Palaeoenvironmental analyses from MIRE project sites:

Comerslade and Long Holcombe, Exmoor

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On behalf of
Exmoor National Park Authority

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1 Summary

The project background

1.1 Exmoor National Park Authority (ENPA) have an ongoing program of moorland improvement and restoration (the MIRE project), with the aim of restoring around 1000 hectares of wetlands and bogs between 2006 and 2009. The restoration work on Exmoor focuses around blocking drainage ditches in peatland systems. This may result in disturbance to the archaeological record which may be preserved on, within or below the peat. In addition, the mires preserve a palaeoecological record which is essential in the understanding of the nature and development of the historic and contemporary environment.

1.2 This objectives of this project were to undertake baseline environmental archaeological survey and analysis of two of the proposed MIRE project sites: Comerslade (at around NGR SS737372) and Long Holcombe (at around NGR SS769356). Owing to limitations in time available to undertake the project, it is limited in scope and only presents outline data rather than a more rigorous analysis of the palaeoenvironmental archives preserved at the sites.

Results of analysis

1.3 Peat development at the sites is asynchronous. At Comerslade peat accumulation begins at around 6400 cal BC and at Long Holcombe at around 3000 cal BC. The sequences at both sites appear to extent to the at least the recent (last 200 years) past, with peat accumulation continuing at Long Holcombe.

1.4 The sampling resolution is not sufficient for a detailed analysis of the vegetation development pathways and mechanisms for vegetation change at either site; however, both record significant woodland cover at the bases of the sequence, and have the potential to document the processes that have led to the formation of the current Exmoor landscape. Comerslade has greater potential for informing processes in prehistory (in particular the Mesolithic environment and the Mesolithic/Neolithic transition), and Long Holcombe for informing processes through the medieval and post-medieval period. As such, both sites hold high archaeological value, although for different reasons.
2 Project background

The MIRE project

2.1 Exmoor National Park Authority (ENPA) have an ongoing program of moorland improvement and restoration (the MIRE project), with the aim of restoring around 1000 hectares of wetlands and bogs between 2006 and 2009. The project is designed to enhance biodiversity, mitigate carbon dioxide release from the drying out of peatlands and restore the water retention of the area to improve river base flow and reduce peak flows and downstream flooding. The work is collaborative with English Nature, Southwest Water and the Environment Agency.

2.2 The restoration work on Exmoor focuses around blocking drainage ditches in peatland systems. This may result in potential disturbance to the archaeological record which may be preserved on, within or below the peat. In addition, the mires preserve a palaeoecological record which is essential in the understanding of the nature and development of the historic and contemporary environment. As a consequence, English Heritage have agreed a program of archaeological assessment in advance of restoration works at key sites in collaboration with the archaeological team at ENPA.

Previous palaeoecological and archaeological work on Exmoor

2.3 The palaeoecological potential of Exmoor’s moorlands has been recognised since the 1970s when pioneering work on the role of human impact on peat initiation was undertaken at The Chains by Merryfield and Moore (1974). Further palaeoecological work was undertaken in the late 1980s in close association with prehistoric archaeology (field systems) from Hoar Moor (Francis and Slater, 1990) and Codsend Moor (Francis and Slater, 1992). Work in the late 1990s began to examine the potential of valley mires on Exmoor (Fyfe, 2000; Fyfe et al., 2003a), and further work demonstrated the high archaeological value of such peatland systems as part of a larger project drawing in both lowland and upland landscapes (Fyfe et al., 2003b; Rippon et al., 2006). In 2005 ENPA commissioned a survey to examine the palaeoecological and archaeological potential of two of the moorland units (Fyfe, 2005). In addition two key peat depth survey projects have been undertaken, by Merryfield (1977) and Bowes (2006) which provide a reasonable estimation of the distribution of blanket peat of Exmoor.

2.4 The archaeology of Exmoor is described in several key publications, with the first comprehensive survey by Grinsell (1970). In the 1990s the Royal Commission on Historic Monuments in England (RCHME) undertook a new
field-based survey of the park, which was published as Riley and Wilson-North (2001). These surveys demonstrated that archaeology extends across the full range of the park, with around 4000 known monuments and sites which span from the Mesolithic through to the historic period.

**Objectives**

2.5 The specific objectives of this project are to undertake archaeological evaluation of two of the MIRE project sites, based on palaeoenvironmental sampling and analysis of representative cores extracted from the sites. Specifically, the work will examine the cores for pollen, testate amoebae, macrofossils, tephra and date them using radiocarbon analysis. Pollen analysis offers the opportunity to examine vegetation succession on each site, along with reconstructing vegetation development and human impact in the wider landscape. Testate amoebae are sensitive proxy indicators of past climatic conditions in ombrotrophic or water-shedding peatland systems (Charman *et al.*, 2000). Different species occupy specific ecological niches which are directly related to water table depth. Water table depth is primarily driven by the summer moisture deficit. Tephra (volcanic ash) offers the potential for improved chronological control within peatland science.

**Schedule of works**

2.6 The project was undertaken during March and April 2008. Field sampling was undertaken in the week beginning 10 March, with laboratory work starting at the end of that week. Samples for dating were submitted to the Scottish Universities Environmental Research Centre (SUERC) Radiocarbon Lab on 14 March. The draft report was prepared in the week starting 1 April.

**Project archive**

2.7 Samples from Comerslade and Long Holcombe are archived within the School of Geography at the University of Plymouth. Prepared samples are kept within the same archive. A paper archive and electronic archive is maintained at the University of Plymouth.

**Pollen and vegetation nomenclature**

2.8 Throughout this report the results are discussed by the taxonomic names of the pollen recorded in the sequence (following Bennett, 1994). The discussion section uses both taxonomic and the common (English) names for the plants that these pollen taxa represent. Testate amoebae are discussed by their taxonomic names.
3 Methodology

Field survey and sampling

3.1 At Comerslade and Long Holcombe field sampling was undertaken at locations specified by the Exmoor Countryside Archaeological Advisor. These were determined from data taken from existing surveys. At Comerslade a 30x30 m grid was laid out to examine local variation in peat depth. Depths were measured using a depth probe and gauge auger, and locations of cores recorded in three dimensions using dGPS. At Long Holcombe, a single coring transect was used to locate the deepest peat using similar methods. Owing to limitations of time, it was not possible to record in detail the stratigraphy of each core; rather a representative core was described in the laboratory using the Troels-Smith (1955) scheme.

3.2 The presence of large wood within the sequence at Comerslade (see 4.1; Table 1) made recovery of a sample core problematic. As a consequence samples from Comerslade were recovered by cleaning back a stream section adjacent to the probing grid. Samples were taken using overlapping 30x10x5 cm monolith tins. At Long Holcombe duplicate cores were recovered using a closed Russian-type corer (Jowsey, 1965).

Palaeoecological analyses

3.3 Thirty-two 1.0 cm$^3$ sub-samples were taken from the sections at Comerslade and Long Holcombe at 8 cm intervals for pollen analysis. Samples were prepared using standard procedures (see Moore et al., 1991). An exotic marker tablet was added to facilitate calculation of pollen and charcoal concentrations (Stockmarr, 1971). Samples were screened through sieves, to retain the 10-106 micron fraction. Non-pollen organics were removed using an acetolysis digestion. The remaining material was mounted in silicon oil for identification at x400-1000 magnification.

3.4 A minimum of 300 land pollen grains (including Cyperaceae) were identified from each level. Grains were identified using the keys in Moore et al. (1991) and Andrew (1981). Identification was standardized to the taxonomy proposed by Bennett (1994). Charcoal fragments were counted from each pollen sample in two size classes (10-50 microns, 50-100 microns) and are expressed as number of charcoal fragments per cm$^3$ and as a charcoal:pollen ratio.

3.5 Nine 1.0 cm$^3$ sub-samples were taken from the section at Comerslade and 16 from the core at Long Holcombe for testate amoebae analysis. Samples were
prepared using standard procedures (see Charman et al., 2000). An exotic marker tablet was added to facilitate concentration calculations (Stockmarr, 1971). Samples were disaggregated in boiling water for an hour and sieved to recover the <180 micron fraction. The remaining material was stored in distilled water and examined under x400-600 magnification, using keys in Charman et al. (2000) for identification where testate amoebae were preserved.

3.6 Five 2.0 cm³ macrofossil samples were taken from the main stratigraphic units in the sample cores (two from Long Holcombe, three from Comerslade). Samples were sieved to retain the >250 micron fraction, and the resultant fraction examined at low magnification (x20-50), and identifiable macrofossils recorded to characterise the main peat-forming vegetation in the stratigraphic units.

3.7 Examination of the cores for tephra horizons was undertaken using contiguous 5 cm samples from Comerslade and contiguous 10 cm samples from Long Holcombe. This ‘scanning’ approach allows an assessment of whether tephra horizons are present within sequences; however, it does not identify their precise locations, which requires higher resolution analysis. The samples were ashed at 450 degrees, with the remaining material subject to an acid digestion to remove organics, prior to mounting and scanning of the residue at x200-400 magnification. Tephra shards were classified by their optical properties (colour and morphology) into either clear vesicular shards or intermediate (yellow to olive brown) fluted and vesicular shards.

3.8 Five radiocarbon samples were taken from 1 cm slices of peat from Comerslade and three radiocarbon samples using 2 cm slices of peat from Long Holcombe, with the humic acid fraction used for AMS dating. Dates were positioned according to the stratigraphy of the cores. Dates are presented as calibrated ages BC/AD, with calibrations performed using the CALIB5.0.2 program (Stuiver and Reimer, 1993).
4 Results

Field sampling

4.1 Up to 1.8 m of peat was recorded at Comerslade; however, the stratigraphy included large and impenetrable wood; as a consequence Comerslade was sampled from an open section, recovering 1.28 m of peat from NGR SS7379737201. The stratigraphy of the sections is presented in Table 1 and graphically on Figure 1. 1.22 m of peat was recovered using a closed chamber corer from Long Holcombe at NGR SS7694435651.

Table 1: Stratigraphic descriptions of sample cores from Comerslade and Long Holcombe. H indicates degree of humification on the Troels-Smith system (1-4 with 4 representing the most humified peat). Macrofossil content is described as relative abundance on a 1-10 scale.

<table>
<thead>
<tr>
<th>depth (cm)</th>
<th>description</th>
<th>Troels-Smith</th>
<th>H</th>
<th>macrofossil content</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>living root matt</td>
<td>Th2 Th2</td>
<td>H1</td>
<td></td>
</tr>
<tr>
<td>9-10</td>
<td>dense layer of Carex sp. roots</td>
<td>Th4</td>
<td>H2</td>
<td>unidentifed wood: 1</td>
</tr>
<tr>
<td>10-51</td>
<td>well humified monocot peat</td>
<td>Th4</td>
<td>H4</td>
<td>charcoal: 4 Poaceae/Cyperaceae: 5 UOM: 7 Juncus seeds: 8</td>
</tr>
<tr>
<td>51-68</td>
<td>well humified monocot and wood peat, wood pieces up to 6 cm diameter</td>
<td>Th2 Th12</td>
<td>H4</td>
<td>wood (Corylus): 5 woody roots: 4 Poaceae/Cyperaceae: 4 UOM: 4 bark: 1 Juncus seeds: 1 mineral matter: 1</td>
</tr>
<tr>
<td>68-72</td>
<td>Solid piece of wood</td>
<td>Th2 Th12</td>
<td>H3</td>
<td></td>
</tr>
<tr>
<td>72-108</td>
<td>well humified monocot and wood peat. Wood pieces up to 6 cm diameter</td>
<td>Th2 Th12</td>
<td>H3</td>
<td>wood (Corylus): 5 woody roots: 4 Poaceae/Cyperaceae: 4 UOM: 4 bark: 1 Juncus seeds: 1 mineral matter: 1</td>
</tr>
<tr>
<td>108-128</td>
<td>well humified structureless organic-rich clay with thin platy clasts</td>
<td>Sh4 As+</td>
<td>H4</td>
<td>Poaceae/Cyperaceae: 5 beetle fragments: 1 Juncus seeds: 8 Carex seeds: 3 mineral matter: 6</td>
</tr>
</tbody>
</table>
Figure 1: Stratigraphy, physical properties, dates and results of tephra preliminary scanning from (A) Comerslade and (B) Long Holcombe.
Long Holcombe

0-76  mid- to dark-brown compact monocot. and moss peat.  Th3 Tb1  H2  
Sphagnum leaves: 7  (inc. s. acutofolia, s. cuspidate and s. papillosum) 
Ericaceous stems: 5  
charcoal: 1  
Poaceae/Cyperaceae: 3  
UOM: 1  
Juncus seeds: 7  
Carex seeds: 2  
Poaceae seeds: 1  
unidentified wood: 3  
charcoal: 6  
Poaceae/Cyperaceae: 4  
UOM: 5  
mineral matter: 3  
Juncus seeds: 4  
Carex seeds: 2  

76-122  dark brown to black monocot peat  Th3 Tb1  H4  

122-158  mid-brown grading to grey silt  Ag4  n/a  

Chronological control

4.2 Results from the eight radiocarbon samples are presented on Table 2 and shown on Figure 1.

Table 2: Radiocarbon dates from Comerslade and Long Holcombe

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>14C age</th>
<th>lab code</th>
<th>fraction</th>
<th>d13C</th>
<th>cal range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comerslade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-21</td>
<td>1780±30</td>
<td>SRR-16676</td>
<td>humic</td>
<td>-27.7</td>
<td>AD 130-340</td>
</tr>
<tr>
<td>50-51</td>
<td>3605±30</td>
<td>SRR-16677</td>
<td>humic</td>
<td>-28.9</td>
<td>2040-1880 BC</td>
</tr>
<tr>
<td>80-81</td>
<td>5915±30</td>
<td>SRR-16678</td>
<td>humic</td>
<td>-27.6</td>
<td>4850-4710 BC</td>
</tr>
<tr>
<td>106-107</td>
<td>7145±30</td>
<td>SRR-16679</td>
<td>humic</td>
<td>-28.5</td>
<td>6070-5980 BC</td>
</tr>
<tr>
<td>124-125</td>
<td>7350±30</td>
<td>SRR-16680</td>
<td>humic</td>
<td>-28.4</td>
<td>6350-6080 BC</td>
</tr>
<tr>
<td>Long Holcombe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-38</td>
<td>520±30</td>
<td>SRR-16681</td>
<td>humic</td>
<td>-28.4</td>
<td>AD 1320-1450</td>
</tr>
<tr>
<td>76-78</td>
<td>1175±30</td>
<td>SRR-16682</td>
<td>humic</td>
<td>-28.2</td>
<td>AD 770-970</td>
</tr>
<tr>
<td>116-118</td>
<td>4375±30</td>
<td>SRR-16683</td>
<td>humic</td>
<td>-28.1</td>
<td>3090-2900 BC</td>
</tr>
</tbody>
</table>
All dates lie in their correct stratigraphic order, and age-depth models have been constructed for each core on the basis of the dates (Figure 1). The age-depth model on Figure 1 presents the age range that is represented by each depth, on the basis of the 2 sigma confidence limits of the calibrated dates. For Comerslade a third order polynomial was used to fit the age-depth relation between 50 and 106 cm, with linear interpolation and extrapolation used outside these depths. The Long Holcombe age-depth relationship has been established through linear interpolation and extrapolation.

Tephra analysis

4.3 The results of the scanning to identify possible tephra horizons is presented on Figure 1. Tephra shards were found within both sequences throughout the profiles. The depth-resolution of the analysis is not sufficient to warrant any clear development of a tephra stratigraphy at either sequence at present; however, it seems likely that each sequence preserves at least three distinct tephra horizons, which warrant further investigation and geochemical typing.

Palaeoecological analysis: Comerslade

4.4 The results of the 16 pollen samples from Comerslade are presented on Figure 2 as percentage TLP (total land pollen), with spores presented as percentage TLP and spores. A total of 7998 pollen and spore grains were identified. Four pollen zones have been distinguished and are described here.

**COM-lpaz1 128-100 cm  c.6300-5920 cal BC**

*Corylus*-Pteropsida (monolete) undiff.
The lowest pollen zone in the sequence from Comerslade has a mix of arboreal (60-70% TLP) and herbaceous taxa (30-40%). The arboreal taxa comprise *Corylus* (c.40%), *Quercus* (c.10%), *Betula* (c.5-10%), *Salix* (c.5%), with *Pinus* and *Ulmus* between 2 and 5%. Ericoidal types are rare within the zone. The herbaceous diversity is greatest is the lowest sample (19 herbaceous pollen taxonomic units), with Poaceae (12%), Cyperaceae (10-15%) and *Filipendula* (up to 5%) the main types. Pteropsida (monolete) undiff. are well represented, at between 35 and 60% TLP and spores.

**COM-lpaz2 100-60 cm  c.5920-2890 cal BC**

*Corylus*-Quercus*-Pteropsida* (monolete) undiff.
Zone 2 is marked by an expansion of arboreal taxa, to levels above 80%. This is mainly accounted for in an increase in *Corylus* and *Quercus* types. *Salix* declines to trace values at the start of the zone. Herbaceous types
decline, and *Filipendula* falls to trace values, with Poaceae and Cyperaceae also reduced. *Potentilla*-type and Apiaceae increase to low levels from trace records in the previous zone. Pteropsida (monolete) undiff. decline towards the top of the zone.

**COM-Ipaz3** 60-44 cm  c.2890-1490 cal BC
*Corylus*-Poaceae
The zone is marked by the start of a decline in arboreal taxa (principally *Corylus*) and an expansion of Poaceae (to c.20%) and Cyperaceae (to 10%). *Potentilla*-type, *Melampyrum* and Apiaceae continue to be recorded at low levels through the zone. *Ulmus* declines to trace levels between 56 and 48 cm, and is only recorded in one other sample.

**COM-Ipaz4** 44-8 cm  c.1490 cal BC – cal AD 1150
Poaceae-*Corylus*
The zone is marked by a further decline in arboreal types (down to a nadir of 20% at 16 cm) and a further expansion of Poaceae (up to 40% TLP). *Potentilla*-type expands to between 4-8%, and there is also a peak in *Plantago lanceolata* and *Succisa pratensis* between 24 and 16 cm depth. *Calluna* is recorded above 1% consistently through the zone, and *Betula* is reduced to trace values.

4.5 The results of the testate amoebae analysis from Comerslade are presented on Figure 3, arranged by preferred water table depth (taken from Charman *et al.*, 2000) from wettest (left) to driest (right). Samples for testate amoebae were prepared at 8 cm intervals from the upper stratigraphic unit; however, the lower units were assessed using spot samples. Although testate amoebae are sensitive water table indicators from water-shedding peatland sites they are likely to have limited application from within woody peat.

4.6 Out of the nine samples examined, only four preserved testate amoebae, and none of these included sufficient concentrations of tests to make a meaningful, representative count. It is not possible to draw any interpretations or conclusions from this data set. Testate amoebae are sensitive to degradation through oxidation and post-depositional disturbance; this is the most likely explanation for poor representation at Comerslade.
Figure 2: Percentage pollen diagram from Comerslade (taxa expressed as percentage total land pollen), including depths of 14C samples and stratigraphy.
Figure 3: Percentage testate amoebae diagram from Comerslade, showing total concentration and number of individuals identified. Core stratigraphy is also shown.
Palaeoecological analysis: Long Holcombe

4.7 The results of the 16 pollen samples from Long Holcombe are presented on Figure 4 as percentage TLP, with spores presented as percentage TLP and spores. A total of 7042 pollen and spore grains were identified. Five pollen zones have been distinguished and are described here.

**LHo-lpaz1** 120-92 cm  c.3290-580 cal BC  
*Corylus*-Betula-Poaceae  
The lowest pollen zone is dominated by arboreal pollen taxa, starting around 80% total land pollen (TLP). *Corylus* is the dominant arboreal taxa (at between 25-40%). *Quercus* is persistent at around 10%, *Betula* starts at over 20%, declining through the zone, recovering towards the top. *Alnus* is present between 5 and 10%. The non-arboreal taxa are dominated by Poaceae, which increases through the zone to 40%. Within the herbaceous taxa only Apiaceae and *Potentilla* are also recorded in all samples. Epiphytes (*Polypodium* and Pteropsida) are recorded at their highest values in the diagram.

**LHo-lpaz2** 92-76 cm  c.580 cal BC – cal AD 880  
Poaceae  
The start of zone 2 is marked by a decline in arboreal types, from 75% to 20% TLP. All arboreal taxa show a decline, although it is most pronounced in *Corylus* and *Betula*, which falls to trace levels only. Poaceae dominate the pollen assemblage (values at 63%). Other herbaceous types increase in values

**LHo-lpaz3** 76-60 cm  cal AD 880-1090  
Poaceae-Cyperaceae  
The start of zone 3 is marked by an increase in Cyperaceae values low values to over 20%. Poaceae values decline in the first sample in the zone, although they increase in subsequent samples. There is little variation in other herbaceous pollen taxa. The start of the zone is also marked by an expansion of *Sphagnum*, although values fluctuate showing variation between samples. Arboreal types remain present in low proportions, similar to those from the preceding zone.

**LHo-lpaz4** 60-20 cm  cal AD 1090-1600  
Poaceae-Cyperaceae-*Calluna*  
Pollen zone 4 is marked by an increase in *Calluna* at the start of the zone, to values up to 10%. Cyperaceae continue to be recorded at levels between 15 and 20%. Poaceae are reduced through the zone to c.30%. Other
herbaceous taxa recorded in the zone include *Rumex acetosa* (1-2%), *Potentilla*-type (2-6%), *Plantago lanceolata* (between 1 and 5%), Asteraceae (trace levels) and Brassicaceae (trace levels). Cereal types are recorded sporadically within the zone, including *Secale cereale* and *Hordeum*-type. Arboreal types are recorded at levels similar to those from the preceding zone, and *Fagus* is recorded for the first time in the sequence.

**LHo-lpaz5** 20-0 cm cal AD 1600 - present  
Poaceae-Cyperaceae  
The zone is marked by the reduction of *Calluna* to trace values, a re-expansion of Poaceae and a gradual decline in Cyperaceae. Representation of arboreal types is the lowest of the entire sequence at the start of the zone. Herbaceous diversity declines, although the main dicot. taxa continue to be well-represented (i.e. *Plantago lanceolata*, *Rumex acetosa* and *Potentilla*-type). *Sphagnum* spores decline to trace levels.

4.8 The results of testate amoebae analysis from 16 samples from Long Holcombe are presented on Figure 5 arranged by preferred water table depth (taken from Charman et al., 2000) from wettest (left) to driest (right). With the exception of three samples (depths of 4-5, 8-9 and 88-89 cm) concentrations were too low to allow for representative or meaningful counts.

4.9 The samples from which representative (>150) counts have been made show different assemblages at 88-89 cm depth and the upper two samples. At 88-89 cm the sample is dominated by *Centropyxis cassis* and *Difflugia oblonga*. The upper samples are characterised by taxa that have wetter affinities, including *Pseudodifflugia fulva*, *Euglypha strigosa* and *Cyclopyxis arcelloides*. 
Figure 4: Percentage pollen diagram from Long Holcombe (taxa expressed as percentage total land pollen), including depths of 14C samples and stratigraphy
Figure 5: Percentage testate amoebae diagram from Long Holcombe, showing total concentration and number of individuals identified. Core stratigraphy is also shown.
5 Discussion

The age of the sequences

5.1 The radiocarbon dates from the sequences indicate that peat developed at Comerslade during the later Mesolithic, shortly before 6350-6080 cal BC (7350±30; SRR-16680). Peat accumulation was most rapid over the basal 30 cm (at around 10 yr cm$^{-1}$) and slowed to around 60 yr cm$^{-1}$ through the phase characterised by wood peat (Figure 1). At Long Holcombe peat development began during the later Neolithic, at 3090-2900 cal BC (4375±30; SRR-16683). There are only three dates from the sequence. The age-depth model from these three dates indicates that accumulation was very slow until around cal AD 770-970 (1175±30; SRR-16682) at which time accumulation rates increased dramatically. Although this broadly fits the stratigraphy of the sequence, this interpretation of the chronology from Long Holcombe must be cautious as it is based on limited dating control, strongly influenced by the position of the dates. It is highly likely that additional dating control points will refine this age-depth model. The chronologies, as they currently stand, both indicate that there has been little loss of peat from the upper levels of the sequences. Extrapolation of the chronologies presents its own problems, but suggests the top of the Comerslade sequence falls between cal AD 1570-1890, and that Long Holcombe continuous to cal AD 1820-1900. Field observations suggest that at the sampling sites Comerslade is not currently accumulating peat; Long Holcombe is.

5.2 The presence of tephra horizons offer a superb opportunity to develop high-quality, improved chronologies for the sequences, and the first opportunity to develop proper time-equivalence horizons for sequences on Exmoor. Four tephra horizons have been recently identified from one other sequence on Exmoor (Ian Matthews, pers. comm.). Resolving the precise positions and geochemically typing the horizons from Comerslade and Long Holcombe should become a high priority for further work.

5.3 Biostratigraphic correlation between the two sites suggests that zones COM-lpaz1 and 2 may predate the sequence at Long Holcombe, zone COM-lpaz3 may equate to LHo-lpaz1, zone COM-lpaz4 may equate to LHo-lpaz2, and zones LHo-lpaz3 to 5 post-date the sequence at Comerslade. Although this is largely borne out (see dates for zone boundaries in sections 4.4 and 4.7) there is a notable discrepancies for the dating between boundaries COM-lpaz3 and 4 and LHo-lpaz1 and 2. This may reflect either: (a) real divergent vegetation pathways between the sites; (b) chronological issues, most likely derived from the limited dating control at Long Holcombe; or (c) the poor temporal sampling resolution caused by the limited number of samples from
each sequence. It is not possible at this stage to resolve these issues. A better temporal resolution of pollen samples (through sampling at 4 or 2 cm intervals) at both sites and more dating control points (from Long Holcombe) would be required.

Vegetation development and human impact

5.4 The Mesolithic environment of this part of Exmoor, as represented through pollen zones COM-Ipaz1 and 2 (Figure 2), was predominantly hazel (*Corylus*)-dominated as testified by the large wood remains visible in the section and the dominance of hazel in the pollen record. The site would have begun as a wet flush or mesotrophic fen characterised by species-rich tall fen vegetation, including meadowsweet (*Filipendula*), sedges (*Cyperaceae*) and some willow (*Salix*) locally on site. The abundance of ferns (Pteropsida undiff.) confirms an epiphyte-rich hazel woodland across at least the local upland area.

5.5 Zone COM-Ipaz2 (Figure 2) shows reduced open ground taxa with more closed canopy vegetation across the local upland. It is not possible at this sampling resolution to identify any human impact in the Mesolithic or early Neolithic section of the diagram. Such impacts tend to be small-scale and ephemeral in nature, and can only be identified by close sampling (e.g. Simmons and Innes, 1996). However, the presence of Mesolithic groups on Exmoor has been proven through excavation and lithic work at Hawkcombe Head, and through palaeoecological analyses and lithics at Exebridge at the confluence of the Exe and the Barle (Fyfe *et al*., 2003a), therefore the opportunity to examine the relationship between these groups and their environment is highly valuable. It is not until zone COM-Ipaz3, at around 60 cm depth, that any long lasting opening of the canopy is recorded, dated to c.3420-2360 cal BC (the large age range for the start of canopy opening is a function of the low sampling resolution of the pollen analysis, and would be reduced by higher resolution analysis). Further canopy opening and expansion of grasses in the local area occur into zone COM-Ipaz4. This is most likely associated with human modification of the upland vegetation (clearance of hazel and expansion of grassland).

5.6 The Long Holcombe sequence (Figure 4), which overlaps and post-date the upper zones at Comerslade, also record significant human modification of the upland vegetation at the coarse scale. The earliest zone has poor temporal resolution, but in the broadest sense indicates a semi-open upland around 3090-2900 cal BC, with hazel, birch (*Betula*) and alder (*Alnus*) locally present, possibly as woodland edge, or ecotonal vegetation, with open grassland on the higher, more exposed parts of the local landscape. By the start of pollen zone LHo-Ipaz2, the date of which is poorly resolved (1160 cal BC-cal AD 10;
better sampling resolution through this boundary would undoubtedly move this, possibly to earlier than this range), extensive clearance of this woodland had begun, with grass-heath expanding.

5.7 Zone LHo-lpaz3, which coincides with a change in stratigraphy, marks a clear shift to sedge-dominated local vegetation, along with a substantial increase in *Sphagnum* spores. Caution is needed with interpretation of *Sphagnum* levels, as there is no clear relationship between abundance of spores and abundance of the bryophyte in peatlands. However, the change must mark a shift to more bryophyte-rich vegetation. The macrofossil sample from the stratigraphic unit (Table 1) identified *Sphagnum* section *acutifolia*, *Sphagnum* section *cuspidatum* and *Sphagnum papillosum* along with *Carex* seeds. The age-depth model (see discussion in section 5.1) supports a shift in local peat accumulation rates around this boundary as well. It is not clear at this point why the stratigraphic change occurs, although the character of the peatland could be controlled by either climatic changes or human activities which may have modified the hydrology of the surrounding area leading to increases in surface water tables. Further analyses would be required to resolve this issue.

5.8 The start of LHo-lpaz3 also marks the start of a persistent presence of cereal types in the local area, notably rye (*Secale cereale*) and barley type (*Hordeum* type), at between cal AD 390 and 1040, derived from the age-depth model. The interpretation of barley pollen grains is problematic, as the pollen taxonomic unit includes wild grasses (Anderson, 1978). However, the rye type is monospecific, giving a positive indicator of cultivation. Cereal grains are notoriously poorly represented owing to their poor dispersal (Vuorela, 1970), and presence of grains typically represent cultivation in the extra-local area. Fyfe *et al.* (2003b) have identified a similar pattern from the south side of Exmoor, dated to around cal AD 1000, which they argue marks a shift in the mode of agricultural regime on south western uplands. Other high Exmoor sequences have not recorded this change (e.g. The Chains: Merryfield and Moore, 1974), so it is surprising that it is recorded at Long Holcombe, and further analyses may support this existing model of Fyfe *et al.* (2003b) and Rippon *et al.* (2006) and extend our understanding of agricultural practice on the upland through this period.

*Surface wetness indicators from testate amoebae*

5.9 Concentrations of testate amoebae from both Comerslade and Long Holcombe are too low to enable any robust reconstruction of surface wetness and thus climatic changes through the sequences. There is; however,
potential from Long Holcombe to record recent climatic changes (see section 5.13).

The archaeological and palaeoecological value of the sites

5.10 This section makes reference to the recently-published Archaeological Research Agenda for south west England (Webster, 2008). Full details of the Research Aims for the region can be obtained through examination of this document, which is available online. For brevity, only reference to the Research Aims will be given here (e.g. RA10: Addressing the lack of understanding of key transition periods).

5.11 Both Comerslade and Long Holcombe record vegetation in their lower samples that is significantly different to the present vegetation, and both document at least part of the key transformation(s) that have led to the present character of Exmoor. Their location, in the centre of ceremonial complexes, also means they are more sensitive to archaeological landscapes at least in prehistory, than other sequences on Exmoor. In this sense, they hold at least regional significance for this palaeoecological story.

5.12 Comerslade has exceptionally high value beyond this for three main reasons. First, it is one of only four sites known on Exmoor which include significant wood within the stratigraphy (the others being Halscombe Allotment, Warren Farm and Broadmead). These types of sites are extremely rare within the southwest region beyond sections that can be observed in the intertidal zone (so-called submerged forests), and scarce at the national level. They are important as they offer the potential to determine the status and character of woodland in uplands through the early Holocene (RA18a: Targeting specific soil and sediment contexts for environmental information; RA25b: Improve our understanding of Palaeolithic and Mesolithic landscapes). Second, Comerslade dates to the later Mesolithic, a period which is the focus of ongoing research on Exmoor, lead by Bristol University, based around the later Mesolithic settlement site (one of a handful nationally) at Hawkcombe Head. The environmental context and relationships between Mesolithic groups and their environment is poorly understood although work on Dartmoor and to the south of Exmoor has demonstrated woodland manipulation during the later Mesolithic (RA10a: Addressing the lack of understanding of key transition periods). Third, Comerslade lies within a rich archaeological landscape, and will record the impact of past human activities related to these monuments (e.g. White Ladder stone row, the barrow complexes etc.) (RA10c: Addressing the lack of understanding of key transition periods; RA21b: Improve our understanding of the environmental aspects of farming).
5.13 Although Long Holcombe also records an important part of the prehistoric period, the rates of accumulation through the lower part of the section mean that the value of the site is lower (based on the current age-depth model derived from limited dates). The site has high value, though, for the understanding of the agricultural regime through the medieval period (RA21d: *Improving our understanding of the environmental aspects of farming*), in particular the role of arable cultivation on the higher moorland, as explored by Fyle *et al.* (2003) and Rippon *et al.* (2006). Further, the presence of good concentrations of testate amoebae in the upper (recent) levels and the implied continued peat growth at the site means that targeted high resolution analysis of the last 200-300 years would be possible to allow the relationship between recent climatic change and vegetation succession (and human management of the upland) to be explored (RA21e: *Improving our understanding of the environmental aspects of farming*). This may also inform ecological management of upland sites, by modelling the response of species and communities to water table variations over the recent past, and projecting these relationships under future climate change scenarios (using climate predictions from UKCIP08).

6 Conclusions and recommendations

6.1 Both Comerslade and Long Holcombe hold high archaeological value owing to the palaeoecological record contained within them. Comerslade is one of a handful of sites with the region which preserve a full and continuous record of environmental change from the later Mesolithic period to close to the present. It is nationally significant as a site which preserved macrofossil and microfossil evidence for ‘pre-disturbance’ woodland, the character of which is currently a focus of lively debate within mainstream ecology and conservation management (see Vera, 2000, Svenning, 2002 and Mitchell, 2005). Further, it covers several of the key transitions which are currently the subject of ongoing work in archaeology, notably the Mesolithic-Neolithic transition and the emergence of field systems through the Bronze Age, of which little is known or understood on Exmoor.

6.2 The value of Long Holcombe lies in its potential to inform questions of medieval landscape development and the farming economy, in particular the role and chronology of cereal cultivation on the upland and upland management. It also holds high potential for understanding the complexity of vegetation response to recent climate change through examination proxy-climate indicators (testate amoebae) in the uppermost levels of the sequence, which are likely to be most vulnerable to disturbance on and around the site.
6.3 It is regretful that this report was unable to present a more full analysis of the sections, owing to both time and resource constraints imposed by the funding agency. As a consequence much of the discussion of value of these sites has been limited, and certainly not realised. Greater emphasis was needed, in particular, on: (1) improving the sampling resolution of the pollen analysis at both sites, with key emphasis on transition periods; (2) refining and typing the tephra horizons which have been identified within the sequences to develop key time-equivalent horizons for future palaeoecological work in the region; (3) further chronological control, in particular at Long Holcombe, to refine the age-depth model for the sequence.

6.4 Long Holcombe appears to record continuous peat accumulation to the present day, and has the potential to develop a strong understanding of recent vegetation changes. The recent (last 200-300 year) environmental record will be extremely sensitive to restoration works and it is recommended that the better preserved areas of the peatland experience minimal or no disturbance where possible.

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7 References


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