The Mesolithic of the wetland / dryland edge in the Somerset Levels

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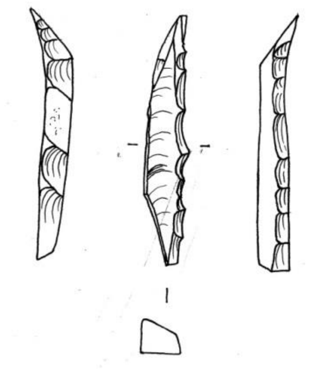

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The Mesolithic of the wetland / dryland edge in Somerset: Executive summary

The project has involved an audit and updating of existing HER data for the Mesolithic in Somerset, leading to a 40% increase in entries. Field techniques have been developed and applied to locate two stratified final Mesolithic sites with palaeoenvironmental and palaeoeconomic potential. This involved a combination of borehole surveys, geophysics and test pits to examine the evidence for Mesolithic and early Neolithic activity at the wetland / dryland interface in the Somerset Levels. Palaeoenvironmental studies provided evidence of the changing character of the wetlands beside three known Mesolithic sites, each situated on sandy burtle sediments of Pleistocene date, at Greylake, Chedzoy and Shapwick. The environmental evidence provided by these three sites is mainly of the late Mesolithic and early Neolithic. There is a fourth case study of Queen's Sedgemoor where a long peat sequence was examined which dates to 5600-200cal BC, but with an unfortunate gap of non-preservation at the Mesolithic/Neolithic transition. There were additional small-scale test pit investigations of other burtles in Shapwick parish in the Brue valley.

The project also provided the opportunity to synthesise borehole evidence from four geoarchaeological projects in the middle Parrett valley carried out prior to engineering works. These data provide a basis for reconstruction of the palaeotopography and palaeoenvironments of the valley in the early and middle Mesolithic, thus complementing the later Mesolithic focus of the three case study sites.

Previous records of site distributions and lithic artefacts from Somerset, and particularly the Levels, have been synthesised while the lithics from our own excavations are also reported.

The palaeoenvironmental methods employed varied according to the intensity of investigation and the potential of each site. All investigations at the four case study sites involved pollen and plant macrofossil analysis. Other palaeoenvironmental techniques employed at selected sites included non-pollen palynomorphs, charcoal, diatoms, ostracods, foraminifera, molluscs, insects, sediment micromorphology and particle size analysis.

The chronology of changing environments and Mesolithic and Neolithic human activity is provided by 58 radiocarbon and two optically stimulated luminescence dates. The development of dating models at an early stage in the post-excavation process facilitated the targeting of palaeoenvironmental analysis at the horizons most relevant to research questions and project objectives. The chronological model has facilitated comparison with the results of the Somerset Levels Project which involved outstandingly important investigations of Neolithic to Iron Age sites but did not excavate any Mesolithic sites.

The results of our investigation demonstrate that Mesolithic sites at Shapwick and Chedzoy, previously thought of as mainly early and middle Mesolithic respectively, and thus predating the development of peats in their area and of limited potential for organic preservation, both include artefacts and biological evidence of the final

centuries of the Mesolithic. It is notable in this context that sites representing the last millennium of the Mesolithic are rare in England.

A significant outcome of this project is that, with the long established evidence for early Mesolithic, recent evidence of middle Mesolithic and this new evidence of final Mesolithic assemblages at the burtle sites at Shapwick and Chedzoy, there is the potential on both sites for evidence relating to each of the key stages of the Mesolithic as well as the transition to the Neolithic.

There is some evidence for Mesolithic burning from around 6000 cal BC at Shapwick and Queen's Sedgemoor in addition to that previously reported in intertidal coastal contexts at Minehead and Burnham. There was limited evidence for human activity around the Mesolithic-Neolithic transition but there is clearer evidence of activity, probably relating to pastoralism from pollen and insects at Shapwick and from pollen and non-pollen palynomorphs at Chedzoy, in both cases from *c* 3300 cal BC.

Test pits at Brickyard Farm on Shapwick Heath produced evidence of stake and postholes associated with charcoal dated to the Mesolithic- Neolithic transition, suggesting that such small islands of dry ground may have been foci for activity at this date.

Deeper peat sequences dating back to 6000 cal BC were investigated at Queen's Sedgemoor, Greylake and the middle Parrett Valley. None of the sediments encountered were as early as the Greylake human burial evidence of the ninth millennium cal BC. The topography of the early Mesolithic in the Parrett Valley is now much better understood and it is suggested that some of the techniques employed in the present study (pollen, charcoal and non-pollen palynomorphs) would help to locate deeply buried Mesolithic sites if used in future borehole investigations.

Recommendations are made for the maintenance of year-round high water tables in the Brue valley to maintain suitable conditions for both surviving trackways and the Mesolithic sites especially at Shapwick Burtle. Fortunately the Brue Valley sites are largely in Nature Conservation ownership. Our excavations at Shapwick showed good wood and peat preservation above the level of the Sweet Track which is 20 m east, thus indicating that preservation conditions may be more favourable than was indicated by recent water table monitoring. In the Kings Sedgemoor area, three sites with high potential, and in need of sensitive future management, are identified at (i) The Chedzoy- Sutton Hams – Mount Close Batch area, where this survey has demonstrated survival and significance at Chedzoy, (ii) the wetland between Chedzoy and Westonzoyland, not investigated by us, but indicated by previous work, (iii) the wetland north of Greylake where this project investigated a peat sequence of high potential.

The project has contributed to raising the public profile of the Mesolithic period locally and nationally and it is argued that a state of the art research-led excavation, perhaps on a modest scale, is the logical way of building on the success of this project and advancing our understanding and awareness of the Mesolithic and the transition to farming.

Acknowledgements

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Chapter 1: Introduction to the project
by Martin Bell

Background

The Somerset Levels and Moors is one of England's largest lowland wetland areas and of great importance for the preservation of well stratified prehistoric sites and biological remains which enable palaeoenvironmental reconstruction. Until now, however, the Mesolithic archaeology of the area has received little attention except from those studying lithic artefacts. Mesolithic sites are known particularly from many 'islands' of Pleistocene Burtle Formation beach and nearshore sands and from some wetland edge areas of 'hard' geology. The edges of many of these sites are buried below Holocene wetland sediments offering the potential for organic preservation. The existence of early Mesolithic human remains at Greylake and numerous Mesolithic flint tools on these 'islands' that only rise slightly above the present floodplain suggest that well stratified sites are likely to exist along their margins. Recent palaeoenvironmental investigations have also demonstrated the presence of Mesolithic river and lake systems within the Brue and Parrett valleys.

The potential of the 'island' sites to transform our understanding of the Mesolithic was highlighted by discoveries of waterlogged sites on the Mesolithic wetland edge at the Welsh side of the Severn Estuary, particularly on the edge of a former island at Goldcliff (Bell 2007) and the dryland edge at Llandevenny (Brown 2005, 2007). The potential of coastal and riverine wetland edges was further highlighted by Bell *et al* (2006), and in the archaeological resource assessment for South West England (Webster 2008), in the Mesolithic section of the Maritime Research Frameworks (Bell *et al* 2013) and in the Mesolithic Research and Conservation Framework (Blinkhorn and Milner 2014).

The continued existence of well stratified wetland / dryland Mesolithic sites is threatened by desiccation of the waterlogged deposits, especially where they occur at the edge of the 'islands' of hard geology in the floodplain. This threat is intensified where arable farming occurs. In the areas outside the SSSIs in the Somerset Levels it is thought that arable farming may increase because of the significant changes to agri-environment schemes that have taken effect from 2012 onwards. This would pose particular risks for sites at the wetland edge.

Wilkinson and Bond (2001) highlighted that in a sedimentary environment such as the Somerset Levels there will be differential representation of types of site depending on the extent to which they are buried. Early Mesolithic wetland and wetland edge activity will be deeply buried within the Lower peats.

Research Aims and Objectives

Research Aims

- How significant was the wetland edge to communities at different stages of the Mesolithic?
- What contribution can Mesolithic wetland edge sites make to key research questions in the Mesolithic, eg the role of plant resources, the manipulation of

plant resources by fire, questions of seasonality and sedentism, the relationship between burial and settlement?

- Improved understanding of how the wetland landscape changed during the Mesolithic period and its relationship to settlement patterns.
- Do wetland edge sediments preserve traces of footprint-tracks of people and animals as at the wetland edge in the Severn Estuary Levels?
- Is there evidence of late Mesolithic activity especially in the last millennium of the period?
- Do the distributions, date, sedimentary context, artefacts, economy and character of wetland edge Mesolithic sites indicate any continuity of activity between Mesolithic and initial Neolithic communities?

Methodological aims

- Development of exemplary methodological approaches to the assessment of the Mesolithic of the wetland edge which can be applied in other geographical areas.
- To combine coring, geophysics, test pitting and environmental analysis to establish sediment sequences at the wetland edge without large scale excavation.

Management aims

- Review and collate existing information on the Mesolithic of the Somerset Levels enhancing the Historic Environment Record (HER).
- To undertake fieldwork to identify well-preserved Mesolithic sites at the wetland / dryland edge.
- Identify and assess deposits of Mesolithic date that are likely to have a high palaeoenvironmental potential.
- Improve understanding of the potential threats facing Somerset Levels wetlands.
- Identify landscapes with high potential for the preservation of Mesolithic sites feeding into the wider management objectives of the Avalon Marshes Landscape Project.
- Contribute to the development of effective strategies combining heritage protection with nature conservation.

Outreach aims

- To raise the profile of Mesolithic wetland archaeology regionally and nationally so that there is understanding and support for management strategies which protect these heritage assets.
- To ensure that those involved in the development of nature conservation strategies in the Somerset Levels are aware of the significance of Mesolithic sites and associated sediments in terms of the evidence they provide for the past trajectories of biological communities of conservation significance.

Objectives

- Enhancement of Mesolithic data on the Somerset HER.
- Improved methodology for the investigation of wetland / dryland edge sites with minimum excavation.
- Establish whether well stratified sites of Mesolithic date survive at the wetland edge.
- Improved methodology for the correlation of borehole, test pit and geophysical data (especially GPR) at the wetland / dry-ground interface.

- Establishment of the nature and timing of Mesolithic activity at key wetland edge sites.
- Establish the potential of wetland edge sites to preserve significant organic and palaeoenvironmental evidence.
- Enhanced understanding of the changing geography and environments of the Somerset Levels Mesolithic including areas little investigated previously such as Queen's Sedgemoor, Kings Sedgemoor and Southlake.
- Improved understanding of the threats to Mesolithic heritage assets, wider recognition of the significance of these assets, recommendations to reduce the impact of the threats, including recommendations which take account of the combined requirements of heritage and nature conservation.

Research need

This proposal addressed the objective identified in the National Heritage Protection Plan (Topic 4G) of developing a framework and guidelines for assessment of the significance of buried early Holocene sites at the wetland / dryland edge. This has been achieved by bringing together, and substantially extending, ongoing archaeological and palaeoenvironmental research by the four partner organisations in the Somerset Levels focusing activities for the first time in this area on the Mesolithic Heritage resource. The four partner organisations are : The Department of Archaeology, University of Reading; Somerset County Council Heritage Service; The Department of Archaeology, University of Winchester; The Natural History Museum. Each has been responsible for specified parts of the project: Reading : Shapwick Burtle and Chedzoy; Somerset: HER aspects; Other burtle investigations in the Brue Valley, community involvement; Winchester: Greylake and synthesis of previous palaeoenvironmental work in south Somerset Levels; Natural History Museum: Queen's Sedgemoor. The project has achieved considerable added value because Somerset County Council has provided match funding to follow on from work it has already undertaken on Mesolithic sites and deeply stratified stratigraphic sequences in the Parrett valley and Queen's Sedgemoor. The project has also benefited from association with the HLF funded *Avalon Marshes Landscape Partnership* project in terms of community participation and the development of potential conservation, research and public education projects.

The agri-environment schemes applicable to the Somerset Levels and Moors are in the process of change. A new scheme, called Countryside Stewardship, is due to begin in July 2015. This scheme is designed to be more specifically targeted compared to previous schemes, focusing especially on SSSIs and the need to get them into 'favourable condition' . This means that the geographical extent of agri-environment support on the Somerset moors will be significantly reduced outside the SSSI boundaries. There is therefore a very significant threat that the unalleviated pressure of market forces will lead to more arable farming on peat soils, especially for maize. This is likely to increase pump drainage in the area and possibly the installation of sub-surface drainage. The probable extension of the area under arable will also create pressure on the Internal Drainage Board to implement hydrological regimes that are favourable to the new land uses. All these pressures are likely to increase the rate of peat wastage through aeration and desiccation.

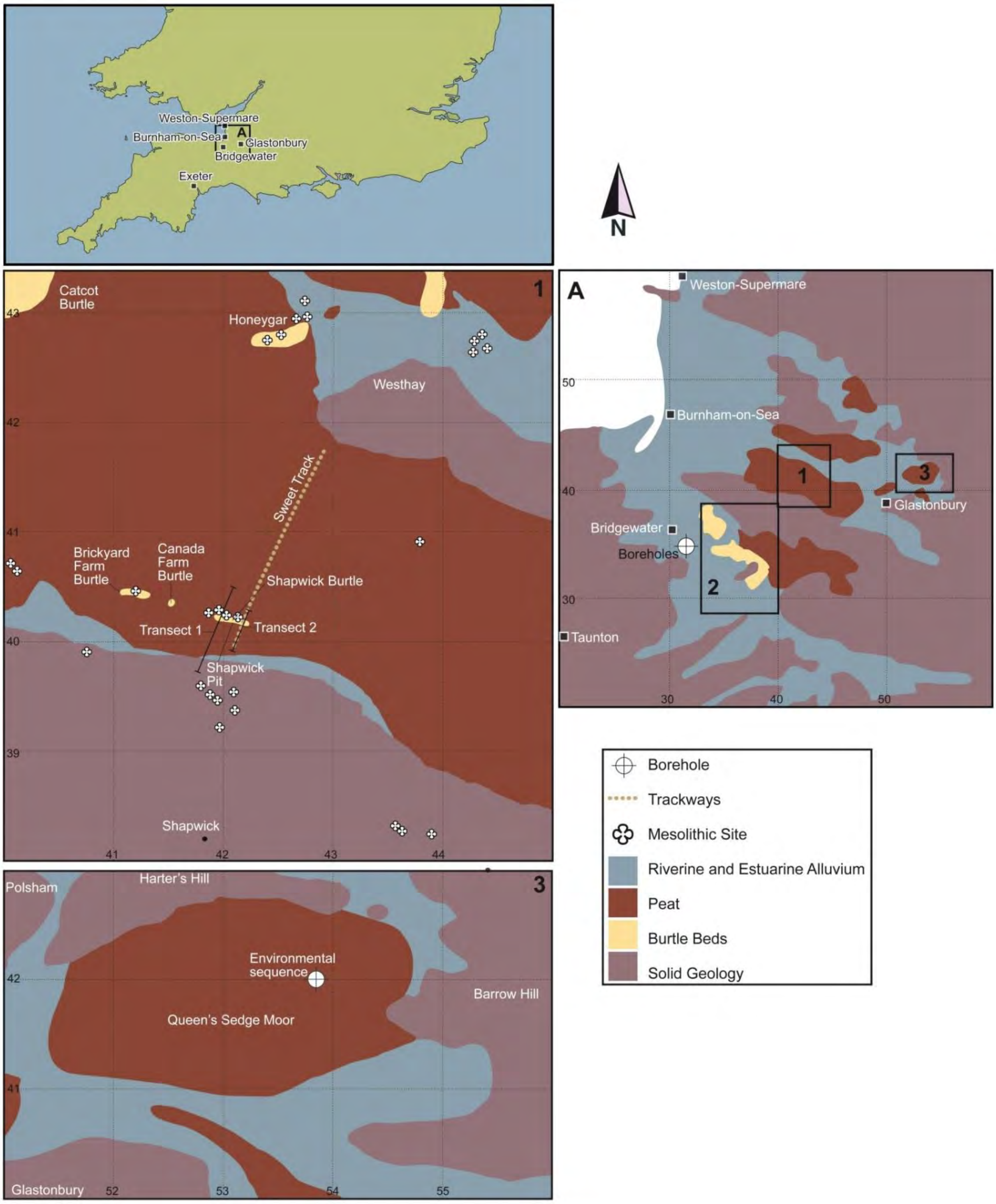

Figure 1.1. The study area showing (1) the Shapwick and adjacent sites and (3) the Queen's Sedgemoor case study. The King's Sedgemoor area (2) is shown in Figure 1.2 (Graphic S. Lambert-Gates).

In the Brue Valley many of the islands known to contain Mesolithic flint (Figure 1.1) lie within SSSIs and several are under the direct ownership of nature conservation bodies (Natural England, Somerset Wildlife Trust, Hawk and Owl Trust and the RSPB). It is intended that the project results will inform and promote suitable land management practice by these organisations for Mesolithic sites and deposits of palaeoenvironmental significance. This would build on existing co-operation, for example with the management of the Sweet Track, and will provide a model for replication elsewhere in the country.

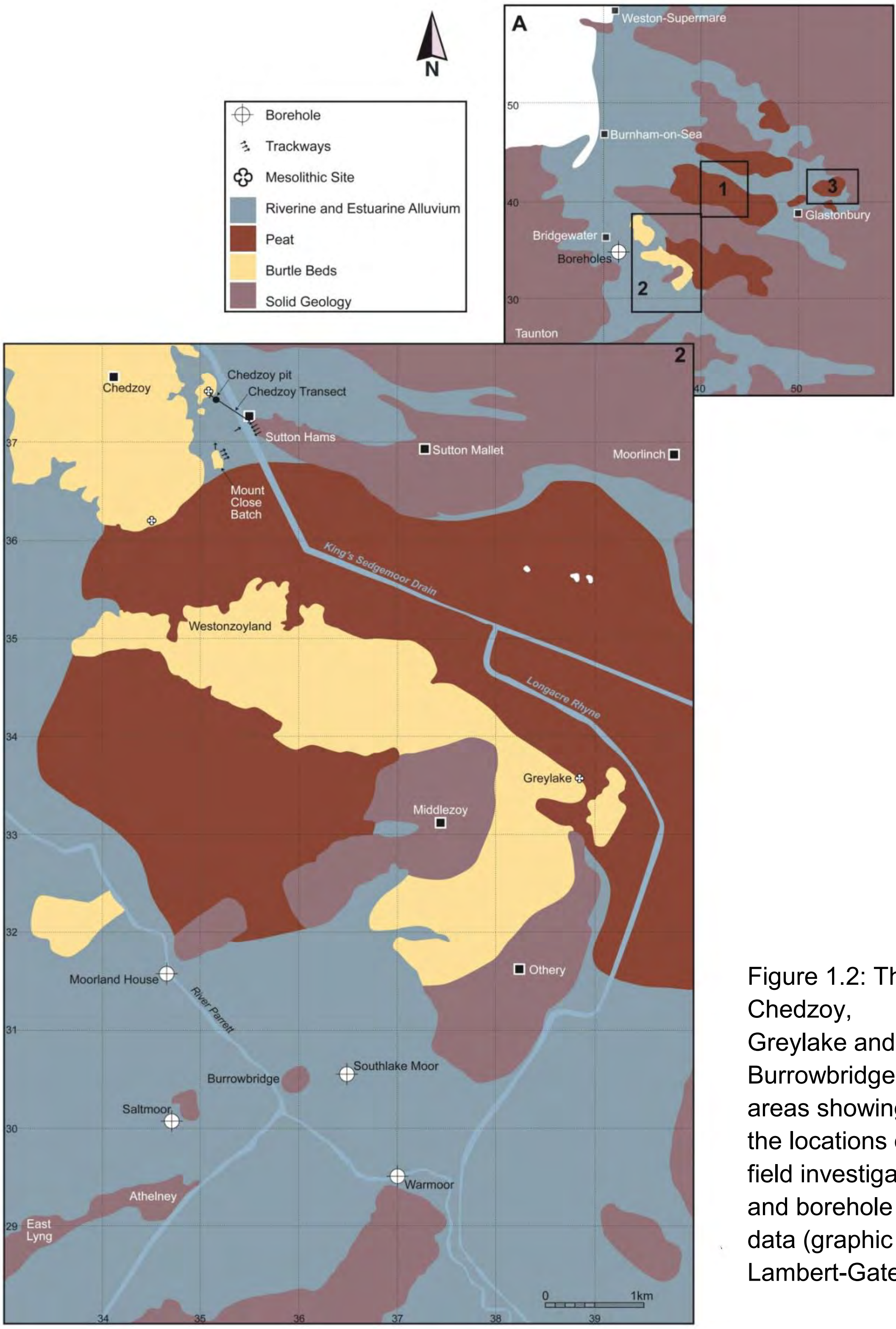

Figure 1.2: The Chedzoy, Greylake and Burrowbridge areas showing the locations of field investigation and borehole data (graphic S. Lambert-Gates).

Project Scope

The study area focuses on the Levels and Moors area in the present county of Somerset. This represents the historic lowland floodplain. This does not include North Somerset and the North Somerset Levels. The synthesis of known Mesolithic archaeology and the updating of HER information applies to the present county of Somerset excluding Exmoor National Park (ENP, which has a separate HER).The palaeoenvironmental analysis as part of this project has focused on four key sites (Shapwick; Chedzoy; Greylake and Queen's Sedgemoor) where high potential had been demonstrated. The project also includes prospection for other Mesolithic wetland sites on other burtles in the Shapwick Heath area of the Brue valley but it did not include palaeoenvironmental work on those additional sites. The project included synthesis of results from the Burrowbridge area where boreholes and analysis have been funded from other sources.

Historic Environment synthesis and enhancement (led by Richard Brunning). A desk based survey led by Richard Brunning synthesised all the available data for Mesolithic sites and some related palaeoenvironmental information for the Somerset Levels. C.J. Bond's involvement enabled the integration of data from his research (Bond 2006) into the HER and project synthesis. A review of lithics in aggregate producing areas (including the Burtle beds) has been conducted as part of the EH administered Aggregates Levy Sustainability Fund (Firth and Faxon 2008). That work has also informed the synthesis.

Interfaces
The proposed project has interfaced with several other projects. Somerset County Council has funded palaeoenvironmental assessment of parts of the Parrett floodplain (including the Burrowbridge and Southlake Moor area) through the 'Somerset Rivers Project'. This has identified the existence of a late Mesolithic river system and a freshwater lake in that part of the floodplain.

In addition the SCC managed 'Lost Islands of Somerset' project (funded by SCC and Leader +) has been investigating the archaeology present on some of the 'islands' of hard geology that rise above the floodplain. This has included dating of the early Mesolithic human remains from Greylake and analysis of the flint assemblage from that site as part of a 'Greylake Project', which is being undertaken by SCC and Oxford University. The present project has provided resources for the Greylake coring and core descriptions, dating and palaeoenvioronmental analysis.

The Avalon Marshes Landscape Partnership (AMLP) is an HLF project in the Brue valley that seeks to conserve and enhance the cultural heritage of the area as part of its remit. This created the opportunity to devote some of the community archaeology component of that fieldwork towards further investigation of the Mesolithic potential of the numerous islands of burtles and hard geology in the area through test pitting (eg Shapwick Heath). SCC and EH are both partners in the project. The results of this project proposed have helped to develop management strategies and further investigation of such sites in the latter stages of the AMLP and is expected to inform the development of follow on work for proposal to the HLF. The AMLP has provided some of the funds for the test pitting and the Mesolithic outreach day, via SCC (note:

these funds were not drawn from the AMLP project elements that EH is financially supporting).

The project has also interfaced with Mesolithic research on wetland / dryland edge contexts especially in the Severn Estuary levels at Goldcliff with its abundant evidence for Mesolithic human and animal footprint-tracks (Bell 2007). All these studies take place under the wider umbrella of the Severn Estuary Levels Research Committee (chaired by Dr Brunning) which provides interface with other projects in the area.

Introduction to the geology and sediments

The Somerset Levels are an extensive area of reclaimed Holocene wetland lying between the upland area of Mendip Carboniferous Limestone to the north, Jurassic Lias and Oolite to the east and Devonian rocks of the Quantock Hills to the west. Valleys were incised deeply into the solid geology in the Pleistocene, valley floors are up to 19m below the present level in the Brue valley. Buried Pleistocene glacial sediments have been claimed in parts of the Somerset Levels (Campbell *et al* 1999).

During interglacial periods higher sea level resulted in marine incursions into the Levels leading to in the deposition of sandy and muddy shoreline and sub-tidal sediments which are known as burtles and are exposed as sandy islands within the Somerset Levels wetland. These Burtle beds (named after the village of Burtle in the Brue valley) were first described in the nineteenth century and subsequently by Bulleid and Jackson (1938; 1941) (Hunt 1998; 2006; Allen 2002). There is a current investigation of the burtle beds at Greylake by Prof A.Brown (pers. comm.). They principally date to the last Ipswichian interglacial but amino- acid racemisation indicates that lower parts of them may represent earlier interglacials. The burtles are of particular significance to the present project because Mesolithic sites including several of those investigated here are on these sandy 'islands'.

There are also Pleistocene terrace gravels west of the study sites in valleys draining the Quantocks and stony head deposits which formed as a result of slope process during cold stages. On the coast at Brean Down the cliff section exposes both head deposits and extensive blown sands derived from the bed of the Bristol Channel during the last glacial period of lower sea level. These aeolian deposits occur elsewhere along the coast of the Bristol Channel (Catt 2001) and may also be expected to underlie parts of the Somerset Levels stratigraphy.

The palaeotopography and inundation history of the area were investigated using borehole evidence by Kidson and Heyworth (1976). A Bristol Channel borehole produced evidence of marsh / fen and possible lake margin deposits (Brown 1977). Since then a much fuller picture has been obtained by commercial, archaeological and other boreholes and some of that evidence is included in this report. In the early Mesolithic, before sea level rise progressed into the Somerset Levels there were riverine environments and evidence has recently been found as reported here for possible lacustrine areas.

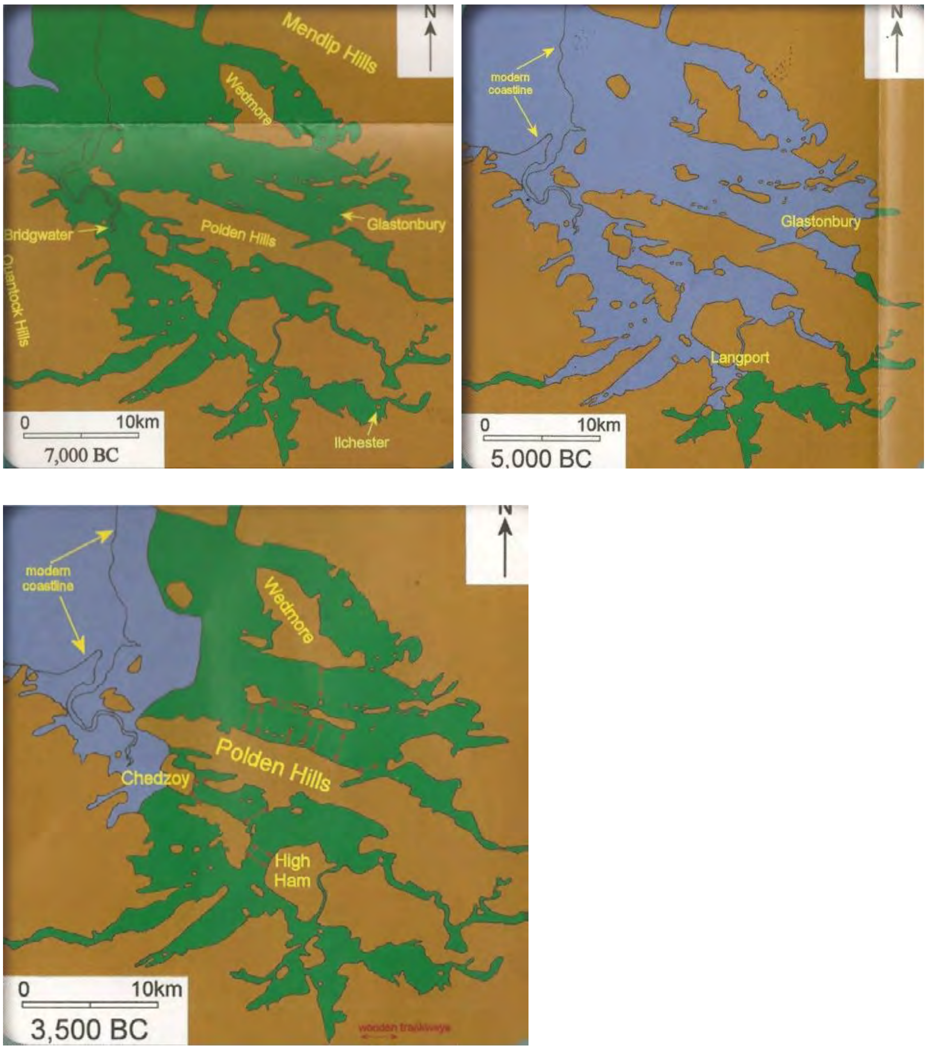

Figure 1.3. The key stages in the Mesolithic and initial Neolithic of the Somerset Levels: 7000cal BC riverine and lacustrine valley but slopes and hills dryland, 5000 cal BC Marine incursion with estuarine sediments, 3500 cal BC peat formation wooden trackways (Neolithic to Iron Age) are shown in red (after Brunning 2013b).

In response to the rapid rate of relative sea-level rise during the early Holocene, the valleys of the Somerset Levels became extensively flooded. However, prior to marine inundation across much of the Levels, this positive sea-level tendency resulted in a rise in the regional water table which, in turn, led first to the localised formation of fen and then reed peat (paludification) in marginal freshwater environments. The rate of sea-level rise eventually outpaced that of biogenic terrestrial sedimentation and peat formation was followed by estuarine mudflat and saltmarsh environments during the Mesolithic. During phases of reduced marine influence reed peats and wood peats extended seawards. These are exposed intertidally along the shoreline at Minehead where they are dated to the later Mesolithic 5600-4500 cal BC (Jones *et al* 2005), Burnham 5474-3374 cal BC (Druce 2005) and Brean, 4708-4253 cal BC (Bell 1990). Radiocarbon dating and dendrochronology at Stolford show peat accumulation coinciding with the Mesolithic - Neolithic transition (Hillam et al 1990; Campbell and Baxter 1979). The development of coastal sand / gravel barriers will have reduced marine influence in some areas as shown at Porlock where various episodes of peat formation occurred between *c* 6400-3800 cal BC. (Jennings *et al* 1998). Those sites where peat formation spans the Mesolithic- Neolithic transition at Stolford, Porlock and Burnham are of particular palaeoenvironmental interest. With reduced marine influence and as the rate of sea level rise reduced and sedimentation occurred in the wetlands so, near the end of the Mesolithic, open estuarine environments were replaced by reedswamp and then a hydroseral succession to fen woodland and raised bog in the Brue valley. In the wetter area of Kings Sedgemoor there was extensive reed and sedge peat but only localised raised bog (Alderton 1983). Due to the relative distance from the palaeoshorelines, peatlands continued to form, more or less uninterrupted, in the inner river valleys such as the Brue and Kings Sedgemoor and Queen’s Sedgemoor~~,~~. However, occasional episodes of mid-Holocene marine incursions are evident in seaward areas, with corresponding episodes of freshwater flooding and *Cladium* sedge growth further inland. Along the coast minerogenic saltmarsh sedimentation continued with occasional seawards extensions of peat in periods of reduced marine influence until the wetlands were drained and probably protected from marine inundation by seawalls, first temporarily in the Roman period and then following post Roman marine incursion by drainage and reclamation in Saxon, Medieval and later times. The topography of the area has subsequently been greatly affected by the effects of drainage since the Roman period. Some of the burtles may once have been completely buried by peat and hence many will have increased in size as peat wastage has proceeded. This implies the possibility of reasonably preserved but vulnerable contexts along the burtle margins. Similarly, peat wastage resulting from drainage and farming activity revealed the ‘lake villages’ at Glastonbury and Meare. In addition, peat cutting has had a significant impact on the landscape and its cultural heritage, with peat cutting being responsible for the discovery of the wooden trackways and associated artefacts that typify Somerset Levels.

The peat lands are separated by higher ridges and islands of solid geology and from north to south these comprise: the Wedmore ridge; the islands at Meare and Westhay; and the Polden Hills. Smaller lower islands are formed by the sandy burtle and rise slightly above the peatlands. In the Brue valley these include the Shapwick Burtle and burtles at Brickyard Farm and Canada Farm which have been investigated by this project. In the catchment of the Parrett valley and Kings Sedgemoor Drain the Burtles include Chedzoy and Sowey island where investigations have been carried out as part of this study, the latter at Greylake. The margins of the islands both of bedrock and burtle sand are buried by accumulating peat and consequently many of the prehistoric trackways were created to provide crossing places between the islands of solid geology and the burtles.

Mesolithic and Neolithic Archaeology

The archaeology of the Somerset Levels has been more thoroughly investigated and is better known than that of any other area of British wetland mainly due to the Somerset Levels Project which ran from 1973-1989. Full accounts of the discoveries are published in 15 volumes of *Somerset Levels Papers* (Coles *et al* 1973-1989) and in a summary book (Coles and Coles 1986). Subsequent work, with an emphasis on conserving the wetland archaeological resource, is reviewed by Brunning (2013).

The sites investigated by the Somerset Levels Project were Neolithic to Iron Age and there were no excavations of Mesolithic sites. The project did, however, carry out fieldwalking and recorded flint scatters on the bedrock and burtle areas, many of these were Mesolithic.

In the 1930s Mesolithic flints were found by H.S.L. Dewer on the Burtle Beds at Greylake (Middlezoy) and Shapwick and reported by Clark (1933). Wainwright (1960) published larger collection of lithics from both sites, noting the similarity between the two assemblages which were characterised by non-geometric microliths, and burins with the presence of tranchet axes he assigned the assemblages to the early Mesolithic. Jacobi (1979, 50) considered the Shapwick assemblage somewhat later omitting Shapwick but not Greylake from his map of early sites. Subsequently Norman (2001, 34) and Bond (2007) have identified a proportion of later Mesoilithic material Shapwick and some other burtle sites. As part of the Somerset Levels Project , Brown (1986) published flint finds from peat and fieldwalking in the Brue valley. The main concentration of Mesolithic flint (Brown 1986, fig 5) was on the burtle beds at Burtle itself, Honeygar Farm, Peacock Farm, Shapwick burtle, Canada Farm, and Edington Burtle. There was also a scatter of Mesolithic findspots on the north edge of the Polden Ridge particularly around Ashcott and Shapwick. Brown noted the complete absence of late Mesolithic forms, arguing that none of microliths need be later than 6th millennium cal BC, although he noted that later Mesolithic activity may have been masked by peat growth at the wetland edge. He reported a few early Neolithic flints at Burtle itself and Peacock

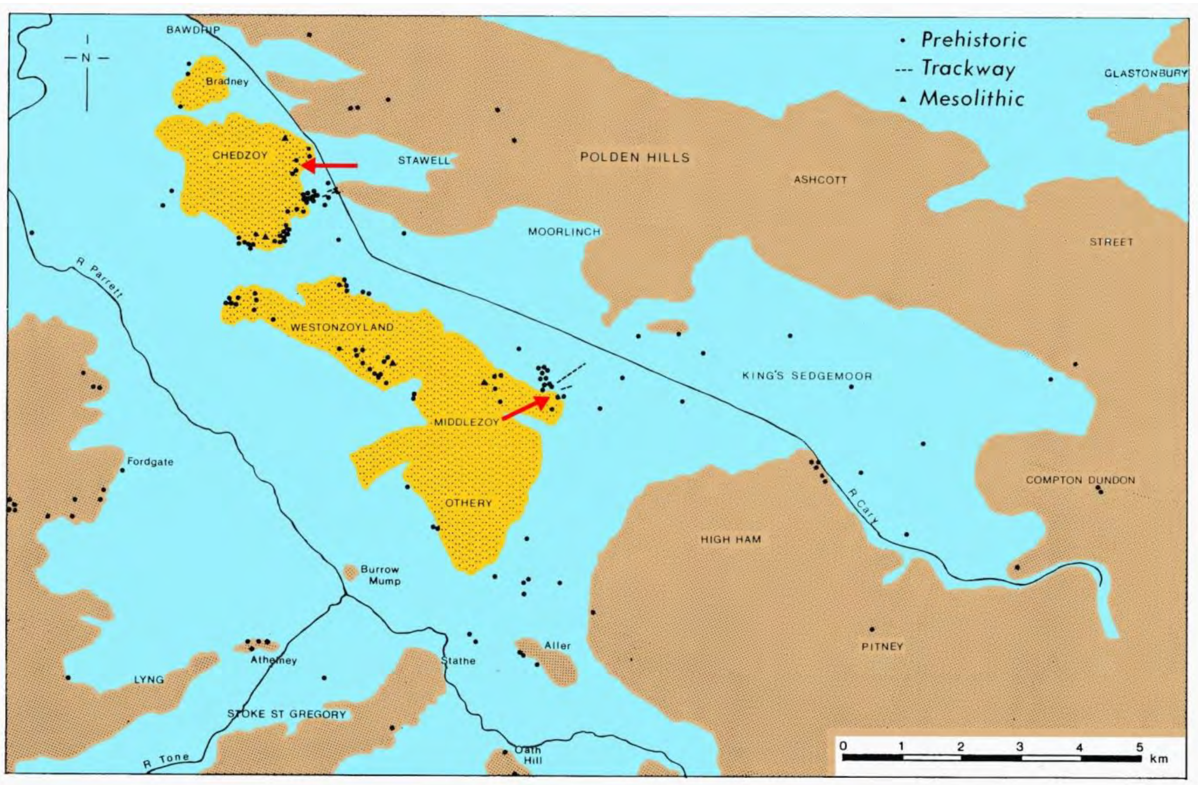

Figure 1. 3. Kings Sedgemoor showing prehistoric finds recorded by the Somerset Levels Project. Burtles are shown in yellow, wetland in blue, solid geology in light brown (from Coles 1989). The red arrows show the location of sites investigated upper arrow at Chedzoy, lower arrow at Greylake.

Farm but most of the Neolithic flints were from the peatlands most notably along the Sweet Track. The work of the Somerset Levels project was very much focused in the areas where peat was being cut in the Brue valley. There was no excavation, but some stratigraphic investigation and field observations, eg in cut drains, in the King's Sedgemoor area and also fieldwalking on the surrounding dry ground Polden slopes and the burtles. This aspect drew on the fieldwork of C.J. Norman (Figure 3; Coles 1989). It revealed a marked concentration of prehistoric, mainly lithic, activity on the east side of Chedzoy burtle and in 4 or 5 clusters on the Sowy burtle (that occupied by Westonzoyland, Middlezoy and Othery). In reviewing the Somerset Levels project Coles (1989) concluded that this Mesolithic activity was mainly ninth to seventh millennium. Subsequently Norman (2001) has published an important paper on the Mesolithic activity at Chedzoy (Parchey), a site immediately adjacent to the wetland sedimentary contexts examined here. The assemblage he considered was the only one in Somerset to produce significant amounts of later Mesolithic artefacts, typologically he suggested a date c 7000-5000 BC. In discussing this material Norman also noted some individual later Mesolithic artefacts among the assemblages from Brue Valley sites at Shapwick and Edington Burtle and Brickyard Farm. The Chedzoy assemblage is especially notable for the occurrence of types of hollow based points more familiar from the Horsham type assemblages of the Weald to the east. That finding is of particular interest given the presence of lithic raw materials which may derive from the headwaters of the River Brue 40km to the east and chalk flint derived from the same direction all suggesting mobility along an east-west axis. A small number of early Neolithic artefacts were noted among the Chedzoy assemblage.

Further work was done at Shapwick as part of the multi-period Shapwick project (Gerrard and Aston 2007; Aston and Gerrard 2013, fig 3.3). Shovel pitting produced further Mesolithic artefacts on the Shapwick Burtle (Bond 2007) and a number of sites in the parish on the lower north slope of the Poldens Hills. Many of these areas also produced artefacts considered to be of early Neolithic date (Aston and Gerrard 2013, Fig 3.9). Brunning and Firth (2012) have reported on human skulls found in the sandpit at Greylake which had earlier produced a large Mesolithic assemblage, as well as later artefacts. Radiocarbon dating showed these skulls were of early Mesolithic date (8430-8270 cal BC (Wk-30930; 9118±37 BP) and 8450-8270 cal BC (Wk 30931; 9134±37 BP; Brunning and Firth 2011) deriving from the only open Mesolithic cemetery in Britain. A report on the lithic evidence found at Greylake between the 1920s and 1940s has recently been prepared (Shaw and Scott 2012). This comprises some 4000 artefacts of primarily early Mesolithic date, artefact types dated elsewhere between 9300 and 8800 cal BC. Osteological and isotopic work on the Greylake human remains by Dr R. Schulting (Oxford University) is in progress. The Greylake finds are immediately adjacent to the wetland contexts investigated as part of the present study.

Known Neolithic activity was concentrated in the areas of cut peat in the Brue valley where the Somerset Levels Project was focused. Some 25 Neolithic trackways were recorded and date between *c* 3838 BC (Post Track) and 2400 cal BC. The Sweet Track has been investigated in the greatest detail the main publications being Coles *et al* 1973, Coles *et al* 1979, Coles *et al* 1984. It was dated to the very beginning of the Neolithic in the area 3807-6BC (Hillam *et al* 1990). The Sweet Track is of particular relevance in the present study because the investigation at Shapwick burtle took place just 20m from its southern end against the burtle. The stratigraphic and environmental evidence from the track will be reviewed in the context of the present investigation. On Kings Sedgemoor possible trackways have been identified in drainage ditches at the edge of burtles at Moor Drove and Mount Close Batch and at the end of the Mercia Mudstone promontory at Sutton Hams where the tracks probably crossed to Mount Close Batch (Norman and Clements 1979; Norman 1980; Norman 2001). Two of these possible trackways from Mount Close Batch have been radiocarbon dated to the Neolithic (3670-3130 cal BC (HAR-4375; 4690±90 BP) and 3500-2920 cal BC (HAR-4374; 4510±80 BP).

Methodology

Methods Statement

- A desk top study has been undertaken led by Richard Brunning synthesising all the available data for Mesolithic sites and relevant palaeoenvironmental information from the Somerset Levels.
- Three main sites (Greylake; Chedzoy and Shapwick Burtle) have been investigated by coring and test pit excavation of preserved Early-Middle Holocene strata at the edge of the Burtle islands which are known loci of Mesolithic flint artefacts (Figures 1-3).
- The detailed methods for coring, test pits, environmental sampling and environmental analysis are outlined in Appendix 2.
- Test pitting on three or four other Burtle 'islands' in the Brue valley, (eg Brickyard Farm and Canada Farm and the western end of Shapwick Burtle) were undertaken to clarify the character and extent of the Mesolithic activity.
- The results of previous boreholes in the Burrowbridge area (Figure 2) were synthesised as part of an evaluation of the early to mid Holocene sequence in the Parrett Valley
- Three areas of geophysical survey (GPR) were undertaken by Paul Linford (English Heritage) to assess the potential of the technique for mapping buried deposits of early-middle Holocene date.
- One area of very deep (7.5m) peat was examined on Queen's Sedgemoor (Figure 1.3) and sampled to investigate the Mesolithic and Neolithic sections of this long peat sequence.
- The project archive will be deposited with the Somerset County Museum Service

7. Results

The project study areas are presented chronologically starting with the sites where the palaeoenvironmental sequences started in the 6th millennium cal BC continuing into the Neolithic at Queen's Sedgemoor and Greylake and then Chedzoy and Shapwick where the evidence is from the final Mesolithic and Neolithic.

Chapter 2: Synthesis of existing Mesolithic data from the Somerset Levels

by Richard Brunning and Jan Grove

Summary

Mesolithic Somerset encompassed a diverse and dynamic landscape with significant variation both spatially and chronologically. The archaeological evidence for the period in Somerset has some very significant limitations, most notably the lack of targeted excavations of Mesolithic sites. In other respects the county has significant advantages for Mesolithic research, including the comparative wealth of human remains and the great potential for palaeoenvironmental deposits and waterlogged remains.

The character of the later Mesolithic environment is moderately well studied from a small but significant number of palaeoenvironmental investigations, but the evidence for earlier landscapes is tantalisingly slight. Very little dating or analysis had been carried out on the deeply stratified deposits of the preceding millennia, until the recent work associated with Hinkley Point, this project and another English Heritage project on submerged landscapes (Sturt, 2013) .

The recovery of large quantities of human remains from caves in the Mendip hills mean that Somerset contains the vast majority of such evidence from the UK (Meiklejohn *et al* 2011). This has been augmented by the recent dating of the Mesolithic cemetery at Greylake, possibly representing the only ‘open air’ Mesolithic cemetery in the UK (Brunning and Firth 2012). Although Mesolithic cremations have recently been found in open air contexts in both Essex and Ireland (Pitts 2015). The value of this wealth of human remains is diminished by the early date of many of the discoveries and the limited recording which took place, although recent reinterpretation of some of the material has helped address this (Schulting 2005).

Direct evidence of Mesolithic structures and occupation sites is extremely limited. The uplands on either side of the study area have produced evidence of Mesolithic features at Hawkcombe Head on Exmoor (Gardiner 2007 and 2009) and Langley’s Lane on Mendip (Davies and Lewis 2005, Davies *et al* 2006) while the putative ‘Mesolithic structure’ at Lower Pitts Farm, Priddy, is probably Neolithic and of doubtful interpretation (Taylor and Smart 1983). More definitive evidence for Mesolithic structures comes from two islands of hard geology in the Somerset Levels and Moors at Walpole and West Waste.

As is the case elsewhere in the UK, the vast majority of evidence for the Mesolithic period comes in the form of lithics derived from surface collection by amateur and professional archaeologists. This creates an inherent bias in the data, both spatially and in terms of what is collected and what is overlooked. The small quantity of most of the finds also reduces the ability to reliably interpret the data.

The positive aspects of the Somerset lithic data are that it has been analysed by several competent archaeologists (Wainwright 1960, Norman 1975 and Bond 2006,

2007 and 2009 a and b) and two of the largest collections from Chedzoy and Greylake have been the subject of detailed studies (Norman 2002 and Shaw and Scott 2012). In addition, the long running Shapwick Project provides a case study of intensive investigation from one parish (Bond 2007). This provides a valuable picture of the density of Mesolithic finds in one area, which is probably representative of much of the wider landscape.

The character of the Mesolithic archaeological record in Somerset

The study area for this overview is limited to the present day county of Somerset, excluding Exmoor National Park, which now maintains a separate archaeological record. The figures below relate to this study area alone but in the subsequent discussion reference will be made to a small number of significant sites that lie just beyond its limits on Exmoor and the northern Mendip hills. The Mesolithic period begins at the end of the Younger Dryas around *c*.9600 cal BC and ends with the introduction of farming in the Neolithic, which in Somerset probably takes place around 3900-3800 cal BC.

At the beginning of the project a total of 138 Historic Environment Records in the Somerset HER related to Mesolithic activity. Almost all of these were small flint scatters retrieved by fieldwalking. Other artefactual evidence included possible Mesolithic animal bone (2 sites), bog oak (one site), wooden remains (one site) and human remains (3 sites). Generation of 55 new sites through this review has increased this total to 193 sites through the addition of new lithic entries, an increase of 40% on the previous total.

Analysis of the Somerset HER data showed that, in addition to the under reporting of Mesolithic lithic finds, the database was not capable of retrieving comprehensive information on palaeoenvironmental investigations and associated dating. Addressing these flaws is beyond the means of the current project and needs to be considered for such data across all periods.

The character of the evidence for the Mesolithic period within Somerset is a product of the archaeological work which has generated it and is therefore significantly biased by the methodology of collection and retention and by the people undertaking the work. Over almost all the Somerset Levels and Moors area, Mesolithic deposits are deeply stratified and are therefore out of the reach of normal archaeological activity. Any distribution maps should therefore solely be taken as indicators of areas of archaeological fieldwork and especially of surface collection of lithics, rather than as significant pointers to patterns of Mesolithic activity.

The evidence from the intensive fieldwork in Shapwick shows that evidence for Mesolithic activity is almost ubiquitous (Bond 2007). This does not mean that there are not distinct concentrations of activity at different periods, merely that that there is a considerable background ‘noise’ that masks such concentrations and can distract the eye when considering distribution maps, especially when many finds can only be assigned to very broad chronological periods on typological grounds (Blinkhorn and Milner 2014).

Lithic evidence

The discussion below merely presents a brief overview of the available evidence. Detailed analysis of the data was out of the remit of the project but a recent case study covering the northern Somerset Levels and Mendips has reviewed the lithic evidence for material exchange, technology and social behaviour (Bond 2007). Clive Bond has also reappraised the evidence from his PhD for the study area and he prepared a briefing document for the present survey, the Shapwick section of which is reproduced as Appendix 1.

Distribution and character of sites
The existing knowledge of the Mesolithic period in the Somerset study area is limited by the lack of excavated sites. The vast majority of known locations of Mesolithic activity are represented by small flint scatters recovered from fieldwalking, with the test pitting in Shapwick parish being a rare exception. It is hard to interpret the significance or character of such sites from such limited data, especially as there is an almost total absence of associated scientific dating.

The Shapwick Project provides a good example of the general distribution of Mesolithic and early Neolithic transition sites in a wetland edge parish (Bond 2007). The extensive fieldwalking and shovel pit testing that was undertaken there augments the previous work of the Somerset Levels Project and earlier researchers and collectors (Wainwright 1960 and Brown 1986).

A significant number of the Mesolithic find spots are located on the islands of hard geology (ie bedrock and especially burtles) in the Levels and moors. This is partly a product of limited field walking undertaken by the Somerset Levels Project (Brown 1986) and partly from amateur collection.

Two island sites are of especial significance, Parchey and Greylake, because of the large quantities of lithics recovered from them and because of the association with human remains at the latter site (Norman 2003 and Brunning and Firth 2012).

Detailed lithic studies – technology, chronology and society
The analysis of lithic technological change in the Mesolithic is hampered by a continuing inability to identify and date significant technological changes. The long bladed sites of the later Palaeolithic are poorly dated and the degree of continuity with the Early Mesolithic is not fully understood (Barton and Roberts 2004). Recent dating indicates that the Long Blade sites are Terminal Upper Palaeolithic and very early Holocene and Mesolithic communities may only have become established with developing woodland cover after the pre-boreal oscillation *c* 11400 cal BP (Conneller and Higham 2015). The overlap of the Mesolithic and early Neolithic is also subject to debate (Milner 2012). The effect of this is that the 5800 years of the Mesolithic are “often seen as a ‘timeless’ period, lacking history and change until the arrival of the Neolithic” (Blinkhorn and Milner 2014, 7).

The lack of a scientific dating for the Mesolithic can be contrasted to the precision now achieved for the Early Neolithic through Bayesian modelling (Whittle *et al* 2011). Scientific dating for technological change during the Mesolithic will only come from excavation of Mesolithic sites. Such excavations are extremely rare not just in the study area but also throughout the UK (Blinkhorn and Milner 2014). Mesolithic flint technologies are commonly divided into an early phase (c.10000-8500 BP) and a late phase (c.8500-6000 BP) but some researchers are now suggesting that a middle Mesolithic technology can be identified in southern and central England. The study area benefits from an overview of the existing lithic material conducted by Clive Bond (2006, 2009a and b). Two of the largest collections of Mesolithic lithics have been the subject of detailed reporting. The sites at Parchey and Greylake provide detailed evidence of activity on the islands immediately adjoining the wetland edge investigations undertaken by this fieldwork (Norman 2003 and Shaw and Scott 2012). Five other sites have collections numbered in the thousands : Blue Anchor Bay (SHER 33892), Lower Pitts Farm, Priddy (SHER 23965), Goughs Cave (SHER 10398), Westleigh Farm, Broom Field (Norman 1975) and Greenway Farm on the Quantocks (Norman 1975 and 1982). There are only another 14 sites with more than 100 Mesolithic flints.

More limited analysis has been undertaken of the lithics from Shapwick Burtle (Wainwright 1960) and the parish of Shapwick as a whole (Bond 2007). Detailed microwear and residue analyses are lacking although the work on the Neolithic Sweet Track flint clearly shows the potential for material excavated from wetland contexts (Morris 1984).

From the existing information it is clear that much of the flint and chert recovered in Somerset had travelled significant distances from their point of origin (Bond 2009 a and b)

Human remains

Somerset has a comparatively large assemblage of Mesolithic human remains. Several caves of the Mendip hills have produced human bones, most notably the large assemblage of at least 50 individuals from Avelines Hole, which lies just outside the project area but is relatively close to the wetland edge in the Axe valley. That site has been recently reinterpreted (Schulting 2005 and Conneller 2006) suggesting its use for burial over a relatively short period around roughly 8,300 cal BC.

Three other caves within the project area have also yielded Mesolithic human remains. Gough's Cave produced 'Cheddar Man', a young adult male representing the most complete Mesolithic human skeleton in Britain. Many other human remains were rumoured to have been discovered in the cave but not retained (Hosfield *et al* 2008, 50), suggesting that it may have been a cemetery similar to Aveline's Hole a short distance to the north.

The human remains from Totty Pot consist of three adults and one child, although other human bones, which would bring the total to six individuals, were handed to the police who cremated them (Murray 2007 and 2010).

The site of the old sand quarry at Greylake on Kings Sedgemoor also produced the remains of at least five individuals (represented by crania) and and an uncertain number of long bones. Only two crania, a mandible, four tibiae and a phalanx and half a metatarsal survive, as the other remains have been lost or were destroyed by bombing of the Royal College of Surgeons in World War II. The surviving crania are from young adult males, one of whom had sustained a blow to the head from which he had recovered (Brunning and Firth 2012). Sir Arthur Keith identified one of the crania sent to him as an adult female (ibid). The discovery of the phalanx and metatarsal within the concreted sand filling one of the crania suggests the possibility of excarnation of the bodies before burial.

The dated human remains are overwhelmingly of early Mesolithic date. Early Neolithic human remains are also known from the Mendip caves (eg. Schulting *et al* 2010, Lewis 2011) so the absence of later Mesolithic human remains is interesting. This may suggest a change in burial practice but the number of sites producing evidence is so low that such interpretation must be treated with some caution.

Isotope analysis

Isotope analysis is being undertaken by Rick Schulting on the human remains from the Mendip caves and from the Greylake site. The results of this study are not yet

Table 2.1. Dating of human bone and other Mesolithic sites from the study area

Site	Lab code	Sample no	Material dated	RC age BP	$\delta^{13}C$ ($^{0}/_{00}$)	$\delta^{15}N$ ($^{0}/_{00}$)	C: N	Calibrated date cal BC (95% confidence)	Notes	Ref
Greylake	OxA-25666	E22/23	human mandible	9170 +/- 40	-18.8			8534-8515 (3.2%) and 8481-8288 (92.2%)		Brunning & Firth 2012
Greylake	Wk-30930	E22	Human bone, skull	9118 +/-37	-19.4	9.1		8445-8360 (19.2%) and 8355-8260 (76.2%)		
Greylake	Wk - 30931	E23	Human bone, skull	9134 +/-37	-20.4	9.6		8460-8275		
Gough's Cave	BM-525	GC1 - 'Cheddar Man' tibia	Human bone, tibia	9080 +/-150				8700-7750		Stringer 1986
Gough's Cave	OxA- 814	GC1 - 'Cheddar Man'	Human bone, talus	9080 +/-150				8610-7980	talus	
Totty Pot	BM-2973		Human bone, adult left humerus	8180 +/-70	-19.4			7450-7050		Ambers & Bowman 2003
Totty Pot	OxA-16457	TP1	Human bone, adult ?male left femur	8245 +/-45	-19.7	10.3	3.2	7455-7085		Schulting *et al* 2010
	Weighted mean		T'=0.6:T'(6%) = 3.8: v=1	8226+/-38				7450-7080		
Badger Hole	OxA-1459	BH 2/178 3 227 31	Human bone, mandible	9360 +/-100				8770-8480		Humphrey &Stringer 2002
Badger Hole	OxA- 679	BH1	Human cranial fragments	9060 +/-130				8460-7990		
Walpole	Wk - 25817	S8/W2 PWL08	Structure 8 *Alnus* sp	5405 +/-66				4360-4050		C & NHollinrake pers comm
Priddy Circle	OxA-22023	PC108 1012	Charcoal *Acer* sp	6246 +/-46	-25.6			5320-5700		Lewis & Mullin 2011

		<5>								

known. Ian Barnes of the Natural History Museum is also about to conduct an isotope study of Mesolithic human remains in England.

Faunal remains

Faunal remains are limited to a very small number of sites. A few animal bones were present in Aveline's Hole and were abundant in Totty Pot (Hosfield *et al* 2008, 49). Some later Mesolithic faunal remains were also recorded at the Langley's lane site on the Mendips (Davies and Lewis 2005). Ongoing work in Gully Cave, Ebbor is recording superb faunal assemblages from the end of the last ice age and the early Mesolithic (Danielle Schreve pers. comm.).

Structures

The uplands just beyond the boundaries of the study area have produced evidence of possible Mesolithic structures at Hawkcombe Head on Exmoor (Gardiner 2007 and 2009) and pits at Langley's Lane on Mendip (Davies and Lewis 2005, Davies *et al* 2006). The putative 'Mesolithic structure' at Lower Pitts Farm, Priddy, is probably Neolithic and of doubtful interpretation (Taylor and Smart 1983, Taylor 2001 and Hosfield *et al* 2008, 50).

The most significant structure from the levels and moors area is the enigmatic double post row (structure 8) from the wetland deposits bordering Walpole island (C and N Hollinrake pers comm.). The posts have been dated to the late Mesolithic (refs) and other structures in nearby palaeochannels are very early Neolithic in date. Initial assessment of lithics from the nearby island have suggested that only Neolithic activity is represented (Norman 2014) and no Mesolithic features have been recorded on the island. The evidence from Walpole hints at the waterlogged potential of such deposits, well proven from the excavations on the other side of the Estuary at Goldcliff (Bell 2007).

Palaeoenvironmental analysis

There is a wealth of information concerning coastal change in the Holocene from both sides of the Severn Estuary with many detailed and well dated palaeoenvironmental sequences. This evidence has revealed an extremely complicated picture of coastal change, underpinned by fluctuations in sea level rise (and possible evidence of falls) these processes have been influenced by a range of factors including climate change, depression tracks and the formation and destruction of natural coastal barriers. Allen (2006, 17) acknowledged that such factors and agencies combined 'to create a seemingly haphazard range of lithostratigraphic responses as expressed in the estuarine/coastal Holocene of southern Britain'.

The same paper used palaeoenvironmental evidence and 138 associated radiocarbon dates from the Severn Estuary to demonstrate that the Holocene sequence in the area had a broad tripartite lithostratigraphic division that corresponded to similar evidence from southern Britain and elsewhere in northwestern Europe. The division distinguished early Holocene silt dominated sequences, formed in mudflats and salt marshes, from mid Holocene intercalated silts and peats (formed in high-intertidal to supratidal marshes) and then a return to silt dominance in the later Holocene (Allen 2006). The dates of these transitions vary spatially but in the Somerset Levels the main episode of peat formation was between *c* 4000-1000 cal BC, but there are earlier and later dates in some places. In the Somerset area this division has been formalised into the Lower, Middle and Upper Somerset Levels Formation (Haslett *et al* 2001) corresponding to the Wentlooge Formation on the Welsh coast.

The evidence summarised below demonstrates that the variations within this broad tripartite division could be considerable and heavily influenced by local topographic factors. The availability of numerous scientific dates for coastal changes on the English side of the estuary demonstrates the continuous nature of such changes and the short timescale over which many of them took place. The tripartite division is also brought into question by the existence of intercalated peat deposits in the earlier Holocene sequence (eg. Heyworth and Kidson 1976, Hill *et al* 2006 and Wilkinson 2007). The early Holocene is less often studied because it is more deeply buried behind the present coast. The peat layers from this epoch have also suffered more compaction than later similar deposits because of the substantially greater overburden.

The rate of relative sea level rise is constantly being recalculated at a national level (eg. Shennan *et al* 2000) but more importantly has been revised within the Severn Estuary area in recent years (eg. Long *et al* 2001 and Haslett *et al* 2001).

Table 2.2. Rates of relative sea level rise in Bridgwater Bay (after Long et al 2001)

Phase	cal. BC	MSL rise (m)	Av. rate (mm yr^{-1})
1	7500-5500	-25 to-10	7.5
2	5500-4000	-10 to –5	3.3
3	4000-0 BC/ AD	-5 to –2.5	0.6

Early Holocene c. 9600-5000 cal BC

Climatic amelioration at the end of the Devensian glaciation appears to have occurred rapidly with temperatures broadly comparable to those of today being reached within a few hundred years from 9600 cal BC (Atkinson *et al* 1987; Cope and Lemdahl 1995). The retreat of the glaciers led to eustatic global sea level rise from around –55m OD at the beginning of the Holocene to present day levels by *c*.4900 cal BC (Tooley and Shennan 1987). This led to the submergence of the present Severn Estuary, the Somerset Levels and Moors, and the North Somerset and Avon Levels by c.4500 cal BC.

Thin peat layers are known from deep cores along the Somerset coastline and the M5 route (Kidson and Heyworth 1976 and Long *et al* 2001). These represent possible fluctuations in sea level rise giving rise to the formation of upper saltmarsh or supratidal marsh conditions. They exist between –21.3mOD up to c.-2m OD just below the beginning of the peat dominated Middle Somerset Levels Formation. It may be possible to separate them out into a group between –20m OD and –12m OD and an upper group between –8mOD and –2mOD (Long *et al* 2001) but such a division seems unproductive because of the lack of dating information for most of the layers. Their existence suggests that the difference between the Lower and Middle Somerset Formations are not as strong as has previously been suggested.

Scientific dates for the Lower Somerset Levels (Severn) Formation, dated to before *c.* 5000 cal BC, have been very limited but have been increased by recent work at Minehead (Jones *et al* 2005) Woolaston (Brown *et al* 2006) Burnham-on-Sea (Druce 1998) and Porlock (Jennings *et al* 1998). They are presented in Table 2.3. Many additional dates from recent work at Hinkley Point are given in Sturt *et al* (2013) The dates available before 1998 were used as sea level index points to suggest Mean Sea Levels (Jennings *et al* 1998) although palaeoenvironmental analysis had not been carried out on most of the earliest samples. This suggested that the Highbridge cores represent a MSL of –25 to-26m OD at c.7500 cal BC MSL (Jennings *et al* 1998). By *c.*5900 to 6200 cal BC MSL had risen rapidly to between *c.*-12.5 to –14m OD and by *c.*5000 cal BC MSL was *c.*-8mOD (Jennings *et al* 1998, table 1, 166).

The implications of this rapid sea level rise on the changing coastline have been modelled in detail for the central Axe valley (Haslett *et al* 2001) where the marine sediments of the Lower Somerset Levels Formation were studied in detail. Between *c.*8000 and 5000 cal BC the sea level rise was c.5-6mm yr^{-1} (Haslett *et al* 2001, or 7.5 according to Long *et al* 2001). During this time the estuarine surface, which penetrated far inland of the modern coastline, would have been dominated by mudflats/low marsh environments. Mid to high marsh would only occupy a narrow, relatively steeply inclined, fringe along the coastline (Haslett *et al* 2001). There would be a need to transfer a large amount of tidal water off the surface of the low marsh during flood and ebb tides. This high hydraulic duty (Allen 1997 and 2000) would require a relatively dense network of wide and deep tidal creeks.

Transition from Lower to Middle Somerset Formation c.5000-4000 cal BC
From *c.* 5000 cal BC the rate of sea level rise began to decrease from the previous very rapid rate of c.5-6mm y yr^{-1} to c.2mm yr^{-1} between *c.*5000 and 3000 cal BC (Haslett *et al* 2001). This had major effects on the development of the coastline as organic sedimentation began to outpace sea level rise. This allowed the development of the Middle Somerset Levels Formation and Middle Wentlooge peat dominated environments to develop over the study area.

The deceleration in sea level rise would have allowed the mid marsh environments to expand and dominate a larger part of the estuary with a decrease in hydraulic duty and a corresponding decrease in tidal creek size (Haslett *et al* 2001). Eventually the higher marsh environments would squeeze out the middle marsh and would dominate the estuarine environment with small tidal creeks and a reduction in tidal flooding frequency (Haslett *et al* 2001).

The timing of the change from silt to peat environments and the character of the peat environments varied from place to place along the estuary (see Table 2.3 for the different radiocarbon dates). In general the peat deposits are thicker inland while towards the coast they become increasingly intercalated with silt layers at Minehead, Stolford, Burnham-on-Sea, Huntspill and East Brent. The available evidence can be summarised form SW to NE along the study area as follows;

Porlock Bay: The main peat layer at Porlock formed between c.4500 cal BC and *c.*3540 cal BC after which it was overlain by deposits of sand, grit, silt and clay (Jennings *et al* 1998). The cessation of the organic formation in this area partly reflects the increased vulnerability of the coastal gravel barrier to storm events as the deceleration of sea level rise decreased longshore sediment supply. In addition anthropogenic disturbances within the catchment may have increased the supply of inorganic material into the area (Jennings *et al* 1998).

Minehead Bay: Three periods of peat deposition were identified on the present foreshore at Minehead (Jones *et al* 2005). The earliest deposits were created in marginal saltmarsh conditions around 5,000 cal BC and an alder carr peat sometime between 5,400 and 5,000 cal BC. There was then another gap of several hundred years until peats were laid down in a mixture of upper saltmarsh, freshwater reedswamp and alder carr environments created sometime between *c*.4800-4500 cal BC.

Parrett Valley: Very little dating and analysis has been carried out in this area. Around the mouth of the Parrett between Stolford and the Poldens Heyworth and Kidson (1976) recorded the Middle Somerset Levels Formation as intercalated peat and clay along the coast and as a thick peat layer further inland, deposition beginning around 4,000 cal BC. The Middle Somerset Levels Formation exists as a thick peat layer in the central Parrett valley and has been briefly characterised by Alderton (1983) and has been dated on its base at Sutton Hams to c.3900 cal BC (Coles and Dobson 1989). Further inland near Langport recent evidence has dated the base of the Formation to 4840-4520 cal BC (Wilkinson 2006 see table 1 for details). This limited evidence suggests that the organic deposits of the Formation developed seawards over a period of several hundred years in the 5th millenium cal BC.

Brue/Axe Valley: Intercalated peat and silt deposits are known from Burnham-on-Sea (Druce 1999), the Huntspill River (Brunning and Farr Cox 2006), Walpole (Hollinrake and Hollinrake 2001) and East Brent (Haslett *et al* 2001a). The M5 boreholes also show similar deposits (Long *et al* 2001) although the accuracy of the interpretation may be open to question and they are undated.

The intercalated peat deposits have been dated between 5440 and 3370 cal BC at Burnham-on-Sea (Druce 1999) and between *c.* 4780 and 1320 cal BC at Walpole (Hollinrake and Hollinrake 2001). Godwin (1960) recorded intercalated peat and silt on the River Huntspill between Puriton Bridge and Withy Bridge. At Withy Bridge two peat layers (not noted by Godwin) formed in short lived higher saltmarsh conditions in the later Bronze Age and early Iron Age sandwiched between clays created in lower saltmarsh ecosystems (Vickery 1999). A transect between Brean and Wedmore (Haslett *et al* 2001a) showed the main peat deposit dividing into intercalated peat and clays at Brean and to the south in the area north of Brent Knoll. The beginning of the peat formation is dated to 4200-3200 cal BC and its surviving end to between *c.*2000 and 1500 cal BC (Haslett *et al* 2001a).

In the Axe valley the beginning of the main peat layer has been dated to between 4905 and 4540 cal BC, continuing until sometime between 1775 and 1425 cal BC (Haslett *et al* 2001). In the central Brue valley peat formation began between 4500 and 4000 cal BC (Coles and Dobson 1989) with an earlier thin peat in places forming possibly as early as *c*.4700 cal BC (Wilkinson 1999).

Table 2. 3. Radiocarbon dates associated with Mesolithic palaeoenvironmental investigations in Somerset

Interpretation	Age cal BC	RC years BP	Lab. code	Site Reference
Base reedswamp/saltmarsh peat 1	5670-5380	6600±70	Wk- 5311	**Minehead Sites 75-77**. Jones *et al* 2005
Base reedswamp/saltmarsh peat 2	5640-5370	6570±70	Wk- 5310	
Top reedswamp/saltmarsh peat 2	5620-5310	6490±80	Wk-5309	
Base brackish/freshwater reed peat 3	5540-5290	6440±70	Wk- 5308	
Base alder carr/reed peat	5630-5380	6560±60	Wk- 5302	**Minehead Site 27**. Jones *et al* 2005
Base alder carr/reedswamp peat	4830-4490	5810±70	Wk- 5304	**Minehead Site 44-5**. Jones *et al* 2005
Top alder carr/reedswamp peat	4830-4520	5820±60	Wk- 5303	
Base alder carr peat site 45	4780-4460	5770±70	Wk- 5305	
Base reedswamp site 46	4710-4360	5700±70	Wk- 5306	**Minehead Sites 46-7**. Jones *et al* 2005
Base reedswamp site 47	4830-4520	5820±60	Wk- 5303	
Base of peat (eroded top)	4720-4250	5620±100	HAR-8546	**Brean Down foreshore** Crabtree in Bell 1990
Base fourth peat	4235-3800	5210±80	Beta-142355	**Brean-Wedmore** Haslett *et al* 2001
Forest bed	6609-6425	7730±50	Beta-81655	**Porlock Bay**. Jennings *et al* 1998
Peat	6380-5970	7280±90	OxA-6570	
Top second peat	5941-5540	6870±90	Beta-61544	
Top second peat	5987-5777	6707±50	Beta-86775	
Base fourth peat	4340-3970	5290±75	OxA-6572	
Base fourth peat	4460-4040	5450±70	OxA-6569	
Base fourth peat	4500-4240	5515±65	OxA-6571	

Base fourth peat	4458-3662	5250±180	Beta-61542	
Top fourth peat	3940-3540	4925±60	OxA-6402	
Top fourth peat	4040-3780	5120±55	OxA-6399	
Top fourth peat	4240-3700	5160±100	OxA-6401	
Top fourth peat	4225-3705	5140±100	Beta-61543	
Base of Middle Somerset Levels Formation peat	3625-3195	4640±60	Beta-142351	**Brean-Wedmore** Haslett *et al* 2001a
	4335-4050	5370±50	Beta-142353	
	4235-3800	5210±80	Beta-112355	
Bulk sample, reed peat (C)	5440-5080	6340±70	Wk-5298	**Burnham-on-Sea.** Druce 1998
Base of peat (B)	4660-4340	5590±70	Wk-5297	
Base of peat (A)	4360-4000	5299±70	Wk-5299	
Top of peat (A)	3780-3370	4790±70	Wk-5300	
Peat base	3503-3094	4570±60	Wk-9019	**Walpole, Somerset**. Hollinrake & Hollinrake 2001 and pers comm
Peat top	4672-4245	5580±100	Wk-9020	
Lowest peat	5990-5790	6994±30	Wk-25711	
Base of peat 3	4330-4040	5345±37	Wk-27346	
Peat base	4781-4370	5750±80	Wk-9021	
Base of peat below main peat layer	4770-4460	5745±45	OxA-11233	**Shapwick Burtle.** Wilkinson 1999
Peat base Sutton Hams	3970-3660	5020±80	HAR-5354	**Central Brue valley**. Coles & Dobson 1989
Peat base Shapwick Heath	4611-4046	5510±120	Q-423	
Peat base Eclipse track	4448-4055	5440±70	HAR-4865	
Peat base Meare Village East	4315-3964	5270±70	HAR-7064	
Peat base Walton Heath	4680-4350	5650±70	HAR-1831	
Peats and Submerged forest	Multiple 14C and Dendro. dates			**Stolford and Hinkley Point** Campbell and Baxter 1979 ; Sturt *et al* 2013 Hillam *et al* 1990

Conclusion

The Somerset HER was not able to immediately collate all the known information of Mesolithic date. This has now been rectified in regard to lithic finds with the addition of many new sites but the recording of palaeoenvironmental information could only be tackled as part of a systematic review of all such data, which clearly lies outside the remit of this project.

The known Mesolithic archaeological resource in Somerset shares many characteristics with much of the rest of England (Blinkhorn and Milner 2014). The majority of the evidence is derived from the casual surface collection of flint remains, producing relatively small quantities of material. The value of the litihic evidence is augmented by a small number of detailed site studies and wider overviews (Bond 2006, 2009 a and b) and by the intensive fieldwork in one parish. What are lacking above all else, are modern excavations of Mesolithic sites. Without these, it is unlikely that reassessment of the existing lithic collections will add anything significant to the overviews already conducted by Bond (2006, 2009 a and b). It appears unlikely that archaeological mitigation relating to development projects will generate such excavations, so specific research fieldwork is required, targeting sites known from lithic collection.

Somerset is fortunate to contain extensive palaeoenvironmental deposits of Mesolithic date and this project had added significantly to that data set. Development control related projects have provided some of this data and seem likely to add more in the near future. The main problem lies with obtaining and dating palaeoenvironmental samples from the earlier Mesolithic period, because of their great depth below ground and the lack of organic material to radiocarbon date. The existence of deeply stratified deposits with occasional peat lenses along the coastal strip suggests that there is great potential for retrieving and analysing palaeoenvironmental remains from the earlier Mesolithic and significantly adding to our knowledge of the changing landscape and coast. The potential has been ably demonstrated by the recent work associated with Hinkley Point (Sturt *et al*. 2014) and the project Determining potential: onshore/offshore prehistory (EH 6918). The ongoing retrieval and analysis of faunal remains from Gully cave in Ebbor Gorge will provide complementary evidence of the changing landscape at the edge of the Mendip hills.

This project and previous work, have demonstrated the potential of the Somerset Levels and Moors area for significantly improving our understanding of the Mesolithic period in England. The human remains from Greylake and the wooden structures from Walpole have shown the presence of rare forms of evidence and excellent waterlogged preservation. This project has demonstrated the potential of the wetland edges of the islands of hard geology in the floodplain and the existing lithic data points to significant occupation on many of those islands. The islands in the Somerset floodplain and their wetland edges, are well placed for future fieldwork investigation into the Mesolithic period that could yield nationally important results.

Chapter 3: Queens Sedgemoor: Palaeoenvironmental Analysis of a Mesolithic-Neolithic Sedimentary Sequence

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Summary

A sediment core extracted from Queen's Sedgemoor, Somerset, has undergone high resolution radiocarbon dating. Subsequent directed palynological, diatom and calcareous microfossil analyses focussed on the sedimentary sequence associated with the Mesolithic and early Neolithic periods. This report therefore summarises the radiocarbon results and the micropalaeontological analyses for the sedimentary sequence between 3m and 7.6m depth. Radiocarbon dating has ensured a secure chronology to the sequence, whilst microfossil evidence supports stratigraphic evidence for hydroseral succession and the development of a raised bog setting. Very low pollen counts have limited the palaeoenvironmental potential of deposits associated with the Mesolithic-Neolithic transition period. However, a clear picture of landscape change is presented for much of the sedimentary archive, with the additional presence of microscopic charcoal within the sedimentary sequence indicating human activity in the area during the late Mesolithic (*c*. 4400–4100 cal BC).

Introduction

A 7.74m deep sediment core was extracted from Queen's Sedgemoor (elevation c. 4.9m OD), with the field location pre-determined through a coring survey undertaken in summer 2012 (Figure 1.1; ST 54105 42211). The location was chosen based on the sedimentary sequence being one of the thickest in the area and containing sedimentary units most representative of the sequence encountered during the initial survey. The sequence is typified by well humified peats which terminate in blue-grey silts at *c*. 7.5m depth. A thin blue-grey silt layer is also present within the peat profile at *c*. 5.8–6m depth (-0.9m to -1.1m OD). A selection of core images is provided for reference (Figure 3.1). A radiocarbon dating strategy was first developed in order to secure the chronology of the sequence. This was then used to direct a microfossil assessment to focus on the sedimentary deposits broadly associated with the Mesolithic and early Neolithic periods. The initial assessment yielded promising results for much of the sequence dated to the pre-Neolithic and consequently full analysis of pollen and diatoms was recommended within the sediments between depths 3.06m and 7.74m. In addition, an analysis of the organic remains, with particular focus on Foraminifera and ostracoda, was undertaken on the two minerogenic units by John Whittaker (NHM, London).

Figure 3.1: A summary of key stratigraphic units within the sedimentary sequence being assessed as part of the project. 50cm sedimentary sections displayed, extracted using a Russian Corer. L-R: 4.80-5.30m, 5.60-6.10m, 7.20-7.70m, note the minerogenic units at c. 5.82-6.00m and 7.56-7.74m depth

Depth (m)	**Stratigraphy**
3.06-3.15m	Dg1, Dh1, Th1, Tb1, Dl++
	Dark brown sphagnum-rich peat
3.15-3.35m	Tb2, Sh1, Dg1, Dh+
	Orange brown sphagnum-rich peat
3.35-4.90m	Dh2, Dg1, Dl1, Sh+
	Dark brown herbaceous peat
4.90-5.20m	Dg2, Dh1, Sh1, Th+, Dl+
	Dark brown very well humified peat
5.20-5.60m	Dh2, Dg1, Sh1, Th+, Dl+
	Dark brown herbaceous humified peat
5.60-5.82m	Dg2, Sh2, Dh+, Th+
	Dark brown very well humified peat
5.82-6.00	***Ag2, As2, Dh+, Sh+***
	Blue-grey clayey silt
6.00-7.16	Dg2, Sh1, Ptm1, Dl+, Dh+, Th+
	Medium brown shell-rich very well humified peat
7.16-7.48m	Dg2, Sh2, Dh++, Th+, Dl+, Ptm+
	Medium brown very well humified peat
7.48-7.56m	Dg2, Sh1, Ag1, Ptm+, As+, Dh+, Th+
	Medium brown very well humified silty peat
7.56-7.74m	***Ag2, As1, Sh+, Dg+***
	Blue-grey clayey silt

Table 3.1: A brief summary of the sedimentary stratigraphy under investigation at Queens Sedgemoor. The two minerogenic units are highlighted in bold

Techniques

A total of 15 sedimentary horizons were chosen for radiocarbon dating from the 7.74m sedimentary sequence. The sampling strategy was based on changes in sedimentary composition through the profile. Samples were required from throughout the sequence in order to i) assess whether the sedimentary sequence does include deposits dating to the Mesolithic and if so, ii) assist in locating the approximate position (depth) at which the transition from the Mesolithic to the Neolithic took place. The radiocarbon dating strategy is outlined in Chapter 9 and summary of the radiocarbon dates can be found in Table 9.8 and Figure 9.13

For the pollen analysis, peat samples had previously been processed using standard preparation techniques at 0.16m intervals between 3.06 and 7.74m sequence. As encountered during the assessment, pollen preservation was very poor in samples between 4.16 and 5.55m. In addition, whilst present in slightly higher numbers, poor pollen preservation was encountered within the basal minerogenic samples (7.54m and 7.74m). These samples were re-prepared to ensure preparation methodologies were not responsible, but similar low pollen yields were once again encountered. As a consequence, no pollen data is presented for these depths due to the potential for such low counts to bias subsequent palaeoenvironmental interpretations. Therefore, of the 30 samples initially assessed, 19 contained sufficient pollen to warrant full analysis. The fossil pollen and spores were identified and counted using a Leica microscope with magnifications of x400 and x1000. Where possible, a sum of 300 or more pollen grains, per level was counted for each sample. Pollen taxonomy, in general, follows that of Moore *et al*. (1991) modified according to Bennett *et al*. (1994). Spores were recorded outside of the basic pollen sum. Please refer to Figure 3.2 for a diagram of the pollen assemblages. Microscopic charcoal was also noted where present, with approximate quantities achieved using the technique of Clarke (1982), and are summarised in Figure 3.3.

For diatoms, samples were extracted at regular intervals throughout the minerogenic layers (5.78–6m, 7.56–7.74m). In addition, preliminary assessments revealed good diatom preservation in the upper section of the basal peat unit (6–6.9m) and so additional samples were prepared through this unit. The basal minerogenic unit (7.56–7.74m), contained no diatoms. In total, 14 samples yielded sufficient diatom assemblages to warrant full analysis. Diatom species were identified with reference to Hendy (1964) and van Der Werff and Huls (1958–1974). A diagram summarising the key diatom taxa encountered within Queens Sedgemoor is shown in Figure 3.4.

The remaining sedimentary material from the two minerogenic units (5.82–6m and 7.56–7.74m) was then divided into 3cm bulk samples and analysed for Foraminifera and ostracods. Sample preparation, microfossil picking and subsequent identifications and palaeoenvironmental interpretations was undertaken by John Whittaker (NHM, London). A total of 12 samples underwent analysis. During this analysis, visible assessments were also made for the preservation of other organic remains. The results of this analysis can be found in Table 3.2. Additional samples have been assessed for microfossil presence from the basal peat unit (8cm bulk samples, 6–7.56m depth). A full review of these samples is beyond the remit of this project, but passing reference will be made when relevant palaeoenvironmental interpretations are being made. Samples were placed in an oven to dry, after which hot water was poured over each sample and sodium carbonate was added to assist in the removal of the clay fraction. After soaking overnight, each sample was washed through a 75 micron sieve using hand-hot water. Each residue was then decanted back into the bowl and dried in the oven in preparation for analysis.

Results

Radiocarbon dating

A summary of the radiocarbon results can be found in Table 9.8, whilst an age-depth model is provided in Figure 9.13. Please note, the two dates obtained from 0.81m depth (SUERC-48415 and SUERC-48416) were obtained through funding provided by the Somerset Archaeological and Natural History Society's Maltwood Fund, but have been included in the table and associated age-depth model for reference.

The results indicate that the first shift from minerogenic to organic sedimentation at Queen's Sedgemoor took place before 5620–5480 cal BC (7.49m depth; Figure 3.1 C). A brief return to minerogenic conditions occurred at *c*. 6m depth and is dated to 4940–4790 cal BC (Figure 3.1B). The timing of the subsequent return to peat accumulation at 5.80m depth is believed to have taken place in *4755-4620 cal BC, (95% probability*) based on the radiocarbon age depth model (*refer to RC dating chapter here*). There then follows uninterrupted peat accumulation until the present day, with a shift to raised bog conditions (inferred through the abundance of *Sphagnum*-rich peat) at 3360-3020 cal. BC.

Based on the relatively uniform accumulation rates present throughout the sequence, it is suggested that the upper section of the peat profile may have been lost. Peat cutting coiuld be a contributing factor, but there are no records of extraction having ever taken place on Queen'sSedgemoor (Brunning pers comm). It is therefore likely that drainage and agricultural activities resulted in peat wastage leading to the lowering of the surface by at least 1m. In addition, assuming peat accumulation has been constant, as suggested by the age-depth model in Figure 9.13, it can be concluded that the shift from the Mesolithic to Neolithic periods (*c*. 4000 cal BC) took place in the sedimentary profile at a depth of around 4.7m. The approximate depth at which the Mesolithic-Neolithic transition is believed to have taken place has been plotted on the pollen diagrams (Figures 3.2 and 3.3) for reference.

Palynological Analysis

Palynological analyses were undertaken on the samples at 0.16m intervals between 3m and 7.54m depth. Palynological assessments of deposits above this section is therefore beyond the scope of this report. A summary of the pollen results is provided in Figures 3.2 and 3.3:

7.38–7.20m QS-P01: The basal zone is dominated by *Alnus* and *Corylus-Myrica* type, with a distinct peak in *Alnus* at the base of the zone and Cyperaceae at the top of the zone. Contributions are also made by *Quercus*, *Ulmus* and *Typha latifola*. No charcoal was encountered in this zone. The transition from QS-01 and QS-02 is dated to *5690–5565 cal BC* (*95% probability*).

7.20–6m QS-P02: This zone is also typified by a dominance of tree species, contributing *c*. 50–60% TLP throughout the zone. Shrub taxa show a subtle decline in abundance through the zone, with herb taxa showing a respective increase. *Alnus* and *Corylus-Myrica* type dominate, and whilst Cyperaceae is encountered in much lower abundances at the start of the zone, its abundance gradually increases from 10% to 20% TLP with height. Contributions are also made by *Ulmus* and *Quercus*. The persistent presence of *Typha latifola* throughout the zone is noted, increasing in influence with height. Spores are evident throughout the zone, primarily through *Pteridium* and *Polypodium*, but retain relatively low values. The transition between QS-02 and QS-03 is dated to *c. 4880-4760 cal BC* (*95% probability*).

6–5.5m QS-P03: Coinciding with the estuarine clayey-silt layer and the overlying peat, this zone is dominated by *Alnus*, *Quercus* and *Ulmus*, with *Corylus-Myrica* type and a variety of herbs (incl. Cyperaceae and Poaceae) also contributing. *Typha latifola* is also present in relative abundance throughout. Pteropsida monolete spores are initially absent, but then appear in abundance at the top of the zone. Microscopic charcoal begins to be present consistently throughout the samples, in relatively low abundances. However, there is an overall increase in abundance with height through the zone. The timing of the transition into the overlying zone of poor pollen preservation is not known, but predates *4570–4420 cal BC* (*95% probability*).

5.5–4.3m Zone of Low Pollen: Pollen counts proved insufficient within this zone. Samples contained almost no pollen, with Pteropsida monolete spores being the only palynomorphs encountered (often in abundance). These pollen assemblages are therefore insufficient to be included in Figure 3.2. This is very unfortunate considering the fact that the transition between the Mesolithic and Neolithic activities is likely to have taken place within this section of the sedimentary profile (c. 4.7m depth). This is potentially reflected in the presence of much higher amounts of microscopic charcoal within this section of the unit, especially towards the base of the zone (predating the theorised Mesolithic-Neolithic transition). This section of organic accumulation can be inferred estimated to have accumulated over a period of 975-900 years (95% probability) based on the age depth model. The overall tree-shrub-herb ratios are broadly similar when the underlying and overlying zones are compared, to suggest no drastic shift in vegetation took place during this period.

4.3–4.1m QS-P04: Although only containing a single pollen sample, the strong contrast in pollen assemblages at this depth with the overlying assemblages, combined with the almost total absence of pollen in the underlying sediments, justifies the consideration of an additional LPAZ. The sample is dominated by *Ulmus* (30% TLP), whilst *Tilia* and *Pinus* also contribute. Shrubs are almost wholly absent within this sample, contrasting markedly with the overlying sediments. Cyperaceae is present at *c*. 20%. Spores of Pteropsida monolete and Pteridium are also present in abundance. Microscopic charcoal fragments continue to be found, but in lower abundance when compared to the underlying zone.

4.1–3.14m QS-P05: This zone is typified by the highest percentage of herbaceous species in the entire pollen profile, present due to the sudden drop in tree taxa, primarily as a result of *Ulmus* dropping to <5% TLP. Cyperaceae and Poaceae dominate. Shrubs also contribute, with increases in *Corylus - Myrica* type often reflected by a reduction in Ericaceae. Trees including *Betula*, *Quercus*, *Pinus* and *Tilia* are already encountered in low abundances, but continue to fall through the profile, whilst *Alnus* shows a comparative increase with height. *Ulmus* remains

present, but with very low values throughout when compared to its dominance in the underlying zone. Microcharcoal is again present but in relatively low numbers.
3.14–3.06m QS-P06: Whilst again based on only a single sample, the sudden increase in shrub species (*Corylus-Myrica* type and Ericaceae) at the expense of herbaceous taxa (primarily Cyperaceae and Poaceae <5% TLP) justifies a separate zone at the top of the diagram. This zone also marks the onset of raised bog conditions, exemplified by the very large amount of *Sphagnum* spores and leaves encountered during analysis, and associated with the distinct shift in stratigraphy. Microcharcoal is almost wholly absent from the upper sample.

ii Diatom Analysis
Diatoms were encountered in abundance throughout the thin blue-grey clayey silt layer at 5.8–6m depth, but absent in the basal minerogenic unit at 7.56–7.7m depth. Diatoms were also encountered in relative abundance throughout the upper section of the lower organic unit. A summary of the key taxa is provided in Figure 3.4:
6.9–6.34m QS-D01: Fresh and fresh-brackish diatom species dominated the assemblages, with species including *Aulacoseria ambigua, Epithemia Zebra, Anomeoneis* spaerophora, Cocconeis *placentula* and *Navicula oblonga* most common. Occasional brackish and marine species were encountered, but their presence was often in isolated samples within the zone whilst their relative abundances was very low (*c*. 2%TDV) throughout the unit.

6.34–6.06m QS-D02: Whilst fresh and fresh-brackish taxa continue to dominate, there are clear shifts in the taxa encountered. Planktonic species almost wholly disappear within this zone, typified by the shift in abundance of *Aulacoseira ambigua* from *c*. 20-30% TDV in the underlying zone, to 0% within QS-D02. *Connoneis placentula* also disappears within this zone after contributing over 20% TLV in the underlying zone. *Anomeoneis sphaerophora* increases from *c*. 10% TDV to >20% TDV, whilst *Epithemia zebra* remains relatively stable at *c*. 20% TDV within the zone. A number of taxa increase in relative abundance through this zone, including the fresh benthic taxa *Nitzschia linearis* (15% TDV) and the brackish taxa *Campylodiscus clypeus* (20% TDV). There was also a large number of *Pinnularia* and *Epithemia* frustules noted, but could not be identified to species level due to the preservation of their girdle bands only. As a consequence, up to 20% additional taxa could not be given palaeoecological affinities, although these genera are likely to be freshwater taxa.

6.06–5.95m QS-D03: This zone includes the samples taken on either side of the peat-minerogenic sediment boundary at *c*. 6m depth and as a consequence spans only two diatom assemblages. However, the zone contains substantially different diatom taxa in contrast to overlying and underlying zones. The fresh benthic taxa *Stauroneis brevistriata* (often referred to as *Pseudostauroneis brevistriata*) dominates, contributing *c*. 50% TDV, whilst the taxa that had previously dominated, such as *Nitzschia linearis, Campylodiscus clypeus* and *Epithemis zebra*, are all present below 2% TDV. There is an overall distinct increase in brackish and marine taxa through the zone.

5.95–5.83m QS-D04: Coinciding with the minerogenic unit, this zone is typified by a dominance of marine, marine-brackish and brackish water diatom species, with both planktonic and benthic species regularly encountered. The species present were typified by *Paralia sulcata, Actinoptychus senarius, Nitzschia navicularis, Diploneis didyma* and *Achnanthes brevipes*. Fresh-brackish and freshwater species were encountered in greater numbers towards the unit boundaries with the overlying and underlying organic-rich sediments, including *Navicula oblonga, Epithemia zebra, Synedra ulna* and *Anomeoneis sphaerophora*.

5.83–5.78m QS-D05: The zone is typified by a shift back to the dominance of fresh-brackish and freshwater species. Whilst some saline tolerant taxa remain (*Nitzschia navicularis, Diploneis didyma*) the fresh benthic taxa *Epithemia zebra* dominates (20% TDV), supported by the fresh-brackish taxa of *Cocconeis placentula, Navicula oblonga* and *Anomeoneis sphaerophora*.

Foraminiferal/ostracod Analysis (John Whittaker)
Results of the microfossil analysis are summarised in Table 3.2, including comments on organic remains in addition to the Foraminifera and ostracods. The lower minerogenic unit (interval 7.56–7.74m) displayed very little organic recovery. During microfossil preparation, occasional fragments of plant debris and seeds were encountered, whilst some small insect remains were also visible in in the uppermost two samples. However, similar to the absence of pollen and diatoms, no Foraminifera or ostracods were found.

The upper unit (5.82–6m) contains foraminifera and ostracods in relative abundance. The species encountered in the lower samples are brackish indicators, typified by the dominance of the ostracod *Cyprideis torosa*, supported by the relative abundance of Foraminifera *Haynesina germanica*, *Ammonia sp*. and *Jadammina macrescens*. There are also occasional non-marine ostracods encountered within the units, including *Heterocypris salina*, *Herpetocypris sp*. and *Candona neglecta*. The uppermost sample, from the border between the minerogenic unit and overlying peat, is devoid of Foraminifera and ostracods, but is noted for its much higher organic content, and presence of other organic remains including fish bones, insect remains, seeds, and cladoceran ephippia.

Interpretation

Radiocarbon dating indicates the onset of organic sedimentation at Queens Sedgemoor occurred sometime around 5620–5480 cal BC. The minerogenic deposit underlying this organic unit remains poorly understood however, due to the total absence of any foraminifera, ostracods, diatoms and a very low abundance of pollen. Only occasional plant remains, seeds and insect fragments were encountered, the analysis of which were beyond the remit of this project. As a consequence little can be concluded regarding the likely provenance of the basal unit at this stage. The deposits may be the remnants of either freshwater or estuarine conditions, but which have undergone significant weathering and/or decalcification to result in the removal of any palaeoenvironmental signature. The sediments under analysis were encountered at *c*. 7.6m depth within the archive, which is *c*. -2.7m O.D. As a consequence, considering the likely lower elevation of relativel sea level during the Mesolithic, it is suggested that a freshwater setting is more likely than that of an estuarine one.

Minerogenic sedimentation was replaced by organic sedimentation at *6000–5765 cal BC* (*95% probability*, with sedimentation continuing for an estimated *940-1190 years* (*95% probability*), until *4880–4785 cal BC* (*95% probability*. The deposit contains a very distinctive palaeoenvironmental story, displayed through the microfossil record encountered. It is interesting to note that the lower-most 0.5m of the organic unit was devoid of diatoms and similarly, freshwater molluscs do not appear until above *c*. 7.14m depth (John Whittaker, pers. comm). The lower-most section coincides with the basal pollen zone QS-P01 which is suggestive of a marginal alder carr environment due to the dominance alder, hazel and sedges. The subsequent appearance of diatoms and molluscs coincides with QS-P02 and their presence, supported by the pollen record, reveals an aquatic setting due to the abundance of the pollen taxa *Typha latifola* (bulrush) present. Mollusc species such as *Bithynia tentaculata*, and *Planorbis planorbis* are often encountered (Richard Preece, pers. comm), increasing in abundance with height through the profile. A freshwater setting is further supported by the relative abundance of insect remains, non-marine ostracods, fish/amphibian remains and charophyte oogonia within the unit (John Whittaker, pers. comm). In addition, diatoms are encountered from *c*. 6.9m upwards, with the taxa such as *Aulacoseira ambigua* and *Epithemia zebra* typical of freshwater settings. The abundance of alder and hazel QS-P02, in addition to lower levels of oak and elm, suggests the alder carr environment remains, but is now located around the margins of a freshwater setting. Complete hazelnuts were also encountered within the organic unit during sampling, reinforcing the suggestion that there was an abundance of hazel proximal to the sampling site. The organic unit was found to be very well humified and this suggests the aquatic environment was relatively shallow and/or well oxidised to enable organic decomposition to occur. Microscopic charcoal is only encountered occasionally, suggesting the influence of forest fires were somewhat limited at this stage. It is therefore likely that the peat development began as a terrestrial setting, which became waterlogged and subsequently developed into a shallow freshwater environment during the *940-1190 years* of sedimentation. Further analysis of the abundant macrofossil record (plant macrofossils, insects, Mollusca, etc) is needed before it is possible to conclude whether an open lake setting prevailed, or whether a freshwater wetland with vegetated pools and permanent water was present during this time (although the latter is considered more likely).

Due to the continual rise in relative sea level throughout the Holocene period, it is very likely that this freshwater setting was located proximal to a palaeocoastline for some (or indeed all) of its existence. The occasional presence of diatom taxa that require more saline waters to survive supports such a statement, potentially indicative of episodic saline water incursions into the lake. Such interpretations must be met with caution as a number of the ‘fresh-brackish’ and ‘brackish’ benthic taxa encountered that are often indicative of saline conditions, can also be encountered in lake settings with higher pH levels. The sporadic presence of definitive marine plankton species such as *Paralia sulcata, Actinoptychus senarius* and *Pseudomelosira westii*, however, does support the suggestion that occasional incursions from the open estuary were experienced.

A thin layer of blue-grey clayey silt, positioned at *c*. 5.8-6m depth, began forming *4880–4785 cal BC* (*95% probability)*. This unit was deposited in an estuarine setting, indicated by the dominance of brackish and marine planktonic and benthic diatoms within QS-D03, QS-D04, combined with the abundance of herbaceous pollen taxa and the presence of the characteristic Chenopodiaceae (Goosefoot Family) within QS-P03.

Planktonic diatoms are encountered in their greatest abundance within this unit (>35% TDV), typified by the marine taxa *Paralia sulcata*, *Actinoptychus senarius* and *Pseudomelosira westii*. The benthic component is dominated by estuarine taxa such as *Nitzschia navicularis*, *Surirelly striatula* and *Diploneis didyma*. Indeed, over 90% of the diatoms encountered are typical of marine and brackish settings.

The calcareous microfossil assemblages also reflect this interpretation due to the dominance of *Cyprideis torosa*, which is a brackish ostracod typically encountered in tidal flats and creeks. This is further supported by the relative abundance of Foraminifera, where the agglutinating foraminifer *Jadammina macrescens* initially dominates, only to be replaced by calcareous taxa *Haynesina germanica* and *Ammonia* sp. with height through the profile. *J. macrescens* is a taxon often encountered in the mid-high marsh environment, whereas *H. germanica* is more closely affiliated to mid-low marsh and tidal flats. The calcareous microfossil assemblages therefore indicate that the setting was initially a saltmarsh, with brackish mudflats subsequently developing in response to increased marine influence (relative sea-level rise). This is supported by the diatom results, through the gradual rise in marine planktonic taxa with height through the profile. Whilst there are some non-marine ostracods encountered, their abundance is low and all these taxa can tolerate low levels of salinity. The dominance of the diatom *Staurosira brevistriata* immediately prior to and during the onset of minerogenic sedimentation (Figure 3.4) is indicative of a shift in the site's palaeohydrology in response to this period of relative sea-level rise. This freshwater taxa has been noted to increase in abundance with catchment disturbance within lake systems (e.g. Barker *et al*. 1994). The taxon is very robust and also often seen as a pioneer species due to its ability to colonise during periods of change. *S. brevistriata* can also indicate lower water levels, transparent water, and/or decreased nutrients, which may also explain the total lack of planktonic taxa during this transition into brackish conditions (Reinemann *et al*, 2009). The abundance of *S. brevistriata* across the transition between freshwater and estuarine conditions has also been encountered within interbedded coastal sequences in Scotland (Shennan *et al*., 1995).

The microfossil signal preserved in the uppermost minerogenic deposits indicates a gradual reduction in estuarine influence. Diatom assemblages show a gradual increase in fresh and fresh-brackish benthic taxa, at the expense of marine planktonic and brackish benthic species (QS-D04 and QS-D05). The absence of forams and ostracods from the uppermost minerogenic sample (Table 3. 2) further reinforces the suggestion that, by this stage, terrestrial conditions were beginning to prevail and the influence of marine inundation was no longer a dominant environmental factor. The minerogenic layer is approximately positioned at -1m O.D. and this, combined with the *relative* age, means it can be associated with the Lower Wentlooge formation, representing extensive saltmarsh deposition across much of the Somerset Levels (Housley *et al*., 1999). Queens Sedgemoor then experiences the shift to uninterrupted freshwater peat accumulation (*4755–4620 cal BC* (*95% probability)*, which is also typical of the Somerset Levels, whereby a transition from the Lower Wentlooge formation into the 'upper peat' takes place. This is broadly dated across the Levels to 4600–4200 cal BC (Hosfield *et al.,* 2007) and hence Queens Sedgemoor fits well into this regional model. Indeed, the estuarine layer can be correlated across much of the Upper Brue Valley, thickening westwards, in accordance with the borehole survey undertaken by Housley *et al*. (1999)

The subsequent return to peat accumulation is estimated to have occurred in *4755–4620 cal BC* (*95% probability)*. This inferred age coincides very well with the regional picture as, at Shapwick Heath, marine clays of Late Mesolithic date were succeeded by *Phragmites* peat from 4710–4480 cal BC (Tinsley 2002). The shift to freshwater peat accumulation encompasses the upper part of pollen zone QS-P03 and is once again typified by alder and hazel, suggesting the return of alder carr conditions to the locale, with oak, elm and lime wildwood on the valley sides. Occasional aquatic taxa support a relatively waterlogged setting. Hazel initially dominates, supported by the presence of alder, elm, sedges and wild grasses, suggestive of open woodland proximal to the sampling site. The final diatom sample from the base of the peat unit (QS-D05) contains a suite of fresh and fresh-brackish taxa (*Epithemia zebra, Anomeoneis sphaerophora, Cocconeis plcentula*), although saline tolerant taxa persist in low abundances (*Nitzschia navicularis, Diploneis didyma*), to infer that the location was not yet beyond the reach of tidal influence.

Between 4.3m and 5.5m depth, pollen counts were too low to enable reliable palaeoenvironmental interpretations. Fern spores are found throughout this section, often in abundance. Fern spores are often resistant to decay and this raises the question as to whether the overall low pollen assemblages are a result of poor pollen preservation. Repeated palynological preparations ensured the very low pollen counts encountered was a fair representation of the sedimentary archive. The peat deposits were predominantly well humified within this section of the core, adding weight to the interpretation that the site may have experienced lower relative water tables during this time. This would have resulted in the peatland being drier, encouraging microbial activity and the post-depositional decay of the subsurface strata and associated pollen grains. Such an interpretation may help explain the relative abundance of microcharcoal within this zone. Lightning strikes will occasionally have caused natural fires, and such natural fires would be more common if the landscape was experiencing relatively dry conditions. However, the likelihood of numerous strikes over a small time period seem remote, leading to the conclusion that fire may have been used to maintain and/or extend disturbed areas to assist in activities such as foraging or hunting (Innes *et al.,* 2013). Moreover, land management by burning often is associated with enhanced fern and bracken growth (Norton 1979) and consequently fern and bracken spores seem to be significantly correlated with the early Holocene human activity and associated disturbances visible in pollen record (Kuneš *et al.* 2008). Based on the inferred depth at which the shift from the Mesolithic to the Neolithic takes place (4.7m), charcoal is most abundant during the later Mesolithic (5.14-5.55m depth), coinciding with the return to freshwater peat deposition.

Pollen preservation returns to levels suitable for palaeoenvironmental analysis at c. 4.2m depth. The record indicates the relative dominance of tree taxa including oak, lime and elm, with hazel understory. However when QS-P03 and QS-P04 are compared in further detail, fern and bracken spores are found in very high abundance in the upper sequence, indicating ferns are well established within the immediate locale. This is likely to be the case considering the presence of such spores in the underlying zone of poor pollen preservation. This, in addition to the relative abundance of sedges and grasses in the overlying sediments, suggests a fen peatland has now become established within Queens Sedgemoor.

The presence and relative abundance of elm at 4.2m is worthy of consideration. Below the zone of poor preservation, elm is common, typically contributing 10-20% TLP. This percentage increases to *c*. 30% TLP at 4.20m (QS-P04), before a sudden reduction in abundance to *c*. 5% TLP in the overlying zone. There is also a distinct increase in shrub and herb taxa that mirrors the decline in elm. The transition from QS-P04 to QS-P05, is estimated to date to *3680–3480 cal BC* (*95% probability*). The presence and timing of this shift could therefore be associated with the Neolithic elm decline. When taking into account the regional picture, there is considerable variation in the timing of the elm decline across the Somerset Lowlands, with dates varying from c. 3700 cal BC at Shapwick Burtle, to c. 2500 cal BC at Meare Heath (Marshall, *pers comm*). Queens Sedgemoor is one of the earliest sites in the region to record the elm decline. Such temporal variation in an apparent reduction in elm across the region (inferred through palynological records) would therefore suggest a single ‘event’ (natural or human induced) is unlikely to be responsible for this decline . The exact cause(s) of the Early Neolithic elm decline remain a source of debate, but it is believed that a multi-causal hypothesis of the combined influence of the European Elm beetle, paludification and human activity is likely responsible (Batchelor *et al*., 2014). In the case of human activity, the elm decline was marked by the expansion of grasses and ruderals, and the discovery of cereal pollen, all suggesting that the elm clearance was for cultivation. The absence of any cereal pollen from the Queens Sedgemoor assemblages suggests this may not be the case in this instance, at least not in the immediate locale of the sampling site. As indicated by the associated increase of herbaceous taxa to c. 50% TLP however, the elm decline appears to have opened up the oak, elm and lime “wildwood”, resulting in the expansion of herbs (Wilkinson and Straker, 2007). The apparent reduction in other tree taxa including lime, oak and pine, may add weight to the theory of human-driven elm decline and associated deforestation. Again, in accordance with the regional palaeoenvironmental picture, pollen diagrams from across the Somerset Levels suggest that the upland areas were originally characterised by various combinations of lime, oak, elm and ash woodland, and these appear to have been impacted by human forest clearance at various times during the Neolithic (Wilkinson and Straker, 2007). The fact that oak, elm and lime all show drops in abundance in QS-P05 and QS-P06 therefore suggests Queens Sedgemoor supports this broad trend. Alder is the only tree able to show signs of stability (and even recovery) through the overlying pollen zones, but this may be indicative of the more regional picture of alder carr conditions prevailing elsewhere across the Severn lowlands and above the intertidal zone, likely to be located proximal to Queens Sedgemoor at the time (Caseldine and Maguire, 1986). However, the alder signal should be treated with caution due to the very high level of pollen production when compared to other trees (Andersen 1973).

The final pollen zone, QS-P06, is defined by a distinct shift in shrub taxa, primarily through the re-establishment of hazel and heather. The expansion of shrubs is at the expense of the herbaceous species, with reductions in sedges and wild grasses accordingly. There is also a distinct drop in fern spores, being replaced by a rise in *Sphagnum*. This, combined with the very clear stratigraphic shift to *Sphagnum*-rich peat, is concluded to indicate a shift to acidic raised bog conditions at the locale. The timing of this shift has been securely dated to 3360–3030 cal BC. A number of trackway sites situated to the east, including Abbots Way, Shapwick Heath and Meare Heath, also show a shift to raised bog conditions in the Neolithic. However the dates reveal their transitions occurred slightly later, with Shapwick Heath turning into a raised bog after 2860–2470 cal BC for example (Wilkinson and Straker, 2007). All sites experienced a distinct increase in *Corylus-Myrica*, similar to that encountered at Queens Sedgemoor, which is probably evidence of *Myrica* (sweet gale) growing on the surface of the raised bog (Beckett and Hibbert, 1979). It is therefore clear that a period of raised bog development typified areas of the central and eastern Somerset Levels, as shown by such broadly synchronous events. Throughout these changes at both Shapwick and Queens Sedgemoor, alder is thought to have fringed the fens that surrounded the raised bog and remained a major constituent of the pollen spectra (Beckett 1979). This suggests alder carr conditions prevailed close to the Queen’s Sedgemoor area throughout the period under investigation.

The identified shift from fen peat to raised bog conditions at Queens Sedgemoor has had a clear impact on the site’s vegetation cover, but the pollen assemblages must be treated with caution. The record preserved within the sedimentary archive is also likely to also reflect a shift in pollen input. Whereas a fen peatland would experience pollen input from a variety of sources including the i) local tree canopy, ii) in-wash, iii) vegetation from the immediate vicinity and iv) rainfall, the onset of raised bog conditions results in the bog surface becoming independent of the local water table. This would have resulted in a greater proportion of the pollen input being derived from rainfall and local vegetation (Tauber, 1965). Such a shift in pollen source input is likely to explain why many of the tree taxa are no longer evident within QS-P06, whilst the loss of almost all herbaceous taxa is likely a response to the limited taxa able to thrive in the acidic setting. Alder remains abundant and is likely to still be fringing the fens that surrounded the raised bog. The absence of any microcharcoal within the zone could infer that anthropogenic activity may have halted at the site, potentially due to the raised bog being seen as a less suitable resource for Neolithic exploitation. Alternatively, the raised bog may have been used for the grazing of livestock, hence limiting the need for burning to take place.

Discussion

The sedimentary sequence encountered at Queens Sedgemoor contains evidence of hydroseral succession, whereby there is a transition from open water to a fen peat environment, which is then replaced by a raised bog setting. In this instance, the hydroseral succession sequence is interrupted by a brief phase of estuarine inundation. Further analysis of the plant macrofossils and associated proxy data (insects, Mollusca, etc) will help elucidate whether the site was initially a large open lake or a freshwater wetland with vegetated pools and permanent water, although the latter is considered more likely. The absence of suitable pollen assemblages at the depths associated with the Mesolithic-Neolithic transition is unfortunate given the remit of this project, but the high-resolution radiocarbon dating strategy and palaeoenvironmental analyses of the overlying and underlying strata has helped elucidate the timing of bog formation in the Queen’s Sedgemoor area.

It is interesting to note that between 4.3-5.5m, not only was there a very low presence of pollen, but all attempts at radiocarbon dating failed due to the overall lack of identifiable plant macrofossils. As previously discussed, these factors infer a high level of humification of peat deposits dated to the Mesolithic-Neolithic transition. Palaeoclimatic data does suggest that the Neolithic period is positioned within the Holocene 'climatic optimum', with summer temperatures at the Somerset Sweet Track estimated as being 2–3˚C warmer at around 3800 cal BC (Koç and Jansen, 1994; *cited in* Wilkinson and Straker, 2007) than today. Such conditions would have favoured peat decomposition and could have been a factor in causing such poor pollen preservation. This evidence, combined with the relative abundance of microcharcoal during the late Mesolithic, and the abundance of fern spores throughout the zone, therefore indicates that the optimal climatic conditions of the time may have encouraged the active exploitation and selective burning of Queens Sedgemoor by its Mesolithic-Neolithic inhabitants. There is certainly evidence for potential anthropogenic activity revealed within the pollen and microcharcoal records, with the timing of changes to the woodland structure coincident across the Somerset Levels.

Considering the wealth of palaeoenvironmental data provided through this study, it is worth commenting on the quality of the associated anthropogenic signal preserved within the sequence. The evidence provided through microscopic charcoal and pollen reconstructions can be interpreted as reliable signals of human activity, but it is appreciated that the signals are somewhat subtle. This could be explained by the nature of the sedimentary basin into which sediment accumulation (and hence deposition of the pollen and charcoal) has taken place. The overall geometry and sedimentary history of the basin was originally established by the coring programme of Housley *et al*. (1999) and further analysed during the field work undertaken during this study. The results suggest that the sample site is likely to have been located at least 0.5km from wetland-dryland margin at the time these sediments formed.

Whereas all the other sites being investigated as part of this project are located on the wetland edge, the position of the Queens Sedgemoor sample location towards the centre of a wetland basin (and hence at a distance from the wetland edge), may explain why the potential anthropogenic signals are appearing to be less distinct. Whilst the charcoal records and much of the arboreal pollen encountered within the Mesolithic-Neolithic sequence would have been derived from the surrounding dryland catchment, subsequent transportation into the basin would have led to the anthropogenic signal being 'diluted' with distance. It may also be the case that the Queen's Sedgemoor area experienced less prehistoric activity than for instance the Brue valley areas investigated by the Somerset Levels Project. One potentially significant difference is the absence of many 'islands' of hard geology on the moor that may have been the foci for prehistoric activity. However, the absence of known prehistoric sites can probably be largely attributed to the lack of archaeological prospection in the area, the generally low level of development and the absence of peat cutting.

ORGANIC REMAINS

Depth in core	582-585cm	585-588cm	588-591cm	591-594cm	594-597cm	597-600cm	peat	756-759cm	759-762cm	762-765cm	765-768cm	768-771cm	771-774cm
plant debris + seeds + spores	x	x	x	x	x	x		x	x	x	x	x	x
insect remains	x	x	x	x	x	x		x	x				
fish bone	x				x	x							
cladoceran ephippia	x					x							
brackish ostracods		x	x	x	x	x							
non-marine ostracods			x	x	x								
brackish foraminifera			x	x	x	x							
Bithynia opercula					x								

BRACKISH FORAMINIFERA

Depth in core	582-585cm	585-588cm	588-591cm	591-594cm	594-597cm	597-600cm	peat	756-759cm	759-762cm	762-765cm	765-768cm	768-771cm	771-774cm
Haynesina germanica			x										
Ammonia sp. (brackish)			x	x									
Jadammina macrescens					x	x							

BRACKISH OSTRACODS

Depth in core	582-585cm	585-588cm	588-591cm	591-594cm	594-597cm	597-600cm	peat	756-759cm	759-762cm	762-765cm	765-768cm	768-771cm	771-774cm
Cyprideis torosa		f	xx	xxx	xx	x							

NON-MARINE OSTRACODS

Depth in core	582-585cm	585-588cm	588-591cm	591-594cm	594-597cm	597-600cm	peat	756-759cm	759-762cm	762-765cm	765-768cm	768-771cm	771-774cm
Heterocypris salina			x	x									
Herpetocypris sp.			o	x									
Candona neglecta					x								

Organic remains are recorded on a presence (x)/absence basis only
Foraminifera and ostracods are recorded: o - one specimen; x - several specimens; xx - common; xxx – abundant/superabundant; f – fragments only

Grey - Calcareous foraminifera of low-mid saltmarsh and tidal flats;
Green - Brackish ostracods of tidal flats and creeks;
Blue - Non-marine ostracods, but able to tolerate low salinities

	582-585cm	585-588cm	588-591cm	591-594cm	594-597cm	597-600cm	peat	756-759cm	759-762cm	762-765cm	765-768cm	768-771cm	771-774cm
Ecology	*Freshwater wetland*	*Initially saltmarsh, with brackish mudflats quickly developing, finally returning to freshwater wetland. Some decalcification*						*Mudflats with evidence of waterlogging or weathering (and completely decalcified). Considered freshwater in the absence of any brackish evidence*					

Table 3.2: A summary of the Foraminifera and ostracod assemblages encountered within the minerogenic deposits at 5.82-6.00m depth and 7.56-7.74m depth. An overall summary of organic remains encountered is provided within the uppermost table, complemented by a subdivision and focus on the respective Foraminifera and ostracod taxa encountered in subsequent tables. The table also includes a summary of palaeoenvironmental interpretations associated with the assemblages encountered

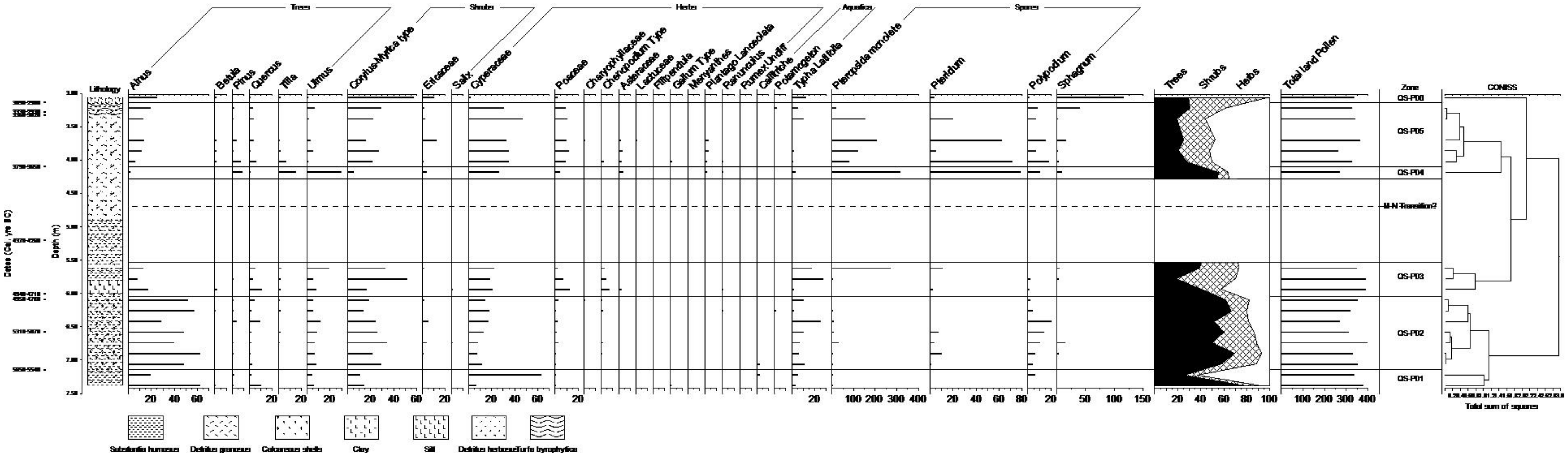

Figure 3.2: A summary of the pollen results from the Queens Sedgemoor sedimentary archive, including LPAZs based on cluster analysis. Only species with >2% TLP are displayed. Key radiocarbon dates have been included, in addition to a line denoting the theorised Mesolithic-Neolithic transition at c. 4,000 Cal. yrs BC.

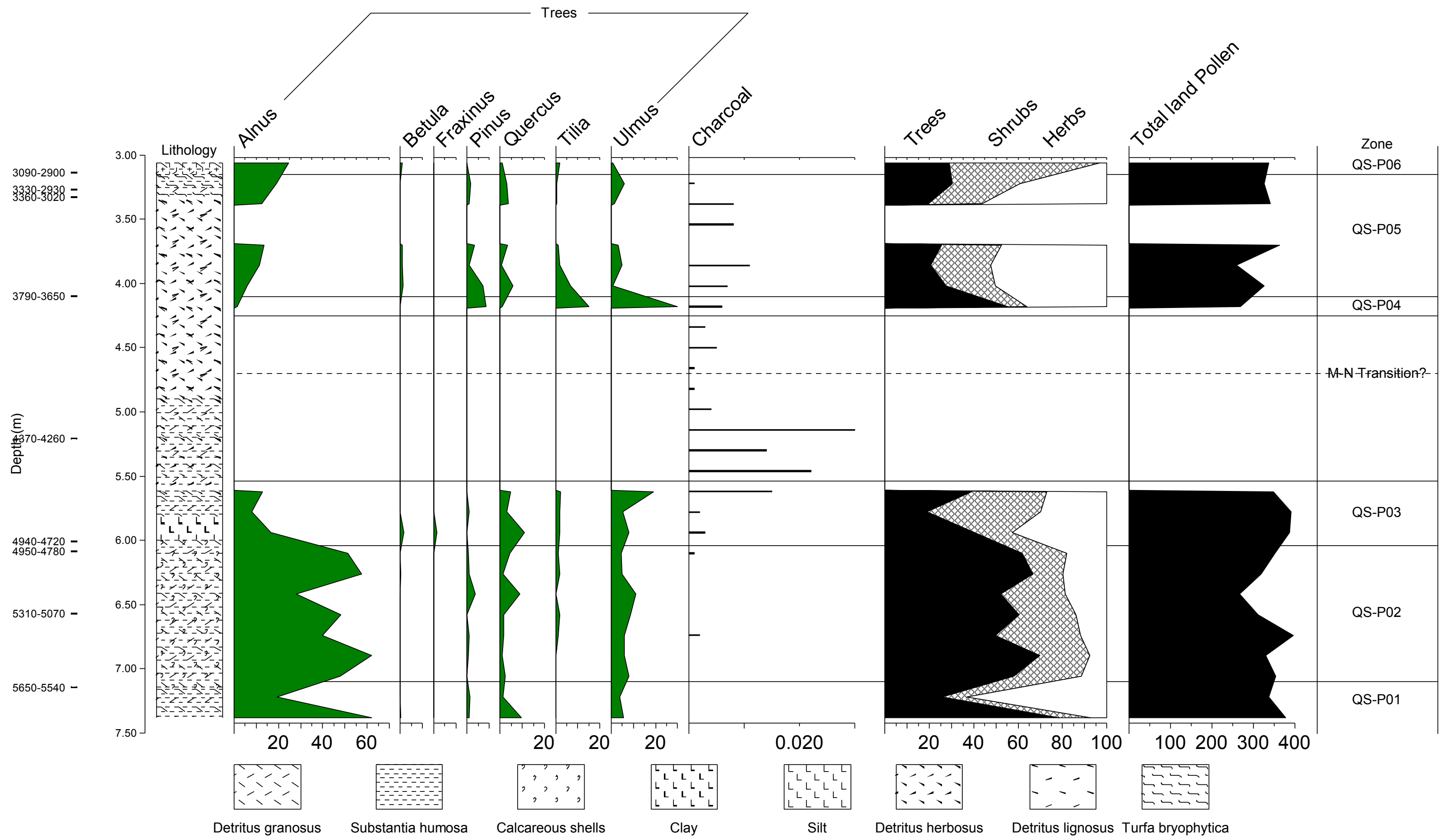

Figure 3.3: A summary of the tree taxa encountered within the pollen signal at Queens Sedgemoor, in addition to a review of the charcoal abundance within the samples under investigation.

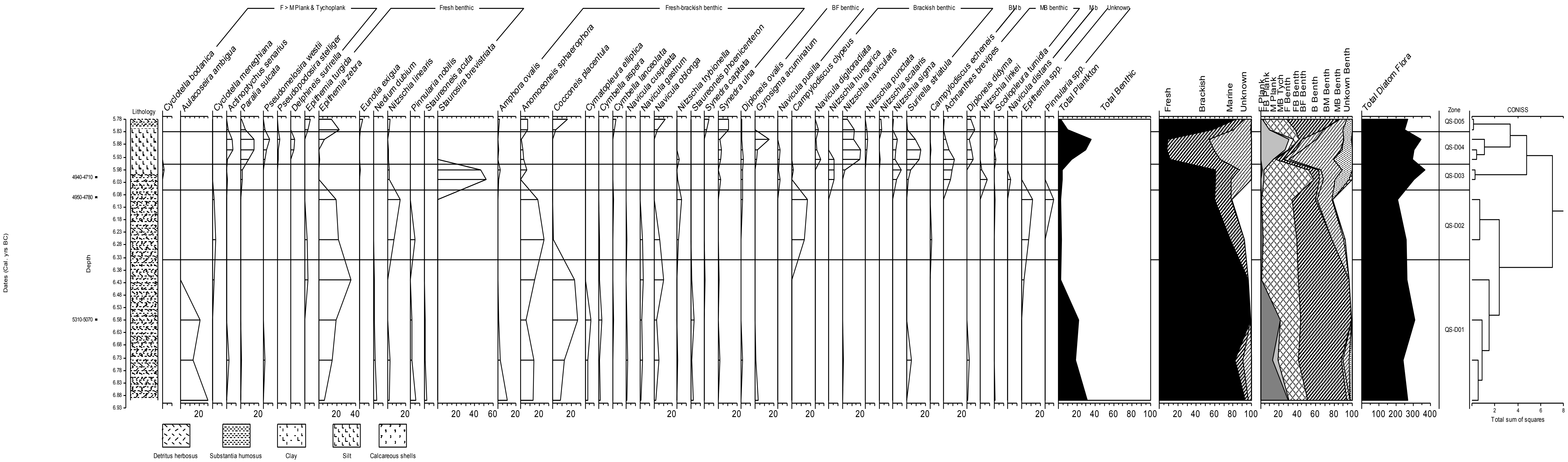

Figure 3.4: A summary of the diatom assemblages encountered within the Queens Sedgemoor sedimentary sequence. Only species >2% TDV are displayed. Local diatom assemblage zones have been developed based on cluster analysis. Key radiocarbon dates have also been included. For ease of display, all planktonic and tychoplanktonic taxa have been grouped together, with freshwater taxa to the left of this grouping, increasing in salinity tolerance to the right. The cumulative salinity graph (towards the right of the diagram) is divided into broad 'fresh, brackish and marine' groupings. This has been achieved by combining fresh and fresh-brackish taxa together (fresh), brackish-fresh, brackish and brackish-marine taxa together (brackish), and marine-brackish and marine taxa together (marine). This includes both planktonic and benthic taxa. A more detailed summary of salinity tolerances is provided to the right.

Chapter 4: Greylake Burtle, Mesolithic stratigraphy

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with contributions by Rob Batchelor, Peter Marshall, Alex Brown and Lionello Morandi

Introduction

Greylake is arguably the most important Mesolithic site on the Somerset Levels, and certainly the location with the longest history of archaeological investigation. Mesolithic activity at Greylake is associated with an 'island' of Pleistocene sands and gravels ('burtle') that presently projects 4m above the surrounding seasonal pasture of King's Sedgemoor, 1.7km west-north-west of Middlezoy (Figures 1.1 and 4.1). Archaeological interest in the site dates from 1928 when five human skulls and accompanying long bones were discovered during sand extraction of a 140x140m area on the north of the island (Gray 1928, Brunning 2013). Only two skulls, a mandible (in the Blake Museum, Bridgwater) and four tibiae (in Somerset County Museum, Taunton) now remain, the remainder probably having been destroyed in the bombing of the Royal College of Surgeons, London in World War 2.

AMS ^{14}C measurements of two samples from the skulls and one from the mandible date their burial to the Early Mesolithic 8430-8270 cal BC (Wk-30930; 8450-8270 cal BC), (Wk-309319134±37 BP; 8540-8280 cal BC), 9170±40 BP (OxA-25666, 9118±37 BP; 8540-8280 cal BC) (Brunning and Firth 2011, Brunning 2013a). Greylake is the only open air Mesolithic cemetery in Britain (Brunning 2013a). In addition to the human skeletal remains, some 4000 flint and chert artefacts were collected by H.S.L. Dewar and Arthur Bulleid from the quarry in the 1930s, and thus the site is also the richest Mesolithic stone artifact scatter in Somerset (Clark 1933). Interim accounts of the assemblage suggest that it is entirely of Early Mesolithic date and might therefore be contemporary with the burials (Clark 1933; Wainwright 1960; Norman 1982, 2007). Were this to be the case, it would make Greylake unique among British sites in combining artefact manufacture with disposal of the dead (Meiklejohn *et al.* 2011; Brunning 2013). Beaker and Bronze Age finds have also been made at Greylake, including Beaker burials from the quarry (Bulleid and Jackson 1938, 1941; Gray 1926, 1928) and Late Bronze Age human skeletal remains and possibly timbers from peats to the immediate north of the island Brunning (1998)

All the Mesolithic finds outlined above were probably recovered either from the present soil on Greylake Burtle or from the fills of features cut into the sand island Gray (1928) reported finding long bones two feet below the surface of the sand. Aggregate extraction did not extend to areas where the Pleistocene sands and gravels dip below the later Holocene freshwater and intertidal deposits of King's Sedgemoor, and therefore no exposures in this zone have been available for archaeological study. Therefore geoarchaeological works as part of the present project were designed to examine the interface between the Pleistocene and Holocene deposits in order to:

1. Better understand the stratigraphic and palaeoenvironmental context of the Mesolithic finds;

2. Locate strata that might be contemporary with the Early Mesolithic lithic scatters and burials;
3. Reconstruct the changing environments of the Mesolithic and Early Neolithic.

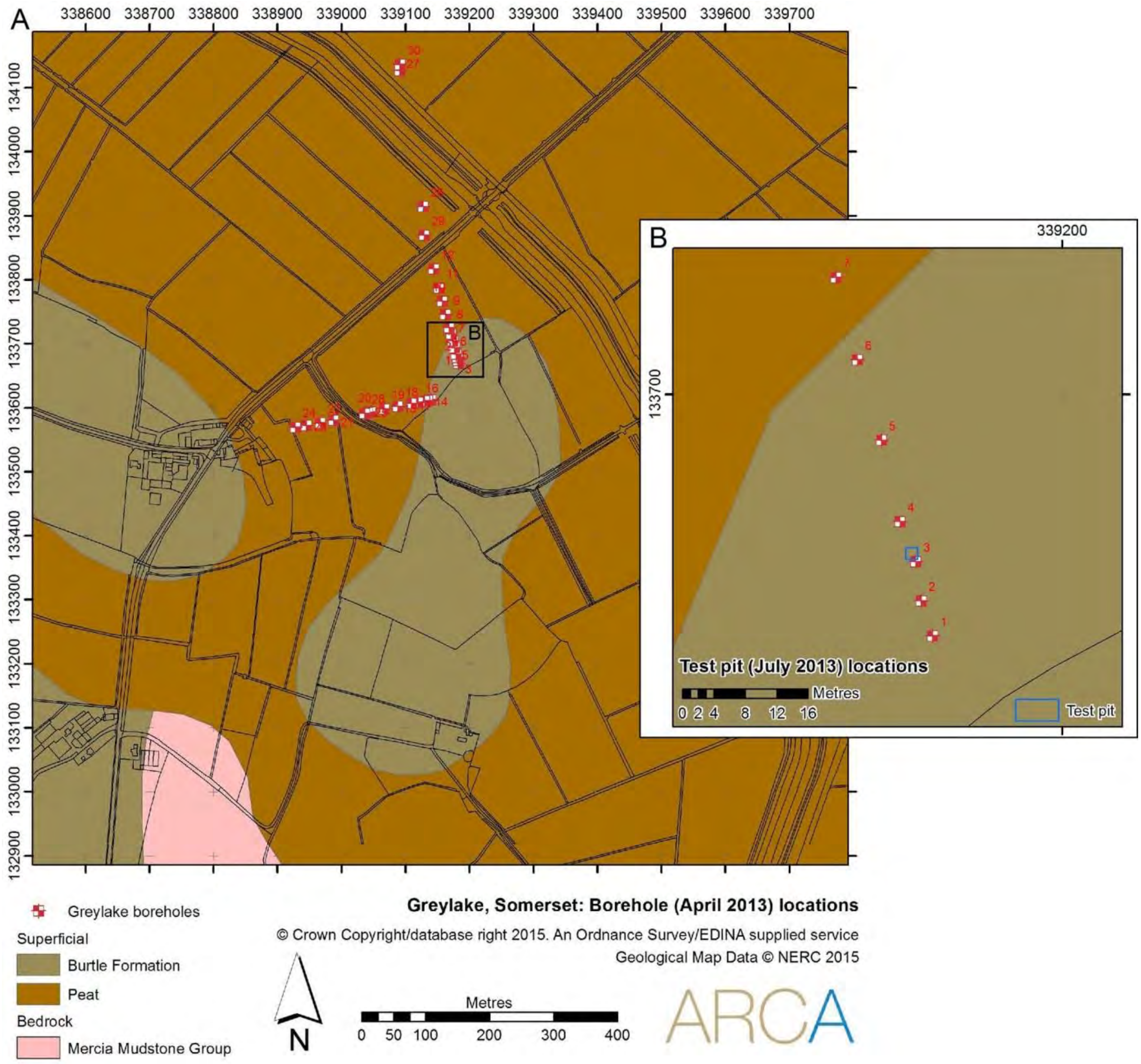

Figure 4.1: Greylake a. Location of boreholes drilled in April 2013, and b. Location of test pit

Geological and geomorphological setting

Greylake Quarry 2 is the type site of the Burtle Formation (Hunt 1998, Campbell *et al*. 1999, British Geological Survey 2014a). This Middle-Upper Pleistocene unit comprised of well-sorted sands and gravels, outcrops as low ridges and isolated hills at the margins of the Somerset Levels. Exposures in the Greylake quarries indicate that the deposits are of *c.* 7.6m thickness and comprise tabular beds of medium sands, and rounded and sub-rounded, matrix-supported gravels (Hunt 1998).

Absolute dates of the deposits have not been obtained from Greylake or elsewhere, but published amino acid ratios (AAR) on *Corbicula flum*inalis (D-aIle/L-Ile = 0.26 and 0.18) from Greylake Quarry 1 suggest the strata include fossil material of marine isotope stage (MIS) 9 and 7 age (Hunt *et al.* 1984; Hunt 1998; Campbell et al. 1999). AAR data from Quarry 2 on the other hand (on *Patella vulgata* and *Macoma baltica*), indicate a last interglacial (Ipswichian, MIS 5e) age (Andrews *et al.* 1979, Hunt 1998). Recent AAR dating of shells in an exposure 150m south-east of BH1 by Kirsty Penkman also indicate an MIS 5e age for the upper part of the sequence (Tony Brown per comm). Boreholes drilled as part of the 1990s Geological Conservation Review west of the quarries demonstrated that the Burtle sequence comprises a diamicton overlain by grey silts containing roots. These were further capped by marine sands overlain by a palaeosol and calcrete developed in gravels, and in turn overlain by marine sands and finally silts (Hunt 1998, figure 9.4, 297). Campbell *et al.* (1999) have interpreted the stratigraphic evidence from the outcrops and boreholes as indicating that the lower marine sands (which they term the Greylake Member) are of MIS 7 age while the upper marine sands (Middlezoy Member) date from MIS 5e. Vertebrate (e.g. *Dama dama*, *Bos primigenius*, *Cervus elephas*) and invertebrate (e.g. the freshwater bivalve *Corbicula fluminalis*) fossils from the Middlezoy Member confirm the presence of interglacial climates during the accumulation of the upper part of the sequence, while the appearance of *Hydrobia* throughout the sequence suggests that accretion was mostly in intertidal conditions (Hunt 1998).

The Burtle Formation sits unconformably on deposits of the Triassic Mercia Mudstone Group (MMG) and indeed clasts of mudstone are observed as inclusions in several of the Burtle facies. The Burtle beds are in turn overlain by Holocene fluvial and intertidal deposits, and which are classified by the British Geological Survey as the Somerset Levels Formation (Campbell *et al.* 1999; British Geological Survey 2014b), but by most archaeologists and physical geographers working in the Severn Estuary Levels as the Wentlooge Formation (Allen and Rae 1987). These Holocene strata onlap both the Burtle Formation hills and the MMG outcrop and have a vertical thickness in excess of 12m just 500m north of Greylake burtle (in BH26 - see below). The focus in the remaining part of this report is on the Somerset Levels Formation/Wentlooge Formation.

Methodology

Geoarchaeological works comprised two phases of fieldwork in April and July 2013, subsequent laboratory processing and assessment in September-November 2013, initial ^{14}C measurement in March-July 2014, and biostratigraphic analysis and a second phase of ^{14}C dating from August-December 2014.

The first phase of fieldwork was hand and mechanical augering of two borehole transects emanating from the Greylake Burtle island. Borehole locations were first determined on the project's ArcGIS database and then eastings-northings coordinate data uploaded to a Leica Zeno dGPS (accuracy ±0.8m). The latter instrument was used in the field to mark in (using surveyor's pegs) the borehole positions. Following the completion of the drilling, the boreholes were re-surveyed using a Leica System 1200 GPS, giving a horizontal and vertical accuracy of better than ±15mm (Figure 4.1).

Manual borehole drilling was carried out by a team of three using Dutch/Edelmann (for compact surficial strata) and 20mm diameter gouge augers. Twenty-four such boreholes were drilled between 15 and 19 April 2013 (BH1-24). Individual boreholes were drilled from the ground surface to the Burtle Formation or Mercia Mudstone Group deposits that underlie Holocene alluvial, peat and intertidal stratigraphy or to 6m below ground level (BGL), whichever was the lesser. Soil/sediment retained in the auger heads was described according to standard geological criteria (Jones *et al.* 1999; Munsell Color 2000; Tucker 2011) and then discarded, the arisings later being used to backfill the hole. Further boreholes were then drilled at four locations where particularly interesting stratigraphy was deemed likely on the basis of topographic position and/or manual augering results (24-26 April 2013). Three of the latter boreholes (BH25-27) were drilled using 75-55mm diameter gouge augers powered by a two-stroke Atlas Cobra hammer and logged as described for manual augering above (Figure 4.2), and the last (BH28) was recovered as a continuous series of 1m long and 50mm diameter cores. Finally near surface peat strata of 4m thickness were also sampled as 0.5m long by 50mm diameter cores with a Russian auger in one location (BH29). Cores were transported to the laboratory where (in the case of mechanically drilled cores) they were initially passed through an MS2C 60mm diameter core sensor attached to a Bartington MS2 magnetic susceptibility meter, and volume magnetic susceptibility readings taken at 30mm intervals. The cores were then cut open using a bench-mounted stone saw and a sharp blade was used to slice each core in two on a longitudinal axis. One half of the core was placed in storage, while the other was described using the same approach as employed in the field and then passed to Quest, University of Reading for bioarchaeological and ^{14}C sub-sampling. The former comprised 1cm^3 samples for pollen assessment and the latter 1cm-thick slices for 'bulk' AMS measurements. Lithological and positional data collected during the borehole drilling were combined within a RockWorks 15 database and that software then utilised to plot Figures 4.5 and 4.7. Locational data for each borehole is included in Appendix 2a, while lithological data collected in both the field and laboratory is presented in Appendix 3.

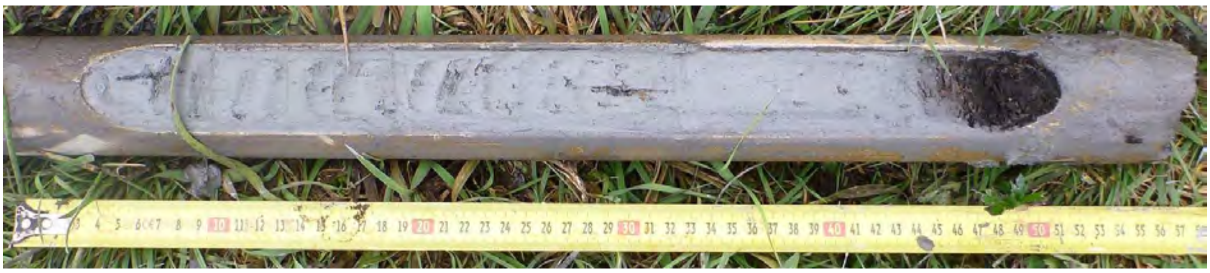

Figure 4.2. Greylake: Gouge auger head retrieved from 9-9.55m BGL in BH26. Note laminated silts and fine sands, and sharp contact with peat at c. 9.46m BGL

A single test pit measuring 1.5m x 1.5m was hand-excavated to the immediate north of BH3 between 17 and 19 July 2013 to further explore the peat strata and Burtle Formation surface at the edge of the Greylake Burtle (Figure 4.1). The test pit

Figure 4.3. View from the north-west of the Greylake burtle test pit during excavation and showing the location of the sample column (prior to removal)

position was plotted in the project's ArcGIS database at a location where the Burtle Formation surface was estimated at 1.2m BGL (i.e. so that no stepping of the trench or shoring was required). The positional data were then transferred to a Leica System 1200 RTK GPS and the latter instrument used to position the test pit corners. The test pit was then excavated by context and bone finds (there were no artefacts) recorded to Ordnance Survey NGR and OD using a total station (Figure 4.3). A 0.5x0.5m area in the north-east corner of the test pit was not excavated, but rather sediment was removed as a continuous series of 0.05m-thick bulk samples. These latter were placed in labelled sealable plastic buckets. On completion of the excavation the western section of the test pit was cleaned, photographed, drawn at a scale of 1/10 and three monolith samples taken, after which the test pit was backfilled.

The monolith and bulk samples collected from the test pit were transported to the University of Winchester for further study. Strata sampled in the monoliths was initially cleaned by the removal of a *c*. 1mm thickness to expose a fresh surface. Photographs were then taken after which lithological descriptions were made using the same criteria as employed in the study of the core samples. The monoliths were then passed to Quest at the University of Reading and sub-samples taken for biostratigraphic assessment and ^{14}C dating. Sub-samples for palynological study were taken according to the same protocols as employed on the cores, while terrestrial macrofossils were opportunistically removed from the monoliths using forceps for AMS measurement. Bulk samples were processed using the flotation technique with mesh sizes of 0.5 and 0.25mm for the residue and flot respectively. Residues were air dried, and then sorted by eye and with the aid of a low power binocular microscope, while flots were not sorted, but rather have been retained in a wet state in glass jars. Appendix 3 contains the descriptions of the monolith stratigraphy.

Through the offices of Peter Marshall (English Heritage), six samples were submitted for AMS ^{14}C measurement. Paired dates on humin and humic fractions were obtained from the Scottish Universities Environmental Change Research Centre (SUERC) on three 'bulk' samples from the cored borehole, BH28, while the University of Belfast's ^{14}Chrono Centre, dated two terrestrial macrofossil samples from the monoliths. Finally, a single AMS ^{14}C date was obtained on a domesticated cattle tibia (*Bos* sp – identification by Dr R. Bendrey) from the interface between Units 3 and 5.

Results

The text below outlines firstly the results of ^{14}C dating and secondly the stratigraphy as exposed in the boreholes and the test pit.

AMS ^{14}C dating
The results of the AMS ^{14}C measurements are presented in Table 4.1, while Figure 4.4 compares the probability distribution of the results.

Lab. No.	Loc.	Depth	Material	14C age/error	δ^{13}C	Calibrated date (2σ)*

		(m BGL)		(BP)		
UBA-25439	TP	0.84-0.85 [+3.3mOD]	Twig	4489±38		3360–3020 cal BC
UBA-25438	TP	1.21-1.22 [+2.94m OD]	*Crataegus* sp.	4745±39	-28.4	3640–3370 cal BC
SUERC 59490	TP	1.25 [2.92mOD]	*Bos* sp. (Tibia)	4842±32	-21.5	3690–3530 cal BC
SUERC-53058	BH28	3.75-3.76	Peat (humic)	5642±27	−27.1	
SUERC-53059	BH28	3.75-3.76	Peat (humin)	5642±29	−28.4	
Weighted mean	BH28	3.75-3.76 [+0.33m OD]	Peat			4530–4445 cal BC
SUERC-53056	BH28	7.53-7.54	Peat (humic)	6229±29	-28.0	
SUERC-53057	BH28	7.53-7.54	Peat (humin)	6245±27	-27.2	
Weighted mean	BH28	7.53-7.54 [-3.45m OD]	Peat			5300–5205 cal BC
SUERC-53051	BH28	7.92-7.93 [-3.84m OD]	Peat (humic)	6979±30	-30.0	5980–5760 cal BC
SUERC-53052	BH28	7.92-7.93 [-3.84m OD]	Peat (humin)	6855±28	-29.8	5790–5670 cal BC

Table 4.1. Results of AMS ^{14}C dating of samples from Greylake.
* calibration was carried out by Peter Marshall using the IntCal13 curve (Reimer et al. 2013) and OxCal v 4.2 (Bronk Ramsay 2009).

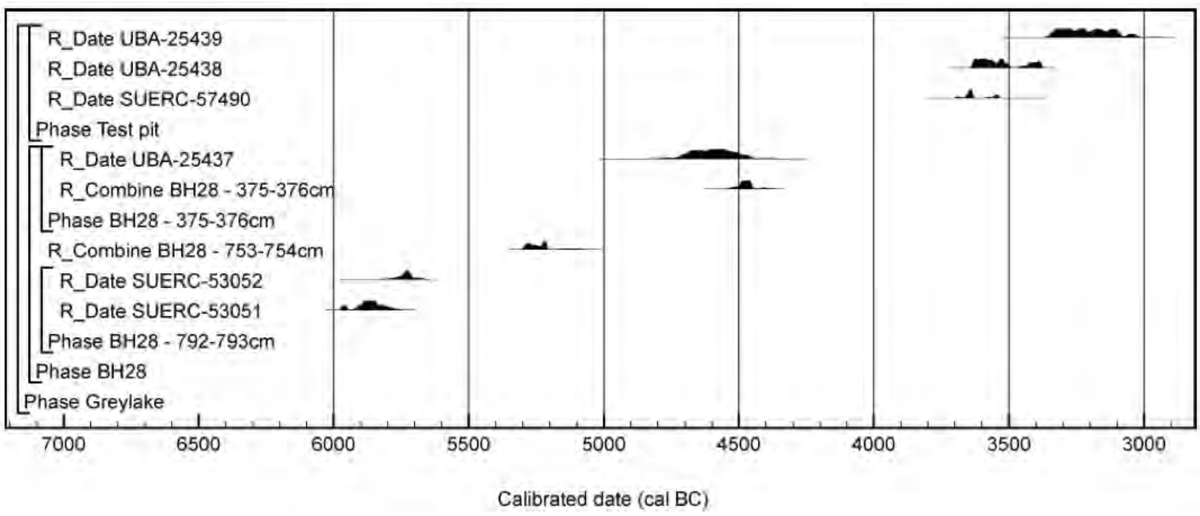

Figure 4.4. Probability distributions of dates from Greylake. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993). Illustration by Peter Marshall

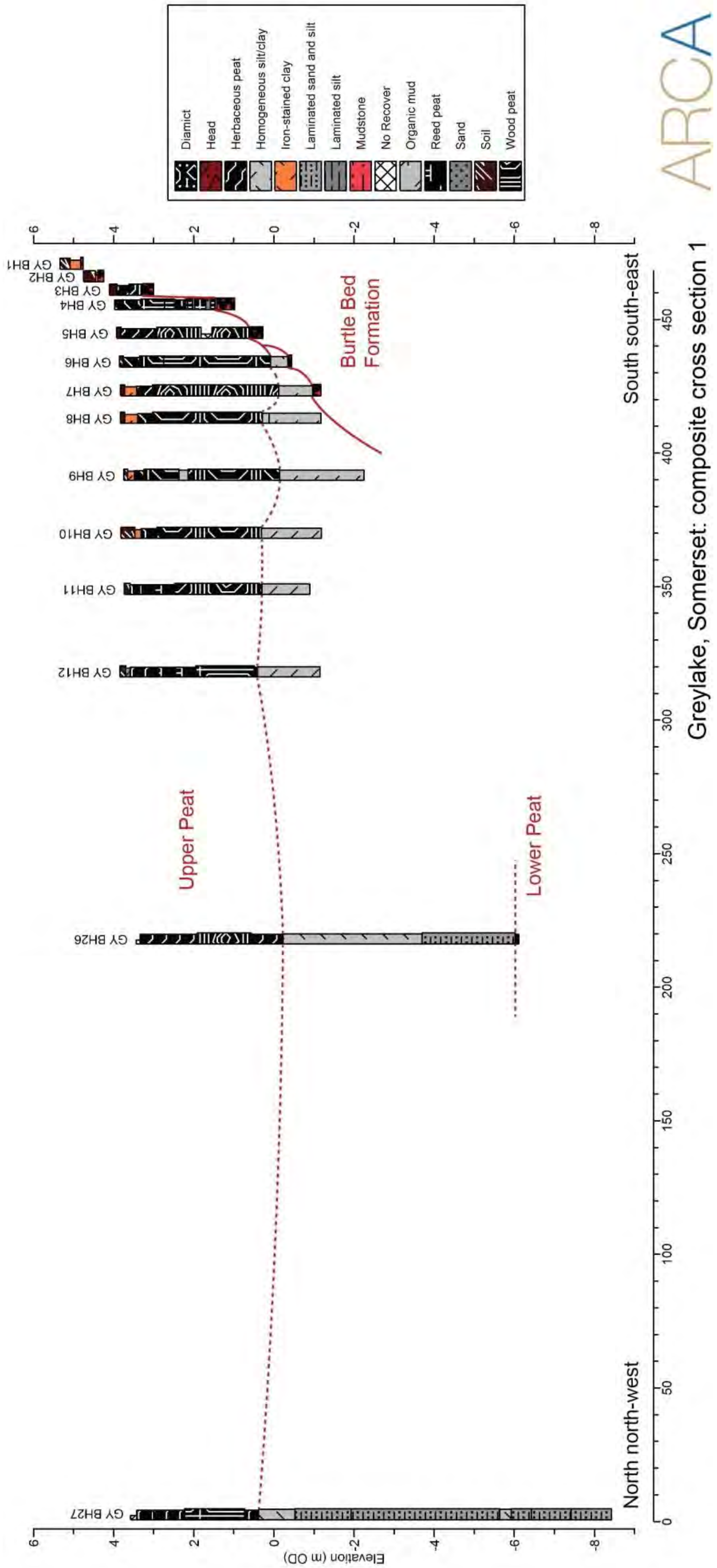

Figure 4.5.
Greylake:
North (bottom) to
south (top)
composite cross
section (see Figure
4.1 for location of
boreholes)

The chronometric data demonstrate that the 'Lower Peat' (see below), outcropping at -3.58 to -4.10m OD between Greylake Burtle and the hamlet of Greylake to the west is of sixth millennium cal BC age (c. 5850-5250 cal BC). Although this is a Mesolithic range, accretion of the Lower Peat nevertheless post-dates the Early Mesolithic burials – and presumably the lithic scatters - on Greylake Burtle by some 2500-3000 years. Dates on the lower contact of the 'Upper Peat' vary between the test pit and BH28, although this is no great surprise given that the relative outcrop elevations (+2.97m OD for UBA-25438 versus +0.15m OD for SUERC-53058/9 in BH28). The ^{14}C data therefore demonstrate that the Upper Peat took c. 900 years following *c.* 4500 cal BC to grow 2.82m and thereby to cover the margins of Greylake burtle. The date on the cow tibia (SUERC-59490) indicates human activity of Neolithic date at the interface between the weathered surface of Greylake burtle and the overlying Upper Peat.

Stratigraphy

The two borehole transects were set out so as to both sample the valley between Greylake Burtle and the hamlet of Greylake (Transect 2), but also to examine the relationship of the deposits on the flank of the Burtle with those of the wider moors to the north (Transect 1) (Figure 4.1).

Transect 1 (Figure 4.5)

Transect 1 comprises BH1-12, 26, 27, 29 and 30, and the test pit. The origin of the transect is on the north-west margin of Greylake Burtle (BH1) from which it extends 480m north-north-westwards onto the moor (BH30), and in doing so it crosses Langacre Rhyne.

The base of the Holocene stratigraphy in the southern part of the transect rests upon sands of the Burtle Formation. However, the complete Holocene sequence was not penetrated by boreholes in the northern part of the transect, including in those drilled mechanically (BH26-27, which penetrated to 9 and 12m BGL respectively) (Figure 4.5). The contact between the Somerset Levels and Burtle Formations therefore drops rapidly between BH1 (+4.82m OD) and BH7 (-0.98m OD), while it is presently unclear how far to the north of BH7 the Burtle Formation extends.

A grey blue silt/clay unit unconformably overlies the Burtle Formation in the southern part of the transect from BH3 northwards (as evidenced by Unit 5 in the test pit – Figure 4.5), but evidence from mechanical borehole BH26 suggests that a wood peat underlies the fine-grained mineral deposits in the north part of the transect (Figure 4.2). However, given that this peat does not appear north of Langacre Rhyne in BH27, it would appear to be either part of a local outcrop or a bed that steeply shelves to the north to pass beneath the stratigraphy penetrated by BH27. A further possibility is that the peat has been scoured from the location of BH27. The evidence for this hypothesis are sands (included laminated silts and fine sand units), which demonstrate the presence of tidal creek or channel environments and which might have removed any prior organic strata. Indeed, the Lower Peat in BH26 is unconformably overlain by such sand strata, suggesting that the (probable) alder carr environment in which it formed was succeeded (albeit perhaps separated by a hiatus) by high energy intertidal conditions. Whatever the mode of genesis it is highly likely that the wood peat found at -6.02m OD in BH26 is earlier than the Lower Peat (i.e. earlier than *c.* 5250 cal BC) in BH28 (see below) given the -3.58 to -4.10m OD outcrop of the latter.

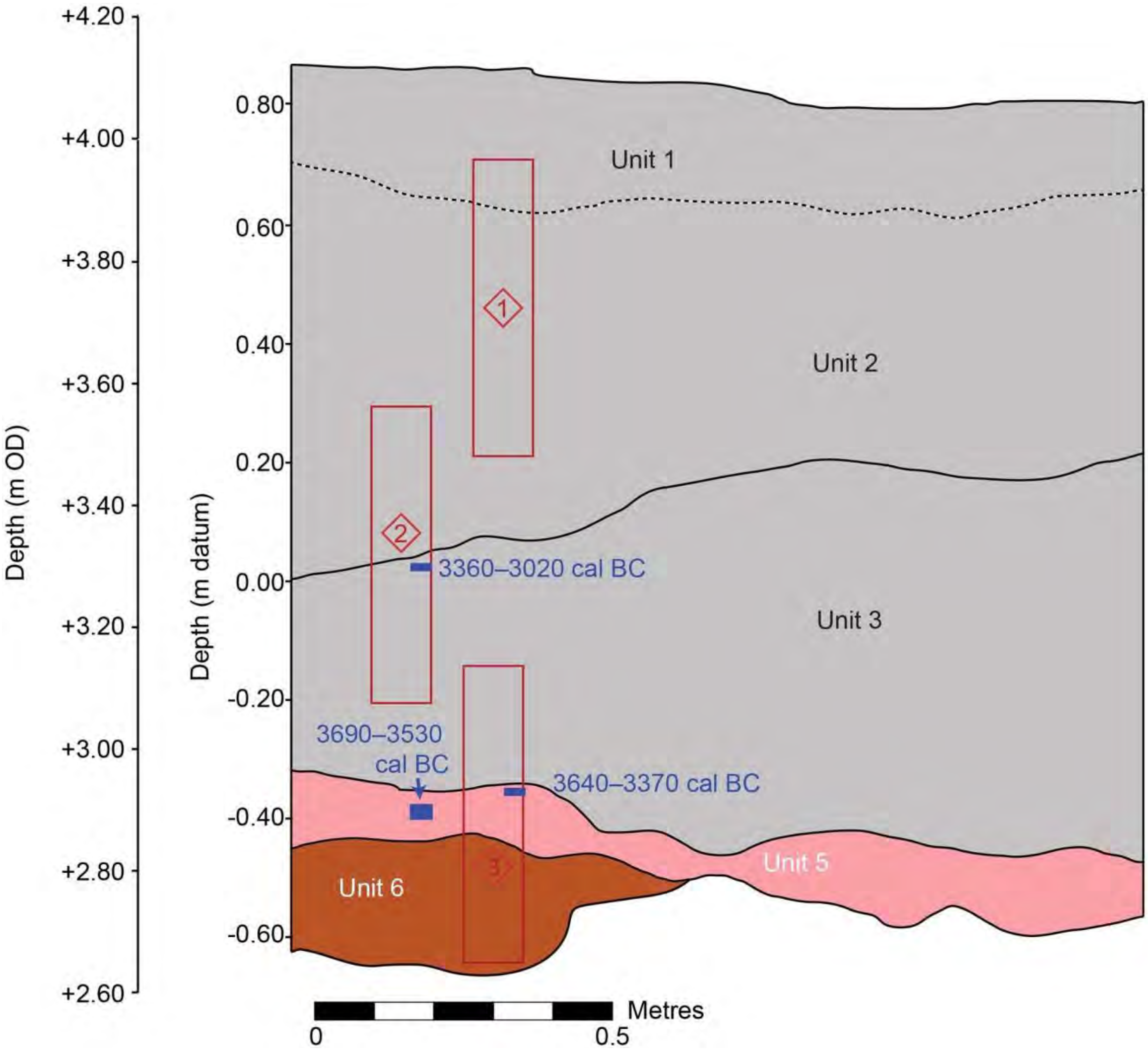

Figure 4.6. Greylake test pit : Western section of the July 2013 excavation

The sands overlying the wood peat in BH26 and found at the base of BH27 fine upwards and are succeeded by the same grey blue silt/clays that are found overlying the Burtle Formation in the northern part of the transect. It is not possible to assign an age to these mineral deposits on the basis of evidence presently available, but they probably formed entirely during the Mesolithic assuming that the date for the bottom of the Upper Peat in Transect 2 is widely applicable (SUERC-53058 and SUERC-53059, Table 4.1). The grey-blue silt/clays are in turn overlain at a reasonably constant elevation of 0m OD by a reed peat that changes upwards into a wood peat. The peat unit is 3-4m thick in all boreholes except those drilled through the edge of the Burtle island where it is progressively thins as the Burtle Formation rises. Indeed the stratigraphy of this Upper Peat is best exemplified by the exposure in the test pit (Figure 4.6). Here a 0.06m-thick blue grey sandy silt (Unit 5) was encountered at the interface between deposits of the Burtle Formation (Unit 6) and the overlying peat (Units 1-3). These mineral deposits contained frequent reedy plant remains, but there is also evidence for the presence of woody terrestrial flora including *Crataegus* sp., a fossil of which was dated to 3640–3370 cal BC (UBA-25438, Table 4.1). Unit 5 is unconformably overlain by Unit 3, a dark brown moderately humified wood peat that contains frequent boulder to pebble-sized wood fragments. An unidentified twig from the top of this layer was ^{14}C dated to 3360–3020 cal BC suggesting that the peat built up during the second half of the fourth millennium cal BC, i.e. the later Neolithic (it being possible that UBA-25438 is a root fragment from a plant growing from a surface in Unit 3). Unit 3 is in turn overlain by a dark grey highly humified herbaceous peat (Unit 2) in which the present soil has developed (Unit 1).

A single bovid bone (SUERC-59490; 3690–3530 cal BC) and several charcoal fragments were found in the test pit at the interface between the Burtle Formation and the overlying grey-blue silt/clays. These demonstrate human activity on the surface of the burtle during the Neolithic and preceding inundation by the marsh, but artefacts were not found in the overlying peat suggesting the burtle s were not subsequently the locus of human activity. Indeed the bulk samples recovered from the test pit contained large quantities of waterlogged plant macro remains (particularly wood), but neither artefactual material nor further bone were found.

Transect 2 (Figure 4.7)

Transect 2 comprises BH13-25 and BH28. It runs from the western side of Greylake Burtle 230m westwards across the valley separating that feature from Greylake and Manor Farms (collectively the hamlet of Greylake).

The stratigraphy sampled by Transect 2 is broadly similar to that of Transect 1. The Burtle Formation slopes downwards from +4.60m OD in BH14 to -0.37m OD in BH17 and is then lost from BH18 westwards. It is of particular note that in the mechanically drilled BH25 and BH28 the base of the Holocene sequence rests on deposits of the MMG, demonstrating that the Burtle Formation outcrop is not present at this location. Nevertheless deposits of the Burtle Formation were found at the base of the Holocene succession in BH23 and BH24. If it is assumed that the Burtle Formation once comprised a continuous outcrop along the south-west margin of the Parrett valley, these data demonstrate that late Pleistocene or early Holocene erosion has truncated the unit in the centre of the transect.

In BH28 and BH25 Mercia Mudstone Group strata are overlain by c. 0.3m of grey blue silt/clays, which are in turn sealed by a 0.6m-thick wood peat at -3.58 to -4.10m OD. As outlined above this Lower Peat has been dated to 5850-5250 cal BC and although of Mesolithic date, it formed at least two millennia later than the Early Mesolithic activities on Greylake Burtle. Also as discussed above it is unlikely that the Lower Peat unit is an equivalent of the lower wood peat of BH27 given the 2m elevation difference. The -3.58 to -4.10m OD peat in BH28 is conformably overlain by grey blue silt/clays as far as +0.07m OD. The lack of structure in the silts/clays may be a result of bioturbation caused by plant growth in the muds as reeds were found throughout. The stratigraphic sequence is completed by the same 4m-thick reed and wood peat previously described for Transect 1, the initiation of which has been dated to c. 4500 cal. BC in BH28.

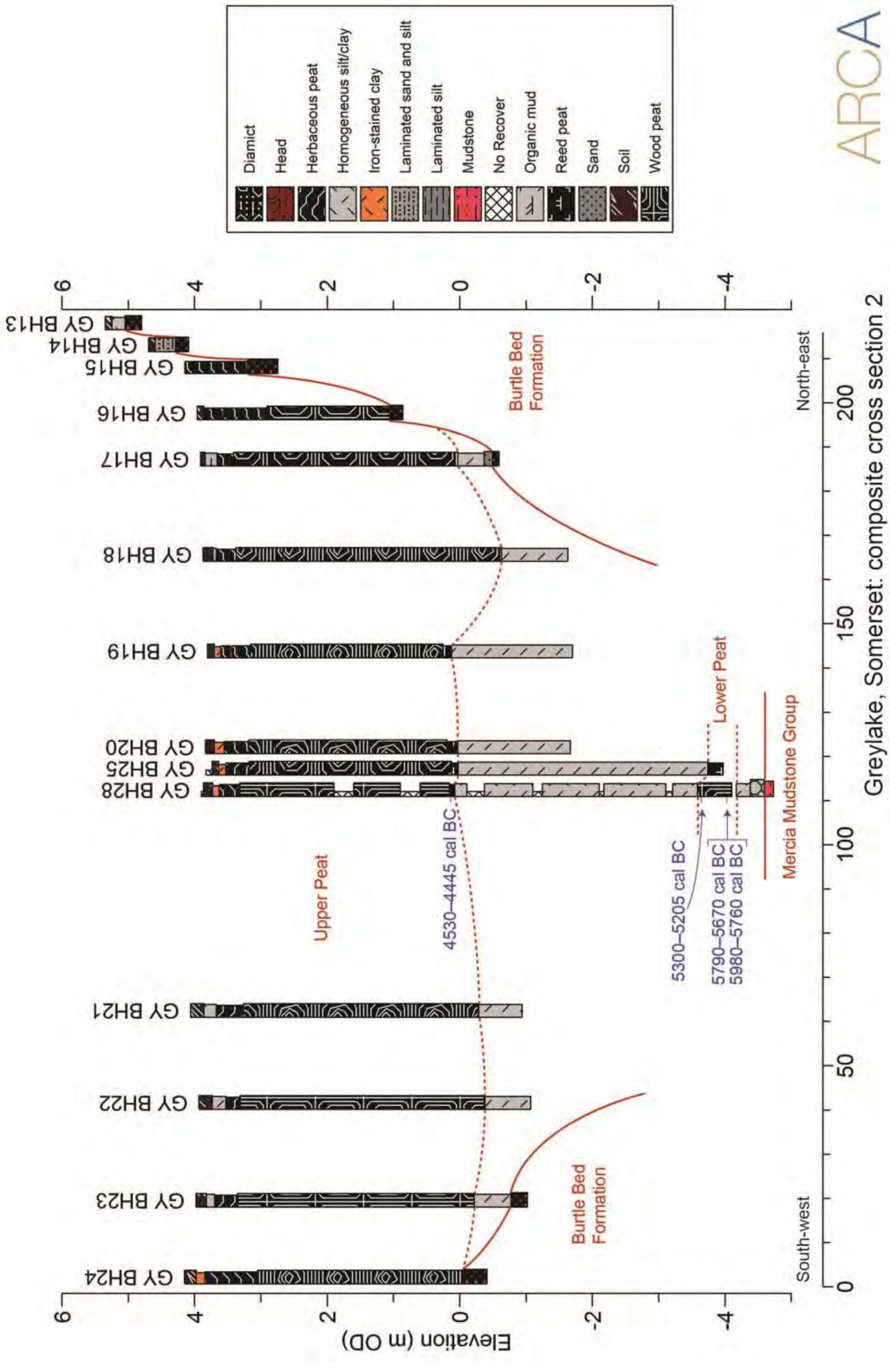

Figure 4.7. Greylake: West (bottom) to east (top) composite cross section (see Figure 4.1 for location of boreholes).

Greylake pollen analysis report

by C.R. Batchelor, A.D. Brown and L. Morandi

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Introduction

This report summarises the results of pollen and non-pollen palynomorph analysis undertaken by Quaternary Scientific (QUEST), University of Reading, in connection with the archaeological excavation and borehole survey at Greylake. The analysis focussed on the sediments from Monolith 3 in the archaeological test pit, and select peat strata of borehole BH28.

Methods

Pollen analysis

A total of seven samples were extracted at 4cm intervals through the base of the Peat in Monolith 3. A total of 43 samples were extracted from borehole BH28. The pollen for all sites was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (>125μm); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992).

Initially, an assessment of the each sample was carried out, to record the concentration, preservation and main taxa of pollen and spores recorded on 10% of the slide. If sufficient concentrations of pollen were recorded, full analysis was carried out. The analysis procedure consists of counting the pollen and spores present until a count of 600 total land pollen is (TLP) is reached except in situations of poorer preservation/concentration. This consists of tree, shrub and herb taxa; aquatics and spores are counted as a percentage of total land pollen. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992). The concentration of microscopic charred particles (>40um on a minimum of 1 axis) is also recorded for the first 300TLP counted. The pollen diagrams were plotted and divided into local pollen assemblage zones (LPAZ; where relevant) using numerical methods (constrained cluster analysis; CONISS) in Tilia v1.7.16 (Grimm, 2011) (Figures 6 & 7).

Results of the Greylake bh28 pollen analysis

Results of the BH28 pollen analysis
The percentage pollen diagram has been divided into three zones (LPAZ's GL-1 to 3) using CONISS and are summarised below. Poor pollen preservation prevented full analysis at a number of levels, but the taxa noted during an initial assessment are displayed as trace values Table 4.2..

LPAZ GL-1 -3.40 to -4.07m OD (7.61 to 8.16m BGL)
>5980-5670 to 5300-5205 cal BC ***Alnus* – *Corylus* type - *Quercus***
This zone is characterised by high values of tree (60-90%) and shrub (30%) pollen. *Alnus* dominates (40-60%) with *Corylus* type (5-30%), *Quercus* (20%), *Pinus*, *Ulmus* (both <10%), *Tilia*, *Betula*, *Hedera* and *Salix* (all <3%). Herbaceous pollen (15%) is dominated by Cyperaceae and Poaceae (both <10%) with *Chenopodium* type and sporadic occurrences including Apiaceae and Asteraceae (all <3%). Aquatic taxa include *Typha latifolia*, *Sparganium* type and *Potamogeton* type (all <1%). Spore taxa are dominated by *Filicales* (which increases from 5% to 55% at the top of the zone) and *Polypodium vulgare* (<5%). Total pollen concentration is generally <250,000 grains/cm^3, with the exception of a peak of 1,300,000 grains/cm^3 at -3.82m OD. Microcharcoal concentrations are <6500 fragments/cm^3 with the exception of a peak of 56,000 fragments/cm^3 at -3.73m OD.

LPAZ GL-2 -3.07 to -3.40m OD (7.16 to 7.61m BGL)
5300-5205 to >4770-4445 cal BC ***Quercus* – *Corylus* type - Poaceae**
This zone is characterised by a decline in tree (40%) and shrub (30%) pollen values. *Quercus* and *Corylus* type dominate (both 30%) with *Pinus*, *Ulmus* (both <10%), *Fraxinus*, *Betula*, *Tilia*, *Alnus* and *Salix* (all <5%). Herbaceous values increase (30%), dominated by Poaceae (20%) and Cyperaceae (15%) with *Chenopodium* type, Asteraceae, *Artemisia* (all <3%). Aquatic taxa include *Typha latifolia*, *Sparganium* type and *Potamogeton* type (all <1%). Spore taxa values are minimal comprising *Filicales*, *Polypodium vulgare* and *Pteridium aquilinum* (all <3%). Total pollen concentration rarely exceeds 80,000 grains/cm^3 with the exception of 40,000 at -3.29m OD. Microcharcoal values reach a peak of 35,000 fragments/cm^3 at -3.37m OD but otherwise do not exceed 8400 fragments/cm^3.

LPAZ GL-3 0.39 to 0.19m OD (3.70 to 3.90m BGL)
From 4770-4445 cal BC ***Quercus* – Poaceae – *Corylus* type**
This zone is characterised by high values of tree (60%) and shrub (15%) pollen values. *Quercus* dominates (40%) with *Corylus* type (15%) *Alnus*, *Pinus*, *Tilia*, *Ulmus* *Fraxinus* and *Salix* (all <5%). Herbaceous pollen (30%) is dominated by Poaceae (25%) with *Chenopodium* type (<10%), Cyperaceae, Lactuceae, Apiaceae and *Artemisia* (<5%). Aquatic values are relatively high, dominated by *Typha latifolia* (<10%) with sporadic occurrences of *Sparganium* type. Spores values are generally <5% with the exception of high *Filicales* values at 0.39m OD (30%). Total pollen concentrations are <100,000 grains/cm^3, with the excption of a peak in values at 0.27m OD (530,000 grains/cm^3) at 0.31m OD. Microcharcoal values are high, increasing through the zone from 5000 to 71,000 fragments/cm^3.

Results of the Greylake monolith pollen analysis

Results of the Monolith pollen analysis
3.08 to 2.86m OD ***Alnus* – Cyperaceae – *Quercus***
From 3640-3370 cal BC
Minimal pollen was preserved in the samples below 2.94m OD; only sporadic occurences of *Tilia*, *Corylus* type, Poaceae and *Filicales* were noted.

The five samples analysed above this contained an analagous pollen assemblage and thus no local pollen assemblage zones have been defined. The samples are all characterised by high values of tree (50%) and shrub (15%) pollen. *Alnus* dominates with *Quercus*, *Corylus* type and limited values of *Pinus*, *Ulmus*, *Fraxinus*, *Betula*, *Tilia* and *Salix* (all <3%). Herbaceous values are moderate (25%), dominated by Cyperaceae with a range of other taxa including Poaceae, Lactuceae, *Plantago lanceolata*, *Chenopodium* type, Caryophyllaceae, Apiaceae and *Ranunculus* type (all <2%). Aquatic values are limited (<2%) comprising most commonly, *Potamogeton* type and *Sparganium* type. Spore values are low (10%) dominated by *Filicales* with *Polypodium vulgare* and *Pteridium aquilinum*. Total pollen concentration is around 500,000 grains/cm^3 and microcharcoal concentration is around 1000 fragments/cm^3.

Interpretation of the Greylake monolith and BH28 pollen analysis
Combined, the Greylake BH28 and Monolith pollen sequences represent a mid-Holocene record covering approximately 2500 years. The BH28 sequence examined in this pollen study commences around 6000 cal BC and continues to approximately 4500 cal BC corresponding to the late Mesolithic period; the Monolith sequence represents a later period, dating to around 3640-3370 cal BC, corresponding to the early Neolithic period.

BH28 - LPAZ GL1
The results of the pollen analysis indicate that LPAZ GL-1 correlates with the accumulation of the basal wood peat which accumulated between *ca*. 5980-5760 and 5300-5205 cal BC. During this period, the peat surface was dominated by alder (*Alnus*) with occasional willow (*Salix*) and a ground flora comprising sedges (Cyperacceae), grasses (Poaceae - probably including *Phragmites australis* - reeds) and ferns (*Filicales*). These taxa indicate the presence of damp woodland, growing within fen carr and the more limited growth of sedge fen / reed swamp *communities*. The presence of still or slowly moving water is also indicated by the presence of aquatic plants such as bulrush (*Typha latifolia*), bur-reed (*Sparganium* type) and pondweed (*Potamogeton* type). The sporadic occurrence of *Chenopodium* type throughout the zone probably represents the nearby growth of saltmarsh plants such as *Suaeda maritima* (annual seablite) and an estuarine influence as opposed to disturbance indicators such as fat hen (*Chenopodium* type).

Other tree and shrub taxa such as oak (*Quercus*), elm (*Ulmus*), ash (*Fraxinus*), birch (*Betula*), ivy (*Hedera*), blackthorn (*Prunus*) and elder (*Sambucus*) may also have occupied the fen carr woodland with alder and willow, but more likely formed a mosaic of mixed deciduous woodland with lime (*Tilia*) on the adjacent dryland. Generally high values of *Corylus* type are interpreted as representative of *Corylus avellana* (hazel) as opposed to *Myrica gale* (bog myrtle). The two are notoriously difficult to split palynologically, however, *Corylus avellana* is considered the more likely due to the presence of macrofossil remains and an absence of those from bog myrtle or other heathland indicators with which it is normally associated). Hazel may have formed an understorey component of the dryland woodland; however, the high values of this light-loving shrub suggest either openings in the woodland cover (glades), or more likely, its growth towards the woodland margin at the wetland dryland interface.

Significantly, at -3.73m OD, microcharcoal concentrations are high suggesting an episode of burning (NB similarly high to those recorded at Shapwick). Whilst some of these fragments may have derived from an allocthonous (external) source, the concentrations are sufficiently high to indicate *in situ* or nearby burning of the alder woodland and sedge fen, particularly as occasional fragments were of a similar morphology to those from charred sedges/grasses. Whether this burning was the result of natural or Mesolithic burning is not possible to determine, however, it does occur during the decline of alder woodland from the peat surface. Not only is this indicated by the decline of alder pollen values, but light loving ash, hazel and ferns all increase subsequently suggestive of woodland disturbance. No definitive anthropogenic indicators are recorded.

BH28 – LPAZ GL-2

The transition to LPAZ GL-2 coincides with a change from wood peat to homogenous silts and clays indicative of inundation. The results of the pollen analysis indicate that during this period, the alder and willow carr woodland retreated to non-inundated areas of the floodplain surface, and was replaced by sedges, grasses, Chenopodiaceae and mixed aquatics forming sedge fen / reed swamp and to a lesser extent, salt marsh communities. Individual grains of *Hordeum* type and cf *Cereale* type pollen are also recorded within this zone, however, rather than representing an anthropogenic origin, it is considered more likely that these grains originate from coastal grasses such as *Glyceria* (sweet-grass) which have a similar pollen grain morphology (e.g. Andersen, 1979; Coles 1978b *et al*., 2012).

The reduction in local alder dominated-carr woodland inevitably led to an increase in pollen source area, and thus a stronger vegetation signal from the dryland. Mixed deciduous woodland dominated by oak with lime, elm, ash and birch continued to occupy the dryland. The high values of hazel however, suggest an increase in hazel, most likely forming shrubland on the margins of the mixed deciduous woodland. High values of microcharcoal are also recorded towards the base of the zone, but since this occurs within mineral-rich alluvial/ intertidal deposits, there is greater potential that the material originates from an allocthonous source.

BH28 - LPAZ GL-3

The results of the pollen analysis from LPAZ GL-3 (from 4770-4445 cal BC) include high values of Poaceae pollen, indicating that the peat surface was dominated by reed swamp with bulrush and some sedge fen. *Chenopodium* values decline towards absence at the base of the zone indicating a reduction in salt-marsh influence. *Alnus* and *Salix* pollen values remain relatively limited indicating either limited stands of carr woodland, or its growth at greater distance on a more stable peat surface. On the dryland, the woodland remained largely unchanged from LPAZ GL-2, although the lower *Corylus* pollen percentages indicate the reduced presence of hazel shrub.

Significantly, microcharcoal concentrations increase through LPAZ GL-3, to higher concentrations than those recorded in LPAZ GL-1 or GL-2. It is considered likely that these concentrations reflect a localised burning event, particularly because some of the fragments are morphologically similar to that of burnt grasses/sedges. As above, it is uncertain if the burning event is of natural or anthropogenic origin; high values of fern spores suggest a vegetative response to the burning, but nothing definitively anthropogenic is recorded.

Monolith

Wood peat began accumulating on the upper flanks of Greylake burtle from around 3640-3370 cal BC (early Neolithic). The results of the pollen analysis indicate that from this period, the peat surface consisted of a mosaic of alder dominated carr woodland, together with a range of herbaceous and aquatic taxa including sedges, grasses, bur-reed, bulrush, buttercups (*Ranunculus* type), marsh valerian (*Valeriana* type), dock/sorrel (*Rumex acetosa*/*acetosella*/*obtusifolius*), mint (*Mentha* type) and polypody ferns forming sedge fen / reed swamp type communities. These communities are confirmed by the presence of alder, bramble, saw sedge (*Cladium mariscus*) and dock/sorrel/knotweed (*Rumex*/*Polygonum* sp.) in the plant macrofossil record. An estuarine influence may be indicated during this period by the presence of *Chenopodium* type (e.g. *Suaeda maritima* – annual sea-blite).

The dryland signal is less strong, but indicates the presence of oak-dominated mixed deciduous woodland with occasional lime, ash and elm. Once again, the pollen percentage values of hazel suggest its growth towards the woodland margins, or the presence of open areas (e.g. glades). Indeed the occurrence of open areas, disturbed ground and rough grassland is also indicated by the presence of herbs such as ribwort plantain (*Plantago lanceolata*), thistles (*Cirsium* type), dandelions (Lactuceae) and possibly fat hen (*Chenopodium* type). The possibility that this herbaceous assemblage may be indicative of an anthropogenic origin is enhanced by moderately high values of microcharcoal (1000-2000 fragments/cm^3) and, towards the top of the sequence, increasing values of potential disturbed soil indicator *Diporothela rizophila*.

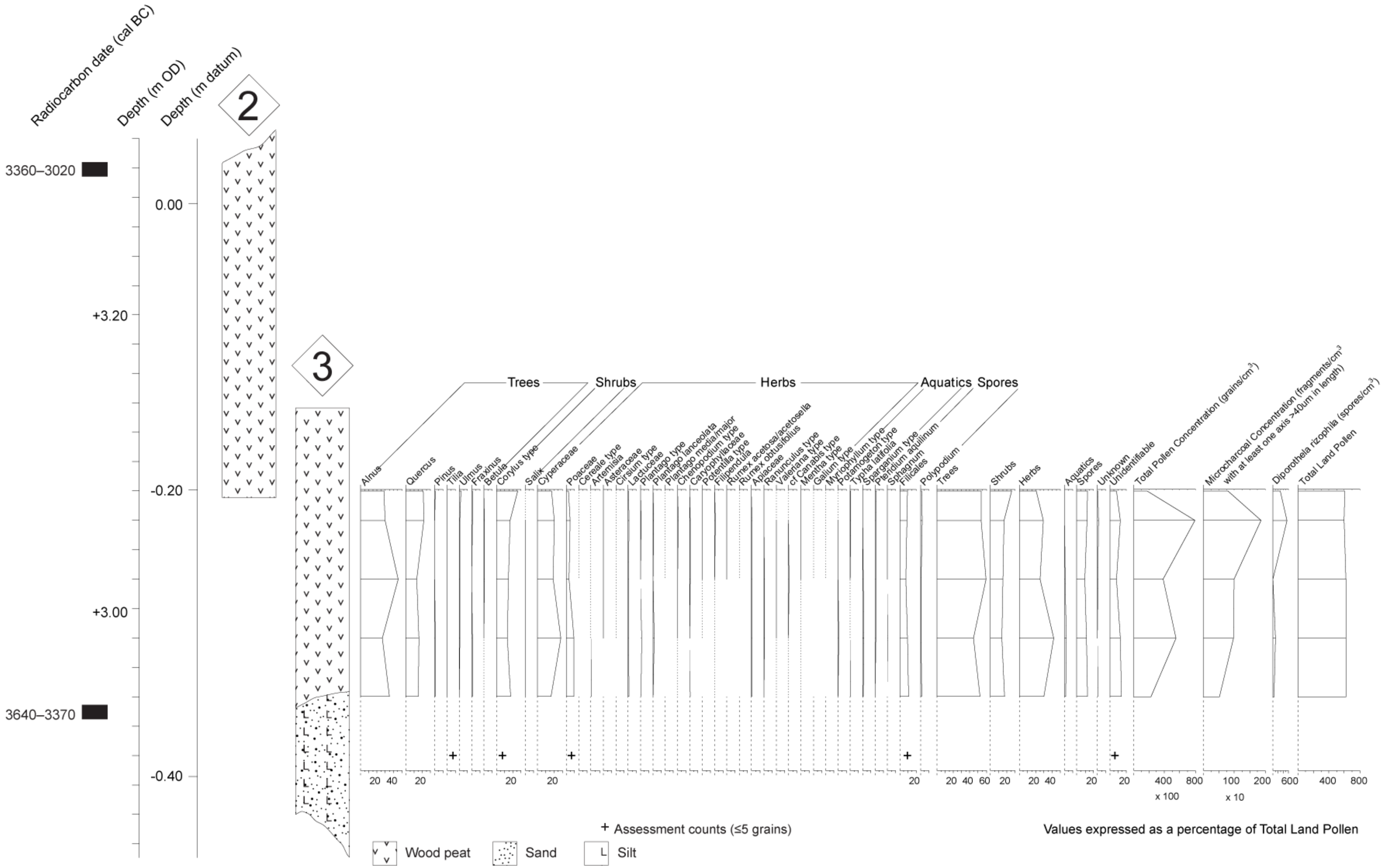


Figure 4.8a: Greylake Monolith pollen percentage diagram

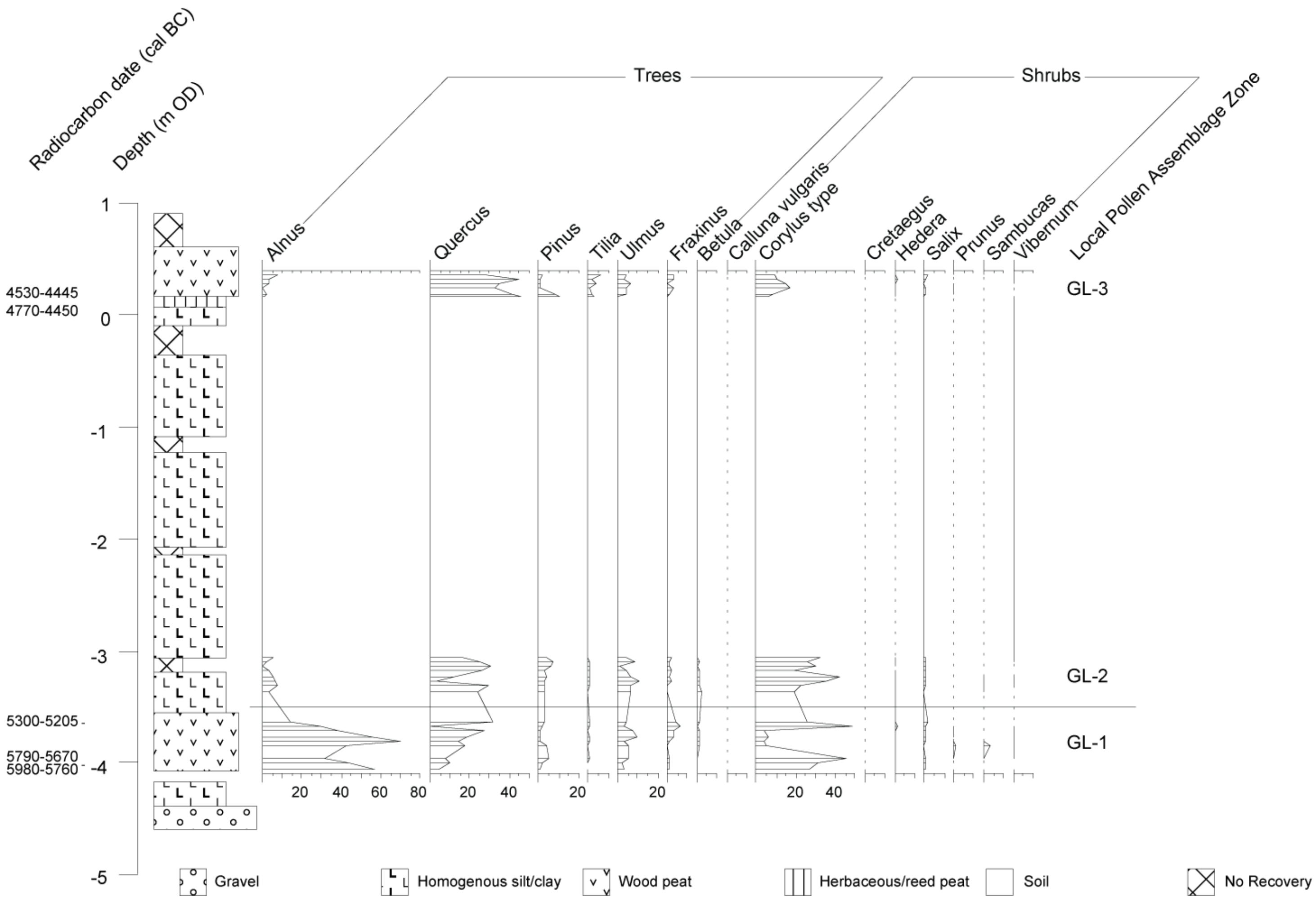


Figure 4.8b: Greylake BH28 pollen percentage diagram

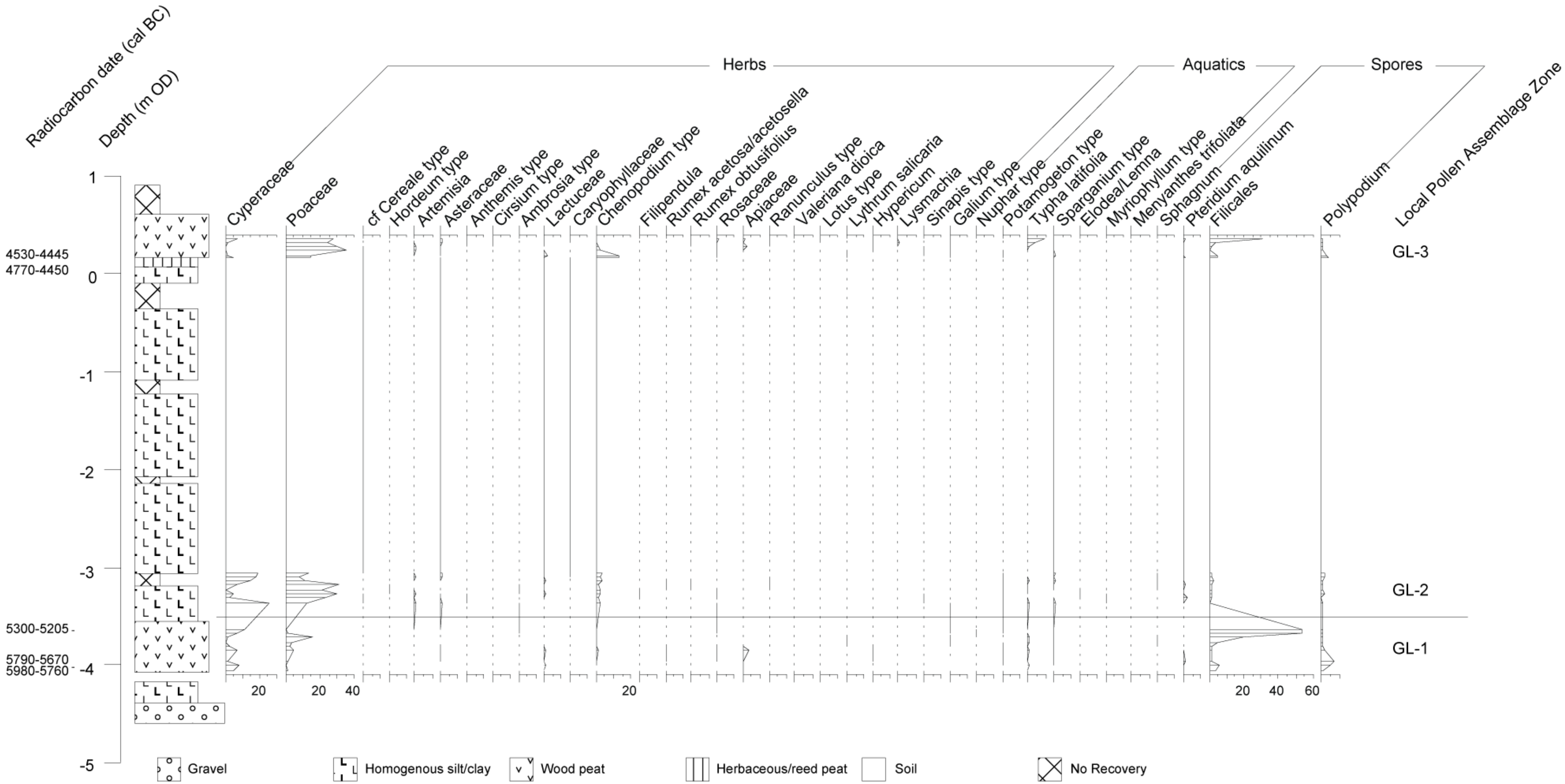


Figure 4.9a: Greylake BH28 pollen percentage diagram

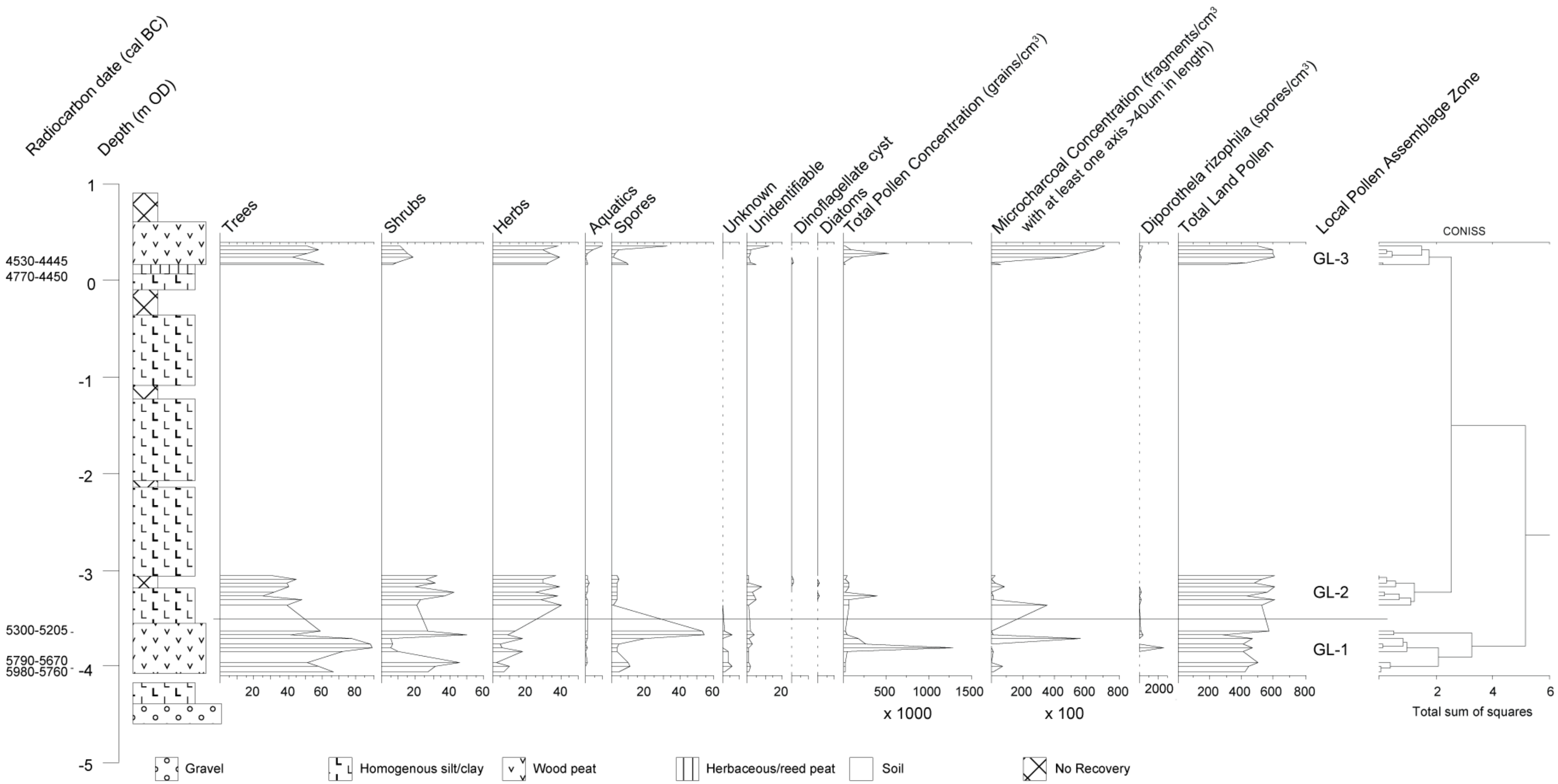


Figure 4.9b: Greylake BH28 pollen percentage diagram

Table 4.2: Greylake BH28 pollen assessment data

Depth (m OD)	0.75	0.64	0.53	0.5	0.46	0.42	0.17	0.13	0.09	-3.40	-3.46	-3.49	-3.53	-3.57	-3.59	-3.95	-4.11	-4.15	-4.19	-4.23
Depth (BGL)	**3.34**	**3.45**	**3.56**	**3.59**	**3.63**	**3.67**	**3.92**	**3.96**	**4.00**	**7.49**	**7.55**	**7.58**	**7.62**	**7.66**	**7.68**	**8.04**	**8.20**	**8.24**	**8.28**	**8.32**
Trees																				
Alnus		+	+	+	+					++	+	+	+	+	+	+				
Quercus	+	+		+	++	+	++	+	++	+	+		+	+		+				
Pinus				+	+		+	++	+				+			++	+		+	
Tilia			+	+																
Ulmus					+			+	+			+	+	+		+				
Fraxinus													+							
Shrubs																				
Corylus type	+		+						+	++	+	++	++	+	+	+				
Hedera			+																	
Herbs																				
Cyperaceae	+			+	+	+	+			++			+	+						
Poaceae			+				+	+	+			+								
Lactuceae									+											
Chenopodium type							+	+	++	+										
Aquatics																				
Typha latifolia									+											
Sparganium type					+															
Spores																				
Pteridium aquilinum									+		+									
Filicales	++	++	+	+		+			+			+	++	+++	++	+				
Polypodium			+				+						+			+				
Other																				
Diporothela rizophila				+																
Dinoflagellate cyst							+		+											

Results and interpretation of the non-pollen palynomorph assessment

A few helminth eggs were identified in the sequence. Two of them were recovered at -3.66 m OD, and measure 55 x 31μm and 57 x 35μm respectively (Figure 4.10a-b), while a third egg measuring 55 x 25μm was found at -4.33m OD (8.12m) (Figure 4.11). In spite of minimal variations in the morphology, they all seem most likely to have been produced by the genus *Trichuris*, although the slightly ornamented surface of one of the eggs found at -3.66m OD may point to *Capillaria* spp. (Figure 4.10a) (Fugassa *et al*. 2008; Florenzano *et al*. 2012).

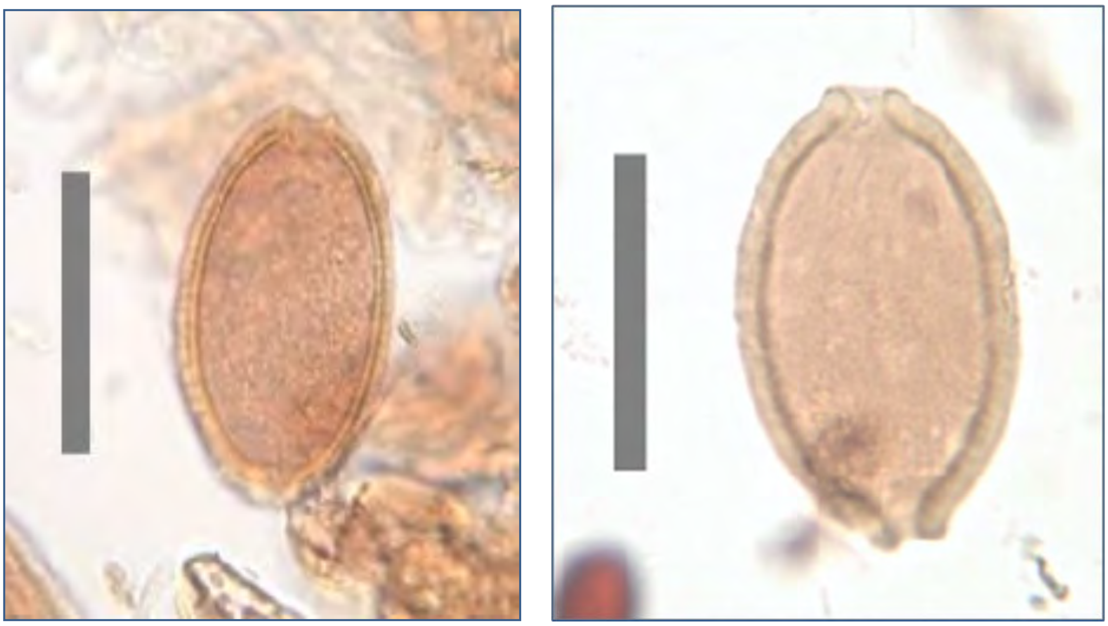


Figure 4.10 (a) *Trichuris* or *Capillaria* sp. egg (scale bar = 40μm); (b) *Trichuris* sp. egg, Greylake (scale bar = 40μm), BH28, Greylake

Figure 4.11: *Trichuris* sp. egg, BH28, Greylake (scale bar = 40μm)

Trichuris species are common whipworms infecting human and animal hosts. In this case, allowing for shrinkage due to the sample preparation, the eggs are very close to the size boundary between the species infecting humans and pigs and larger eggs typical of wild and domestic animals (Dark 2004). It is therefore difficult to indicate a host for these parasites, although the absence of coprophilous fungal spores, usually germinating in the gut of herbivores (Wicklow 1992), speaks for the presence of omnivore mammals on the marsh edge. It is worth noting that some *Capillaria* spp. may be transmitted to humans through the consumption of undercooked or raw fish, causing fluid loss and vomiting, or by eating infected rodents, leading to liver problems (Cuomo *et al.* 2008; Ferreira and Andrade 1993). On the other hand, *Trichuris* causes dehydration and anaemia in humans, the infection being caused by poor hygiene practices in food preparation (Mitchell and Tepper 2007). However, the spread of infectious diseases is a complicated issue, and the timing and causes for their diffusion across Europe and the New World is not clear as yet (Araujo *et al*. 2008; Gonçalves *et al*. 2003).

Greylake Discussion

It has previously been suggested that the burtles may have been used for hunting and short stay and the Poldens for settlement and hunting (Coles 1978b). Wilkinson and Bond (2001) note that it could equally be argued there was a settlement focus on the Burtles. In fact that seems much more probable given the major concentration of Mesolithic artefacts at Chedzoy and Greylake and the lesser concentrations on other burtle sites. It might also be noted that Mesolithic people often seem to have favoured sandy sites as for instance in the Weald.

Wilkinson and Bond (2001) emphasise the extent to which Mesolithic site distributions are masked and distorted by later sedimentary blankets. Early Mesolithic sites in valley bottom riverine situations will, as Figures 4.5-4.7 demonstrate, be masked by around 8m of sediment. As sea level related water table rises, peat formation and estuarine sedimentation progressed the margins of the higher ground were progressively mantled by sediment reducing the area of burtles and other bedrock exposures available for settlement and for the discovery of finds by fieldwalking or shallow excavation. In the transect west of Chedzoy burtle (Hennessy 2000) the wetland edge has migrated at least 280m east as a result of Holocene sedimentation. Wetland edge movements of several 10s of metres are demonstrated by the other transects (Fig 5.4 and 5.8). The intertidal transect at Goldcliff in the Severn Estuary illustrates exactly this phenomena where the island wetland edge has migrated 300m progressively burying a series of Mesolithic settlement/ activity areas at successively higher levels as settlement retreated up slope. It can not necessarily be assumed that traces of particular activity episodes will be found at higher levels. The Goldcliff activity areas were relatively discrete some 4-6m across some a few 10s of metres across. It is salutary to note that a Mesolithic flint scatter discovered buried in a pollen sampling pit at Llandevenny, Newport at the very edge of the wetland produced hardly any artefacts when Wessex Archaeology excavated extensive areas on the slope and spur above uncovering a significant Romano-British site (Wesssex Archaeology pers comm.). The concentrations recorded by Norman's careful grid plotting at Chedzoy were about 40-60m across. It follows that even late Mesolithic sites represented by discrete clusters at the wetland edge may have been completely buried by later sediments.

Although as the previous text makes clear, strata contemporary with the Early Mesolithic burials and lithic scatters were not located on the edge of Greylake Burtle, the boreholes nevertheless penetrated deposits of Mesolithic date. The base of the valley sequence between Greylake Burtle and the hamlet of Greylake (Transect 2) rests on rocks of the MMG, but the overlying dark grey silts and clays must predate *c*. 5800 cal BC (Figure 4.7), and are likely to have formed on intertidal mud flats during the Late Mesolithic. The overlying Lower Peat in BH28 dates from the period *c*. 5250-5800 cal BC and judging by the presence of woody macrofossils, is likely to have formed in either alder carr. Organic strata in a similar stratigraphic position have been located elsewhere on the Somerset Levels and investigated in detail at Shapwick Burtle, where a wood peat outcropping at -4.43m OD to -2.88m OD was dated between 5710-5540 cal BC and 5210-4840 cal. BC (Wilkinson 1998, Tinsley 2007). Although slightly later than the Greylake Lower Peat, the data from the two sites is suggestive of an episode of estuary contraction during the sixth millennium BC. However, the absence of a peat at *c* -3.5 to -4.5m OD in those parts of the northern transect (Transect 1) drilled to more than 6m BGL (i.e. BH26 northwards) suggests that the Lower Peat outcrop is restricted to the valley sides in the lea of the Burtle Formation outcrop. Peat earlier than the Upper Peat may outcrop on King's Sedgemoor, but are likely to be more deeply buried - as witnessed by the wood peat at -6.02m OD in BH26 - and are therefore likely to represent pre-5800 cal BC phases of reduced relative sea level rise. Nevertheless the presence of such strata can only be demonstrated by the use of geotechnical borehole drilling equipment. However, a knowledge of the outcrop height and environments represented by these peats is important as the regression of intertidal environments to the west during their formation will have presented opportunities for Late Mesolithic communities to exploit the associated ecotonal environments.

The Lower Peat is overlain in both borehole transects by grey bedded and laminated silts and clays. These deposits are also of Late Mesolithic age (i.e. earlier than *c.* 4500 cal BC), formed on mud flats and in intertidal creeks, and indicate a renewed period of estuary expansion. The varied thickness (3.66m in BH28 cf >8.80m in BH27), elevation of outcrop (c. -3.5m OD in BH28 cf. <-8.0m OD in BH27) and of facies, demonstrate that deposition was neither synchronous across the site, nor in chronologically or spatially identical depositional sub-environments. Clearly deposition of these mineral deposits occurred first in the centre of the King's Sedgemoor basin and that the mud flat and creek sub-environments spread landwards from there. Nevertheless assuming that the tidal range of the Severn Estuary was the same in the Late Mesolithic as it is today (*c.* 15m) and allowing for the effects of sedimentation, permanent marine waters are unlikely to have filled the centre of the King's Sedgemoor, meaning that the basin will have been a large expanse of mudflats at low tide throughout much of the Late Mesolithic. However, environments of this nature should not be written off as locations for human activity as evidence from landscapes elsewhere in the Severn Estuary Levels has demonstrated that such environments were exploited by Late Mesolithic hunter-gatherers, e.g. Goldcliff (Bell 2007).

In contrast to the Lower Peat, the Upper Peat has a relatively even outcrop elevation of c. 0.0 to +0.5m OD (lower contact), and was found in all boreholes at a relatively uniform 3-4m thickness (only less where the unit onlaps Greylake Burtle). It is therefore likely that the *c.* 4500 cal BC age of the base of the Upper Peat in BH28, approximately dates its development across the whole study area. A significant environmental change must therefore have occurred around this date for such a spatially and vertically extensive organic stratum to form. Indeed an approximately synchronous episode of estuary contraction throughout southern England has been recognised and which approximately coincides with the Mesolithic-Neolithic transition (Waller and Long 2003).

While an age for the initiation of the Upper Peat has been provided by BH28 (*c.* 4500 cal BC) and further ages obtained for its growth onto the edge of Greylake Burtle (*c.* 3500-3000 cal BC), it is unclear when peat growth ceased on the basis of present data from Greylake (although it is recognised that this was not an aim of the present study). Nevertheless, as is noted above, it is clear that the Upper Peat was developing as regional economies shifted from the hunter-gatherer mode of the Late Mesolithic to the mixed farming and hunter-gatherer base of the Early Neolithic. The base of the Upper Peat might therefore contain proxy data that record this transition and show its impact on the wider environment.

Although the Upper Peat (Units 3-1) sealed mineral strata (Unit 5) in the test pit excavated on the edge of Greylake Burtle, there is no evidence that the latter formed a stable terrestrial surface. In other words although there is some indication of pedogenesis in Unit 5, it is unlikely that the stratum formed the ground surface. Indeed Unit 5 remains something of an enigma. It has morphological properties that are superficially similar (i.e. colour and grain size) to those of the mineral layer found between the Lower and Upper Peats, but it outcrops 2.8m higher than the mineral layer elsewhere. It cannot have formed in intertidal environments while the (freshwater) Upper Peat was accumulating elsewhere at lower elevations on the moors. Therefore and despite morphological similarities with intertidal deposits elsewhere, Unit 5 probably formed as a result of diagenesis of the Burtle Formation. However, the upper part of any soil profile that might have developed during such weathering, was removed prior to the spread of the Upper Peat to Greylake Burtle, and with it have gone any strata that might have formed a surface on which Early Mesolithic people were active.

Chapter 5: The wetland edge at Chedzoy
by Martin Bell

with contributions by C.R. Batchelor, S. Carson, C.J. Bond, S. Hennessey, P. Marshall , L. Morandi, D. Young, and the English Heritage Geophysics Team.

King's Sedgemoor Background

King's Sedgemoor was not subject to the peat cutting in the later twentieth century which produced so many finds of trackways and artefacts in the peat fields of the Brue valley north of the Polden ridge. Even so artefact scatters were known on the sandy burtle islands (Figure 1.3) and trackways had been observed in ditch sections at the edge of the Moor. From 1981-4 the Somerset Levels Project conducted a survey of Sedgemoor which included systematic examination of the areas cut for peat and the edges of drainage ditches, it also included fieldwalking of cultivated land round the edges of the Moor (Coles and Campbell 1982; Coles and Orme 1983, 1984a; O'Hare 1985). Coring was also carried out in order to establish the stratigraphic and environmental history (Alderton 1983). In concluding the Somerset Levels Project Coles (1989, 14) noted that all the indications were that there was abundant archaeological evidence still sealed by peats and clays on Sedgemoor and that there was a clear need for further work before adequate comparison could be made with the wetland archaeology north of the Poldens. The present work at Chedzoy and Greylake (Chapter 3) goes some way towards addressing the need identified by Coles.

Figure 5.1. Chedzoy (Parchey) location map.

The Somerset Levels Project survey, which also drew on the surveys of C. Norman, recorded extensive lithic scatters on the east side of Chedzoy burtle, and in distinct patches on the north side of Sowy island especially round Westonzoyland and Greylake (Figure 1.3; Coles 1989). Typologically the Mesolithic activity was considered to be mainly 9th to 7th millennium cal BC. Norman (2001) published an important paper on a Mesolithic flint scatter on the burtle at Chedzoy (also called Parchey) reporting one of the largest Mesolithic assemblages in the west country (Figure 5.2). His finds resulted from systematic fieldwalking which showed that the main concentration of artefacts was in the south east corner of a cultivated field immediately adjacent to the transect which forms a case study in the present investigation. The latter is in part designed to put Norman's discoveries in a sedimentary and palaeoenvironmental context. His assemblage included 86 microliths and 60 related forms. He dated the assemblage between 7000 and 5000 cal BC, thus later than the dates proposed for the other Somerset Levels Burtle sites. The study was important in demonstrating the use of lithic resources from different areas and thus providing some indication of the mobility of the communities concerned. The raw materials included 45% of chalk flint with fresh cortex and 55% Upper Greensand chert from the Westbury/ Wincanton area, thus perhaps pointing to patterns of mobility 40-50km in an easterly direction. Among the predominantly Mesolithic assemblage about 25% of the lithics were regarded as spanning the period from the early Neolithic to the Bronze Age, the later also being represented by some pottery. Material of Neolithic date included Leaf arrowheads, serrated flakes and flakes from polished axes. A possible Neolithic cursus monument (SHER 11852) has been observed from air photographic evidence at Westfield Farm 1.6km Prompted by this possible cursus find, Hennessy (2000) investigated the sedimentary sequence west of the Chedzoy (Figure 5.4). There are also numerous sites of relic field systems and associated enclosures (those closest are SHER 11250, 11845 and 11846).

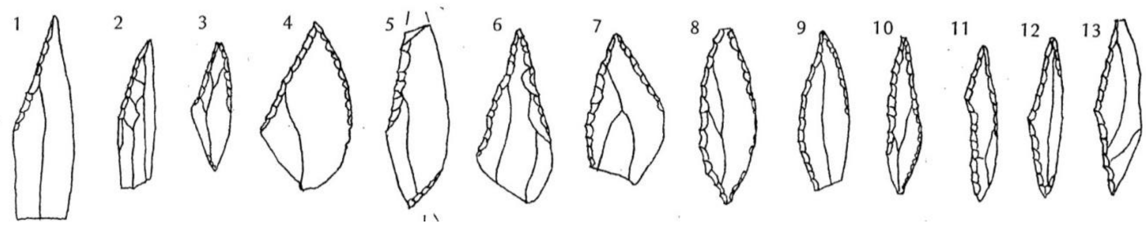


Figure 5.2. Examples of Microliths from Chedzoy (after C. Norman 1982).

Lithics of Mesolithic to Bronze Age date were also reported by Norman (2003) from the south edge of Chedzoy burtle at Triggol's field where a small concentration of Mesolithic debitage occurred near the sand peat interface. Fieldwalking by the Somerset Levels Project (Coles and Orme 1983) identified flint scatters on the sandy burtles generally close to the Moor boundary at Chedzoy and Sowy (the large burtle with the villages Westonzoyland, Middlezoy and Othery). Within the King's Sedgemoor area the two major lithic concentrations are those on the burtles at Chedzoy (Parchey) and Greylake (Chapter 3) and it is immediately adjacent to these two areas that the coring and test pitting reported here was conducted.

Norman and Clements (1979) reported trackways in ditch sections at the west end of the Sutton Hams Mercian Mudstone promontory which projects into King's Sedgemoor. These trackways were revealed by cleaning of the back ditch on the east side of King's Sedgemoor drain, an artificial drainage channel made in the 1790s, where the back ditch clipped the tip of the bedrock promontory. As many as seven probable trackway alignments were recorded suggesting this route was significant, probably over an extended period, although they are unfortunately not dated. Flint artefacts have been found and human and animal bones are also reported. The tracks were largely exposed in section and it is unknown how far they extend into the Moor. The northern most indicates movement in the general direction of the Chedzoy burtle. On the east edge of Chedzoy burtle is a separate small burtle island Mount Close Batch. Here Norman (2001) reports eight possible trackways one heading north in the general direction of the Chedzoy lithic scatter, the others in the general direction of the Sutton Hams trackways noted above 500m east, strengthening the evidence for the significance of this natural crossing point, although once again the Mount Close Batch tracks are undated. On the south east edge of the sandy Chedzoy burtle (ST 34773626) Norman (1980) has recorded two trackways in the section of Moor Ditch. One is more substantial, composed of longitudinal roundwood and brushwood with pegs; the other is of brushwood. They appear to head south in the direction of the burtle at Westernzoyland. These trackways are dated to 3670-3130 cal BC (HAR-4375; 4690+/-90 BP) and 3500-2920 cal BC (HAR-4374, 4510+/-80 BP). (Coles and Dobson 1989; now recalibrated)

As part of the Somerset Levels Project investigation of King's Sedgemoor Alderton (1983) carried out a borehole survey to establish the sediment and environmental sequence. Thirty-six boreholes were put down in restricted clusters where the potential was thought to be greatest for the finding of peat sequences and in other cases where restricted natural crossing places of the wetland could be identified, eg between Mount Close Batch and Sutton Hams and Beer Wall. The locations of all but two (east of the mapped area) of the boreholes / borehole transects are shown on Figure 5.3 and the stratigraphy revealed is summarised in Figure 5.4. The two areas most relevant to the current project are the peatlands north of Middlezoy, between Chedzoy and Greylake and the west end of Sedgemoor near Chedzoy. In the Middlezoy area 3, boreholes were made with up to 4.1 m of peat, largely *Cladium* sedge peat with at the base *Phragmites* peat over clay and woody peat in the middle and towards the top in one hole. A thin clay was present on the surface of 2 out of 3 boreholes.

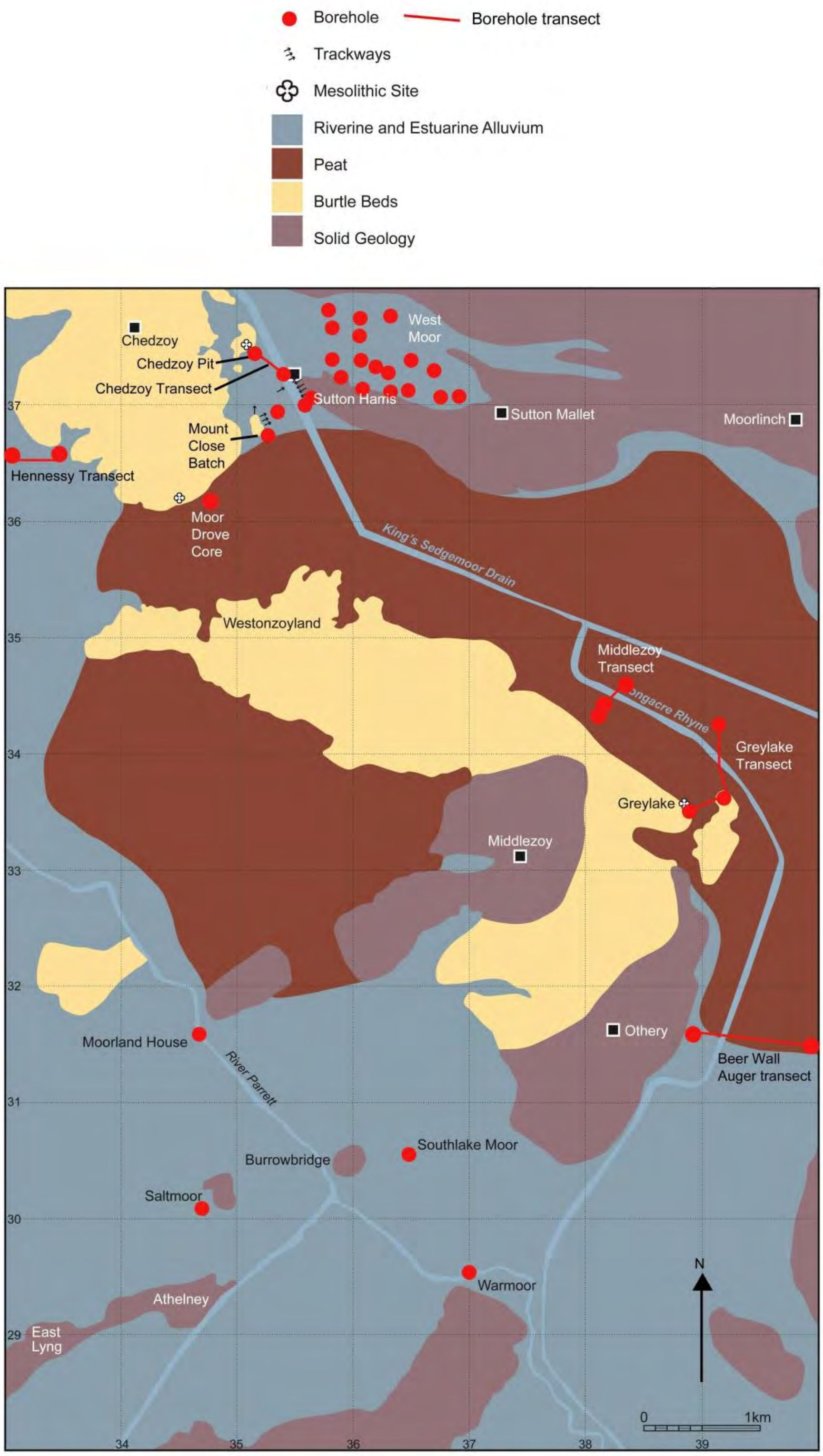
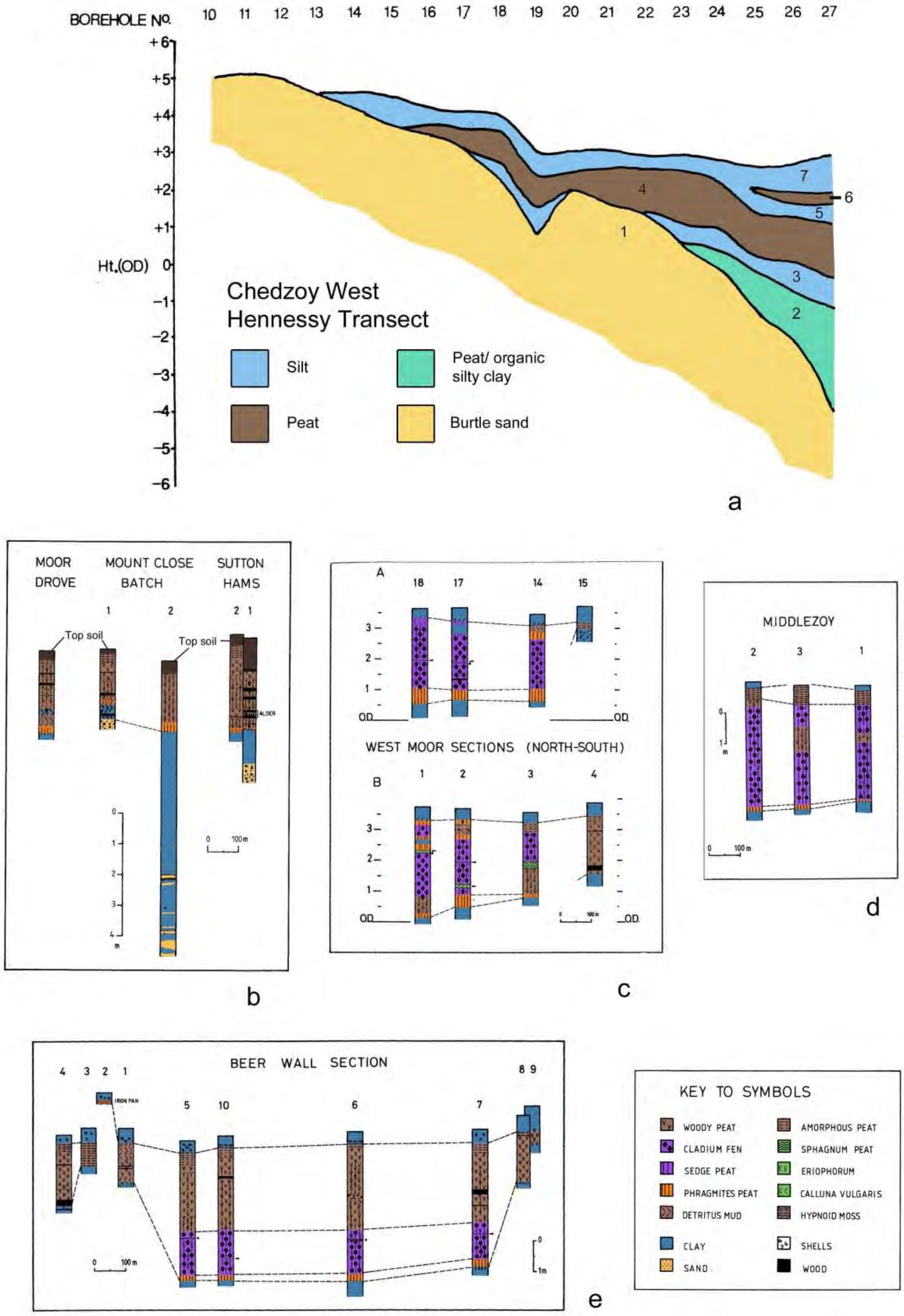


Figure 5.3. Kings Sedgemoor and the Parrett Valley showing the locations of boreholes by Alderton (1983), Hennessey (2000) and the present project in the Kings Sedgemoor and the location of selected boreholes by Winchester University in the Parrett Valley (Chapter 8).

Figure 5.4. Kings Sedgemoor: boreholes modified from Hennessey (2000) and Alderton (1983). Graphic Jennifer Foster.



On the south edge of the Chedzoy burtle at Moor Drove close to the probable trackway recorded by Norman (1980) estuarine silt was overlain by 2.9m of peat with frequent inwashings of silt of brackish origin, *Phragmites* peat at the base, then detritus peat overlain by wood peat. Four boreholes were put down between the small Burtle at Mount Close Batch, where Norman (1980) found eight possible trackways, and the promontory at Suton Hams where Norman and Clements (1979) reported 7 possible trackways, thus apparently a significant, perhaps long lived, prehistoric routeway. Borehole MCB1, close to the Mount Close Batch burtle had 2.3m of peat over sandy burtle, the peat mostly detrital and woody included persistent input of slope sediments from erosion of the burtle. MCB2, roughly midway between Mount Close Batch and Sutton Hams, produced a sequence of 9.5m with Mollusca indicating a thin freshwater marl at the base. Above this was 7.2m of estuarine clay overlain by 2.3m of thin *Phragmites* peat at the base then wood peat. Borehole 1 at Sutton Hams was 4.1m of Holocene sediment above sandy gravel. Estuarine clay (1.2m) followed by a hydroseral succession, thin *Phragmites* peat, then fen carr and wood peat. The inwash of slope sediments from the promontory is noted.

MCB 2 shows that there is a deep river channel south of Kings Sedgemoor drain which would have been within about 200m of the Chedzoy lithic scatter. This may have drained West Moor and the southern slope of the central Poldens and then drained south through Sedgemoor. The present drainage along Kings Sedgemoor Drain to the north west is an artificial cut made in the 1790s. Prior to this the original drainage was south through Rowing Lake to the River Parrett (Williams 1970, Figs 21-22). A Geological Survey (Sheet 295) transect which passes through the narrow gap taken by the present drain running west between Chedzoy and Pendon Hill shows only a shallow channel here and a map of subsurface contours on the Somerset Levels confirms this and indicates that early drainage will have been to the south probably between the Chedzoy and Westonzoyland burtles (Kidson and Heyworth 1976, fig 9).

Another of Alderton's (1983) transects was across the Sowy river drainage immediately north of Beer Wall 2km south of the Greylake site (Figure 5.3-4). Coles (1989, 17) reports a scatter of prehistoric wood from the area and it is a natural narrow crossing point. The transect revealed up to 5m of peat overlying clays. There was reed peat at the base overlain by 1.5m of sedge peat and then woody peat covered by a thin layer of clay. The Geological Survey map, Sheet 296 shows peat to the north of Beer Wall and alluvium to its south, indicating that in recent times it has formed a significant sedimentary boundary.

As part of a BA dissertation at what was then King Alfred's College, Winchester (now University of Winchester) Hennessy (2000) put down a 520m transect of 27 boreholes from the west side of Chedzoy burtle with the intention of exploring the sedimentary context of a possible cursus monument (Figure 5.3). The deepest of these cores went down to -5m OD. The transect revealed seven sedimentary units summarised on Figure 5.4a. At the base were Burtle sands (1), overlain by organic muds with peat and laminations of estuarine sediment (2), then silts with marine Foraminifera (3), then peat (4), grey clay (5), peat (6) and blue grey clay (7). This area 800m from the present course of the River Parrett has clearly been subject to greater estuarine influence than the more enclosed Kings Sedgemoor Drain basin to the north investigated by Alderton (1983). In Hennessey's transect the upper peat is separated into two bands, not seen in the other boreholes. Hennessey's transect shows clear evidence of draping whereby stratigraphic unit rises up as it nears dry ground as the result of greater autocompaction of the sediments where the sequence is most thick (Allen 1999). Correlation between boreholes is made more difficult by the fact that in Alderton's (1983) survey only those on West Moor are related to Ordnance Datum. However, levels on the Ordnance Survey map suggest that most of her boreholes are at *c* 4m OD and this is probably a reasonable approximation for the purposes of general correlation.

The Somerset Levels project survey (Alderton 1983) showed that Sedgemoor had a very different ecological history from the Brue valley north of the Poldens. The survey did not find a basal lower peat, although deeper coring by Hennessey (2000) and the present survey subsequently did. There was evidence for major estuarine incursion in the deeper boreholes, there was little or no evidence for extensive raised bog development which was so extensive north of the Poldens. However, some localised, and relatively brief, raised bog development was found by Alderton (1983) on West Moor. On Kings Sedgemoor, as the name suggests, sedge peat predominated, especially in the Middlezoy and Beer Wall transects, with fen wood peat round the dry ground edge. Parts of the Moor, especially Middlezoy were very wet and subject to flooding with deposition of detritus muds at Moor Drove and Mount Close Batch. Such wetter areas are likely to have influenced the location of activities and routeways. It is noted that pollen preservation on Sedgemoor is often poor, perhaps a result of periods of desiccation or calcareous influx (Coles and Orme 1983) and Alderton's work is not accompanied by pollen diagrams. Peats are overlain by clays in places on West Moor, south of Chedzoy and Middlezoy but not in the transect between Mount Close Batch and Sutton Hams. It has been argued that this upper clay relates in part to the practice of warping, deliberate flooding of the wetland with minerogenic sediment charged water to create a favourable soil for cultivation. This practice is attested historically on King's Sedgemoor (Williams 1970, 176; Coles and Campbell 1982).

Fieldwork at Chedzoy

The main concentration of Mesolithic artefacts identified by Norman (2001) at Chedzoy is within 20m of the peat edge (Figure 5.5). Here Carson (2009) cored a transect and dug a test pit (ST350375) as part of a Geoarchaeology MSc dissertation at Reading University. Below the peat she discovered flints, bone, waterlogged seeds and charcoal at a depth of *c* 0.8m. This established the potential for further work on the site as a case study in the present project.

The 40m transect of eight boreholes made by Carson was extended to form a 100m transect of 22 boreholes. In addition the geophysics team from English Heritage carried out GPR and ERT transects to assist in the reconstruction of the sedimentary cross section (Figures 5.6-7). As part of the present project Carson' s test pit at 25m was supplemented by a test pit at 41m, excavated entirely by hand with artefacts 3D recorded. Samples were taken for sediment analysis, pollen, plant macrofossils, and beetles.

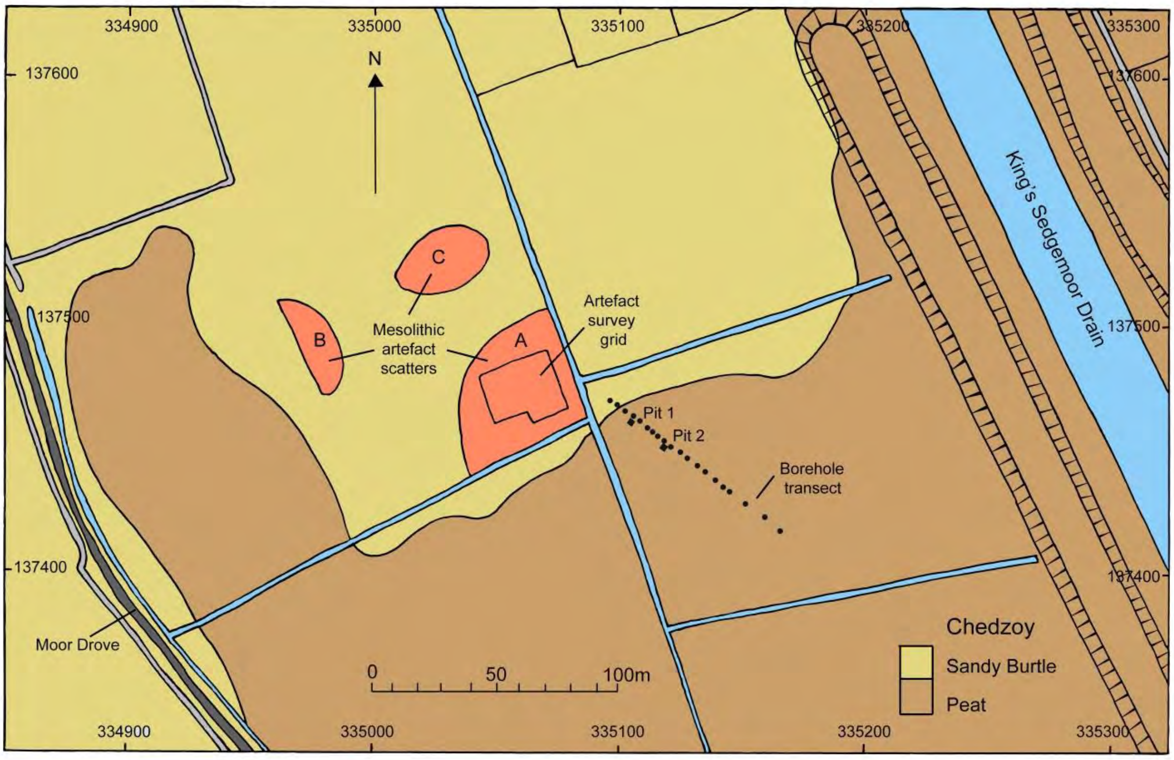


Figure 5.5. Chedzoy (Parchey) the Mesolithic artefact scatters identified by Norman (2001) in relation to the wetland edge and borehole and test pit transect. Graphic Jennifer Foster.

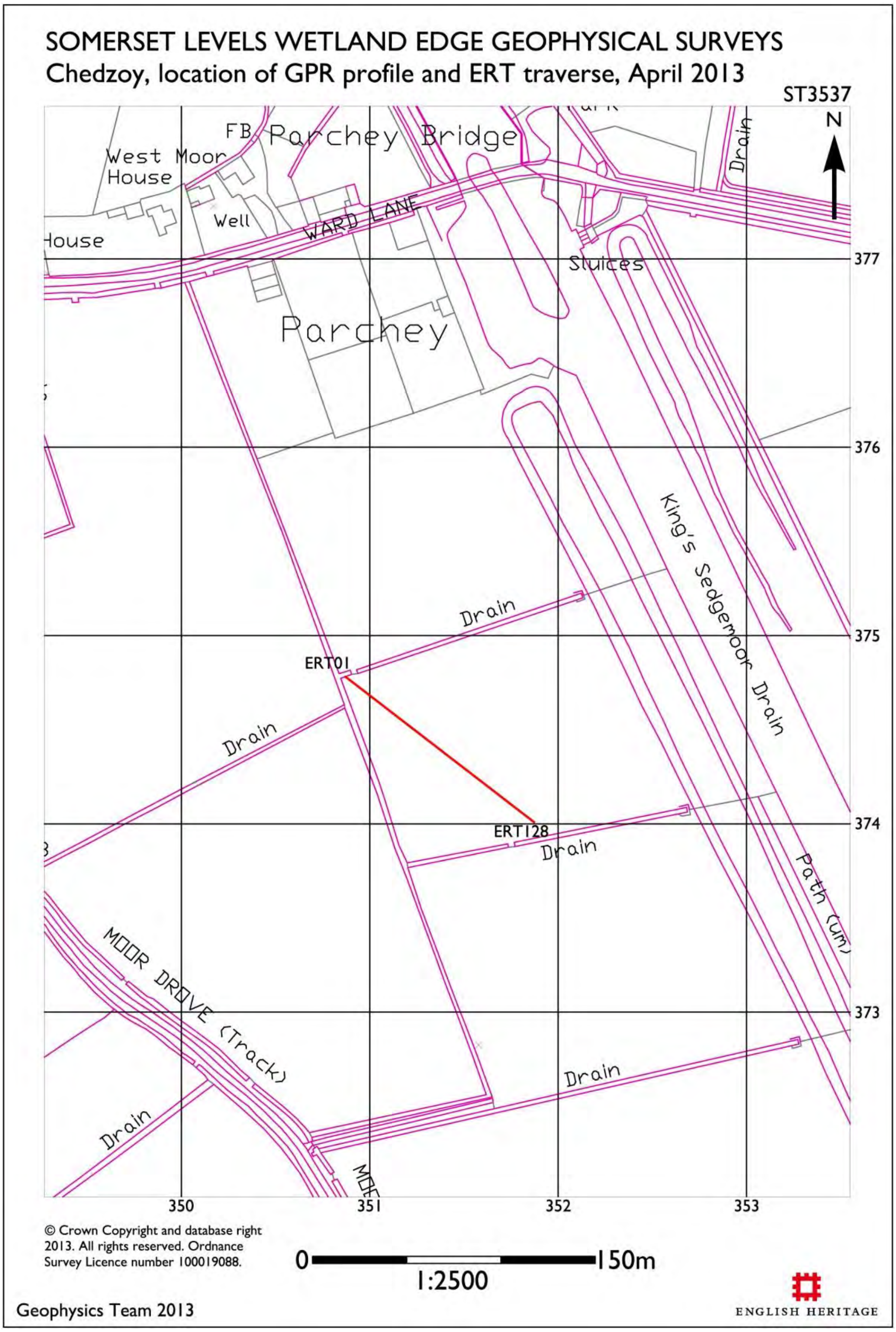


Figure 5.6 Chedzoy ERT Geophysics transect (by English Heritage Geophysics Team).

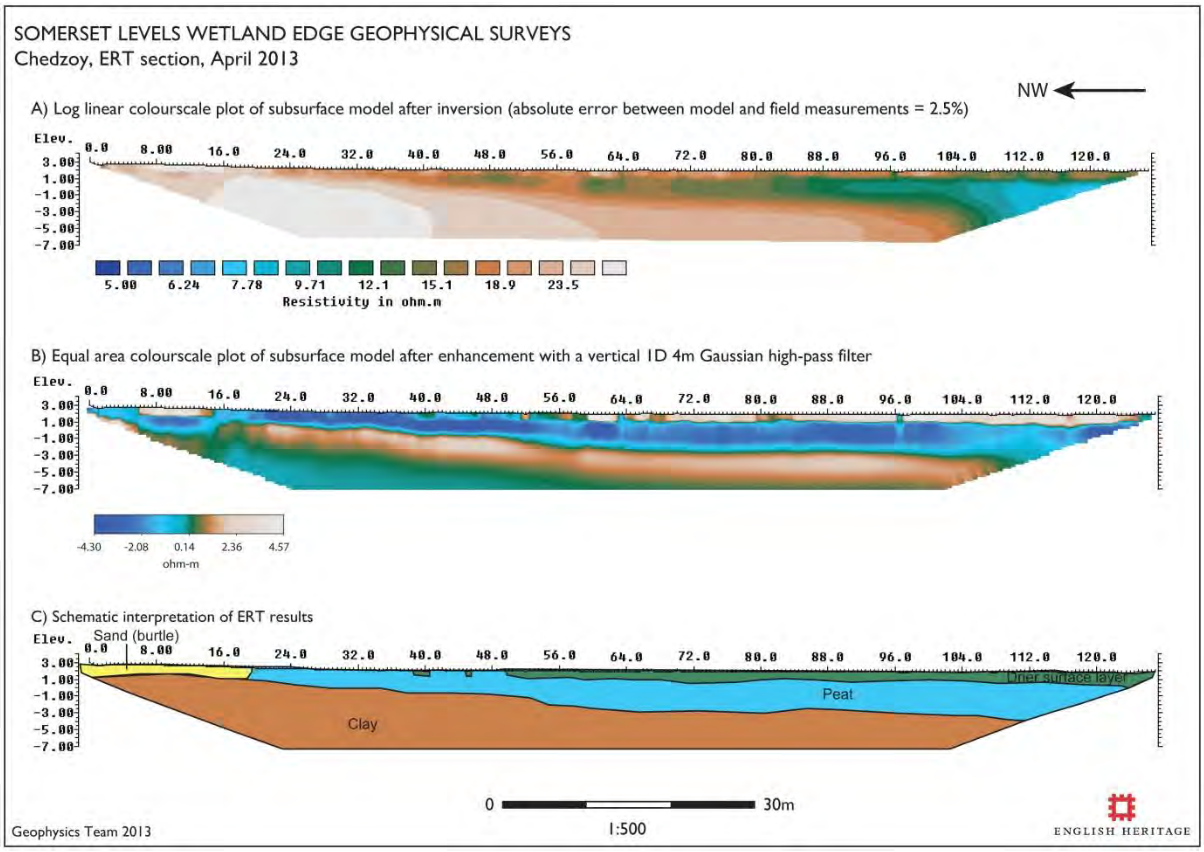
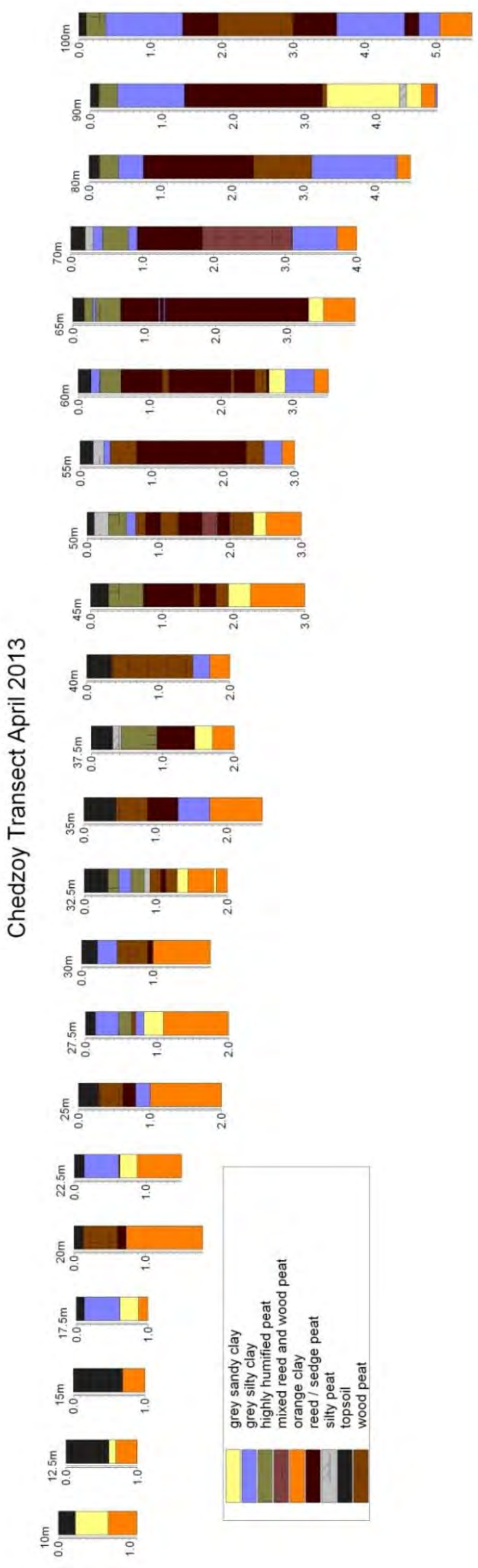


Figure 5.7 Chedzoy transect ERT sections (by English Heritage Geophysics Team).

Figure 5.8. The coring transect at Chedzoy (Graphic Simon Maslin).



In the north west corner of the field investigated immediately adjacent to the area where Norman had found the main concentration of lithic artefacts, sandy burtle sediments were exposed where cattle had trampled in an area sheltered by the hedge corner two cores were found, with a chert scraper and flake. In a badger set in the area worked on by Norman there was a snapped blade with blunting retouch, which may be a microlith (at ST 3502737515).

The borehole transect is shown in Figure 5.8. From 10-40m boreholes are at 2.5m intervals, from 40-70m at 5m intervals and from 70-100m at 10m intervals. The Holocene sediments gradually thicken to the south east where at 100m there are up to 5m of Holocene sediments. The main sedimentary units from the top down are as follows:

Unit 1, Humified peat
Unit 2, Silty clay in some boreholes especially 55-100m
Unit 3, Reed, sedge and wood peat
Unit 4, Silty clay especially in boreholes 55-100m
Unit 5, Silty peat (only present at 100m at -1.42m OD). Radiocarbon dated 5200-4940 cal BC. This may correspond to the lower peat in the Greylake transect (Chapter 3) the sample from which is only a little earlier.
Unit 6, An Old Land Surface developed on the grey sandy or silty clay and only really clearly identified in the trenches.
Unit 7, Mercia Mudstone weathered as orange –red clay

The sediments have been further investigated by two trenches:-

Figure 5.9 Chedzoy: Excavation of Trench 1 by Sharon Carson (2009).

Figure 5.10. Chedzoy Trench 1 section (scale 10cm divisions).

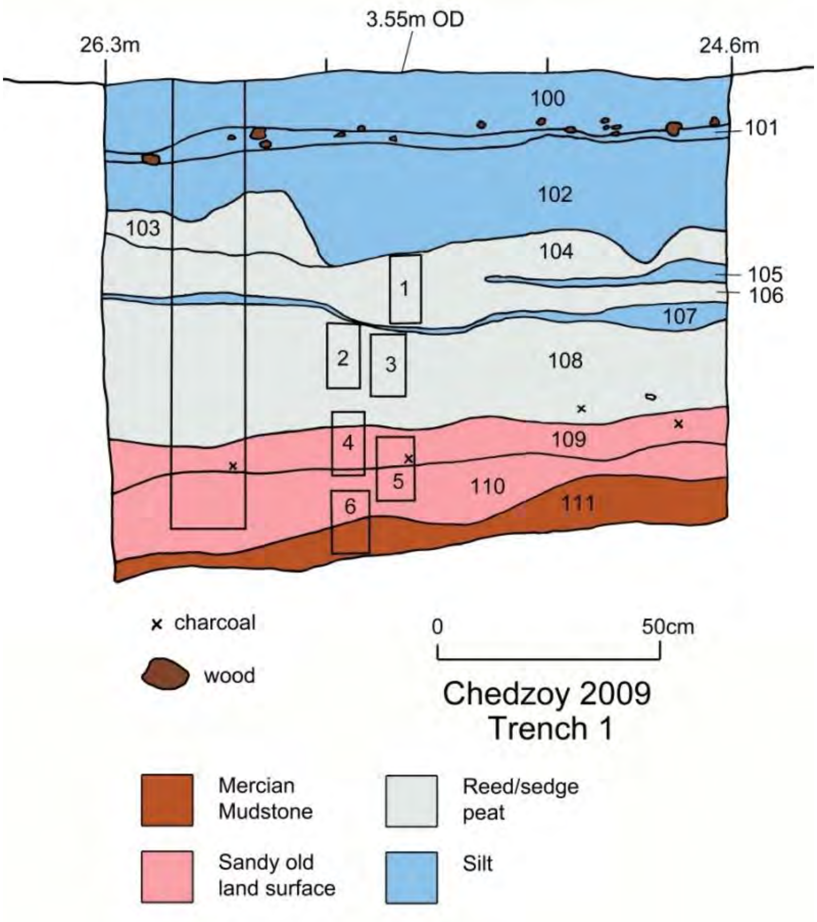


Figure 5.11. Chedzoy Trench 1 section.

Trench 1
by Sharon Carson

This pit was excavated in 2009, before the present project, as part of an MSc dissertation, between 24.6m and 26.3m on the coring transect and at 3.55m OD (Figure 5.9). It was 1 by 1.5m and 1.1m deep. The stratigraphy is shown in Figures 5.10-11 and is as follows:-

Context 100, 0-0.10m, Turf and topsoil, silty

Context 101, 0.10-0.15m, A stone accumulation horizon and the base of topsoil, contained pieces of brick, daub and stone, this suggests that the field has been pasture for at least several decades.

Context 102, 0.15-0.27m, Silt probably the result of flooding perhaps deliberate warping. The base of this unit is marked by pockets, irregularity and some mixing into the surface of underlying peat, perhaps the result of cultivation. This could represent the fill of a shallow drainage channel at the wetland edge, cut tangentially to the trench. The silt fill might relate to flooding, or warping.

Context 103, 0.27-0.39m, Peat with some alluvial clay intermixed, disturbance as above.

Context 104, 0.39-0.47m, Silty peat

Context 105, 0.4-0.45m, Silt lens on west part of section only, could reflect slope processes from the burtle or riverine flooding.

Context 106, 0.45-0.50m, Peat below silt lens on west part of section, equivalent to lower part of 104.

Context 107, 0.47-0.49m, Thin silt lens, could reflect slope processes from the burtle or riverine flooding.

Context 108, 0.49-0.80m, Peat reeds and wood, some traces of discontinuous fine silt laminae. The base of this layer is irregular and shows pockets (Figure 5.10) which are likely to be the result of tree rooting from the wood peat. A piece of stone and charcoal was found near the base of this layer. The equivalent of Contexts 8 and 9 in Trench 2.

Context 109, 0.80-0.88m, minerogenic Old Land Surface, light brown, three pieces of charcoal were recorded on the section. The equivalent of Context 10 in Trench 2

Context 110, 0.88-1.05m, gleyed silty clay, probably gleyed subsoil but possibly with some alluvial input. The equivalent of Context 11 in Trench 2.

Context 111, 1.05-1.08, Reddish purple clay interpreted as the weathered surface of Mercia Mudstone.

Both Contexts 109 and 110 produced lithic artefacts, the same was found in Trench 2. In 109 there was a microlith (19), three chert flakes / blades and a chert chip. In 110 there was a chert flake with scraper retouch (102), three chert blades or flakes, one flint blade, one flint chip and two chert chips. Laboratory sieving of contexts 109 and 110 produced charcoal, lithic microdebitage, tiny bone fragments and waterlogged seeds.

Samples taken from Trench 1 included a 1m monolith used for pollen analysis and a sequence of samples taken for sediment micromorphological analysis of Contexts 104-111. Twenty-five bulk samples were taken for laboratory analysis mainly sieving for artefacts and biological evidence, 10 litres being taken from the basal landsurface.

Summary of Pollen Analysis from Trench 1
by Sharon Carson

Pollen analysis was carried out by Carson (2009) and 15 levels were counted to 150 land pollen grains, charcoal was also counted. The pollen results are only briefly summarised here from the original dissertation.

0.78-0.98m Pollen preservation was unfortunately very poor in the basal sediments below 0.76m and the sediments were predominantly minerogenic below 0.83m. Similarly poor pollen preservation has previously been reported on Sedgemoor (Coles and Orme 1983). Poaceae was the dominant type. The main tree type is *Alnus* with some *Quercus* and *Tilia*. *Typha latifolia* increases as *Potamogeton* decreases to the top of this zone. Some standing water may be indicated. Charcoal is present below 0.8m

0.58- 0.78m Total pollen increases to the top of this zone. Cyperaceae and Poaceae predominate, while *Alnus* is the main tree type predominating at 0.64m then reducing. Trees and shrubs increase through this zone. Charcoal peaks at 0.88m.

0.44-0.58m *Alnus* peaks at 70% at 0.55m then decreases sharply to the top of the zone. *Corylus* appears but at low amounts. Cyperaceae falls as Poaceae becomes more abundant with a peak of 60% at 0.48m. *Typha latifolia* and *Potamogeton* may indicate some standing water. Charcoal increases to the top of this zone.

Depth (cm)	Context 108 44-67			Context 108 67-82			Context 109 82-92			Context 110 92-98		
Sieve	4mm	2mm	1mm	4mm	2mm	1mm	4mm	2mm	1mm	4mm	2mm	1mm
Charcoal (frag.)	0	0	0	0	0	2	1	6	35	4	3	16
Hazelnut Shell (frag.)	0	0	0	0	0	0	0	1	2	0	0	0
Micro Debitage	0	0	0	0	0	0	0	1	2	0	2	0
Seeds:												
Rubus Undiff.	0	0	0	0	0	0	0	0	9	0	0	1
Rubus (frag.)	0	0	0	0	0	0	0	0	7	0	0	0
Ranunculus	0	0	0	0	0	2	0	0	6	0	0	0
Sambucus Nigra	0	0	1	0	0	0	0	0	0	0	0	0
Urtica	0	0	0	0	0	2	0	0	0	0	0	0
Apiaceae	0	0	0	0	2	0	0	0	0	0	0	0

Table 5.1 Chedzoy Trench 1, Contexts 108-110, plant macrofossils by Sharon Carson

Sieve fraction	4mm	2mm	1mm
Charcoal (frag.)	26	189	504
Chert Blade/Flake	2	3	0
Micro Debitage	2	8	22
Hazelnut Shell (frag.)	1	16	32
Bone	4	1	0
Microlith	1	0	0
Seeds:			
Rubus Undiff.	0	0	59
Rubus Undiff. (frag.)	0	0	54
Ranunculus	0	0	85
Schoenoplectus	0	0	16
Urtica	0	0	25
Eleocharis Palustris	0	0	5
Milium (frag.)	0	0	15
Stachys Palustris	0	0	1
Caryophyllaceae	0	0	1
Potentilla	0	0	1
Sambucus Nigra	0	0	1
Salvia	0	0	1
Asteraceae	0	0	1

Table 5.2 Chedzoy, Trench 1, plant macrofossils by Sharon Carson.

Summary of plant macrofossil and other evidence from sieving Chedzoy Trench 1
by Sharon Carson

Sub- samples of 0.5 litres were removed from the monolith tin for sieving down to 0.5mm but only samples down to 0.5mm have been analysed (Table 5.1). Plant macrofossils were few in Context 108. They were better represented in Context 109. Where *Rubus* and *Ranunculus* were represented. Of particular note in Context 109 is the presence of charcoal and hazelnut shell, some charred, and three pieces of lithic microdebitage. Context 110 also produced charcoal and two pieces of lithic microdebitage but only one seed of *Rubus*. An additional sample of 10 litres was analysed from Context 109 (Table5.2). In this sample the most notable finds were a microlith, five chert blades / flakes, many pieces of microdebitage and much charcoal and hazelnut shell some charred. There were many seeds from the 12 taxa listed on Table 5.2. The key conclusion is that flint artefacts and waterlogged plant macrofossils are present in the Old Land Surface below the peat only about 15m from the wetland edge. The amount of anthropogenic material indicates that activity extended to this point before the site was buried by peat growth. The presence of some charcoal in the base of the peat (Figure 5.11; Table 5.1) indicates that activity may have extended into the period of peat formation. Although pollen was not well preserved in these basal contexts there was reasonable preservation of waterlogged macrofossils. There are additional samples from this context which have not been fully analysed and identified.

Summary of Sediment Micromorphology from Chedzoy Trench 1
by Sharon Carson

Six samples taken but analysis was restricted to Samples 4 and 6 (Figures 5.11-12). <u>Context 111</u>. A red / orange coloured silty sandy clay with a striated b-fabric and a microstructure of planes and channels. The plant remains are mineralised roots

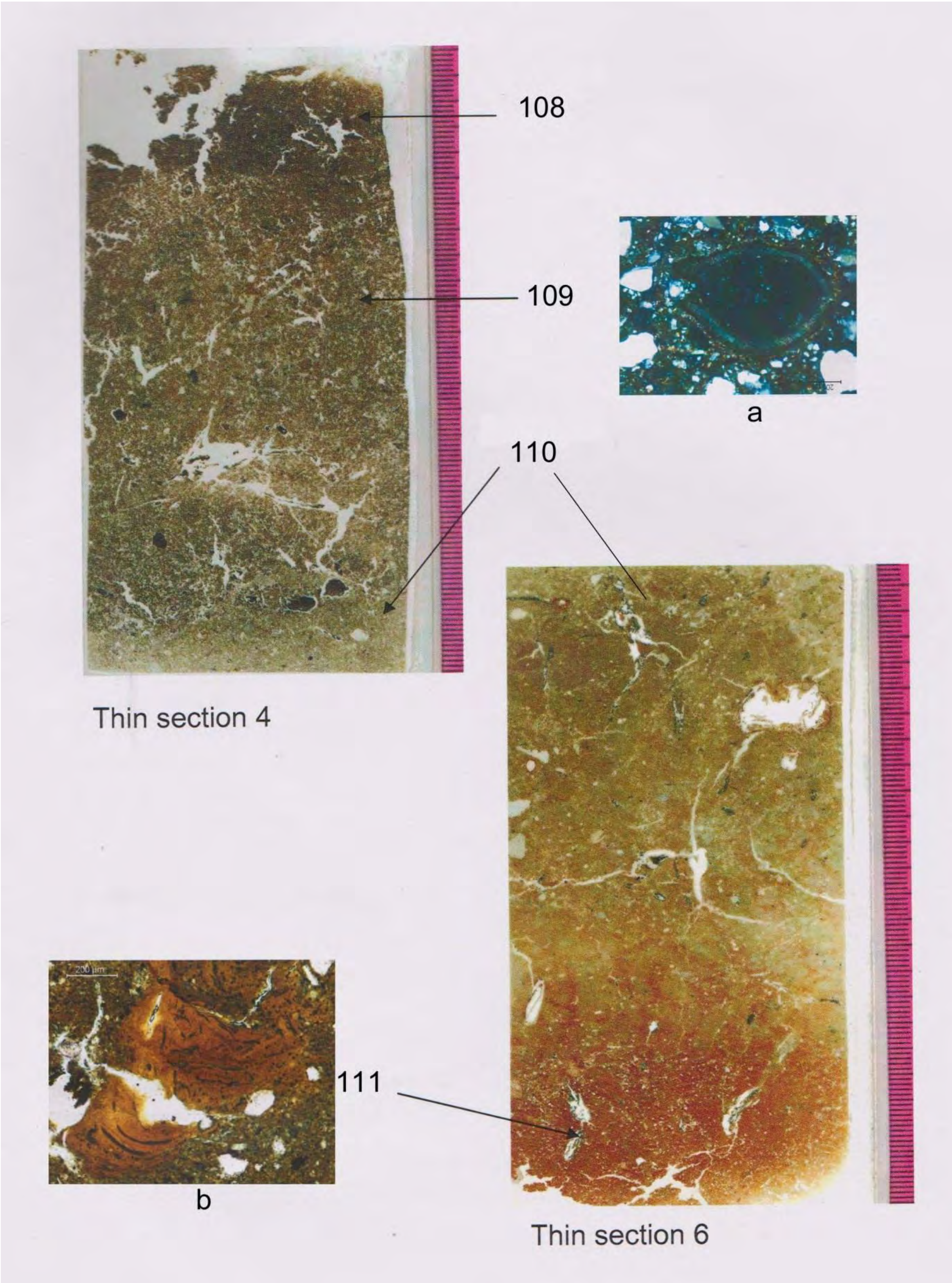


Figure 5.12 Chedzoy, Trench 1 sediment micromorphology Sections 4 and 6 (a) Context 109 possible *Rubus* seed, (b) Context 111 clay coatings PPL.

(10%) replaced with pyrite framboids. Glauconite and gypsum are present. The upper boundary is gradual and diffuse over a 300mm range. Clay coatings have crescentic laminations forming 30% of the matrix (Fig 31). They are red/ orange in colour and have some degree of birefringence in XPL. The main minerals are quartz, gypsum, glauconite and iron pyrite (mineralised plant material). Sandstone rock fragments sub-rounded and 2mm in size present.

Interpretation. The clay laminations and striated clays are interpreted as post depositional features. In the field this context was interpreted as the weathered surface of the Mercia Mudstone, the thin section indicates it has been subject to some pedogenic alteration.

Context. 110. A grey sandy clay with vughy microstructure and undifferentiated b-fabric. It has a porphyritic related distribution and is unsorted to moderately sorted. The inclusions of quartz are unoriented but the plant remains display some moderate orientation, with the inclusions being random and unreferred. The upper boundary spans 10mm and can be described as being abrupt, wavy and sedimentological. The horizon has the same proportion and distribution of rocks and minerals, including glauconite and gypsum, as the underlying material with a striated clay matrix and iron pyrite framboids replacing plant material.

Interpretation. In the field this context was interpreted as a horizon within the Old Land Surface. The thin section indicates it has formed as a result of pedogenesis from the underlying context, there may also have been some contribution by slope processes of sand and perhaps silt from the adjoining burtle sediments.

Context 109. A minerogenic and amorphous organic sandy clay with a gefruic related distribution and complex packing. The upper boundary is diffuse and irregular spanning 40mm. The inclusions are unoriented and their distribution is random and unreferred. It contains 40% plant material and some seed shells which are round in form and 1mm in size (Figure 5.12a). The sediment contains aggregates of cemented sand which are sub-angular and make up around 2% of the context. It also contains sandstone and quartzite fragments which are sub-rounded and 2-3mm in size and each make up 1%. There is a high abundance of sub-rounded quartz grains at 50% which are 0.5mm in size. Glauconite is also present.

Interpretation. Waterlogged plant material shows that during the formation of this layer the watertable was rising leading to the transition to overlying peat forming communities.

Context 108. Peat 80% with the inclusion of some quartz grains 20% suggesting perhaps some mixing, perhaps trampling, or colluvial input from the Burtle Beds upslope.

Figure 5.13. Chedzoy Trench 2, sampling in progress (scale 0.5m divisions).

Figure 5.14. Chedzoy, Trench 2, section (small scale 0.1m divisions, large scale 0.5m divisions.

Trench 2
by Martin Bell

This pit (Figures 5.13-15) was excavated between 40-42m on the coring transect and at 3.46m OD between 15-19 April 2013. The work was done by a team of 4-6. The pit was 2m by 2m and was 2.1m deep, while below 1m it required pumping. The section is shown in Figures 5.14-15 and was as follows:-

Context 1, 0-0.15m peaty topsoil colour (10YR2/1 Black) apparently cultivated with patches of sitly clay derived from underlying horizon.

Context 2, 0.15-0.20m silty clay lens on east half of section only, probably the result of riverine or estuarine flooding perhaps warping (Coles and Campbell 1982).

Context 3, 0.20-0.26m Humified peat

Context 4, 0.26-0.27m Thin discontinuous clay, a brief flooding episode [colour ?? as 2].

Context 5, 0.27-0.65m Reed / sedge peat, only occasional wood (10YR2/1).

Context 6, 0.65-0.85m, wood peat with large ? alder stump on right of section.].

Context 7, 0.85-1.25m reed / sedge peat,]. At 1.15m there is a radiocarbon dated horizon 3770-3630 cal BC.

Context 8, 1.25-1.36m reed / sedge peat with frequent small wood.

Context 9, 1.36-1.63m, Wood peat. Tree trunk in west section. At depth 1.35m there is a radiocarbon dated horizon 4040-3800 cal BC.

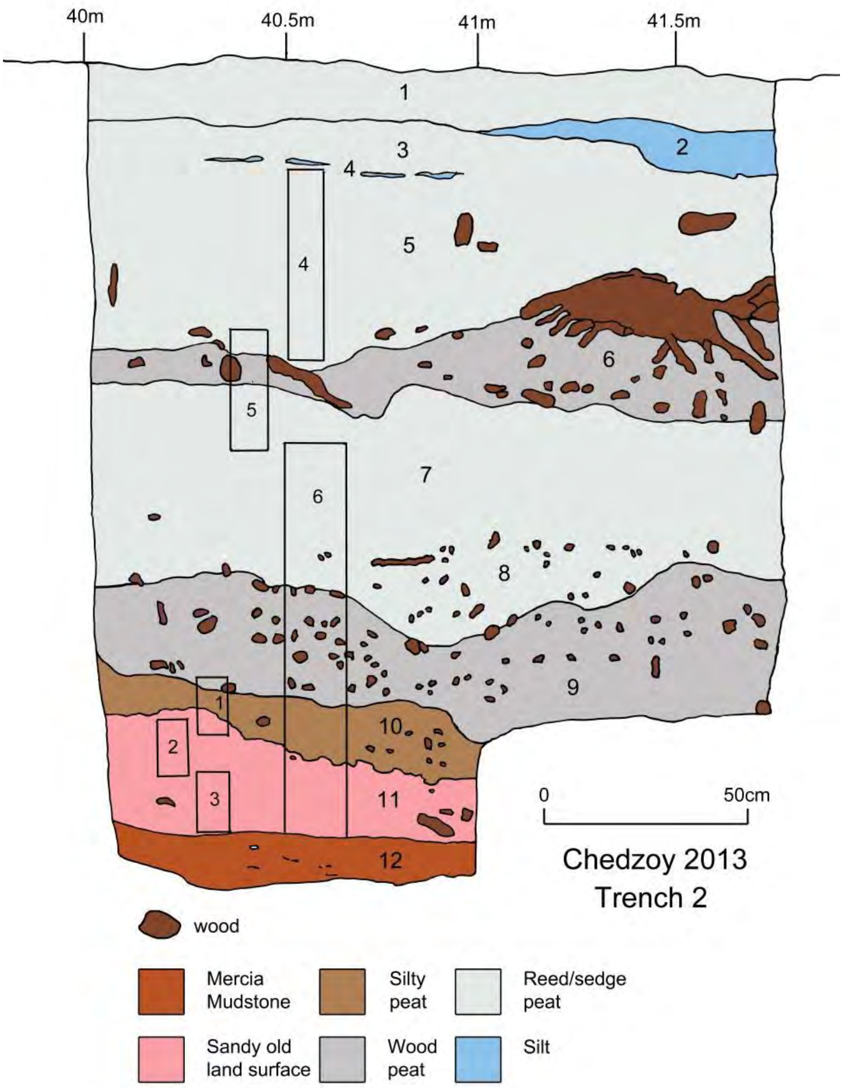
Context 10, 1.63-1.76m, silty reed peat. At 1.66m there is a radiocarbon dated horizon 4230-3995 cal BC.

Context 11, 1.76-1.97m, sandy clay, interpreted as the Old Land Surface preceding peat inception.

Context 12, 1.97-2.10m, Orange clay interpreted as the weathered surface of the Mercian Mudstone.

Radiocarbon dates from Trench 2 are as follows. The base of the peat (Monolith 6, 68-69cm) is dated 4230-3995 cal BC (weighted mean of SUERC-53048 and SUERC-53049; 5269+/-BP). Monolith 6, 56-58cm which is 8cm above a core/ adze flake and 12cm above the base of the peat, is dated to 4040+/-3800 cal BC (UBA-25303; 5134+/-44 BP). Thus the peat base is very late Mesolithic.

Figure 5.15. Chedzoy Trench 2, (a) section, (b) Monolith tin 6, red arrow marks the chert core / adze tip (scale 0.2m), (c) Flint in peat, (d) Flint in minerogenic Old Land Surface, (e) Bone Find 17 in Old Land Surface.



a b

c d e

The upper of the two available dates is from Monolith 6, 16-18cm and is 52cm above the base of the peat. This date is 3770-3630 cal BC; this suggests quite rapid accumulation of wood peat in the early Neolithic.

At the very base of the wood peat Context 9 a flint flake (20) and some charcoal was found. Also near the bottom of this context Monolith 6 (Figure 5.15) had a core / adze tip (21) and a chert chip at a depth of 0.61m. Those are at the horizon radiocarbon dated 4230-3995 cal BC. Below this excavation of Context 10, the silty reed peat, produced a possible scraper (18) and a flake with possible edge utilisation (19) and a chert flake. Laboratory sieving of samples from Context 10 produced three chert blades, one chert chip and a flint chip. Excavation of the Old Land Surface (Context 11) recovered 3 flint flakes (Figure 5.15) , four pieces of flint microdebitage, all from sieving, six chert flakes / blades, all but one from sieving, and nine pieces of chert microdebitage, of which six were from sieving. An animal bone was also present in Context 11 (Figure 5.15e). This has been identified by Charlotte Scull as a red deer (*Cervus elephas*) left humerus. Its sd measurement is 24.73mm. The articulation surfaces are in places eroded and there is possible evidence of animal gnawing. Unfortuately the bone had insufficient collagen to be dated (P.Marshall pers comm).

It is clear therefore that artefact deposition occurred both on the minerogenic Old Land Surface (Context 11) and in the overlying organic silty peat (Context 10) and in the very base of the overlying wood peat (Context 9). Since the radiocarbon date from this artefact horizon, and the overlying date 12cm higher both predate the Sweet Track, the earliest Neolithic evidence in the West Country, it seems probable that this represents very late Mesolithic activity and that activity continued into the period when organic sediments were building up around the fringes of the site. The core/ adze flake within the base of the peat indicates very late Mesolithic activity on this site. This is about a millennium later than the latest dates previously suggested for Mesolithic activity at Chedzoy on typological grounds (Norman 2003).

Contexts 10 and 11 were totally sampled for sieving in the laboratory, an area 1.5m by 0.5m. Other samples taken were three monolith tins (4-6) for dating, pollen and plant macrofossil examination. Analysis was in the end confined to Monolith 6 once it was established that this covered the Mesolithic to early Neolithic time frame of the project. Three samples (1-3) were taken for possible micromorphological analysis of the Old Land Surface but that was not undertaken because micromorphological evidence was already available from this context as a result of Sharon Carson's work on Trench 1 outlined above (Figure 5.12). Bulk samples of Context 11 were taken for insect analysis and Sample 2 of 6.25kg was assessed by Dr David Smith (Smith 2013). It produced a very small fauna which was badly preserved, the presence of flowing water was indicated by *Cyphon* spp but the taxa present had no wider interpretative value so more detailed analysis was not recommended. Now that we know that the overlying peaty Context 10 may be late Mesolithic and contains lithic artefacts, analysis of that context would perhaps have been more productive, but that is with hindsight, and samples are available in storage.

There is possible environmental evidence of previous Mesolithic activity at Chedzoy from charcoal in the borehole at 100m along the transect, at a depth of 467-472cm which is dated 5200-4940 cal BC (SUERC-53050; 6087±29 BP).

Plant macrofossils from Trench 2 Chedzoy
by Dan Young (Quest)

Methods
Three samples from the basal landsurface Chedzoy Trench 2 were analysed for their seed remains. These included flots and wet-sieved sub-samples from samples <1> and <3> (Context 10) and <4> (Context 11). The three wet-sieved samples and flots were scanned using a stereozoom microscope at x7-45 magnifications, with identifications and quantifications of all seed taxa recorded (Table 5.3). Identifications of the seeds have been made using modern comparative material in the University of Reading reference collection, and reference atlases (e.g. Cappers *et al.,* 2006). Nomenclature used follows Stace (2005).

Results and interpretation of the macrofossil analysis
The results of the plant macrofossil analysis of samples from Trench 2 are shown in Table 8. Relatively few seeds were recorded within the three samples, the assemblage being too small for a full environmental interpretation. The assemblage is limited to shrub taxa in samples <1> and <3>, including the edible species *Corylus avellana* (hazel) and *Rubus* cf. *fruticosus* (blackberry), and *Myrica gale* (bog myrtle). One of the hazelnut shells in sample <3> was charred. Although limited, the assemblage in samples <1> and <3> is typical of a wet moorland or a wetland fen which is only occasionally flooded; the presence of a charred hazelnut may represent burning by a natural fire event, or the accumulation of burnt waste material from human activities. The assemblage in sample <4> included blackberry and *Sinapis/Brassica* sp. (e.g. charlock/black mustard). The presence of *Sinapis*/*Brassica* in sample <4> is indicative of waste or disturbed ground, whilst blackberry may have been growing in hedgerows or wood margins nearby to the site.

Table 5.3: Results of the waterlogged plant macrofossil (seeds) analysis of samples from Trench 2, Chedzoy

Sample number	Waterlogged seeds			
	Latin name	**Common name**	**Number**	**^{14}C potential (seeds only)**
<1> Context 10	*Rubus* cf. *fruticosus* seed	blackberry	7	Yes
	Myrica gale	bog myrtle	1	Insufficient mass
<3> Context 10	*Corylus avellana* nut shell	hazel	1	Yes
	Corylus avellana nut shell (charred)	hazel	1	Yes
	Rubus cf. *fruticosus* seed	blackberry	4	Yes
	Rubus sp. thorn	e.g. blackberry	1	Insufficient mass
<4> Context 11	*Sinapis/Brassica* sp.	e.g. charlock/black mustard	2	Insufficient mass
	Rubus cf. *fruticosus* seed	blackberry	1	Yes

Chedzoy 2013: Waterlogged Wood & Wood Charcoal Identifications.
By P. Austin

Aims & Methods
Four wood samples and 3 charcoal samples from Chedzoy were examined to identify any woody taxa present in the samples suitable for potential ^{14}C dating, and

to assess the overall potential of the assemblage for further analysis. Standard procedures for the analysis of waterlogged wood and wood charcoal, as described in Hather (2000), were followed. Nomenclature follows Stace 1997.

Results

The results of the analysis are listed in Table 5.4. Suitability for ^{14}C dating is indicated by the letter 'Y'; 'X' = not suitable for dating. In total 4 taxa were identified: *Prunus sp.* (blackthorn, cherry), *Quercus* sp. (oak), *Salix/Populus* sp. (willow/poplar), All the woods identified are hardwoods (Angiosperm). No softwoods (Gymnosperm) were identified.

Comments

Material in both waterlogged and charred samples were sufficiently well preserved and of suitable size for identification. The waterlogged wood samples contained 2 woods, Alder and Willow/Poplar. Both taxa are commonly associated with wetland environments. The charcoal samples also contained 2 taxa, oak and blackthorn/cherry. These taxa are more general in their ecology requirements but are typically associated with dry/damp conditions rather than wetland. Further analysis is unlikely to result in the recovery of additional information and is therefore not recommended.

Table 5.4. Chedzoy 2013: Wood Identifications.

Sample		**ID (qty)**	**Wt (g)**	**^{14}C**
Charcoal	Tr. 2; <1>	*Prunus* sp. (10)	0.393	Y
Charcoal	Tr. 2; <16>	*Prunus* sp. (4)	0.184	Y
Charcoal	467-472cm	cf *Quercus* sp. (2)	0.012	X
Waterlogged	Wood 1. Depth 60cm	*Alnus* sp.	-	Y
Waterlogged	Wood 3. 68cm	*Salix/Populus* sp.	-	Y
Waterlogged	Wood 5.	*Alnus* sp.	-	Y
Waterlogged	Main trunk horizontal 1.	*Alnus* sp.	-	Y

Chedzoy pollen & non-pollen palynomorph analysis report

by C.R. Batchelor & L. Morandi
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Introduction

This report summarises the findings arising out of the pollen and non-pollen palynomorph analysis undertaken by Quaternary Scientific (QUEST), University of Reading, in connection with archaeological excavations at Chedzoy. The analysis focussed on the sediments from Monolith 6, Trench 2 (Figure 5.12).

Pollen and non-pollen palynomorph analysis

A total of 24 samples were extracted at 4cm intervals through the sequence. The methods of pollen extraction and analysis were outlined in the pollen report in Chapter 4. However, at Chedzoy the count was 300 total land pollen grains (TLP) due to poorer preservation than at Greylake and Shapwick. The pollen diagram was plotted using Tilia v1.7.16 (Grimm, 2011) and zoned by eye (Figure 5.16-17).

During the course of the analysis, the presence of non-pollen palynomorph remains were noted and recorded separately. The abundance of fungal spores and parasite eggs is expressed as microfossils no. per cm^3 (Bosi *et al*. 2011; Florenzano *et al*. 2012; Vaccaro *et al*. 2013), although we are aware that these values are affected by the rate of deposition. As of today, there is no agreed methodology as to the counting method for NPPs and their quantification. Percentage values of the pollen sum is the most commonly used parameter. However, this is likely to be affected by the pollen concentration, leading to a bias in the NPP record (Baker *et al*. 2013). On the other hand, percentages of the total NPP sum may be a suitable method, but it requires the counting of all the microfossil types. The results are displayed in Figure 5.20.

Results of the Chedzoy pollen analysis

The percentage pollen diagram has been divided into three zones (LPAZ's CHED-1 to 3) by eye as summarised below. The division of the diagram into zones has been determined by poor pollen preservation below 0.68m and above 0.36m which prevented full analysis at these levels. The taxa noted during the initial assessment are displayed as trace values at these levels.

LPAZ CHED-1 0.68 to 0.92m Minimal pollen
4385-4125 to 4160-4090 cal BC

This zone is characterised by a near absence of pollen. Only sporadic values of tree and shrub pollen, and fern spores were recorded. *Tilia* was the most commonly noted with single occurrences of *Corylus* type and *Quercus*. *Filicales* and *Polypodium vulgare* spores were also noted.

LPAZ CHED-2 0.36 to 0.68m *Tilia – Alnus – Corylus* type
4160-4090 to 3875-3730 cal BC

This zone is characterised by high values of tree (80%) and shrub (15%) pollen. *Tilia* (declining from 40-20%) *Alnus* (30%) and *Corylus* type (20%) dominate with *Quercus*, *Ulmus*, *Pinus* (all <10%) and sporadic values of *Fraxinus*, *Betula* and *Hedera* (all <3%). Herbaceous values are minimal (<5%), dominated by Cyperaceae and others including Poaceae, Asteraceae and Apiaceae (all <2%). Aquatic values were also minimal (<1%) comprising *Sparganium* type only. Spores were dominated by *Filicales* (20%) with *Polypodium vulgare* (<10%). Total pollen concentration generally did not exceed 100,000 grains/cm^3. Microcharcoal values were limited, decreasing from a peak of 700 fragments/cm^3 to 0 at the top of the zone.

LPAZ CHED-3 0 to 0.36m Minimal pollen
3875-3730 to 3685-3470 cal BC

This zone is largely characterised by a near absence of pollen. Throughout much of the zone, only sporadic values of tree, shrub, and herbaceous pollen, and fern spores were recorded. *Alnus*, *Quercus*, *Tilia* and *Corylus* type were all commonly recorded, together with occasional Cyperaceae, Poaceae, Lactuceae and *Filicales*.

Within the uppermost sample however, a full count was achieved, with the resultant pollen assemblage is strongly dominated by Cyperaceae (70%) with Poaceae, *Corylus* type and *Quercus* (all <10%). Other recorded herbs included *Ranunculus* type, *Chenopodium* type and *Mentha* type (all <1%). Aquatic values were minimal

(<1%) but included *Potamogeton* type, *Typha latifolia* and *Sparganium* type. Within this single sample, total pollen concentration was *c*. 350,000 grains/cm^3, and microcharcoal concentrations were nearly 1000 fragments/cm^3.

Interpretation of the Chedzoy pollen analysis
The dates of the Chedzoy pollen sequence suggest it represents a mid-Holocene record covering over 600 years, spanning the Mesolithic–Neolithic transition. The sequence consists of an Old Land Surface (0.77-0.97m) overlain by peaty silt (0.62-0.77m), wood peat (0.38-0.62m) and finally reed/sedge peat (0.38m-0m).

LPAZ CHED-1 4385-4125 to 4160-4090 cal BC
The results of the analysis indicate a very limited concentration and preservation of remains through LPAZ CHED-1 (prior to 4230-3995 cal BP). Nevertheless, the continual occurrence of *Tilia* (lime) with sporadic *Quercus* (oak) and *Corylus* (e.g. hazel) suggests that lime-dominated mixed deciduous woodland formed an important component of the dryland vegetation, most likely growing on the adjacent burtle itself.

LPAZ CHED-2 4160-4090 to 3875-3730 cal BC
The transition to LPAZ CHED-2 and increase in pollen concentration/preservation around 4290-3950 cal BC coincides with a change from silty peat to wood peat formation, indicative of a change in palaeoenvironmental conditions. The results of the pollen analysis indicate that during this period, the peat surface was dominated by alder (*Alnus*) with occasional willow (*Salix*) and a ground flora mainly comprising sedges (Cyperaceae) and grasses (Poaceae - probably *Phragmites australis* - reeds) with other herbs and ferns including Apiaceae (carrot family), Asteraceae (daisy family), sorrel (*Rumex acetosa*/*acetosella*), mugwort (*Artemisia*), dandelions (Lactuceae) and *Filicales* (ferns - probably including *Thelypteris palustris* – marsh fern). The results of the plant macrofossil assessment also provide unequivocal evidence for the growth of brambles (*Rubus* sp.). These taxa indicate the presence of damp woodland, growing within fen carr and the more limited growth of sedge fen / reed swamp. Limited occurrences of bur-reed (*Sparganium* type) also indicate the nearby presence of still or slowly moving water.

Other tree and shrub taxa such as *Quercus* (oak), *Ulmus* (elm), ivy (*Hedera*), ash (*Fraxinus*) and birch (*Betula*) may also have occupied the fen carr woodland with alder and willow, but more likely formed a mosaic of mixed deciduous woodland with lime (*Tilia*) on the adjacent dryland. Indeed the high values of entomophilous *Tilia* pollen indicate that lime was a highly dominant component of the adjacent dryland woodland during LPAZ CHED-2. High and consistent values of *Corylus* type are interpreted as representative of *Corylus avellana* (hazel) as opposed to *Myrica gale* (bog myrtle). The two are notoriously difficult to split palynologically, however, *Corylus avellana* is considered the more likely due to the presence of macrofossil remains and an absence of those from bog myrtle or other heathland indicators with which it is normally associated. Hazel may have formed an understorey component of the dryland woodland; however, the high values of this light-loving shrub suggest either openings in the woodland cover (glades), or more likely, its growth towards the woodland margin at the wetland dryland interface.

The pollen-stratigraphic record does provide an indication of changes in dryland woodland composition and structure through LPAZ CHED-2, as evidenced by a decline in lime and increase in oak and hazel pollen percentage values. This transition may have been due to one of the following: (1) natural vegetation succession with oak out-competing other taxa; (2) the expansion of peat onto former dry land causing the retreat of lime woodland (paludification; Waller, 1994; Grant *et al*., 2011), or (3) human interference. No evidence of human activity is recorded within the pollen stratigraphic record, however, microcharcoal is recorded in low and declining values through the zone which is suggestive of burning (Incidentally, these values are significantly lower than the peaks recorded at Shapwick/Greylake, Chapters 3 and 5). Nevertheless, the occurrence of bone and flint artefacts within the Old Land Surface and overlying peaty silt, increases the likelihood that the microcharcoal is of local/anthropogenic origin. The argument for a human impact on the vegetation is enhanced by the nearby presence of early and later Neolithic artefacts from the lithic scatters within a few tens of metres of the sequence (Figure 5.5; Norman 2002).

LPAZ CHED-3 3685-3470 cal BC

Local pollen assemblage zone CHED-3 is characterised by a decline in pollen concentration and preservation. This transition is correlated with a change from wood to dominantly reed/sedge peat formation. The presence of non-pollen palynomorphs was also noted during this period and investigated separately (see below). The minimal pollen values recorded through much of the zone indicate a continuance of mixed deciduous woodland on the dryland, and alder carr on the peat surface. However, within the final sample, a full analysis count suggests a large decline in alder carr and the dominance of sedge fen and reed swamp on the peat surface. On the dryland, a large decline in woodland is also indicated, specifically in lime, elm and hazel. It is considered likely that this decline in woodland is consequent of the burtle being submerged by peat

Grass grains with a morphology similar to cereal pollen are recorded within the uppermost sample (Poaceae >40um); however, these are considered more likely to represent the growth of coastal grasses rather than to represent an anthropogenic signal (e.g. Andersen, 1979; Waller and Grant, 2012). On the other hand, no other definitive evidence of a marine signal is recorded in the pollen assemblage. Furthermore, due to the aforementioned evidence of Neolithic activityincluding trackeways in the nearby vicinity, the potential impact of human activity on the local vegetation would not be unexpected.

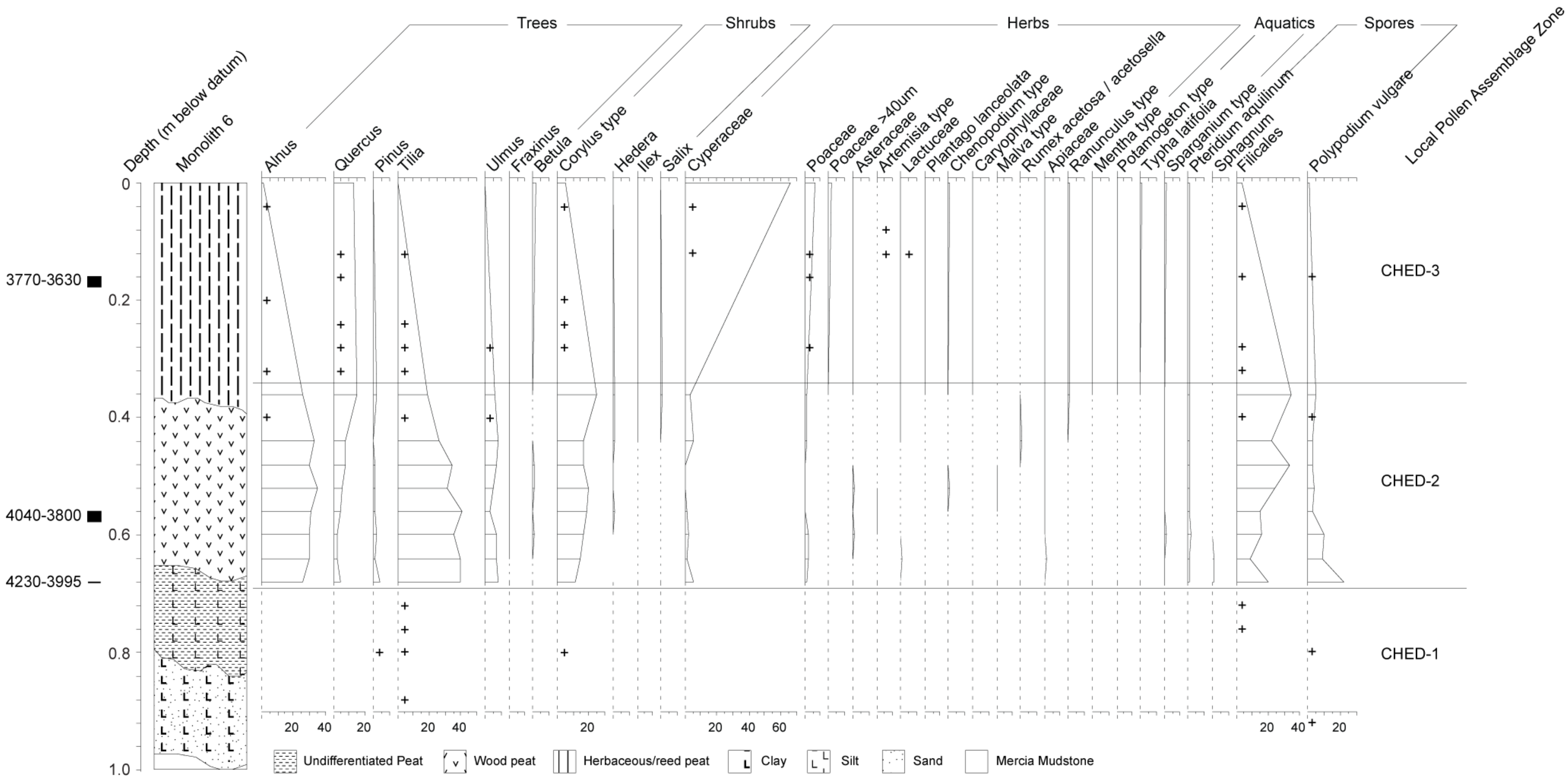


Figure 5.16: Chedzoy pollen percentage diagram by R. Batchelor

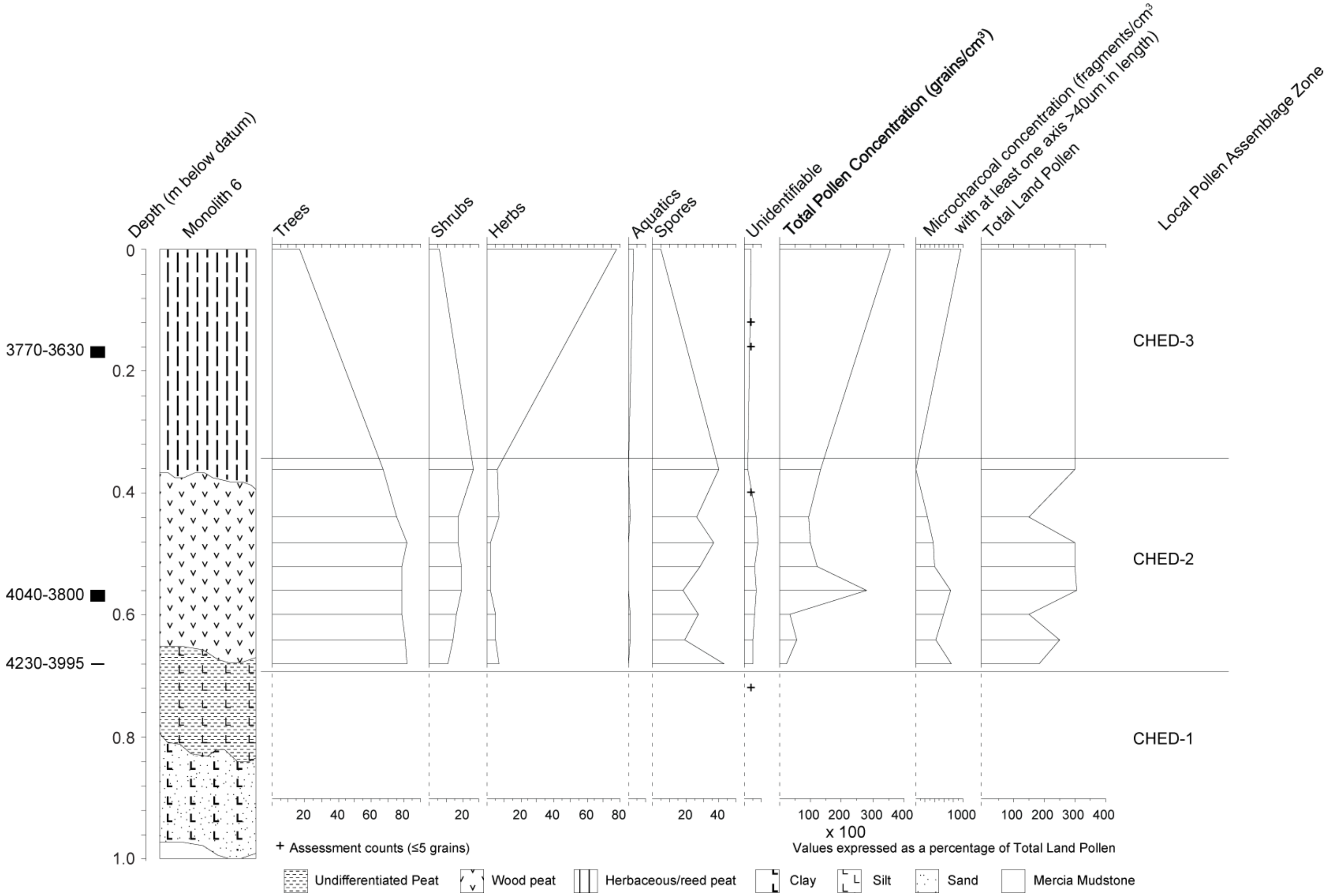


Figure 5.17 Chedzoy pollen percentage diagram by R. Batchelor.

Results & interpretation of the Chedzoy non-pollen palynomorph analysis

The results of the non-pollen palynomorph analysis are displayed in Figure 5.20. The sequence has revealed the presence of several obligate and potentially coprophilous taxa localised in the top 40cm, 3900-3770 to 3685-3345 cal BC, as opposed to a total absence of dung indicators in the lower part. Among these, *Sordaria*-type, *Sporormiella*-type and *Podospora*-type are highly reliable proxies for local herbivore activity on the site (Cugny *et al*. 2010; van Geel *et al*. 2003). Their growth primarily concerns the dung of ovicaprines, cervids, equids and lagomorphs (Richardson 1972; 2001).

Although it remains difficult to exactly specify the intensity of grazing pressure (Blackford and Innes 2006; Mazier *et al*. 2009; Cugny *et al*. 2010; Baker *et al* 2013), all the samples from the top 24cm, 3810-3605 to 3685-3345 cal BC, consistently show the presence of one or more than one genus unequivocally indicating herbivore presence.

It is worth noting that spores of *Bombardioidea* (Figure 5.18), characterized by a subapical circle of small pores and perhaps representing an extinct species, have been considered as indicators of elk (*Alces alces*) dung in northwest Europe (van Geel and Aptroot 2006; Bos *et al*. 2006; 2013). On the other hand, the rise of biporate sordariaceous spores occurring at 28cm, 3830-3650 cal BC, may not necessarily be connected to animal presence. The type has been shown to be positively correlated with grazing pressure by Cugny *et al*. (2010, although erroneously classified here as *Sordaria* 55B, that should show markedly protruding pores: see e.g. van Geel 1978), but may also represent other saprobic or non-coprophilous taxa (Ellis and Ellis 1988). This view seems to be supported by the absence of obligate fimicolous genera in the same levels.

At -12cm, 3745-3480 cal BC, local animal activity is confirmed by the finding of an intestinal parasite egg (*Trichuris* Gen.; Figure 5.19). Evidence of whipworm infection is known in Britain even in pre-agricultural contexts, as first stressed by Dark (2004) for late Mesolithic samples dated between 5740-5620 cal BC (OxA-12359; 6790± 38 BP) and 5840-5660 cal BC (OxA-12357; 6871±33 BP), the earliest case in Europe. *Trichuris* eggs do not necessarily derive from herbivores, as they may be hosted also by omnivores such as pigs or humans. The size of the egg found at Chedzoy (64µm x 36µm, probably reduced by the shrinking effect caused by the pollen preparation) allows us to exclude a human or pig origin (that should be indicated by considerably smaller eggs (Dark 2004; Dark and Gale 2007; Anastasiou and Mitchell 2013)), pointing, given the age of the sample, to other wild mammals (e.g. red fox or Cervidae (Maroo and Yalden 2000; Sianto *et al*. 2012)).

Finally, between 0.48 and 0.20cm, 3965-3855 to 3790-3565 cal BC, high numbers of *Diporotheca rhizophila* spores are recorded. In modern contexts, this spore is commonly associated with *Solanum* (nightshade), and in the past it is assumed that it was associated with *Thelypteris palustris* (marsh fern). However, palaeoecological investigations in Switzerland indicate that the spore may generally be an indicator of major soil disturbance and extensive soil erosion due to the impact of prehistoric people, and livestock trampling of wetland deposits (Hillbrand *et al*., 2012). If this is the case, it correlates well with the increase in potentially coprophilous taxa (particularly sordariaceous ascospores) and limited pollen concentration.

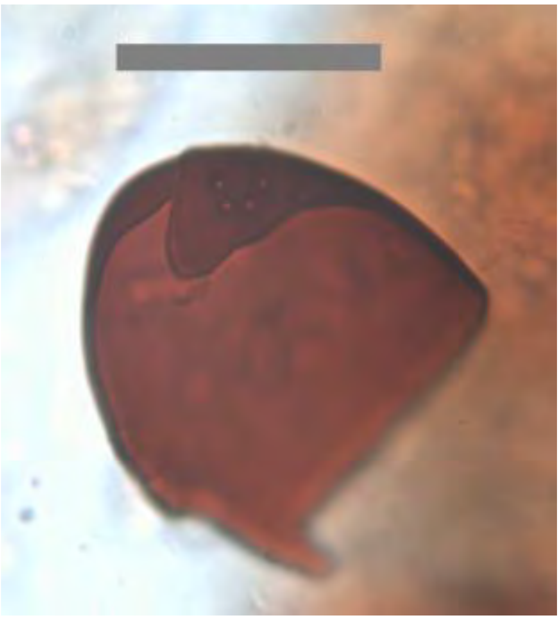


Figure 5.18: Spore of Bombardioidea, Chedzoy (scale bar = 40μm)

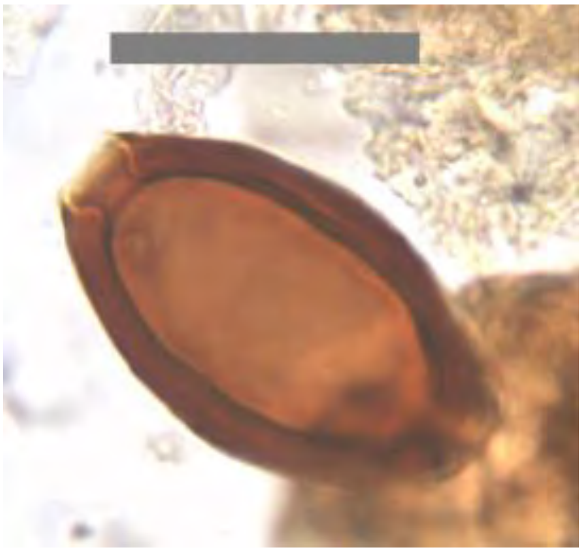


Figure 5.19: *Trichuris* sp. egg, Chedzoy (scale bar = 40μm)

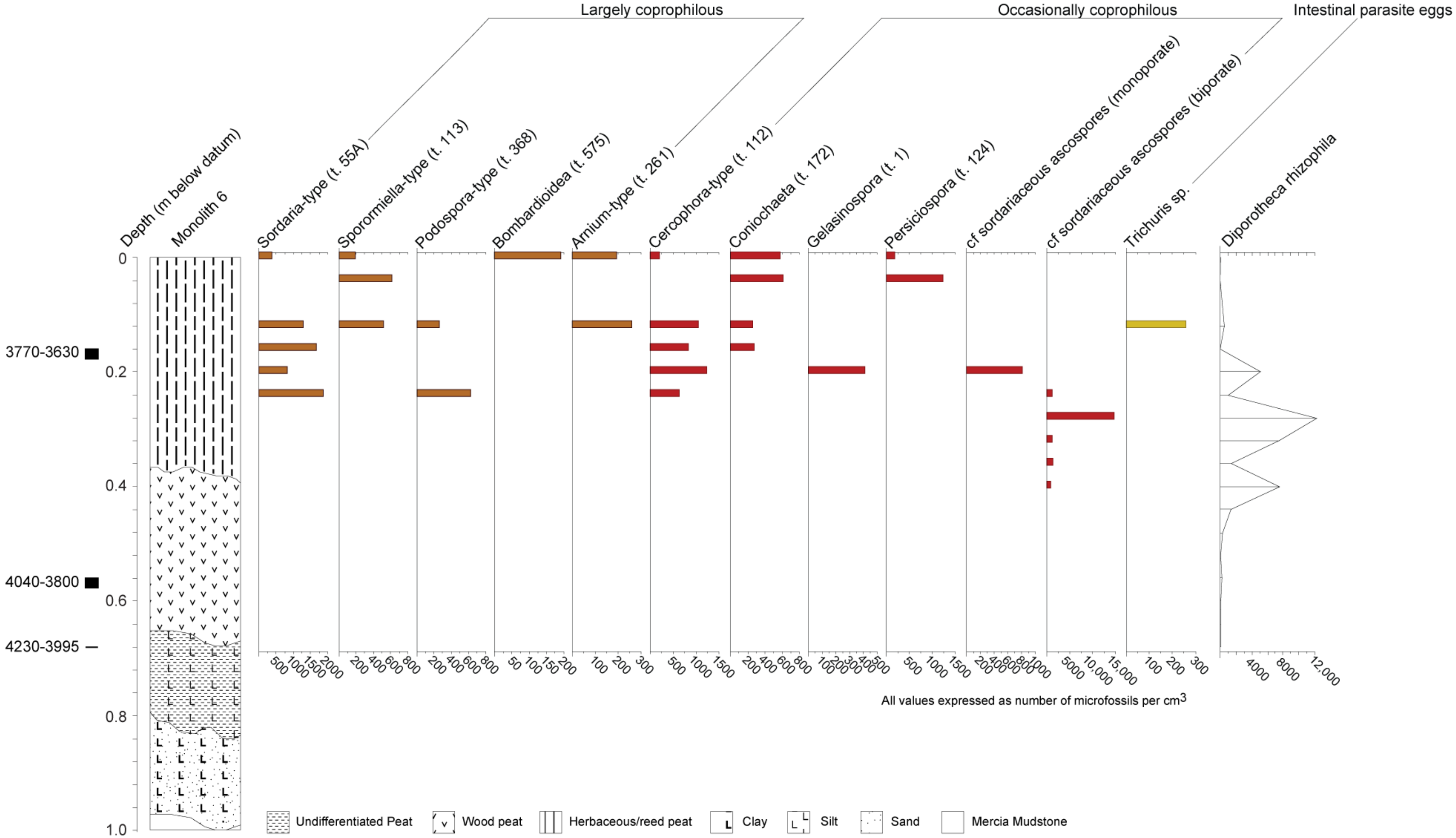


Figure 5.20: Chedzoy non-pollen palynomorph concentration diagram

Summary

The results of the Chedzoy pollen and non-pollen palynomorph analysis are as follows:

1. The analysis provides a partial reconstruction of the environmental history of the site over a >600 year period spanning the Mesolithic-Neolithic transition
2. Pollen concentration and preservation was poor below 0.60m and above 0.36m; non pollen-palynomorphs were recorded between 0 and 0.36m.
3. The poor pollen concentration recorded at Chedzoy has affinities with previous work on the site carried out by Carson (2009). Furthermore, during the course of previous peat stratigraphic work at Kings Sedgemoor, poor pollen preservation and concentration was also recorded, potentially as a result of desiccation and/or calcareous water discharge (Norman and Clements, 1979; Norman, 1980).
4. The peat surface at Chedzoy was initially dominated by alder carr woodland from 4230-3995 cal BC, prior to an apparent transition to sedge fen / reed swamp. The dryland was occupied by mixed deciduous woodland dominated by lime. Changes in the composition and structure of dryland woodland are noted through the sequence; specifically the decline of lime woodland. No indications of a transition towards ombrotrophic (raised bog) conditions are recorded.
5. Changes in vegetation composition and structure may be a consequence of peat expansion onto areas of former dryland (paludification). However, human interference is equally likely to have played a role, as evidenced by the following: (1) *in situ* and nearby archaeological remains within the Old Land Surface (worked flint and bone) and peaty silt (worked flint); (2) low microcharcoal values indicative of burning towards the base of LPAZ CHED-2; and (3) strong indications of livestock presence and possible soil erosion between 0 and 0.44m.
6. The pollen diagram from Trench 1 (Carson, 2009) is different to that recorded in Trench 2. Direct comparison between the two sequences is hindered by a lack of radiocarbon dates in the Trench 1 sequence, but it is considered likely that a similar interval of time is represented and that the initiation of herbaceous/reed peat formation and subsequent wood peat formation is near-contemporaneous in both sequences. It is only possible to compare the vegetation history through the wood peat, due to an absence of pollen in the herbaceous peat of Pit 2. Despite the closer location of Trench 1 to the burtle edge, it appears to contain a substantially weaker dryland pollen signal. Percentage values of lime, oak and hazel for example are *c.* 30%, 5% and 15% in Trench 2, compared with <5% for each in Trench 1. The Trench 1 signal is instead dominated by wetland taxa alder, grasses and sedges together with a continual presence of pondweed and bulrush. Potential pollen-stratigraphic evidence of human activity occurs in the form of pastoral/clearance indicators (e.g. plantain, sorrel, mugwort) and charcoal.

Chapter 6: Shapwick Burtle Mesolithic site and the Sweet Track

by Martin Bell
with contributions by P. Austin, R.Y. Banerjea, C.R. Batchelor, C.J. Bond, A.D. Brown, Z. Hazell, L. Jones, P. Marshall, S. Maslin, D. Smith, P. Toms and D. Young

The Sweet Track and its palaeoenvironmental context

The present investigation was carried out adjacent to Shapwick burtle in the Brue Valley at the southern end of the Sweet Track (Figure 1.1a and b). The Shapwick burtle is a prominent linear rise extending for 400m by 50 m from just west of the Shapwick- Westhay Road to the east (Figure 6.1). The ridge rises c 2.5m above the surrounding peat fields. This t argeted investigation has built on and consolidated a significant history of previous work, mainly concentrated on the Neolithic Sweet Track. Collections of Mesolithic flints from the Shapwick burtle were published by Clark (1933) and Wainwright (1960). The occurrence of this Mesolithic site has not figured prominently in the many discussions of the Sweet Track, because it is considered largely early Mesolithic in date. However, as we will see, there is evidence of later Mesolithic activity. Another factor for the limited attention given to the Mesolithic Shapwick site may be the wider issue of separate compartmentalisation of Mesolithic and Neolithic studies (Bell 2007,1).

The Sweet Track was found in 1970 (Coles and Coles 1986). In 1971-2 it was excavated at Site B c 30m north of the edge of Shapwick Burtle then thought to represent its terminal (Coles *et al* 1973). The Sweet Track is some 1.8km long and runs between the Shapwick burtle and the Lias outcrop at Westhay to the north. It dates to the very beginning of the Neolithic in Western Britain (Whittle *et al* 2011) with a dendrochronological date of 3807/6 BC (Hillam *et al* 1990). The Post Track, which preceeds it on almost the same line, is a little earlier with some ash timbers dated 3838 BC. The Sweet Track has produced a diverse range of wooden artefacts, lithics and pottery providing a exceptionally well dated material culture assemblage from the initial Neolithic (Coles and Brunning 2009). A series of sites along the Sweet Track have been subject to detailed palaeoenvironmental investigations many of which are relevant to the present study. From south to north the main palaeoenvironmental investigations were:-

<u>Site B</u> (Burtle), (Coles *et al* 1973) close to the burtle edge at Shapwick and the present investigation, a short and undated pollen diagram by Hibbert in Coles *et al* (1973; fig. 5).

<u>Site D</u> (Drove) (Coles and Orme 1979) Plant macrofossil analysis by Beckett (1979), beetle studies by Girling 1979).

<u>Site F</u> (Factory) (Coles *et al* 1973) A long diagram by Hibbert in Coles *et al* (1973, fig 3) and a detailed diagram focused on 0.3m below and 0.7m above what was defined as the trackway level; this diagram is supported by six radiocarbon dates

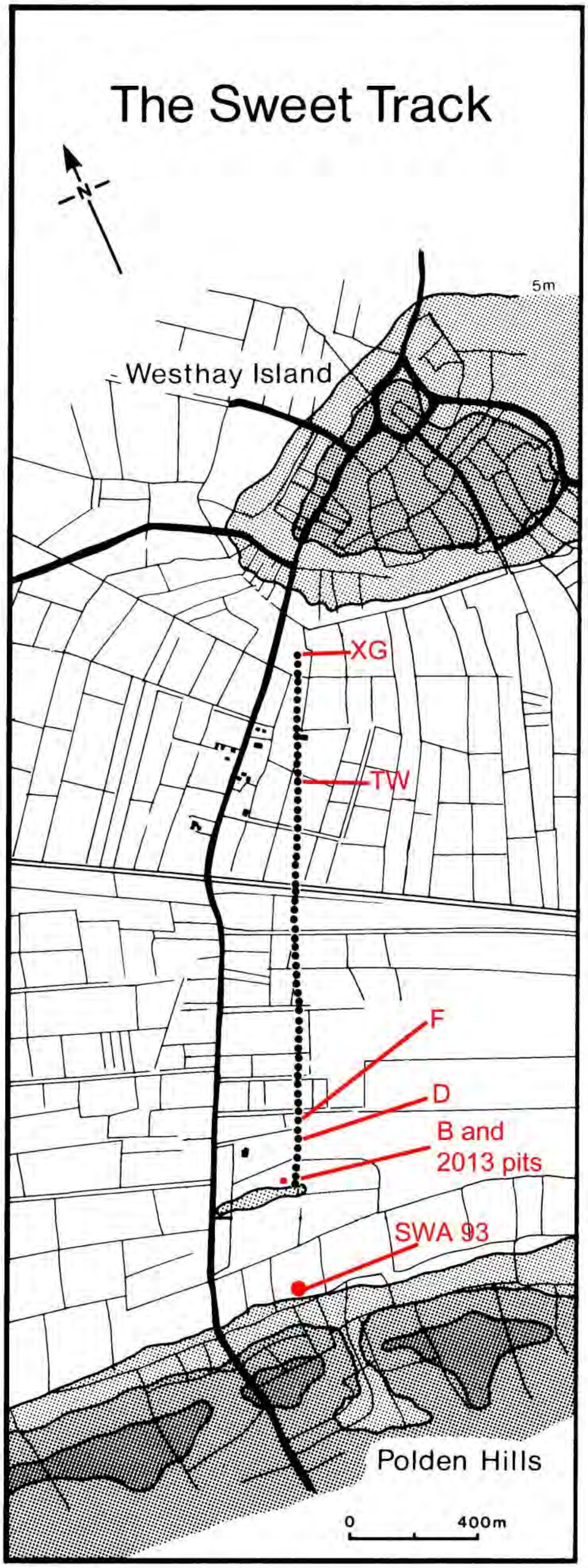


Figure 6.1a**:** The Sweet Track (a) between Westhay island and the Polden Hills, letters indicate the main palaeoenvironmental sample locations (after Coles and Orme 1984, fig 1, with additions).

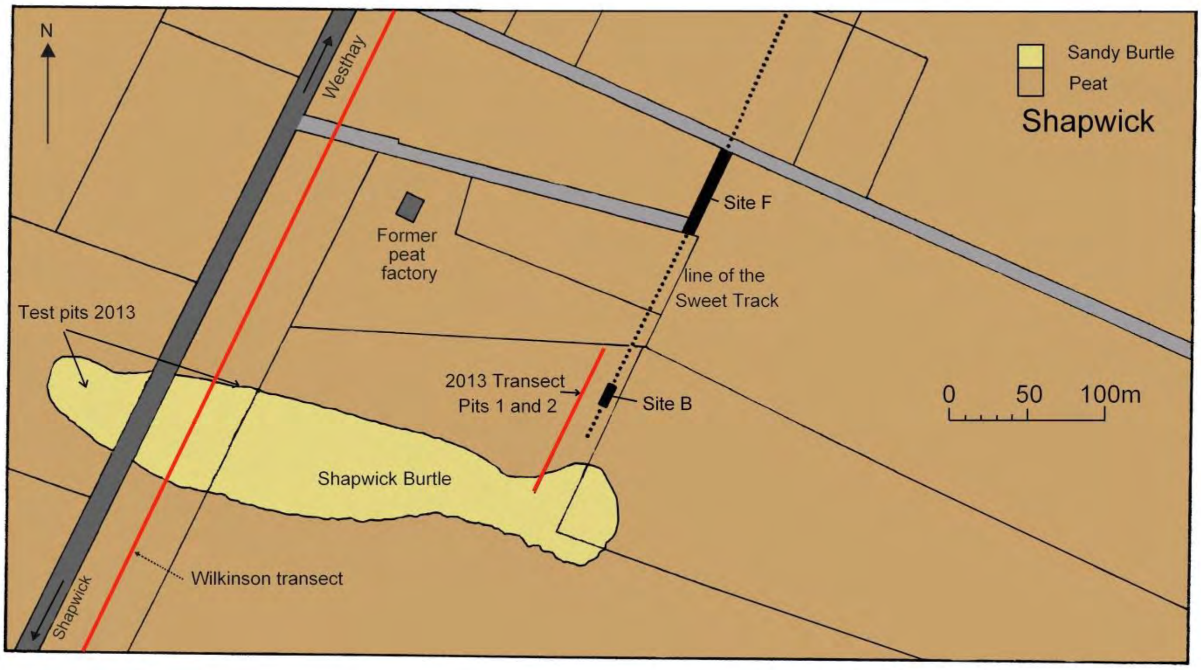


Figure 6.1b Shapwick Burtle showing the location of the core transects in red of Wilkinson (1998) and the present project, Trenches 1 and 2 and the Sweet Track (graphic J. Foster).

Figure 6.2 Coring transect across the Brue valley from Shapwick (left) to the former peat factory (right), (after Wilkinson 1998; Wilkinson and Bond 2001; Jones 2013).

(Beckett 1979, fig 56-7). This diagram represents a key point of comparison for the present study. Site TG (Coles and Orme 1984b) plant macrofossil analysis by Caseldine (1984, figs 73-75) and insect analysis by Girling (1984)

Site TW (Coles and Orme 1984b) Pollen diagram by Caseldine (1984, fig 78-9) supported by 4 radiocarbon dates, also plant macrofossil analysis (Caseldine 1984, fig 76).

Site XG (Coles and Orme 1984b) close to the northern end of the track at Westhay Pollen diagram by Caseldine (1984,figs 80-81).

In addition to the key palaeoenvironmental investigations a series of other investigations of varying scale along the length of the trackway are described by Coles and Orme 1984b) with a summary of the Sweet Track evidence as a whole in Coles and Coles (1986, chapter 3) and the more recent conclusions outlined by Coles and Brunning (2009).

The Shapwick burtle has long been considered as the southern terminal of the Sweet Track. To its south there is a further deep channel which has an upper fill of peat (Figures 6.2 and 6.6) and there has been a suspicion that the trackway may have continued across this. Accordingly, the northern field in this area was included within the Scheduled Ancient Monument boundary. That inference, of a southern continuation, was supported by the observation of a possible plank in the edge of Shapwick Moor Rhyne (Brunning pers. comm.). An excavation by Dr Brunning 150m south of the drain produced split oak timbers which may represent a continuation of the trackway to the Shapwick bedrock. A pollen diagram was prepared from this excavation and there are six radiocarbon dates for that sequence which provide valuable comparanda for the present project (Wells *et al* unpublished).

The deepest of the Sweet Track palaeoenvironmental sequences comes from the Factory Site and the two diagrams from here (Hibbert in Coles *et al* 1973 and Beckett 1979) highlight the main environmental trends seen with varying clarity in the other pollen diagrams. Minerogenic silts were encountered below 6.5m, above this was a basal peat at 5.4-6.5m with predominantly tree pollen of alder and hazel, with oak and elm probably present on the dryer areas. There is low representation of herbs and those mainly of aquatic and mire types. From 5.4-1.9m there is silt considered to be of estuarine origin in which pollen was not preserved. Above 1.9m there is reed peat which from 1.5m was subject to colonisation by trees. It is at this transitional stage between reed peat and the early stages of fen woodland development that the Sweet Track was constructed, and it is marked on the Hibbert (in Coles *et al* 1973, fig 3) diagram at 1.3-1.1m. Subsequently fen wood peat developed, giving way to raised bog at 2860-2470 cal BC (4054±45 BP; SRR-879).

Both diagrams show a marked decline in elm at the trackway level and the Hibbert diagram highlights a rise of herbs and bracken at this level. Clearance herbs also occur a little above the trackway level on the Beckett diagram. The assumption has been that these vegetation changes relate to the activities of Neolithic communities. Now that the date of the trackway has been established by dendrochronology it is apparent that the calibrated ranges of the two dates below the Sweet Track horizon on the Beckett (1979, fig 56-7) diagram are both younger than the date of the trackway. This may be explained by the fact that peat has accumulated around the three-dimensional form of the trackway and also perhaps that peat has become compressed around the more resilient form of the track. The implication of this is that the vegetation changes seen as coeval with trackway construction are likely to be a little later.

Of particular interest, from the perspective of the present project, is tree ring evidence from the Sweet Track which shows that at the northern end of the trackway oaks up to 400 years old were used clearly derived from long established woodland. At the south end were smaller oaks of 100-150 years (Morgan 1988), considered to be the produce of clearance around 3950 BC (Hillam *et al* 1990) which is some 200 years earlier than the currently known earliest dates for the Neolithic in South West Britain (Whittle *et al* 2011). We cannot necessarily assume that the clearance, presumably in the Shapwick area, represented by these younger trees is by people, whether hunter-gatherers or farmers; it could be the result of natural factors such as a major storm. However, there is other possible evidence for the management of woodland resources by people prior to the construction of the Sweet Track, from the possible evidence for the use of coppiced wood in the track (Rackham 1979). Whilst we may once have assumed that these possible effects on the woodland are the result of initial Neolithic activity the discovery of extensive evidence for hazel coppicing in the Mesolithic of Denmark (Pedersen *et al* 1997) means that we cannot exclude the possibility of its earlier origins here as a contributory factor to the high hazel values seen in the Sweet Track diagrams from well below the trackway (Coles *et al* 1973, fig 3).

The broader sedimentary sequence in the Brue valley was investigated by Wilkinson (1998) as part of the Shapwick project. A 500m transect of 34 cores was put down just east of the Shapwick to Westhay road, some c 230m west of the Sweet Track and the site of the present investigation (Figure 6.2). This transect runs across the Shapwick burtle. In the peatlands to south and north the present ground surface is at c 3-4m OD and there is a Holocene sequence up to 7m deep in the valleys either side of the burtle; these sequences go down to c -5.5m. There are four main Holocene sedimentary units from the top down and radiocarbon dates from Borehole BHA (Fig 6.2, highlighted with red circle) are from Tinsley (2007):-

Main Upper Peat base 1750–1530 cal BC (3363±35 BP; OxA-11234). Elsewhere on the Sweet Track this transition is dated to 4340–3960 cal BC (5290±80 BP; HAR-1857;) and elsewhere on Shapwick Heath to 4600–4040 cal BC (5510±120 BP;Q-423; Coles and Dobson 1989, 69)
Silty clay
Lower Peat, base 5710–5540 cal BC (6700±45; OxA-11230); top 5620–5470 cal BC (6580±50; OxA-11231)
Basal silty clay

Tinsley (2007) found charcoal was associated with minerogenic sediments underlying the basal date and this may result from Mesolithic burning for which there is extensive evidence in the Severn Estuary (Bell 2007). Tinsley observed that there was much less charcoal in the later Mesolithic levels. This accorded with the view that much of the Mesolithic activity in the Somerset Levels was early, rather than late, Mesolithic.

Bond (2007, 722-723), in writing about the Shapwick Project lithic finds, interprets this settlement pattern in those terms; much early, then little later material from lithic scatters. Importantly, there is a difference between the early Meso scatters on Shapwick Burtle and the associated cores, debitage and waste, with the odd retouched form on the Polden Hills; only a single snapped microlith was recovered. This is due to: (1) Line walking not being able to recover lithic scatters and small microliths (further grid walking required at set locales); (2) It may actually represent a real divide, hills and river streams, for 'gearing up', flaking production, whereas Shapwick Burtle being a task-based location, including a hunting stand, or a place specifically linked to hunting, fishing and foraging

The Shapwick burtle has long been known as the findspot of Mesolithic flints exposed by cultivation and animal burrowing on its surface. The first finds were by Dewar and Bulleid (Bulleid and Jackson 1838; Dewar and Godwin 1963) and reported by Clark (1933). Further finds were reported by Wainwright (1960). Dr Chris Norman has kindly provided illustrations of all the

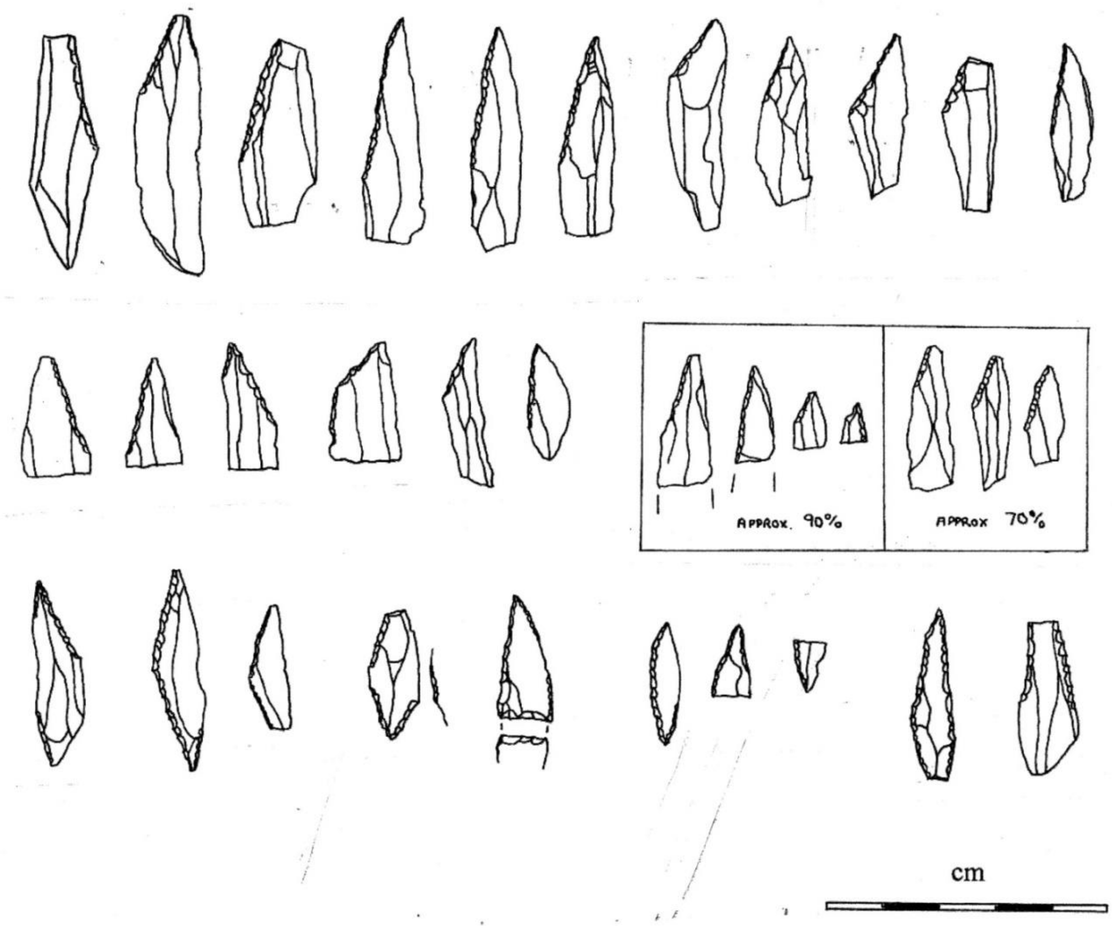


Figure 6.3 Microliths from the Shapwick Burtle site (kindly provided by Dr C. Norman).

microliths which he had traced from the site in local museum collections up to 1999 (Figure 6.3). Other flints from the site are in the collection of Mr Jerome Hayes of Shapwick who has kindly shown them to us. Hayes' lithic collection, together with those made by J.M.Coles and J.J. Taylor from the Shapwick burtle, were first summarised and analysed by Bond (2004a). Most lithic artefacts from Shapwick Burtle are predominantly early Mesolithic, but Brown (1986) identified some material of the seventh millennium. Test pitting on the Burtle, as part of the Shapwick Project, revealed further early, and some late, Mesolithic flint artefacts (Appendix 1; Bond 2007). Given the date of the Sweet Track at the very beginning of the Neolithic, the site is of considerable interest in terms of the Mesolithic / Neolithic transition.

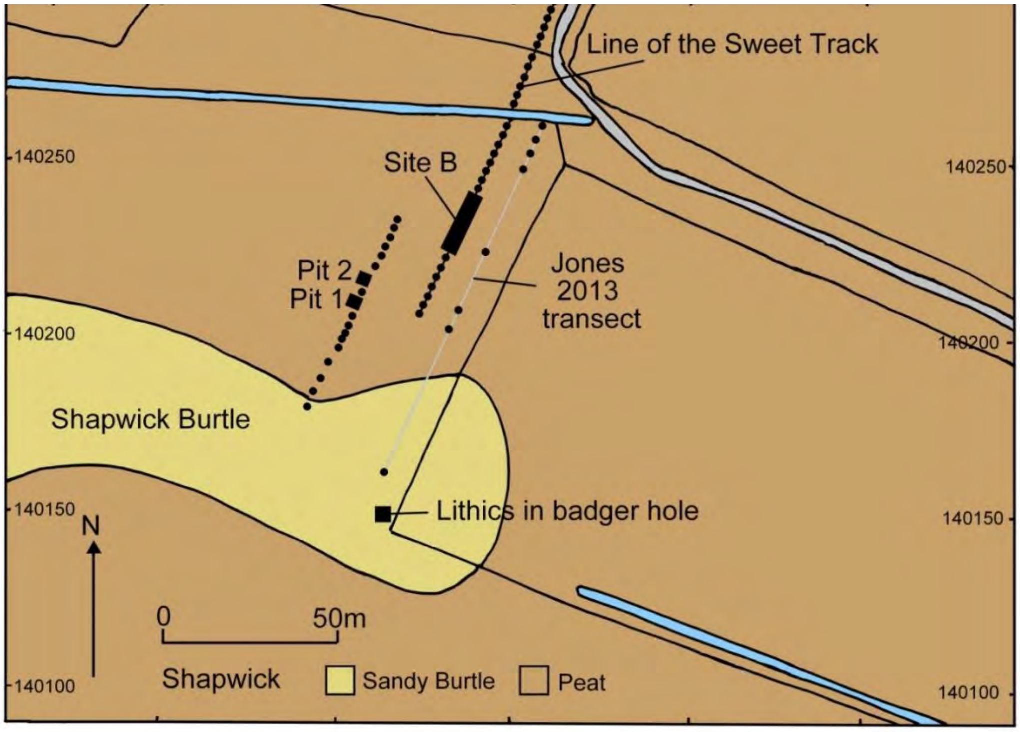


Figure 6.4 Shapwick Burtle Sweet Track Site B excavations, borehole transects of Jones 2013 and the boreholes and Trenches 1 and 2 of the present project. Graphic Jennifer Foster.

The sedimentary sequence against the edge of the Shapwick burtle has been further investigated by Louise Jones (2013) as part of a Reading University PhD project on *in situ* preservation in the Somerset Levels. She put down a 270m transect of 15 boreholes 5m east of the line of the Sweet Track and crossing the burtle (Figure 6.6; Jones 2009; 2013). The sediments were investigated to a depth of c 5m and there was monitoring of the borehole locations for 16 months to record water table levels, redox potential and groundwater chemistry in order to look at water table and geochemical factors in the preservation environment of the Sweet Track. Ground Penetrating Radar investigation of the same transect was carried out by Christine Bunting (pers. comm.) in 2012 as part of a PhD project at Reading University on the use of GPR for archaeological assessment in wetlands.

Since the Sweet Track at its southern end is 1.3m above the base of the peat and is of initial Neolithic date it is clear that peat of late Mesolithic date survives against the burtle edge, hence the investigation of this area as a case study in the present project. At Site B close to the burtle edge evidence was found at the trackway level of a clay patch and a charcoal horizon which could point to colluviation and perhaps activity at the burtle edge (Figure 6.5; Coles *et al* 1973, Fig 11). An alternative explanation for the clay patch is material brought up from the underlying layer by a tree throw.

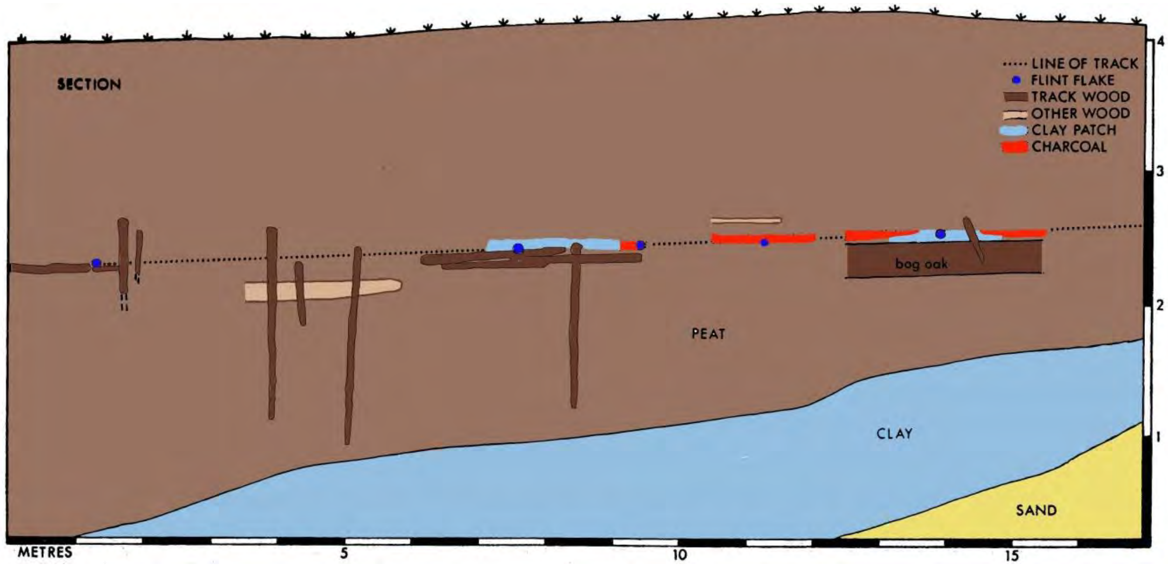


Figure 6.5. Sweet Track Site B excavation (Coles *et al* 1973, Figure 11) showing the stratigraphy against the burtle edge.

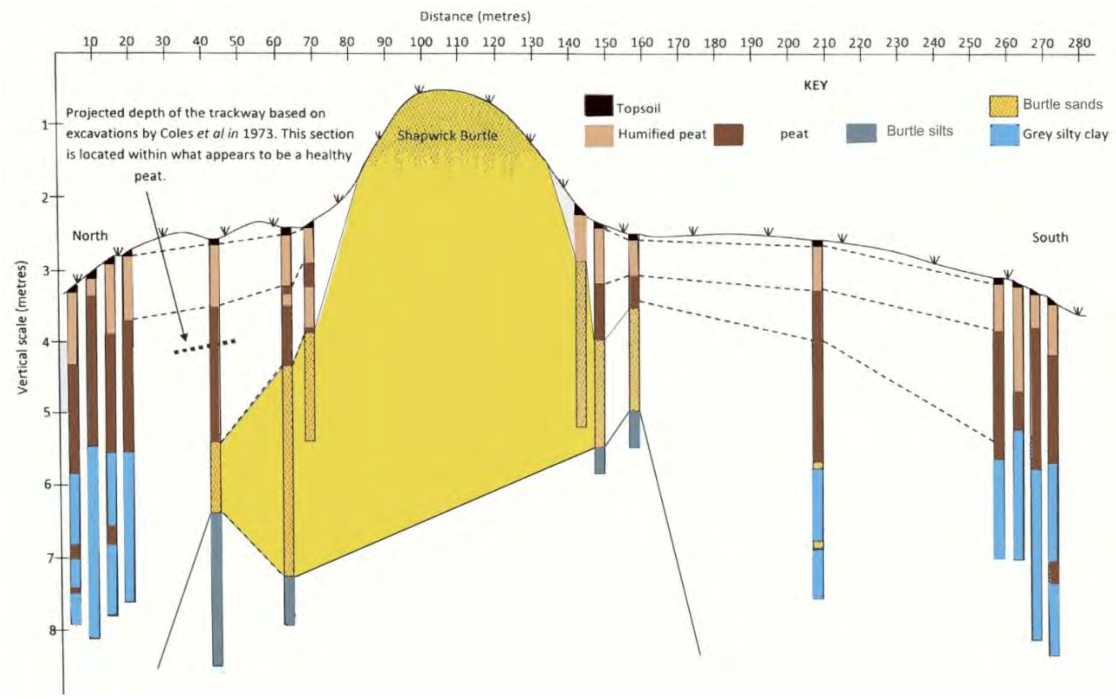


Figure 6.6 The transect of Louise Jones (2009, fig 10) across the Shapwick Burtle, modified using information from further boreholes (Figure 6.12) and excavation in 2013 (graphic Louise Jones and Jennifer Foster).

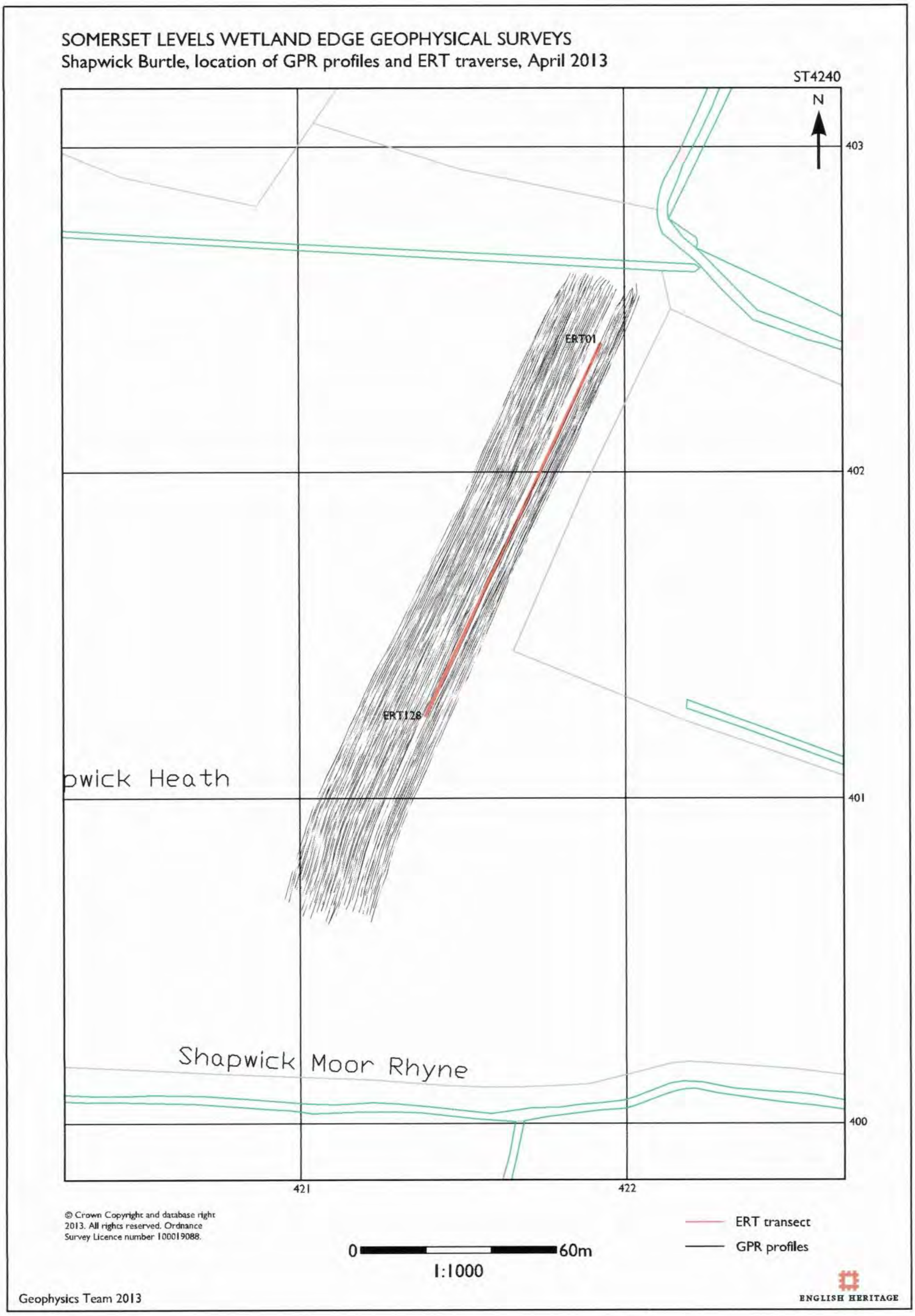


Figure 6.7 English Heritage geophysical survey across the Shapwick Burtle 2013 GPR and ERT.

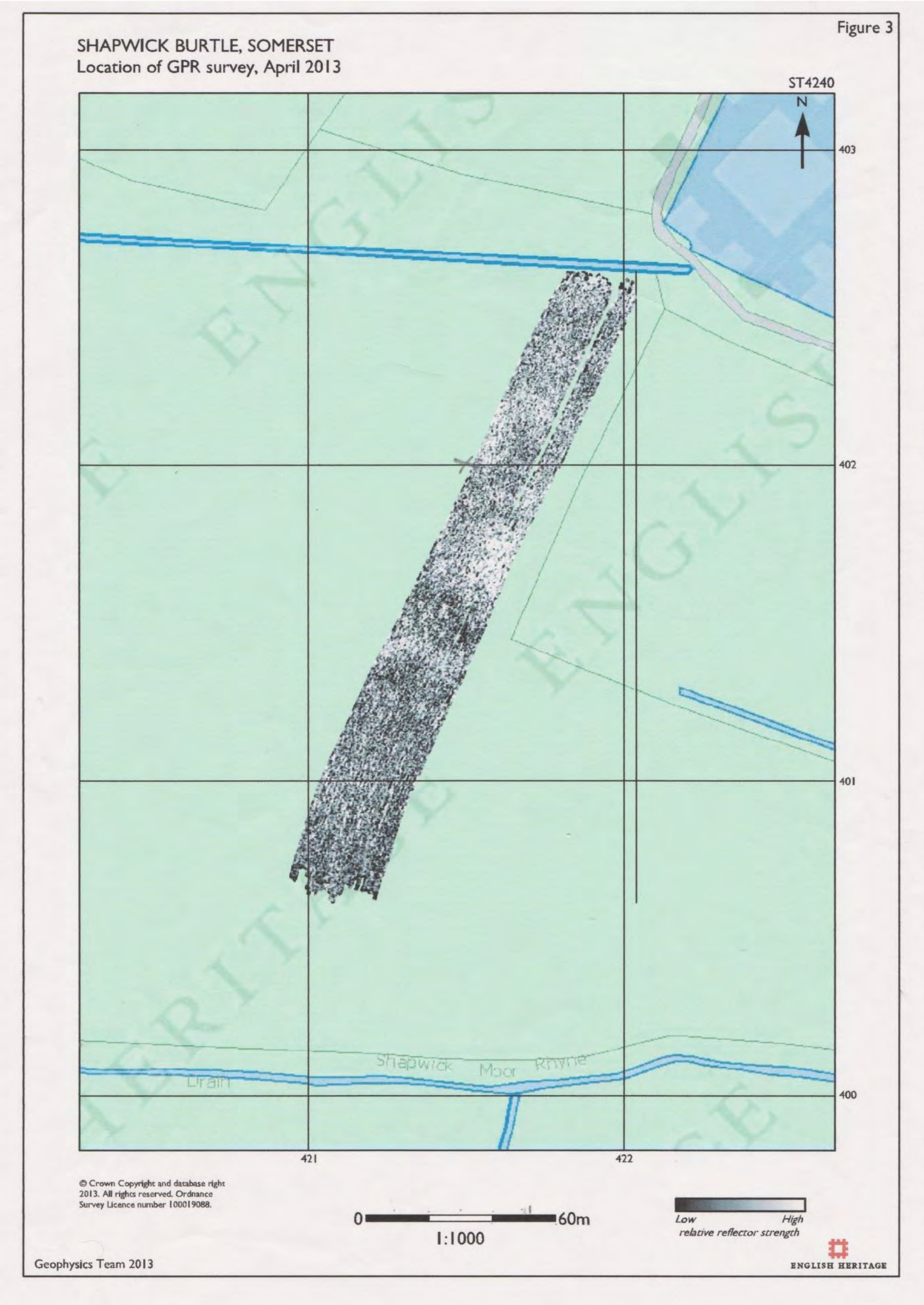
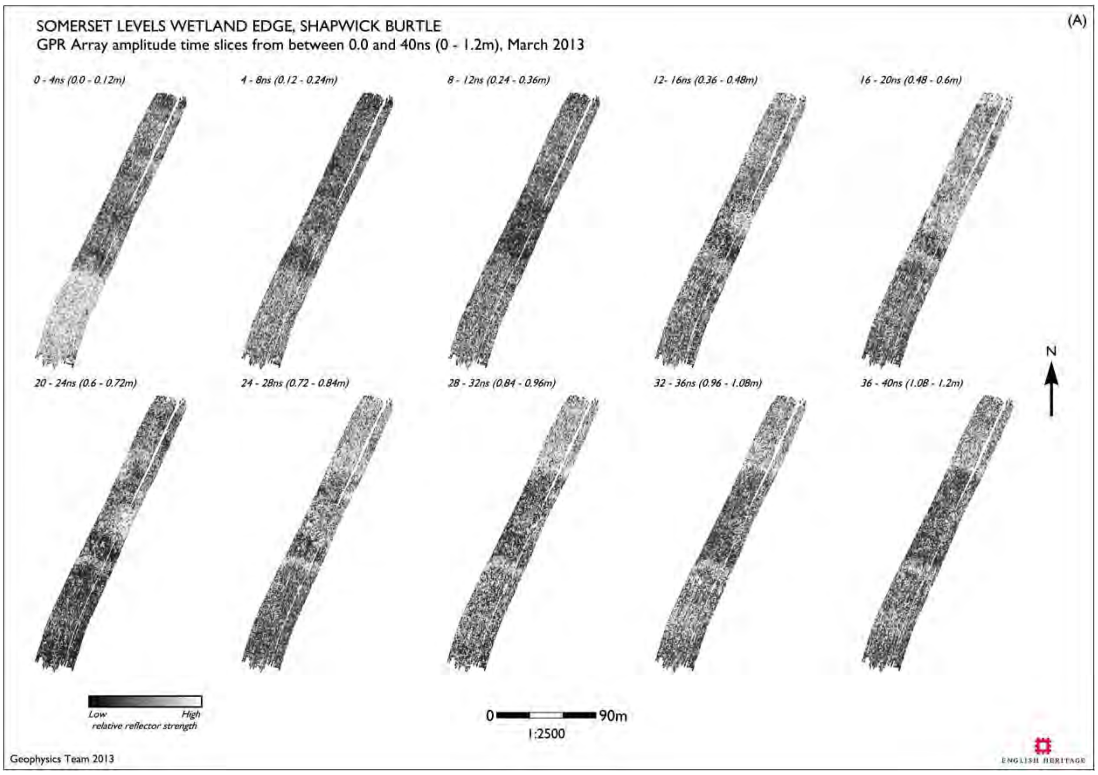


Figure 6.8. Shapwick Burtle GPR survey (English Heritage Geophysics Team).

Figure 6.9 (A and B) Shapwick Burtle GPR Survey (English Heritage Geophysics Team).



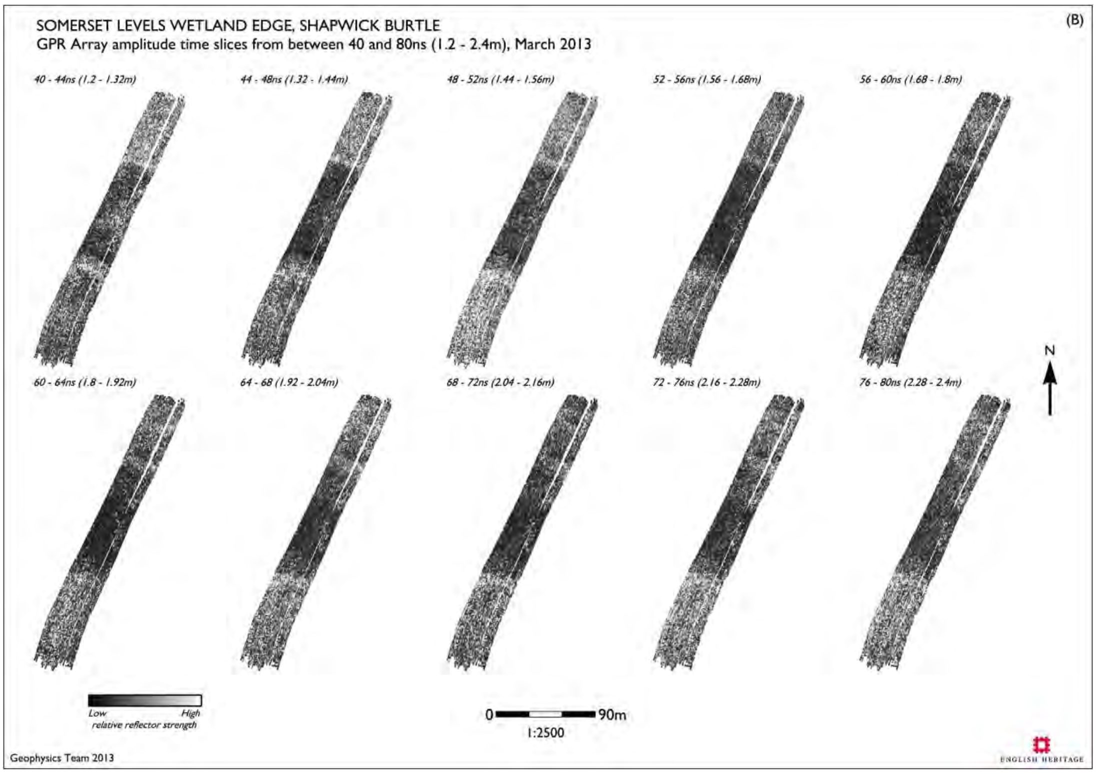
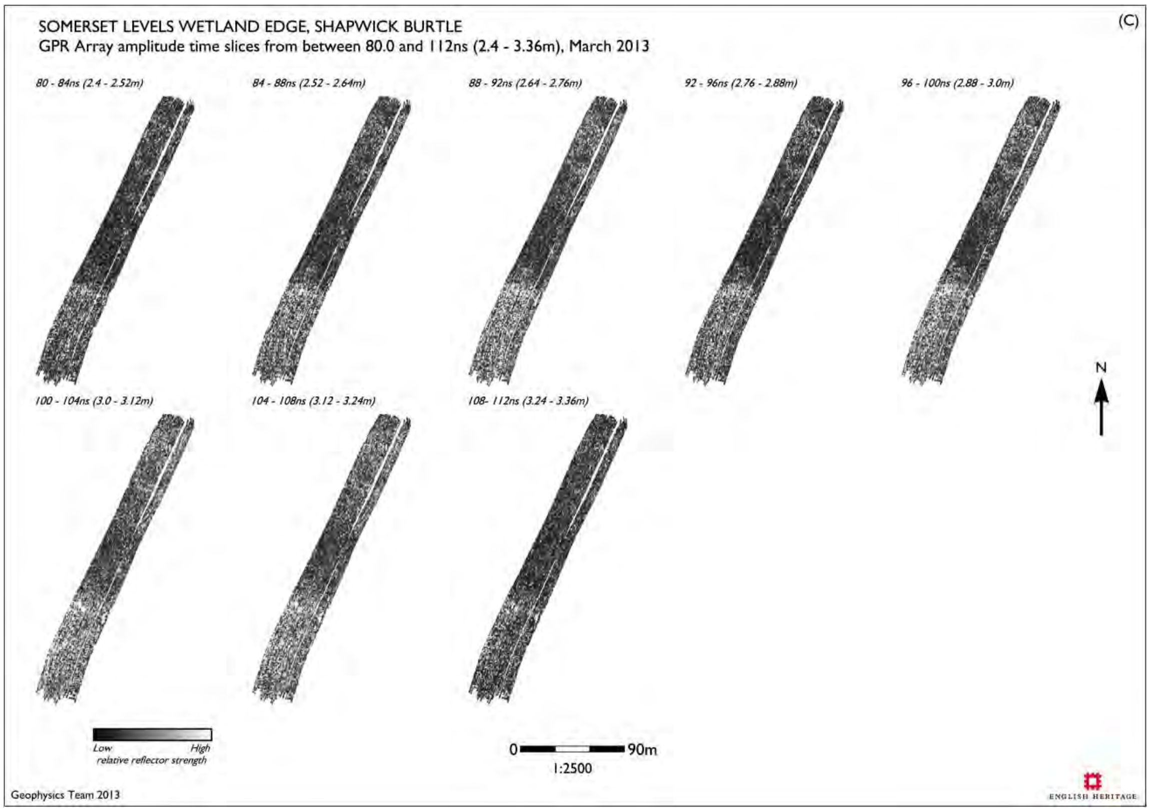


Figure 6.9 (C) Shapwick Burtle GPR Survey (English Heritage Geophysics Team).



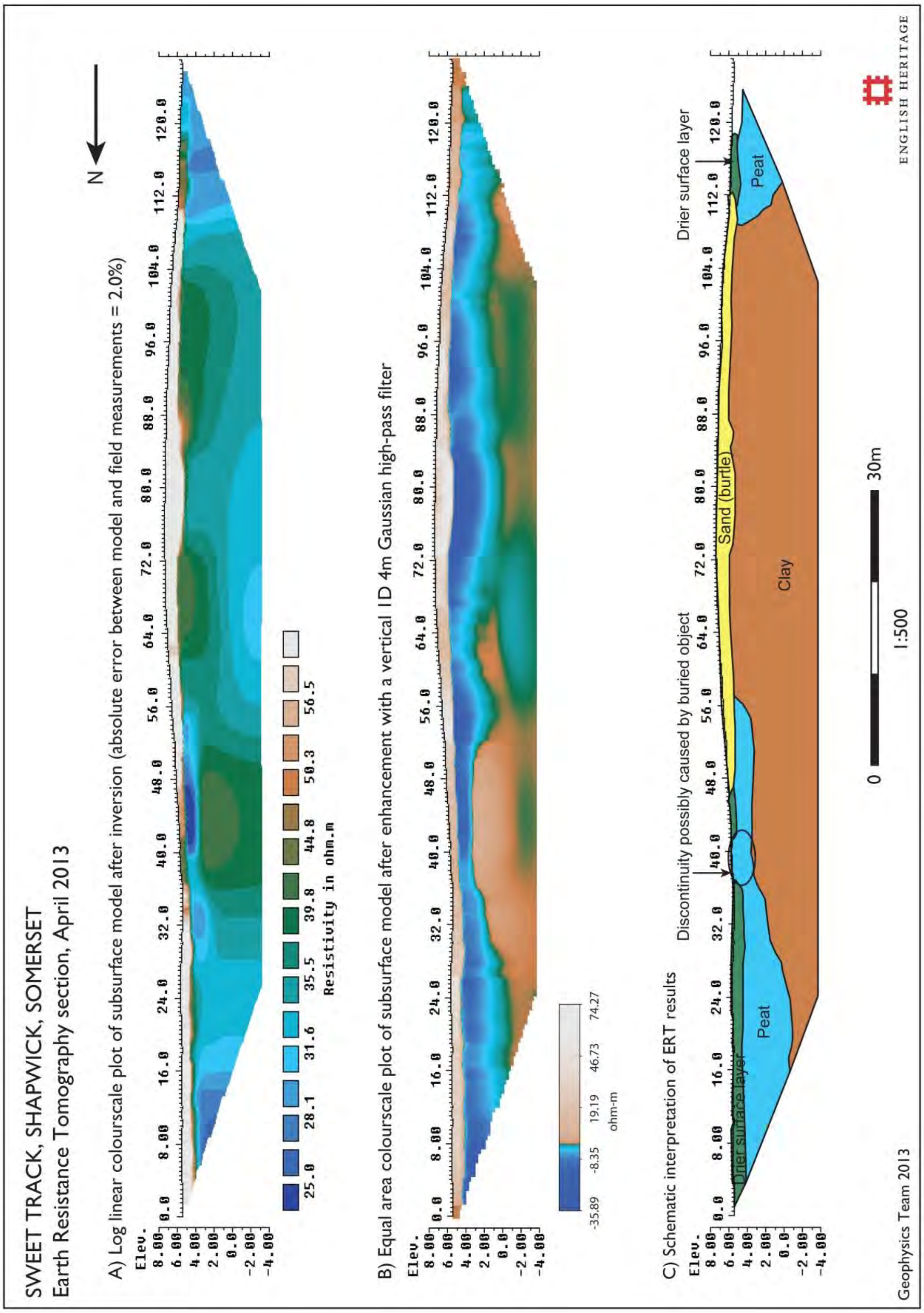


Figure 6.10. Shapwick Burtle Earth Resistance Tomography Survey (English Heritage Geophysics Team).

The sedimentary sequence on the north side of the burtle had been established as a result of the Somerset Levels Project excavation at Site B, the borehole transect of Wilkinson to the west and the borehole survey of Jones just east of the Sweet Track. The Neolithic Sweet Track has been extensively investigated, but without investigation of the later Mesolithic waterlogged deposits immediately adjacent to the burtle which the current project is designed to investigate. Further coring and geophyical investigation was carried out in order to establish the optimum place for positioning of two small trenches where the burtle edge was buried by peats. The purpose of these trenches was to establish whether occupation horizons were preserved and provide material for dating and environmental assessment. Scheduled Monument Consent for this investigation was provided by the Secretary of State for Culture Media and Sport advised by English Heritage. Permission was also obtained from Natural England since this site is part of a National Nature Reserve and within an SSSI. An English Heritage team led by Linford et al (2015) did further Ground Penetrating Radar survey of a strip 30m by 200m along the line of the Sweet Track and over the burtle in the week beginning 22.4.13 as part of the present project. These surveys clearly show the burtle and sediments outcroppings as bands along the edge of the burtle (Figures 6.7-10).

Borehole Transect 2013

The fieldwork at Shapwick (NGR ST 4216 4020) took place 15-29.7.13 with an average team of 10 people. Although the burtle is a clearly defined topographic ridge its edge is not easy to define and in all probability the present ridge is made visible by the wastage of peat which may formerly have buried much, possibly all, of the burtle. This possibility is strengthened by the identification in coring of humified peat rising well up the side of the burtle.

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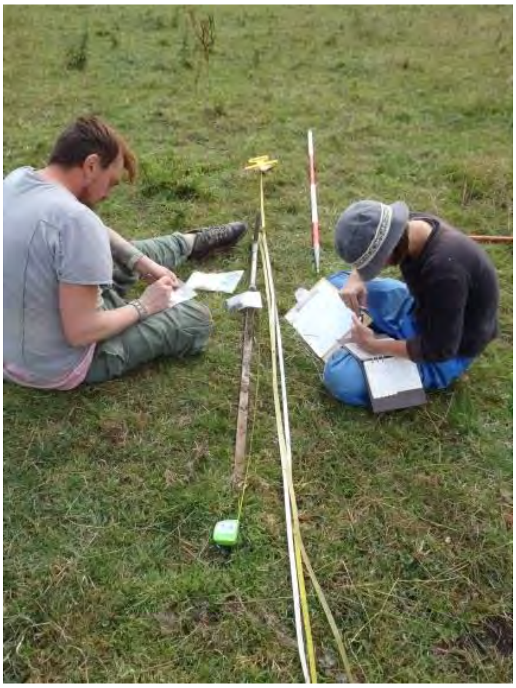


Figure 6.11 Recording the boreholes at Shapwick

In order to establish the wider sedimentary sequence and suitable locations for the sample pits close to the burtle edge a transect of auger holes (Figure 6.12) was put down with a gouge auger at right angles to the burtle edge 20m west of the line of the Sweet Track and 25m west of the transect (Figure 6.6) investigated by Louise Jones (2013). The line was 61.5m long and in the central part of the transect around the burtle edge the holes were spaced at intervals of 2.5m with wider intervals, c 5m, at either end. The boreholes were mostly between 5 and 6m deep. Each was described in the field and samples were taken from each stratigraphic unit and more closely from key horizons to facilitate particle size and other forms of analysis where necessary to clarify the nature of sediments and the comparison between boreholes.

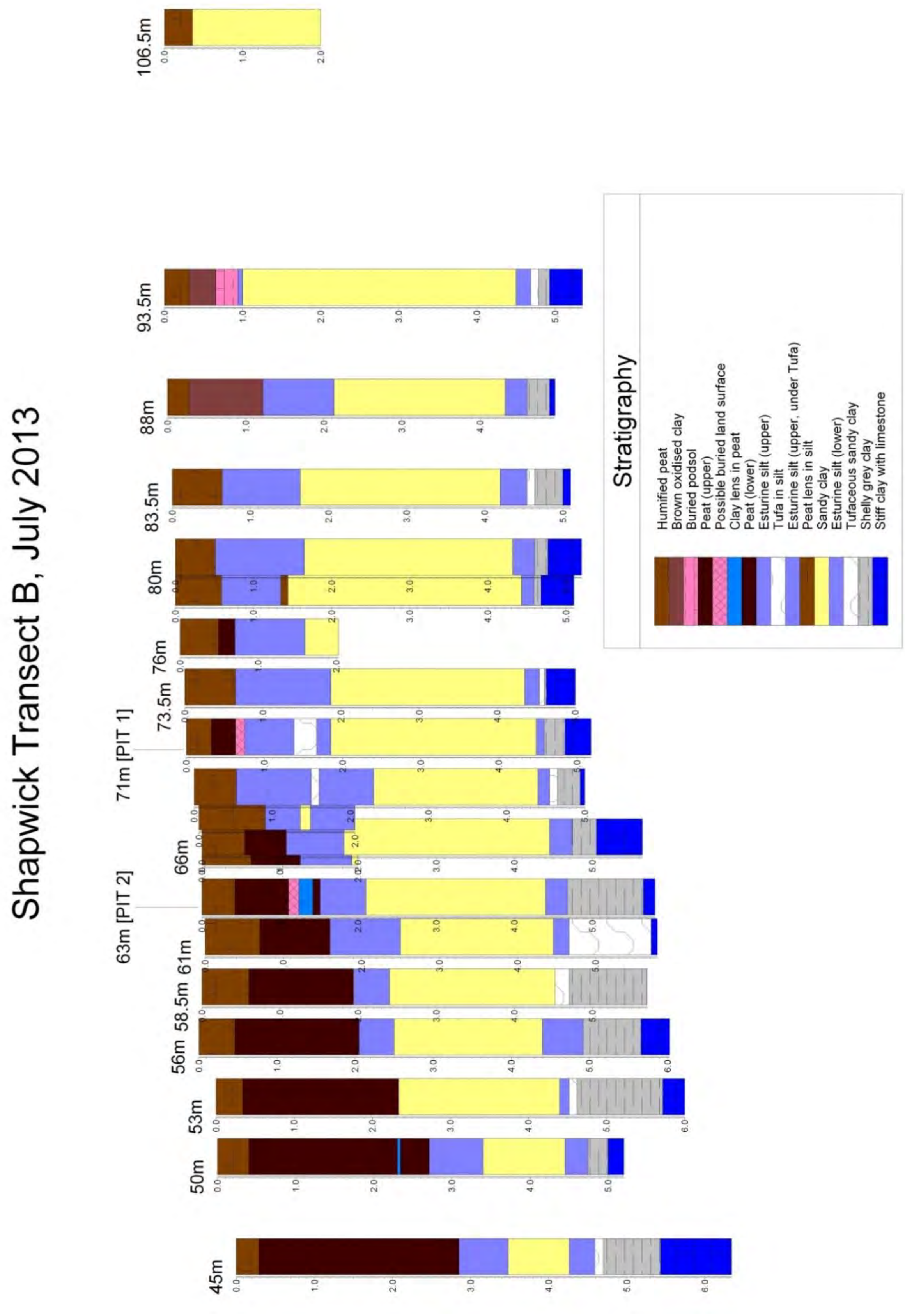
The boreholes established the following main sedimentary units:-
Unit 1. Below the turf a layer of humified peat up to 0.4m thick near the burtle edge, thinning against the burtle to the south and to the north where conditions were wetter.
Unit 2. Peat which increased in thickness from 76m to the north where at 45m the total thickness of peat (Units 1 and 2) reached 2.8m. A few decimetres from the base of the peat some cores produced traces of a clay lens.
Unit 3. Blue grey silt, near the base of this Unit some boreholes revealed calcareous nodules. The upper part of the silt unit was oxidised where the burtle rose to the south.
Unit 4. Sandy clay, this was thinnest to the north c 0.8m and increased in thickness to the south where it reached a thickness of 3.5m. This is interpreted as the sandy burtle sediments of Pleistocene interglacial date.
Unit 5. Below Unit 4 is a fairly horizontal surface around 4.3m depth with silts, shelly grey clays and tufaceous sandy clay. This is interpreted as an earlier phase of the burtle sequence.
Unit 6. A very stiff clay with limestone fragments which was difficult to penetrate and is interpreted as Head, or the weathered surface of the bedrock.

On the basis of the boreholes, locations were selected for two palaeoenvironmental sampling Trenches. These were excavated entirely by hand, all artefacts being 3-D recorded.

Trench 1 (Figures 6.13-14)

This was at 70-72m on the coring transect and was 2m square. The whole pit was excavated to a depth of about 0.8m which was the base of the Old Land Surface below peat. One square metre was excavated below this through underlying grey silts down to a total depth of 2m, the basal 0.25m of which were sandy sediments. The stratigraphic sequence is shown in Figures 6.13-14 and comprises the following units from top to bottom, not all contexts are on the illustrated section. The peat was all very dessicated, cracks extended to the base of this peat, and wood and other plant macrofossils were in poor condition throughout. Although very dessicated the peat down to 0.40m appeared to be raised bog peat in thin compressed bands marked by varying degrees of humification. Below 0.40m it is wood peat:-

Figure 6.12. Shapwick borehole transect (graphic S. Maslin).



Trench 1 Context 1 (0-0.05m) Turf and topsoil developed on humified peat, greyish brown (10YR5/2).

Context 2 (0.05-0.17m) Humified peat very dark grey (10YR3/1).

Context 3 (0.17-0.18m) Thin discontinuous band of charcoal some bark and wood fragments.

Context 4 (0.18-0.23m) Fibrous peat , brown (7.5YR5/4).

Context 5 (0.23-0.40m) Humified silty peat black (7.5YR3/4).

Context 6 (0.40-0.44m) Very fibrous peat some wood, dark brown (7.5YR3/4).

Context 7 (0.44-0.50m) Humified peat black (10YR2/1).

Context 8 (0.50-0.52m) Bark in places degraded woody peat elsewhere dark reddish grey peat (5YR4/2), some charcoal present.

Context 9 (0.52-0.62m) Wood peat light yellowish brown (10YR6/4). The base of the peat is dated 3350-3090 cal BC. Thus it occurs at the time of increased wetness when beaver gnawed wood occurs in Trench 2.

Context 10 (0.62-0.68m) Minerogenic silty clay less peaty with depth containing wood fragments and the rotted stumps of shrubs marked mainly by their bark, roots extended into the underlying two contexts, dark greyish brown (10YR4/2). Interpreted as the upper unit of an old land surface on which peat developed. Context 10 produced 6 lithics: 2 hammerstone fragments; 2 blade segments and 2 chips.

Context 11 (0.68-0.76m) Minerogenic silt 72% with sand 22% and clay 7%, brown (7.5YR5/2). Interpreted as the lower unit of an old land surface. Micromorphological samples 1 and 2 were taken to test the field hypothesis that this was an Old Land Surface. Context 11 produced 8 lithics: a utilised blade (99); a microburin (113); 5 Flakes and blades; a hammerstone fragment. Figure 6.13 b and c shows examples *in situ*.

Context 12 (0.76-1.62m) Minerogenic silt 75% with sand (13%) and clay 12%. Light brownish grey (2.5Y6/2). Occasional root penetration to base. Three pieces of charcoal and two pieces of microdebitage were found in the top 0.2m.The context is interpreted as estuarine alluvium which underlies the main peat of the Brue valley.

Context 12a (1.62-1.67m) Calcareous rootlet nodules forming a bificating band. These are interpreted as forming in the subsoil of a possibly truncated landsurface.

Context 13 (1.67-1.88m) Silt 77% with clay 12% and sand 11% becoming increasingly sandy with depth. This is interpreted as the burtle.

A full suite of samples was taken from this Trench but because of the dessicated nature of the peat encountered only limited assessment has been carried out. Bulk samples of the Old Land surface Context 11 have been sieved in the laboratory and produced some lithics. The micromorphological samples 1 and 2 from the Old Land Surface have been analysed by Dr Banerjea and are reported below. Four samples of peat between 0.26-0.36 from Monolith 111 were assessed for pollen; preservation was acceptable in the Old Land Surface between 0.26-0.36 but the decision was made to concentrate on pollen in Trench 2 and analysis did not proceed beyond assessment. A beetle sample from the Old Land Surface 121 was assessed but produced no beetles.

Figure 6.13. Shapwick Trench 1, (a) showing monolith tins scale divisions 0.5m. The Old Land Surface is at the level of horizontal string. (b) and (c) flint flakes in Old Land Surface, Context 11 with 1cm scales.

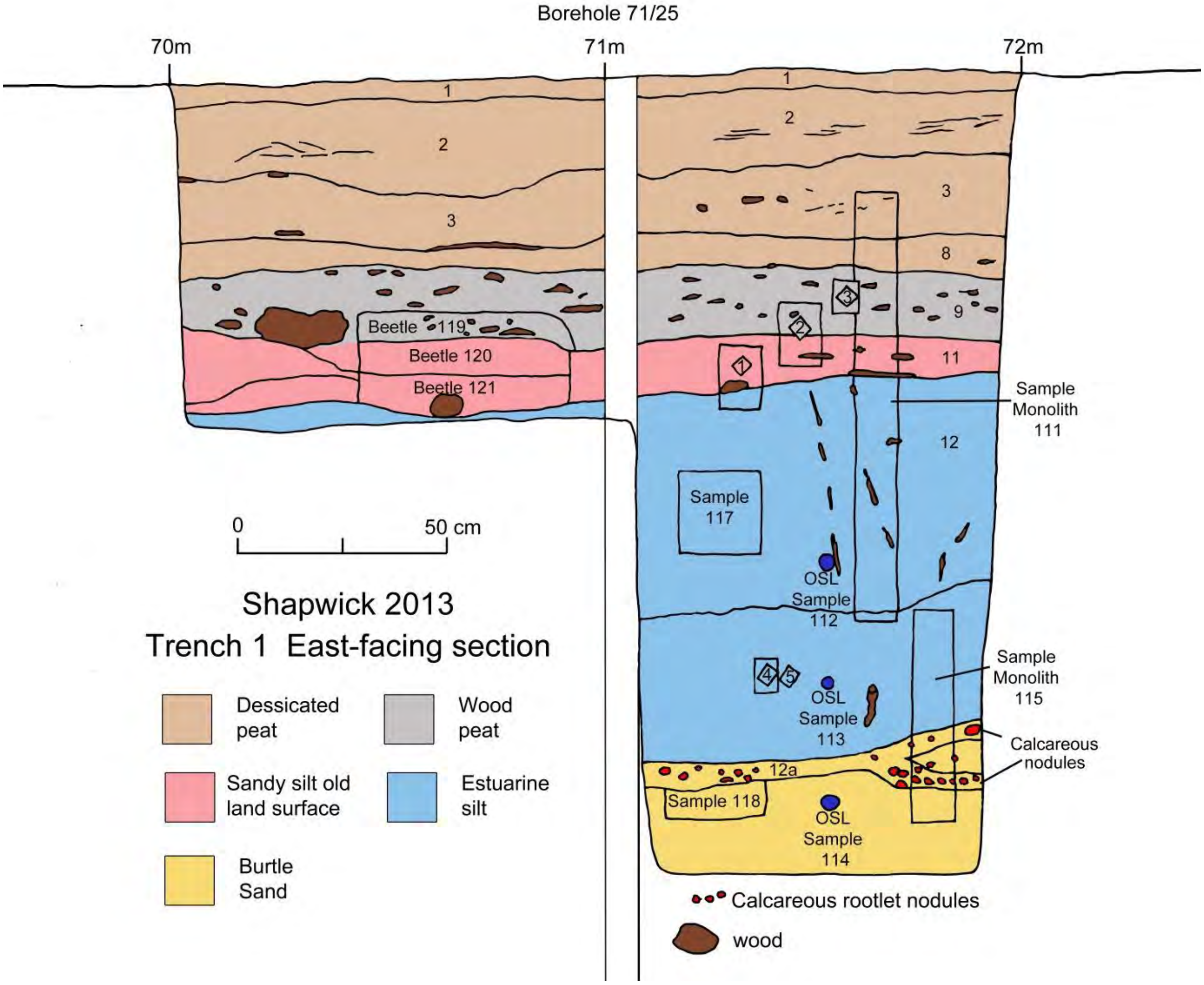


Figure 6.14. Shapwick sections of Trench 1 showing the location of samples, not all analysed (Graphic J. Foster).

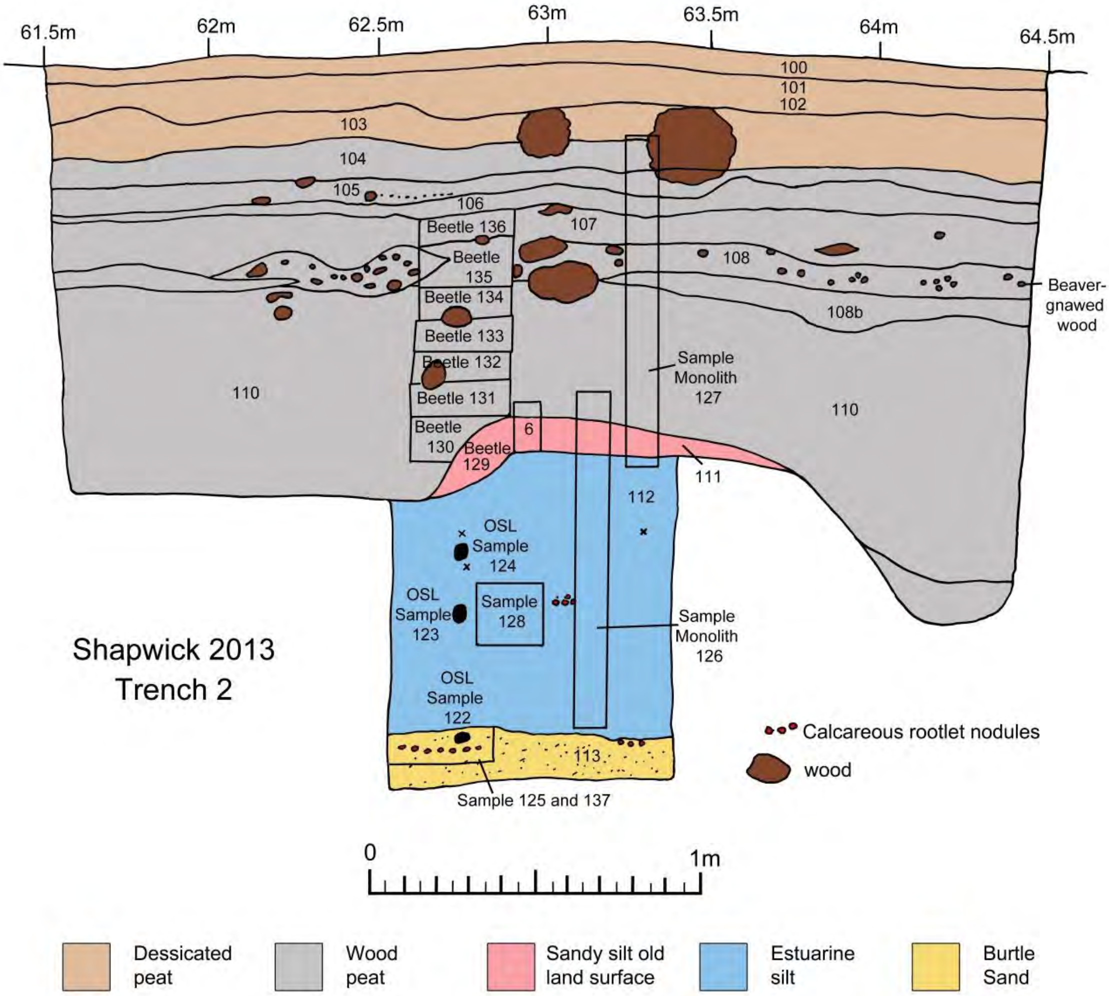


Figure 6.15 Shapwick Section of Trench 2 showing contexts and samples (graphic J. Foster).

Trench 2 (Figures 6.15-16).

This was at 61.5-64.5m on the borehole transect and 3m square. The whole pit was excavated to a depth of 1.3m and 1 square metre was taken down to a depth of 2.2m at which point conditions became too wet with running sand to go deeper. Below the turf was 0.45m of highly humified and desiccated peat with cracks and much root penetration. A north-south fairly rectangular section trench was identified 0.9m wide and 0.6m deep; this cut down to the woody peat and is likely to represent old peat cutting, or prospection. There are irregularities in this part of the field which may relate to this episode but there is no surface indication of large scale systematic peat cutting. The simplified stratigraphic sequence in this pit is shown in Figure 6.15 and the sequence of 18 radiocarbon dates obtained from the sequence on Figure 6.16a. The sequence of layers from the top of the pit was as follows:-

<u>Contexts 100-1</u> Turf and soil developed on humified, brown peat (7.5YR 5/4).

Context 102 Humified peat, dark brown (7.5YR 3/2).

Context 103 Humified compacted peat, very dark brown (7.5YR 2.5/3).
In the above layers 0-0.45m the peat was cracked and dessicated, cracks did not penetrate the more compacted Context 104 and below this organic material was better preserved.

Context 104 Compacted layered peat , very dark brown (7.5YR2.5/3).

Context 105 Fibrous peat , very dark brown (7.5YR7/4). Peat from this layer was radiocarbon dated 3090-2880 cal BC.

Context 106 Humified peat, black (7.5YR2.5/1)

Context 107 Clayey peat black (7.5YR3/1)

Context 108A. Below this was a wood peat layer 10-20cm thick (Figure 6.17) [add colour] (10YR4/4). This comprised an upper layer of pieces of roundwood mostly about 4cm in diameter but one piece 10cm in diameter. Of particular interest were the distinctive marks on 22 of these pieces made by beaver gnawing. In most cases the beaver had chewed through the roundwood producing the distinctive facets of their wide teeth (Figure 6.17b-d), in some case (eg 109) both ends were beaver cut. There were also cases where closely spaced parallel marks along the stems showed that the beaver had stripped the bark (Coles 2006 and pers. comm.). Twenty pieces of the beaver gnawed wood have been identified as follows (Figure 6.19): *Salix/ Populus* 13; *Corylus* 1; *Alnus glutinosa* 3; *Fraxinus excelsior* 1; *Quercus* 1. Wood diameter ranged from 9-55mm and the number of rings from 5 to <40. This wood layer was notably well preserved and the marks in excellent condition, given that it was only 0.65m below the surface. There are three dates for the beaver gnawed wood between 3330-2920 cal BC (Figure 6.16a).

Context 108B The beaver gnawed wood overlay a single thickness of roundwood trunks and branches in peat [add colour] (5YR5/6). Eight of these pieces have been identified as follows *Alnus glutinosa* 5; *Salix / Populus* 1; *Quercus* 1; *Betula* 1, thus differing from the immediately overlying beaver gnawed layer. The wood in this layer was larger some 15- 20cm and up to *c*50 rings, but there was some smaller roundwood. In general this wood was in less good condition than the overlying beaver gnawed wood but the context contained some well preserved leaves and hazel nuts. Both the beaver gnawed wood and the underlying roundwood lay at all angles and without any clear organisation, human cut marks, or of pegs which might have indicated human construction. There are three radiocarbon dates for wood in Context 108B between 3360 and 2900 cal BC and one date for peat at the base of this layer 3370-3020 cal BC (Figure 6.16a).

Context 109-110 0.6m of reed and wood peat, yellowish red (5YR4/6). The base of this layer was irregular with hollows separated by a ridge. A hollow on the south side was 0.6m deep and evidently the result of treethrow, within it was the stump and part of the trunk of a substantial ash tree (229). The hollow on the north side was 0.25m deep and is also likely to have been a result of tree throw, although in this case there was no clearly related trunk. Substantial pieces of roundwood from these layers were of alder, ash, oak and hazel (Table 6.1). Within the peat, mainly in the basal 2-5cm 38 uncharred hazelnuts were found in hand excavation. There is a radiocarbon date towards the top of this layer of 3370-3020 cal BC, one near the middle of the layer of 3630-3370 cal BC and two dates for the base of the peat of 3705-3360 cal BC (Figure 6.16a). Three radiocarbon dates for two hazel nuts come from the very base of the peat on the north side of the trench where the peat was deeper, they are dated between 4060-3940 cal BC.

Context 111 Between the two probable tree throw hollows was a ridge c 1m wide on the surface of which was Context 111, a 0.1m thick, mainly minerogenic layer of sandy silt, greyish brown (10YR5/2) with some small gravel grade quartz pebbles. The surface of this layer was 40% sand, 55% silt, 5% clay. Only c 2m square of this layer had survived the putative tree throw episodes and this was entirely sampled (partly in blocklift tins and partly bulk samples) for subsequent sieving in the laboratory. No artefacts were found in this layer in the field but subsequent sieving produced a microlith (Artefact no 28; Fig 10.1), a fragment of flint micro-debitage and 32 pieces of charcoal comprising *Fraxinus excelsior* 19; *Corylus avellana* 5; *Quercus* 8; Maloideae 1. Unfortunately this charcoal has not been dated so we do not know whether it may correspond to the period of Mesolithic or very early Neolithic activity. The artefacts and charcoal suggest this layer is an Old Land Surface on which the peat had subsequently developed, it thus corresponds to Context 11 in Trench 1. Micromorphological Sample 6 has been analysed as reported below to test the field hypothesis that this is an Old land Surface. Since the underlying layer comprised estuarine silt, the sand and quartz pebbles must have been derived from erosion of the sandy burtle to the south. Since it overlies the estuarine sediment it appears to have derived from slope process on the burtle edge and thus may relate to disturbed ground on the burtle, rather than to fluvial action at its edge. It is notable that Coles *et al* (1973, fig 11) found a minerogenic clay patch and an area of charcoal within the peat at a level corresponding to the Sweet Track. This suggests the possibility of ground disturbance and colluviation at the end of the trackway.

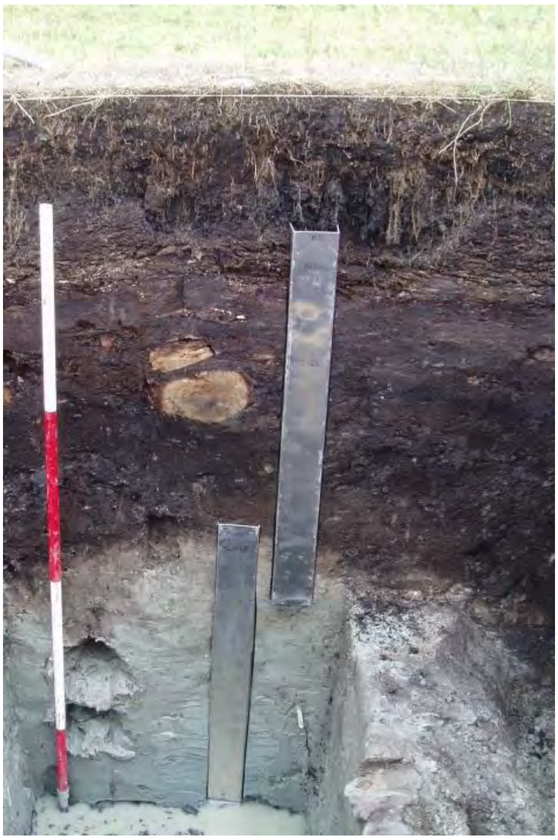


Figure 6.16 Shapwick, Trench 2 showing section and sample monoliths 126 (top) and 127 (bottom), (scale divisions 0.5m).

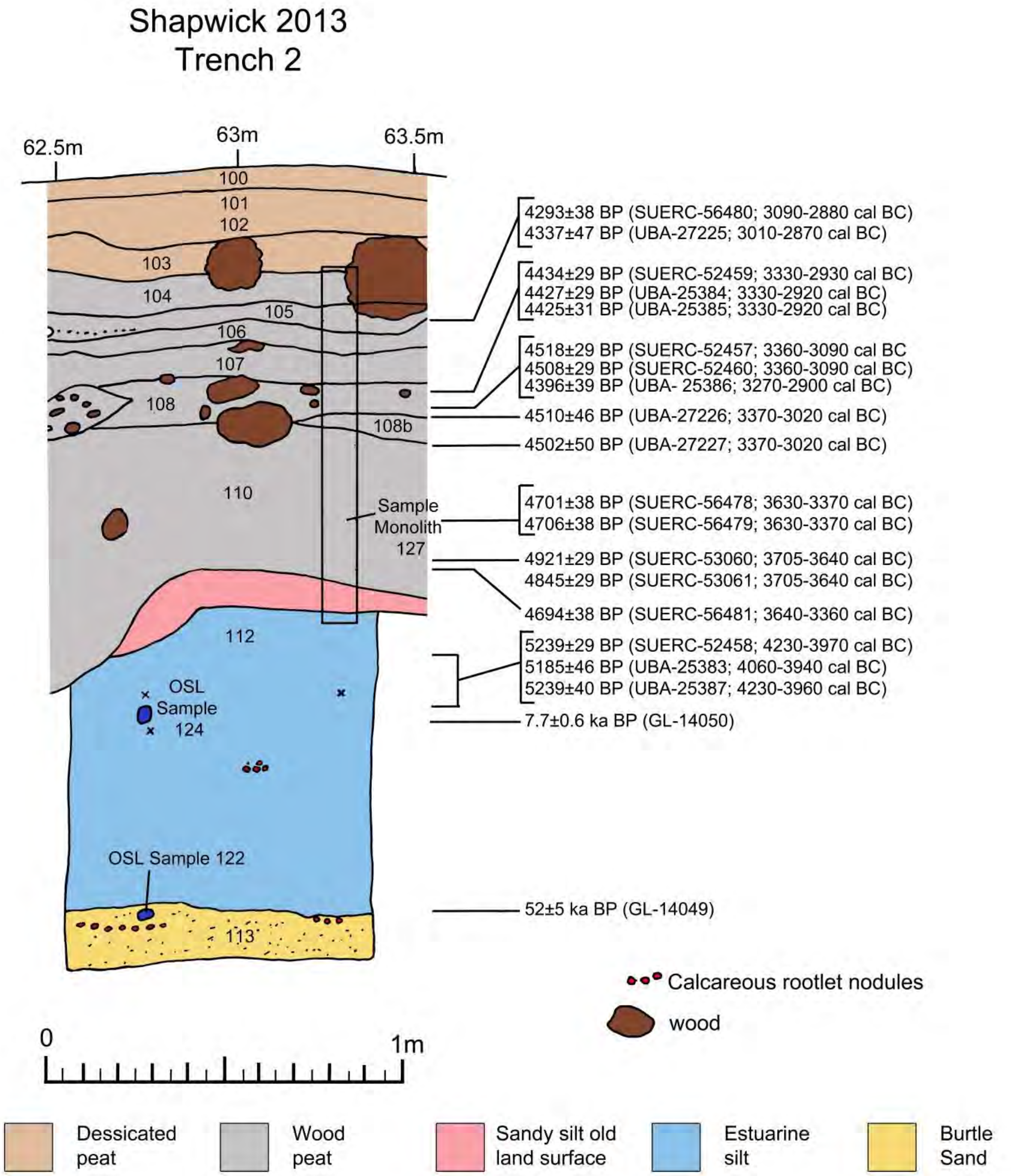


Figure 6.16a Shapwick Trench 2 Radiocarbon and OSL dates (Graphic Jennifer Foster).

a

b

c

d

Figure 6.17 Shapwick: Beaver gnawed wood layer, Context 108a. Photos M artin Bell

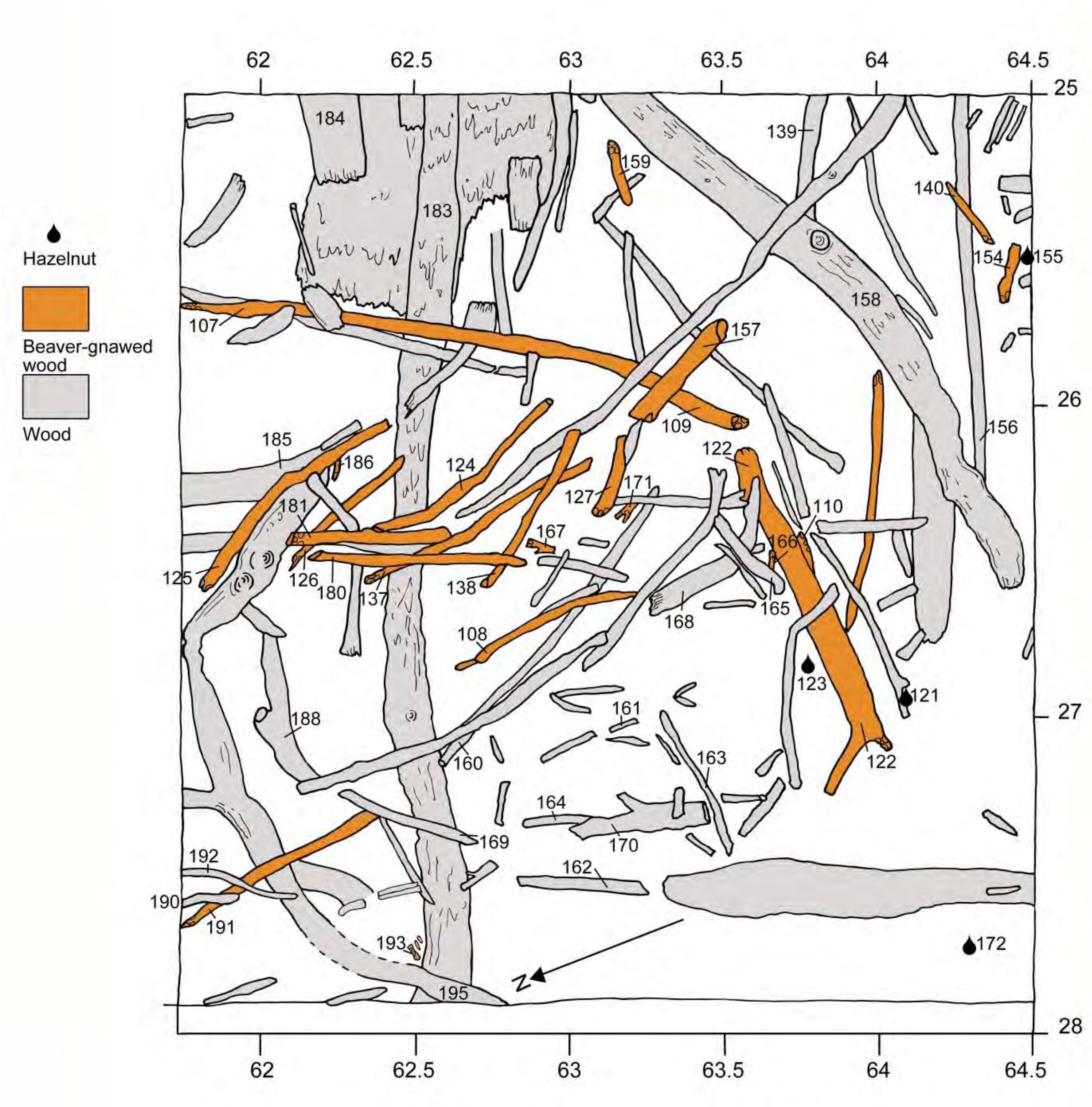


Figure 6.18 Shapwick Trench 2, plan of surface with beaver gnawed wood and underlying larger roundwood (graphic J. Foster).

Context 112 The putative Old Land Surface was underlain by 0.84m of minerogenic silts (75%) with 15% sand and 10% clay, brownish grey (2.5Y6/2). This deposit which underlies the main peat in the Brue Valley is interpreted as of estuarine origin. Six pieces of charcoal were found within the upper 0.55m of this layer. An optically stimulated luminescence date by P. Toms 0.3m below its surface was 6890-4490 BC (7.7+/-0.6ka BP). This is c 2 millennia earlier than the peat overlying the Old Land Surface which may thus be of some duration. At a depth of 0.45m in this context was a lens of calcareous nodules formed on roots pointing to an episode of vegetation development during its formation.

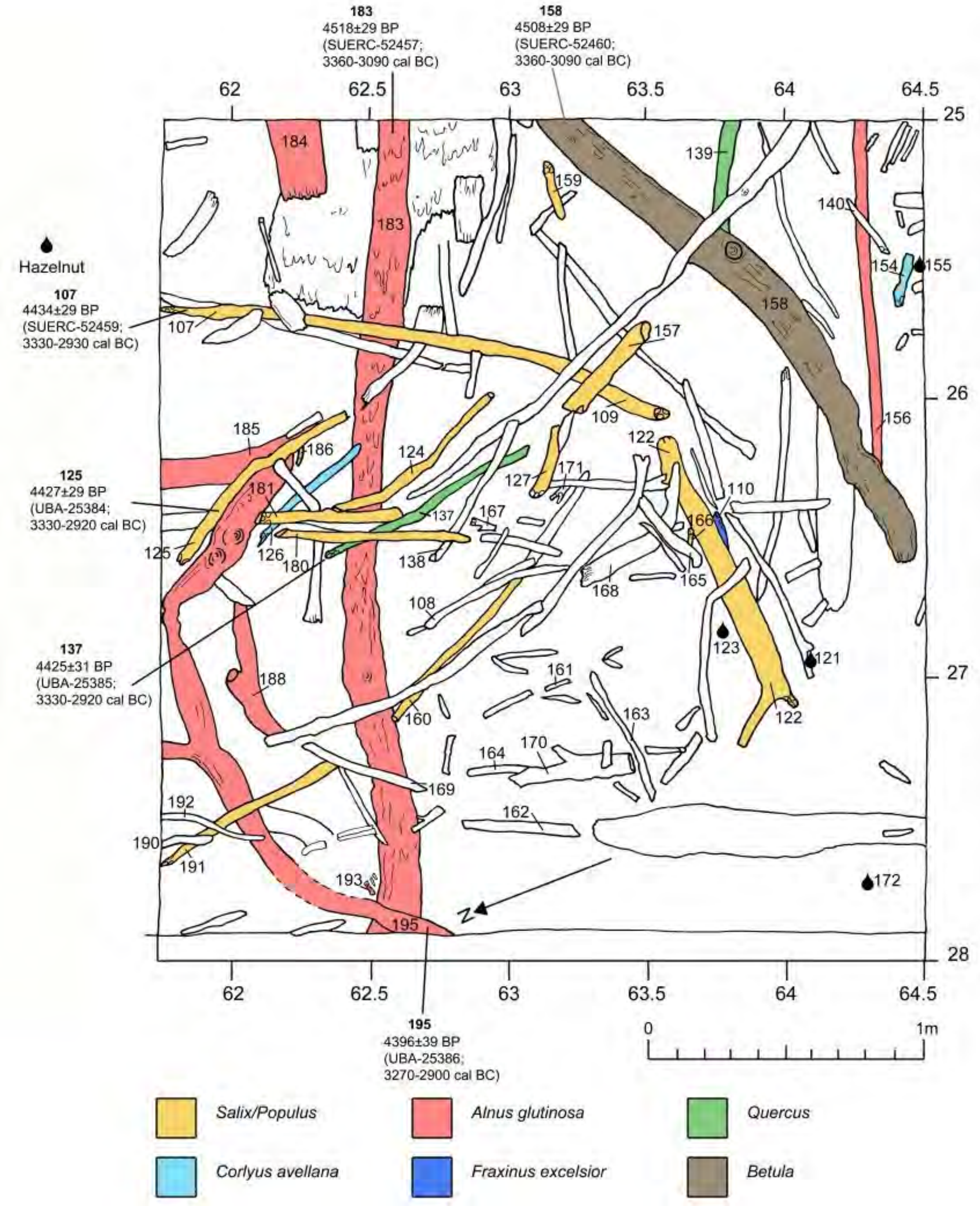


Figure 6.19 Shapwick Trench 2, Context 108, wood identifications and dated samples for the layer of beaver gnawed wood (Context 108; see Figure 6.18) and the underlying wood layer (Context 108b) (graphic J. Foster).

Context 113 At a depth of 2.1m below the surface, the sediments became increasingly sandy (42% sand, 53% silt, 5% clay) . This sand was running with water and it was not possible to excavate below the top 0.2m of this context, although coring demonstrated it was 1.8m thick. Between the surface of this layer and 0.05m depth were two discontinuous lenses of calcareous nodules. These have been thin sectioned and this shows a clear concentric structure picked out by differential iron staining (Figure 6.20). In some cases they appear to have formed around what is now a void. This suggests that they are nodules which have formed round roots which have subsequently decayed in the subsoil of a possibly truncated landsurface developed on the burtle sands. It is hoped eventually to establish the date of this episode by Uranium Series dating of the nodules. They also occurred in the same unit in Trench 1. An Optically Stimulated Luminescence date just below the top of Context 113, produced a date of 52+/-5ka BP though with some uncertainties outlined in P. Toms report (Appendix 5). That confirms the Pleistocene date of the sandy layer and it is interpreted as the burtle. Burtles are interpreted as interglacial coastal and nearshore sediments. In a number of cases the burtles are clearly eroded remnants with steep sides and this date suggests an episode of erosion and thus exposure to light around the middle of the Devensian glaciation. An alternative possibility is that it represents coversand deposition against the burtle edge at that date (A.G. Brown pers. comm.) Deep wind blown sands were laid down against Brean Down in the Devensian (ApSimon *et al* 1961).

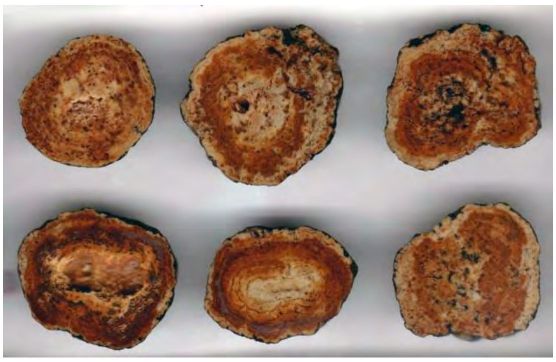


Figure 6.20. Sections of calcareous rootlet nodules from Trenches 1 and 2.

Samples obtained from this Trench (Figure 6.15) included 2 x 1m monolith tins: of these Sample 126 was subsampled for pollen, macrofossils and radiocarbon dating from the deposits below the highly humified surface peat; a sequence of 8 beetle samples (129-136) from the peat below 0.5m; a micromorphology sample (6) and bulk samples for laboratory sieving from the probable Old Land Surface; and two samples (122 and 124) were submitted for Optically Stimulated Luminescence dating of the silty clay and underlying sandy unit. It is hoped in the future to obtain Uranium Series dates on the calcareous rootlet nodules (Sample 116).

Shapwick pollen analysis report

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Introduction

This report summarises the findings arising out of the pollen analysis undertaken by Quaternary Scientific (QUEST), University of Reading, in connection with archaeological excavations at Shapwick. Pollen analysis focussed on the sediments from Monolith 127 (Contexts (105-112)) in Trench 2.

Methods
The methods of pollen extraction and analysis were outlined in the pollen report in Chapter 4. A total of 24 samples were extracted at *c*. 4cm intervals through the sequence (Figures 6.21-3).

Results of the pollen analysis
The percentage pollen diagram has been divided into three zones (LPAZ's SHAP-1 to 3) using CONISS and are summarised below. Poor pollen preservation at 0.96m prevented full analysis at this level, but the taxa noted during an initial assessment are displayed as trace values within the diagram.

LPAZ SHAP-1 0.74 to 1.00m *Corylus* type – *Alnus* – *Tilia*
Prior to 3740-3465 to 3560-3390
This zone is characterised by high values of tree (65%) and shrub (30%) pollen. *Corylus* type (25%), *Alnus* (25%), *Tilia* (20%) and *Quercus* (15%) dominate with *Pinus*, *Ulmus*, *Fraxinus*, *Betula*, *Hedera*, *Salix* and *Viburnum* (all <5%). Herbaceous values are low (<10%), including Cyperaceae (5%) with Poaceae, *Chenopodium* type, *Ranunculus* type, Asteraceae (all <2%). Aquatic taxa were very limited (<1%), including sporadic values of *Sparganium* type, *Potamogeton* type and *Myriophyllum* type. Spore values were high dominated by *Filicales* (25-50%) with *Polypodium vulgare* (<5%). Total pollen concentration was relatively low throughout the zone (<50,000 grains/cm^3). Microcharcoal values were very high at the base of the sequence (66,000 fragments/cm^3, declining to <5000 fragments/cm^3)

LPAZ SHAP-2 0.36 to 0.74m *Alnus* – *Corylus* type - *Quercus*
3560-3390 to 3255-3110
This zone is characterised by high values of tree (70%) and shrub (25%) pollen. *Alnus* dominates (50%) with *Corylus* type (20%), *Quercus* (15%), *Betula* (5%), *Tilia*, *Pinus*, *Fraxinus*, *Hedera*, *Vibernum* and *Salix* (all <5%). Herbaceous values (5%) are dominated by Cyperaceae with others including Poaceae, *Chenopodium* type, *Ranunculus* type and Rosaceae. Aquatic values are very limited (<1%), including sporadic occurrences of *Potamogeton* type, *Myriophyllum* type, *Typha latifolia*, *Sparganium* type & *Menyanthes trifoliata*. Spores are dominated by *Filicales* which decline to <10% through the zone. Total pollen concentration varies through the zone and increases from *c* 100,000 grains/cm^3 to *c* 400,000 grains/cm^3 at 0.56m. Microcharcoal values are very low, varying between 0 and <5000 fragments/cm^3.

LPAZ SHAP-3 0 to 0.36m *Corylus* type – *Betula* - *Taxus*
3255-3110to 3015-2880
This zone is characterised by high values of tree (55%) and shrub (30%) pollen. *Corylus* type (up to 35%) and *Betula* dominate (up to 30%) with *Taxus*, *Quercus*, *Alnus* (*ca*. 15%), *Tilia*, *Ulmus*, *Fraxinus*, *Calluna vulgaris*, *Hedera* and *Vibernum* (all

<3%). A peak in *Salix* values is also recorded at 0.30m (55%). Herbaceous values are dominated by Cyperaceae (10%) with Poaceae, *Artemisia* and *Centaurea scabiosa* (all <1%). Aquatic values increase to include *Menyanthes trifoliata* (3.5%) with *Sparganium* type, *Typha latifolia* and *Myriophyllum* type (all <1%). Spore values are dominated by *Sphagnum* (20%) with sporadic occurrences of *Filicales*, *Polypodium vulgare* & *Osmunda regalis*. Total pollen concentration declines through the zone from 500,000 to 160,000 grains/cm^3. Microcharcoal is absent throughout the zone.

Interpretation of the pollen analysis

The Shapwick pollen sequence spans a sedimentary sequence of estuarine clays (context 112) overlain by an Old Land Surface (context 111), wood and reed peats (contexts 110, 108a,b) and unidentifiable/clayey peats (contexts 107-103). Radiocarbon determinations on hazelnut shells from the top of the Old Land Surface were dated to 4230-3940 cal BC; peat accumulation commenced shortly before 3705-3360 cal BC and continued until at least 3090-2880 cal BC. Whilst the Sweet Track was not recorded within the 2013 excavations, its dendrochronologically dated age of 3806/7 BC (Hillam *et al*., 1990) places it at the very base of the peat, towards the interface with the underlying Old Land Surface.

LPAZ SHAP-1 **prior to 3740-3465 to 3560-3390 cal BC**
This pollen assemblage zone correlates with the basal estuarine alluvium (context 112), Old Land Surface (context 111) and initial stages of wood/reed peat formation (context 110).

The results of the pollen analysis indicate that during this period, the peat surface was dominated by alder (*Alnus*) with occasional willow (*Salix*) and a ground flora mainly comprising sedges (Cyperaceae) and grasses (Poaceae - probably *Phragmites australis* - reeds) with other herbs and ferns including marsh valerian (*Valeriana* type), daisies (Asteraceae), ferns (*Filicales* – probably including *Thelypteris palustris* – marsh fern) and polypody (*Polypodium vulgare*). These taxa indicate the presence of damp woodland, growing within fen carr and sedge fen / reed swamp. The occurrence of aquatic taxa such as bur-reed (*Sparganium* type), bulrush (*Typha latifolia*), pondweed (*Potamogeton* type) and possibly Ranunculus type, if these were crowfoots, also indicate the nearby presence of still or slowly moving water. Finally of note is the occurrence of *Chenopodium* type pollen. Genera of the family Chenopodiaceae (goosefoot family) may be found growing in two main locations: (1) waste, dry ground and cultivated land (e.g. *Chenopodium album* – fat hen), and (2) salt marshes (e.g. *Suaeda maritima* – annual sea-blite). Due to the nearby presence of dryland it is possible that the presence of *Chenopodium* type represents fat hen, however, its presence may also indicate fluvial inundation of the site and the influence of estuarine conditions throughout this period.

Other tree and shrub taxa such as *Quercus* (oak), *Ulmus* (elm), ash (*Fraxinus*), birch (*Betula*) and ivy (*Hedera*) may also have occupied the fen carr woodland with alder and willow, but more likely formed a mosaic of mixed deciduous woodland with lime (*Tilia*) on the adjacent dryland. Indeed the high values of entomophilous (insect pollinated) *Tilia* pollen indicate either that lime grew very close to the site, and/or was a dominant component of the adjacent dryland woodland during LPAZ SHAP-1. High and consistent values of *Corylus* type are interpreted as representative of *Corylus avellana* (hazel) as opposed to *Myrica gale* (bog myrtle). The two are notoriously difficult to split palynologically, However, *Corylus avellana* is considered the more likely due to the presence of macrofossil remains and an absence of those from bog myrtle, or other heathland indicators with which it is normally associated. Hazel may have formed an understorey component of the dryland woodland; however, the high values of this light-loving shrub suggest either openings in the woodland cover (glades), or more likely, its growth towards the woodland margin at the wetland dryland interface. *Pinus* (pine) would have been common in this region during the early Holocene, but was gradually out-competed by mixed oak-lime woodland. Thus, the raised values of pine pollen during this zone would appear to support the interpretation for a relatively open environment with the grains derived from an extra-regional source. Alternatively, the elevated pine values may be the result of the fluvial/estuarine environment of deposition; *Pinus* grains are particularly buoyant enabling them to float over long distances (e.g. Hopkins, 1950).

Significantly, high and declining values of microcharcoal were recorded from the base of the diagram to 3620-3420 cal BC that correlate with the estuarine clays, Old Land Surface and very base of the peat. Ordinarily, it would not be possible to split anthropogenic from naturally derived microcharcoal, however, on the basis of the macroscopic charcoal, flint debitage and microliths recorded within the Old Land Surface deposits during the archaeological excavations, a local and anthropogenic origin is considered more likely. This is further enhanced by the aforementioned Sweet Track, which on the basis of its chronology, should correlate with the transition from the Old Land Surface to peat formation. The impact of this human activity on the local vegetation is however, equivocal. A contemporaneous / near-contemporaneous increase in pollen from light-loving taxa is recorded, including that of hazel, ash, bracken (*Pteridium aquilinum*) and *Filicales* (ferns), which is suggestive of woodland disturbance. However, it is not possible to establish whether these changes in vegetation are the result of natural environmental changes or human activity.

LPAZ SHAP-2 **3560-3390 to 3255-3110 cal BC**

The transition into LPAZ SHAP-2 around 3630-3370 cal BC is characterised by a change in vegetation composition and structure on both the peat surface and dryland. On the peat surface, the decline of sedges and grasses and increase of alder is suggestive of succession from mixed alder-dominated fen carr and sedge fen / reed swamp, to a dominantly alder fen carr environment. From 0.56m, *Betula* pollen values also increase suggesting the invasion of birch into a maturing of the fen carr woodland. Also recorded however, is an increase in diversity of herbaceous and aquatic taxa to include pinks (Caryophyllaceae), cinquefoil (*Potentilla* type), bedstraw (*Galium* type), watermilfoil (*Myriophyllum* type) and bogbean (*Menyanthes trifoliata*). These, together with grasses and sedges suggest a continuation of at least some open and/or waterlogged areas on the peat surface.

Tilia pollen values decline substantially from the base of the zone to 0.60m (*3560-3390* to *3440-3300* cal BC), indicating the decline of lime from the nearby mixed deciduous woodland over a 90-260 year period. *Ulmus* pollen percentage and concentration (not displayed here) values also decline, suggesting the reduction of elm woodland at 3560-3390 cal BC. Whilst the values of *Ulmus* pollen indicate that it was a minor component of the woodland cover at this time, its under-representation might be expected due to the pollen filtration caused by the wetland and dryland woodland canopy. The potential causes of this change in woodland community are outlined in relation to other palaeoenvironmental and archaeological evidence in the following discussion section.

LPAZ SHAP-3 ***3255-3110 to 3015-2880 cal BC***

The transition into LPAZ SHAP-3 correlates with a change in stratigraphy from wood peat to clayey peat then unidentifiable peat indicative of wetter conditions. This shift is reflected in the pollen-stratigraphic record by the decline of alder-dominated fen carr and expansion of willow (with the clay peat), then sedges, grasses, aquatic taxa, *Sphagnum* moss and heather (*Calluna vulgaris*) (with the unidentifiable peat). A high number of testate amoebae were also noted, whilst bogbean and sedges were the only taxa recorded during the plant macrofossil assessment. Combined, the presence of these taxa is suggestive of hydroseral succession from fen carr towards raised bog conditions. It is not argued that full raised bog conditions were reached at this time; the pollen values of atypical plants are insufficient for this; instead a transition towards these conditions is thought to be taking place. The expansion of yew (*Taxus*) and birch is also of note, since these trees are associated with drier or well-drained peat surfaces, not wet acidic conditions (e.g. Beckett and Hibbert, 1979; Deforce and Bastiaens, 2007; Batchelor, 2009; Branch *et al*., 2012). It is therefore anticipated that both birch and yew represent fen woodland, most likely with alder, oak and hazel growing at the wetland-dryland interface. On the dryland, the continuation of mixed oak-hazel dominated woodland is indicated with lime and elm.

Discussion

Since the early 1970’s seven largely pollen-based palaeoenvironmental reconstructions have now been undertaken along the Sweet Track route (Figure 6a). From north to south, these are as follows:

1. XG (Caseldine, 1984)
2. TW (Caseldine, 1984)
3. F – the Peat Factory site (Coles *et al*., 1973)
4. D – the Drove site (Beckett, 1979)
5. B – the Burtle site (Coles *et al*., 1973)
6. Shapwick (present investigation)
7. SWA93 - Shapwick Heath (Wells *et al*.,1999)

The sampling resolution, methodology, pollen sum used and number of radiocarbon determination varies between sequences, reducing the comparisons that can be made between investigations. Furthermore, the previously analysed sequences generally provide a record of vegetation change over a longer period than that represented by the new Shapwick sequence (e.g. LPAZ’s SHAP1-3 are represented by LPAZ’s SF1 & SF2 of the Drove site diagram). Nevertheless, some useful comparisons and correlations in vegetation history and evidence of human activity can be made, particularly when compared with the archaeological record.

The decline of lime and elm woodland
As outlined above, the new pollen-stratigraphic record from Shapwick indicates that lime represented a dominant component of the nearby dryland woodland prior to its decline, which commenced around *3560-3390* cal BC and continued until *3440-3300* cal BC. Lower values of *Ulmus* pollen within the same record indicate that elm represented a much smaller component of the local woodland prior to its decline around *3560-3390* cal BC. Similarly, a definitive decline in lime and elm values is recorded in each of the palaeoenvironmental records listed above, with the decline of elm generally preceding that of lime. This decline is only radiocarbon dated in the Drove site (sometime before 3330-2900 cal BC; Beckett, 1979) and Shapwick Heath (3630-3090 cal BC; Wells *et al*., unpublished) records. Nevertheless, the similar timing of the decline suggests the change in dryland vegetation was a synchronous event. The decline of these taxa also occurs towards the end of the well-documented 'Neolithic elm decline' recorded between 4393 and 3340 cal BC in British pollen records (Parker *et al*., 2002; Batchelor *et al*., 2014).

Despite the differences in pollen sum, it is also noted that in comparison to the much higher values of lime pollen recorded in the new Shapwick record, the XG, TW, Peat Factory and Drove site records generally contain a much higher ratio of elm to lime pollen prior to their decline. These differences are anticipated to reflect the different position of each site relative to the dryland where lime was growing; the new Shapwick site is located closest to the burtle edge and therefore contains the highest values of entomophilous lime pollen. This interpretation is enhanced by the record from the Burtle site in which the values of lime and elm are approximately equal; this site is closest (*c*30m, Figure 6.4) to the new Shapwick record.

Traditionally, the lime decline has been attributed to one or more of the following causes: (1) climatic cooling (Godwin, 1956); (2) soil deterioration due to waterlogging and peat formation (paludification; Waller, 1994); and (3) human induced land clearance (Turner, 1962). In a recent and detailed study of the mid-late Holocene lime decline across lowland Britain, Grant *et al*. (2011) added 'discontinuities in sedimentation', 'changes in sedimentary environment' 'reciprocal changes in pollen representation' and 'marine inundation' to this list of factors.

The new record from Shapwick indicates the potential role of human activity on both the wetland and dryland, since a number of microcharcoal and charcoal fragments have been identified prior to the decline, towards the base of context (110); clearance indicator bracken (*Pteridium aquilinum*) is also present in low values. The macro-charcoal fragments largely consist of ash with some oak and hazel. In addition, the subsequent presence of *Hordeum* type (barley) and possible cereal pollen between *c*. *3440-3300* and *3255-3110* (0.60 to 0.34m) may indicate opening up of the local landscape for cultivation. It is highlighted, however, that both *Hordeum* type and *Cereale* type pollen have a morphology similar to that of coastal grasses which also produce large Poaceae grains (e.g. Andersen, 1979; Waller & Grant, 2012). It is therefore possible that these grains originate from a natural rather than anthropogenic source. It is also highlighted that no pastoral indicators (e.g. *Plantago lanceolata* – ribwort plantain; *Rumex acetosella / acetosa* – sorrel) are recorded at this time.

The likelihood of a human influence on local vegetation at this time is supported by both archaeological and palaeoecological evidence from previous records along the Sweet Track. The strongest archaeological evidence is the Sweet Track itself which is recorded in approximately the same stratigraphic position as the decline of these woodland taxa in each record; anthropogenic pollen indicators of disturbance commonly recorded include: (1) increases in light-loving hazel; (2) herbs indicative of clearance, pastoral and/or arable activity (e.g. cereals (*Cereale* type), ribwort plantain (*Plantago lanceolata*), mugwort (*Artemisia*) and sorrel (*Rumex acetosa*)), and (3) increases in bracken. It is of note however, that the precise relationship between the decline and the Sweet Track varies between records: in the Peat Factory and Burtle records, the decline commenced prior to the trackway; at the TW site the decline occurs within the trackway, and at Shapwick Heath, the Drove site and XG, the decline post-dates the trackway. This is further complicated by the Drove site record itself, in which the Sweet Track is plotted between 3640-3380 and 3330-2900 cal BC; dendrochronological dates on the Sweet Track of 3806/07, however, suggest it should be plotted below its position in the diagram.

Whilst the evidence for a human impact on vegetation would appear strong, it is suggested here that the decline of lime and elm may also have been influenced by paludification (see e.g. Waller, 1994; Grant *et al*., 2011; Batchelor *et al*., 2014). Paludification may have had an impact in two ways: (1) the gradual retreat of lime/elm over a prolonged period as a consequence of wetland expansion onto former dryland (>1000 years), or (2) lime/elm growing locally, probably on-site prior to wetland formation and subsequent rapid demise (<500 years) (Grant *et al*., 2011). The decline of lime in the new Shapwick sequence begins 14cm above the transition from the Old Land Surface to peat formation and occurs over a relatively rapid period of <260 years. In addition, the decline of lime occurs in tandem with an expansion of alder woodland on the peat surface, this would have had a filtering effect on the pollen derived from the dryland, thus further contributing to the decline of lime within the palaeoenvironmental record. These characteristics may be representative of both paludification types. Within other palaeoenvironmental records along the Sweet Track, the decline of lime/elm occurs sometime after the peat initiation; this is considered to reflect the earlier date of peat initiation at distances further from the burtle edge. The increase of alder with/after the decline is however a more common characteristic.

The expansion of heathland

From *3255-3110* cal BC in the Shapwick sequence, the decline of alder dominated fen carr and expansion of willow (initially only), sedges, grasses, aquatic taxa, *Sphagnum* moss and heather (*Calluna vulgaris*) was recorded and interpreted as a transition <u>towards</u> raised bog conditions. Full raised bog conditions were not reached as indicated by insufficient atypical pollen values and the presence of birch and yew (which are not associated with wet and acidic conditions). Previous records from the Drove site, Peat Factory site, TW and XG contain longer profiles, however, all indicating further expansions in heather, crowberry (*Empetrum*), *Sphagnum*, and a transition to *Sphagnum* peat (i.e. full raised bog conditions). This transition occurred from 2860-2470 cal BC, i.e. post-dating the top of the new Shapwick sequence.

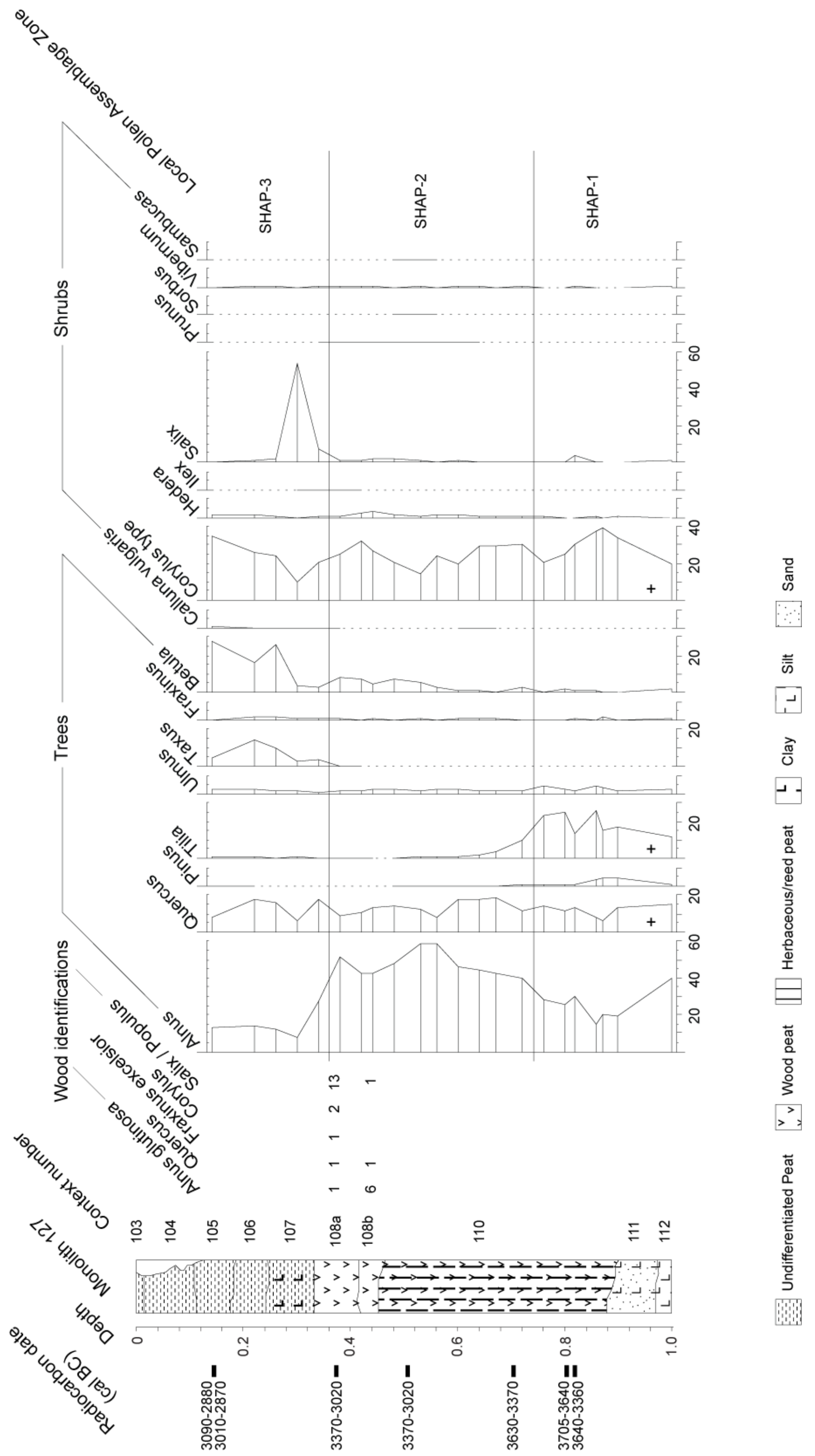

Figure 6.21: Shapwick pollen percentage diagram

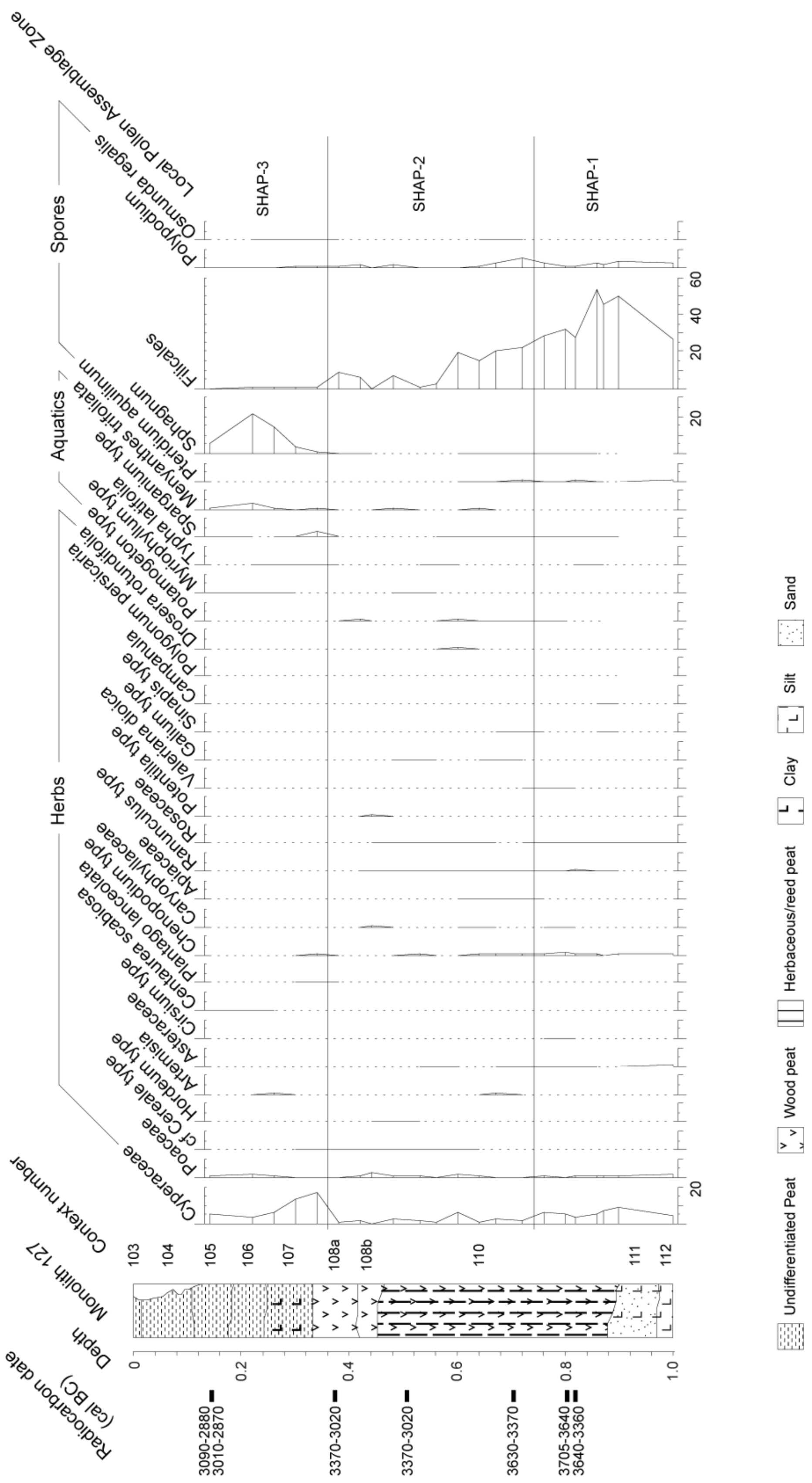

Figure 6.22: Shapwick pollen percentage diagram

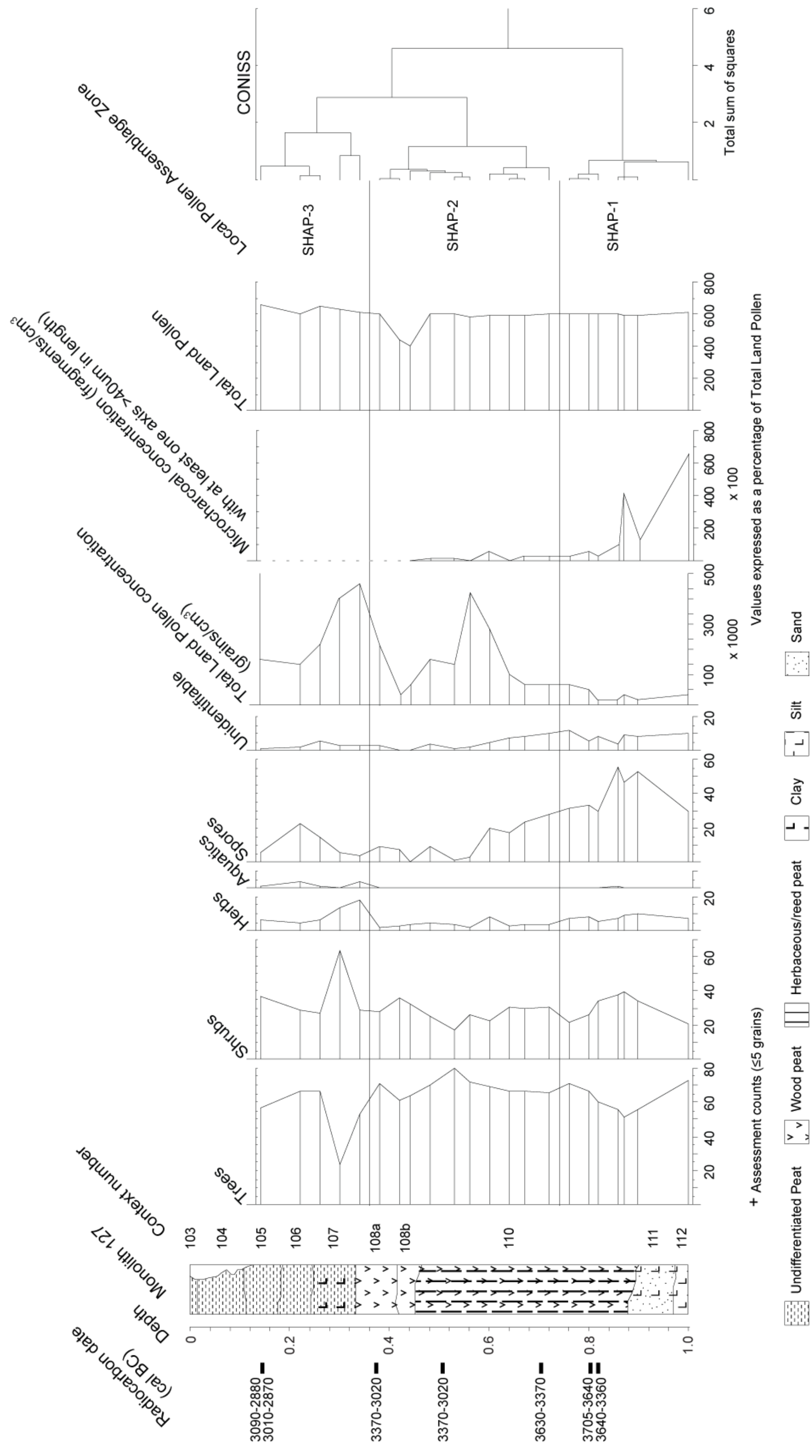

Figure 6.23: Shapwick pollen percentage diagram

Shapwick waterlogged wood and charcoal identifications
By Zoë Hazell (English Heritage) and P. Austin

Method
Wood identifications were carried out on 38 waterlogged wood samples from Trench 2 at Shapwick. For each wood sample, thin sections of each plane (transverse section (TS), tangential section (TLS) and radial section (RS)) were cut by hand using a double-edged razor blade. These were mounted in distilled water on dissection slides and then examined under a high-power Leica DM2500 light transmitting microscope between magnifications of x40 and x400. The identification keys and texts of Schweingruber (1990) and Hather (2000) were used, as well as English Heritage's wood reference collection held at Fort Cumberland, Portsmouth. Nomenclature follws Stace (1997). The maximum cross-section size (diameter) of each of the pieces was measured using Mitutoyo CD-8"CW digital callipers. Where a complete diameter was not present, the maximum radial measurement was recorded.

Results
Waterlogged wood
The waterlogged wood assemblage (Table 6.1) was composed mostly of roundwoods from small branches. The apparent predominance of wetland taxa, specifically *Alnus and Salix / Populu*s, indicates a riverine or wetland environment. In total, four hardwood taxa were identified: *Quercus* sp. (oak), *Populus/Salix* sp. (poplar/willow), *Betula* sp. (birch) and *Alnus* sp. (alder).
Charcoal
The charcoal from Shapwick (Table 6.1)was generally well-preserved and all but two of the fragments could be identified, suggesting a drier environment than that indicated by the waterlogged wood. (eg ash and oak).

Table 6.1. Shapwick wood and charcoal identications from Trench 2, 2013

Waterlooged wood Beaver-gnawed wood				
Find number	**Context**	**Taxon**	**Diameter mm**	**Notes**
2013.107	108A	*Populus/ Salix* sp.	53.10	Complete roundwood Inner bark present
2013.125	108A	*Populus/ Salix* sp.	31.48 <30	Complete roundwood Possible wood working mark on side*
2013.137	108A	*Quercus* sp.	35.98 <20	Complete roundwood Patch of inner bark present Tyloses absent throughout Possible boring holes (woodworm-sized)*

2013.183	108A	*Alnus* sp.	80.33	Complete roundwood A small patch of complete bark attached
Find number	Context	Taxon	Diameter mm	Ring count
2013.109	108A	*Salix/Populus*	43	<30
2013.159	108A	*Salix/Populus*	34	<30
2013.191	108A	*Salix/Populus*	33	<30
2013.126	108A	*Corylus avellana*	28	<25
2013.122	108A	*Salix/Populus*	56	<25
2013.154	108A	*Corylus avellana*	32	<25
2013.181	108A	*Salix/Populus*	25	<10
2013.186	108A	*Salix/Populus*	11	<7
2013.193	108A	*Alnus glutinosa*	9	<5
2013.124	108A	*Salix/Populus*	15-25	<20
2013.127	108A	*Salix/Populus*	30	<10
2013.157	108A	*Salix/Populus*	55-60	<40
2013.110	108A	*Fraxinus excelsior*	35	16
2013.180	108A	*Salix/Populus*	30	<20
2013.166	108A	*Salix/Populus*	26	<15
2013.185	108A	*Alnus glutinosa*	46-63	<50
Waterlogged wood (not beaver-gnawed)				
2013.139	108B	cf *Quercus* sp.	23-=43	<20
2013.160	108B	*Salix/Populus*	25	<15
2013.156	108B	*Alnus glutinosa*	-	<15
2013.188	108B	*Alnus glutinosa*	42	<50
2013.184	108B	*Alnus glutinosa*	85	<40
2013.195	108B	*Alnus glutinosa*		<40
2013.158	108B	*Betula* sp.		<50
2013.183	108B	*Alnus glutinosa*		<50
2013.227	110	*Alnus glutinosa*	-	<50
2013.231	110	*Fraxinus excelsior*	-	<30
2013.143	110	*Quercus* sp	-	<50
2013.229	110	*Fraxinus excelsior*	-	<30
2013.228	110	*Alnus glutinosa*	-	<20
2013.144	110	*Corylus avellana*	-	<30
2013.230	109	*Alnus glutinosa*	-	<30
2013 Sample 158		*Betula* sp.	47.25 mm	Partial roundwood (1/4 section). Pith not present Small patch of inner bark present. Possible boring holes present*
2013 Sample 195		*Alnus* sp.	63.74 mm	Complete roundwood Patch of complete bark
Charcoal				
Sample	**Context**	**Taxon**	**no.**	**weight g**
105	111	*Fraxinus excelsior*	5	0.078
	111	*Corylus avellana*	3	0.031
	111	*Quercus* sp.	1	0.007
106	111	*Fraxinus excelsior*	7	0.119
	111	*Quercus* sp	3	0.074
107	111	*Fraxinus excelsior*	3	0.043
	111	Maloideae	1	0.029
	111	*Quercus* sp.	4	0.095
	111	Indeterminate	2	0.068
108	111	*Corylus avellana*	2	0.046
	111	*Fraxinus excelsior*	4	0.018

Notes on the taxa
Although it is not always possible to take the wood identifications to species level, it is possible to narrow down the likely species from those native within the British Isles (following Stace 1997).
Quercus sp. (oak) (Fagaceae family): the presence of flame-like latewood vessel patterning indicates that this is a deciduous oak. Within the British Isles, this includes only *Q. robur* (pedunculate oak) and *Q. petraea* (sessile oak) (Gale and Cutler 2000: 204).
Populus/Salix sp. (poplar/willow) (Salicaceae family): the wood of these two taxa are hard to differentiate reliably based on their wood taxonomy. There are multiple species (and their respective hybrids) of both taxa that are native to the British Isles.
Betula sp. (birch) (Betulaceae family): in the British Isles the native types of *Betula* sp are *B. nana* (dwarf birch), *B. pendula* (silver birch) and *B. pubescens* (downy birch) (although hybrids also occur).
Alnus sp. (alder) (Betulaceae family): *A. glutinosa* (alder) is the only native alder in the British Isles.

The Insect Remains from Shapwick

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Introduction
The insect remains from three excavations (Trench 1 and Trench 2 at Shapwick and the site of Chedzoy) in 2013 on the Somerset Levels are described here.

The two sections through the peat beds at Chedzoy and Trench 1 at Shapwick produced no insect remains. This suggests that preservation was poor at both of these sites (Smith 2013).

However, in Trench 2 at Shapwick initial assessment indicated that the eight samples collected at 10 cm intervals in a continuous section through the peat deposit (Figure 6.15) , all contained well preserved insect faunas. The bottom of this peat sequence has now been dated to 4230-3970 cal BC and is, therefore, broadly contemporary to the Sweet Track itself. The following report presents the results of an analysis of this sequence of insect faunas. The eight samples examined correspond to Pollen Zones LPAZ SHAP 1-3.

Methods
The samples were processed using the standard method of paraffin flotation as outlined in Kenward *et al*. (1980) in the Department of Classics, Ancient History and Archaeology, the University of Birmingham. Insect remains were sorted and identified under a low-power binocular microscope at magnifications between x15 – x45. Where achievable, the insect remains were identified to species level by direct comparison to specimens in the Gorham and Girling insect collections housed in the

Department of Classics, Ancient History and Archaeology, the University of Birmingham.

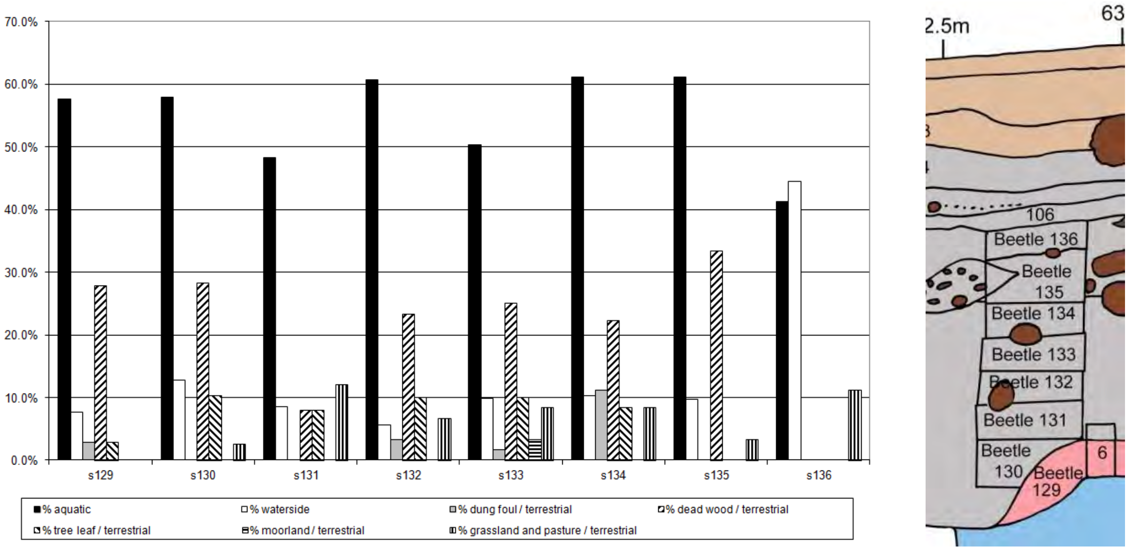

Figure 6.24. Ecological groupings for the Shapwick 2013 insect faunas

Analysis

The majority of the insect fauna recovered were Coleoptera (beetles) with a few Hemiptera (true bugs) and Diptera (flies) present. A large number of Trichcoptera (caddis fly) larvae were recovered from 70–60 cm in the section.

A list of the insects recovered from Trench 2 is presented in Table 6.2. The nomenclature for Coleoptera (beetles) follows that of Lucht (1987). The right hand Column in Table 6.2 lists the host plants for the phytophage species of beetle that were recovered and are predominantly derived from Koch (1989; 1992). The plant taxonomy follows that of Stace (2010).

In order to aid interpretation, where possible, taxa have been assigned to ecological groupings. The Coleoptera follow a simplified version of the scheme suggested by Robinson (1981; 1983). The affiliation of each beetle species to a particular ecological grouping is indicated in the second column of Table 6.2. The meaning of each ecological code is explained in the key at the base of Table 6.2. The occurrence of each of the ecological groupings is expressed as a percentage in Table 6.3 and is illustrated in Figure 6.24. The pasture/grassland, dung and woodland ecological groupings are calculated as percentages of the number of terrestrial species, as opposed to the whole fauna. An individual taxon can occur in more than one ecological grouping and, therefore, the proportions presented in Tables 6.3 and Figure 6.24 can exceed 100%.

The third column in Table 6.2 also includes the Red Data Book (rarity) status of the insects recovered from Shapwick. This information, and the codes used are derived from Hyman and Parsons (1992, 1994). The RDB classifications are outlined at the base of Table 6.2.

Discussion

The eight insect faunas recovered from the section in Trench 2 at Shapwick are very similar in their overall nature (see the ecological groupings in Table 6.3 and Figure 6.24).

The majority of the terrestrials beetles recovered from Trench 2 at Shapwick are associated with deciduous woodland, in fact the ecological groups 'dw – deadwood' and 'tl – tree leaf' account for more that 30% of the terrestrial faunas recovered in most samples (see Table 6.2 and Figure 6.24). These are values similar to that suggested by Robinson (2000) and Smith *et al.* (2010) as being indicative of closed canopy woodland. Many of the species recovered such as *Dasytes plumbeus, Calambus bipustulatus, Melanotus rufipes, Cerylon histeroides, Cerylon ferrugineum, Asphidiphorus orbiculatus, Grynobius planus, Anobium punctatum* and the two species of 'long horns' recovered, *Grammoptera* spp. and *Leiopus nebulosus* are associated with the deadwood of a range of deciduous trees (Koch 1992; Buckland and Buckland 2006). Several of the beetles recovered also provide information on the species composition of this woodland. The tenebrioniid *Corticeus bicolor* and the scotytid *Pteleobius vittatus* are often associated with elm (*Ulmus* spp.), the scolytid 'shot borers' *Hylesinus crenatus* and *Leperisinus varius* with ash (*Fraxinus* spp.) as are *Dryocoetes villosus, Xyleborus dryographus,* and the 'nut weevil' *Curculio venosus* with oak (*Quercus* spp.) (Koch 1922). In addition, the small scolytid *Ernoporus caucasicus* is associated with lime (*Tillia* spp.) (Koch 1992). The dominance of these faunas with woodland species probably suggests that the adjacent area of Shapwick Burtle was covered in a dense stand of dry-land forest, a conclusion which is also supported by the pollen analysis from this section (see Batchelor and Brown above). However, several other species recovered are associated with carr and wetland woods, for example, the Colydiidae *Bothrideres contractus*, which is normally associated with willow (*Salix* spp.) and the 'leaf beetle' *Agelastica alni* which is associated with alder (*Alnus* spp.) (Koch 1992).

The terrestrial fauna also contains small numbers of species which are associated with other types of environments. Several of the elaterid 'click beetles' and the curculioniid weevils, such as *Orthochaetes setiger*, are associated with grassland. A single individual of the 'leaf beetle' *Altica* and the weevil *Micrelus ericae* were recovered from the 90–80 cm sample, both of these species are associated with heather (*Erica* spp,) and traditionally are thought to represent moorland. Finally, a very small number of *Aphodius* dung beetles were recovered from between 90–70 cm (for dates see Figure 6.16a), it may be that these species are associated with the dung of a range of large herbivores. The beaver-worked' wood is from Context 108 above this layer.

Unsurprisingly, water beetles account for the vast majority of the insects recovered. Most of the taxa of water beetles recovered are associated with slow-flowing shallow, fresh water; often in areas full of rich stands of waterside plants (mainly the taxa which account for ecological group 'a' in Table 6.3 and Figure 6.24). All of the 'diving water beetles' *Hygrotus decoratus, Hydroporus scalesianus, H. palustris* and *Porhydrus lineatus*, the 'whirligig' *Gyrinus* spp. along with the 'minute moss beetles' *Hydraena testacea, Ochthebius minimus, Hydrochus elongatus, H. carinatus* and the 'silver water beetles' *Coelostoma orbiculare, Laccobius* cf. *sinuatus* and *Chaetarthria seminulum* are normally associated with this type of aquatic environment (Nilsson and Holmen 1995; Foster and Friday 2012, 2014; Duff 2012). A small Helodidae, probably *Cyphon* spp., occurs in very large numbers throughout the section, this is a taxa which is associated with shallow water as a larvae and with damp waterside vegetation as an adult.

A number of the plant feeding species associated with waterside vegetation (ecological group 'ws' in Table 6.3 and Figure 6.24) occur throughout the section suggesting that this aspect of the landscape also remained relatively stable throughout the period of time represented by these peat deposits. The 'reed beetles' *Donacia aquatica* and *Plateumaris sericea* are both associated with a range of sedges (*Carex* spp.) (Koch 1992) and are commonly recovered in faunas throughout the section. The weevil *Limnobaris pilistriata* is associated with rushes (both Juncaceae and Cyperaceae) and it is noticeable that this species only occurs above the beaver gnawed wood in the section; perhaps suggesting that the activity of the beavers may have changed the nature of the body of water in the area to some extent.

Species of biogeographical importance

The insect faunas recovered at Shapwick contain a number of species of insect that are now extinct, or comparatively rare, in the British Isles. This includes two water beetle species *Hydroporus scalesianus* (RDB2) and *Hydrochus carinatus* (RDB3). It has been suggested that the decline in the occurrence of both species is probably due to recent drainage of wetlands (Shirt 1987; Hyman and Parsons 1992). Other rare species identified in these samples are associated with dead wood. *Ernoporus caucasicus* (Red Data Book 1) is a feeder on lime (*Tilia cordata* Mill.) and is today only found in very small and isolated populations in a limited number of ancient woodlands in Britain (National Biodiversity Network 2014). Similarly, the small 'false click beetle' *Dirhagus pygmaeus* (Red Data Book 2) is also considered rare today and limited to a number of scattered records in the west and southeast of England. However, fossil finds of both of these species suggest that it was much more widespread, if not common, in the past (Girling 1982, 1985; Smith and Whitehouse 2005; Whitehouse and Smith 2010). The Colydiidae *Bothrideres contractus* is today considered to be extinct in the British Isles, with only a limited number of records of this species from northern Europe (Buckland and Buckland 2006; Hymans and Parsons 1992). It has, however, been recovered from a number of other Early Neolithic sites in Britain and Ireland, such as Thorne Moor Wastes, South Yorkshire (Whitehouse 2006), Stileway, Somerset (Girling 1985) and Sluggen Bog, County Antrim (Whitehouse 2006).

Conclusions and comparisons to other sites in the Somerset Levels

The nearest comparison to the faunas recovered from the 2013 excavation of Shapwick Trench 1 site come from Maureen Girling's work on the Sweetrack at both the original Drove site and the more complete section in TG area of the Turbary site

(Girling 1979, 1984). At both locations the Sweet Track itself is associated with an environment dominated by *Phragmites* reed swamp, rather than woodland and carr (Girling 1979, 1984). It is only in the upper, later Neolithic deposits at the Turbary site that similar insect faunas and alder carr woodland are encountered. This difference in contemporary environment must relate to the location of the various sites within the moor itself. The present excavation at Shapwick is located near to the end of the trackway as it lies against the edge of the sandy burtle at Shapwick. The insect faunas recovered from the Shapwick site therefore suggest that carr woodland and dryland deciduous woods dominated in this area of the moor and on the Burtle at the time of the trackways.

Other excavations at sites associated with the Somerset Levels trackways have produced broadly similar woodland faunas to those seen here, for example those from the late Neolithic and Early Bronze age sites at Stileway (Girling 1985), the Baker site (Girling 1980) and the Rowland's Track (Girling 1977).

Table 6.2. Insect faunas recovered from Trench 2 Shapwick

Sample no.	**Ecological codes**	**RDB status**									**Phytophage plant hosts (nomenclature follows that of Stace 2010)**
Depth (cm)			**120-140**	**110-120**	**100-110**	**90-100**	**90-80**	**70-80**	**60-70**	**50-60**	
Sample number			**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	
									Beaver gnawed wood		
HEMIPTERA											
Family, genus and spp. Indet.			-	-	-	1	3	2	6	-	
COLEOPTERA											
Carabidae											
Elaphrus spp.	ws		-	-	-	-	1	-	-	-	
Loricera pilicornis (F.)			-	-	-	-	1	1	-	-	
Dyschirius globosus (Hbst.)			1	-	1	1	2	1	-	-	
T. quadristriatus (Schrk)/ *T. obtusus* Er.			-	-	-	-	-	-	1	-	
Lasiotrechus discus (F.)			-	-	-	-	1	1	-	-	
Bembidion spp.			1	1	-	2	1	-	-	-	
Pterostichus diligens (Sturm)			-	-	-	-	2	-	-	-	
Pterostichus minor (Gyll.)	ws		-	2	1	-	2	1	-	-	
Pterostichus spp.			-	1	-	2	-	1	1	-	
Dromius linearis (Ol.)	ws		-	-	-	1	-	-	-	-	
Halididae											
Haliplus spp.	a		-	-	-	-	-	-	2	1	
Dytiscidae											
Hygrotus decoratus (Gyll.)	a		-	-	-	-	-	1	-	-	
Hygrotus spp.	a		-	-	-	1	1	-	-	-	
Hydroporus scalesianus Steph.	a	RDB2	1	-	1	-	-	-	-	-	
Hydroporus palustris (L.)	a		-	-	1	-	-	4	3	-	
Hydroporus spp.	a		1	1	2	2	4	1	6	5	
Porhydrus lineatus (F.)	a		-	-	-	-	1	1	-	-	
Agabus spp	a		2	2	-	1	2	1	1	1	
Gyrinidae											
Gyrinus spp.	a		1	-	-	2	1	1	-	-	
Hydraenidae											
Hydraena testacea Curt.	a		2	3	1	6	9	6	-	-	
Hydraena spp.	a		-	-	-	3	-	1	-	-	
Ochthebius minimus (F.)	a		1	-	-	-	-	2	-	-	
Ochthebius spp.	a		-	1	3	-	3	4	3	3	
Limnebius spp.	a		2	-	-	-	-	-	-	-	
Hydrochus carinatus Germ.	a	RDB3	-	-	-	-	3	-	-	-	
Hydrochus elongatus (Schall.)	a		2	3	1	-	-	1	-	-	

Hydrochus spp.	a		-	-	-	1	-	-	-	-	
Hydrophilidae											
Coelostoma orbiculare (F.)	a		-	-	-	-	-	-	1	3	
Cercyon analis (Payk.)	rt		1	-	-	-	-	-	-	-	
Cercyon convexiusculus Steph.	ws		-	-	-	-	2	1	-	-	
Cercyon spp.			2	-	2	1	-	-	-	-	
Megasternum boletophagum (Marsh.) / maculatum			1	1	-	-	-	-	-	-	
Hydrobius fuscipes (L.)	a		-	2	-	1	1	1	1	1	
Laccobius c.f. sinuatus Motsch.	a	NB	-	-	-	-	6	5	-	-	
Laccobius spp.	a		1	-	-	4	-	-	1	-	
Enochrus spp.	a		-	-	-	-	-	-	5	1	
Chaetarthria seminulum (Hbst.)	a		-	-	-	-	-	-	-	1	
Histeridae											
Acritus nigricornis (Hoffm.)	df		-	-	-	1	-	-	-	-	
Silphidae											
Phosphuga atrata (L.)	df		-	-	-	-	-	3	-	-	
Silpha spp.			-	-	-	-	1	-	-	-	
Scydmaenidae											
Neuraphes spp.			1	-	-	-	1	-	-	-	
Scydmaenidae Gen. & spp. indet.			1	-	1	2	-	-	-	-	
Orthoperidae											
Corylophus cassidoides (Marsh.)	ws		1	2	-	-	2	-	1	-	
Ptiliidae											
Ptilidae Genus & spp. indet**.**			3	1	1	-	1	-	-	-	
Acrotrichis spp**.**			1								
Staphylinidae											
Eusphalerum sp.			-	-	-	-	-	1	2	-	
Phyllodrepa spp.			-	-	-	-	1	-	-	-	
Omalium spp.			-	-	1	-	-	-	-	-	
Lathrimaeum unicolor (Marsh.)	ws		1	1	-	-	-	-	-	-	
Phyllodrepa spp.			-	-	1	-	-	-	-	-	
Lesteva longelytrata (Goeze)	ws		-	1	-	-	2	-	-	-	
Lesteva spp.	ws		-	2	1	2	-	1	-	1	
Trogophloeus bilineatus (Steph.)/ *erichsoni* (Sharp)	ws		3	6	-	-	-	-	-	-	
Oxytelus rugosus (F.)			-	-	-	-	1	-	-	-	
Oxytelus nitidulus Grav.	ws		1	-	1	-	-	-	-	-	
Stenus spp.			1	1	2	1	4	4	4	6	
Euaesthetus bipunctatus (Ljungh)	ws		-	-	-	-	1	-	-	-	
Lathrobium spp.	oa		1	2	1	2	5	1	2	-	
Cryptobium fracticorne (Payk.)	ws		-	-	-	-	-	-	-	2	
Erichsonius cinerascens (Grav.)	ws		-	-	-	-	-	-	-	1	
Philonthus spp.			-	1	1	2	2	1	-	-	
Philonthus spp.			1	-	-	-	-	-	-	-	
Aleocharinidae Genus & spp. Indet.			6	10	6	1	-	1	1	-	
Pselaphidae											
Euplectus spp.			-	-	-	-	1	1	-	-	
Bryaxis spp.			2	1	-	-	1	1	-	-	
Rybaxis sp.			1	-	-	-	-	-	1	-	
Brachygluta spp.			1	-	-	-	-	-	-	1	
Trissemus impressus (Panz.)			-	1	-	-	-	-	-	-	
Cantharidae											
Cantharis sp.			-	-	1	-	-	-	-	-	
Melyridae											
Dasytes plumbeus (Müll.)	dw-p	NB	-	-	-	-	-	1	1	-	larvae in dead wood: adults in grassland
Elateridae											
Agriotes spp.	p		-	-	-	1	-	1	1	-	
Melanotus rufipes (Hbst.)	dw		-	-	-	-	2	-	-	-	rotting wood from a range of deciduous trees
M. spp.	dw		-	-	-	-	-	1	-	-	
Calambus bipustulatus	dw	NB	-	-	1	-	-	-	-	-	Larvae in the deadwood of a range of deciduous

(L.)											trees
Denticollis linearis (L.)	dw		-	-	-	-	1	-	-	-	rotting wood from a range of deciduous trees
Athous haemorrhoidalis (F.)	p		-	1	-	1	1	-	-	-	
Eucnemidae											
Melasis buprestoides (L.)	dw	NB	1	-	-	1	1	-	-	-	
Dirhagus pygmaeus (F.)	dw	RDB3	-	1	-	-	1	-	1	-	rotting wood from a range of deciduous trees
Dascillidae											
Dascillus cervinus (L.)	oa		-	-	-	-	1	-	-	-	
Helodidae											
Helodidae Gen. & spp. Indet. (?*Cyphon* spp.)	a		46	64	19	33	45	48	40	10	
Cryptophagidae											
Atomaria spp.			-	1	-	1	-	-	-	-	
Phalacridae											
Phalacrus caricis Sturm	ws		-	-	-	-	-	-	3	-	
Lathridiidae											
Enicmus minutus (Group)			-	-	-	1	1	-	-	-	
Corticaria/ corticarina spp.			-	-	-	-	1	1	1	-	
Colydiidae											
Bothrideres contractus (F.)	dw	X	-	-	-	-	-	-	1	-	in deciduous woodland mainly on *Salix* spp. (willow) and *Populus* spp. (poplar)
Cerylon histeroides (F.)	dw		-	-	-	-	3	-	-	-	under bark of a range of hardwood trees
Cerylon ferrugineum Steph.	dw		3	-	-	-	-	-	-	-	under bark of a range of hardwood trees
Cerylon sp.	dw		-	4	-	-	-	-	-	-	
Coccinellidae											
Coccidula rufa (Hbst.)			-	-	-	-	-	-	-	1	
Cisidae											
Cis spp.	dw		-	-	-	1	-	-	-	-	
Asphidiphoridae											
Aspidiphorus orbiculatus (Gyll.)	dw		-	-	-	-	-	1	-	-	fungus and slime moulds in rotting wood
Anobiidae											
Grynobius planus (F.)	dw		1	1	-	-	2	-	-	-	
Anobium punctatum (Geer)	dw		-	-	-	2	1	-	1	-	
Ptinidae											
Ptinus spp.			-	-	-	-	-	1	-	-	
Mordellidae											
Anaspis spp.			-	-	-	-	2	1	1	-	
Tenebionidae											
Corticeus bicolor (Ol.)	dw		-	-	-	1	-	-	-	-	often *Ulmus* (elm)
Scarabaeidae											
Aphodius fimetarius (L.)	df		-	-	-	-	1	-	-	-	
Aphodius spp.	df		-	-	-	-	-	1	-	-	
Cerambycidae											
Grammoptera spp.	dw		1	-	-	1	1	1	-	-	
Leiopus nebulosus (L.)	dw		-	-	-	-	-	1	1	-	
Chyrsomelidae											
Donacia aquatica (L.)	ws		-	-	-	-	-	-	1	-	Usually on *Carex* spp. (sedges)
Donacia spp.	ws		1	2	-	-	-	-	-	-	
Plateumaris sericea (L.)	ws		-	-	2	2	3	8	2	5	Usually on *Carex* spp. (sedges)
Prasocuris phellandrii (L.)	ws		-	-	-	-	-	1	1	-	On aquatic APIACAE (Umbellifers)
Agelastica alni (L.)	tl	RDBK	-	-	2	-	-	2	-	-	on *Alnus* spp. (alder)
Haltica spp.	m		-	-	-	-	1	-	-	-	Often on *Erica* spp. (heather)
Chaetocnema spp.			-	-	-	1	-	-	-	-	
Scolytidae											
Scolytus spp.	dw		-	-	-	-	-	1	-	-	
Hylastes spp.	dw		-	-	-	-	-	-	1	-	Mainly *Pinus* spp. (pine)
Hylesinus crenatus (F.)	dw		-	-	-	-	1	-	-	-	Mainly on *Fraxinus* (ash)
Leperisinus varius (F.)	dw		-	3	1	-	-	2	-	-	Mainly on *Fraxinus* (ash)
Pteleobius vittatus (F.)	dw		-	1	-	-	1	1	1	-	on *Ulmus* spp. (elm)
Dryocoetes villosus (F.)	dw		2	-	-	-	-	-	-	-	usually associated with *Quercus* spp. (oak) and other hardwood trees
Ernoporus caucasicus Lindem	dw	RDB1	1	-	-	-	-	-	-	-	on *Tillia* spp. (lime)
Xyleborus dryographus	dw	NB	1	-	-	-	1	-	3	-	Mainly on *Quercus* spp. (oak)

(Ratz.)											
Curculionidae											
Apion spp.	p		-	-	1	-	3	1	-	1	
Trachyphloeus spp.			-	2	-	-	-	1	-	-	
Polydrusus spp.	tl		-	-	-	-	2	1	-	-	on young deciduous trees
Sitona spp.			-	-	-	-	1	-	5	-	
Rhyncolus spp.	dw		-	1	-	1	-	-	-	-	
Bagous spp.	ws		1	1	-	-	2	-	-	9	
Tanysphyrus lemnae (Payk.)	a		1	1	-	-	-	-	-	-	*Lemna* spp. (duckweed)
Thyrogenes spp.	ws		-	-	-	-	-	-	-	1	
Orthochaetes setiger (Beck)	p	NB	-	-	1	-	-	-	-	-	various plants on chalky and sandy land
Curculio venosus (Grav.)	tl		-	1	-	-	-	-	-	-	larvae in acorns and adults on leaf of *Quercus* spp. (oak spp.)
Curculio spp.	tl		1	-	-	-	1	-	-	-	
Magdalis sp.	tl		-	-	-	1	1	-	-	-	
Limnobaris pilistriata (Steph.)	ws		-	-	-	-	-	1	2	9	JUNCACEAE (rushes) and CYPERACEAE (sedges)
Micrelus ericae (Gyll.)	m		-	-	-	-	1	-	-	-	On *Calluna* spp. and *Erica* spp. (heathers)
Ceutorhynchus ?contractus (Marsh.)	p		-	-	-	-	1	-	-	-	Usually associated with RESEDACEAE (Mignottes Family) and PAPAVERACEAE (Poppy Family)
Ceutorhynchus spp.	p		-	-	1	-	-	-	-	-	
Rhynchaenus sp.	tl		-	3	-	2	2	-	-	-	
HYMENOPTERA											
Formicoidea Family Genus and spp. indet.			1	-	-	-	-	-	-	-	
DIPTERA											
Diptera Gen. & spp, indet.			-	-	-	3	1	9	9	10	

Key to ecological groupings used
a= aquatic water beetles
ws = waterside taxa often associated with emergent vegetation
df = taxa often associated with dung
p= taxa associated with grassland and open areas
dw = taxa associated with dead wood and fallen timber
tl = species associated with tree leaf
m= taxa associated with moorland

Red Data Book status (Hyman and Parsons 1994)
RDB1 = Endangered
RDB2 = Vulnerable
RDB3 = Rare
RDBK = Status not sufficiently known
RDBX = presumed extinct in the British Isles
NA and NB = notable species

Table 6.3. Ecological groupings for the Shapwick 2013 Insect faunas

Sample	**120-140 S 129**	**110-120 S130**	**100-110 S131**	**90-100 S132**	**80-90 S133**	**70-80 S134**	**60-70 S135**	**50-60 S136**
Sample weight (kg)	7.8	5.5	5.6	4.7	4.5	3.5	3	3.5
Sample litre (l)	6	7	7	6	5	5	3.5	5
number of individuals	104	133	58	89	151	126	103	63
number of species	41	37	28	36	60	49	35	20
% aquatic	57.7%	57.9%	48.3%	60.7%	50.3%	61.1%	61.2%	41.3%
% waterside	7.7%	12.8%	8.6%	5.6%	9.9%	10.3%	9.7%	44.4%
% dung foul / terrestrial	2.8%	0.0%	0.0%	3.3%	1.7%	11.1%	0.0%	0.0%
% dead wood / terrestrial	27.8%	28.2%	8.0%	23.3%	25.0%	22.2%	33.3%	0.0%
% tree leaf / terrestrial	2.8%	10.3%	8.0%	10.0%	10.0%	8.3%	0.0%	0.0%
% moorland / terrestrial	0.0%	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%	0.0%
% grassland and pasture / terrestrial	0.0%	2.6%	12.0%	6.7%	11.7%	8.3%	3.3%	11.1%

Shapwick Particle size analysis
by S. Maslin

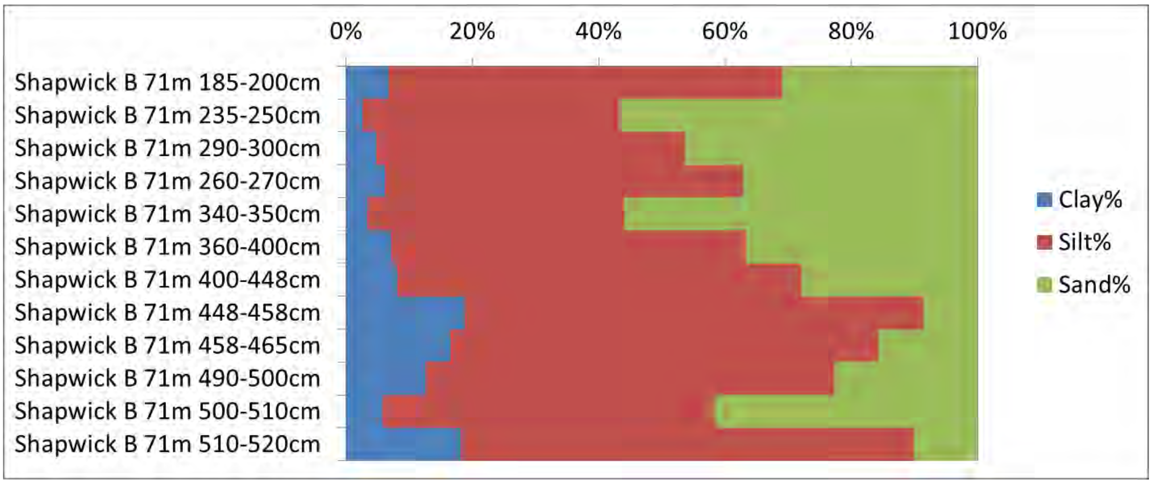

Figure 6.25a. Shapwick particle size analysis from the boreholes below Trench 1 (71m) and Trench 2 (63m) (graphic S. Maslin).

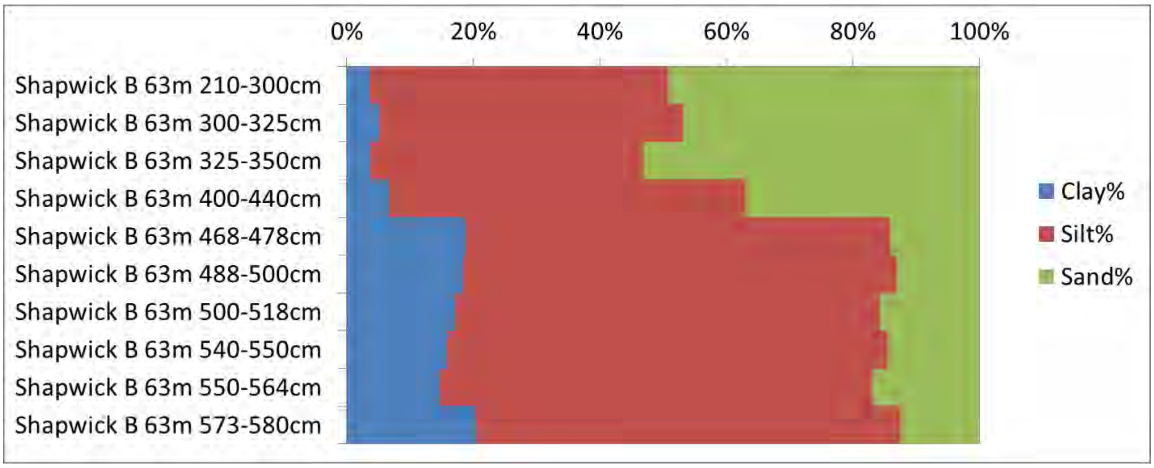

Figure 6.25b. Shapwick particle size analysis from the boreholes below Trench 2 at 63m

Shapwick
Particle size analysis has been undertaken in order to characterise the sediment sequence and investigate the composition of the underlying burtle deposits so that we can identify any sediment increments derived from their erosion (Figure 6.25a and b). Table 6.4 provides the results of particle size analysis of the samples from Trenches 1 and 2.

Trench 1. A sequence of 12 samples from the borehole below Trench 1 (Figure 6.25a) from 1.85-5.20 m have been analysed by laser granulometer. From 2-4m the samples are 40-50% sand with under 10% clay. Below 4m clay is between 10-20% and the sediments are predominantly silt.

From the borehole below the pit at 4-4.48m at the base of the burtle sands sieving produced fragments of *Cerastoderma* (cockle) and *Hydrobia* shells and many calcified roots. At 4.58-4.65m in shelly grey clay there a mollusc fauna of *Hydrobia*, *Bithynia*, *Planorbis* and *Carastoderma* with abundant *Chara* oospores indicating freshwater conditions subject to marine influence.

Shapwick 2013	Clay	Silt	Sand
Trench 1 Monolith 111 Old Land Surface 34-35cm silt loam	6.83	71.57	21.59
Trench 1 Monolith 111 50-51cm silt loam	11.70	69.37	18.90
Trench 1 Monolith 111 90-91cm silt	14.00	79.65	6.30
Trench 1 Monolith 115 base of Context 12, 25-26cm silt loam	11.16	75.49	13.31
Trench 1 Monolith 115 Context 13, 46-47cm, silt loam	11.87	77.11	11.02
Trench 2 Monolith 127 84-85cm silt loam	5.03	55.17	39.79
Trench 2 Monolith 127 99-100cm silt loam	7.74	69.53	22.73
Trench 2 Monolith 126 Context 112, 30cm silt loam	9.98	74.35	15.50
Trench 2 Monolith 126 Context 113, 99-100cm silt loam	5.48	52.92	41.60

Table 6.4 Shapwick Trenches 1 and 2: Particle size analysis.

Trench 2. 10 samples have been analysed (Figure 6.25b) between 2.1 and 5.8m with the same objective and similar results: c 40% sand and c 5% clay down to 4m, below that predominantly silt with about 20% clay and 15% sand.

From the borehole below Trench 2 at 3.75-4m in the lower part of the burtle sands there were cockle fragments and calcified roots. At 4.78-4.88m in the shelly grey clay there was an abundant freshwater mollusc fauna including *Lymnaea*, *Planorbis*, *Bithynia* and some land Mollusca eg *Carychium* with ostracods and abundant *Chara* oospores.

These samples indicate that the shelly grey clay represents freshwater conditions which gave way to marine conditions represented by the burtle sands. Both are thought to be of interglacial date. These burtle related samples will be the subject of analysis separately from the English Heritage funded project.

Shapwick sediment micromorphology analysis

by R.Y. Banerjea
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Introduction

The aim of the research at Shapwick was to examine the environmental context of the Mesolithic site. Micromorphology was undertaken on samples 1, 2 and 6, which were collected from two profiles: samples 1 and 2 from Trench 1, (Figure 6.26), and sample 6 from trench 2, (Figure 6.27). Samples 1 and 2 represented three field units: silty estuarine clay (Context 12); buried soil (Context 11), and a dark brown organic-rich layer (Context 9). Sample 6 represented a buried soil (Context 111), and a dark brown organic-rich layer (Context 110). During excavation, Trench 1 (Figure 6.26) showed the best opportunity to collect samples to examine the stratigraphy and buried soil (Contexts 11 and 111) using micromorphology. During excavation, Trench 1 produced the majority of the cultural material comprising charcoal and flints. Trench 2 produced one microlith from Context 111, but the old land surface in this trench was discontinuous due to tree throw events.

The aims of the micromorphological analysis were to identify the pedogenic and formation processes within the sequence and to address the following specific questions:
1. Do Contexts 11 and 111 have the characteristics of a buried soil in terms of pedogenic processes and formation processes?
2. What features and formation processes have produced the dark organic-rich clay horizon?
3. Is there any evidence for human activity such as microdebitage, angular flints, charcoal, bone fragments?
4. Is there any environmental evidence such as plant fossils and/or phytoliths?

Methods

Sample preparation
Six micromorphological thin-sections (8 x 6 cm) were prepared from the monoliths 1, 2 and 6 (2 slides per sample) in the Microanalysis Unit, University of Reading (Figures 6.26-7). The procedure followed is the University of Reading standard protocol for thin section preparation. Samples were dried to remove all moisture and then impregnated with epoxy resin while under vacuum. The impregnated samples are then left overnight so that the resin can enter all of the pores. The samples are then placed in an oven to dry for 18 hours at 70˚C before they are clamped and cut to create a 1cm slice through the sample. The surface of the 1cm slice is flattened and polished by grinding on the Brot. The prepared surface of the 1cm slice is then mounted onto a frosted slide and left to cure. This is followed by cutting off the excess sample, so the sample is down to a thickness of 1 or 2mm. The sample, which is now mounted to the glass slide and has been reduced to 1 or 2mm thick, is taken back to the Brot and ground down to approximately 100µm. This 100µm section is then further thinned by lapping it on a Logitech LP30 precision lapping machine to the standard geological thickness of 30µm. The samples are then cover slipped ready for analysis.

Sample Description
Micromorphological investigation was carried out by Rowena Banerjea, Quaternary Scientific, University of Reading, using a Leica DMLP polarising microscope at magnifications of x40 - x400 under Plane Polarised Light (PPL), Crossed Polarised Light (XPL), and where appropriate Oblique Incident Light (OIL). Thin-section description was conducted using the identification and quantification criteria set out by Bullock *et al* (1985) and Stoops (2003), with reference to Courty *et al* (1989) for the related distribution and microstructure, Mackenzie and Adams (1994) and Mackenzie and Guilford (1980) for rock and mineral identification, and Fitzpatrick (1993) for further identification of features such as clay coatings. Tables of results use the descriptions, inclusions and interpretations format used by Matthews (2000)

and Simpson (1998). Micropictographs were taken using a Leica camera attached to the Leica DMLP microscope.

Micromorphology enables the following properties to be examined at magnifications of x40 - x400 under PPL, XPL and OIL: thickness, bedding, particle size, sorting, coarse:fine ratio, composition of the fine material, groundmass, colour, related distribution, microstructure, orientation and distribution of inclusions, the shape of inclusions, and finally the inclusions to be identified and quantified. In addition, post-depositional alterations can be identified and quantified such as: effects on the microstructure by mesofaunal bioturbation and cracking due to shrink-swell of clays or trampling; translocation of clays and iron; chemical alteration such as the neoformation of minerals such as vivianite and manganese; organic staining as a result of decayed plant material; and excremental pedofeatures such as insect casts and earthworm granules.

Results and interpretation

Micromorphology descriptions for each deposit are recorded in Table 6.5, the frequency and types of inclusions within these deposits are recorded in Table 6.6, and the abundance of post-depositional alterations and pedofeatures within the deposits is recorded in Table 6.7. To determine the deposit type classification, each deposit was grouped using the following diagnostic sedimentary attributes and inclusions which provide crucial information concerning the origin of inclusions, transportation mechanisms of particles and the deposition processes. To ascertain the origin of sediment components descriptions were made of particle size, shape, and the composition of the coarse and fine fraction, particularly the frequency of rock, minerals and anthropogenic inclusions (Table 6.6). The depositional events are characterised by the following sedimentary attributes: sorting, related distribution, orientation and distribution of the inclusions (Table 6.5), and bedding structure (Table 6.6). Understanding the formation processes for deposits is crucial to interpreting the depositional pathways of rock fragments and minerals, any anthropogenic debris such as charred wood and artefacts, and other types of plant remains and microfossils (La Motta and Schiffer 1999; Matthews 2010; Schiffer 1987). Analysis of post-depositional features provides crucial information concerning the effects of weathering, preservation conditions (Bisdom *et al* 1982; Brady and Weil 2002; Breuning-Madsen *et al* 2003; Canti 1999; Courty *et al* 1989) and stratigraphic integrity of the deposit (Canti 2003; 2007; Courty *et al* 1989).

Microstratigraphic unit classification and descriptions

The following units have been classified (Figures 6.26-7): reworked estuarine sediment (Context 12); soil development horizon; buried soil; organic-rich clay (Context 9); and peat (Context 110). Micromorphological analysis shows that there are two microstratigraphic units (a and b) that comprise each of the buried soil horizons identified in the field (field contexts 11 and 111), which show different stages of the pedogenic process. Contexts 11a and 111a have been classified as soil development horizons, and Contexts 11b and 111b as buried soils.

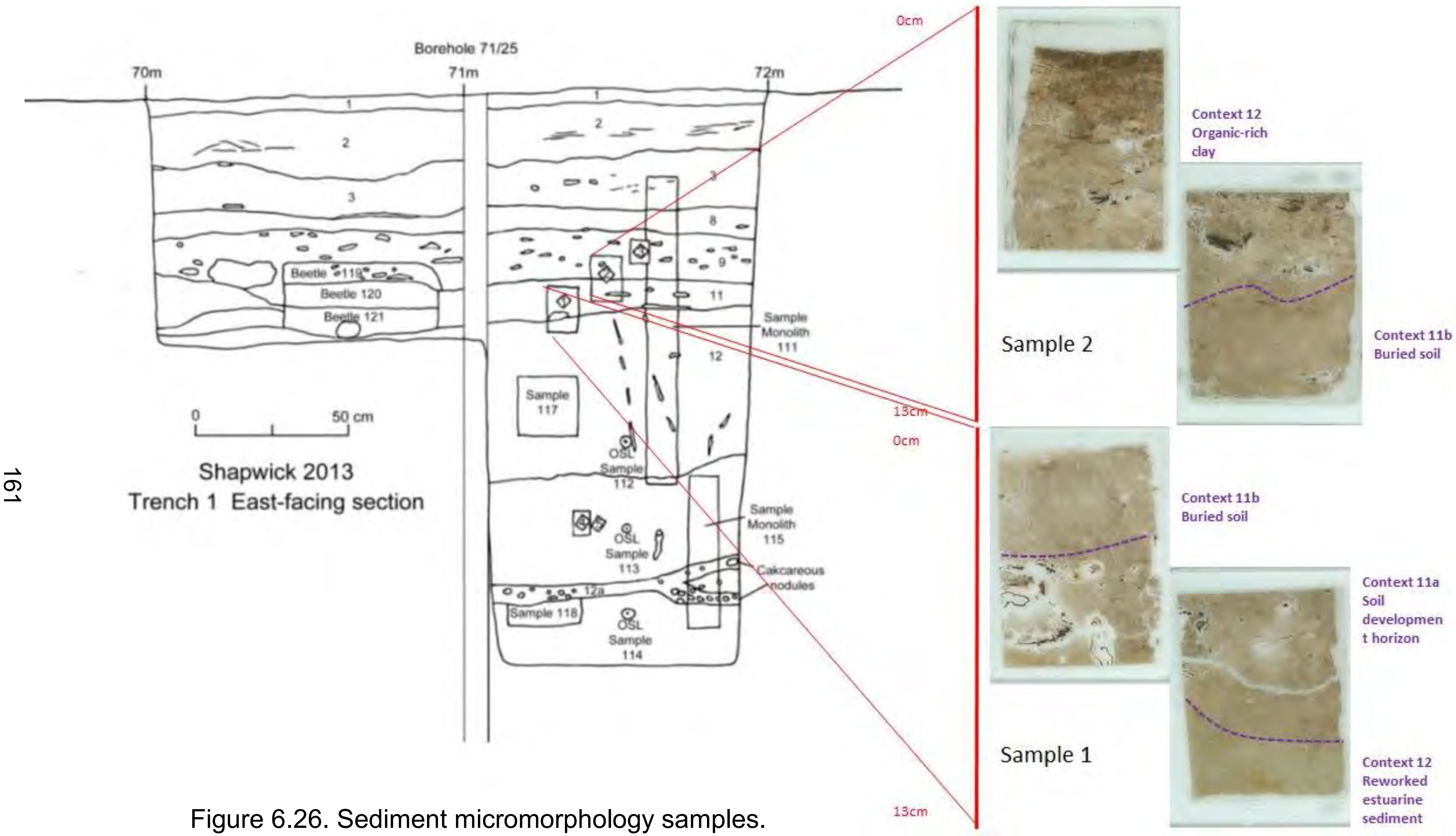

Figure 6.26. Sediment micromorphology samples.

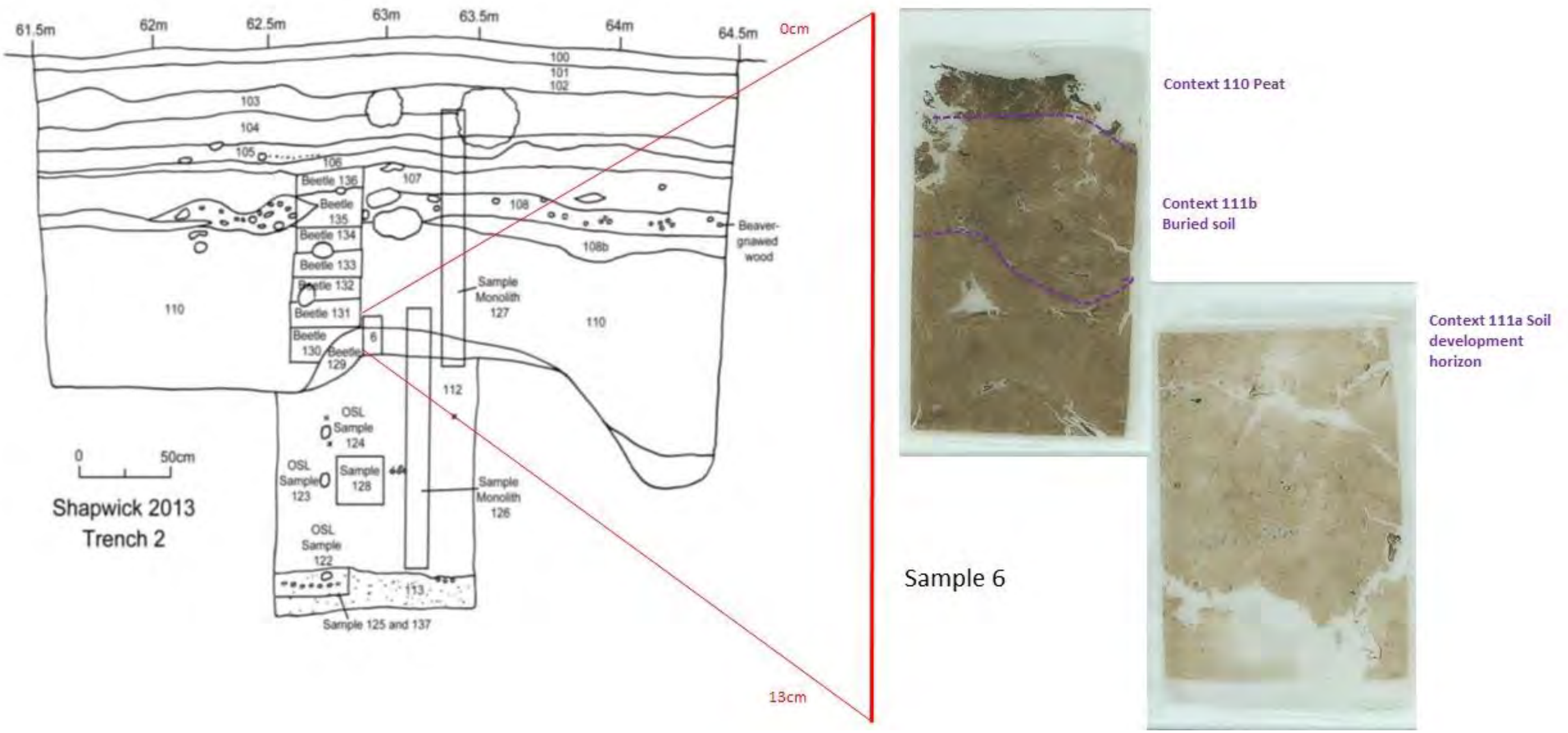

Figure 6.27 Shapwick Trench 2. Sediment micromorphology. Showing relation to the position of sample 6 in Trench 2.

Reworked estuarine sediment
Context 12 (sample 1) has been classified as reworked estuarine sediment. This unit has a clay loam and silty clay loam particle size and has bimodal (poorly sorted sand and well sorted silt) particle size (Table 6.5). The colour (PPL: light greyish brown with yellow/orange patches; XPL: bluish grey with yellow/orange patches) has a bluish grey hue (Table 6.5) that is characteristic of estuarine silts and clays, with iron mottles. There are no micro-laminations visible in this unit as would be expected to have formed in a low energy estuarine environment (Table 6.6), and instead it has a massive bedding structure, which suggests that the sediment may have been reworked, a process that incorporated the poorly sorted sand particles and removed any evidence for micro-laminations. The sediment is compacted as it has a closely embedded related distribution (Table 6.5). The inclusions are mostly unoriented and unrelated, random and unreferred, with some locally oriented clusters of sand-sized quartz grains (Table 6.5), which indicates a haphazard deposition of inclusions.

In origin, the inclusions (Table 6.6) predominantly consist of quartz, 70%, with the remaining inclusions comprising muscovite, manganese, iron and ferruginous plant remains (Figure 6.28). Abundant bioturbation, 10-20% (Table 6.7) seems to be root disturbance given the decayed and ferruginous plant tissue in channels. Clay coatings, 2-5% (Table 6.7) are also impregnated with Fe and organic staining.

Figure 6.28: Ferruginous plant remains, Context 12, slide 1 m-b, PPL.

Soil development horizon
Contexts 11a and 111a have been classified as soil development horizons. Sample 1 shows that Context 11a has a gradual, diffuse, pedological basal boundary sediment below (Table 6.5), which shows that the soil began to develop on the reworked estuarine silt. This unit has a silty clay loam particle size and has bimodal (unsorted sorted sand and well sorted silt) particle size (Table 6.5). This unit contains organic fine material (Table 6.5), more plant remains (Table 6) and bioturbation (Table 6.7) than Context 12 below. The presence of organic fine material is also represented by the browner colour than Context 12 below (Table 6.5). This horizon may have been a B-horizon as it has a sub-angular blocky ped structure in places, as indicated by the presence of complex packing voids in Context 11a (Table 6.5).

In origin the inclusions predominantly consist of quartz, 50%, with the remaining inclusions comprising ferruginous plant remains (Figure 6.28), 30%, muscovite, manganese and iron (Table 6.6). Context 111a contains charred wood, <1.5mm, and charred plant remains (Figure 6.29), <5% (Table 6.6). Bioturbation seems to result from root disturbance as there are fragments of roots in channels (Figure 6.29), and it is more abundant in Context 11a, than in 111a (Table 6.7). Clay coatings occur, <2%, and are impregnated with Fe and organic staining, but coatings are largely Fe and organic staining (Table 6.7).

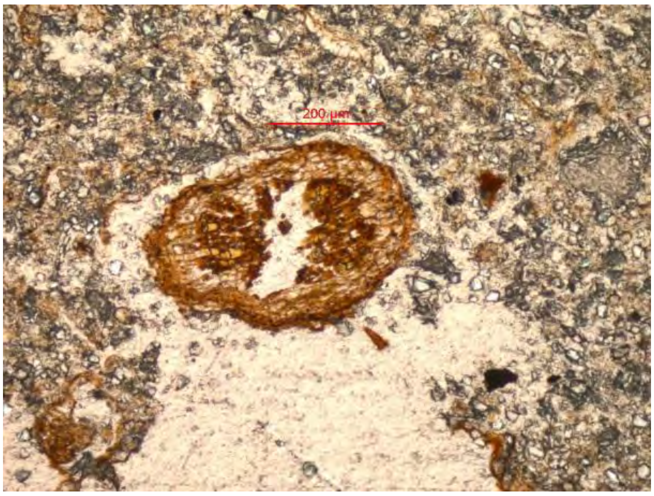

Figure 6.29: Ferruginous root-vascular bundle, Context 11a, slide 1 t-m PPL

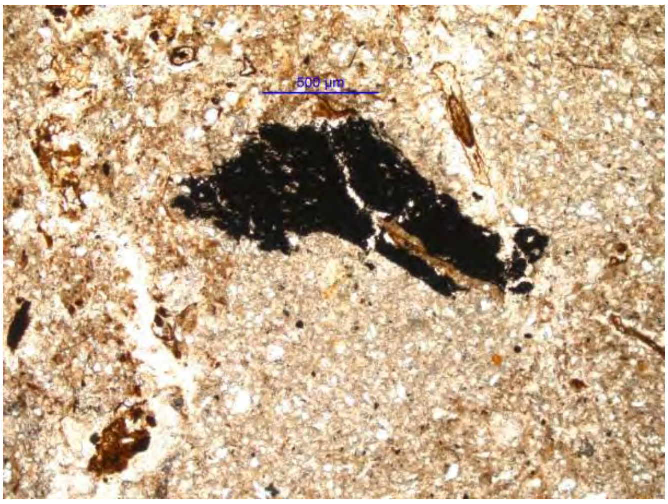

Figure 6.30: Charred wood fragment, Context 111a, 6 m-b, PPL

Buried soil

Contexts 11b and 111b have been classified as buried soils. This palaeosol has been compacted by burial, as evident by the (loosely) embedded related distribution (Table 6.5), and shows evidence of the decomposition of organic matter by the occurrence of organic staining (Table 6.7). Both compaction and the decomposition of organic matter are features of buried soils (Retallack 2001). Buried soils continue to undergo pedogenic processes after burial and it is important to understand the nature of burial when interpreting those (French 2003: 41). There are subtle differences in Context 111b in particle size, colour, and the amount of organic staining to 111a and sorting and the amount of organic staining between Contexts 11a and 11b (Tables 1 and 3). (11b) and (111b) have more abundant organic staining than (11a) and (111b) (Table

6.7) and the sand particles are less well sorted in context 11b than in 11a) (Table 6.6). Context 111b has a slightly coarser particle size in comparison with 111a below (Table 6.5). A less blocky ped structure and a greater amount of organic staining in contexts 11b and 111b suggests that these contexts contained more organic matter and therefore, may have been an A horizon (SASSA 2007). Again, there is abundant / very abundant bioturbation (Table 6.7), which seems to result from root disturbance.

Unlike, context 11b, context 111b contains fragments of charred wood and charred plant remains (Figure 6.31), <0.2mm, and fragments of rounded flint, <0.5mm (Table 6.6).

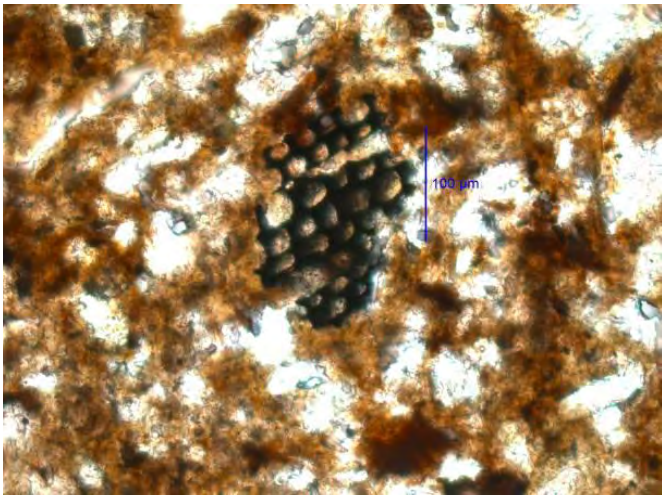

Figure 6.31: Charred plant fragment, Context 111b, slide 6 m-b, PPL.

Organic-rich clay
Context 9, has been classified as an organic-rich clay horizon (Table 6.5). This context overlies the buried soil, context 11b and the boundary between the two is gradual and diffuse (Table 6.5). This context has a silty clay loam/silt loam particle size and bimodal sorting (unsorted sand and well sorted silt; Table 6.5). The organic composition of the fine material has contributed to the dark brown colour of the sediment (Table 6.5). Context 9 has a micro-laminated bedding structure (Figure 6.32; Table 6.6).

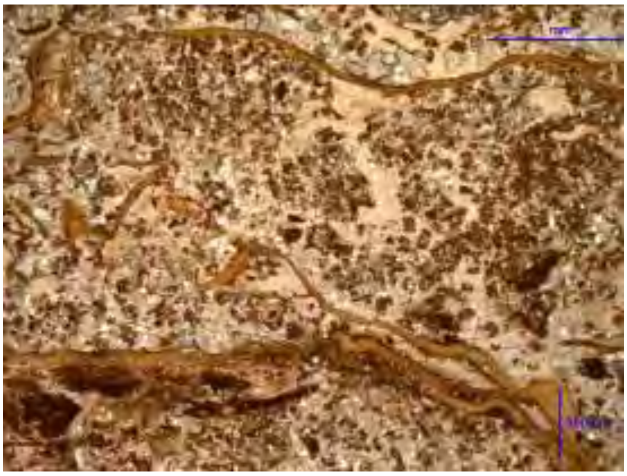

Figure 6.32: Microlaminations due to linear and parallel alignment to basal boundary of plant/wood remains, Context 9, slide 2 m-b, PPL

Micro-laminations are indicative of repeated periodic accumulation over time (Goldberg and Macphail 2006). The micro-laminations comprise lenses of organic material and mineral-rich clay. Minerals are mostly unoriented and unrelated, random and unreferred (Table 6.5). There are some locally oriented clusters of sand-sized quartz grains close to organic materials as if they have been washed-in; organic materials are strongly oriented aligned parallel to basal boundary (Table 6.5). This context shows some compaction as it is loosely embedded towards the base, but linked and coated towards the surface (Table 6.5). Root bioturbation is only visible in the upper part of this context (Table 6.7).

In origin, context 9 consists of minerals and organic materials (Table 6.6). The mineral composition is predominantly comprised of quartz (15-40%), although less abundant than other contexts in micromorphology samples 1, 2 and 6 (Table 6.6). The organic materials (Figures 6.33-4; Table 6.6) comprise wood (10%), ferruginous plant remains (40%), and charred plant remains (<5%). Flint fragments, <5%, (sub-angular and sub-rounded) occur in the basal 1cm of this context and are <1mm in size (Table 6.6).

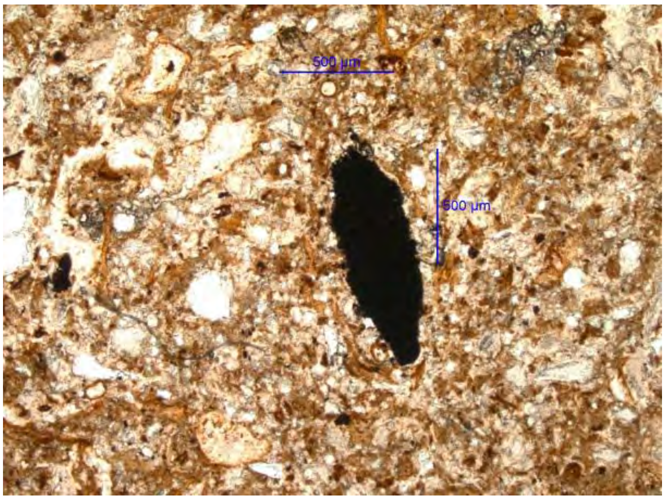

Figure 6.33: Stem (top) Charred plant, unidentifiable (below centre), Context 9, slide 2 m-b, PPL

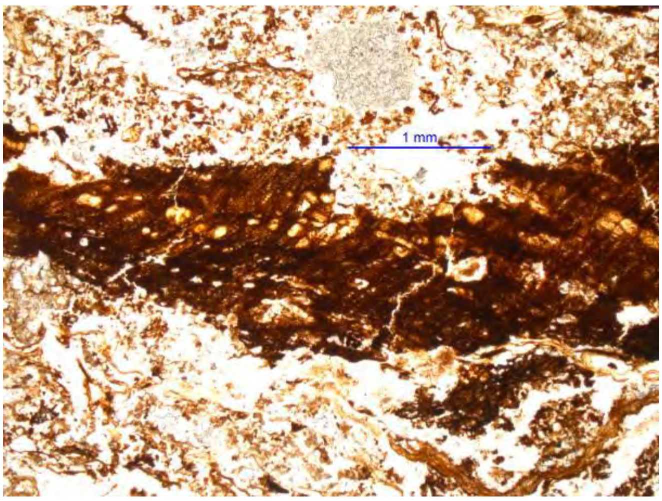

Figure 6.34: Wood- not charred, Context 9, slide 2 m-b, PPL

Peat
Context 110 has been classified as peat (Table 6.5). The fine material is predominantly organic with some mineral compnent (Table 6.5). Mineral inclusions consist of silt-sized quartz (Table 6.5), which are moderately sorted (Table 6.5). Context 110) has a micro-laminated bedding structure, indicative of repeated periodic accumulation over time (Goldberg and Macphail 2006). The organic materials are strongly oriented, aligned parallel to the basal boundary, whereas minerals are unoriented and unrelated, random and unreferred.

In origin, Context 110 predominantly consists of organic material comprising ferruginous plant tissue, >70%, and the mineral component comprises quartz, <15%, and iron, <15% (Table 6.6).

Anthropogenic detritus
Microdebitage
Microdebitage is defined as highly angular, flint particles less than 1000 μm in maximum dimension resulting from deliberate lithic reduction (Fladmark 1982). Two contexts contained fragments of flint, <5% (Table 6.6): the organic-rich clay, Context 9, contained sub-angular flints, <1000um, and sub-rounded flints, <600um, in the middle part of this context; and the buried soil, Context 111b, contained rounded flints, <500um. It is possible that these flint fragments, which are very few in abundance, represent microdebitage but the rounding suggests otherwise.

Charred organic materials
Small fragments, <1.5mm, of charred organic materials occur at low frequencies (Figures 6.30-31), <5-10% (Table 6.6) in the organic-rich clay (Context 9), the buried soil, Context 111b, and the soil development horizon in plan 15 (Context 111a). These fragments are mainly unidentifiable, but there are <5% fragments of charred wood within the soil development horizon, Context 111a. The low frequencies and size of the charred fragments suggests that these fragments may have been blown or washed in from nearby fires.

Environmental remains
The micromorphology is consistent with the field interpretation of reed and wood peats (Bell *et al* 2013: 14-17). Micromorphology from Context 9, the organic-rich clay, shows wood in the middle part of the deposit on this slide, suggesting that a wood was overlaid by a reed peat.

Post-depositional alterations
Weathering and decay processes
All units show substantial evidence for translocation processes, chemical weathering and fluctuating reduced conditions as indicated by the translocation of clay and iron, manganese neomineral formation, and organic staining (Table 6.7).

Clay translocation, in the form of unlaminated clay coatings, is not abundant and occurs in the reworked estuarine sediment, Context 12, 2-5%, and in the soil development horizons in both profiles, Contexts 11a and 111a, <2% (Table 6.7); many of these clay coatings are impregnated with iron and organic staining. Iron staining and coatings occur in all deposits at frequencies of 5-10% and 10-20%

(Table 6.7), and manganese neomineral formations occur in all deposits, with the exception of the peat (Context 110), most abundantly in the organic-rich clay (Context 9), 10-20%, and less frequently in the reworked estuarine sediment (Context 12), 2-5% (Table 6.7). Free iron is highly mobile only when present in the ferrous state which occurs under anaerobic conditions (Courty *et al* 1989) but oxidises to produce intrusive and impregnative iron and manganese pedofeatures as a result of wetting drying cycles (Lindbo *et al* 2010). Manganese may accumulate at the top of either the water table or the capillary fringe, and in association with decaying organic matter (Bartlett 1988; Rapp & Hill 1998). Fluctuating water tables lead to alterations of reducing and oxidising conditions (Brammer 1971; Brown 1997; French 2003; Lindbo *et al* 2010).

Darkening in colour, known as organic staining, is observed in thin-section from the decomposition of organic matter (Courty *et al* 1989) and occurs here in all deposits with the exception of the peat (Context 110) (Table 6.7). It occurs most abundantly in the buried soil horizons (Contexts 11b and 111b) and the organic-rich clay (Context 9), 10-20% (Table 6.7).

Bioturbation
Bioturbation, most probably from root disturbance occurs in all deposits with the exception of the lower part of the organic-rich clay (Table 6.7), and is identified by channels in the microstructure (Table 6.5). Fragments of roots are visible within many of the channels (Figures 6.29 and 6.35). Some chambers occur within the microstructure of the reworked estuarine sediment (Context 12), soil development horizon (Context 11a), and buried soil (Context 11b) indicating that mesofaunal activity may have occurred (Table 6.5).

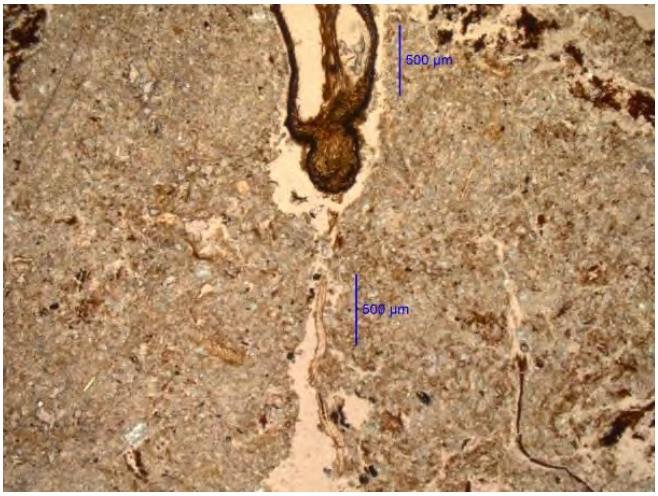

Figure 6.35: Decayed root in channel, Context 111a, slide 6 m-b, PPL

Discussion and conclusions

Sequence of depositional events
In Trench 1, samples 1 and 2 (Figure 6.26) show that the sequence of depositional events is as follows, base to top: a soil developed on a deposit of reworked estuarine sediment; the soil then became buried by an organic-rich clay deposit, which was overlaid by a peat deposit (not analysed in this micromorphology report). In Trench 2, sample 6 (Figure 6.27) shows that a soil developed and that, unlike the soil in Trench

1, this soil was buried by a deposit of peat rather than organic-rich clay sediment. This may suggest that the location of sample 2 in Trench 1 coincided with a low-energy environment where the silty clay loam/ sandy silt loam sediment, Context 9, (Table 6.5) was deposited at the edge of a channel.

Evidence for pedogenesis
There is evidence for soil development (Contexts 11a and 111a) and buried soils (Contexts 11b and 111b) in both Trenches 1 and 2 (Figures 6.24-5). Context 11a has a gradual, diffuse, pedological basal boundary with the sediment below (Table 6.5), which shows that the soil began to develop on the reworked estuarine silt. The buried soil horizons show compaction by burial under later peat deposits.

Evidence for human activity
The evidence for human activity comprises charred wood and plant remains but there is no clear evidence for microdebitage and given the limited number of lithic artefacts from the trenches (11 in Trench 1; 2 in Trench 2) this is not expected. The charcoal fragments are small, <1.5mm, and do not occur in high abundance, <5-10%, suggesting that these fragments do not represent *in situ* burning, but it is possible that these fragments may have been blown or washed in from nearby fires. Fragments of charred wood and plant remains were only identified within the soil development horizon and buried soil from Trench 2 (Figure 6.25) and organic-rich clay in Trench 1 (Figure 6.24). The burning of vegetation along the wetland edge to promote good grazing for animals (Law 1998) is another possibility for the source of the charcoal fragments. However, the other environmental evidence certainly does not suggest extensive clearance.

The evidence for microdebitage resulting from *in situ* deliberate lithic reduction is poor. Two contexts contained fragments of sub-rounded or sub-angular shaped flint, <5% (Table 6.6): the organic-rich clay in Trench 1 (Figure 6.24) and the buried soil in Trench 2. It is possible that these flint fragments, which are very few in abundance, represent microdebitage that has been washed in from elsewhere on the site. However, erosion and transportation from the Burtle sands cannot be discounted as a possible source for these flint fragments (British Geological Survey 2013).

Environment
The micromorphology indicates that there was a period of stabilisation that enabled a soil to form on a deposit of reworked estuarine sediment. This soil shows evidence of root bioturbation, which is possibly from the vegetation it supported, as root channels did not occur in the overlying peat and the lower part of the organic-rich clay (Table 6.7). The formation of the organic-rich clay in Trench 1 (Figure 6.24) indicates the in-wash of fine sediment from low energy flooding. The micromorphology is consistent with the field interpretation of reed and wood peats (Bell *et al* 2013: 14-17). Micromorphology from Context 9, the organic-rich clay, shows wood in the middle part of the deposit on this slide, suggesting that wood was overlaid by a reed peat.

Table 6.5: Deposit type descriptions to characterise depositional events and materials at Shapwick, Somerset Levels, UK.

Deposit type	Profile	Sample number	Unit number	Basal Boundary	Particle size	Sorting	Fine material	Groundmass	Colour	Related distibution	Microstructure	Inclusions: Orientation and Distribution
Reworked estuarine sediment	Plan 10	1 m-b	12	N/A	Clay loam/ silty clay loam	Bimodal: poorly sorted sand; well sorted silt.	Mineral	Crystallitic	PPL: light greyish brown with yellow/orange patches. XPL: blueish grey with yellow/orange patches.	Closely embedded and coated.	Channels 10% Chambers 5% Vughs 2%	Mostly unoriented and unrelated, random and unreferred. There are some locally oriented clusters of sand-sized quartz grains.
Soil development horizon	Plan 10	1 m-b	11a	Gradual, diffuse pedological	Silty clay loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crysallitic and isotropic	PPL: mid-brown to orangey brown. XPL: dark brown to dark orangey brown.	Loosely embedded and coated, and linked and coated.	Channels 15% Chambers 10%	Unoriented and unrelated, random and unreferred.
	Plan 10	1 t-m	11a	N/A	Silty clay loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crysallitic and isotropic	PPL: mid-brown to orangey brown. XPL: greyish brown to dark orangey brown.	Loosely embedded.	Compound packing voids in places 10% Channels 25%	Unoriented and unrelated, random and unreferred.
	Plan 15	6 m-b	111a	N/A	Silty clay loam/ silt loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crystallitic and isotropic	PPL: mid-brown to orangey brown. XPL: dark greyish brown to dark orangey brown.	Closely embedded and coated.	Channels 20%	Unoriented and unrelated, random and unreferred.
	Plan 15	6 t-m	111a	N/A	Silty clay loam/ silt loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crystallitic and isotropic	PPL: mid-brown to orangey brown. XPL: dark greyish brown to dark orangey brown.	Closely embedded and coated.	Channels 20%	Unoriented and unrelated, random and unreferred.
Buried soil	Plan 10	1 t-m	11b	Gradual, diffuse pedological	Silty clay loam	Bimodal: poorly sand; well sorted silt	Mineral and organic	Crysallitic and isotropic	PPL: mid-brown to orangey brown. XPL: dark greyish brown to dark orangey brown.	Loosely embedded.	Channels 15% Chambers 10%	Unoriented and unrelated, random and unreferred.
	Plan 10	2 m-b	11b	N/A	Silty clay loam	Bimodal: poorly sand; well sorted silt	Mineral and organic	Crysallitic and isotropic	PPL: mid-brown to orangey brown. XPL: dark greyish brown to dark orangey brown.	Loosely embedded.	Channels 10% Chambers 10% Vughs 2%	Unoriented and unrelated, random and unreferred.
	Plan 15	6 t-m	111b	Gradual, diffuse pedological	Silty clay loam/ sandy silt loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crystallitic and isotropic	PPL: dark orangey brown. XPL: greyish brown to dark orangey brown.	Loosely embedded and coated, and linked and coated.	Channels 25%	Unoriented and unrelated, random and unreferred.
Organic-rich clay	Plan 10	2 m-b	9	Gradual, diffuse pedological	Silty clay loam/ sandy silt loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crysallitic and isotropic	PPL: mid-brown to orangey brown. XPL: dark greyish brown to dark orangey brown.	Loosely embedded and coated, and linked and coated.	Spongey 20%	Minerals are mostly unoriented and unrelated, random and unreferred. There are some locally oriented clusters of sand-sized quartz grains close to organics. Organics are strongly oriented aligned parallel to basal boundary.
	Plan 10	2 t-m	9	N/A	Silty clay loam/silt loam	Bimodal: unsorted sand; well sorted silt	Mineral and organic	Crysallitic and isotropic	PPL: orangey brown. XPL: very dark greyish brown to very dark reddish brown towards the surface.	Loosely embedded towards base, and coated, and linked and coated towards surface.	Channels 10% Chambers 5% Spongey 10%	Minerals are mostly unoriented and unrelated, random and unreferred. There are some locally oriented clusters of sand-sized quartz grains close to organics. Organics are strongly oriented aligned parallel to basal boundary.
Peat	Plan 15	6 t-m	110	Clear, wavy and diffuse pedological	Peat	Moderately sorted silt	Organic with some mineral	Isotropic	PPL: dark brown to very dark brown	Linked and coated	Planes 10%	Organics are strongly oriented aligned parallel to basal boundary. Minerals are unoriented and unrelated, random and unreferred.

Table 6.6: Table showing the frequency and types of inclusions present, Shapwick, Somerset Levels, UK.

Deposit type	Sample number	Unit number	Thickness on slide (cm)	Bedding	Rock	Minerals & Aggregates					Organic/Plant remains								Micro-fossil			
					Flint	Quartz	Mica: muscovite	Gypsum	Manganese	Iron	Wood (non-charred)	Charred wood	Charred organic remains unident	Charred plant remains	Plant tissue ferruginous	Plant tissue (with cellulose)	Plant tissue (no cellulose)	Amorphous plant tissue Mn/Fe replaced	Spherical Fungal Spore	Pollen	Spherulites	Diatom
Reworked estuarine sediment	1 m-b	12	2.5-5.4	Massive		*****	*		*	**					**							
Soil development horizon	1 m-b	11a	3.7-6.5	Massive		*****	*		**	**					****							
	1 t-m	11a	4.5-5.0	Massive		*****	*		**	**					****	*						
	6 m-b	111a	8.5	Massive		****	*		**	***		*			***			*				
	6 t-m	111a	3.5-5.2	Massive		****	*		**	***			*		***	*		*				
Buried soil	1 t-m	11b	4.5-5.5	Massive		*****	*		**	***					***							
	2 m-b	11b	4-4.5	Massive		*****			**	***					***							
	6 t-m	111b	2.5-4.0	Massive	*	***			**	**			*	*	****	*		*				
Organic-rich clay	2 m-b	9	5	Micro-laminated	*	****	*		**	***	**		*		****							
	2 t-m	9	8.5	Micro-laminated	*	***			***	***			*		****							
Peat	6 t-m	110	1.0	Micro-laminated		**				**					******							

*Key: ****** = >70%; ***** = 50-70%; **** = 30-50%; *** = 15-30%; ** = 5-15 %; * = <5%*

Table 6.7: Table showing the abundance of post-depositional alterations and pedofeatures, Shapwick, Somerset Levels, UK.

Deposit type	Sample number	Unit number	Weathering				Decay		Trampling, shrink-swell etc.	Bioturbation				
			Translocation		Chemical alteration					Microstructure effects		Excremental pedofeatures		
			Clay coatings unlaminated	Iron	Gypsum crystal formation/	Manganese neomineral	Organic staining	Spherical fungal spores	Related distribution	Cracks	Mesofaunal / root bioturbation	Mesofauna cast	Organic/ organo-mineral	Earthworm granule
Reworked estuarine sediment	1 m-b	**12**	●●	●●●		●●	●●				●●●●			
Soil development horizon	1 m-b	**11a**	●	●●●		●●●	●●●				●●●●●			
	1 t-m	**11a**	●	●●●		●●●	●●●				●●●●●			
	6 m-b	**111a**	●	●●●●		●●●	●●●				●●●●			
	6 t-m	**111a**	●	●●●●		●●●	●●●				●●●●			
Buried soil	1 t-m	**11b**		●●●●		●●●	●●●●				●●●●●			
	2 m-b	**11b**		●●●●		●●●	●●●●				●●●●			
	6 t-m	**111b**		●●●		●●●	●●●●				●●●●●			
Organic-rich clay	2 m-b	**9**		●●●●		●●●	●●●●							
	2 t-m	**9**		●●●●		●●●●	●●●●				●●●●			
Peat	6 t-m	**110**		●●●						●●●				

Key: ●●●●● = >20%; ●●●● =10-20%; ●●● = 5-10 %; ●● = 2-5%; ●

Shapwick Conclusions

by Martin Bell

It was already known in advance of the present project that Mesolithic wetland deposits survived at the Shapwick burtle edge, at least at the time of the Sweet Track Site B excavations in 1971-2 (Coles *et al* 1973). What was less clear, and required investigation by the present project, was what potential the deposits had for understanding the Mesolithic site, and how the deposits had fared in the 41 years since the Site B excavation. Both trenches located a Mesolithic Old Land Surface and sediment micromorphological investigation supports the field interpretation of Contexts 11 and 111 as buried soils. Closest to the burtle edge in Trench 1 there was a scatter of lithics and charcoal but that surface was not sealed by peat until 3350-3090 cal BC, so some of the lithic material might be early Neolithic. The overlying peat at Trench 1 was highly desiccated and both the peat and Old Land Surface of very limited value in terms organic evidence either environmental, or artefactual. Fortunately Trench 2, just 5.5m further north from the burtle edge, presented a very different picture. Here only the top 0.35m of peat was severly dessicated and below this peat and wood were well preserved. Here the earliest organics, hazelnuts in the base of the Old Land Surface, are dated 4230-3970 cal BC and peat started to form 3640-3360 cal BC (Figure 6.16a). Here the Old Land Surface only survived in places as a result of tree throw. Charcoal was present in the Old Land Surface but the only lithic artefacts were a rod microlith, a type considered to be late Mesolithic and a flint chip. Rod microliths from the Fir Tree Field Shaft in Dorset are dated to the very latest Mesolithic (Allen and Green 1998). Biological evidence survives at Shapwick Trench 2 from the last *c* two centuries of the Mesolithic and through the early and mid Neolithic and the pollen evidence can be related to the diagrams from the Sweet Track.

From these results it might be concluded that the wetland edge activity areas, of which Trench 1 may represent a marginal area, have limited potential for organic survival, whilst the neighbouring wetland has limited artefactual, but high palaeoenvironmental, potential. This may well be a misapprehension created by the tiny sampling investigations of Trenches 1 and 2. Evidence from elsewhere (Chapter 11) indicates that Mesolithic activity areas can be patchy with zones of artefact concentration surrounded by virtually blank areas. It is perfectly possible, perhaps likely, that waterlogged Mesolithic activity areas survive on the eges of the Shapwick burtle.

The position of our trenches was carefully calculated from the earlier evidence of Site B (Coles *et al* 1973), the Jones transect (Figure 6.6), the geophysical results (Figures 6.8-10) and further detailed borehole investigation at 2.5m intervals in the key zone (Figure 6.12). As it turned out, when radiocarbon dates were obtained, the position was not ideal. Trench 1 lacked organic preservation and Trench 2 had a 1.15m peat sequence which started forming at about the Mesolithic – Neolithic transition. If the trench had been 2m to the west then a peat sequence of 1.6m is indicated by the 61m borehole (Figure 6.12). If the Trench had been located 4.5m to the west at Borehole 58.5m then a 2m peat sequence would have been encountered with perhaps up to 1m of Mesolithic peat. However, that would have required an excavation almost 3m deep to the burtle surface and thus the excavation of a larger area, shoring and pumping. Such an approach is likely to have been problematic just 20m from the Sweet Track.

The Optically Stimulated Luminescence date of 7.7ka BP from the upper part of estuarine silt underlying the Old Land Surface in Trench 2 is 1500 years earlier than the hazel nuts at the base of the peat. This implies that the Old Land Surface may be of some duration and thus that there is an interval between the maximum marine incursion at this point and peat inception. However, two caveats should be considered: first the uncertainties of the OSL date noted in Dr Toms Report (Appendix 5); the second that the date is from 20-30cm below the top of the estuarine sediment. However, the existence of an interval is independently suggested by the sandy nature of the Old Land Surface in both trenches. The sand appears to derive from colluvial slope process at the burtle edge. It is notable that, south of the burtle against the Polden edge, Wells *et al* (1999) found yellow-orange clay overlying blue clay, this also suggests colluvial processes. Coles *et al* (1973) found a lens of clay at the level of the Sweet Track (Figure 6.5), which might be either colluvial, or the result of tree throw bringing up underlying estuarine silt. We can conclude that there is some evidence of small scale slope process in the last 1500 years of the Mesolithic in both our trenches and that of Wells *et al* (1999) and further possible evidence at the Sweet Track *c* 3807-6 cal BC at Site B. This is likely to relate to environmental disturbance on the dry ground and this may relate to Mesolithic activity. We cannot, however, exclude the effects of disturbance created by natural agents, particularly perhaps the activities of animals taking advantage of the dry ground.

Evidence of possible very small-scale colluvial processes comes from both the Wells *et al* (1999) section south of the burtle and our Trenches 1 and 2, in each case significantly predating the Sweet Track. That opens up the intriguing, if highly tenuous, possibility that this reflects linear disturbance factors related to a natural routeway for people and / or animals well before formalisation by construction of the Track. Establishing whether this tenuous hypothesis is correct would require further, very carefully targeted, excavation at the wetland edge. It does, however, identify a way in which the tricky question of Mesolithic routeways could be further investigated (Bell forthcoming, Chapter 3).

In the Wilkinson Shapwick transect (Figures 6.1-2) the discovery of charcoal predating 5720-5530 cal BC may well relate to Mesolithic activity on the burtle. At the possible continuation of the Sweet Track, south of the Shapwick Burtle, Wells *et al* (1999) record relatively high charcoal peaks between 4075-4625 cal BC, this may indicate later Mesolithic activity, either on the burtle, or the adjacent Polden slopes. Charcoal was found in both Trenches 1 and 2 of the present excavations, however, in this on-site context, that could derive from hearths. It is notable that microcharcoal is well represented in the Old Land Surface and much lower in the overlying peat (Figure 6.23) suggesting less burning on the burtle in the Neolithic. The abundance of hazel pollen in Trench 2 and its local presence confirmed by the finding of many hazel nuts at the bottom the the peat (some radiocarbon dated to the Mesolithic) is noteworthy given Rackham's (1979) suggestion, on the basis of Sweet Track wood, for a coppice cycle for hazel and other species. There is also growing evidence for the management of hazel on coastal Mesolithic sites in Denmark (Pedersen *et al* 1997).

A key objective of our project was to investigate the Mesolithic – Neolithic transition, given that the Sweet Track is the earliest securely dated Neolithic site and associated cultural artefact assemblage in Western Britain (Whittle *et al* 2011). The trackway has figured prominently in many accounts of the process of Neolithisation (eg Thomas 2013, 248) albeit often with little reference to the presence of earlier Mesolithic activity. The relationship between the Sweet Track and vegetation change thus assumes particular significance. The pollen diagrams from Site F by Hibbert (in Coles *et al* 1973) and Beckett (1989) indicated the elm decline with some evidence of reduced woodland and clearance herbs from the time of the trackway. Orme (1982, 18) observed that the dates for the peat at Sweet Track Site F appear to be young by comparison with the track dates. The dendrochronological date for the trackway has subsequently confirmed this. The dated pollen diagram at Site F (Beckett 1979) has the Sweet Track between levels dated to 3640–3370 cal BC) and (4744±45 BP; SRR-882) and 3330–2900 cal BC (4405±45 BP; SRR-881). This would suggest the Sweet Track dates to c 3300 cal BC whereas it has subsequently been dated dendrochronologically to 3806-7 BC (Hillam *et al* 1990). The difference is likely to relate to the fact that, unusually among trackways, the Sweet Track has a pronounced 3-D form designed to raise the walkway above water, thus perhaps creating a degree of uncertainty about the peat horizon directly associated with construction, since peat has accumulated around the structure. In addition there are the probable effects of subsequent compression of peat around the more resistant form of the structure. The corollary of this is that the vegetation changes identified on the Beckett diagram from Site F such as the *elm* decline and woodland reduction may be a few centuries after the construction of the Sweet Track and the presence of clearance herbs a little later still, *c* 3000 cal BC. Indeed, the dates suggest that the Beckett (1979) Site F diagram, which extends 0.3m below the level at which the track is marked, and the base of which is dated 3698-3627 cal BC, does not extend down to the period of the Sweet Track. The originally published Site F diagram by Hibbert (in Coles *et al* 1973) extends 0.65m below the level of the track to the junction with underlying estuarine silts at 1.9m and below this, after an interval where pollen is not preserved, the diagram picks up between 5.4 and 6.5m in the Lower Peat. In this 1973, undated, diagram the elm decline occurs at 1.4m *c* 0.1-0.3m below the level of the trackway and clearance herbs are present from about the level of the trackway.

There is some evidence of woodland disturbance in the early Neolithic from the Somerset Levels Project diagrams and that from Trench 2. However, some of the vegetation changes thought to be coeval with the Sweet Track may in some cases be a little later given the dating evidence reviewed from Site F. From the beetle evidence of Trench 2 Dr Smith infers a dense stand of dryland forest on the burtle. Indeed both the pollen and beetle evidence suggest virtually closed woodland which is surely significant given that we know, from the date of peat inception in Trench 1, that Trench 2 was within 5.5m of the wetland edge at the time of peat inception. However, Smith does record some beetles of grassland and a very small number of dung beetles at 90-70cm, ie between 3630-3020 cal BC. Caseldine (1984), reviewing pollen evidence from sites TW and XG at the northern end of the Sweet Track, recorded a clear elm decline at what was identified as the trackway level.

However, this is dated *c.* 200 years later than what is now known to be the date of the trackway. On both diagrams lime declines, then oak, followed a little later by an increase in clearance herbs between horizons dated 3686-3508 and 3246-3101 cal BC. Wells *et al* (1999), at what may be a southerly extension of the Sweet Track, record synchronous declines of lime and elm at 3610-3090 cal BC. Wells *et al* (1999) also record that charred particles were common 3340-3700 cal BC. This coincides with the period when dung beetles are represented in the Trench 2 sequence. That date very closely matches the Trench 2 date for the *Tilia* decline (3630-3370 cal BC). However, the elm decline is less marked in the Trench 2 diagram from which we may infer the greater abundance of elms to the south towards the Poldens at Shapwick. However, there are marked elm declines from other pollen diagrams from the Sweet Track (Beckett 1979; Hibbert in Coles *et al* 1973) so perhaps at Trench 2 a wider signal may, to some extent, be masked at the wetland edge by local woodland. As Caseldine (1984, 73) observed, in discussion of sites at the northern end of the Sweet Track, we need sites near the wetland edge to obtain a clear picture of the dryland vegetation and activities. To some extent that is what we have tried to provide at the southern end, although it is apparent that there may be complications created by dense wetland edge vegetation partially masking a dryland vegetation signal.

We can conclude from this that later Mesolithic and initial Neolithic clearance was certainly not large scale but rather small-scale and localised. This is not what would be expected if there was a permanent, or even perhaps, frequently occupied settlement on the burtle itself, as might be inferred from the material culture from the Sweet Track excavations. However, many of these objects seem likely to have been deposited as a result of ritual activities (Coles and Brunning 2009; Bond 2004a). More probably settlement was small-scale, perhaps temporary and more probably on the Polden edge rather than the burtle, given the limited palaeoenvironmental traces and the evidence that the Sweet Track continued south of the burtle (Wells *et al* 1999). The relatively transient character of the Neolithic occupation is suggested by the evidence of the Sweet Track itself, which is thought to have had an active life of only 9-12 years (Coles and Brunning 2009) and does not seem to have been immediately replaced by any other structure.

On balance the new evidence seems to point to a rather smaller scale clearance with limited or equivocal evidence for agriculture, certainly in the initial Neolithic, than has often been inferred from the earlier Sweet Track pollen diagrams. Indeed the earliest disturbance seems to be rather later, maybe two to five centuries, after construction of the Sweet Track. Even so, the fact of the tracks construcion using wood from 13 types of tree, and the possibility that some of the wood was derived from trees which had previoiusly been managed, indicates that initial Neolithic, and possibly earlier communities, had some effect on woodland.

The beaver gnawed wood and the underlying layer of roundwood are reminiscent of the accumulations of flood drifted wood seen at the dry ground edge of the Somerset Levels during the severe flood in of January- February 2014 (eg photograph in Independent 29.1.14, p1). The beaver gnawed wood was well preserved and there is evidence of wetter conditions when it was accumulating. It is reasonable to infer that the beavers' activities were the cause of these wetter conditions *c*3330-2920 cal BC, uness the wetter conditions attracted the beavers to the area. This is two to four centuries later than the clearest evidence for woodland reduction inferred from a range of pollen diagrams above, so we do not have direct evidence that the beavers were responsible for the reduction in woodland, something of which modern analogues show they are perfectly capable (Coles 2006).

Site management and* in situ *preservation

The *in situ* preservation of the Sweet Track is considered in detail with the results of monitoring by Jones (2013). The results of this project also have significant implications for the future management of the site, which is part of the Shapwick Heath National Nature Reserve, and thus in the beneficial ownership of Natural England. The Shapwick pits were 20m west of the Sweet Track and provide some indication of the health of the peat containing the track. In Trench 1 all of the peat was very desiccated and wood was in very poor condition, mainly represented by bark and some dried wood. By contrast in Trench 2 only the top 0.45m of peat was desiccated and cracked. Below this was a layer of compact silty peat which the desiccation cracks did not penetrate. Below this peat and wood preservation was very good especially in the beaver gnawed wood layer of middle Neolithic date. This indicates that the early Neolithic peats containing the Sweet Track may remain in good condition and may not, at present, be as adversely affected by seasonally lower water tables as feared from the results of water table monitoring (Jones 2013). This assumes that the beneficial effects of the compact silty peat layer observed in this trench extend widely in the field and have not been disrupted by previous diggings for ditches, peat or archaeological excavation. The effects of localised excavation may not, however, be as serious as might be imagined. Trench 1, in which the peat was very desiccated on the burtle edge, was only 5.5m from Trench 2 where peat preservation was very good below the very desiccated top 0.45m.

The explanation for the apparent good survival of early and middle Neolithic peat despite monitoring evidence that the water table falls below the level of the Sweet Track in the summer (Jones 2013) is possibly a capillary fringe the water table that has so far maintained sufficiently damp conditions for effective preservation. Identifying ways of quantifying, and monitoring, capillary fringe is a particular research priority in wetland archaeological conservation. Attempts to do this using Time Domain Reflectometry at Glastonbury Lake Village (and we understand from colleagues also elsewhere) have proved problematic (Jones 2013; Louise Jones pers. comm.).

Also problematic is the preservation of Mesolithic horizons associated with activities on the burtle, although organic deposits of very late Mesolithic date survive in Trench 2 and are presumably represented by thicker deposits to the north. It is also the case that the dessicated Trench 1 produced 15 pieces of struck flint and the better conditions in Trench 2 produced only one microlith, a flint chip and some charcoal as evidence of human activity. Not surprisingly, therefore, the main concentration of Mesolithic activity may be on the burtle and its edge affected by desiccation. We have noted, however, that Mesolithic activity is often patchy and Mesolithic activity areas are likely within the wetland edge sediments especially now that it is clear that late, as well as early, Mesolithic activity is represented on Shapwick Burtle. In view of this, it is clearly important that water tables at the site do not fall any lower than their present level or, given the evidence for bog oaks being exposed by peat wastage (Jones 2013), are raised, thus protecting both Mesolithic evidence and the Sweet Track. The present lack of control over the sub-surface hydrology around the burtle also leaves the waterlogged deposits vulnerable to destruction during periodic extreme events, such as summer droughts.

Chapter 7: Brue valley test pits

by R. Brunning and M. Cox

Fieldwork location

The area of Shapwick parish was chosen for the test pit study because it encompassed Shapwick Burtle, which was one of main areas of fieldwork, and because it contained a dense concentration of small islands of hard geology, many of which had produced Mesolithic flint. Shapwick parish had also been the subject of an intensive programme of archaeological work that, although focused on later periods, provided some general information on the neighbouring dryland edge through the results of extensive fieldwalking (Gerrard and Aston 2012).

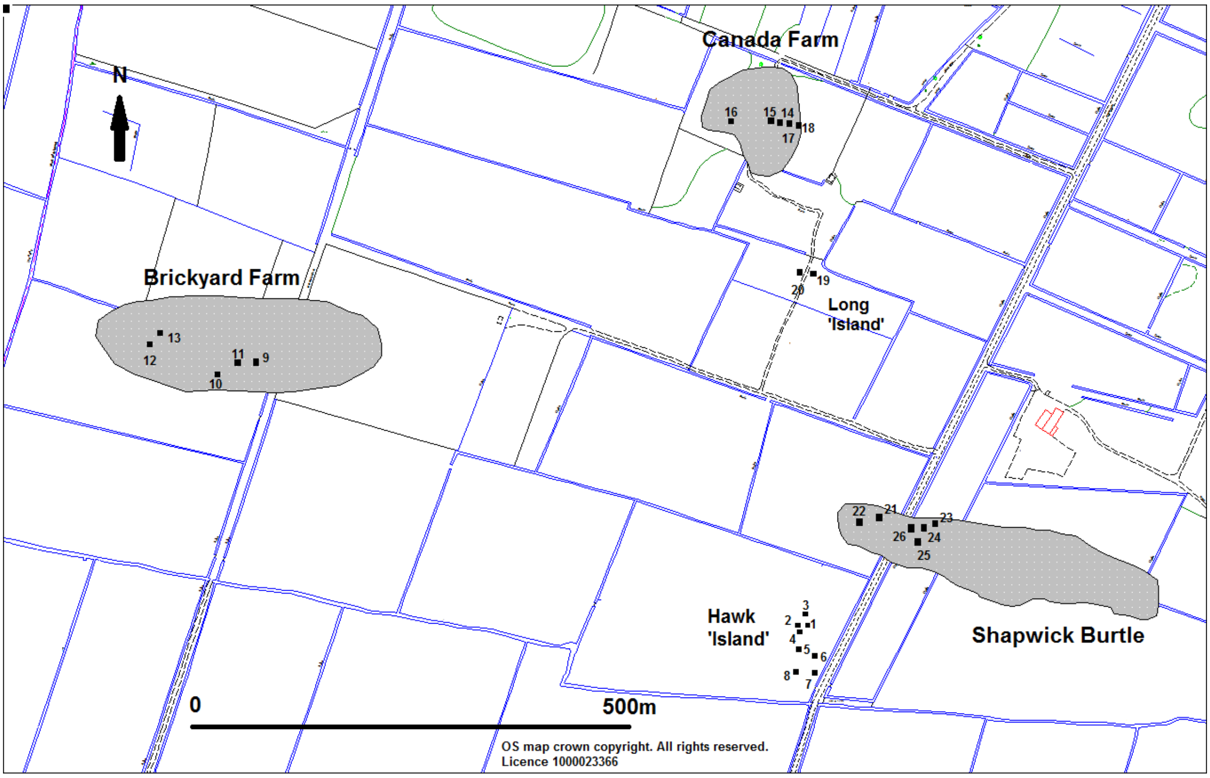

Figure 7.1 Brue Valley test pits 2013 (graphic R.Brunning)

The six locations (Figure 7.1) were all thought to represent probable islands of hard geology, eg burtles, in the floodplain. The test pitting proved that two of the locations were not in fact the locations of peaks of hard geology. In one case the apparent island probably represents post-medieval deposition of clay and in the other the undulations apparent on the ground surface were probably caused by peat wastage.

Methodology

Each pit was 1m by 1m in size. After the removal of the topsoil, the pit was excavated down to the underlying hard geology (if present). All the soil removed was intended to be hand sieved through a 1cm mesh. In some cases the clayey soil was so hard baked that it proved impractical to sieve all the material. The excavations were carried out by a mixture of professional archaeologists and local volunteers.

Results

The results varied significantly between the six locations. They are summarised in Table 7.1.

Table 7.1. Test pit locations and results

Island	Pit	Grid ref	Finds, features and comments
Hawk Island	1	ST41808 40121	All peat to 40cm
	2	ST41803 40125	All peat to 40cm
	3	ST41808 40129	All peat to 40cm
	4	ST41802 40119	Stony topsoil overlying peat
	5	ST41801 40091	Stony topsoil overlying peat
	6	ST41812 40087	Frequent stones to 30cm depth then peat
		ST41812 40070	Frequent stones to 30cm depth then peat
	8	ST41794 40078	Frequent stones to 30cm depth then peat
Brickyard Farm	9	ST41173 40412	3 stake holes, 5 flint chips and 1 flake
	10	ST41149 40404	2 stake holes
	11	ST41155 40411	19th century finds
	12	ST41105 40435	post hole with charcoal fill – early Neolithic
	13	ST41108 40441	Charcoal flecks
Canada Farm	14	ST41773 40697	
	15	ST41768 40698	Much modern finds
	16	ST41720 40690	Much modern finds
	17	ST41778 40693	
	18	ST41779 40691	Encountered peat at island edge

Long Island	19	ST41767 40506	All peat. Bronze Age wooden stake
	20	ST41786 40523	All peat
Shapwick Burtle- West Field	21	ST41891 40231	1 flint flake
	22	ST41855 40234	2 flint flakes late Meso to early Neo
Shapwick Burtle- Middle Field	23	ST41935 40236	3 flint flakes Mesolithic to Neolithic
	24	ST41928 40224	11 flint flakes Mesolithic to early Neolithic
	25	ST41926 40217	6 flint flakes from early Meso to early Neo
	26	ST41923 40220	

Hawk Island

This location was chosen because a lighter patch of soil on a small rise had been noted in a peat field to the west of Shapwick Road, immediately south of the western end of Shapwick Burtle. It was named Hawk Island as the land was owned by the Hawk and Owl Trust.

Eight pits were excavated across the area. These proved that the raised area of lighter soil had been formed by the deposition of a mixed clayey soil and stone rubble on top of the peat. This deposit had subsequently been spread over a wider area by ploughing. This deposition had probably taken place in the recent past, although no definitive dating evidence was obtained. There was therefore no 'island' of hard geology in this area.

Brickyard Farm

Brickyard Farm island is visible as a low narrow ridge that extends into four fields. The island was occupied by Brickyard Farm, a dwelling that was occupied in to living memory. The farmhouse is now largely destroyed and a large part of the island is covered in scrub. The test pits were located on the southwestern end of the island where a pasture field allowed easier excavation.

Pit 9

Beneath a 20cm deep light grey brown sandy clay topsoil (901) was a 10cm deep light yellow sandy clay with orange mottles (902) overlying a more compact orange/yellow sandy clay (911) interpreted as natural geology. This had been disturbed by two root holes and a 20cm diameter animal burrow in one corner. The natural was cut by three possible stake holes (903, 907, 909) and a larger more

Figure 7.2 Excavating a test pit in the Brue Valley.

irregular feature (905). The stake holes had the following dimensions. The top 2 layers produced 5 flint flakes and one flint chip.

903- 45/50mm diameter, 55mm deep. Fill (904) grey/brown sandy clay
905- 70mm by 115mm, 10cm deep. Fill (906) grey/brown sandy clay
907- 40mm diameter, 35mm deep. Fill (908) grey/brown sandy clay
909- 50/60mm diameter, 80mm deep. Fill (908) grey/brown sandy clay

Pit 10

Beneath a 20cm deep grey-brown sandy clay (1001) containing modern pottery was the sandy clay weathered natural that had been cut by two stake holes. Hole 1002 was 60mm in diameter and 55mm deep and hole 1004 was 50mm in diameter and 90mm deep with a smaller and shallower circular feature. Both were filled with orange-yellow sandy clay.

Pit 11 produced only 19th century pottery and brick or tile fragments.

Pit 12

A grey brown sandy clay (1201) overlay the natural orange-grey sandy clay that was cut by a post hole (1203) 140mm by 100mm and 100mm deep. Its fill (1204) was an orange-grey sandy clay with frequent charcoal. Charcoal from context 1204 was dated to 3960-3710 cal BC (95% confidence; SUERC-57737; 5037±30BP).

Pit 13 produced only a few charcoal flecks and patches sitting directly on top of the weathered natural at c.37cm depth below ground.

Canada Farm
Canada Farm forms a significant rise occupied by a modern farm that is still standing but has now been converted into a bat roost. Modern material was present in many of the pits around the farm but none of the 5 pits revealed prehistoric features or finds. The orange-grey sandy clay natural was often highly disturbed by mole runs and root holes. Pit 18 at the edge of the island encountered a humified peat at a depth of c.20cm.

Long Island
This area was targeted because a long irregular mound was visible on 1940's aerial photographs. It was also visible on the ground surface following an almost sinuous course. Two pits were excavated into it. Both pits encountered only natural peat deposits so there is no hard geology island present. Pit 20 was excavated to a depth of 30cm with a trial hole in one corner to 70cm. Pit 19 was excavated to a maximum of 95cm in one half of the pit. At that depth an alder roundwood stake was recovered, 117mm long and 35mm in diameter, that had been cut on two sides to form a wedge shaped point. This was dated to 1690-1520 cal BC (SUERC-54259 3333±30 BP; 95% confidence).

Shapwick Burtle- West Field
Two test pits (21 and 22) were excavated on the Burtle in the field to the west of the road. Not cut features were noted in either pit although there were occasional charcoal flecks throughout. The weathered natural was in both pits heavily disturbed by mole holes and root penetration.
Some modern pottery was present in the upper 20cm of pit 21. Pit 21 produced only a single prehistoric flint flake while pit 22 produced two flint flakes of late Mesolithic to early Neolithic date.

Shapwick Burtle - Centre Field
This investigation follows previous shovel pit investigations as part of the Shapwick Project (Appendix 1). Four test pits (23-6) were excavated in the narrow field to the east of Shapwick Road. The weathered natural was in both pits heavily disturbed by mole holes and root penetration to the extent that it would be hard to recognise any stake holes which may ever once have been present. It was of little surprise that none of the pits produced evidence of cut features.

Flint finds were recovered from pits 23 to 25. Pit 23 yielded three flint flakes of Mesolithic to Neolithic date. Pit 24 produced eleven flint flakes of Mesolithic to early Neolithic including one core rejuvenation flake with a gloss from use on one edge (2401).

Pit 25 produced six flint flakes from early Mesolithic to early Neolithic date.

Summary

A series of 26 1m square test pits were excavated on six different locations in the central Brue valley in the area of Shapwick parish. The technique proved to be a rapid and effective way of investigating the potential small islands of hard geology thought to exist in the area. Two locations proved not to be such islands. One was creation by the deposition of material on the peat surface in the medieval and post-medieval period and the other was a product of peat desiccation. Lithic material was retrieved from six test pits and possible stake holes were recorded in two pits at Brickyard Farm. Charcoal retrieved from a stake hole from pit 12 on Brickyard Farm was dated to the very beginning of the Neolithic period.

Figure 7.3 Shapwick Burtle Pit 24, the proud finder of a flint flake 2401.

Chapter 8: The middle Parrett valley, Somerset: a review of Mesolithic stratigraphy and ^{14}C chronology

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Introduction

Mesolithic strata buried beneath the current floodplain of the River Parrett has been revealed in number of borehole investigations in the period 2006-2010. Although the data have yet to be published, they are available as 'grey literature' reports (Wilkinson 2007a, 2007b, 2009) and it is the latter that is the basis for this report. The relevant boreholes were drilled for one of either two reasons: 1. In advance of bank strengthening between Monk's Lease Clyse and Northmoor Green being undertaking by the Environment Agency and its contractor, Black & Veatch Ltd, or 2. As part of projects funded by Somerset County Council to locate infilled palaeochannels of the River Tone (Table 8.1, Figure 8.1). In the former case the primary purpose of the investigation was to determine whether earlier embankments existed between the present flood defences and if the former sealed a stable ground surface. Thus the discovery of Mesolithic strata was a bi-product of the investigation. In the latter situation the aim of the projects was to test the depth and profile, but also to characterise the infilling and determine the age of palaeochannels visible on

Project name	Year	Sponsor	Boreholes	Depth drilled
Bank strengthening between Monk’s Leaze Clyse and Northmoor Green	2006	Environment Agency	14	4-8m
Bank strengthening between Thatcher's Arms and Moor House	2007	Black & Veatch Ltd	4	8-?m
Southlake Moor: bank assessment and palaeochannel investigation	2008	Somerset County Council	10	5-12m
Saltmoor: palaeochannel investigation	2010	Somerset County Council	6	5-11m

Table 8.1. Stratigraphic investigations of the middle Parrett valley that have encountered Mesolithic strata

LiDaR imagery in the Burrowbridge areas prior to reflooding of the moors. In all cases the investigative works were carried out by ARCA, the geoarchaeological consultancy of the University of Winchester.

In the text below an explanation is first provided of the geological and geomorphological background to the investigations of the Parrett stratigraphy. Next the field and laboratory methodologies employed by ARCA are outlined. Finally the Mesolithic lithostratigraphy sampled in the Parrett boreholes is discussed on the basis of depositional and chronological context. Biostratigraphic assessment and analytical data acquired by Quest for the Southlake Moor and Saltmoor sites are incorporated within the discussion.

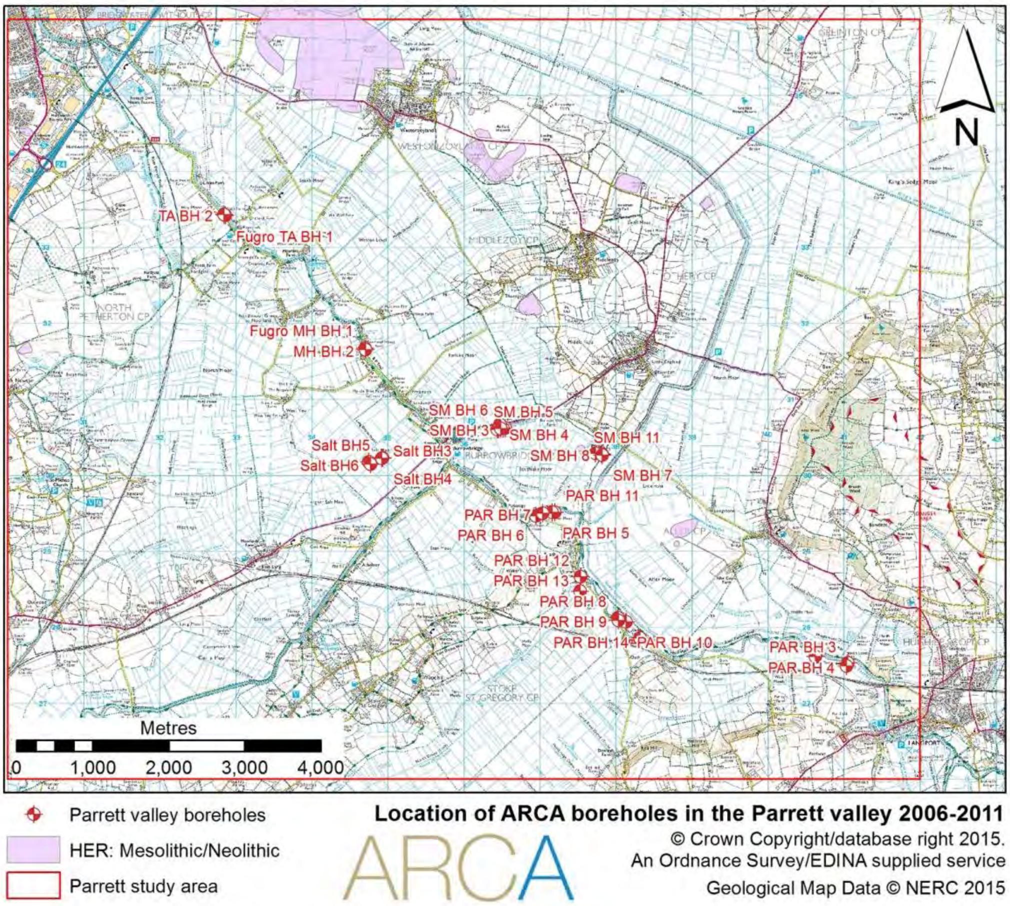

Figure 8.1: Location of borehole projects in the middle Parrett valley 2006-2011

Geological and geomorphological setting

The middle Parrett valley comprises the 18 km stretch of the Parrett river between Langport in the south-east and Bridgwater in the north-west (Figure 8.1). At the present day the gradient of this part of the Parrett river is <0.2m/km, while the middle Parrett stretch as far east as Oath is affected by tidal processes. The floodplain of the Parrett ranges in width between 140m at Langport and 5 km downstream of its confluence with the Tone, while it is bounded by the Polden ridge and isolated hills to the north and smaller outcrops to the south. The northern hills rise to 100m at Higham (but the Polden ridge is <100m OD) and is formed of deposits of the Triassic Mercia Mudstone Group (MMG), overlain by Lower Jurassic Lower Lias and Rhaetic beds (BGS 2014). The Burrow Mump MMG outcrop of c 35m OD elevation sits in isolation within the centre of the valley at Burrowbridge and thus overlooks the entire stretch. Elsewhere the Parrett floodplain is relatively flat, varying between 6m OD at Langport and 5m at Bridgwater and is mapped as Quaternary 'alluvium' (Figure 8.2) (BGS 2014). The south bank Tone tributary joins the Parrett in the Burrowbridge area, but although prior to drainage, there must have been north bank tributaries (e.g. from the Othery island), these do not survive in the present topography.

Prior to the investigations reported here, very little stratigraphic work had been carried out of the middle Parrett valley.

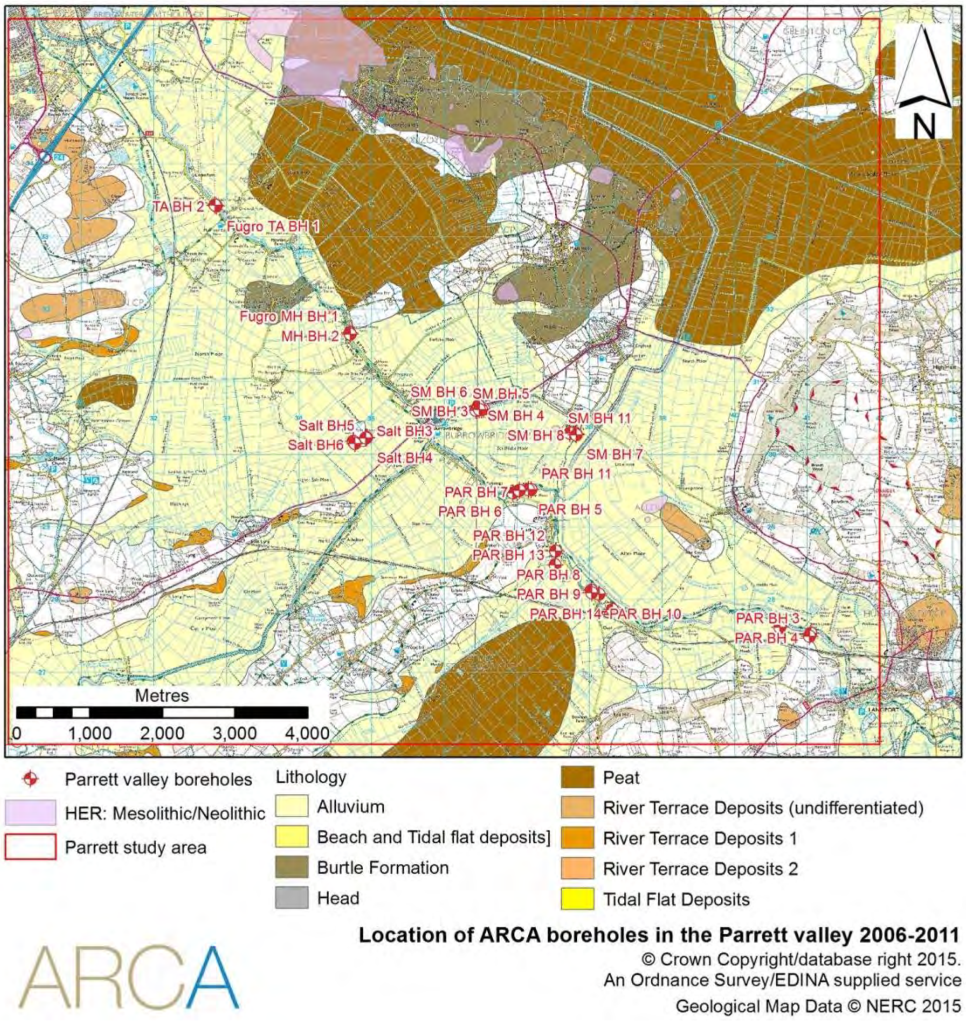

Figure 8.2. The Quaternary geology of the Middle Parrett valley

Methodology

The methodology employed during all four projects reported here was broadly similar. In the case of those carried out prior to bank strengthening the borehole locations were targeted on those areas most significantly affected by engineering work, while for the investigation of palaeochannels, transects of boreholes were setup perpendicular to the palaeochannel axis as identified in the LiDaR data. In all cases borehole positions were planned in the office using the ArcGIS software and the relevant coordinates transferred to a GPS for site survey. A Leica GS20 dGPS (horizontal accuracy ±0.300m following post-processing) was used to survey in the boreholes for the two bank strengthening projects, a Leica Zeno dGPS (±1.500m accuracy) for Saltmoor and a Leica System 1200 RTK GPS (±0.015m accuracy) for Southlake Moor. Elevation data was acquired using the Leica System 1200 GPS for the Southlake Moor site and by reference to LiDaR data for the other sites.

Except in the case of two geotechnical boreholes at Thatcher's Arms and Moor House, boreholes were drilled using Eijelkamp percussion drilling equipment comprising an Atlas Cobra petrol-powered hammer, a 53mm diameter by 1000mm long core-sampler and 75-50mm diameter by 1000mm gouge augers and 1000mm extension rods. Continuous core samples were taken from the present ground surface to the depths outlined in Table 8.1 in the case of the projects associated with bank strengthening works. These cores were then transported to the laboratory for further study. At Southlake Moor and Saltmoor, gouge augers were used to sample

Lab. No.	Site	Loc. ~	Depth (m BGL)	Material	^{14}C age/error (BP)	Calibrated date (2σ)*
Wk 20276	War Moor	PAR BH7	8.78-8.80	Peat	5823±65	4840-4520 cal. BC
Beta 229912	Moorland House	MH BH1	16.75-17.20	Peat	7740±60	6680-6460 cal. BC
Beta 229913	Moorland House	MH BH2	6.30-6.31	Peat	4520±50	3370-3080 cal. BC (92.9%) 3060-3030 cal. BC (2.5%)
Wk 25626	Southlake Moor	SM BH2	12.81-12.82	Peat	6336±33	5470-5450 cal. BC (1.2%) 5380-5220 cal. BC (94.2%)
Wk 25628	Southlake Moor	SM BH11	2.18-2.19	Peat	4975±33	3910-3870 cal. BC (5.7%) 3810-3660 cal. BC (89.7%)
Wk-30634	Saltmoor	Salt BH5	3.87-3.88	Peat	4368±25	3090-3060 cal. BC (4.9%) 3030-2910 cal. BC (90.5%)
SUERC-36630	Saltmoor	Salt BH6	10.81-10.83	Shell+	7560±40	6480-6360 cal. BC

Table 8.2. Results of AMS ^{14}C dating of samples from the middle Parrett floodplain
* calibration using the IntCal13 curve (Reimer et al. 2013) and OxCal v 4.2 (Bronk Ramsay 2009).
+ Operculae of the freshwater gastropod, *Bithynia tentaculata*.
~ For locations, see Figures 8.1 and 8.2

the stratigraphy of the majority of the boreholes and the exposed strata described on site and then discarded. Once the profile of the palaeochannels had been determined two further boreholes were drilled on each site using a core sampler. In the laboratory the plastic tubes containing the cores were sliced in two longitudinally using a bench mounted stone saw, and the strata revealed were then carefully hand-cleaned and described using standard geological criteria (Tucker 1982, Jones *et al*. 1999, Munsell Color 2000). The stratigraphy exposed in the gouge augers was described in the field according to the same criteria.

At Thatcher's Arms and Moorland House one borehole was drilled by the geotechnical contractor Fugro Ltd using a Dando (‘Shell and auger’) rig. Gouge auger heads were used and the stratigraphy described on site by a geotechnical engineer. Samples of key deposits collected both from the auger head and also by using a U4/100 core sampler. On completion of the drilling the Fugro geotechnical engineer provided ARCA with the borehole logs and a single peat sample from the Moorland House site [16.75-17.20m below ground level (BGL)].

Bulk peat sub-samples of 10mm thickness were collected from organic strata found in the cores for the purpose of ^{14}C dating from all four sites (a sub-sample of the 16.75-17.20m BGL sample from Moorland House was also dated), while operculae of the freshwater gastropod, *Bithynia tentaculata* were also collected for dating purposes from Saltmoor. A total of 17 such samples were submitted to Beta Analytic Inc (Florida, USA), Scottish Universities Environmental Research Centre (SUERC, East Kilbride, Scotland) and the Waikato Radiocarbon Laboratory (Waikato, New Zealand) for AMS ^{14}C measurement. Relevant results are included here as Table 8.2.

Sub-samples of 10mm thickness were also collected for biostratigraphic assessment (Southlake Moor) and analysis (Saltmoor). Six sub-samples from Saltmoor were analysed and twenty-one sub-samples (Southlake Moor) assessed for their fossil pollen content. The methods of pollen extraction and analysis were outlined in the pollen report in Chapter 4. Pollen *analysis* consisted of counting the grains and spores until a total of 300 total land pollen was reached while assessment consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide).

Five sub-samples were examined from the Saltmoor site to recover microfaunal remains including Ostracoda, Foraminifera and Charophytes. The extraction process involved: (1) measuring the sample volume by water displacement, (2) processing the sample by wet sieving through a 125μm mesh size, and (3) drying the samples; (4) dry-sieving of the samples through a nest of different size fractions. Semi-quantitative estimates of specimens of ostracods and charophytes from the fraction >250μm were made with using modern reference material and publications (e.g. Athersuch *et al.,* 1989; Meisch, 2000; Murray, 1979).

Twenty sub-samples were assessed from the Southlake Moor site to examine their diatom content. The diatom extraction involved the following procedures (Battarbee *et al.* 2001):

1. Treatment of the sub-sample (0.2g) with Hydrogen peroxide (30%) to remove organic material and Hydrochloric acid (50%) to remove remaining carbonates;
2. Centrifuging the sub-sample at 1200 rpm for 5 minutes and washing with distilled water (4 washes);
3. Removal of clay from the sub-samples in the last wash by adding a few drops of Ammonia (1%);
4. Two slides were prepared, each of a different concentration of the cleaned solution, were fixed in mounting medium of suitable refractive index for diatoms (Naphrax).

The diatom assessment procedure thereafter consisted of scanning the prepared slides at 2mm intervals along the whole length of the coverslip and recording the concentration and state of preservation of diatoms, and the principal diatom taxa.

Stratigraphy

The text below discusses the Mesolithic stratigraphy of the Parrett valley on the basis of its relative stratigraphic position and chronology. Three composite cross sections have been constructed to visualise the outcrop of Mesolithic strata along the valley as a whole (Figure 8. 3) and at the two most intensively investigated sites, Southlake Moor (Figure 8.4) and Saltmoor (Figure 8.5).

Before discussing the stratigraphy it is important to note one key point, namely that excepting the two geotechnical boreholes (MH BH 1 and TA BH1), no borehole extended to rockhead, and this despite drilling to >12m BGL in the case of boreholes at Southlake Moor and Saltmoor. The geotechnical boreholes indicate that fluvial gravels overlie MMG bedrock at 19m BGL (-12.5m OD) (Moorland House) and that head lies above MMG at 10m BGL (-2m OD) at Thatchers Arms (Figure 8.3). Pleistocene fluvial gravels were also encountered at 12m BGL (-8.7m OD) in the northern part of Southlake Moor (SM BH2 and SM BH10) (Figure 8.4), while head formed an apron around Barrow Mump in the southern part of the same site at 7m BGL (-3.8m OD) (SM BH5). On the Saltmoor site, early Holocene gyttja deposits outcropped at 10.7m BGL (-7.2m OD) (Salt BH1-2, Salt BH6) but could not be penetrated by the drilling device (Figure 8.5). The Early Holocene topography of the Parrett valley was therefore a great deal more variable than that of later periods . For example spreads of solifluction deposits emanated from local bedrock outcrops, several of which are now submerged beneath subsequent infill (e.g. Thatchers Arms and Barrow Mump).

The earliest Holocene deposits recognisable in the Parrett boreholes are lacustrine deposits and these have been found in two locations: Saltmoor and at Moorland House (Figures 3 and 5). Both sequences have been dated by AMS ^{14}C to the seventh millennium BC (Table 8.1: Beta 229912 and SUERC-36630). However, the character of the two sets of deposits is different and therefore they might derive from separate lakes, different parts of the same lake or they otherwise indicate that the properties of a single lake had changed over time. The Moorland House deposits were described by geotechnical engineers and therefore it is difficult to be precise about their exact nature. Nevertheless the basal part of the sequence appeasr to be comprised of laminated muds and thin peats. A single bulk sample from these deposits at 16.75-17.20m BGL (-9.25 to -9.70m OD) was found to contain the gastropod species *Bithynia tentaculata* and *Valvata piscinalis*, suggesting the presence of a moderate-sized or large water body containing slow moving or still water (Wilkinson in Thomas and Rackham 1996).

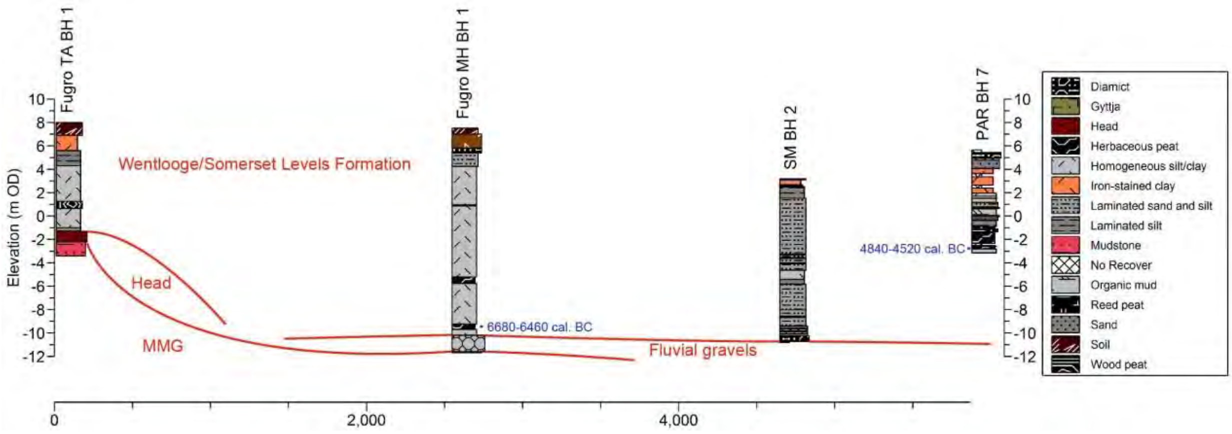

Figure 8.3. Longitudinal east-west composite cross section along the Parrett from War Moor (right) to Thatchers Arms (left

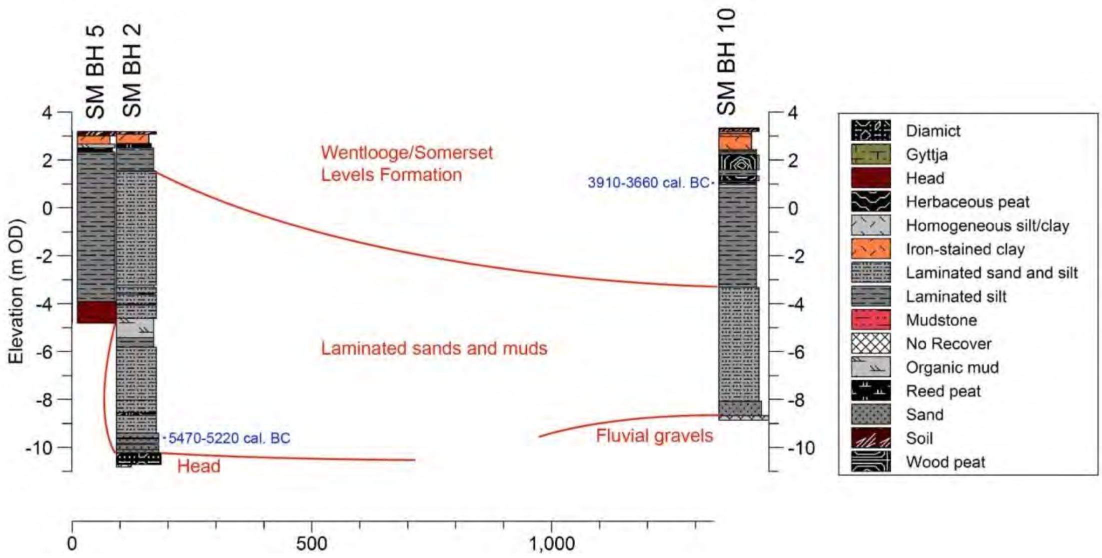

Figure 8.4. Composite north-east (right) to south-west (left) cross section through Southlake Moor

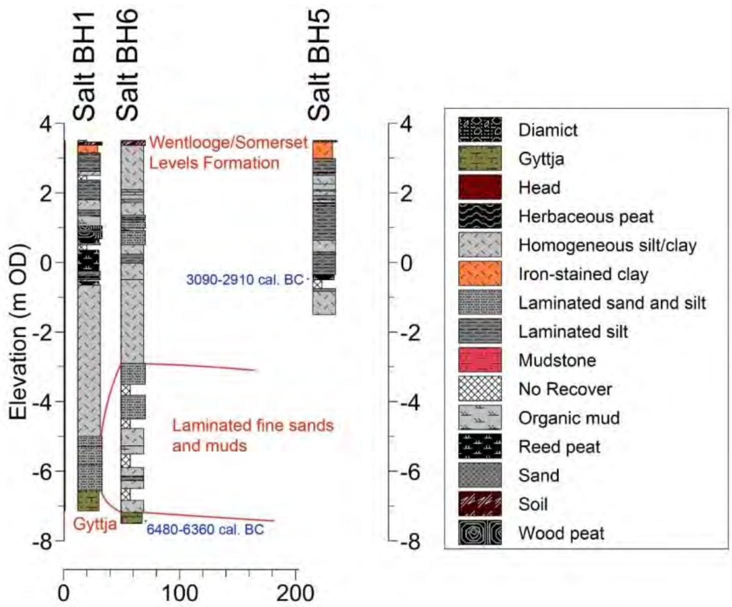

Figure 8. 5. Composite east (right) to west (left) cross section through Saltlake Moor

Lacustrine deposits

The Saltmoor lacustrine deposits comprised gytjja and like the basal strata at Moorland House also contained frequent mollusc shells (both gastropods and bivalves). While a small sample window precluded detailed macroscopic study, an analysis was carried out of the biostratigraphy of six samples with the following results:

Pollen

The pollen assemblage is analogous between samples, thus the application of local pollen assemblage zones is not appropriate (Figure 8.6). The samples are characterised by high values of tree (60%) and shrub (35%) pollen: *Alnus* (40%) and *Corylus* type (35%) dominate, with *Quercus* (15%), *Ulmus* (5%), *Fraxinus*, *Betula* (both <5%) and sporadic occurrences of *Pinus*, *Tilia*, *Calluna vulgaris*, *Hedera*, *Salix* and *Frangula alnus* (all <2%). Herbaceous pollen is limited (<5%), including Poaceae, Cyperaceae, Asteraceae, *Chenopodium* type and Apiaceae only. Aquatic and spore taxa are limited to sporadic occurrences of *Sparganium* type, *Dryopteris* type and *Polypodium vulgare* only (all <1%). Total Pollen Concentration generally declined from *ca*. 400,000 grains/cm^3 at 11.00m BGL to *ca*. 50,000 grains/cm^3 at 10.74m BGL. No microcharcoal fragments were recorded.

The results of the pollen analysis indicate that *Alnus* (alder) dominated the wetland with *Salix* (willow), probably forming fen carr woodland, which is typical of low-lying wetlands and analogous to other sites in the Somerset Levels. The ground flora consisted of herbs, aquatics and ferns including Poaceae (grasses), Cyperaceae (sedges), Asteraceae (daisies), Apiaceae (carrot family), *Polypodium vulgare* (polypody) and *Dryopteris* type (buckler fern). *Quercus* (oak)*, Ulmus* (elm)*, Fraxinus* (ash)*, Betula* (birch)*, Corylus* (hazel) and *Hedera* may also have grown within the alder fen carr but more likely formed a more mature woodland community on drier areas of the wetland, or on higher dry ground with *Tilia* (lime).
Genera of the family Chenopodiaceae (goosefoot family) (recorded at 10.78m BGS) may be found growing in two main locations: (1) waste, dry ground and cultivated land (e.g. *Chenopodium album* – fat hen), and (2) salt marshes (e.g. *Suaeda maritima* – annual sea-blite). The presence of *Chenopodium* type in the pollen record at 10.78m OD might therefore be an indication of either brackish or open conditions. However, only one grain was recorded, and no other no other palynological indicators of either type of environment were noted.
The consistency of the assemblages indicates that no significant change in vegetation composition or structure took place between 10.74 and 11.00m BGL. No indications of anthropogenic activity were recorded, and there are no pollen-stratigraphical indicators for the chronology of the sequence.

Ostracods, Mollusca, Foraminifera and plant macrofossils

Two distinct environmental settings can be recognised on the basis of their microfauna/flora in the studied interval. The uppermost sample and the lower most two samples represent periods dominated by freshwater environments. The two intervening samples represent a brackish episode. Occurrence data are depicted in Figure 8.7.

11.00m – 10.87m BGL (2 samples)
<u>Ostracods</u>: Ostracods are extremely rare in this interval and represented by individual juvenile specimens of *Loxoconcha elliptica*, *Cyprideis torosa* (smooth) *Heterocypris salina* and *Candona* spp.
<u>Miscellaneous</u>: These samples are dominated by the operculae of the freshwater gastropod, *Bithynia* sp. accompanied by common gastropod shells and oospores and gyrogonites of charophytes including rare specimens of *Nitellopsis obtusa*.

The dominance of *Bithynia* in this interval points to a slow-moving large body of freshwater. *Bithynia* prefers muddy substrates and dense growths of aquatic plants so their occurrence together with remains of charophytes is typical. Charophytes are indicators of clear, slow moving or standing fresh to slightly brackish water preferring calcium-rich waters. The occurrence of *Nitellopsis obtusa* does further indicate fresh water. Present day charophytes are found in areas of lowland fen including the Somerset Levels. The ostracods point to the proximity of environments similar to those described for the overlying interval.
10.87m – 10.75m BGL (2 samples)
<u>Ostracods</u>:
In contrast to the underlying interval ostracods are very abundant in these samples. They comprise principally of *Cyprideis torosa* (smooth variety), *Heterocypris salina*, *Loxoconcha elliptica* and *Candona* spp. *Candona* (including rare specimens attributable to *C. angulata* in the lower sample). In addition, the upper sample contained common specimens of *Cytherura gibba* and rare specimens of *Semicytherura ?cornuta*.
<u>Miscellaneous</u>:
Charophyte oospores, representing at least two different unidentified species, are at their most abundant in this interval but *Bithynia* is entirely absent. Very rare specimens of the foraminifer *Haynesina germanica* were recovered from the upper sample.

A brackish lagoonal environment is proposed for this interval. *Cyprideis torosa* is tolerant of a wide range of brackish environments, while *Candona angulata* with which it is often associated prefers slightly saline waters. *Loxoconcha elliptica* and *Cytherura gibba* are exclusively brackish water species confined to estuaries and lagoons. The Foraminifera *Haynesina germanica* is indicative of brackish water environments, common in estuarine, lagoonal or supratidal environments. The presence of charophytes is consistent with mildly brackish conditions and the total absence of *Bithynia* is explained by its restriction to freshwater habitats.

10.75m - 10.69m (1 sample)
<u>Ostracods</u>:
A single specimen of *Loxoconcha elliptica* was the only ostracod recovered from this sample.

<u>Miscellaneous</u>:
Bithynia sp. operculae are at their most abundant in the uppermost sample analysed. They were accompanied by common gastropods (e.g *Valvata piscinalis*) and

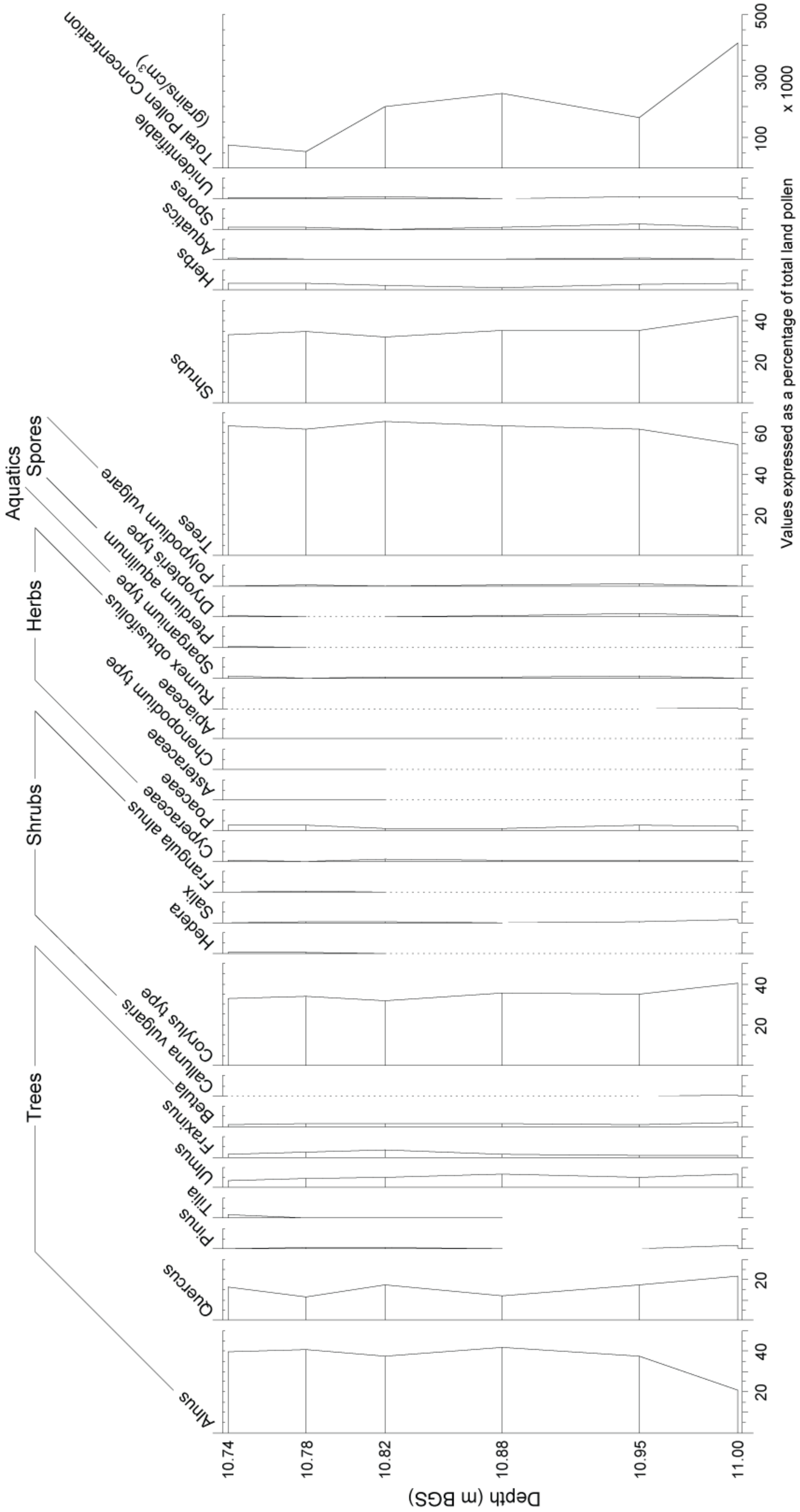

Figure 8.6: Pollen Percentage Diagram, Saltmoor, Somerset Levels

fragments of bivalves and rare charophyte gyrogonites and oospores including those of *Nitellopsis obtuse*

This sample represents the return to conditions similar to those seen in the lowermost two samples. The dominance of *Bithynia* and charophytes indicating clear, slow-moving or standing fresh to slightly brackish, calcium-rich waters. However, the presence of *Nitellopsis obtusa* in particular favours a freshwater interpretation.

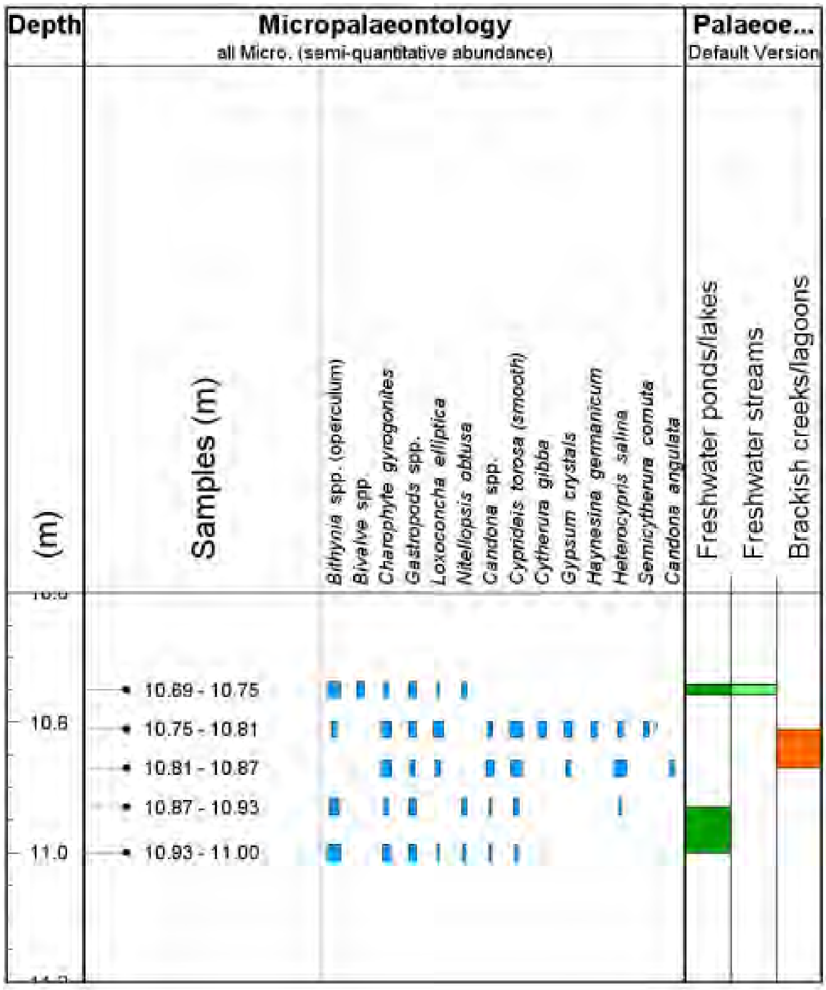

Figure 8.7: Distribution of calcareous microfauna /flora in BH6

Summary

The data from Saltmoor, and perhaps by implication Moorland House, suggest that calcium-rich lake waters were contained within local depressions set in the bedrock. The latter might result from abandoned Pleistocene or Early Holocene palaeochannels of the Parrett. Faunal macrofossils suggest that the waters were initially fresh, but that in the deposits between 10.87 and 10.75m BGL there are indications of tidal input leading to the formation of a brackish water lagoon. The latter demonstrates a connection with the river and hence the Bristol Channel. This transition to brackish conditions is correlated with the presence of a single *Chenopodium* type pollen at 10.78m BGL, which may or may not represent the nearby growth of saline plants. The fact that the brackish phase was short-lived (in lithostratigraphic terms), and that slow-moving or standing calcium-rich freshwater returned between 10.75 and 10.69m BGL, suggests a complex relationship of the site to the river and hence relative sea level (RSL) rise. The results of the pollen stratigraphic record indicate a local wetland environment throughout dominated by alder and willow fen carr woodland. Oak, hazel, ash and birch may have formed part of this community, but more likely formed more mature mixed deciduous woodland on drier areas of the wetland or on higher drier ground with lime. There are no indications that either vegetation community changed significantly over time.

Intertidal and alluvial deposits

The lacustrine deposits described above from Moorland House and Saltmoor are succeeded by a suite of Mesolithic mineral deposits (clays, silts and fine sands) and peats. These same strata also form the base of the Holocene sequence at Southlake Moor and the lowest part of the sampled sequence in boreholes to the east of Burrowbridge.

The earliest intertidal/alluvial stratigraphy for which there are good data with regards depositional environment is from possible channel fills on Southlake Moor. These strata outcrop from -9.5 to -3m OD across the site (SM BH2 and SM BH10) (Figure 8.4) and comprise grey (Munsell 5 Y 5/1) laminated silts and fine sands, with occasional thin peat beds. An AMS ^{14}C date on one of the latter produced an age of c. 5500-5200 cal. BC (Table 8.2, Wk 25626), while marine planktonic diatoms such as *Cymatosira belgica, Paralia sulcata, Campylosira cymbelliformis, Podosira stelligera, Actinoptychus undulatus* and *Rhaphoneis* spp were recovered from a sample at -9.07m OD during microbiological assessment. In addition to the above the deposits contained benthic mesohalobous diatoms such as *Nitzschia navicularis, Diploneis didyma and Diploneis aestuari*, but the dominance of the marine forms indicate a connection with the Bristol Channel and the influx of saline waters. Similar laminated deposits were noted above the lacustrine sequence at the Saltmoor site (Figure 8.5), while it is probable (as noted above, only geotechnical descriptions were available for the lowest Holocene stratigraphy) that they also outcrop at Moorland House (Figure 8.6). Boreholes from the eastern part of the Parrett study area did not penetrate to sufficient depth to encounter the laminated sediments (if indeed they are present at this location), partly because they were drilled from the top of the present flood defences).

The laminated beds are sometimes overlain by homogeneous mineral silt/clays (the homogeneity might be a product of bioturbation) and frequently by peat. Although the latter does not occur in every borehole, it is common across the study area and as noted above outcrops at -1 to +2m OD. Several radiocarbon dates have been obtained on the base of the peat and have produced ages ranging from 4820-4520 cal. BC (Table 8.2, Wk 20276) at War Moor to 3090-2910 cal. BC at Saltmoor (the late date at the latter location might be the result of the presence of a palaeochannel). It would therefore appear that in the Parrett valley, just as in other parts of the Somerset Levels, there was a phase of estuary contraction at the very end of the Mesolithic and which led to the development of freshwater marsh. This phase then lasted into the Bronze Age according to AMS ^{14}C dates from the eastern part of the study area.

Conclusions

The various borehole studies carried out by ARCA in the Parrett valley between 2006 and 2010 have demonstrated that Mesolithic depositional environments were much more dynamic than those of later periods. Dynamism undoubtedly reflects the rapid rate of RSL rise in the Early Holocene, but is also a factor of the varied topography left by periglacial processes (e.g. solifluction and braided channel development) at the end of the Pleistocene in comparison to the generally flat terrain of the Neolithic and later. Nevertheless there is no evidence in any borehole reviewed here for the presence of deposits dating from the first two millennia of the Holocene and it is therefore likely that such strata have been eroded by later processes. Rather the earliest Holocene strata are lacustrine beds of mid-seventh millennium BC age at Saltmoor and Moorland House. These are likely to have formed in hollows in the Pleistocene topography, initially in an entirely freshwater environment, but with indications for later brackish water input. The latter demonstrates a connection with the River Parrett and the fact that the latter must have been tidal. Later still in the mid-late sixth millennium BC, lithological and diatom evidence demonstrates that tidal waters extended up the channel system as far as the northern part of Southlake Moor. Deposition of laminated sands and muds in these tidal conditions thereafter deposited the majority of the Holocene sequence in the Saltmoor and Southlake Moor areas (9-12m), albeit that there is evidence of brief standstill phases in the form of occasional thin organic layers. This rapid intertidal sedimentation only ceased in the latest Mesolithic (mid-fifth millennium BC) when depositional rates outstripped RSL rise and freshwater marsh developed across much of the Parrett valley. The resultant peats thereafter continued forming until the Bronze Age. The vestiges of human occupation during the Mesolithic might be expected in any part of the sequence, although such activity might have been ephemeral and irregular in the intertidal deposits that form the majority of the sequence. Nevertheless, while the very limited palynological work that has been carried out shows no evidence for human activity, it is notable that magnetic susceptibility peaks in the laminated sequences from Southlake Moor suggest the input of ash into valley during the Mesolithic.

The text above presents an outline picture of changing environments in the Parrett valley during the first half of the Holocene. The majority of the work has been carried out as subsidiary elements of projects seeking to mitigate flood defence or reflooding works and so lacked a Mesolithic focus. The limited data that have been acquired by these means highlight our present lack of knowledge of depositional environments and human activity in the Parrett valley during first five millennia of the Holocene. Nevertheless there are a number of important implications of the results that have been obtained, key of which is that the Holocene basin fills of the middle Parrett valley range up to almost 18m in thickness, and are typically of >12m. Furthermore given that the base of the peat unit at -1 to 2m OD (c. 2-4m BGL) has been dated to the 4800-3000 cal. BC interval, 8-14m of deposits infilling the middle Parrett valley are of Early Neolithic and (mostly) Mesolithic date. These deposits exist mostly below 4m BGL and can therefore only be investigated in boreholes.

Chapter 9: The Mesolithic of the wetland/dryland edge in the Somerset levels – radiocarbon dating

by Peter Marshall, Christopher Bronk Ramsey, Elaine Dunbar and Paula Reimer

Introduction

Fifty-eight radiocarbon measurements were obtained on samples submitted for dating from Chedzoy (five), Greylake (10), Shapwick (20), and Queen's Sedgemoor (23). The samples were dated at the Oxford Radiocarbon Accelerator Unit (OxA-), The Queen's University Belfast (UBA-), and Scottish Universities Environmental Research Centre (SUERC-) between 2013–2015.

Laboratory methods

The 13 samples dated at The Queen's University Belfast were processed and dated by Accelerator Mass Spectrometry (AMS) as described in Reimer *et al* (2015).

Thirty-eight samples were dated at the SUERC. The single bone sample from Greylake was pre-treated using a modified Longin method (Longin 1971) and the waterlogged wood, plant macrofossils and peat samples as described by Stenhouse and Baxter (1983). CO_2 obtained from the pre-treated samples was combusted in pre-cleaned sealed quartz tubes (Vandeputte*et al* 1996) and then converted to graphite (Slota *et al* 1987). For each of the peat samples both the alkali-soluble ('humic acid') and alkali- and acid-insoluble ('humin') fractions were dated. The samples were dated by AMS as described by Freeman *et al* (2010).

The nine samples submitted to Oxford were prepared and dated as described by Brock *et al* (2010), Dee and Bronk Ramsey (2000), and Bronk Ramsey *et al* (2004).

All three laboratories maintain continual programmes of quality assurance procedures, in addition to participating in international inter-comparisons (Scott 2003; Scott *et al* 2010). These tests indicate no significant offsets and demonstrate the validity of the precision quoted.

The results (Tables 9.1, 9.3–6, and 9.8) are conventional radiocarbon ages (Stuiver and Polach 1977), and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986).

Radiocarbon calibration

The calibrations of these results, which relate the radiocarbon measurements directly to the calendrical time scale, are given in Tables 9.1, 9.3–6, and 9.8 and in Figures 9.1, 9.3–5, and 9.13). All have been calculated using the datasets published by Reimer *et al* (2013) and the computer program OxCal v4.2 (Bronk Ramsey 1995; 1998; 2001; 2009). The calibrated date ranges cited are quoted in the form recommended by Mook (1986), with the end points rounded outward to 10 years.

The ranges in Tables 9.1, 9.3–6, and 9.8 have been calculated according to the maximum intercept method (Stuiver and Reimer 1986); the probability distributions shown in Figures 9.1–13 are derived from the probability method (Stuiver and Reimer 1993).

Chedzoy

To establish the extent to which waterlogged organic sediments of Mesolithic date are preserved close to the lithic scatter on the sandy burtle island a 100m long transect of 21 boreholes and two test pits were dug across the wetland edge at Chedzoy burtle.

Trench 2

Three samples were dated from Trench 2 (Table 9.1; Fig 9.1) at 41m on the transect to establish if waterlogged deposits of Mesolithic or early Neolithic date were present in the basal sediments. Measurements on the humic and humin fractions of the peat sample from 0.68–0.69cm, 3cm below a Mesolithic core which was found in the monolith tin and had been deposited within the peat, are statistically consistent (T'=1.3; T'(5%)=3.8; v=1; Ward and Wilson 1978) and a weighted mean has been calculated (5269±20 BP) as providing the best estimate for the age of the deposit.

Age-depth modelling

An age-depth model (Bronk Ramsey 2008) for the sequence from Trench 2 was constructed to provide a chronology for the pollen analysis (Batchelor and Morandi, this report). A uniform aged depth model (U-Sequence; Fig 9.2) in which the accumulation rate is unknown but assumed to be constant (Christen *et al* 1995) shows good overall agreement (A_{model}=130). The model confirms that waterlogged deposits of late Mesolithic/early Neolithic date survive at the base of the sequence and estimates for the ages of selected events identified in the palaeonvironmental record are given in Table 9.2.

Borehole 100m

A single fragment of cf *Salix/Poplus* sp. type charcoal in the lowest peat at 467-472cm in the borehole at 100m was dated as the charcoal seems likely to relate to human activity at the time basal peat was forming by a rising water-table on the land-surface. The charcoal dates to 5200–4940 cal BC (SUERC-53050; 6087±29 BP; Fig 9.1).

Greylake Burtle

The objective of the dating strategy at Greylake was to establish to what extent waterlogged organic sediments of Mesolithic date are preserved close to the lithic scatter on the sandy burtle islands. The results are shown in Tables 9.3–4 and Figure 9.3.

Borehole (BH) 28

Borehole (BH) 28 was drilled between Greylake Burtle and high ground to the west and sampled peat and intertidal strata between the two features. Measurements on the humic and humin fractions of the peat sample from 792–793cm at the base of the Lower Peat are not statistically consistent (T'=9.1; T'(5%)=3.8; v=1). The early sixth millennium cal BC ages for the humic and humin fractions do though indicate that the lower peat is considerably younger than the Mesolithic activity on the Greylake Burtle 8445-8260 cal BC (Wk-30930; 9118±37 BP) and 8460-8275 cal BC (Wk-30931; 9134±37 BP; Brunning and Firth 2011).

Statistically consistent (T'=0,2; T'(5%)=3.8; v=1) measurements on peat from 753–754cm (weighted mean - 6238±20 BP) provide a date of 5300–5205 cal BC (95% confidence) for the upper contact of the Lower Peat and a maximum age for the burial of the peat shelf by intertidal sediments.

Two samples were submitted from the lower contact of the Upper Peat - 375–376m – a peat sample and bulked aerial sedge remains. The three radiocarbon determinations are statistically consistent (T'=2.4; T'(5%)=6.0; v=2) providing a weighted mean of 5651±19 BP. The best estimate for the formation of this deposit is therefore 4540–4450 cal BC (95% confidence)

Test pit
Three samples were dated from the Greylake test pit that was dug immediately north of Borehole (BH) 3. UBA-25438 provides a date of 3640–3370 cal BC (95% confidence) for the lowest Holocene sediments, blue grey silt / clay (Unit 5), and UBA-25439 a date of 3360–3020 cal BC (95% confidence) for the top of the moderately humified peat (Unit 3). The results establish that organic preservation of early Neolithic material, but not Mesolithic, occurs in Unit 3 (and the underlying mineral Unit 5) of the test pit

A single bovid bone found at the interface between the Burtle Formation and the overlying grey-blue silt/clays (Unit 5) dates to 3690–3530 cal BC (95% confidence; SUERC-57490).

Shapwick

Trench 1
A slice from the base of the peat Monolith 111, which in this pit was very desiccated, was submitted to establish the date of peat encroachment on the edge of the burtle where peat overlies a Mesolithic flint scatter. Measurements on the humic and humin fractions of the peat are statistically consistent (T'=1.2; T'(5%)=3.8; v=1) and a weighted mean (4495±21 BP) provides the best estimate for its formation of 3350–3090 cal BC (95% confidence; Table 9.5; Fig 9.4).

Trench 2
Twenty radiocarbon determinations were obtained from Trench 2 (Table 9.6) to establish the temporal relationship between waterlogged sediments investigated at the wetland edge in the pit and both the Mesolithic period and the construction of the Sweet Track (3807/06 BC, Hillam *et al* 1990). In addition two OSL samples were dated from the estuarine silt and Burtle sand that undelay the organic sediments in the test pit.

Measurements on three hazelnut shells from the Old Land Surface [111] UBA-25383; SUERC-52458; UBA-25387 are statistically consistent (T'=1.1; T'(5%)=6.0; v=2) and could be of the same actual age. These provide a date for the onset of waterlogged conditions which led to peat formation of *4045–3940 cal BC (90% probability; context_111*) and probably *4010–3960 cal BC* (*68% probability*).

Monolith 127 was taken through the 1.15–1.55m thick peat overlying the old land-surface in order for detailed palynological analysis (Batchelor and Brown, this report). Samples from five levels were submitted for radiocarbon dating from Monolith 127 in order to construct a precise and robust chronology. Measurements on the humic and humin fractions of peat samples from 70–71cm and 80–81cm are both statistically consistent (T'=0.0; and T'=3.4; T'(5%)=3.8; v=1) and weighted means have been calculated for both samples (70–71cm; 4704±27BP, and 80–81cm; 4883±21 BP) as providing the best estimates for their age of formation. Radiocarbon determinations on two unidentified twigs from 14-15cm are also statistically consistent (T'=0.5; T'(5%)=3.8; v=1) and could be of the same actual age.

Three samples of roundwood, SUERC-52457; SUERC-52460; and UBA-25386, from immediately below the horizon containing the beaver gnawed wood are statistically consistent at 99% confidence (T'=7.5; T'(1%)=9.2; v=2) and probably all died with a very short period of each other. The three determinations on the overlying beaver gnawed wood, SUERC-52459; UBA-25384; UBA-25385, are statistically consistent **(**T'=0.1; T'(6%)=6.0; v=2) and could all have died at the same time.

A model for the Trench 2 shows poor agreement between the radiocarbon dates and the stratigraphic sequence (Fig 9.5; A_{model}=22) with the date for 80–81cm identified as having poor individual agreement (*R_Combine 80-81cm*; A=1). The model (Fig 9.6) with *R_Combine 80-81cm* excluded shows good agreement between the radiocarbon dates and the stratigraphic sequence (Fig 9.6; A_{model}=124) and provides estimates for the deposition of context [108B], of *3215–3035 cal BC* (*95% probability*; *context_108B*; Fig 9.6) and the beaver gnawed wood of 3070–2930 cal BC (*95% probability*; *context_108A*; Fig 9.6). The best estimate for the deposition of the hazelnut shells on the Old Land Surface (context [111]) is *4045–3940 cal BC* (*91% probability*; *context_111*; Fig 9.6) and for when when the peat at 14-15cm formed is *3000–2880 cal BC* (*95% probability*; *last_14_15cm;* Fig 9.6).

Using the posterior estimates from the model for Trench 2 (Fig 9.6) for the samples from Monolith 127 an age-depth model (Bronk Ramsey 2008; Bronk Ramsey and Lee 2013) has been constructed (Figs 9.7–8) to provide a chronology for the pollen analysis (Batchelor and Morandi, this report). The model has good agreement (A_{model}=61) and confirms that on the evidence of the hazelnut dates, waterlogged deposits of late Mesolithic date survive at the base of the sequence with estimates for the ages of selected events identified in the palaeonvironmental record given in Table 9.7. At the point sampled in Monolith 127, peat accumulation began in the early Neolithic.

Interpretation

The radiocarbon dating programme has established that waterlogged early Neolithic deposits survive close to the wetland edge, although these post-date construction of the Sweet Track and the difference in ages of the basal peats in the two test pits suggests the start of peat formation at the edge of the burtle was asynchronous (Fig 9.8).

Comparison of the chronology of disturbance in the pollen records from Shapwick (Batchelor and Morandi, this report), the Sweet Track Factory site (Beckett and Hibbert 1979; Fig 9.9) and Shapwick Burtle (Wells *et al* unpubl; Fig 9.10) shows interesting differences - for example it is clear that the decline in *Tilia* happens earliest at Shapwick (71% probability; Fig 9.11).

Queen's Sedgemoor

Twenty-three radiocarbon measurements were obtained on samples from a 7.70m deep sediment core was extracted from Queen's Sedgemoor (Table 9.8) and the age-depth model is shown in Figure 9.12.

The age-depth model estimates that the first shift from minerogenic to organic sedimentation at Queen's Sedgemoor took place before *6000–5765 cal BC* (*95% probability; Boundary_base;* Fig 9.12). A brief return to minerogenic conditions occurred at *c*. 6.0m depth and is estimated to have taken place in *4880–4785 cal BC* (*95% probability; minerogenic;* Fig 9.12*)*. The timing of the subsequent return to peat accumulation at 5.80m occurred in 4755–4620 cal BC (*95% probability; organic;* Fig 9.12*)*. The Mesolithic/Neolithic transition is estimated to occur at *c* 470cm in the core.

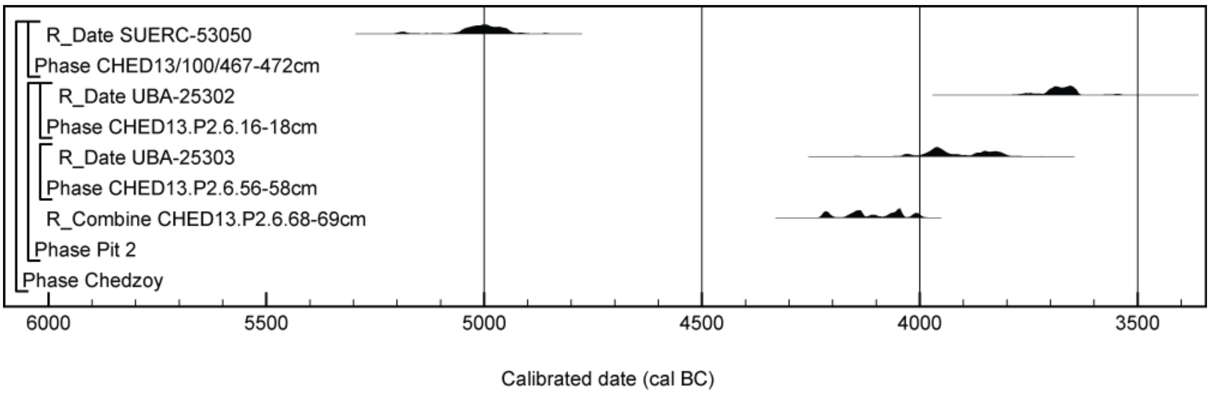

Figure 9.1: Probability distributions of dates from Chedzoy. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

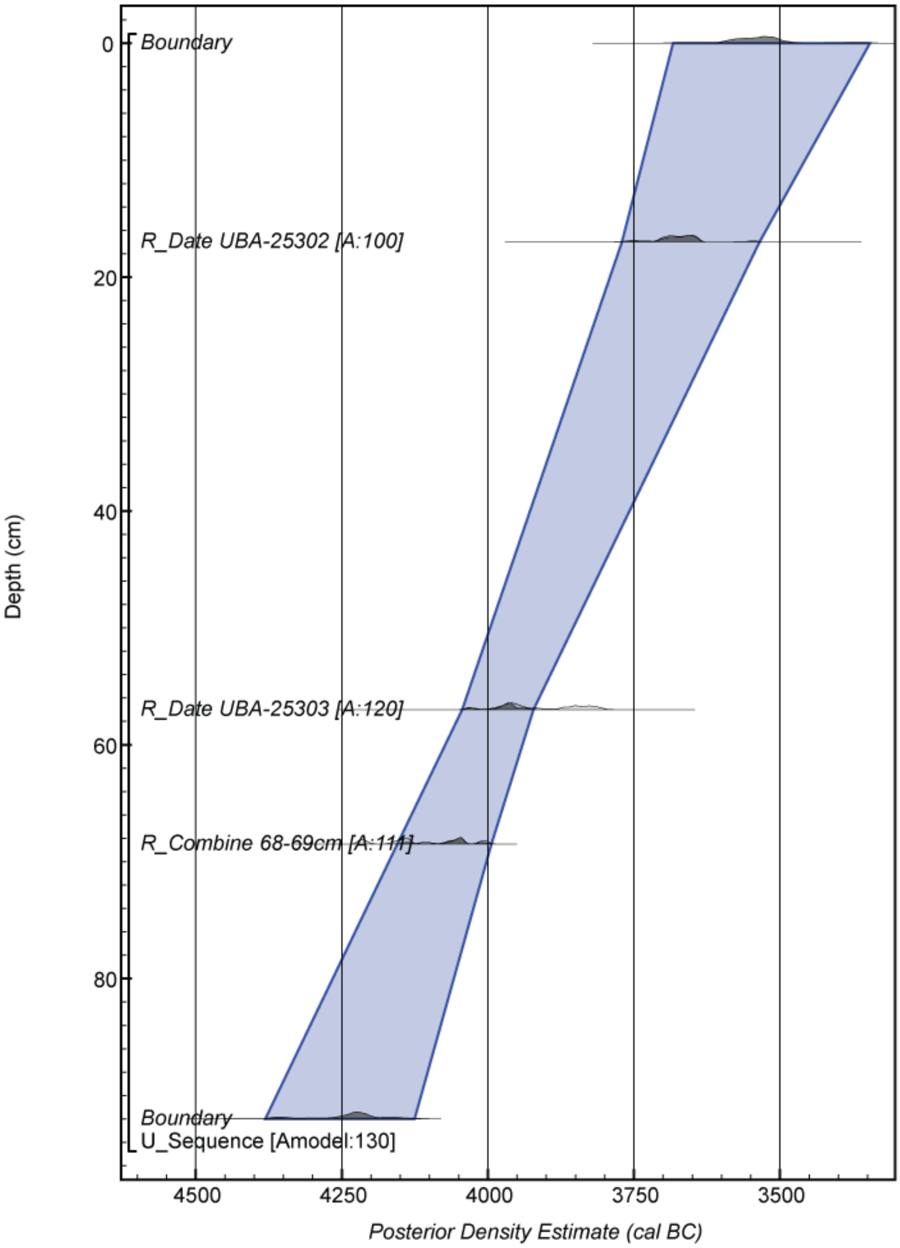

Figure 9.2: Bayesian age-depth model of the chronology of the sediment sequence at Chedzoy (U_Sequence model; Bronk Ramsey 2008). The coloured band shows the estimated date of the sediment at the corresponding depth, at 95% probability. For radiocarbon dates, the lighter distribution is the result of simple calibration and the darker distribution is the posterior density estimate provided by the model

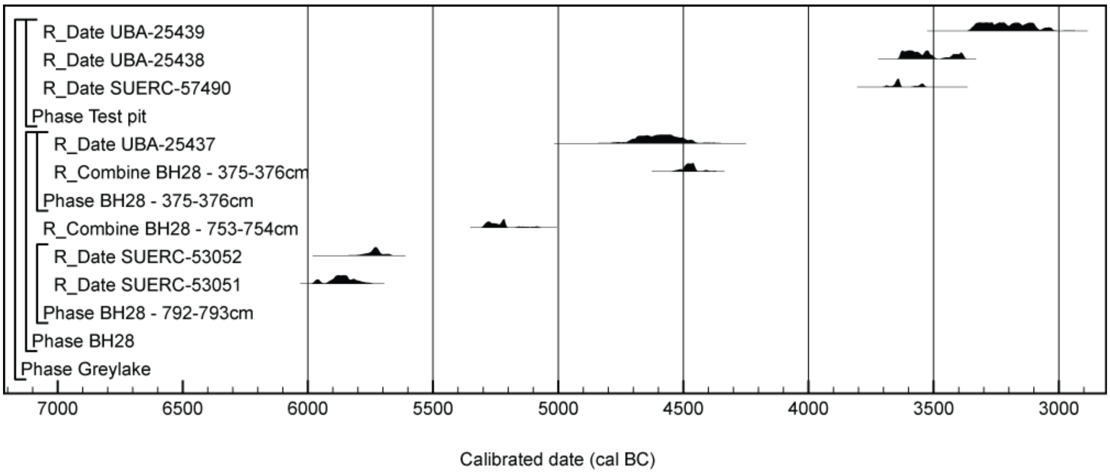

Figure 9.3: Probability distributions of dates from Greylake. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

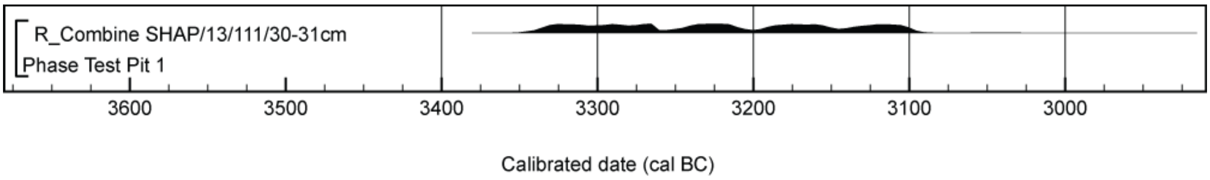

Figure 9.4: Probability distributions of dates from Shapwick – Trench 1. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

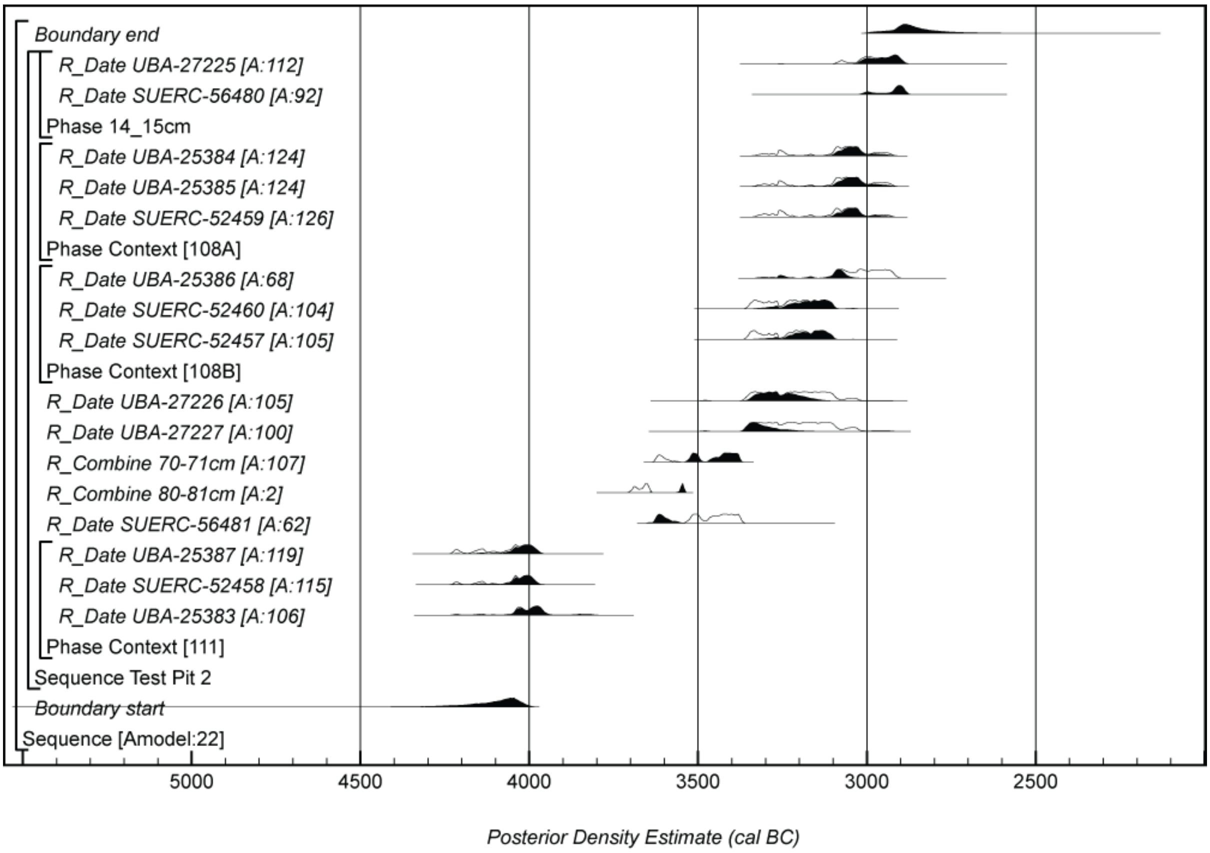

Figure 9.5: Probability distributions of dates from Shapwick Trench 2. Each distribution represents the relative probability that an event occurs at a particular time. For each radiocarbon date, two distributions have been plotted: one in outline which is the result of simple radiocarbon calibration, and a solid one based on the chronological model used. The large square brackets down the left-hand side of the diagram and the OxCal keywords define the overall model exactly.

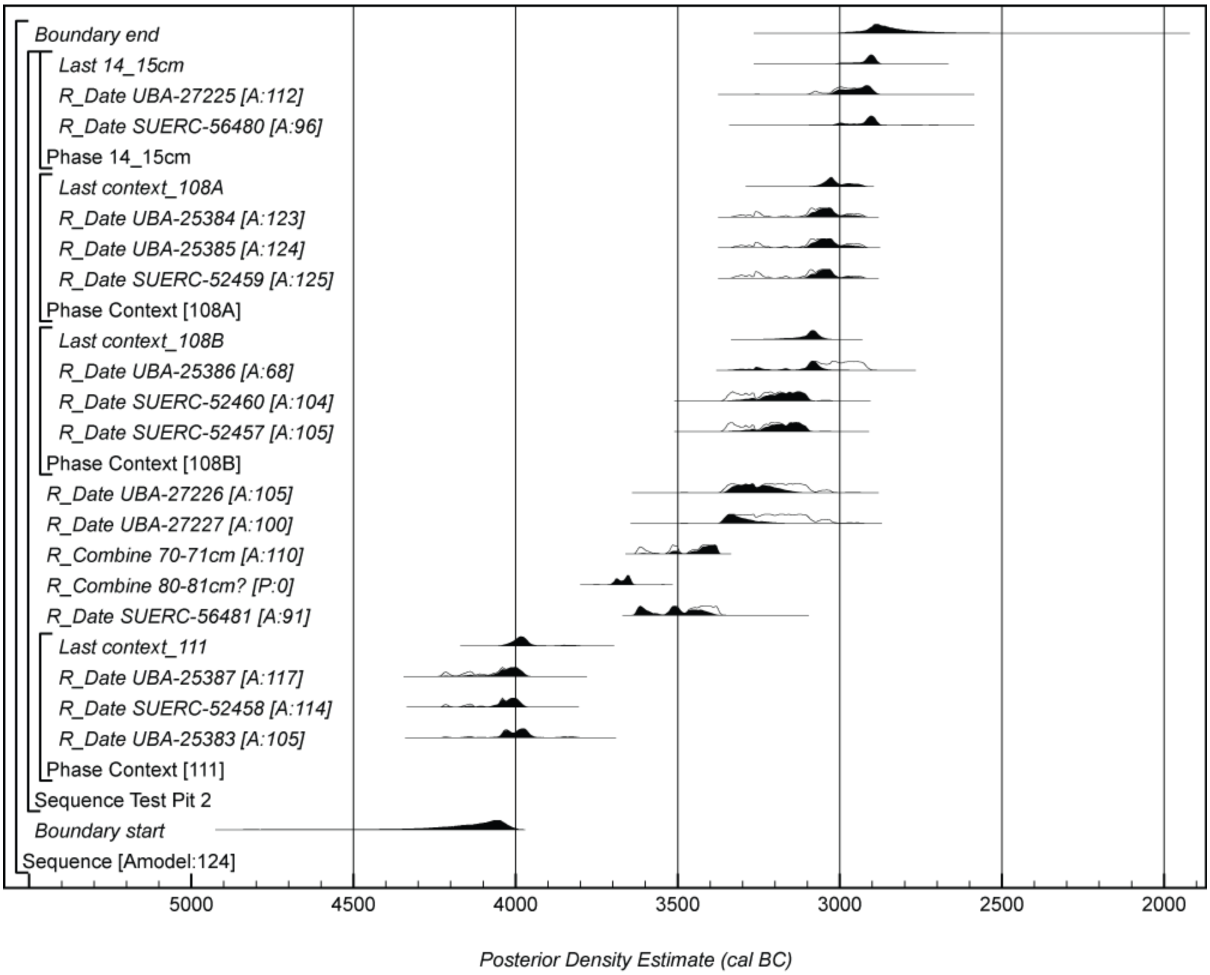

Figure 9.6: Probability distributions of dates from Shapwick Trench 2. The format is identical to Figure 9.5

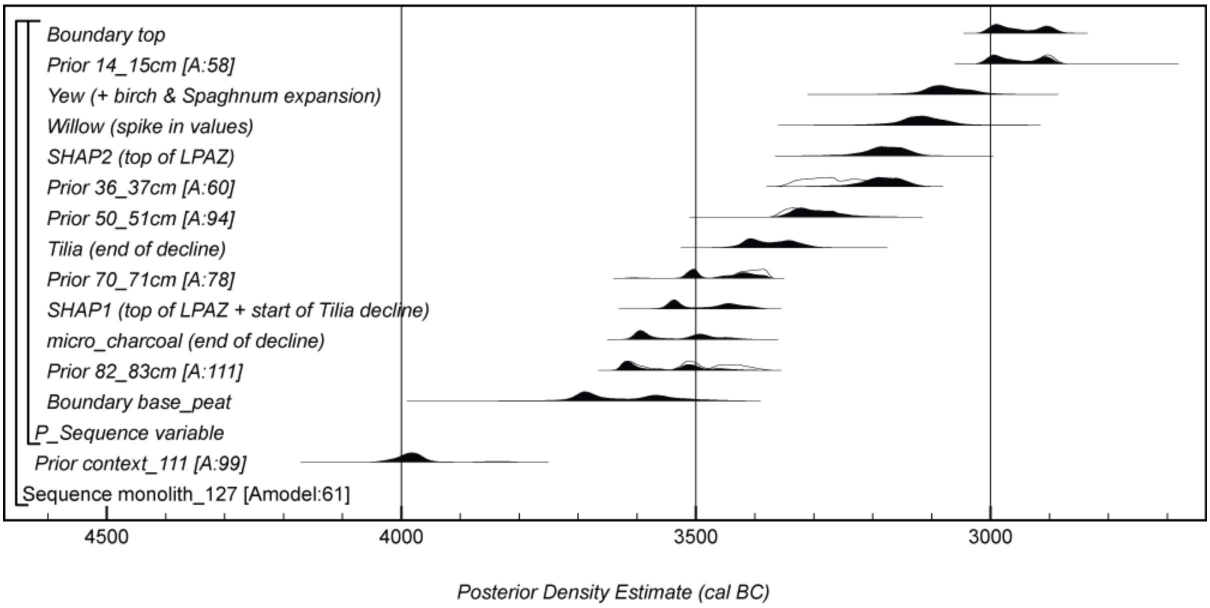

Figure 9.7: Structure of the age-depth model for Shapwick Trench 2 – the prior distributions are obtained from the model shown in Figure 9.5

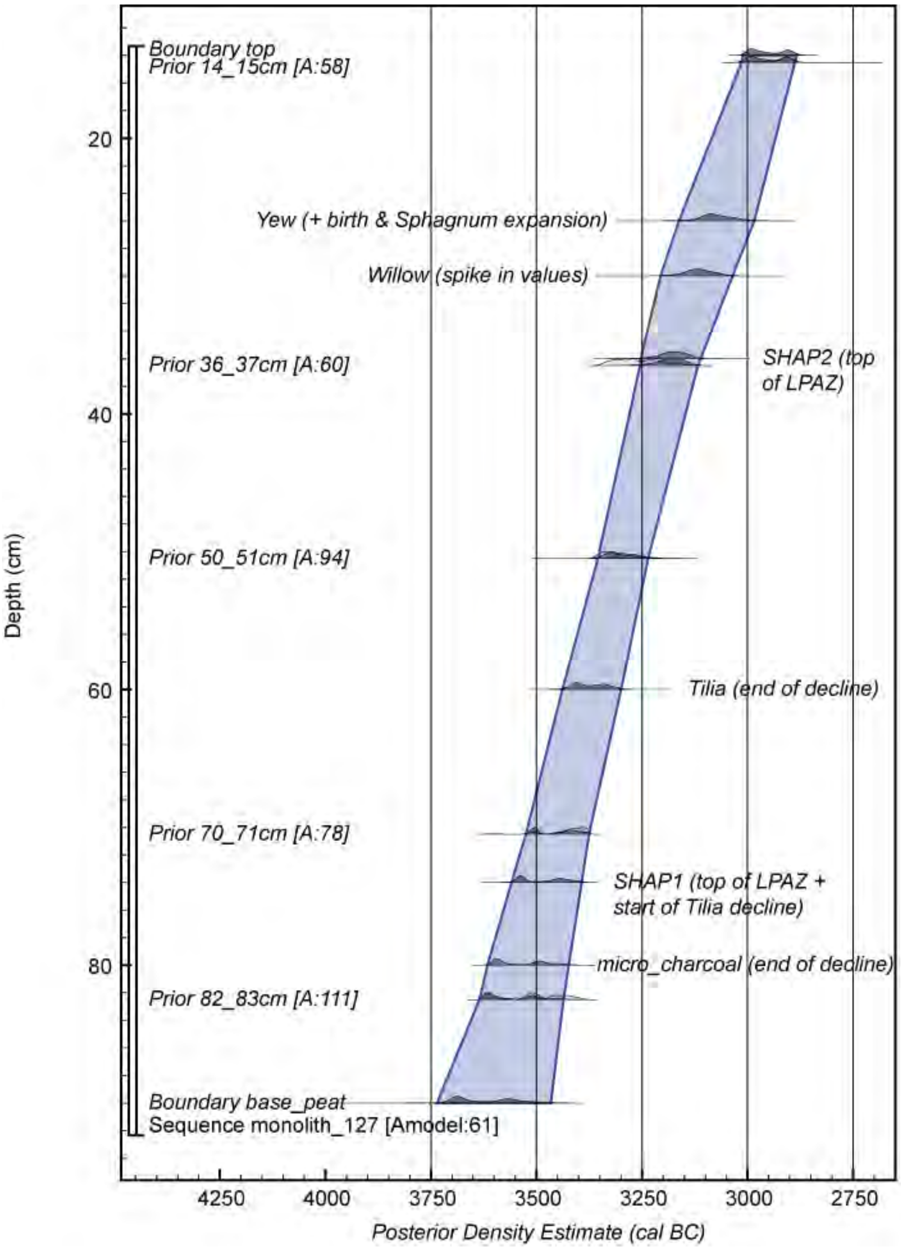

Figure 9.8: Bayesian age-depth model of the chronology of the Shapwick Trench 2 monolith 127 (P_Sequence model (k=0.01–100); Bronk Ramsey 2008; Bronk Ramsey and Lee 2013). The coloured band shows the estimated date of the sediment at the corresponding depth at 95% probability. Derived from the model shown in Figure 9.7

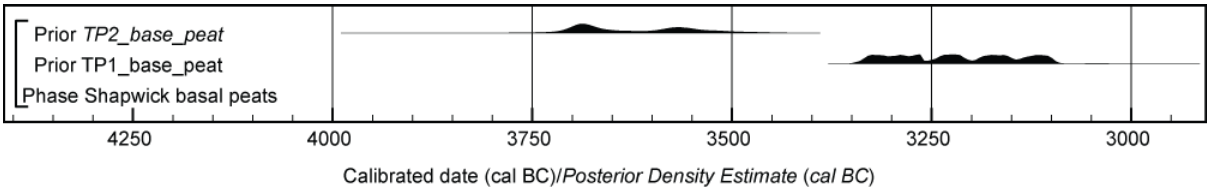

Figure 9.9: Probability distributions for the age of basal peats in Trenches 1 and 2 at Shapwick

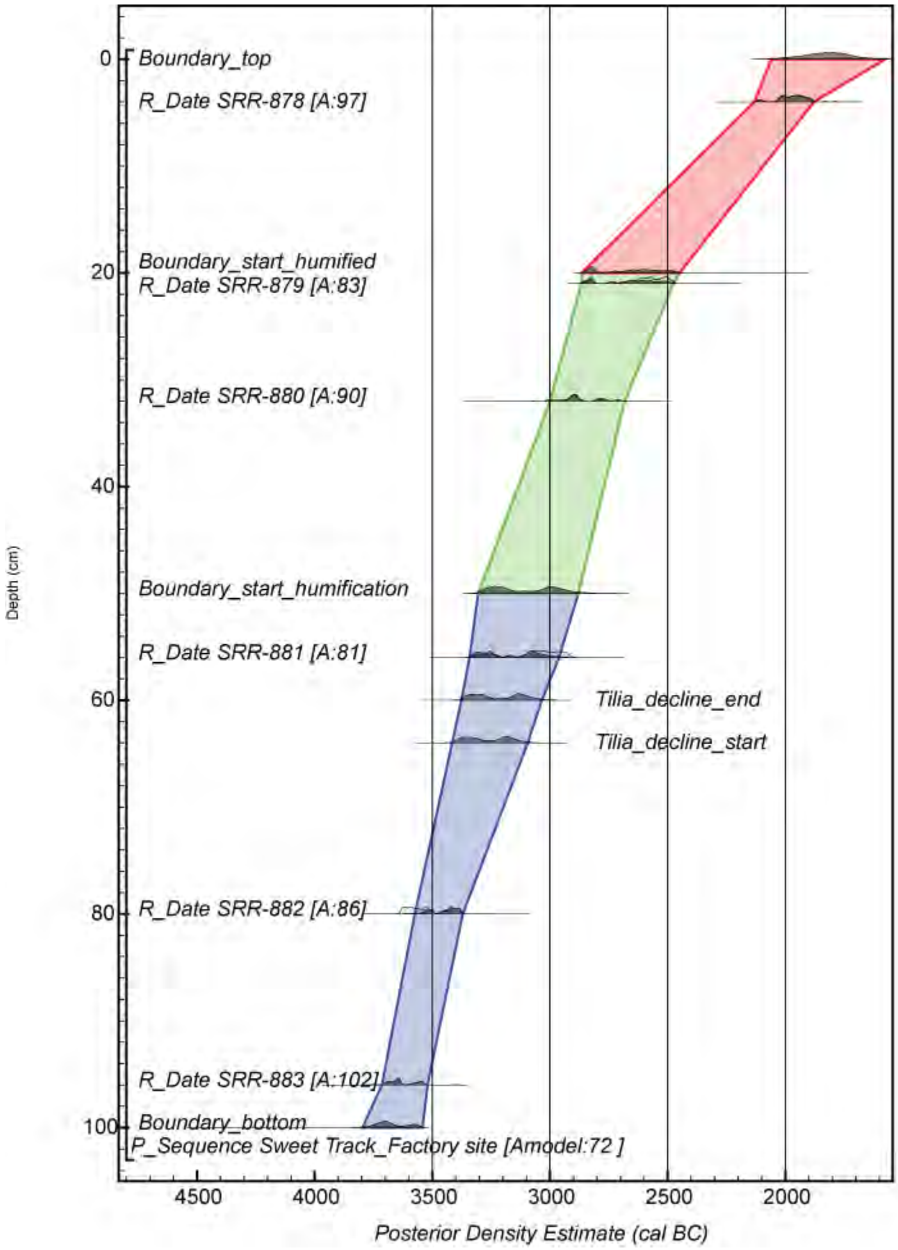

Figure 9.10: Bayesian age-depth model of the chronology of the Sweet Track Factory site sequence (P_Sequence model (k=0.01–100); Bronk Ramsey 2008; Bronk Ramsey and Lee 2013). The coloured band shows the estimated date of the sediment at the corresponding depth at 95% probability.

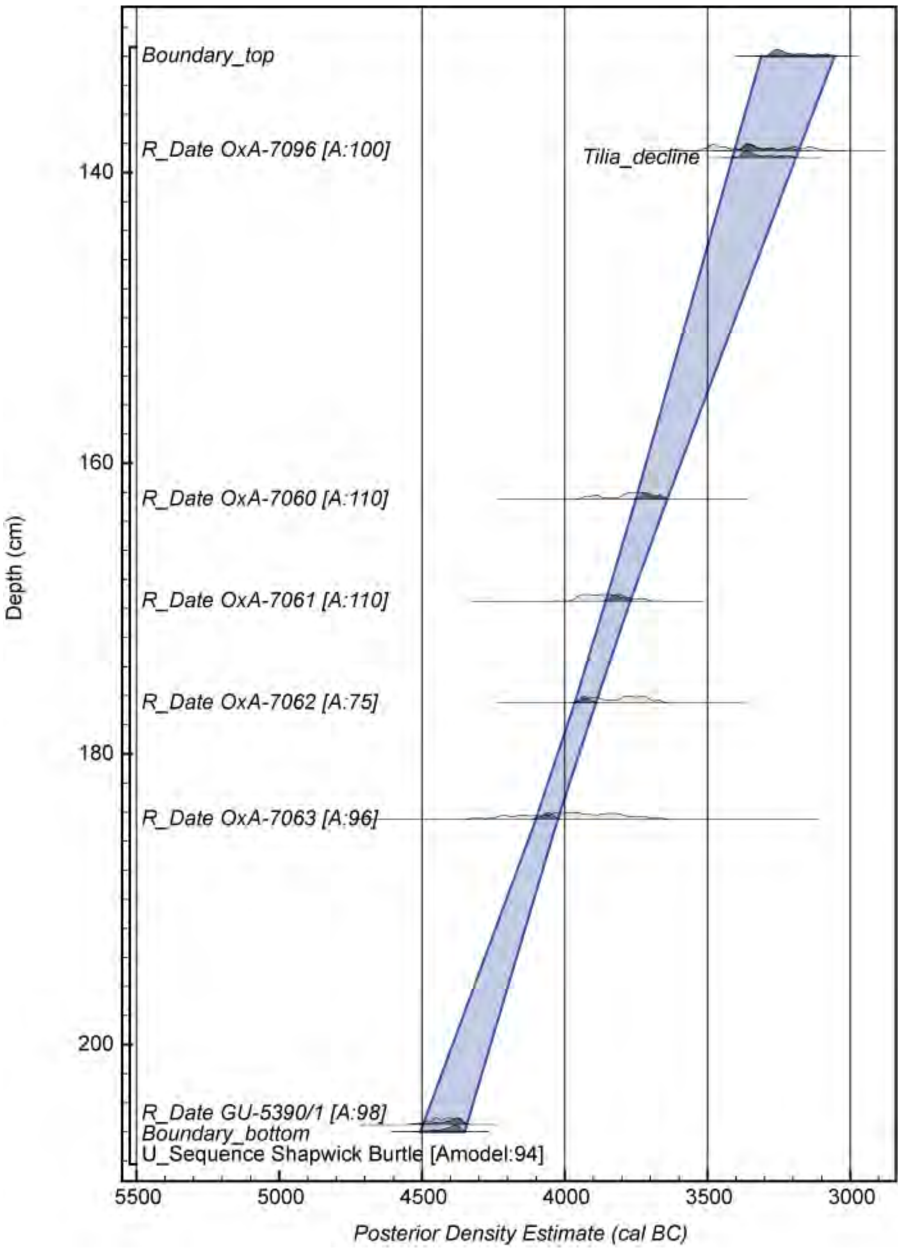

Figure 9.11: Bayesian age-depth model of the chronology of the sediment sequence at Shapwick Burtle (U_Sequence model; Bronk Ramsey 2008). The coloured band shows the estimated date of the sediment at the corresponding depth, at 95% probability. For radiocarbon dates, the lighter distribution is the result of simple calibration and the darker distribution is the posterior density estimate provided by the model

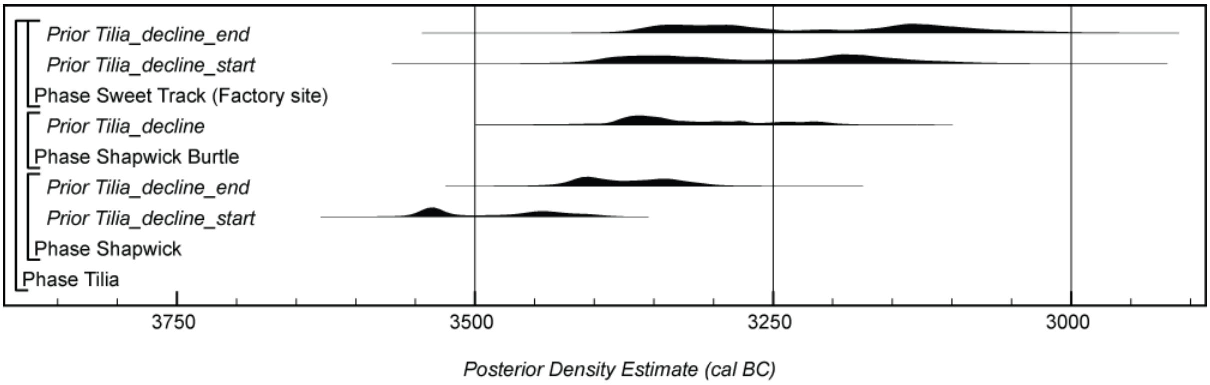

Figure 9.12: Estimates for the age of declines in *Tilia* pollen percentages recorded at Shapwick, the Sweet Track Factory site (Beckett and Hibbert 1979) and Shapwick Burtle (Wells *et al* unpubl) – the estimates are derived from the models shown in Figures 9.8 and 9.9–10

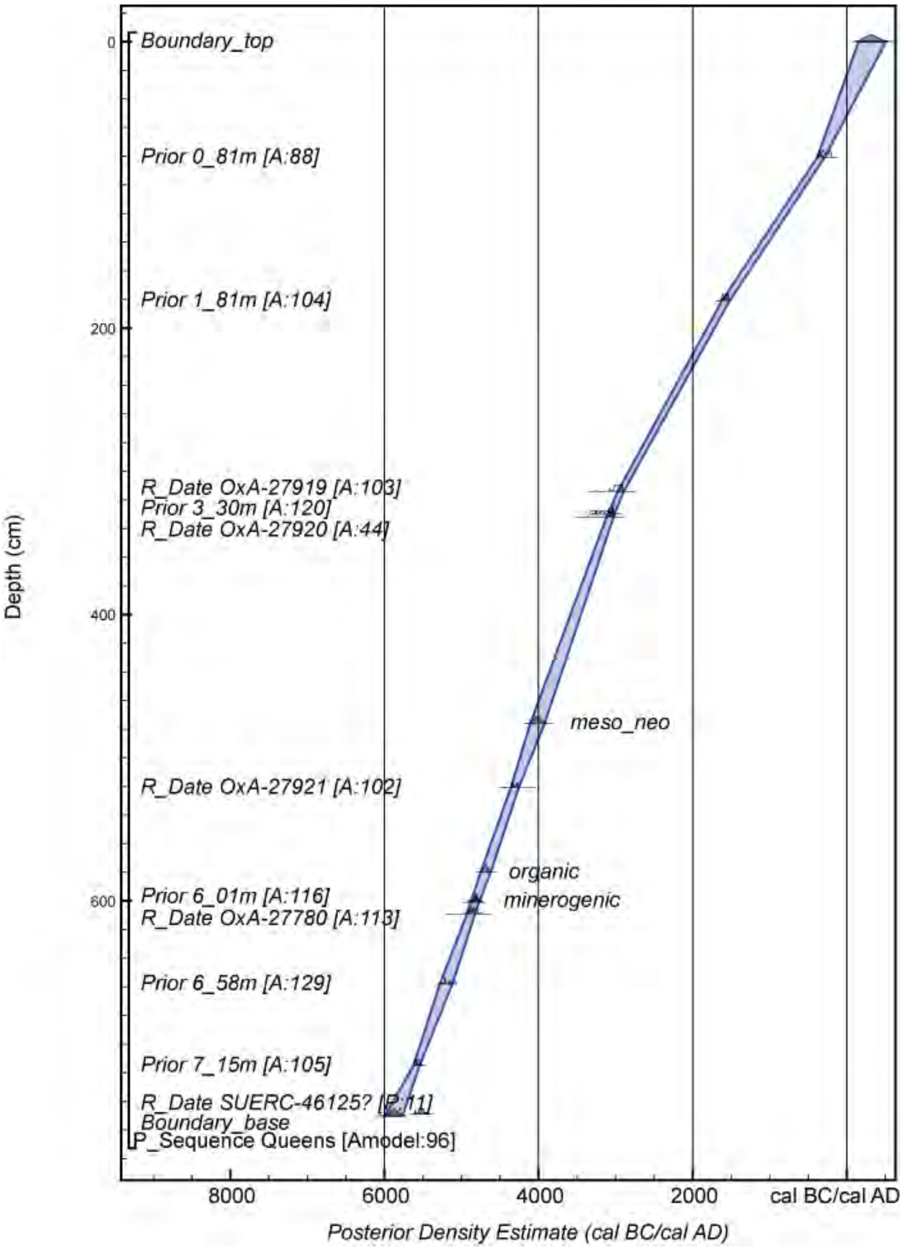

Figure 9.13: Bayesian age-depth model of the chronology of the Queen's Sedgemoor core (P_Sequence model (k=0.01–100); Bronk Ramsey 2008; Bronk Ramsey and Lee 2013). The coloured band shows the estimated date of the sediment at the corresponding depth at 95% probability.

Table 9.1: Chedzoy radiocarbon results

Laboratory Number	**Sample reference**	**Context**	**Material**	**Radiocarbon Age (BP)**	**$\delta^{13}C$ (‰)**	**Calibrated Date (95% confidence)**
SUERC-53050	CHED/13/100/ 467–472cm	This sample is from a borehole at 100m along the auger transect and from a depth of 467–472cm	Charcoal (0.16g), cf*Salix/Poplus* sp. type (R Pelling English Heritage)	6087±29	−24.9	5200–4940 cal BC
SUERC-53048	CHED13.P2.6. 68-69cm	This sample is from Trench 2. Monolith 6 Sample 0.68–0.69cm is at depth 1.67-1.68cm.	Peat (73g) M. Bell (Reading Univ) – humic acid	5291±27	−27.8	
SUERC-53049	CHED13.P2.6. 68-69cm	As SUERC-53048	Peat (73g) M. Bell (Reading Univ) - humin	5242±27	−27.4	
	Weighted mean SUERC-53048 and SUERC-53049		T'=1.3; T'(5%)=3.8; v=1	5269±20		4230–3995 cal BC
UBA-25302	CHED13.P2.6. 16-18cm	This sample is from Trench 2. Monolith 6 Sample 16–18cm is at depth 1.13–1.15cm.	Waterlogged plant macrofossils (10mg), two *Rubus* seeds and one *Alnusglutinosa*catkin (D Young, QUEST)	4888±43		3770–3630 cal BC
UBA-25303	CHED13.P2.6. 56-58cm	This sample is from Trench 2 Monolith 6 Sample 56-58cm is at depth 1.50-1.52cm.	Waterlogged plant macrofossils (10mg), five *Rubus* seeds (D Young, QUEST)	5134±44		4040–3800 cal BC

Table 9.2: Chedzoy: age estimates for palaeonvironmental events

Depth (cm)	**Event**	***Posterior Density Estimate (cal BC; 68% probability)***	***Posterior Density Estimate (cal BC; 95% probability)***
0	Top of pollen diagram	*3590–3495*	*3685–3470 (90% or 3395–3345 (5%)*
0.12	Occurrence of intestinal parasite egg	*3665–3595*	*3745–3585 (90%) or 3515–3480 (5%)*
0.20	Decrease in *Diporotheca rhizophila*	*3720–3665*	*3790–3655 (90%) or 3595–3565 (5%)*
0.24	Presence of coprophilous fungal spores indicative of grazing	*3750–3695*	*3810–3685 (90%) or 3640–3605 (5%)*
0.28	Rise of sordariaceous spores	*3775–3725*	*3830–3715 (90%) or 3685–3650 (5%)*
0.36	Top of LPAZ CHED 2	*3840–3790*	*3875–3770 (91%) or 3760–3730 (4%)*
0.40	Start of occurrence of coprophilous fungal spores	*3875–3820*	*3900–3770*
0.48	Increase in *Diporotheca rhizophila*	*3955–3940 (4%) or 3920–3880 (64%)*	*3965–3855*
0.68	Top of LPAZ CHED 1	*4140–4130 (5%) or 4070–4030 (61%) or 4010–4005 (2%)*	*4160–4090 (17%) or 4080–3990 (78%)*
0.92	Base of pollen diagram	*4370–4345 (6%) or 4265–4190 (56%) or 4180–4155 (6%)*	*4385–4125*

Table 9.3: Greylake borehole 28 radiocarbon results

Lab Number	Sample reference	Context	Material	Radiocarbon Age (BP)	δ^{13}C (‰)	Calibrated Date (95% confidence)
SUERC-53058	Greylake13 BH28 376-375cm	This sample is from Borehole (BH) 28 and is from the lower contact of the lower peat at 3.76-3.75m BGL, ie, (+0.14 to +0.15m OD).	Peat (4.1g) (K Wilkinson, Winchester Univ) – humic acid	5642±27	−27.1	
SUERC-53059	Greylake13 BH28 376-375cm	As SUERC-53058	Peat (4.1g) (K Wilkinson, Winchester Univ) - humin	5642±29	−28.4	
	Weighted mean SUERC-53058 and SUERC-53059		T'=0.0; T'(5%)=3.8; v=1	5642±20		4530–4445 cal BC
UBA-25437	Greylake13 BH28 376-375cm – sample A	As above	Waterlogged plant macrofossils, aerial sedge remains (D Young, QUEST)	5754±64	−27.2	4770–4450 cal BC
SUERC-53056	Greylake13 BH28 754–753cm	This sample is from Borehole (BH) 28 and is from the upper contact of the Lower peat at 7.54-7.53m BGL, i.e. (-3.64 to -3.63m OD.	Peat (7.8g) (K Wilkinson, Winchester Univ) – humic acid	6229±29	−28.0	
SUERC-53057	Greylake13 BH28 754–753cm	As SUERC-53056	Peat (7.8g) (K Wilkinson, Winchester Univ) - humin	6245±27	−27.2	
	Weighted mean SUERC-53056 and SUERC-53057		T'=0.2; T'(5%)=3.8; v=1	6238±20		5300–5205 cal BC

SUERC-53051	Greylake13 BH28 792–793cm	This sample is from Borehole (BH) 28 and is from the base of the Lower peat at 7.93-7.92m BGL, i.e. -4.03 to -4.02m OD	Peat (5.9g) (K Wilkinson, Winchester Univ) – humic acid	6979±30	−30.0	5980–5760 cal BC
SUERC-53052	Greylake13 BH28 792–793cm	As SUERC-53051	Peat (5.9g) (K Wilkinson, Winchester Univ) - humin	6855±28	−29.8	5790–5670 cal BC
		Chi-square test SUERC-53051 and SUERC-53052	T'=9.1; T'(5%)=3.8; v=1			

Table 9.4: Greylake Test Pit radiocarbon results

Lab Number	Sample reference	Context	Material	Radiocarbon Age (BP)	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Calibrated Date (95% confidence)
UBA-25439	Greylake13. TP 0.28-0.29m	This sample is from the Greylake test pit which is immediately north of Borehole (BH) 3 - 0.28-0.29m from the top of Monolith 2	Waterlogged twig (unidentified) (D Young, QUEST)	4489±38	–			3360–3020 cal BC
UBA-25438	Greylake13. TP.−0.35–−0.36m	This sample is from the Greylake test pit which is immediately north of Borehole (BH) 3 from -0.35 to -0.36m datum [+2.91 to +2.92m OD]	Waterlogged plant macrofossils, *Crategus* sp. (D Young, QUEST)	4745±39	−28.4			3640–3370 cal BC
SUERC-57490	Test Pit Unit 5 Bone OLS	A single bovid bone and several charcoal fragments found in the test pit at the interface between the Burtle Formation and the overlying grey-blue silt/clays	Animal bone, *Bos* sp. (A Pluskowski, Reading Univ))	4842±32	−21.5	6.1	3.4	3690–3530 cal BC

Table 9.5: Shapwick Trench 1 radiocarbon results

Lab Number	**Sample reference**	**Context**	***Material***	**Radiocarbon Age (BP)**	**δ13C (‰)**	**Calibrated Date (95% confidence)**
SUERC-53062	SHAP/13/111/30-31cm	This sample is from the base of the peat in Monolith 111. The peat overlies an old landsurface which contained flint flakes and micro debitage of probable Mesolithic date.	Wood peat (52g) M. Bell (Reading Univ)	4472±29	−27.6	
SUERC-53063	SHAP/13/111/30-31cm	As SUERC-53062	Wood peat (52g) M. Bell (Reading Univ)	4517±29	−27.5	
	Weighted mean SUERC-53062 and SUERC-53063		T'=1.2; T'(5%)=3.8; v=1	4495±21		3350–3090 cal BC

Table 9.6: Shapwick, Trench 2 radiocarbon results

Lab. Number	Sample reference	Context	Material	Radiocarbon Age (BP)	δ^{13}C (‰)	Calibrated Date (95% confidence)
Old land-surface						
SUERC-52458	SHAP/265 – context (111) sample A	An old land-surface was identified at the base of the wood peat this contained a microlith and another flint. Many hazelnuts were found in the old land-surface and these two hazel nuts found together as sample SHAP265 come from the top of that old land-surface	*Corylus avellana* nut (1.19g) M. Bell (Reading Univ)	5239±29	−29.4	4230–3970 cal BC
UBA-25383	SHAP/265 – context (111) sample B	As SUERC-52458	*Corylus avellana* nut (1.72g) M. Bell (Reading Univ)	5185±46	−29.8	4060–3940 cal BC
UBA-25387	SHAP/212, layer 111	An old land-surface was identified at the base of the wood peat this contained a microlith and another flint. Many hazelnuts were found in the old land-surface and this hazel nut comes from the top of that old land-surface.	*Corylus avellana* nut (1.86g) M. Bell (Reading Univ)	5239±40	−25.8	4230–3960 cal BC
Wood layer						
SUERC-52457	SHAP/183 – layer 108	Tree trunk 183 was part of a distinct layer of wood which underlay the beaver gnawed wood (SHAP 107; 137; 125). It is one of three samples submitted for dating from this layer (the others are 195 and 158).	Waterlogged wood (3.1g)?*Alnus/Corylu s*bark/outer ring of 32 year ring sequence (R Howard, NTRDL)	4518±29	−31.9	3360–3090 cal BC
SUERC-52460	SHAP/158	Tree trunk 158 was part of a distinct layer of wood which underlay the beaver gnawed wood (SHAP 107; 137; 125). It is one of three samples submitted for dating from this layer (the others are 195 and 108).	Waterlogged wood (1.76g) ?*Alnus/Corylus* bark outer rings ?<5 rings of 40 year sequence (R Howard, NTRDL)	4508±29	−27.4	3360–3090 cal BC
UBA-25386	SHAP/195	Tree trunk 195 was part of a distinct layer of wood which underlay the beaver gnawed wood. It is one of three samples submitted for dating from this layer (the others are 183 and 158).	Waterlogged wood (3.3g) ?*Alnus/Corylus* outer part (uncertain number) of ?20 heavily distorted ring sequence (R	4396±39	−30.5	3270–2900 cal BC

			Howard, NTRDL)			
Beaver gnawed wood						
SUERC-52459	SHAP/107 – context 108	Roundwood sample 107 was one of 22 pieces of mostly small roundwood forming a distinct thin layer which had evidence of beaver gnawing on one or in some cases two ends.	Waterlogged wood (1.9g) ?*Alnus/Corylus*, outer 8 rings (18–25) of 25 year sequence (R Howard, NTRDL)	4434±29	−29.4	3330–2930 cal BC
UBA-25384	SHAP/125, context 108	Roundwood sample 125 was one of 22 pieces of mostly small roundwood forming a distinct thin layer which had evidence of beaver gnawing on one or in some cases two ends.	Waterlogged wood (2.25g) ?*Alnus/Corylus* wood, bark + outer ring of 15 year sequence (R Howard, NTRDL)	4427±29	−30.9	3330–2920 cal BC
UBA-25385	SHAP/137, context 108	Roundwood sample 137 was one of 22 pieces of mostly small roundwood forming a distinct thin layer which had evidence of beaver gnawing on one or in some cases two ends.	Waterlogged wood (2.94g) ?*Alnus/Corylus*, wood, outermost four rings (11–14) of 14 year ring sequence (R Howard, NTRDL)	4425±31	−30.7	3330–2920 cal BC
Monolith 127						
SUERC-56480	SHAP_127_0.14-0.15m_sample_A	Monolith 127 at 14–15cm	Waterlogged twig, unidentified	4293±38	−26.5	3090–2880 cal BC
UBA-27225	SHAP_127_0.14-0.15m_sample_B	As SUERC-56480	Waterlogged twig, unidentified	4337±47	−27.2	3010–2870 cal BC
UBA-27226	SHAP_127_0.36- 0.37m	Monolith 127 at 36–37cm	Waterlogged wood, cf *Prunus* sapwood bark removed	4510±46	−30.3	3370–3020 cal BC
UBA-27227	SHAP_127_0.50- 0.51m	Monolith 127 at 50–51cm	Waterlogged twig, unidentified	4502±50	−30.7	3370–3020 cal BC
SUERC-56478	SHAP_127_0.7-0.71m	Monolith 127 at 70–71cm	Wood peat (g) M. Bell (Reading Univ) humic acid	4701±38	−28.5	
SUERC-56479	SHAP_127_0.7-0.71m	As SUERC-56478	Wood peat (73g) M. Bell (Reading Univ) - humin	4706±38	−28.5	

	Weighted mean SUERC-56478 and SUERC-56479		T'=0.0; T'(5%)=3.8; v=1	4704±27		3630–3370 cal BC
SUERC-53060	SHAP/2/127/ 80–81cm	Monolith 127 at 80–81cm	Wood peat (73g) M. Bell (Reading Univ) humic acid	4921±29	−28.4	
SUERC-53061	SHAP/2/127/ 80–81cm	As SUERC-53060	Wood peat (73g) M. Bell (Reading Univ) - humin	4845±29	−28.5	
	Weighted mean SUERC-53060 and SUERC-53061		T'=3.4; T'(5%)=3.8; v=1	4883±21		3705–3640 cal BC
SUERC-56481	SHAP_127_ 0.82-0.83m	Monolith 127 at 82–83cm	Waterlogged twig, unidentified	4694±38	−27.8	3640–3360 cal BC

Table 9.7: Shapwick, Monolith 127 – estimated ages of selected events in the palaeoenvironmental record

Depth (cm)	**Event**	***Posterior Density Estimate (cal BC; 68% probability)***	***Posterior Density Estimate (cal BC; 95% probability)***
14	Top of pollen diagram	*3010–2955 (44%) or 2925–2890 (24%)*	*3015–2880*
26	Expansion of yew (*Taxus*), birch (*Betula*) and *Sphagnum* values	*3115–3035*	*3165–2980*
30	Spike in willow (*Salix*) values	*3155–3075*	*3210–30735*
36	Top of LPAZ SHAP 2	*3210–3140*	*3255–3110*
60	End of decline in lime (*Tilia*)	*3425–3380 (36%) or 3370–3325 (32%)*	*3440–3300*
74	Top of LPAZ SHAP 1 (start of decline of lime (*Tilia*))	*3555–3520 (33%) or 3465–3415 (35%)*	*3560–3390*
80	End of decline in micro-charcoal values	*3610–3570 (38%) or 3515–3470 (30%)*	*3620–3540 (48%) or 3539–3420 (947%)*
90	Base of context [110]	*3715–3650 (40%) or 3600–3530 (28%)*	*3740–3465*
100	Base of pollen diagram	Cannot be determined	Cannot be determined

Table 9.8: Queen's Sedgemoor radiocarbon results

Laboratory Number	Sample reference	Material	Identification	Radiocarbon Age (BP)	$\delta^{13}C$ (‰)	Calibrated Date (95% confidence)
SUERC-48415	QS1_0.81 m A	wood	Twigs (indet)	2243±34	−27.6	400–200 cal BC
SUERC-48416	QS1_0.81 m B	plant macrofossils	Monocot stems	2157±34	−26.1	360–95 cal BC
SUERC-46120	1.81m - sample A	plant macrofossils	*Calluna vulgaris* (woody stems) x 5	3288±29	−27.8	1640–1490 cal BC
OxA-27778	1.81m - sample B	plant macrofossils	29 x *Calluna* flowers + 1 x leaf cluster	3328±27	−28.6	1690–1520 cal BC
OxA-27919	3.14m	plant macrofossils	3 x charred twigs + 3 x twiggy frags	4357±34	−27.2	3090–2900 cal BC
SUERC-46121	3.30m - sample A	plant macrofossil	*Calluna*stem	4439±29	−25.5	3330–2930 cal BC
SUERC-46122	3.30m - sample B	plant macrofossils	2 x small twigs (unidentified) + 1 x *Erica flower* + 17 x *Erica tetralix* leaves & 12 x frags + 1 x *Betula*bracht	4421±29	−26.1	3320–2920 cal BC
GU30209	3.32m - sample A	wood	Woody fragments (indet)	Failed: insufficient carbon	–	
OxA-27920	3.32m - sample B	plant macrofossils	11 + 8 frags – *Caldiummariscus* + 7 ?monocot stem frags	4492±34	−21.9	3360–3020 cal BC
SUERC-53794	4.1m – sample A	peat	Humic acid	4916±35	−28.6	
SUERC-53795	4.1m – sample A	peat	Humin	4987±35	−27.9	
	4.1m - peat		T'= 2.1 T'(5%)=3.8; v=1	4952±25		3790–3650 cal BC
GU30210	4.89m - sample A	plant macrofossils	13 x small indet leaf frags + 1 x *Alnus* seed + 4 fern croziers	Failed: insufficient carbon	–	
P33640	4.89m - sample B	wood	Small indet woody fragments including 1 charred	Failed: low yield	–	
GU30211	5.19m - sample A	plant macrofossils	*Calluna* stem x 6	Failed: insufficient carbon	–	
P33641	5.19m - sample B	plant macrofossil	1 x fern crozier	Failed: low yield	–	
GU30212	5.21m - sample A	plant macrofossils	10 whole + 4 frags *Cladium*nutlets	Failed: insufficient carbon	–	
OxA-27921	5.21m - sample B	plant macrofossils	34 x charred monocot stems (*Cladium*)	5473±36	−27	4370–4260 cal BC
SUERC-53799	5.8m – sample A	peat	Humic acid	6122±35	−30.1	5210–4945 cal BC
SUERC-53800	5.8m – sample A	peat	Humin	6280±35	−31.3	5330–5210cal BC
OxA-27779	6.01m - sample A	plant macrofossil	*Calluna* twig	5948±32	−26.5	4940–4720 cal BC BC
OxA-27922	6.01m - sample B	wood	Wood fragment (unidentified)	5938±39	−23.2	4940–4710 cal BC
SUERC-53801	6.01m – sample C	peat	Humic acid	6051±35	−29.5	
SUERC-53802	6.01m – sample C	peat	Humin	6037±35	−29.2	

	6.01m - peat		T'= 0.1; T'(5%)=3.8; v=1	6044±25		5010–4845 cal BC
OxA-27780	6.09m - sample A	wood	Twig (unidentified)	5972±32	−27	4950–4780 cal BC
SUERC-46123	6.58m - sample A	wood	*Betula* bark fragment	6232±29	−28.9	5310–5070 cal BC
OxA-27824	6.58m - sample B	wood	Twig (unidentified)	6202±31	−26.8	5300–5050 cal BC
SUERC-46124	7.15m - sample A	wood	*Betula* bark fragment	6583±30	−27.9	5620–5480 cal BC
OxA-27825	7.15m - sample B	wood	Twig (unidentified)	6678±31	−27.6	5650–5540 cal BC
P33648	7.17m	plant macrofossils	1 x small twig + 2 x *Alnusglutinosa* fruits + 1 *Alnus* bud scale + small frag of *Alnus* cone + small frag of *Cladium*nutlet	Failed: low yield		
SUERC-46125	7.49m - sample A	plant macrofossil	*Calluna* twig	6587±29	−28.5	5620–5480 cal BC
P33649	7.49m - sample B	plant macrofossils	1 x *Betula* bud + 1 x indet bud	Failed: insufficient carbon		

Chapter 10. The Mesolithic of the wetland / dryland edge in the Somerset Levels: surface collected and excavated lithics assemblages
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Introduction

A total of 121 struck flint and chert artefacts have been made available for study (Appendix 6). This brief report summarises the lithic technology and contexts for each sub-assemblage. Four sub-assemblages, based on excavated or un-stratified contexts are recorded:

- Un-stratified Shapwick (17 lithics, or 14.0%)
- Excavated Shapwick (19 lithics, or 15.7%)
- Brue Valley Other Locations – Trenches 1 and 2, from Burtle island and other potential island locations within the parish (31 lithics, or 25.6%)
- Un-stratified Chedzoy (4 lithics, or 3.3%
- Excavated Chedzoy (50 lithics, or 41.3%).

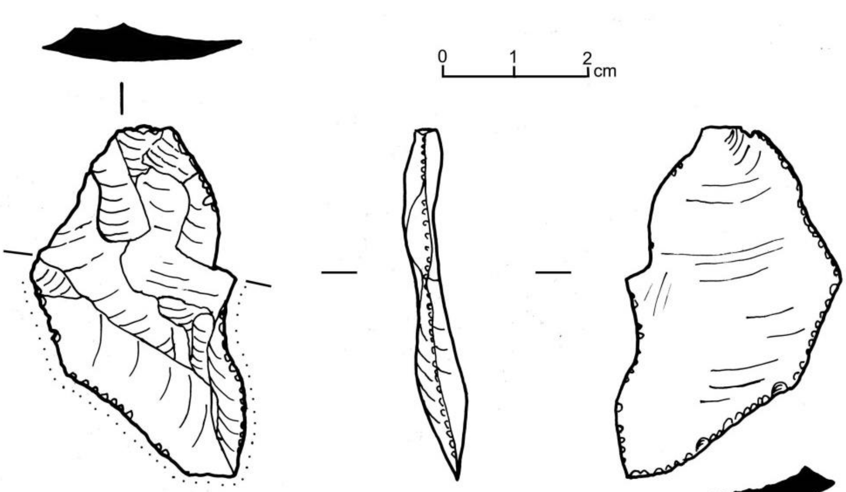
List of illustrated lithics (see Fig. 10.1)
Brue 2401j Context: Pit 24.Core rejuvenation flake (utilised, with gloss), Green-black-grey flint
Chedzoy 5 Unstratified. End scraper, Brown Chocolate (Black Down Hills) chert
Chedzoy 18 Pit 2.End scraper, Green-black-grey flint
Chedzoy 21 Pollen Monolith 6, Pit 2. Core/adze fragment? Green-black-grey flint
Chedzoy 102 Pit 1, Context 82-92cm. End scraper on a core rejuvenation flake, Brown Chocolate (Black Down Hills) chert.
Chedzoy 19 Pit 1, Context 7 (residue). Microlith, obliquely blunted point, Green-black-grey flint
Shapwick 113 Pit 1, Layer 11. Microburin, snapped, Green-black-grey flint
Shapwick 280 Pit 2, Layer 110. Microlith, lanceolate form, Green-black-grey flint
Shapwick 23a Unstratified, Burtle corner. Thinning flake, possibly from an axe/adze, Brown Chocolate (Black Down Hills) chert.

Un-stratified Shapwick

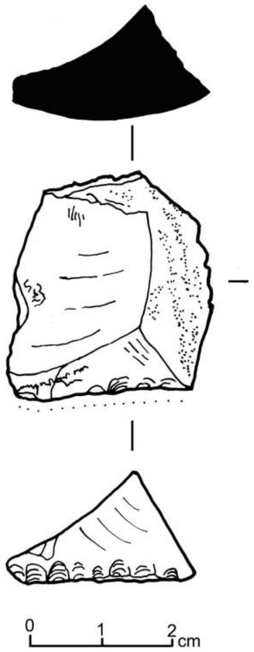
A total of 17 lithics were recovered. Prehistoric, in generic terms, but particularly dominant is Mesolithic, a mixture of early and later lithic technology. Table 10.1 provides a breakdown of the main types of lithic artefacts recovered.

Type	*Context*	*No.*
Chip	Molehills on top of Burtle	2
Flake microdebitage	Molehills on top of Burtle; beside badger sett	4
Flake	Molehills on top of Burtle; badger upthrow	6
Core rejuvenation flake	Next to badger sett on Burtle	1
Blade	Molehills on top of Burtle; beside badger sett; badger upthrow	3
Axe/Adze thinning flake	Corner and top of Burtle	1
Totals		**17**

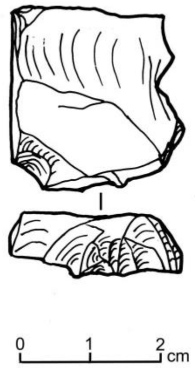
Table 10.1: Quantification of un-stratified lithics, surface-derived material of Shapwick Burtle.



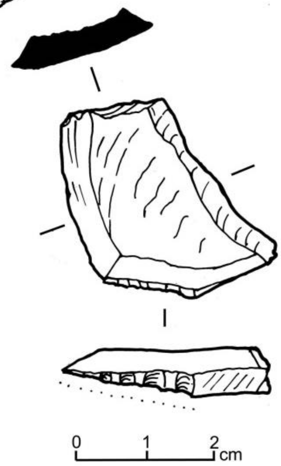
Brue 2401



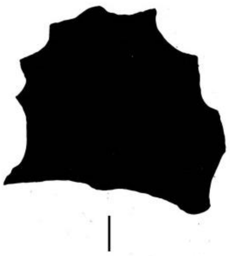
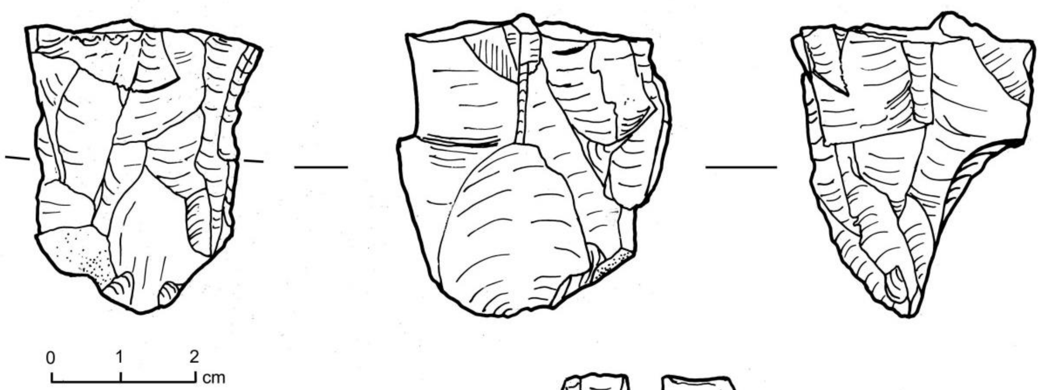
Chedzoy 5



Chedzoy 18



Chedzoy 102

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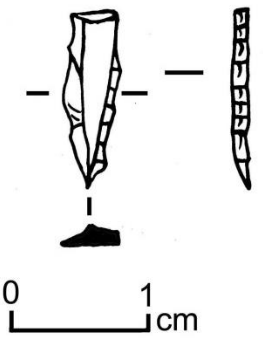
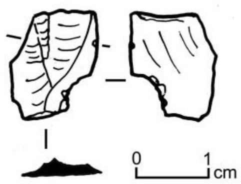
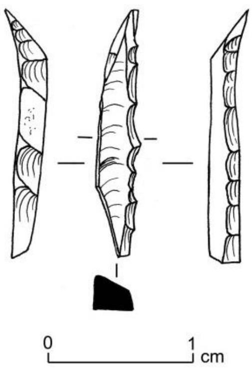


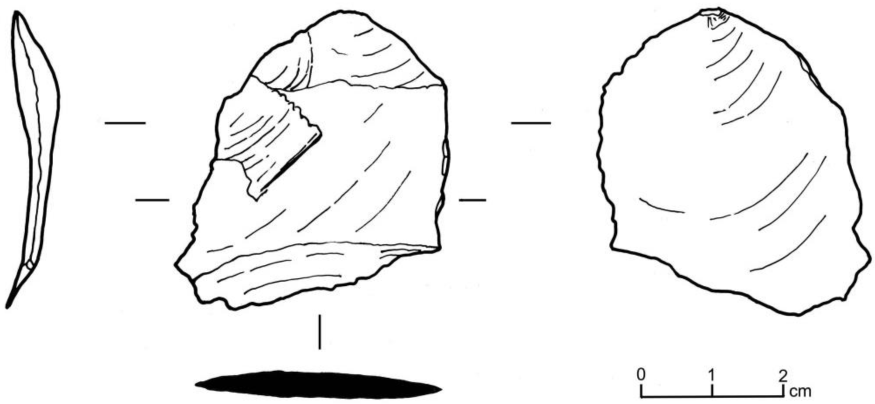
Chedzoy 19



Shapwick 113



Shapwick 280



Shapwick 23a

Previous page : Figure 10.1 Lithics from the Somerset Levels: Brue Valley, Chedzoy and Shapwick. (Graphic by Jennifer Foster).

Condition
All lithics are fresh, with little sign of rolling within the ploughed soil. The lithics are commonly snapped, with distal or proximal ends missing. The majority of the lithics are patinated/ recorticated, with variety ranging from light to medium and heavy patina. At Shapwick Burtle, as elsewhere in the Somerset Levels, it has been noted that the degree of patina may be an indicator of the age, particularly early Holocene date of the material (Bond 2007; Brown 1986). Here, the type of raw material, technology and degree of patina, does appear to relate to age: for example, the axe/adze thinning flake, recovered in the top corner of the Burtle (Fig 10.1, Shapwick 23a), made from chert (Blackdown Hills), has a heavy patina, and is technologically also characteristically early Mesolithic. A previous example has been collected from the Burtle molehills by J. W. P. Hayes.

Raw material
Whilst most artefacts were patinated, an attempt has been made to attribute the type of raw material, through observations on snapped pieces, or the character of silica with or without patina. The majority of lithics are of a Downland nodular flint imported into the area from at least 40 km east (Bond 2004b, 2011a). There are two examples of chert, one being the axe/adze thinning flake (Blackdown Hills, facies, observed in exposures near Wellington); a second chert, a snapped blade (early Mesolithic) made on Greensand Chert type, likely to be from the Vale of Tone catchment.

Technology and typology
Small spalls, small fine flakes, termed here 'microdebitage' (lithics less than 5m in size) are noted, with chips and larger flakes. These types of artefact, together with the core rejuvenation flake and blades demonstrate flake production nearby. The small size of flakes, chips, spalls, together with the tertiary stage of reduction present (most have no cortex), may suggest reduction of pre-prepared cores. Plain and punch platforms are present, indicating a high level of control of core preparation for blade manufacture. The fine flakes and blades present are consistent with a blade-centred technology, likely to indicate early Mesolithic broad blade, but also to a lesser extent later Mesolithic narrow blade production (Pitts and Jacobi 1979).

Excavated Shapwick
A total of 19 lithics were excavated, all but 1 being excavated from Trench 1, layers 10 and 11. The majority of the assemblage is attributed to the Mesolithic, both early and later periods, with a few pieces possibly of earlier Neolithic date: two flakes (Trench 1, Layer 10). Table 10.2 provides a breakdown of the main types of lithic artefacts recovered from excavated Trench 1 and 2, adjacent to Shapwick Burtle.

Condition
Once again, all lithics are fresh, in non rolled condition. Most artefacts, in contrast to the surface derived material are not patinated/recorticated. This assemblage, being technologically blade-centred, with occurrences of fine parallel-side blades, often snapped, with less patina (light), may suggest a later Mesolithic emphasis. Some lithics are also commonly snapped, possibly a bi-product of blade production. Yet, flakes also give complete feathered and hinge terminations, enabling measurement.

Table 10.2: Quantification of excavated lithics from Trenches 1 and 2, adjacent Shapwick Burtle, 2013.

Type	***Context***	***No.***
Chip	Trench 1, Layer 10	1
Flake microdebitage	Trench 1, Layer 10 and 12; Trench 2, Layer 110	4
Flake	Trench 1, Layer 10 and 11	7
Core rejuvenation flake	Trench 1, Layer 10	1
Blade	Trench 1, Layer 10 and 11	4
Microburin	Trench 1, Layer 11	1
Microlith	Trench 2, Layer 110 (Sample 104)	1
Totals		**19**

Raw material
The majority of worked stone is flint, the Green-black-grey nodular Downland derived flint imported into the area from the Wessex chalklands. A single irregular flake, attributed a generic prehistoric period is made on a Greensand Chert, perhaps Vale of the Tone material.

Technology and typology
As on the surface of the Burtle, the lithics give small and fine spalls, flakes as microdebitage and larger flakes. These, together with the core rejuvenation flake and fine parallel-sided blades and the two primary flakes (near 100% cortex on dorsal surface) indicate flaking and core reduction occurring nearby. Debitage with no cortex and a few examples of secondary stages of flake production (less than 50% cortex on the dorsal surface) have also been recorded. Where proximal ends and bulb/platforms are present, plain and punch forms are observed. The presence of feathered terminations may also suggest control, well executed flake/blade production, by skilled knappers. The emphasis appears to be on blade production, broad blade, but more, a later Mesolithic narrow blade manufacture. The presence of a microburin (Fig 10.1, Shapwick 113), with light patina, taken with the later form microlith (Fig 10.1, Shapwick 280) excavated from Trench 2, layer 11 (Sample 104), may well point to later Mesolithic activity. The microlith, blunted on both dorsal edges, is almost arc-blunted (Clark 1934, 57). It may best fit a fine obliquely blunted point, or lanceolate form, part of Jacobi's (1979, 56-63) later Mesolithic South-West techno-complex. The level of duration of this activity may be slight, as observed here. But, importantly, this later Mesolithic presence confirms a previous reassessment and phasing of the sizeable mixed lithic assemblages and microlith forms from various locales on Shapwick Burtle (Bond 2004b, 2006, 2007).

Brue Valley – Other Locations (See above Chapter 7)

Table 10.3 provides a breakdown of the main types of lithic artefacts recovered from the hand excavation of some 26 Test Pits across three Burtle sand islands: Canada Farm; Brickyard Farm; Shapwick Burtle and other possible 'island' locations in the low-lying wetland, or fen-edge areas of the parish of Shapwick. This methodology, the hand excavation of 1m x 1m, builds on previous shovel test pit survey and test pit excavations that were part of the Shapwick Project (Thorpe and Gerrard 2007). Both that project, and local fieldworkers and the Somerset Levels Project have located mostly Mesolithic material on mineral islands on Shapwick Heath (Bond 2006; Brown 1986).

Table 10.3: Quantification of excavated lithics from 1m x 1m Test Pits across Shapwick Burtle and possible 'island' locations.

Type	***Context***	***No.***
Chip	Brickyard Farm - topsoil, Pit 9 (n=1)	1
Flake microdebitage	Pit 24 (n=1)	1
Flake	Brickyard Farm - topsoil, Pit 9 (n=5); Pit 2 (n=1); Pit 21 (n=1); Pit 22 (n=1); Pit 24 (n=7); Pit 23 (n=3); Pit 25 (n=6);	24
Core rejuvenation flake	Pit 24 (n=3); Pit 25 (n=1)	4
Blade	Pit 22 (n=1)	1
Totals		**31**

A total of 31 lithics were excavated, the highest numbers of struck flint and chert coming from Brickyard Farm (Pit 9) and Pit 25. Some potential earlier Neolithic material is noted, but predominately Mesolithic technology is present, both early and later material.

Condition
All artefacts are fresh, with little sign of rolled edges, or plough damage. A few examples of burnt material is also observed (n=6), indicative of hearth activity nearby. Most lithics are patinated/recorticated, with light to medium levels of discolouration. Many lithics are not complete.

Raw material
The main type of raw material, in keeping with the Shapwick Burtle assemblages consists of flint. The type of flint is, as mentioned above, a Green-black-grey material, a Downland nodular source imported into the Somerset Levels. Only a single cortical flake, of prehistoric date, perhaps Mesolithic is made of chert; a Blackdown Hills chert, from the facies most likely to be from the vicinity of Wellington in the Tone Vale.

Technology and typology
A single fine, small microdebitage flake (Pit 24), was recovered, but a chip (Pit 9), flakes and core rejuvenation flakes were located. A single large and complete core rejuvenation flake (from Brue Valley Pit 24 (Figure 10.1, Brue 2401 and Fig 7.3), with signs of edge-utilisation and gloss, typically a broad flake, technologically, earlier Neolithic in types was recorded. This flake, its edge-use and gloss is directly comparable to similarly used flakes excavated beside the Sweet Track, perhaps set as a cache (Brown 1986). Otherwise, with exception of a few squat-like flakes, the majority of this sub-assemblage fits well a Mesolithic flake/blade-production technology. The flaking stage present is dominated by tertiary flakes (mostly without cortex), but primary and secondary reduction is also evident. Pre-prepared cores, flake and blade blanks, may be the main focus of this technology, indicative of highly mobile communities staying only short duration at each locale.

Unstratified Chedzoy

Table 10.4: Quantification of lithics recovered from the surface of the field at Chedzoy.

Type	***Context***	***No.***
Flake	Unstratified trampled area field corner	1
Blade, Retouched	From badger hole on Burtle (ST35027 37515)	1
Core	Unstratified trampled area field corner	2
End scraper	Unstratified trampled area field corner	1
Totals		**5**

These artefacts are similar to the mixed surface-derived collection, including quantities of Mesolithic material recovered by Norman (1982, 2003). An end scraper, flake, a retouched blade and two cores (one chert) has been recorded. The end scraper (Fig 10.1, Chedzoy 5) is a simple form, retouched on the end of a thick/backed Blackdown Hills Chert blank. This is typically Mesolithic, possibly early. The cores, one is a simple bipolar core blade core (B1 core), made on Blackdown Hills chert, again Mesolithic, but with the size of parallel-sided blade scars, likely to be later Mesolithic. The second core is a multi-platformed type (B3 type) with, platforms at right-angles, with fine narrow-flake scars, with slight patina, on a Green-black-grey nodule, with river smooth chalky cortex. The flake (with no patina), also made of same flint may be Mesolithic, possibly later Mesolithic. The retouched blade, without patina, fine and parallel-sides is later probably Mesolithic in date.

Excavated Chedzoy

Table 10.5: Quantification of lithics excavated from Trenches 1 and 2, adjacent the Chedzoy Burtle sand island 2013.

Type	***Context***	***No.***
Unworked pebble	Trench 1, Context 7	2
Chunk	Trench 2, sump hole; Bag 1, Grey sandy clay sump	3
Flake microdebitage	Trench 1, Context 7; Trench 2, Sample 1, 5, 4, 14 and 18	9
Flake	Trench 2, sump hole, Pollen Monolith 6, Peaty clay silt; Trench 2, Sample 3, 4, 6, 10 and 18; Grey sandy clay (Trench 2?); Trench 1, Context 7 and 8	23
Core rejuvenation flake	Trench 2, sump hole; Trench 2; Trench 1, Context 8; Trench 2, Sample 1 and 6	6
Blade	Trench 1, Context 7 (cleaning up profile) and residue	2
Microlith	Trench 1, Context 7 (residue)	1
End scraper	Trench 2; Trench 1, Context 82-97 cm	2
Core/adze fragment	Trench 2, Pollen Monolith 6, Peaty clay silt	1
Totals		**49**

A total of 49 lithics have been recovered, 17 from Trench 1 and 32 from Trench 2. Amongst the artefacts, some can only be attributed a generic prehistoric date, but most technologically are Mesolithic, with a higher frequency of later Mesolithic material. Few artefacts are attributed to a later Mesolithic and/or earlier Neolithic, or earlier Neolithic date, confirming the spatial and chronological separation of assemblages across the field noted by Norman (2003). Only a single broad flint flake, later Mesolithic and/or earlier Neolithic in period is excavated from Trench 2 (Grey silty clay) and a probable large, earlier Neolithic and/or middle Neolithic chert flake is recorded from a Grey sandy clay context (Trench 2?).

Condition

All artefacts are in a fresh condition, with no evidence of rolling in the plough soil. Lithics are mixed, some snapped, others complete. In terms of patina/recortication, again, many are discoloured, with even medium to heavy patina (particularly cherts); other lithics, including flint are less patinated. Only a single flint flake is burnt. It is possibly Mesolithic, excavated from Pollen Monolith 6, from Peaty clay silt, Trench 2.

Raw material

Almost equal numbers of flint and chert are observed (ratio, 25/49, 51.0%). However, with the condition of some pieces, the level of patination/recortication, made at times distinguishing flint from chert highly problematic. The fine grained variants of the Blackdown hills cherts, possibly a distinctive Black-grey chert with a source at the head of the River Brue (cf. Bond 2004a, Table 14.5; Bond 2006; Bond 2011, 204, Fig 2), was difficult to separate from the normally distinctive Green-black-grey Downland nodular flint. An absence of Greensand Chert (a blond colour chert, from the River Tone catchment) is noteworthy. However, as noted elsewhere (Bond 2009, 347-8, figs 52.3d, 52.5), there is a distinctive emphasis on chert at Chedzoy, but with the fine grade Downland nodular flint imported from the Wessex chalklands. This emphasis, or balance in raw materials is absent further north into the Brue Valley, as seen at Shapwick Burtle.

Technology and typology

The presence of fine, small spalls, microdebitage and flakes, core rejuvenation flakes, with snapped blades, chunks also suggest flaking near to the excavated Trench. A core, possibly reused from a broken adze/axe, has also been recorded in situ in Pollen Monolith 6, Peaty clay silt, Trench 2 (Fig 10.1, Chedzoy 21). This together, with the quantity of debitage with tertiary, some secondary and primary flake stages indicate core reduction within the vicinity, perhaps near to the edge of the Burtle island. The technology evident consists of small flake, to blade production, consistent with a Mesolithic, or more later Mesolithic date. A few pieces suggest the presence of a small, narrow-flake industry, giving an earlier Neolithic presence. (see Appendix 6, i.e. Find No. 19, a flint core rejuvenation flake [LM/EN], context –Grey silty clay, Pit 2; Find No. 20, a chert flake [EN/MN], context – Grey sandy clay; Find No. 104, a flint flake [EN], context – Pit 1).

There is a preference for platforms observed on flakes, to be plain and punch type and terminations are commonly feathered, or plunged. A high degree of skill is exhibited, characteristic of systematic blade or narrow flake manufacture, in the later Mesolithic into the earlier Neolithic.

The excavated retouched forms; the two end scrapers on flakes (Fig 10.1, Chedzoy 18, Trench 2 and Chedzoy 102, Trench 1) , the retouched blade, core/adze fragment and microlith (Fig 10.1, Chedzoy 19, Trench 1) , an obliquely blunted point down one edge (Clark 1934, 56), are all consistent with a later Mesolithic date. This simple, small and slender rod form also fits well Jacobi's (1979, 56-63) later Mesolithic South-West techno-complex. This assemblage is indicative of task-centred stays, linked to the edge of the Burtle island at Chedzoy and fits well the survey assemblage in the field further into the island (Norman 2003, Table 2, fig 7, no 13).

Discussion

Quantities of lithics, mostly dating to the Mesolithic have been recovered for over 100 years from the Burtle islands in the Brue and the Parrett. Both the surface derived material collected from molehills and ploughed fields and the excavated assemblage, fit well the range of types and broad period of lithics previously recovered. Across the Levels, but most notably demonstrated in the excavated and survey assemblages from the Shapwick Project (Bond 2007, 697-702, fig 15.5), flake industries tend to be blade and narrow flake-centred. By contrasting, condition (patina), raw material use, known technology and typology, it is possible to group much of the material from these multi-period lithic scatters. The assemblages present here fit that pattern, and are indicative of highly mobile hunter-gatherer groups, or herder groups, perhaps present in the Somerset Levels and adjacent uplands over the early Mesolithic into the earlier Neolithic. Over that extended time, blade and flake technology traditions change slightly, but with some consistency in the use of imported raw materials; Downland nodular flint. Local procured cherts, over time become less significant (Bond 2004a, fig 14.5; 2011, 205, table 3).

Importantly, for the first time this project has deployed scientific techniques to sample palaeo-environmental strata and radiocarbon contexts with material culture *in situ*. For the first time, in strata adjacent to the Burtle sand island slope, with deposits grading into the peat, technological and typologically diagnostic lithics have been recovered and dated. This may be the case for Trench 1 at Shapwick Burtle. Whilst some of these contexts may represent eroded old land surfaces, on an unstable sandy Burtle slope, their excavation and radiometric dating is significant.

At Shapwick Burtle the microburin from Trench 1, layer 11 (Shapwick 113) and the late microlith rod-like form (Shapwick 280) from Trench 2, Layer 11 (Sample 104). Trench 2 is sealed by peat dating to 3640-3360 cal BC and 3705-3640 cal BC. The base of the peat is dated 4230-3970 and 4060-3940 cal BC. This implies that these characteristic later Mesolithic artefacts are dated to the very latest phases of later Mesolithic hunter-gatherer activity at Shapwick Burtle. This deposit is in close proximity to the siting of the earlier Neolithic Post-Track and the Sweet Track dated by dendrochronology to 3838 BC and 3806-7 BC (Hillam *et al.* 1990). A presence, if not a sustained duration of activity at this locale is now demonstrated. This presence has been evidenced by surface scatters on Shapwick Burtle and its implications discussed elsewhere (Bond 2004).

The Chedzoy lithic assemblage is equally significant, with a flake and core/adze fragment (Chedzoy 102) , excavated from a pollen monolith in Trench 2, Pollen Monolith 6, Peaty clay silt. This strata is of wood peat, Context 9. It is viewed by the excavator as consistent with the radiocarbon determination of 4040-3800 cal BC, just above this context. Therefore, again, material culture of a later Mesolithic character is radiocarbon dated, with palaeo-environmental data *in-situ*, just off the Burtle sand island.

Conclusions

The target excavated pits at, just off the Burtle island edge at Shapwick Burtle and Chedzoy have successfully recovered palaeo-environmental data, chronologically and technologically diagnostic lithics *in situ.* The surface collection at other locations in the wetland has also added to the known multi-period lithic scatters on the smaller Burtle islands (Bond 2004b, 42-5, figs 3 and 4). This work, once again, has demonstrated these sites as unique heritage assets which remain fruitful for new finds and key for understanding the nature of Mesolithic and later settlement in the Somerset Levels. Critically, the radiocarbon dated strata with lithics now demonstrate that these locales were not solely the preserve of people using early Mesolithic Maglemosian-type industries (*contra*

Wainwright 1960). Instead, as suggested from surface scatters (cf. Bond 2006, 2009c), their occupation, even if only over brief stays is extended into the later Mesolithic.

The Somerset Levels Burtle sand island sites, with their adjacent palaeo-ecology, deep strata and surface and buried material culture (lithics, pottery, trackways), all offer a rare glimpse into the transition from hunter-gatherer lifeways, to earliest arrival of the Neolithic 'package' in South-West England. These lithics in context both spatially within the landscape and on the Burtles and horizontally, as in excavated strata adjacent the sand islands are a unique heritage asset. Artefact, place and strata, combine to denote these sites as a resource of some considerable local, regional and national significance (English Heritage 2012c, 13-14)..

Chapter 11: Conclusions regarding the Mesolithic of the wetland/ dryland edge in Somerset

by Martin Bell, Rob. Batchelor, Clive Bond, Richard Brunning, Tom Hill, Peter Marshall and Keith Wilkinson

11.1 Introduction

This project addresses a national problem with reference to a county-based case study. The problem is that the Mesolithic period, covering 5700 years, half of the postglacial, has received far less archaeological attention than other periods. Our understanding of the period in England has relied heavily on a very small number of key sites particularly Star Carr, Yorkshire. Most sites are surface lithic scatters, without evidence of environment or economy. Substantial bodies of palaeoenvironmental evidence exist (eg Simmons 1996; Innes *et al* 2013) but few of them are directly related to archaeological sites and artefact assemblages. The result is that we have parallel, and to a significant extent disconnected, archaeological and palaeoenvironmental discourses (Bell 2007, 1). Well-stratified sites with a range of sources of evidence have proved difficult to locate, especially during assessments as part of the planning process. There is concern that they may sometimes be overlooked because of deep burial, a lack of appropriate methodology for investigation and because of a lack of focus on the period.

Although the Somerset Levels are famous for their wetland archaeology, all the excavations have been focused on the Neolithic to Iron Age. Mesolithic sites were known but not excavated and their potential remained unclear. It has now been established that some of these sites extend into the wetland and are vulnerable to the effects of drainage. Local planners and stakeholders need to be able to define the Mesolithic heritage assets more precisely in order to develop more effective plans for conservation. It was established at the outset of this project, in consultation with English Heritage, that it should focus on the Mesolithic but also encompass the early Neolithic in order to avoid past problems of period compartmentalisation which have inhibited investigation of Neolithisation.

This project has involved an audit and updating of existing HER data for the Mesolithic and a combination of borehole surveys, geophysics and test pits to examine the evidence for Mesolithic and early Neolithic activity at the wetland dryland interface in the Somerset Levels. Palaeoenvironmental studies provided evidence of the changing character of the wetlands beside three known and important Mesolithic sites, each situated on sandy burtle sediments of Pleistocene date at Greylake, Chedzoy and Shapwick. The palaeoenvironmental evidence provided by these three sites is mainly of the late Mesolithic and early Neolithic. There is a fourth case study of Queen's Sedgemoor where a long peat sequence was examined and which dates to 5600-200 cal BC, but with an unfortunate gap of non-pollen-preservation at the Mesolithic – Neolithic transition. There were additional small scale test pit investigations of other burtles in the Shapwick parish of the Brue valley. The project also provided the opportunity to synthesise borehole evidence from four geoarchaeological projects in the middle Parrett valley carried out prior to engineering works. These data provide a basis for reconstruction of the palaeotopography and palaeoenvironments of the valley in the early and middle Mesolithic, thus complementing the late Mesolithic focus of the three case study sites.

Previous records of site distributions and lithic artefacts from Somerset, and particularly the Levels, have been synthesised, while the lithics from our own excavations are also reported.

The palaeoenvironmental methods employed varied according to the intensity of investigation and the potential of each site. All investigations (other than the small-scale Brue valley test pits) involved pollen analysis; at the four study sites this was accompanied by some work on plant macrofossils. Other palaeoenvironmental techniques employed at selected sites included non-pollen palynomorphs, diatoms, ostracods, Foraminifera, molluscs, insects, sediment micromorphology and particle size analysis. The chronology of changing environments and Mesolithic and Neolithic human activity is provided by 58 radiocarbon and two optically stimulated luminescence dates, provided by English Heritage. These have made possible comparison with the dates obtained from previous work in the area.

In terms of artefact assemblages a division has often been made between early Mesolithic assemblages (9500- 6500 cal BC) and later Mesolithic assemblages (6500-4000 cal BC). Previous writers have argued that the Somerset Levels Mesolithic assemblages are mainly early Mesolithic. Bond (2009a) has argued that there is also Middle Mesolithic material. A Middle Mesolithic phase has also been recognised in the Fenland of East Anglia at Peacock's Farm and Letter F Farm (Smith *et al* 1989) and in the Wissey embayment (Healy 1991). Norman (2003) argued that the Chedzoy site dated between 7000 -5000 cal BC. Bond (2004a, 2009b) has identified a small proportion of late Mesolithic material among the Somerset assemblages, including Shapwick burtle.

In terms of past environment the key divisions are:-

(a) An early Holocene terrestrial phase *c* 9550-8000 cal BC, largely dryland conditions, incised valleys and slopes undergoing succession to closed forest. This phase is absent, or at least extremely rare, on the Levels. Deposits of this age have not been investigated on the Levels because, if they exist, they are buried under deep deposits of later Holocene date.
(b) Marine transgression, initially in the most deeply incised valleys to seaward, then progressively rising water tables leading to the formation of the lower peats. Those dated are mostly between *c* 6000-5500 cal BC
(c) Extensive estuarine phase with laminated silts indicating saltmarsh and mudflat environments *c* 5500- 4500 cal BC.
(d) As the rate of sea-level rise slowed estuarine environments were colonised by reed swamp from about 4500 cal BC. This is the base of the upper peat which continued forming though the Neolithic and later and is associated with the many trackway finds.

Conclusions are presented under the research aims outlined in the original project design (Bell *et al* 2013) and are shown below in italics. In many cases the evidence obtained has contributed substantially to the original aims, in others the evidence has been more limited. It seems sensible to reflect on both positive and more limited outcomes here in order to focus and direct future research.

11.2 Research aims and results

11.2.1 How significant was the wetland edge to communities at different stages of the Mesolithic?
Early Mesolithic sites at the base of the valleys on the Somerset Levels, if they exist, are deeply buried by up to 20m of later Holocene sediment and will be very difficult to locate. Their topographic context is now clearer from borehole evidence in the middle Parrett valley (Chapter 8). No deposits earlier than *c* 6500 cal BC have been dated by this project but the underlying topography has been shown to be far more varied prior to burial by later Holocene sediments. River valleys were incised as a result of low Pleistocene sea levels and slopes and rises are in some cases now buried by later sediments. There may have been areas of impeded drainage, created for instance by periglacial geomorphic processes, such as slope process or coversand

deposition, leading to areas of wetland and lakes. The Parrett boreholes identify one, probably two, former lakes, at Saltmoor and Moorland House, and dated to the seventh millennium cal BC. Former lakes are likely to have attracted Mesolithic settlement, albeit that the known early Mesolithic sites are on the burtle rises perhaps 10m above the level of nearby rivers.

In the later stages of middle Mesolithic marine incursion, when the basal peats were forming, activity seems to have continued at Chedzoy but is less evident from the other lithic scatters. Bond (2009a) has argued that marine incursion into the Levels could have reduced access by later Mesolithic groups. Conversely in the Severn Estuary at Goldcliff it can be shown that Mesolithic activity continued despite marine transgression and associated vegetation changes (Bell 2007). Evidence for burning at the wetland edge (11.2.3) provides significant, but indirect, evidence for the importance of the wetland edge ecotone to Mesolithic communities in the Somerset Levels from at least 6000 cal BC.

The project has produced direct evidence that, in the late Mesolithic when estuarine silts were giving way to reed and then wood peat, Mesolithic activities are represented. At Chedzoy this is in the form of lithics during the early stages of peat formation from c 4230-3995 cal BC. At Shapwick, the presence of late Mesolithic artefact types, especially the rod microlith, and evidence for later Mesolithic narrow blade techniques (Chapter 10) also points to activity continuing to close to the end of the Mesolithic. However, in that case the artefactual evidence is all from the minerogenic Old Land Surface below the basal peat where organic preservation in the form of hazelnuts is dated 4010-3960 cal BC. The small island of Brickyard Farm produced charcoal of the Mesolithic-Neolithic transition from a posthole, suggesting that it was the focus of activity, in addition to the nearby Shapwick Burtle. At Greylake our investigations did not find later Mesolithic activity, the previously found lithic assemblage is largely early Mesolithic and peat inception occurred 3640-3370 cal BC. However, the discovery in our test pit of a bovid bone, apparently smashed for marrow which has been dated to the early Neolithic (3690-3530 cal BC), opens up the possibility of activity during that period.

It should be appreciated that the Greylake test pit was a very small sample of the wetland edge zone and its position in relation to earlier lithic finds from the sandpit could not be as closely defined as was possible through the exemplary records of Norman’s (2002) earlier work at Chedzoy, or the information available at Shapwick.

Issues of poor and non-preservation of pollen have been encountered, particularly apparently where reed and sedge peats were subject to flooding by calcareous waters. Unfortunately within the long Queen’s Sedgemoor sequence pollen was not preserved in the key Mesolithic – Neolithic transitional horizon between about 4500 and 3800 cal BC. The project also encountered this problem of poor pollen preservation in sedge peats at Chedzoy. The Somerset Levels Project had previously reported the same problem in their work in the Kings Sedgemoor area. Fortunately at Chedzoy the zone of non-preservation was slightly above the Mesolithic – Neolithic transition from around 3700 cal BC. However, that did limit our ability to pick up early Neolithic changes, although this deficiency was partly addressed by analysis of non-pollen palynomorphs in the upper part of the early Neolithic sequence. The latter demonstrated the presence of coprophilous fungi, and thus perhaps grazing animals, from about 3800 cal BC (Figure 5.20).

A significant outcome of this project is that, with the long established evidence for early Mesolithic, the recent evidence of Middle Mesolithic and the new evidence of final Mesolithic assemblages at the burtle sites at Shapwick and Chedzoy, there is the potential on both sites for evidence relating to each of the key stages of the Mesolithic as well as the transition to the Neolithic.

What contribution can Mesolithic wetland edge sites make to key research questions in the Mesolithic?

11.2.2 The role of plant resources.

Our investigations have shown plant macrofossils surviving in very late Mesolithic contexts at Chedzoy and Shapwick. These are particularly plants of the woodland edge and a number of these are likely to have contributed to the diet. This is particularly true in the case of a charred hazelnut at Chedzoy. Examination of larger areas and samples would be required to see if other edible plants are represented by charred seeds and are therefore more likely to have been used by people. There are additional samples available from our excavations which could be used to address these questions.

11.2.3 The manipulation of plant resources by fire.

There is quite widespread evidence in the form of charcoal. This occurs below the basal peat in Tinsley's (2007) Shapwick study. Charcoal occurs in the Queen's Sedgemoor sequence (Chapter 3) after a horizon dated 4940-4710 cal BC and is also represented in the intertidal peat exposures at Burnham (Druce 1998) and Minehead (Jones *et al* 2004). It could be argued that this charcoal reflects natural wildfire. However, the occurrence of charcoal deposits beginning at about the same time in the Welsh Severn Estuary, especially at Goldcliff, where they are associated with occupation sites, significantly strengthens the likelihood that the charcoal relates to human activity, especially where, as at Minehead, some charcoal can be shown to derive from the burning of reeds (Jones *et al* 2004). In the Severn Estuary it has been argued that an important reason for this burning was to encourage the plant resources of the woodland edge (Bell 2007). Charcoal occurrence may serve as a useful proxy for intensity of human activity in future borehole based studies, especially when accompanied by other sources of evidence such as pollen or non-pollen palynomorphs or microdebitage. Evidence of Mesolithic burning in the form of ash, detected by magnetic susceptibility, has previously been found in boreholes from Hallen, Avonmouth and central Bristol (K. Wilkinson pers. comm.).

11.2.4 Questions of seasonality and sedentism.

The occurrence of charred plant remains such as reeds has been used at Goldcliff to suggest the time of the year when burning occurred and thus when wetland activities may have taken place (Bell 2007). Somerset deposits with charred particles would repay investigation from this perspective but that would require larger samples and more detailed investigation than are available from the small-scale investigations reported here. The presence of bone and plant macrofossils associated with occupation at Chedzoy and Shapwick means that both have potential to contribute to these questions in the late Mesolithic .

Evidence for the sources of lithic materials at both Chedzoy and Shapwick (Chapter 10) points to the derivation of both chert and flint in the Brue headwaters and the Chalk, suggesting eastward patterns of mobility, or evidence for the transfer of materials between different groups.

11.2.5 T*he relationship between burial and settlement.*

It appears from the previously obtained dating evidence from Greylake that in that case lithic evidence for early Mesolithic activity is closely associated with Mesolithic burials dated 8534-8275 cal BC. This substantially enhances the potential of other, especially early Mesolithic, lithic scatters in research terms, given the potential of the calcareous burtle deposits for bone survival and the important contribution which isotopic work on human bones can make to issues of diet, seasonality and mobility in the Mesolithic.

11.2.6 Improved understanding of how the wetland landscape changed during the Mesolithic period and its relationship to settlement patterns.
This has been reviewed under 11.2.1 above.

11.2.7 Do wetland edge sediments preserve traces of footprint-tracks of people and animals as at the wetland edge in the Severn Estuary Levels?
The estuarine sediments which were laid down between *c* 6000 and 4000 cal BC are clearly laminated with silts separated by partings of fine sand; this is illustrated at Greylake (Figure 4.2) and it has been seen elsewhere. In the Severn Estuary intertidal exposures these laminated sediments preserve the footprint-tracks of people, animals and birds (Allen 1997; Bell 2007). It is highly likely that footprint-tracks are also present in the Somerset Levels sequence, but they will only be seen in much more extensive exposures and should be particularly looked for in the laminated sediments exposed in the intertidal zone.

11.2.8 Do the distributions, date, sedimentary context, artefacts, economy and character of wetland edge Mesolithic sites indicate any continuity of activity between Mesolithic and initial Neolithic communities?
As noted above it has previously been contended that the Mesolithic sites of the Somerset Levels are essentially early Mesolithic, predating the formation of the Levels wetland, and indeed this is probably one reason why the significance and potential of these Mesolithic sites has been largely overlooked. A significant outcome of the present project has been to demonstrate that at Chedzoy, Brickyard Farm and Shapwick, activity continued to the end of the Mesolithic. In the case of Chedzoy lithics were stratified in peat dated 4230-3995 cal BC. This is notable because Norman (2003) reports a proportion of early Neolithic artefacts from the adjacent flint scatter and there is a possible cursus on the burtle 1.6km to the west. Cursus monuments are mostly dated around 3600-3000 cal BC (Barclay and Bayliss 1999) and were generally constructed in open environments (Barclay and Harding 1999). In other words there is a case for both final Mesolithic and early to middle Neolithic activity at Chedzoy. The evidence for trackways in the area dated to 3532-3098 cal BC (Coles and Dobson 1989) also strengthens its significance in terms of the late Mesolithic and early Neolithic.

Both Chedzoy and Shapwick, and probably Brickyard Farm, produced deposits of the Mesolithic – Neolithic transition. That boundary must also be present at Greylake in the Upper Peat , albeit not in the peat sequence sampled in the test pit. There is some evidence from the pollen and perhaps from charcoal of the effects of people on vegetation communities at this time. Neither site produced any very clear ‘landnam’ type clearance although this was evident in earlier diagrams from the Sweet Track (Beckett 1979; Hibbert in Coles *et al* 1973). Furthermore, increased dating resolution, especially the absolute dating of the Sweet Track, suggests that some of the originally identified possible human impacts and evidence for agriculture is, in at least some cases at the southern end of the track, perhaps some centuries later than the Sweet Track (Chapter 6, conclusions). Coles and Brunning (2009) suggested that the evidence for pastoral farming may have preceded arable farming in this area and that is consistent with the developing picture. It is interesting that in the Wells *et al* (1999) pollen diagram from south of Shapwick burtle there is evidence of reduced woodland at 3610-3090 cal BC, and from the Shapwick diagram dung beetles appear around 3300 cal BC when there is also more evidence for possible human effects on vegetation. At Chedzoy coprophilous fungi, indicating grazing animals, are present after 3900-3770 cal BC. Taken as a whole that may imply that significant effects on the vegetation occurred 300-500 years after the construction of the Sweet Track with which they were originally associated. This is consistent with evolving models of the Neolithic where the ‘landnam’ based models of the 1970s and 1980s have been replaced with models of a more gradual and apparently patchy transition, with a greater emphasis on pastoralism and mobility (Thomas 2013), which seems to accord with the evidence for the patterning and composition of the lithics across the Levels and Mendip.

Methodological aims

11.2.9 Development of exemplary methodological approaches to the assessment of the Mesolithic of the wetland edge which can be applied in other geographical areas.

A staged approach has been developed involving geophysics, boreholes and targeted small-scale test pit excavation to examine the stratigraphic sequence in detail and then obtain targeted samples for palaeoenvironmental analysis. The test pit stage turned out to be vital in order to fully appreciate the significance of the sequence and its potential. If what was required was establishing the potential of a sequence rather than, as here, its Mesolithic and Neolithic environmental history, then palaeoenvironmental analysis would only need to go as far as the assessment stage and is likely to involve a smaller range of techniques than employed here. In the case of the main study sites reported here it was decided, in consultation with the English Heritage Science team, that a reasonably full analysis should be conducted given the importance and sensitivity of the sites involved.

The project has also proved innovative in terms of the dating strategy developed by Peter Marshall. A conventional approach has often been to obtain palaeoenvironmental sequences and then date them. In this project dating was carried out at the initial post-excavation stage, enabling us to target palaeoenvironmental analysis on the parts of the sequence most relevant to the research questions and project objectives. Such targeting is important in the context of both limited resources and the need to demonstrate that they are deployed effectively.

We suspect that sometimes individuals and organisations have been put off excavating Mesolithic sites by perceived difficulties and high costs. This exercise has demonstrated what can be achieved through very small scale excavations and at modest cost. The limitations of the keyhole approach we have adopted should also be acknowledged. It locates key sequences but cannot provide the sample sizes of lithics, bones and seeds necessary to address many of the research questions of the period.

11.2.10 To combine coring, geophysics, test pitting and environmental analysis to establish sediment sequences at the wetland edge without large scale excavation.

The sediment and environmental sequences have been established at the four key study sites and these sites have been compared to previously obtained sequences in the Brue valley (Figures 6.2 and 6.6) and Kings Sedgemoor (Figure 5.4) to develop a fuller understanding of the Mesolithic and early Neolithic parts of the sequence in those areas. In addition the sedimentary sequence of the Middle Parrett valley has been synthesised (Chapter 8). The development of a robust chronology is an integral part of the creation of sedimentary models and has enabled us to identify contexts requiring more detailed investigation.

Management aims

11.2.11 Review and collate existing information on the Mesolithic of the Somerset Levels enhancing the Historic Environment Record (HER).

A thorough audit of the HER data for Mesolithic Somerset has taken place as part of this project and the records were updated, increasing the number of Mesolithic entries from 138 to 193, a 40% increase. The HER audit exercise also brought to light difficulties in retrieval of relevant palaeoenvironmental records, a problem which applies more generally to other periods and will need to be addressed beyond this project. The way in which other HER's (eg Worcestershire CC) have addressed this problem need to be investigated.

11.2.12 To undertake fieldwork to identify well-preserved Mesolithic sites at the wetland / dryland edge.
The project was successful in identifying late Mesolithic sites with organic preservation at Chedzoy and Shapwick. In both cases the pits excavated just caught the final centuries of the Mesolithic. If the trenches had been a few metres further into the wetland and one metre deeper we would have attained a longer late Mesolithic sequence at both sites and one better able to identify any Mesolithic impact and distinguish that from the effects of Neolithic communities.

11.2.13 Identify and assess deposits of Mesolithic date that are likely to have a high palaeoenvironmental potential.
Recognition of deposits with high palaeoenvironmental potential was achieved and the development of a chronological model was an essential part of targeting the most important contexts. The complementary nature of sources of palaeoenvironmental evidence as part of a multi-proxy approach is apparent from this study. The insects significantly enhance the pollen evidence by pointing to the period when grazing animals are represented (somewhat later than the Sweet Track) and non-pollen palynomorphs also indicate the presence of grazing animals at Chedzoy. The project also provided the opportunity for small scale exploration of the potential of some sources of palaeoenvironmental evidence which have been little used in relation to Mesolithic sites and landscapes, particularly non-pollen palynomorphs. This could prove very useful in detecting the activities of both grazing animals and people, especially when used alongside charcoal to identify deeply buried traces of human activity in boreholes. Such investigation could perhaps be undertaken in selected key areas, for instance where boreholes encounter an old landsurface with a peaty top perhaps in a place favourable for settlement, such as near lacustrine sediments, or on a topographic rise by a river confluence. In such places investigation of charcoal occurrence, non-pollen palynomorphs, investigation of magnetic properties (K. Wilkinson pers. comm.) and a check for microdebitage could help to identify the locations of deeply buried sites and activities which cannot be reached by conventional excavation. Both charcoal occurrence in boreholes and lithic occurrence in grab samples have identified possible Mesolithic foci in submarine contexts in the North Sea and English Channel (Bell and Warren 2013).

11.2.14 Improve understanding of the potential threats facing Somerset Levels wetlands.
The new Countryside Stewardship scheme, which is about to be introduced in 2015, is designed to focus support for environmentally beneficial agricultural practices, such as higher water tables, on areas of particular nature conservation significance. Areas beyond these, which have previously come under the scheme are likely to face more intensive farming involving lowered water tables. In the Brue valley substantial areas are in nature conservation ownership. At Shapwick it is clearly important that watertables are maintained at a high level through the year since the results show that very significant archaeological and palaeoenvironmental deposits are still preserved. Our project has focused more on the King's Sedgemoor area than was the case with previous studies and has particularly drawn attention to the archaeological significance of three areas:-

(i) The Chedzoy, Sutton Hams, Mount Close Batch area (Figure 1.2) where there is a concentration of Mesolithic evidence and trackways, some Neolithic. Our Chedzoy investigation shows that preservation of wetland edge late Mesolithic deposits, of which there are very few identified in England, is currently good, but would suffer if water tables were to be lowered. This would impact particularly severely on the trackways of the area which have not been studied in any detail.

(ii) The wetland between the burtles at Chedzoy and Westonzoyland where the presence of trackways was recorded by Norman (1980), also near a concentration of Mesolithic sites (Figure 1.3). Our project has not investigated that area but the available evidence suggests potential similar to that identified at Chedzoy.

(iii) At Greylake this project has demonstrated wetland deposits surrounding a significant Mesolithic site with evidence for human burials dated 8534-8360 cal BC. The Mesolithic predates the waterlogged levels identified from c 5980-5760 cal BC. However, the finding of a smashed early Neolithic cattle bone suggests the possibility of early Neolithic activity in the area. This is at a natural crossing point of the levels (Figure 1.3) and there are known trackways and wood structures in the area including a post alignments of the late Bronze Age (Brunning 1998; Cole 1983).

This project has also investigated two areas which have seen little investigation in the past. On Queen's Sedgemoor it was shown in Chapter 3 that a long palaeoenvironmental sequence survives and this would be compromised by major watertable reduction. Indeed, high resolution radiocarbon dating provided an age-depth model that suggested at least 1m of peat had already been lost through drainage and peat wastage; this likely encompassed the last *c*.1500 years of peat accumulation. The project has also synthesised the sediment sequences of the middle Parrett valley which may be affected by flood prevention work following the severe flooding of February 2014. The problem in both Queen's Sedgemoor and the Parrett Valley is that there has not been the history of archaeological investigation which would help to identify areas of particular Mesolithic and early Neolithic potential. This is an activity to which community archaeological groups could make a most valuable contribution.

11.2.15 Identify landscapes with high potential for the preservation of Mesolithic sites feeding into *the wider management objectives of the Avalon Marshes Landscape Project in the Brue Valley.*
In the Brue valley the archaeological and palaeoenvironmental potential of the burtle and other wetland edges has been clearly demonstrated by the results from Shapwick burtle (Chapter 6) and by previous work in that area. Test pitting of other burtle areas has produced Mesolithic and Neolithic lithics and a posthole with a final Mesolithic or initial Neolithic date of 3950-3761 cal BC from charcoal was found in Pit 12 at Brickyard Farm (Chapter 7). The burtle edges in the Brue valley clearly have a very high potential for the preservation of significant archaeological and palaeoenvironmental evidence and the bedrock edges, to the north at Westhay and the south at the base of the Poldens, also have considerable potential, especially close to the terminals of later prehistoric trackways which may mark natural routeways across the later Mesolithic levels. The potential of areas near the bedrock edge is shown, for instance, by the Wells *et al* (1999) investigation of a possible southern extension of the Sweet Track.

11.2.16 Contribute to the development of effective strategies combining heritage protection with nature conservation.
The benefits of combined strategies have already been clearly shown, particularly by conservation of the Sweet Track within the Shapwick Heath National Nature Reserve in the Brue valley. Here the key factor is the maintenance of high watertables year round and if possible, given the Wells *et al* (1999) study indicating a southerly extension of the Sweet Track, to extend those conditions to the foot of the Poldens. What the present project has shown is that regimes of high water table are not only important for the preservation of later trackways but also contribute to that of significant, and nationally very rare, late Mesolithic waterlogged levels. This has been demonstrated at Shapwick and almost certainly applies to other burtle edge sites. At both Shapwick and Chedzoy this project has shown that what were thought to be mainly earlier Mesolithic sites, perhaps therefore with limited potential for organic preservation, in fact have final Mesolithic artefacts in

association with excellent preservation of a range of environmental and potentially palaoeconomic evidence.

Whether there is any potential for combining nature and archaeological conservation in the other key area which this project has highlighted, the triangle at Chedzoy- Sutton Hams- Mount Close Batch, requires discussion with nature conservation interests. This is also true for the area north of Greylake. The land in these areas is privately owned unlike the situation in the central Brue valley where there are extensive nature reserves managed by nature conservation organisations.

Outreach aims

11.2.17 To raise the profile of Mesolithic wetland archaeology regionally and nationally so that there is understanding and support for management strategies which protect these heritage assets.

A community archaeological project run by Somerset County Council formed part of this project and was responsible for the burtle test pits excavations in Shapwick parish (Chapter 7). A 'Stone Age Day' was held at St Dunstan's Leisure Centre, Glastonbury in July 2013. The objective was to present information on the Mesolithic and Neolithic periods to the public in an accessible 'hands on' format. Activities included making a Mesolithic shelter, demonstrations of flint knapping, a Stone Age Menu challenge and Mesolithic food taster session, using stone axes to cut wood and firing an atlatl and a replica Neolithic bow. The event was well attended by over 300 people, mainly family groups. The children seemed to particularly enjoy using the tools and weapons.

Presentations about the project were given to public audiences, predominantly non-professionals, in Chepstow in February 2014 and at Street in February 2015; the latter, a very successful wetland focused day conference arranged by Dr Brunning, was attended by *c.* 240 people.

An article on the project has been requested by *British Archaeology* for completion in June 2015 and this will be prepared subject to agreement by English Heritage and project partners.

11.2.17 To ensure that those involved in the development of nature conservation strategies in the Somerset Levels are aware of the significance of Mesolithic sites and associated sediments in terms of the evidence they provide for the past trajectories of biological communities of conservation significance.

The project has benefited from excellent support and advice from the Natural England and other nature conservation staff in the Shapwick Heath Natural Nature Reserve and those working for other nature conservation organisations in the Brue valley who have done everything possible to facilitate our work. Regular dialogue between Dr Brunning and nature conservation interests takes place. The task of raising the profile of Mesolithic Archaeology nationally is an ongoing process. One way of highlighting the period and its potential would be an exemplary research-led excavation of a key site, maybe modest in scale, but sufficient to produce the samples of lithics, seeds and bones and perhaps wood and other artefacts needed to go beyond the potential demonstrated here. Chedzoy has emerged as the site with the greatest potential for such a research-led medium scale excavation.

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