays and silts (Tabor 2002: 12) but was somewhat abandoned (Davey 2005). An area further to the east, which would have been partially covered by a planned ‘transect’ focusing on an area of the Upper Lias sands at Woolston, was substituted for more detailed investigation. In later publications this is the area denoted by Locality 5 (for example Tabor 2008a: 25 figure 5 and Randall 2010a: Chapter 4)

Woolston Manor Farm is laid out around a basin-shaped combe (figure 3.1, 3.18). At its centre the modern farm buildings and old farmhouse sit on raised ground a few hundred metres north of a tributary that runs westwards into the Cam. The area includes scheduled earthworks (National Monument no. 28855) in Trinities field to the southeast. SCEP carried out work in the locality in 2006/7. More intensive methods were employed than for the previous localities in the hope that it would provide an opportunity to determine successive agricultural systems through the alignment of the boundaries linked to a central area of habitation. The aim was to cover all accessible land with geophysics and regular test pits. A further 59.5m^2 of test pits were targeted on geophysical anomalies and, as part of University of Bristol training excavations, three small trenches were opened in the Plain of Slait (Tabor 2008b). Three fields within the locality provided charred material included in this study.

3.5.1 Ladyfield 1 (LF1)

Ladyfield 1 (figure 3.18, 3.19, table 3.12) is a plateau dipping towards a valley to the southeast. Under pasture when originally surveyed it has since been ploughed.

The 2x1m test pit (TP365729 128246) located within a ‘bounded’ area produced an organic-rich fill from the abandonment of a depressed floor with probable Middle Bronze Age pottery (Tabor 2008b: 88).

3.5.2 Lady Field 3 (or Great Cowleaze) (LF3)

Lady Field 3 (figure 3.18, table 3.12) covers the lower south-facing slopes and bottom of the combe. Unlike Trinities the upstanding earthworks in the field, including well preserved terracing platforms and banked trackways, was not scheduled. The confusion of earthworks and the associated high density of magnetic anomalies range from the Iron Age to the 14th century AD. One test pit (TP365893 127860) showed a platform cut into early hillwashes, ditchfills, occupation horizons and dark hillwashes with a concentration of Middle to Late Iron Age pottery. Other test pits provided smaller but comparable assemblages. In TP65869 27870 a Late Iron Age ditch can be shown to have been deliberately filled, re-cut in the 1st century AD and refilled with material including a Durotrigan bowl. The ditch was subsequently replaced by a Romano-British ditch on a slightly different orientation as part of a new field system (Tabor 2008b:87-91).

3.5.3 Rye Close (RC)

Currently used as pasture and divided into horse paddocks the field Rye Close (figure 3.18, table 3.12) has a slight south-facing slope to the north which gives way to flatter ground towards the modern farm buildings. One of the test pits (TP365808 127805) revealed an area of Romano-British habitation. It yielded a large assemblage of 2nd-4th century AD pottery from two re-cut ditches and a sealing black abandonment layer with semi-articulated roofing tiles, seemingly in place after sliding from a decaying roof (Tabor 2008b: 91).

3.6 The radiocarbon dates

The site information tables include calibrated radiocarbon dates from the contexts, many undertaken during the current project. Table 3.13 gives further information regarding the identifications of the particular dated plant remains, laboratory numbers, the returned date in years before present (BP) and the calibrated date, using OxCal 4.2 and the IntCal13 curve (Bronk Ramsey 2009, 2013, Reimer et al 2013) (see also figures 3.7-3.9, 3.13-3.14, 3.17, 3.19 and chronology section 2.4.2). Table 3.14 provides the same information for the dates returned for non-charred plant remains, mostly animal or human bones. In most cases the non-plant dates come from contexts not studied archaeobotanically but are important in the interpretation of the wider matrix.

The apparently high ‘failure’ rate of radiocarbon results returning modern or very late or dates that appear to disagree with the pottery and other artefactual material, should not be seen as discouraging. In some cases this will lead to reassessments of the overall chronology (Tabor pers. comm.). Homeground samples from the current study were selected to address specific anomalies and research questions relating to dubious identifications of ‘early’ free threshing wheat (de Carle 2006). The non-Iron Age results are comparable with dates returned for other projects (van der Veen 1992, Campbell & Straker 2003) reinforcing the questionable status of the crop before the Late Roman period and supporting the need to directly date items from more assemblages.

3.7 Summary: all across the landscape

The survey work carried out by SCEP provides an overview of boundaries in the agricultural landscape, centres of settlement and some of the industries taking place in the area around the hillfort of South Cadbury. However, the descriptions of the landscape appear ‘naked’ without vegetation. Limited evidence of agriculture has to some extent led previous researchers to de-emphasise, or ‘play down’, the importance of agricultural crops. The bulk soil sampling programme that SCEP developed provides a series of archaeobotanical samples across archaeological periods (see table 3.15 and individual sites in the current chapter). The samples come from a diverse range of sites and context types (tables 3.1-12), including ceremonial and aggrandising sites, but importantly also covering domestic, agricultural, industrial contexts and field boundaries, in a relatively compact region.

Despite localised time lags and adjustments in individual ditches and features, the generalised pattern of organisation in land division across the SCEP region is interpreted as follows. From the Early Bronze Age the ‘ranching style’ long linear field arrangement moves through a series of systems using smaller enclosures laid out with dispersed settlement. The increased management of land, concentrating resources such as animal manure (Randall 2010a), would have had a significant effect on the labour associated with agriculture. Finally the Romano-British field layout shows much continuity with the previous periods. However, this is a period known for changes in technology, new intensity in the use of certain crops such as spelt, eventually a move towards free threshing wheats (M. Jones 1981) and changes in the destination of agricultural surplus. These changes will be investigated using the archaeobotanical remains of seeds, chaff and wood charcoals.

4 Methods

This chapter lays out the methods used in the study of the SCEP archaeobotanical material. Section 4.1-4.3 introduce the sampling criteria used in the field, flotation, early stages of assessment and sorting of the material. Section 4.4 summarises decisions taken in the identification and quantification of the charred crop, weed and wild herbaceous plants. Section 4.5 covers the identification and quantification of wood charcoal, while section 4.6 introduces the other features observable for wood charcoals. The data analysis methods used for the charred crops, weeds and wild herbaceous plants are covered in sections 4.7-4.9, while the data analysis of wood charcoal is dealt with in section 4.10.

4.1 Recovery

4.1.1 On-site sampling

Survey and excavation within the South Cadbury Environs Project, headed by Dr Richard Tabor, ran for more than 15 years, aspects of the work continuing under the South Somerset Archaeological Research Group (SSARG) (Randall 2009). Over some of that time research grants allowed the employment of project staff but the majority of work was undertaken by skilled volunteers and students. Various levels of sampling strategy and charcoal recovery were in place well before the involvement of the current author. The overarching regional landscape aims are laid out by Tabor (2004). Through the years the sampling strategy has changed and developed. During earlier excavations bulk soil samples tended to be taken according to the judgement of the excavators, concentrating on the 'worth' of contexts or where charred remains were visible in high densities. Since then there have been moves towards more systematic sampling of what is described as 'all contexts' (Randall & Caldwell forthcoming). This was instigated for recovery of information on sediment and context formation rather than specifically for the recovery of plant remains mainly due to the availability of expertise. From 2004 onwards samples were limited to around 10 litres with multiple bags taken from some larger contexts (Randall & Caldwell forthcoming). Samples were taken from a range of different excavation types. These included systematic test pits sometimes as small as a one square metre, targeted test pits focusing on features highlighted by geophysical survey, ranging to large open area excavation.

Ultimately sampling variability is imposed by the changing sampling strategy in the field and the fact that the volume of soil processed for each sample was not consistent. However, studying the composition of the samples in the following thesis is concerned mostly with the relative proportions of the taxa and plant parts reducing this as a problem. In addition the volume of the majority of samples was recorded before flotation to allow calculation of the density of items.

The archaeological dating periods used were determined by the South Cadbury team, based on pottery sequences examined at the post-excavation stage, radiocarbon dates, and the recorded stratagraphic relationships between contexts and features. Context and feature type was generally assigned in the field but in some cases reclassified later.

4.1.2 Flotation

Bulk soil samples were stored and then processed by project staff and volunteers at the South Cadbury project base, Home Farm, Sutton Montis, Somerset. Weight and volume were recorded for each bag of sample. Water only flotation was used with some light agitation of the sediments as the tank used was fed with water from above (figure 4.1). The heavy residue was collected with a 1mm mesh and a 250µm sieve was used to collect the floating fraction. Samples were left to air dry (Randall & Caldwell forthcoming).

At least a proportion of the heavy residues were sorted by the project for the recovery of artefacts, pottery, burnt stone, small animal bones, charred plant material and molluscs. Assessment of the size and shape of the pottery and lithic component was made to look at the nature of deposition and context information (Randall & Caldwell forthcoming). This process has not been fully completed for all samples. As the number of samples with available sorted charred material from the heavy residue was limited, for consistency it was decided to focus investigation on charred material from the floated part of the sample. The light fraction from the flotation process (flots) was analysed at the Department of Archaeology, University of Sheffield.

4.2 Assessment

Sample flots were initially scanned at low magnification to assess the richness and the variety of plant remains. From this initial assessment a list of potential samples for further study was created. Criteria essentially focused on the number of wood charcoal fragments (aiming for an estimated 200 fragments per sample or greater) and number of crop items (estimated 50 or greater). As more detailed information on context type and preliminary dating became available an attempt was made to select samples for identifications to provide a spread of periods, locations and features. However, this sometimes required preference being given to the less rich samples and there remain a number of potentially valuable samples that would be suitable for consideration at a later date.

164 samples were sorted for non-woody taxa and wood charcoal was studied for 93 of these samples. The samples come from a range of context types: pits, ditches, postholes and layers associated with both excavated habitation and landscape features across the five survey Localities of the SCEP landscape.

4.3 Sorting and laboratory sub-sampling

The selected samples were passed through a stack of sieves, 4mm, 2mm, 1mm and 0.3mm, each size fraction was sorted with the aid of a low power stereomicroscope x7-x40 (figure 4.2) for charred seeds, fruits, grains, chaff fragments and other identifiable plant fragments excluding wood charcoal. In the majority of cases these largest, coarse, fractions (4/2mm) were sorted in their entirety. It was occasionally necessary to sort only a subsample of material from the smaller, fine fractions (1/0.3mm) using a sample divider (riffle-box). The sorted subsample was never smaller than 1/8, and in the majority of cases this was much higher. Unsorted split fractions were stored separately.

It has been shown that there is a marked reduction in positive type identification with the reduction in size of wood charcoal fragments (Keepax 1988). Therefore wood charcoal fragments were only retrieved from the 4mm and 2mm fractions. A random selection of charcoal, estimated to be approximately 50 fragments, of the 4mm and then 50 fragments from the 2mm fractions was made using a riffle box (van der Veen & Fieller 1982). Using the riffle box further fragments were selected as necessary to provide a minimum of fifty recordable fragments or until the sample fraction was exhausted aiming for a total of 100 across the sample (Keepax 1988).

4.4 Identification and quantification: crops, weeds and wild herbaceous plants

Plant remains (excluding charcoal) were identified using a range of stereomicroscopes with magnifications up to x80. Identification was made based on comparison with modern material from the Department of Archaeology, University of Sheffield reference collection, seed atlases (Anderberg 1994; Berggren 1969, 1981; Cappers et al. 2006, and online resource; Musil 1963; Nesbitt 2006), as well as descriptions and illustrations in floras (Clapham et al. 1989; Stace 2010; Ross-Craig 1974), published archaeobotanical reports and articles (for example: Bakels 1978; Bogaard 2011, Butler 1990, Jacomet et al 1989, Jacomet 2006, Knözer 1970; Körber-Grohne 1991; Lange 1979; Valamoti 2004; Van Zeist & Bakker-Heeres 1982, 1985). Due to the smaller and well recognised flora of Britain, there is a tendency for those British archaeobotanical reports consulted not to include detailed catalogues or descriptions of any but the rarer identifications, hence the reliance here on wider continental sources. Advice of Sheffield staff particularly Dr M. Charles, Prof. G. Jones, laboratory colleagues Dr A. Livarda, C. Longford, E. Simmons and A. Walker were invaluable. Within the study grain is used to refer to the caryopses of the cereals while the colloquial seed refers to a range of fruiting bodies including achenes, seeds, fruits, nutlets and caryopses.

The crops found within the SCEP assemblage are all common species of cereals and pulses with well established identification criteria (e.g. Jacomet 2006). For the cereals both grain and chaff were identified. Following their first instances in chapter 5, common British names are normally used in the text, tables and diagrams.

Initially wild/weed taxa were divided into approximate types. Effort for further identification was then concentrated on the more common of these. Beyond certain distinctive types the majority of grass seeds were divided into three categories based on size (large, medium and small). Cyperaceae, which are notoriously difficult to identify (van der Veen 1992), were treated similarly.

Names of the weed and wild species as far as possible follow the pattern and order in which they appear in the British flora (Stace 2010). Most of the recovered and identifiable plant remains were seeds but other plant parts from the flots included tuberous material and a few tubers which have not been identified further, nutshell, mostly hazel (*Corylus avellana*) and a few samples with material identified as charred fruit flesh, the accompanying seeds and the cell patterns within the material most closely resembling species of the Rosaceae and *Malus* sp. (apple) (Anderberg 1994).

4.4.1 Quantification of plant items

Where possible, a characteristic part of each seed or other plant part was selected as the 'countable element' to give a minimum number of plant parts (G. Jones 1991). Preference was given to parts most likely to survive charring, burial and be distinctive enough for identification purposes, for example the glume bases of glume wheats or the rachis nodes of free threshing cereals. For cereal grains and wild grass seeds, the embryo end was counted a representative of the whole seed, detached embryos were also noted but numbers not included in further calculations. Glume wheat glume bases were each counted as one, while joined spikelet forks were counted as two glume bases. For free threshing cereal rachises the node, the point of attachment to the spikelet, was the counted item. Culm (straw) nodes (large, ≥2mm) and culm bases were counted; smaller culm nodes (≤2mm) were recorded separately as it was thought these may represent smaller grasses. A few samples containing probable culm fragments without nodes have been noted in the tables and approximate counts or estimates made but no further use was made of them beyond recording presence. For flax, the hooked end of the seed was counted while, for large pulses, and wild *Vicia* L./*Lathyrus* L. spp. seeds, the hilum was counted. Where the hilum was not preserved, or the cotyledons split, an estimate of the number of whole seeds present was made. In the case of other wild taxa other distinctive parts were selected. In species where the seed coat can become separated from the inner seed, such as *Chenopodium* L. sp. and *Rumex* L. sp., only the inner seed was counted. If a sample contained items that were identifiable but did not correspond to the characteristic part, but where it was judged that they did not corresponded to items already recorded, these too were included.

The 'minimum number of plant parts' method was not suitable for all the recovered categories of charred plant material. Hazel (*Corylus avellana*) nutshell was generally highly fragmented. At first a rough count of fragments was kept to give an indication of presence. Where very high numbers, estimated as greater than 100 fragments, were found, a weight in grams was recorded. In the case of fragments of tuberous material, and fruit flesh, low fragment numbers were counted; for samples with higher frequencies an estimate (>25, >50, >100, >200) was recorded.

4.4.2 Calculating total counts

The 'raw' counts were initially recorded separately for each size fraction in each sample. In order to create an overall total count for the whole sample, these 'raw' counts were transformed by multiplying up the counts for the subsamples according to the fraction sorted. Multiplied-up counts for all size fractions (4mm, 2mm, 1mm and 0.3mm) were then summed to give a total count for each sample. Where the volume of soil processed was known, the number of crop and wild/weed seeds per litre of soil was also calculated as was the weight of charcoal (from the 4/2mm fractions) in grams per litre of soil.

4.5 Identification and quantification: wood charcoal

A reflected light microscope with dark and light fields at magnifications of x100, x200 and x500 was used to view fresh fracture surfaces, made by hand. Anatomical observations of the cellular structures of the charcoal fragments were made by looking at the transverse then longitudinal-radial, and where necessary the longitudinal-tangential planes. Type identifications were made by comparison of the diagnostic features with the charred wood reference collection at the Department of Archaeology, University of Sheffield and wood anatomy atlases (Hather 2000, Schweingruber 1990). Identifications of the first ten samples were checked by Dr H. Pessin (University of Sheffield) in order to develop a basic regional reference collection of the most frequent types.

Wood type names have been used as in many cases wood charcoal can only be securely identified to genus. Therefore, for the British flora, identifications such as *Prunus* spp. could represent a number of separate taxa. As expected, where assessable, all *Quercus* (oak) identifications showed ring porous patterning of the deciduous types. 'Pomoideae' (some researchers use Maloideae) is used to represent a large group of species from the subfamily of Rosaceae which can display many internal variations even within species. Likely British examples include: C*rataegus* (hawthorn), *Sorbus* (service tree/whitebeam/rowan) and important domesticated fruit trees such as *Malus* (apple). In some cases two separate taxa shared very similar anatomical patterns. In such cases an intermediate category had to be recorded, for example *Populus/Salix*, *Corylus /Alnus*. For *Populus* and *Salix* this is not a problem, as they tend to share similar habitats and some anthropogenic uses, but *Alnus* and *Corylus* have very different environmental preferences, qualities of their wood, and therefore uses.

A few fragments of an unknown gymnosperm (softwood) were identified in the assemblage. Although resin canals were thought to be present, indicative of *Pinus* sp., the inter-vessel pitting was inconclusive. As it was such a rare identification it was recorded as‘softwood’. Where distinguishing features were not visible, or were obscured, or where the preservation was poor, fragments were recorded as ‘unidentified’. These can provide information suggesting formation processes and state.

Fragment counts were used in recording and quantification as it has been shown that the number of charcoal fragments and the weight of species in samples co-vary (Chabal 1992, Asouti & Austin 2005). In addition the majority of charcoal reports consulted made use of fragment counts aiding potential comparison. After the pilot study of ten samples was completed it was decided to record the total weight of 4mm and 2mm sized fragments within each sample before identification was started as a rough measure of quantity.

4.6 Other features of wood fragments: ‘non-taxon analysis’

Additional features, observed, in the course of species identification were recorded as described below. All details were then stored in a Microsoft Access database.

4.6.1 Presence of bark and pith

Regions of pith cells appear as homogonous rounded cells indicating the central region of the stem. Bark was less frequently preserved and less distinct. Cells in the area adjacent to the outer layers appeared dense and compressed with thin flaking sheets of material at the very edge. Some species can show cell pattern in the bark distinct from that of the wood (Schweingruber 1990). As the South Cadbury charcoal fragments were generally small (<6mm). The presence in a single fragment of both bark and pith suggests twig material.

Further growth features such as right angled bends and wear marks, previously used to indicate management practice such as hedge laying in waterlogged woods (Lambrick and Robinson 2009) or patterning within the growth rings indicating consistent growth cycles (Rackham 1977) did not survive in recognisable form in the fragmented SCEP charcoal assemblage and so could not be recorded.

4.6.2 Assessment of growth-ring curvature

To provide an indication of the calibre of wood or zone of the tree represented in the samples, an attempt was made, where feasible, to assess the ring curvature and angle of the rays. The assessment of ring curvature was only undertaken for fragments from the ≥4mm fraction, where a clear view of the transverse plane was available. Fragments were evaluated under the lowest magnification (x100) following Marguerie & Hunot (2007). Suitable fragments were recorded as displaying 'strong', 'moderate' or 'weak' ring curvature: 'strong' where a significant curvature was observed probably representing twigs; 'moderate' where some curvature could be perceived suggesting branches; or 'weak' where the curvature at this magnification showed growth rings appearing as straight and the rays appear parallel, indicating wood from either the trunk or larger branches (figure 4.3). For fragments where the direction of rings was inconsistent, for example in uncertain direction or curved back on themselves, the fragment was recorded as 'knot'. However, for the majority of the assemblage the curvature observation could not be made because of poor preservation or the visible section being too small. Within the 2mm fraction only those fragments with both pith and bark could be confirmed as a full twig or small branch, therefore characterised as 'strong'. This assessment acts only as a guide. 'Moderate' fragments, and those 'strong' fragments which did not retain their outer bark, may have broken off from what was originally a more substantial piece of wood. Furthermore some of the shrubs and smaller woody species may never have grown to a size sufficient to display 'weak' curvature.

4.6.3 Presence of fungal hyphae

Fungal hyphae appeared in the longitudinal planes as white, or in some cases yellow, filaments 'crisscrossing' the vessels. The presence of such fungus, which normally lives on outer surfaces, within the wood tissues is associated with dead wood not protected by bark. The growth of such fungi is accelerated by higher temperatures and humidity such as occur in the British summer (Marguerie & Hunot 2007). However, evidence can be highly localised and easily overlooked during general identification.

4.6.4 Incidence of insect degradation

The presence of large, sometimes irregular holes has been interpreted as possible tunnels of wood boring-insects such as stag beetles and woodworm. Unlike wood vessels the edges of these holes have indistinct borders without regions of increased brilliance. As with fungal hyphae the small, localised holes may be easily overlooked during identification.

4.6.5 Presence of radial cracks

Cracks running radially within the line of the ray cells may be an indication of the dampness of the wood and burn temperature. However, the anatomy of the wood also plays an important role in their frequency. Cracks are more common in the larger rays such as the multi-seriate rays of *Quercus* (oak) and are less frequent in pith-wood (Marguerie & Hunot 2007).

4.6.6 Level of vitrification

As the components of wood are heated they decompose leading to the loss of cell layers, followed by collapse and fusing of the vessels which, in the right conditions, can lead to a glass-like shiny appearance. The severity of this fusing used to be considered indicative of the temperature of combustion, but recent studies have shed doubt on this (cf. McParland et al 2007), pointing to a wide range of other factors potentially affecting the degree of vitrification. Evidence of vitrification was assessed as one of three levels.

- **Level 1:** Some shine to the section. Few signs of smaller cells fusing.

- **Level 2:** Shiny appearance to the section. Some background parenchyma cells appear fused and glassy but the larger cells are still visible although deformed, sometimes allowing allocation to a species type.
- **Level 3:** Most if not all of the cells are fused with no discernable pattern. A smooth surface, crazed, sometimes showing semi-concoidal fractures not recognisable as any particular species.

If a single piece of charcoal displayed more than one level of vitrification, assessment was made on the basis of those areas that allowed type identification.

Some species had features which allowed them to be recognised, in good cases, with level 2 vitrification. For example the wider rays and large dendritic vessel patterns sometimes allowed an identification of deciduous *Quercus* to be assigned to fragments with quite marked fusing present. On the other hand identifications within some groups, such as those with diffuse vessel patterns and small rays, which are dependent on more subtle differentiation of smaller features, were hard to attribute safely even when the vitrification was relatively low.

4.7 Data analysis: crops, weeds and wild herbaceous plants

4.7.1 Selection of species categories

Before statistically analysing the assemblage, counts were standardised and categories simplified to reduce biases related to preservation, while limiting the loss of useful information. Closely related initial identification categories were amalgamated where they were likely to represent the same taxon. This removes some of the variation between samples that is due to different levels of identification (usually resulting from different degrees of preservation), leaving only variation due to botanical composition. Firstly uncertain identifications (cf. - meaning 'compare') were amalgamated with their corresponding, more secure identifications for both crop and weed/wild categories.

All categories of barley grains were amalgamated into a single category. All but a few grains were of the hulled type, or belonged to the great majority that were not well enough preserved to be assessed. Similarly, most grains could not be characterised as either twisted or straight, and straight grains occur in both the two- and six-row species. It was therefore not possible to explore variation in barley species or varieties between samples. In some of the analyses, emmer and spelt grains were categorised together as ‘glume wheat’ because of the difficulty of differentiating between them. Free threshing wheat grains were, however, always considered separately (despite the difficulty of distinguishing some of them from spelt) because of their different crop processing requirements. Details of the amalgamated crop and weed categories used in statistical analyses are given in table 4.1. Taxa that were not used in the analyses are listed in the shaded sections at the bottom of the tables in the appendix.

Rare taxa, occurring in only a few samples, tend to create noise in statistical analyses by appearing as ‘outliers’ etc., and they add little to the compositional analysis of samples (Gauch 1982, G. Jones 1983, Lange 1990 ,van der Veen 1992). Taxa present in fewer than 10% of samples were therefore omitted from statistical analyses, following G. Jones (1983) and van der Veen (1992).

4.7.2 Proportional assignment of indeterminate and species categories

Indeterminate crop categories, such as *Triticum* sp. and cereal sp. (which would be incorrectly treated as unrelated to other categories in statistical analyses) were proportionally assigned (table 4.2) to the more accurately identified taxa making up the combined category, on the basis of the proportions of the more certain identifications in each sample, as follows.

- ***Triticum* sp. glume bases** were divided proportionally between a) emmer and b) spelt.
- ***Triticum* sp. grains** were divided proportionally between a) free threshing wheat type and b) glume wheat type (emmer and spelt).
- **Indeterminate cereal grains** were divided proportionally between a) barley, b) glume wheat type (as calculated above) and c) free threshing wheat type (as calculated above). Rye and oat grains were not included in

statistical analyses because (i) they are more distinctive in shape (and therefore less likely to be recorded as indeterminate cereal grains) and (ii) they were present in much smaller numbers (so any potential underestimate of their proportions would be negligible).

- **Indeterminate cereal rachis nodes** were divided proportionally between a) free threshing wheat and b) barley. Where no positively identified rachis nodes were present, the indeterminate rachis nodes were divided proportionally on the basis of the proportions of free threshing wheat and barley grain (where present).

A similar process was used to assign commonly occurring wild taxa that were identified as indeterminate between two types. In tables and graphs the use of the plus symbol (+) at the end of a species name denotes a count based to some extent on proportionally assigned items.

4.7.3 Combining samples from the same source

In order to identify similarities and differences between archaeological depositional episodes, rather than multiple sampling of the same episode (G. Jones 1991), samples that had been sorted separately from the same or very close statigraphic contexts were considered for amalgamation. After checking that their contents were similar, the two subsamples from Sheepslait SS/024 were amalgamated but samples from the Homeground house floor were kept separate because of their spatial spread.

4.8 Determining crop processing stage

Three different methods were used to identify the products and by-products of crop processing: identification of the principal crop category in each sample, the ratios of chaff to grain in each sample, and the physical characteristics of the weed seeds accompanying the crops in each sample. These complementary methods were applied to the SCEP samples to identify samples deriving from similar crop processing stages.

4.8.1 Principal crop category

For each SCEP sample containing at least 50 cereal items, crop percentages were calculated for the following categories: glume wheat grains, glume wheat glume bases, free threshing wheat grains, free threshing wheat rachis nodes, barley grains, barley rachis nodes, rye grains, rye rachis nodes, oat grains, flax seeds and pulse seeds. An arbitrary cut-off point of 70% (after Hald 2008) was chosen to indicate that a sample was predominantly made up of a single crop category.

4.8.2 Chaff to grain ratios

Glume wheats spikelets (emmer and spelt) generally contain two grains enclosed by two glumes (giving an average glume base to grain ratio of 1:1 or 1). Therefore, a glume base to grain ratio greater than one is likely to represent a by-product (removed at a late stage of glume wheat processing), while ratios of much less than one indicate a cleaned product. Roughly equal numbers may represent whole spikelets, threshed but uncleaned spikelets, or a subsequent mixture of glumes and grains.

For six-row barley, each rachis node bears three spikelets each containing one grain (a rachis node to grain ratio of 1:3 or 0.3). Therefore a rachis node to grain ratio of more than 0.3 is likely to represent a by-product (removed at an early stage of processing), ratios around 0.3 may indicate whole ears or subsequent mixture of early stage waste and product, and rachis to grain ratios much lower than 0.3 indicate a cleaned product. The ratios for free threshing wheat (with an average rachis node to grain ratio for whole ears of 1:2-1:5 or 0.5-0.2) and rye (with an average rachis node to grain ratio for whole ears of 1:2 or 0.5) were also calculated.

These ratios were calculated for samples containing at least 50 cereal items, and then only for taxa with a minimum of ten items.

4.8.3 Physical characteristics of weed seeds

Weed seeds harvested with the crop are removed at various stages of crop processing. The physical characteristics of the weed seeds removed at each stage of crop processing differ depending on the method used at each stage, and these characteristics have been used to identify crop processing stages (G. Jones 1983, 1984, 1987). G. Jones (1984) demonstrated that ethnographically collected samples from different stages of traditional, non-mechanised crop processing on the Greek island of Amorgos could be distinguished on the basis of weed seed characteristics using discriminant analysis. The following weed seed characteristics were used:

a) The aerodynamic properties of the seeds including the density, the presence or absence of features such as wings and hairs, classified as light (L) or heavy (H); these features are most relevant to the actions of winnowing as very light seeds or those with a pappus of hairs tend to be blown away during winnowing.
b) The tendency for the seeds to stay in heads, spikes or clusters during threshing, classified as free (F) or headed (H); pertinent to coarse sieving as the free seeds pass through the sieve with the product while the heads remain in the sieve and are removed.
c) The size of the seeds classified as big (B) or small (S); relevant to fine sieving as the smaller seeds pass through the sieve while larger seeds, similar in size to the grains, are retained.

These characteristics were used to classify weed seeds into physical categories, e.g. BHH (big, headed, heavy), SFL (small, free, light) and so on (see results table 5.6). Discriminant analysis was then used to distinguish the products and by-products resulting from different crop processing stages (the by-products of winnowing and coarse sieving, and the products and by-products of fine sieving) on the basis of these weed seed categories. Discriminant analysis selects the linear combination of variables (in this case the weed categories) that best discriminate between predefined groups (in this case the four groups of ethnographic crop processing samples). Discriminant analysis also allows samples of unknown crop processing stage (e.g. archaeological samples) to be classified (on the basis of the weed seed categories) into one of the predefined groups (G. Jones 1987).

To apply this method to the SCEP samples, the wild/weed taxa were categorised according to these same characteristics. Weeds identified only to genus were included only if the species in the genus shared common seed characteristics. Only those samples with 50 or more cereal items and 10 or more characterised weed seeds were used, reducing the number of samples to 87. The percentage of each characterised weed taxon in each sample was transformed using square roots, and the resulting values for the weeds within each of the weed categories summed. These samples were then entered into a discriminant analysis alongside the similarly transformed data from Amorgos (provided by G. Jones). The discriminant functions extracted from the ethnographic data were used to classify the archaeological samples (of unknown processing stage) into the processing group they most closely resemble. The programme used for discriminant analysis was SPSS statistics version 19 (IBM 2010).

4.9 Compositional analysis

Correspondence analysis was used to explore variation in the composition of the samples. Correspondence analysis is an ordination technique that arranges cases (here the archaeobotanical samples) along axes, on the basis of a number of different variables (here the counts of taxa and plant parts) (for fuller explanations see Lange 1990: 43, Bogaard 2004, Shennan 1997). The program used to run correspondence analysis was CANOCO 4.5 (ter Braak 2006). The data was analysed using the unimodal response model, with symmetrical focus scaling (biplot scaling). The results were plotted using CANODRAW (Smilauer 2006). In most cases axis 1 was plotted horizontally against axis 2, vertical, as these two axes account for most of the variation in the data.

Graphically correspondence analysis positions each sample relative to all other samples and to all other species and *vice versa* (Lange 1990). The plot origin is considered its neutral ‘centre of gravity’. Positive or negative association between the samples and species, represented by points, is shown by their divergence and the direction or angle at which they plot from the origin. Points that diverge in opposite directions indicate a negative association. The distance from the origin gives a measure of the ‘degree’ of divergence, how ‘unusual’ a sample is (Lange 1990, ter Braak & Similauer 2002, Bogaard 2011). The individual points were coded to explore hypotheses about the potential causes of compositional similarities and differences. In the same plots, samples were displayed as pie-charts showing the proportions of taxa or groups of taxa in each sample.

Correspondence analysis was carried out first on the crop component of samples (from all sites) containing at leat 50 crop items. The three largest localities (Central Locality 2, Sigwells Locality 3 and Sheepslait Locality 4) were then analysed separately. Correspondence analysis was also performed on the weed/wild component of those samples identified as glume wheat fine-sieve by-products to explore compositional variation in wild/weed taxa unrelated to crop processing.

4.9.1 Archaeological information

To explore the potential role of different factors in determining the botanical variation between samples, information relating to locality, site, archaeological period and context type was displayed by coding the sample points in correspondence analyses with the archaeological context-related information.

4.9.2 Ecological information

Ecological information was used to code the sample points in the correspondence analysis of wild/weed taxa in glume wheat fine-sieve by-product samples. Taxa were grouped by habitat preference, soil pH, life cycle, flowering onset and length of the flowering period. Ecological information was taken from the Floras

(Hanf 1984, Clapham et al 1989, Fitter & Peat 1994, Hill et al 1999, Cope & Gray 2009, Stace 2010) and 'Comparative Plant Ecology' (Grime et al 2007).

4.10 Data analysis: wood charcoal

4.10.1 Selecting species categories

To reduce the effect of preservation biases in order to focus on species composition uncertain wood charcoal identifications (cf.) were amalgamated with their corresponding more secure identifications. Taxa present in fewer than 10% of samples were grouped together as 'other', and excluded from the later analysis.

4.10.2 Principal wood taxon

For each sample the percentages of each taxon were calculated, excluding unidentified' fragments. An arbitrary cut-off point of 75% was chosen to indicate that a sample was predominantly made up of a single wood taxon.

4.10.3 Diversity: Shannon-Weiner Index

Researchers such as Austin et al (2009) and Smith (2002) have suggested that woodland clearance and regeneration are reflected in a reduction and expansion of the number of species present. The number of species identified in a sample gives a simple measure of species diversity; however, this does not take account of how evenly the fragments in the sample are distributed between the taxa, their relative abundance (Fowler et al. 1998). Diversity indices provide a combined measure of the total number of species and the abundance of each species. High diversity indicates a large number of species evenly distributed while low diversity may indicate a low number of species, the uneven distribution of species, or a combination of the two (Pielou 1977: 291-310). The Shannon-Weiner diversity index was used, calculated using the formula:

$$\mathbf{H' = \frac{N \ln N - \sum(n_i \ln n_i)}{N}}$$

(Where N= total numbers of fragments of all species, n_i = the total numbers of fragments of each species, and ln is the natural logarithm). This equation is equivalent to the more frequently quoted $H' = -\sum p_i \ln p_i$ (where p_i = the proportion of each species) but it requires fewer stages of calculations.

It should be noted that use of the indices assumes a standard sampling procedure which cannot be fully ensured for archaeological assemblages limiting the use of the results.

4.10.4 Compositional analysis

Correspondence analysis was used to explore variation in wood charcoal composition for those taxa present in 10% or more of samples,
while retaining the information of the individual samples. Sample points were coded according to locality, site, archaeological period and context type. Taxa were also coded according to ecological information including most common terminal habitat, moisture preferences, preferred soil pH, maximum canopy height. Taxa were also coded by Keepax's (1988: 339) fuel value, based on burning qualities of British species, combining factors such as burn length, temperature and ease of ignition and Keepax's hardness rankings.

4.10.5 Fragmentation/preservation index

To investigate taphonomic characteristics of the assemblage, Asouti's (2001, 2003a, Miller 1988) fragmentation/preservation ratio (FR/Pr Index) was calculated for each sample, by dividing the number of unidentified fragments by the number of identified fragments. Samples with ratios more than one standard deviation from the mean result were highlighted as showing particularly poor preservation.

5 The crop and weed results

Overall species representation is presented in sections 5.1 and 5.2. Changing agricultural practices are considered in sections 5.3 to 5.4, focusing on samples containing at least 50 crop items (excluding culm nodes). First these samples were used to explore the taphonomic effect of crop processing which creates a filter on the taxa found in the archaeobotanical samples. The identification of crop processing stages was addressed by three complementary methods: percentages of the principal crop components, ratios of chaff to grain, and Physical characteristics of the weed seeds. Compositional differences relating to field location and husbandry practices were then explored for samples from similar crop processing stages.

5.1 The spectrum of crops

Nine possible crop plants were identified in the SCEP samples. Tables 5.1-5.3 summarise the quantity of each crop type by both locality and period in three ways: the number of samples in which the crop type is present (table 5.1); the maximum number of crop items in an individual sample (table 5.2) and the total number of crop items (table5.3). Despite the difficulties (Popper 1988), presence, or ubiquity, was used as a simple way to include data from the smaller samples and sites not suitable for later forms of analysis.

Tables 5.1-5.3 include samples from the Neolithic to the Romano-British period placing them in the latest period suggested by the dated material. Following the radiocarbon dating program, for clarity, samples with problematic dates (HG1/014, 016, 019a, 019b, 023, 025, 045, 006a, 006b, 006c, 006d, HG2/003, 010 SG12/146, MO1/006, 008, MO2/006, 011) have been excluded from the summaries, leaving 146 samples. However, it should be noted that the samples with unexpected radiocarbon dates, and those outside the spread of periods under study, are included in the analysis because much of the work took place before final dates were received.

5.1.1 Cereals

5.1.1.1 Wheats (*Triticum* L.)

5.1.1.1.1 Glume Wheats: emmer (*Triticum turgidum* ssp. *dicoccum* (Schrank) Thell. (traditionally *T. dicoccum* Schülb.) and spelt (*Triticum aestivum* ssp. *Spelta*(L.) Thell. (traditionally *T. spelta*)

Glume wheat grains or, more often, glume bases were found in 126 of the samples (86%). There were over twice the number of glume bases as the total number of cereal grains, and many more than wheat grains, making glume bases the most numerous recorded item. This is unlikely to have been caused by charring as grains tend survive at higher temperatures and for longer periods of charring than glume bases (Boardman and Jones 1990).

Emmer is normally identified as the principal wheat crop in the British Neolithic and Bronze Age but was to varying extent replaced by spelt in later periods (M. Jones 1981, van der Veen 1992). Across the SCEP assemblage emmer and spelt are present in samples from all localities. Beyond the earliest samples, where cereal items are generally low, both wheats are identified across the periods (tables 5.1-5.3). Emmer glume bases are present in fewer samples overall (64 samples for emmer; to 89 for spelt). The presence data (table5.1) from the Middle Bronze Age suggests that spelt is not significantly rarer than emmer. Spelt glume bases are identified from two out of 17 samples while emmer glume bases are present within five of the samples. However, in this period, spelt is only present in very low total numbers, 1-4 items (table 5.3) while there are 79 emmer glume bases, 93% of the positive identifications. In samples relating to the Late Bronze Age the proportion of emmer glume bases drops to around 15% and spelt becomes dominant. Even so, across the rest of the periods, spelt tends not to completely replace emmer. During the Iron Age emmer makes up between 25-30% until the Romano-British period when it drops to just 10% of the identified glume bases. Hinting at later changes to come, in the late Romano-British Woolston samples, where spelt itself appears in very low numbers, no emmer was identified.

The glume base proportions are not directly replicated in the grain values. From the late Bronze Age onwards the proportion of emmer remains higher than expected, at some localities even outnumbering spelt grain identifications. The identification of grains is problematic with much internal variation and overlap between species (Hillman et al 1996, G. Jones 1998). The puffing effect of charring is more likely to disguise the relatively straight sided shape and flattened dorsal surface required to identify a grain as spelt. It is therefore likely that the proportion of spelt grains has been underestimated.

5.1.1.1.2 Free threshing wheat type (*Triticum cf. aestivum* L. ssp. *aestivum*)

The expansion of free-threshing wheat, most probably the hexaploid bread wheat, is thought to have largely taken place in Britain towards the end of the Iron Age though there is some debate (Campbell & Straker 2003, Mills 2006). Apparently Iron Age finds of breadwheat from Thorpe Thewles and Chester House, in northwest Britain were radiocarbon dated as Medieval and modern respectively (van der Veen 1992). Although free threshing grains were identified in significant numbers, especially from the house structure at Homeground where samples were dated using pottery as Late Iron Age (Tabor pers comm), the results of direct radiocarbon dating (570-653 CAL AD - UBA-21922, 1664 CAL AD - UBA-21924) indicates that many of the grains could be intrusive, deriving from a later Victorian midden, apparently inverting the contexts, while the barley from a third context gave what was thought to be a reasonable Late Iron Age date. Similarly an unexpectedly late date for the archaeological context was also recorded for a free threshing wheat grain from Sigwells SG12/146 (1896-1904 CAL AD - OxA-23727). Intrusive charred seeds may have become incorporation into samples during flotation if sufficient care was not taken to clean the equipment and separate samples while drying (Keepax 1977) or material from overlying deposits may have fallen from the trench edges. Alternatively grains may have been incorporated into the archaeological deposits before excavation, for example by the action of ploughing on shallow deposits, or by transportation of grains down the soil profile by the action of washing, perhaps along root-holes and drying-cracks, which can be particularly prevalent in clay soils. The action of earthworms is another possibility: although most active within the first 20cm, earthworms are present in most soils except the most acidic and, in dry conditions, many species can be found curled up in burrows, lined with material including seeds and small stones, some 0.5 to 1.5m below the surface (Canti 2005, Law 2009).

Even excluding the samples that returned unexpected radiocarbon dates (tables 5.1-5.3) free-threshing grains appear to be present in low numbers from the Middle Bronze Age onwards. From the Early Neolithic free threshing wheat type grains are frequently found in low numbers in archaeobotanical samples dominated by glume wheats. These are often interpreted as minor crop contaminants though it is possible that free threshing wheat varieties were grown as a specialist crop in some regions (Campbell & Straker 2003). In Iron Age samples from the Danebury Environs Project, Campbell (2000a) identified a short grained spelt that exhibited many of the characteristics associated with free-threshing wheat grains. The majority of free-threshing wheat identifications within the SCEP assemblage are based on grain morphology which is not ideal (Hillman et al 1996). Even when rachis is identified, M. Jones (1984) suggests that some could represent the basal part of the wheat ear which is difficult to distinguish as tough or free-threshing. Very few rachis fragments were positively identified except from the Romano-British samples from Ladyfield, where a significant number of suitable grains were found in concentration. Sites and contexts of unquestionable date suggest that, within the SCEP region free threshing wheat did not become a major crop until the late Romano-British period.

5.1.1.2 Barley (*Hordeum vulgare* L.)

Barley grain was the most ubiquitous grain type identified, present in 113 out of 146 samples across all localities and periods. The exception was Early Iron Age Sheepslait, a single sample with only indeterminate cereal grain. 31 of the SCEP samples contained rachis identified to barley. It was not possible to take this identification further. Where it could be assessed, most of the barley grains were identified as hulled and straight but the majority were too poorly preserved to differentiate. Exceptions include two possible twisted grains from the Middle/Late Iron Age sample SG13/263 and Late Iron Age samples SG12/207 (2 grains) and SG14/038 (1 grain). In addition 18 possible naked barley grains were identified from Late Iron Age sample SG23/034.

5.1.1.3 Oat (*Avena* L. sp.)

Except for two Middle Bronze Age samples from the Central area (Locality 2), oat grains occur more consistently and in slightly higher numbers across the localities from the Middle Iron Age onwards. Only two probable florets of oat were recovered within the SCEP material, from Middle Iron Age SS/127 and Late Iron Age SGS21/017. It was not possible to assess whether they represent cultivated (*Avena sativa* L., *Avena strigosa* Schreb.) or weed (*Avena fatua* L.) forms. It is largely thought that oat was probably not established as a crop until the Late Iron Age (Campbell 2000a, Straker 2000). The low numbers in the SCEP samples are consistent with oat as a weed. Oat is still considered a troublesome weed of modern arable (Behrendt & Hanf 1979, Cope & Gray 2009).

5.1.1.4 Rye (*Secale cereale* L.)

A single rye type grain was identified in a Middle Iron Age sample from Sigwells. Rye grain in combination with distinctive rye rachis internodes does not occur until the Late Iron Age at this site. Rye is present in 9 out of a total of 16 Romano-British samples with a particularly high number in the extremely rich, lone sample from Nine Acres (Locality 1). Even here rye makes up only a very small proportion of the potential crop element suggesting it might be present as a weed in these particular samples rather than a crop in its own right.

5.1.2 Pulses: Celtic/horse/field bean (*Vicia faba* L.) and pea (*Pisum sativum* L.)

Although pulses are part of the Old World 'founder crop' suite found in the Near East and central Europe, in Britain (and much of northwestern Europe) they are rarely identified in early agricultural periods (Fairbairn 2000). Secure identifications of pulse crops, both Celtic/horse/field bean (*Vicia faba* L., here after referred to as Celtic bean) and pea (*Pisum sativum* L.), appear in the SCEP samples from the Middle Iron Age onwards. The processing requirements of pulses means they are less likely to come into contact with fire than cereals, reducing their potential for preservation and archaeological recovery.

5.1.3 Fibre/oil crop: flax (*Linum* cf. *usitatissimum* L.)

Although flax too is one of the founder crops that spread into Europe, flax identifications are rare in the southern region of Britain before the Middle Bronze Age (Helbaek 1952, Greig 1991, Campbell & Staker 2003). Finds of Neolithic flax have increased in the south but are still less numerous than those from northern Britain and Ireland (Hastie 2011). One of the Milsoms Corner Early Neolithic pit samples provided two seeds identified as flax. However, preservation was poor and there is a possibility that they represent a wild species, such as *Linum bienne* Mill.or the much smaller seeded *L. catharticum* L. In most cases the flax seeds in the SCEP assemblage occurred in low numbers, for example in five Middle Bronze Age samples from the Sigwells Bronze Age metal working camp (SGBA). The only concentration of flax comes from a Middle to Late Bronze Age sample (SG19/096) from which seeds were directly dated to 1193-848 cal BC. From the Central locality two Late Bronze Age contexts also yielded flax seeds and a single Sigwells Romano-British sample contained four seeds. Generally it is expected that oil rich seeds such as flax will be poorly preserved by charring which suggests they are likely to be underrepresented compared to cereals. The presence of flax seeds is often thought to be indicative of gathering/cultivation of the seeds for consumption or the production of oil, as the harvesting of plants for fibres often occurs before the seeds mature and the retting/processing involves no drying of the plant, reducing opportunities for the seeds to become charred (Hastie 2011, Herbig & Maier 2011, Karg 2011).

5.1.4 Cereal culms

The presence and number of large culm (straw) nodes and basal culm nodes which are probably derived from cereal straw are included in tables 5.1-5.3. Identification was based on size alone and no attempt was made to take identification further. Particularly high occurrences of both large culm nodes (≥2mm) and the basal culms nodes were noted at Late Iron Age Sigwells. However this is one of the periods with the most samples available for study. There were fewer culm nodes in the Late Iron Age at Central or Sheepslait, although these samples (particularly one Sheepslait sample) do contain very slightly higher numbers compared to the other periods. The Later Sigwells samples also contain higher numbers of non-node culm fragments and tuberous material (see shaded sections in the appendix). Overall culm nodes are present in samples across most time periods and localities but generally in very low numbers. They appear to be a little more common in later periods. As might be expected, based on the numbers found in the plant, basal culms nodes are less numerous and a little less ubiquitous.

5.1.5 Wild plant remains

5.1.5.1 Weeds?

The most common wild seed types from the SCEP samples include grasses (particularly *Bromus* L. spp.); legumes (including *Vicia* L./*Lathyrus* L. spp. as well as smaller types such as *Trifolium* spp.); various achenes of Polygonaceae (particularly *Rumex* L. spp., docks, and *Fallopia convolvulus* (L.) Á. Löve, black bindweed; bedstraws, (*Galium* L. spp); along with Chenopodiaceae (*Chenopodium* L. spp. and *Atriplex* L. spp.). Following studies such as that of van der Veen (1992, table 6.4), and summaries in Grime et al (2007) and Fitter & Peat (1994), many of the wild species recovered from the SCEP samples have arable fields as one of their principal habitats, or are associated with disturbed ground. A small number of species are not commonly found in arable fields today. Many are plants of damp ground such as *Carex* L. spp., *Juncus* L. spp., *Eleocharis* L. sp. and some *Ranunculus* L. spp., chiefly *flammula*. Although present, these types are not particularly common within the SCEP samples but have been found in a number of other British crop assemblages, while *Carex* L. spp. *and Eleocharis* L. sp. were found within the Romano-British granary deposits at South Shields, associated with the stored crops (van der Veen 1992). These species may indicate poor drainage or may simply have grown in ditches and hollows alongside the crop. Species now more closely associated with perennial grassland may have thrived at the field margins or within the crop due to the lack of mouldboard ploughing (Hillman 1981). Other sources of these species, apart from arable fields, cannot be completely excluded. Some plant remains may have been subject to burning after being collected as fodder, brought to site by animals in dung, attached to the coats of animals, or human clothing, brought onto site as building material such as thatch and floor coverings, or simply grew on site.

Large seeded grasses, for example *Bromus* L. spp., are sometimes cited as a 'famine food' (M. Jones 1981). The distinction between crop, weed, and indeed waste, may be seen as a modern western concept (Campbell 2000a). There is potential for many weed species to have been intentionally harvested or simply retained with crops through less thorough grain cleaning in order to supplement both animal and human consumption. Behre (2008) identified intentionally collected plant remains from Northern European prehistoric and medieval sites, and the stomach contents of bog bodies, such as *Polygonum lapathifolium* (L.) Delarbre., *Chenopodium album* L, *Fallopia convolvulus* (L.) Á. Löve , *Bromus secalinus* L. and *Rumex acetosella* Raf., and suggested that they were regular parts of the human diet. They could be easily gathered, as their seed production was high and their growth, habitat and size ensured that they could be harvested in the same way as crops. Another advantage of these species is their thick seed coats which aids storage. Many other weed and wild species were probably used in times of dietary stress.

- Other potentially wild species such as poppy (*Papaver* L. sp.) have a range of culinary and medicinal uses but were not found in any particular concentrations nor was the cultivar positively identified. It is possible that species of the family Brassicaceae may represent oil crops, such as mustard, or leafy vegetables. Identification of *Brassica* L. spp. seeds is difficult especially when the seed coat is damaged through charring (Campbell 2000a). In view of this it was not possible to identify further most of the seeds within this group. The distinctive fragments of the wild radish seed pod (*Raphanus raphanistrum* L.), a frequently occurring archaeophyte, and arable weed (Stace 2010), which can also be cultivated, was found in 11 samples from the Middle Iron Age onwards. Except for unusual concentrations from the Sigwells pit scatter (SGW13/263 (28), and 14/032 (78)), numbers of *Brassica* L. spp. seeds were generally low.

Most carbonised plant remains recovered archaeologically tend to be the relatively dense parts such as seeds and grains. Without the conditions for waterlogging or desiccation, fleshy and fragile vegetative parts such as leaves, roots and stalks, frequently used as culinary elements, tend to be poorly and rarely preserved (Dennell 1976b:231, van der Veen 2007). Along with the requirement of exposure to fire, either accidentally or through waste disposal, this highlights the wide range of plant resources not visible in the carbonised record.

5.1.5.2 Fruits and nuts

A few taxa, including the woody perennials, can be excluded as potential weeds on ecological grounds. There is only limited evidence for these wild ‘hedgerow’ plants, which may have been collected to supplement the diet. The most ubiquitous and numerous is hazel nutshell (*Corylus avellana* L.). Nutshell is included as a category in the summary tables (5.1-5.3). At least a few fragments are present across all localities and in the majority of periods. Quantities of nutshell were recovered from the Early Neolithic pit samples, in such numbers that it was decided to weigh the material from some samples rather than counting the fragments. The largest concentration of nutshell (MC/1889) weighed 173g making up the vast majority of the flot with much smaller proportions of charcoal and seeds. Beyond this period there is no particular pattern to the presence of nutshell other than low occurrences where reduced numbers of samples were studied.

Both the seeds and flesh of a fruit, probably crab apple (cf. *Malus sylvestris* L.), were recovered from Sigwells Middle Bronze Age contexts along with a single identification of probable bramble (*Rubus* L. sp.) (SG10/054). Elderberry seeds (cf. *Sambucus nigra* L.) were represented in four samples all from the Middle Iron Age or later. A fruit stone, probably sloe (*Prunus spinosa* L.) was found in the Middle Iron Age Pit fill, Sheepslait SS/248. Other relatively large seeds, thought to represent a Rosaceae species, were found in two other similarly dated Sheepslait contexts and a Romano-British sample from Castle Farm. It was not possible to take their identification further. As the sorted material represents only the light fraction (see methods 4.1.2), more fruit stones and other dense items may be present in the heavy fractions of the samples. However, a brief examination, without magnification, of some of the heavy fractions from the Sigwells West pits revealed no obvious items.

5.2 Density calculations

Table 5.4 collates sample information on the volume of material floated and the number of charred items (seed, chaff and wood charcoal) recovered, of various types, in the samples. This is used to make calculations of their density per litre of soil. The density of charred plant remains is often used to infer the 'intensity' of plant-related activities involving fire (Miller 1988). Buurman (1993) suggests that samples with high densities are likely to represent samples with a distinct composition while those with only low density are likely to represent settlement noise, the scattered waste from a wide variety of sources that collected in features by chance in chance combinations. This may mean that they are representative of the everyday, repeated actions. Even samples of greater than 100 items, depending on the size of the content, may represent just a teaspoon of material in a litre of soil matrix (M. Jones 1995).

5.2.1 Density of seed and chaff items

Where values were available, only four samples contained charred seed items (grain, chaff and weed/wild seeds) in densities of greater than 100 items per litre of processed soil. A Middle Iron Age Pit fill sample SS/285 contained 208 items per litre, the original sample being just 1.7 litres; Middle to Late Iron Age pit fill SG13/263 (104 items per litre, 66 litres) and the Romano-British ash deposit NA/007 (168 per litre, 17 litres). These samples are all made up of high numbers of chaff items, particularly glume bases. The exception is the sample with the highest density in the study, the Romano-British sample LF3/014 (479 items per litre) which is dominated by grain; the original sample was just 0.9 litres. The concentration of charred material can be seen in section photographs and drawings from the SCEP archive. Only a further twelve samples had densities greater than 50 items per litre: four Middle to late Iron Age samples from the Moor; one of the Romano-British midden deposits from Castle Farm; a Middle Bronze Age sample from trench 16; three Late Iron Age samples from the Sigwells South trenches (21-23); the two Romano-British Sigwells samples and a Late Iron Age sample from a floor levelling deposit at Sheepslait. The mean density of charred seed items in the SCEP assemblage is 20 items per litre but only 42 of the SCEP samples had densities equal to or greater than 20 items per litre. The median value is much lower at 9 items per litre; in fact 61 of the samples contained less than 5 items per litre. Most of these very low densities relate to samples from the earlier periods, Early Neolithic to Early Iron Age. However, this is likely to be a result of the lower numbers of samples available. Samples with low numbers of items, which would probably have provided low density values, were available from the later periods (Middle Iron Age onwards) but, as there were many more samples to choose from at the assessment stage, these tended to not to be selected for sorting except where there were questions related to dating or site coverage.

The use of bulk soil samples means that some of the charred material may have originally been present in concentrations especially in thin layers and small pockets, like LF3/14, but have become ‘diluted’. Nevertheless, based solely on the density values, none of the SCEP samples represent discrete stored crops (Dennell 1976b) and therefore some level of mixture is expected across the assemblage.

5.2.2 Comparing seed and wood charcoal density within the samples

Comparing the wood charcoal densities with the seed/chaff densities (table 5.4, figure 5.1 using log scales) of the samples, there appears to be little or no linear relationship between the density of charred seed/chaff items and the weight of 4 and 2mm charcoal fragments. A very low Spearman rank-order correlation of 0.068 was calculated from the data. The lack of a strong positive correlation indicates that the levels of crop/weed items represented in units are not dependent on the amount of wood or *vice versa*.

5.3 Crop Processing

The following analyses are based on only those samples containing 50 or more cereal crop items.

5.3.1 Percentages of principal crop components

On the basis of relative abundance of crop components, using an arbitrary 70% cut-off to highlight the main crop component, the SCEP samples split into three groups: samples rich in glume wheat glume bases; samples rich in grain and mixed samples (table 5.5) as follows.

- **Products**: represented by 2 samples containing 70% or more barley grain (SG12/174, MC1336), 1 sample containing more than 70% free threshing wheat grain (LF3/16) and 1 sample containing more than 70% flax seed (SG19/096).

- **By-products**: 27 samples containing 70% or more glume wheat glume bases.
- **Mixed**: 68 samples of mixed composition, containing less than 70% of any individual crop component.

Middle Bronze, Late Bronze/Early Iron Age and Romano-British samples are roughly evenly split between samples dominated by one type of cereal item (≥70%) and mixed samples. From the best represented period, the Middle Iron Age, 20 samples are mixed, while eight are dominated by glume wheat glume bases making up 28% of the Middle Iron Age cereal-rich samples. Despite the Late Iron Age being the second best represented period, only one Late Iron Age cereal-rich sample (HG1/008) is made up of at least 70% glume wheat glume bases. All 12 Late Iron Age Samples from Sigwells (Locality 3) and three Sheepslait (Locality 4) samples fall in the mixed group. Even when glume bases and grains are taken together, the Late Iron Age has a greater proportion of mixed samples than the other periods. This is largely due to the samples from Sigwells, where a there is also a high proportion of mixed samples in the Middle Iron Age.

5.3.2 Ratios of the principal crop components

For glume wheats the expected ratio of glume bases to grains in whole ears is c.1.00 (two grains and two glume bases in each spikelet). The ratio of glume wheat glume bases to glume wheat grains was calculated for 96 samples (see method 4.8.2). The vast majority, 88 samples, have a ratio of one or greater (table 5.5) pointing towards the presence of fine-sieve by-products, which is the processing stage at which most glume wheat glume bases are separated from the grain. 46 of these ratios are greater than five. Of the eight samples providing a ratio of less than 1.00, sample SG12/174 (ratio 0.62) was dominated by barley grain. The remaining seven samples, SG23/034 (0.75), SG13/265 (0.20), MC/1361 (0.63), SG12/261 (0.54), SG12/165 (0.27), MC/1319 (0.22), and SG14/003 (0.36) are all from the mixed category.

For the free threshing wheat the expected ratio of rachis internodes to grains is c.0.25-0.33 (4 grains per spikelet). The ratio of free threshing wheat rachis internodes to grains was calculated for 29 samples. 24 of these contained only grain, four produced ratios well below 0.10 (0.01-0.07), all suggestive of grain from the later processing stages. One sample (LF/013) gave a ratio of 0.38, possibly representing an unprocessed crop. The higher ratio of rachis could also be representative of the by-products of the early stages of processing, winnowing or coarse sieving, where the rachis are underrepresented due to differential preservation. Referring back to the results of the principal crop component analysis, this sample was regarded as mixed, but when looking at both chaff and grain numbers the sample is made up of 87% free threshing wheat.

For barley, the expected ratio of rachis internodes to grains is c.0.33-0.5, depending on whether it is 6-row or 2-row barley. The ratio of barley rachis internodes to grains was calculated for 89 samples. In 39 of these only grain was identified. 43 of the 89 samples provided ratios less than 0.20, suggesting a partially processed crop. Of those samples with a ratio greater than 0.33 sample SS/188 (0.22) contained too few barley items to give a reliable ratio. Four samples, all from The Moor, with larger numbers of barley items, gave ratios between 0.20-0.31. Of these, MO1/14 (0.30) was previously identified as mixed, while MO1/021 (0.31), MO1/022 (0.26) and MO1/023 (0.20) were dominated by at least 70% glume wheat glume bases. The potentially poorer preservation of rachis fragments could mean that the barley items from these samples, and possibly others with lower ratios, may still represent unprocessed crop. The only sample with a markedly higher proportion of rachis internodes to grains was the Early Bronze Age linear ditch sample, SG16/020, with a ratio of 2.70. This suggests that the sample represents an early processing by-product. It was classified as mixed by the principal crop percentages because it is a mixture of barley rachis and grains but together these make up 90% of the sample.

For rye, the expected ratio of rachis internodes to grains is c.0.50. Ratios were calculated for rye in four samples. In all cases rachis internodes outnumbered grains. The lowest ratio was 2.33 in sample LF3/014, already highlighted as possibly including unprocessed free threshing wheat. In all four samples, rye was only a very small component of the sample. Even in sample NA/007, where rye was represented by 17 grains and 96 rachis internodes (ratio of 5.65), rye still fails to reach 4% of the total crop.

Calculating ratios for each crop type has highlighted a few samples likely to represent unprocessed crop or by-products from early stages of crop processing. However, many samples are a mixture of glume wheat dominated by chaff, and free threshing cereals represented by grain. This is not really surprising as the rachis of free threshing cereals is usually removed early in the processing sequence, while the removal of glume wheat glume bases requires an additional dehusking stage which can be carried out at a later time (Hillman 1984). Therefore, the majority of crop-rich samples derive from the later stages of crop processing.

5.3.3 Physical characteristics of the weed seeds

G. Jones' (1983, 1984) method for identifying crop processing stages using the accompanying weed species complements the assessments made above. This method relies on comparing the physical characteristics weed seeds found in archaeological samples with those from ethnographic samples collected from known crop processing stages (see methods 4.8.3)

Only those SCEP samples with at least 10 weed seeds were included in this analysis, reducing the number of samples to 87. Weed species within these samples were classified according to their 'size', 'headedness' and 'aerodynamic properties' and grouped according to these characteristics (table 5.6). Discriminant analysis was then used to compare the weeds from the archaeological samples with those from the ethnographic samples in terms of these characteristics. The results of this analysis are presented in table 5.5 and figure 5.2. These indicate that the SCEP samples derive from the later crop processing stages with, in most cases, a high probability (<0.90). 60 of the 87 samples were classified as fine sieve by-products while 27 samples were classified as cleaned products.

The discriminant analysis also provides a secondary classification. For the majority of samples those originally classified as fine sieve by-product gave a secondary result of cleaned product and those classified as cleaned product a secondary result of fine sieved by-product. Nine of the 87 samples would be classified as winnowing by-product but at a low probability (<0.03). These results reinforce the suggestion that the vast majority of the SCEP samples represent the later stages of crop processing while the by-products of earlier processing stages (winnowing and coarse sieving) are largely unrepresented.

The ethnographical samples were collected from free threshing wheat and barley, whereas the SCEP samples contain both free threshing cereals and glume wheats. Some researchers suggest that in the processing of glume wheat spikelets small, headed, heavy weeds may be retained longer with the crop in the processing sequence. The action of pounding breaks up the heads into component parts effectively creating seeds which appear to behave as small, heavy and free weeds (Charles 1989: 176, Hald 2008: 64). Nevertheless, within the SCEP samples, the number of taxa classified as having small, headed and heavy seeds is generally low suggesting this is not a significant issue for the samples considered here.

A number of the SCEP samples lay within an area of overlap between fine-sieve products and by-products. Both G. Jones (1983) and van der Veen (1992: 86) point out that differentiating between the two groups may be difficult as it depends on how thoroughly the sieving was carried out and mesh size of sieves used. Samples in the overlap zone may also represent crops that have not yet been (fine) sieved.

Of the samples with more than 30 weed seeds, only two of those classified as fine-sieve products fall securely within the ethnographic spread of fine sieve products. One of these, LF3/14, has already been highlighted as a free threshing wheat grain product on the basis of the principal crop percentages. The second sample, MC/1278, is one of the samples identified on the basis of the principal crop percentages as a likely fine-sieve by-product, containing 77% glume wheat glume bases, the rest of the crop component being barley grain. It is therefore likely that the weeds in MC/1278 derive from the cleaned barley crop in this partially mixed sample, so it was excluded from the weed analysis of glume wheat by-products. Although the proportion of barley grain is high in this sample, it is not dissimilar to other samples with more than 70% glume bases, but the weed seeds in these other samples apparently derive primarily from the by-products as they were classified as such by the weed analysis.

Of the samples containing greater than 70% of one type of cereal grain, two (MC/1336, 74% barley grain and LF3/16, 88% free threshing wheat grain) were not included in the weed analysis as they contained fewer than ten weed seeds. This fits well with the samples representing cleaned crop products. Sample SG12/174 (82% barley grain), however, was classified with high probability amongst the fine sieve by-products by the weed analysis, the second most probable classification being as a winnowing by-product.

Of the 27 samples with 70% or more glume wheat glume bases, the discriminant analysis classified 18 as fine sieve by-products. One, MC/1413, contained fewer than ten weed seeds. Eight samples (MC/1278, MC/1429, MO1/021, MO1/022, MO1/23, MO2/17, SG12/238, and SS/285) are classified as fine-sieve products. However, nearly all these samples fall outside the region of the plot securely associated with the ethnographically collected samples, making their classification unreliable. On the basis of the high percentage of glume wheat glume bases, samples MC/1429, MO1/021, MO1/022, MO1/23, MO2/17, SG12/238 and SS/285 were treated as fine sieve by-products.

With the exception of the ambiguously classified MC/1278 and MC/1413, 25 glume wheat fine-sieve by-product samples were used for weed analysis to investigate cultivation practices. There were too few crop processing products samples to be analysed in the same way, and samples of mixed processing stage, or mixed crop composition, would have mixed weed assemblages making them unsuitable for further weed analysis.

5.4 Crop compositional analysis

In the following analyses all plots show correspondence axis 1, plotted horizontally, and axis 2 plotted vertically unless otherwise stated. The codes used for the crop items in correspondence analyses are given in table 5.7

All 98 samples containing 50 or more crop items (excluding culms and culm nodes) were plotted using correspondence analysis. In a plot of axis 1 against axis 2 (figure 5.3a), the majority of species and samples cluster tightly at the origin of the plot. Sample SG19/096 is located at the extreme positive (left) end of the first axis in a similar position to flax. This is because the Middle Bronze Age SG19/096 is the only sample where flax was identified as the dominant crop. Two Romano-British samples LF3/014 and to a lesser extent LF3/016 also plot away from the main group, towards the positive (top) end of the second axis in the same direction as free threshing wheat rachis internodes and grains which predominate in these samples. The free threshing wheat grain predominates in both samples, and rachis, although rare in both of these samples, is virtually absent from all other samples. In order to observe variation in the remaining samples these three samples were removed from the further crop correspondence analyses.

In the resulting plot (figure 5.3b), the samples remained tightly clustered around the origin except for sample SG16/020 which is separated off at the positive end of both axes (right and top) in the same direction as barley rachis internodes which predominate in the sample. SG16/020 was also removed from further analyses which use the remaining 94 samples.

5.4.1 All Localities

After removing the extreme outliers the data points in the plot are more widely distributed. In order to display the plots more clearly, the analysis is presented as four figures showing: crop items and samples as separate plots of axis 1 against axis 2 (figure 5.4); separate crop item and sample plots of for axis 1 plotted against axis 3 (figure 5.5), both axis combinations with sample points represented by pie charts showing the proportions of crop items (figure 5.6); separate plots of the samples coded by locality and archaeological period (figure 5.7).

Samples dominated by cereal grains (especially barley and glume wheat) tend to be positioned towards the positive (right) end of the first axis, while samples dominated by chaff (especially spelt glume bases) are positioned towards the negative (left) end (figure 5.4 and 5.6a). Therefore this axis appears to be a reflection of crop processing stage. Samples dominated by spelt glume bases are located towards the negative (bottom) end of axis 2, and those dominated by emmer glume bases towards the positive (top) end of the same axis (figure 5.4 and 5.6a). Samples with a significant proportion of free threshing wheat grains are also located towards the positive end of axis 2. Samples dominated by free threshing wheat are located towards the positive (top) end of the third axis and emmer glume bases towards the negative (bottom) end of axis 3 (figure 5.5 and 5.6b).

When the samples are coded according to their site locality (figure 5.7a) samples from Sigwells (Locality 3) tend to be located in the bottom right quadrant of the plot, i.e. towards the positive end of axis 1 and the negative end of axis 2. In contrast there is a tendency for samples from the Central Group of sites (Locality 2) to be positioned towards the positive (top) end of the second axis. The third biggest group of samples, Sheepslait (Locality 4) plot across the two groups but are not found towards the extreme positive (top) end of the second axis. The lone, exceptionally large sample representing the Clay Area (Locality 1), NA/007, is located towards the negative end of both axes. This sample, as well as containing very high numbers of spelt glume bases, also contains the only significant amount of rye grain and chaff drawing these crop components towards the extreme negative ends of both axes.

In broad terms this indicates that Sigwells samples form a continuum from those dominated by spelt glume bases and those containing predominantly cereal grains(barley and to a lesser extent glume wheat). Samples from the Central area generally contain a greater proportion of emmer glume bases and, in some samples, free threshing wheat grains. The Sheepslait samples are of varying crop composition.

When the samples are coded by archaeological period (figure 5.7b) the three Early and Middle Bronze Age samples plot in the upper right quadrant, towards the positive end of both axes, due to their composition of emmer chaff and/or barley grain. The Late Bronze Age/Early Iron Age samples are distributed across the remaining three quadrants due to their higher spelt chaff or barley grain content. The Middle Iron Age samples are more evenly distributed throughout the plot. The securely dated Late Iron Age samples are located in the bottom right quadrant (towards the positive end of axis 1 and the negative end of axis 2), rich in spelt glume bases and/or cereal grain. Samples from Homeground, Central area (Locality 2), group together towards the positive (top) end of axis 2 (with some of the other samples from the Central area) due to the higher instances of both emmer glume bases and free threshing wheat. The Homeground samples were originally dated to the late and very late Iron Age but some samples have since returned much later radiocarbon dates particularly from well preserved free threshing type wheat grains (table 3.3, 3.13). The Romano-British and Saxon samples are located towards the negative ends of both axes (bottom left quadrant), indicating higher proportions of spelt glume bases. It should be noted, however, that two Romano-British samples (LF3/14 and LF3/16), identified as outliers in figure 5.3a were both rich in free threshing wheat grain.

At this level it is difficult to distinguish clearly the distribution in the plot relating to chronological period from that relating to location. To assist interpretation the samples were divided into two groups relating to location: those from the Central 'lowland' sites surrounding the perimeter of the hillfort (Locality 2) and those from the 'upland' localities of Sigwells (Locality 3) and Sheepslait (Locality 4).

5.4.2 Central area (Locality 2)

When samples from the Central area (Locality 2) are analysed separately, emmer glume bases plot towards the positive (right) end of axis one and spelt glume bases towards to the negative (left) end (figure 5.8 & 5.10a). Rye grains, rachis internodes, and free threshing wheat rachis internodes, plot towards the extreme negative (left) end of axis 1 but are rare. The barley and glume wheat grains (along with other but rarer cereal and pulse grains: Celtic bean, pea and to a lesser extent oat and rye) are positioned towards the positive (top) end of the second axis, while samples dominated by glume wheat glume bases (with rare occurrences of free threshing rachis internodes) are positioned towards the negative (bottom) end of the axis. The second axis generally appears to reflect crop processing except that free threshing wheat grain is located at the negative (bottom) end of this axis. When the third axis is plotted (figure 5.9, 5.10b) free threshing wheat grain is located at the positive (top) end of this axis.

When the samples are coded according to site (figure 5.11a), the most noticeable feature is the separation of the two larger sites, The Moor and Homeground. Samples from The Moor plot largely towards the positive (top) end of the second axis while those from Homeground plot towards the negative (bottom) end of the same axis. This indicates that samples from The Moor contain a greater proportion of grain while Homeground samples contain more glume wheat glume bases. The three samples from Castle Farm plot towards the negative end of the first axis (left) because of the predominance of spelt glume bases in these samples. The two samples from Crissells Green both plot towards the positive (right) end of the first axis due to the high proportion of emmer glume bases in both samples. Three of the Milsoms Corner samples plot in the lower left quadrant towards the negative end of both axes as they are dominated by spelt glumes bases. The other three samples from Milsoms Corner plot at the positive (top) end of the second axis, and are dominated by barley and glume wheat grains.

When the samples are coded according to archaeological period (figure 5.11b) the samples with problematic dates (the only samples to cover the Late Iron Age) group towards the negative (bottom) end of the second axis, due to the significant quantities of emmer glume bases in these samples. The Middle Iron Age samples from The Moor and Milsoms Corner largely plot towards the negative (left) end of the first axis being dominated by spelt glume bases. Romano-British samples show little grouping. The Early/Middle Bronze Age samples from Crissells Green plot towards the positive end of the first axis, due to the predominance of emmer glume bases. The Middle Iron Age samples from The Moor, and Early to Middle Bronze Age samples from Crissells Green and Homeground, make up most of those of questionable date. Overall the crop composition of samples shows no observable time trend. Crop composition appears to relate more to the site (figure 5.11a) than to chronological period (figure 5.11b).

When the samples are coded according to depositional context (figure 5.12), it appears that crop composition is again more closely related to site than to context. Although samples from house floors, and especially gullies, tend to be located towards the positive (right) end of axis 1 and the negative (bottom) end of axis 2, all except one of these samples are from Homeground. Similarly the three postholes samples plotting at the positive end of axis 2 are all from Milsoms Corner.

5.4.3 Upland area, Sigwells (Locality 3) and Sheepslait (Locality 4)

When samples from Sigwells and Sheepslait (Localities 3 & 4) are analysed as a group, the grains of barley and glume wheat (as well as rye, oat, pea and Celtic bean) plot towards the positive (right) end of axis 1 and glume wheat glume bases towards to the negative (left) end (figure 5.13 & 5.14). This reflects crop processing. The second axis is dominated by a few samples containing free threshing wheat grain at the positive (top) end and rare occurrences of free threshing rachis (barley and rye) and flax at the negative (bottom) end. Among the glume wheat glume bases, emmer is located in the top left quadrant, towards the negative end of the first axis and the positive end of the second axis.
There appears to be little or no compositional difference between the two localities or between the individual sites within Sigwells and Sheepslait (figure 5.15a). When samples are coded by period (figure 5.15b) samples from the Late Iron Age tend to be grain rich, towards the positive (right) end of the first axis. Samples from the Late Bronze Age/Early Iron Age are rich in glume wheat glume bases plotting towards the negative (left) end of the first axis, and samples from

the Romano-British period, particularly those richer in spelt glume bases, plot towards the negative (bottom) end of the second axis. Samples coded by context type (figure 5.16) show little discernible patterning. The vast majority of the Sigwells/Sheepslait (Locality 3/4) samples come from pit fills. This contrasts with the Central area (Locality 2) where floor and ditch contexts are more prevalent.

5.5 Compositional analysis of weed species from glume wheat fine-sieving by-product samples

Following the crop processing analysis (section 5.3 above), 26 samples were identified as likely to have derived principally from the same type of crop processing, by-products, from the fine-sieving of glume wheats. The weed/wild components of these samples were analysed using correspondence analysis to identify differences in the growing conditions of glume wheats from the South Cadbury Environs. Weed taxa present in fewer than three samples (10%) were excluded from the analysis, as was one sample (MC/1413) with only 3 weed seeds, leaving 25 samples.

The codes used for the wild/weed taxa in the analyses are given in table 5.8. In a plot of axis 1 against axis 2 (figure 5.17) sample CG/020 is separated towards the positive (top) end of the second axis in the same direction as *Chenopodium rubrum/glaucum*, as well as the indeterminate categories, Brassicacea, *Persicaria* spp. and Lamiaceae. These taxa are not particularly rare, but they are found in slightly higher numbers in sample CG/020 than in other samples. The removal of the indeterminate Lamiaceae category resulted in a plot where CG/020 and other samples remained in similar positions but CG/020 was no longer an extreme outlier making the rest of the plot more readable (figure 5.18). Correspondence analysis plots of samples were also coded by locality (figure 5.19a), site (figure 5.19b), period (figure 5.20a) and context type (figure 5.20b).

5.5.1 Location/period/context

In the plots coded by locality (figure 5.19a) and site (figure 5.19b), the most noticeable grouping is the positioning of the seven Sheepslait (Locality 4) samples in the top left quadrant (towards the negative end of axis 1 and positive end of axis 2). The single sample from Nine Acres (Locality 1) plots towards the positive (right) end of axis 1. The majority of the samples from the Central group of sites (Locality 2) plot towards the negative (bottom) end of axis 2 (figure 19a), except that CG/020 is located towards the positive (top) end of this axis (figure 5.18b). The four samples from Sigwells (Locality 3), all plot with the samples from the Central area (Locality 2) towards the negative (bottom) end of the second axis. However, three samples from the Sigwells West (SGW) pit scatter plot together towards the negative (left) end of the first axis whereas the Roman building from Trench 7 (SGRB) is located towards the positive (right) end of the same axis (figure 5.19b).

When the samples are coded by period (figure 5.20a) the earliest samples, Middle Bronze Age CG/020 and three Late Bronze to Early Iron Age samples from Sheepslait, plot in the upper left quadrant (towards the negative end of axis 1 and positive end of axis 2). Samples from the Middle Iron Age are found across the plot but are absent from towards the positive (right) end of axis 1. The Late Iron Age, problematic samples from Homeground, and Romano British samples plot towards the negative (bottom) end of axis 2. Samples of Later Iron Age or uncertain date also tend to be located towards the positive (right) end of axis 1. There seems therefore to be a slight temporal trend from the top to bottom and left to right of the plot. However, with so few samples, it is difficult to separate the effect of chronological period from that of location. Coding samples by context (figure 5.20b) reveals little discernible patterning.

5.5.2 Crop weed ecology

To interpret the correspondence analysis of the weed taxa from glume wheat fine-sieving by-products, a range of ecological information, relating to the growth habit and preferred habitat of the weeds was collected from published sources.

This information was used to code the taxa in the correspondence analysis. First, weed species were classified according to their habitat preference or, for species that could not be assigned to a particular habitat, by their taxonomic group. The correspondence analysis was further explored through the classification of weed species according to their preferred soil pH, life history and flowering period. The proportion of *Avena* L. sp. to *Bromus* L. ssp. was also calculated following Campbell (2000a). Codes used for the weed taxa in the correspondence analysis are listed in table 5.8.

5.5.2.1 Habitat and taxonomic groups

The habitat preferences of wild/weed taxa were taken from Floras (Clapham et al 1989, Cope & Gray 2009, Fitter & Peat 1994, Hanf 1984, Stace 2010) and *Comparative Plant Ecology* (Grime et al 2007) (table 5.9). Only one habitat group, arable/ruderal, was well represented, and many of the species in this group can be found in both arable and ruderal habitats. Taxa associated with grassland habitats (e.g. *Ranunculus* L. sp. and *Plantago lanceolata* L.) and wet habitats (e.g. *Montia fontana* L.) were represented by few seeds and have been included in the 'not classified' category in correspondence analysis plots. Large taxonomic groups which could not be assigned to a preferred habitat were classified separately in the correspondence analysis plots. For example, *Galium* spp. (bedstraws, here mainly *Galium aparine* L.) are frequent crop weeds but also grow in other habitats (Grime et al 2007). Other taxonomic groups, not identified to species or genus were also classified separately. Grass seeds were split into three size categories: large, medium and small, and legumes into large-seeded *Vicia/Lathyrus* spp. and small-seeded legumes. Taxonomic groups represented by few seeds were included in the 'not classified' category.

A correspondence analysis plot of samples, showing the proportions of these habitat/taxonomic groups (figure 5.21), indicates that the highest proportions of arable/ruderal taxa are found in a group of samples from Sheepslait and the single sample from Crissells Green, located towards the negative (left) end of the first axis and the positive (top) end of the second axis. Samples with the highest proportions of *Galium* spp. tend to be located in the same area of the plot. Samples with a high proportion grasses are located in the lower half of the plot, towards the negative (bottom) end of the second axis, the area associated with samples from the Central area (Locality 2; Milsoms corner, Homeground and The Moor) and Sigwells (Locality 3). Within this group, samples with a greater proportion of large grasses (mostly *Bromus* L. spp., especially *Bromus hordeaceus* L./*secalinus* L.) plot towards the negative (left) end of axis 1. These species are commonly associated with winter cereals (Hanf 1983). Medium-sized grasses (primarily *Lolium* L. sp.) tend to be associated with samples towards the positive (right) end of axis 1 The 'small grasses' are found in samples across the plot but in slightly higher proportions in samples towards the negative (bottom) of axis 2. There is a tendency for *Vicia* L./*Lathyrus* L. spp. to be found in samples towards the positive (right) end of axis 1, and for small-seeded legumes (e.g. *Trifolium* L. sp. and *Medicago* L. sp.) to occur in samples towards the negative (left) end of the same axis.

Overall, the first axis appears to separate those glume wheat fine sieving by-product samples containing a high proportions of the large grass seeds from those with significant amounts of medium grass seeds, while the second axis differentiates the grass-dominated samples from those with 'classic' arable/ruderal weeds.

5.5.2.2 Soil pH

Weed taxa were classified according to median soil pH, after Grime et al. (2007) (table 5.10). Samples with a higher proportion of taxa associated with neutral soils (median pH 7) were prevalent towards the positive (top) end of the second axis and negative (left) end the first axis (figure 5.22), the area of the plot associated with Sheepslait and the sample from Crissells Green, There is also a slight tendency for samples with the highest proportions of taxa associated with acid soils (median pH 6-6.5) to be located towards the negative (bottom) end of axis 2.

5.5.2.3 Life history

Weed taxa were classified according to their life history, as annuals (summer or winter) or perennials (table 5.11). The vast majority of weeds are annuals. Samples from Sheepslait, towards the positive (top) end of axis 2 and the negative (left) end of axis 1, contain the highest proportions of summer annuals, whereas samples from the Central/Sigwells area, towards the negative (bottom) end of axis 2, have greater proportions of winter annuals and a few perennial species (figure 5.23). Winter annuals geminate in autumn and, in an autumn-sown crop, are well established by the spring so able to compete well with the spring-germinating summer annual weeds. In a spring-sown crop, ploughing prior to sowing destroys most of the overwintering annuals, favouring the summer annuals which germinate after the ploughing and are able to grow with little competition. The differences in the distribution of summer and winter annuals may therefore reflect differences in glume wheat sowing time between the Sheepslait and Central/Sigwells areas.

The percentage of summer annuals (figure 5.23) in the Crissells Green and Sheepslait samples could also be associated with high levels of disturbance due to hoeing or weeding unrelated to sowing, while the presence of perennials in some of the Central and Sigwells samples may indicate lower levels of soil disturbance (Ellis & Russell 1984, G. Jones 2002, Légère & Samson 2004). Modern field experiments also suggest that annual grasses, such as those associated with the Central and Sigwells samples, are favoured by reduced cultivation disturbance (Légère & Samson 2004). Some of the taxa (such as *Chenopodium rubrum* L./*glaucum* L.), towards the positive (top) end of the second axis (figure 5.18a), are also associated with nutrient-rich soils (Clapham et al 1989, Hill et al 1999, Grime et al 2007), while nitrogen-fixing leguminous species (such as *Vicia/Lathyrus* spp.) tend to be slightly more common towards the negative (bottom) end of the second axis (figure 5.21).

5.5.2.4 Flowering onset and length of the flowering period

The time of flowering onset and length of the flowering period has also proved successful in distinguishing autumn and spring-sown crops (Bogaard et al 2001, Bogaard 2004). Weeds species flowering late in the year or with a long period of flowering are indicative of a spring sown crop, while those that flower early for an intermediate or short period are more likely to occur in autumn-sown crops. Following Bogaard et al (2001), the weed species were classified according to their flowering time and duration of flowering, information taken from Grime et al (2007) and Fitter & Peat (1994) (table 5.11). The correspondence analysis plot showing date of flowering onset, and length of the flowering period, for species in the samples (figure 5.24) shows late flowering species to be most prevalent towards the positive (top) end of axis 2 and negative (left) end of axis 1 where summer annuals had previously indicated spring sowing for the Sheepslait glume wheats. The proportion of taxa with an early or intermediate onset of flowering and a short flowering period is higher towards the negative end axis 2, where winter annuals also indicated autumn sowing of glume wheat for sites in the Central/Sigwells area.

To investigate whether there was a difference in sowing time between the two glume wheats (emmer and spelt) the percentage of emmer glume bases (compared to spelt) in each sample of glume wheat fine-sieving by-products, was plotted against the proportions of weed seeds classified as short flowering with an early onset of flowering (figure 5.25). There appears to be no relationship between the type of wheat and the flowering time of the weeds, suggesting that there is no direct relationship between sowing time and type of glume wheat.

5.5.2.5 Oat (*Avena* L. sp.) vs. Brome (*Bromus* L. spp.)

Campbell (2000a) suggested that, in the Danebury environs, the appearance of spring sowing might be identified by an increase in the numbers of oat (*Avena* L. sp.), which flower relatively late (June-September), compared with the numbers of *Bromus* subsection *Bromus* L., which are winter annuals. These two species were chosen because the seeds of both are large and therefore likely to be removed at a similar late stage of crop processing. They are therefore likely to be present in grain-rich products rather than the by-products of crop processing. To see whether a similar change was observable in the SCEP samples, the overall percentages of *Bromus* sp. and *Avena* sp. were calculated for grouped periods (table 5.12). Total numbers are low for both types until the Middle Iron Age, after which, in the contexts unambiguously dated to a single period, the proportion of oat increases from 13% to 23% in the Late Iron Age. This reaches a maximum of over 40% oat in the Romano-British contexts, largely due to a high proportion of oat (18 seeds) compared to brome (3 seeds) in the free threshing wheat sample LF3/014. Following Campbell's argument, this would suggest an increase in, but not a complete switch to spring sowing. It is also possible that oats are of a cultivated species, though there is no evidence for this.

On the basis of this analysis it is not possible to say whether there are differences between the sowing times of wheat and barley because the weeds of both are likely to be present in the mixed SCEP samples. Based largely on traditional practices Campbell (2000a) suggested that, at Danebury, spelt was almost exclusively autumn sown (forcing maslins containing the glume wheat to be autumn sown), and that barley, thought to be sown as a pure crop at Late Iron Age Danebury, was frequently spring sown. However, in the case of both crops, sowing time is not fixed, and may vary between varieties (Hillman 1981, Francis 2009).

To investigate whether there was a difference in sowing time between glume wheat and barley at the SCEP sites, the percentage of barley items (barley grain plus rachis internodes) amongst all wheat and barley remains, was plotted against the percentage of oat (compared to brome) in samples with 50 or more cereal items (Figure 5.26). There appears to be no relationship between the quantities of barley and oat, suggesting that there is no direct relationship between sowing time and cereal type (barley or wheat).

5.6 Summary

The Neolithic SCEP samples are largely dominated by hazel nutshell. Barley was apparently the most common grain crop throughout all periods and in all localities. Emmer appears to have been the main wheat crop in the Middle Bronze Age, while the Late Bronze Age sees a rise in the importance of spelt wheat. By the Middle Iron Age there is evidence of new crops namely oat, rye, Celtic bean and pea. Samples from the Sigwells area (Locality 3) tend to be dominated by spelt, while there is more emmer in the Central area (Locality 2). Most of the crop dominated samples represent the products or by-products of late stages of crop processing.

Analysis of the weeds in the glume wheat sieving by-products indicates that the Middle Bronze Age to Middle Iron Age samples from Sheepslait and Crissells Green are characterised by species with a preference for arable/ruderal habitats, in particular summer annuals with a late flowering period, some of which have a preference for fertile conditions. This may indicate intensive cultivation of glume wheat and/or, perhaps more likely given the prevalence of late flowering species, spring sowing. However, Middle Iron Age to Romano-British samples from the Central and Sigwells areas are characterised by grasses and winter annuals which flower early for a short period only, as well as a few perennials, suggesting autumn sowing of glume wheat and/or lower levels of soil disturbance under a less intensive agricultural regime. On the other hand, the percentage of oat relative to brome, may indicate a slight increase in spring sowing overall though the number of oats is very small throughout.

6 Wood charcoal results

Eighteen wood charcoal types were identified from the 93 samples selected for wood charcoal analysis from the SCEP assemblage. This chapter brings together the results of the charcoal identifications from across four of the SCEP landscape localities, firstly looking at taxa presence within contexts and then considering the absolute and percentage fragment counts by locality and period. The chapter then describes correspondence analysis results of the charcoal assemblage from all localities, identifying patterns relating to archaeological site, period and context type. The plot for all localities is also used to explore ecological, and use, differences in the wood taxa. Correspondence analysis is used to explore variation within the largest localities, Central (Locality 2), Sigwells (Locality 3) and Sheepslait (Locality 4). Finally, other aspects of the charcoal fragments are analysed, including ring curvature and preservation features.

6.1 Species representation

6.1.1 Presence of taxa and overall percentages of fragments

The taxa present in each period and locality are summarised in tables 6.1 and 6.2. Overall, the most frequent and abundant taxon was deciduous *Quercus* (oak) present in 91 samples (making up 48% of all SCEP fragments). *Prunus* spp. (blackthorn/cherry) is the next most common taxon, present in 80 samples (14.2% of fragments). The Pomoideae group (hawthorn/apple/pear/whitebeam) is present in 74 samples (8.7% of fragments). Undifferentiated *Corylus/Alnus* (hazel/alder) is present in 72 samples, definite *Corylus* in 54 samples and definite *Alnus* in 14 samples. *Alnus* appears to be less common than *Corylus* but together *Corylus* and *Alnus* make up 11% of the wood charcoal identifications. *Fraxinus* (ash) is found in 64 samples, (11.4% of fragments), *Acer* (probably field maple) in 46 samples (3.9% of fragments). *Populus/Salix* (poplar/willow/sallow) and *Ulmus* (elm) are both present in 19 samples (0.6% of the fragments each) and *Rosa* (rose) in 10 samples (0.2% of fragments). All of these species were identified from at least one period within each of the survey localities, excluding *Alnus*, *Populus/Salix,* *Ulmus* and *Rosa* which were absent at Woolston (Locality 5), probably due to the low number of charcoal samples from this site. Overall, these 11 taxa make up 98.9% of the identified fragments.

Eight rare types (present in 1-3 samples) were also identified, usually represented by only a few fragments. These include *Ilex* (holly), *Frangula alnus* (alder blackthorn), *Viburnum* (guelder rose/wayfaring tree), *Rubus* (bramble), *Hedera* (ivy), *Betula* (birch), *Taxus* (yew) and an undifferentiated softwood. *Taxus* was positively identified in just one Late Bronze Age posthole (MC/1301), where it was the biggest constituent (58 fragments) of the identified wood charcoal, perhaps suggesting it represents the material of the original post.

6.1.2 Fragment counts

Percentage fragment counts were calculated for each period and locality, excluding the unidentified fragments. These are summarised in table 6.2 and figures 6.1-6.3, which include only those periods with a minimum of three samples. Rare taxa were classified as 'other'. Absolute and percentage counts for each sample are presented in tables 6.3-6.6.

Using an arbitrary cut off point of ≥75% as a measure of whether a sample was dominated by a particular wood taxon, just over a quarter of the samples are classified as primarily of one dominant species. The most common dominant taxon was deciduous *Quercus* which made up at least 75% of 20 samples across various periods and localities. Two samples from the Middle Bronze Age enclosure at Sigwells (posthole SG19/132 and ditch fill SG19/151) were made up of 85% and 99% *Fraxinus*, a Middle Bronze Age posthole at Crissells Green (CG/024) contained 78% *Prunus* spp., and the Sheepslait hearth context (SS/042) 97% *Acer*. The remaining 69 samples were more mixed.

6.1.2.1 Central area (Locality 2) (figure 6.1)

The Central area (Locality 2) provides the longest coverage of periods, from the Early Neolithic through to the Romano-British period. From the Early Neolithic and into the Middle Iron Age deciduous *Quercus* is the taxon with the highest proportion of identified fragments, though this fluctuates by some 20%. In the Neolithic, the second most prevalent taxon is *Corylus*, assuming that most of the *Corylus*/*Alnus* fragments are in fact *Corylus* as suggested by the proportions of more securely identified fragments and the very high numbers of hazel nutshell in the samples (approximately 21%). The next most common taxon is the Pomoideae (12%). In the Middle Bronze Age the second most common taxon is *Prunus* spp. (26%), the other taxa not reaching more than 7% and in total making up only around 11.5% of fragments. In Late Bronze Age samples the levels of *Prunus* spp. and Pomoideae even out (13% and 14%) and the effect of the high number of the *Taxus* fragments in MC/1301 can be seen in the 'other' category. In both the Early and Middle Iron Age the second most common taxon is again *Prunus* spp. (28-22%) but the third most common taxon, Pomoideae, stays below 10%. Difficulties in dating the Homeground samples mean that the Middle to Late Iron Age samples cannot be assigned to a definite period but deciduous *Quercus* remains the most common taxon in these samples, and there is little notable change in the other taxa.

The most obvious change through time is the apparent fall in the proportion of deciduous *Quercus* from the Late Iron Age onwards. This is due to a general increase in the proportion of small tree and shrub species, particularly *Prunus* spp. and Pomoideae. Other species such as *Ulmus* also increase, but overall the there is little discernible difference in the species richness of the samples. In the Romano-British samples *Fraxinus* appears to be more significant, making up 26% of the fragments, almost equal to the proportion of deciduous *Quercus*. In the other periods *Fraxinus* tends to be present in low amounts only, and the two Saxon samples do not follow the declining trend in the proportion of deciduous *Quercus*.

6.1.2.2 Sigwells (Locality 3) (figure 6.2)

The Middle Bronze Age samples from Sigwells are distinctive because of the significant proportion of *Fraxinus* (45%) with deciduous *Quercus* (39%). The Middle Iron to Late Iron Age samples appear similar to the Central samples, with high proportions of deciduous *Quercus* (62-39%). The next most common taxon is *Prunus* spp. (23-12%) although there are quite high instances of *Acer* (6.6%) in the Late Iron Age. *Fraxinus* is again more frequent in the Romano-British samples, this time at the even higher level (56%), with deciduous *Quercus* falling to just 26%.

The Middle Bronze Age and Late Bronze are represented by one sample each from the linear boundary ditch and the ring ditch of a round barrow in the very small trench 16. The two trench 16 samples have taxa proportions distinct from the other Sigwells periods (table 6.4). The Middle Bronze Age sample (SG16/020), contains a significant proportion of *Corylus* (around 68% if *Corylus*/*Alnus* identifications are reassigned proportionally), with Pomoideae (22%). The Late Bronze Age sample (SG16/006) contains around 63% *Prunus* spp. The proportions of these taxa are never as high in other Sigwells samples.

6.1.2.3 Sheepslait (Locality 4) (figure 6.3)

From the Late Bronze/Early Iron Age through to the Middle/Late Iron Age at Sheepslait, the relative abundances of taxa stay largely similar. The most common species throughout is deciduous *Quercus*. In the Late Bronze/Early Iron Age, the next most common identification is the undifferentiated *Corylus*/*Alnus* and positively identified *Corylus.* In the Middle Iron Age, *Fraxinus* increases slightly at the expense of deciduous *Quercus*, and *Corylus* remains important. The marked increase in *Acer* is entirely due to the single sample in which it is dominant at 92%. In the latest (Middle Iron Age) samples, *Fraxinus* appear less important, while the proportion of *Corylus* remains significant, but there is also a slight increase in the proportion of *Prunus* spp. and Pomoideae fragments.

The lone Early Bronze Age sample from the ring ditch of the barrow in Down Close and a single Late Iron Age sample from the Sheepslait site were not included in figure 6.3 but both samples fit the general pattern for the Sheepslait locality (table 6.5).

6.1.2.4 Woolston (Locality 5)

As there are only two samples from Woolston (locality 5) from chronologically separated periods (Bronze Age and Romano-British) it is not possible to discus temporal change within this area. The Late Bronze Age sample (LF1/004) is similar to samples of the same date from the Central area (Locality 2). Deciduous *Quercus* is the most common taxon (61%), and the next most common taxon is Pomoideae (23%). The Late Romano-British sample (RC/039) is almost entirely dominated by deciduous *Quercus* fragments (98%) (table 6.6).

6.2 Species diversity

To investigate species diversity, the Shannon-Weiner index was calculated for each period within the SCEP localities with at least three samples (Central, Locality 2; Sigwells, Locality 3; Sheepslait, Locality 4). These results are presented in table 6.7 and figure 6.4 and, for the individual samples from all sites and periods, in table 6.8 and figure 6.5.

Eight to 14 taxa were identified at each locality across every period. In general, species diversity increases through time (figure 6.4) though it is unclear how much of this is an effect of increasing numbers of samples. The Neolithic and Bronze Age samples in the Central area have the lowest diversity scores (below 1.2), and the number of species is low (8 and 9 species), with deciduous *Quercus* predominating (62% and 64%, table 6.7). The trend in the following periods in the Central area is for increased diversity (figure 6.4), with increased numbers of species and lower proportions of deciduous *Quercus* (figure 6.1). At Sheepslait too there is a small increase in species diversity from the Early to the Late Iron Age.

The species diversity of the Sigwells samples shows a downward, but erratic, trend (figure 6.4). Diversity drops in the Middle Iron Age with low species richness (8 species) and high numbers of deciduous *Quercus* (and to a lesser extent *Prunus* spp.), rises in the Late Iron Age, and drops again in the Romano-British samples, with only 8 species represented, dominated by *Fraxinus*. The Middle and Late Iron Age scores for Sigwells and the Central area are very similar to one another, but the Sigwells Bronze Age score is much higher and Romano-British scores lower.

In the individual samples, species richness ranges from 1 to 11. The sample diversity scores within periods and localities are highly variable (figure 6.5). Some periods, particularly the Early Bronze Age at Down Close (Sheepslait, Locality 4), the Middle Bronze Age and Romano-British period at Woolston (Locality 5) are represented by just one sample each. In some cases low species diversity may indicate the presence of a single timber burnt *in situ*, as in SG14/50 (H= 0.53), described as 'gully or timbers', while high diversity may indicate contexts that were left open, as in SG12/126 (H=1.93), the upper fill of pit feature 044.

Overall there is no simple linear time trend in species diversity in any of the localities. Rather, differences in species diversity and composition occur at different times in different localities, and are influenced by the use of wood in each context as much as, or more than, the availability of taxa in the landscape.

6.3 Wood compositional analysis

6.3.1 All localities

As seen in the diversity results, combining samples by period hides differences between individual samples and masks the low numbers of samples present in some periods for some localities. Correspondence analysis was therefore used to explore the similarities and difference between samples, and to establish whether genuine temporal and spatial trends can be detected in the wood charcoal assemblage.

In a correspondence analysis plot of all samples and all taxa present in at least 10% of the samples (figure 6.6), one sample (SS/042) is located at the extreme negative (left) end of axis 1 and extreme positive (top) end of axis 2 in a similar direction to *Acer* (field maple). *Acer* makes up just over 87% of this Middle Iron Age hearth sample, while no other sample contains such a high concentration of *Acer*. In order to observe variation in the remaining samples, sample SS/042 was removed from further wood charcoal correspondence analyses.

After removing the outlier, the data points in the resulting plot are widely distributed. In order to display the plots more clearly, the analysis is presented as a series of figures showing: the taxa and samples as separate plots of axis 1 against axis 2 (figure 6.7), separate taxon and sample plots of axis 1 against axis 3 (figure 6.8), both axis combinations with sample points represented by pie charts showing the proportion of taxa (figures 6.9 and 6.10), separate plots of the samples coded by locality and by archaeological period (6.11).

In the sample plot coded by taxon (figure 6.9), samples dominated by deciduous *Quercus* are located in the lower left quadrant of the plot, towards the negative end of both axes. Samples containing high amounts of *Fraxinus* are located towards the positive (right) end of axis 1. Samples with greater proportions of *Prunus* spp. (and to a lesser extent Pomoideae) are located in the upper left quadrant, towards the negative (left) end of axis 1 and the positive (top) end of axis 2. Samples with greater proportions of *Corylus* (and the intermediate *Corylus/Alnus*) are also located towards the positive (top) end of axis 2 but in a more positive (right) direction along axis 1, in or close to the upper right quadrant of the plot. Axis 3 (figure 6.10) clearly distinguishes samples rich in *Prunus* spp. towards the negative (bottom) end of the axis from those rich in *Corylus* (and *Corylus/Alnus*) towards the positive (top) end.

When the samples are coded according to site locality (figure 6.11a), those from the Central area (Locality 2) are distributed across the plot, but tend to be towards the negative (left) end of axis 1. Samples from Sigwells (Locality 3) and Sheepslait (Locality 4) are also located across the plot. The two samples from Woolston (Locality 5) are found in the lower left quadrant towards the negative ends of axis 1 and 2, in the region associated with high proportions of deciduous *Quercus.*

When the samples are coded by chronological period (figure 6.11b), the Early Neolithic samples (from Milsoms Corner, Central area, Locality 2) are all located towards the negative (left) end of axis 1. The Early and Middle Bronze Age samples are distributed across the plot. The Late Bronze/Early Iron Age and the Middle Iron Age samples are also located across most parts of the plot, though none are located at the extreme positive (right) end of axis 1. The Late Iron Age samples nearly all plot towards the negative (left) end of axis 1, where Fraxinus is a rare component of the samples. Roman-British samples again plot across the plot while the two Saxon samples are both located in the bottom right quadrant towards the negative ends of both axes, as they are dominated by deciduous *Quercus*.

6.3.2 Ecological characteristics and wood properties

Taxa were classified according to a number of different ecological characteristics and properties relating to the use of their wood (table 6.9). The ecological characteristics included 'most common terminal habitat' (Grime et al 2007), moisture preference (Grime et al 2007, Green et al 1994, Stace 2010), preferred soil pH (Grime et al 2007), and maximum plant height (Grime et al 2007). The wood properties included rankings of fuel value and hardness (Keepax 1988: 339). The correspondence analysis plot of samples was then coded according to the proportions of taxa possessing each of these characteristics or properties in turn (figures 6.12-6.14).

The sample plot showing the 'most common terminal habitat' of taxa (figure 6.12a) closely reflects the major taxa in the assemblage (figure 6.9) because the category 'woodland on acid soils' is made up exclusively of deciduous *Quercus* plotting in the lower left quadrant, towards the negative end of both axes while the category ‘woodland on limestone soils’ applies solely to *Fraxinus*, which dominates samples towards the positive (right) end of axis 1. Samples with greater proportions of taxa classified as scrub/hedge (*Prunus*, *Pomoideae*, *Acer* and *Corylus*) are located in the upper left quadrant, towards the positive (top) end of axis 2. The second axis therefore reflects a distinction between woodland and scrub/hedge taxa, and the first axis may at least partly reflects the different soil preferences of the two major woodland taxa.

In the sample plot showing the moisture preferences of taxa (figure 6.12b), the same domination of *Fraxinus* (with a preference for damp conditions) to the right of the plot, and deciduous *Quercus* to the left, can be seen, but this time most of the scrub/hedge taxa share the preference of *Quercus* for slightly drier conditions). The first axis may therefore reflect a moisture gradient, with taxa (such as *Acer*) requiring well drained soils towards the negative (left) end of the axis and *Fraxinus* which is sometimes described as a flood plain species towards the positive (right) end.

In the plot showing the pH of taxa (figure 6.13a), the preference of deciduous *Quercus* for acid soils (around pH 4) is again apparent in the lower left quadrant. Taxa with slightly higher pH values such as *Acer* (pH 5) and *Prunus* (pH 6) also plot towards the negative (left) end of axis 1, but the positive end of axis 2. Taxa that favour more neutral to basic soils, such as *Fraxinus* and *Corylus* (pH 7), are found in greater proportions towards the positive (right) end of axis 1. Differences in pH therefore appear to be reflected in both axes.

In the plot showing the maximum plant height of taxa (figure 6.13b), the tallest trees plot towards the negative (bottom) end of axis 2. This is not surprising given that the woodland taxa, such as deciduous *Quercus* and *Fraxinus*, are common in these samples. The smaller trees and bushes (of scrub and hedge) are more common towards the positive (top) end of axis 2.

The plot of samples displaying the ranked fuel values of different wood taxa (figure 6.14a) is again dominated by the most common taxa, *Quercus*, *Fraxinus* and *Prunus*, which happen to have different fuel values, thus appearing distinct in the plot. The same is true of the plot showing hardness values (figure 6.14b), except that, because *Fraxinus* and *Prunus* share the same hardness value, they are not distinguished in the plot.

The domination of the analysis by a few, very common taxa make it difficult to distinguish patterning due to fuel value and hardness from those related to availability in the landscape. Overall, however, axis 1 seems to reflect soil pH and to some extent water availability (or drainage), which may indicate exploitation of different parts of the landscape in different localities.

This fits with the geographic location of the Central area (whose samples plot towards the negative end of axis 1 in figure 6.11a) on the acid soils, and partly fits with the location of Sigwells on the edge of the limestone. The Bronze Age and Romano-British samples from Sigwells (but not the Iron Age samples) are located towards the positive end of axis 1 in figure 6.11. Axis 2 appears to reflect the type of vegetation exploited, whether large woodland trees or the smaller bushes and trees of scrub and hedge.

6.3.3 Regional variation

In order to look in more detail at the differences within localities, the samples for the three biggest localities (Central, Sigwells, and Sheepslait) were analysed separately. In each case, the analysis is presented as a series of figures showing: the taxa and sample plots, a sample plot represented by pie charts showing the proportions of taxa, and plots of the samples coded by site (where appropriate), chronological period, and depositional context.

6.3.3.1 Central (Locality 2)

In a correspondence analysis of all samples and taxa from the Central area (Locality 2) (figure 6.15), the Romano-British sample from a ditch fill (CF/1107) is located towards the extreme positive end of both axes in the same direction as

Fraxinus which makes up around 70% of the sample. In order to observe the variation in the remaining samples, sample CF/1107 was removed from the analysis of the Central area. The resulting taxon and sample plots are more widely dispersed (figure 6.16).

Samples dominated by deciduous *Quercus* are located towards the negative (left) end of axis 1 and those with a more mixed composition, and a relatively high proportion of *Prunus* spp., towards the positive (right) end of the same axis (figures 6.16a and 6.17). Samples with a relatively large proportion of Pomoideae are located towards the positive (top) end of axis 2, and those with similar quantities of *Fraxinus* towards the negative (bottom) end of the axis.

When samples are coded by site (figure 6.18a), Milsoms Corner samples are distributed across the plot. Homeground samples are located towards the positive (right) end of axis 1, because of their relatively mixed composition. Samples from Crissells Green and The Moor are also widely distributed across the plot, though the Crissells Green samples are absent from the upper left quadrant, and samples from The Moor are largely absent from the lower right quadrant, where the single Castle Farm sample (with a significant proportion of *Fraxinus*) is located.

It is difficult to distinguish compositional differences due to location (site) from those relating to chronological period. When samples are coded by chronological period (figure 6.18b), the Neolithic samples (all from Milsoms Corner) mostly plot towards the negative (left) end of axis 1 because deciduous *Quercus* is a large component of these samples. The Middle and Late Bronze Age samples (from Crissells Green), are widely distributed, as are the Late Bronze/Early Iron Age samples. The Middle Iron Age samples plot along axis 1 but are located neutrally on axis 2. The Late Iron Age and Romano-British samples plot towards the positive (right) end of axis 1, while the Saxon samples plot towards the negative (left) end of the same axis due to a predominance of deciduous *Quercus*.

When samples are coded by context (figure 6.19) those derived from gullies and associated house floors plot towards the positive (right) end of axis 1, indicating that their composition may have more to do with archaeological context than either site or period (figure 6.18). Samples from pits, ditches and postholes are distributed across the plot. Pits, however, are absent from the bottom right quadrant, where samples have high proportions of F*raxinus*.

6.3.3.2 Sigwells (Locality 3)

When samples from Sigwells (Locality 3) are plotted on their own, those with a high proportion of *Fraxinus* plot towards the positive (right) end of axis 1 (figures 6.20 and 6.21). One sample (SG16/020) is located at the extreme positive (top) end of axis 2 due to the high proportion of *Corylus* fragments in this sample. Samples with high proportions of deciduous *Quercus* plot towards the negative ends of both axes (figure 6.20a and 6.21). Other taxa, particularly *Prunus* spp. and *Acer,* are located towards the negative (left) end of axis 1 and neutrally on axis 2.

When samples are coded by site (figure 6.22a), a very clear grouping is seen. Samples from the Bronze Age enclosure, Romano-British building (trench 7) and Sigwells South are located towards the positive (right) end of axis 1, as they contain significant amounts of *Fraxinus*. On the other hand, samples from Sigwells West (trenches 12-14) are located towards the negative (left) end of this axis, and are dominated by deciduous *Quercus* or *Prunus* spp., with a mixture of other, often smaller, scrub taxa. The two samples from trench 16 are also located towards the negative end of axis 1 but are dominated by different taxa (*Prunus* spp. or *Corylus*).

When samples are coded by period (figure 6.22b), a similar pattern is observed because period is closely aligned with site at Sigwells. However, the three Romano-British samples, although coming from different trenches, all plot towards the positive (right) end of axis 1, with the Middle Bronze Age samples. Context type is also closely related to the sites or trenches within the field, with the vast majority of pits belonging to the Sigwells West pit cluster (figure 6.23), though the pits from other trenches also plot in the area of the lower left quadrant, close to the Sigwells West pits. Other context types plot around the cluster of pit samples.

6.3.3.3 Sheepslait (Locality 4)

When the Sheepslait (locality 4) samples are plotted alone, samples with a high proportion of deciduous *Quercus* are located in the upper left quadrant towards the negative end of axis 1 and positive end of axis 2 (figures 6.24 and 6.25). Samples with a significant proportion of *Fraxinus* are located towards the negative end of both axes. At the positive (right) end of the first axis, samples with greater amounts of *Prunus* spp. and Pomoideae plot in the upper right quadrant towards the positive end of both axis, while samples with *Corylus* and indeterminate *Corylus*/*Alnus* plot in the lower right quadrant towards the positive end of axis 1 and negative end of axis 2.

There is no discernible patterning in the sample plots coded by period or context (figure 6.26).

6.4 Other features of wood fragments

6.4.1 Ring curvature

For the larger wood charcoal fragments, an assessment of ring curvature was recorded, where possible, to indicate the calibre of wood present in the samples. These data are summarised by site and period in figures 6.27-6.32. Fragment counts were used in preference to percentages to preserve a sense of the number of fragments on which the graphs are based. The proportion of fragments showing strong, moderate or weak curvature is displayed within each taxon bar. As the assessment of ring curvature requires a minimum fragment size, the majority of fragments could not be classified. However, where they could be assessed (see methodology 4.62), there is a tendency, in most periods and localities, for fragments of deciduous *Quercus* and *Fraxinus* to include more fragments with weak to medium ring curvature indicating the use of trunk or small branches. Other taxa, especially *Prunus* spp., appear to be more frequently associated with medium and strong curvature, suggestive of small branches or twigs. This is particularly marked in summaries of central area through the Iron Age (figure 6.27 and 6.28).

6.4.2 Preservation features

Tables 6.10-6.12 summarise, for each sample, the frequency of features of wood fragments which indicate their taphonomy and state of preservation, such as the presence of pith and bark, fungal hyphae or holes thought to relate to insect damage, radial cracks and level of vitrification.

Generally, features pointing towards the use of decaying, dead or dying wood are relatively few for the SCEP assemblage, showing no particular patterning by site or period. Twelve samples contain fragments for which the presence of fungal hyphae (filaments seen in the longitudinal vessels) has been recorded. The highest incidence of insect degradation (uneven edged holes from burrowing insects) comes from the Middle Iron Age Pit fill, SS/192 (20 fragments). All the affected fragments in SS192 are *Corylus* or *Corylus/Alnus*. The sample with the next highest incidences is five fragments of *Taxus* from the Late Bronze Age posthole MC/1301. A further 15 samples contained only one or two fragments with insect damage. Overall only three samples include wood charcoal fragments were recorded as displaying both fungal hyphae and insect damage.

Radial cracking is much more common, observed in fragments from 64 of the samples. Dependent on the water content as well as the anatomy of the burning wood, it is to some extent species dependent. 70% of the identified fragments showing radial cracks were deciduous *Quercus*. This is unsurprising as the large multiseriate rays of *Quercus* are more likely to split. Overall there are no particular trends by site or period relating to the frequency of radial cracking. Three samples show particularly high numbers of fragments with radial cracks: Romano-British scoop SG21/005 (11 fragments, mostly deciduous *Quercus* but also fragments of both *Rosa* and *Fraxinus*); Middle Iron Age pit SG13/270 (22 fragments, all assigned to deciduous *Quercus*) and a Late Bronze Age potential post, MC/1301 (30 fragments of *Taxus*).

Vitrification was by far the most common preservation feature, recorded in well over 2000 fragments, and may indicate the temperature of burning, though this has been questioned (e.g. McParkland et al 2009). In many cases it was also one of the main factors limiting the identification of charcoal fragments. A cluster of samples from the house floor and gully at Homeground (HG1/016,019 and the 006 samples) contained the greatest number of fragments showing the highest level of vitrification (level 3).

6.4.3 Fragmentation /preservation index

Asouti's (2003) fragmentation/preservation index (ratio of unidentified to identified fragments, Fr/Pr) was used to assess whether there were any general trends in the assemblage's level of preservation that might correlate with other taphonomic indicators, in particular vitrification. For Asouti's assemblages, an index of <0.5 was used to indicate good preservation, 0.6-0.9 moderate numbers of indeterminate fragments, and 1-5 high proportions of poorly preserved fragments (Asouti 2001, 2003: 1193). By this measure, all but one of the samples from the SCEP assemblages are well preserved. Instead, therefore, samples with a Fr/Pr index more than one standard deviation higher than the mean of all the samples are singled out for comment, and comparison with their vitrification level, below.

Of these samples, the cluster from the house floor and gully at Homeground, with very high vitrification levels (see section 6.4.2 above), also has a large number of unidentified fragments, with the highest Fr/Pr index (0.43) in HG1/006c. HG2/010 (Fr/Pr 0.28), a ditch deposit a few meters away, also shows an unusually high incidence of unidentified fragments but no highly vitrified fragments were present. The dating of the Homeground samples is questionable and there is a strong possibility that the unusual material represents contamination from later overlying deposits.

Another group of samples, with a high Fr/Pr index (CG/020, CG/024, CG/008; Fr/Pr 0.33, 0.39, 0.28) also contains numerous fragments with the highest vitrification level. On the other hand, the Middle Iron Age pit fill MO2/025 (Fr/Pr 0.27) contained only one fragment assessed as highly vitrified. SG21/005 (Fr/Pr 0.58) is the only sample to have a significantly higher index than the assemblage mean for the Sigwells samples. From Locality 4, neither DC/005 (Fr/Pr 0.23) nor the palisade trench SS/003 (Fr/Pr 0.28) are recoded as containing fragments with the highest level of vitrification, but the Down Close sample contained only four fragments larger than 4mm suggesting high levels of fragmentation. The Moor, Sigwells and Sheepslait samples all had less than one hundred fragments suitable for identification.

6.5 Summary

The landscape-wide picture is that of a spectrum of wood taxa present in the samples, while those selected for use, across both sites and periods, remains relatively similar. Deciduous *Quercus* tends to be the most common and ubiquitous identification; in the Early Neolithic samples the secondary species is *Corylus*. In the Central area (Locality 2) deciduous *Quercus* appears to become less dominant in the Late Iron Age while there is an increase in the smaller shrub species, particularly *Prunus* spp.. There are increased levels of *Fraxinus* in some samples from both Middle Bronze Age and Romano-British sites which is particularly marked at Sigwells (Locality 3). Correspondence analysis differentiates samples based principally on the proportions of deciduous *Quercus* or *Fraxinus* and secondarily on the proportions of these larger 'woodland' taxa and the smaller hedge and scrub species. The ecological information shows that there are differences between samples, based on the soil preferences of the trees, perhaps indicating where in the landscape the wood was collected. It is almost impossible to distinguish these aspects from properties of the wood relating to potential use.

When the survey localities are considered separately, differences in the proportions of taxa in the samples are most closely aligned with site, rather than period or context type. Within Locality 3, the Iron Age pits from Sigwells West a form a particularly strong group dominated by deciduous *Quercus* and scrub species in contrast to high levels of *Fraxinus* in the preceding and following periods.

Limited information is available relating to the size of the wood collected but deciduous *Quercus,* and to a lesser extent *Fraxinus,* is associated with higher numbers of fragments showing weak ring curvature suggesting a larger calibre of wood, most likely from the branches or trunks of relatively mature trees, while taxa such as *Prunus* spp. include greater proportions of fragments showing strong ring curvature suggesting the use of small branches and twigs. Other features of the charcoal fragments point to differences in the pre-depositional treatment of the charcoal but, aside from the high levels of vitrification in samples from the Homeground roundhouse (where the date has been questioned), no clear period or site patterns were identified.

7 Discussion

Section 7.1 introduces sources of variation in the archaeobotanical samples. Section 7.2 moves on to consider thematic aspects of the crop weeds and wild herbaceous plants, while section 7.3 looks at thematic aspects of the wood charcoal. Section 7.4 then goes on to consider the changes in both classes of plant remains and how they fit into the understanding of the SCEP landscape, and beyond, over time.

7.1 Source of variation in the archaeobotanical samples

One of the questions asked of the SCEP material (section 1.6) was whether archaeological feature types have distinct archaeobotanical signatures. Emphasis on archaeological context was introduced as an important consideration in archaeobotanical study in the 1970s (Dennell 1976b). For the SCEP samples context types include pits, scoops, postholes, ditches, gullies, floors, fire and industrial deposits. The context types and their frequency are not equally distributed across time and the landscape. Most of these contexts represent 'negative' features, places where things are likely to collect and further disturbance is generally low. With the possible exception of some of the pits the SCEP assemblage provides no obvious primary, *in situ*, 'storage' contexts. The archaeologically determined context types were used to code the individual samples within the various correspondence plots of the cereal components, weed types and wood species. Although the categories used to classify the SCEP context types were necessarily broad, in most cases no discernible patterning across the landscape and periods was seen that could be sufficiently disentangled from the overlying effect of site trends.

However, the archaeobotanical content of samples often provides more information about past human activities than the context from which they were recovered. The final resting place of much archaeobotanical material is largely removed from the original activities that produced it.

Archaeobotanical remains are often re-deposited away from the fire contexts where, prior to burning, the plant remains may already have represented secondary refuse. This potentially leads to much mixing of material from different actions and events. In order to investigate human behaviour we are ideally looking for evidence of a single action or repeated patterns of behaviour (van der Veen 2007), such as the burning of the waste of everyday actions, for example dehusking and fine-sieving. Similarly, the vast majority of wood charcoal found on site is likely to come from the most frequently repeated burning events, cooking, heating and craft fires. However, unlike items from cereal crops, it is more difficult to recognise the levels of mixing that have taken place after collection and burning.

Archaeobotanical samples are typically composed of varying quantities of wood charcoal fragments, crop grains, cereal chaff and the seeds of wild plants. The plant remains may derive from a variety of sources including fuel, food, building materials, from single or multiple actions. It is important to distinguish, as far as possible, which taxa are derived from which source.

7.2 Crops, weeds and seeds of wild herbaceous plant species

7.2.1 The sources of wild plants

A key research question identified was what other types of plant resources, aside from the domesticated crops, what other types of plant resources were gathered? And, in light of this what vegetation types would have been available for use in the landscape, and how were they used and perhaps managed? Wild taxa may have been harvested with crops or have arrived on site by other routes. Seeds of woody perennials taxa such *Corylus avellana* (hazel), *Sambucus nigra* (elder) and the larger Rosaceae (blackthorn, blackberry etc.) occur in low numbers in a few samples. Although such species have the potential to invade cultivated ground, they tend to be present only in a vegetative state and are unlikely to set seed and be gathered with the harvested crop. They are therefore more likely to be brought onto site as collected fruits or for their wood (Bogaard 2011: 100). Other apparently wild plants, such as poppy (*Papaver* sp.), or brassicas (Brassicaceae) may have been grown intentionally, in gardens or small plots, for their seeds or fruits, as leafy vegetables, medicinal plants or have occurred naturally as weeds of rough ground around habitation and working areas.

Plant material may also have been brought onto site as fodder (for example hay), stabling or byre material, gathered from a range of habitats such as grassland, woodland and wetland. Such material may have become burnt due to the cleansing of buildings, or other areas, or to the disposal of contaminated waste. Plant material may also have been brought onto site by the animals themselves. Dung, containing a variety of plants from habitats grazed by livestock could have been used as a fuel. In regions such as the Near East dung is an important source of charred plant material (Charles 1998, Hald 2008, Miller & Smart 1984, Valamoti 2004, 2013). Dung is considered an unlikely fuel in many areas of northwest Europe and Britain due to the availability of wood and the climatic constraints of preparing and drying the dung for use as fuel (Fuller *et al* in press).

Experimental work on sheep suggests that digestion biases the survival of weed seeds in favour of species that are small seeded (<2mm) and those with strong seed coats (Wallace & Charles 2013). Such bias is not obvious in the SCEP assemblage. However, with a penned sheep producing 400-1100 pellets of dung during a single day and the close relationship between the arable and animal elements in a mixed farming economy, dung is likely to have been present around the sites. Especially common species within the SCEP assemblage are nitrophilous annual weeds, including *Chenopodium* and *Atriplex* spp., *Persicaria* sp., *Solanum* spp., common colonisers of middens and manure heaps (Kenward & Hall 1997). Without geochemical analysis and wider artefactual and faunal information, it would be difficult to confirm or fully eliminate dung as at least a partial source of some plant remains. However, burning such material deprives the farmer of important nutrients useful in manuring depleted soils, sometimes a significant reason for keeping, and sometimes housing, animals in the first place (Broderick & Wallace forthcoming, Cunliffe 2005). The possibility of dung derived seeds cannot be fully ruled out, but on balance the analysis is not suggestive of dung fuel patterns (Charles 1998) and dung fuel remains an unlikely source of charred seeds within the SCEP assemblage.

Due to the range of possible sources for plant remains, Hall and Huntley (2007), in their review of archaeobotanical remains from the North of England, repeatedly question the assumption that the majority of sample contents represent arable activity. The mixture of charred crop items and wood charcoal in the SCEP samples already points to a variety of sources for the plant material brought onto the sites.

However, the majority of wild taxa in the cereal-rich SCEP samples have the potential to grow in the disturbed habitats associated with past cultivation. Most are species recorded as growing in present day 'arable' habitats but also 'ruderal' or 'grassland' habitats (Grime et al 2007). Some species identified as archaeophytes, weeds not found in Britain before their introduction by man in prehistory alongside crops and livestock (Preston et al 2004), are likely to have grown and been collected with crops, although the most common and numerous species tend to be those capable of surviving in a range of habitats. On the other hand, many species which were weeds in the past are no longer associated with modern arable fields, where deep ploughing and chemicals have reduced the numbers of species to all but the most resilient.

Two species, in particular, both present within the SCEP samples and frequently classified as weeds in studies such as that of van der Veen (1992:202, table 6.4), *Danthonia decumbens* (heath grass) and *Montia fontana* (blinks), are particularly questioned by Hall and Huntley (2007: 213) as having potentially entered the archaeobotanical record in ways other than accompanying cereal crops. Although associated with damp to wet conditions, the 20th century description by Clapham et al (1989) also describes *Montia fontana* as being found in arable fields in South West England. It could have been a potential crop weed in the SCEP assemblage, perhaps suggesting poor drainage within some of the fields or at field margins. *Danthonia decumbens* is more difficult to justify using modern floras. Descriptions of the relatively large seeded species include the fact that the seeds are stored/distributed by ants. The species is not generally found in fertile and newly established grassland, habitats more closely aligned with the potential conditions of arable cultivation because of the very slow perennial growth of the grass (Cope & Gray 2009). Hillman (1981) highlighted identification of heath grass (referred to in his text by the previous name *Sieglingia decumbens*) as among the most common of the seed types associated with cereal remains, particularly the chaff, at the Iron Age Romano-British farmstead of Cefn Graenog. A tufted grass, *Danthonia decumbens* is frequently associated with wet acid heath in the southeast as well as limestone heath and mountainous pastures in the west. Hillman suggests that the absence of heath grass from the later suite of arable weeds is likely to be due to the use of efficient, deep, mouldboard ploughing rather than the shallow action of the prehistoric ard.

7.2.2 Crop processing and the consumer/producer debate

Another of the basic research questions posed above (section 1.6) related to the recognition of the state of crop processing within charred non-wood material. Previously studies of processing have focused primarily on questions related to the nature of the subsistence economy and wider social organisation. A strong theme in British archaeobotanical studies is the distinction between crop producers and consumers. Producer sites are communities that were directly involved in the cultivation and harvesting of arable crops, while consumer sites, based around a pastoral economy or where specialist craft or other non-arable activities were focused received crops from elsewhere (M. Jones 1985). M. Jones (1985) plotted the botanical composition of charred site archaeobotanical site assemblages, as three-way percentage graphs of grain, chaff and weeds seeds. Initially he used these diagrams to compare Iron Age sites from the upper Thames Valley. He suggested that differences in the relative proportions of these remains reflected the status of sites as agricultural producers or consumers. His hypothesis was that producer sites were more likely to yield large quantities of grain, as the part of the harvest least likely to be treated as waste. He suggested that with each further action of processing and transportation the perceived value of the crop would increase and, at consumer sites receiving crop products through exchange, only the waste weed and chaff from processing would be allowed to make their way onto settlement fires. However, Jones' model failed to be replicated at other sites investigated by Jones himself and others, such as Maiden Castle (M. Jones

& Palmer 1991) and the Roman granary at South Shields, Tyne and Wear, a classic consumer site (van der Veen 1992). This is consistent with the view that even producers are not profligate with grain.

Hillman (1981) had previously suggested that the sites most closely involved in the cultivation and harvest of crops would be characterised by the presence of chaff and straw from the earliest stages of crop processing (winnowing and coarse sieving), in particular culm nodes and the rachis of free threshing cereals, while, at consumer sites, these crop components would be rare in comparison to grain. Campbell (2000a) reinterpreted the scarcity of chaff, and therefore a dominance of cereal grains, as suggesting that chaff was required as fodder at sites focusing on livestock husbandry while, at sites where charred chaff is abundant, chaff was not used as fodder but as a fuel. Stevens (2003) suggested that grain-rich samples point towards communal storage as semi-cleaned spikelets while chaff would be more prevalent when storage was carried out at the household level as partially threshed ears. The former would yield processing waste dominated by grain, the latter by weed seeds. In their critique of the other models, van der Veen and G. Jones (2006, 2007) emphasised the scale of production suggesting that, where large scale production was taking place, accidental charring of crop products is more likely to occur, which would account for large grain-rich samples, while chaff- and weed-rich samples result from day-to-day crop processing.

Correspondence analysis of the crop composition of the SCEP samples indicated that crop processing was the primary factor differentiating samples. Both the crop components and the weeds seeds associated with the crops point to the majority of SCEP samples representing the later stages of processing, the products or the by-products of fine sieving. Along with the density of items, this suggests that most of the SCEP samples probably represent day-to-day small scale final processing, use and consumption of cereals even in the dispersed settlements outside the hillfort which might be assumed to have grown their own crops.

Although culm nodes, which are mostly removed during the early stages of crop processing, were present in some SCEP samples, these were few in number at most sites, and are probably not indicative of early crop processing stages. Only in a few late Iron Age samples from Sigwells and Sheepslait were culm nodes present in sufficient quantities to suggest the presence of early processing by-products or unprocessed crops. In one Sigwells Middle Bronze Age sample (SG16/020), rachis internodes made up 73% of the barley in the sample which is consistent with a product of early processing. This sample appears to come from a 'field boundary' rather than habitation. The lack of plant remains from early processing stages is often explained by poor preservation or the fact that processing usually takes place in the fields away from habitation and the sources of fire which might carbonise such remains (Boardman and Jones 1990, Jones 1987, 1990). One of the Late Romano-British Ladyfield 3 samples (LF3/014) contains free-threshing wheat rachis internodes, and may represent whole ears, though the same composition could result from the mixing of grain and rachis. The ratio of rye grain to rachis internodes in a few of the Romano-British samples, particularly the 'industrial' waste sample from Nine Acres (NA/007; with a grain: rachis ratio of 1:6) and two of the samples from Castle Farm, (with a ratio of 1:25 or consisting of rachis only), could also point to early processing but in none of these samples is rye the dominant crop; it may even represent a weed. There is also a possibility that rye grains have been misidentified and therefore underrepresented.

7.2.3 Crop mixing and mixed crops

Nearly all of the SCEP samples show some degree of mixture. Where the plant species represent widely different growth habits or economic potential, it is likely that the crops became mixed at the point of refuse disposal or deposition (Greig 1991). It is difficult to determine the exact point at which mixing occurred or which crops were grown together. Dennell (1976b) suggested that minor contaminants may be indicative of crop rotation, but ethnographically G. Jones and Halstead (1995) found that, rather than representing plants persisting within fields from previous years, contaminants were more closely associated with impurities within the seed corn that was sown. Results reported by G. Jones and Halstead (1995) on traditional farming, on the Greek island of Amorgos, showed that crops sown as a deliberate monocrops tended to be made up of over 90% of the intended grain. Only eleven of the SCEP samples with at least 50 crop items reach this purity, even when the chaff and grain of the same species are counted together.

Although most of the SCEP samples are dominated by glume wheat glume bases, they frequently contain roughly equal quantities of barley and glume wheat grains. It is likely that the low numbers of glume wheat grains are part of the glume wheat processing by-products but, due to their different processing requirements, it is unlikely that barley and glume wheat were grown together. On the other hand, it is possible that the two glume wheats (emmer and spelt) were grown as a maslin, though they may have been grown separately and became mixed at a later stage, during refuse disposal or deposition.
Maslins may be sown, harvested and stored together as part of an economic strategy to mitigate risk, based on the differing strengths of the crop species (G. Jones & Halstead 1995). If required, the crops can be at least partially separated after harvest, e.g. by sieving if there are natural size differences between the grains of each species. The final proportion of each species may vary considerably due to differences in the grain sown or differential success of each species in responses to soil, weather condition and competition (G. Jones & Halstead 1995).

Campbell (2000b) has suggested that a combination of glume wheat chaff and barley grains may be the result of the glume wheat by-products being used as fuel to dry grains of barley (but possibly other crops) prior to storage. Alternatively Charles and Bogaard (2001) have suggested that a mixture of barley grain and glume wheat chaff may represent a deliberate fodder mixture.

7.2.4 Ecological amplitude of the crops

One of the basic questions it was hoped SCEP material may be able to address was where in the landscape were people growing crops? In many cases this would also be linked with understanding of husbandry techniques. The crop species themselves are relatively uninformative about the conditions in which they grew and prevalent husbandry methods. The range of climatic conditions where barley can be successfully grown is very broad. It can be grown on both light and heavy soils, except in places with very poor drainage, and on soils with a pH below 6 (M. Jones 1981). Barley is frequently associated with the poorest soils (van der Veen 1992).

Of the wheats, spelt will grow on both the heavier soils often associated with bread wheat (the type most likely to be represented by the free threshing wheat within the SCEP assemblage) and on drier, lighter soils traditionally associated with emmer. M. Jones (1981, 1984) interprets the increasing importance of spelt through the Bronze Age into the Iron Age as representing increased arable production through an expansion of the areas used for crop growing onto new, heavier soil types. Nation-wide wheat growing experiments (van der Veen and Palmer 1997) showed that in warmer winters the differences between emmer and spelt yields is minor. However, when January temperatures are low, spelt is higher yielding than emmer.

Sites with high numbers of pulses have been associated with intensive agricultural systems where nitrogen fixing crops were used to maintain the fertility of arable land (van der Veen & O'Connor 1998). Over southern Britain Campbell and Straker (2003) identified a general pattern of Celtic bean (*Vicia faba*) as more typical of Bronze Age sites while pea (*Pisum sativum*) became more important in the Iron Age. Within the SCEP samples this differentiation is not apparent in a correspondence analysis of the crop species. Overall identifications of Celtic bean were the more numerous. Both species are securely identified from the Middle Iron Age onwards, and are frequently found together in samples until the Romano-British period when pea alone was identified. The processing requirements of the pulses mean that they are less likely to come into contact with fire compared with cereals. It is also possible that, in an integrated mixed economy focused largely on animals, soil fertility was not a major limiting factor in the SCEP region until the Middle Iron Age.

7.2.5 Land under the plough

Pertinent to the question of where in the landscape crops may have been grown is their relationship to the animal economy (section 1.6). Randall's (2010a) interpretation of the SCEP archaeological survey and excavation results was that the field pattern regularly incorporated tracks and features suitable for stock handling (such as sorting gates, pens and runs). The structure of the enclosed areas would aid movement from the unbounded to the bounded landscape. For Randall the frequency of such features points to the purpose of the structured fields as primarily for livestock rather than crops. Of course the presence of livestock handling features in the fields does not preclude such spaces being used for growing crops even if only for part of the year, within a rotation. Spring sowing of crops would maximise the time for winter grazing (M. Jones 1981: 104) or, alternatively, autumn-sown crops could be grazed early in their vegetative growth period without too many ill effects, and even promoting tillering from the cropped base (Epplin et al 2000). Animals may also graze the stubble after harvest. Grazing animals on arable land speeds the incorporation of nutrients into the soil and may also add nutrients through the addition of dung.

Direct evidence of cultivation of the SCEP soils is scarce and relates only to the latest periods under study. From the Romano-British period or later in the Cadbury Valley (east part of Locality 2, Central Area), two of the sites produced evidence of ploughing overlying the prehistoric features. At The Moor this was shown by distinct cross ploughing marks, but at Crissells Green the identification of a buried plough soil relies on the random distribution of highly fragmented and abraded pottery and charcoal flecks, suggesting possible manuring (Randall 2010a: 137). To the south of Cadbury, geophysics suggests buried lynchets and unditched small rectangular fields yet to be fully investigated.

7.2.6 Sowing time – organising the year

Relating to questions about the husbandry techniques employed in the SCEP region sowing time informs the pattern of the agricultural year which has wider implications for both agricultural and social organisation. In western Britain, the year round availability of water and generally mild winters means that cereal crops need not be obligatorily spring sown. Wheat and barley are dependent on day-length to instigate the change from vegetative growth to flowering. Modern varieties of emmer wheat are frequently associated with spring sowing. However, wild emmers germinate in autumn (Hillman 1981) suggesting that this may not have been the case for ancient varieties. In lowland Britain spring sowing generally gives lower yields than autumn sowing of the same crop due to the reduction in the time available for photosynthesis (Ellis & Russell 1984) but changes in sowing time do not greatly change the timing of harvest (Gill et al 1980, van der Veen 1992). Therefore the crop species do not themselves indicate sowing time which is more dependent on crop variety.

The weeds accompanying the crops provide an alternative line of evidence. In northeast England, van der Veen (1992) found weak evidence for emmer being associated with spring germinating weeds but cautioned on the effect of other factors such as the availability of nitrogen. Studies such as that of Bogaard et al (2005) indicate that there tends to be a bias towards spring sown indicators in fine-sieve by-products of crops. This reaffirms the need to compare samples from the same crop processing stage when attempting to determine crop sowing time but also strengthens the argument that, where the winter annuals are present in significant amounts in fine sieving by-products, they are strongly suggestive of an autumn sowing regime. Modern weed studies in Germany have shown that flowering time and duration are successful indicators for distinguishing autumn- and spring-sown crops that, unlike germination time, are usually available in regional floras (Bogaard et al 2001).

A correspondence analysis of the SCEP samples most likely to represent glume wheat fine sieve by-products may indicate differences in sowing time. Late and long flowering weed species, suggestive of spring sowing are prevalent in Sheepslait samples, and a lone sample from Crissells Green, while early, short flowering species, suggestive of autumn-sown crops, predominate in the majority of the Central and Sigwells samples. This may represent a chronological change in the sowing time of glume wheats, from spring sowing in the Bronze Age and Early Iron Age (primarily at Sheepslait) to a mixture of spring and autumn sowing in the Middle Iron Age (Sheepslait) and autumn sowing at the other Middle Iron Age sites), and finally to predominantly autumn sowing in the Late Iron Age and Romano-British periods (in the Central and Sigwells areas). There was, however, no consistent link between the proportions of spelt or emmer and the occurrence of weeds indicating autumn or spring sowing.

Within the Danebury Project, Campbell (2000a: 55) interpreted cereal patterns as indicative of autumn sown spelt-barley maslins in the early Iron Age followed by both autumn and spring sowing of monocrops by the Late Iron Age. This was based on increasing purity of each species in grain-rich samples, the association of spelt with autumn sowing and the 'traditional' tendency for barley to be spring sown. A shift to spring sowing of some of the crops was supported by the increase in spring germinating oat relative to autumn germinating brome spp.. This was accompanied by an increase in other crops such as pea. Pulses too are considered likely candidates for spring sowing as they are frost sensitive (Hillman 1981). Campbell's interpretation need not conflict with the spring to autumn change in the sowing of the SCEP glume wheat because Campbell's change in crop and sowing time takes place between the Early Iron Age and Late Iron Age, and so does not preclude spring sowing of glume wheats in pre-Iron Age periods. In any case the rate and direction of change may be different across different landscapes and social groups.

A combination of spring and autumn sowing may represent a deliberate strategy of spreading both labour and risk. Some of the ground preparation needed before sowing could take place away from the busy post-harvest period in autumn, and sowing some crops in spring gives a second chance of a crop should disease, weather conditions or other factors 'spoil' the grain or reduce the grain yield of crops sown earlier in the agricultural year.

7.2.7 Cultivation intensity

The intensity of cultivation also relates to choices of husbandry techniques and wider social organisation through the allocation of labour and other resources.

The crop correspondence analysis (results section 5.4) indicated that emmer, though rarely dominant, is more frequent in samples from the Central area (Locality 2) while barley dominates many of the Sigwells (Locality 3) samples, and that this pattern owes more to location than to chronological period. Spelt is common in samples for both areas, and samples from Sheepslait (Locality 4) show no evidence of crop specialisation. Drawing on differences between six Late Iron Age sites in north east England, van der Veen (1992, van der Veen & O'Connor 1998) was able to distinguish two groups of sites on the basis of both crops and weeds. Sites in Group A (north of the River Tyne), were characterised by emmer (with some spelt and barley) and arable weeds indicative of intensive cultivation, while sites in Group B (to the south of the River Tyne in the Tees lowlands) were mostly dominated by spelt wheat (with some barley) and arable weeds characteristic of less fertile soil conditions, and limited soil working, indicating a more extensive regime (van der Veen 1992). It has been suggested that emmer is more suited to an intensive cultivation regime, while spelt is favoured by extensive cultivation, probably because it is hardier and more tolerant of marginal soils than emmer (van der Veen & Palmer 1997, van der Veen & O'Conner 1998).

Analysis of the weeds associated with the SCEP glume wheats (results section 5.5), however, indicates that weeds from both the Central and Sigwells areas are, if anything, indicative of an extensive regime, with evidence of autumn sowing and/or limited soil disturbance. The available data, however, do not allow us to distinguish between all three (not mutually exclusive) aspects. In addition emmer, which in other areas (van der Veen 1992) has been linked with more intensive regimes, is more prevalent in the Central area. Due to their similar position on the limestone scarp, Sheepslait might be expected to have weeds indicating similar cultivation conditions to those at Sigwells. In fact, however, the Sheepslait glume wheat samples are, if anything, associated with weeds characteristic of higher levels of soil disturbance and/or fertility, indicative of more intensive cultivation of glume wheats than in either the Sigwells or Central areas though again we are unable to distinguish which aspects are causing the results. This variation highlights regional variation in cultivation practices, whereby different crop species may be subject to similar husbandry regimes (as in the Central and

Sigwells areas), and a different husbandry regime applied to the same range of species elsewhere (as at Sheepslait).

7.3 Wood charcoal

7.3.1 Does charcoal reflect availability in the prehistoric treescape?

It was hoped that charcoal identifications would also add information on the available vegetation types in the SCEP landscape (section 1.6). Various foraging models, more often used for looking at food procurement, have been applied to wood collection, especially for fuel use. The ‘principle of least effort’, such as the rationale used by earlier researchers, Salisbury & Jane (1941) for Maiden Castle, assumes that people collect firewood in direct proportion to the abundance or availability of the species in the landscape directly around the site. This model has been shown by archaeological excavation as well as by ethnographic and biological studies to be, if not false, an over-simplification (Shackleton & Prins 1992). The abundance of a species in the landscape is not the only factor affecting the availability of its wood to people.

An important aspect can be the ease of collection. In some periods it is thought that there was a tendency to use coppiced and younger, round wood because the smaller poles are quicker to harvest with the tools available (Rackham 1986). Some locations may be inaccessible, for example, cliff faces can act as refuges to species while other properties such as spines, irritants or the tendency to drop branches all play a part in how convenient or desirable it is to collect a specific wood taxon.

It can be difficult to make species identifications from small dispersed charcoal fragments, limiting the amount of ecological information available. Moreover, long lived organisms such as trees and shrubs can change drastically in form, and can also influence, and ultimately change, the physical conditions of their surroundings, in particular the soil conditions. Both juvenile and mature examples of species are frequently found in very different habitats (Grime et al 2007) and yet, as the largest and apparently most durable organism in the landscape, the woody species often define the habitat in which they live.

Within the SCEP region, variation in the underlying geology means that there are many potential soil types within a relatively small area (see section 2.1.5). All the SCEP sites studied here are located on, or at the edge of, potentially acid and lime-rich soils. A correspondence analysis of the SCEP charcoal samples shows that all the studied localities tend to have taxa that prefer both acid and basic soils. Many of the woody species can grow in soils with a range of pH values. The presence of wood charcoal from woodland species does not necessarily indicate dense woodland. The smaller, light-demanding species present in the SCEP material, tend to grow around clearings or at the woodland edge. Given the topography and soils of the SCEP landscape, water availability is likely to have been greatest towards the valley bottoms, where there are springs, streams and boggy areas. These are likely locations for alder (*Alnus*), poplars, aspens, willows and sallows (*Populus/Salix*). These species are also strongly associated with the clays of the Somerset Levels and Moors landscapes. These species of wet or damp habitats are often thought of as poor fuel, which may explain their relatively low fragment counts.

The National Vegetation Survey (Hall et al 2004, Rodwell 2006) synthesis of ancient woodland types suggest that the SCEP charcoal assemblages represent various combinations of lowland mixed (W10c/W8d), deciduous woodland containing plenty of oak. Rackham's more specific classification of hazel-ashwoods (Rackham 2003: 482) may be more appropriate. Within this, oak (probably *Quercus robur*) with an ivy (*Hedra helix*) sub-community indicates acid soils, while ash (*Fraxinus excelsior*) and field maple (*Acer campestre*) are more characteristic of calcareous soils. These communities combined with those of wetter areas in the vales, wood pasture and scrub, cover most of the taxa identified in the SCEP region in reasonable proportions.

On the basis of pollen and charcoal data for Somerset, and the types of soils within the region, lime (*Tilia*) was originally expected, but was not present, in the SCEP wood charcoal identifications. Across Britain lime is generally poorly represented in charcoal assemblages (Keepax 1988). Straker (1990), discussing charcoal results from nearby Brean Down, suggests that because lime charcoal is very soft it does not survive well archaeologically. However, Keepax (1988: 345-7) suggests that lime is no softer than alder (*Alnus*), which is present in the SCEP samples, albeit in very low numbers. Keepax notes that the perishable nature of fresh lime wood means that it is not traditionally used in woodworking, and its poor fuel qualities mean that people would not have preferentially collected lime wood. There would also be no impetus to preserve or encourage areas of lime woodland in the landscape. Rackham (1988, 2003) suggests that lime would have been present on prime agricultural soils which may have been some of the earliest soils to be cleared of trees.

As expected for the area around South Cadbury, there are few or no early colonising taxa (only one fragment of potential birch (*Betula*)) or those indicative of heathland habitats, such as gorse (*Ulex*) and heathers (Ericaceae), that could provide evidence of contrasting habitats as found during projects such as the A30 improvements, Devon (Gale 1999), though the very rare fragments of undifferentiated softwood, possibly pine, may have come from such areas.

Unfortunately although investigators such as Gale (1991) call for studies to move beyond the creation of species lists, the SCEP charcoal evidence on its own is of limited value in the investigation of factors such as percentage coverage, density and distribution of the trees and woody shrubs within the landscape. Mollusc studies may later be used to complement the charcoal data in assessments of the degree of openness and rate of clearance on a local scale through prehistory. Even then, the influence of human selection and incomplete burning of wood at archaeological sites may prevent the reconstruction of the prehistoric treescape.

7.3.2 The use of wood: anthropogenic choice

7.3.2.1 Fitness for task: ranking different wood properties

Wood is a material that people would have been in contact with every day and could observe in great detail. Evidence of complex wooden tools, weapons and constructions at sites such as Mesolithic Star Carr (Lillie et al 2005) suggest that there was an established, sophisticated knowledge of various woods and their properties in Britain from quite early periods. Although knowledge of working wood with stone was quickly lost with the introduction of metal tools, what is thought of as English carpentry, with most of the joints recognisable today, was largely present by the Bronze Age (Taylor pers. comm.). With this understanding 'fitness for task' is likely to have been an important factor in the selection of wood.

Studies such as those of Keepax (1988) and Marston (2009) have attempted to calculate rankings for the expected preference of locally available wood types, drawing on both technical studies and anecdotal descriptions. These rankings have then been compared with the proportions of taxa found in archaeological assemblages. Such rankings mainly focused on the physical properties of the wood and how these affected their value as material for, predominantly, fuel and construction, for example the temperature at which the woods burn, their strength and their resistance to decay. However, there is a wide range of tasks that could have taken place at the SCEP sites, and properties of the woods that may be a disadvantage for one task may be an advantage for another. For example a wood which produces a lot of smoke when burnt would be undesirable when cooking inside a building but a useful trait in curing and preserving foods.

7.3.2.2 Fuel value: keep the home fires burning

With limited evidence for catastrophic burning of standing buildings, the majority of the wood charcoal in the SCEP samples is likely to represent fuel. Keepax's (1988) study of wood charcoal from across Britain, has shown that (alongside availability) fuel value was the strongest determining factor in the presence of woods at archaeological sites. The ubiquity of woody taxa considered to have good to excellent value as fuel across the SCEP localities and periods may support this. However, except when found in fire installations such as hearths, kilns and furnaces, it is difficult to guarantee that charcoal was used primarily as fuel. In most cases the value of a wood as a fuel is greatly influenced by the dryness of the wood and the size and shape (Gale 2003). Treatment too can change the qualities of a species. Alder (*Alnus*), willow (*Salix* sp). along with poplar (*Populus* sp.), a wood particularly selected for match making because of its poor burning qualities are considered by authors such as Boulton and Jay (1947) as poor fuel woods providing low heats and tending to smoulder. However, some of these poor woods do have traditional uses as charcoal fuels (Gale and Cutler 2000: 463), efficient conversion to charcoal effectively doubling the calorific value of the un-carbonised wood.

Fuel values were not available for some taxa in the SCEP assemblage. *Rosa* provide dense wood that burns relatively well and, like some of the less ubiquitous species identified in the SCEP assemblage with smaller growth habits, may have been useful as kindling. Some species present at levels to low too be included in the correspondence analysis are also likely fuels. *Ilex* (holly) burns at high temperatures though much faster even when green, while *Taxus* (yew) is considered a superior fuel, when seasoned, providing an intense heat with a long burn time, though it can spark (Boulton & Jay 1947) which is perhaps an unwelcome attribute in flammable wood and thatched buildings. *Hedera* (ivy), which is a poor fuel, could have been growing on the larger trees and shrubs and have been brought onto site unintentionally.

7.3.2.3 Strength and effort

The range of species identified from charcoal tends to be narrower than that identified from waterlogged samples (Lambrick & Robinson 2009). Some species such as hazel burn well but are also valuable for other properties and tasks such as hurdle making (Warren 2006). Taxa that were valuable for construction may have been less likely to be selected as fuel, and therefore underrepresented in charred assemblages (unless they were burnt after they had gone out of use). Woods have different strengths including their ability to withstand compression and tension. For both use as fuel and for craft or construction purposes, the qualities of the wood must be balanced with the ease of working. Keepax's 'hardness' value is a reflection of what Marston (2009) describes as handling time rather than the quality of the wood as a construction material. Nevertheless, oak, which should be one of the more arduous woods to work, is the most ubiquitous and numerous species in the SCEP assemblage. As with fuel value, there are many factors that may affect the suitability of woods for specific construction and craft tasks, such as whether or not they are seasoned or the part of the tree represented. A standard oak will be useful for very different tasks than one that has been drastically coppiced, a form in which oak was much more widely managed in prehistory (Gale 2003). The maximum height of a taxon gives an indication of the construction elements for which it could be used. It is unreasonable to suggest that a central post or roof beam could have been made from ivy but where the plant was growing and how it was managed will have a had a large effect on the suitability of the timber for different purposes.

7.3.2.4 More than the numbers – convention and belief

The use of ranking systems based on quantifiable qualities of woods assumes optimising behaviour on the part of the people using the wood, which may not have been the case. There are more subjective and culturally specific influences on wood choice that are difficult for archaeologists to evaluate (Asouti & Austin 2005, Shackleton & Prins 1992, Smart & Hoffman 1988). These include aesthetic qualities, prestige, rules, traditions, folk knowledge, ownership and the seasonality of tasks. Who in the community actually collected the wood may also have had an effect on wood selection, as well as the way that learning and knowledge about the plants and their qualities or personalities were transferred. Wood (either from exotic or locally available species) is sometimes transported over great distances and, by this, may have been given what we might now think of as ‘added value’.

In many cultures trees are used as symbols and proxies for other living and more esoteric entities. Perhaps because of their size, rootedness and potential for transformations, trees tend to be given higher positions in hierarchies of ‘aliveness’ and agency than the smaller herbs (Bloch 1998). Alongside the banks, ditches and trackways that can be seen in the archaeological record of the SCEP region, some trees may have played an important role in the social or economic division of the landscape or in the production of foodstuffs (Dufraisse 2008), which might have discouraged their felling. Certain trees in the landscape may need to be managed, for example by pruning or hedge-laying. This may result in a surplus of suitable 'waste' material from taxa which otherwise would not be preferred. Over time, human choice of wood, and other uses of the landscape, such as grazing, exert a considerable impact on the growth of trees and shrubs. Some favoured species may be overused, perhaps even to extinction. Conversely, some species could see an increase either through active encouragement or non-selection. Clearance, for example, opens up new areas, increasing the number of colonising taxa with a high light requirement (Gale 1991).

7.3.3 Herding trees

7.3.3.1 Nutritious fodder

Linked to the research questions of how the plant material fits into the animal economy acorns and mast from trees and other woody taxa are important sources of forage for livestock. The leaves, twigs and bark of various woody species are also regularly eaten by livestock out in the landscape. As suggested above, use as animal feed, even if supplementary, is likely to have been an impetus for the harvest of young branches and twigs. These may have been transported to site as leafy fodder or leaf hay to maintain animals through times when access to growing grass was in short supply. A widespread practice across Europe until the 19th century, the use of leaf fodder continued much later in some areas such as Greece (Halstead 1998, Eichhorn et al 2006). Even leafless twigs, twig fodder, were of value in winter (Haas et al 1998). Archaeological evidence for the consumption of woody taxa by animals has been identified through dental microwear (Mainland 1998) as well as the analysis of pollen, plant macrofossils and phytoliths in the faeces of sheep and goat, particularly from alpine lake villages (Rasmussen 1993, Akeret et al 1999, Delhon et al 2008) sometimes found in association with large quantities of twigs.

Beyond being an emergency resource, leaf fodders have different qualities depending on species, time of harvest, treatment and storage. Of the taxa identified in the SCEP assemblage, those considered to produce leaves of high forage quality, with nitrogen levels considered optimal for cattle nutrition (at levels comparable to meadow hay) include *Ulmus*, *Fraxinus* and *Acer.* Intermediate levels are found in *Corylus* and *Populus*, while *Quercus* leaves have been shown to contain only low levels of nutrients (Hejcmanivá et al 2013) but are ethnographically well attested as fodder.

The process of harvesting leaf fodder leaves behind large pieces of wood that can later be used as fuel, while material left by the animals or unused at the end of the season can be used as kindling (Halstead 1998). Some charcoal researchers have used a predominance of branch and twig material in the charcoal assemblages of particular sites to suggest management of the trees for leaf foddering (Regnell 2003). Trees that are repeatedly harvested produce distinctive re-growth but, distinguishing fodder production from other management strategies will always be difficult.

7.3.3.2 Woodland management

One way of ensuring the availability of a resource in the landscape is through its management. One of the secondary research questions identified was whether there was evidence of non-arable plant resources being actively managed and conserved (section 1.6). Although some of the SCEP charcoal was identified as coming from fast-grown wood, there is no direct evidence for the practice of coppicing, pollarding, shredding or other woodland management practices. Roundwood fragments were rare and too small to be assessed for ring curvature to identify regular cycles and ages of coppice or pollarded rods in the manner of Poole's (1984) interpretation of management from the Danebury charcoals. Studies of waterlogged wood from the Somerset Moors and Levels, within sight of South Cadbury, provides much of the information available on management and wood use in Southern Britain. Based on the wood from three Levels sites, Rackham (1977) suggested that, during the Neolithic, an elaborate process of ‘drawing’ was practised, the hazel rods being harvested from trees, at various stages of re-growth, rather than cutting a single area down to the coppice stools at regular intervals, in the medieval manner. The branches harvested in this way show various ages (4-10 years growth) selected as stems of suitable size but leaving others to grow on. Such a practice may reflect the prioritising of leafy fodder for domestic animals over the collection of wood (Rackham 1977, M. Jones 1996). By the Iron Age, the waterlogged wood recovered from sites on the Levels suggests a change towards the felling of plots of hazel, a method apparently little different to that recorded for medieval woods (Rackham 2003).

7.3.3.3 Hedges

Of relevance to the three-way relationship between crop husbandry, animal management and social organisation, it is frequently assumed that up-standing barriers were needed to divide and manage the landscape, restricting the free movement of both animals and humans. The presence of hedges or fences may be inferred from archaeological subsoil features. Floristically, hedgerows closely resemble scrub and woodland edge. Species characteristic of these habitats are well represented in the SCEP samples, though whether or not they do represent such habitats is partially dependent on the numerous P*runus* spp. and Pomodieae group identifications, and the interpretation that many of these probably represent the thorny, relatively light-demanding, small trees and shrubs, the blackthorns (*Prunus spinosa*) and hawthorns (*Crataegus monogyna*). A few indeterminate thorns were identified in Romano-British samples from Ladyfield, The Moor and Castle Farm.

7.4 Changes over time

Samples from the earliest contexts are underrepresented probably due to taphonomic processes such as reworking, biological and physical destruction which tend to be greater for the oldest deposits (Clapham & Stevens 1999). Changes in agriculture and in the landscape may not have occurred at convenient boundaries between periods dated by artefacts. The following sections will consider changes in the SCEP archaeobotanical record relative to wider research, addressing further aspects of the key research questions posed above (section 1.6) by exploring trends in the crops, evidence for other plant resources gathered and observations of the wood charcoal within the key periods. These issuses will be addressed in the context of integration of the arable economy with the animal based economy and within the prevailing social setting drawing on aspects of the wider archaeological research for each period. It is split chronologically into: Early Neolithic; Late Neolithic and Early Bronze Age; Middle to Late Bronze Age including the earliest Iron Age (particularly at Sheepslait); Iron Age; and Romano-British periods.

7.4.1 The Early Neolithic: cereals vs. nuts

Although evidence of cereals in British Neolithic contexts is widespread, cereals tend to be represented by very low quantities of material at each site (Fairbairn 2000, Bogaard & G. Jones 2007, Jones & Rowley-Conwy 2007) with a few notable exceptions, such as Hambledon Hill, Dorset (Jones & Legge 2008), Windmill Hill, Wiltshire (Whittle et al 2000) and, further north, Lismore Fields, Derbyshire (G. Jones in press). The plant remains from the Early Neolithic pit alignment and possible hearth contexts at Milsoms Corner, on the spur of land on the approach to what would later become the hillfort, are mostly seeds of crop weeds and other wild species. A total of 135 litres of soil were processed from the ten samples selected for study. Hazel nutshell was abundant but only 28 identifiable seed or chaff items were recorded, including one poorly preserved barley grain, two indeterminate cereal grains, a single glume wheat glume base and a flax seed. The few seeds of potential crop weeds include *Stellaria* cf. *media*, *Vicia*/*Lathyrus* sp. and seeds of Polygonaceae. Due to these low numbers, the Neolithic samples were excluded from the main statistical analyses of crop changes. However, thousands of hazel nutshell fragments were recovered from these Early Neolithic samples, particularly MC/1889 and MC/1839, for which the shell recovered from the flot was weighed rather than counted; further material would probably be recoverable from the heavy residues.

The pre-depositional taphonomy of cereals is very different to that of nutshell. Jones (2000) points out that the nutshell represents the waste from consumption rather than the product which would normally be consumed. The equivalent waste parts for cereals are chaff and straw. Nutshell, also has little value beyond its use as kindling or fuel whereas chaff and straw may have other uses such as fodder and building materials. What is more, the dense nutshell survives charring relatively well while lighter material such as chaff and straw tend to survive poorly (Boardman and Jones 1990). There is a suggestion that hazel nutshells within pits could be suggestive of processing of hazelnuts by roasting (Score & Mithen 2000, Mithen et al 2001), although the Milsoms corner pits do not match the shape and dimensions of the previously identified Mesolithic examples and the deposits are much smaller.

The SCEP Early Neolithic samples are from pits in the wider landscape rather than overt settlement-based contexts. The evidence of relatively rapid intentional filling of the pits is indicated by minimal weathering and the inclusion of artefacts such as 'elegant' pottery associated with sites across the southwest, a Cornish polished axe, fragments of quern stone from the Mendips and rubbers (Tabor 2008a: 45). These assemblages are similar to those across Neolithic southern Britain where gathered food remains outnumber those of cultivated crops (Robinson 2000) and point towards ceremonial actions. Cereal-based assemblages are perhaps more likely to be associated with areas of settlement, particularly houses. These types of context are well represented at continental Neolithic sites, and in later periods in the SCEP landscape itself. Unfortunately the lack of archaeobotanical sampling during the hillfort excavations means that no material is available from the tantalising gully and post-built rectangular buildings found on the South Cadbury hilltop. A concentration of hazel nutshell is reported from pits associated with the most prominent of the buildings, and was used to obtain a radiocarbon date for the mid 4th century BC (Tabor 2008a).

To date, all that can be said about the Early Neolithic crops is that barley and glume wheat, probably emmer (Greig 1991, Campbell & Straker 2003), were available in the SCEP landscape, and that wild resources seem to have played a significant role compared to later periods, especially the Iron Age.

Wood charcoal results from Neolithic Hambledon Hill (Austin et al 2009:461) indicated a greater diversity in the wood species than that recorded for later periods. The Early Neolithic SCEP samples show relatively low diversity compared to samples from the following periods. The more numerous species represented are deciduous *Quercus*, *Corlyus* and *Corylus/Alnus*, Pomoideae and *Prunus* spp.. The presence of possible scrub or wooodland edge taxa as well as understory species suggests clearings. However, it is unclear how much this slightly restricted range of species results from the samples all coming from tightly clustered contexts of the same type in what may have been a tree rich environment. Other periods are represented by a range of context types widely spaced sites on a range of substrates. In the later periods people may have had less choice of wood in their immediate surroundings and so had to collect from a wider range of habitats, while Neolithic samples might represent taxa that were immediately to hand without the need to travel further or use other taxa.

7.4.2 The Late Neolithic/Early Bronze Age: home on the ranch

In syntheses of the development of British crops and husbandry, the later Neolithic is often amalgamated with the Early Bronze Age, periods largely missing from the present study. Even allowing for the difficulties of preservation, sample number and plant quantification, researchers such as Stevens and Fuller (2012), Moffett et al (1989) and Robinson (2000) suggest a decline in the evidence for arable in the British Late Neolithic/Early Bronze Age c.3300-1500 BC, following the adoption of cereals as part of the 'Neolithic Package'. Stevens (2007) sees this as reflecting a largely pastoral society, with limited cereal cultivation, at a time of population collapse the abandonment of a cereal-based economy, and increased reliance on livestock and wild resources, is seen as a likely response in the face of climatic deterioration towards colder and wetter conditions (Stevens 2007). This is similar to the shorter term responses observed in relation to climate fluctuations at Late Neolithic Alpine lakeshore settlements in Switzerland (Schibler & Jacomet 2010).

The radiocarbon dating undertaken as part of the current study pushed forwards the date of what had been thought to be a cereal-rich Early Bronze Age sample (SG16/020) leaving only a single Early Bronze Age sample from a Down Close test pit (DC/005). This sample contained only a few indeterminate cereal grains, weed seeds and nutshell fragments, which provided little evidence on the possible contraction of arable cultivation in this period.

The archaeological survey evidence from the SCEP landscape shows that relatively widespread flint and Early Bronze Age pottery distributions tend to be greater in the lowlands and valley sides. Across southern Britain, agriculture is assumed to have been located on the lighter, easily tractable soils. The landscape divisions in the SCEP region, the long linear parallel ditch systems, enclose large areas apparently not subdivided. In some places these run for in excess of 600m and are spaced 100m apart. They seem to indicate a preference for the slopes and higher ground, including the lighter soils where crop agriculture might be expected. The linear features are also present across some of the heavier soils of Sparkford and Weston Bamphfylde. Large areas, regardless of the terrain, are systematically divided. Traditionally this organisation of the landscape is linked to a 'ranching' style consistent with a focus on livestock. The archaeologically recorded features represent a landscape suitable for an extensive approach to livestock management, regulating access to grazing but allowing sheep or cattle to range freely for fodder and access to water without the need for close supervision. For Tabor, this distribution across soil types lends weight to the land divisions not being dependent on a significant amount of arable agriculture (Tabor 2008a 51, 54, Randall 2010a).

None of the ditch features that have been excavated are particularly deep, and Randall (2010a) suggests that they would not have been stockproof on their own, creating a need for extra barriers in the form of maintained hedges, fences or hurdles. Smith (2002) has suggested a progressive decline from the Neolithic to Early Bronze Age in the 'true woodland' taxa with an increase in secondary woodland resulting from episodes of regeneration. However, charcoal results from DC/005 fail to add much information, indicating only mixed wood resources of oak, ash, hazel and possible hedge species in the form of *Prunus* spp. and a trace of the Pomoideae group.

7.4.3 The Middle/Late Bronze Age: ‘vive la revolution’

Whether real or not, the largely pastoral Early Bronze is seen by Stevens and Fuller (2012) as being followed by an upsurge in the importance of cereals in the Middle Bronze Age, an ‘agricultural revolution’. They argue that, from this period onwards, there is more evidence of both cereal grains and their processing waste from across southern Britain. In the SCEP archaeobotanical study, the Middle and Late Bronze Age is represented by a greater number of samples than the preceding periods, although samples with high numbers of cereal items are still relatively rare, limiting their use in statistical anlayses. The types of sites and contexts represented include field and enclosure boundaries but the majority of Middle Bronze Age samples come from an area interpreted as a ‘temporary craft camp’ at Sigwells. The most important site for the Late Bronze to Early Iron Age is an elite ringwork at Sheepslait.

On the steep slopes of the Milborne Valley, south east of Cadbury castle, a hillwash some 30cm in depth was identified in test pits. Burnt clay and small charcoal fragments, statigraphically dated to the Middle Bronze Age, indicate a period of soil instability that may be related to clearance while, at other locations, early hillwashes are sealed under later prehistoric activity (Randall 2010a:137). Following this, in the later second millennium, there appears to be a hiatus in the formation of colluvial deposits pointing to a reduction in soil disturbance on the hills (Tabor 2008a:69). This is associated with diagnostic Late Bronze Age Pottery, restricted to the Cadbury Hill and its immediate surroundings, with concentrations also at Woolston and Poynington Down.

The Middle/Late Bronze has been associated with two important changes in the crop record. Martin Jones (1981) first discussed the gradual replacement of emmer wheat by spelt. Since his 1981 synthesis, the increased number and geographical spread of assemblages has shown that this change is far from uniform (Campbell & Straker 2003). In southwest England, spelt is considered to be a Late Bronze Age introduction (Fitzpatrick et al. 2007). Spelt has been identified at a number of south western Middle Bronze Age sites including Brean Down, Somerset (Straker 1990) and Potterne, Wiltshire (Straker 2000). Single spelt glume bases were identified from both Middle Bronze Age Enclosure 5026, Castle Hill and Pattesons Cross, East Devon (Clapham 1999:51, 86, Clapham & Stevens 1999) and there are identifications as far west as Trethellan Farm, Cornwall (Straker 1991, Campbell & Straker 2003). The evidence of glume wheat glume bases in the SCEP assemblage suggests a shift away from emmer in favour of spelt in the South Cadbury Landscape starting in the Late Bronze Age.

Early barley in southern Britain is represented by naked two- and six-row, and hulled six-row forms, but the presence of two-row hulled barley is uncertain (Campbell & Straker 2003). By the Late Bronze Age, largely hulled barley was found (Fitzpatrick et al 2007). In Iron Age southwest Britain, occasional grain finds of naked barley have been identified at sites such those in the Danebury environs. However, Campbell (2000a) suggests that these represent genetic variation within the predominantly hulled population rather than a separate crop. The difference between hulled and naked barley is caused by a single recessive gene (Zohary et al 2012).

A concentration of five samples, from Bronze Age Sigwells, contain the greatest number of flax seeds in the SCEP assemblage. The emergence of flax has been suggested as a particular feature of the Middle to Late Bronze Age to the east in the Thames Valley (Lambrick & Robinson 2009). Flax seeds from the largest concentration (sample SG19/096) gave a Late Bronze Age radiocarbon date of 1193-848 cal BC, well after earlier dates from areas such as the Thames Valley.

Animal bone evidence from SCEP points to cattle and sheep as the most important species, with pig represented in lower numbers (Randall 2010a). In the middle Bronze Age, many of the linear landscape features established in the Early Bronze Age appear to fall into disuse. Some new enclosures like that at Sigwells are aligned on similar lines but in a largely unenclosed landscape. Smaller, more locally focused systems, including enclosures, droveways and stock handling features, are seen in association with dispersed houses within the fields, in areas such as Milsoms Corner (Randall 2010a:147). The landscape features are suggestive of daily tasks being concentrated closer to domestic areas than previously. This may indicate that stalled animals were integrated into what may have been more intensive arable cultivation (Randall 2010a).

Randall sees higher instances of pig in the Late Bronze Age Sheepslait animal bone assemblage as at odds with the largely unbounded landscape character around Cadbury and the linear arrangements directly surrounding the Sheepslait site at this time (Randall 2010a:157). Normally pigs are associated with smaller landscape divisions due to the need for closer control. Instead, Randall suggests that the assemblage reflects defined consumption events within or associated with an enclosure type, the ringwork, that is associated elsewhere with elite occupation (Yates 2007:18). The crops themselves do not appear particularly 'special' but the suite of weeds in the glume wheat fine sieving by-products marks the earlier periods at the site as different from others in the SCEP landscape. It is possible that the crops, like the pigs, were from the same smaller landscape units outside what Randall calls the arena of daily livestock husbandry, predominately an extensively managed cattle- and sheep-based subsistence regime.

When interpreting weed assemblages, it is difficult to distinguish spring sowing from fertility (perhaps through manuring). The distinctive weed assemblage from Late Bronze/Early Iron Age Sheepslait may therefore be the result of fertilising the crop growing plots with pig manure, which is particularly high in nitrates and phosphate (Chambers et al 2001), or the sowing of spring crops, both of which would be significant to the site and the way in which the landscape was managed.

7.4.4 The Iron Age: expansion and control

The Late Bronze into Early Iron Age perhaps sees the beginning of a shift in animal economy (Hambleton 1999, Randall 2010a) which reaches its height in the Middle Iron Age and leads researchers such as Albarella (2007) to describe the period up to the Roman invasion as the 'Sheep Age'. One way the change in animal husbandry may be reflected is in the apparent disappearance of one of the Bronze Age crops. Robinson and Lambrick (2009:53) observe a general dearth of flax finds from the Early Iron Age until 100 AD in the Thames Valley and, to a certain extent, this is also apparent in the SCEP archaeobotanical material. Except for two seeds from Early Iron Age contexts (Central, Locality 2), flax has not been identified in the Iron Age. It reappears only in the Romano-British samples, again only in low numbers. In both regions this may simply be the effect of preservation and archaeological recovery. However, Lambrick and Robinson (2009) suggest that a reduction in the cultivation of flax might 'dovetail' with the increasing importance of sheep in the Iron Age. Sheep provide both a source of fibres for textiles through their wool and a source of fats and lanolin as an alternative to linseed oil. Flax must be cultivated on relatively fertile ground (which may need the addition of manure, and requires weeding, harvesting, and retting (a relatively obnoxious process) before the fibres can be cleaned and prepared for spinning. On the other hand, wool, a secondary product, can be annually sheared from animals that can graze over a range of landscape types, (including some of low fertility) while the primary reason for keeping the animals is as a source of protein through dairying or meat production.

Emmer wheat has been described as present only in small amounts in Iron Age plant assemblages in central southern Britain (M. Jones 1996), such as that of the Danbury Environs (Campbell 2000a; 46). In some areas, it has been suggested that emmer was no longer grown as a crop in its own right but was a contaminant or part of an intentional maslin with spelt (M. Jones 1996). van der Veen (1992) showed that emmer continued as a major crop until around 350BC in the upland area north of the river Tyne, and there is increasing evidence for the persistence of emmer in some areas of lowland southern England (Campbell 2000a and references therein), including the dominance of emmer in one particularly grain-rich deposit from Ham Hill, Somerset (Ede 1999). In the Iron Age SCEP assemblage, spelt never completely replaces emmer, though spelt is more numerous. Pelling's (2006) study of archaeobotanical samples from the landlocked naval base, RNAS Yeovilton, approximately 4km west of the SCEP study area, seems to show a shift from emmer to spelt only in the Late Iron Age and Roman periods. However, this is based on only a few Middle/Late Iron Age samples with low numbers of crop items.

The Middle Iron Age (around 350BC) has been identified as the climax in the shift from emmer to spelt (M. Jones 1984, 1996, van der Veen 1992), the culmination of earlier innovations and changes resulting in soil nitrogen depletion indicated by an increase in nitrogen-fixing leguminous weeds and expanded use of legume crops (M. Jones 1995). It is also at this point that pea and Celtic bean are securely identified in the SCEP assemblage. The switch to spelt is thought to relate to an expansion of arable agriculture onto heavier, clay soil types (M. Jones 1981, 1984, 1995) which, in the SCEP landscape, may have included the valleys and vales. Alongside changes in the crops themselves, a key innovation in the Iron Age was the gradual appearance and expanded use of metal agricultural implements. The introduction of metal sickles, and later metal ard share tips, improved the cutting edge of the former, and allowed the ard to pass more easily through heavy, wet soils (M. Jones 1991). These changes in technology would have played an important role in the expansion of agriculture onto previously marginal, less easily worked, soils.

Redistribution has particular relevance for the British Iron Age and into the Romano-British period, which relates to the identification of producers and consumers within social hierarchies (see above) and the organisation of the landscape. This is the period when significant surplus production beyond the household level, and increased economic specialisation, is inferred due to greater quantities of cereals recovered archaeologically and evidence of storage. The production and distribution of surplus grain is an important factor in the rise of social elites and non-agricultural settlements. It is thought that the movement of crops around the landscape, potentially over long distances, may have begun in this period (Cunliffe 2005). Hillforts have been particularly identified as centres of redistribution within the landscape (Cunliffe 1984, 2005, Barrett 2000, Payne 2006, Bradley 2007).

During the Middle Bronze Age, there is limited evidence of grain storage in pits in south west Britain (Fitzpatrick et al. 2007). However, it is widely accepted that some pits, particularly in the Iron Age, were used for grain storage and later used for the deposition of rubbish (Hill 1995, Cunliffe 2005, Tabor 2008a). Charred grain found in pits, particularly in the basal layers, are often thought to represent stored grain, while chaff remains have been interpreted as the remains of a lining, material that sealed the pit, the tinder/fuel from domestic fires or used to start fires for the sterilization of pits before reuse (Campbell 2000a, Monk 1985:114). Sharples (1991), following his work at Maiden Castle, speculated that the large surplus storage capacity of the pits within the hillfort was well beyond the needs of those living inside the ramparts and was therefore storage for a wider community. He saw control of the grain supply as giving leverage to those within the ramparts over the producer communities living outside.

There is a large increase in both the number and the size of pits across the SCEP landscape in the Middle Iron Age. While there are many types and therefore different uses for these pits, the general pattern is that pit fills seem to change from rapid single episodes in earlier periods, to complex combinations of rapid fills separated by periods of slow silting (Tabor 2008a: 125). The majority of Middle/Late Iron Age SCEP archaeobotanical samples come from pits, in particular the extensive pit scatter at Sigwells West. This, along with at least two unexcavated other probable pit groups outside the hillfort, Hicknoll Slait (at the far east of Locality 2) and The Plain of Slait, Woolston (Locality 5) is used by Tabor (2008a, 2008b) to argue that such clusters of numerous pits were not confined within hillforts but were accessible to those outside.

The basal or lower contexts of the Sigwells pits were not particularly rich in charred grain remains. Randall's (2006) detailed investigation of the taphonomy of some of the pits suggests that cereal grains were present largely in the upper layers, resulting from long term accumulations rather than discrete deposits. It is certain that the plant remains from the pits represent later stages of cereal processing, and in much larger quantities than in previous periods. It is difficult to assess whether the pits were all used at some point for grain storage and, if so, how many times each pit was used but, in most cases, *in situ* grain storage is not represented in the structured deposits and silting episodes in the pits.

Sowing time (section 7.2.6) also has implications for the use of pits and the types of grain storage used. Autumn sowing, as identified for some of the SCEP Iron Age glume wheat samples, would mean that the time between harvest and re-sowing was no more than two months (van der Veen & G. Jones 2006). Pits are generally thought to be used for long term storage of grain because of their large size and the need for the pit to remain sealed to be effective. In an autumn sowing regime, pit storage would be more suitable for surplus grain than for seed corn. However, there are ethnographic precedents for the temporary use of sealed pits to kill pests, the grain then being moved into houses for more accessible storage (Halstead and Jones 1989). At many Iron Age sites, including the hillfort at the centre of the South Cadbury landscape, large numbers of four- or six-post structures have been interpreted as granaries with raised floors (Barrett 2000a: 320, Cunliffe 2005: 411). These could provide an alternative place for the short-term storage of grain intended for consumption.

Regional reviews of charcoal suggest an increase in the range and number of wood species used in the Iron Age (Keepax 1988, Smith 2002). The diversity of the SCEP charcoals also increases in the Iron Age, peaking in the Late Iron Age. Scrub species do play a larger role in the SCEP Iron Age, and it is these light-demanding species that would be favoured by land clearance.

There may be some evidence for the deliberate transportation of wood for a specific purpose in the Iron Age. The wood correspondence analysis identifies the Sigwells pits as a distinct group within Locality 3, distinguished by, in some cases, a high proportion of deciduous *Quercus* (and in other cases by scrub species) as opposed to *Fraxinus* which predominates in other Sigwells contexts. Taphonomic evidence (Randall 2006, 2010b) indicates the pits were left open for some time, and some marked by posts erected in the pits. It is therefore possible that deciduous *Quercus* was preferentially selected for posts and brought to the site (which is located on the limestone scarp where a predominance of ash-woodland might be expected, as seen in the charcoal from the Sigwells periods before and after the pit scatter) from some distance away.

7.4.5 The Romano-British period: market forces

The Roman-British SCEP samples sparsely cover a significant span of time and a great deal of social and agricultural change. It seems that the samples studied here represent the 'agricultural crop base' lacking evidence for the new foods and exotic plants, mainly fruits, vegetables and herbs that appeared with the expansion of, and inclusion within, the wider Roman Empire. This is unsurprising as these 'luxuries' are more often found, and in greater quantities, at military, urban, or rural elite sites (Livarda 2011, van der Veen et al 2007), site types not yet represented within the SCEP survey. Even so there are hints of changes in the more basic subsistence crops produced in the SCEP landscape across the Romano-British period, in line with results from further afield.

Most of the emmer glume bases identified in Romano-British samples are from the plough soil samples from The Moor where there is a possibility of residuality. From the latest Romano-British samples at Woolston (Locality 5), where spelt itself appears to be a contaminant, no emmer was identified. At Catsgore, one of the previously studied sites geographically close to the study region, thousands of spelt glume bases were recovered from Roman kiln/oven deposits, while emmer glumes bases made up only 1% of the assemblage (Hillman 1982). Kilns such as those at Catsgore, and many other Romano-British sites, have been interpreted as being used to roast germinated grains for the production of malt, the main ingredient in the production of beer. Although it is thought that beer production was common in prehistory, the scale of production suggested at sites like Catsgore provides the first evidence of production on a large scale beyond that of domestic consumption (van der Veen & O'Connor 1998).

The free threshing wheat sample from Ladyfield 3 is one of the few SCEP samples to represent a grain product, and this too may be an example of crop production for an external market. Towards the end of the Iron Age there is increased evidence for the expansion of (free threshing) bread wheat (Campbell & Straker 2003). Free threshing wheats are considered to be poor competitors with weeds when compared with the glume wheats (M. Jones 1984, 1995), and the loose packing of the ear makes the free threshing types more vulnerable to attack by birds and fungi. On the other hand, bread wheat responds to intensive methods of cultivation, such as the application of fertiliser. The free threshing characteristic also reduces processing and transport costs, making it a more suitable commodity for trade (Green 1981, M. Jones 1981, Mills 2006).

Like the crops and wild plants, the wood charcoals from the Romano-British SCEP sites do not appear to include any of the newly introduced or exploited species. In the Romano-British period, wood charcoal assemblages from some areas of Britain show a reduction in the number of species (Gale 1988) thought to be a consequence of over-exploitation or higher selectivity. In other areas no significant difference between Romano-British and the preceding periods can be recognised (Smith 2002). Based on the limited number of samples available, the diversity of taxa in the Central area is high, and, although the diversity is much lower at Sigwells, the range of species is not dissimilar to that of the Middle Iron Age. It may be that there was little pressure on wood fuel in the SCEP region because of the absence of large fuel-using industrial centres, such as major pottery production sites, iron smelting or lead workings, around which deforestation might have occurred.

8 Conclusions

8.1 The SCEP landscape from the Neolithic to the Romano-British period

This study of material from a large post-excavation archive, the South Cadbury Environs Project, considers archaeobotanical and wood charcoal evidence from across a region as called for by researchers such as Campbell & Straker (2003), and van der Veen and Jones (2006) and also provides a sequence over much of later prehistory, covering many economic and social changes.

The principal research questions (section 1.6) were addressed through the identification and quantification of the charred plant material from five survey localities (eleven sites). The composition of the samples was investigated through the use of multivariate correspondence analysis of both the crops (chapter 5) and wood charcoal (chapter 6). Sample composition was considered in relation to location, chronological period and archaeological context. Following the identification of the principal crops and crop processing stages of the crop-rich samples, the underlying ecological differences in the weed and wild taxa were investigated. For the fine-sieving by-products of glume wheats, this provides information demonstrating differences in the cultivated soils, crop sowing time and to some extent intensity of cultivation. The ecological amplitude of the wood taxa, the size of the wood collected, its ease and suitability for different purposes were considered, providing information relating to the source of the wood and its use.

Key findings of plant utilisation from the SCEP landscape:

- Spelt replaces emmer as the main glume wheat cereal crop from the Late Bronze Age.
- The Middle Iron Age sees an increase in number of possible crops (i.e. the addition of pulses oat and rye).
- Free threshing wheat only becomes a major crop in the Romano-British period.

- All sites and periods are represented by the late stages of crop processing, mostly by-products.
- Weeds indicate Middle Bronze Age spring sowing of the glume wheats changing to autumn/spring and then autumn only sowing from the Middle Iron Age onwards.
- In terms of spatial rather than temporal variations (and not fully distinguishable from sowing season), Sheepslait samples indicate a relatively intensive crop husbandry regime, while Central weed types suggests lower fertility and/or disturbance although higher frequencies of emmer suggest more intensive cultivation than the extensive pattern favouring spelt and barley at Sigwells.
- The range of wood charcoal species utilised remains fairly consistent over time and across the landscape, but there is a small increase in the number of smaller, scrub species in the Iron Age.
- At Sigwells the Middle and Late Iron Age samples are distinguished by a mix of oak and scrub species, whereas the preceding and following periods are typified by high levels of ash charcoal matching the expected woodland type on the limestone plateau.

8.2 Were there differences in the crops and their husbandry over time and in different locations?

The archaeobotanical composition of the SCEP samples generally corresponds with that from across southern Britain (M. Jones 1981, 1991, 1996, Grieg 1991). However, there is much localised variation in crop choice and the exact timings of adoption, largely dependent on local conditions (Campbell & Straker 2003). Numbers of recovered charred cereal grains, chaff fragments and other plant items do not necessarily indicate the importance, either dietary or economic, of the crops, or the extent of the area taken up by cultivation.

Across most of the archaeological sites and all periods (except the Romano-British period), barley was the most numerous grain. Where it could be assessed, the variety was hulled. However, glume wheat glume bases were the most numerous crop item overall. From all periods where samples were large enough to be used, the results of crop processing analysis suggested that the samples from the SCEP region represent the late stages of crop processing, fine sieving products and by-products. The only sample with significant numbers of barley rachis internodes, which are normally removed during the early processing stage of winnowing, was from a Middle Bronze Age field boundary at Sigwells, a context away from habitation.

The **Early Neolithic** was represented by a few items of crop plants recovered from pit contexts at Milsoms Corner. Both glume wheat and barley were represented alongside abundant hazel nutshell fragments. **Late Neolithic/Early Bronze Age** samples are poorly represented. Like much of Britain (Stevens and Fuller 2012), evidence for cereal crops was sparse.

The low numbers of cereal items from **Middle to Late Bronze** samples limited their use in later analysis. However, for early periods emmer was usually identified as the main glume wheat. From the Middle Bronze Age, where numbers of cereal items start to increase, the quantity of spelt was only slightly less than that of emmer. From the Late Bronze Age, spelt became the most common wheat perhaps related to the expansion of cereal agriculture including use of heavier soils and/or increasing production under more extensive regimes; over time such conditions favoured the spelt component of mixed glume wheat crops. The Sigwells metal working camp provided a few concentrations of flax seeds, a crop that might have been partially neglected in later periods due to changes in the animal economy favouring sheep, an alternative source of oils and fibres. From Middle Bronze Age Crissells Green and Late Bronze/Early Iron Age Sheepslait, the arable weeds in glume wheat fine sieving by-product samples, are suggestive of a spring sowing regime. The dominance of a few weed taxa favouring habitats of high disturbance and high fertility are overall suggestive of intensive crop husbandry, probably in small plots.

Larger numbers of samples containing 50 or more cereal items were available from sites covering the **Middle and Late Iron Age**, many of the contexts coming from pits. The shift in favour of spelt continued but a proportion of emmer persisted, probably grown as a maslin with spelt. This suggests emmer was not strongly selected against. A mixture of spring and autumn sowing was identified for the glume wheats in the Middle Iron Age, with only autumn sowing identified in later samples. This period also saw the introduction, or an increase in the use, of new crops such as nitrogen-fixing pulses (pea and Celtic bean). This may have been a response to lower soil fertility due to over-use of land or following an expansion of arable agriculture onto less tractable soil types, facilitated by developments in plough technology. The types of weeds also point to more extensive husbandry methods. Rye first appears in Middle Iron Age samples at Sigwells though in very low numbers, possibly representing a commensal of other crops.

In the **Romano-British** period, autumn sown spelt is the dominant glume wheat type. Barley declined slightly compared to wheat, and rye increased to a level similar to that of emmer. Radiocarbon dating calls into question finds of free threshing wheat grains before this period. The most secure date for the introduction of free threshing wheat as a separate crop comes from the Late Romano-British period at Ladyfield 3, if not later. This reinforces the repeated scepticism voiced each time free threshing wheat is suggested as a major cultivar before the early medieval period (e.g. van der Veen 1992, Campbell & Straker 2003).

Due to uneven representation of archaeobotanical remains, it is difficult to separate completely differences relating to location from those relating to chronological period. Of the three larger localities, the Central area stands out because of the relative importance of emmer (and free threshing wheat) especially in the early samples but also through the Iron Age at sites like Homeground. The Sigwells area is characterised by spelt. Sheepslait, having a similar limestone scarp position, might be expected to produce an archaeobotanical assemblage resembling that of Sigwells, but instead the crop composition shared similarities with both Central and Sigwells. The weed assemblage from Sheepslait was clearly distinguished by the prevalence of weeds closely associated with highly disturbed arable/ruderal habits, and weeds suggestive of the spring sowing of glume wheat. In contrast, the weed assemblages from the Central and Sigwells areas appeared similar to one another, indicating lower levels of disturbance and, from the Middle Iron Age, weeds suggesting autumn sowing of glume wheat. This highlights the nuanced differences that can be seen in the crops grown and their husbandry even across what, compared to some regional reviews and synthesis, amounts to a small geographical area.

8.3 Were there differences in the sourcing and use of wood over time and in different locations?

Most of the wood charcoal recovered is likely to represent fuel use. The range of species utilised was relatively stable through time. However, differences between the taxa represented were shown to be more closely linked with site than with chronological period. As expected for lowland Britain, deciduous oak (*Quercus*) tended to be the most ubiquitous taxon. Samples from the Iron Age Sigwells West pits were distinguished by particularly high proportions of oak in combination with smaller hedge or scrub species, while the periods before and after this were marked by high levels of ash (*Fraxinus*) thought to be more typical of the location. All taxa are consistent with mixed lowland woodland, woodland edge, and consequently hedges. Charcoal fragments from oak and ash, potentially large trees, frequently showed weak ring curvature indicative of timbers and large branches. There seems to have been a general increase in the Iron Age in the use of smaller hedge, scrub or woodland edge species, particularly from the *Prunus* spp. group. These species included greater numbers of charcoal fragments with strong ring curvature indicating the use of smaller branches and twigs. This trend may relate to increased clearance of woodland and the use of wood from closely managed areas or hedgerows, as suggested by pollen profiles and waterlogged evidence from nearby regions. However, the fragmented nature of the assemblage means that other indicators of management could not be further addressed.

8.4 Wider archaeological implications of the study

Crops and their weeds have provided a greater understanding of crop husbandry practices in the SCEP landscape, where the majority of the population were directly involved with agricultural production. This has implications for the organisation of annual agricultural tasks, as has previously been suggested for the

Danebury area (Campbell 2000a, Hamilton 2000) and wider task-scape. For example, spring sowing in the Bronze and Early Iron Age would have permitted a relatively mobile settlement pattern and open use of the landscape in what has been interpreted from the land divisions as a largely pastoral economy (Randall 2010) something akin to ranching. Sowing in spring reduces the proportion of the year that crop fields needed to be directly protected and tended to ensure a harvest. A shift towards greater prevalence of autumn sowing in the Iron Age, when coupled with settlement patterns and land divisions, may indicate an increasingly less mobile society with stronger claims to particular areas of the more divided and bounded landscape. The suggested shift from a small-scale intensive regime to an extensive regime contributes to discussions of both the physical and social organisation of the landscape. Extensive crop husbandry would tend to take up more of the landscape, reducing the amount available for grazing but a lower input of labour per unit of land perhaps allowed the support of greater numbers not directly involved with food production.

The wood charcoal results, as well as 'dressing the stage' with vegetation, also suggest the expansion of intensively used land and possible stress on the tree species available. Whether this was due to loss of these species from the habitat due to overuse or to restrictions on where people were sourcing wood in a more highly controlled landscape is hard to ascertain. As well as clearance for cultivation and the sourcing of wood, pressures on tree cover would have included the grazing of growing herds and possibly foddering. Despite its low archaeological survival, wood would have been one of the most important, and at times abundant, resources in the SCEP landscape, vital for tasks such as construction but particularly important as fuel.

As well as clarifying that free threshing wheats are not major crops at SCEP Pre-Romano British sites, directly dating a number of the SCEP grains added yet more examples of the problems in interpretation of such grains and highlighted the continued need for caution in their identification elsewhere. The radiocarbon dating contexts by cereal grains, flax seeds and hazel nutshell has also been important in refining the pottery sequence and therefore landscape sequences for the South Cadbury region, which is having an impact further afield.

8.5 Future work

More recent, and ongoing, archaeological excavation and survey within the SCEP region, such as that at Crissells Green (2008), the emergency excavation at Castle Farm (2009) and new investigations, mostly test pitting of fields south of the hillfort around the village of Sutton Montis and further afield, continue to provide additional archaeobotanical evidence for the SCEP region. The results presented here can provide focus and direction to further archaeobotanical research on this new material, in particular in relation to agricultural intensity and changes in crop husbandry practices.

There is also further scope for the archaeobotanical results to be used in conjunction with data from the other finds categories. This may go some way towards addressing new questions relating to site-based spatial patterning and more general taphanomic investigations. This too might feed into chemical analysis of a collection of soil sub-samples retained from the bulk samples before flotation, originally used in magnetic susceptibility.

It would be particularly interesting to compare the SCEP archaeobotanical samples more formally with the individual sample results from other sites as well as projects from the wider region and beyond. Correspondence analysis could be extended to include samples of crops, weeds and charcoal from other sites, alongside the SCEP samples. These might include nearby Yeovilton (Pelling 2006), Ilchester (Murphy 1983), Brean down (Straker 1990), and sites from the wider region of southwest Britain. Of particular interest and relevance will be new archaeobotanical work taking place ahead of quarrying just 17km away at the hillfort of Hamdon or Ham Hill (Sharples pers. comm.). This is of interest because of the proximity of Ham Hill to Cadbury, and the similarities in landscape position, on the edge of the high ground and at the interface of the Wessex region and the southwest. This larger dataset would allow comparison with other regional studies such as Campbell's work on the Danebury environs and those based on a much larger super-regional scale such as northeast Britain (van der Veen 1992), as well as newer syntheses such as that for eastern Britain

(Parks 2012) and the overviews of the Thames Valley (Lambrick & Robinson 2009, Robinson 2011, Hey & Robinson 2011a, 2011b).