UPLAND PEATS - MANAGERIAL ASSESSMENT

VOLUME 2

The Case Studies and Appendices

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APPENDIX 1: DETAILED METHODOLOGY

A1.1 CONTEXT FOR THE CASE STUDIES

A1.1.1 At the outset of the project, it was recognised that there was a need to test methodologies and examine the impact of threats within a series of representative areas of upland. A focus on specially selected areas would serve to establish a methodology that could be applied to the whole issue of site visibility in the areas of upland peat, and serve to explore and quantify the character and scale of the threats that have an impact on the archaeological resource. The project examined four areas of peatland in the North West: the South-West Fells of the Lake District; the Langdale Fells in the Lake District; the western slopes of the Forest of Bowland in Lancashire; and the western outlying uplands of south Lancashire, on Anglezarke Moor (Fig 1). These areas were chosen specifically to maximise and expand on the results of earlier surveys. Within the South-West Fells, the western part of the transect, around Barnscar, and the eastern part of the transect around the Hesk Fell 'D'-shaped enclosure, had previously been surveyed as part of the Lake District National Park Survey (Quartermaine and Leech forthcoming). The majority of the transect, comprising the higher ground between these two sections, was newly investigated as part of this programme. In the Langdale Fells, the southern part of the transect had been intensively field walked in 1984 (Claris and Quartermaine 1989), and a programme of test pitting had been undertaken by Reading University in 1986 (Bradley and Edmonds 1993). The northern two-thirds of the transect were newly examined as part of the present programme. None of the Forest of Bowland transect had been examined previously, although the eastern boundary of the transect coincided with the western limit of the earlier United Utilities survey (LUAU 1997). The Anglezarke transect was wholly within the extent of the detailed survey undertaken in 1983 and 1984 (Howard-Davis 1996).

A1.1.2 Three of the areas (South-West Fells, the Langdale Fells and Anglezarke Moor) mapped the eroding peat scars in the vicinity of archaeological sites, in sufficient detail to provide comparative data for assessing the changing condition of the peatlands. The selection of the four areas depended on three principal criteria: the landscapes had to be disparate; affected by different threats; and the visibility of the archaeological sites within them had to be dissimilar. The South-West Fells is an area with a relatively dense distribution of archaeological sites, and only discrete areas of blanket peat, and provided an opportunity to test the identification of buried archaeology as the basis for modelling site distributions. Similarly, there is a dense distribution of archaeological remains in the Langdale Fells, in the form of axe-production sites, and the landscape is subject to considerable visitor pressure. The archaeological resource of the Forest of Bowland is relatively unknown, but the peat coverage is widespread. The area has been managed as a grouse moor since the nineteenth century, so it was anticipated that there would be little erosion, allowing it to act as a control. Finally, Anglezarke Moor, an area of Pennine upland, on the fringes of a large conurbation, has been severely affected by fires, and has revealed a rich but varied archaeological resource.

A1.1.3 ***Form of this volume:*** Volume 2 provides a detailed exposition of the survey methodology (*Appendix 1*), together with the results of the detailed archaeological and palaeoenvironmental investigation of the four study areas (*Appendices 2–5*). The archaeological monuments identified by the project are incorporated as a gazetteer in *Appendices 6–9*. A report on the radiocarbon dating from the project is presented as *Appendix 10*. All the figures for both Volume 1 and 2 are incorporated into a third volume (*Volume 3*).

A1.2 FIELDWALKING / PEAT SCAR RECORDING

A1.2.1 A programme of fieldwalking was undertaken for each of the study areas as a means of establishing the nature of surface archaeological remains. By examining peat scars it was also possible to investigate sub-surface features. Each of the four transects was fieldwalked in its entirety; the areas varied in extent from 0.5 x 2.5km for the South-West Fells to 0.6 x 4.6km for Anglezarke Moor. This fieldwork followed on from, and was informed by, aerial photographic analysis of the areas, which defined the extent of obvious peat scars. In practice, the vertical aerial photographic coverage did not provide an effective means of defining the peat scars, partly because of the altitude from which the photographs were taken, and partly because the coverage was out of date (*Section 3.2.14*). The oblique aerial photographic coverage was limited, and the need for up-to-date, low-level coverage prompted a series of flights over the Langdale Fells and Anglezarke Moor. This was particularly pertinent in the case of Anglezarke, where there had been a large moorland fire in 2003 (*Section 2.10.13*).

A1.2.2 The fieldwalking was undertaken systematically, along parallel traverses, between 10m and 20m apart. The survey team recorded the extent of the peat, and evidence of surface features, while also examining erosion patches and watercourse gullies, to check for any evidence of sub-surface remains. Where erosion or disturbance was recorded, the recovery of artefactual material was made a priority. The survey recorded the depth and character of the peat scars where archaeological features were identified. In the Langdale Fells, irrespective of their archaeological content, the extent of all peat scars was recorded as an experiment to determine the effectiveness of this technique. It became apparent that the technique was very time-consuming in areas with substantial numbers of scars, and it was not applied to the other transects. Given that the archaeological remains of axe production were generally identified at the interface of the mineral soil and the peat, it was deemed important to record whether the scars penetrated down to the interface, to establish whether its visibility caused a bias in the distribution of sites.

A1.2.3 On Anglezarke Moor the erosion was on such a large scale that it was not feasible to record each individual scar by ground survey. The limits of areas of widespread scarring, and sites or find-spots, were recorded on the ground, and the recording of the extent of the scars was enhanced using rectified oblique aerial photographs.

A1.2.4 ***Site Recording:*** the sites were located by means of Global Positioning System (GPS) techniques which, with differential GPS equipment, can produce accuracies of better than ± 0.25m. The GPS survey recorded the outlines of archaeological sites, or site groups, but did not extend to the detailed recording of monuments. Digital descriptions of the monuments were compiled in the field on a palm computer, and input into a database. The descriptions recorded the character and form of the monument, and the relationship between the site and the adjacent peat.

A1.3 PROBING

A1.3.1 Probing was undertaken to assess its effectiveness in identifying buried archaeological features. Trials of this technique were undertaken within the South-West Fells study area, where it was anticipated that the remains of archaeological sites constructed from stone would be found, and it would be possible to acquire comparative data from other explorative techniques (*eg* geophysics). The other study areas did not have the same potential, and would not have provided appropriate comparative data from other techniques; this belief was reinforced by a brief and unproductive *ad hoc* trial within the Forest of Bowland area. Within the South-West Fells study area, probing was applied in two distinct circumstances, *ie* where archaeological features were visible protruding from the peat, or monument groups appeared to end at the edge of blanket peat.

A1.3.2 The selected areas were systematically probed on a 2m grid, using steel rods of 5mm and 8mm diameter, with depth markers. Where it was believed that a feature had been encountered, its extent and shape were defined by more intensive probing, marked with canes, and recorded by differential GPS.

A1.3.3 In addition, a sub-surface topographical survey was conducted in those areas where archaeological features had been identified by the initial probing. The sub-surface survey was conducted using a total station to record points, on a 2m grid, on the mineral soil or bedrock underlying the peat cover. These readings were obtained by mounting the prism on top of the probe, and then probing through the peat until solid ground was encountered. The data were then processed, using the *Surfer32* surface-modelling program, to produce a shaded relief map of the land surface below the peat, and any archaeological features situated upon it.

A1.4 TEST PITTING

A1.4.1 A programme of test pitting was undertaken near Black Beck, in the South-West Fells, within an area also examined by probing, resistivity survey, and ground-probing radar (GPR) survey. The area selected for test pitting was deliberately located outside the limits of the Barnscar scheduled monument (SM 32861). The study by Bradley and Edmonds (1993) in the Langdale Fells had also included test pitting, and their results were used as comparative data.

A1.4.2 Small test pits (0.2 x 0.2m), on an approximate 10m grid, were excavated, with a shovel, through the peat down to the level of the mineral soil, over an area of *c* 2ha. The intention was primarily the retrieval of artefacts, which, when encountered, were bagged, recorded and located using a differential GPS, and the test pit was increased in size to 0.4 x 0.4m. In order to assess the extent of the deposits from which finds were recovered, additional test pits (0.2 x 0.2m) were dug at 1m intervals from the original test pit until no further finds were encountered. Test pits revealing archaeological features or artefacts were recorded with trench description sheets, but only the location was recorded of those with negative findings. The generic soil types for groups of test pits was recorded.

A1.5 RESISTIVITY SURVEY

A1.5.1 ***Field Survey:*** a resistivity survey was undertaken, as one of a range of sub-surface investigative techniques under assessment. The trial had to be located in an area of demonstrable sub-surface archaeological remains, where there was also the opportunity to use other techniques. Following fieldwalking across all of the study areas, and initial probing in the South-West Fells and the Forest of Bowland, the BS VI area of Barnscar (Quartermaine and Leech forthcoming) was selected for the trial because it had a confirmed archaeological resource, that was partly buried by shallow peat. The archaeological remains primarily had a stone structural character, but also had the potential for earthwork components; as such, the area had the greatest potential of all those investigated for testing remote sensing techniques. The survey area was divided into two parts (Areas 1 and 2), *c* 40m apart, with a combined area of 0.49ha (Fig 28).

A1.5.2 Resistivity readings were taken at 1m intervals along survey traverses 1m apart. Each 20 x 20m survey grid was surveyed in ‘zig-zag’ mode. Resistivity measures the resistance to an electric current when it is passed through the soil, which is determined both by the soil’s moisture content and its porosity. In general, dense features that are impervious, such as stone, offer relatively high resistance to the current, while features such as ditches, which usually retain moisture, are relatively low in resistance. A Geoscan RM15 resistance meter was employed, attached to a Geoscan Research Mobile Twin Probe Array. The array was configured with 0.5m probe separation, and two remote probes, connected to the RM15 *via* a cable drum, were positioned approximately 15m outside the survey grid. In this configuration, the RM15 has a typical depth of penetration of approximately 0.5m to 1m, and data collection at 1m intervals provides a balance between cost and resolution.

A1.5.3 ***Data processing:*** following data collection in the field, the data were downloaded and processed using the specialist software *Geoplot 3*, developed by Geoscan Research. The processing steps carried out were the ‘despiking’ of high contact resistance readings (spike replacement; X Radius = 1, Y Radius = 2), and high-pass filtering of the data (X Radius = 10, Y Radius = 10; Weighting = Gaussian). Processing the data in this way enhances any archaeological anomalies. The processed data have been presented as grey-scale plots (Fig 29), and abstracted anomalies have been interpreted. Evaluation trenches were excavated to ground-truth the results (*Section A1.7*).

A1.6 GROUND-PROBING RADAR SURVEY

A1.6.1 ***Field Survey:*** a ground-probing radar (GPR) survey was carried out by Erica Utsi of Utsi Electronics Ltd, on behalf of OA North, as part of the assessment of a range of sub-surface investigative techniques. The assessment had to be located in an area where there were demonstrable sub-surface archaeological remains and the opportunity to provide direct comparisons between techniques. The BS

VI area of Barnscar was selected and the areas surveyed precisely coincided with those examined by the resistivity survey (*Section A1.5*). The survey traverses were 1m apart, and sampling intervals were set to 100mm. The survey was carried out using an impulse of 2 nanoseconds, and a scan time of 80 nanoseconds. This methodology provided a good balance between time and cost and data resolution. The equipment used for the survey was a 250MHz transducer pair, as a single channel of an Utsi Electronics Groundvue 3 system. The radar uses bow-tie antennas for close ground coupling, and arrayed antennas for narrowed signal beam.

A1.6.2 The results have been outlined in detail in a separate report (Utsi 2005); a summary is presented below (*Section A2.11)* together with the results from the resistivity and probing surveys (*Sections A2.10* and *A2.7*). The GPR data provide a very good basis on which to construct a sampling strategy for intrusive investigation. By comparing the results of two-dimensional data with three-dimensional 'time-slices', it became evident that there were differences between anomalies. This process, and the time-slices themselves, helped to distinguish between archaeological and geological sources for the reflected signals received by the radar and, ultimately, which particular locations to sample (Utsi 2005).

A1.6.3 An approximation of transmission speed was used to translate the depth, measured in nanoseconds, to depths measured in centimetres (Utsi 2005, 3). It is likely that, given the variable water content of the site, this represents a compromise.

A1.7 EVALUATION TRENCHES

A1.7.1 Three evaluation trenches were excavated in the South-West Fells study area over potential archaeological features identified by detailed probing. The trenches were excavated entirely manually, on the basis of their individual stratigraphic units, and were located by differential GPS equipment, accurate to ± 0.25m. Altitude was established in relation to Ordnance Survey Datum.

A1.7.2 The stratigraphy in each trench was recorded on paper, employing an adaptation of the system used by English Heritage's Centre for Archaeology, and sufficient to identify individual features. The archive includes both a photographic record and accurate, manually drawn plans and sections at appropriate scales (1:50, 1:20, and 1:10). All artefacts and ecofacts were recorded using the same system, and will be handled and stored according to standard practice (following current Institute of Field Archaeologists guidelines; IFA 2008) to minimise deterioration.

A1.8 PALAEOENVIRONMENTAL STUDY

A1.8.1 ***Transect Coring:*** a programme of coring was undertaken within each study area, to investigate the depth, type and preservation of the peat, and to record the presence of basin and valley mires. The distances between the cores were variable, and were dependent on the nature of the peat deposits, and the complexity of the underlying land formation. In addition, the density of coring varied between the study areas, with the most intensive in the Langdale Fells, and the least intensive in the Forest of Bowland (*Sections A3 and A4*). Cores were obtained using a lightweight gouge auger, and their locations were surveyed by differential GPS, the data being transferred into the GIS (Geographic Information System) established for the project. The fieldwork was recorded on *pro-forma* record sheets, using terminology and procedures outlined by Troels-Smith (1955) for the sediment stratigraphy. Notes were also made of local characteristics, such as ground cover, changes in topography, and the nature of any erosion features. Particular attention was paid to peat haggs and erosion gullies, especially in areas of deep peat, to maximise the likelihood of identifying associated archaeological remains.

A1.8.2 ***South-West Fells:*** given the variable nature of the peat coverage in the South-West Fells study area, and the presence of a number of scheduled monuments, a combination of both observation and coring was employed for the recording of peat type and depth. In the lowest-lying area of the transect, around Barnscar, coring was limited to the drainage areas where deposits appeared deepest, and to the gentle foot-slopes of The Knott. On the plateau, behind The Knott, coring was undertaken on a systematic grid pattern, demarcated by the steep slopes leading up to the higher ridges of White Pike and Woodend Height. Above the plateau, much of the area consisted of steep crags interspersed by small ledges and basins, and there the survey was carried out in a more *ad hoc* manner, with cores taken only in areas of deeper peat. On the eastern side of the study area, coring was carried out on a systematic grid, particularly on the saddle of gently sloping land between Woodend Height and Hesk Fell. A large proportion of this area was reclaimed pasture, and had only a relatively thin cover of topsoil.

A1.8.3 ***Great Langdale:*** there, a relatively detailed survey of peat depth and type was carried out, covering the full extent of the study area (OA North 2003a). The survey followed a rough grid pattern, with sediment cores taken every 100–250m, using a gouge auger, and sediment depths probed at every 20–50m. The intensity of the survey depended on the complexity of the peat morphology, and visible changes in peat depth. Consequently, the survey was more detailed in the southern half of the transect, where the peat was deeper and erosion features were most marked. The stratigraphy was described for each core, and spot samples were taken from different peat types, for comparison, and to analyse the macrofossil remains. In addition, small basin mires near archaeological sites, likely to have received pollen from a local area, were recorded.

A1.8.4 ***Forest of Bowland:*** the implementation of the Forest of Bowland peat survey was constrained by the access available to land within the boundaries of the Bleasdale Estate. As a grouse moor, it was only open for survey during the period between the end of the nesting season (July) and the start of the shooting season (12th August). The western end of the study area, around Nicky Nook and the south-eastern end of Harrisend Fell, lay outside the boundaries of the Bleasdale Estate, and was fieldwalked early in the programme, separately from the remainder of the transect within the estate. A rapid walkover survey ascertained the condition of the peat, and was followed by transect coring. Because of widespread erosion across the transect area, the stratigraphy was assessed, where possible, from the abundant exposed peat faces, rather than by coring.

A1.8.5 ***Anglezarke Moor:*** following an initial walkover of the survey area, a series of cores was taken, on a north-east/south-west-aligned axis, on transects spaced roughly 100m apart. As the topography of the Anglezarke area was relatively uniform, it was considered that three such transects would be sufficient to determine the general pattern of peat depth in the area.

A1.8.6 ***Sampling Sites:*** in addition to recording deposits in the field, samples of peat were taken from significant sites for pollen and macrofossil analysis, and radiocarbon dating, where there were well-preserved peat deposits, which were likely to represent those of the local area and, which with other sample sites, would provide an indication of the character of the peatlands within the study area. These sites were key to determining levels of truncation and inception dates. Each site was sampled using monolith tins or a Russian Auger, and the samples were described and sub-sampled in the laboratory.

A1.8.7 ***South-West Fells:*** within this study area, samples were taken by means of a Russian Auger. The character of this transect varied both in altitude and density of archaeological features, and, consequently, the choice of sampling sites took account of these variations. One was chosen from the lowest-lying area of Black Brook (SD 13741 95509), adjacent to Barnscar; one from the plateau behind The Knott (SD 14655 95410); and one from the saddle of land on Ulpha Fell (SD 16321 95153) (Fig 35).

A1.8.8 ***Langdale Fells:*** three sampling sites were chosen, based on their peat depth, position in the study area, and proximity to archaeological sites (Fig 46). Sampling Site 1 was an exposure of peat, *c* 2m deep, on Harrison Combe, near the Pike of Stickle (NY 27434 07469), and archaeological Sites 208 and 209 (Claris and Quartermaine 1989), which were localised peat scars that had revealed axe-production debitage. Sampling Site 2 was an exposure of peat *c* 1m deep situated towards the centre of the study area (NY 27837 09020). Both peat exposures appeared to have been created by drainage, although peat cutting cannot be ruled out. Sampling Site 4 was an exposure of peat *c* 1.5m deep (NY 27560 07370), partly situated on top of Site 123, an excavated working floor on the gently sloping foot-slopes of the Pike of Stickle (OA North 2004a). Both the peat and the working floor had been exposed by footpath erosion, and part of the site had been excavated prior to the peat sampling, in advance of path repair (*ibid*). The peat deposit was situated on a small ledge, measuring only a few metres across, and was selected on the basis that the pollen record could represent very local vegetation. In all instances, exposed peat faces were sampled with monolith tins.

A1.8.9 ***Forest of Bowland:*** given the considerable variation in peat depth within the Forest of Bowland study area, a strategy was adopted to sample three sites as representative as possible of this variation (Fig 55). Sampling Site 1 was located on the very deep peat at White Moss (SD 5764 5085); Sampling Site 2 targeted the intermediate peat near the edge of the plateau at Stake House Fell (SD 5568 4990); and the third sample was taken from the relatively shallow (and heavily eroded) peat on the south-western periphery of the unenclosed land (SD 5499 4941). In all instances, exposed peat faces were sampled with monolith tins.

A1.8.10 ***Anglezarke Moor:*** three sampling sites were chosen, based on peat depth and topography, utilising exposed peat faces in areas of blanket erosion, and deep narrow erosion gullies. The Anglezarke study area incorporated a number of slopes, varying in angle, which separated several plateaux. The sampling sites were chosen to take into account the differing topography, and to gather data on the age and spread of the peat. Their choice also had the aim of examining those areas that appeared to be more prone to different types of erosion processes (Fig 64).

A1.8.11 ***Analysis of the peat depth and stratigraphic data:*** the details of each core, including its location, peat depth, and generalised peat type, were entered into an *Excel* spreadsheet for incorporation into the GIS. The same information, alongside more detailed lithological descriptions of each core, was also imported into the visualisation software, *Rockworks*, to determine peat depth and stratigraphy in relation to topography.

A1.8.12 ***Palynological analysis:*** the monolith samples taken from each study area were cleaned, described, and sub-sampled for pollen. The samples were prepared using standard procedures (Faegri and Iversen 1989), and mounted in silicone oil. Two exotic (*Lycopodium*) spore tablets were added to each sample to provide a standard counting reference, and to determine pollen concentrations. The pollen slides were examined with an Olympus BH-2 microscope using x400 magnification, and x1000 for critical identifications. Counting continued until a sum of at least 300 land pollen or 300 *Lycopodium* spores was reached. Pollen identification used the standard keys of Faegri and Iversen (1989) and Moore *et al* (1991), and the reference collection held by OA North. Cereal-type grains were only taken to a general level, as many were crumpled and/or in a poor state of preservation. Microscopic charcoal >5µm was quantified relative to the number of pollen grains counted on each slide, and the number of Spheroidal Carbonaceous Particles (SCP or soot) was also recorded where present. Plant nomenclature follows Stace (1991). The pollen counts were entered into the TILIA/TILIAGRAPH software (Grimm 1991), and are presented as percentage pollen diagrams. The pollen sum includes Total Land Pollen. Pollen from aquatic taxa and Pteridophyte/Bryophyte spores are shown as the percentage of Total Land Pollen plus group. No pollen assemblage zones were applied to the diagrams.

A1.8.13 ***South-West Fells:*** to determine the nature of peat initiation at the various altitudes, the pollen study concentrated on the transition between the underlying subsoil and the basal peat. Additionally, to ascertain whether a significant amount of the peat was missing, pollen samples were taken from the top 0.10m at each sampling site. It was anticipated that a comparison could be made with pollen studies carried out at Devoke Water (Pennington 1965a), Barnscar (Walker 1965a), and Tewit Moss (Quartermaine and Leech forthcoming) (Fig 79).

A1.8.14 ***The Langdale Fells:*** although the effects of peat erosion were very visible in the Langdale Fells, the survey results suggest that it was considerably more localised and limited in extent, by comparison with the other study areas examined by this project. Given the importance of Great Langdale and its associated Neolithic activity, it was evident that the sampling strategy should concentrate on the timing and nature of peat inception in this area. On this basis, pollen samples were taken at three sites from the very base of the peat, at its interface with the underlying buried soil/geology.

A1.8.15 ***Forest of Bowland:*** as very little palaeoenvironmental work has been carried out in this area, it was clear that a fairly comprehensive record of vegetation change would be important. Accordingly, pollen samples were taken from the whole of the profile from each sampling site.

A1.8.16 ***Anglezarke Moor:*** a considerable amount of palaeoenvironmental work was carried out in this area in the 1980s and 1990s (Bain 1991; Howard-Davis 1996), and the sampling strategy aimed to complement it. Initially, the plan was to re-sample Bain's sites, to measure any loss of peat depth since his study. However, following on-site discussions with the English Heritage radiocarbon advisor (Peter Marshall), an alternative means of achieving the same aim was devised, whereby other locations were sampled, and the results reviewed alongside Bain's work. This decision took account of the inherent problems of finding the exact positions of Bain's sample sites, coupled with the possible reworking of sediments. It was evident that, as with the present project, Bain had utilised one of the many erosion channels and peat haggs on Anglezarke Moor to provide exposed peat faces for sampling using monoliths. However, considerable erosion and channel instability appeared to be affecting several of Bain's sites (*eg* Black Brook: Plate 29). Taking these matters into account, the preferred approach was to sample at new sites, so that specific questions might be addressed, while using Bain's palynological results as a form of relative dating.

A1.8.17 ***Plant Macrofossil Analysis:*** sub-samples, varying in size depending on the original sample (*ie* core, monolith or bulk), and the type of sediment, were prepared for the analysis of plant macrofossils, by soaking them in water and then sieving through a set of graded sieves of 2mm, 500µm and 250µm mesh sizes. The residues were assessed for their charcoal and plant macrofossil content, and examined with a low-powered binocular microscope. The plant macrofossils were recorded in either a semi-quantitative or qualitative manner. In Great Langdale, representative spot samples were taken during the transect coring, and these were analysed with a binocular microscope to confirm field identifications. The data were used to confirm changes in the peat type, and to highlight phases of increased burning of the mire surface. The macroscopic charcoal quantifications are included in the pollen diagrams.

A1.8.18 ***Radiocarbon Dating:*** to determine the date of peat inception at each sampling site, 0.02m-thick samples from the very base of the peat were submitted for radiocarbon dating. In addition, one radiocarbon sample was taken from near the surface of the peat at Forest of Bowland Sampling Site 1, and from both sampling sites on Anglezarke Moor, with the aim of determining the extent of peat loss (*Section A10*).

A1.9 ARCHIVE

A1.9.1 A full archive has been compiled in accordance with the project design (OA North 2003a), and current IFA and English Heritage guidelines (IFA 2008; English Heritage 2006). The paper and digital archive will be deposited with the Lancashire and Cumbria Record Offices as appropriate. The pollen residues and slides will be retained at OA North.

APPENDIX 2: THE CUMBRIAN SOUTH-WEST FELLS

A2.1 INTRODUCTION

A2.1.1 The Cumbrian South-West Fells study area (Figs 1, 2 and 3) was deliberately selected as an area with proven archaeological remains (Quartermaine 1989; Leech 1983), and generally thin and patchy peat cover. The absence of peat meant excellent site visibility, and allowing for differences of topography, provided a control to assess the archaeological potential of other upland areas, where site visibility was restricted.

A2.1.2 The study area measured 0.5 x 2.5km and bisected the northern part of the South-West Fells. The western part of the transect has already been surveyed as part of the English Heritage-funded Lake District National Park Survey (LDNPS; Quartermaine and Leech forthcoming) (Figs 3 and 16), which recorded an extremely rich archaeological resource. The transect extended through the Barnscar cairnfield complex (SD 134 959), one of the largest cairnfields in England (Plates 1 and 34). In the main, the features at Barnscar comprise a palimpsest of a Bronze Age cairnfield and its associated field systems, with a later prehistoric and Romano-British settlement and field system superimposed on top. The LDNPS has provided a detailed record of this landscape (Fig 17).

A2.1.3 The original LDNPS survey of Barnscar was targeted on an area of known archaeological remains (Quartermaine and Leech forthcoming), and did not extend significantly above the level of the natural bench upon which Barnscar is set. In part this reflected an assumption that settlement areas favour particular altitudes and types of topography, and that there was little profit in extending the survey on to the steeper and higher ground towards the summit of Yoadcastle. The South-West Fells survey area extended considerably to the east of Barnscar, and beyond the LDNPS study area, in order to test this assumption (Fig 3).

A2.1.4 Although the blanket peat is generally thin, the presence of a large number of small basin mires provided the opportunity to examine and compare local environmental conditions through time. Given that the original LDNPS, undertaken some 18 years ago, recorded the extent of mires, the new survey could also examine any changes to the wetland boundary (Fig 34).

A2.2 LOCATION, GEOLOGY AND TOPOGRAPHY

A2.2.1 The study area measured approximately 0.5 x 2.5km (Fig 3), and extended from the western side of The Knott, across White Pike and Yoadcastle, to finish on the south-eastern flanks of Hesk Fell. Altitude across the transect varies between 152m and 487m AOD.

A2.2.2 The South-West Fells of the Lake District consist of andecite lava and tuff (British Geological Survey 1992) and form a narrow range of hills defined by the coastal plain to the west and south, the Duddon valley to the east, and the Esk valley to the north. The central ridge is formed by a series of low summits, rising to a maximum height of 572m AOD at Whitfell. Around the perimeter of the steep-sided central ridge, at an altitude of between 150m and 250m AOD, is an extended, broad terrace, with a gentle surface gradient.

A2.3 ARCHAEOLOGICAL BACKGROUND

A2.3.1 While the archaeological landscapes of the South-West Fells are believed to be predominantly of Bronze Age date (Quartermaine and Leech forthcoming), the history of settlement on the adjacent coastal plain may date to a much earlier period. The archaeological evidence for Mesolithic settlement is, however, patchy, probably reflecting the areas within which fieldwork has been concentrated. Scatters of Mesolithic flint have been found along the coastal plain from Walney Island (Barnes and Hobbs 1950), up to Eskmeals (Bonsall *et al* 1986; Cherry and Cherry 1986; 1987), and as far north as St Bees (Cherry and Cherry 1973). The sites at Eskmeals (Monks Moors and Williamson's Moss, Fig 79) were ranged along the edge of the old coastline, and excavation evidence suggests that occupation sites were both fairly small and structurally simple (Bonsall *et al* 1986; 1994). The Monks Moors 1 flake scatter covered approximately 35 x 15m, within which there was an elongated oval arrangement of hearths and stakeholes, 7 x 24m in extent (Bonsall 1981). The chronology of these sites falls within the later Mesolithic period, with radiocarbon dates suggesting occupation at Monks Moors 1 *c* 979–5382 cal BC (6750±155 BP; BM-1216). Those from Williamson's Moss suggest that the earliest occupation there was *c* 4459–4336 cal BC (5555±40 BP; UB-2545; Bonsall *et al* 1986, 26). This is consistent with the less precise dating afforded by the artefact scatters, which generally show later Mesolithic affinities.

A2.3.2 Although the evidence is slim, it would appear that Neolithic activity on the coastal plain was more widespread, and occupation perhaps more settled and permanent. This is characterised by the only excavated Neolithic settlement site from the region, at Ehenside Tarn. The site was excavated in 1871 (Darbishire 1873), but the basic recording techniques of that time did not identify any structures or features, apart from a large central hearth. Considerable quantities of domestic tools were uncovered, however, including stone axes (and a hafting), axe-polishing stones, quern stones, wooden paddles, wooden bowls, and ceramic vessels. The artefact assemblage suggests a substantial settlement, with a mixed economy that included hunting, fishing, cereal production and the working of axes.

A2.3.3 During the Bronze Age, human disturbance to the natural vegetation appears to have extended to the uplands between *c* 200m and 300m AOD, particularly in south-west Cumbria, in the areas adjacent to the coastal plain (Pearsall and Pennington 1973). In the uplands there are dense concentrations of clearance cairns, burial cairns and field systems, many of which are likely to date from this period. During this time, oak woodland decreased, and grassland expanded. In view of the lack of evidence for cereal cultivation, this change has been interpreted as indicating pastoralism, with grazing animals preventing regeneration of woodland (Pearsall and Pennington 1973). One consequence was that soils became more susceptible to leaching and erosion. Climatic deterioration, starting perhaps *c* 1600–1200 BC, may have exacerbated this trend (Pearsall and Pennington 1973). A colder and wetter climate developed, with a fall in mean temperatures of up to 2°C, which is likely to have reduced the growing season by as much as five weeks (Lamb 1981, 55). Such a climatic decline would have made the more marginal lands more difficult to farm successfully, and there is evidence that many settlements on Dartmoor were abandoned at about this time (Burgess 1985, 201). Although the chronology of upland settlement in the North is more uncertain, there is considerable evidence for Bronze Age activity from the Lake District and Pennines, but only very few high-altitude Iron Age settlements are known. The implication is that there was an extensive retreat.

A2.3.4 As the climate improved during the late Romano-British and post-Roman period (*c* AD 300–600), many of the upland areas were re-occupied, and even cultivated for cereals. Warmer and drier conditions (detectable by indications of a slow growth rate in many lowland bogs surrounding the mountains at this time) encouraged this development (Hodgkinson *et al* 2000), and led to the complete deforestation of these areas, along with major soil changes. The environmentally damaging exploitation which began in the Bronze Age was therefore compounded during the Romano-British period, and accelerated the severe erosion of soils.

A2.3.5 Although the evidence for early medieval vegetation change is scarce, it seems likely that there was further clearance of lowland woodland. The many ‘thwaite’ place-names, *ie* ‘clearing’ (Armstrong *et al* 1952, 494), also suggest expansion into areas of regenerated woodland, which had not been felled in either the Bronze Age or Roman period. The climate of north-west Europe during the early medieval period (*c* AD 400–1100) seems to have been warmer and drier than today (Lamb 1977), and this may have aided settlement and exploitation of the upland landscape. The ‘Norse’ period may also have seen the introduction of large-scale sheep farming in the uplands, which expanded in the later medieval period when monastic estates became established (Winchester 2000). What is likely to have been a patchy mosaic of regenerating scrub and grassland in the uplands could not survive grazing by sheep, and gave way to the largely open fell country, now characteristic of central Lakeland (Pearsall and Pennington 1973, 252). The late medieval period was also marked by the start of a prolonged period of climatic deterioration (the so-called ‘Little Ice Age’), which saw colder and wetter conditions established from *c* AD 1200–1700 (Lamb 1977). These conditions are likely to have accelerated the expansion of mire and acid grassland.

A2.3.6 Archaeological investigations in the survey area began with Lord Muncaster in 1885, who excavated several cairns, recovering cinerary urns from one or more of these (Dymond 1893). Dymond (*ibid*) produced a survey of the Barnscar settlement, but only included about half of the associated cairnfield. Between 1957 and 1958, Walker (1965a) excavated ten cairns at Barnscar, and came to the conclusion that their construction was associated with an episode of deforestation. In the 1980s, a detailed survey of the area was undertaken as part of the Lake District National Park Survey (Quartermaine and Leech forthcoming).

A2.4 SUMMARY OF INVESTIGATIONS

A2.4.1 The South-West Fells study area has patchy peat cover, and between the peat areas there is a well-documented rich archaeological resource. Because of its archaeological potential, it was an ideal area to test the effectiveness of a broad range of techniques, varying from rapid prospection methods to intensive investigative methods. The important aspect was to ensure that there was overlap in the survey areas to allow comparisons between the techniques (Figs 28 and 32). The first stage was to fieldwalk the entire transect to examine the surface for evidence of archaeological remains, and also to establish the potential for buried remains by examining the exposed sections of peat scars. This highlighted the areas with peat deposits, so the follow-on stage was a general probing survey, which was targeted on those areas of peat around the Barnscar cairnfield. This highlighted areas of potential in the vicinity of the BS VI group (Fig 17), which were then investigated more intensively by detailed probing to create a sub-surface model (Fig 23). Evaluation trenches were later excavated over the sites of features identified by the detailed probing (Fig 24). In the same areas as the detailed probing (in the BS VI area), two remote sensing surveys, resistivity and ground-probing radar, were used and their results were compared with each and with the detailed probing (Fig 32).

A2.4.2 Remote from the area surveyed by probing, several small test pits on a 10m grid were excavated to assess artefact preservation and density. The area for this was to the east and above the Knott (Fig 27), an area with identified clearance cairns. Topography determined the density of coring undertaken to assess peat depth for the palaeoenvironmental study, and specific sampling sites were chosen on the basis of the results of the coring, in combination with those from the fieldwalking. These were sampling sites separate from other areas that were subject to more detailed investigation.

A2.5 FIELDWALKING

A2.5.1 In total, 69 new sites were identified in the course of the fieldwalking (Fig 18; Table 15) which are presented in detail in the site gazetteer (*Appendix 6*), and are in addition to the 2507 monuments previously recorded by the LDNPS programme, within the vicinity of the study area (Quartermaine and Leech forthcoming). Descriptions of all the sites are presented in the Site Gazetteer (*Section A6*).

Site type	Numbers of sites
Clearance cairns	48
Putative burial cairns	2
Putative round-house	1
Walls	2
Areas of peat cutting	5
Peat scale	1
Sites associated with copper mining	7
Unidentified structures	2

Table 15: Sites recorded by the present survey

A2.5.2 ***Western Transect – The Knott:*** three cairnfields were identified (G1, G2 and G3; Fig 19) during the fieldwalking, at altitudes that ranged from 275m to 330m AOD. All were in an area measuring approximately 600 x 600m, situated on the plateau on the eastern flank of The Knott (Plate 11). This area had not been examined by the LDNPS (Quartermaine and Leech forthcoming), as activity at such an altitude had been considered unlikely. The majority of the cairns identified in the transect (40) were within these three cairnfields; the remainder were dispersed (Figs 19 and 20).

A2.5.3 Cairnfield G1 covered an area of approximately 100 x 40m on the north-west-facing slope of the plateau, between White Pike and The Knott (Fig 19), at a height of approximately 280m AOD. The survey identified 14 cairns (SW174–87) and a possible round-house (SW188). The cairns formed a compact linear group, extending on an approximately east/west axis along a relatively wide bench between two steep slopes. To an extent, the shape of the group reflected that of the local topography, exploiting the ground with shallower slopes and better drainage. The cairns varied in size from 2m to 5m in diameter, with the largest examples at either end of the group. Those to the east were adjacent to the possible round-house. The putative round-house only survived as a 0.5m wide semi-circle of stone.

A2.5.4 Cairnfield G2 was found on the eastern side of the plateau, against the flank of White Pike (Fig 19), lying between 320m and 330m AOD. In total, 15 cairns (SW159–73) were identified, which although quite tightly clustered within an area 80 x 80m, still appeared to be distributed randomly. With the exception of SW166, the cairns ranged in diameter from 2m to 5m, and were consistent with construction during stone clearance. Cairn SW166 was significantly larger (*c* 8m in diameter and 0.75m high), and was also on a slightly raised ledge above, and at a distance from, the other cairns. The size and position of this cairn suggests deliberate differentiation, perhaps for funerary purposes (Plate 13). The cairn was too overgrown to detect a kerb, but a depression in its centre indicated possible antiquarian investigation.

A2.5.5 The third cairnfield (G3) covered an area of 110 x 40m, on the moderately sloping southern flank of The Knott, between 285m and 295m AOD (Fig 19). The group comprised 11 cairns (SW145, SW193–194, SW197–204), all between 2m and 4m in diameter. Although constructed on an approximate north-east/south-west axis, the distribution of the cairns appeared fairly random, with the southernmost seven cairns being slightly more tightly clustered.

A2.5.6 The remaining cairns were spread across the plateau and southern flanks of The Knott (Fig 19), which formed a natural col. Three of these cairns (SW189–91) were found in close proximity to a low stone bank (SW195), 25m long, aligned approximately east/west, and constructed of undressed stones. Apart from their proximity, there was nothing to suggest a relationship between the bank and the cairns.

A2.5.7 Cairn SW192 was in relative isolation, on the western side of the plateau, just below The Knott (Fig 19). Considerably larger than the other clearance cairns on the plateau, with a diameter of 7m, its size and position suggest a burial cairn. In addition to the three principal cairn groups, there were also a few clearance-type cairns scattered across the gently sloping col (SW146-9 and SW213-5).

A2.5.8 A short length of well-constructed wall (SW150) was the only feature recorded on the south-western side of White Pike, and is considered to be of post-medieval date. Only 7m of the wall was extant, extending out from a natural outcrop of rock, and it probably formed a bield.

A2.5.9 ***Eastern Transect – Cockley Moss / Hesk Fell:*** within the eastern part of the study area, across Cockley Moss and Hesk Fell, five areas of historical peat cutting were identified (Plate 8), all in areas which have a peat depth of over 0.75m. Two of these areas (SW156 and SW157) were located on top of Hesk Fell (Fig 20; Plate 24), and covered areas of 20 x 20m and 25 x 50m respectively. The three other areas were all on Cockley Moss. Site SW154 measured approximately 30 x 80m, on the north-east-facing slope of Cockley Moss. Sites SW152 (Plate 14) and SW153 represent fairly large areas of peat cutting, on the relatively flat saddle of land in the middle of the Moss, and were measured as 50 x 150m and 40 x 80m in extent respectively. The two areas lie on either side of peat scale SW151, a stone-built structure constructed against the side of a small hillock. A chute opened out on to the top of the hillock from the upper part of the west wall, and an entrance was identified in the north wall. This peat scale belongs to the Type B classification, as defined by Winchester (1984), as it has two access points, one from the uphill side, where the peat was put into the scale, and one on the downhill side, where the dried peat was removed.

A2.5.10 The survey identified seven sites (SW205 and SW207–12) associated with the disused copper mine on the southern flanks of Hesk Fell (Plate 35), consisting of three buildings, sections of path, a walled-up gateway, and associated spoil heaps.

A2.5.11 Three post-medieval pastoral structures were identified within the eastern half of the study area (Fig 20). SW158 was a right-angle of drystone wall on the eastern flank of Hesk Fell, measuring 3 x 5m, and was a small bield. Site SW155 was a small length of wall built on top of a natural outcrop, on the western side of Cockley Moss, and was also probably a bield. SW206 was a large rectangular structure, measuring 5 x 20m, aligned down the slope of the south-west side of Hesk Fell. It appeared to have been crudely constructed, and may have been some form of sheep fold.

A2.6 PEAT SCAR PROSPECTING

A2.6.1 The prospecting of peat scars was undertaken in conjunction with the fieldwalking exercise. Peat scars were only encountered on the western slopes of Cockley Moss, or on the Cockley Moss col, between Hesk Fell and Woodend Height. Nine long, straight, linear scars were noted at the base of the col, almost all related to peat cutting (Plate 8). Further up the slope, a number of much smaller scars, in no particular pattern, were partly linked to lines of drainage, but most were associated with scarp slopes. In all, 38 of these smaller scars were observed; very few had eroded to the point where a mineral soil was visible. In general, the amount of erosion and peat disturbance was significantly less on the South-West Fells than in any of the other study areas. No archaeological remains were discovered in the peat scars.

A2.7 PROBING SURVEY

A2.7.1 Two different methodologies were applied to the probing survey. One involved general probing across a wide area, at sufficient separation to identify stone features. Following on from this, closer probing was undertaken to provide a more detailed record of features identified by the general survey. The record from the general survey showed only those features that had been highlighted by probing, rather than the whole of the sub-surface. The closer survey, as an adjunct to this less empirical, but more rapid, approach aimed to provide a more detailed picture. Two areas were systematically probed, and the depth and position of each reading were recorded with a total station. This enabled the production of a digital terrain model.

A2.7.2 ***Wider Area Survey:*** over the course of four days, two archaeologists probed a total area of 5.13ha in the vicinity of the Barnscar cairnfield (Fig 21). The first area, of approximately 3.25ha, lay on the southern edge of the Barnscar cairnfield, and north of Black Beck. The probing was concentrated along the edges of the peat cover nearest to the known monuments. Overall, the peat depth ranged from 0.1m to 1.2m. No potential archaeological features were identified.

A2.7.3 The second area of probing was to the east of Black Beck, approximately 250m north-east of the first survey. This area, of approximately 1.9ha, contained cairns partially covered by peat. The peat depth varied between 0.1m and 0.8m. Nine potential new cairns were identified (Fig 22), four of which were located in the northern part of the survey, among cairns clearly visible above the peat. Of these four potential cairns, only one had any surface expression, and all of them were typically smaller (2–3m in diameter) than the cairns recorded previously, which were generally 4–6m in diameter.

A2.7.4 A further two potential cairns were identified in the southern part of the survey. The smaller of these measured *c* 2m in diameter, and was visible as a slight rise. It was, however, suspected that this feature was nothing more than a large stone. The second feature measured some 6m in diameter, with a height of 0.4m. There was no indication of it on the surface, but detailed probing showed it to be very regular in shape, with a rounded profile, and it was therefore recorded as a cairn.

A2.7.5 ***Sub-surface Modelling by Detailed Probing:*** two areas (1 and 2) containing potential features detected by probing were selected for detailed sub-surface survey (Figs 22 and 23). Area 1 measured 60 x 30m, while Area 2 measured approximately 30 x 45m. Both areas were surveyed in a single day.

A2.7.6 The survey of Area 1 (Fig 23) was centred on an area of cairnfield which included five cairns (Sites BS817, BS819, BS821–3; Fig 17) previously identified by the LDNPS (Quartermaine and Leech forthcoming). The aim of the investigation was to determine whether there were additional elements between the visible cairns. In the event, the survey identified three further, smaller cairns, and a series of parallel linear features, aligned on a north-east/south-west axis.

A2.7.7 The survey of Area 2 (Fig 22) clearly showed the two features (A1 and A3) that had been identified as possible cairns in the initial probing survey (*Section A2.7.2*), along with what appeared to be a bank (A2), extending for some 30m south-west from the larger of the two possible cairns (A1). The bank had a sinuous shape at its north-eastern end, and appeared to divert around the larger cairn.

A2.8 EVALUATION TRENCHES

A2.8.1 Three evaluation trenches were excavated over the potential archaeological features identified by the detailed probing survey in Area 2 (Fig 24). Trench 1 was targeted on the possible cairn (A1) (*Section A2.7.5*) and measured 0.9 x 4.86m. The excavation revealed a sequence of peat deposits overlying a well-compacted mound, comprising 80% angular to rounded stone, typically less than 0.2m in diameter, within a gritty silt matrix. This mound had been eroded on the north-western and south-eastern sides by water action, accentuating the shape and profile of the mound. Given that the stone make-up is typical of such features (Quartermaine and Leech forthcoming), it is likely that this originated as a clearance cairn. There is also a remote possibility, however, that it was a natural deposit of stone that has been formed into a mound by water action (Fig 25).

A2.8.2 Trench 2 targeted the possible bank (A2; Fig 26), and measured 0.5 x 3.5m. The linear feature identified by the sub-surface survey comprised a deposit of silty gravel, which included no sizeable stone components. The gravel deposit had, however, been cut back by water erosion, and there were large boulders revealed within the adjacent stream channels. The feature was very distinct from that revealed in Trench 1, and it appeared likely that it was entirely natural in origin.

A2.8.3 Trench 3 was targeted on the second putative cairn (A3), and measured 1.2 x 1.2m. Probing had suggested that it was small, with very sharply defined, steep edges, perhaps a boulder, and this was confirmed by the excavation (*Section A2.7.4*).

A2.9 TEST PITTING

A2.9.1 The test pitting was carried out over the course of two and a half days, and involved the excavation of 200 pits (Fig 27) in an area of 2ha to the east of The Knott, remote from the geophysics and probing test areas. The pits were positioned in accordance with an approximate 10m grid; each measured 0.2 x 0.2m. Only one (TP82) produced any finds, the object recovered being the butt end of a green tuff axe (SD 14533 95196).

A2.9.2 The axe butt measures 78 x 38 x 17mm, and is made from a fine-grained Seathwaite tuff (J Quartermaine *pers comm*). It is very patinated, as would be expected from being under peat, and it was consequently not possible to establish reliably its precise petrography. While it is possible that it is made from Group VI rock, the typical raw material of the Langdale axe industries (Claris and Quartermaine 1989), this cannot be reliably established without thin-sectioning. The flaking is somewhat irregular, and would appear to be determined by a fault running the length of the artefact; there is no evidence of any polishing. Its form could easily be Neolithic, although some types of Mesolithic tranchet axes have similar butt ends; so without the cutting edge, its date must remain uncertain. If the source is Langdale, however, it is more likely to be Neolithic, and the implication from the rough form of the implement is that it is a rough-out, rejected because of the fault running through it. Against this is the fact that the normal working practice for the Neolithic axe production sites was to undertake all roughing out at source (Claris and Quartermaine 1989), so that rejects would normally have been left at the quarry site. The presence of the axe at Barnscar would imply that it was roughed out or partly roughed out there, and one possibility, given its very small size, is that it had begun to be worked from a former axe of full size. The absence of any polished surface is perhaps not surprising, as secondary working could have reduced considerably the size of the original piece. If reworked, its date could be some considerable period after the manufacture of the original item. Reworked axes have been found within Bronze Age contexts (for instance, from a Beaker grave at Chew Park, Somerset (ApSimon 1977, 175), and domestic sites at Risby Warren, Lincolnshire (Riley 1957), and Beacon Hill, Flamborough (Manby 1979, 79)).

A2.10 RESISTIVITY SURVEY

A2.10.1 The resistivity survey was conducted on 16th and 17th February 2005 in the same areas as the probing (Fig 28). Ground conditions were generally very rough, with both areas covered with tussocks of grass, moss, and gorse (Plate 15). There were numerous and substantial areas of standing water, together with outcropping rocks and boulders, conditions which can have a detrimental effect on the results of geophysical survey. One of the objectives of the trial was to assess the effectiveness and suitability of geophysical techniques when prospecting in upland areas.

A2.10.2 ***Results:*** the waterlogged ground conditions and outcropping boulders resulted in some problems with obtaining readings. Nevertheless, the results from the resistivity survey were generally quite encouraging. Several anomalies have been tentatively identified from the survey data (Figs 29 and 30), which compare closely with the probing results (Fig 32).

A2.10.3 ***Area 1:*** the larger of the two areas contained a number of discrete anomalies of potential archaeological significance. General areas of high resistance can be recognised (R1; Fig 30) in the southern and north-western parts of the area, which possibly represent the extent of a natural basin. This feature was also identified by the Ground-Probing Radar (Fig 31; *Section A2.11*)). The ground level at the southern end of the site was higher (with outcropping rock) than the rest of the area, suggesting that the high resistance features there were bedrock. Low resistance areas across the survey area probably attest the presence of waterlogged material in natural hollows (R2; Fig 30).

A2.10.4 There were four discrete, high resistance anomalies (R3), and two lower resistance anomalies (R4), each of which was approximately 3.5m across. These probably represent isolated buried features, such as cairns or large boulders (Fig 30). They correlate with anomalies detected by the GPR survey (*Section A2.11.4*), and features located by the probing survey (*Section A2.7*). Each of these had, to varying degrees, a low-resistance 'halo' which, from the properties of the features, would normally represent an infilled ditch or cut (*eg* R5). Alternatively, Donald Walker's excavations of the cairns at Barnscar revealed that they were constructed over large pits, which he suggested were the result of the removal of a tree stump (1965a).

A2.10.5 A high-resistance curvilinear anomaly in the south-east corner of the area may possibly be due to a geomorphological feature, such as a gravel or cobble ridge (R6). It may otherwise have a geological origin, and represent a small ridge of bedrock. It appeared to curve around the end of one of the high-resistance anomalies, R1 (Fig 30); both appear to correlate with features recognised by the GPR (*Section A2.11.4*).

A2.10.6 ***Area 2:*** this area appears to be generally more homogeneous than Area 1. There are some obvious higher resistance linear anomalies, aligned in a north-east/south-west direction, that are likely to have a geomorphological origin (R7; Fig 30). High-resistance anomalies at the extreme eastern and southern edges of the area (R8) may represent isolated features similar to those identified by GPR (*Section A2.11.6*).

A2.11 GROUND-PROBING RADAR

A2.11.1 The ground-probing radar (GPR) survey was carried out on 17th and 18th February 2005 on the same areas as the probing and resistivity surveys (Fig 31). This summary of the GPR survey results is reproduced from the report by Utsi Electronics Ltd (Utsi 2005). The results comprise two sets of data, *ie* two-dimensional profiles and three-dimensional 'time-slices' (Figs 31 and 33). The two-dimensional profiles are vertical sections through the ground, produced in 'real-time', when the antennae are dragged across the survey area in straight lines, at the specified transect interval. The three-dimensional 'time-slices' are produced when all the vertical profile data are collated and converted into three-dimensional data, from which plan views of the survey area can be 'sliced', to show data at a certain depth. For the purposes of this trial, and to compare the GPR results with the data collected from the resistivity survey, the three-dimensional 'time-slices' are shown.

A2.11.2 The results from the GPR survey have revealed a number of anomalous features that appear to be contained within shallow peat basins. Both sets of GPR data suggest that there may be more than one type of archaeological feature present. Figure 31 is an example of a 'time-slice' plot of approximately 0.4m depth.

A2.11.3 ***Area 1:*** GPR survey revealed the existence of a number of anomalous features, set within a landscape of a few shallow peat basins. Both the two-dimensional and three-dimensional data suggest that there is more than one type of archaeological feature present.

A2.11.4 The largest anomalies in Area 1 appear to be structures composed of a large number of individual elements (Fig 31), which appear anomalous because of their position within the larger peat basin. They correlate with features abstracted from the resistivity survey (*Section A2.10.3*; R3 and R4), and were located during the probing survey (Fig 32). There is also a possible sub-surface ridge, which extends out from one of the groups of anomalies. It is not possible to distinguish between archaeological and geological features on the basis of the GPR evidence alone, but it is probable that the large anomalies within the peat basin are not the result of natural deposition. The ridge may be geological in origin, although its proximity to one of the presumed archaeological features tends to suggest that there is some association. It is also possible that it is, at least in part, a man-made structure. The much smaller anomalies close to the southern edge of the peat basin are similar and cannot be categorically defined as either man-made or natural.

A2.11.5 There appear to be several possible areas of interest within the northern part of Area 1, spatially associated with the northern part of the ridge. These anomalies (E1, E3, E4 and E5) are smaller in extent than those within the centre of the survey area (Fig 31).

A2.11.6 ***Area 2:*** there was only one anomaly (Anomaly 1) within Area 2, which was similar to the large anomalies in Area 1 (Fig 31). This area contained a large proportion of stone material under the peat, but it is not clear how great a proportion of this is geological or archaeological in origin.

A2.11.7 Both areas contained significant quantities of what appear to be large stones, especially in Area 2. The two-dimensional profiles show considerable detail of the sub-peat stratigraphy (Fig 31), and evidence for a stratigraphic change within the peat itself in Area 2.

A2.12 THE PALAEOENVIRONMENTAL STUDY

A2.12.1 ***The Peat Profile:*** the coring survey (Fig 34) revealed that, at the western end of the transect, the deeper peat deposits were very much confined to areas in and adjacent to present-day drainage channels, and areas of impeded drainage. In general, a thin topsoil of *c* 0.05m depth, or a peaty topsoil of 0.20–0.40m depth, was encountered, similar to that on the slightly higher ground around Barnscar and the foot-slopes of The Knott. The most extensive area of peat in this lowermost terrain occurred in the catchment of Black Beck, a stream that drains to the south-west along the south-eastern side of the Barnscar ridge. Depths of peat of up to 1m were recorded on the valley floor, and on the flanks of the adjoining slopes. Not only were the gentler western slopes blanketed, but the slightly steeper flanks of the higher ground on the north-eastern side had not hindered encroachment. Much of this peat contained the remains of monocotyledonous plants, with wood fragments recorded near its base in some locations.

A2.12.2 On the steep slopes, between Barnscar and the high rises of The Knott and White Pike, peat was limited to wet flushes associated with the two main drainage channels. Elsewhere, a covering of topsoil, up to 0.05m thick, was recorded. Deeper peat was recorded on the plateau immediately north-east of the Knott, where depths of up to 1.5m had developed (Fig 39). It appears, however, that a ridge of higher ground runs in a north/south alignment on this plateau, and there the peat grades into a peaty soil, 0.30–0.40m deep. The deeper deposits consisted of monocotyledonous peat, with wood fragments towards its base in some places. On the steeper slopes, north and east of the plateau, deposits of peat were limited to small ledges and basins. In general, a peaty soil less than 0.30m deep was encountered.

A2.12.3 Peat deposits within the study area also occurred on the col between the high rises of Woodend Height, Stainton Pike and Hesk Fell, where peat deposits up to 3m in thickness were recorded (Fig 39). The deposits were, however, widely variable in depth, probably due in part to the evident peat cutting (*Section A2.5.9*). As with the other deeper deposits, the peat consisted of monocotyledonous peat with occasional wood fragments towards its base. The peat became increasingly shallow on the western flanks of Hesk Fell, although depths of up to 1.5m were encountered on its flat summit, where it had a more humified character.

A2.12.4 The eastern end of the South-West Fells study area encompassed an area of enclosed/reclaimed land, on the southern and eastern foot-slopes of Hesk Fell.

There peat deposits were generally very limited, and were confined to wet flushes. Most of the land surface was covered in less than 0.30m of peaty soil.

A2.12.5 ***Sampling Sites:*** the South-West Fells study area crosses at least three topographical zones, with differences in altitude, the topography of the peat, and the nature of the archaeological sites. The sampling sites were chosen to examine these differences (Fig 35). Sampling Site 1 was originally intended to be located on the northern flanks of Black Beck, bordering the area of drier ground around Barnscar. As this point was just inside the Barnscar Scheduled Monument, however, the site was shifted *c* 50m to the south, to an area of peat approximately 1m thick adjacent to the Black Beck channel (SD 13741 95509). Sampling Site 2 was situated on the plateau behind The Knott (SD 14655 95410), and consisted of 1m thickness of peat. The peat at both sites contained no erosion features and therefore no scars. The samples were taken with a Russian-type peat corer. To retrieve sufficient material for radiocarbon dating, duplicate cores were taken, and 0.02m-thick slices were taken from the discrete boundary between the base of the peat and its transition with the subsoil.

A2.12.6 Sampling Site 3 was in the area of deep peat on the Cockley Moss col (SD 16321 95153). The site lay on an eroding exposure of peat approximately 1m deep, probably caused by peat cutting (Plate 22). Peat depths of over 2m were recorded nearby, and it is possible that at least 1m of peat was missing. The peat face was sampled with monolith tins, and a 0.02m-thick slice of material was taken from the base of the peat for radiocarbon dating. The monolith tins and the cores taken from the Russian auger were sub-sampled for pollen analysis.

A2.12.7 ***Sampling Site 1 (SD 13741 95509):*** the lithology of the core from this site is as follows:

0–0.20m	Modern surface roots and *Sphagnum*
0.20–0.35m	*Sphagnum* peat
0.35–0.80m	Monocotyledonous peat with occasional wood fragments
0.80–0.83m	Very humified organic soil with wood fragments
0.83–0.98m	Stony soil with a high organic content and wood fragments.

A2.12.8 Several pollen samples were taken from the very base of the peat, at its transition with the underlying organic soil, to determine the nature of the vegetation at this interface. Material taken from the base of the monocotyledonous peat, at a depth of 0.78–0.80m, provided a radiocarbon date of 3360–3020 cal BC (4490±40 BP; SUERC-4523/GU-6080). The pollen data (Fig 36) suggest that the vegetation at the time of the peat inception was a scrub woodland dominated by hazel/bog-myrtle (*Corylus avellana*) with high levels of birch (*Betula*), and alder (*Alnus*). The latter probably grew on wetter areas adjacent to drainage channels. Oak (*Quercus*) was probably growing on areas of drier ground, with a few elm (*Ulmus*) and lime (*Tilia*) trees. This date is some time after the recorded primary and secondary elm declines, which have been dated to 4448–4055 cal BC (5440±70 BP; SRR-3065) and 3894–3377 cal BC (4850±80 BP; SRR-3068) at Williamson's Moss (Tipping 1994). The elm decline has also been dated regionally at Red Moss, Greater Manchester (Hibbert *et al* 1971) to 4034–3663 cal BC (5060±80 BP; Q-913). The tree pollen assemblage below the monocotyledonous peat indicates that the deposit was accumulating some time after the alder rise (*c* 5000–4000 BC), and after lime reached its most northerly limits, which is thought to have occurred around 4000 cal BC (5500 BP) (Birks 1989; Quartermaine and Leech forthcoming).

A2.12.9 The radiocarbon date of 3360–3020 cal BC (4490±40 BP; SUERC-4523/GU-6080) for the base of the peat would appear to support this general chronology. The levels of herb pollen, between 40% and 50%, and the presence of fern spores, imply that the shrub/woodland was open in character, and some areas are likely to have been cleared. The high values of herb pollen recorded may, however, suggest the over-representation of herbaceous taxa on the mire surface, rather than from a more general source. The herbaceous pollen is dominated by *Poaceae* (grass), *Cyperaceae* (sedge), and *Ranunculus* sp (buttercups), with *Succisa pratensis* (devil's-bit scabious), and *Potentilla* sp (cinquefoils), which may all be found growing on wetter ground and areas of peat development. Similarly, the relatively high level of *Sphagnum* moss indicates wet conditions. The relatively low levels of *Calluna vulgaris* (heather) pollen indicate that either conditions had not become acidic enough to encourage its spread, or that the mire surface was too wet. The presence of *Plantago lanceolata* (ribwort plantain) pollen, an anthropogenic indicator, suggests some pastoral activity around the site. The single grain of *Cerealia* pollen, at 0.74m depth, may indicate very early cereal cultivation nearby, but based on a single grain, this must be a tentative conclusion. Although abundant microscopic charcoal fragments were present in all of the basal samples at Sampling Site 1, the lack of macroscopic charcoal in the peat suggests that no burning of the mire surface had taken place.

A2.12.10 Other palaeoenvironmental evidence is known from roughly 2km north-east of Barnscar, where complete post-glacial pollen sequences have been recovered from Devoke Water (Pennington 1965a), and Tewit Moss (Quartermaine and Leech forthcoming) (Fig 79). At Devoke Water, a change in sediment deposition from minerogenic to organic material, around the time of the elm decline, has been attributed to increased erosion following forest clearance (Pennington 1964). Similarly, at Tewit Moss, the pollen record indicates some changes in the vegetation prior to the elm decline, with a series of small-scale, temporary clearances and burning episodes throughout the Neolithic and Bronze Age. These culminated in a major phase of clearance, which reached its peak at 1727–1406 cal BC (3260±70 BP; CAR-916; Quartermaine and Leech forthcoming). Limited pollen analysis carried out on the buried soil below one of the numerous cairns at Barnscar (Walker 1965a) suggested that, prior to its construction, the area was very similar to the Neolithic landscape indicated by Sampling Site 1 (Black Beck), consisting of a partially wooded landscape of birch, oak, alder and hazel. Given that the age of the archaeological cairn complex at Barnscar is unknown, it can only be assumed from Walker's (1965a) study that the cairn was constructed in a fairly open landscape. The evidence from the present study suggests that this cleared landscape had been created by 3360–3020 cal BC (4490±40 BP; SUERC-4523/GU-6080), very much earlier than the widespread Bronze Age clearance highlighted at Tewit Moss (Quartermaine and Leech forthcoming).

A2.12.11 In a more regional context, palaeoenvironmental data are available from Williamson's Moss, Eskmeals (Tipping 1994), and Ehenside Tarn (Walker 2001) (Fig 79), situated on the south-west Cumbrian coastal plain. Evidence suggests that small-scale woodland clearance began at *c* 4400–4000 cal BC (5440±70 BP; SRR-3065) at Williamson's Moss, and slightly later, at *c* 3900 cal BC, at

Ehenside Tarn. After a period of regeneration at both sites, much more extensive and sustained woodland clearance occurred at *c* 3800–3400 cal BC (4850±80 BP; SRR-3068) at Williamson's Moss, and *c* 2660 cal BC at Ehenside Tarn. At the latter site, this was associated with agricultural activity, including the consistent presence of cereal-type pollen (Walker 2001). A tentatively identified cereal pollen grain was also recorded at Barfield Tarn from deposits dated to *c* 3850 cal BC (Walker 2001), and there are sporadic records of cereal-type pollen in the Tewit Moss pollen diagram from the possible elm decline, dated regionally to 4000–3800 cal BC. However, these records do not appear to be closely correlated with any marked clearance episodes in the diagram (Quartermaine and Leech forthcoming). Cereal pollen is difficult to distinguish from some wild grasses, such as *Glyceria* (sweet grasses), which are aquatic or wet ground plants (Andersen 1979). The records of cereal-type pollen from these sites, however, together with the single cereal grain identified from the Black Beck sampling site, is strongly suggestive of Neolithic cereal cultivation in the local area.

A2.12.12 The pollen data from the coastal strip show evidence for Mesolithic and Neolithic clearance, but when compared with the data from the Black Beck sampling site, as well as Sampling Site 2 (*Sections A2.12.16–19*), suggest that the area around Barnscar was much more open than the coastal areas, at the time of peat inception (*c* 3300–3000 cal BC). At Tewit Moss, the value of herb pollen was *c* 30% of the Total Land Pollen (TLP) at this time, and at Ehenside, only 10%. A substantial peak in herb pollen, reaching levels of *c* 50%, is evident in the Tewit Moss pollen diagram, after the elm decline and well before the substantial Bronze Age clearance episode (Quartermaine and Leech forthcoming) highlighted above. This evidence suggests that initial small-scale clearance activity took place in south-west Cumbria from the late Mesolithic period onwards, with more intensive episodes throughout the Neolithic and Bronze Age. These episodes, however, vary in both length and magnitude, depending on the intensity of occupation at a given location. This evidence is in marked contrast to that from the wider South Lakeland area, which shows more or less undisturbed Neolithic woodland, with the first significant clearance activity not until after *c* 2280–1880 cal BC (3690±70 BP; CAR-554) in the northern fringes of Morecambe Bay (Wimble *et al* 2000).

A2.12.13 The pollen records from both Devoke Water and Tewit Moss show increased but fluctuating levels of heather and sedge pollen, in response to temporary clearance episodes following the elm decline, thus suggesting that acidic conditions are likely to have become established in the Neolithic period, and became more widespread during the Bronze Age. The evidence suggests that some areas around Devoke Water had developed into permanent open heather moorland by the Romano-British period, when there was an acceleration in clearance activity. Pennington (1965a) interpreted a band of organic, soil debris in the stratigraphy at Devoke Water as an erosion episode caused by increased clearance. This organic band, which has subsequently been dated to cal AD 148–679 (1585±130 BP; NPL-119), contained large numbers of heather pollen (Pennington 1970; Callow and Hassall 1969).

A2.12.14 Although it is possible that a period of increased heather growth occurred at Black Beck, the wider extent of its spread is not evident from the base and top samples. Indeed, the pollen assemblage from the top of the diagram reflects the present-day vegetation at the site, with a dominance of grass, *Pteridium* (bracken), sedge, and a number of other grassland taxa. The limited tree pollen at the top of the diagram is dominated by *Pinus* (pine) pollen, and is likely to originate from the nearby plantations. Very high levels of microscopic charcoal, reaching levels of nearly 80% of the Total Land Pollen (TLP), were also recorded, as were Spheroidal Carbonaceous Particles (SCP) (soot), which is normal in relatively recent deposits. Their presence in the lower deposits, however, is more difficult to explain.

A2.12.15 The abundance of diatoms in the top two samples at this sampling site was particularly notable. The assemblage from a depth of 0.28m was analysed (King 2004), and was very similar to that found in the top 0.12m at Devoke Water, which is believed to represent the period between 1960 and 1985 (Pennington 1965a; Quartermaine and Leech forthcoming), and is generally indicative of undisturbed conditions. There is thus very little to suggest that the top of the peat is missing. Although the stratigraphy of the profile does not exhibit any breaks in deposition, more detailed analysis of the whole of the profile would be required to identify any losses in the past.

A2.12.16 ***Sampling Site 2 (SD 14655 95410):*** the stratigraphy of Sampling Site 2 (Fig 35), from the plateau behind the Knott, is as follows:

0–0.06m	Surface roots and *Sphagnum*
0.06–0.11m	*Sphagnum* peat
0.11–0.44m	Humified monocotyledonous peat
0.44–1.05m	Humified amorphous peat with wood fragments
1.05–1.10m	Organic stony sandy soil
1.10–1.40m	Stony sandy silt.

A2.12.17 As at Sampling Site 1, several samples for pollen analysis were taken from the base of the peat, at its transition with the underlying mineral soil. Material taken at a depth of 0.98–1.00m provided a radiocarbon date of 3370–3090 cal BC (4530±35 BP; SUERC-4524/GU-6081), which almost matches that from the base of the peat at Sampling Site 1. Given the inherent imprecision of radiocarbon dating, however, it is not possible to say that peat started to accumulate at exactly the same time at the two sites. The results of the pollen analysis (Fig 37) appear remarkably similar to those from Sampling Site 1, although there are some localised differences. The levels of tree and shrub pollen were slightly lower at Sampling Site 2 during the development of the organic soil, but increase to over 80% TLP at the time of peat inception, mainly because alder appears to have been dominant at this higher altitude. Although grassland appears to have been fairly extensive at the time of inception, the relatively low levels of sedge pollen and *Sphagnum* spores suggest that conditions were perhaps drier. The higher levels of oak and elm pollen at Sampling Site 2, coupled with the higher levels of microscopic charcoal, suggest that this more upland location may have received a higher percentage of regional pollen. Equally, it may also be indicative of less clearance on the slopes at this site. Macrofossil charcoal was also recorded in the peat, and this may indicate either more local fires, or burning of the actual mire surface.

A2.12.18 A comparison of the pollen record from Sampling Sites 1 and 2 suggests that open conditions existed at both sites prior to peat initiation. The apparently synchronous peat development suggests that local factors were in place to encourage a relatively early inception date, compared with Sampling Site 3 (*Sections A2.12.21*). The pollen assemblage recorded in the organic soil, which was sealed by the subsequent accumulation of peat, suggests a cleared landscape and associated anthropogenic activity; the clearance may have been instrumental in the development of the peat. At Sampling Site 2, woodland, consisting primarily of alder (*Alnus*), regenerated; at Sampling Site 1, however, nearest to Barnscar, the landscape remained open. At both of these sampling sites, the pollen assemblage at the top of the column is indicative of a landscape dominated by grass, with sedge and *Sphagnum* growing in the wetter areas, and is similar to the modern vegetation. The pollen record from both sites also suggests that heather was not dominant (although it may have increased within the unsampled middle sections of the profile), which in turn implies the development of acidic grassland, typical of many upland areas of blanket peat, rather than heather moorland.

A2.12.19 At both of these sites, levels of microscopic charcoal became very marked (nearly 100% TLP) in the topmost sample, and levels of SCP (soot) increased slightly. The values of tree and shrub pollen towards the top of the profile are slightly higher at Sampling Site 2, and may represent the persistence of birch and alder on some of the upland crags and ledges. Interestingly, pine pollen, which is thought to be dispersed over long distances, is not well represented, although the site is near to modern plantations. However, as Tallis and Switzur (1990) suggest, there may be more constraints on the vertical transport of pollen upslope. Alternatively, the top of the deposit at this sampling site may represent a period before the plantations were created.

A2.12.20 Diatoms were present in the sample at a depth of 0.12m and, like those towards the top of the peat at Sampling Site 1 (*Section A2.12.7*), indicate a relatively undisturbed environment (King 2004). A stratigraphic change, from humified peat with wood fragments to humified peat, was recorded at 0.45m. More detailed pollen analysis would allow this event to be characterised.

A2.12.21 ***Sampling Site 3 (SD 16321 95153):*** the stratigraphy at Sampling Site 3 on Cockley Moss col (Fig 35) is as follows:

0–0.08m	Surface roots
0.08–0.10m	Layer of very disturbed roots
0.10–0.87m	Humified monocotyledonous peat
0.87–0.88m	Very organic sandy soil
0.88–0.95m	Sandy soil with stones.

A2.12.22 The profile from this sampling site appeared to consist of a much more humified peat, in comparison with the two lower sites. The lower layer, at a depth of 0.85–0.87m, provided a radiocarbon date of 1920–1680 cal BC (3480±40 BP; SUERC-4522/GU-6078), which suggests that peat inception at this higher site took place some 1400 years later than at Sampling Sites 1 and 2. The results of the pollen analysis (Fig 38) indicate that, prior to the peat development, open conditions predominated, with herbaceous taxa contributing to *c* 60% TLP. Hazel-type (*Corylus*) was the dominant tree/shrub pollen, with limited alder (*Alnus*), and only traces of birch (*Betula*). Some oak (*Quercus*) and elm (*Ulnus*) pollen is also recorded. After the transition to peat, levels of grass pollen declined, being replaced by higher values of pollen from buttercups and cinquefoils, both of which may have grown on the bog surface. Levels of birch and alder pollen also increased, suggesting some woodland regeneration. Although macroscopic charcoal was found at all levels, there is little to suggest increased human occupation at this time, although the increase in cinquefoil-type pollen may be indicative of sheep grazing (Moore *et al* 1986). The values of other herbaceous pollen in this lower layer remain high, including ribwort plantain, sorrels, buttercups, and sheep's bit scabious. The low levels of heather pollen at this time of transition from organic soil to peat does not indicate a period of podsolisation and deterioration in soil conditions often associated with the development of blanket peat.

A2.12.23 The pollen assemblage at the top of the diagram is in marked contrast to those from Sampling Sites 1 and 2, and reflects a heather-dominated landscape. Heather moorland is very different from the grass-and sedge-dominated landscape that is visible today, and, given that the area around the sampling site has been subjected to peat cutting (Plate 8), it is very probable that these samples represent a truncated peat profile. Some of the peat in this area is up to 2m deep, and it is possible that up to 1m has been lost from the peat surface at the sampling site, possibly as a result of truncation. This can only be determined with any certainty, however, by comparing the pollen record from complete and possibly truncated profiles.

A2.13 DISCUSSION

A2.13.1 ***The Archaeological Resource:*** the fieldwalking survey has demonstrated that the distribution of cairnfields is more extensive than had previously been recognised. The survey area used by the LDNPS (Quartermaine and Leech forthcoming) was restricted to the natural bench (at an altitude of *c* 240m AOD), as it was thought that there was little likelihood of archaeological remains at a higher altitude. The present survey, however, has recorded new cairnfields on the plateau between The Knott and White Pike, which rises to 1031ft (314m) (Fig 19). The high and craggy ground extending from White Pike across Woodend Height to Stainton Pike was devoid of archaeological features. The remains encountered in the eastern half of the study area related either to peat cutting, copper mining, or sheep farming, and were probably all of post-medieval date.

A2.13.2 The cairnfield on the plateau between The Knott and White Pike would appear to indicate primary woodland clearance, with groups of randomly distributed cairns. No rationalised field systems or proto-field systems were recognised. Such cairnfields are believed to date from the Bronze Age (Quartermaine and Leech forthcoming).

A2.13.3 Extensive exploitation of the peat resource in the eastern part of the study area is represented by five relatively large areas of peat cutting, and the presence of a well-constructed peat scale for the drying of cut peat. Peat was the primary domestic fuel in the Lake District between the sixteenth century, when woodlands became largely reserved for charcoal production, and the late-eighteenth century, when road and rail improvements allowed the import of coal (Winchester 1984, 116). In Eskdale, to the north of the study area, a survey of peat huts conducted in 1982 identified 35 along the valley sides (*ibid*). Two main types of hut were identified, categorised as Types A and B. The Type A hut was a simple, low construction, with a single entrance, while the Type B hut was built into the hillside, with a raised doorway on the uphill side for putting the wet peat in, and a lower entrance on the downhill side for removing the dried peat. Peat Scale SW151 (*Section A6*) corresponds in form to a Type B hut, which was typically later than the Type A form, coming into use in the late eighteenth century (*ibid*).

A2.13.4 The disused copper mines illustrate the industrial heritage of the upland environment. All are sited on steeply sloping ground where no peat is present, and so are not directly affecting or being affected by peat cover. The structures are ruinous but apparently stable.

A2.13.5 ***Methodology Trials:*** the survey of the South-West Fells transect was used to undertake trials of a range of different techniques to assess their potential for future surveys, including probing, resistivity survey, GPR survey, and test pitting. This study area was selected for the trial as it had a demonstrable and largely mapped archaeological resource, disappearing beneath peat.

A2.13.6 ***Probing:*** the probing through the peat, to detect sub-surface features, was moderately successful, demonstrating that an area of 5ha could be examined over the course of four days. The survey identified nine previously unknown cairns SW136-144). More intensive probing, in the area identified as having the most potential and the majority of the newly discovered cairns, revealed the detailed morphology of the underlying mineral soil, and defined the form of the cairns and other features. This was demonstrated most effectively in Area 1, where at least three new cairns and a series of parallel banks were recorded (Fig 23). The survey of Area 2 revealed a complex peat/mineral soil interface, and recorded what was initially interpreted as a cairn and a boundary bank. Subsequent trial excavation, however, indicated that these features may have been natural (Figs 25 and 26).

A2.13.7 ***Geophysical Survey:*** the same areas examined by detailed probing were also investigated by resistivity and Ground-Probing Radar (GPR) surveys. Both techniques proved to be highly successful in identifying features of potential archaeological significance, despite the ground conditions. It is reassuring that the two techniques produced very similar results, and most of the GPR 'time-slice' plots correlate almost exactly with the resistivity data and the detailed probing survey (Fig 32). The 'time-slice' plot which perhaps best illustrates this was at 17.81ns (0.4m) and 22.19ns (0.6m) (Utsi 2005), suggesting that this was the optimum depth for resistivity survey in this area. Although, in Area 1, several of the features were evident on the surface, the geophysical survey was able to clarify the actual form of the monuments. In particular, the surface survey identified a discontinuous linear bank, with three isolated cairns continuing the alignment. In contrast, the geophysical surveys show this as a fairly continuous bank, with the 'cairns' as high points on it. Significantly, this morphology of the monument was not adequately represented by the detailed probing survey.

A2.13.8 ***Test Pitting:*** although 200, 0.2 x 0.2m, test pits were excavated, over an area of 2ha, this exercise was of limited success in identifying new sites. A significant drawback was that while the pits allowed a search for artefacts, they were too small to differentiate between artificial structures and naturally occurring stone.

In addition, the small size of the pit constrains excavation once the peat depth exceeds 0.5m. From the 200 excavated test pits, only one artefact was recovered (*Section A2.9.2*), which overall represents a relatively low success rate.

A2.13.9 ***Conclusion:*** the various surveys have been able to identify structural features beneath the peat, and for the most part have been able to define the sub-surface topography. Given that the surveys were undertaken within and adjacent to a known cairnfield, it is perhaps not surprising that they have revealed further buried components of cairns and banks. Significantly, the GPR survey has clearly demonstrated that elements of features visible on the ground are in fact more substantial, and that some features previously identified as cairns are in fact elements of banks. Consequently, the technique may permit reassessment of other cairnfields without intrusive investigation.

A2.13.10 The newly identified cairns were within an area of mire, and were overlain by a thin peat deposit, which demonstrates that in localised areas, there has been an expansion of peat to engulf cairnfields. Significantly, although the wider probing survey examined a broad area, between the edge of the Barnscar cairnfield and Black Beck (Fig 21), where there was potential for buried remains, the technique revealed no structural components. To some extent, this demonstrates that the edges of the archaeological landscape largely respected the edges of the mire, and that its edges have not changed significantly since the creation of the cairnfield. Such an interpretation of the sequence, from the physical evidence, is reinforced by the radiocarbon date for the inception of the peat at Sampling Site 1, near Black Beck, at 3360–3020 cal BC (4490±40 BP; SUERC-4423), *ie* almost certainly pre-dating the development of the cairnfield.

A2.13.11 ***The Palaeoecological Evidence:*** the evidence from Sampling Sites 1 and 2 suggests that the peat developed in the two areas simultaneously, at around 3000–3300 cal BC, although the dates are not precise enough to indicate whether peat initiation was synchronous at the two sites. The reason why it occurred at this time is unclear, because this coincides with the recognised shift to the warmer and drier conditions of the Sub-Boreal (Pennington 1969). It is possible that woodland clearance was instrumental, as the pollen assemblage in the base of the peat indicates a landscape of relatively open shrub/woodland, with disturbance indicators, and, at Sampling Site 1, possible evidence for cereal cultivation.

A2.13.12 ***Sampling Sites 1 and 2:*** although a complete pollen sequence from the sampling sites was not analysed, the limited pollen evidence, alongside the geomorphology of the peat deposits, suggests that peat development was confined to areas of impeded drainage. At Sampling Site 1, this was concentrated in and around the existing drainage channel of Black Brook, and at Sampling Site 2, in two basins separated by a ridge of higher ground. Pollen analysis was confined to samples from the base and top of the peat profiles, and revealed no evidence for the development of heather moorland. The central part of each sequence was not examined, however, so it remains possible that heather did expand in the intervening centuries. The diatom evidence suggests that at present the areas of peat are extremely wet and oligotrophic.

A2.13.13 ***Sampling Site 3:*** this, the highest site within the South-West Fells study area, is within an area of blanket peat, which developed up to 1500 years later than the peat formation at Sampling Sites 1 and 2, when conditions were relatively open.

The cause of this phase of peat initiation is unclear, but appears to have occurred at a time of general acceleration in peat growth in the central Lakes area (Pearsall and Pennington 1973), perhaps as a response to increased clearance. At some stage during the development of this peat, heather moorland took hold, and up to 3m of blanket peat developed. At Sampling Sites 1 and 2, however, the incomplete pollen record has not recorded this expansion.

A2.13.14 ***Discussion:*** although no samples were dated from the top of the peat deposits, the palaeoenvironmental analysis has highlighted a number of points. The uppermost pollen assemblages from Sampling Sites 1 and 2 closely resemble the present-day vegetation, which is dominated by grass and sedge. Along with the relatively high levels of pine pollen at Sampling Site 1, which probably originate from the plantations nearby, this suggests that the surface of the peat from these two areas is modern. It is possible that Sampling Sites 1 and 2 have been subjected to peat loss in the past, but this will only be identified through more detailed stratigraphic studies, pollen analysis and extensive scientific dating.

A2.13.15 In marked contrast, the pollen evidence from the surface of the peat at Sampling Site 3 recalls a former landscape dominated by heather, very different from today's landscape of grass and sedge. The obvious evidence for peat cutting in the area of Ulpha Fell, plus the discovery of a peat scale, suggests that this area was utilised as a peat resource in the past.

A2.13.16 It seems that the areas of peat at lower altitudes in the South-West Fells study area developed relatively early, and are confined to areas of impeded drainage. They are somewhat limited in depth and extent, and are, therefore, unlikely to have completely masked any archaeological features. The evidence also suggests that, at present, the surfaces of the peat are modern and may be undisturbed. Although the deeper blanket peat on Ulpha Fell has been subjected to peat cutting in the past, the present-day threats appear limited. Serious erosion gullies have not yet developed, and there is no evidence for threats from burning or tourism. Given the age of the peat, however, and its proximity to the archaeological complex at Barnscar, it remains possible that archaeological features survive beneath it.

APPENDIX 3: THE LANGDALE FELLS

A3.1 INTRODUCTION

A3.1.1 The Langdale Fells study area was primarily selected in order to review the impact of visitor pressure upon the peat landscape, as its location in the central Lake District makes it a popular destination for walkers. The plateau behind the summits of Harrison Stickle and Pike of Stickle has substantial peat coverage, which overlies extensive Neolithic axe-production sites (Claris and Quartermaine 1989; Bradley and Edmonds 1993). The area is important for the present study because earlier surveys, dating back to 1984 (Claris and Quartermaine 1989), have recorded the axe-production workings in detail, including precise mapping and fixed-point photographs. Investigation of the area, as part of the present study, has enabled a direct comparison between the landscape of 1984, and that of 2004. The survey has the potential to quantify the impact of visitor and grazing pressure, and can serve as a comparison for other areas with peat cover which have similar recreational and pastoral uses.

A3.2 LOCATION, GEOLOGY AND TOPOGRAPHY

A3.2.1 The Langdale Fells study area measured approximately 0.6km by 4km (Fig 4). It extended from the craggy summits around the Pike of Stickle and Harrison Stickle, north along a gently-sloping, peat covered ridge, past Thunacar Knott and High Raise, to just the north of Long Crag. The altitude of the transect is between 650m and 762m AOD (Fig 40).

A3.2.2 The geology of the area is dominated by the igneous rocks of the Ordovician period (500–440 million years ago) known as the Borrowdale Volcanic Group. These consist of a series of mainly volcanic rocks, including lava flows, tuffs and agglomerates (Taylor *et al* 1971, 12–17). The hard form of this geology has contributed to the elevated and rugged mountain landscapes in the central Lake District. By contrast, a much gentler landscape has developed out of the Silurian rocks south of Coniston and Ambleside, which includes Windermere and the Howgill Fells. A near complete ‘collar’ of carboniferous rock exists around the central fells, only broken on its south-western coastal flanks by Upper Permian Triassic rocks (Moseley 1978).

A3.2.3 The source rock for axe manufacture is a fine-grained tuff of the Seathwaite Fell Tuffs, itself an upper band of the Borrowdale Volcanic Group (Claris and Quartermaine 1989, 3; Fig 41). The tuff was formed by the deposition of volcanic ash under water, and the bands are interspersed with others of ignimbrite, resulting from the deposition of lava (Taylor *et al* 1971). Although originally a horizontal band, it now slopes down to the north, and outcrops mainly on the faces of Pike of Stickle and Harrison Stickle in the Langdale area. The band has been glacially eroded, and detached blocks of the tuff are present within moraines, as well as scattered as scree across the slopes of the Great Langdale valley. The tuff has the same mechanical properties as flint, and can be worked by hand in a regular and controlled manner. It was quarried and rough-outs were prepared close to or at the outcrops, and then transported away from the uplands for subsequent finishing at sites such as the Ehenside Tarn settlement on the Cumbrian coastal plain (Darbishire 1873).

A3.2.4 The volcanic doming of the central fells played a major role in the development of its radial drainage pattern, which was subsequently enhanced by glaciation, to create the major valleys (including Great Langdale) that radiate out from the centre of the Lake District (Pennington 1978, 2003). The high relief and good drainage of the central fells has hindered peat development, which tends to occur mainly on the gentler slopes of the north and on the coastal plain to the west (Pennington 1978). Consequently, lake deposits have been the source of much of the earlier vegetation history of the central fells (Pennington 1965a; 1965b; 1975; 1978). On present evidence, it appears that peat development occurred in the central uplands in the second half of the post-glacial period, but this was initially confined to shallow basins and areas of impeded drainage (Pennington 1978). It is likely that this peat development was initiated during a long period of human activity on the central uplands, and in Great Langdale, during the Neolithic period, this activity was probably associated with axe production.

A3.2.5 The characteristic radial disposition of mountain ranges and valleys in the Lake District allows for high-level interior routes, capable of linking all areas of relevant outcrops. This also provides valley routes, leading off from Scafell to the coastal plains in the west, and from Great Langdale to the Pennines and the Lancashire coast in the east and south. Indeed, as the course of the band of tuff skirts a number of the major Lakeland valleys, there is a possibility that the main places where the rock was quarried may in part have been determined by their ease of access from other areas (Bradley and Edmonds 1993).

A3.3 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

A3.3.1 ***History of Investigation:*** the initial identification of axe production in the area was made at Martcrag Moor, between Stake Pass and Pike of Stickle (Plate 32), by a Professor Watson before 1921 (Bunch and Fell 1949), and the industry was initially named after Stake Pass. In 1948, Clare Fell, along with Brian Bunch, discovered the enormous working deposits in South Scree gully (*ibid*), and her further research highlighted the very substantial scale of the workings across Great Langdale. This led to a corresponding change in name to the ‘Langdale Axe Factories’ (Fell 1950; 1954). Chris Houlder (1979) and Dick Plint (1962) demonstrated further working around the area of Scafell Pike and Glaramara. An attempt to schedule the sites as Ancient Monuments could not be enacted due to the lack of reliable mapping for the monuments, and this prompted the establishment of a detailed survey of the axe-production sites by The National Trust, in conjunction with the Cumbria and Lancashire Archaeological Unit (now Oxford Archaeology North). This survey explored the Langdale and Scafell Pike areas extensively, but also examined areas above and below lines of outcropping fine-grained tuff, and recorded numerous small axe-working areas connected to this geology (Claris and Quartermaine 1989) (Fig 41).

A3.3.2 Several excavations of axe-production sites have been undertaken, including significant work on the isolated site of Thunacar Knott, in 1969–70. This revealed a single flake layer, or chipping floor, with associated broken rough-outs, overlying a natural mineral soil and sealed beneath 0.10–0.25m of peat

(Clough 1973, 27–31). Importantly, this site produced a radiocarbon date of 3350–2923 cal BC (4474±52 BP; BM 676), and a possible posthole was identified. A second trench uncovered a scatter of many thousands of small trimming flakes (*ibid*).

A3.3.3 More recently, Richard Bradley and Mark Edmonds excavated six sites at Stake Beck, Dungeon Gill (site 148), Harrison Stickle, two quarry sites on Top Buttress (sites 95 and 98) (Plate 30) and one on Loft Crag (site 87; Bradley and Edmonds 1993; site numbers are as given in Claris and Quartermaine 1989). A further quarry at Dungeon Gill was also excavated, as were isolated sites on Stake Beck and on the shoulder of Harrison Stickle.

A3.3.4 A programme of recording was undertaken by the Lancaster University Archaeological Unit in 1991, in advance of path repair work undertaken by the National Trust. This entailed detailed mapping of those sites affected by the repair works, and also those on Top Buttress, on the face of Pike of Stickle. The programme also included mitigating excavations of a site on the shoulder of Harrison Stickle, and another on the shoulder of Thorn Crag (OA North forthcoming). The most recent excavations in the area were undertaken on the so-called Site 123, in May 2003, in response to proposed footpath repair. Site 123 is on the plateau behind Pike of Stickle and Loft Crag, and is set above the outcropping band of Group VI bedrock (OA North 2004a; Fig 44).

A3.3.5 In addition to these projects, pollen studies of the surrounding area have provided more knowledge of the basic vegetational history of this area than is available for most other parts of upland Britain (Pennington 1970; 1975; Fig 80).

A3.3.6 ***The 'Axe Factories':*** the Great Langdale sites were the largest producers of stone axes in Britain, with the rock (petrological Groups VI and XI) being recognised as the most commonly represented raw material of British Neolithic stone axes (Chappell 1987; Clough and Cummins 1988; Annable 1987). The Great Langdale complex comprises a range of axe-production sites, grouped at intervals near the outcrops of Seathwaite Fell Tuff, which continue west from Great Langdale to Scafell Pike, and north to Glaramara. The sites are widely distributed, covering some five square kilometres of fell, and range from places where very small quantities of parent material were prised from the ground, to large-scale quarries and associated major spoil mounds. The largest of the production sites, and the site made famous by the discoveries of Bunch and Fell (1949), is in Great Langdale itself, hence the name is enshrined in archaeological literature. Axes were, however, made at several other locations, in particular on Glaramara and Scafell Pike (Claris and Quartermaine 1989; Fig 41).

A3.3.7 The 'Great Langdale axe factory' consists of a variety of sites which fall into four categories, site types A–D (Claris and Quartermaine 1989). Type A sites are defined as those exhibiting clear evidence of quarrying from outcropping rock, rather than from screes or block fields. Type B sites are those on or close to sources of raw material, where exploitation of naturally available blocks of fine-grained tuff was possible without the need for quarrying. Type C sites used raw material which had detached from and settled far below the parent rock. Type D sites are those where axe production was taking place away from all apparent sources of fine-grained tuff in outcrop or scree.

A3.3.8 The largest area of working on the Langdale Pikes is around the south face of Pike of Stickle (Plate 30), and, to a lesser extent, the south face of Harrison Stickle (types A and B). There, the fine-grained tuff was quarried directly from the rock face, often exploiting natural fissures, leaving clear signs of conchoidal fracturing, and in some cases creating small artificial caves. The sites are located on a series of narrow ledges, situated one above the other on the face of Pike of Stickle. Accompanying these quarries are extensive quantities of debitage, ranging in size from angular blocks, which have evidently been detached from the rock face, to the characteristic flake debitage of axe rough-out manufacture. The screes on the flanks of the mountain, where Type C sites occur, are largely made up of this raw material (*ibid*).

A3.3.9 A limited number of potentially significant sites have been identified at a distance from the principal stone sources, on potential access routes leading away from the main working areas and towards the major valley floors (type D sites). These sites occur on the northern flanks of Pike of Stickle and Loft Crag, and in the area of Harrison Combe and Thunacar Knott (Plate 5). There are also sites on the lower shoulder of Harrison Stickle, along the main paths leading down into Great Langdale. These sites consist of chipping floors well beyond the known distribution of the rock used for making axes, and imply the use of chance finds of glacially distributed rock, or the working of rock transported by human agency. In either case, the linear spread of these sites suggests a routeway that led into the valleys of Wasdale, Borrowdale or Langdale. It was type D sites that were most likely to be encountered by the present study.

A3.3.10 ***Chronology:*** radiocarbon dates from type A sites have a relatively late chronology. A quarry site on Top Buttress (site 95), close to the summit of Pike of Stickle, produced two dates from within the sequence of debitage build-up. The stratigraphically lowest material provided a date of 3645–3377 cal BC (4760±50 BP; BM 2628), and the upper material produced a date of 3517–3103 cal BC (4590±50 BP; BM 2627; Bradley and Edmonds 1993).

A3.3.11 Radiocarbon dates have been obtained from several type D sites on the Langdale Pikes. Charcoal obtained from the site at Thunacar Knott has given a radiocarbon date of 3350–2923 cal BC (4474±52 BP; BM 676; Clough 1973, 21–31). This site is some distance from the stone source, and may represent an ancillary working floor, doubling as a temporary camp. A type D site on the shoulder of Harrison Stickle, though, produced a much earlier date of 3772–3530 cal BC (4870±50BP; BM 2625; Bradley and Edmonds 1993). Excavations of a type D site and putative temporary camp at Stake Beck, also produced another early date of 3709–3371 cal BC (4790±80BP; OXA 2181; Bradley and Edmonds 1993). A particularly useful date came from the type D site at Thorn Crag (site 187), where charcoal recovered from directly below a layer of waste flakes produced a radiocarbon date of 4041–3662 BC (5080±90 BP; OxA-4212; Hedges *et al* 1994, 360–1). This provides a *terminus post quem* for the site, and coincides with the beginnings of forest clearance identified in the pollen sequence at Blea Tarn, on the southern side of Great Langdale (Pennington 1975; Fig 80).

A3.3.12 One of potentially the most significant dates comes from a type D site (site 123), on the plateau behind Pike of Stickle and Loft Crag (Plate 23). The site was above the outcropping band of Group VI bedrock, and may have exploited a separate, higher band of tuff, of a distinct petrographic group (probably Group

XI). The flakes were within a very humified organic soil at the base of the peat, and a radiocarbon date from charred *Empetrum nigrum* seeds within the flake deposit produced a date of 5968–5732 cal BC (6965±30 BP; KIA23485; OA North 2004a), *ie* from the Mesolithic Period. As only one sample was dated, however, there is a very clear need for additional confirmation of the antiquity of the site.

A3.3.13 ***Peat Cutting:*** an extensive survey of Great Langdale was undertaken by the National Trust between 1988 and 1991 (Lund and Southwell 2002), which identified on the higher fells areas of peat cutting, peat houses and associated peat tracks. The peat tracks connected the turbaries on the fells with the farms below; some of these routes can still be identified in Great Langdale (*ibid*).

A3.3.14 There are at least 13 peat huts surviving on National Trust land in Great Langdale, all occupying the northern side of the valley, at elevations between 190m and 420m AOD. All but two of the huts were adjacent to well-engineered footpaths. Peat-cutting areas have only been confirmed above Pike Howe and east of Tarn Crag, although areas of peat can be reached from all the huts (*ibid*). From Millbeck Farm, a path leads to a peat hut by Tarn Crag, and there are associated peat-cutting areas to the east, at *c* 470m AOD (Fig 81). There is also a peat hut on the path up to Pike Howe, with peat-cutting areas higher up. Adjacent to Troughton Beck is a track, also used as an outrake, which leads to an area of peat on Martcrag Moor (Plate 32), although no peat-cutting scars have been found. All these routes are now in use as footpaths by visitors (*ibid*).

A3.3.15 The most spectacular of the peat tracks is that ascending from Raw Head to the east of Scale Gill (Fig 81), which was probably also used as an outrake. It begins as a series of alternate zigzagging routes, some of which are heavily incised into the slope. The overlapping of the tracks would appear to indicate that the routes moved as they became severely eroded. Part way up the route, a clapper bridge leads to the remains of two shielings, which may have been reused as peat huts. The path then leads to a group of seven peat huts, on a plateau at 410m AOD. Above the huts, the footpath is revetted, and at one point passes an outcrop which has been worked back to allow access to the higher fell. This track, and a second one, led from the peat huts to an area of peat higher up the fell, at approximately 470–490m AOD. This route is not heavily used by visitors, and its clearly engineered character reflects its original use for turbary (Lund and Southwell 2002). None of the areas with evidence of peat cutting, or related activity, fall within the present Langdale Fells study area, and all are at a lower altitude (the highest being at 490m AOD).

A3.4 FIELDWALKING

A3.4.1 In total, 101 peat scars were examined in the course of the fieldwork (Figs 43 and 44). Out of these, 75 had eroded to a depth where either mineral soil or bedrock was visible. Archaeological remains were found in eight scars (L1, L2, L12, L15, L21, L22, L24 and L28, described in the Gazetteer, *Section A7*). Descriptions of all the sites are presented in the Site Gazetteer.

A3.4.2 The distribution of the peat scars follows a broad band along the top of the ridge that extends between the Langdale Pikes and the lower slopes of High Raise (Fig 47). While there are some in the southernmost part of the study area, which coincide with footpaths and areas of visitor activity, the majority are on the gentle moorland of Thunacar Knott and High Raise, where there is relatively little pressure from visitors. Neither do the scars, for the most part, coincide with lines of drainage; instead, they appear to be random. From the air, the scars have a very irregular shape: there are no indications of the straight lines formed by peat cutting, and it therefore seems likely that the erosion pattern is natural (Plate 33).

A3.4.3 ***Site L1 (NY 27984 07272):*** Site L1 was located on the footpath to the north of Dungeon Ghyll, and south-west of Harrison Stickle, corresponding to Claris and Quartermaine site 152 (1989). At the time of the present survey, *c* 30 flakes were seen lying at the interface of the mineral soil and the covering humic material. The maximum depth of the organic soil there was 0.5m. A rough-out was seen in the path within 3m of the scar.

A3.4.4 ***Site L2 (NY 27409 07771):*** Site L2 was located 400m north of Pike of Stickle, 210m from the nearest previously known site (site 16 (Claris and Quartermaine 1989)) on Stake Beck (Fig 43). The two flakes recovered from this site were a mass-reduction flake, and a secondary shaping flake. Although mineral soil was visible at the base of the 0.5m-deep peat section, both of these flakes were found lying on top of peat which had eroded from the face of the scar.

A3.4.5 ***Site L12:*** Site L12 is a scar caused by erosion of a footpath, from Loft Crag to the base of Pike of Stickle (Fig 44). The path crosses several known sites, and was therefore examined for any fresh erosion. The erosion was confined to the path, and there was no evidence of this expanding. All the previously identified sites were visible, but no others were noted. Erosion of the path does not appear to have increased significantly since the 1990 survey.

A3.4.6 ***Site L15 (NY 27629 07394):*** Site L15 (Fig 44) comprised a single axe-thinning flake, found within peat towards the base of a 1.2m-deep peat scar, *c* 240m west of Pike of Stickle and 15m north of the path which runs between Harrison Stickle and Pike of Stickle.

A3.4.7 ***Site L21 (NY 27629 07394):*** a 1.4m-deep peat scar was located on the edge of the plateau, *c* 60m north-east of the path which skirts the base of Pike of Stickle (Fig 44), in the vicinity of a group of three previously identified sites (208, 209 and 211). Four flakes were recovered, comprising two medium-sized thinning flakes and two probable platform-trimming flakes. The scar did not extend down to the mineral soil, and the flakes were recovered from within the peat. One of the flakes was high in the peat and the other was found towards the base of the scar. Other small flakes were noted along the length of the scar, but were very degraded.

A3.4.8 ***Site L22 (NY 2740 0746):*** Site L22 was located *c* 90m north-west of Site L21, on the western edge of the plateau behind Pike of Stickle. All the artefacts recovered there were found lying on the mineral soil, beneath 1.4m of peat. A cluster of 20–30 flakes was seen, although many of the smaller flakes were badly degraded, heavily-patinated, and tended to crumble when lifted. Consequently, only six, larger and more robust mass-reduction flakes were retained.

A3.4.9 ***Site L24 (NY 27436 07635):*** a single reduction flake was recovered from this site, a 0.4m deep scar on the western edge of Harrison Combe, at the interface between the peat and the mineral soil (Fig 43).

A3.4.10 ***Site L28 (NY 27436 07645):*** Site L28 was located *c* 10m to the north-east of site L24. There, a single small flake was recovered from a lens of degraded stone within the peat profile, about 0.4m below the surface of the peat.

A3.5 THE PALAEOENVIRONMENTAL STUDY

A3.5.1 ***The Peat Profile:*** the data from the palaeoenvironmental cores were entered into a visualisation program/GIS and plotted to produce a detailed map of the peat deposits in the Langdale Fells (Fig 48). The core survey revealed that the deepest peat deposits occurred at the southern end of the transect, in a relatively deep basin bordered by the higher ridges of the Langdale Pikes. Peat depths of up to 2m were frequently recorded in the upper Dungeon Ghyll valley, within the Harrison Combe area, and on a small plateau and ledges on the valley sides. Elsewhere, on the steeper slopes, and in areas of footpath erosion, peat depth reached no more than 0.20m. The topography of the central part of the study area, between Thunacar Knott and High Raise, opens out to the west, and there peat depths generally decreased. The exception to this was within the central area and in small basins, where depths of over 1 m were recorded (Fig 47). The eastern flanks of the study area followed a ridge of high ground, and there the peat deposits reached depths of no more than 0.40m. A similar pattern emerged at the northern end of the transect, where peat was generally around 0.30–0.40m in depth, but slightly deeper on the small plateau, or in lower-lying areas. A distinct band of sandy material was often encountered in the peat cores, which possibly indicates a period of increased inwash following vegetation loss, or a deterioration in climate.

A3.5.2 Some of the spot samples that were taken while coring were analysed under a binocular microscope. Most of the peat on the sides of the upper Dungeon Ghyll valley consisted of highly amorphous organic material, with variable amounts of monocotyledon (grass/sedge) remains and charcoal fragments. Some of the deeper peat from the small plateaux, and lower-lying areas, contained fragments of *Calluna* (heather) and *Eriophorum* (cotton-grass). Limited areas of moss (*Sphagnum*) peat had developed in the bottom of the Dungeon Ghyll valley, towards the southern end of the study area, which signifies the development of valley mire in places, at an early stage in the advance of the peat.

A3.5.3 ***Sampling Site 1 (NY 27434 07469):*** Sampling Site 1 was located in an area of deep peat, on the western side of Harrison Combe (Plate 33), on relatively flat ground below Pike of Stickle (Fig 46). Numerous peat gullies have developed within the existing peat cover, leaving peat cliff scars, some up to 2m deep. The stratigraphy of the monolith sample taken from one of these exposures was as follows:

0–0.05m	Modern roots
0.05–0.99m	Humified peat with monocotyledonous remains
0.99–1.44m	Humified peat with monocotyledons and wood fragments
1.44–1.47m	Very humified amorphous peat
1.47–1.52m	Very humified sandy peat-with-iron (iron pan)
1.52–1.55m	Very organic soil (mor humus).

Material taken from the very base of the humified peat, at its interface with the layer of peat-with-iron (1.45–1.47m), was dated to 2140–1830 cal BC (3620±40 BP; SUERC-4516/GU-6072) (Fig 49).

A3.5.4 ***Sampling Site 2 (NY 27837 09020):*** this site was located in an area of blanket peat on the southern slopes of High Raise (Fig 46), where erosion by drainage was considerable. Peat cliff scars up to 1m deep had developed, apparently by natural slumping. Because one of the major aims of the project was to date the peat inception, only the basal 0.50m of the deposit was sampled. The stratigraphy of the upper 0.50m of peat from nearby coring sites consisted of humified peat with monocotyledons and occasional heather fragments. The lower layers of the peat at Sampling Site 2 were made up of:

0.60–0.83m	Monocotyledonous peat
0.83–1.02m	Very humified peat with monocotyledons and wood fragments
1.02–1.05m	Very organic soil (mor humus).

The date of the basal peat, at the interface with the organic soil, proved to be 1380–1050 cal BC (2980±35 BP; SUERC-4517/GU 6074) (Fig 50).

A3.5.5 ***Sampling Site 3 (NY 27820 07461):*** this site was located on an eroded peat face, across the upper Dungeon Ghyll valley from Sampling Sites 1 and 2. Prior to analysis, however, it was decided to make the study of another site (Sampling Site 4) a priority, because of its association with axe-working sites, its position in relation to Sampling Sites 1 and 2, and its interpretative potential. No further work was therefore carried out at Sampling Site 3.

A3.5.6 ***Sampling Site 4 (NY 27560 07370):*** this site was located in a small basin of peat, on the foot-slopes to the north of the Pike of Stickle (Fig 46). The peat had been truncated on one side by an eroding footpath, leaving a 1.50m deep peat face, with evidence of a chipping floor (Site 123; OA North 2004a) in the basal peaty soil (Plate 23; Fig 46). Only the basal 0.50m of the peat deposit was sampled, in pursuit of evidence for the date and nature of peat inception. The unsampled upper material was a monocotyledonous peat, with few observable changes. The stratigraphy of the basal 0.50m of peat was as follows:

1.04–1.425m	Monocotyledonous peat with *Sphagnum*
1.425–1.435m	Very humified amorphous peat with charcoal
1.435–1.47m	Very humified amorphous peat
1.47–1.49m	Peaty soil (mor humus).

Material taken from the base of the very humified amorphous peat, at the interface with the peaty soil (1.45–1.47m), was dated to 2470–2200 cal BC (3865±35 BP; SUERC-4521/GU-6076) (Fig 51).

A3.5.7 A radiocarbon date had previously been obtained from the same site (Site 123), taken from a point 9.5m to the south-east of Sampling Site 4 (OA North 2004a). A charred *Empetrum nigrum* seed from the organic material within which the flake layer was embedded was dated by AMS techniques to 5968–5732 cal BC (6965±BP; KIA-23485). Stratigraphically, the two samples were extremely close, one being from the peat interface just above the flake deposit, while the other was apparently within the flake deposit, yet the difference in the dates is *c* 3500 years. This would suggest that at least one of the dates was contaminated, and the date of the organic material, in which the working floor was preserved, cannot at present be confirmed.

A3.5.8 ***Results:*** the radiocarbon dates from the basal peat at Sampling Sites 1 and 4 suggest that peat initiation in and around the Langdale Fells occurred *c* 2500–2000 cal BC (Fig 48), in a landscape where heather had already become established. The burning of vegetation is indicated by the presence of charcoal macrofossils within the mor humus and the overlying peat. The percentages of the tree and shrub pollen is *c* 45–50% in the diagrams from Sampling Sites 1 and 4 (Figs 49 and 51), a figure very similar to that at Langdale Combe and Red Tarn Moss, after the elm decline (Walker 1965b; Pennington 1975). The ratio of tree to shrub pollen appears lower at the sites in this study, however, possibly due to the higher values of hazel-type pollen at this higher altitude. Hazel-type pollen includes pollen from both hazel itself, and bog myrtle (*Myrica gale*), which may have been growing on or near the site. The relatively low levels of pollen of birch, elm, pine and oak suggest that these species were only minor components of the vegetation at the site, or that these pollen types represent the dispersal of grains from vegetation on the lower slopes.

A3.5.9 What is striking about the pollen diagrams from Sampling Sites 1 and 4 is the apparent continuity in the assemblages, even when the stratigraphy changes from mor humus to peat. It appears that there was no sudden change in the vegetation that may have contributed to the initial formation or subsequent development of the peat. The development of the mor humus itself, plus the presence of an iron pan at the very base of the peat at Sampling Site 1, suggests that waterlogging and podsolisation had occurred, which itself would have inhibited vertical drainage and facilitated the development of blanket mire (Birks 1988). Additionally, the peak in *Sphagnum* spores, within the iron-rich deposit, suggests that local conditions had become wetter (Fig 49). The evidence suggests that the vegetation and soil conditions on the Langdale Fells underwent considerable modification over a long period prior to the initiation of the peat, and this may have been anthropogenically driven, at least in part. Peat formation began some time after the main period of activity and clearance of the uplands (*Section A3.5.9*), and represents a period when certain environmental thresholds had been reached. This goes some way towards explaining the age difference between the Mesolithic radiocarbon date for the deposit with axe flakes at Site 123, and the Late Neolithic to Early Bronze Age peat-humus interface just above it (*Section A3.5.9*): evidently, no soil or peat developed over the axe debitage at this altitude for some considerable period. Alternatively, the chronological difference could be explained by the working floor becoming embedded into much older, soft organic material. Today, where stones have been placed on paths that cross an area of peat or mor humus, they quickly become trodden into the underlying matrix, and in the future the two might be interpreted as contemporary. A subsequent minor clearance episode is registered just above the base of the peat at Sampling Site 4, and is related to a substantial peak in microfossil and macrofossil charcoal. Without a radiocarbon date, however, the age of this phase of activity is uncertain. It is probable, though, that it is more recent than the basal peat, which has been dated to 2470–2200 cal (3865±35 BP; SUERC-4521/GU-6076).

A3.5.10 The date of the peat inception at Sampling Site 2 at Langdale, suggests that peat initiation occurred earlier in the southern end of the study area (Fig 48). From there the peat encroached both northwards and upwards, enveloping the area near to High Raise by 1380–1050 cal BC, *ie* in the Middle Bronze Age. By this time, arboreal pollen had fallen to levels of *c* 40% Total Land Pollen, and microscopic charcoal had reached levels of 60–80% (Fig 50). At both Sampling Sites 1 and 2 a slight recovery of arboreal pollen occurs, primarily from an increase in birch. A period of recovery in the birch woodland has also been recognised at a number of other sites around Great Langdale at this time (Pennington 1975). As the uppermost peat deposits were not analysed in this study, it is not clear what vegetation changes occurred in Great Langdale after the Middle Bronze Age. Pennington (1973) and Pearsall and Pennington (1973) suggest that, after the initial period of Neolithic clearance, many of the upland areas surrounding the Langdale Fells recovered and woodland regenerated. However, this was not true of the highest fells, where conditions impeded the regeneration of woodland. Instead, soil deterioration encouraged the persistence of a heath moorland.

A3.5.11 Much of the existing palaeoenvironmental information from the upland areas of Cumbria has come from the many tarn deposits (Fig 80), mostly sampled and analysed by Winifred Pennington (1965a; 1965b; 1975). The lake sediments not only contain a record of vegetation changes in the surrounding catchment, but also exhibit marked changes in stratigraphy. These represent fluctuations in water level, coupled with changes in the amount of surface run-off of material. The evidence from many of the lake deposits around Great Langdale suggests that relatively closed woodland existed up until *c* 3500 BC. Pennington calculated the tree line to be at a height of *c* 750m (1975): pollen evidence from Red Tarn (Helvellyn), situated at 719m, indicated the presence of relatively closed forest during the Atlantic period (*c* 5500–3000 BC) (Pennington and Pearsall 1973). Pollen evidence from a number of tarn deposits near to Langdale, including Blea Tarn, Little Langdale, and Red Tarn (Wrynose), indicates that episodes of clearance, with a significant expansion of heather, became most marked after the elm decline (Pennington 1965a; 1965b; 1975; Walker 1965b), and a stratigraphic change at the Wrynose site, at the pollen zone VIIa/b boundary at *c* 3000 BC, is believed to represent increased erosion (Pennington 1965a).

A3.5.12 At Red Tarn (Wrynose), the rise in heather was associated with a clearance episode involving fire (Pennington 1975), while at Langdale Combe there was an increase in plants associated with disturbance and peat development. Excavation of an axe-production site at Thorn Crag (Hedges *et al* 1994, 360–1) allowed the dating of a charcoal deposit immediately beneath the axe-debitage deposit, and directly on top of natural subsoils. The deposit was interpreted as being the product of clearance (either anthropogenic or natural) by fire. The charcoal was dated to 4041–3662 cal BC (5080±90 BP; OxA-4212), and broadly coincides with an interpolated date for a clearance episode from Red Tarn (Pennington 1964).

A3.5.13 Analysis of the tarn sediments shows a correlation between the first appearance of acid humus and increases in heather pollen. Pennington (2003) suggests that acidification of the soil associated with the replacement of forest by heather, after the elm decline at *c* 3000 BC, ultimately brought about peat inception on many of the uplands around Great Langdale.

A3.5.14 As much of the research around the Langdale Fells has been confined to the tarn deposits (Fig 80), very little is known about the actual timing of peat inception. A fragment of birch, in the base of the peat at Red Tarn Moss, provided a radiocarbon determination of 2582–2042 cal BC (3890±90 BP; NPL-122), broadly similar to the date of peat inception at Sampling Site 4 in the present study. Similarly, pollen evidence from a deposit of peat at Thunacar Knott shows a reduced percentage of elm, the disappearance of pine, and a substantial increase in heather pollen at *c* 0.10m above the base of the section (Pennington 1973). Through correlation with other diagrams, it has been suggested that this marked change took place around 2500 BC, and at Blea Tarn was associated with profound disturbance of the woodland (Pearsall and Pennington 1973).

A3.6 DISCUSSION

A3.6.1 ***Archaeological Resource:*** with the exception of site L12 (which was not a new site), the remaining seven sites (L1, L2, L15, L21, L22, L24 and L28) fall into the Site Type D category (Claris and Quartermaine 1989), where axe production was taking place away from the outcrops of fine-grained tuff. The implication is that the raw material was either glacially transported, or manually carried to the sites. Excavation on Thunacar Knott (Clough 1973) has revealed a possible posthole, perhaps from a tent or similar temporary structure. It may be, therefore, that these sites were located on the courses of established routes, between lower ground and the outcrops.

A3.6.2 Sites L1 and L15 were also found on or near to modern routeways. Site L1 lay on the main footpath on the northern side of Dungeon Ghyll, which leads down into Great Langdale itself. Site L5 was just to the north of the extant footpath, which crosses Harrison Combe between Harrison Stickle and Pike of Stickle.

A3.6.3 Site L15 is interesting in that, along with Sites L21 and L28, the flakes were found within the peat/mor humus, and not at the interface with the mineral soil, as might have been expected. The flake from L15 was in good condition, with no signs of rolling or damage, and within the peat/mor humus, *c* 1.1m from the surface, 0.1m above the mineral soil, approximately 80m from the nearest previously identified site (Site 123; OA North 2004a). If the flake was deposited at the time of working, its position would suggest that peat formation had begun while axe production was still in progress.

A3.6.4 Site L21 was located to the north of Pike of Stickle, and would appear to coincide with Claris and Quartermaine Site 208 (1989). Again, there is an implication that the material came from within the peat, albeit close to the mineral soil interface. The flake from L28 was found within a stony lens in the peat/mor humus, which may well have been washed down-slope from the rock outcrop to the south of the site, during severe weather conditions.

A3.6.5 The flakes from Site L2 were found lying on peat, which had eroded from the face of the scar. This implies that the flakes themselves also came out of the peat, and not from the interface with the mineral soil. Unfortunately, it was not possible to determine their original position in the peat profile.

A3.6.6 ***Distribution:*** although the present survey examined an expansive area of Harrison Combe, Thunacar Knott and High Raise, and looked at numerous peat scars that extended down to the mineral soil, the only scars containing flakes were within a relatively localised area. The distribution of sites was typically on the plateau immediately behind the Langdale Pikes, or in a line extending out from the area of Loft Crag, towards Stake Beck. The implication is that the sites define a broad band of activity that follows a potential access route into Borrowdale, *via* Stake Beck, thus according with the preliminary conclusions from the 1984/5 survey (Claris and Quartermaine 1989). The present-day path that leads from Pike of Stickle to Stake Beck passes to the west of the rock outcrop, and follows the easiest route to the head of the beck. The path is, however, very exposed to the elements. The eastern side of the rock outcrop, on the other hand, is more sheltered, and consequently, more suited to temporary camps: it is of little surprise that this is where sites have been found.

A3.6.7 Given that the only evidence for the debitage deposits is from peat scars, the distribution of the scars has the potential to bias the results. All the scars lay in the southern half of the study area, eliminating the possibility of identifying sites on the lower slopes of High Raise. There is, however, a substantial distribution of scars throughout the southern half of the transect (Fig 47), yet those containing debitage were only within the south-easternmost part of the distribution. This would suggest that the sites are indeed concentrated along the line of a former routeway, leading to Stake Beck and beyond.

A3.6.8 Another potential cause of bias in the results was that some scars did not extend down to the mineral soil, potentially preventing the discovery of artefacts. Artefacts were, however, discovered within the peat in three separate instances, and 75% of the scars examined had eroded sufficiently for mineral soil to be exposed. Over half of the scars where mineral soil was not exposed were located in the southern 800m of the study area. Therefore, while there may be some bias in the results from this southern part of the area, the effect on the remainder of the transect appears to be negligible.

A3.6.9 No clear evidence of peat cutting was encountered in the course of the survey. Therefore, either any peat cutting had been on a small scale, or it was sufficiently ancient for the evidence to have been lost beneath new peat.

A3.6.10 ***Palaeoenvironmental Landscape:*** the evidence from sites in and around Great Langdale suggest that woodland clearance in the central fells became most marked after the elm decline, and was associated with the period of axe production. The evidence suggests that some time after clearance, increased acidification and podsolisation of soils led to the development of mor humus and the spread of heather moorland. In the central uplands, such as the Langdale Fells, peat development ensued, initially within areas of impeded drainage such as shallow basins. The development of mor humus and an iron pan would have further impeded drainage, creating wet ground conditions and subsequent peat formation.

A3.6.11 The organic deposits within the Langdale Fells study area exhibit this change from mor humus to peat, at *c* 2400–1830 cal BC, in the southern area between Pike of Stickle and Harrison Stickle, where waterlogging would have occurred. The relatively high levels of elm and pine recorded in the base of the peat, just above the chipping floor at Thunacar Knott (Clough 1973), had by that date all but disappeared, leaving a relatively open landscape dominated by heather, hazel, bog myrtle, and alder scrub woodland (Figs 49, 50 and 51). This relatively open landscape, coupled with the fact that many of the Neolithic finds occur in the mor humus or at the very base of the peat, suggests that peat initiation occurred some time after the main phase of clearance and axe production, in an open landscape of scrub woodland with heather. The date range for axe production is potentially quite large, even if the Mesolithic date from the charred *Empetrum* seeds, at Site 123 (*Section A3.3.12*; OA North 2004a) is disregarded. The earliest site would then be that at Thorn Crag (*Section A3.3.11)* dated to 4041–3662 cal BC (5080±90 BP; Oxa-4212), while the latest is at Top Buttress (site 95), with a date of 3517–3103 cal BC (4590±50 BP; BM2627; Bradley and Edmonds 1993, 128). Neolithic activity associated with axe production in the Great Langdale area was therefore potentially over 1000 years earlier than the date of peat inception.

A3.6.12 Although the pollen records from many of the tarn deposits surrounding Great Langdale (Fig 80), show a recovery of woodland after the Neolithic clearance (*eg* at Blea Tarn and Red Tarn, Wrynose), the higher fells around Angle Tarn, Red Tarn (Helvellyn), and Langdale show an expansion in heather moorland, and the persistence of open conditions. The fact that these are the highest tarns from which palaeoenvironmental data have been obtained suggests that altitude, with more severe climatic conditions, may have influenced this development. By *c* 1300–1000 BC, the peat above Great Langdale had encroached northwards as far as High Raise.

A3.6.13 ***Causes of Erosion:*** until the fieldwork commenced, although footpath erosion had been recognised as a major problem in the management of the peat and archaeological sites at Langdale (Quartermaine 1994), very little was understood about the mechanisms involved. The effect of footpath erosion alone is usually limited to the path itself, although in areas where paths coincide with areas of deep peat or drainage features, the damage can be extensive. The damage is especially marked in the relatively steep-sided valley in the south of the study area, between Pike of Stickle and Harrison Stickle, and also very prominent on the route of the footpath north of High Raise, where it crosses peat with a depth of *c* 0.50m.

A3.6.14 Although the effects of footpath erosion and maintenance are apparent in this study area, other, much more widespread processes are also serving to erode the peat. Although these processes appear most marked in the southern part of the study area, where the deepest peat deposits were encountered (making the erosion scars more visible), the effects of what appears to be drainage erosion and natural wastage are ubiquitous. Peat haggs up to 2m deep have developed, dissected by gullies. In a number of locations, drainage channels were visible at the base of the peat, so that the surrounding deposits have slumped. Such erosion is common in areas of peat overlying drift-covered limestone, where natural sink-holes have developed, but it is not known how common the process is on other substrates. Towards the centre of the study area, just south-west of High Raise, much of the terrain has a gentle west-facing slope that drops down towards Langstrath. There the erosion pattern takes on a slightly different form, with many of the scars running parallel with the contours (whereas gully erosion causes scars on the same axis as the fall-line). It is possible that these scars have developed as a result of slumping and subsequent removal at the break of slope, although peat cutting cannot be ruled out.

A3.6.15 A research programme carried out in the 1990s highlighted the severe damage caused to the vegetation of the Langdale Fells by intensive sheep grazing (Quartermaine 1994). The damage was most marked on the stands of heather and bilberry, as sheep tended to ignore the tough grasses and sedge now prevalent in the area. Trampling and the development of sheep paths (trods) were also noted as causes of erosion. The pollen record shows that heather was once much more widespread at Langdale (Figs 49, 50 and 51). If heather has been specifically targeted by sheep, on sites where suitable forage is limited, it is possible that periods of over-grazing have exposed peat surfaces, making them more susceptible to weathering and drainage erosion. Nevertheless, severe winter conditions and high rainfall in the Great Langdale area probably have been, and may still be, instrumental in the survival of archaeological remains.

A3.6.16 ***Peat Scar Survey:*** the survey has demonstrated that the examination of peat scars is an effective technique for the identification of archaeological remains. This conclusion is, however, offset by the fact that Great Langdale has been the focus for exceptional levels of archaeological activity, so that there are considerable and widespread scatters of worked lithics known. If the technique did not work in the Langdale Fells, therefore, it would not work anywhere.

APPENDIX 4: FOREST OF BOWLAND

A4.1 INTRODUCTION

A4.1.1 The Forest of Bowland (Figs 1 and 5) was selected for the project as it was believed to have extensive tracts of largely undisturbed peat, much of which is actively managed to preserve its vegetation cover. It was thought that the character and conservation of this landscape would allow it to act as a control for comparisons with other peatlands. As the project progressed, however, this was shown to be an erroneous premise. In particular, the west-facing scarp of this upland block had numerous erosion patches, and substantial areas of mineral soil have been exposed in recent years.

A4.1.2 To the immediate west, the Over Wyre mosses were extensively surveyed by the North West Wetlands Survey (NWWS) (Middleton *et al* 1995), and the west-facing periphery of the Bowland upland block provides a well-defined interface between the two projects. An archaeological survey had already been undertaken over the United Utilities Plc holdings, which extend across the southern and eastern parts of the Forest of Bowland, and cover approximately one-third of the designated Area of Outstanding Natural Beauty (AONB). This survey used standard techniques, and identified only limited archaeological remains (LUAU 1997), mostly post-medieval in date. The absence of any earlier archaeological features was attributed to poor site visibility, a consequence of the surviving depth of peat. However, a palaeoecological study at Fairsnape Fell, on the western slopes of the Forest of Bowland (Fig 82), demonstrated vegetation change in both later prehistory, and in the historical period (Mackay and Tallis 1994b).

A4.2 LOCATION, GEOLOGY AND TOPOGRAPHY

A4.2.1 The Forest of Bowland study area measured approximately 0.5 x 3.7km (Fig 5), and extended from the eastern edge of the NWWS study area, at the Lancaster Canal near Cabus (SD 485 485), *via* Nicky Nook and Stake House Fell, to White Moss on Grizedale Fell (SD 575 505). The latter boundary line coincided with the western edge of the survey area of the United Utilities Plc survey (LUAU 1997). With both its western and eastern boundaries contiguous with those of previous surveys, the present project provides useful opportunities to compare results (Fig 5). The altitude of the transect is between 100m and 464m AOD.

A4.2.2 The Forest of Bowland is bounded by the transitional landscape of the Bowland Fringe and Pendle Hill, which extends from the Lune Valley, around the slopes of the Bowland Fells, before merging into the Ribble Valley. The dominant feature of the area is the central upland core of deeply incised gritstone fells, with extensive tracts of heather moorland and blanket bog (Fig 52). The Trough of Bowland acts as a natural pass connecting the valleys of the Marshaw Wyre and the Langden Brook, and dividing the upland core into two distinct blocks. The Millstone Grit was laid down by rivers and deltas in the Carboniferous Period, and occurs as thick beds of coarse-grained sandstone ('gritstone') separated by layers of more easily eroded mudstone shales (Hughes 1988). The core of Bowland is a hard sandstone, which forms the fell tops, while the softer beds of shale have eroded to form lower, undulating areas, broken by low scarps and valleys. The drainage pattern of the area has cut deep cloughs through the harder sandstone, in a radial pattern emanating from the upland moorland plateau.

A4.3 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

A4.3.1 ***Mesolithic Period:*** until the end of the last ice age (*c* 10,000 BC), the Bowland area is unlikely to have been permanently occupied, and the earliest archaeological remains are probably of Mesolithic or Neolithic date. Although Mesolithic material has frequently been found in the Pennine uplands, few sites have been noted in and around Bowland. This may be due in part to the thick peat cover on the fells, which will have obscured both Mesolithic and Neolithic remains. Sites have been discovered under similar environmental circumstances elsewhere in the Pennines (Stonehouse 1988; 1994), however, by the investigation of erosion scars in the peat. The absence of such sites from the Forest of Bowland may in part reflect a lack of investigation, alongside the poor site visibility attributable to the peat. Nevertheless, Mesolithic sites in particular should be expected, as they have been found in neighbouring uplands, as for example on Anglezarke Moor (Howard-Davis 1996) where extensive peat fires resulted in exposure of the archaeologically sensitive mineral soils. In general, analysis of the lithic scatters has shown that sites in the uplands were mainly temporary hunting camps, with the more permanent settlement on the lowlands (Cowell 1996, 21).

A4.3.2 ***Neolithic Period:*** activity from this period is largely represented by lithic scatters, to their distribution suggesting that settlement was concentrated on the lowlands, broadly corresponding to the Mesolithic pattern (Middleton 1996, 40). To date, there are no Neolithic sites recorded in the Historic Environment Record for the immediate Bowland area, other than find-spots of arrowheads, though there are three stone axe sites to the south and east of the River Hodder (*op cit*, 36–8). The relative lack of Neolithic material, other than arrowheads, might suggest that the uplands were primarily utilised for hunting.

A4.3.3 ***Bronze Age:*** in comparison with previous periods, there is a significant increase in the number of known sites in Lancashire of Bronze Age antiquity. While the larger proportion of sites is in the lowlands, a significant number are located in the valleys penetrating the uplands, perhaps indicating an increase in population and activity. Sites have been recorded along the Hodder and the upper Ribble Valleys, but none on the Bowland fells (*op cit*, 42). Generally, Bowland has displayed less evidence for settlement during this period, in comparison with other upland areas.

A4.3.4 The Bowland area includes two examples of early Bronze Age burial mounds, one at the Bleasdale Circle (Dawkins 1900; Varley 1938), and the other at Waddington on Pinder Hill (Middleton 1996; Manby 1986, 86, 105). In addition, two unexcavated bowl barrows are recorded in the HER at Brown Hills Farm, Easington, and Bronze Age artefacts have been recovered from excavations on the cave site of Fairy Holes, near Whitwell (Musson 1947; Greenwood and Bolton 1955, 25).

A4.3.5 ***Iron Age:*** towards the end of the Bronze Age, early in the first millennium BC, blanket peat appears to have spread across the uplands. From about 950 BC, much of the upland landscape appears to have been abandoned, possibly linked to a fall in population, and the area remained without settlement into the Iron Age (Middleton 1996, 55). Pollen evidence indicates that in Bowland there was an increase of activity in the Late Iron Age, represented by woodland clearance (Mackay and Tallis 1994b, 578). It is likely that there was only woodland on the fringes of the Bowland uplands, and that the fells were covered in peat. There is no definite archaeological evidence of Iron Age settlement on the fells, but it remains possible that this owes more to a lack of research than a genuine abandonment of the landscape (Haselgrove 1996, 69).

A4.3.6 There are two 'hillforts' within Bowland, which may also date to the Iron Age. One of these is a large oval earthwork, called the Druid's Circle, near the Upper Hodder in Easington parish. It was subject to evaluatory excavation by Raistrick in 1931, although the excavation and recording standards were poor. Neither the function nor the date of the earthwork were elucidated, and even the exact location of the trenches was not recorded (Raistrick 1934, 44–8). The earthwork was subsequently grubbed out during the Second World War (Higham 1978, 107). A site at Great Dunnow hill has also been claimed as a possible hillfort (*op cit*, 108), but this identification is uncertain.

A4.3.7 ***Roman Period:*** the central area of the Pennines, including Bowland, was taken under Roman military control in the years AD 70–2 (Shotter 1993, 13). During the early 70s, a fort was established at Ribchester, and it was probably from there that Bowland was administered during the later first century. Despite the nearby presence of a major Roman centre, there are few known sites or find-spots of Roman date in or around the Bowland fells (*ibid*). A settlement of native Iron Age character has been excavated at Barker House Farm, on the western side of the Forest of Bowland, to the south of Lancaster, but radiocarbon dates indicate occupation in the first and second centuries AD (OA North 2004b). The site is close to the Kirkham to Lancaster Roman road, and yet there was no indication of Romanisation in the design of the settlement or its artefactual assemblage. This would reinforce findings from elsewhere within the northern, and particularly the upland, zone, that settlement retained its Iron Age character. A further feature from this period is the Roman road from Ribchester to Burrow-in-Lonsdale, which runs through Bowland (Graystone 1992). The route crosses Browsholme Heights, Croasdale Fell and Botton Head Fell (*op cit*, 9), with sections that can easily be followed.

A4.3.8 ***Early Medieval Period:*** there are no known archaeological remains dating from the early medieval period within the Bowland area. The nearest upstanding remains from this period are the pre-Conquest stone crosses from the minster site of Whalley, and the nearest settlement remains are at Ribblehead, near Ingleborough (Kenyon 1991, 125). Nevertheless, historical, place-name, and, to a lesser extent, palynological, evidence, suggests that the area was settled and exploited throughout the fifth to tenth centuries (LUAU 1997).

A4.3.9 ***Medieval Period:*** prior to the Norman Conquest, the Forest of Bowland seems to have formed part of the holdings of Earl Tostig, brother of Harold Godwinson (Shaw 1956, 8; Kenyon 1991). After the Norman Conquest, the manor and land of Bowland was owned by Roger de Poitou, who moved the centre of administration from Grindleton to Slaidburn (Kenyon 1991). He subsequently granted the Forest of Bowland area to Robert de Lacy, as part of a larger grant including the Hundred of Blackburn and the manor of Slaidburn (*ibid*). At some time before 1106, Henry I agreed not to afforest any more de Lacy land in Blackburnshire and Bowland (Wightman 1966, 64), and as a result, Bowland, along with Pendle, Trawden and Rossendale, became a chase rather than a forest.

A4.3.10 ***Forest of Bowland Vaccaries:*** it would appear that the uplands were kept as demesne land, with much of it used for cattle ranching, centred on vaccaries (Newman 1996, 117). These vaccaries were based around a farmstead, usually located in a valley bottom, such as Whitendale in Bowland, and most would have had some arable land or dependent arable farms to sustain the vaccary workforce (*ibid*). The first documentary reference to the vaccaries in Bowland dates from 1242 (Farrer 1903, 156; Higham 1978, 42), although the evidence of place-names, and to a lesser extent palynological studies, suggests that the later medieval vaccary system was based on much earlier cattle rearing economies in the uplands (*ibid*).

A4.3.11 The vaccary sites are, for the most part, still occupied by post-medieval farms, and the territorial divisions associated with them have changed little since the medieval period (Porter 1973, 39). The Slaidburn division of the Chase, to the east of the study area, contained the vaccaries of Randolph Booth, Highoke, Brennand, Whitendale, Croasdale, Batterax, Staple Oak, Hareden, Trough and Sykes (Shaw 1956, 365), the closest to the present study area being Sykes and Trough. Croasdale, Highoke and Randolph Booth appear to be the only vaccaries for which the farm sites are not known, as they seem not to have survived long into the post-medieval period. The vaccary pastures, at least for Croasdale and Randolph Booth, are recorded throughout the sixteenth century, though.

A4.3.12 The vaccaries were supervised by a feudal official known as an instaurator, who was responsible for their business (Porter 1973, 40). That all the vaccaries were linked into one system is reflected by a right of way, part of which is known as the Ouster Rake, which links Whitendale, Brennand, Trough and Sykes, and, *via* the present Trough of Bowland road, connects with Hareden and Staple Oak. This route, and others connected to it, may have been a drove route.

A4.3.13 Within Bowland, it cannot be conclusively demonstrated that each vaccary developed a nucleated hamlet, because the tenancies recorded potentially refer to distributed settlement throughout the vaccary. Batterax, which is the best documented of Bowland's vaccaries in the post-medieval period, did grow as a hamlet around the vaccary farm, but scattered farms had also been established on the periphery of the vaccary's cultivated lands at least by the eighteenth century. These, in due course, formed the settlement of Dunsop Bridge (Porter 1980, 61). Sykes can also be assumed to have been a nucleated settlement from at least the early sixteenth century.

A4.3.14 During the fifteenth and sixteenth centuries, the lord's interest in the direct control of the vaccaries gradually dwindled (Newman 1996, 117). With the deforestation of the upland areas, the former vaccaries were re-let as copyhold tenancies, thus forming the post-medieval settlement pattern of tenanted individual farmsteads and hamlets (*ibid*).

A4.3.15 ***Industrial Exploitation:*** the general lack of settlement, the poor communications, and the unspoiled nature of most of the open moorland, all indicate a lack of industrial activity in much of the Bowland area. Bowland did not develop large-scale industries because it lacked mineral wealth, particularly coal, and was peripheral to the main centres of textile production as they developed in the eighteenth century.

A4.3.16 It is likely that the limestone that outcrops at the surface in Bowland, as in the neighbouring Craven uplands, was quarried from an early date. Quarrying will have increased in the late eighteenth and early nineteenth centuries, in step with the demand for walling to enclose much of the moorland (Porter 1980, 116). The presence of eighteenth- and nineteenth-century limekilns in Bowland suggests that stone was also quarried for lime. Across the fells there is evidence from place-names, and in the form of abandoned quern rough-outs, for the quarrying of millstone and the manufacture of grinding stones (LUAU 1997).

A4.3.17 Within the limestone are veins of lead, and both Raistrick (1973) and Higham (1989) have argued for Roman lead mining in Bowland, but there is no conclusive evidence of this. There was certainly medieval mining, and exploitation of this resource appears to have carried on into the nineteenth century (LUAU 1997).

A4.3.18 In the late nineteenth century, the Bowland fells began to be exploited for their water, to supply the nearby conurbations, a use which continues to the present day.

A4.4 FIELDWALKING

A4.4.1 In total, 68 sites were identified in the course of the fieldwalking (Fig 53), comprising 61 clearance cairns, of which 57 were within a single cairnfield (Fig 54), two probable burial cairns, three quarries, a small enclosure, and an area of ridge and furrow. The majority of the sites were within the western part of the study area, where there was less peat cover. Descriptions of all the sites are presented in the Site Gazetteer (*Section A8*).

A4.4.2 ***Nicky Nook Cairnfield:*** the cairnfield recorded by the survey was in an area measuring approximately 250 x 300m, to the north and east of the summit of Nicky Nook (Plate 9). The group comprised 57 cairns, with widely ranging diameters, of 1.8–6.5m. The cairns were located within a relatively narrow altitude band, exploiting the gently sloping and better drained ground around the summit, with a little over half of the cairns on a south- or east-facing aspect (Fig 54). The majority of the cairns (39) were located between the 200m and 210m AOD contours, with a further 15 between 190m and 200m AOD. Only two cairns were located above 210m AOD. The general distribution of the cairns appeared to be fairly random, although the southern edge of the cairnfield was clearly demarcated by a line of small cairns, which lie along the break of slope on the southern side of Nicky Nook, and may have defined a former boundary.

A4.4.3 Six cairns were located to the east of the main group. Two of these (sites B279 and B280; Plate 17) were relatively large and prominent, and might possibly represent burial cairns. They were situated next to each other, at around 195m AOD, on the edge of an east-facing slope, with an extensive east-facing vista. Three more cairns were located within 80m of these two, and were much smaller, having the appearance of clearance cairns. The remaining cairn (B272) was in relative isolation, further down the eastern flank of Nicky Nook at *c* 155m AOD, and *c* 225m from the next nearest cairn.

A4.4.4 Also located on the eastern flank of Nicky Nook was a small stone-built enclosure (Site B273), consisting of two curved, banked mounds, which formed the sides, leaving entrances to the east and west. The whole structure was approximately 12m in diameter. A small mound of stone was set just within the eastern entrance, but the precise function of this, or the building as a whole, is not known.

A4.4.5 A further cairn (B283) was located within enclosed land on the top of a small hill, overlooking Fell End Farm, at about 180m AOD, spatially associated with an area of ridge and furrow (B282). The cairn was quite large, *c* 8m in diameter, and was situated adjacent to a modern field boundary. This position, coupled with the fact that it lies within a field of ridge and furrow, suggests that it was a medieval or post-medieval clearance cairn.

A4.4.6 ***Quarries:*** in addition to the cairns, three quarries were identified within the area of Nicky Nook. The largest of these (B274), on the southern side of the summit, measured 180 x 40m. The considerable size of this quarry implies a commercial concern, potentially providing stone for nearby Scorton. Two smaller quarries, B275 and B281, were located on the top of Nicky Nook, and measured 15 x 15m and 15 x 35m respectively. Quarry B275 was adjacent to field boundaries, and was potentially a source of walling stone.

A4.4.7 ***Peat Scar Prospection:*** the prospection of peat scars was undertaken in conjunction with the fieldwalking exercise. Much of the peat on the upper slopes of Stake House Fell had been removed by either peat cutting or by fire. It is known that a plane crashed into the fell during the Second World War (J.Hickling *pers comm),* which resulted in an unrestrained fire that burnt away large areas of peat. While these areas can clearly be seen today, and reflect considerable loss of peat, the recovery of vegetation over the past 60 years has meant that while structural remains may be apparent, the visibility of lithic scatters is severely restricted.

A4.4.8 The remaining areas of peat scarring were concentrated at the heads of the cloughs that lead down the fell sides. Particularly severe areas of erosion were seen on the south-facing slope between Stake House Fell and White Moss, and to the south-east of White Moss leading into Hunters Clough and Fiendsdale. These scars all appeared to have been enhanced by high-energy water erosion, and are mostly narrow and deep. No archaeology was seen in any of them, although any artefactual evidence, such as lithics, could easily have been washed away.

A4.5 THE PALAEOENVIRONMENTAL STUDY

A4.5.1 ***The Peat Profile:*** the plateau of Nicky Nook, at the south-western end of the Forest of Bowland study area, was generally covered with less than 0.20m of peaty soil, which decreased in depth on the steeper slopes that surround the plateau (Fig 56). Deposits were cored to a depth of *c* 1.7m at SD 5194 4883, although *c* 1.5m of the column consisted of clayey silt, sealed by *c* 0.20m of modern vegetation roots with sphagnum moss. It is likely that this is the site of an infilled tarn, whose sediments may contain a record of local changes in vegetation. The valley between Nicky Nook and the south-western end of Harrisend Fell consisted of enclosed fields of improved pasture, and an assumption was made that little peat would have survived there. Similarly, the western spur of Stake House Fell, from a point on the moor road (SD 5365 4900) to the north-eastern end of intake (SD 5470 4935), comprised improved and enclosed pasture, with less than 0.20m of peaty soil.

A4.5.2 The vegetation on the south-western spur of Harrisend Fell, at SD 5365 4975, was in marked contrast to the grass-covered slopes of Nicky Nook, and adjoining areas of improved pasture. This relatively steeply sloping spur of land was covered with stands of heather, which in places appeared to have been cut to ground level. Slightly deeper deposits of peaty soil, up to *c* 0.50m in depth, were present near the very base of the slope, although elsewhere depths of no more than 0.20m were reached. The steeper slopes, adjoining the stream valley on the south-eastern flanks of Grizedale Fell, appeared to have experienced a great deal of surface run-off, with the erosion of small gullies, and the formation of haggs of peaty soil, 0.20–0.50m deep (Plate 18). The only area on this part of Harrisend Fell with any appreciable depth of peat was a small basin mire at SD 5387 4996, which consisted of 0.90m of monocotyledonous peat.

A4.5.3 Just to the east of the Stake House intake, at SD 5470 4935, the landscape was dominated by a mosaic of heather-covered peat haggs, less than 1m deep. These were interspersed with expanses of bare rock, that in places had developed a thin soil, colonised by grass. This type of land cover dominated the study area for nearly 1km, up to the south-west flank of Stake House Fell (SD 5545 4955), where it was delimited by relatively steep slopes, covered by a thin topsoil (Plate 28). It was obvious that this area had suffered severe erosion and associated peat loss in the past, and marks the position of a bad wild fire, reported to have taken place in the 1940s, following a plane crash (J.Hickling *pers comm*). A further catastrophic fire is reported in the area during 1947, following a summer drought, at a time when keeper numbers were especially low after the Second World (Mackay and Tallis 1996). The fire is said to have lasted for about three months, damaging over 400ha of moorland on the Bleasdale Estate and 1600ha of moorland on the neighbouring Abbeystead Estate. To what extent these two events coincided is not clear, although the catastrophic effect is self-evident. It is highly probable that the expanses of exposed bedrock across this part of the moor are attributable to erosion precipitated by these fires.

A4.5.4 Near the summit of Stake House Fell, expanses of bare rock with relatively linear edges of peat may represent areas of former peat cutting. Indeed, the current tenant farmer of Stake House Farm has indicated that the tracks that lead up to the plateau of Stake House Fell were once used by horse-drawn peat carts.

A4.5.5 Beyond the area of widespread erosion, the peat ranges in depth from *c* 1.20m to depths of over 2.50m, such as at White Moss at the north-eastern end of the transect (Fig 56; Plate 18). Much of the peat consisted of a highly amorphous deposit, overlain by monocotyledonous peat with occasional heather remains. Though the peat seemed to be relatively intact, deep gullies, which appear to be natural drainage features, have cut through to the bedrock. This is especially marked at White Moss (SD 5725 5052), where gullies of up to 2.50m in depth form an intricate network between upstanding peat haggs. The exact mechanisms involved in creating this type of landscape are unclear, as the present eroded terrain does not appear to resemble the summit erosion described by Mackay and Tallis (1996) on Fairsnape Fell (SD 5947), *c* 4km south of White Moss (*Section*

2.6.1). It does, however, resemble Bower's (1961) 'type 1' dissection, which is usually confined to deep peat on flat areas at higher altitudes.

A4.5.6 ***Sampling Site 1 (SD 5764 5085):*** Site 1 was located on the 1.95m-deep peat at White Moss (Fig 55). The stratigraphy was as follows:

0–0.28m	Humified monocotyledonous peat
0.28–0.96m	Monocotyledonous peat with heather fragments
0.96–1.61m	Monocotyledonous peat
1.61–1.87m	Humified monocotyledonous peat
1.87–1.95m	Very humified amorphous peat
1.95–2.01m	Very organic sandy soil with stones.

Peat at a depth of 1.93–1.95m, at the very base of the deposit, was dated to 5720–5550 cal BC (6720±35 BP; SUERC-4505/GU-6058), for the peat inception. Peat from a depth of 0.01–0.03m gave a date of 490–380 cal BC (2350±35 BP; SUERC-4504/GU-6056).

A4.5.7 ***Sampling Site 2 (SD 5568 4990):*** Sampling Site 2 was located in an area of peat on the south-western end of Stake House Fell (Fig 55), at an altitude intermediate between Sampling Sites 1 and 3. The core consisted of *c* 0.80m of peat, from which the stratigraphy was as follows:

0–0.74m	Monocotyledonous peat
0.74–0.81m	Humified monocotyledonous peat
0.81–0.90m	Organic sandy soil with stones.

The basal peat, at a depth of 0.79–0.81m, gave a radiocarbon date of 3520–3350 cal BC (4645±35 BP; SUERC-4506/GU-6060) for peat inception.

A4.5.8 ***Sampling Site 3 (SD 5499 4941):*** Sampling Site 3 was situated in the area of badly eroded peat on the south-western periphery of Stake House Fell (Fig 55). The sampled peat deposit had a depth of 0.50m, which consisted of:

0–0.24m	Very loose sandy humified peat
0.24–0.27m	Humified peat with heather fragments
0.27–0.51m	Very humified monocotyledonous peat
0.51–0.55m	Very organic sandy soil.

The basal peat, at a depth of 0.49–0.51m, gave a radiocarbon date of 760–380 cal BC (2365±40 BP; SUERC-4507/GU-6062) for peat inception.

A4.5.9 ***Results:*** the purpose of the pollen analysis was to provide a record of vegetation change in the area, focused on the inception of the peat. Sampling Site 1 was selected to provide a framework within which to compare Sampling Sites 2 and 3. On this basis, only the key features pertinent to the study are discussed here. Sampling Sites 1 and 2 have provided the earliest pollen evidence for the Forest of Bowland, as work at Fairsnape Fell (Mackay and Tallis 1992; 1994a; 1996) concentrated on more recent deposits, which were dated no earlier than the Iron Age.

A4.5.10 Peat inception at Sampling Site 1 occurred during the Mesolithic period at 5720–5550 cal BC (6720±35 BP; SUERC-4505/GU-6058). The pollen record indicates that the landscape was dominated by trees (*c* 80% Total Land Pollen), with *Corylus avellana*-type (hazel/bog-myrtle), *Alnus* (alder), *Quercus* (oak), *Betula* (birch), *Ulmus* (elm) and *Pinus* (pine) (Fig 57). The presence of *Calluna vulgaris* (heather), *Poaceae* (grass), and several other herbaceous taxa suggests that there were limited openings in this woodland. The relatively high concentrations of microscopic charcoal from the start of the sequence, alongside the presence of charred macrofossil fragments (> 100 µm) at the base of the profile, indicates localised burning. The identification of *Cyperaceae* (sedge) pollen and *Sphagnum* moss spores, however, suggest that conditions were relatively wet, and not conducive to natural firing. It is possible, therefore, that the charcoal originates from small-scale clearance or campfires, suggesting some form of Mesolithic activity in the area.

A4.5.11 The pollen assemblage at 1.68m depth suggests a slight regeneration in the woodland surrounding the fell, associated with a decrease in microscopic charcoal fragments and the disappearance of charcoal macrofossils. This period of regeneration was interrupted at 1.26m depth, when a marked rise in non-arboreal pollen was recorded, at a time when microscopic charcoal increased to former levels and macrofossil charcoal returned. A decline in elm and pine pollen was also recorded at this time. The elm decline has been dated regionally at Red Moss, near Bolton (Hibbert *et al* 1971), to 3959–3656 cal BC (5010±80 BP; Q912), and dated by Barnes (1975; quoted in Middleton *et al* 1995) to 3970–3340 cal BC at Moss Farm in Over Wyre, to the west of the Forest of Bowland study area (Fig 82).

A4.5.12 The peat inception at Sampling Site 2 occurred at 3520–3350 cal BC (4645±35 BP; SUERC-4506/GU-6060), shortly after a clearance phase was registered at Sampling Site 1. The overlap of the two diagrams at this point is supported by the similar pollen percentages for the groups in the summary diagrams, where herbs form *c* 40%, dwarf shrubs 10%, shrubs 20%, and trees 30%, of the Total Land Pollen (Fig 58). An increase in heather pollen was recorded at a depth of *c* 0.65m at Sampling Site 1, with a decline in arboreal pollen, and a peak in macrofossil charcoal fragments. *Plantago lanceolata* (ribwort plantain) also appears in the pollen record for the first time at this level. It is possible that these changes in the pollen diagram record an increase in anthropogenic activity, including burning. Because only a partial pollen diagram (as defined by the project design; OA North 2003a) was produced for Sampling Site 2, the heather peak recorded at Sampling Site 1, at a depth of 0.50m, was not apparent at Sampling Site 2.

A4.5.13 The similar pattern shown in the summary diagrams (apart from the decrease in arboreal pollen at the very top of Sampling Site 1), plus the similar charcoal levels at the top of both diagrams, suggest that the two profiles were truncated to a similar period. This must remain a tentative conclusion, however, until the peat has been dated from the top of the profile at Sampling Site 2. What is certain is that, at Sampling Site 1, where the surface of the peat was dated to 490–380 cal BC (2350±35 BP; SUERC-4504/GU-6056), at least 2300 years of palaeoecological history have been lost. Based on an average accumulation rate of 0.058 cm/year-1 for the post-Iron Age peat at Fairsnape Fell, which was calculated by Mackay and Tallis (1994a), it is possible that Sampling Site 1 (and probably Sampling Site 2) has been truncated by up to 1.45m. As the rate of peat accumulation is site-specific and dependent on a number of factors, including geomorphology, drainage patterns and vegetation type, the true extent of the loss can only be conjectured.

A4.5.14 Peat inception at Sampling Site 3 has been dated to 760–380 cal BC (2365±40 BP; SUERC-4507/GU-6062), and may be related to Iron Age climatic deterioration, with cooler and wetter conditions resulting in paludification and peat development. Recent work on peat development at Caithness has suggested that its spread was controlled by a complex interaction between climate, vegetation change and human agency (E Tisdall *pers comm*). It is possible that early activity on the lower slopes of the Forest of Bowland inhibited the spread of peat, which subsequently developed when the area was abandoned. The pollen record in the lower half of the diagram (Fig 59) shows a staggered reduction in arboreal pollen to <10% at 0.24m depth, accompanied by a significant rise in heather, and a diversification in non-arboreal pollen between 0.24m and 0.32m in depth. The evidence suggests that, after the Iron Age, the landscape of Bowland became progressively cleared, resulting in the heather-dominated landscape visible today.

A4.5.15 A possible break in the stratigraphy at Sampling Site 3 occurred at a depth of 0.25m, with a change from humified peat with heather fragments to very friable sandy peat. In addition, a change in the pollen record at this depth includes a rise, from previously depleted levels, in alder and hazel pollen, and a marked reduction in the diversity of herbaceous taxa. It is possible that this represents a stratigraphic break, although radiocarbon dates would be required to confirm this. Based on an average of 0.058 cm/year-1 for the accumulation rates of post-Iron Age peat deposits (Mackay and Tallis 1994a), a depth of up to 0.96m of peat may be missing from Sampling Site 3.

A4.5.16 ***Causes of Erosion:*** the loss of peat on the margins of the Forest of Bowland study area around Sampling Site 3, is surprisingly extensive. This is in part due to an extreme fire event (*Section A4.5.3*). The blanket peat situated away from the area of intensive erosion is considerably more intact, and areas of relatively flat ground and gentle slopes are covered by up to 2m of peat, occasionally dissected by grips and natural drainage gullies. The effects of heather burning for the grouse shooting industry appears limited, and of all the study areas, the Forest of Bowland is the most vegetated.

A4.5.17 At the time of the survey, natural drainage appeared to be the most considerable cause of erosion. This was particularly visible at White Moss (SD 575 505), which is situated in a large basin or possible col. Here, water erosion has formed a reticulate pattern of closely spaced 2m-deep drainage gullies, which have cut through the peat and down to the bedrock. The gullies appear to represent Bower's (1961) 'type 1' dissection, which is confined to deep peat on relatively flat areas. The fact that a great deal of surface peat has also been lost in this area is supported by the date of 490–380 cal BC (2350±35 BP; SUERC-4504/GU-6053) from the surface of the peat at Sampling Site 1). It is highly unlikely that natural drainage alone has truncated the peat to this depth, and peat cutting cannot be ruled out.

A4.5.18 The two types of active erosion in the Forest of Bowland exhibit very different appearances. On the shallower peat margins, where burning and peat cutting probably occurred, widespread 'blanket' erosion has left extensive bare patches with occasional upstanding peat haggs. Some areas have revegetated, but, for the most part, weathering processes are now removing any remaining peat.

A4.5.19 In the central area of deep peat, gully erosion has left a reticulate pattern. Research carried out by Wishart and Warburton (2001) on the erosion of gully systems in the Cheviot Hills shows that once incision to the base of the peat has occurred, parallel retreat of the gully sides takes place. This area is subjected to constant water erosion, and it is therefore inevitable that the peat will eventually be completely eroded.

A4.6 DISCUSSION

A4.6.1 All the archaeological sites recorded by the Forest of Bowland survey were in the western part of the study area, on Nicky Nook or Fell End. Archaeological remains were visible either where there was little peat cover or where land was improved or semi-improved. The peat scar survey, which examined areas of erosion in peat-covered areas, recovered no archaeological sites.

A4.6.2 The cairnfield discovered on Nicky Nook appears to represent primary clearance. The cairns were generally found randomly distributed within small groups, and more rationalised field systems or proto-field systems do not appear to have developed. Although it is not always the case, these types of cairnfield are generally associated with primary woodland clearance, as opposed to subsequent land improvement (Quartermaine and Leech forthcoming). Although there is little absolute dating for these landscapes in north-west England, they are often associated with Bronze Age-type funerary monuments, such as round and ring cairns, and it seems likely that they reflect Bronze Age exploitation of the marginal lands.

A4.6.3 The area of Grizedale Fell, Stake House Fell, and White Moss had peat coverage but no visible archaeology. Large areas of Stake House Fell had been denuded of peat, however (*Section A4.5.3*). At the time of survey these denuded areas were too overgrown to see any lithic evidence, although structural remains, had any been present, would have been visible. The areas of scarring on White Moss have in part been caused by high-energy water erosion, and it is likely that any lithics sealed beneath the peat have been washed away.

A4.6.4 Mesolithic material is frequently found in the Pennine uplands, although few prehistoric sites have been discovered in the Forest of Bowland, despite an identification survey of the extensive estate owned by United Utilities (LUAU 1997). While the survey identified extensive post-medieval remains, reflecting the activity surviving on top of the peat, there was a dearth of earlier and specifically prehistoric sites, which is in marked contrast to the results from many other landscape surveys of the uplands of Northern England and North Wales (*eg* Bootle Fell, West Cumbria (Quartermaine and Leech forthcoming), and Penmaenmawr, North Wales (J Quartermaine *pers comm*)). The explanation offered (*ibid*) was that prehistoric sites were hidden by the extensive blanket peat and that medieval sites were contiguous with present-day farms.

A4.6.5 To an extent, the palaeoenvironmental work undertaken as part of the present study supports this view. The results show that peat inception occurred during the Mesolithic period on the central plateau, and gradually spread outwards, with a marked increase during the Iron Age. The pollen record from the earliest peat deposits at White Moss (Sampling Site 1) indicates a wooded landscape, with only small openings. The relatively high level of microscopic charcoal in these deposits, however, does suggest that there was some anthropogenic activity. Further activity will have been confined to the lower slopes, still without peat, once inception had occurred on the higher fells. During the Iron Age, peat encroached onto the lower slopes, and ultimately may have obscured later prehistoric structural remains, except in those areas affected by severe erosion.

A4.6.6 The pollen record from White Moss (Sampling Site 1) indicates a significant clearance phase contemporary with the elm decline, or shortly after it, when values of elm and pine pollen fell, and there was a substantial increase in herbaceous pollen. Such clearance, probably anthropogenic, is in keeping with the regional picture for the Neolithic period.

A4.6.7 A substantial increase in heather pollen, alongside the first appearance of plants indicative of disturbed ground, such as ribwort plantain, mugwort (*Artemisia*) and golden rod (*Solidago virgaurea*-type), suggests intensive anthropogenic modification of the landscape prior to the Iron Age. This is contemporary with a peak in microscopic charcoal fragments at a depth of 0.50m, at Sampling Site 1, indicative of burning.

A4.6.8 A period of woodland regeneration is indicated towards the top of the diagram at Sampling Sites 1 and 2 (Figs 57-8), but the peat was truncated at both sites shortly afterwards. Both sites appear to have been truncated to similar levels, and the dating of the surface of the peat at Sampling Site 1 indicates that over 2000 years of palaeoecological history have been lost in the area around White Moss.

A4.6.9 Peat inception at Sampling Site 3 was dated to 760–380 cal BC (2365±40 BP; SUERC-4507/GU-6062) which may be related to Iron Age climatic deterioration. It is possible that early activity on the lower slopes of the Forest of Bowland inhibited the spread of peat, which subsequently developed when the area was abandoned. After the Iron Age, however, the landscape was progressively cleared, resulting in the heather-dominated landscape visible today (Fig 59).

A4.6.10 Overall, the evidence suggests a continuous occupation of the Forest of Bowland throughout the prehistoric period, from the Mesolithic period until possible abandonment in the Early Iron Age. It is highly likely that archaeological remains exist, but are presently masked by deep deposits of peat. Given the large scale of the natural drainage erosion prevalent in the central area of Bowland, it is highly likely that sites will be revealed at some point in the future. In addition, the Forest of Bowland is unique in its expanse of rich, tall, heather moorland. This, coupled with unrestricted access to the Forest of Bowland as of 2005 (as a result of the CROW Act), could also mean that the area is at a higher risk from accidental fires than previously.

APPENDIX 5: ANGLEZARKE MOOR

A5.1 INTRODUCTION

A5.1.1 The Anglezarke Moor transect was selected to encompass an area of actively eroding peat that contained a relatively well-known archaeological resource (Howard-Davis 1996; Fig 6). It was possible in this area to compare differing site visibility, as the western side of the moor had suffered severe erosion, whilst the eastern still has thick peat cover.

A5.1.2 The principal cause of the erosion on Anglezarke Moor has been a damaging succession of fires, of which the first documented was in 1958 in the area of Stronstrey Bank. This was followed by severe fires in the late 1970s and early 1980s, which prompted the archaeological surveys of 1983 and 1985 (Howard-Davis 1996). At the outset of the present project, in 2003, there was a further major fire on the western slopes of Anglezarke Moor (Plate 7). In addition, the area has been extensively drained artificially (Fig 60; Plate 4).

A5.1.3 It had originally been proposed to have a north/south orientated transect extending onto Rivington Moor (OA North 2003a); however, following the 2003 fire, it was recognised that Anglezarke Moor provided a unique opportunity to examine the impact of wild fires on peats. As a consequence, the orientation of the study area was changed to align east/west, so as to include areas of both burnt and unburnt moorland, between White Coppice and Belmont Reservoir (Fig 6).

A5.2 LOCATION, GEOLOGY AND TOPOGRAPHY

A5.2.1 The Anglezarke Moor study area measured approximately 1 x 4.6km (Figs 1 and 6). It extended from the unclassified road running around the eastern side of Anglezarke reservoir, across Hurst Hill, Round Loaf and Black Hill Upper, to the line of the A675 in the east.

A5.2.2 The solid geology of the area belongs to the Upper Carboniferous Millstone Grit Series, the major local components being Fletcher Bank Grit (a coarse pebbly sandstone incorporating large quartz crystals) and Haslingden Flags (a coarse sandstone with a blocky jointing system) (Isaac 1972). Both have been quarried extensively from outcrops at the western edge of the moor, the former for the production of millstones, and the latter for civil engineering purposes, including the construction of the Anglezarke reservoir system and the M61 motorway (*ibid*). Localised mineralisation of the fault lines has resulted in the formation of deposits of witherite, barites, and galena, which have been extracted on an occasional, small-scale basis. Poor-quality coal has also been mined from the moors, but in a limited and localised fashion, and usually only for domestic use.

A5.2.3 Anglezarke Moor, along with the adjacent Rivington Moor, comprises an area of approximately 37km^2 of unimproved moorland, forming a substantial western outlier to the South Pennines. The area is largely at a lower elevation than the main bulk of the Pennine chain, with heights in the range of 200–380m AOD. The Anglezarke-Rivington Moors outlier is well defined, bounded to the east by the South Pennines, and to the west by the low-lying Lancashire coastal plain. The conurbation of Greater Manchester is situated to the south, while the northern side is bounded by lower-lying farmland and the industrial town of Blackburn. In geological terms, it represents the western extremity of the Rossendale Anticline, and its western boundary is marked by a typical Pennine fault scarp (the Brinscall Fault), which largely dictates the nature of the drainage around the western foot of the moor (*ibid*).

A5.2.4 The topography is a mixture of plateau moorland and stepped slopes, resulting from differential weathering of the interleaved soft shales and mudstones and harder sandstone. Unconsolidated Newer Drift Boulder Clays and blanket peat overlie these, and for the most part dictate the drainage of the upland plateau (Lawes Agricultural Trust 1970).

A5.3 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

A5.3.1 ***Lithic Sites:*** like most of the Central Pennine Chain, Anglezarke has been scoured by flint collectors, although little modern archaeological investigation had taken place prior to the survey conducted in 1983–5 by Lancaster University Archaeological Unit (Howard-Davis 1996). A wide-scale programme of flint collecting was undertaken by John Hallam, in conjunction with the Chorley and District Archaeological Society, during the 1950s and early 1960s (*op cit*, 138). This work examined areas of peat scarring from across the moor, and significant sites included an assemblage of 11 flakes of Mesolithic date from the eroded surface of the large Round Loaf mound (SD 637 182). An anthropogenic origin has been proposed for this large mound, measuring 50 x 45m, one suggestion being that it represents an exceptionally large example of a Neolithic round barrow, as typified by Duggleby Howe in North Yorkshire (Loveday 2002). Mesolithic material on the surface, however, might indicate a much earlier date, although it may have been redeposited. The absence of any identifiable quarry ditch around the mound might also imply a natural feature, although an excavation within the mound appeared to reveal a sequence of construction (J Hallam *pers comm*).

A5.3.2 The main scatters of lithic material were on Stronstrey Bank, at the western end of the study area, and on the steep slopes of Black Brook, at its northern edge (Fig 61; Howard-Davis 1996). The lithic sites on Stronstrey Bank were exposed following a moorland peat fire in 1958, and surface collection was reinforced by a small excavation (SD 619 178), producing an assemblage of 317 lithics, ranging in date from the Mesolithic to Bronze Age (*op cit*, 143).

A5.3.3 The Black Brook material was from a discrete area of peat scars, adjacent to a tributary gully of Black Brook itself (Sites 36–8 in Howard-Davis 1996). The assemblage comprised 400 lithic artefacts, all of Mesolithic date, and appeared to represent three small working floors.

A5.3.4 Probably the most significant site was revealed by excavation following the collection of a lithic assemblage from within a scar exposed by an early 1980s fire at Rushy Brow (SD 6329 1769), to the east of Hurst Hill (*op cit*, 153). The site included two structures comprising stones and stakeholes, which were tentatively interpreted as temporary shelters. The lithic assemblage was closely concentrated around the structures, suggesting that the material was a product of tool working by people using the shelters. Over 400, largely chert, fragments were recorded, suggesting an Early Mesolithic date. The character of the material is comparable with that from Star Carr (Clark 1954), which has dates of 9600–8000 cal BC (9557±210 BP; Q-14) and 10,100–7700 cal BC (9488±350BP; C353). In 1985, worked antlers identified from the same site were dated to 9658–8633 cal BC (9700±160BP; OxA-1176; Day and Mellars 1994) and 9237–8551 cal BC (9500±120BP; OxA-1154; Day and Mellars 1994).

A5.3.5 ***Neolithic Period:*** the only two Neolithic chambered cairns known in Lancashire are both on Anglezarke Moor. The better known of these is a chambered long-cairn known as the Pikestones (SD 627 172), which has an elongated trapezoidal shape, with a length of 43m, and a width of 17m (Bu'lock 1958). At the north-western end of the cairn is a prominent, exposed cist, formed of large upright slabs leaning against each other in a triangular formation. Lynch (1966) has suggested that the site belongs to the group of Derbyshire megalithic tombs. The other is a chambered round cairn (site 40 (Howard-Davis 1996)) on Stronstrey Bank, which was discovered during the Anglezarke survey (*ibid*) and is a prominent, pear-shaped cairn, with a chamber formed by a large unworked slab, used as a cap stone, resting on uprights. The stone slopes down to the ground at the back, and is supported at the front by an upright portal on one side, and the body of the cairn on the other. There are some similarities between this site and traditions visible within the megalithic tombs of North Wales, such as at Bron Y Foel Isaf (Powell *et al* 1969, 125–6). Neolithic activity is also represented by the lithic material from the Stronstrey Bank excavations (*Section A5.3.2*), and occasional lithic finds from elsewhere on the moor.

A5.3.6 ***Bronze Age:*** as with the Neolithic period, Bronze Age lithic types are well represented in collections from the area, notably from the excavation on Stronstrey Bank (*Section A5.3.2*). In addition, there are a number of clearance cairns on the western and eastern margins of Stronstrey Bank, which may be exposed elements of a cairnfield, and may date to the second millennium (Fig 61). An elliptical, kerbed cairn (site 73) near Jepson's Gate (SD 6239 1734), which was exposed by moorland fire in the early 1980s, has also been tentatively dated to the Bronze Age. The cairn was excavated in September 1983 (Howard-Davis 1996), revealing maximum dimensions of 5.3 x 3.8m, with a height of 0.6m. The structure was defined by substantial uprights around the edge, providing a kerb, and at its base was a pit filled with charcoal. No extant evidence of a burial was identified, although the presence of deposits high in phosphate around the central pit may be an indication of a former interment.

A5.3.7 The chronology of the cairn is uncertain, as no artefacts were recovered and no samples taken for radiocarbon dates. However, palynological analysis of a peat core taken from a site 3m outside the cairn (Barnes 1996, 149–53) revealed distinctive changes in the pollen record, suggesting that peat inception close to the cairn occurred *c* 1250 cal BC. The upper part of the peat profile is likely to date to the Romano-British period, suggesting truncation. Barnes' interpretation is that, from *c* 1250 cal BC, a wet grass-heath, typical of the uplands, was growing on Anglezarke Moor, with birch/oak/alder woodland and some hazel scrub on the marginal slopes, which were gradually being cleared. Although it has been suggested that the cairn belongs in just such an environment (Howard-Davis 1996), the peat is not directly associated with the cairn and, in the absence of any scientific dating, cannot be used as a proxy dating tool.

A5.3.8 ***Iron Age / Roman:*** there are no confirmed Iron Age or Romano-British field monuments from the Anglezarke uplands, although several palynological studies (Barnes and Bain 1985) have recorded recurring periods of clearance in the forested moorland margin during this period. These clearances are in association with a rise in the representation of *Cerealia*, and other species generally associated with mixed agricultural activity. The inference is that areas of the moor and peripheral woods were subject to controlled modification or improvement, in order to favour small-scale agricultural activity. This in turn implies that there was some, probably limited, occupation of the moorland margin during the Iron Age and Romano-British periods. In this respect, it is also perhaps significant that there is a series of denuded walls within the peat at Jepson's Gate (sites 70–2 and 76–7). The palynological work by Brian Barnes at the Jepson's Gate cairn indicates that the peat in this area spanned the range between *c*1250 cal BC and *c* cal AD 200 (Barnes and Bain 1985), with the upper limit reflecting truncation by fire. While this would suggest that the walls were established within this period, it is also possible that they were from a later period, and with the truncation of the peat by fire and water, the stone material of the walls has in effect dropped through the peat.

A5.3.9 ***Medieval Period:*** the name Anglezarke appears to be Norse in origin, from *Analf* (Old Norse personal name) and *Erg* (shieling or summer pasture-hill), although beyond a series of place-names, there is no evidence for early medieval activity on the moors (Mills 1976). Little has been recorded for the historical period. Lead-mining rights were held by the Knights Hospitaller and, from the late fourteenth century to 1600, the moor was held by the Stanley family, Earls of Derby (Farrer and Brownbill 1911). It was subsequently sold, by the sixth Earl, to the Moseley family for £400, and afterwards passed to the Standish family of Duxbury. In 1847 it was bought by Liverpool Corporation for water catchment, and in due course passed into the holdings of North West Water, thence to United Utilities, which owns and administers it today (Simmons 2003).

A5.3.10 ***Post-medieval Settlement:*** the moors have not been densely populated in recent historical times. In 1666, 25 hearths were liable to tax, and in 1832 there were 32 families living on and around the moor (Farrer and Brownbill 1911). By 1961, the population had fallen to a total of 30 (www.visionofbritain.org.uk/data). The farmsteads occupy the sheltered valleys on the periphery of the inhospitable upland plateau: many of them are now abandoned. The surviving farmhouses have a southerly aspect, and are characterised by stands of fast growing trees planted as windbreaks. The farm buildings were surrounded by some improved land, largely intended for domestic use, but the primary income was derived from pasturing sheep on the upland commons (Simmons 2003).

A5.3.11 ***Industrial Exploitation:*** as with many of these moors in the medieval and post-medieval periods, small-scale industrial extraction, particularly for lead ore, is a significant part of Anglezarke's history (Farrer and Brownbill 1911, 294–5). There are considerable numbers of mine shafts, and associated extraction mounds. A line of five shafts (site 5) has been identified on Brown Hill, and at the southern end of Stronstrey Bank is a large expanse of mining debris, which includes substantial amounts of iron ore, associated with nine shafts.

A5.3.12 The proximity of the surrounding villages and towns to the resource provided by peat on the moor led to an inevitable exploitation of the area for fuel. While the evident truncation of the peat, notably around Jepson's Gate, has been attributed to fires, it is probable that truncation is in part also attributable to peat cutting (Howard-Davis 1996). There are linear peat scars from peat cutting in the area of Stronstrey Bank, and within the peat at Ferney Slacks (SD 64180 19861) is a 19m-long section of timber track (site 4 (Howard-Davis 1996)), formed of cut timbers, with side guides, to accommodate wheeled vehicles (Plate 31). It is not associated with any of the known industrial sites, and was probably used to transport cut peats.

A5.3.13 ***Quarries and Millstones:*** a further valuable resource was the millstone grit that underlies the moor, and remains at a quarry at the northern end of Stronstrey Bank reveal in full the purpose of this extraction. Scattered across the moorland are the blanks of millstone wasters, some propped up for working, and others still in the process of being separated from the bedrock. More successful attempts to extract millstones are marked by numerous hollows. This relatively small-scale quarry was superseded by the adjacent and much larger Black Coppice quarry (SD 6195 1866), which provided building stone for the area. At Withnell, on the northern side of the moor, are two further large quarries, testaments to the quality of the stone as a building material (Howard-Davis 1996).

A5.4 FIELDWALKING

A5.4.1 The survey transect was within an area that had been subject to intensive surveys in 1983 and 1985, which had included systematic fieldwalking to ensure that all archaeological remains then visible on the surface were recorded. The present survey re-examined these areas to identify what archaeological sites had become exposed or had been covered by peat or destroyed during the last 20 years, and as such provided an indication of how the condition of the moorland has changed. Previously recorded archaeological monuments were not resurveyed by the current project, although all were checked, and all the sites that have been recorded as part of the present phase of survey have been newly exposed since these earlier surveys. In total, 19 sites were recorded in the course of the fieldwork (Fig 62), all located within the western part of the study area, where the greatest erosion has occurred. The 19 sites comprised nine cairns, six findspots of lithic material, three structures, and the probable site of a campfire. These sites are described below and are listed in the gazetteer (*Section A9*).

A5.4.2 ***Cairns:*** all of the cairns recorded by the present survey were small and appear to be associated with field clearance. Almost all were on Stronstrey Bank (Fig 62; Plate 19). Their discovery increases significantly the number of previously identified cairns, and there is now a group near the western edge of Stronstrey Bank, with 11 cairns within an area that is 100 x 50m in extent (which includes cairns A123-7); given this relative density of small cairns, it is probable that this represents a cairnfield. As further erosion exposes the underlying mineral soil, it is likely that more cairns will be revealed, and the distribution of the cairns will become more uniform and they will increase in concentration. The putative cairnfield is located on the generally flat natural bench of Stronstrey Bank, which would have had considerable potential for agricultural exploitation (Plate 21). Cairnfields on the western fells of the Lake District occupy a similar topographical setting (*Section A2*), and it is reassuring that Stronstrey Bank appears to be conforming to the typology.

A5.4.3 ***Lithic Finds:*** the six findspots of worked flint or chert were spread across the study area, although three of the sites (A109, A111, and A130) were concentrated on the fire-eroded western slopes of Hurst Hill (Fig 62). Four of the six locations produced single artefacts only. Of these, A103 was a heavily-patinated distal end of a broken flint blade, A109 a spall of fine black chert, A120 a single heavily-patinated flake with some edge damage, and A132 a piece of patinated grey flint.

A5.4.4 Site A111 produced 14 pieces of worked flint, from an area of approximately 1.5m². All the pieces were less than 9mm in length and five showed signs of having been burnt. Four were of brown flint, four were grey, and three were too burnt to distinguish the original colour. One piece was a chip off a hammer stone, and one would appear to be a pressure-flaking spall, although also displaying some re-touch. The relatively close concentration of the flakes suggests that they formed part of a small working floor. Three pieces of grey flint which were fairly crudely worked were recovered from Site A130 on Hurst Hill. Although the artefacts reinforce the evidence for prehistoric activity across the moor, none shows any diagnostic traits that can be assigned to a specific period.

A5.4.5 ***Structural Features:*** structural elements included a stone-built rectangular structure (A104; Plate 36)), measuring approximately 4 x 6m, on the eastern side of the small stream, to the east of Rushy Brow. It was constructed on top of the peat, making it relatively recent in date. Site A107 comprised two sides of a crudely built rectangular structure, measuring 3.3 x 1.5m, located within a peat scar on the south-west flank of Hurst Hill. The structure was set on mineral soil, aligned with its long axis in an east to west direction, but with only the north and west sides surviving as a single course of stone.

A5.5 THE PALAEOENVIRONMENTAL STUDY

A5.5.1 ***The peat profile:*** the stratigraphical transect revealed that the depth and extent of peat in the study area was primarily influenced by the local topography (Fig 64). The peat has, however, been eroded to varying degrees, both locally and on a wider scale. The deepest peat, which reached depths of 3.5m in places, was situated at the eastern end of the transect, where it was only interrupted by the lines of natural drainage (Plate 29). The general stratigraphy of this deeper peat indicated that the initial development was of a very humified amorphous peat with occasional monocotyledon remains, which developed into a much less humified monocotyledonous peat. Charred and uncharred heather fragments were visible throughout the profile in some of the cores (*ie* at Core A; Fig 64). The peat generally decreased slightly in depth on the flat central plateau, just west of Black Hill Upper (Core B; Fig 64); where depths of 1–2m were recorded. There the peat was generally unhumified throughout, containing monocotyledon remains and occasionally both charred and uncharred *Calluna* sp (heather) fragments. At the western end of the transect, near to Hurst Hill, the depth of the peat decreased dramatically from 1.60m (at Core C; Fig 64) to 0.30m (at Core D; Fig 64), over a distance of only *c* 200m. Small pockets of deeper peat were visible, but on the whole, deposits of less than 0.35m of very humified peat were evident. Extensive patches of bare rock were prevalent in this area, colonised in places by lichens, mosses and grasses. On the whole, the remaining peat formed a network of upstanding haggs, dissected by numerous erosion patches and drainage gullies. As this area has experienced numerous fires in the past (*Section A5.1.2*), it is likely that much peat has been lost both through burning and subsequent weathering.

A5.5.2 ***The Sampling Sites:*** two sampling sites were chosen for further pollen investigations and radiocarbon dating. Sampling Site 1 (Fig 65) was sited on the central plateau of relatively deep peat near Black Hill Lower (SD 64659 18318), where a 2.5m deep exposure of peat formed one side of a relatively clean-cut V-shaped channel (Plate 29). Sampling Site 2 was on the western periphery of this plateau (SD 63084 17990) on Hurst Hill, and was taken from a 0.50m-deep peat hagg. A 0.02m slice of material from both the base and top of the two profiles was radiocarbon-dated. A third sampling site was originally planned, on the shallow peat (<0.50m deep) on the steep south-east-facing slope south of Hurst Hill (SD 62549 17528), where there had been a number of fires. As Bain (1991) had previously analysed a number of samples from this locality, however, it was decided to incorporate the palaeoenvironmental results from his work within the present assessment to evaluate differing methodologies. Several samples were taken from the uppermost 1.10m of peat from Sampling Site 1, to determine how the new sampling sites related to Bain's work on the central plateau of Anglezarke Moor, and whether previous palynological studies might be used as a relative dating tool.

A5.5.3 ***Sampling Site 1 (SD 64659 18318):*** the depth of the deposits was 2.50m, and the stratigraphy was as follows (Fig 64):

0–0.12m Very humified sandy peat with modern roots

0.12–0.52m Humified amorphous peat

0.52–1.32m Monocotyledonous peat with occasional heather fragments and *Sphagnum*

1.32–2.10m Monocotyledonous peat

2.10–2.12m Wood layer

2.12–2.28m Very humified amorphous peat (mor humus?)

2.28–2.52m Very humified amorphous peat becoming sandy with depth.

Two samples, from the top and the base of the peat, were taken for radiocarbon dating. Material from near the top, at a depth of 0.125–0.145m, gave a date of cal AD 1060–1280 (845±35 BP; SUERC-4511/GU-6064). Material from the base of the peat, at a depth of 2.31–2.33m, provided a date of 3800–3650 cal BC (4945±35 BP; SUERC-4512/GU-6066).

A5.5.4 ***Sampling Site 2 (SD 63084 17990):*** Sampling Site 2 was placed in an area of erosion, with upstanding peat haggs *c* 0.50m deep (Fig 64). The stratigraphy of the sampled peat face was as follows:

0–0.07m Very humified amorphous sandy peat with modern roots

0.07–0.33m Humified amorphous peat with occasional sand (slight colour change at 0.28m depth)

0.33–0.34m Dark band of very humified amorphous peat with charcoal

0.34–0.44m Humified amorphous peat.

Peat taken at the top of the sample, at a depth of 0.07–0.09m, was dated by radiocarbon assay to cal AD 1630–1950 (210±40 BP; SUERC-4514/GU-6068). Material near the very base of the peat, at 0.41–0.43m depth, provided a radiocarbon age of 2200–1940 cal BC (3685±35 BP; SUERC-4515/GU-6070). The profile contained two possible breaks in the stratigraphy, at depths of 0.28m and 0.34m, the lower one being represented by a band of dark material, and the upper by a slight colour change. Both these changes could reflect changes in accumulation rates related to climatic fluctuations. Pollen analysis from Sampling Site 2 was limited to two samples taken from near the surface of the peat, since it was anticipated that the nature of the pollen assemblages from these levels might indicate whether or not the surface of the peat was intact.

A5.5.5 ***Results and comparison with Bain (1991): Sampling Site 1:*** Bains's Black Brook and Round Loaf sites were closest to Sampling Site 1, and therefore a direct comparison could be made. At Bain's Black Brook site (SD 6316 1849), 2.20m of peat overlaid 0.10m of mor humus (Fig 83). At Bains's Round Loaf site (SD 6340 1798), 1.50m of peat sealed 0.20m of woodland mor humus (Fig 84). The basal 0.40m at Sampling Site 1 was a very humified organic material with wood fragments (Fig 66), and it is likely that this represented a deposit similar to that recorded by Bain (1991) at Round Loaf. The mor humus probably developed during a period of increasing instability and diversification of the woodland habitat, and represents a localised increase in the water table. This is likely to have followed disturbance or removal of woodland cover, probably by Late Mesolithic or Early Neolithic peoples.

A5.5.6 The pollen evidence from the base of the peat at Black Brook and Round Loaf shows increasing instability in the woodlands, which Bain (1991) attributes, in part, to the use of fire for clearance. The transition from mor humus to humified peat at Black Brook was contemporary with an increase in grass, herbs and fern taxa in the palynological record, alongside the first appreciable amounts of microscopic charcoal. Macrofossil charcoal fragments within the peat were also recorded for the first time at this level, and the percentage of arboreal pollen declined significantly from >90% to about 60%. At Black Brook, peat inception was dated to 3660–3360 cal BC (4740±70 BP; HAR-6210), with a similar date for peat inception at Sampling Site 1, of 3800–3650 cal BC (4945±35 BP; SUERC-4512/GU-6066). These dates also correlate closely with the Flandrian III chronozone, dated to 3960–3656 cal BC (5010±80 BP; Q912) at Red Moss, near Bolton, Greater Manchester (Hibbert *et al* 1971). Flandrian III is characterised by a fall in the values of elm, lime and ash pollen, a corresponding rise in the pollen from plants characteristic of disturbed and open ground, and a substantial rise in heather pollen.

A5.5.7 No direct correlation of the detailed pollen record from Sampling Site 1 could be made with Bain's work, because of the way he calculated his percentages. Bain (1991) measured the percentage values of all pollen taxa relative to the arboreal pollen, whereas in this study, the more common practice of calculating the values relative to Total Land Pollen, was used. At Bain's Round Loaf site, however, a marked rise in heather pollen (Fig 84) was dated to cal AD 360–647 (1550±70 BP; HAR-6211), and a similar rise in heather pollen at the Black Brook site (Fig 83) was dated to cal AD 24–380 (1840±70 BP; HAR-6420). There was also a marked rise in heather pollen at Sampling Site 1 (Fig 66). A similar peak in heather was also recorded in a shallow (0.22m) peat profile near to Jepson's Gate (site 73). This peak is clearly shown in pollen assemblage zone AE-c of Barnes' pollen diagram (Howard-Davis 1996). Barnes suggests that this zone represents 'a period of active anthropogenic modification of the marginal forest' (Barnes 1996, 152). In this case, however, the peak in heather was interpreted by Barnes (1996) as being earlier than the Romano-British period.

A5.5.8 Assuming that the peak in heather and herbaceous taxa recorded at a depth of 0.50m at Bain's Round Loaf site, and *c* 0.48m at Sampling Site 1, is synchronous, it appears that the two profiles have been truncated to similar depths. The dates of the top of the peat from both profiles, of cal AD 1224–1430 (650±80BP; HAR-6418) at Round Loaf, and cal AD 1060–1280 (845±35 BP; SUERC-4511/GU-6064) at Sampling Site 1, accord with this. The dates do suggest, however, that slightly more peat was intact at Bain's Round Loaf site when it was sampled. In summary, the exercise has indicated that previous, well-dated palynological work in an area can indeed be used to interpolate dates, although success requires pollen diagrams at a fine resolution, and comparable methods of presenting pollen percentages.

A5.5.9 ***Sampling Site 2:*** the base of the peat at Sampling Site 2 was dated to 2200–1940 cal BC, *ie* the Late Neolithic or Early Bronze Age. By correlating his pollen records and establishing a local pollen zonation, Bain (1991) suggested a Late Neolithic to Early Bronze Age inception date for the peat at Mineral Horizon, Pikestone Ploughings, and other sites bordering the study area (*eg* Hatch Brook; Winter Hill). Thus Bain's evidence, alongside the radiocarbon date for peat inception at Sampling Site 2, appear to signify a major expansion of blanket peat across Anglezarke Moor during this period.

A5.5.10 The two pollen samples, analysed from near the surface of the peat at Sampling Site 2, record the presence of heath moorland on Anglezarke Moor (Fig 67) by cal AD 1630–1950 (210±40 BP; SUERC-4514/GU-6068). This is much younger than the surface peat at the centrally located Sampling Site 1. The presence of SCPs (Spheroidal Carbonaceous Particles), or soot, combined with high levels of charcoal, suggests that the samples post-date the Industrial Revolution. It was, however, anticipated that the samples would have high levels of pine pollen from nearby plantations, but this was not the case, implying that the surface samples and the plantations are not contemporary.

A5.5.11 Through a combination of radiocarbon dating and cross-correlation of his pollen diagrams, Bain (1991) also established that the surface of the peat on the periphery of the moor (Pikestone Ploughings and Pikestone) appears to be slightly younger than that from the centre of the moor. This would make it reasonable to suggest that the peat on the periphery might be slightly more intact. The peat there does, however, exhibit at least one episode of loss and re-growth in the past. At Pikestone Ploughings, a discontinuity in the pollen assemblage suggests a hiatus, above which the pollen record was characteristic of the seventeenth century (Bain 1991, 300). It is possible, therefore, that peat loss on the periphery of Anglezarke Moor may have been occurring for at least 300 years.

A5.5.12 Although it is not ideal to apply a theory of peat accumulation rates from one site to another, a comparison with the date and depth of both sampling sites in this study suggests that, potentially, at least 1.47–1.60m of peat is missing from Sampling Site 2. This is based on an accumulation rate of *c* 0.5mm/year-1 (calculated on the depth of peat between the upper and lower dates) at Sampling Site 1, and the assumption of a similar accumulation rate at Sampling Site 2. The possiblity of loss is supported by the stratigraphy, and the likely hiatus in the pollen record highlighted by Bain (1991) from peripheral locations. Ironically, the surface of the peat at Sampling Site 2 is younger than that from the deeper peat on the central plateau. In the absence of a comparison with a convincingly intact site, it is difficult to determine the extent of loss at Sampling Site 1. Although nearly 1000 years of peat development has seemingly been lost or simply failed to develop on the central plateau, when compared with the loss on the western margins of the moor, this figure is relatively small. A comparison of the depths of material from the sites, plus the radiocarbon dates, suggests that over 4000 years of palaeoecological history have potentially been lost from the peripheral areas. The unavoidable conclusion is that there has been a long history of erosion on the slopes around the plateau, exacerbated by fire.

A5.6 DISCUSSION

A5.6.1 ***Archaeological Resource:*** the field survey identified 19 new sites, which are in addition to the 44 sites identified during the 1983 and 1985 surveys in the same area (Howard-Davis 1996). The new sites were found in areas of erosion, and, for the most part, were in the westernmost quarter of the study area, which had been affected by the recent (2003) fire (*eg* Site A108; Plate 37). Generally, the western part of the study area has suffered far greater erosion than the central and eastern parts, thus exposing more sites (Fig 60). The recovery of lithic material from the eastern part of the transect (Sites A120 and A132) demonstrates prehistoric activity there, but fewer sites were exposed, presumably because erosion scars were scarcer. The finding of these 19 sites does not reflect methodological problems in the earlier survey of the area, as both the 1983 and 1985 surveys were intensive: rather, the new discoveries indicate new exposure by erosion and peat loss. The finding of these additional sites, marking an increase of nearly 50% in the number previously identified, indicates the expansion of eroded areas since 1985, and hints at further exposure of archaeological remains if erosion continues unabated.

A5.6.2 Ten of the recently discovered archaeological sites were clearance cairns, on or near the natural bench of Stronstrey Bank, at the western periphery of the moor (Plate 20). This is in addition to a further 12 clearance-type cairns (sites 22, 24, 27–8, 52–4, 56–7, 61, 79 and 80) identified by the 1980s surveys within the Stronstrey Bank, Hurst Hill, and Pikestones areas. The key aspect of this discovery is that the area has all the topographical characteristics of these containing cairnfields in other parts of the North West, most notably in the South-West Fells of the Lake District. It is well-drained, gently sloping land, raised above an adjacent area of agriculturally viable lowland, but not so high that the land loses its usefulness for farming (typically below 300m AOD). These cairnfields are associated with forest clearance and land improvement, usually dated to the Bronze Age (*eg* Quartermaine and Leech forthcoming), although in the case of Barnscar, on the Cumbrian South-West Fells, there is an implication that this activity had its origins in the Neolithic period (*Section A2.12.12*). The chronological development of the clearance mounds on Anglezarke Moor remains a pertinent point for future research.

A5.6.3 ***Palaeobotanical Evidence:*** in the case of Anglezarke Moor, the evidence, from this study, alongside the work of Bain (1991) and Barnes (1996), suggests a number of episodes of human modification of the vegetation. The first of these is apparent in the record after *c* 2850 cal BC, and coincides with a deterioration in soil conditions, and the development of a woodland mor humus on the central plateau. During this time, arboreal pollen values declined from more than 90% to *c* 60% of Total Land Pollen, accompanied by an increase in microscopic charcoal.

A5.6.4 The second major clearance episode was dated to the Late Neolithic or Early Bronze Age, and was marked by a significance rise in non-arboreal pollen, plants which favour disturbed ground, and ericaceous pollen. This coincides with a number of peat inception dates recorded by Bain (1991), along with that from Sampling Site 2. This phase is likely to represent the development of heather moorland, and it is tempting to relate it to the appearance of a potentially significant number of clearance cairns on the Stronstrey Bank bench.

A5.6.5 A third significant modification of the uplands, dated to the Late Roman or early medieval period, is represented by a second substantial peak in heather, and was identified at a number of the sampling sites (*Section A5.5.7*). It is possible that, during the medieval period, intense anthropogenic activity marked the beginning of a long period of erosion.

A5.6.6 Overall, there appears to be palaeobotanical evidence of the impact of humans on the vegetational landscape of the Anglezarke uplands from at least the Neolithic period. After this time, continued occupation was marked by specific large-scale landscape changes. It is not surprising that only a limited number of prehistoric sites have been found on the central plateau, given the great depths of peat (up to 3m in places). Where erosion has been severe, however, a number of prehistoric sites, including flint scatters and a Bronze Age cairn, have been discovered. It is possible that Bronze Age activity may have been limited to areas where peat had yet to develop. Dating the basal peat adjacent to these Bronze Age sites could confirm this hypothesis.

A5.6.7 At first glance, the radiocarbon dates from the surface of the peat, both in this study and in Bain's (1991), appear to suggest that surface erosion of the peat on the periphery of Anglezarke Moor is much more limited. However, a comparison of the depths and peat inception dates between the peat on the central plateau and the periphery of the moorland implies that perhaps over 1.50m of peat has been lost or there has been a hiatus in peat growth. Whether this is due to former peat cutting is unclear, although a consistent record of truncation and re-growth within the stratigraphic and pollen evidence is apparent (*Section A5.5.11*). It is likely that the peripheral area of Anglezarke Moor has suffered a long history of severe peat loss, possibly originating in the medieval period. However, there has been a more recent recovery in peat growth since then.

A5.6.8 In contrast, the radiocarbon dates from the modern surface suggest that up to 1000 years of palaeoecological history has been lost or failed to accumulate in the area of deep peat, which has been subjected to repeated 'controlled' heather burning. A recent study on carbon sequestration in a Pennine blanket bog (Garnett *et al* 2000) suggests that there is evidence that rotational burning causes a net reduction in peat development. Unlike accidental fires, however, which can damage vast areas of the peat matrix itself, managed burning rarely removes all former vegetation (*ibid*).

APPENDIX 6: GAZETTEER OF SITES IN THE CUMBRIAN SOUTH-WEST FELLS STUDY AREA

In the following gazetteer, each site appears with, on separate lines, its reference number, and its grid reference (Figs 18, 19 and 20), followed by the description. At the outset of the survey, a batch of unique site numbers was allocated to each study area to ensure there was no overlap (the Langdale Fells - 1-99; Anglezarke Moor – 100-35; the South-West Fells - 136-215; the Forest of Bowland - 216-90). In addition, each was provided with a suffix to clarify the study area (Langdale -L; Anglezarke – A; South-West Fells - SW; Forest of Bowland – B). The number sequence is not completely continuous, reflecting the fact that some initial site numbers were either amalgamated into single sites or they were reinterpreted as having a natural origin.

SW136
SD 13982 95785
A possible clearance cairn, identified by probing.

SW137
SD14017 95785
A possible clearance cairn, identified by probing.

SW138
SD 14062 95823
A possible clearance cairn, identified by probing.

SW139
SD 14066 95838
A possible clearance cairn, identified by probing.

SW140
SD 14010 95847
A possible clearance cairn, identified by probing.

SW141
SD 14043 95859
A possible clearance cairn, identified by probing.

SW142
SD 14036 95861
A possible clearance cairn, identified by probing.

SW143
SD 14013 95862
A possible clearance cairn, identified by probing.

SW144
SD 13974 95872
A possible clearance cairn, identified by probing.

SW145
SD 14426 95027
A probable clearance cairn, *c* 4m in diameter, 0.2m high.

SW146
SD 14537 95079
A probable clearance cairn, *c* 2m in diameter, 0.15m high.

SW147
SD 14539 95094
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW148
SD 14881 94993
A large pile of stones, *c* 7m in diameter, consisting of an outer arc with an almost triangular pile of stone to the north. It stands to 0.4m high, and was possibly a disturbed cairn.

SW149
SD 14896 94990
A probable clearance cairn, *c* 2.5m in diameter, 0.15m high.

SW150
SD 15005 95011
A wall extending for 7m out from an outcrop of stone. It was reasonably well constructed of large stone blocks, up to 0.75m across.

SW151
SD 16706 94896
A peat scale. This was a stone-built hut with interior measurements of 3 x 1.5m, and the walls were approximately 0.5m thick. The entrance lay on the north and a flue or chute were located in the west wall. The structure was built into the side of a small hillock so that the top of the chute can easily be reached by climbing. The hut was within 40m of a large area of historical peat cutting (SW152).

SW152
SD 16686 94844
A large area of historical peat cutting, *c* 50 x 150m.

SW153
SD 16670 94978
An area of historical peat cutting, *c* 40 x 80m.

SW154
SD 16390 95419
An area of historical peat cutting, *c* 30 x 80m.

SW155
SD 15964 95029
A wall, 6m long, with up to three courses surviving; built over a natural outcrop.

SW156
SD 17537 94806
A possible area of peat cutting: square-shaped scar measuring 20 x 20m, on the top of Hesk Fell.

SW157
SD 17586 94698
A possible area of peat cutting, *c* 25 x 50m.

SW158
SD 17781 94659
A right-angle of dry-stone wall measuring 3 x 4m and 0.5m high. It was possibly the remnants of a peat scale or shieling.

SW159
SD 14763 95284
A probable clearance cairn, *c* 4m in diameter, 0.1m high.

SW160
SD 14772 95276
A probable clearance cairn, *c* 3m in diameter, 0.1m high. It was very overgrown.

SW161
SD 14783 95272
A probable clearance cairn, *c* 4m in diameter, 0.2m high. It was largely grassed over.

SW162
SD 14794 95276
A probable clearance cairn, *c* 2m in diameter, 0.1m high.

SW163
SD 14779 95278
A probable clearance cairn, *c* 2.5m in diameter, 0.2m high.

SW164
SD 14782 95291
A probable clearance cairn, *c* 2.5m in diameter, 0.2m high.

SW165
SD 14792 95298
A probable clearance cairn, *c* 4m in diameter, 0.3m high.

SW166
SD 14817 95311
A large cairn, *c* 8m in diameter and 0.75m high, situated on a slight rise above a group of 14 clearance cairns (Cairnfield G2 (Fig 19)). It was probably a burial cairn rather than a clearance cairn. It was too overgrown to see if any kerb was present and a depression in the centre indicated that it has been excavated at some point.

SW167
SD 14780 95301
A probable clearance cairn, *c* 4.5m in diameter, 0.3m high.

SW168
SD 14776 95312
A probable clearance cairn, *c* 2.5m in diameter, 0.2m high.

SW169
SD 14784 95320
A probable clearance cairn, *c* 2.5m in diameter, 0.2m high.

SW170
SD 14801 95331
A probable clearance cairn, *c* 2m in diameter, 0.1m high.

SW171
SD 14782 95329
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW172
SD 14771 95329
A probable clearance cairn, *c* 3m in diameter, 0.1m high.

SW173
SD 14761 95317
A probable clearance cairn, *c* 5m in diameter, 0.3m high.

SW174
SD 14346 95516
A probable clearance cairn, *c* 5m in diameter, 0.4m high.

SW175
SD 14354 95516
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW176
SD 14359 95510
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW177
SD 14366 95522
A probable clearance cairn, *c* 2m in diameter, 0.1m high.

SW178
SD 14370 95522
A probable clearance cairn, *c* 2.5m in diameter, 0.3m high.

SW179
SD 14373 95513
A probable clearance cairn, *c* 3m in diameter, 0.3m high.

SW180
SD 14375 95517
A probable clearance cairn, *c* 3m in diameter, 0.3m high.

SW181
SD 14380 95522
A probable clearance cairn, *c* 4m in diameter, 0.4m high.

SW182
SD 14381 95524
A probable clearance cairn, *c* 3m in diameter, 0.4m high.

SW183
SD 14387 95522
A probable clearance cairn, *c* 3.5m in diameter, 0.3m high.

SW184
SD 14395 95527
A probable clearance cairn, *c* 4m in diameter, 0.4m high.

SW185
SD 14407 95523
A probable clearance cairn, *c* 4m in diameter, 0.3m high.

SW186
SD 14412 95506
A probable clearance cairn, *c* 4m in diameter, 0.4m high.

SW187
SD 14422 95511
A probable clearance cairn, *c* 5m in diameter, 0.3m high.

SW188
SD 14427 95515
A possible round-house, comprising a curved pile of stones approximately 0.5m wide forming a semi-circle. It would have had a diameter of *c* 7m if complete.

SW189
SD 14479 95305
A probable clearance cairn, *c* 3.5m in diameter, 0.2m high.

SW190
SD 14469 95289
A probable clearance cairn, *c* 2m in diameter, 0.15m high.

SW191
SD 14448 95297
A probable clearance cairn, *c* 4m in diameter, 0.2m high.

SW192
SD 14474 95136
A cairn, *c* 7m in diameter by 0.4m high, positioned away from and slightly higher than nearby cairns. It was also directly opposite burial cairn SW166. It was too overgrown to check for a kerb but its location would suggest this was a burial cairn.

SW193
SD 14497 94963
A probable clearance cairn, *c* 4m in diameter, 0.3m high.

SW194
SD 14491 94954
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW195
SD 14409 95268
A wall or stone bank, approximately 25m long, constructed of large stones mostly about 1m across. It had only a single course.

SW197
SD 14486 94958
A probable clearance cairn, *c* 3m in diameter, 0.3m high.

SW198
SD 14486 94950
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW199
SD 14475 94968
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW200
SD 14479 94972
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW201
SD 14480 94971
A probable clearance cairn, *c* 3m in diameter, 0.2m high.

SW202
SD 14444 94984
A probable clearance cairn, *c* 4m in diameter, 0.25m high.

SW203
SD 14429 95014
A probable clearance cairn, *c* 2.5m in diameter, 0.3m high.

SW204
SD 14423 95005
A probable clearance cairn, *c* 2m in diameter, 0.2m high.

SW205
SD 17592 94270
Copper-mine workings, slag heap and quarry.

SW206
SD 17320 94422
A stone-built structure, aligned east/west down the slope of the hill. Only the northern wall and the end walls survived, and stood to a height of 0.4m. The walls were crudely built and utilise earthfast boulders. The whole structure measured *c* 20 x 5m.

SW207
SD 17412 94190
A small stone-built hut, forming part of a copper mine. The hut measured 3.5 x 5m and stood 2.5m high at the apex of the gable. It was constructed on a platform of large boulders, which were used to even out the slope. The entrance was in the eastern side of the building facing the other mine buildings.

SW208
SD 17524 94175
A walled-up gateway in a dry-stone wall, where the track from the mine workings used to pass through leading to a spoil heap, *c* 100m downslope

SW209
SD 17525 94177
A path from mine buildings to a spoil heap downslope. It was approximately 150m long and 6m wide; it had been cut into the side of the hill and revetted with stone on the western side.

SW210
SD 17482 94204
A stone-built structure 4.5m square and 2.5m high at the apex of the gable. The entrance was in the east, facing the path which linked it to the next complex of structures. In the internal north-east corner of the building was a stone-built hearth measuring 2 x 1.5m, and 1m high. The hearth was built into the wall of the hut, with a blocked-up opening leading to the outside in the east, and an internal stoke hole in the west. The hearth was full of burnt material. The masonry on the inside of the hut still had some lime mortar visible.

SW211
SD 17485 94205
A route leading from building SW210 upslope to building SW212. It was *c* 100m long and 5m wide, and revetted with stone to the south.

SW212
SD 17562 94218
A complex of stone buildings linked to SW210 by path SW211. The structure was divided into four parts aligned east/west. The first part measured 4m square and stood 2.5m high at the gable end, with a window in the west and entrance in the south. The second part of the complex measured 4 x 5m, had a large entrance in the south and again stood 2.5m high. The third structure measured 4 x 6m, and was in a more ruinous state than the previous two, with no southern wall. The last structure was even more ruinous, and measured 3 x 4m. There were many roof slates littering the area around the entire complex.

SW213
SD 14588 95180
A clearance cairn, *c* 3.5m in diameter, 0.15m high.

SW214
SD 14657 95219
A probable clearance cairn, *c* 3m in diameter, 0.15m high.

SW215
SD 14533 95196
A flaked axe/pick made of Group VI rock. It was recovered from Test Pit 82 (Fig 27). Only the butt end has survived.

APPENDIX 7: GAZETTEER OF SITES IN THE LANGDALE FELLS

In the following gazetteer, each site appears with, on separate lines, its reference number, and its grid reference (Figs 43 and 44), followed by the description. At the outset of the survey, a batch of unique site numbers was allocated to each study area to ensure there was no overlap (the Langdale Fells - 1-99; Anglezarke Moor – 100-35; the South-West Fells - 136-215; the Forest of Bowland - 216-90). In addition, each was provided with a suffix to clarify the study area (Langdale -L; Anglezarke – A; South-West Fells - SW; Forest of Bowland – B). The number sequence is not continuous, reflecting the fact that some initial site numbers were either amalgamated into single sites, or because they were reinterpreted as having a natural origin, or because they were found to coincide with previously recorded sites.

L1
NY 27984 07272
Approximately 30 flakes, some heavily-patinated, were seen lying at the interface of the mineral soil and the overlying humic soil in a scar measuring 3.5m long by 1.5m wide and 0.75m deep. The scar was located on the eastern side of a footpath. A rough-out axe was seen lying in the path within *c* 3m of the scar.

L2
NY 27409 07771
Two flakes were found at either end of a long scar, approximately 50m apart. One appeared to be a medium-sized reduction flake, and the other a much smaller secondary shaping flake. Both were found lying on peat that had eroded from the face of the scar. Mineral soil was visible beneath 0.5m of *in situ* peat.

L12
NY 27742 07136 to 27949 07370
A path running from the top of Loft Crag to the base of Pike of Stickle, along which several previously recorded sites were visible. The peat in this area was very shallow with mineral soil/bedrock exposed throughout, but the erosion was confined to the path and does not seem to be spreading.

L15
NY 27629 07394
A single thinning flake found in a 5m-long peat scar. The scar was approximately 1.2m deep without reaching mineral soil. The flake was found towards the base of the scar but was still securely within the peat.

L21
NY 27483 07426 to 27640 07445
A very long, sinuous scar up to 1.4m deep, without reaching the mineral soil. Four flakes were recovered from it. A small thinning flake was recovered from the southern end of the scar, quite high up in the peat. The remaining three flakes were found *c* 20m further north and comprised one thinning flake and two possible platform-trimming flakes. Occasional other small flakes were seen along the length of the scar but were too degraded to be retained.

L22
NY 27360 07477 to 27420 07459
An elongated ‘U’-shaped scar orientated roughly east/west, 1.4m deep, exposing degraded bedrock. Two mass-reduction flakes were recovered from the interface of the peat and the mineral soil at the south-east end of the scar. A group of about 20 flakes were seen at the interface of the peat and the mineral soil at the north-west end of the scar. Of these flakes, however, only six mass-reduction flakes were retained, as the smaller flakes were so badly degraded that they tended to fall apart on being lifted.

L24
NY 27436 07635
A small scar 1.5m long and 0.4m deep eroded down to degraded bedrock. A single medium-sized reduction flake was recovered from the interface of the peat and the bedrock.

L28
NY 27436 07645
A small scar *c* 2m long and 0.5m deep. A single flake was found in a layer of degraded stone within the peat at about 0.4m from the surface.

APPENDIX 8: GAZETTEER OF SITES IN THE FOREST OF BOWLAND

In the following gazetteer, each site appears with, on separate lines, its reference number, and its grid reference (Fig 54), followed by the description. At the outset of the survey, a batch of unique site numbers was allocated to each study area to ensure there was no overlap (the Langdale Fells - 1-99; Anglezarke Moor – 100-35; the South-West Fells - 136-215; the Forest of Bowland - 216-90). In addition, each was provided with a suffix to clarify the study area (Langdale -L; Anglezarke – A; South-West Fells - SW; Forest of Bowland – B).

B216
SD 52025 48543
A clearance cairn, *c* 3.5m in diameter.

B217
SD 52060 48507
A clearance cairn, *c* 5.7m in diameter.

B218
SD 52078 48507
A clearance cairn, *c* 3.5m in diameter.

B219
SD 14881 94993
A clearance cairn, *c* 1.8m in diameter.

B220
SD 52087 48519
A clearance cairn, *c* 3m in diameter.

B221
SD 52075 48529
A clearance cairn, *c* 3.5m in diameter.

B222
SD 52079 48541
A clearance cairn, *c* 3.6 x 2m, 'kidney'-shaped.

B223
SD 52083 48542
A clearance cairn, *c* 3m in diameter.

B224
SD 52092 48539
A clearance cairn, *c* 4.3m in diameter.

B225
SD 52101 48544
A clearance cairn, *c* 2.5 x 1.5m.

B226
SD 52118 48534
A clearance cairn, *c* 3 x 1.5m.

B227
SD 52113 48518
A clearance cairn, *c* 2.5m in diameter.

B228
SD 52115 48512
A clearance cairn, *c* 3m in diameter.

B229
SD 52123 48512
A clearance cairn, *c* 2m in diameter.

B230
SD 52125 48515
A clearance cairn, *c* 4m in diameter.

B231
SD 52133 48514
A clearance cairn, *c* 4m in diameter.

B232
SD 52140 48515
A clearance cairn, *c* 2.5m in diameter.

B233
SD 52066 48577
A clearance cairn, *c* 6.5m in diameter.

B234
SD 52080 48588
A clearance cairn, *c* 3.5m in diameter.

B235
SD 52086 48580
A clearance cairn, *c* 2.7m in diameter.

B236
SD 52104 48580
A clearance cairn, *c* 2m in diameter.

B237
SD 52092 48570
A clearance cairn, *c* 2m in diameter.

B238
SD 52084 48568
A clearance cairn, *c* 2.5m in diameter.

B239
SD 51901 48634
A clearance cairn, *c* 3.7m in diameter.

B240
SD 51924 48635
A clearance cairn, *c* 3.5m in diameter.

B241
SD 51963 48623
A clearance cairn, *c* 3.4m in diameter.

B242
SD 51958 48629
A clearance cairn, *c* 3m in diameter.

B243
SD 51956 48635
A clearance cairn, *c* 3m in diameter.

B244
SD 5201 48612
A clearance cairn, *c* 4m in diameter.

B245
SD 51998 48620
A clearance cairn, *c* 3.5m in diameter.

B246
SD 51979 48629
A clearance cairn, *c* 4m in diameter.

B247
SD 51962 48648
A clearance cairn, *c* 3.8m in diameter.

B248
SD 51930 48663
A clearance cairn, *c* 3m in diameter.

B249
SD 51954 48673
A clearance cairn, *c* 2.5m in diameter.

B250
SD 51967 48673
A clearance cairn, *c* 3m in diameter.

B251
SD 52000 48662
A clearance cairn, *c* 4.5m in diameter.

B252
SD 52036 48665
A clearance cairn, *c* 5.5m in diameter.

B253
SD 52064 48687
A clearance cairn, *c* 4m in diameter.

B254
SD 52064 48606
A clearance cairn, *c* 3.5m in diameter.

B255
SD 52125 48672
A clearance cairn, *c* 4m in diameter.

B256
SD 52141 48668
A clearance cairn, *c* 4m in diameter.

B257
SD 52139 48643
A clearance cairn, *c* 2.5m in diameter, with a 1m-wide hole in centre where it appears that stones have been removed.

B258
SD 52172 48638
A clearance cairn, *c* 3.5m in diameter.

B259
SD 52176 48632
A clearance cairn, *c* 4m in diameter.

B260
SD 52196 48621
A clearance cairn, *c* 2.5m in diameter.

B261
SD 52157 48607
A clearance cairn, *c* 3m in diameter.

B262
SD 52152 48608
A clearance cairn, *c* 3m in diameter.

B263
SD 52138 48618
A clearance cairn, *c* 4.5m in diameter.

B264
SD 52119 48606
A clearance cairn, *c* 3m in diameter.

B265
SD 52021 48729
A clearance cairn, *c* 3m in diameter.

B266
SD 52047 48761
A clearance cairn, *c* 3.5m in diameter.

B267
SD 52044 48770
A clearance cairn, *c* 4m in diameter.

B268
SD 52067 48758
A clearance cairn, *c* 7m by 3m, ‘kidney’-shaped.

B269
SD 52089 48768
A clearance cairn, *c* 5m in diameter.

B270
SD 52083 48753
A clearance cairn, *c* 3.5m in diameter.

B271
SD 52090 48751
A clearance cairn, *c* 3m in diameter.

B272
SD 52564 48817
A clearance cairn, *c* 3.6m in diameter.

B273
SD 52563 48698
A small enclosure, with entrances at east and west, formed by two low, curving banks encompassing an area *c* 12m in diameter.

B274
SD 51943 48466
Large area of quarrying, *c* 180 x 40m, on the top and southern side of Nicky Nook.

B275
SD 51855 48550
A quarry measuring approximately 15 x 15m.

B276
SD 52405 48660
A clearance cairn, *c* 4m in diameter.

B277
SD 52393 48670
A clearance cairn, *c* 3m in diameter.

B278
SD 52302 48750
A clearance cairn, *c* 5m in diameter.

B279
SD 52345 48686
A cairn, *c* 4m in diameter, possibly from clearance, but its position suggests a burial cairn.

B280
SD 52353 48681
A cairn, *c* 7m in diameter, possibly from clearance, but its position suggests a burial cairn.

B281
SD 51953 48569
An area of quarrying *c* 33 x 13m.

B282
SD 53000 49000
An area of ridge and furrow in fields on hill overlooking Fell End Farm.

B283
SD 53105 48948
A large clearance cairn located against a field boundary, within an area of ridge and furrow. The cairn is *c* 8m in diameter; its position against a current field boundary within an area of ridge and furrow suggests a medieval or post-medieval origin.

APPENDIX 9: GAZETTEER OF SITES ON ANGLEZARKE MOOR

In the following gazetteer, each site appears with, on separate lines, its reference number, and its grid reference (Fig 62-3), followed by the description). At the outset of the survey, a batch of unique site numbers was allocated to each study area to ensure there was no overlap (the Langdale Fells - 1-99; Anglezarke Moor – 100-35; the South-West Fells - 136-215; the Forest of Bowland - 216-90). In addition, each was provided with a suffix to clarify the study area (Langdale -L; Anglezarke – A; South-West Fells - SW; Forest of Bowland – B). The number sequence is not continuous, reflecting the fact that some initial site numbers were either amalgamated into single sites or they were reinterpreted as having a natural origin.

A103
SD 63371 17644
The distal end of a broken flint blade. It comprised heavily-patinated, mottled grey flint with white inclusions. It was found in a large area of scarring near Rushy Brow.

A104
SD 63420 17597
A rectangular stone-built structure measuring *c* 4 x 6m, aligned north/south. The walls were *c* 0.5m thick. A large pile of rubble was located at the northern end of the structure. The structure appeared to have been built on top of the peat.

A105
SD 62946 18051
A small clearance cairn *c* 1.5m diameter.

A106
SD 62840 17836
A small cluster of stones in a ring *c* 1m in diameter. It may be the remains of a disturbed clearance cairn, but it is lying on the peat and may be the remains of a relatively recent campfire.

A107
SD 62564 17477
Two sides of a crudely-built stone structure. Only one course of stone was visible, lying directly on the mineral soil. The structure was 3.3m long and 1.5m wide, aligned east/west.

A108
SD 62566 17563
A small clearance cairn *c* 2m diameter, lying on top of the peat. Stones had been removed from the centre of the pile.

A109
SD 62653 17623
The findspot of a single black chert spall.

A111
SD 62574 17606
A scatter of 14 flint spalls, all less than 9mm in length, found within an area of 1.5 x 1.5m. Five of the pieces had been burned, one being a chip off a hammer-stone, and one had some re-touch present, but appeared to have broken off a larger piece, and one is a spall resulting from pressure flaking.

A120
SD 64341 18230
A flake of heavily-patinated grey flint.

A121
SD 61994 17640
A possible small clearance cairn, 1.5m diameter.

A123
SD 61964 17980
A clearance cairn, *c* 4m in diameter, with stones in the centre that were smaller than those around the edges.

A124
SD 61959 18050
A dubious cairn which was possibly disturbed, measuring 6 x 4m.

A125
SD 62024 18085
A small clearance cairn *c* 3m in diameter. It was poorly defined.

A126
SD 62009 18080
Two small piles of stones, each approximately 1 x 0.5m, with a 1.3m gap between the two. It was possibly a disturbed clearance cairn.

A127
SD 61990 18086
A small clearance cairn *c* 3m in diameter. It was poorly defined.

A128
SD 62020 18250
A possible clearance cairn standing *c* 0.5m high and 2.5m in diameter.

A129
SD 62020 18279
A possible clearance cairn, only 1m in diameter.

A130
SD 62679 18052
Three pieces of heavily-patinated, grey-brown flint with white inclusions. All would appear to have been sourced from river gravel. All three show some signs of being used as hammer-stones.

A131
SD 64872 19161
A rectangular structure, measuring *c* 10 x 20m, with one internal division. The walls stand to a height of 1m in places though most are grassed over. Some possible terracing can be seen to the north of the structure.

A132
SD 65006 17773
A small piece of heavily-patinated, grey flint, which was broken off a larger core; it is very crudely worked.

APPENDIX 10: RADIOCARBON DATING

by Peter Marshall, Denise Druce and Gordon Cook

A10.1 INTRODUCTION

A10.1.1 In total, 34 radiocarbon measurements have been obtained on samples from the four areas investigated as part of the Uplands Peats Project. Of these, 20 measurements pre-dated the initiation of the present project and were obtained as part of palaeoenvironmental work connected to other projects; they serve to improve an understanding of landscape and vegetational history at two of the sites that were investigated by the present project (the Langdale Fells and Anglezarke Moor).

A10.2 METHODS

A10.2.1 Fourteen samples were dated at the Scottish Universities Research and Reactor Centre (SURRC) in East Kilbride in 2004–5. They were measured by Accelerator Mass Spectrometry (AMS) at the Scottish Universities Environment Research Centre AMS Facility, with sample preparation and measurement as outlined in Slota *et al* (1987) and Freeman *et al* (2004).

A10.2.2 Sixteen peat samples were measured at AERE Harwell in 1984–5. They were pre-treated as described by Mook and Waterbolk (1985) (whole peat fraction), combusted to carbon dioxide, and synthesised to benzene using methods similar to those initially described by Tamers (1965) and a vanadium-based catalyst (Otlet 1977). Radiocarbon content was measured using liquid scintillation counting as described by Otlet (1979).

A10.2.3 Three peat samples were dated at the University of Birmingham, using a methane proportional counter (Shotton *et al* 1967) following an alkali pretreatment as outlined by Shotton *et al* 1969. A single sample of wood (*Betula* fragment) was also dated, at the National Physics Laboratory, Teddington, in 1964. The sample was prepared according to methods outlined by Callow *et al* (1963) and measured by gas proportional counting (carbon dioxide).

A10.2.4 ***Radiocarbon Dating:*** the radiocarbon results (Tables16-18) and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986). They are conventional radiocarbon ages (Stuiver and Polach 1977).

A10.2 5 ***Calibration:*** the radiocarbon determinations have been calibrated with data from Stuiver et al (1998), using OxCal (v3.5) (Bronk Ramsey 1995; 1998). The date ranges have been calculated according to the maximum intercept method (Stuiver and Reimer 1986), and are cited in the text at two sigma (95% confidence). They are quoted in the form recommended by Mook (1986), with the end points rounded outwards to 10 years. The probability distributions (Figs 85 and 86) are derived from the usual probability method (Stuiver and Reimer 1993).

A10.2.6 ***Objectives of the radiocarbon dating programme:*** the overall aims of the dating programme were to:

- date peat initiation

- date significant 'anthropogenic events' in the pollen record
- date the top of truncated peat profiles to provide an estimate of the extent of peat loss.

A10.2.7 ***Sampling:*** samples were taken in the field using a Russian auger or monolith tin and were sub-sampled in the laboratory to provide enough material for radiometric analysis of the 'humic' and 'humin' fractions. The original intention of the sampling programme was to obtain radiometric measurements on both peat fractions. However, after pre-treatment, only the 'humic' acid samples were found to be large enough for radiometric analysis. The 'humin' samples were very small, many of them being only a few grams in weight and low in carbon content (being mostly sand with a very small organic component). Given the potential for obtaining inaccurate results from 'humin' fractions of such size, it was decided to proceed only with analysis of the 'humic' fraction: all the results reported here therefore came from AMS measurements made on the 'humic fraction'. As all the sites are located in 'acid' upland environments, and the samples consisted of well-humified peat, the dates from the 'humic' fraction should be reliable (Shore 1988), since downwards migration of humic acids, as is often the case in alkaline conditions (Dresser 1970) is considered unlikely.

A10.2.8 AMS measurements on small-size peat samples can give inaccurate results because of the lack of homogeneity in the samples. However, in this case, as the whole 'humic' sample from large samples (*c* 100g) was processed, it is believed that this should not be a problem.

A10.3 SOUTH-WEST FELLS

A10.3.1 Three sites from the South-West Fells, in Cumbria, were sampled to date peat inception. Sampling Site 1 (NGR SD 13741 95509; 152.79m AOD) was situated in a small valley bounded to the east by the high ridges of Hesk Fell (Fig 35). The site was waterlogged, being adjacent to a small stream. Approximately 1m of peat had developed in the bottom of the valley, which was encroaching upslope and in places covered archaeological sites. Peat inception on this lowest plateau is dated to 3360–3020 cal BC (4490±40 BP; SUERC-4423).

A10.3.2 Sampling Site 2 (NGR SD 14655 95410; 307.08m AOD) was situated on a relatively flat plateau bounded on the north by the steep crags of White Pike and on the south by the peak of the Knott (Fig 35). The site was one of two shallow basins separated by a ridge of slightly higher land, where up to 1m of peat had developed in places. A date for peat inception of 3370–3090 cal BC (4530±35BP; SUERC-4424) was provided by a sample from a depth of 0.98–1.0m.

A10.3.3 Sampling Site 3 (NGR SD 16321 95153; 402.67m AOD) was positioned in the trough of gently sloping land between the two peaks of Wooded Height and Hesk Fell (Fig 35). The area was covered by blanket peat up to 2m deep in places. Occasionally, bedrock was exposed by a combination of drainage erosion and peat cutting. Sampling Site 3 consisted of a face exposed by peat cutting. Peat inception there is dated to 1920–1680 cal BC (3480±40 BP; SUERC-4522).

A10.3.4 ***Results:*** the results from the South-West Fells (Fig 85) suggest that the date of peat inception was strongly influenced by the local topography, and was not just a function of altitude, given that the youngest date came from the highest site.

A10.4 THE LANGDALE FELLS

A10.4.1 Three sites from the Langdale Fells were sampled in 2004 to provide material for dating peat inception. Sampling Site 1 (NGR NY 27434 07469; 660.72m AOD) was in an area of deep peat situated on a plateau on the slopes below Pike of Stickle on Langdale Fell (Fig 46). The peat had been eroded in places down to bedrock, probably by fluvial action, leaving peat haggs up to 2m deep in places. The date of peat inception, 2140–1830 cal BC (3620±40 BP; SUERC-4516), came from the southern end of the study area, where the peat is deepest.

A10.4.2 Sampling Site 2 (NGR NY 27837 09020; 675.28m AOD) was placed at the northern end of the study area, where the shallowest peat deposits were recorded (Fig 46). The site was on a relatively gentle slope that became much steeper to the west. Much of the peat appeared to have been eroded by fluvial action and the single sample was taken from an eroded edge of peat, *c* 1.0m deep. Peat inception is dated to 1380–1050 cal BC (2980±35 BP; SUERC-4517).

A10.4.3 Sampling Site 4 (NGR NY 27560 07370; 659.31m AOD) was in an area of peat situated on a small plateau on the slopes below Pike of Stickle on Langdale Fell (Fig 46). The site was relatively flat and adjacent to an axe-working floor. Peat inception is dated to 2470–2200 cal BC (3865±35 BP; SUERC-4521).

A10.4.4 A single sample from Red Tarn Moss (Table 17) has also been measured to provide a date for peat initiation, as part of work on the environmental history of tarns of the central Lake District (Pennington 1970; Haworth *et al* 2003)

A10.4.5 ***Results:*** peat inception in the Langdale Fells started at some time in the late third millennium cal BC (Fig 85). The results also suggest that peat development may have been influenced by altitude, with the higher parts of the study area only beginning to gain peat cover in the late second millennium cal BC.

A10.5 FOREST OF BOWLAND

A10.5.1 Samples from three sites were submitted to provide dates for peat initiation and, at the most intact site, the top of the peat was also dated. Sampling Site 1 (NGR SD 57642 50853; 448.82m AOD), in the central part of the peatlands, known as White Moss, was placed in a slight basin surrounded by gentle slopes (Fig 55). The nature of the terrain means that there is a tendency for the site to become waterlogged, and hence over 2m of blanket peat has developed in the area. At the time of the survey, however, fluvial action appeared to be actively eroding large areas of the peat body. The two samples (SUERC-4504–5) came from the top and base of what was thought to be the best-preserved area of peat (in comparison to those from the periphery, Sampling Sites 2 and 3). SUERC-4505 (5720–5550 cal BC; 6720±35 BP) dates peat inception and SUERC-4504 (490–380 cal BC (2350±35 BP) the top of the surviving peat in this area.

A10.5.2 Sampling Site 2 (NGR SD 55686 49901; 392.35m AOD) was situated on a spur of gently sloping ground on Stake House Fell (Fig 55). Much of the area near the site has undergone considerable erosion in the past, and at the time of the survey fluvial action appeared to be removing the bulk of the remaining peat. The single sample provided a date for peat inception of 3520–3350 cal BC (4645±35 BP; SUERC-4506).

A10.5.3 Sampling Site 3 (NGR SD 54993 49415; 350.62m AOD) was situated on an area of sloping ground on the periphery of the Forest of Bowland near Stake House Farm (Fig 55). The area has undergone considerable erosion in the past and was covered with peat haggs *c* 0.5m deep. Bare ground was visible in large areas between the peat haggs. The single sample from this site provides a date for peat inception of 760–380 cal BC (2365±40 BP; SUERC-4507).

A10.5.4 ***Results:*** peat inception on the Forest of Bowland has a broad span that extends between the Mesolithic period and the Iron Age and follows a fairly steady development with the earliest inception on the highest ground, and the latest on the lower ground. The results (Fig 86) clearly illustrate the major differences in the date of peat initiation across the central part of the Forest of Bowland, and more surprisingly suggested that over 2000 years of peat accumulation had been lost from the central part of the peatlands. This might indicate the importance of summit-type erosion that occurs in peat on higher, flatter ground (Mackay and Tallis 1996), and which was also found at Fairsnape Fell (Mackay and Tallis 1994b), on the western slopes of the Forest of Bowland.

A10.6 ANGLEZARKE MOOR

A10.6.1 The four samples submitted in 2004 came from two sites. Sampling Site 1 (NGR SD 64659 18318; 342.27m AOD) was situated in the central part of Anglezarke Moor, where the blanket peat reaches depths of up to 3m (Fig 64). Sampling Site 1 was a 2m-section of peat exposed in a tributary stream of a main channel that runs adjacent to the plateau of Black Hill. The two peat samples (SUERC-4511–2) came from near the base and top of the peat deposit. SUERC-4512 provided a date of 3800–3650 cal BC (4945±35 BP) for peat inception in the central part of the Anglezarke moorland, while SUERC-4511 provided a date of cal AD 1060–1280 (845±35 BP) for near the top of the peat profile.

A10.6.2 Sampling Site 2 (NGR SD 63084 17990; 316.95m AOD) was situated on the edge of the central plateau near Hurst Hill (Fig 64). The area is relatively flat but has been subjected to a number of threats, including fire. The two peat samples (SUERC-4514–5) came from near the base and top of the peat layer. SUERC-4515 (2200–1940 cal BC; 3685±35 BP) provided a date for peat inception on the edge of the central plateau, while SUERC-4514 (cal AD 1630–1950; 210±40 BP) provided a date for near the top of the peat profile.

A10.6.3 A further 19 dates were obtained from Anglezarke in 1984–5 in support of palaeoenvironmental work undertaken by Bain (1991), 16 of which were funded by English Heritage (Table 18).

A10.6.4 ***Results:*** three radiocarbon measurements from the central plateau of Anglezarke Moor provided dates for the start of peat initiation (Fig 86). These results suggest peat initiation started in the late fourth millennium cal BC on the highest part of the plateau and then spread outwards. A further three dates (Fig 86) show that peat initiation away from the central plateau took place considerably later, starting in the first half of the third millennium cal BC.

A10.6.5 The three dates obtained from the top of peat profiles on the edge of the Anglezarke plateau (Fig 86) all show the limited extent of the surface erosion of the peat in this part of the moorland. This can be compared to the central part of the plateau where the radiocarbon results suggest that a considerable amount of the more recent peat has been lost.

A10.7 CONCLUSIONS

A10.7.1 The radiocarbon results have provided dates for peat initiation at all four sites investigated as part of the Upland Peats Project. Chronological variations in the start of peat growth at both site and intra-site level are probably related to a complex range of topographical and environmental mechanisms. Although some significant 'anthropogenic' events have been identified in the pollen records from all four sites, none has been scientifically dated, given the time constraints of the project. However, if further work is undertaken, then such dating should be considered. Dated, truncated profiles from Anglezarke Moor and the Forest of Bowland suggest that variable amounts of peat loss have occurred.

Laboratory number	Context and material	Height of samples (m) AOD	Radio-carbon age (BP)	δ13 C (‰)	Calibrated date range (95% confidence)
South-West Fells					
SUERC-4423	Sampling Site 1, 0.78–0.80m, peat, humic acid fraction	152.01–151.99	4490±40	-29.4	3360–3020 cal BC
SUERC-4524	Sampling Site 2, 0.98–1.00m, peat, humic acid fraction	306.1–306.08	4530±35	-30.5	3370–3090 cal BC
SUERC-4522	Sampling Site 3, 0.85–0.87m, peat, humic acid fraction	401.82–401.8	3480±40	-28.0	1920–1680 cal BC
Langdale Fells					
SUERC-4521	Sampling Site 4, 1.45–1.47m, peat, humic acid fraction	657.86–657.84	3865±35	-28.5	2470–2200 cal BC
SUERC-4517	Sampling Site 2, 1.00–1.02m, peat, humic acid fraction	674.28–674.26	2980±35	-28.2	1380–1050 cal BC

SUERC-4516	Sampling Site 1, 1.45–1.47m, peat, humic acid fraction	659.27–659.25	3620±40	-27.9	2140–1830 cal BC
Forest of Bowland					
SUERC-4504	Sampling Site 1, 0.01–0.03m, peat, humic acid fraction	448.81–448.79	2350±35	-28.2	490–380 cal BC
SUERC-4505	Sampling Site 1, 1.935–1.955m, peat, humic acid fraction	446.885–446.865	6720±35	-27.8	5720–5550 cal BC
SUERC-4506	Sampling Site 2, 0.795–0.815m, peat, humic acid fraction	391.555–391.535	4645±35	-28.8	3520–3350 cal BC
SUERC-4507	Sampling Site 3, 0.49–0.51m, peat, humic acid fraction	350.13–350.11	2365±40	-29.1	760–380 cal BC
Anglezarke Moor					
SUERC-4511	Sampling Site 1, 0.125–0.145m, peat, humic acid fraction	342.145–342.125	845±35	-28.1	cal AD 1060–1280
SUERC-4512	Sampling Site 1, 2.31–2.33m, peat, humic acid fraction	339.96–339.94	4945±35	-28.7	3800–3650 cal BC
SUERC-4514	Sampling Site 2, 0.07–0.09m, peat, humic acid fraction	316.88–316.86	210±40	-29.7	cal AD 1630–1950
SUERC-4515	Sampling Site 2, 0.41–0.43m, peat, humic acid fraction	316.46–316.44	3685±35	-29.0	2200–1940 cal BC

Table 16 Radiocarbon results from Upland Peats Project (2004–5)

Laboratory number	**Context and material**	**Radio-carbon age (BP)**	**δ13C (‰)**	**Calibrated date range (95% confidence)**
NPL-122	*Betula* fragment	3890±90	-25.0	2620–2040 cal BC

Table 17 Radiocarbon result previously gained from Red Tarn Moss, Great Langdale

Laboratory number	**Context and material**	**Radio-carbon age (BP)**	**δ13C (‰)**	**Calibrated date range (95% confidence)**
Winter Hill				
HAR-6419	Well-humified *Eriophorum-Calluna* peat, 0.70–0.75m	1890±80	-28.2	50 cal BC – cal AD 340
HAR-6206	Highly humified amorphous peat, 1.17–1.20m	2940±70	-29.4	1390–920 cal BC
Birm-1162	Highly humified amorphous peat, 1.35–1.39m	3750±80	-29.4	2460–1920 cal BC
Pikestones				
HAR-6424	Well-humified monocotyledonous peat, 0.20–0.24m	540±70	-28.7	cal AD 290–1480
HAR-6209	Highly humified amorphous peat, 0.40–0.45m	1710±70	-29.4	cal AD 130–540
Pikestone Ploughings				
HAR-6208	*Sphagnum*-monocotyledonous peat, 0.35–0.37m	310±80	-29.6	cal AD 1430–1950
Black Brook				
HAR-6421	Moderately humified *Eriophorum-Calluna* peat, 0.50–0.55m	1110±70	-27.5	cal AD 720–1030
HAR-6420	Well-humified *Eriophorum-Calluna* peat, 1.05–1.10m	1840±70	-28.9	cal AD 20–390
HAR-6210	Highly humified amorphous peat, 2.20–2.24m	4740±70	-29.1	3660–3360 cal BC
HAR-6207	Mor humus organic soil, 2.42–2.46m	5660±80	-29.6	4710–4340 cal BC
Mineral Horizon				
HAR-6423	Highly humified monocotyledonous *Sphagnum* peat, 0.64–0.67m	710±80	-28.6	cal AD 1160–1410
HAR-6422	Highly humified monocotyledonous *Sphagnum* peat, 0.97–1.00m	260±80	-28.3	cal AD 1440–1950
Round Loaf				
HAR-6418	Well-humified monocotyledonous peat, 0.10–0.15m	650±80	-28.6	cal AD 1220–1440
HAR-6416	Moderately humified *Calluna-Eriophorum* peat, 0.30–0.35m	1270±70	-28.7	cal AD 640–960
HAR-6211	Well-humified *Calluna-Eriophorum* peat, 0.50–0.55m	1550±70	-28.9	cal AD 350–650
HAR-6212	Well-humified *Calluna-Eriophorum* peat, 0.60–0.65m	1710±70	-28.2	cal AD 130–540
HAR-6417	Highly humified *Eriophorum* peat, 0.99–1.03m	2570±110	-28.6	970–390 cal BC

Birm-1161	Highly humified peat with *Betula* fragments, 1.51–1.56m	3880±70	-25.0	2570–2140 cal BC
Birm-1160	Highly humified mor humus with *Betula* fragments, 1.77–1.815	4630±75	-25.0	3640–3100 cal BC

Table 18 Radiocarbon results previously gained from Anglezarke Moor

