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ALSTON MOOR MINER-FARMER LANDSCAPE
PALAEOENVIRONMENTAL ASSESSMENT

ENVIRONMENTAL STUDIES REPORT

Jacqui Huntley

ARCHAEOLOGICAL
SCIENCE

ENGLISH HERITAGE

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Alston Moor Miner-Farmer landscape: palaeoenvironmental assessment

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SUMMARY

A literature search produced over 100 pollen sites lying within the North Pennines Area of Outstanding Natural Beauty although only 10 had absolute dates. Of the total only three lay within the core Alston miner-farmer project area with a further three in the old Alston Manor. Many of the previous palaeoenvironmental investigations were designed to answer questions about broad-scale vegetational changes through the Holocene and, as a result, are largely unsuitable to address details concerning farming or mining activity in relation to any one mine. Although the broad conclusion is that almost any pollen work within the project's core area could produce useful information it is suggested that effort be concentrated in a few areas. One is at Valley Bog where there is already a reasonable amount of understanding of the sedimentary sequences and effort could quickly 'home-in' on key depths. Others are in relation to the Mounthooly and Nenthead mines, while a fourth site with potential is Whitley Castle. Work in the former three areas should attempt to find several small basins/mires in order to investigate spatial, as well as temporal, patterns. Given the history of mining in the area it is also recommended that associated geochemical analyses are undertaken.

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ARCHIVE LOCATION

The archive will be deposited at the NMR

DATE OF RESEARCH

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COVER PHOTO Miner farmer landscape – Teesdale

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BACKGROUND TO THE MINER-FARMER PROJECT

In 2008, English Heritage's Research Department (now part of the Heritage Protection Department) initiated a five-year project called 'Miner-Farmer Landscapes of the North Pennines Area of Outstanding Natural Beauty (AONB)' (Ainsworth 2008). This multidisciplinary landscape investigation is intended primarily to investigate the interwoven influences of historic industry and farming on the development of the landscape and settlement pattern of the AONB. The findings will inform the conservation, protection and management not just of the historic environment, but also of the so-called 'natural' environment, which has been widely, profoundly, and in many places obviously, shaped by past human activity. The project is being undertaken in partnership with the North Pennines AONB Staff Unit, the Environment Agency, Natural England and the North Pennines Heritage Trust and brings together, through a modular programme of research described below, contributions from all the partner organisations, from several specialist teams within English Heritage's Research Department, and from a number of contractors. Main funding has been provided by English Heritage's Historic Environment Enabling Programme (HEEP), now National Heritage Protection Commissions Programme (NHPCP).

At almost 2000 square kilometres, the AONB, which was designated as such in 1988, is the second largest in England and Wales, spanning parts of the counties of Cumbria, Northumberland and Durham. In 2003, the AONB was awarded European Geopark status, a UNESCO designation for areas with world-class geological heritage, making it Britain's first protected landscape with this status and also a founding member of the UNESCO Global Parks Network. The research concentrates on a core sample area in and around Alston Moor, a remote upland massif lying between the confluence of the Rivers Nent and North Tyne. In geological terms, the so-called 'Alston Block' is particularly complex, formed by alternating bands of limestone, sandstone and shales, within which are seams of coal, lead, iron and other minerals. As elsewhere in the AONB, all these resources have been intensively exploited for hundreds, if not thousands, of years, leaving a rich and diverse legacy of industrial remains.

The Miner-Farmer project contributes to the 2004 *Statement of Joint Accord* between English Heritage and the National Association of AONBs, which pledged the organisations to work together to further the understanding, conservation, enhancement and public enjoyment of the historic environment within these 'protected landscapes' (see also the EH Research Agenda (English Heritage 2005)). With potential to deliver methodological models for holistic landscape research which will inform a range of national conservation, protection, management and research agendas for the wider environment, but especially for upland and industrial (particularly lead mining) landscapes, the project responds to key national themes and priorities identified for research (English Heritage ibid.). It also addresses gaps in knowledge identified in the *Regional Research Frameworks* for the North-East Petts and Gerrard (2006) and the North-West (Brennand 2006) and *The North Pennines Lead Industry: Key sites and proposals for action* (North Pennines Partnership 1998). It meshes well with the Peatscapes project, (in its final stages at the start of the Miner–Farmer Landscapes project), which is examining peat primarily as a natural resource (in other words, disregarding its historic use as a form of domestic and industrial fuel) and dealing issues such as the damaging artificial drainage of blanket bogs (North Pennines AONB Partnership 2011). Both projects contribute to the objectives of the AONB's own management plan for the period 2009-14 (North Pennines AONB 2009), many of which correspond closely to English Heritage's (2005) *Research Agenda*. The extent to which industrial activity has contributed to both the creation and destruction of the wider historic environment through time has been poorly understood. Previous recording of these landscapes has been too often restricted to individual buildings and/or archaeological sites with little regard to the overall development of the landscape and the historical, archaeological and architectural context within which the different elements reside. Nor has there been any systematic evaluation of threats that are pertinent to these landscapes to inform long-term conservation and management.

The Miner-Farmer project consists of the following modules:

Module 1: Desk-based aerial survey of 234 square km as part of the National Mapping Programme being undertaken by the English Heritage Aerial Survey and Investigation team (Heritage Protection Department).

Module 2.1: Supply of aerial imagery, including lidar, RGB full spectrum and infrared orthophotography, and hyperspectral data. Contract awarded to Infoterra Ltd. Funded by Historic Environment Enabling Programme (NHPCP 5330), Peatscapes Project (AONB), and Living North Pennines Project (AONB).

Module 2.2: Archaeological ground survey of 32 square km of the core sample area by the English Heritage English Heritage Archaeological Survey and Investigation team (Heritage Protection Department).

Module 2.3: Capacity-building: archaeological ground survey of 18 square km of the core sample area to be surveyed under contract by North Pennines Archaeology Limited. Funded by the Funded by Historic Environment Enabling Programme (NHPCP 6072).

Module 2.4: Applications of remote-sensing: research, in collaboration with VISTA Spatial and Technology Unit at Birmingham University, into the identification of moorland industrial activity and the relationship with the natural environment and erosion, including gathering of environmental data. Funded by the Funded by Historic Environment Enabling Programme (NHPCP 5761)

Module 2.5: Landscape characterisation study of farmstead types by the English Heritage Historic Landscape Characterisation team (Heritage Protection Department).

Module 2.6: Study of the built environment within the project area by the English Heritage Architectural Survey and Investigation team (Heritage Protection Department).

Module 2.7: Study of the consequences of mineral procurement, environmental impact and pollution by the English Heritage Archaeological Science team (Heritage Protection Department).

Module 3: Targeted ground survey by the English Heritage Archaeological Survey and Investigation team (Heritage Protection Department).

Module 4: Targeted geophysical survey by the English Heritage Archaeological Science team (Heritage Protection Department).

Module 5: Publication of results.

This report results from work undertaken as part of Module 2.7 and also forms part of Module 5.

AIMS AND OBJECTIVES OF THE PALAEOENVIRONMENTAL ASSESSMENT

The aims of the palaeoenvironmental assessment are to determine the extent of our knowledge of past landscape use in the north Pennines and to discuss the potential for new work in relation to the overall Alston Miner Farmer project.

The objectives are to review existing pollen diagrams and produce a layer for inclusion in the project's GIS, to summarise the vegetation changes at different periods of time and to recommend areas where further work would be feasible

BACKGROUND

Many proxy datasets can provide information about past vegetation and landscapes but the most common and widespread technique is that of pollen analysis in association with an independent means of dating deposits, notably radiocarbon. The present project lies within an area that has had a long history of pollen work being undertaken although many of the pollen diagrams are not dated *per se* but rely upon comparison with other diagrams from elsewhere within the country for their dating. In addition, many projects were aimed at understanding large-scale, changes in vegetation over long time periods – often for the whole of the Holocene. Temporal resolution of such diagrams can therefore be quite limited since, at best, a few tens of levels were analysed. In addition, at least some cores are lacking in peats representing the last few thousand years – perhaps as a result of peat cutting – or the pollen in them is not well preserved as a result of peat drying and humifying. A further limitation is that many of the diagrams were produced from cores taken in large mires or areas of blanket peats and thus the pollen is representative of many hectares – a regional scale. If the effect of humans, for example extent and nature of arable agriculture, on a few hectares and over short periods of time are to be studied then small mires or basins are needed as they retain pollen principally from only a few hundreds of metres around them. The catchment area of the pollen, which will vary through time depending upon the degree of woodland around a site (Jacobson and Bradshaw 1981), should always be considered in interpretation and, especially, when questions are being formulated at the start of any project.

In terms of agriculture there have been many attempts to define a suite of pollen taxa representative of either arable or pastoral agriculture – see for example Turner (1979), Fenton-Thomas (1992), and Pratt (1996). Obviously the clearest evidence of arable agriculture is the presence of cereal type pollen grains. Problems here reflect the fact that most cereals are cleistogamous (self pollination occurs in the non-opening flower) and the pollen grains themselves are large and heavy (Dimbleby 1965, 37). Therefore their pollen is not dispersed especially far and as most pollen diagrams are produced from cores taken in the centre of large mires or lakes the chance of cereal pollen reaching them is low. Thus even very low values of cereal type pollen could well indicate local cultivation. Cereal type pollen is defined as large grains of Gramineae (Poaceae) with large and well-defined annuli around the single pore. As such three categories are recorded with only *Secale* (rye) being identifiable to species. *Triticum*/*Avena* (wheat/oats) are generally defined as grains more than 40 microns diameter with >10 micron annulus around the pore whilst *Hordeum*-type (barley-type) are 32-45 microns with an 8-10 micron annulus (Andersen,1978). Barley-type grains also include those of large wild grasses such as *Glyceria* etc, themselves often characteristic of mires and wetlands thus quite likely to be present in the assemblage. Most of the older diagrams, however, make no attempt at divisions beyond 'cereal-type'.

The presence of *Plantago lanceolata* pollen is often taken as representing clearance for pasture following work by Iversen (1941) in Denmark. Oldfield (1960) challenged this suggesting that at least some of it would have been part of the natural succession of erosion events resulting from storms and flooding. It is therefore suggested that using the occurrences of several pollen types from arable weeds might lead to a better interpretation.

However, despite the wide variety of issues, pollen has been, and remains, the main proxy dataset by which we infer past vegetation.

Traditionally pollen diagrams are zoned – periods of time over which the pollen assemblages are relatively constant. The zone boundaries are where significant changes occur, for example the rise in alder pollen – the Alder Rise or the fall in elm pollen – the Elm Decline. Whilst these are likely to occur at approximately the same time they are not absolutely synchronous and onset can vary by some centuries. If, as in the Alston Miner Farmer project, one topic being investigated only covers 2-3 centuries in the first place – for example, the major lead industry – then lack of independent dates is a problem. Diagrams are still zoned in the same way today but the zone boundaries are usually then radiocarbon dated. A final limitation therefore is that of absolute dating. Many diagrams pre-date the routine use of radiometric dating methods and thus their chronology derives from comparison with other, hopefully reasonably local, radiocarbon dated diagrams. Whilst this is not necessarily a critical issue for major changes in the vegetation, such as the Alder Rise, it can lead to uncertain and/or poor resolution of local changes due to, for example, changes in agricultural practice in a specific valley or industrial activity in some moorland areas.

METHODOLOGY

To determine the extent and nature of pollen work within the Alston Moor area a literature search of academic journals and books was undertaken using Web of Knowledge. The searches used key words such as pollen, palynology, vegetation history with the counties Westmorland, Cumberland, Cumbria, Lancashire, Yorkshire, Durham, Northumberland and geographical areas northern England and Pennines. Discussions with colleagues produced some doctoral or Master's level theses although the latter rarely included dated sequences. By far the majority of the work was in relation to "vegetation history" questions rather than specific archaeological ones and thus the issue of 'grey literature', i.e. reports that would be kept in the county Historic Environment Records offices, fortunately did not arise to any great extent. Wherever possible the original papers were read although, in a few instances, only the abstracts were easily available. Basic information such as geographical locality of site, whether absolute dating was undertaken and bibliographic information was extracted into a simple Access database and then imported to ArcGIS9 for spatial display. Data from other pollen sites were already available in the author's northern database and hence the record numbers in this report are taken from that and therefore not necessarily sequential.

DATA RESULTS AND SUMMARY

Figure 1 presents the records of the individual cores taken from within the North Pennines AONB where it can be seen that there are more than 100 diagrams although only 10 are scientifically dated. Table 1, at the end of this report, presents the details of the sites. Within the Alston Moor core project area itself there are, however, only five diagrams in total from three sites and none of which is dated using absolute techniques. These include core 83:Kilhope Law 1 (Turner and Hodgson 1979), 202:Kilhope Moor (Raistrick and Blackburn 1932) and 87 and 88:Knoutberry1 and 2 (Turner and Hodgson 1983).

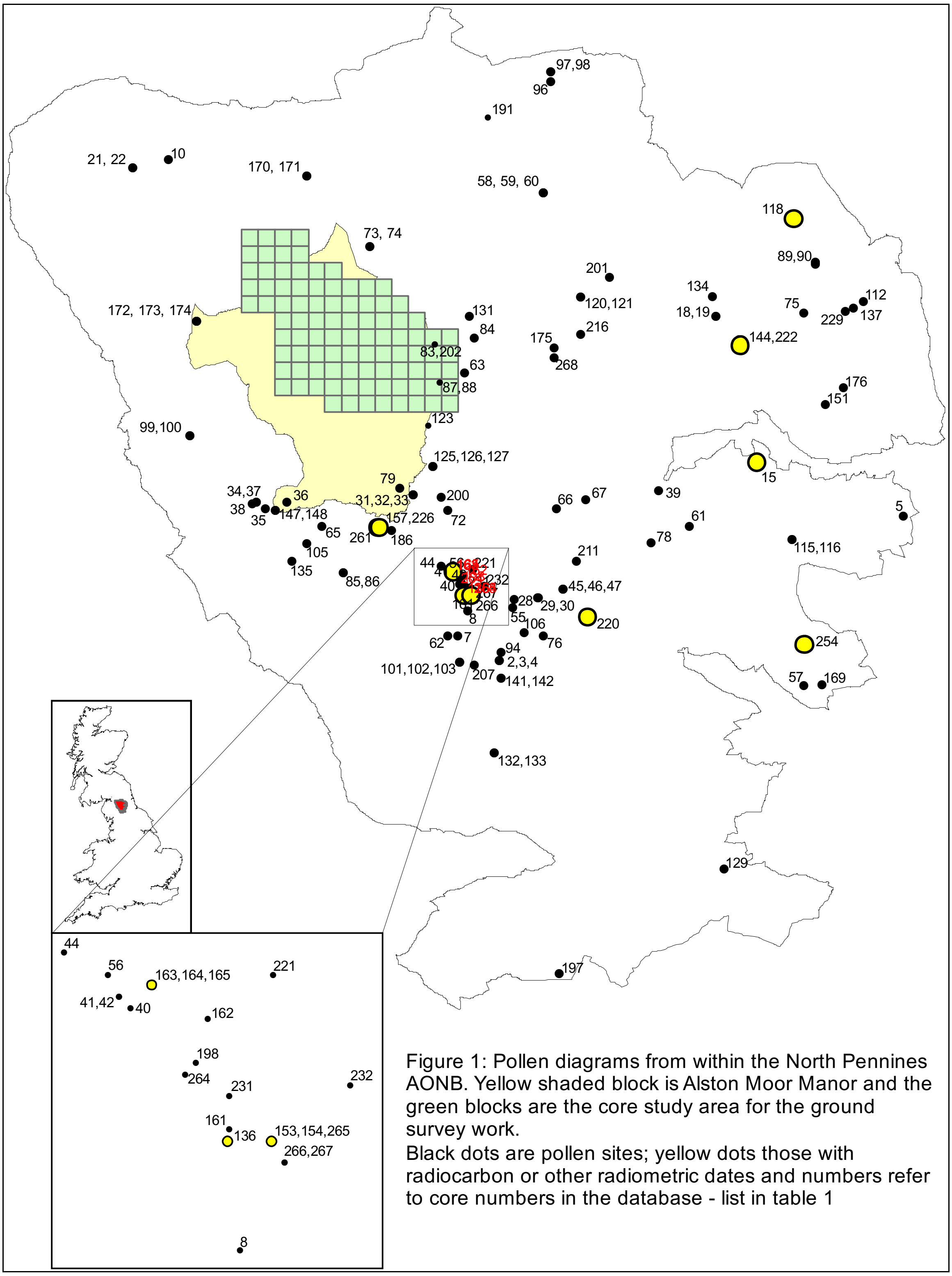

Figure 1: Pollen diagrams from within the North Pennines AONB. Yellow shaded block is Alston Moor Manor and the green blocks are the core study area for the ground survey work.
Black dots are pollen sites; yellow dots those with radiocarbon or other radiometric dates and numbers refer to core numbers in the database - list in table 1

Given the very low numbers of cores from the core project area, the area of investigation was widened to encompass all of the historical Alston Moor Manor (yellow shade on Figure 1). Disappointingly this made rather little difference with only a further 5 or so sequences being added and, again none with radiocarbon dates. Cores 172,173 and 174 from Woldgill Burn are presented as part of the Flandrian vegetation history work of Turner and Hodgson (Turner and Hodgson 1979, 1981, 1983, 1991) thus no specific data are available. Core 36, Cross Fell Slate Sike and core 79 John's Burn are both in an old Master's thesis (Godfree 1975).

Expanding the area to the whole of the AONB, many of the other sites are concentrated around the Cross Fell and Upper Teesdale areas for historic reasons such as the construction of Cow Green Reservoir when there was a need to record and understand the history of the area before it was submerged under water. In general there is a reasonable spread of information available from throughout the AONB although it almost seems that palynologists avoided Alston Manor itself as there are hardly any diagrams from within it. Most of the cores are from the blanket peats or higher valley mires which were the areas of deeper peat and more appropriate to the questions being asked at the time.

Returning to the project core area, the Kilhope Law work was part of the summary of the early Holocene forests by Turner and Hodgson (1979, 1983). The datasets are considered to cover the period 8800-7000 years ago which the authors delimited by the first rise of elm/oak for the basal event and the decrease in pine/rise in alder as the upper limit. For each of their 52 sites they took the samples that lay within these parameters and looked at the maximum, mean and minimum values for each tree pollen type within these samples. These values were subsequently summarised into five categories: 0-20%, 21-40% and so on.

Turner and Hodgson then produced maps of density of tree pollen types that showed clear variation between quite small areas, although remembering that the data covered almost 2000 years of vegetation. For example, pine pollen was particularly abundant in upper Teesdale and in the southern upper reaches of the Derwent (Figure 2) where, in addition, pine stumps are commonly seen in the lower peats. Such stumps are not apparent at all in many of the Teesdale peats. Although the reason for this is unclear the authors argued that it might reflect an altitudinal limit for pine. On the other hand, pine produces vast quantities of pollen and that from trees growing in the lower reaches of the Tees valley could easily account for high values in the upper Tees. However, there is no obvious reason why only certain of the higher areas should have high pine pollen values as it should be blown all over the region.

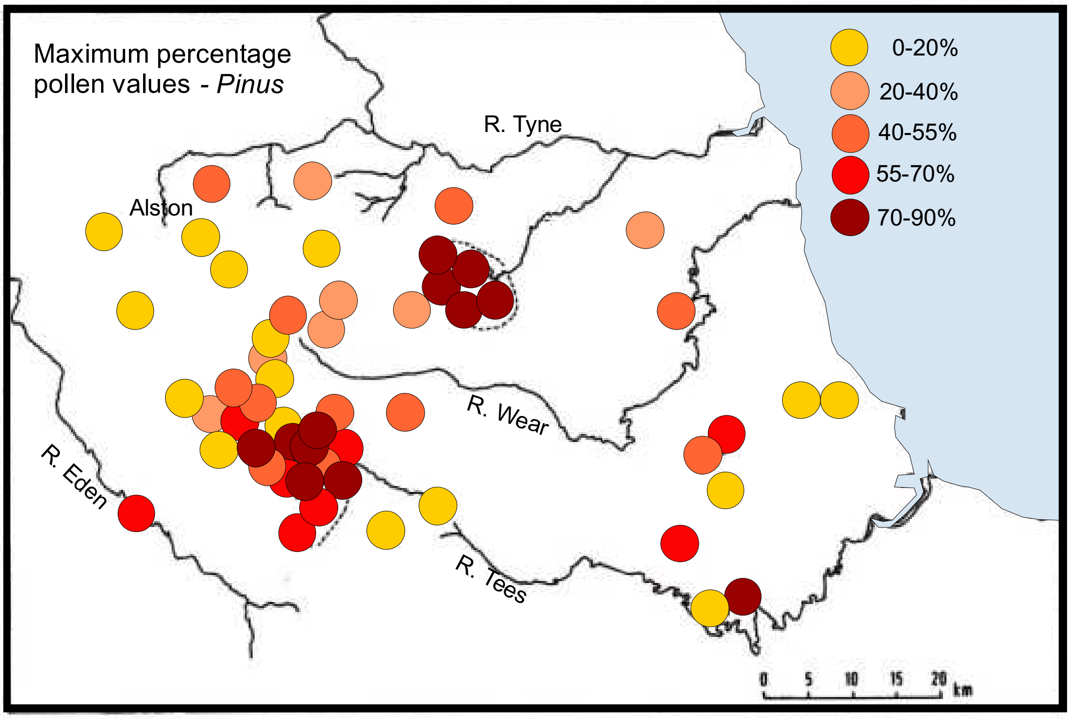

Figure 2: maximum pollen percentage values of *Pinus* (redrawn from Turner and Hodgson 1979)

Birch, on the other hand, was low in areas of pine dominance although this could partly be an artefact of the data being calculated as percentages. At this period elm pollen values were highest in the western uplands with a positive correlation with altitude – not an intuitive correlation at all as elm is more usually considered a species of modern lowland forest. It also shows some correlations with specific soil types although they, too, have some relationships with altitude. Oak, hazel and alder also have high correlation with altitude and, taken together, strongly imply that a mixed hardwood woodland was growing over much of the upper 'moorlands' during the early Holocene compared with a willow, pine and birch in the lowlands, albeit with some oak, elm and so on. Perhaps a more interesting fact is that tree pollen values in these upland sites are typically 76% or more. This indicates that the woodlands were probably local given that a value of 70% is often defined as representing locally growing trees as opposed to pollen blown in from more distant stands.

Trying to tease out further information for this period Turner and Hodgson ran some multivariate analyses on the data with sites being the samples and pollen data the variables. The cluster analysis produced six distinct groups of sites – in other words, each group comprising sites with similar pollen assemblages – and these have been plotted in Figure 3. Each colour is one group or cluster. Whilst green sites are quite close together yellow cluster sites are quite bi-modal and the other clusters are rather more widely spread. At the extreme, two sites within 150m of each other are classified as green and dark blue so rather different despite their physical proximity.

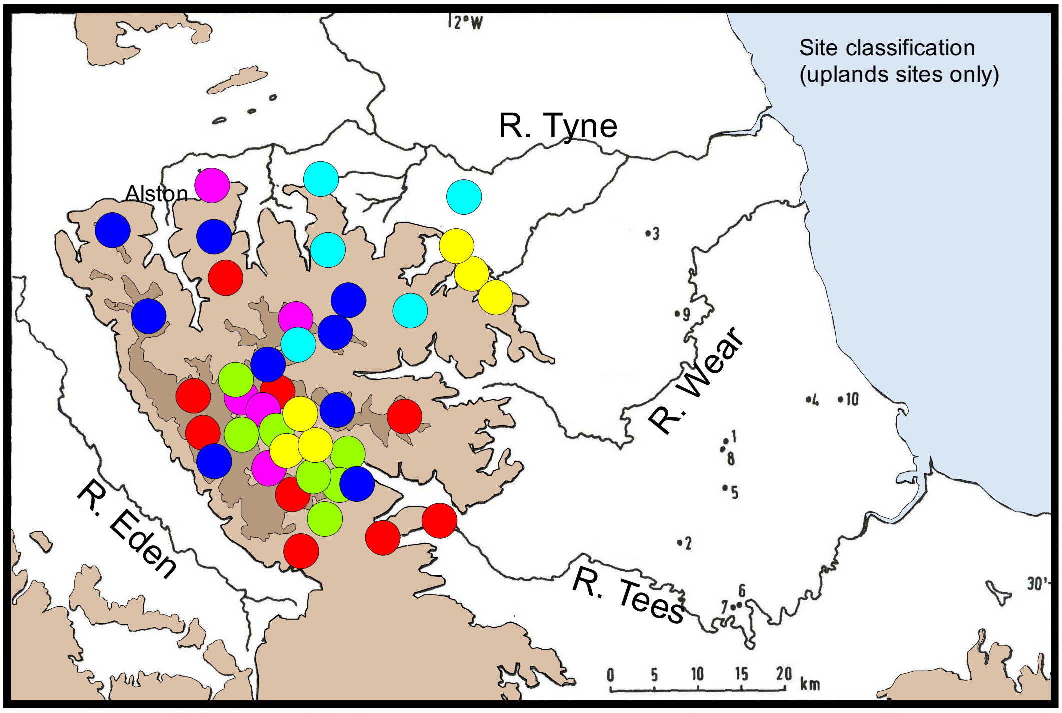

Figure 3: Sample groups derived from a classification of the pollen data – one colour per group of samples (redrawn from Turner and Hodgson 1979). Upland sites only

What this really says is that overall vegetation patterns are complex and that small spatial-scale variations can and do occur. Once people have been introduced to the equation, remembering that these plots are 8800-7000 years ago at a time when human impact would have been minimal, the picture is likely to become even more complex. This strongly suggests that a different approach is needed to address questions relating to discrete historic assets such as mines and farms and that the collection of cores from several small sites in any one locality to investigate truly local changes is paramount.

By the mid-Holocene, some 7000-5000 years ago, there was a somewhat different overall picture and the cores from Knoutberry demonstrate this to some extent (Turner and Hodgson,1983). In the analyses of this period the authors included data from 38 sites including Knoutberry. The sites were again essentially mires of one type or another as the extensive blanket peats, familiar today, had yet to develop. In pollen assemblage terms the dataset spans from the Alder Rise to the start of the Elm Decline – both significant and obvious changes in pollen diagrams (although not necessarily completely contemporary at all sites). The overall picture of woodland change during this period strongly relates to spatial patterning with changes from north-east to south-west predominating. On the other hand, small-scale changes due to variations in soils and/or basin types do not seem as clear as in the early Holocene.

Up to about 5000 years ago then the soils, altitude and location had the greatest effect on vegetation and hence pollen assemblages. With the onset of the Neolithic, people had a much greater effect but to investigate these to any great extent pollen diagrams with absolute dates are required. These are not, however, available with the Alston Moor core project area or, indeed, the historical area of Alston Moor Manor. The nearest are from cores 157 and 261:Valley Bog (Chambers 1978; Chambers *et al* 2006). The earlier diagram, from core 157, by Chambers starts at 0.70m below ground surface, with the upper 0.5m not sampled, and comprises over 6m peat. Peat inception seems to have been between 7000-8000 years ago although there is no basal date. The Alder Rise is rather later than at many other lowland sites in County Durham, likewise the Elm Decline is a little later. Chambers notes that 18 examples of Mesolithic lithics have been recorded for the area and uses this as supporting evidence to his argument that the decrease in forest cover at about 5900 years ago was a result of human activity. He also notes the records of a few horn cores of probable aurochs, in one case also associated with a lithic. Whilst it is certainly plausible that hunter gatherers contributed to a decrease in forest cover, widespread change in forest seems much more likely to reflect environmental or climatic changes. Valley Bog is one site where the pollen catchment area should be considered in the interpretation as this clearance may simply be a local event and hence quite possibly a result of human activity.

After the Elm Decline there is major clearance of woodland dated approximately to the Bronze Age and there are a few records of the occasional cereal pollen grain at Valley Bog. Chambers suggests that these have blown in from the lowlands but, given the features of cereal pollen as discussed above, it seems more likely that they are indicative of small-scale but local cultivation. At 1.52m, dated to about 2100-2200 years ago *Calluna*, heather, pollen rises dramatically although it is not clear, as stated by the author, whether this reflects general widespread increase in moorland or a swamping of the pollen assemblage by *local* heathland – heather, like pine, produces vast quantities of wind blown pollen.

Turning to the Chambers *et al* (2006) diagram their core (261) is just less than 2m long – they were looking primarily at the recent history of the moorlands rather than the whole vegetation history present within the basin. It therefore adds the otherwise missing top layers of peat to the original Valley Bog core. Macrofossils were examined from throughout the core but pollen only from the upper 0.55m. At this level *Calluna* pollen comprises >40% total land pollen, followed by values of ~20% until 0.25m then rising again to 60-80% to the surface. By inference with the earlier diagram it suggests that all of this deposition occurred within the last 2000 years or so and this is in accord with radiocarbon dates from the 2006 core – 1.64–1.65m 2780±40 which they calibrated to AD 1010–830 (no Lab.Number given). What is clear is that this basin has a long record covering the last 2-3000 years and therefore fine-resolution and geochemical work could be undertaken on it in relation to the Alston Miner-Farmer project.

In very general terms there is evidence for major clearance from the Neolithic onwards with most sites in the North Pennines AONB having low values of tree pollen from about the later Bronze Age. Trees are replaced by either grassland or heathland depending to some extent upon the altitude, aspect etc of the site but also upon the activity of humans. Once we get to Roman and later times there is the problem that many sites have truncated profiles. Whilst this might reflect periods of much drier climate and the consequent drying out of peat it can also reflect periods of peat cutting and hence removal of Roman-age and later peat. Despite this it is concluded that any sites within the project area have some potential to add to our understanding of local landscape history.

CONCLUSIONS AND RECOMMENDATIONS

It is disappointing to find that, given the long history of academic pollen work in the region, so few diagrams relate to the Alston Moor area and none of which has been radiometrically dated. On the other hand, this means that there is a more or less clean slate for pollen work. It is the case that almost any depth of peat will address some questions of relevance to the project although material covering the last 2-3000 years would be best. Equally it means that quite shallow peats might still have high potential. However, the any future work will need to be focussed on specific questions and the limitations of pollen given due consideration.

Temporal resolution of the pollen sequences also needs to be taken into account.. In the north Pennines peat grows typically of the order of 1cm over 20-30 years so even a 1cm slice produces an integrated pollen picture of a couple of decades or more. If we want to look at more rapid changes, such as associated with the life of a particular smelter, then thinner slices of peat might well be preferable. This immediately increases resources needed to undertake the work. Equally, a normal pollen count is of the order of 500 pollen grains per slice but to look at agriculture, especially cereal cultivation, counts of at least 1000 grains are required – and should also be tied to sites with mostly local pollen representation. Work on several small basins within an area would help to tease out fine spatial patterning which could be important when considering arable versus pastoral farming. For each of these sites there is a need to produce a dated skeleton diagram, followed by homing in on the periods of most interest. After all, the early to mid Holocene is irrelevant if the interest is in lead mining and its effect upon the landscape. Usually pollen analysts try to identify every grain as far as possible but, depending upon the questions asked, it may be better to be less detailed – after all pollen residues are small and can be stored for many decades should someone wish to re-visit the samples to address a different question. For example, colleagues looking at tree lines in Scandinavia are classifying pollen into only three types – pine, birch and 'other' which means that they can look at many many more samples in a given time as it does not matter what the 'other' types are.

Whilst pollen is perhaps the main indicator of vegetation change, we are interested in land-use generally and especially that related to mining activity. Lead ore processing was carried out in several areas around Alston with major smelters at, for example, Nenthead. Volatile compounds would have been produced during the smelting and subsequently deposited within peats. The use of geochemical techniques to recognise lead, copper and zinc have long been acknowledged (Livett *et al.*, 1979) and. more recently, have been used to provenance ore signatures and look at episodes of ancient mining (Cloy *et al.* 2005; Le Roux *et al* 2004; Mighall *et al* 2002; Mighall *et al* 2009). The use of such techniques should prove highly rewarding for the present project. A combination of pollen and geochemical work around sites where the archaeology is already quite well known is probably best as the questions can be more focussed. Again, a dated skeleton diagram needs to be produced in order to target the depths of relevance. Newshield Moss above the Mounthooly mines could be one such area and there must be potential around the Nenthead mining complex given the proximity of blanket peats above the town.

Given the existing and detailed work for the lower sediments of Valley Bog and the dates for the upper deposits this may well be another site worth further investigation. Though it lies outside the core project area it is quite close to the remains of Green Hurth mines so could contribute to an understanding of these historic assets.

Although there is the potential of answering many questions relating to the impact of mining in the area it is important not to overlook an important Iron Age site in the area, that of Whitley Castle. It has an impressive set of ditches which are clearly waterlogged and hence have very high potential for survival of pollen (and macrofossils). Whilst ditches often start infilling only after the people have moved away (or when they no longer need them for defence), hence not providing evidence for activity during occupation, the ditches at this site could provide evidence of post-Roman activity in the area.

Pollen work ties in well with the National Heritage Protection Plan as it helps to identify and assess the potential of historic assets by providing a context for them – the physical remains of lead mining cannot be divorced from the landscape in which the extraction and processing took place and being able to say whether the land around the mines was being used to grow cereals or vegetables; or that it was grassland because all of the local peat had been cut for fuel; or determining the degree of pollution all contribute to that context. Palaeoenvironmental work adds to the understanding of historic assets and helps to define the area of interest.

Table 1: list of pollen sites within the North Pennines AONB. Table ordered alphabetically by site name. The core num is the unique identifier but numbers are not consecutive as this is a sub-set of the northern pollen database (ongoing work, for information contact the author).

CORE-NUM	SITE-NUM	SITE-NAME	NORTHING	EASTING	REFERENCE	Dated
2	2	Arngill Head Brocks 1	383400	525000	Turner and Hodgson (1979)	
3	2	Arngill Head Brocks 2	383400	525000	Turner and Hodgson (1979)	
4	2	Arngill Head Brocks 3	383400	525000	Turner and Hodgson (1979)	
5	3	Bellow Moss	407700	533700	Hodgson (1974)	
7	5	Black Band	380900	526500	Squires (1970)	
8	6	Black Hill	381500	528000	Squires (1970)	
10	9	Black Rigg	363500	555100	Turner and Hodgson (1983)	
186		Bog Hill	376900	532800	Johnson and Dunham 1963	
15	11	Bollihope Bog	399000	537000	Roberts et al (1973)	yes
18	14	Burnhope Burn	396400	545700	Turner and Hodgson (1981)	
19	15	Burnhope Dam	396400	545700	Turner and Hodgson (1979)	
191		Catton Carr	382800	557700	Raistrick and Blackburn (1932)	
21	17	Cold Fell 1	361300	554600	Turner and Hodgson (1979)	
22	17	Cold Fell 2	361300	554600	Turner and Hodgson (1991)	
29	23	Cronklery Pastures 1	385710	528800	Squires (1970)	
30	24	Cronklery Pastures 2	385720	528800	Squires (1970)	
28	22	Cronkley Fell	384300	528700	Squires (1970)	
31	25	Crook Burn 1	378200	535000	Turner and Hodgson (1979)	
32	25	Crook Burn 2	378200	535000	Turner and Hodgson (1979)	
33	25	Crook Burn 3	378200	535000	Turner and Hodgson (1979)	
34	26	Cross Fell East	368800	534500	Turner (1984)	
36	28	Cross Fell Slate Sike	370600	534500	Godwin and Clapham (1951)	
35	27	Cross Fell South	369300	534100	Turner (1984)	
37	29	Cross Fell Summit	368800	534500	Turner (1984)	
38	30	Cross Fell West	368500	534400	Turner (1984)	
39	31	Cuthbert's Hill	393000	535200	Hodgson (1974)	
40	32	Dead Crook 1	380500	530200	Turner et al (1973)	
41	33	Dead Crook 2	380400	530300	Turner et al (1973)	
42	33	Dead Crook 3	380400	530300	Turner et al (1973)	
44	35	Dubby Moss	379900	530700	Turner et al (1973)	
45	36	Dufton Moss A	387200	529300	Squires (1970)	
46	36	Dufton Moss b	387200	529300	Squires (1970)	
47	36	Dufton Moss C	387200	529300	Squires (1970)	
254		Eggleston Common	401840	526051	Chambers, Daniell et al (2006)	3+ Pb 210
197		Fog Close	387000	506200	Hall (1979)	
264		Foolmire Sike	381000	529600	Turner et al (1973)	
198		Foolsike Moss	381100	529700	Turner et al (1973)	
55	44	Fox Earth Gill	384200	528200	Squires (1970)	
56	45	Furness Moss	380300	530500	Turner et al (1973)	
57	46	Goosetarn Beck	401700	523500	Hodgson (1974)	
58	47	Graham's Moss 1	386000	553100	Turner and Hodgson (1979)	
59	47	Graham's Moss 2	386000	553100	Turner and Hodgson (1979)	
60	47	Graham's Moss 3	386000	553100	Turner and Hodgson (1979)	
61	48	Great Eggleshope	394800	533100	Turner and Hodgson (1979)	
200		Green Combs	379900	534800	Hodgson (1974)	

63	50	Green Swang	381300	542300	Hodgson (1974)	
62	49	Greenmines	380300	526500	Squires (1970)	
65	52	Hard Hill	372700	533100	Johnson and Dunham (1963)	
66	53	Harthope Moss	386800	534100	Turner and Hodgson 1979, 1991	
67	54	Harthope Quarry	388600	534700	Turner and Hodgson (1983)	
201		Heathery Burn	390000	548000	Raistrick and Blackburn (1932)	
72	59	Herdship Hill	380300	534000	Godfree (1975)	
73	60	High Bank Moss 1	375600	549900	Turner and Hodgson (1979)	
74	60	High Bank Moss 2	375600	549900	Turner and Hodgson (1979)	
75	61	Hisehope Burn	401700	545900	Godfree (1975)	
76	62	Howden Moss	386000	526500	Simpson (1976)	
78	64	James' Hill	392500	532100	Turner and Hodgson (1979)	
79	65	John's Burn	377400	535400	Godfree (1975)	
83	68	Kilhope Law 1	379600	544100	Turner and Hodgson 1979, 1991	
84	69	Kilhope Law 2	381900	544400	Godfree (1975)	
202		Kilhope Moor	379600	544100	Raistrick and Blackburn (1932)	
85	70	Knock Ridge 1	374000	530300	Turner and Hodgson (1979)	
86	70	Knock Ridge 2	374000	530300	Turner and Hodgson (1991)	
87	71	Knoutberry 1	379900	541800	Turner and Hodgson (1983)	
88	71	Knoutberry 2	379900	541800	Turner and Hodgson (1983)	
89	72	Lamb Shield 1	402400	548900	Turner and Hodgson 1981, 1983, 1991	
90	73	Lamb Shield 1	402400	548800	Turner and Hodgson (1979)	
94	77	Long Crag	383500	525500	Squires (1970)	
96	79	Long Moss	386500	559800	Hodgson (1974)	
97	80	Low Stublick 1	386500	560400	Turner and Hodgson 1979, 1983	
98	80	Low Stublick 2	386500	560400	Turner and Hodgson 1979, 1983	
99	81	Melmerby Fell 1	364800	538500	Turner and Hodgson (1983)	
100	81	Melmerby Fell 2	364800	538500	Turner and Hodgson (1991)	
101	82	Mickle Fell	381000	524900	Squires (1970)	
207		Mickle Shoulder	381900	524800	Raistrick and Blackburn (1932)	
102	83	Mickleton Moor 1	381000	524900	Turner and Hodgson (1979)	
103	83	Mickleton Moor 2	381000	524900	Turner and Hodgson (1991)	
105	85	Milburn Forest	371800	532000	Godfree (1975)	
106	86	Mire Holes	384900	526700	Squires (1970)	
112	92	Mown Meadows	405300	546600	Hodgson (1974)	
211		Newbiggin Carr	388000	531000	Bartley et al (1976)	
115	95	Pawlaw Pike 1	401000	532300	Turner and Hodgson (1983)	
116	96	Pawlaw Pike 2	401000	532300	Turner and Hodgson (1983)	
118	98	Pow Hill	401200	551600	Turner and Hodgson 1979, 1981, 1991	yes
216		Quickcleugh C	388300	544600	Godfree (1975)	
120	100	Quickleugh A	388300	546800	Turner and Hodgson 1983, 1991	
121	100	Quickleugh B	388300	546800	Turner and Hodgson (1979)	
265		Red Sike RS2	381800	529000	Turner et al (1973)	
266		Red Sike RS2	381900	528800	Turner et al (1973)	
267		Red Sike TS1	381900	528800	Turner et al (1973)	
123	102	Sally Grain	379200	539200	Turner and Hodgson (1979)	
125	104	Scraith Head 1	379400	536700	Turner and Hodgson (1979)	
126	104	Scraith Head 2	379400	536700	Turner and Hodgson (1983)	

127	104	Scraith Head 3	379400	536700	Turner and Hodgson (1991)	
129	106	Seven Hills	396900	512500	Hodgson (1974)	
131	108	Shivery Hill	381600	545700	Hodgson (1974)	
132	109	Shot Moss 1	383100	519500	Turner and Hodgson (1979)	
133	109	Shot Moss 2	383100	519500	Turner and Hodgson (1991)	
134	110	Sikehead	396200	546900	Hodgson (1974)	
135	111	Silverband	370900	531000	Turner (1984)	
220		Simy Folds	388800	527700	Donaldson (1983)	yes
136	112	Site W	381400	529000	Turner et al (1973)	yes
221		Slapestone Sike	381800	530500	Turner et al (1973)	
137	113	Smiddy Shaw	404700	546200	Godfree (1975)	
268		South Foul Sike	386700	543200	Godfree (1975)	
222		Stanhope Common	397800	544300	McDonald 1993 ****	
141	117	Staple Moss 1	383500	524000	Turner and Hodgson 1979, 1983	
142	117	Staple Moss 2	383500	524000	Turner and Hodgson (1991)	
144	119	Steward Shield	398000	544000	Roberts et al (1973)	yes
147	122	Teeshead 1	369900	534000	Turner (1984)	
148	122	Teeshead 2	369900	534000	Turner (1984)	
151	125	Thornhope Burn	403000	540400	Hodgson (1974)	
153	127	Tinkler's Sike	381800	529000	Turner et al (1973)	
154	127	Tinkler's Sike	381800	529000	Turner et al (1973)	yes
226		Upper Valley Bog	376300	533100	Johnson and Dunham 1963	
157	130	Valley Bog	376300	533100	Chambers (1978)	yes
261		Valley Bog VB1	376208	533091	Chambers, Daniell et al (2006)	3+ Pb 210
229		Waskerley	404200	546000	Raistrick and Blackburn (1932)	
161	134	Weelfoot Moss	381400	529100	Turner et al (1973)	
165	138	Weelhead Moss	380710	530420	Turner et al (1973)	yes
162	135	Weelhead Moss 1	381200	530100	Turner et al (1973)	
163	136	Weelhead Moss 2	380700	530400	Turner et al (1973)	
164	137	Weelhead Moss 3	380710	530410	Turner et al (1973)	
169	142	White House	402800	523600	Hodgson (1974)	
170	143	Whitfield Lough 1	371800	554100	Turner and Hodgson (1979)	
171	143	Whitfield Lough 2	371800	554100	Turner and Hodgson (1991)	
231		Widdybank Fell	381400	529400	Turner et al (1973)	
232		Widdybank Moss	382500	529500	Turner et al (1973)	
172	144	Woldgill burn 1	365200	545400	Turner and Hodgson (1979)	
173	144	Woldgill burn 2	365200	545400	Turner and Hodgson (1983)	
174	144	Woldgill burn 3	365200	545400	Turner and Hodgson (1991)	
175	145	Wolfscleugh	386700	543800	Godfree (1975)	
176	146	Wolsingham	404100	541400	Hodgson (1974)	

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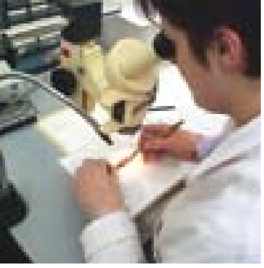
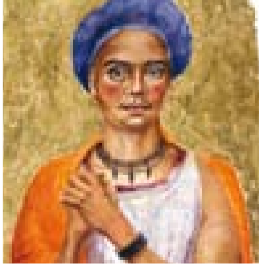



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