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HUMAN-ENVIRONMENT RELATIONS ON BODMIN MOOR DURING THE HOLOCENE

By

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Abstract

Human-Environment Relations on Bodmin Moor During the Holocene
by Benjamin R.Gearey

This thesis describes palaeoenvironmental investigations on Bodmin Moor aimed at determining the timing, nature and extent of human induced environmental change on the moor. Pollen, charcoal and loss-on-ignition investigations were carried out at two main areas with chronological control provided by radiocarbon dating. The first area investigated was Rough Tor where five sequences were examined. Palynological analysis of these sequences demonstrated that the early vegetation cover of the moors was dense hazel scrub with oak and birch as components of the local woodland. Clearance of this woodland began in the Neolithic and led to the spread of grassland and expansion of alder onto the damper soils of the upland slopes. Intensified clearance marks the Bronze Age, with the almost complete destruction of local tree and shrub cover. There is no evidence for cultivation and landuse was mainly pastoral. A reduction in anthropogenic activity at some point in the third millennium BP resulted in the expansion of trees and shrubs, although some form of activity probably continued nearby. Renewed clearance activity in the Iron Age/Romano-British period points to human interest in the higher moorland in this period. The development of meadow at Rough Tor North suggests continuing pastoral activity into the historical period. The medieval settlement and cultivation of the Rough Tor moors is evident in the demise of meadow, appearance of cereal pollen and spread of acid grassland.

The second area investigated was the East Moor. Four sequences were examined along a transect from the higher slopes of the East Moor plateau to the valley bottom at Tresellern Marsh. Sediment accumulation began at different times at each location and it is suggested that late peat accumulation at one site was due to removal of earlier sediments through early tin streaming activity. Early Holocene vegetation cover on the high slopes was dense hazel with oak and perhaps some elm present locally. The valley was dominated by hazel and probably oak on the valley sides with alder spreading later onto the mire areas. Clearance in the Neolithic resulted in the spread of alder on the higher slopes and birch on the mires. Further clearance in the Bronze Age resulted in the demise of most of the tree and shrub cover and the spread of grass and heathland. Clearance intensified in the Romano-British period. Landuse was pastoral, although limited cultivation in Tresellern valley was possible. Grazing activity continued on the moor, with some cultivation near to Watery Marsh. Intensified activity in the medieval period was apparent in the form of increases in pastoral indicators in the pollen record and the presence of arable land indicated through the record of cereal pollen.

The implications of the palaeoenvironmental data for the earliest settlement and human activity on the moor are considered and comparisons and contrasts between Bodmin Moor and other uplands in south-west England and the British Isles are drawn. The evidence for activity in the Neolithic and Bronze Age fits in with current theories of settlement on Bodmin Moor. The intensification of clearance and farming activity in the Romano-British period suggests that the scope and intensity of human interest in the moor did not decline at this time as has been interpreted from the archaeological record.

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For My Father and My Mother

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award.

Relevant scientific seminars and conferences were regularly attended at which work was often presented and external institutions visited for consultation purposes.

Presentations and conferences attended:

March 1992: Postgraduate Palaeoecology Conference, University of Sheffield. Pollen Taphonomy in a Windy Climate

March 1993: Postgraduate Palaeoecology Conference, Royal Holloway and Bedford New College. Palaeoenvironmental Investigations at Rough Tor, Bodmin Moor.

March 1994: Postgraduate Palaeoecology Conference, University of Plymouth.

April 1995: Association for Environmental Archaeology: Meadow and Grassland Development at Rough Tor, north-west Bodmin Moor.

November 1995: Dartmoor National Park Moorland Research Group: Environmental Change on Bodmin Moor

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Chapter One:
Palaeoecological Study on the Uplands of South-West England.

1.1. Introduction

In the 1986 Silver Jubilee Volume of *Cornish Archaeology*, R.J. Mercer discussed the lack of palaeoenvironmental work in Cornwall and suggested that "..the expansion of our knowledge in this area must remain one of our principal priorities for the immediate future." (Mercer, 1986:37). This sentiment was echoed later in the same volume by P.M. Christie who stressed the importance of investigating complete fossil landscapes as opposed to single sites and pointed out that the palaeoenvironmental picture for Cornwall "..has a long way to go before it is as full as that for the later prehistoric period in counties further east." (Christie, 1986:83). Other archaeologists have also pointed out the dearth of palaeoenvironmental data for the south-western uplands: Fleming (in Todd 1987:111) highlighted "...the opportunity [in Cornwall], not yet fully exploited, to compare the visible remains of fields with the vegetation record." Johnson & Rose (1994:3) suggested similar unexploited potential for palynological study on Bodmin Moor specifically "...now that the remains of past activity have been located."

Since these observations were made, very little research has been completed to remedy this situation. Bodmin Moor is the largest of the Cornish granite uplands, yet is one of the few English upland areas that has not been the object of detailed palaeoenvironmental investigation. Despite the extensive and well preserved archaeological remains on Bodmin Moor, there has to date been no concerted attempt to reconstruct the timing and magnitude of environmental change associated with human activities. This thesis aims to expand this presently

inadequate database of Holocene human-environment relations through the palaeoenvironmental investigation of key locations on the moor.

The first part of this chapter describes the physical environment of south-west England, followed by a summary of palaeoenvironmental work carried out on the upland areas of Devon and Cornwall: Dartmoor, Exmoor, Hensbarrow and Carnmenellis. The second part reviews the evidence for the settlement of Bodmin Moor and the palaeoenvironmental work that has been carried out there. In the light of this, the key aims of the project are introduced.

1.2. South-West England: physical environment

The peninsula of south-west England (Figure 1.1) is bounded by the Bristol Channel to the north, and the English Channel to the south; no location in Devon is thus more than 40 km from the sea, and in Cornwall nowhere more than 29 km. The south-western climate therefore has a strong maritime influence and may be conveniently summed up as "very mild, but wet and windy." (Brown, 1977:25). This is reflected in an average January temperature of 6.4°C, and an annual temperature fluctuation of 9.5° C at Falmouth, Cornwall (compared to a range of 12.7° C at Greenwich, London). A high average winter temperature of 9.4° C for coastal waters reflects the influence of the North Atlantic drift and the Gulf Stream.

1.3 Palaeoenvironmental work on the uplands of South-West England

This section will review the palaeoenvironmental work that has been carried out on the upland areas of south-west England (Figure 1.1); namely Exmoor, Dartmoor, Carnmenellis and Hensbarrow and West Penwith and will conclude with

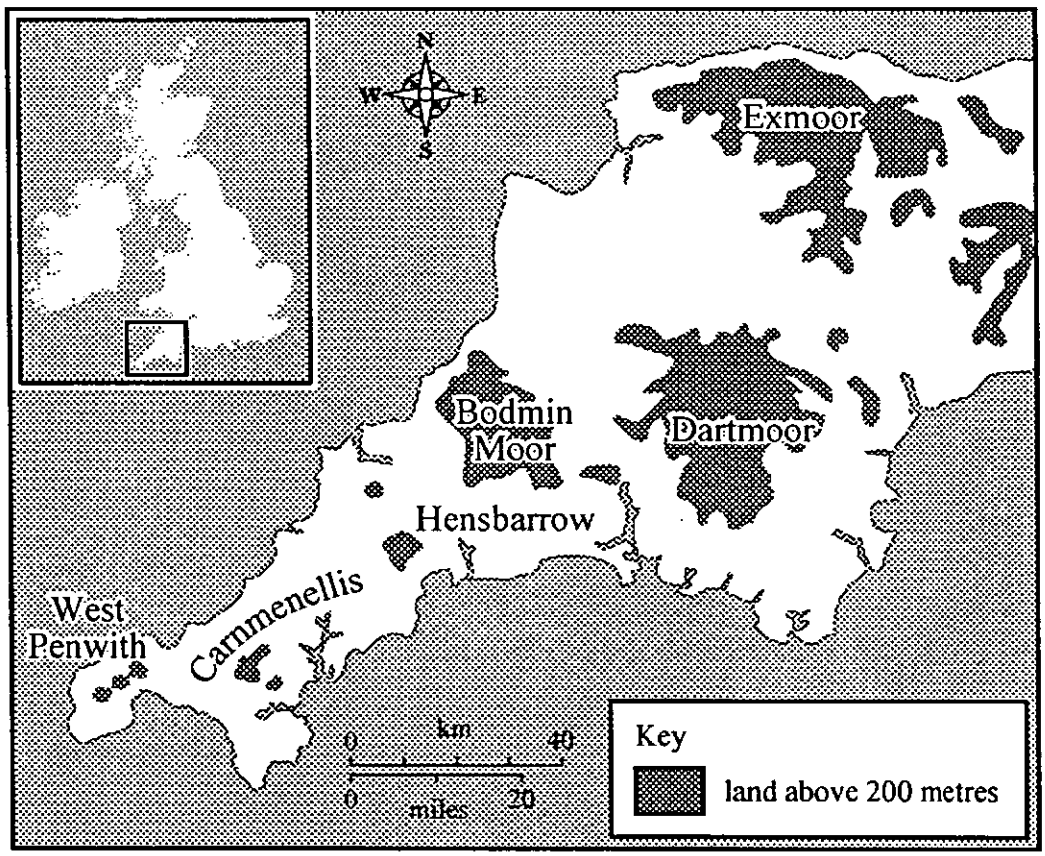
a brief summary of the future research potential in these areas.

Exmoor

The geology of this upland is described by Crabtree (1984). Exmoor is formed from Devonian sandstones, slates and shales, with occasional siliceous limestone; the moor reaches a maximum elevation of 520m and its topography is generally between 400-480m. As it is the north limb of a syncline, the different lithologies outcrop in parallel bands. In common with the other upland areas of South-West Britain, the surface of the moor is characterised by extensive areas of periglacially eroded and transported material. Brown earths occur on the better drained steep slopes, whilst summit areas are characterised by peat and peaty-gley podsols and podsols with gleying (Curtis, 1971). This latter soil type has potential for reclamation, as occurred in the last century and has recently been attempted on the moor (Crabtree, 1984). Although there are extensive remains of field systems, enclosures and settlements on Exmoor, many are partly buried under blanket peat which may also conceal a number of other sites (Ellison, 1977 in Bell, 1984), little archaeological or palaeoenvironmental study has been completed in this area.

Merryfield and Moore (1974) carried out pollen analysis on a peat profile in an area of deep blanket peat on an upland plateau known as 'The Chains'. The authors claim that anthropogenic interference in the landscape, such as the grazing of animals or the ploughing of marginal land, led to the initiation of blanket peat in this area. The basal layers of the sequence contain high levels of *Ulmus* and *Pinus* and are interpreted as representing undisturbed woodland before the arrival of farming cultures. Prior to 4170±75 BP* (UB-821), *Ulmus* and *Pinus* values decline and *Plantago lanceolata* and *Pteridium* increase, indicating Neolithic clearance and agriculture. *Radiocarbon dates are quoted as uncalibrated radiocarbon years before present (BP) unless otherwise stated. Where available, calibrated years BC and AD have been used for discussion of settlement history. Laboratory codes are given where available. See Chapter 2 for further information on the dating conventions followed in this thesis.

Figure 1.1 The granite uplands of south-west England



Due to a recovery in arboreal pollen levels, and only sporadic representation of 'cultural indicators', the Bronze Age is seen as being a period of little human activity and increased disturbance in the form of farming and woodland clearance does not begin again until the Iron Age and Roman periods. Maltby & Crabtree (1976) investigated soil organic matter and peat accumulation in connection with the construction of the Pinkery Canal (*c*.1833). The spoil thrown up by the construction of this canal buries the moorland surface and pre-dates reclamation work carried out in the 19th Century by some 14 years. Pollen analysis was carried out on the buried soils and peat horizons from the spoil heaps. The results showed that there has been some vegetational change since the construction of the canal. Blanket peat accumulation on 'The Chains' is determined to have begun much earlier than the surface peat of the marginal slopes of the plateau. Substantial changes in soil and vegetation may occur between locations only a small distance apart due to differences in slope, drainage, land-use and aspect.

Little environmental study has been carried out on Exmoor in connection with archaeological sites. Bell (1984) recorded that charcoal fragments including hazel, oak and ash were recovered from the Roman sites of Old Burrow and Martinhoe on the North Devon coast; but as these are abundant taxa in the present woodlands of the area, these data provided little information on the composition of past woodland communities.

Francis & Slater (1992) studied blanket peat sequences from Codsend Moors on Exmoor. Peat formation at the sampling site was dated to 2270±70 BP, possibly as a result of anthropogenic forest and scrub clearance. The palaeoenvironmental record included *Plantago lanceolata, Potentilla, Rumex* and cereal pollen, which suggested pastoral and arable activity during the Iron Age. This farming activity declined during the Romano-British period, leading to the regeneration of trees and shrubs. An intensification in human activity in the first millennium AD resulted in the creation of an open, grassy landscape with increasing heath and sporadic

evidence of both pastoral and arable farming continuing through the historical period.

West Penwith

West Penwith is the most westerly of the granite uplands of Cornwall (Figure 1.1) and is very rich in archaeological remains, which include traces of prehistoric field systems and boundaries (Bell, 1984). Dimbleby (1978) carried out pollen analysis on a buried land surface unearthed during the excavation of Carn Euny, a settlement which was established *c.*2000 BP and occupied until *c.*1250BP. The ratio of arboreal pollen to total pollen was 51% prior to the construction of the settlement but dropped to 3% in the layers post-dating the construction. No evidence of agriculture was found in the pollen spectra prior to the construction of the settlement, but the later phases contained cereal pollen, alongside weeds such as *Rumex, Plantago major* and Apiaceae which indicated arable farming. The presence of *Plantago lanceolata* in other samples also pointed to the presence of pasture land nearby. Charcoal evidence from the occupation layers indicated that there was much greater species diversity prior to the construction of the settlement, which correlates with the pollen evidence that there was woodland present during this stage (Sheldon, 1978).

More recently, palaeoenvironmental investigations were carried out on sediments from beneath a Romano-British boundary at Foage, Zennor (Herring *et al.*, 1993). Pollen analysis of the deposit revealed an open landscape dominated by herbaceous grassland, with some areas of heathland nearby. Tree and shrub pollen accounted for only 5-10% of total land pollen, with *Corylus* and *Salix* accounting for the larger proportion of this. Other tree pollen was present only as low traces (below 1%). Tree cover was envisaged as being restricted to field margins and valley sides. There was no evidence for arable agriculture and the predominant landuse was probably pastoral. Scaife (1988, cited in Herring *et al.*, 1993) examined soil profiles from beneath a Bronze Age cairn and a peat-filled channel near an Iron

Age settlement. The soil pollen assemblage was dominated by oak and hazel pollen, and probably corresponded to an earlier phase of landscape development than that represented by the profile from Foage.

Carnmenellis

Evidence of field systems and settlements also exists on the Carnmenellis granite (Figure 1.1), but again there have been no palaeoenvironmental studies carried out on the moor. The Neolithic settlement of Carn Brea lies in the north of this area: although the excavation of this site produced no environmental data, evidence was found for stone clearance prior to cultivation and the density of artefact scatters in those areas that were identified as having been cultivated were taken as evidence of manuring (Mercer, 1981).

Hensbarrow

Miles (1975) and Miles & Miles (1971) excavated five barrows and a ringed bank enclosure in this area (Figure 1.1). Pollen analysis indicated that by the time of the barrow construction, the woodland in the area was largely cleared, although some variation between the vegetation around each barrow was observed (Dimbleby, 1971). The palaeosols from beneath the barrow were reported as being largely similar to the present day soils, although surface peat horizons tended to be thinner, or even absent (Staines, 1979). Woodland clearance appeared to have progressed steadily since the Bronze Age and high values for *Calluna* appeared only late in the pollen spectra, indicating that this species may have followed agricultural abandonment, as has been suggested for Dartmoor (Bell, 1984).

Dartmoor

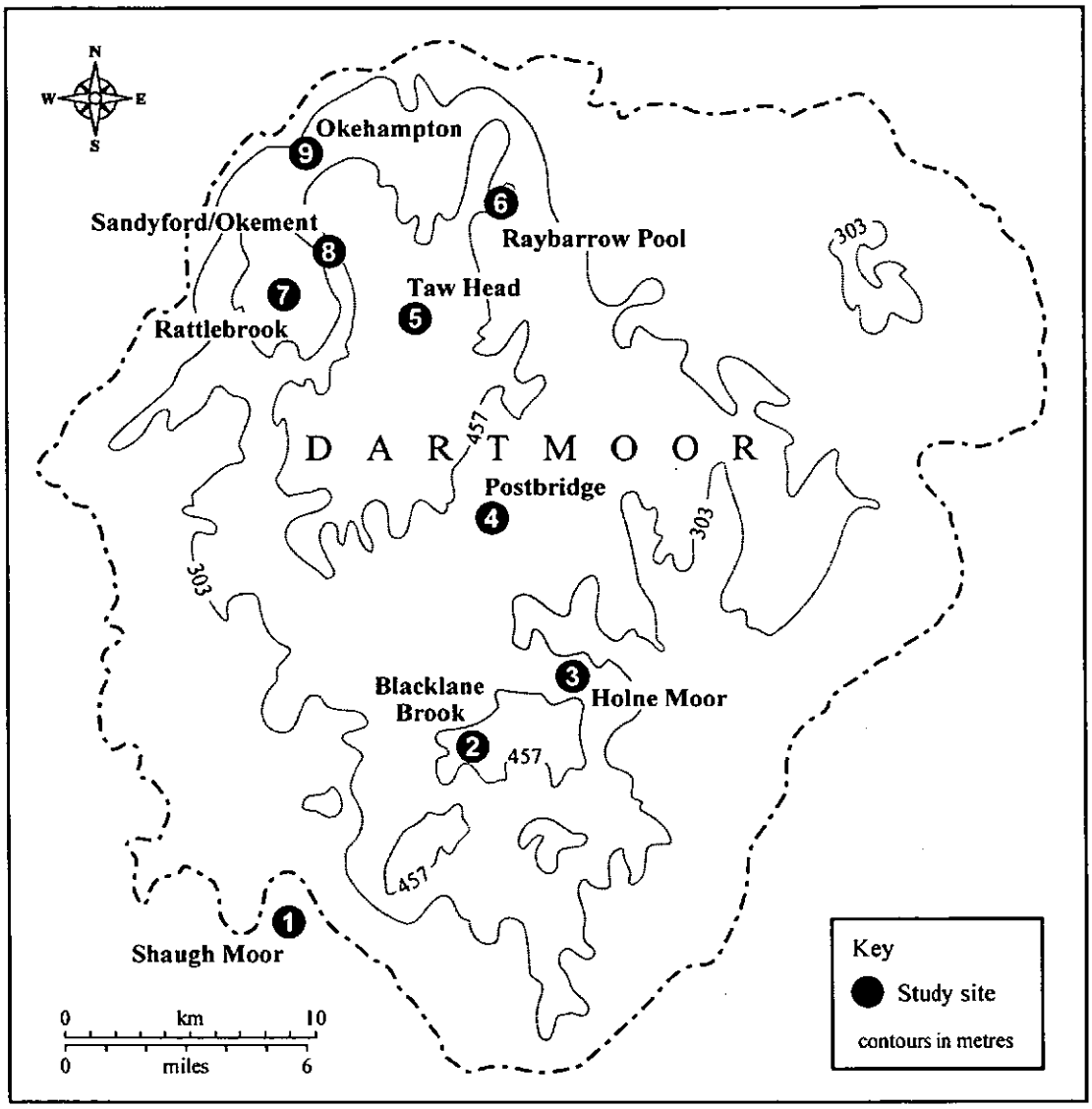
The 500 sq-km of Dartmoor is not only the most extensive of the upland areas of the south-west (Figure 1.1), but is also the most thoroughly investigated in terms of palaeoenvironments and archaeology. Its extensive 'reave' systems have been the subject of detailed archaeological and environmental study for some years

(Fleming, 1978;1983;1988) and the moor has also seen other similar integrated studies of its archaeology and environmental history (eg. Balaam *et al.,* 1982). Figure 1.2 shows the location of selected palaeoenvironmental work on the moor.

The central northern and southern areas of the moor are characterised by thick blanket peat, that tend to be thicker in the north (Staines, 1979). The surrounding peat is thinner (less than 1 m) and merges into stagnopodsolic and mainly podsol soils whilst brown podsolic soils are located on the eastern parts of the granite. Evidence from Wigford Down, Holne Moor and Shaugh Moor (Price & Tinsley, 1976; Keeley, 1982) has been assumed to indicate that the present stagnopodsolic and brown podsolic soils had a common progenitor in the form of a brown soil or brown podsolic type, which degraded through climatic or land-use change into their present form.

Palynological evidence from peat sequences is available from Blacklane Brook, Postbridge, Taw Head, Raybarrow Moor and other locations (Simmons, 1964; Caseldine & Maguire, 1986). The basic vegetational sequence showed the presence of open grasssland, *Empetrum* heath and juniper scrub in the lateglacial. This developed into birch/willow scrub, with sedge and *Sphagnum* mires in the valleys; and by the mid-postglacial, the development of deciduous forest, estimated by around 7600 BP at Blacklane Brook, consisted mainly of *Quercus* and *Corylus*. Simmons (1964) records the rise in *Quercus* pollen as predating that of *Corylus*; a phenomenon also reported by Brown (1977) for Bodmin Moor. These pollen diagrams show early clearance phases, characterised by a decrease in *Quercus* pollen and an increase in 'clearance indicators' (Poaceae and *Pteridium*) and later by shade-intolerant species such as *Fraxinus*. A pollen diagram from Blacka Brook (Beckett, 1981), however, contrasted with these in displaying no clear anthropogenic disturbance of the vegetational sequence.

Figure 1.2: Dartmoor. Selected palaeoenvironmental study sites discussed in section 1.3 are marked



Simmons (1964) estimated that peat development on Dartmoor began around 6000 BP at col sites and in the higher parts of the moor. The more extensive areas of blanket peat developed from around 4900 BP and had reached their present distribution by 2500 BP. Little evidence exists, however, to indicate what conditions prevailed prior to peat formation, and thus what factors led to peat initiation (Caseldine & Maguire, 1984), although recent work has begun to clarify the transition of the upland environment from woodland to blanket bog.

Simmons (1964) and Simmons *et al.*, (1983) studied sequences from Blacklane Brook that contained evidence of woodland recession closely associated with charcoal. This was suggested as reflecting the burning of the upland vegetation by Mesolithic communties. More recently, pollen and charcoal analysis of blanket peat profiles from Blackridge Brook and Pinswell, Northern Dartmoor, (Caseldine & Hatton, 1993) have shown the influence of burning and grazing on the transition from hazel dominated woodland to blanket peat. Burning at the Pinswell site between 7700-6300 BP changed a hazel woodland with fern-rich understorey to a vegetation community more typical of a woodland edge, dominated by *Calluna* and *Melampyrum*. Later vegetation changes included a transition to acid grassland, dominated by *Lotus uliginosus*, a brief period of woodland regeneration and finally the development of true blanket peat dominated by *Calluna*, *Potentilla* and other species typical of acid peat. The early phases of burning were attributed to deliberate burning of the uplands by Mesolithic communities, implicating human influence in the development of the peat-covered landscape that is so typical of the present environment of Dartmoor.

The pollen diagrams suggested a series of small scale woodland clearances during the Neolithic, followed by reduced levels of disturbance during the fifth millennium BP. Palynological evidence from Postbridge, Taw Marsh and Raybarrow Pool (Simmons, 1964; 1969) showed that clearance led to a decline in *Quercus*, and is characterised by increases in *Plantago lanceolata* and *Pteridium*.

Pollen evidence from Shaugh Moor indicated a similar pattern of small scale clearances followed by woodland regeneration, and appeared to continue in this location up to the beginning of the fourth millennium BP (Beckett, 1981). No indications of cultivation were found in these diagrams, suggesting that the moor was used mainly for pastoral activities.

The Bronze Age, for which there is the most extensive archaeological evidence for human occupation on the moor, is characterised by a significant increase in woodland clearance in many pollen diagrams from Dartmoor. The pollen diagrams from Raybarrow Pool, Postbridge and Taw Head display increases in 'clearance indicators' such as *Plantago, Pteridium* and Lactuceae indet. (Simmons, 1964). Beckett's (1981) peat and soil pollen diagrams show that well defined clearance phases are associated with the construction of the Bronze Age monuments.

The question of the land use associated with the field systems and enclosures of the uplands, is one that has been much considered, not only for Dartmoor but for other upland areas in the South-West. Price & Tinsley (1976) studied soils from Trowlesworthy Warren and Wigford Down and concluded that crops were grown at both sites. Elsewhere, however, indication of arable activity is very sparse or non-existent (Caseldine & Maguire, 1984). This does not necessarily show that arable farming did not take place on the moor, because of the problems attached to the identification of this activity in the pollen record (cf Behre, 1981). Other evidence has been taken as indicating a primarily pastoral function for the Bronze Age field systems: Price (1973) pointed out that large amounts of 'clitter' in the fields would make them unsuitable for agriculture and the lack of cultivation marks or lynchetting on Holne Moor or Shaugh Moor would appear to support this contention (Balaam *et al.,* 1982). Beckett's (1981) pollen diagrams from Shaugh Moor contain primarily pastoral indicators, such as *Plantago lanceolata, Rumex* and *Ranunculus acris*-type. After comparing Bronze Age, medieval and modern layers, Beckett concluded that Bronze age grazing pressure was intense, and has

probably only been exceeded during the present period (Beckett, 1981: 262).

Simmons (1964) carried out pollen analysis on a soil beneath and adjacent to a stone row of possible Bronze age date. Cereal pollen was identified in this case and it was deduced that agricultural activity was carried out prior to the construction of the row in a clearing in a woodland consisting mainly of oak, alder and hazel. By the time the stone row was built, the clearing had become colonized by grasses and heather.

The Iron Age is less well represented by archaeological evidence than the preceding period, and it is suggested that human activity at this time may have spread from the moorland onto lower ground, possibly due to a climatic deterioration (Caseldine & Maguire, 1984), although the exact reason for this change in settlement patterns remains a matter of some debate (Silvester, 1979; Christie, 1986). The pollen evidence for this period includes clearance phases in the diagrams from Taw Head and Rattlebrook. Cereal pollen appears for the first time in these diagrams during this period (Simmons, 1969). The discontinuous record of 'cultural indicators' such as *Plantago* and *Pteridium*, suggest that human pressure on the moorland was intermittent. Southern Dartmoor was also apparently less intensively utilised during this period, as levels of ruderal pollen fall and tree and moorland indicators remain constant (Beckett, 1981; Staines, 1979).

During the Iron Age and early historic period, human communities may have been involved for the first time in the reclamation of moorland, as opposed to the clearance of woodland (Caseldine & Maguire, 1984). Austin *et al.* (1981: 59) suggested that there was a fluctuating 'tide line' between moorland and agriculture with "...locally , stretches of ancient woodland interspersed with regenerating scrubland at times of decreased pressure on the land resource."

Probably little human occupation took place during the early historic period, as is the case for the other granite uplands of Devon and Cornwall and that which did occur probably had limited ecological impact compared to that of the Bronze Age. Evidence for the medieval period is more extensive.

The settlements and field systems of Okehampton Park and Holne Moor (Maguire *et al.*, 1983; Beresford, 1979), on the edges of the moor, have been attributed to the 11th Century. On Holne Moor, plough marks were found sealed beneath peat and other palaeoenvironmental data in the form of pollen and lynchet marks suggested arable cultivation. Okehampton Park yielded a pollen diagram that also contained evidence for cultivation in the form of cereal and arable land weed pollen. This phase falls between radiocarbon dates of 710±70 BP (HAR-3906) and 230±60 (HAR-3433). Pollen recovered from within one of the buildings contained the pollen of *Hordeum*, *Triticum* and *Secale* (Austin *et al.*, 1981).

Beckett's (1981) pollen evidence for the post-medieval period contains only traces of cereal pollen, which he interpreted as representing cultivation on the lowlands. Simmons' (1964) pollen diagram from Taw Head displayed a fall in *Alnus* which was possibly due to the activity of tinners destroying the wet valley habitat of this tree. This explanation was rejected by Austin *et al.* (1981) who suggest that the most likely explanation is the clearance of the slopes around Okehampton Park for the expansion of agricultural land. The 12th century afforestation is recorded in diagrams from Taw Head (Simmons, 1964), Okehampton Park (Austin *et al.*, 1981) and Wotter Common (Beckett, 1981).

1.4 Palaeoenvironmental investigation in the south-west: conclusions.

Palaeoenvironmental data for the uplands of Devon and Cornwall are both spatially and temporally uneven. Some areas, such as Carnmenellis that are apparently very

rich in archaeological remains, have been poorly investigated palaeoenvironmentally. In the more extensively investigated areas, such as Dartmoor, the extent of human impact in the early postglacial is becoming increasingly better researched, but for other areas, further potential for palaeoenvironmental study remains.

In some areas, this is partly related to the perception that suitable, continuous deposits are lacking. Another possible factor is the geographical isolation of the south-western peninsula.

Whilst the general pattern of environmental change is slowly emerging for the better researched areas such as Dartmoor, the nature and height of the tree-line and the extent to which it was anthropogenically controlled are still poorly understood for these areas. Associated with this is the status of the earliest soils of the uplands and the degree to which human and climatic factors were responsible for their degradation. The causes and timing of peat formation in the upland environment also needs further study.

Another question concerns the variation in vegetation communities on the uplands during the early Holocene, prior to human impacts. Pollen diagrams from Exmoor are, for example, characterised by higher levels of *Ulmus* and *Pinus* pollen than diagrams from Dartmoor.

The abandonment of the uplands at the end of the Bronze Age, which marks the 'high tide' of human settlement in these areas, raises the issue as to whether these areas were always marginal, and were 'pushed over the edge' by human activity, or whether other factors such as climatic deterioration are equally to blame for their environmental deterioration.

1.5 Bodmin Moor

Although Bodmin Moor (or Foweymoor, as it was known up until the nineteenth century) is the largest of the Cornish granite uplands, it is not particulary extensive nor are its elevations very high compared to other areas of British upland. For the purposes of this study, the moor will be defined as that area included within the Bodmin Moor survey by Johnson & Rose (1994) (Figure 1.3). In its fullest extent, the moor covers an area of around 400 sq. km, and includes the parishes of Advent, Altarnun, Blisland, Cardinham, Davidstow, Linkinhorne, North Hill, St Cleer, St Clether, St Breward, St Neot and Warleggan (Figure 1.4). All these parishes include part of the moor within their boundaries, and have rights of common pasture upon it. The main block of moorland covers an area of approximately 193 sq. km. and is mostly over 210m OD, rising to its highest point at Brown Willy (410 m OD). In comparison, Dartmoor occupies some 500 sq. km, has a large central area over 490 m OD and its highest tor is Great Willhays (621m OD).

The majority of the drainage lines of Bodmin run out from the centre of the moor to the south. The rivers in the north-west (the De Lank and others) drain into the Camel estuary and thus out to sea at Padstow; the central and southern rivers (Warleggan and Cardinham Water) drain into the Fowey and those in the east (the Inny, the Lynher, Penpont Water and Witheybrook) into Plymouth Sound. Dozmary Pool (259 m OD), Cornwall's only natural inland lake, is situated in the centre of the moor; Brown (1977) suggests that it has probably been an open sheet of water since the lateglacial.

Figure 1.3: The area covered by the Bodmin Moor survey. Nos 1-11 denote areas surveyed at 1:1000. (Map from Johnson & Rose, 1994:based on OS map 1:100000 scale map of Cornwall. Crown Copyright Reserved.)

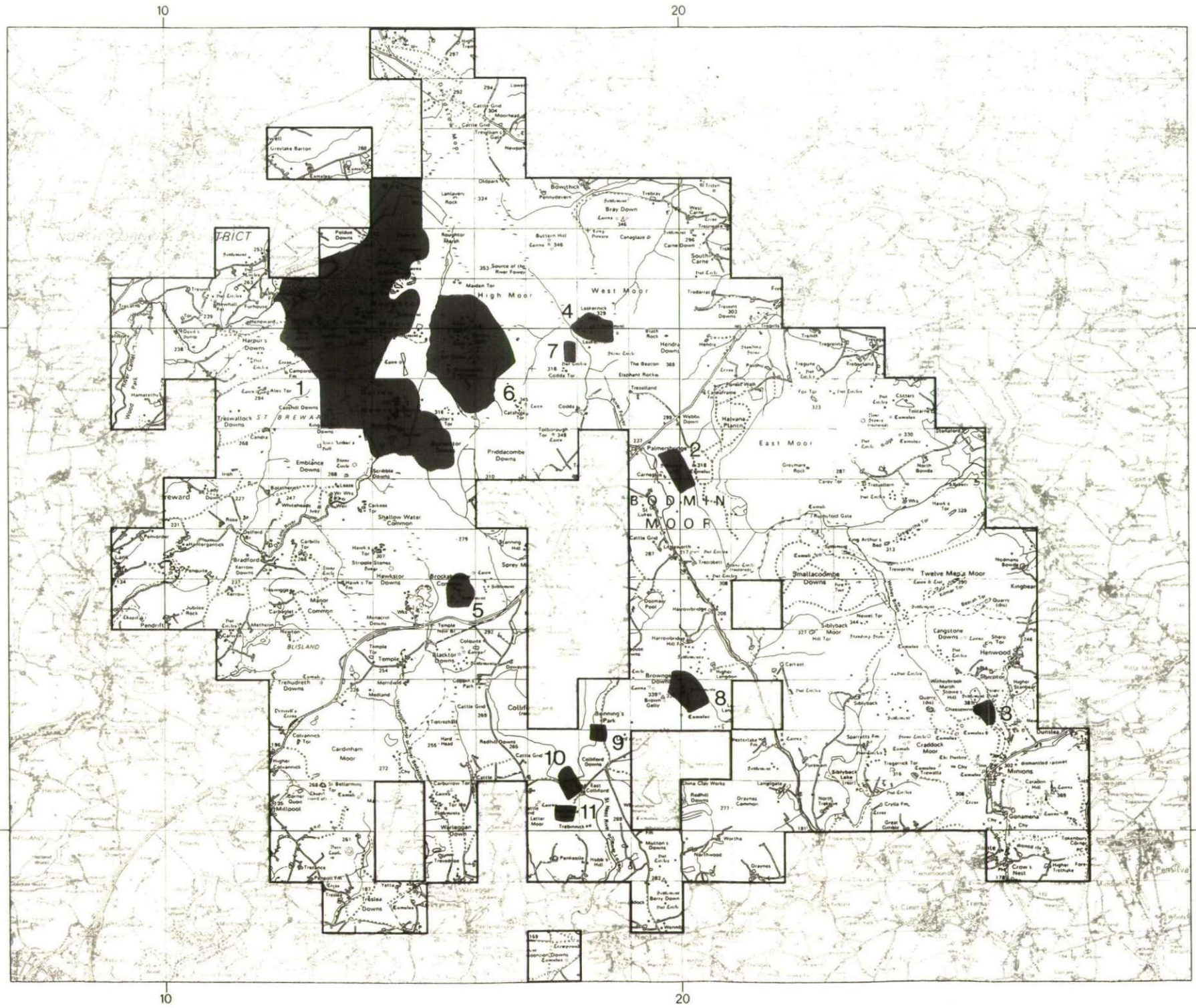
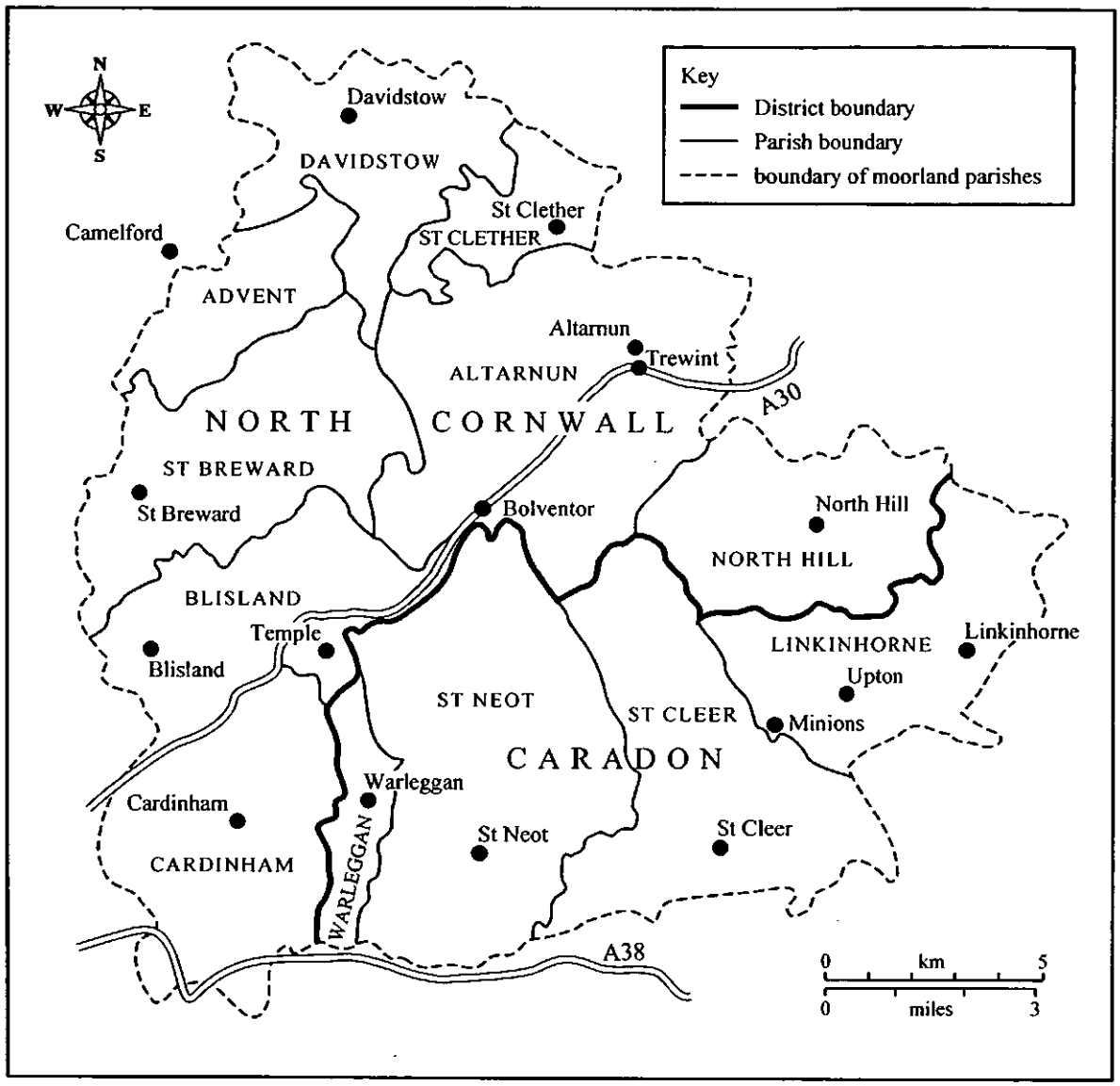


Figure 1.4: The contemporary human geography of Bodmin Moor



Climate

Bodmin Moor experiences lower than average temperatures, increased cloud cover and rainfall than lowland Cornwall. The northern central area of the moor (above 300 m OD) has an average rainfall of 1778 mm, compared to 950 mm at the coast 10 km to the north. Most of the remaining area (above 250 m OD) has 1524 mm and the lower reaches of the moor, 1397 mm (Brewster, 1977). The warmest months are July and August, and the driest April, May, June and July. The warm, wet winters of Cornwall mean that sleet and snow fall on average on only seven days in the year. This mild climate means that the county has a long growing season of around 275 days for Bodmin Moor compared with 175 for Dartmoor and as much as 325 days for the rest of Cornwall. Bodmin Moor has the greatest range of humidity in the county and cloud and hill fog can cover the moor for extended periods.

Geology and geomorphology

The geology of South-West England is described by Edmonds *et al.* (1985). The extensive granite upland areas, which trend south-west from Exeter to Land's End, of Bodmin, Dartmoor, Hensbarrow, Carnmenellis, West Penwith and the Isles of Scilly are igneous intrusions into Devonian and Carboniferous sedimentary rocks which occurred during the Armorican folding, *circa* 290 million years ago. Smaller areas of granite exist between Bodmin and Dartmoor (Kit Hill and Hingston Down); north of Hensbarrow (Castle-an-Dinas and Belowda Beacon); and on either side of Carnmenellis (Carn Brea and Godolphin).

Figure 1.5 shows the igneous intrusion of Bodmin Moor in its local geological setting. During the cooling of the granite, fissures within the rock led to the intrusion of other igneous materials and mineralisation, which produced the lodes of minerals that surround the moor (the metamorphic aureole). These metallic and gangue minerals are arranged in a series of concentric zones around the main emanature zones and are related both laterally and in depth to the thermal

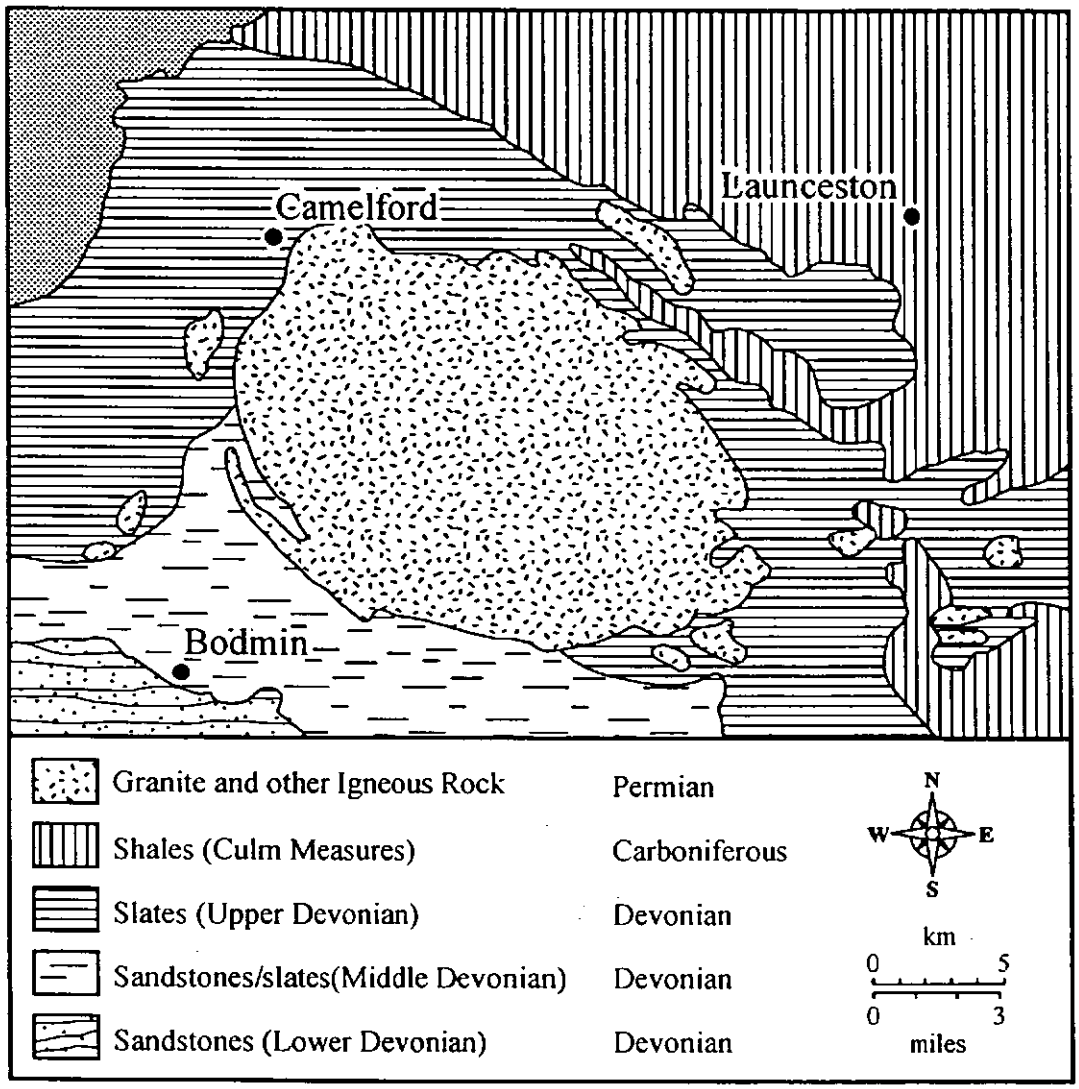
gradients which existed between the hot granite magma and the cool land surface during the intrusion of the granite. Thus, minerals such as cassiterite, wolfram and turmature are located nearest to the granite, and lead, zinc and iron are found in the cooler, outer zones. During the cooling of the granite, the process known as 'kaolinisation' occurred, leading to the production of china clay through the action of carbonic-rich gases on the feldspars. The presence of these minerals on the edge of the uplands of the south-west has been an important factor in the settlement and utilisation of the moorland areas throughout history and probably also prehistory. The weathering of the metalliferous lodes led to the deposition of material on high erosion plateaux and in valley bottoms. These valley deposits were sorted and concentrated by fluvial action, producing the deposits that were much sought after by tin streamers.

Cornwall and Devon lay outside the maximum extent of the last (Devensian) glaciation, but the area was affected by severe periglacial activity, which is responsible for the present topographical features of the moorland areas. The distinctive rounded 'tors' and extensive areas of tumbled rock, scree, or 'clitter', as it is known locally, are the result of periglacial action on the geology of the area. The tors mark a series of erosion surfaces at *c*.420m, 390m and 350m OD, formed during the Tertiary period (70-2 million years BP).

Soils and Vegetation

Brewster (1977) discussed the soil and vegetation characteristics of the moor. On the slate areas surrounding the moor, the soils are well drained, acidic brown earths. The soils of the moor are formed on the 'head' deposits, which are found on Dartmoor, Exmoor and east Devon, as well as on Bodmin. 'Head' is formed of locally derived, weathered granite fragments embedded in a finer matrix, known locally as 'rab' or 'growan' and soliflucted downslope in periods of intense periglacial activity.

Figure 1.5: The granitic intrusion of Bodmin Moor in its local geological context



The soils themselves range from coarse loamy brown podsols to ferric stagno-humic soils and deep basin peats of the Crowdy series. On the 'head' the most common is a gritty, stony yellow-brown loam. Podsols, gleys and peat are also all found on this surface; although the commonest is the peaty-gleyed podsol. This latter soil usually supports *Molinia-Agrostis* grassland. Below 200 m, and on some steeper, higher slopes, a humic brown podsol is found, which underlies *Agrostis-Festuca* grassland and bracken. Surface water gleys occur on the hill tops in association with rushes (*Juncus* spp.), heather *(Calluna vulgaris)* and purple moor grass *(Molinia caerulea).*

Peat deposits suitable for palaeoenvironmental work on Bodmin Moor are fragmentary, in contrast to Dartmoor, which due to its greater altitude and rainfall, is characterised by two extensive tracts of blanket bog above 460m OD. These bogs have ceased active growth and are presently suffering rapid erosion in some locations (Simmons, 1964). Bodmin Moor has only small areas of blanket peat, on High Moor and until recently, on Smallacombe Downs. Other thin areas of inactive blanket peat and mineral soils are the main feature of the moor. A great deal of peat has been removed through peat cutting for the tin industry in the 19th century century and for domestic use. Valley peats have also been disturbed through 'tin streaming' activities and the creation of reservoirs on the moor has also drowned other areas, as at Crowdy and Colliford. The implications of this apparent scarcity of undisturbed peat for palaeoenvironmental reconstruction are discussed in Chapter 2.

1.6 Settlement on Bodmin Moor: a summary

This section will present a brief summary of the evidence for the prehistoric settlement of Bodmin Moor, with some mention of later activity on the moor. Reference to the other uplands of the south-west will also be made, although the

majority of evidence is from Dartmoor, as there has been very little excavation on any of the other granite moors.

Bodmin Moor has been a focus for agricultural and pastoral activities since the earliest settlement of south-west England (*c.* 5000 BP) and has been described as being "invaded by large parcels of enclosed land which reach almost to every part" (Axford, 1975:9). The full spatial extent of prehistoric and medieval enclosure and settlement on the moor has been demonstrated by the recent publication of the Bodmin Moor survey (Johnson & Rose, 1994). The survey itself is the product of a six year collaboration between the Cornwall Archaeological Unit, English Heritage and the Royal Commission on Historical Monuments. Aerial photography was used to locate archaeological sequences and detailed (1:1000) survey of the 15 km^2 of the moor with the most complex remains carried out. The remainder of the upland was surveyed at a scale of 1:25000. In total, the survey identified some 4200 structures of prehistoric and later date, 1601 prehistoric huts, 500km of field boundaries and over 700 ha of cultivation ridges.

The south-west peninsula would have offered a wide range of resources to Mesolithic gatherer-hunters, ranging from the large estuaries and inland river valleys, to the upland areas of Bodmin, Dartmoor and Exmoor. The duration of the Mesolithic in Cornwall and Devon is unclear, although it might reasonably be seen as lasting around 2-4000 years (Herring & Lewis, 1992). Mesolithic communities, by their very nature, are unlikely to leave any trace in the archaeological record, except in the form of microlith scatters that represent implement manufacture and animal kill/butchery sites. Jacobi (1979) constructed a model of Mesolithic landuse for the south-west, based on the seasonal availability of resources: the spring-early summer was probably spent near the coast due to the availability of fish, shell-fish and sea birds. The gatherer-hunter communities may have followed the movement of deer onto the uplands in mid-late summer, whilst a movement back to the rocky coastlines in the winter and

early spring would have permitted the exploitation of fish, shell-fish and sea birds.

Dennell (1983) has pointed out that such models remain largely untested and a number of different explanations may apply, whilst Berridge & Roberts (1986) discuss the reliance of this model on the proposed movements of red deer, largely ignoring the possible importance of lithic material and plant foods. The most substantive collection of microliths from Bodmin Moor is from around Dozmary Pool (Wainwright, 1960; Jacobi, 1979). Brown (1977) pointed out that Dozmary Pool has been a continuously open body of water since the late-glacial and this probably explains why it may have acted as a natural focus for gatherer-hunter bands. Jacobi (1979) suggested that the majority of the Mesolithic flints from Dozmary Pool dated to the 'early hunter' period (8-10000 BP) Other flint scatters have been discovered in the eroding banks of Crowdy and Siblyback Reservoirs (Trudigan, 1977a,b), in other areas such as in eroding hedge banks and in ploughed fields across the moor (Herring & Lewis, 1992). Flint scatters were also found in residual contexts in the excavations of the Colliford Barrows (Griffith, 1984) and a cairn near Crowdy Reservoir (Trudigan, 1977a).

Recent field walking in the Butterstor area has led to the discovery of 36 concentrations of flints in an area of 5.3 hectares (Herring & Lewis, 1992). The authors calculate that if the density of sites in this area is representative of the whole moor, some 140 000 scatters of flints would be expected over the 20 000 hectares of the moor (Herring & Lewis, 1992:9). However, the small size of most scatters suggests that the majority represent single episode use of sites and not home base or semi-permanent habitations. The estimated number of flint scatters when spread across the 2-4000 years of the Mesolithic, suggests a low site creation rate and perhaps only 3 or 4 gatherer-hunter bands were utilising the 200 square kilometres of Bodmin Moor during the Mesolithic period at any one time (Herring & Lewis, 1992).

By way of comparison, Jacobi *et al.* (1976:308) estimated that at any one time only around 25 such bands could have been operating in the south Pennines, an area of approximately 24 000 square kilometres. Such estimations indicate that the carrying capacity of upland areas for gatherer-hunter groups was surprisingly low. Dartmoor, Bodmin Moor's larger neighbour, has yielded comparatively little archaeological evidence of Mesolithic utilisation apart from occasional flint scatters (Jacobi, 1979), although the extensive blanket peat which covers much of this upland probably conceals a large number of microlith scatters (Caseldine & Hatton, 1993).

The evidence for Neolithic settlement on Bodmin Moor has increased markedly in recent years; the hill-top enclosures of Rough Tor, Stowes Pound, De Lank and several other possible sites (Berry Castle, Tregarrick Tor and Notter Tor) and the long cairns at Bearah Tor, Louden and Catshole have all been tentatively attributed to the earliest Neolithic (Todd, 1987; Herring & Lewis, 1992; Johnson & Rose, 1994). The dating of these structures is largely based on the apparent similarities between these sites and the excavated Neolithic hill-top settlement of Carn Brea, near Redruth (Mercer, 1981). The Trevethy Quoit burial chamber on the south-eastern edge of the moor and the Stripple Stones Henge at Hawk's Tor also indicate Neolithic activity on the moor. The distribution of chambered tombs on Dartmoor, such as Butterdon Hill, Cuckoo Ball and Meacombe suggests a similar interest in the eastern and southern fringes of this moor in the Neolithic (Todd, 1987), which may have taken the form of seasonal, pastoral use of the upland (Fleming, 1988).

Despite the possible evidence for an early interest in the uplands, the precise timing of settlement on Bodmin Moor remains unclear. Grooved ware sherds from the excavation of the Davidstow Moor barrow cemetery point to some form of activity in the north-west sector of the moor in the later Neolithic (Christie, 1988). Other evidence supporting Neolithic utilisation of Bodmin Moor is

indicated by Hencken's (1932) report of axes and leaf arrowheads from the Altarnun parish and Mercer's (1970) discovery of two ungrouped greenstone implements of unknown date from a possible cultivated surface during the excavation of a hut circle on Stannon Down, 1 km to the south-west of Rough Tor. Rose (in prep.) postulates that the stone circles and stone rows, that are as yet undated on Bodmin Moor, may belong to the fifth rather than the fourth millennium BP.

Settlement on the south-western uplands is thought to peak during the Bronze Age, although there has been little excavation on Bodmin Moor and even less on the other Cornish granite areas. Exmoor has a large number of barrows and cairns, but fewer groups of huts or enclosures, perhaps pointing to less intensive settlement (Todd, 1987). Most of the dating evidence for settlement in this period is derived from parallels with Dartmoor, although the number of excavated sites here is very low in comparison to the total extent of remains on the moor: only 6 of the 2546 huts on the moor have been dated by radiometric methods (Price, 1993).

The best examined sequences on the moor are the 'reave' systems, an extensive system of land boundaries laid out around the fringe of the moor *circa* 3200BP (Fleming, 1978;1983;1988). Beyond the enclosed land is open moorland that seems to have functioned as a communal area of rough pasture. Fleming (in Todd 1987:119) described a model for the cultural context of the reaves in which

"...land is 'owned' at a higher socio-political level, probably that of the community responsible for the system as a whole...presumably consisting of closely related households co-operating in all manner of agricultural operations."

Parallels between the Dartmoor reaves and the East Moor co-axial system on Bodmin Moor have been suggested (Fleming in Todd 1987; Fleming, 1988) but the piecemeal layout of the latter indicates that this is not an entirely accurate

comparison (D.Hooley, pers.comm.).

The Stannon excavation (Mercer, 1970; 1976) demonstrated Bronze Age settlement in this part of the moor, but little other direct evidence of the timing of human activity on Bodmin Moor is available, although it is thought probable that the majority of the huts and field systems on the moor belong to the third-fourth millennium BP (Todd, 1987; Christie, 1988). Radiocarbon dates from excavated cairns on Bodmin Moor fall between 2162-1746 cal.BC, pointing to the Bronze Age as the main period of cairn construction (Harris *et al.*, 1984; Christie, 1988), although the date range for the settlements on the moor is likely to be wider (Johnson & Rose, 1994). The excavation of the Colliford barrows (Griffith, 1984) also demonstrates Bronze Age activity. The Rillaton barrow in the south-east of the moor was opened by workmen in the nineteenth century and artefacts discovered inside included a gold cup, bronze dagger and beads; characterisitic components of the richly furnished early Bronze Age burials found in Wessex (Todd, 1987).

The end of Bronze Age settlement on the moors is thought to be due to the mid-first millennium climatic deterioration (Todd, 1987:151), although the precise status of first millennium settlement on the uplands is unclear and may have continued in some areas, including Bodmin Moor (Quinell, 1986). Iron age pottery discovered in the settlement at Garrow Tor demonstrated some form of activity on the moor at this time (Silvester, 1979). The defended settlements or 'rounds' that cluster around the moorland, such as Trevinnick on the west side of Bodmin Moor and Allabury on the East Moor, belong to the Iron Age/Romano-British periods and have been interpreted as indicating a continuing interest in the moorland resources, although some are clearly defensive structures in strong natural positions where topography and altitude were more important than economic considerations (Silvester, 1979:181). Human interest in Bodmin Moor seems to have been restricted to its use as seasonal grazing from the early historic

medieval period (11th to 14th centuries), when a number of socio-economic and environmental factors led to the settlement and cultivation of large areas of the upland (Preston-Jones & Rose, 1986; Johnson & Rose, 1994). Table 1.1 summarises the general sequence of human settlement on Bodmin Moor with the corresponding archaeological evidence as it is presently understood.

The lack of excavation on Bodmin Moor means that there is a surprising dearth of evidence concerning the timing and nature of prehistoric settlement. Most of the assumptions regarding the patterns of anthropogenic activity are based on structural comparisons between sequences on Dartmoor and elsewhere in the south-west. Another source of data that is frequently utilised by archaeologists to characterise changes in settlement on Bodmin Moor (eg. Silvester, 1979; Todd, 1987; Christie, 1988) is that derived from palaeoenvironmental studies. However, as the following section will show, this is despite the relative lack of studies on the moor that relate specifically to the main periods of prehistoric activity.

Yrs BP (appx)	Archaeological Evidence	Inferred settlement/landuse *Population*
	Moorland hamlets	Medieval cultivation and grazing *High*
	Transhumance huts?	Seasonal grazing
2000 -	Garrow Tor settlement	*Very low*
	↑	
	Transhumance settlements?	Settlement moves off uplands but some permanent occupation possible. Grazing on uplands continues. *Low/very low*
	↑	
4000 -	Stannon settlement, Colliford barrows. Davidstow barrows. Cairns. Majority of huts & fields, ritual monuments?	Bronze Age peak in moorland settlement. Intensive pastoral activity. *High*
	↑	
6000-	Flint scatters. Hill top enclosures? (Rough Tor, Stowes Pound) Long cairns? (Louden, Bearah Common, Catshole) Trevethy Quoit, Stripple Stones. Ritual monuments?	Periodic/seasonal use of uplands *Very low/absent*
	↑	
	↑	
8000 +	Flint scatters at Dozmary Pool and other locations	Seasonal use of uplands. *Absent*
	↑	

Table 1.1: Summary of archaeological evidence and inferred land-use and population level on Bodmin Moor. A question mark indicates that the evidence is conjectural and no dating evidence is available. Population refers to estimated population resident on the moor itself.

1.7 Palaeoenvironmental evidence from Bodmin Moor

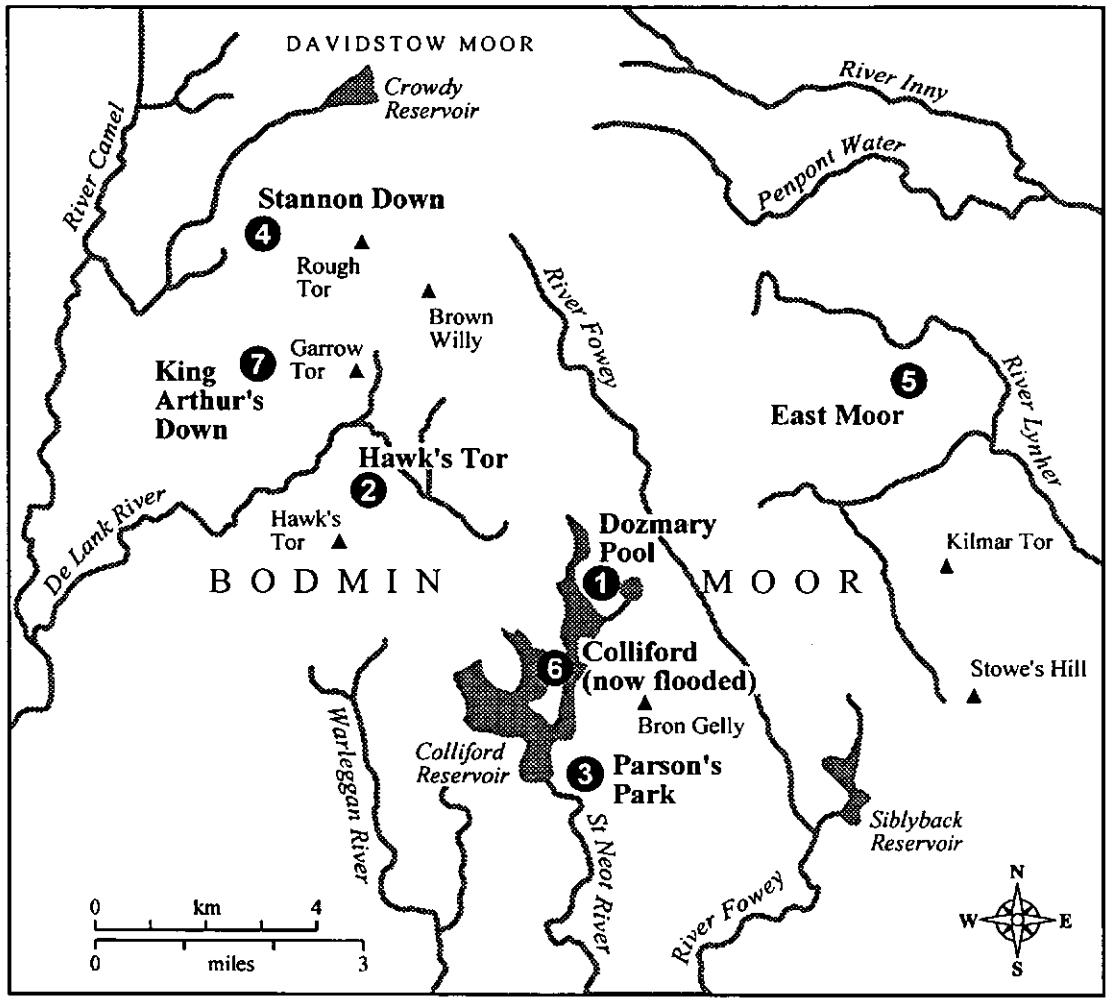
The following section is concerned with the palaeoenvironmental research that has been completed on the moor. Figure 1.6 shows the location of previous palaeoenvironmental studies on the moor.

Long profile studies

The basic post-glacial vegetational sequence of Bodmin Moor was established by Conolly *et al.* (1950) from a sequence at Dozmary Pool (Figure 1.6). The lowest deposits (230 cm of a 270 cm profile) contained high levels of *Corylus* and *Betula*, low levels of *Quercus* and *Ulmus* and no *Tilia* or *Alnus*. This phase was attributed to pollen zone V (the Boreal) of the Godwin scheme (Godwin, 1940;1975). Layers of ash and charcoal located in the core appeared to coincide with sudden drops in the frequencies of arboreal pollen.

Brown (1977) examined deposits from Hawk's Tor, Dozmary Pool, Stannon Marsh and Parson's Park and this study remains the major source of evidence of palaeoenvironmental change for Bodmin Moor. The following is largely a summary of his work, with comments from Caseldine's (1980) review of the data. Figure 1.7 presents the sequence as established by Brown in schematic form (after Caseldine, 1980). The earliest dated lateglacial deposits are at Hawk's Tor and Parson's Park; the former yielded a radiocarbon date of 13088±300 BP (Q-979). The landscape was dominated by a rich herb flora, although Brown considered the above radiocarbon date to be too young for the incorporated flora. The ameliorating climate which led to the lateglacial interstadial saw the development of juniper scrub by around 12000 BP at Hawk's Tor, and the spread of birch scrub (11500-11000 BP) into the valley bottoms. Caseldine (1980) thought it likely that birch was much more widely spread at lower altitudes. The brief cold-snap of the Younger Dryas (Loch Lomond stadial), between 10800 and 10300 BP is marked by the disappearance of the woody components of the flora.

Figure 1.6: Locations of palaeoenvironmental studies on Bodmin Moor



Years BP	Lowe & Walker (1984)	BODMIN MOOR		
		Summits	Hillsides	Valleys
5000-			Hazel scrub Oak woodland prevalent at lower altitudes	
6000-		↑		
			woodland recession: alder rise	raised bogs alder carr
7000-	*The Holocene*			↑
		↑		smaller bogs & grassland
8000-			↑	raised bog
9000-		Upland grassland and heather moor	open woodland with elm	birch-willow carr
		Empetrum heaths	birch-hazel copses hazel-oak scrub	*Sphagnum* sedge mires
10000-	.....			
	Loch Lomond Stadial	moss/lichen heaths	snowbeds	
11000-	.....	grass heaths		tall herb-poor mires
			Juniperus scrub and ericaceous heath	birch-willow carr
12000-	*Lateglacial*			
	Interstadial	↑	↑	tall herb rich fen
		moss/lichen heaths	grass/heaths	peaty lakes
13000-				

Figure 1.6: Lateglacial/early Holocene environmental change on Bodmin Moor based on Brown (1977) (After Caseldine, 1980:6). Climatic division after Lowe & Walker (1984:10).

The initiation of colder conditions was dated at Hawk's Tor to 10884± 210 BP (Q-1016). The improving climate that marks the beginning of the Holocene is first evidenced on Bodmin by a radiocarbon date of 9654±190 BP (Q-1017) from a sedge peat at Hawk's Tor. The vegetation cover consisted of juniper scrub and *Empetrum* heath. The archaeological record has been interpreted as indicating that Mesolithic communities were already exploiting the moorland at this stage (Jacobi, 1979). Birch woodland had possibly developed in the valley bottoms by this time (Caseldine, 1980). Climatic improvement was deduced from the presence of *Hedera* pollen by 9200 BP, which requires average summer temperatures of at least 13° C. By this time, *Quercus* and *Corylus* were evident in the diagrams (*c*.9000 BP), seen as indicating that both these taxa had become established on the moor, especially in more sheltered locations. The steady rise in *Corylus*, in an environment that was ideal for colonisation by this taxa was thought to demonstrate that the climatic improvement was only gradual. As Caseldine (1980) pointed out the work of palaeoentomologists such as Coope (1977) provides a warning of the limited value of the pollen record in interpreting rapid climatic changes. The growth of mire vegetation at Dozmary pool suggests that water levels may have been lower around 7-4500 BP and were associated with charcoal layers, interpreted as indicating a period of increased dryness, which Brown attributed as being due to the influence of warmer continental air masses (Brown, 1977).

Brown (1977) concentrated on the first half of the Holocene, his latest radiocarbon date being 6451±65 BP (Q-1025). After this point, his dates were based on vegetational composition and on correlation with the archaeological evidence, which leads to a circularity of argument (Caseldine, 1980). Brown (1977) saw no evidence of Mesolithic/Neolithic human activity, despite the record of *P.lanceolata* in his diagrams from below a tentatively identified *Ulmus* decline. He also interpreted increases in Poaceae and declines in *Betula* and *Alnus* in this period as the effect of an expansion of valley bog at the expense of valley woodland.

Bronze Age activity was regarded as being largely pastoral due to the dominance of *P.lanceolata, Rumex acetosella, Urtica, Pteridium* and low levels of *Cerealia*-type in the pollen diagrams. The pattern is one of a general decline in woodland cover and increasing representation of *Centaurea cyanus* (possibly indicating cultivation), whilst increases in *Pteridium* and *Ulex* were interpreted as representing the invasion of field boundaries, due to a reduction in grazing pressure. However, although the moorland around the pool may have been used as rough grazing, there were no actual prehistoric field systems or enclosures within 2 km of Dozmary Pool. The vegetation of these fields would not be clearly recorded at the Dozmary Pool sampling site: the record of *Pteridium* and *Ulex* probably represents growth of these species on the drier slopes around the mire. The increase in these taxa thus may or may not have been closely related to changes in the intensity of grazing pressure. A change in stratigraphy from moderately humified to unhumified peat was interpreted as marking a climatic deterioration at the end of the Bronze Age (*c.*2500BP). Iron Age activity was seen as moving off the upland area with the apperance of *Fagus* seen as being a result of the spread of beech due to disturbance to the lowland forests. A decline in *P.lanceolata* at Hawk's Tor and Parsons Park was possibly due to a tailing off of upland agriculture.

From the early Holocene onwards, tree and shrub pollen in Brown's diagrams never rises above 50-60% of total pollen, a feature which was confirmed by pollen analytical work at Redhill Marsh (Caseldine, 1980). This feature was interpreted as indicating that the vegetation of the moor was largely open with grass and heather communities a feature of the environment of the moor. This is explained as being due to the suppressive effect of westerly airflows which dominate the climate of the moor on woodland development. Another possibility was that the topographic location of Brown's sampling sites might mean that any woodland edge may have been some distance away and therefore not clearly detected in the pollen diagrams.

Doubt has also been cast upon the extent to which the pollen diagrams represent the 'natural' vegetation of the moor, since Dozmary Pool appears to have been a focus of Mesolithic activity in the 'early hunter' period, around 8-10000 BP (Jacobi, 1979) and thus much earlier than the date suggested by Brown for the Dozmary microlith assemblage. This period is characterised by *Empetrum* heath and juniper scrub on the hillsides, just prior to the spread of birch woodland. Charcoal layers identified in Brown's core were dated to 7925±100 BP (Q-1023), and further layers higher up to 6793±70 BP (Q-1024); these layers were associated with a birch maximum in the pollen diagram. These levels cannot be stratigraphically associated with the artifacts discovered at the pool, but it has been suggested that they represent evidence of Mesolithic burning (Smith, 1970; Bell, 1984), although Brown was of the opinion that burning would have been unnecessary in the predominately open landscape he envisaged around Dozmary Pool in this period.

Simmons *et al.* (1987) also analysed a core from Dozmary Pool. The results were broadly similar to those of the two earlier studies: total tree pollen does not rise above 42%, and is generally between 18-32% of land pollen. *Quercus* was the major arboreal pollen, varying between 40-65% of AP and *Alnus* rose to a peak of 25%, although it oscillated in value and did not demonstrate any clear and sustained rise. *Ulmus*, *Fraxinus*, *Tilia* and *Pinus* all occured in small, sporadic quantities. Shrub pollen in the form of *Corylus/Myrica* reached a peak of 50% and then fell off to a low of 10%. The levels of herb pollen were interpreted as reflecting the presence of some open land around Dozmary Pool.

The radiocarbon dates obtained from the sequence indicated that the deposits analyzed are non-sequential. Five dates were obtained, of which the top four for the sequence are not in chronological order. Simmons *et al.* (1987) suggested that this may be due to either contamination of the samples, or because of considerable disturbance to the upper part of the profile. In the light of this, the palynological

analyses must be viewed with a great deal of caution. The results may also cast some doubt upon the integrity of the pollen record from the mid-late Holocene published by Brown (1977).

Walker & Austin (1985) examined a peat profile from Redhill Marsh (now drowned under Colliford reservoir - Figure 1.6). The sequence was only 1 metre in depth, but apparently showed early Holocene vegetational development in the area. *Salix* scrub, *Juniperus* and *Empetrum* heath are replaced by *Betula* and later by woodland dominated by *Quercus* and *Corylus*. A marked change in the stratigraphy was interpreted as a hiatus in sediment accumulation as the pollen record above this level displayed an abrupt expansion of heath and grassland and an increase in *Alnus*. The uppermost zone of the diagram reflected the progressive disappearance of tree and shrub cover and the final spread of grass and heathland. A layer of wood fragments consisting of *Betula* and *Salix* roots and branches overlying a layer of *Betula* stems and twigs towards the base of the sequence was dated to 8655±65 BP and 9250±85 BP (Gu-1739). The authors concluded that the layer was difficult to explain in terms of natural processes and it was interpreted as some form of platform constructed by Mesolithic gatherer-hunters, perhaps as part of wildfowl hunting activities on the marsh.

Palaeoenvironmental studies on archaeological sites

The environmental evidence derived from pollen analyses from areas of enclosure and settlement on the moor provides more direct indications of the nature of anthropogenic activity, although these studies are usually bereft of a longer context of environmental change. A series of hut circles and field systems on Stannon Down (Figure 1.6) were excavated by Mercer (1970) prior to their burial by china clay works. The archaeological report described a layer of cultivated soil, predating the construction of the hut circles (3110±95 BP - NPL-134). Pollen analysis of this layer (Mercer & Dimbleby, 1978), however, failed to find any evidence of cultivation either below the walls excavated, or in association with the

fields, and the majority of the weed pollen in the samples (*Potentilla*, *Galium*-type) was characteristic of pastoral rather than arable farming. The peat sealing the remains was assumed to be the result of climatic deterioration, but the Cyperaceae curve displays only a steady rise, which Bell (1984) considered to be incompatible with this hypothesis. The behaviour of the Cyperaceae curve would not seem to automatically invalidate an hypothesis of climatic deterioration, considering that the species of Cyperaceae represented in the pollen diagram and hence their precise edaphic affinities, are unknown. The decrease in *Quercus*, *Corylus* and *Pteridium* followed by an increase in that of *Calluna*, is suggested as being a result of site deterioration due to increased anthropogenic disturbance.

Dimbleby (1963) studied the pollen from beneath two barrows at Otterham and Wilsey Down on the northern edge of the moor, alongside pollen evidence from Bronze Age sites at Crig-a-Mennis (Christie, 1960). The evidence from this latter site was obtained from the upper-organic horizon of a podsolic soil found below the barrow and indicated that the barrow had been constructed in a clearing in hazel-dominated woodland. The record of *Calluna* and the podsolic nature of the soil, suggested that soil acidification had begun by the time of the construction of the barrow. No indicators of arable cultivation were found, but some taxa characteristic of disturbed ground might be regarded as evidence of cultivation.

Brisbane & Clewes (1979) surveyed the prehistoric and later field systems on the East Moor (Figure 1.6) in the area of Clitter's Cairn and carried out studies of the soils and pollen associated with the cairn and its surroundings. The soil pollen from beneath the cairn indicated that the vegetation had been one of oak woodland that had been cleared prior to the construction of the feature, whilst pedological examination of the soil revealed that podsolization was already underway by this time. The later field boundary that overlay the cairn was examined and the soil profile beneath exhibited some disturbance, which was suggested as being due to earthworm activity. The pollen associated with this profile produced no evidence

of cultivation either in this layer or in the adjacent fields. One small field exhibited cultivation in the form of ridge and furrow features that were sealed by peat and thus were assumed to be of prehistoric date. However, most of the ridge and furrow features were of a medieval date and could only have been cultivated for a short period.

Soils from beneath Bronze Age barrows at Colliford, on the southern fringes of the moor, on opposite sides of the St. Neot river were investigated by Maltby & Caseldine (1982;1984) as part of archaeological excavation of two barrows (Griffith, 1984), prior to the submergence of the valley to create a reservoir (Figure 1.6). The two barrows are situated in similar topographic positions; one facing south-west and the other north-east and radiocarbon dates from the structures proved to be statistically inseparable (between 3500 and 3600 BP). Pedological examination of the palaeosols from beneath the two structures, however, demonstrated important differences in soil development beneath each one.

The palaeosol on the south-west facing slope was a brown podsol that had probably developed from a brown earth. In contrast, the soil from beneath the other barrow was in an advanced state of podsolization and had a prominent iron pan, eluvial (Ea) horizon and marked peaty surface and had also quite probably developed from a brown earth. Micromorphological analysis of the brown podzol revealed that the channels in the soil were probably evidence of earthworm activity prior to the barrow construction.

Pollen analysis showed that the vegetation around the site at the time the construction of the barrow began was one of light woodland, probably mainly on the lower slopes of the valley. The vegetation prior to this was open grassland. Heather appeared to be more prominent in the local vegetation prior to the spread of the grassland and it is implied that this was because the vegetation was one of scrubby hazel and oak with open areas dominated by heather, that had already

been modified by Neolithic activity. Burning, possibly in conjunction with over-grazing, may have been responsible for the demise of heather as a major component of the local vegetation. The degradation of the soils may have been due to nutrient stress, changing microclimate, hydrological and vegetational change (or a combination of all four), although the authors stressed that climatic deterioration could not be ruled out. The most pertinent issue raised by this study, however, is the variation in soil and vegetation across such a small area. Soil degradation was clearly more advanced at one location than at another of indistinguishable date and similar location. Several reasons for this are advanced:

i) Different land-use regimes meant that podsolization and the development of a peaty surface occurred much faster at one location than at the other.
ii) Changes in soil were governed as much by slight differences in slope, hydrology and site conditions as by land use, and the inter-play of these factors is still poorly understood.
iii) There may have been a time difference between the two barrows that is obscured by the standard errors of the radiocarbon dates, long enough for the changes in fabric indicated by the different profiles to have occurred.

As the authors pointed out, whatever explanation is correct, this study raised one problem of palaeoenvironmental reconstruction that applies on a more general level: in many situations, the complexities that govern environmental variation are not fully understood and are often smoothed over or ignored in an attempt to provide a clear explanation or model of landscape change.

Following the Bronze Age activity, the vegetation in the Colliford area was *Molinia, Calluna, Erica* and *Ulex*. The organic horizons developed into peat layers and iron pan formation commenced. The medieval period brought local ridge and furrow cultivation, and the post-medieval period saw the improvement of certain fields, mainly after the 17th century. This latter phase is important because it has

produced soils that are comparable in structure and chemistry to the buried brown podzol, thus demonstrating that processes of degradation can be reversible.

Straker (in preparation) carried out pollen analyses on sediments from Stannon Down and 'King Arthur's Hall' (Figure 1.6), a mysterious structure, presumed to be of medieval date, although a prehistoric origin is possible (Johnson & Rose, 1994). Samples were obtained from beneath prehistoric boundaries and ditches and also from features associated with 'King Arthur's Hall'.

The organic layers from beneath two of the boundaries were radiocarbon dated to 3380±50 BP and 3310±50 BP. With the exception of two of the profiles examined, the analyses showed that there was no extensive woodland cover when the pollen accumulated, although patches of hazel-dominated scrub and open woodland were present, that included oak, alder and birch, at a short distance from the site. Samples from two of the trenches contained high (50-91%) levels of arboreal pollen, suggesting that they accumulated under woodland cover. The profiles exhibited decreasing levels of arboreal pollen, indicating progressive clearance of the woodland. There was no evidence for cereal cultivation in the samples, either in the form of cereal pollen, or weeds of cultivation.

The pollen samples recovered from 'King Arthur's Hall' were found to be more difficult to interpret. These samples were obtained from a bank that appeared to consist of a black peaty core, buried beneath a more mineral-rich material overlying a buried soil. The pollen from the peaty core contained 30-40% tree pollen, with 10% Ericales and *c.* 50% grass and herb pollen and displayed a drop in tree and shrub pollen and an increase in Ericales up the profile. The samples from above, however, reverse this trend and show an increase in tree and shrub pollen; lime and oak pollen in particular. Two explanations were advanced for this:

i) the sequence indicated a return to a patchily wooded landscape, with open heather moor areas; and is thus a reversal in the trend indicated by the samples from Stannon which apparently displayed a progression toward open moorland.

ii) the possibility existed that the features at 'King Arthur's Hall' were not medieval, and represent an earlier phase of landscape development.

In the light of the recent reassessment of the date of the features, the latter explanation may be favoured.

A micromorphological study of buried soils from contexts in this part of the moor (Grattan, unpublished) concluded that palaeoenvironmental conditions on the moor prior to the construction of prehistoric boundary walls were not significantly different to those at present. The soils were typical of those formed during cold, wet conditions. The construction of boundary walls in this part of the moor was not in response to a deteriorating soil resource, although possible evidence of anthropogenic enrichment of the soil was found in one context. The author concludes that the soils could very well have evolved and degraded from a brown earth, as has been suggested by other workers on the moor (Maltby & Caseldine, 1982;1984).

The later phases of human land-use on Bodmin Moor are illustrated by a pollen diagram from the integrated archaeological/palaeoenvironmental investigations of medieval and post-medieval settlement at Bunning's Park in the parish of St. Neots (Austin *et al.*, 1989). Pollen analysis of a shallow peat profile, within a short distance of the medieval mill site, provided an estimated 1000-year long profile, although the earliest radiocarbon date was 440±70 BP (HAR-4459). This was augmented by pollen analysis of buried soils and turf layers from sites at Colliford and Bunning's Park.

The vegetational reconstruction begins in the first millennium AD. The landscape at this time was one of open grassland with limited wood and scrub, with little indication of either arable or pastoral activity. By the end of the first millennium, the pollen spectra indicated decreasing levels of wood and scrub and increasing evidence of heathland and pasture. The valley floor appears to have been drier around this time, although whether this was due to changing climatic conditions or the effects of tin streaming on the hydrology of the area is unknown. Some evidence of cereal production was apparent at this date, although it was small in scale and intermittent.

By the late 12th/early 13th century, there was a sudden surge in cereal and pastoral indicators, coinciding with the creation of ridge and furrow features in nearby fields. Documentary evidence showed that there was colonisation of the more northerly parts of the St. Neots moorland in this period, which had a marked impact upon the vegetation and soils of the area, leading to decreasing fertility. Cereal production reached a peak in the second half of the fourteenth century, after this it declines and eventually disappeared. Increasing wetness was indicated in the pollen record, which was attributable either to tin working activities or changing patterns of land management.

1.8 Palaeoenvironmental study on Bodmin Moor - summary

Brown's (1977) study remains the main source for the vegetational history, not only of Bodmin Moor, but for the whole of Cornwall, and in the absence of other studies, has been used in syntheses of the postglacial vegetational development for this area of the British Isles (eg. Birks, 1988b). Certain features of Brown's diagrams have been confirmed by other investigations; for example, the lack of a clearly definable elm decline is a feature of pollen diagrams from Dartmoor as well as Bodmin and the generally low levels of *Alnus* pollen are likewise a feature

of pollen diagrams from the south-west (Caseldine & Maguire, 1984). The general vegetational composition (*Quercus-Betula-Corylus*) has been largely confirmed by other palynological studies from the Moor (eg. Brisbane & Clewes, 1979; Mercer & Dimbleby, 1978): oak and hazel apparently formed the main arboreal components of the postglacial vegetation. Pine never became firmly established, nor did elm, the failure of the latter to spread probably being due to the poor soils (Caseldine, 1980).

Prehistoric land-use was predominantly pastoral in emphasis as cereal pollen appeared in only very low quantities at most sites or was absent entirely (Brown, 1977; Mercer & Dimbleby, 1978; Brisbane & Clewes, 1979; Maltby & Caseldine, 1984). These studies have also demonstrated that a certain degree of variation occurred in the spatial and temporal rate of vegetation clearance. Such studies show distinct limitations with regards to drawing firm conclusions about large scale variations and the temporal pattern of human activity. The nature and extent of early (Mesolithic-Neolithic) activity remains unknown: Caseldine (1980) postulated that the high percentages for hazel found during the Bronze Age may represent secondary woodland, the anthropogenic disturbance of the earlier oak-hazel canopy allowing the spread of the light-demanding hazel but accepted that, given the dominance of this taxon at higher altitudes, such an hypothesis is hard to maintain. There is evidence for Bronze Age activity from the excavations and palaeoevironmental study at Colliford (Griffith, 1984) and Stannon (Mercer, 1970) and radiocarbon dates available from the excavated cairns and barrows on the moor (Trudigan, 1977a, b; Christie, 1988). There is little palaeoenvironmental data concerning Iron Age/Romano-British activity on the moor. The agricultural expansion of the medieval period is recorded at Colliford and Bunning's Park (Austin *et al.*, 1989).

1.9 Human-environment relations on Bodmin Moor during the Holocene - research aims

In the light of previous palaeoecological and archaeological study on Bodmin Moor, four main research aims for this project were identified:

i) ***The further elucidation of the general vegetational pattern*** Generalisation about the environmental evolution of areas the size of Bodmin from only one or two profiles for a region the size of Cornwall is clearly unsatisfactory. This project seeks to elucidate the pattern of vegetational development on the moor prior to the earliest human impacts in more detail. In particular, certain aspects of the nature and sequence of vegetational development as described by Brown (1977) may be examined. The low levels of *Pinus*, early spread of *Quercus* and erratic rise of *Alnus* are taken to be a general feature of the Holocene vegetational history of Cornwall (Birks, 1988b) but are based on limited data. Heath and grassland may have been extensive due to the supression of tree growth by exposure. These assertions are tested through further palynological study.

ii) ***The timing and extent of human impacts*** Improved understanding of the timing and magnitude of anthropogenic impact across the moor is linked closely with the above question and is a major aim of the thesis. Little evidence is available to suggest when the vegetational cover was first modified by human activity and existing research provides little insight into the influence of Mesolithic and Neolithic communities on the natural woodland. This impact would not necessarily be expected to be the same in all locations and at all times and the palaeoecological investigation of different sites should display the spatial and temporal extent of human impact on the moor. For example, vegetation clearance may be very marked in the palynological record in one location, yet apparently much subdued in another in the same period. The establishment of the pattern in key locations will clarify the pattern of the changing environment across the moor.

iii) ***Integration of the archaeological and palaeoecological records*** The extent to which such patterns of change correlate with archaeological evidence of settlement is also important. Is prehistoric vegetation clearance a markedly time-transgressive event, that commences in different sites at the different times, or is it a process which begins in different locations at roughly similar times? This point can be well illustrated by the example of Dozmary Pool (Brown, 1977), where the known early Mesolithic activity might explain the lack of woodland: in this case the vegetational climax might never have been attained in this area. The vegetational development may be revealed to follow a different pattern elsewhere on the moor.

iv) ***Landuse patterns*** The prehistoric land-use of much of Bodmin Moor is based upon certain presumptions concerning the form of the extant field systems (Johnson & Rose, 1994). Permanent settlement is inferred from large huts (4.5-6m) and seasonal settlement is indicated by concentrations of smaller huts. Long boundaries, especially stone walls faced on both sides, indicate the control of stock and grazing areas. Curvilinear fields, cleared areas and lynchetting within fields indicate cultivation. Enclosures, depending upon whether they are lynchetted or not, represent either areas of cultivation, or stock enclosures. The sequence of change is inferred from the overlaying of features but no independent dates are available for each phase.

At present, no firm palaeoenvironmental evidence exists to support these inferences. The evidence that does exist (eg. Brisbane & Clewes, 1979; Maltby & Caseldine, 1984) is derived from pollen studies of soil profiles, that provide what Herring *et al.* (1993) refer to as 'snapshot' views of short stretches of environmental history and are isolated from the long-term picture of anthropogenic exploitation of the land resource. Detailed palaeoenvironmental investigation of critical locations will not only expand the picture of Holocene environmental change and human impact, but will provide a template for the interpretation of the archaeological database.

The use of fire as a tool for ecological management is also connected with the question of human impact on the environment. Can clearance phases evidenced in the pollen record be associated with charcoal layers, as is found in the palynological data from sites on Dartmoor (Simmons, 1969; Caseldine & Hatton, 1993) and attested for other upland areas in Britain, such as the Pennines (Simmons *et al.*, 1981)? Although Brown (1977) considered this in the light of his pollen analytical work on Bodmin, he rejected the notion of anthropogenic burning in the vicinity of Dozmary, as he considered the landscape to be generally open and the deliberate firing of vegetation therefore unnecessary. This situation may be different in other locations on the moor. The question of the Mesolithic/Neolithic boundary in relation to the palynological and charcoal records would be of particular interest, in the light of the discussions of researchers such as Edwards (1988) on the detection of this in the palynological record.

The volume of settlement on uplands such as Bodmin and Dartmoor has prompted some researchers to propose that these areas were particulary attractive to prehistoric communities for some reason and it was only a deterioration in climate, soils or vegetation that led to their abandonment. Alternatively, it has been suggested that the uplands have always been marginal areas, that were only settled through land-hunger, or climatic improvement. Fleming (in Todd, 1987) argues that it is not always entirely clear what proponents of this argument define as 'marginal', or whether such a concept existed in prehistory.

1.10 Summary

This chapter has examined the palaeoecological data for Bodmin Moor and the other granite uplands of south-west England. Research issues that remain unanswered or poorly understood have been discussed and the key research aims of the project have been outlined. This has been considered against the

background of palaeoenvironmental work, or the lack of it, in the case of areas such as West Penwith, on the other granite uplands of the south-west. The next chapter discusses the palaeoecological techniques employed and examines some of the theoretical and practical considerations behind them. In the light of these, the research framework that has been adopted for palaeoecological investigations on Bodmin Moor is described.

Chapter Two: Palaeoecological Techniques - Theoretical and Practical Considerations and a Research Strategy for Palaeoenvironmental Investigations on Bodmin Moor

2.1 Introduction

This chapter discusses the theoretical and philosophical basis of palaeoecological studies and introduces the main palaeoecological techniques employed in this project. These include pollen and charcoal analysis, loss-on-ignition and radiocarbon dating. Survey and sampling methods will also be outlined as well as details of data collection and analysis. The methodologies and techniques outlined below were followed at every site investigated unless otherwise indicated.

2.2 Philosophical approaches and palaeoecology

There has been increasing interest and concern over the philosophical and theoretical underpinnings of physical geography in recent years. This has mainly arisen from the recognition that the

"theoretical framework [of physical geography] seems not to have developed as in other disciplines" (Haines-Young & Petch, 1986:201).

Despite the recognition of the need for a more critical physical geography, the extent to which theoretical approaches have been integrated into practical investigation and explanation in physical geography have yet to attain the profile

that theory occupies in archaeology, for example (Shanks & Tilley, 1987 a, b). Recent criticism of this situation and an attempt to bring the theoretical development of environmental archaeology up to date with its sister discipline of archaeology has been attempted (McGlade, 1995). Whether this will have any effect on the mainstream of palaoenvironmental study remains to be seen.

Despite technological advances in pollen-analytical techniques, palaeoecology has been subject to very little introspection. Edwards (1983) reviewed all the Quaternary palynology papers published during 1981 (39 in total) in six selected journals. He examined each paper for three main issues:

i) was there a clear formulation of a problem to be tackled?
ii) did the researchers set out to test hypotheses? Edwards (1983:116). wrote that "hypothesis testing encourages the impression of thought and the testing of ideas rather than the less structured gathering of facts typical of orthodox pollen analytical studies"
iii) was the underlying scientific method employed an *inductive* or *deductive* strategy? The deductive approach can be seen as an indicator of scientific maturity.

Just half the papers examined included problem formulation, only five papers involved testing of hypotheses, and only one paper had a 'deductive strategy'. These results seem to reinforce the inductionist stance typical of palynology. In part, this is because palaeoecology is a descriptive historical science, and evidence can frequently be ambiguous and open to interpretation in several ways. Birks (1988a:184) suggested that hypothesis-testing should be more common in palaeoecology as it is "..a central process in science.", but also acknowledged the difficulty with this in a science that is essentially descriptive in approach. As Edwards (1983:117) pointed out "..this may not represent an intellectually satisfying state of affairs." The author concluded that a more critical approach to

palynology and less blind data collection is neccessary for the healthy development of the subject. This sentiment was echoed by Haines-Young & Petch (1986:201) with reference to physical geography in general:

"There need to be developments in theorizing, experimentation and the ability to recognize problems for progress to be achieved."

More recently, Oldfield (1993) urged more consideration to be given to the theoretical basis in the design of palaeoecological research strategies

More consideration needs to be given to the interpretation of palaeoecological data, especially where the data are being used in close concert with archaeological data. The problems connected with interpreting material remains in archaeological contexts are the subject of much theoretical investigation, but the same cannot be said of pollen data. The inherent nature of palaeoecology as a discipline should not discourage inquiry and this should not just include the examination of methodological structures in palaeoecology, as recommended by Edwards (1983). The potential for the integration of palaeoenvironmental study into theories of social and political development may also prove fruitful. Closer amalgamation of palaeoecological and archaeological data may lead to significant advances in this and related areas, although further postulation on this is clearly outside the scope of this research.

The research strategy for the Bodmin project has been devised in attempt to acknowledge the theoretical and philosophical issues that concern physical geography generally and palaeoecology specifically. The archaeological data are utilised to build models of possible human impact and to construct hypotheses concerning palaeoenvironmental change. Both are employed in order to be more specific in the questions being asked of the palaeoecological record and also in an attempt to overcome the limitations of the unexcavated archaeological material.

2.3 Synthesis: A research strategy for palaeoenvironmental investigations on Bodmin Moor

Chapter 1 discussed the palaeoecological history of Bodmin Moor, established by past studies and identified the key research questions that have yet to be adequately examined. These questions can be summarised as:

i) what was the character of the early Holocene vegetation cover of Bodmin Moor prior to human impacts?

ii) what was the extent, character and timing of initial anthropogenic impact on the landscape? This includes the question of whether fire was employed to clear vegetation, as has been inferred for other areas of British uplands (eg. Jacobi *et al.*, 1976).

iii) what was the nature and duration of prehistoric land-use on the moor? Of particular interest is the extent to which the palaeoenvironmental record corresponds to archaeologists' perceptions of land-use in the various field systems on the moor.

Sampling sites and pollen taphonomic considerations

A major problem in pollen-analytical studies is that of defining the source area of the sampling site under consideration. Tauber (1965; 1977) suggested that the size of the pollen source area and the surface area of a sampling site were positively correlated: larger basins would have larger pollen source areas, although a number of other factors such as the physical properties of the pollen grains would also affect this. A number of theoretical and empirical studies have apparently confirmed the relationship between source area and sampling site (Andersen, 1970; Bradshaw, 1981; Bradshaw & Webb, 1985). Some workers have produced models to determine the likely source area of sampling sites depending on these lines of evidence, such as that devised by Jacobson & Bradshaw (1981). According to their estimates, a 1 ha site should receive around 20-50% of pollen from vegetation

within 20m (local), 40-60% from that within a few hundred metres (extra-local) and <15% from sources beyond this. Recent work has cast some doubt on these conclusions, particularly with respect to lake sites: Jackson & Wong (1994) have shown that the contribution of non-local pollen can be considerably higher than previously thought, although this is dependent on the nature of the non-local pollen source, particularly with regard to the disperal properties of the taxa. Sugita (1993) produced the following estimates for pollen source area of peat deposits based on site radius (r): r = 250m - 600-800m; r = 50m - 300-400m; r = 2m - 50-100m. Around 30-45% of pollen will be derived from within these distances, which is described as 'adequate' for the comparison of local vegetation patterns.

Sampling sites and research aims

Many pollen-analytical studies of peat or lacustrine sedimentary sequences are carried out by palaeoecologists attempting to establish general vegetational histories, rather than investigating detailed histories of land-use in relation to specific archaeological sequences. This is partly due to the specific research aims of the researcher(s), but also to the limitations of long sequences in addressing specific questions of human-induced environmental change, especially with regards to issues of the location of human activity in relation to the sampling site. The longest sequences and hence the most worthwhile in terms of temporal resolution, are usually present in larger bogs and lakes with essentially 'regional' catchment areas. They may, therefore, provide a good overall picture of environmental change, but only provide a *general* picture of human impacts: "..a spatially smoothed vegetation record." (Prentice, 1985:274).

Palaeoenvironmental investigations that are more concerned with localised human impacts tend to be carried out by environmental archaeologists on specific sites, often as part of archaeological excavations. Such studies are often concerned with soil profiles from, for example, old land surfaces. These may give a good picture of local environmental conditions, but are often isolated from the longer term and

wider scale history (cf Maltby & Caseldine, 1982; 1984). In some instances, this shortcoming has been recognised, for example in the integrated archaeological-palaeoenvironmental investigations of the Dartmoor reaves (Balaam *et al.*, 1982). In the absence of sediments directly connected with archaeological sites, profiles from small deposits, close to archaeological sequences, are the best source of data on human impacts.

In terms of identifying human impacts on the landscape in relation to archaeological sequences, smaller basins will reflect vegetational changes at a spatially more precise level and are thus to be preferred in the identification and characterisation of human-induced environmental change. Other researchers have used sequences from small deposits to detect vegetational changes on a fine spatial scale (10^3-10^4 m^2) (eg. Andersen, 1970; 1973; 1988; Aaby, 1988; Amman, 1991). This approach is strengthened where sequences from a number of different types of palaeoenvironmental repositories are available to identify and compare the palynological signal of vegetation on different scales (Tolonen & Tolonen, 1988; Janssen, 1986).

One problem with palaeoenvironmental investigation on Bodmin Moor is the possible impact of peat cutting and tin streaming on the conformity of sequences. Although areas that have been cut for peat can usually be recognised from the topography and vegetation of the bog surface, there is reason to believe that this may not be the case in some areas, especially those near to prehistoric settlements that may have been disturbed during the early stages of activity on the moor. This means that many of the more obvious deposits on the moor - valley mires and larger deposits of peat - are suspect as regards the recovery of conformable sequences.

Caseldine & Maguire (1984) stressed the importance of the concept of 'space' and spatial variations to future palaeoenvironmental investigations, drawing attention

to research by Maltby & Crabtree (1976) on Exmoor, and Maltby & Caseldine (1982; 1984) at Colliford on Bodmin Moor. The research rationale behind this thesis recognises both the practical and theoretical difficulties of identifying and characterising anthropogenic impacts through palaeoenvironmental study on Bodmin Moor. Where possible, small scale sampling sites with 'local' catchments (*sensu* Sugita, 1994) close to the archaeological systems of interest were utilised to identify the effects of human activity and the individual components of the landscape mosaic. The research design employed in this investigation recognised the importance of detecting spatial variations in palaeoenvironment as a result of natural and anthropogenic factors and the practical difficulties of palaeoenvironmental study on the moor. In the two main areas being investigated, a network of sampling sites was selected with the aim of ensuring that the palaeoenvironmental sequences thus derived were related as closely as possible to the location of anthropogenic activity and also to improve the chance of detecting unconformities or hiatuses caused by peat cutting or tin streaming.

2.4 Site selection

Palaeoenvironmental study on Bodmin Moor is hindered by two factors: firstly, the south-west was outside the maximum extent of the last glaciation and there are therefore no glacially overdeepened basins to preserve extended records of Holocene environmental change. Secondly, as mentioned above, many of the valley mires on the moor have been disturbed by tin-streaming and peat cutting activities rendering them unsuitable for palaeoecological investigations. These factors limit the choice of sites, but as this thesis will show, suitable, undisturbed deposits can be found by the diligent field-worker and the potential for palaeoenvironmental study on Bodmin Moor is considerably greater than has usually been assumed (cf. Caseldine, 1980). Potential sites needed to have suitable, undisturbed deposits close to archaeological remains demonstrating

extensive settlement history, to allow the main aims of the project to be tackled.

A number of sites were investigated prior to the selection of the Rough Tor and East Moor areas. Potential sites were selected on the basis of the archaeological sequences present as identified by the Bodmin Moor survey (Johnson & Rose, 1994). Some areas were not considered, such as the Dozmary Pool and Hawk's Tor areas, due to previous study at these sites (Brown, 1977). In the first instance, Ordnance Survey 1:25000 maps were used to identify potential deposits, but following the recognition that potential sampling sites could not always be clearly discerned on the map, the archaeological data were given priority followed by field reconnaisance of potential sites thus identified. This section also gives a brief summary of the other areas that were considered (Figure 1.3) and the reasons for their rejection:

Sampling sites considered and rejected:

The Witheybrook Valley

The south-east section of the moor contains a number of significant archaeological sequences, notably Stowes Pound which is classed with the Rough Tor enclosure as a possible Neolithic site (Johnson & Rose, 1994). However, this part of the moor was also heavily affected by 19th century industrial activity and most of the mire sites bore extensive evidence of peat cutting and tin streaming. Test coring of possibly undisturbed areas of Witheybrook marsh showed the presence of bands of mineral inwash and it seemed very likely that most of the sediments in the marsh had been disturbed in one way or another.

Field reconnaisance up and around the Withey Brook Valley located a number of other deposits but these were all close to medieval and later farmhouses and had clearly been disturbed by peat cutting or were too shallow to be of much potential. No suitable deposits were found at Higher Langdon where there is a well preserved sequence of prehistoric huts and enclosures.

Trewortha Marsh and Trewortha settlement

Investigation of the medieval and earlier settlements at Trewortha Marsh (now largely under a plantation) failed to identify any deposits that were useful for detailed palaeoecological investigation.

Redmoor Marsh (East Moor plateau)

Redmoor Marsh has been disturbed by tin-streaming activity, but this appears to have been restricted to the north-eastern end (P.Rose, pers.comm.). Test coring of the marsh revealed that the majority of the sediment below the upper layers of peat were unconsolidated, perhaps as a result of the earlier tin streaming disturbing the hydrology of the mire system. The difficulty of recovering such sediment ruled against the use of this site.

East Moor co-axial system

The author had been referred by Mr Peter Rose (Cornwall Archaeological Unit) to a peat deposit that had formed next to an area of settlement infill within the East Moor co-axial system. This deposit was less than 1 metre deep and had clearly begun to form following abandonment of the settlement.

Stannon/Louden area

Field reconnaisance here failed to locate any deposits.

Sampling sites selected:

Rough Tor

The Rough Tor area in the north-west of the moor was found to be one of the most suitable areas for palaeoenvironmental investigations. The field archaeology indicated that this was a particulary important part of Bodmin Moor in prehistory, as it is one of the few locations where continuous enclosure is apparent, leading to a very complex archaeological sequence with possible Neolithic, Bronze Age and later components. The significance of this area in the prehistoric settlement

of the moor has been outlined by the concentration of the Bodmin Moor survey on this area, including the mapping of the field remains at a scale of 1:1000 (Johnson & Rose, 1994). Such a well preserved history of settlement provided an ideal opportunity to construct a model of land-use and environmental change, which could be tested against the palaeoecological record. Several suitable sampling sites were found from which monolith and cores sequences could be retrieved (Chapters 3 & 4).

The East Moor

The second location chosen was the East Moor. Although this area did not have as temporally deep a settlement history as Rough Tor, the extant remains in this area included postulated Neolithic huts and enclosures, the East Moor co-axial field system and extensive medieval field-systems. It is thus a contrasting area to Rough Tor, from which a land-use model could be constructed in a similar way to Rough Tor. The distribution of deposits made it possible to study deposits from three different topographical locations and provided an opportunity to examine a palaeoenvironmental gradient across this part of the moor. It was hoped that the natural variation in vegetation and the pattern of anthropogenically-induced environmental change on a transect across the East Moor could thus be detected and described (Chapters 6 & 7).

2.5 Techniques

The pollen record and the identification of human impact

The identification and characterisation of the role of prehistoric peoples in modifying the vegetation of North-West Europe through pollen analysis has been long-recognised (Iversen, 1941). The detection and interpretation of such anthropogenically induced changes by palaeoecologists and landscape historians has been largely based on the spatial and temporal patterns of:

i) the so-called 'anthropogenic indicators' (*Plantago lanceolata, Rumex* etc.).

ii) microscopic charcoal.

iii) particular tree pollen types (eg. *Tilia, Ulmus*).

More recently, methodological and theoretical advances have made more precise and detailed detection of human impacts possible. These advances include closer and finer sampling intervals, the development of absolute pollen frequency techniques, the use of multivariate data analysis to detect patterns in palynological data and the application of the results of pollen taphonomic studies to the interpretation of fossil pollen spectra. Technical developments have involved the use of phase contrast and electron microscopy that have improved the identification of different pollen types. These developments are reviewed, for example, by Birks & Birks (1980).

Such theoretical and technical developments have clarified the understanding of the behaviour of anthropogenic indicator curves and the nature and extent of human impact in pollen diagrams. The use of pollen analysis in the reconstruction of 'cultural landscapes' has therefore become increasingly precise, especially where human activity has been detected in the archaeological record. Pollen analysis is employed in this project as the primary means of detecting and describing the impact of humans on their environment.

Survey and sampling

Once a potential site for palaeoecological investigations had been identified, the deposit was surveyed to ascertain the depth and extent of the deposit. A 'Kern' level was used to establish a common datum and depth measurements were taken using a probe. Cores were extracted from the maximum depth of sediment. In certain cases, the nature of the deposit in question made survey unnecessary. Graphical representation of the survey results were plotted using the program QUATTRO. Sample extraction was carried out using one or more of the

following devices: standard Russian corer, monolith tins and a Wardennar Corer (Wardennar, 1987). The device employed in sampling at each individual site is indicated in the relevant section. In all cases, the samples extracted were wrapped in tin-foil and cling film and stored in the dark at 4° C prior to analyses.

Stratigraphic description and sub-sampling

Sediment sequences were cleaned in the laboratory and their stratigraphy described using the Troels-Smith (1955) method (see Appendix 1). $1cm^3$ samples for pollen extraction were taken at regular intervals. The sampling interval depended on the length of the sequence: shorter profiles were investigated at 5cm intervals, whilst longer profiles used a sampling interval of 10cm. Depending upon the nature of the information thus derived, further samples were taken to reduce this sampling interval to 5cm. In some cases, a finer sampling interval was employed to examine areas of particular interest.

Pollen extraction, identification and counting

Pollen extraction followed a standard chemical procedure described in detail in Appendix 2. *Lycopodium* spores in the form of tablets were added to each sample to allow the calculation of pollen concentrations (Stockmarr, 1971). The calculation of concentrations avoids the limitations imposed by percentage calculations, as changes in the proportions of pollen types can be assessed independently of each other. There are problems with this method, such as determining the volume of the sample and exotic pollen concentration. In many of the concentration diagrams produced for this study, curves of the individual taxa often rise and fall in unision, indicating the effects of changes in accumulation rates on pollen concentrations, as opposed to actual changes in vegetation (cf. Edwards *et al.*, 1991). Concentration data are thus used cautiously.

Pollen counting was carried out on an Olympus BH2 microscope at a magnification x400 for routine counting and x1000 for identification of 'problem'

grains. The key by Moore *et al.* (1991) was used for identification, aided by a collection of type slides. Pollen nomenclature follows Moore *et al.* (1991) except in the case of Poaceae (=Gramineae), Lactuceae indet. (=Compositae Liguliflorae), Cardueae/Asteroideae(=CompositaeTubuliflorae),*A chillea*-type(=*A nthemis*-type), Apiaceae (=Umbelliferae) and Pteropsida (monolete) indet. (=Filicales) which are named following Bennett *et al.* (1994) after the taxonomic divisions of Stace (1991). No attempt was made to separate the pollen of *Corylus avellana* and *Myrica gale* (cf. Edwards, 1981) and this pollen type is identified as *Corylus avellana*-type. *Cerealia*-type were identified using the criteria of Andersen (1979), with a minimum grain size of >37μm and annulus diameter of >10μm used to separate possible cereal pollen from wild grass pollen. Unidentified grains included crushed, corroded, broken and indeterminate grains.

The pollen sum was 300 total land pollen (TLP), excluding Cyperaceae due to its likely on-site presence and spores. *A lnus* was included in the pollen sum. Some researchers exclude *A lnus* from basic pollen counts due to the likely presence of alder on the damp ground around most sampling sites (Janssen, 1959); although this raises questions regarding the status of this tree in the local vegetation. In the case of several of the sequences investigated during the course of this project, *A lnus* pollen dominated the samples whilst other pollen, especially that of other trees, was present in very low quantities. Excluding *A lnus* from the sum would have necessitated the counting of very many slides to achieve a count of 300 TLP. Moreover, the main interest in this project is that of the vegetation local to the site and excluding any one taxon therefore would have been a false dichotomy in terms of characterising human impacts.

In some instances, less than 300 TLP were counted. This was sometimes due to low pollen concentrations, such as in the mineral soil at the base of some sequences (Rough Tor North monolith C: Chapter 4 Part III). In another case, samples were dominated by high concentrations of Cyperaceae and *Sphagnum*

spores and low numbers of dry land pollen (Watery Marsh: Chapter 6: Part I). It was clear that the pollen spectra were an accurate reflection of the site-specific vegetation and no attempt was made to continue counting to 300 TLP after one to two complete slides had been counted. In two cases, the upper sections of cores were found to be entirely bereft of pollen (Rough Tor south: Chapter 4 Part II and Tresellern Marsh B core: Chapter 6 Part II). Possible reasons for this are discussed in the corresponding sections.

Data presentation and analysis

Pollen percentages and pollen concentrations were calculated and diagrams produced using the computer programs TILIA and TILIA*GRAPH (Grimm, 1991). Percentages were calculated as of TLP and of TLP including spores. The diagrams were zoned for discussion and interpretation with the aid of CONISS (constrained incremental sum of squares) included in the TILIA program. CONISS is derived from the single link method of cluster analysis and utilizes a dissimilarity matrix based on differences between types and proportions of pollen and spores (Birks & Gordon, 1985). The sets of amalgamations of samples must at all times comprise sets of stratigraphically neighbouring levels. The resulting sets are represented by a dendrogram on the right hand side of the pollen diagram. Sectioning the dendrogram at a particular value produces a constrained single link group at that 'height'. One of the problems with interpretation can be defining the extent of clusters and thus the stratigraphic extent of pollen zones (Maher, 1982). This was not often found to be a problem and CONISS generally served to confirm 'intuitive' zonations of the pollen diagrams.

Analysis of pollen data also employed detrended correspondence analysis (DCA) (Hill, 1974; Hill & Gauch, 1980) implemented using the program CANOCO (ter Braak, 1987). A description of the theoretical aspects of the technique is given in Kent & Coker (1992). Detrended correspondence analysis (DCA) arranges data in low dimensional space so that the most similar entities are closest together and

the most dissimilar furthest apart. It assumes the species abundance have a unimodal optimum along underlying gradients which decline to either side. Examples of applications of this technique in the analysis of palaeoeoclogical data are found in Molloy & O'Connell (1991), Ayyad *et al.* (1992) Wiltshire & Edwards (1993) and Caseldine & Pardoe (1994).

The practical application of DCA in palynological study is the detection of groups of the pollen spectra of similar composition. DCA is utilised in this thesis to compare and contrast the palynological data and to aid the correlation of the palaeoecological records. The data were not transformed (cf. Turner, 1986) and 'rare' taxa, pollen types that were recorded only once in any diagram, were excluded from the analysis.

Charcoal analysis

Fire has been identified as one of the most important agents of vegetation disturbance in the mid- to high-latitude forests of the Northern Hemisphere (MacDonald *et al.*, 1991). Natural fires have always affected vegetation and can be caused by natural events such as lightning strikes; prompting the use of fire records as an index of palaeoclimate (Tolonen, 1986).

Fire has been referred to as "the first great force employed by man" (Stewart, 1956 in Patterson *et al.*, 1987). Ethnographic records show that the selective burning of vegetation is a technique of environmental management practised by gatherer-hunter and pastoralist groups across the world; in the herding of animals and as a tool for the removal of vegetation. The growth of new vegetation after burning increases grazing and browsing potential and thus the carrying capacity of a given area of land, in terms of the number of ungulates that can be supported (Roberts, 1989).

The intentional use of fire by prehistoric communities to improve grazing was first

advanced by Iversen (1941) and since his pioneering work, other scholars have suggested the use of fire in the prehistoric period as part of a hunting and browse-creating scheme and as a method to control the herd movements of wild herbivores (Jacobi *et al.*, 1976; Simmons *et al.*, 1981). The analysis of fossil charcoal has become a major tool for palaeoecologists concerned with the reconstruction of the fire history and in the evaluation of the interactions between vegetation, climate and anthropogenic disturbance.

The reconstruction of a fire history may be inferred from both macro- and micro-fossil evidence: the former includes fire scar and tree-ring studies, but the most frequently studied palaeorecords of fire history are derived from microscopic charcoal in sites of airborne or sedimentary deposition in peat bogs, lakes and soils, all of which can have excellent preservation.

Charcoal is generally assumed to reach basins of deposition through aerial fall-out and post-fire erosion of charcoal produced by fires burning near to the site in question, but the actual area of charcoal taphonomy (the processes which govern an object from its actual production to its final deposition) remain very unclear. Clark (1988) considered the problems associated with the interpretation of stratigraphical charcoal data. The following summarises these problems.

The application of particle-motion physics to charcoal suggests that there exists a fundamental difference between the transport and deposition of charcoal typically encountered on pollen slides, and that evidenced in thin sections. The initial lifting of particles in the convective column of a fire will tend to move smaller particles (5-80 μm), that are initially harder to move away from the source area, and with even moderate convection heights, the dispersal of charcoal can be on a regional or even a sub-continental level. Larger fragments of charcoal (50-10000 μm in diameter) will be transported more easily, but will not be suspended at normal surface winds and thus will not move far from the site of the fire. As this

second size of charcoal is that generally encountered in thin-section analysis, and Clark (1988) concluded that this method of analysis will provide better information about the local fire regime of a site than the pollen slide method, which can record charcoal that has been transported over considerable distances. Clark also suggested that the amount of charcoal transported by water into a basin tends to be very low, unless factors of high rainfall, steep topography and the presence of soils with low infiltration rates are involved. If the amount of charcoal actually deposited by water following the episode of burning is so low, then the initial, airborne deposition of material during the actual fire is of increased importance.

Despite the problems advanced by Clark, many researchers continue to utilise the various pollen slide methods for charcoal analysis and claim a good level of success. One recent study employing this method for the analysis of sediments from two sites in the Danish heathland concluded that the good correlation between pollen (ie. *Calluna*) and the charred particles encountered indicated that the "source areas and mechanisms of transport for these particles are identical." (van Odgaard, 1992:223). This may be due to the fact that the lakes that he studied were closed basins and the topography of the area was relatively flat; thus the waterborne charcoal element was of minor importance.

No single measure or approach to the reconstruction of fire histories from sediments will be entirely accurate in detecting local fires (MacDonald, *et al.*, 1991). Variations in spatial extent, intensity, fuel type and meterological conditions all affect the transport and deposition of charcoal, and each site examined must thus be assessed on its own merits. Methods of charcoal analysis are reviewed by Winkler (1985), Robinson (1984), Tolonen (1986) and Patterson *et al.* (1987). The actual comparison of methods of calculating fire history from different indices has not been undertaken on any comprehensive level, although work underway at present should clarify both the dispersion and interpretation of microscopic charcoal (J. Moore, pers.comm.). Charcoal analysis is a valuable tool in

palaeoenvironmental study and investigation of the charcoal record should allow such questions concerning the role of fire in anthropogenic impact on Bodmin Moor to be addressed. Interpretation of charcoal data is not always straightforward (Clark, 1988, MacDonald *et al.*, 1991), and caution in the interpretation of the charcoal record must always be exercised (Edwards, 1988; Patterson *et al.*, 1987).

The method employed in this project is a modified version of that utilised by Peglar (1993). Fragments of charcoal greater than 5 μm were counted on routine pollen slides until 10 *Lycopodium* spores (see above) had been totalled. Fragments were then expressed as number per cm^3 of sediment and plotted alongside the palynological data on the TILIA diagrams. As Patterson *et al.* (1987:16) pointed out after a consideration of the different techniques of charcoal analysis: " the relative changes in charcoal abundance can be assessed quickly by merely counting charcoal abundances along with pollen.". No attempt was made to divide charcoal into different size classes, as preparation techniques tend to cause fragmentation of charcoal particles (Clark, 1984). Any macroscopic charcoal in the sediment cores and monoliths was noted during stratigraphic description and charcoal retained on the sieve during pollen extraction was also recorded using a scale of 1-5 (0 = absent; 5 = abundant).

Loss-On-Ignition

The quantitative ashing of sediments, or loss-on-ignition (LOI), can be used in palaeoenvironmental studies to give an indication of the amount of organic matter present in a sediment and conversely an estimation of the quantity of mineral matter. This is usually employed to indicate the extent of erosion into a basin and thus as a proxy measure of the disturbance to vegetation and soils resulting from human impacts: the removal of vegetation cover can lead to the destabilization of soils and an increase in erosion (Moore *et al.*, 1986; Edwards *et al.*, 1991). LOI is used in this study as a means of describing the organic content of a sedimentary sequence and hence identifying possible erosional episodes.

LOI does not give a true indication of the percentage of organic matter present, as at the temperature of ashing, bound water from clay minerals present is lost (Allen, 1989). High-temperature ignition methods have also been criticised as being inaccurate in that they may only destroy the more readily oxidised organic components; and they may result in the loss of carbon dioxide from carbonates (Gale & Hoare, 1991:262).

The temperature for ignition is a matter of some debate. Ball (1964) found that ignition at 375 ° C avoided loss of structural water, and Davies (1974) concluded that ignition at 430 ° C overcame the problem of the loss of carbon dioxide from carbonates. The latter temperature is recommended by Gale & Hoare (1991), whilst Allen (1989) suggested 550 ° C, despite possible losses of volatile minerals at this temperature. Other research has shown that organic matter is 'done' at 450 ° C (J.McAndrews, pers.comm.) but that carbonates are not appreciably lost at temperatures of 500-550 ° C (J.Alemdinger, pers.comm.) The procedure followed in this thesis is a modified version of that of Gale & Hoare (1991):

1) The sediment sequence was sliced into one centimetre sections and the samples dried in an oven at 105-110 ° C for 24 hours.

2) The dried samples were removed from the oven and allowed to cool. They were then ground up in a mortar and transferred to a crucible (previously weighed). The crucible containing the sample was then weighed to 0.001 g on a Sartorious balance.

3) The crucibles were transferred to a furnace, which is heated to 425 ° C, for 8 hours.

4) The crucibles were removed from the furnace, allowed to cool, and then weighed.

5) Percentage organic matter was then calculated from the pre- and post-ignition weights.

Gale & Hoare (1991) recommended ignition for 24 hours. Due to safety

regulations, it was not possible to leave the furnace at a high temperature overnight. Other workers have used ignition times of eight hours (eg. Edwards *et al*, 1991; Bennett et *al*, 1992) and claimed good results.

LOI methods, and the degree of variation in the exact methodologies employed, may be criticised as inaccurate and imprecise. As far as palaeoenvironmental studies are concerned, loss-on-ignition is not utilised to give a precise measure of organic matter content, but to provide a quick, repeatable and comparative estimation of organic percentages. The results produced by the above described method fulfilled the criteria of simplicity and rapidity, and as far as could be determined, produced consistently good results. Further work is necessary on the theoretical and practical applications of high-temperature loss-on-ignition techniques in palaeoecological studies.

Magnetic susceptibility

The application of environmental magnetism to palaeoecological studies is relatively recent. The magnetic properties of environmental materials may be calculated quickly, cheaply and easily. Moreover, the measurements are extremely sensitive to changes in magnetic concentrations, and magnetic investigations are beginning to become commonplace amongst studies of peat, snow, lake and ocean sediments (Hilton, 1987) The formative studies utilising this method were concerned with lake sediments (Thompson *et al.*, 1975) and worked on the assumption that the magnetic properties of lake sediments could be interpreted in terms of changes in the sources of magnetic minerals eroded from the lakes' catchment area. Subsequent studies have included investigations designed to reconstruct total sediment influxes into basins to evaluate recent catchment change (Dearing & Foster, 1986) and to identify sediment sources (Snowball & Thompson, 1992).

A number of different magnetic parameters can be measured in relation to a

number of physical properties of the sediment. The technique used in this thesis was that of magnetic susceptibility, a measure of the 'magnetisability' of a material. The susceptibility of sediment is related to the magnetic signatures of its mineral content and thus can be used to identify possible inwash episodes into peat and lake sediments and the resulting deposition of detrital allochthonous material (eg. Bennett *et al.*, 1992; Tipping, 1995a). The technique can thus be used alongside LOI as a proxy measure of periods of catchment erosion resulting from anthropogenic activity. Problems of partial dissolution and dilution of magnetite by the growth and accumulation of organic matter means that erosional episodes in peat sequences may not always be clearly identified utilising susceptibility measurements (Gale & Hoare, 1991).

Oldfield (1991) identified minerals from six magnetic mineral sources: soil and rock erosion, and its transport by water; authigenic formation; fly ash; atmospheric deposition of windblown soil, cosmic particles and volcanic ash. These can all contribute to the magnetic record as preserved in sediment sequences, meaning that not only can magnetism be used to address a wide range of questions, but that the use of such techniques can be compounded by various difficulties.

The technique was utilised in an exploratory sense to attempt to investigate whether possible erosional episodes could be detected magnetically. As this technique did not prove successful it was employed on only two sequences. A Bartington Instruments core scanning loop sensor was used to measure the magnetic susceptibility of the sequences. Susceptibility is measured as uncalibrated volume mass susceptibility (dimensionless units).

Chronological control: radiocarbon dating

Chronological control is provided by radiocarbon dating. The theoretical background to this method is described by Libby (1965) whilst discussion of general aspects of sampling, contamination and calibration is given in Aitken

(1991). There has also been recent discussion of the method and its use by Quaternary palaeoecologists by Lowe (1991 and articles therein) and Pilcher (1993).

Precision: the precision of measurement depends on the total number of decays of ^{14}C measured and thus bigger sample and/or longer counting time will improve the precision of the measurement (Pilcher, 1991). However, limitations of time and money restrict length of counting time and practical and technical restrictions limit sample size. Radiocarbon dates are conventionally quoted with $\pm$ one standard deviation (68% probability that the true value is contained within the range).

Calibration: laboratory measurements on a given sample give an age in conventional radiocarbon years, based on the assumption that the atmospheric ^{14}C-^{12}C ratio has been constant. This is not an entirely accurate assumption due to variations in atmospheric radiocarbon concentrations and radiocarbon ages are therefore not the same as calendar years, necessitating a calibration to calendar years based on known-age samples, usually by wood dated dendrochronologically (Aitken, 1990).

A ^{14}C age has a Gaussian probability distribution determined by its standard deviation and thus a most probable ^{14}C age. However, the corresponding calendar age no longer has a Gaussian distribution unless the calibration curve is straight in the period under consideration: ranges of calibrated dates therefore depend on the presence of 'plateaux' and 'wiggles' in the calibration curve and thus the ranges can sometimes be quite wide. Calibrated date ranges in this thesis were calculated using the maximum intercept method of Stuiver & Reimer (1986; 1993) and are quoted in the form recommended by Mook (1986) with end points rounded outwards to 10 years. Calibrations were calculated using data from Stuiver & Pearson (1986), Pearson & Stuiver (1986), Pearson *et al.* (1986) and a bi-decadal weighted average from Linick *et al.* (1985), Stuiver *et al.* (1986) and Kromer *et*

al. (1986) or Kromer & Becker (1993). Calibrated ranges are quoted at two standard deviations (95% probability the true value is within the range).

Samples for radiocarbon dating were taken, where possible, from the sequences from which the pollen samples had been extracted. This was not always possible due to the sampling method employed and re-sampling of deposits was necessary in some cases. In these circumstances, the old and new sequences were correlated by pollen analysis. An excellent degree of correspondence was obtained in all cases. Samples were wrapped in tin foil and polythene bags and submitted to Beta Analytic for standard radiocarbon dating. A second set of samples were submitted to the Ancient Monument Laboratory for dating by English Heritage. The samples from the Rough Tor south core (see table 2.1) were dated by Accelerator Mass Spectrometer (AMS) at the Oxford Radiocarbon Accelerator Unit. AMS allows the dating of very small sample sizes (1-3 milligrams of carbon) (Hedges,1991).

Burned intrusive roots, bioturbation and secondary biogenic activity incorporating recent carbon (bacteria) and secondary deposition can all affect the sample integrity. Dating was therefore carried out on the fine-particulate fraction of the peat, considered to be the most reliable component for dating as it excludes soluble humus as such humus may be mobile in the profile. Root and rhizome penetration can also introduce younger carbon (Dresser, 1970). Anomalous dates can occur even when the fine particulate fraction is used for dating (cf. Smith & Cloutman, 1988; Charman, 1992a).

The following pretreatment procedure was followed:

i) Humic acids were removed by suspending the peat in NaOH.

ii) The sample was acidified in HCl to aid the removal of fine rootlets and organic components by filtration with a 250 μm sieve.

iii) The sample was suspended in KOH to remove any remaining humic

acids

iv) The fine fraction was acidified in HCl, washed with distilled water and dried prior to combustion.

Table 2.1 provides a summary of all the dates obtained and samples submitted from sequences from this study.

2.6 Summary

This chapter has examined some of the philosophical, theoretical and practical considerations behind the main techniques that the project employed - pollen and charcoal analysis, LOI and radiocarbon dating. In the light of these considerations, the rationale behind the research strategy that the project has utilised has been described and the two areas to be investigated - Rough Tor and the East Moor - have been introduced. The next chapter will describe the archaeological sequences in the first area to be investigated. The archaeology will be used to formulate a series of hypotheses concerning human impact and environmental change against which the results of the palaeoenvironmental investigations can be tested.

Sample/depth-cm	Lab.no.	Uncalibrated Radiocarbon yrs. BP (±1sd) *Measured δ13C (per mil)*	Calibrated calendrical age date (2 sigma-95% probability)
RTNa 137-141	Beta-78543	1890±70	20cal.BC -cal.AD2 65 & cal.AD 290-cal.AD320
RTNc 10-15	(Eng. H.)	*	*
RTNc 27.5-32.5	(Eng.H.)	*	*
RTNc 47.5-52.5	Beta-78541	1840±70	cal.AD 45-380
RTNc 57.5-62.5	Beta-78542	2430±60	780-385cal.BC
RTNc 70-77	(Eng.H.)	*	*
RTS 115	OxA-6007	1675±45 *-29.3*	cal.AD 240-440
RTS 150	OxA-6008	3275±50 *-28.3*	1690-1440cal.BC
RTS 175	OxA-6009	4710±80 *-27.3*	3700-3340cal.BC
RTS 220	OxA-60010	8410±90 *-28.5*	7580-7100cal.BC
RTS 280	OxA-60011	5945±65 *-29.6*	5050-4720cal.BC
EMM 17.5-22.5	(Eng. H.)	*	*
EMM 52.5-57.5	(Eng. H.)	*	*
EMM 77.5-82.5	(Eng. H.)	*	*
WM 150	(Eng. H.)	*	*
TMA 10-20	Beta-84823	990±80	cal.AD 890-1225
TMA 25-35	Beta-84824	1830±70	cal.AD100-265 & cal.AD 290-320
TMA 40-50	Beta-84825	2880±60	1130-940cal.BC
TMB 105-109	Beta-84826	920±60	cal.AD 1065 and 1075 and calAD 1155
TMB 78-82	Beta-84827	3360±60	1705-1535cal.BC
TMB 93-100	Beta-84828	4080±80	2865-2810cal.BC & 2695-2485cal.BC

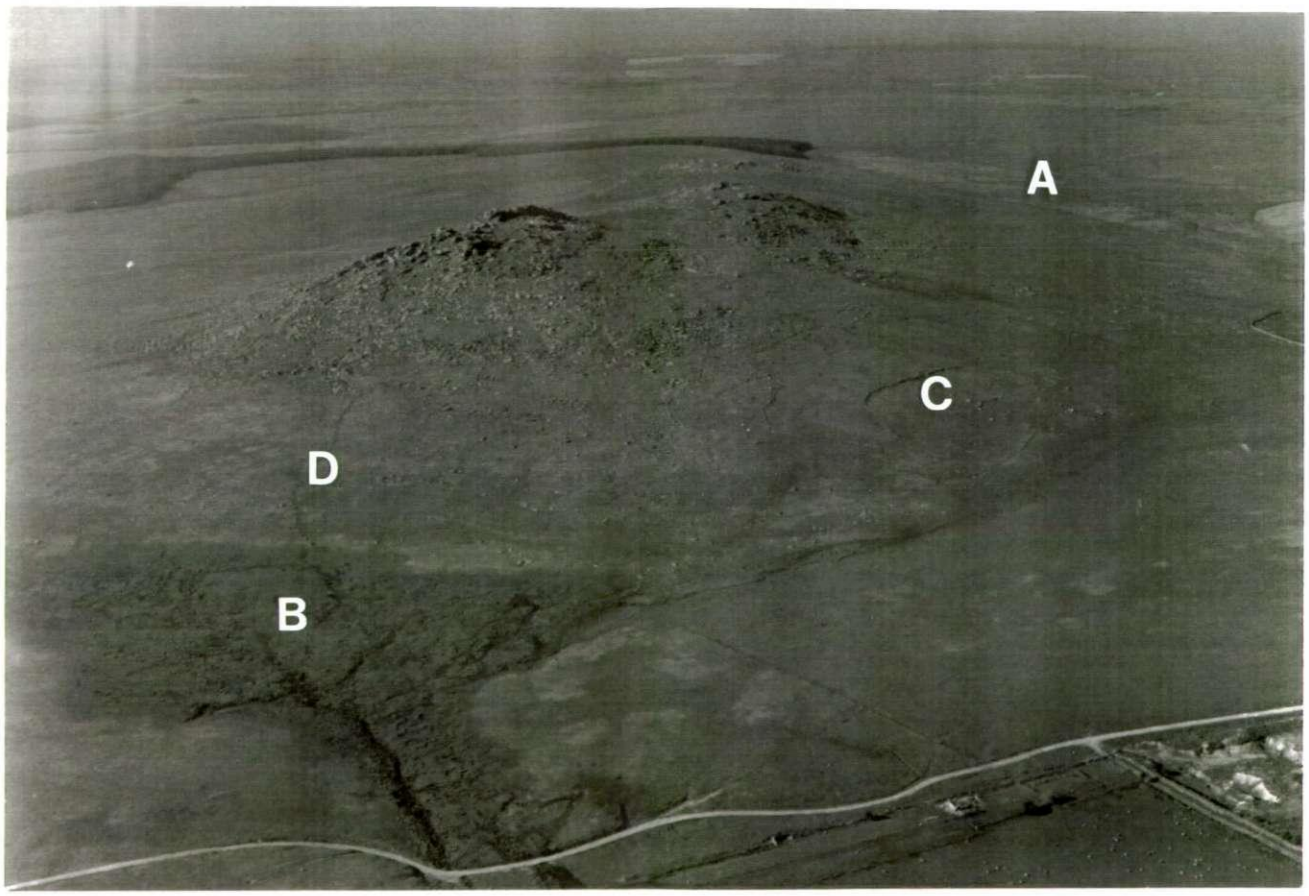
Table 2.1: Summary of Radiocarbon samples obtained and submitted. (Eng.H.) indicates that the sample has been submitted to English Heritage for dating through the Ancient Monuments Laboratory. '*' indicates that the date is not yet available. Sample abbreviations: RTNa - Rough Tor North Monolith A; RTNc - Rough Tor North Monolith C; RTS - Rough Tor South Core; EMM - East Moor Monolith; WM - Watery Marsh Core; TMA & TMB - Tresellern Marsh A & B Cores. δ13C given where available.

Chapter Three:
Archaeology and Prehistoric Activity in the Rough Tor Area: Implications for Palaeoenvironmental study

3.1. Introduction

The Rough Tor area (Plate 3.1) was selected as the first location for palaeoecological investigations on Bodmin Moor. There were two main considerations behind this choice: firstly, the field archaeology on Rough Tor and Rough Tor moors indicates that this part of the Moor was of considerable importance in the prehistoric period. The archaeology includes the enclosure upon Rough Tor itself, the Louden Long Cairn, the Fernacre stone circle and numerous hut circles and multi-phased field systems. Although little excavation has been carried out in this area, the archaeology has been the subject of a detailed field survey (1:1000 scale) by the Cornwall Archaeological Unit and English Heritage (Johnson & Rose, 1994). A detailed analysis of the palaeoecological record provides information about both the timing and nature of the impact of this settlement and contributes to the understanding of the complex archaeological sequences. In particular, the elucidation of land-use and anthropogenic impact on the wider environment and its relation to the archaeology is examined by the analysis of multiple profiles. Secondly, preliminary field reconnaissance suggested that there were suitable deposits near and around the main areas of settlement on Rough Tor for palaeoenvironmental study. These deposits included Rough Tor marsh, peat accumulations around the spring line on the lower slopes of Rough Tor north and south and a profile in a hollow at Rough Tor north.

Plate 3.1: Rough Tor looking north-east (source: Cornwall Archaeological Unit Photographic Archive). Rough Tor Marsh (Chapter 4 part I) is visible in the top right hand corner (A) and the marshy area where the Rough Tor south core (B) (Chapter 4 part II) was sampled from is visible in the left foreground and Medieval fields (C) and prehistoric boundary (D) described later in this chapter are apparent on the near slopes of Rough Tor



The following sections describe the nature of the archaeological remains and from this information, a series of hypotheses concerning the form and nature of environmental impact, which might be expected to be evident in the palaeoecological record, were formulated.

3.2. The Rough Tor area - general characteristics

Rough Tor (396 m OD) is situated in an area of coarse-grained granite moorland (SX 143 807), close to the north-western edge of Bodmin Moor (Figure 3.1;Plate 3.1). It lies in the largest intact block of open land remaining on the moor, centred on Brown Willy and covering an area of *c*.20 square kilometres. The Rough Tor area is one of the densest areas of prehistoric settlement on the moor (Figure 3.2) and its focal point is the defended enclosure upon Rough Tor itself. This is a complex feature built around the rocky outcrops of the tors that contains extensive evidence of habitation in the form of hut circles and platforms (Figure 3.3). This, and the large numbers of hut circles, field systems and ritual monuments nearby suggest that this was a particularly important part of the Moor in the prehistoric period. Following the approach of the Bodmin Moor survey, the area is divided into Rough Tor south and Rough Tor north (relative to the tor itself) for purposes of discussion. Archaeological data used in this chapter, unless otherwise specified, were drawn from Johnson & Rose (1994).

3.3. Neolithic settlement on Bodmin Moor ? The Rough Tor enclosure and Louden long cairn.

The Rough Tor enclosure

The hill top defences on Rough Tor (Figure 3.3) occupy the highest part of the elongated north-east to south-west hill and join Rough Tor to Little Rough Tor;

Figure 3.1: The Rough Tor area

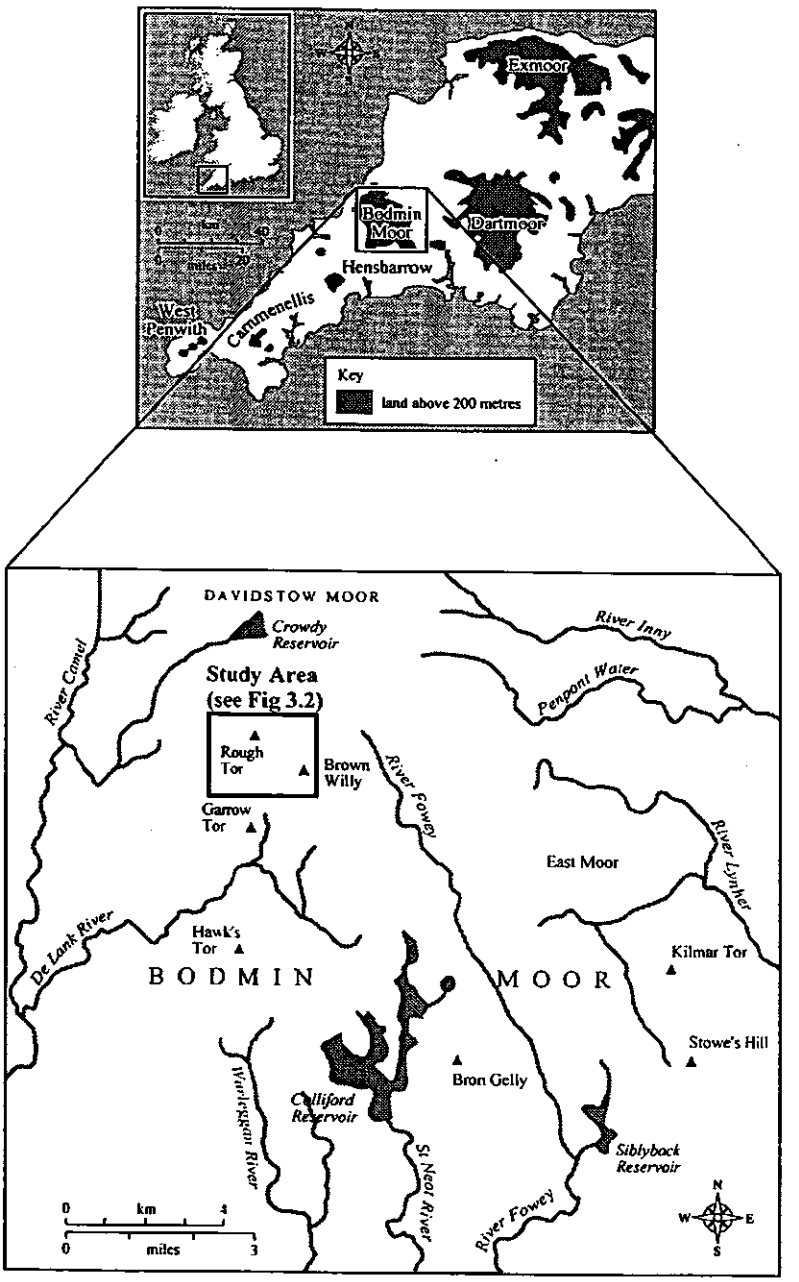
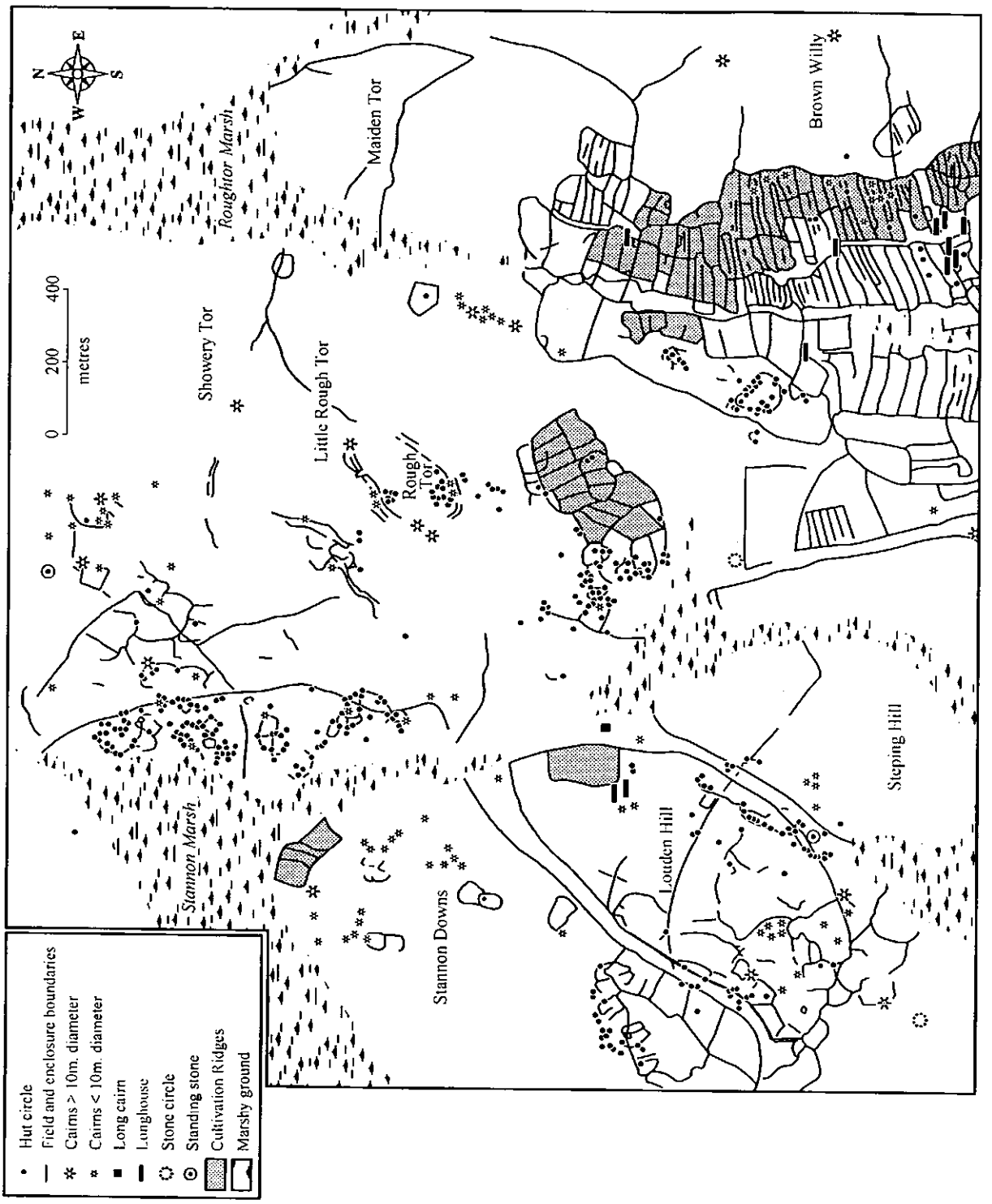


Figure 3.2: The multi-phase archaeological sequences in the Rough Tor area. Based on the Bodmin Moor survey map iii (Johnson & Rose, 1994).



encompassing an area of 6.5 ha and are 350 m long by 210 m at their widest, mostly below the crest of the hill at 370 m. The defences (Plate 3.2) are constructed of stone walls, apparently of orthostats front and rear, with rubble infill. To the north side, up to four defensive lines and two entrances are visible. The more southerly entrance is a deep hollow way passing through four stone lines that bulge outward around the entrance. Three small kerbed cairns are built into the entrances, one in the northerly entrance and two in the southerly and there is a ruined corbelled chamber between the ramparts on the southern side. This may possibly be related to a medieval or post-medieval structure used by herdsmen and is similar to other structures dug into cairns on the more northerly slopes of the tor below.

The defences to the south of the tor are incomplete at the northern end, closest to Little Rough Tor and elsewhere take the form of two lines of piled stones between rock outcrops and areas of dense stone clitter. A third entrance to the south has a staggered approach between the ramparts, with a third wall added at this point. There are also several small stone structures close to the entrance.

Within the enclosure, two groups of 'hut scoops' or hut platforms are visible. One of the groups is located just inside the south-west entrance; and the other is situated inside the more southerly northern entrance. Those in the first group are visible as cleared grassy platforms in the clitter, of either oval or sub-rectangular shape and show no evidence of entrances. Three other structures are set against the ramparts close to the entrance, two on either side. The northern group are closely spaced, roughly circular platforms cut back into the north-west slope: four of these have no build up on the lower side and thus fade into the slope. The platforms within the enclosure range from 3.5-10 m. in diameter and possibly were platforms for tents or wooded huts. The hill top is also characterised by a number of cairns, some of which are both large and complex. During the medieval period, a chapel to St. Michael was set within the cairn on the top of Rough Tor.

Plate 3.2 (top): The northern ramparts of the Rough Tor enclosure looking east towards little Rough Tor.

Plate 3.3 (bottom): The Louden long cairn looking north.

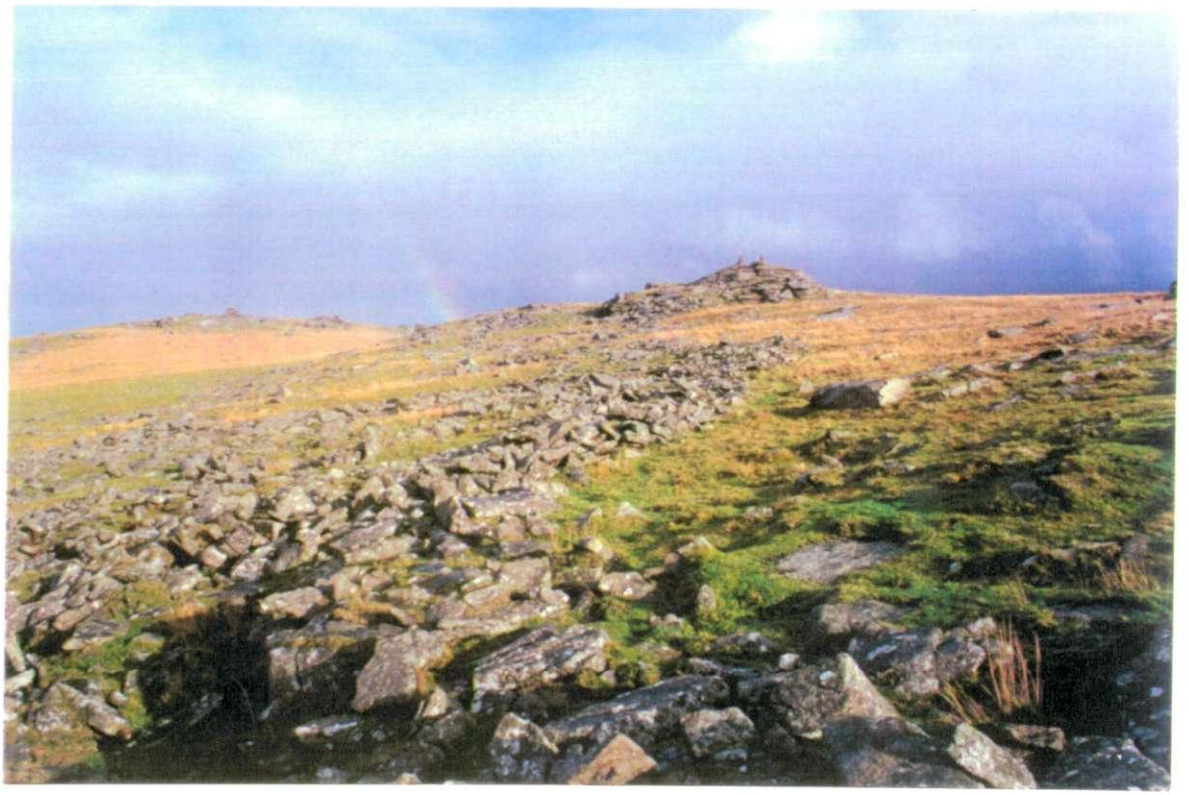
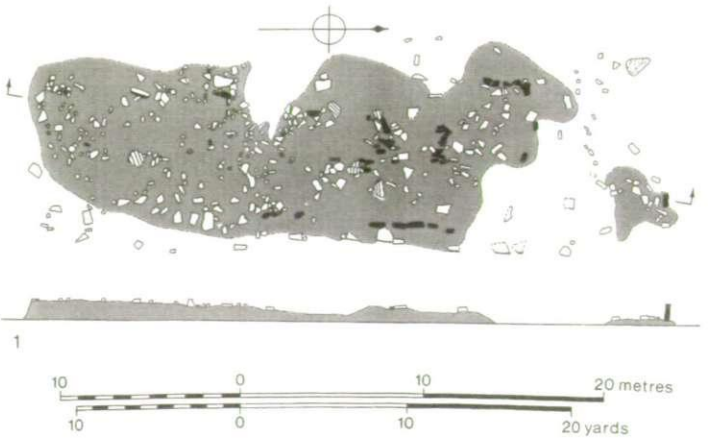


Figure 3.3 (top): The Rough Tor enclosure (from Johnson & Rose, 1994:47)

Figure 3.4 (bottom): The Louden long cairn (from Johnson & Rose, 1994:25)



Until recently it was assumed that the Rough Tor enclosure should be assigned to the Bronze Age. This view has, in the last decade or so, been questioned and an early Neolithic date postulated for the enclosure (Silvester, 1979; Mercer, 1981; Todd, 1987; Johnson & Rose, 1994). The enclosure differs in appearance and location from other Bronze Age defended settlements in several ways, but is similar to the excavated sixth millennium BP enclosure of Carn Brea in several others:

i) the altitude and extreme exposure of the site;

ii) the apparently casual nature of the defences around parts of Rough Tor: there are no signs of any enclosure work to the south of Little Rough Tor and the outer lines of defences on the northern side are merely upright stones acting as a fence;

iii) the presence of the hut platforms suggests that there was a sufficient quantity of wood in the area. This is something of a circular argument, as it assumes that the removal of the greater part of the tree cover in the area was largely complete by the Bronze Age;

iv) the presence of many small entrance gaps, reminiscent of the multiple entrances at the excavated Neolithic enclosure of Carn Brea (Mercer, 1981). The tradition of facing the ramparts with large orthostats is also similar to that found at Carn Brea;

v) the presence of areas of Bronze Age settlement outside the enclosure.

Mercer (1981:190) cited Johnson's (1980:167) description of Rough Tor: ".. the technique of a denture-like rampart which is reminiscent of the Neolithic defence of Carn Brea." in a consideration of the similarities between the two sites. Two other sites on Bodmin Moor are similar to Rough Tor and Carn Brea; Stowes Pound (on the south-east edge of the moor) and Berry Down camp (1.5km north-east of St. Neots). Both these 'tor enclosures' have also been suggested as having their genesis in an early Neolithic phase of settlement (Silvester, 1979).

Todd (1987:76-77) supported an early Neolithic date for the above sites, pointing out that an increasing body of evidence indicated that enclosed hill-top settlement was an important element in settlement during the Neolithic. This has long been recognised on the continent but is only just becoming apparent in a British context. The same author (Todd, 1987:75) suggested that the growth of such enclosed Neolithic settlement units represented:

> "...the growth of a consciousness of identity, natural enough as a dominance over the local environment was steadily achieved, and thus separateness from neighbours."

Rose (in preparation) is, however, more cautious in his discussion of these hill-top enclosures, postulating that they may be either Neolithic or Bronze Age due to the absence of firm dating evidence.

The Louden long cairn

Louden Hill (315m OD) is situated 0.5 km to the south-west of Rough Tor (Figure 3.1). On the lower edge of the north-east slopes of Louden lies the Louden long cairn. This is a low mound of stones (Figure 3.4 & Plate 3.2) orientated north-south along the contour, close to the saddle linking Louden to Rough Tor. Two other long cairns have been discovered on Bodmin, at Bearah Common and Catshole. These structures remain elusive in their exact form and nature, although the one at Bearah Common has a substantial but collapsed chamber and the Louden example has an internal structure of cellular form. Elsewhere in Britain, excavations of similar monuments have revealed that they contain multiple burials and date from the sixth millennium BP (Rose, in preparation).

Fowler (1983:5) suggested that these collective tombs of earth and timber "..betoken the success of a way of life based on the mixed farming of cultivated cereals and domestic livestock.". The Louden long cairn may represent a territorial and ancestral claim to this part of the moor; but whether the builders of the cairn

actually lived and farmed on Bodmin, or utilised it as upland grazing during the summer months as part of a transhumance farming regime, is a matter for speculation. Either way, the long cairn shows that human interest in the north-western area of the moor may have begun at a very early stage, although the exact character of this interest is unknown at present.

No excavation has been carried out in the Louden-Rough Tor area and no chance finds have been reported. Despite the evidence presented above, the date of the Rough Tor enclosure and indeed of all the remains in this area thus remains largely conjectural.

3.4. Field systems on Rough Tor and beyond: Bronze Age pastoralism ?

Rough Tor north & south

The slopes of Rough Tor north are characterised by a system of irregular curvilinear fields (Figure 3.2 and Plates 3.4 & 3.5) covering around 34 ha, defined by low stone banks and walls, and associated with a few slight huts. The system is incomplete, which may be as much a reflection of its original character as of subsequent robbing. To the north of the system, there are clearance cairns where the boundaries trail off, and to the south, occasional isolated lengths of bank and clearance patches suggest that cultivation may have extended as far as Rough Tor south.

Another field system consists of small accreted fields together with two examples of parallel banks following the contour. Two of the boundaries contain cairns, and three hut circles lie close by. There are also a few individual enclosures associated with cairns: these enclosures are strongly lynchetted. The relationship of these enclosures to the field systems described above is unknown.

The field systems are cut through by boundary banks, one of which is characterised by a straight stony lynchet extending from it at right angles. The northernmost of these boundaries is a considerable obstacle, yet it fades out at its north-west end, as if it was continued in some other way (Plate 3.6) - perhaps by a fence or by an area of dense vegetation (Johnson & Rose, 1994). To the south, there is a settlement of around 103 huts, extending for 850 m along the hillside. At least two phases of boundary are apparent in this area:

i) slight and often fragmentary banks, which may be an extension of the field systems;
ii) a series of enclosures defined by more substantial stone banks, some of which appear to utilise elements of the curvilinear field system. These enclosures are confined to the northern two-thirds of the settlement.

The south of the settlement is a more well defined and compact field system than that described earlier. The settlement huts can be divided into at least three phases:

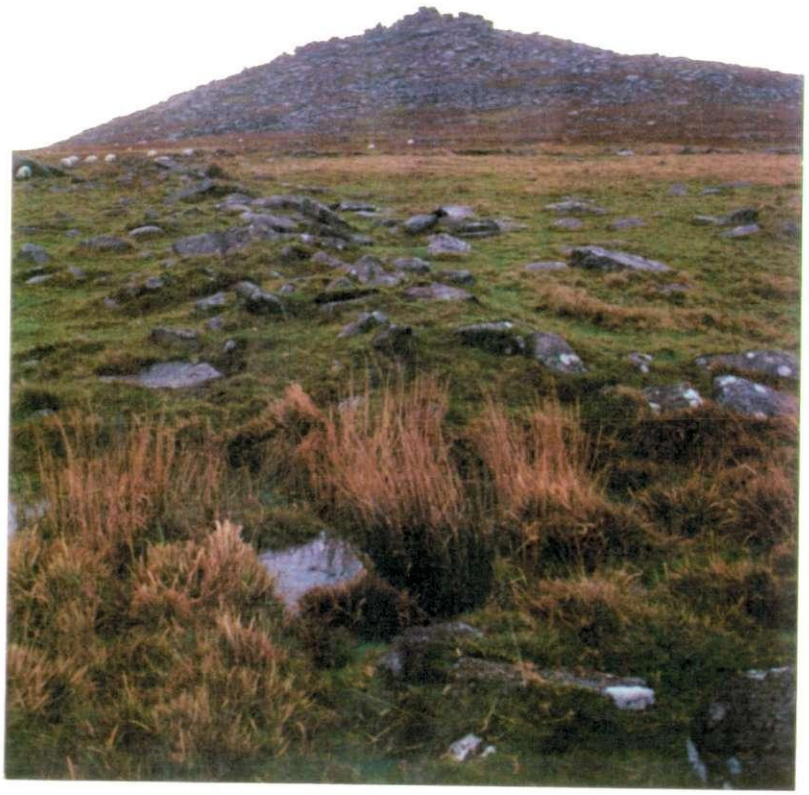
i) a large number throughout the settlement are of a slight, robbed appearance. Possibly they were robbed to provide material for the enclosures;
ii) a smaller number of better defined huts associated with the enclosures;
iii) Three small structures of around 2.5m diameter adjoining the outside of the southernmost enclosure.

The southern slopes of Rough Tor south bear the remains of a settlement (Figure 3.2), the eastern part of which has been destroyed by a medieval village. There are some 48 huts of a slight, rough build and are not associated with any boundaries, although there is a system of curvilinear, irregular fields. This system is also cut by two stone-faced boundary walls (Plate 3.7).

Plates 3.4 & 3.5: Prehistoric enclosures and huts at Rough Tor north

Plates 3.6: The north-western end of the block boundary at Rough Tor north.

Plate 3.7: Looking up at Rough Tor from the south-western end of the block boundary at Rough Tor south.



It is possible that this system is part of that described for Rough Tor north. The Rough Tor area thus contains evidence of a broad range of prehistoric settlement and land-use:

i) the curvilinear accreted fields associated with cultivation and permanent settlements;
ii) permanent settlement with more limited areas of fields or enclosures, with evidence of some cultivation, although the likely emphasis is on pastoralism;
iii) large boundaries dividing the landscape into blocks;
iv) small huts which occur singly or grouped in settlements; presumably associated with seasonal pastoral activity.

Louden Hill

An accretive system of irregular curvilinear fields extends over an area of 30 ha on both sides and on top of Louden Hill (Figure 3.2). The fields tend to be around 0.25-0.75 ha and are defined by low stone banks, slight lynchets and in some cases by stone walls. There are a few huts associated with the fields and three areas of clearance cairns. This system is cut by two cross ridge boundary banks; the southernmost of which uses the line of the earlier wall, incorporating material robbed from neighbouring boundaries. On both the east and west sides of the hill are settlements of huts. Those huts on the east side (*c*.30) are generally small (over three quarters less than 5m in diameter). The western group of *c*. 14 huts tend to be larger and better built (over 7m in diameter) and there is only one enclosure associated with them. It is unclear where they should be placed in the chronology of settlement in this area of the moor.

Stannon Down and Stannon South

Just 0.5 km to the north-west of Rough Tor are Stannon Down and Stannon South, although part of this area has now been largely destroyed by China Clay workings.

An accretive system of curvilinear fields defined by low stone banks of around 9ha in total remains apparent, to the south of the Stannon stone circle (Figure 3.2). The field systems are cut by a cross-ridge boundary, a substantial barrier around 1.5m wide. The boundary is incomplete near the circle, although it appears unlikely that it was robbed to build the circle itself, since the two are made of very different stone. To the north of this system lie several robbed hut circles; although whether the fields are contemporary with these or with the Stannon stone circle is not known. An elongated hut in the same location (13 by 5.6m) may be medieval, although its rounded corners are more typical of a Romano-British construction (Johnson & Rose, 1994).

Stannon Down is the only location in this part of the moor in which there has been any extensive excavation. A system of irregular fields of unknown extent, and a settlement of huts, were excavated when the threat posed by the mining activities became clear. Around 25 huts and associated enclosures are found, ranging in diameter from 5.5-10m, that were subsequently engulfed by the spoil heap of the china clay works. Mercer's (1970) excavations suggested that the hut circles and associated field systems represented middle Bronze Age settlement (*c.* 3400 BP) on the basis of pottery found in the occupation layers. However, excavation revealed that the huts and fields had been superimposed upon what was thought to be a previously cultivated soil surface, which was interpreted as representing a first phase of the settlement, although no structures were related to this phase. The discovery of Greenstone implements and a group of sherds sealed within the lower layer implied a late Neolithic date (first half of the fourth millennium BP) for the earliest agricultural activities at Stannon Down. Whether these early settlers can be linked to the stone circles in this part of the moor is a matter for conjecture.

Three cairns on Stannon Down were also excavated prior to their burial by spoil from the china clay works (Harris *et al.*, 1984). One of the cairns produced charcoal which was dated to 3440±70 BP (HAR-5130). There were few finds

apart from some flint, an urn with cord impressed decoration which contained burnt bone and an incomplete bone pin. The authors postulated that

"...the people cremated and buried formally with urns and bone pins in barrows sometimes belonged not to the ruling chieftan class, represented by the famous Rillaton barrow...but perhaps to those who stood next to the social hierarchy." (Harris *et al.*, 1984:152)

This excavation suggested that the cairns and other ritual monuments in this area belong to the Bronze Age.

Butterstor and Garrow

Further afield, 2-3 km to the south of Rough Tor, lie Butterstor and Garrow Tor (Figure 3.1). The former has an accretive system of curvilinear fields covering around 23 ha in total, with around ten huts (up to 10 m in diameter) scattered throughout the fields. Garrow Tor also has an extensive series of enclosures and hut circles. One of these hut circles was excavated and produced both Bronze Age and Iron Age material (Silvester, 1979).

Medieval and later activity in the Rough Tor area

There are a number of rough huts at Rough Tor and elsewhere on the Rough Tor moors that are probably post-prehistoric transhumance huts. Extensive fields, farms and areas of ridge and furrow mark the medieval settlement of the uplands between the 11th and 14th centuries. Longhouse settlements are apparent on Louden Hill (Plate 3.8) and ridge and furrow at Rough Tor south and north-eastern side of Stannon Downs (Plate 3.9). There are extensive field systems on the western flanks of Brown Willy (Plate 3.10).

Plate 3.8: Medieval longhouse on the south-eastern slopes of Louden Hill with Brown Willy in the background.

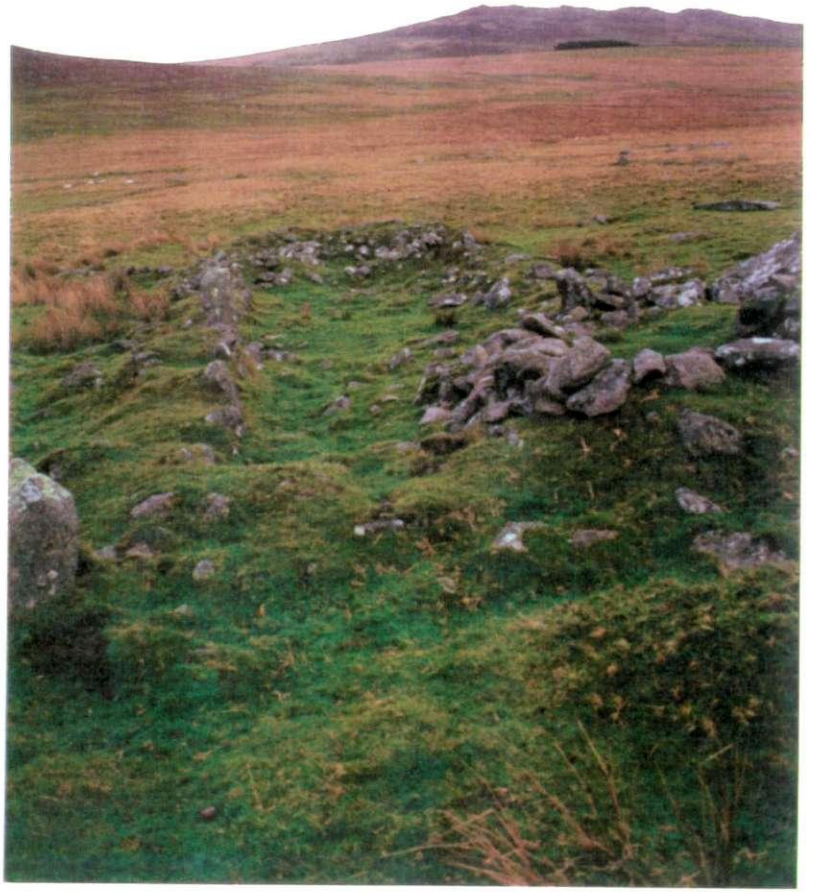


Plate 3.9 (top): Medieval ridge and furrow on the north-eastern slopes of Stannon Down. (A) marks the location of The Rough Tor north monolith A sampling site (see Chapter 4, part III).

Plate 3.10 (bottom): Medieval fields on the western slopes of Brown Willy, seen from Rough Tor.

3.5 Synthesis: archaeological evidence and human activity in the Rough Tor area and beyond

There is no evidence of Mesolithic activity from Rough Tor itself, but the flint scatters of Crowdy reservoir (Trudigan, 1977a, b), Louden Hill and Brown Willy (Herring & Lewis, 1992) denotes the presence of Mesolithic communities on the Rough Tor moors. Rough Tor itself may posssibly have acted as a focus for gatherer-hunter bands, considering the later interest in the location, which may be as a result of earlier activity prior to the introduction of agriculture.

The Rough Tor enclosure and the Louden Long cairn may represent the first definite evidence of communities in the area of study and Mercer's (1970) excavations at Stannon, suggested that human interest in this part of the moor may have begun prior to the main phases of activity indicated by the hut circles and field systems. The Stannon excavation acts as a reminder of the selective nature of cultural landscapes: earlier activity in an area may be obscured or destroyed by the later phases of settlement. The possiblity remains that early agricultural activity was also being carried out on the slopes below the Rough Tor enclosure, but is overlain by the later hut circles of Rough Tor north and south. The influence that the Rough Tor enclosure exerted at any particular time is uncertain, except that it lies within one the most densely settled areas of moorland and the boundary system seems to cluster around it. The enclosure was unlikely to have been permanently occupied and thus was probably used on a seasonal basis. The structure is probably asssociated with the main settlement phases and enclosure may have replaced the Louden long cairn as the main focus of activity in this part of the moor (Johnson & Rose, 1994).

A broad range of settlement and land-use may be identified in the Rough Tor area of the moor. This includes:

i) curvilinear accreted fields possibly associated with cultivation and permanent settlement;

ii) permanent settlement associated with more limited areas of fields and enclosures, with some cultivation, although the emphasis is likely to be on pastoralism;

iii) large boundaries dividing the landscape into blocks.

iv)small huts which occur singly or grouped in settlements presumably associated with seasonal pastoral activity.

A tentative chronology of landuse within the Rough Tor-Louden-Stannon area has been suggested (Johnson & Rose, 1994). The first phase includes the Rough Tor enclosure and Louden long cairn and farms of huts and accreted curvilinear fields developing on the moor in the following order (earliest first):

i) Stannon South

ii) Stannon Down

iii) Louden Hill

iv) Garrow Tor

v) Butterstor

vi) Fernacre

vii) Rough Tor S.

viii) Rough Tor N.

After this initial colonisation of the moor (Figure 3.5) Following this, the land was divided into large blocks (?3600 BP) (Figure 3.6). This phase may belong in between the huts and enclosures. From the third millennium BP onwards, this area may have been used as seasonal grazing. The next major phase of settlement comes in the medieval period with the establishment of the hamlets at Brown Willy and Louden and cultivation of the moor apparent in the cultivation ridges at Rough Tor, Louden and Brown Willy (Figure 3.7).

Figure 3.5: Phasing of the archaeological sequences at Rough Tor i) Early prehistoric. The Rough Tor enclosure, Louden long cairn and early hutsand fields. Figures 3.5-3.7 based on Bodmin Moor survey map iii (Johnson & Rose, 1994).

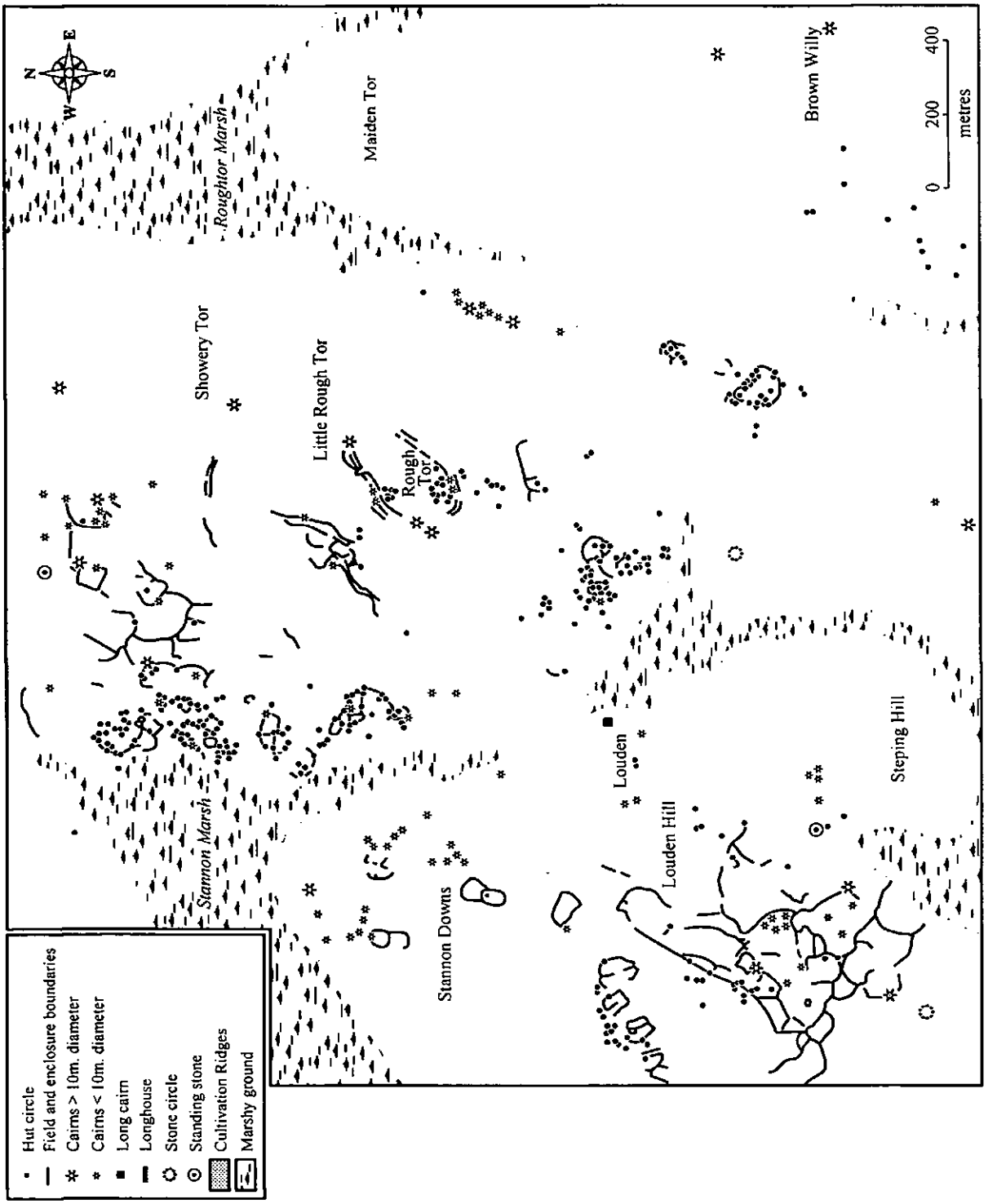


Figure 3.6: Phasing of the archaeological sequences at Rough Tor ii) Later prehistoric. The block boundaries.

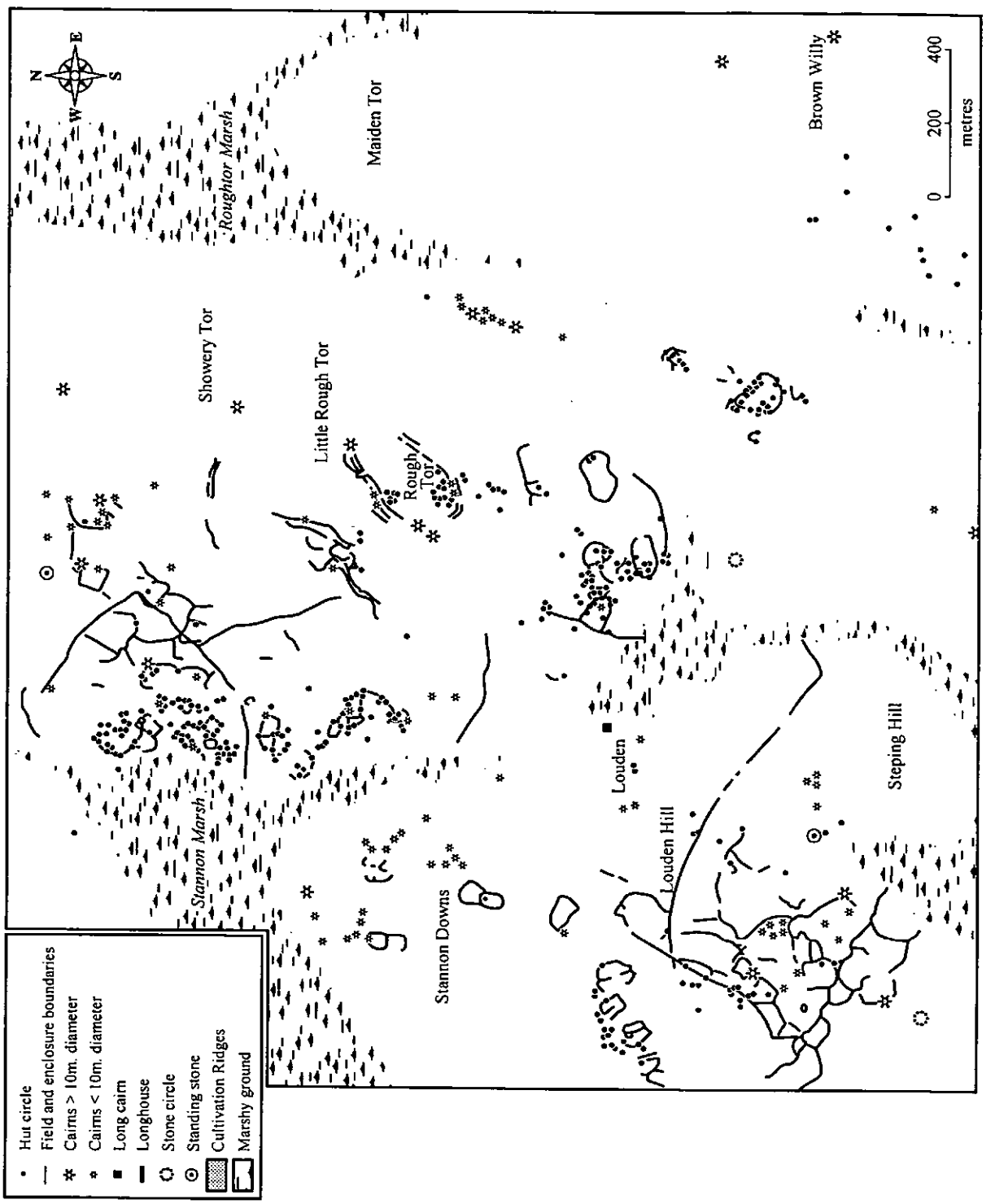
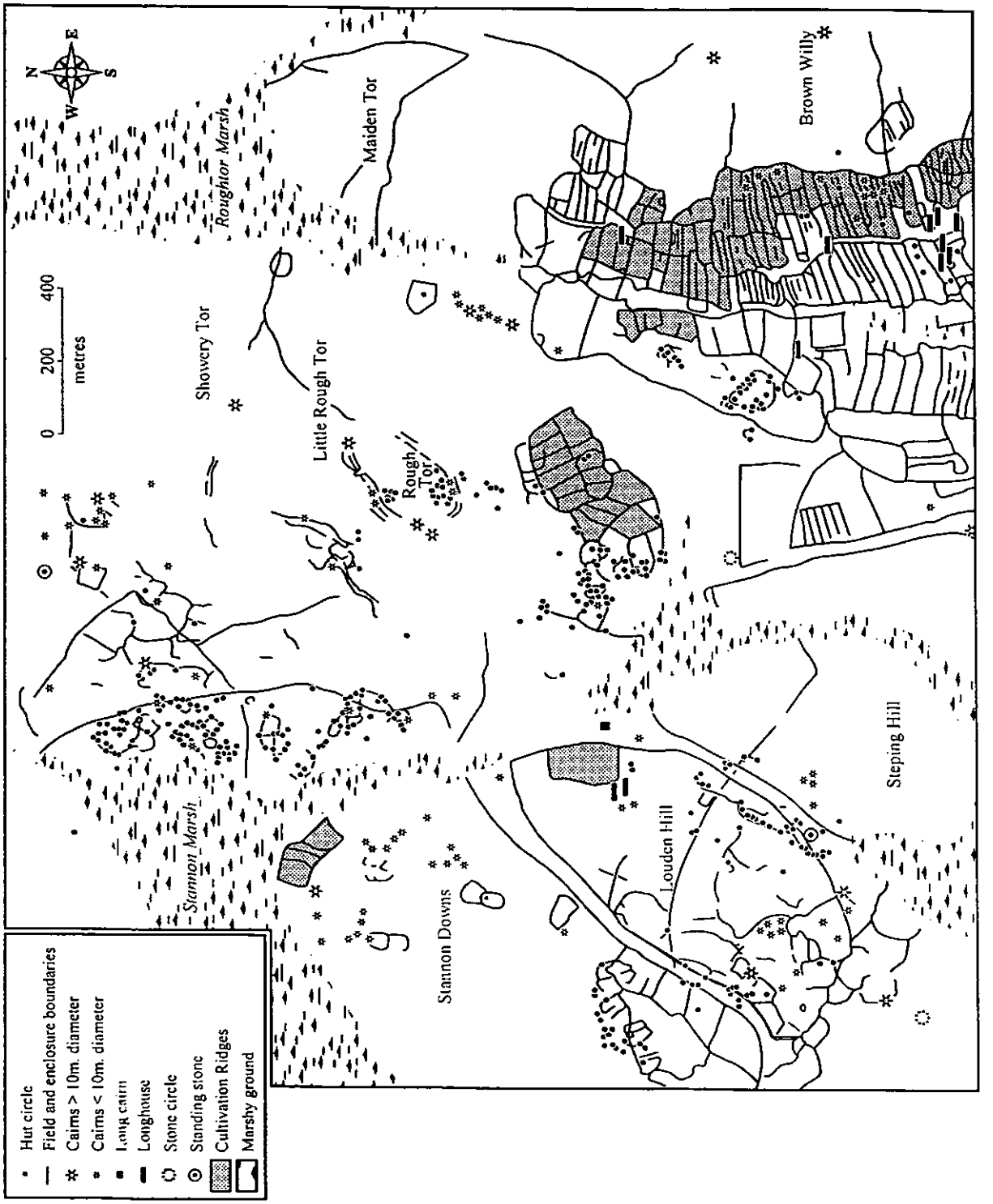


Figure 3.7: Phasing of the archaeological sequences at Rough Tor iii) Post-prehistoric. Medieval settlements, fields and boundaries.



The above dates are working hypotheses only (Johnson & Rose, 1994; Rose, in preparation). Outside these areas, the sequence becomes less clear. There is no evidence of boundaries defining Garrow, although the south boundary at Rough Tor could be the north boundary of the former area. Garrow appears as an island of land defined on three sides by streams and bogs. If this is accepted, then it could be a block in which there was similar activity to those at Rough Tor. The Butterstor field system was abandoned at some point, and the Stannon south system was also abandoned with a string of huts constructed over one of the boundaries (Figure 3.1). Cultivation may have been taking place within this subdivided landscape. The reasons for the abandonment of the system remain unclear: soil degradation or climatic change may have been responsible (Johnson & Rose, 1994).

Pastoral activity occurred either before or contemporaneously with the phase of large boundaries - possibly toward the end of the fourth millennium BP, or the beginning of the third. Researchers assume that, in common with other upland areas of the south-west, most permanent settlements on the moor were abandoned during the third millennium BP (eg. Todd, 1987); although use of the upland as seasonal grazing may have continued into the medieval period. Iron Age pottery found in an enclosed hut at Garrow would suggest that there was some form of permanent settlement during the third millennium BP at the head of the De Lank valley (Silvester, 1979).

The components found in the Rough Tor area of Bodmin tend to be typical of settlement elsewhere on the moor, but nowhere is the chronology as clear as in this area. Prehistoric field systems are generally curvilinear and accreted, apparently having developed from more than one focus, although the time-scale that such patterns represent is unclear. The general impression across the moor is of small farms scattered along the valley sides, implying that the landscape was filling up in a generally informal manner. Settlements tend to occupy well drained

slopes facing in all directions and are rarely found on flat moorland. Present day farm houses tend to fall within the range of 200-275 m OD with prehistoric huts 230-320 m:

> " The impression is one of a continuity of pattern in a reduced form to the present day." (Barnatt, 1982: 106)

In a few locations on Bodmin Moor, such as at Rough Tor and at Craddock Moor, Langstone Downs and Higher Langdon, continuous enclosure is apparent, leading to an extremely complex palimpsest of huts, enclosures and fields in each of these areas. There is some evidence on the moor of large scale land division, in the form of the co-axial field systems, or 'reaves' of Bodmin's larger and better investigated (both archaeologically and palaeoecolgically) neighbour, Dartmoor (eg. Simmons, 1964; Fleming, 1978, 1983; Balaam *et al.*, 1982; Maguire *et al.*, 1983;). The major block boundaries on the slopes of Rough Tor have been described as 'reaves', although they do not form as visually cohesive a system as on Dartmoor (Fowler, 1983:135). However, to make any meaningful comparisons between the extensive boundary systems of Dartmoor and the limited system that is apparent in the Rough Tor area, is difficult. The probable Bronze Age field systems on the East Moor of Bodmin (Chapter 6) have likewise been described as co-axial (Fleming, 1989), but this system, although probably contemporaneous with the Dartmoor reaves, is the product of a series of accretions rather than a single lay-out (D.Hooley, pers.comm.).

The farms on the moor range in size from a few hectares to larger systems and the ratio of huts to enclosed land tends to be in the range of 1-2 huts per hectare, although there are cases where the ratio is up to 10 and as many as 30 huts per hectare of land. This generally high ratio indicates that pastoralism was the main-stay of prehistoric farming (Johnson & Rose, 1994). The fields themselves are between 0.25 and 0.5 ha, although some of the fields at Stannon Down and Butterstor are above 1 hectare. The hut circles are either scattered within the

fields or concentrated into certain areas as nucleated groups. There are very few enclosures on Bodmin within which large numbers of huts are enclosed, with others lying outside, as is found on Dartmoor (Balaam *et al*, 1982).

3.6 A tentative model of human impact and environmental change in the Rough Tor area

A model of human impact and environmental change can be constructed utilising the archaeological data in the Rough Tor area. This includes the expected nature and extent of impact that would be expected to be evident in the palynological record based on the inferred intensity of landuse in the different cultural periods. Changes in the representation of micro- and macroscopic charcoal can also be modelled on the basis of changes in the nature of the local settlement. The basic hypothetical assumption in this section is that the field archaeology provides a reliable means of estimating the extent and nature of human impact in this part of Bodmin Moor during the Holocene. This underlies all the statements made above concerning the palaeoenvironmental record. The predictions of human impact and environmental change are summarised in Table 3.1.

The palynological record

The identification of environmental change that can be attributed primarily to human agency in the palaeoecological record can prove to be an uncertain exercise if material evidence of human presence in the area under study is not available:

"Pollen data are frequently open to various interpretations and no more so than in the case of vegetational changes where proof of human impact is uncertain." (Edwards, 1990:143).

Period/ yrs. BP appx.	Archaeological evidence *Socio-economic trends*	Postulated impact/land-use	Predicted evidence of impact in palaeo-record
0 *Medieval*	Settlements, fields and cultivation ridges at Louden, Stannon and Brown Willy *Colonisation of the moor*	High. Clearance of any remaining tree/shrub cover. Pastoral and arable farming.	Final fall in AP and increases in grass and other NAP esp. pastoral indicators. Cereal pollen possible. Charcoal - increases in micro
Romano-British 2000 - *Iron Age*	Transhumance huts *End of moorland settlements*	Low. Unintensive pastoral activity possible.	Some recovery in AP possible. Increase in heath and grassland. Charcoal: fall in micro and macro levels
4000 - *Bronze Age*	Multi-phased field systems and huts. Stone circle and other ritual monuments. *The 'stable' communities, land allotment. Animal husbandry developed.*	'High tide' of upland settlement. Landscape opened up. Cultivation ? and pastoral activity. Pastoral emphasis dominant in later phases	Marked fall in AP. AI increasing to max.levels. High species diversity. Charcoal: high macro- and micro.
6000 - *Neolithic*	Louden long cairn. Rough Tor enclosure. Flint scatters. *Development of agricultural implements (ard, sickle,hoe)*	Low. Transhumance/early activity. Limited clearance and exploitation of local resources	Falling AP and some increases in NAP. Increase in diversity. Evidence of grassland. AI low but increasing. Charcoal: low macro- and micro.
8000 + *Mesolithic*	Flint scatters. *Developing relations between hunters and herds.*	Very low. Possible small scale, temporary breaks in tree/shrub cover.	High AP low NAP. Low diversity. AI absent or sporadic. Charcoal: low micro- and macro-absent.

Table 3.1: Summary of archaeological evidence, inferred land-use and the palaeoenvironmental record during the Holocene in the Rough Tor area. Socio-economic trends based partly on Fowler (1983). AP-Arboreal Pollen; NAP-Non-arboreal pollen; AI-Anthropogenic indicators (*sensu* Behre, 1981)

For this reason, it is clear that the interpretation of palaeoenvironmental sequences will be considerably enhanced where the distribution of the archaeology of the area under consideration is known.

Obviously, it is never possible to attribute environmental change to any one factor and even where palaeoenvironmental sequences can be retrieved from close proximity to archaeological features, the interpretation of aspects of the palaeoecological record can never be entirely unequivocal.

Palaeoenvironmental study and the identification of human-induced environmental change in the Rough Tor area of Bodmin Moor is considerably aided by the presence of the surveyed field archaeology in this part of the moor. Although no excavation has been carried out and dating of the sequences remains tentative, such information obviously enhances the identification and interpretation of human impact in any palaeoenvironmental sequences recovered from contexts near to the field remains in this part of the moor.

The nature of disturbance visible in the palynological record would be expected to vary as the character and extent of human impact changes across time. This, in turn, is dependent upon two main factors: firstly, the original palaeoenvironment prior to human interference, and secondly the proximity of the sampling site to the location of the maximum disturbance. To expand upon the first consideration: some environments may be regarded as being more sensitive to human-induced disturbance than others, at least as far as regards the detection of such disturbance in the palaeoecological record (cf. Hirons & Edwards, 1991). For example, small scale disturbance to a fairly dense area of woodland would result in the spread of light-demanding understorey taxa, such as hazel, and of grasses and herbs. This corresponds to what may be regarded as the 'classic' clearance phase visible in many pollen diagrams: an interruption to the percentages of arboreal pollen, followed by an increase in shrubs and herbs, which in turn gradually decrease as

the forest regenerates.

Such 'models' of anthropogenically induced disturbance may become considerably less useful when the environment under consideration did not have a relatively dense tree cover. In such cases, human disturbance may well be less well pronounced. If the vegetation is already fairly open and a significant area of open land is present, for example, above the tree line, or in a partially wooded location, then the increase and spread of grasses and light demanding taxa following disturbance may be only very small relative to pre-disturbance levels. If a certain species is present prior to the disturbance, then its spread into the newly created ecological niche may be all but invisible in the pollen record, or may not be clearly attributable to human activity. Considering Brown's (1977) conclusion that Bodmin Moor never had dense forest cover, then this point may be especially relevant to the present study.

The nature of the evidence visible in the pollen record would be expected to change as the character and intensity of human impact changes over the prehistoric period. As the intensity of disturbance increases and a greater area of the landscape is opened up, not only would greater evidence be expected for human presence in the form of falling tree and shrub percentages, but also increased *diversity* in the pollen record. As the settlements evidenced by the field archaeology grew and reached their maximum extent, then a mosaic of habitats and micro-habitats can be envisaged as developing. Such habitats might range from arable plots and pasture land, to general disturbed habitats such as field and path edges, to remnant patches of the former vegetation cover. This environmental mosaic should be apparent in both a temporal and spatial sense and the analysis of multiple profiles should allow this variation to be detected.

The Mesolithic

Increasing evidence for Mesolithic impact upon the natural environment has been

forthcoming in recent years from areas such as Dartmoor, the North York Moors and the Pennines (eg. Jacobi *et al*, 1976; Simmons *et al*, 1983; Simmons *et al*, 1990; Innes & Simmons, 1988; Edwards, 1990; Caseldine & Hatton, 1993). This disturbance usually takes the form of reduced arboreal pollen percentages in pollen diagrams, indicating temporary recession phases in which forest trees recede in favour of more open and lower vegetation communities. These phases are followed by periods of regeneration and stability.

Considering the limited archaeological evidence for Mesolithic presence in the Rough Tor area and the low postulated site creation rate during this period, then it would not be expected that the palaeoecological record would show extensive evidence of disturbance by gatherer-hunter bands. The microlith scatters have been interpreted as representing only short stay hunting camps and any environmental disturbance resulting from such occupation must have been of a limited extent. Unless disturbance occurred very close to the sampling site, or was of a greater extent than might be envisaged from the field archaeology, then it seems unlikely that clear evidence of Mesolithic acivity would be apparent in the palaeoecological record.

The Neolithic

The Neolithic period in Rough Tor and its environs probably represents the earliest unequivocal evidence of human impact. The construction of the Rough Tor enclosure and the Louden long cairn and the early agricultural activity at Stannon all suggest that human interest in this area was steadily increasing from perhaps as early as the sixth to fifth millennium BP. Depending on the nature of this occupation, then the construction of the long cairn and enclosure should be detectable in the palynological record.

If this part of the moor was only used on a seasonal basis in this period, then human activity might be barely apparent, since the summit of Rough Tor may not

have been wooded. On the other hand, clearance of at least part of the area would have been necessary to provide building materials and fuel. Some disruption to tree and shrub pollen frequencies might be expected, but any spread of herbs and grasses might only be slight in this early stage.

In terms of the question of 'floristic diversity' discussed above, then unless there was activity on the slopes of Rough Tor immediately adjacent to the sampling sites, 'anthropogenic indicator' species (*sensu* Behre, 1981) would be expected to be present in only low, intermittent quantities and would not be expected to include those species which are indicative of heavily disturbed habitats (eg. *Rumex*). It seems unlikely that any trace of the cultivation that may have been proceeding at Stannon in this early period (Mercer, 1970) would be directly visible in palaeoenvironmental sequences from Rough Tor.

The Bronze Age

The Bronze Age probably represents the period of maximum activity in this area. The extensive hut circles, field systems, boundary walls and ritual monuments indicate that this period saw intense activity in the period from around the fourth to the third millenium BP.

Tree and shrub pollen percentages should show a marked decline as the anthropogenic impact on the landscape increases. The field evidence for settlement is considerable in this period, and a corresponding increase in ecological niches and 'floristic diversity' (discussed above) brought about by such a widespread disturbance would be anticipated. A more diverse pollen spectrum reflecting this should be apparent. The pollen of herbs characteristic of, for example, damp meadow, waste land, arable land, pasture land, and possibly even cereal pollen, might all be anticipated. The presence of lynchets on Rough Tor north indicates that cultivation was being carried out in an early phase of settlement, but this may have been only short-lived 'snatch crop' cultivation within a dominant framework

of pastoralism (Maguire *et al.*, 1983), and thus would not be apparent in the pollen record. Different percentages and/or types of various pollen should be present at each sampling location, allowing something of the spatial variation in land use to be mapped.

Pastoralism is the postulated mainstay of the Bronze Age economy in this part of the moor (Johnson & Rose, 1994), so high levels of herbs, indicative of pasture land in particular, may be envisaged as being present in the palaeoecological record (*Plantago*, Poaceae, Rubiaceae etc.). Percentages of 'anthropogenic indicators' should decline as land exhaustion sets in toward the close of the Bronze Age and as the division of the landscape into the large blocks interpreted as large scale pastoral activity commenced (Johnson & Rose, 1994).

The behaviour of the anthropogenic indicator curves should give some clues about the nature and extent of settlement in this part of the moor. A sudden rise and decline in these species may provide information as to whether settlement on the Rough Tor moors was of short duration and abandoned suddenly following a climatic deterioration, as has been suggested for some of the British uplands. The moors in this area probably continued to be used as grazing into the Iron Age and Romano-British period and thus the pollen spectra may indicate a steady levelling-off in 'anthropogenic indicators', as the character of the pressure on the land resource changed. As a result, the precise point at which settlement ceased is difficult to locate in the palynological record.

From perhaps the mid-third millennium BP onwards, it would be expected that evidence of human presence would decline and heather communities would spread at the expense of grassland. The climatic deterioration envisaged for the middle of this millennium, that has been suggested as being at least partly to blame for the abandonment of upland settlement, might be apparent in the palaeoecological record as increasingly wet conditions in the environs of Rough Tor. By the Iron

Age/Romano-British period, a pollen spectrum indicating a landscape predominately similar to that of today would be expected, perhaps with some tree and shrub cover remaining in some areas.

Medieval settlement

The medieval settlement of the moor should be apparent in the form of the demise of any remaining tree and shrubs and increases in indicators of both pastoral and arable landuse. The extensive areas of ridge and furrow in this area testify to cultivation during this period and cereal pollen may be a feature of the palaeoecological record. The spread of the acid grassland typical of the Rough Tor moors may be evidenced from around this period as anthropogenic impacts lead to a final demise in soils.

The charcoal record

Microscopic and macroscopic charcoal frequencies will provide further information about ecological and cultural change. In particular, charcoal analysis may indicate whether fire was being used to remove tree cover. Brown (1977) postulated that deliberate burning would have been unnecessary in the predominately open environment around Dozmary Pool, but the situation may be different in this part of the moor.

If the palynological record indicates clearance activity and charcoal frequencies remain low, then this may imply that fire was not being used as a land management tool. Jacobi *et al* (1976) suggested that burning was a predominately Mesolithic land use practice, and its utility ceased with the introduction of agriculture. This contention is supported by Simmons *et al.* (1990), who pointed out that in pollen diagrams from the North York Moors evidence of burning is strong in pre-elm decline clearances, but tended to decline after this eco-cultural benchmark. Edwards (1988) stressed that a number of different interpretations

may be made of charcoal data.

Evidence of burning may be low prior to the earliest phases of activity (the long cairn and the enclosure) and the establishment of the settlements at Rough Tor north should lead to increased charcoal frequencies. Even if fire was not being used to clear vegetation, then domestic hearths and accidental fires should be evidenced in the charcoal record. Moreover, as regional activity increases, then the record of local burning would have been enhanced by 'background' levels. Higher levels of macroscopic charcoal (50-10000μm) would be expected from profiles obtained from closer to the areas of settlement, due to the taphonomy of this size of charcoal (Clark,1988). Macroscopic charcoal is a more reliable indicator of local burning than microscopic charcoal and periods of intense local activity should be marked by increased frequencies of the former size class.

The abandonment of the Rough Tor settlements should be demarcated by a sudden drop in charcoal frequencies indicating reduced anthropogenic activity in the area. Low microscopic levels signalling regional activity would be expected, and very low/absent macroscopic quantities. The increase in local settlement in the medieval period might be demonstrated by increased charcoal levels in this period, although there are few actual sites of habitation at Rough Tor and the nearest settlement is at Brown Willy.

3.7 Summary

This chapter has described the extensive field archaeology in the Rough Tor area. This includes possible Neolithic structures, together with Bronze Age field systems and ritual monuments. The archaeology has been used to formulate a tentative model of the nature and extent of human impact across the Holocene. This model can be tested against the results of the palaeoecological investigations. The next

chapter will describe the results of the pollen analytical studies in the Rough Tor area and their implications for natural and human-induced environmental change.

Chapter Four
Palaeoenvironmental Investigations at Rough Tor
Part I:
Rough Tor Marsh

4.1 Introduction

This chapter describes the results of palaeoenvironmental research at Rough Tor. The first part describes the Rough Tor Marsh sampling site and the second part the Rough Tor south core. The third part concerns the analysis of three monoliths from Rough Tor north. The sampling sites are marked on Figure 4.1 The implications of these sequences for natural and human-induced environmental change on the Rough Tor Moors are discussed in relation to the hypotheses advanced in the previous chapter. The main aims of the chapter are to:

i) to identify the environmental changes during the Holocene in the Rough Tor area;
ii) to characterise the role of human communities in this process;
iii) to assess the degree of correspondence between the model of human impact and land-use for the Rough Tor area and the palaeoecological record.

4.2 Rough Tor Marsh

Rough Tor Marsh is a valley mire to the east of Rough Tor and is c.309m OD. It is c.1.25km long and 300m wide. The lower reaches of the mire (southern end)

Figure 4.1: Map showing location of the sampling sites in the Rough Tor area

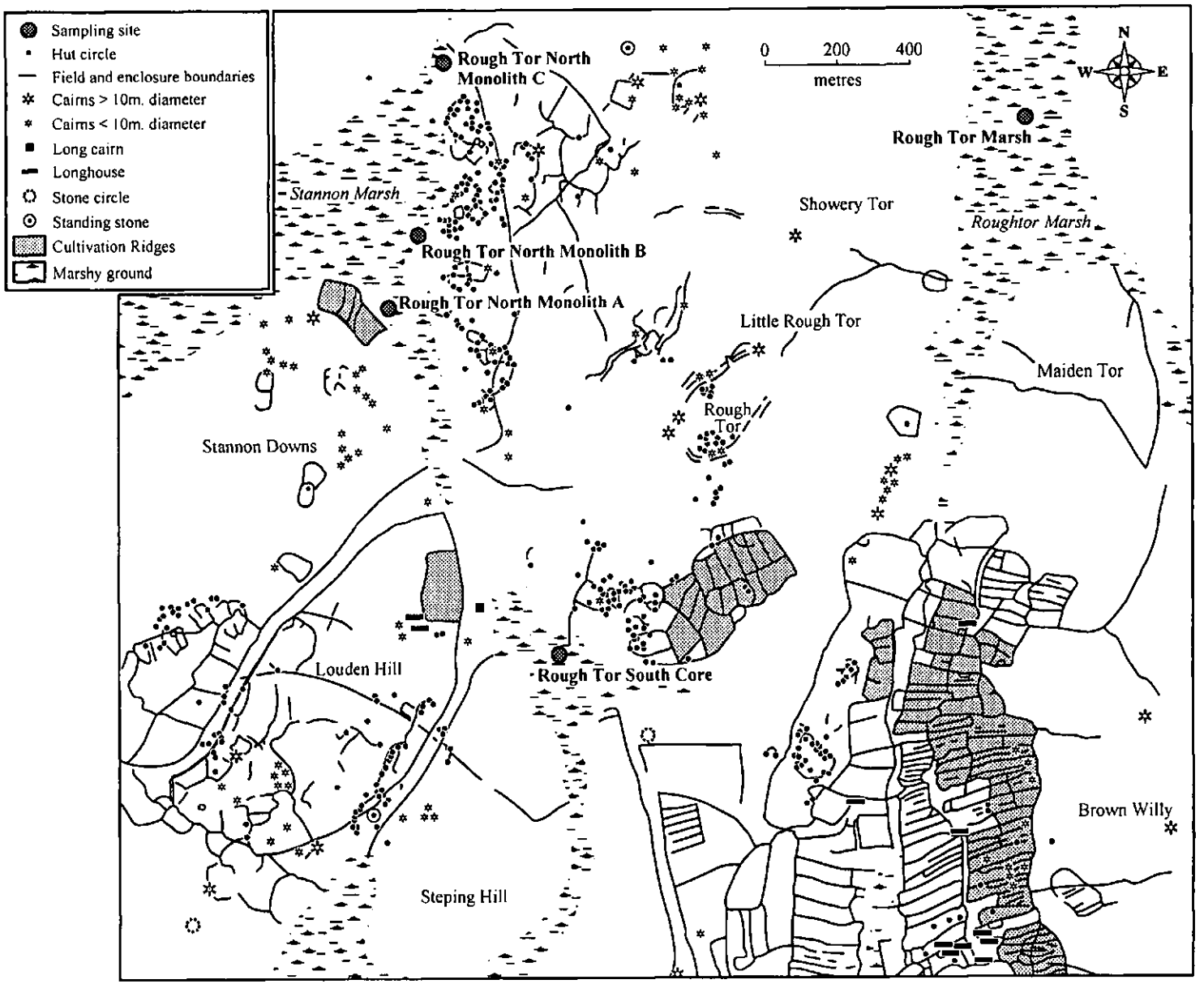
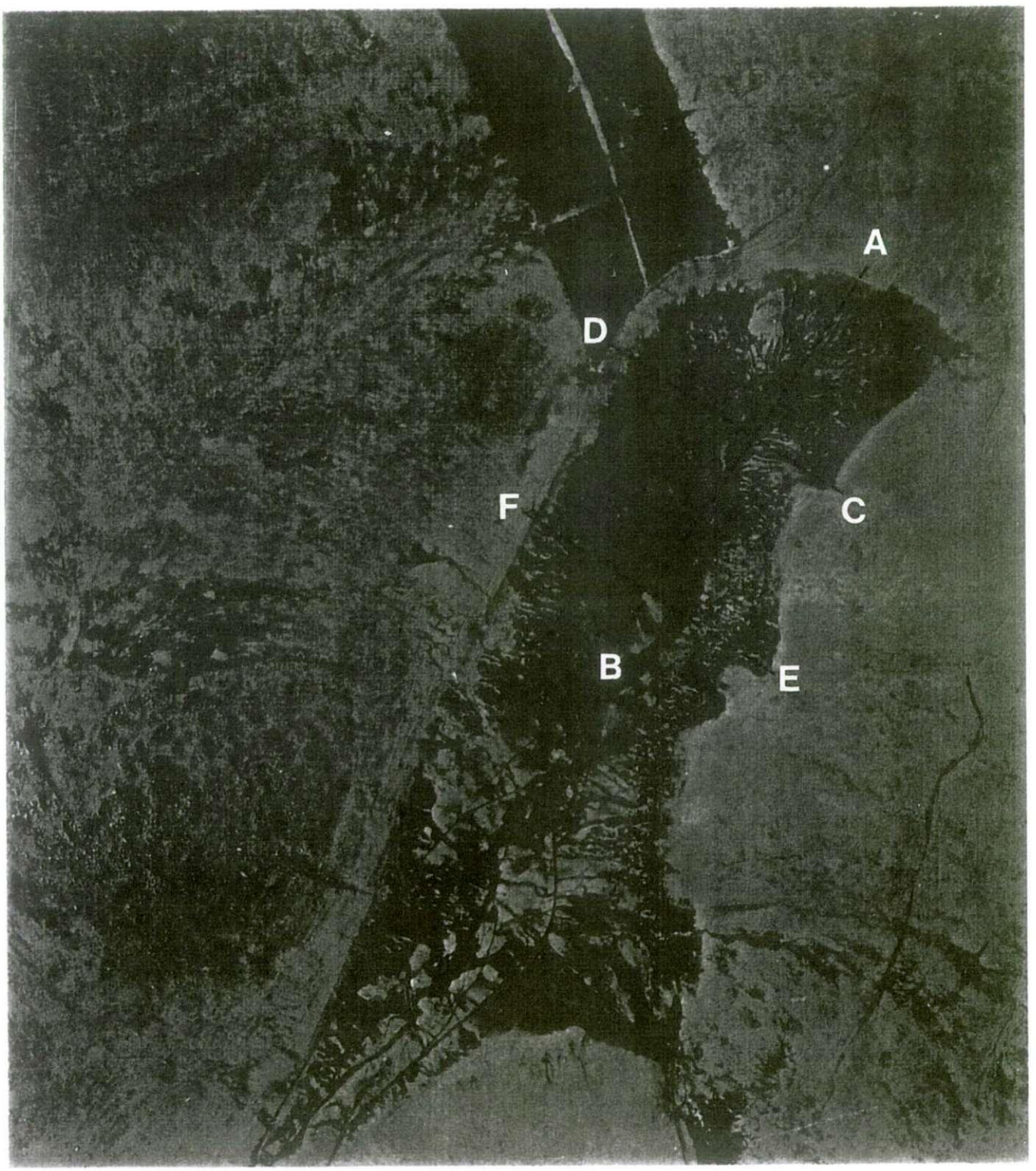


Plate 4.1: Aerial photograph of Rough Tor Marsh. North is to the top of the photograph. Peat cuttings are clearly visible around the fringes of the marsh and the tin streaming works in the lower reaches of the mire. The survey transects (Figures 4.2-4.4) are marked.



have been disturbed by tin streaming activities and by peat cutting. An aerial photograph (Plate 4.1) indicates that only the eastern and southern parts of the marsh are obviously affected in this way, although it is probable that older cuttings may not be clearly apparent from surface features.

This site was investigated:

i) to assess the utility of large valley mire sampling sites in palaeoenvironmental investigations on Bodmin Moor. In particular, to determine the extent to which peat cutting and tin streaming activities have affected such locations;

ii) to compare the evidence for human impacts derived from a valley mire sampling site with that from smaller deposits such as those at Rough Tor north and south that are closer to the locations of human activity as represented by the archaeological sequences.

4.3 Methods

Survey and sampling followed the standard procedure described in Chapter 2. A Russian corer was used to recover the sequence. Pollen extraction and loss-on-ignition followed the procedures described in Chapter 2. A sampling interval of 20cm was employed.

4.4 Results

Survey

Three transects were taken across the marsh: A-B (north-south: Figure 4.2), B-C & D-E (east-west: Figures 4.3.-4.4). The sampling site is indicated on Figure 4.4.

Figure 4.2: Rough Tor Marsh survey transect A-B. Position of transects is shown on Plate 4.1.

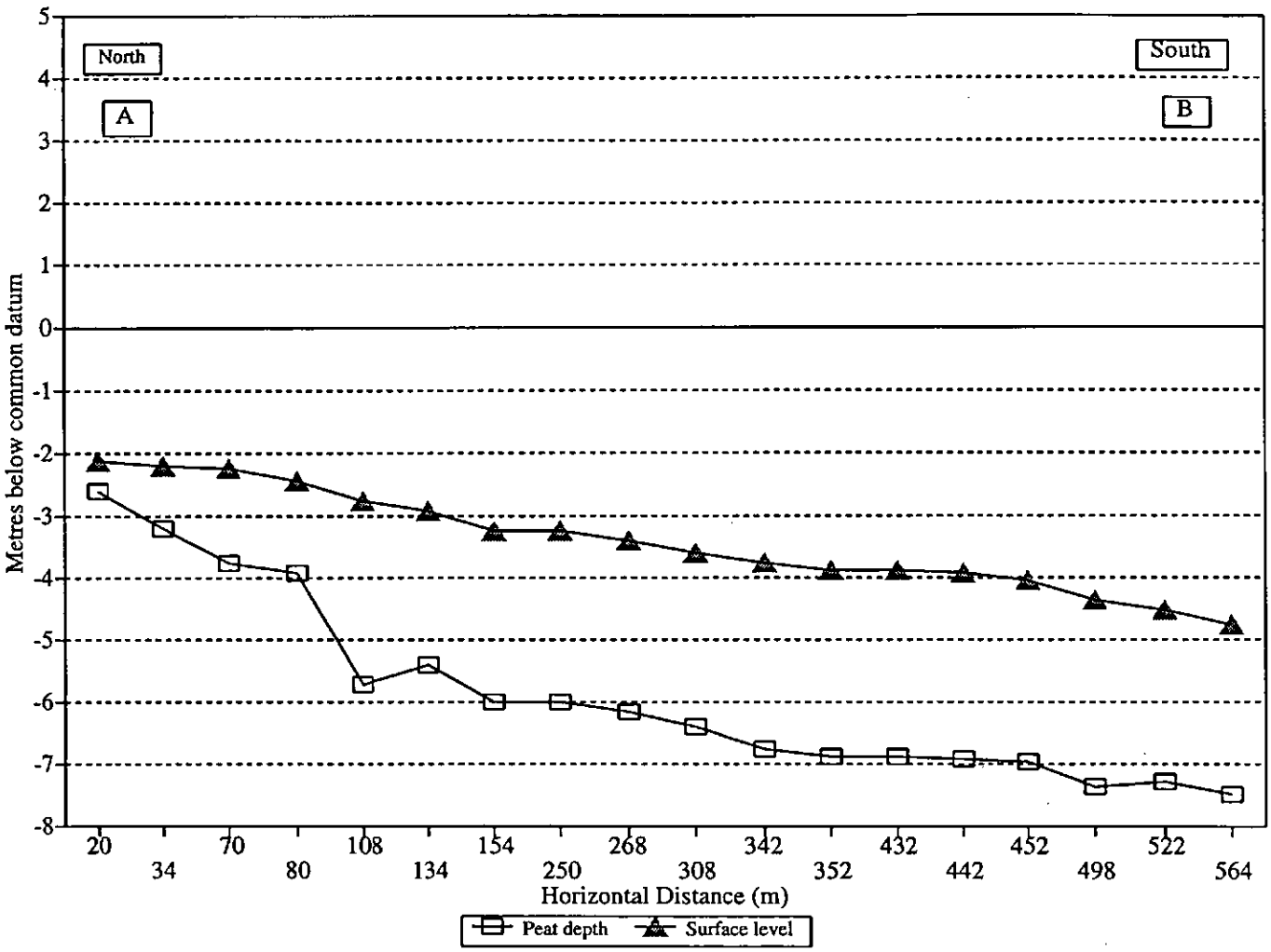


Figure 4.3: Rough Tor Marsh survey transect C-D.

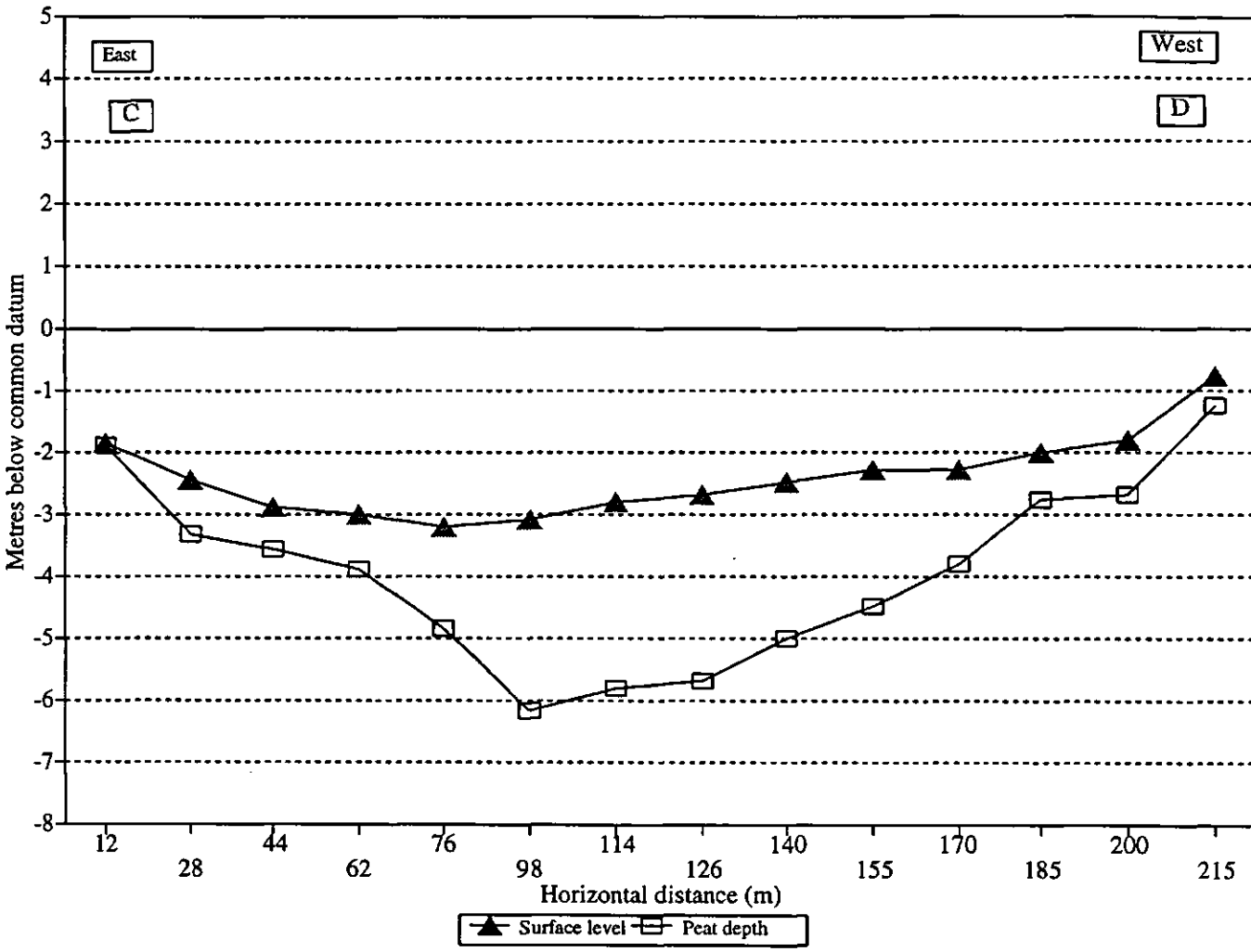
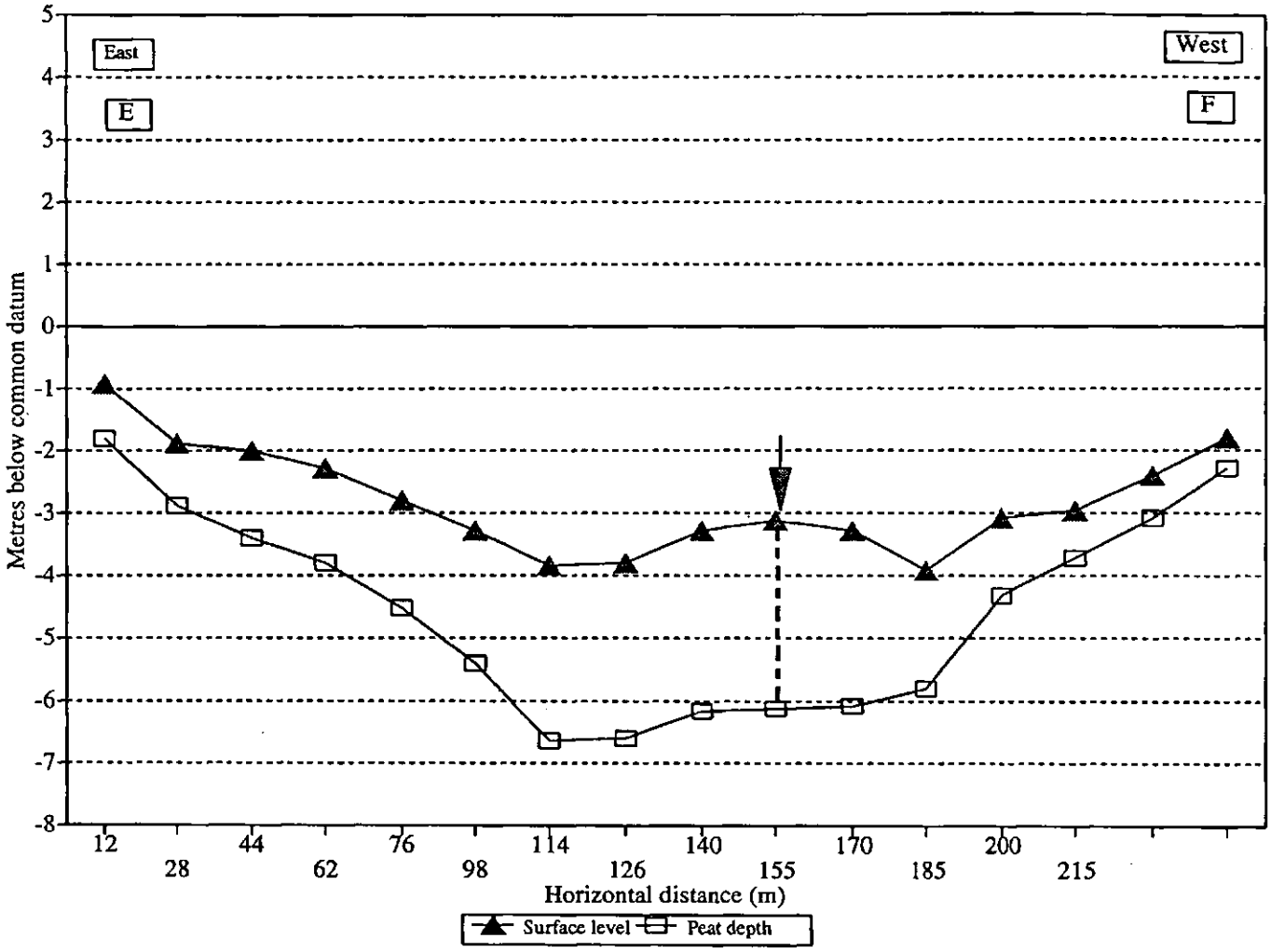


Figure 4.4: Rough Tor Marsh survey transect E-F. Coring location is marked.



Only the northernmost half of the marsh was surveyed, as the tin streaming had made the southern end of the mire very unstable. The basin has gently sloping sides and a smooth, flat bottom, apart from a sudden drop on the A-B transect. The maximum depth of sediment is just over three metres. According to Brown (1977), most upland valley floors on Bodmin Moor have a similar morphology, although the maximum depth of peat in this case is greater than the figure of 1-2m he gives for the average depth of valley mires on the moor.

Loss-on-ignition

The results of loss-on-ignition (LOI) are given in Figure 4.5. Organic percentages are below 10% at the base of the core, where the sediment is a grey, detrital clay which probably represents early inwash into the basin before vegetation cover had stabilised the soils. Above this, organic matter percentages stabilise at above 90%, suggesting a lack of mineral inwash into the marsh. There is a drop around 110-120cm to 70-80%, which may reflect the effects of some form of disturbance in either the marsh or its catchment.

Pollen analysis

The results of pollen analysis are given as a percentage diagram (Figure 4.6) and concentration diagram (Figure 4.7). Table 4.1 summarizes the zonation of the pollen diagram.

4.5 Discussion: interpretation of the Rough Tor Marsh pollen diagram (RTC)

Pollen concentrations (Figure 4.7) are low in the basal sample, 6.7 x 10^3 grains/cm^{-3}, but increase across the zone to 26 x 10^3 grains/cm^{-3} by 240cm. Pollen counts are therefore very low in RTC1 (Figure 4.6) and percentages of unidentified pollen high. Alongside the rising values for LOI (Figure 4.5) across this zone, an early period of rapid inwash into the marsh is inferred with high sediment

accumulation rates. In the light of the low pollen counts, interpretation of the pollen data is tentative. *Betula* is present at 15% and *Pinus* at 10%, with *Corylus avellana*-type percentages increasing to 40% by 240cm. *Corylus avellana*-type is assumed to be mainly *Corylus avellana*, although the marsh sampling site means that *Myrica gale* may have been present near to the sampling site. Poaceae and Ericales percentages indicate the presence of some open grass and heath communities. The palynological impression is of birch woodland with hazel expanding locally onto the better drained soils around the marsh. Birch may have been present on the marsh itself, but the percentages of grass and heathland pollen are probably derived mainly from grass on the marsh which was probably largely open. The records of Lactuceae indet. and Caryophyllaceae in the lowest samples point to some open, perhaps slightly disturbed ground nearby.

Pinus is present at 15% in the lowest samples, a percentage that is not usually thought to indicate local presence. Pollen counts are very low at this point, but some local pine is thought possible. This may be supported by the subsequent decline in *Pinus* and rise in *Alnus* to percentages sufficient to demonstrate a local or near local presence. This is a common feature of palynological records in Britain and is interpreted as indicating that alder out-competed pine on the damper soils of the valley bottom (Bennett, 1984). Had pine not been present locally, then it is difficult to explain the synchroneity of these events. *Alnus* peaks at 10% at 240cm and seems to have replaced *Salix* on the bog surface as part of a hydroseral succession, but itself disappears from the pollen record at 230cm.

The presence of aquatic taxa *Nymphea* and *Menyanthes* and perhaps also the low peak in *Sphagnum* in RTC1 suggest some open water on the bog surface. *Salix* also reaches 10% suggesting a limited local occurrence of this shrub.

Figure 4.5: Rough Tor Marsh core organic matter determined by loss-on-ignition

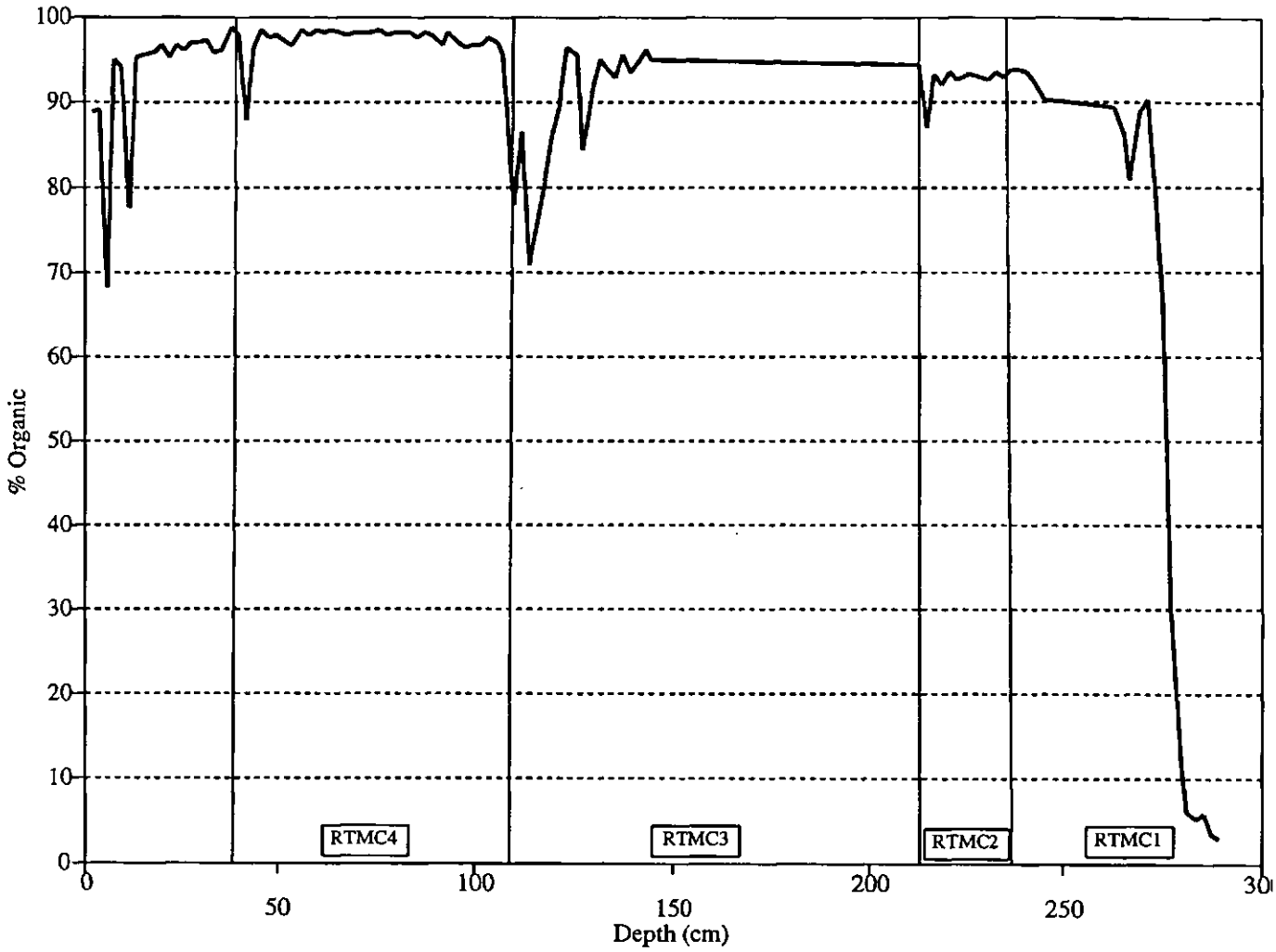


Figure 4.6: Rough Tor Marsh core percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration is x10.

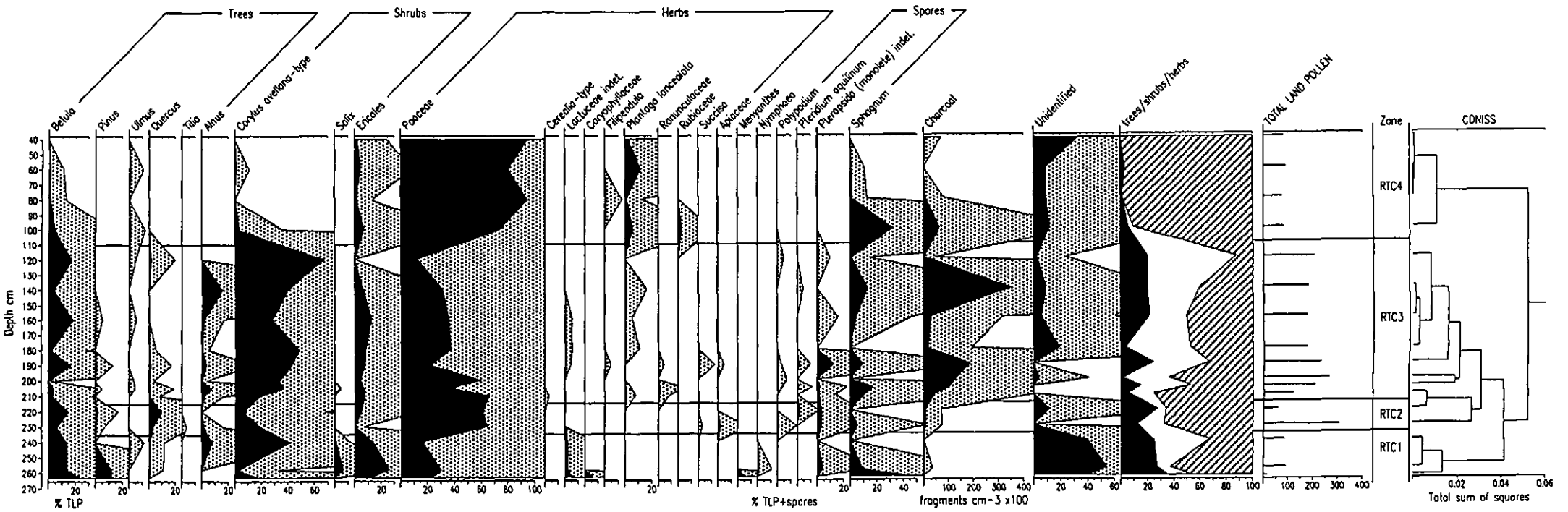
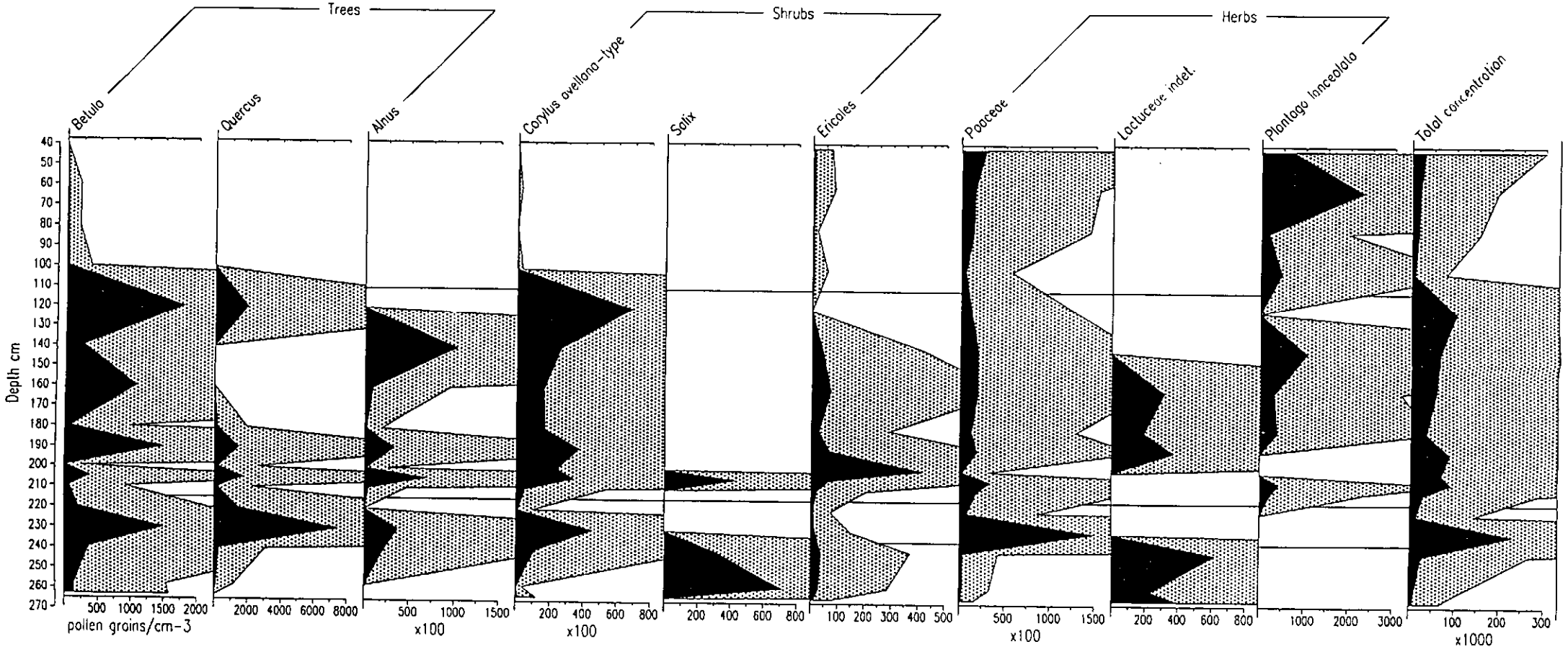


Figure 4.7: Rough Tor Marsh core pollen concentration diagram (selected taxa). Values are of grains cm^{-3}. Exaggeration x10. NB. change in horizontal scales.



Zone	Depth(cm)	Description of main features of zone
RTC4	40-110	*Betula* falls to 1%. Poaceae increases to 80-90%. *P.lanceolata* increases to 12%. *Sphagnum* peaks at 32% TLP+spores at 100cm.
RTC3	110-215	*Betula* fluctuates between <5% to 20%. *Alnus* increases to 16% but disappears by top of zone. *Corylus avellana*-type peaks at 70% but fluctuates around 30-40%. Poaceae 20-30%. Other herbs low and sporadic. *Cerealia*-type recorded at 210cm.
RTC2	215-235	*Betula* increases to 15%. *Quercus* increases to 10%. *Corylus avellana*-type falls to <10%. Poaceae increases to >60%.
RTC1	235-263	*Betula* 15-20%. *Pinus* at 12% but disappears from record by 240cm. *Corylus avellana*-type increases to >40%. *Salix* increases to 6% but falls to <2%. *Alnus* increases to 8% then falls to <2%.Poaceae increases to 30%. Lactuceae indet. 2-5%.

Table 4.1: Zonation of the Rough Tor Marsh pollen diagram

A damp, fairly open environment around the sampling site is therefore envisaged for this period. The aquatic taxa and *Salix* disappear in RTC2 implying that locally it might have become drier.

Brewster (1977) suggested that valley mires on Bodmin Moor tend to have developed along the courses of streams draining acidic rocks: where the flow of water becomes obstructed, ideal conditions for the build up of peat are created. This hypothesis is supported by the palaeoenvironmental data from Rough Tor marsh. The loss-on-ignition curve (Figure 4.5) indicates that the sediments accumulating in the valley became increasingly organic as the vegetational cover developed. As this occurred, the flow of water draining the valley would become restricted leading to the build up of water in the valley bottom. These open pools would soon become colonised by *Sphagnum* and other aquatic plants. These plants would encroach upon the pools and organic matter begin to accumulate (Barko & Smart, 1983). Succession would proceed from open water to bog and the areas of standing water would be much reduced.

The first zone therefore portrays an environment that is becoming increasingly more stable. Birch and hazel are spreading locally with bog developing in the valley, where scattered stands of pine and willow are being replaced by alder. The percentages of Poaceae are probably derived mainly from local grass growth and the status of both trees and of more open habitats on the drier soils on the slopes and hillsides around the mire is difficult to assess. Since the area around the sampling site was quite probably too damp for the growth of hazel, the high percentages of this taxon (up to 50%) in RTC1 may indicate that hazel scrub was fairly dense on the slopes around the mire.

RTC2 opens with a fall in *Corylus avellana*-type, a series of fluctuations in *Betula* and an increase in Poaceae. The birch-hazel woodland has been reduced in extent and grassland has spread as a result. *Quercus* increases suggesting that oak was

unaffected, although *Plantago lanceolata* appears at c.2% at the same level confirming a disturbance of dry-land habitats. *Corylus avellana*-type percentages recover by the top of the zone and *P.lanceolata* disappears pointing to a regeneration of woodland. *Alnus* reappears at 210cm and although it increases to above 10%, it does not display a sustained increase during this zone.

P.lanceolata begins as a continuous curve at the opening of RTC3 pointing to the creation of open areas around the marsh. The appearance of other herb pollen including Lactuceae indet., *Achillea*-type and *P.major/media* suggests the presence of open grassland communities There is little change in the representation of the other taxa, with both *Corylus avellana*-type and Poaceae remaining steady. *Betula* at the opening of the zone and *Alnus* peak at 140cm. Although the *P.lanceolata* curve indicates the maintenance of open areas, it is unclear at the expense of which of the arboreal components of the vegetation this was at until 120cm, when a peak in this herb corresponds to a fall in *Corylus avellana*-type, *Betula* and *Alnus*. This is followed by a recovery in both *Betula* and *Corylus avellana*-type, the disappearance of *P.lanceolata* from the palaeoecological record and a drop in Poaceae. A reduction in open habitats and regeneration in birch-hazel woodland is therefore indicated. A peak in Pteropsida (monolete) indet. is probably related to this increase in relatively undisturbed woodland habitats.

This zone therefore demonstrates a phase of disturbance to the local woodland, which may have been fairly slight at first, but which intensifies towards the top of the zone to result in a reduction in birch and hazel populations and an increase in open habitats dominated by ribwort plantain. This is followed by a phase of woodland regeneration, although *Alnus* does not take advantage of this.

RTC4 is characterised by a sudden reduction in tree pollen from 10% and shrub pollen from 70% to below 10% collectively. This is accompanied by an increase in Poaceae and *P.lanceolata*. The environment represented by this zone is

markedly different from that in the previous zone. The tree and shrub components of the vegetation have disappeared entirely and grassy areas are the only significant elements of the local flora. The sudden nature of this change suggests that there is an hiatus in the sequence at around 110cm. The loss-on-ignition curve shows that there is an influx of mineral matter at around 110-120cm (Figure 4.5) and thus at the same point at which the pollen data records the sudden vegetational change described above. This suggests some form of disturbance in the marsh or its catchment.

The most likely cause of a hiatus in the sequence is peat cutting. This may be supported by the peak in *Sphagnum* at 100cm, as it has been suggested that the activities of peat cutters encouraged the growth of *Sphagnum* by creating localised pools, which then became filled with floating mats of this moss (Brewster, 1977). This phenomenon was observed during fieldwork on the east side of the marsh, an area that has clearly been cut for peat in the past. The peak in *Sphagnum* and sudden influx of mineral matter may therefore represent the infilling of a cut away surface. The abrupt fall in total pollen concentration (Figure 4.7) at the opening of the zone, from 101.8 x 10^3 grains/cm^{-3} at 120cm to 7.8 x 10^3 grains cm^{-3} at 100cm, may result from a period of rapid peat accumulation that might be seen as consistent with this hypothesis.

RTC4 therefore represents a later phase of landscape development, when the previous birch-hazel woodland had already been cleared and grassland was the major ecotype. The only herb apart from grass that was significant on a landscape scale is *P.lanceolata.*

4.6 Interpretation of the charcoal record

Microscopic charcoal levels are very low in RTC1 suggesting a lack of burning

near to the marsh in this period, whilst increased burning is suggested by the rise in frequencies across the following zone. The peak in charcoal at 190cm does not correspond to the opening up of the local vegetation suggested by the increases in Poaceae and reduction in *Corylus avellana*-type. It is therefore unlikely that the destruction of hazel scrub was a result of either natural of humanly-set fires. The increased representation of charcoal may or may not be derived from local anthropogenic sources. If a human source is accepted as being possible, then both the charcoal and pollen data point to a reduction in activity toward the close of RTC2.

Charcoal peaks again at 140cm. This corresponds to a period of human settlement and clearance activity as interpreted from the *Plantago lanceolata* curve, but there is no reduction in actual tree and shrub pollen frequencies at this point. If the increased representation of charcoal is due to human burning, then this cannot be correlated with the clearance of trees and shrubs, as detected in the palynological record. Charcoal frequencies actually fall with the peak in clearance activity, as interpreted from the increase in *Plantago lanceolata* at 130cm but there is an increase in charcoal co-eval with the recovery in tree and shrub pollen at 110cm. These features of the pollen and charcoal data serve to underline the difficulties attached to the interpretation of microscopic charcoal data in terms of human activity (cf Edwards, 1988, Patterson *et al.*, 1987).

4.7 Human impact and vegetational change at Rough Tor Marsh

The early vegetation

The lowest zone of the Rough Tor marsh diagram seems to represent early Holocene vegetational development. Birch is established by the time sediment accumulation begins, followed by hazel and oak, although oak is palynologically not a very significant component of the vegetation in RTC1. The replacement of

pine by alder is also a feature of the pattern of early Holocene vegetational development (Bennett, 1984). The record of Lactuceae indet. and Caryophyllaceae is interpreted as representing the disturbed soil conditions that existed as soil cover stabilised early in the Holocene. This is supported by the loss-on-ignition data that show a transition from a low percentage of organic matter to sediment with a high organic content: a transition from a high energy environment with unstable soils, followed by a consolidation of soils with the spread of trees and shrubs is suggested by these data.

Evidence for clearance activity

The first evidence of human disturbance to the vegetation occurs in RTC2 with a reduction in hazel and increase in grass. This clearance seems to have been selective and did not involve either birch or oak. It seems unlikely that hazel was being deliberately sought for clearance, but hazel was probably the dominant woody component on the area being cleared. Assuming that oak and birch were better established at lower altitudes, then the clearance activity may have been confined to the upper slopes in this period. There is no way of locating the site of this clearance with respect to the sampling site.

The disturbance to the vegetation was localised and the subsequent recovery in hazel and rise in alder in the top half of RTC2 points to a period where there was little human activity. The beginning of the *Plantago lanceolata* curve at the close of this zone indicates the initiation of further anthropogenic activity but the maintenance of tree and shrub pollen percentages makes it difficult to assess the extent or nature of this. The areal extent of open land was either not sufficient to have a palynologically significant effect on the dominant tree and shrub cover, or the creation of open areas was restricted to certain areas of the landscape, whilst woodland continued to increase in other locations.

The marked falls in hazel, birch and alder and the peak in *P.lanceolata* suggest an

intensification in clearance activity with the destruction of woodland on both the hillsides and possibly also the damper soils on and around the marsh itself. This is followed by recoveries in hazel and birch and a break in the *Plantago lanceolata* curve, probably as a result of a contraction in settlement leading to a period of tree and shrub regeneration.

Peat cutting at Rough Tor Marsh?

The sudden change in the pollen curves between RTC3 and RTC4 have been attributed to the removal of the upper layers of sediment through peat cutting. Around one metre of peat has accumulated above the level of the cutting. A high accumulation rate of c. 1mm yr^{-1} would mean that this had occurred at some point during the Dark Ages or possibly the early middle ages. A lower accumulation rate might push the date back into the later prehistoric period. Without radiocarbon dates to determine the age of the sediment above and below the proposed cutting this is speculation. More significant is that hiatuses caused by activities such as peat cutting can be recognised in the palaeoecological record. Table 4.2 summarises the vegetational changes and inferred evidence of human impact for the Rough Tor Marsh core.

4.8 Summary

This part of the chapter has described the results of an analyis of a core from Rough Tor marsh. The sequence appears to stretch back to the early Holocene but there is an hiatus in the sequence, probably caused by peat cutting. Evidence for anthropogenic disturbance to the vegetation has been discussed. The next part of this chapter will discuss the correlation of the sequences from Rough Tor and their implications for human settlement.

Zone/depth cm	Main ecosystem represented	Inferred human impact/activity
RTC4 *40-110*	Open grassland.	Grazing on slopes around marsh
RTC3 *110-215*	Hazel scrub with some birch and alder expanding locally. Some open areas around marsh.	Unintensive pastoral activity. Possible cultivation early in zone
RTC2 *215-235*	Expansion of grassland at expense of hazel. Birch/oak present locally.	Clearance of hazel scrub.
RTC1 *235-263*	Birch woodland with hazel expanding locally. Willow and perhaps pine present near to sampling site. Some open grass and heathland. Damper areas with some standing water possible early in zone	No evidence of human activity.

Table 4.2: Summary of interpretation of the Rough Tor Marsh pollen diagram

Chapter Four:
Palaeoenvironmental Investigations at Rough Tor.
Part II - Rough Tor South

4.9 Introduction: the Rough Tor south sampling site (RTS)

Field reconnaissance identified a deposit on the south-western slopes of Rough Tor (Figure 4.1). This peat accumulation appears to have built up around a spring, as a stream emerges from its south-western edge and drains into a marshy tributary of the River Fowey (see Chapter 3; Plate 3.1). It is clearly domed in profile (Plate 4.2). A prehistoric boundary disappears into the north-east edge of the peat (Plate 4.3), before appearing in a more fragmentary form again some 10 metres downslope. Test probing revealed that around 3 metres of peat had accumulated at this location. This, and its close proximity to the archaeology, including the Louden long cairn, less than 200 metres to the north-west and huts and boundary works on the southern slopes of Rough Tor made it an ideal sampling site for the detection of anthropogenic impacts. The advantage of analysing sequences close to the actual archaeology is that the chance of recognising vegetational change resulting from human activity is subsequently higher (cf. Edwards, 1979; Caseldine, 1980). In addition, the limited extent of the deposits sampled also means that the palaeoecological record should be less influenced by the regional pollen signal received by larger deposits, such as Rough Tor Marsh.

Plate 4.2 (top): The Rough Tor south sampling site, looking south. The domed profile of the deposit is apparent.

Plate 4.3 (bottom): The block boundary (foreground) that disappears into the sampling site at Rough Tor south.

The present vegetation around the sampling site includes *Molinia caerulea, Carex nigra, Agrostis curtissi, Juncus squarrosus, Eriophorum augustifolium* and *Anthoxanthum odoratum*. Other species also present include *Erica tetralix, Calluna vulgaris, Narthecium ossifragum, Potentilla erecta, Laucobryum glaucum, Campylopus paradoxus* and *Dicranum scoparium*.

4.10 Methods

Methods of survey, sampling and pollen preparation followed the standard procedures outlined in Chapter 2. A Wardennar corer (Wardennar,1987) was used to sample the top metre of sediment and a standard Russian corer to extract the remaining two metres. Magnetic susceptibility measurements were also carried out on this sequence.

Radiocarbon dates

Samples submitted for radiocarbon dating from the Rough Tor south core are given in Table 4.3. The basal date of 5945±65 (OxA-6011) is younger than the date above it. This is probably due to contamination of the sample by younger carbon from rootlet penetration and is regarded as being anomalous.

4.11 Results

Survey

The survey transects are presented in Figure 4.8 and Figure 4.9. Obstacles, which were probably boulders, were encountered during depth probing. The survey does not therefore give a true indication of the sub-surface profile of the deposit.

Figure 4.8: Rough Tor south survey transect (east-west). Horizontal exaggeration x 20. The coring location is marked with an arrow.

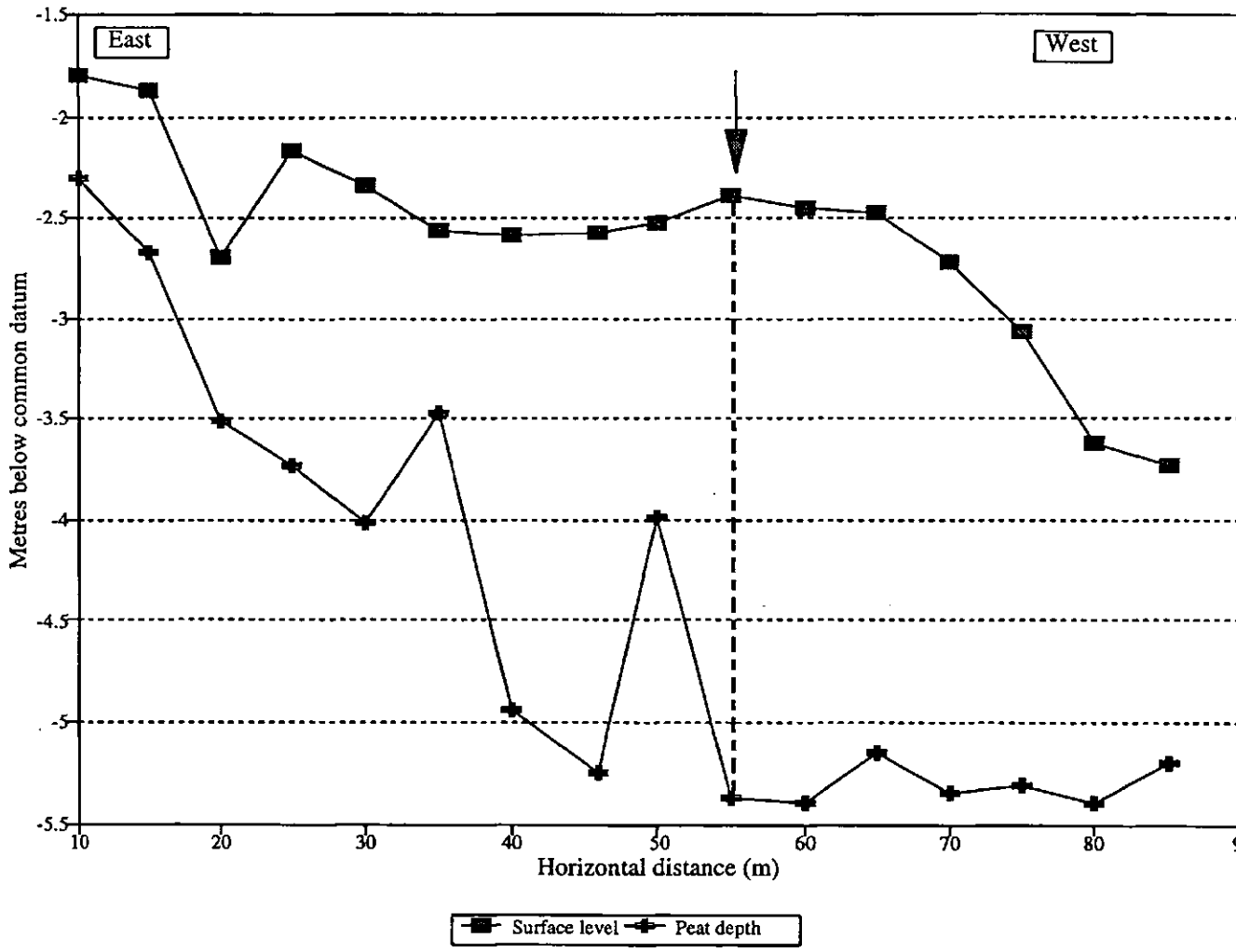
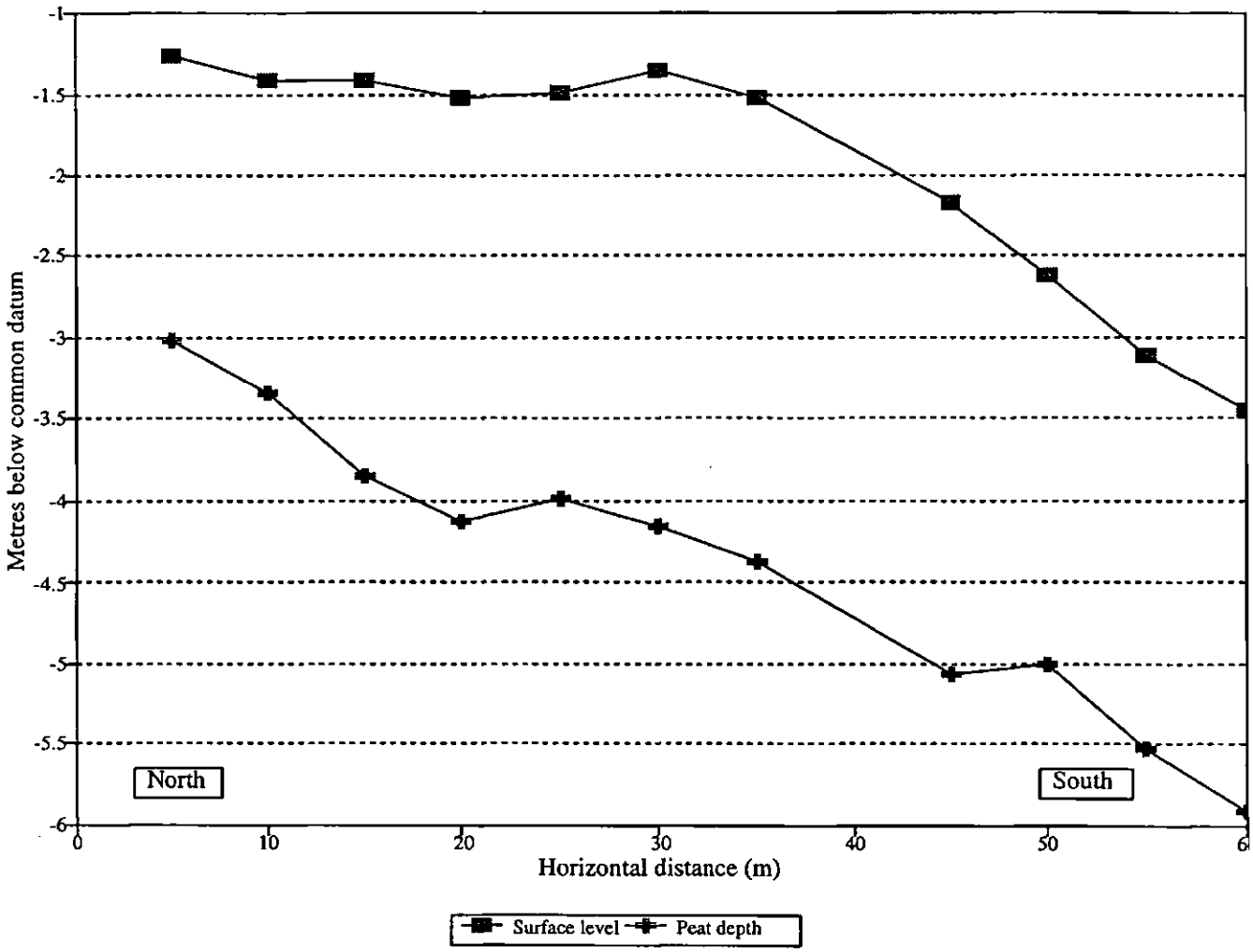


Figure 4.9: Rough Tor south survey transect (north-south). Horizontal exaggeration x 10.



Sample	Lab no.	Uncalibrated date Radiocarbon yrs. BP (±1sd)	Calibrated calendrical age (2σ - 95% probability)
115cm	OxA-6007	1675±45	cal.AD240-440
150cm	OxA-6008	3275±50	1690-1440cal.BC
175cm	OxA-6009	4710±80	3700-3340cal.BC
220cm	OxA-60010	8410±90	7580-7100cal.BC
275cm	OxA-60011	5945±65	5050-4720cal.BC

Table 4.3: Radiocarbon dates for the Rough Tor south core.

Lithostratigraphy

The lithostratigraphy of the Rough Tor south core is summarised in Table 4.4. The sediment consists of well humified brown and black peat, except at the very base of the core where a gray minerogenic clay is recorded. No macrofossils aside from rootlets were present or retained on the sieve during pollen preparations.

Magnetic susceptibility

The results of the magnetic susceptibility determinations are given in Figure 4.10. The sediment has low to negative susceptibility. This represents the diamagnetic contribution of both the sediment matrix and the plastic tube the core was contained in. The only exception to this was at the base of the core, where low positive values are recorded. This corresponds to a grey, minerogenic mud (Table 4.3), possibly laid down in the early Holocene before the vegetation cover had become established and soils had stabilised.

Pollen analysis

The results of the pollen analysis are presented as a percentage diagram and a concentration diagram for selected taxa (Figures 4.11 and 4.12) produced using the program TILIA (Grimm, 1992). The diagram has been zoned for interpretation (Table 4.5). Pollen was present at only trace levels in the top 80 cm of the core and the record is therefore incomplete. Although pollen was scarce, many spores of Zygnemataceae (algae) were present in the samples. These organisms form in oxygen rich, shallow, stagnant fresh water (van Geel, 1976), which implies that the absence of pollen in the top eight samples is due to high levels of aerobic activity. The sediment is highly humified throughout the sequence, so if a change in local sedimentary conditions is responsible, it is not clearly reflected in the lithostratigraphy (Table 4.4)

Depth(cm)	Description	Troels-Smith
0-5	Modern turf line	
5-62	Dark brown peat. Many small rootlets	Sh3/Th1 Nig.2 Strf.0 Elas.1 Sicc.3 Humo.2
62-96	Blacker peat. Many rootlets	Sh3/Th1 Nig.3 Strf.0 Elas.1 Sicc.3 Humo.3
96-116	Black, dense well humified peat. Rootlets	Sh4/Th+ Nig.4 Strf.0 Elas.1Sicc.2/3 Humo.3
116-142	Dark brown peat. Rootlets	Sh4/Th+ Nig.3 Strf.0 Elas.1Sicc.2/3 Humo.3
142-159	Well humified black peat. Fewer rootlets	Sh3/Th+ Nig.4 Strf.0 Elas.1 Sicc.2 Humo.3
159-169	Mottled black-brown peat	Sh4/Th+ Nig.3 Strf.0 Elas.1 Sicc.2 Humo.3
169-207	Well humified black peat	Sh3/Th1 Nig.3 Strf.0 Elas.1 Sicc.3 Humo.3
207-289	Structureless light brown sediment	Sh4 Nig.3 Strf.0 Elas.1 Sicc.3 Humo.3
289-305	Grey minerogenic clay	As4 Nig.3 Strf.4 Elas.1 Sicc.3

Table 4.4: Lithostratigraphy of the Rough Tor south core

Figure 4.10: Magnetic susceptibility of the Rough Tor south core. Units are of uncalibrated volume mass susceptibility (dimensionless units)

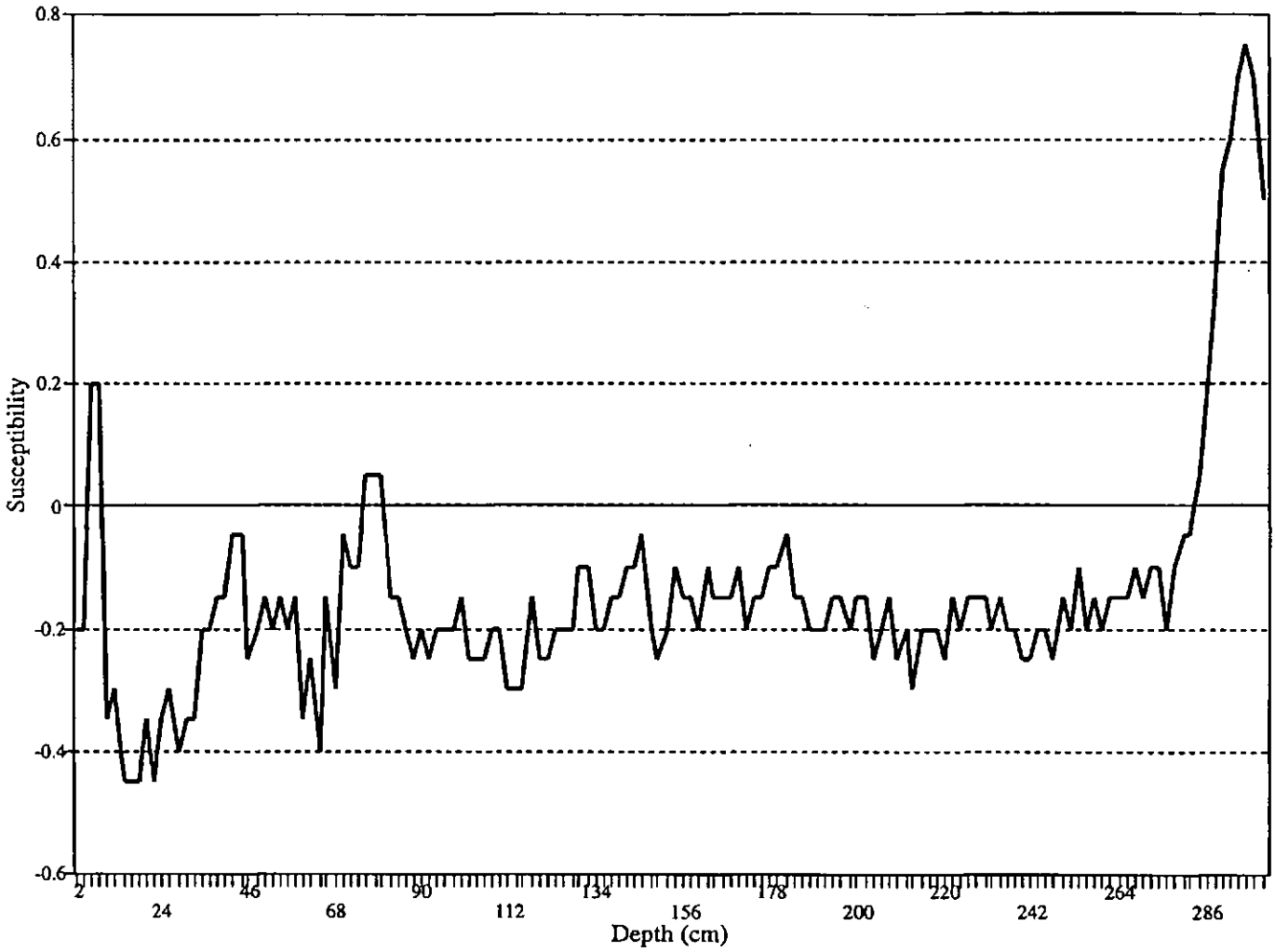


Figure 4.11: Rough Tor south core percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration is x10.

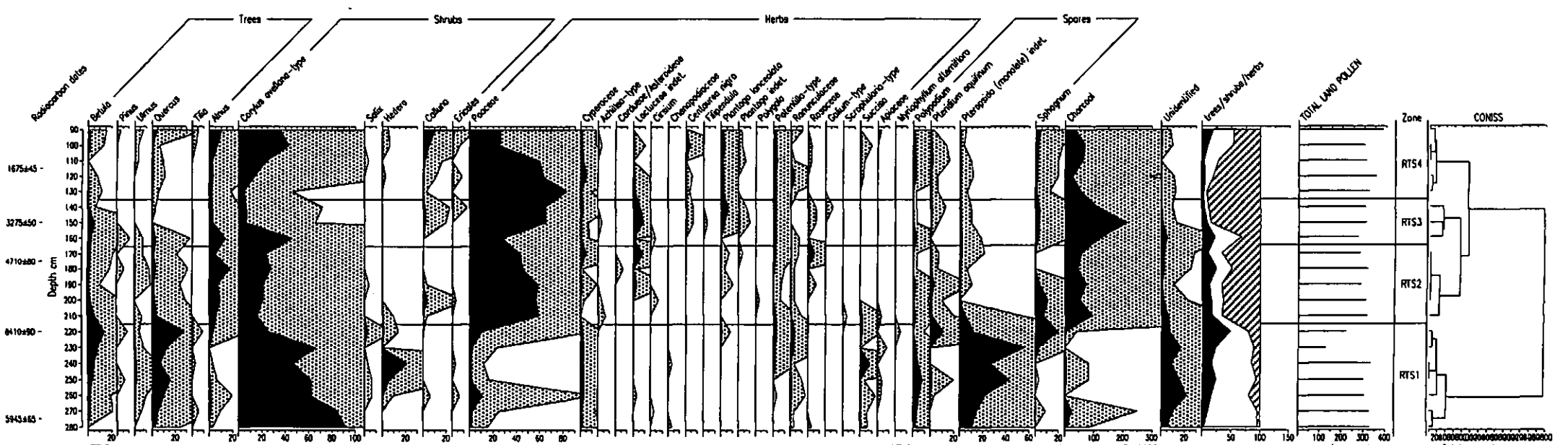
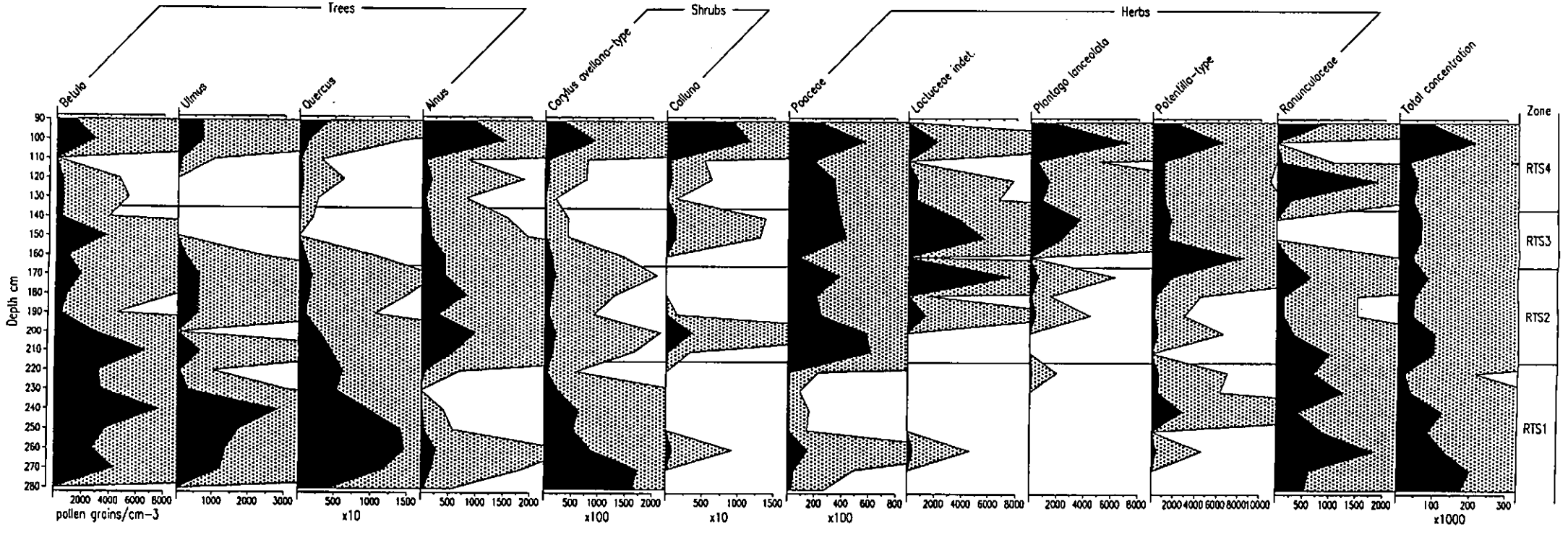


Figure 4.12: Rough Tor south core pollen concentration diagram (selected taxa). Values are of grains cm^{-3}. Exagerration x10. NB. change in horizontal scales.



Zone	Depth (cm)	Description of main features of zone
RTS4	90-135	*Corylus avellana*-type falls to <5% but increases to >40%. *Alnus* increases to >10%. Poaceae peaks at 80% then falls to 30%. *C.nigra* increases to 4%. *Calluna* increases to 10%.
RTS3	135-165	*Corylus avellana*-type peaks at 45%. before falling to 5%. *Alnus* falls to 2-3%. Poaceae increases to 65%. Lactuceae indet. increases to 10%. *P.lanceolata* increases to 6%.
RTS2	165-215	*Corylus avellana*-type at 25-30%. *Alnus* increases across zone to 20%. *Quercus* and *Betula* fall to 2-3%. Poaceae increases to 55%. Other herbs including *P.lanceolata* sporadic but Lactuceae indet. increases to 10%.
RTS1	215-280	*Corylus avellana*-type 50-90%. *Quercus* increases to 28% and *Betula* increases to 15%. *Hedera* increases to 20%. Poaceae low. Herbs sporadic although *Succisa* increases to>5%. *Polypodium* rises to 10% TLP + spores before falling to 1-2% by close of zone. Pteropsida (monolete) indet. increase to 55% TLP + spores but decline to 10% by top of zone. *Sphagnum* increases to 15% TLP + spores. *Pteridium* peaks at >10% TLP + spores.

Table 4.5: Zonation of the Rough Tor south core

4.12 Interpretation of the Rough Tor south pollen diagram

Early woodland cover at Rough Tor south

The samples in the lowest zone of the diagram (RTS1) are characterised by high levels of *Corylus avellana*-type (Figure 4.11). Considering the nature of the sampling site, the majority of this pollen is likely to be that of *Corylus*. Goddard (1971: cited in Smith & Cloutman, 1988) demonstrates that *Corylus* pollen percentages of over 30% only occur in hazel-dominated woodland and Birks (1973) records a *Corylus* percentage of 60% TLP in a woodland with over 90% hazel cover. The percentages in RTS1 of between 50-90% must almost certainly indicate the presence of dense hazel at the sampling site, although this was probably in the form of scrubland rather than tall canopy woodland.

Levels of *Quercus* and *Betula* pollen are low at the bottom of the zone (280cm), but increase steadily towards the top. *Betula* and *Quercus* peak at 220cm suggesting these trees were expanding locally. Arboreal pollen attains nearly 50% TLP at 230cm. On the strength of surface pollen samples from the North York Moors, Tinsley & Smith (1974) concluded that tree pollen percentages of between 25-50% in pollen diagrams may indicate either the presence of woodland within 100m of a sampling site, or the presence of scattered trees around the site. Considering the evidence for hazel scrub around the sampling site, the most plausible explanation of the status of oak and birch in the vegetation at Rough Tor is that these taxa were present in the local woodland and were probably prevalent on the lower, more sheltered ground below the slopes of Rough Tor.

The increase in *Betula* suggests that there was some open ground present in the vicinity, as birch seedlings will not flourish in even low vegetation (Atkinson, 1992), but this is at odds with the record of herbaceous pollen which is present in low quantities. Hazel may have been present in dense copses with more open areas and in clearings where the canopy was less dense into which oak and birch

were expanding.

The high levels of *Polypodium* and Pteropsida (monolete) indet. undiff. in RTS1 suggest a fern-rich ground flora, although ferns were probably also present as epiphytes on the local oak trees. The impression of a shady, undisturbed woodland environment is reinforced by the record of *Hedera* peaks at 240cm. The percentage of *Hedera* suggest ivy was important as part of the local woodland environment. Ivy is characteristic of moderately fertile, undisturbed habitats, but will not flower in heavily shaded conditions (Grime *et al.*, 1988:314). The increase in *Hedera* pollen in the upper part of RTS1 therefore indicates that there was either some opening up of the canopy allowing the establishment of ivy, or a critical climatic threshold had been passed permitting the spread or increased flowering of this shrub. Brown (1977) deduced climatic improvement by 9200BP from the presence of *Hedera* pollen at Hawk's Tor, as this taxon requires average summer temperatures of at least 13 ° C and is susceptible to low winter temperatures (Godwin, 1975). There is a fall in *Corylus avellana*-type and in *Quercus* at this level, but this is not paralleled by an increase in Poaceae, which might be anticipated had there been an opening up of the local canopy. The only herb to show a clear increase is *Succisa*, which rises to nearly 9%. This might support an hypothesis of some form of disturbance in the surrounding woodland. The evidence is therefore somewhat ambiguous, with some suggestion of the peak in *Hedera* resulting from a disturbance to the local vegetation, but the role of climatic change remains a potential factor.

Percentages of Poaceae increase briefly at 260cm. Although there is a decrease in total concentration from 202 x 10^3 grains/cm^3 at 270cm to 134.8 x 10^3 grains/cm^3 at 260cm (Figure 4.12), Poaceae concentrations increase from 4.9 x 10^3 grains/cm^3 to 15.1 x 10^3 grains/cm^3 across the same samples. Other taxa also demonstrate increases in both percentage and concentration values including Lactuceae indet., *Potentilla* and *Calluna*. These changes are synchronous with a

fall in both percentage and concentration values for *Corylus avellana*-type, although the representation of the other tree taxa increase across these samples. This may indicate a minor disturbance to the hazel scrub, resulting in the small-scale and shortlived expansion or increased flowering of these heliophytes.

The spread of grassland and the Alnus rise

The next zone (RTS2) shows distinct changes in the vegetation cover with a decline in *Corylus avellana*-type and increase in Poaceae. Hazel scrub is no longer the major component of the ground cover, permitting the spread of grass communities. Both *Quercus* and *Betula* are also affected and the sharp falls in *Polypodium*, Pteropsida (monolete) indet. and *Hedera* are further evidence of the disappearance of the undisturbed habitat that was present previously. The opening of this zone is dated to 8410±90BP (OxA-6010). This seems a very early date for the corresponding pollen spectra; the *Alnus* rise has been dated to 6451±65BP (Q-1025) at Dozmary Pool. It is possible that the date for this zone is too old, perhaps as a result of inwash of older material from up-slope terrestrial environments

Alnus pollen was present only as a low trace across the previous zone, but begins to increase at the opening of RTS2. Percentages of *Alnus* increase steadily across the zone indicating the local establishment of this tree. *Alnus* concentrations increase from 0.7 x 10^3 grains/cm^3 at 220cm to to 8.1 x 10^3 grains/cm^3 by 180cm. Alder requires high humidity and high oxygen tension, as well as high light intensity for seedling establishment (Grime *et al.*, 1988:74). The spread of this tree in RTS2 most probably reflects the ability of alder to exploit the newly created habitat niche that resulted from the disturbance to the local ecosystem. The removal of the deep rooting woody taxa, in particular the previously dominant hazel, would have resulted not only in the open areas attested to by the pollen record, but in evapotranspirational losses and thus an increasingly damp substrate. Evidence of this increased local wetness may be seen in the peak in *Sphagnum* at the opening of the zone.

Potentilla is present as a low but consistent trace across this zone. The pollen is not identifiable to species but may be referable to *P.erecta*. *Potentilla* is common on grassland and heathland on acidic soils and is presently a feature of the grassland at Rough Tor. *Sphagnum* also peaks at 220cm before falling to a low but fairly consistent trace for the remainder of the diagram. Tallis (1964) concluded that *Sphagnum* spore production is proportional to the *Sphagnum* content of the peat and Conway (1954) suggested that spore production is related to the wetness of the bog surface. Different species of *Sphagnum* have different spore productivities (Ivanov, 1981; Boatman, 1983) so it may be unwise to read too much into peaks in *Sphagnum* in pollen diagrams. The increase in both *Sphagnum* and *Potentilla* suggests that the local sedimentary conditions were becoming less basic in RTS2 and the vegetation was becoming more typical of peat communities than the woodland flora found in RTS1.

The expansion of *Pteridium* at 220cm is synchronous with the fall in *Corylus avellana*-type. The clearance of the shrub cover would have allowed more light to reach the ground-layer, resulting in the spread and/or increased sporulation of *Pteridium*. The importance of this species in the local vegetation is shortlived: its percentages fall to low values in the following samples. *Pteridium* is tolerant of a wide range of edaphic conditions but two features are of particular importance for its growth: a reasonable depth of soil and free movement of water and air through the profile (Rodwell, 1992). Stagnation, in particular, will curtail the growth of bracken and where the water table approaches the surface, the species will not survive. The peak in *Sphagnum* and expansion of *Alnus* described above has been interpreted as indicating increasingly damp substrate and it seems most likely that the demise of bracken following the peak in its spores at the opening of the zone is related to local waterlogging.

The pollen spectra in this zone portray a predominantly open environment; grassland is prevalent on those areas of the landscape previously dominated by

hazel. *Potentilla* is present as part of the local ground flora, as is *Plantago lanceolata*, although the comparatively low percentages of this pollen suggest that this species is not a major element in the grassy sward. Few other herbs show a marked response to the increasingly open conditions, although Ranunculaceae does increase slightly.

As well as the increase in *Alnus* discussed above, *Corylus avellana*-type also increases at the top of RTS2, whilst Poaceae shows a corresponding fall. A recovery in hazel and decrease in the extent of open ground is inferred, although neither *Betula* nor *Quercus* expand to take advantage of this. This may therefore have been a fairly local event, restricted to the damp ground on and below the sampling site and the better drained hill sides nearby. These events are dated to 4710±80BP (OxA-6009).

This recovery of shrub pollen is short-lived, as there is renewed spread of grassland in RTS3 at the expense of hazel and alder. *Corylus avellana*-type displays renewed reductions at the opening of the zone, falling to its lowest value for the diagram at 130cm. *Alnus*, *Quercus* and *Betula* also decline at 140cm. The opening of this zone and the beginning of continuous *P.lanceolata* and *Potentilla* curves and increases in Lactuceae indet. are dated to 3275±50BP (OxA-6008) Other herbs such as *Centaurea nigra*-type, *Achillea*-type, Ranunculaceae and Roseaceae-undiff. are represented by occasional occurrences of their pollens. The beginning of the *Calluna* curve points to the presence of some heather as part of the vegetational mosaic or to more extensive heathland at some distance from the coring location and possibly to a deterioration in soil conditions.

This zone therefore sees the almost complete demise of the remaining tree and shrub communities, whilst the rise in Poaceae and other light-demanding herbs indicates an increase in the area of open ground. By 130cm, the Poaceae curve reaches a highpoint of 84%, suggesting that grassland has reached its maximum

extent for the period of time represented by the diagram. The record of the other herb pollen indicates a damp meadow-like flora on and around the sampling site. The restricted pollen distribution of low growing herbs, such as Lactuceae and *Potentilla,* implies that these taxa were important in the vegetation growing on or very near the sampling site. The nearby hillsides were probably dominated by grass, with some herbs and restricted distributions of heather and bracken amongst the clitter. Some small stands of hazel also remained in certain areas of the landscape, although the pollen record indicates the importance of this shrub was much reduced on a landscape scale.

Later regeneration in trees and shrubs

This picture changes in the upper half RTS4. *Corylus avellana*-type begins to increase in value and Poaceae percentages falls. *Alnus* also recovers slightly. This indicates that local hazel and alder populations were able to regenerate following the almost complete elimination of trees and shrubs in the previous zone. The recovery in *Corylus avellana*-type is dated to 1675±45BP (OxA-6007). Although it may be inferred from the Poaceae curve that there was a reduction in the extent of grassland, there is no significant reduction in levels of *P.lanceolata,* and *Potentilla*-type remains at a similar level to the previous zone, and even expands slightly. *Centaurea nigra* type also reaches a low peak at 100cm, pointing to the maintenance of open grassy areas.

The persistence of these pollen types suggests that although grass pollen falls to *c.*25% TLP, the expansion in the woody taxa did not lead to a great contraction in the area of open ground in the vicinity, although Lactuceae indet. does fall to a trace at the opening of the zone. The regeneration in hazel is not permanent, however, as at the top of the zone, percentages of *Corylus avellana*-type fall and grass pollen is increasing once again, marking a return to a grass-dominated landscape. The increase in *Calluna* that is apparent at the close of the zone shows that heathland was becoming a more significant element of the local vegetation.

The environment represented by RTS4 is thus of a largely treeless landscape which is beginning to revert to its former cover of hazel scrub. This is at the expense of the grassland that has dominated the landscape in the previous phases of landscape development. The persistence of the pollen of certain elements of the grassland vegetation, especially *P.lanceolata*, *Potentilla*-type, but also occasional grains of *Centaurea nigra*-type, *Succisa*, Lactuceae indet. and Roseaceae undiff. demonstrates that the increase in the shrub cover did not spread across the full extent of the open ground available locally. The recovery in hazel is only short-lived and by the close of the diagram, grassland is becoming re-established as the dominant vegetational component of the landscape, although ericaceous communities are possibly beginning to become an element of this picture.

4.13 Interpretation of the charcoal record

No macroscopic charcoal was identified either during cleaning and sub-sampling of the core or retained on the sieve during pollen preparation. Microscopic charcoal is low in RTS1 (Figure 4.11), reflecting an absence of fires of either a natural or anthropogenic origin. The vegetation around the sampling site is dense in this period, and the deposition of extra-local microscopic charcoal is likely to have been very small, unless there was local burning activity. Charcoal increases at the opening of RTS2. This corresponds to decreasing tree and shrub pollen frequencies and increasing grass pollen percentages. The charcoal curve is probably reflecting increased burning activity by human communities. The rise in charcoal concentrations, paralleled by falling tree pollen frequencies could be interpreted as indicating that fire was being used in the clearance process. Two main considerations are advanced against direct firing of the local wood and scrub land:

i) considering the nature of the sampling site and its proximity to areas of

settlement, had fires been set to destroy vegetation in the vicinity of the coring location, then some evidence of this in the form of concentrations of macroscopic charcoal would be expected. The architecture of the hazel shrub is such that the burning of this taxon tends to consume the whole of the shrub, producing considerable quantities of charcoal (Clark *et al.*,1989). The palynological record shows that the hazel cover which was dominant on the slopes of Rough Tor was very close to, if not actually on, the sampling site. Had the vegetation been fired locally, then macroscopic charcoal would be expected in the sediment at the level of the fire event, as is attested at other sites in both the south-west and the British Isles (eg. Caseldine & Hatton, 1993);

ii) wood would have been in demand as a resource for domestic fuel and construction purposes for the human communities settling in the area. The clearance process may therefore have been as much for the collection wood for these purposes, as for the removal of trees to open up the land for settlement and farming. This does not ruleout the possibility that fires were used to burn cut or dead wood as part of the clearance process.

Charcoal peaks in RTS3, indicate increased local burning activity, which may have mainly been domestic fires. The opening up of the vegetation around the sampling site would have also permitted an enhanced input of charcoal derived from regional fire events. This increase roughly parallels that of *P.lanceolata,* suggesting that the increasing fire frequencies are accompanying an expansion in farming activity and possibly also in increasing volume of settlement and local population levels.

4.14 Discussion: anthropogenic impact and Holocene vegetation history at Rough Tor South.

Early vegetation change

The pollen spectra from the lowest zone shows an environment that is covered with dense hazel scrub, with birch, oak and later alder becoming part of the vegetation. There is no clear evidence in the lowest levels of a human presence: herb pollen is at very low levels and the pollen spectra indicate an undisturbed, fern-rich ground flora. Charcoal frequencies are also very low.

The first possible indication of human interference in this landscape is at 260cm. Shrub pollen percentages fall slightly and grass pollen percentages increase to *c.*10%, previously being present as a low trace. Other herbs appear at trace levels in the pollen record at this stage, including Lactuceae indet., *Lonicera*-type and *Potentilla*-type. The brief expansion in grass and herb pollen that is apparent in the middle of RTS1 may be recording a small-scale and short-lived disturbance to the hazel scrub by early human communities. Judging by the changes in the pollen record, this must have been a small-scale event that involved little disturbance to the woodland nearby, or was possibly a more extensive disturbance at a greater distance from Rough Tor south (cf. Edwards, 1979). Equally possible, however, is that this disturbance had a natural origin, such as an opening created by wind-throw, or a natural opening in the woodland created or maintained by the grazing activities of wild herbivores. Whichever interpretation is favoured, this disturbance was not permanent, as the percentages of Poaceae are supressed in the following levels and most of the herbs do not appear in the next sample.

Clearance of woodland and the spread of grassland

The first unequivocal evidence of human interference in the natural vegetation is at 220cm, with falls in *Corylus avellana*-type and increases in Poacaeae. This is accompanied by steep declines in *Hedera*, *Polypodium* and Pteropsida (monolete)

indet., interpreted as showing the reduction in shady woodland habitats. The dominant hazel scrub is being cleared and grassland is becoming the major feature of the local vegetation. These changes take place over some 10cm of sediment, and probably represent a comparatively rapid period of change. The date of 8410±90BP for 220cm (OxA-6010) is calibrated to 7580-7100cal.BC. This is a very early date and probably falls in the later Mesolithic period, although the chronology of the earlier prehistoric period in Cornwall remains vague. It is possible that this apparently early date is a result of contamination by older material.

Three hypotheses may be advanced to account for the vegetational changes recorded in this zone: the decline in oak, hazel and birch and rise in alder is due to natural factors, increased precipitation and the effects of a subsequent expansion in valley bog on the extent of local woodland. Alternatively, the diagram is recording the effects of human clearance activity on the local woodland. Finally, the radiocarbon date may be incorrect.

If natural factors are responsible, then more steady declines in tree and shrub pollen might be expected as opposed to the rather abrupt changes recorded in the diagram. Also, if an expansion of valley bog is responsible, then it is unclear why birch should be affected as well as oak. Moreover, although there is a fairly large area of mire directly below the sampling site, there remains a considerable extent of well drained areas on and around the nearby slopes (see Plate 3.1) that would presumably have been unaffected by any increase in bog. However, if a human agency is accepted as responsible for the spread of grassland and demise of hazel, then this provides a very early date for what appears to be a long-lived opening in the local woodland canopy. There are problems with both hypotheses and it is not clear which one is the most satisfactory. Possibly the initial reduction in hazel, oak and birch is a result of a local expansion in mire unrelated to anthropogenic factors and humanly-induced disturbance to the local vegetation

does not occur until the *P.lanceolata* curve begins at 190cm.

The impression of an absence or low level of human activity is suggested by the fact that alder is able to expand locally in RTS2. Vinther (1983) demonstrated that the establishment of alder seedlings is curtailed by a high level human disturbance, or by the grazing of animals, although seedlings are also not able to become established in areas where tall herb vegetation shades them out. The spread of alder in this period therefore suggests that pressure on the land was not intensive and the disturbance to the local vegetation may have aided the spread of alder (cf. Smith, 1984).

The decline in *Corylus avellana*-type to low levels at 220 cm corresponds to peaks in *Betula* and *Quercus* pollen, which fall off suddenly in the above level. This is probably due to an influx in extra-local pollen, following the opening of the hazel scrub previously dominant in the local vegetation and hence the local pollen deposition.

Intensification of anthropogenic activity

P.lanceolata does not begin as a continuous curve until 190cm, and does not peak until 140cm. There is therefore a very gradual rise in this herb, suggesting that pressure on the land increased fairly steadily and there was not a sudden influx of people into the area, but a rather more gradual increase in human activity. The spread of rosette hemicryptophytes such as *Plantago* can be favoured by increases in grazing and the beginning of the *Plantago* curve may therefore be related to the advent of increased grazing pressures. However, the flowering heads of *P.lanceolata* can be heavily predated by stock (Grime *et al.*, 1988), which may have an effect on the representation of this herb in the palaeoecological record.

An intensification of grazing pressure may also be supported both by the increase in Lactuceae, showing that this herb-type was an important element of the ground

flora, and the expansion in Poaceae. *Alnus* continues to expand and does not peak until 180cm, and *Corylus avellana*-type also increases and peaks at the same level as *Alnus*. This can be interpreted as further evidence that anthropogenic activity was not particularly intense in the period following the first clearances and may have even decreased in intensity towards the close of RTS2. There must have been some form of local activity to prevent hazel scrub from achieving its previous dominant status in the vegetation but areas of the shrub clearly expanded in the later stages of this phase suggesting a reduced human presence .

RTS3 is characterised by renewed falls in *Corylus avellana*-type and *Alnus* and further expansion in Poaceae pollen. *P.lanceolata* is apparent at a relatively low but consistent level across the zone. Lactuceae indet. pollen also peaks, although other herb pollen remains low and sporadic. The renewed falls in tree and shrub pollen and expansion in grass and herb pollen indicate that this zone represents the period of maximum activity at Rough Tor south. Clearance activity apparently intensified and the areas of hazel which previously seem to have remained in certain parts of the landscape, are now modified. Alder is also affected. The charcoal curve peaks at 150cm but tree and shrub pollen continues to fall after this and grass does not peak until 130cm. The date of 3275±50BP (OxA-6008), calibrated to 1690-1440cal.BC indicates that this intensification of activity belongs to the Bronze Age.

Reduction in anthropogenic activity

The final pollen zone shows a marked reversal, with the behaviour of the pollen curves suggesting a relaxation of anthropogenic activity in the vicinity, allowing the regeneration of hazel scrub and alder on the damper ground. *P.lanceolata* remains steady and *C.nigra* also increases, indicating that the regeneration of trees and shrubs is not the single theme of landscape change at this time and that maintenance and possibly a slight change in the character of open areas continued. The recovery in *Corylus avellana*-type is dated to 1675±45BP, calibrated to

cal.AD240-440, suggesting that this reduction in activity occurred in the Romano-British period.

The pollen record therefore records the development of a landscape mosaic in this latter period: hazel and alder have expanded in some locations, whilst indicators of pasture such as ribwort plantain and knapweed point to a continuing anthropogenic presence in the area. Local settlement may have been abandoned or much reduced in extent, but there was continuing use of uplands, probably for grazing. This was probably not on the same scale as in the previous zone, but the continuous nature of the *P.lanceolata* curve suggests that the uplands continued to be used on a regular, as opposed to an intermittent basis. A possible increase in the diversity of the sward to include tall herbs is suggested by the increase in *C.nigra*, often a component of pasture. This may also support an hypothesis of a decrease in grazing pressure, as reduced or patchy grazing will lead to an increase in species diversity. It is also possible that the rise in *Calluna* at 90cm is as much a result of a reduction in the numbers of herbivores in the area, as of soil deterioration: although *Calluna* is low in the grazing hierarchy of sheep, it tends to be grazed in areas where exploitation of the grassland resource is high (Grant & Armstrong, 1993). Reduced pastoral activity can therefore lead to an expansion of heather communities. Table 4.6 summarizes the vegetational changes and inferred human impact for the Rough Tor south core.

4.15 Summary

This section has described the results of the analysis of a core from Rough Tor south. The implications of the pollen analytical investigations for the Holocene vegetation history of the Rough Tor moors has been discussed and the role of human communities in this has been considered. The next part of this chapter will discuss the results of palaeoenvironmental research at Rough Tor north.

Zone/depth cm	Main ecosystem represented	Inferred human impact/activity
RTS4 *90-135*	Grassland with hazel and alder spreading in some locations. later spread of heath land.	Abandonment of local settlement but continuing low intensity pastoral activity. Reduction in burning.
RTS3 *135-165*	Hazel and alder giving way to grassland.	Clearance of woodland intensified. Local settlement & intensified pastoral activity. Peak in burning.
RTS2 *165-215*	Open grassland. Demise of oak and birch. Reduction in hazel, but scrub persisting. Alder increasing in damp areas.	Clearance begins. Low intensity pastoral activity. Sporadic/seasonal land-use probable. Increase in burning.
RTS1 *215-280*	Dense hazel scrub with fern-rich understorey. Oak and birch increasing locally.	Little evidence of human impact or burning.

Table 4.6: Summary of interpretation of Rough Tor south core pollen diagram

Chapter Four
Part III:
Rough Tor North: The Monoliths

4.16 Introduction: The Rough Tor Monoliths

This part of the chapter will describe the results of palaeoenvironmental research at Rough Tor north. Three suitable organic deposits were identified on the slopes of Rough Tor north (Figure 4.1), identified as monoliths A, B and C following the mode of sampling employed.

Monolith A (Plate 4.5) was sampled from a small (5x5m) peat deposit that has accumulated around a small spring, just above a stream that flows down from the south western side of Rough Tor (SX138813). This is immediately below a large group of hut circles from the postulated later prehistoric phase which also contains several small cairns and is within the upper prehistoric block boundary division. Presently much of this ground is a rather stony rough grassland consisting mainly of *Molinia caerulea*, *Festuca ovina* and *Agrostis curtisii*. Other species also represented include *Potentilla erecta*, *Galium saxatile*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Holcus lanatus*, *Carex nigra* and *C.panicea*.

Monolith B (Plate 4.6) was sampled from a boggy flush (10x10m) that has formed around a spring line deposit (SX139814). The vegetation around the site includes *Festuca ovina*, *Anthoxanthum odoratum*, *Nardus stricta*, *Agrostis capillaris*, *Juncus bulbosus* and *J.effusus*, *Carex panacea*, *Potentilla erecta*, *Galium saxatile*, *Ranunculus repens*, *Sphagnum*, *Euphrasia officinalis agg.*, *Polygala vulgaris*, *Luzula campestris* and *Achillea millefolium*.

Monolith C (Plate 4.4 & 4.7) was sampled from a topogenous deposit (40x10m) that has accumulated in a shallow depression next to the main stream at the foot of Rough Tor (SX139819) (Plate 4.4). This site lies immediately below the main group of hut circles from the later prehistoric phase, within the lower prehistoric block boundary division and immediately to the south of an area of medieval ridge and furrow. The present vegetation is a wet grassland consisting mainly of *Molinia caerulea* and *Festuca ovina.* Other species also present are *Anthoxanthum odoratum*, *Agrostis capillaris* and *A.curtisii*, *Potentilla erecta*, *Narthecium ossifragum*, *Carex echinata* and *C.bineris*, *Juncus squarrosus* and *J.effusus.*

4.17 Methods

Sampling, pollen preparation and loss-on-ignition followed the standard procedues outlined in Chapter 2. Survey of the deposits was unnecessary as sampling took place from exposed sediment faces. Sampling began at 30cm for the monolith A and monolith B sequences due to the presence of a thick root layer at the top of the monoliths. Samples for radiocarbon dates were submitted for one level from monolith A and two levels of monolith C, on the basis of pollen-stratigraphic changes.

4.18 Results

Lithostratigraphy

The lithostratigraphy of the monoliths are given in Tables 4.7-9.

Plate 4.4: The monolith C sampling site looking west towards the China clay works at Stannon.

Depth (cm)	Description	Troels-Smith
0-27	Modern turf	
27-46	Dark brown, well humified sediment. Some rootlets	Sh2/Th2 Nig.2-3 Strf. 0 Elas.0 Sicc.3 Humo.4
46-52	Brown, well humified sediment. 47.5-48.5- band of lighter, less well humified matter: well decayed *Sphagnum*?	Sh3/Th1 Nig.1-2trf. 0 Elas.1 Sicc.0-1 Humo.4
52-68	Black, well humified peat	Sh4 Nig.4 Strf. 0 Elas.0 Sicc.2-3 Humo.4
68-81	Grey-black well humified sediment	Sh4 Nig.2-3 Strf. 0 Elas.0 Sicc.2-3 Humo.4
81-87	Lighter coloured, less well humified *Sphagnum* peat	Tb4 Nig.1-2 Strf. 0 Elas.1 Sicc.1 Humo.4
87-153	Black, well humified sediment. 136-137- Pockets of less well humified *Sphagnum*. Gravel towards base	Sh4 Nig.3-4 Strf. 0 Elas.0 Sicc.2-3 Humo.3-4 Gg+

Table 4.7: Lithostratigraphy of Rough Tor north monolith A

Depth (cm)	Description	Troels-Smith
0-30	Modern turf	
30-45.5	Brown/black highly humified peat. Pockets of ligher coloured matter - highly decayed *Sphagnum*. Few rootlets	Sh3/Th1 Nig.2-3 Strf. 0 Elas.1 Sicc.2 Humo.3-4
45.5-56	Light yellowy-brown highly humified sediment. Highly decayed *Sphagnum*?	Sh4 Nig.1 Strf. 0 Elas.1 Sicc.0-1 Humo.4
56-98	Mottled dark brown-yellowy brown sediment 74cm- Large charcoal fragment	Sh4 Nig.1-2 Strf. 0 Elas.1 Sicc.1 Humo.4
98-117	Dark brown sediment. Increasing quantities of gravel toward base	Sh4 Nig.2-3 Strf. 0 Elas.1 Sicc.1 Humo.4 Gg+

Table 4.8: Lithostratigraphy of Rough Tor north monolith B

Depth(cm)	Description	Troels-Smith
0-5	Modern turf line	
5-13.5	Dark brown peat. Some rootlets	Th2/Sh2 Sicc.1/2 Humo.3 Elas.2 Strf. 0 Nig.2
13.5-25.5	Dark brown peat. Increasing rootlets	Th1/Sh3 Sicc.2/3 Humo.3 Elas.1/2 Strf. 0 Nig.2
25.5-30	Black well humified peat layer	Th1/Sh3 Sicc.2/3 Humo.3 Elas.1 Strf. 0 Nig.3
30-31.5	Brown well humified peat layer	Th1/Sh3 Sicc.2/3 Humo.2/3 Elas.1 Strf. 0 Nig.2 Sh2
31.5-58	Black well humified peat	Th1/Sh3 Sicc.2/3 Humo.3 Elas.0 Strf. 0 Nig.3/4
58-77	Dark brown mineral soil. Increasing quantities of gravel towards base.	Sh4/Gg+ Sicc.3 Humo.4 Elas.0 Strf. 0 Nig.2 Sh4

Table 4.9: Lithostratigraphy of Rough Tor monolith C

Monolith A (Plate 4.5) consisted largely of well humified, grey-black sediment of uncertain constituents, although bands and pockets of *Sphagnum* are present in the sequence. There is a change to a brown sediment at 52cm. No macrofossils apart from rootlets were identified either during cleaning and subsampling or retained on the sieve during pollen preparations.

Monolith B (Plate 4.6) consisted of grey-brown sediment of uncertain constituents with a marked change at 56cm, to a dark brown sediment with pockets of lighter coloured material that may be highly humified *Sphagnum*. No macrofossils were identified during cleaning, subsampling or retained on the sieve during pollen preparation.

Monolith C (Plate 4.7) consisted of a dark brown mineral soil that trended into well humified black peat at 58cm. As with the above two monoliths, no macrofossils apart from rootlets were preserved in the sequence.

Loss-on-Ignition

The results of loss-on-ignition determinations are presented as graphs (Figures 4.13-15)

Monolith A: The lowest organic matter percentage of 28% organic matter is at the very base of the sequence (152cm), after which values increase to generally above 50%. A marked increase from 40% to values that level out at around 70-75% is demonstrated from 50-40cm. There are a series of fluctuations in organic percentages evident from 50-65cm and at 95cm, where values drop to below 40%. A further fluctuation occurs at 15-18cm, where values drop briefly to below 60%, before climbing to a high point of 90%.

Plate 4.5: The monolith A deposit prior to sampling.

Plate 4.6: The monolith tins in position to recover monolith B.

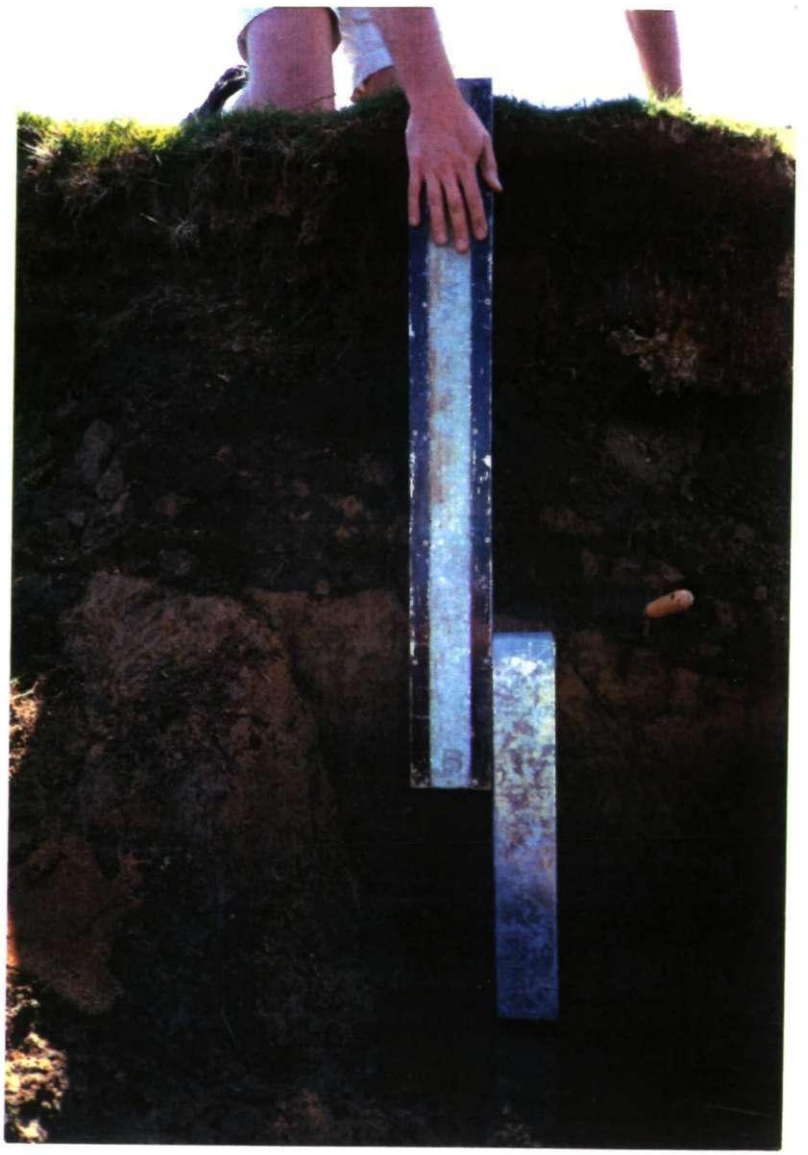


Plate 4.7: The monolith C deposit prior to sampling.

Monolith B: Monolith B is largely below 40% organic matter; the lowest value of just under 20% occurs at the base of the sequence. Percentage organic matter increases fairly rapidly from 40 to a high point of 70% organic matter across a space of 15cm from 35-20cm depth. The curve demonstrates less fluctuations in values than either monolith A or monolith C.

Monolith C: Monolith C has values for organic matter that are generally below 50%, its lowest value of under 5% once again occurring at the very base of the sediment. An increase from under 35% to 80% is apparent from 29 to 18cm. After this point, organic values remain above 60%, apart from a brief drop to c.55% at a depth of 8-10 cm. There are a series of marked fluctuations visible in the organic percentages. This is apparent from 61-53 cm where there is an increase from below 25% to over 50% and then a steady decline back to 30%. A similar cycle is evident from 53-45cm, and from 45-38cm.

Radiocarbon dates

The results of the radiocarbon dating are presented in Table 4.10.

Pollen analysis

The results of pollen analysis of the monoliths are given as percentage (Figures 4.16, 4.18 & 4.20) and concentration diagrams (Figures 4.17, 4.19 & 4.21) produced using TILIA and TILIA*GRAPH (Grimm, 1991). The zonation of the diagrams are summarised in Tables 4.11-13.

Figure 4.13: Rough Tor north monolith A organic matter determined by loss-on-ignition

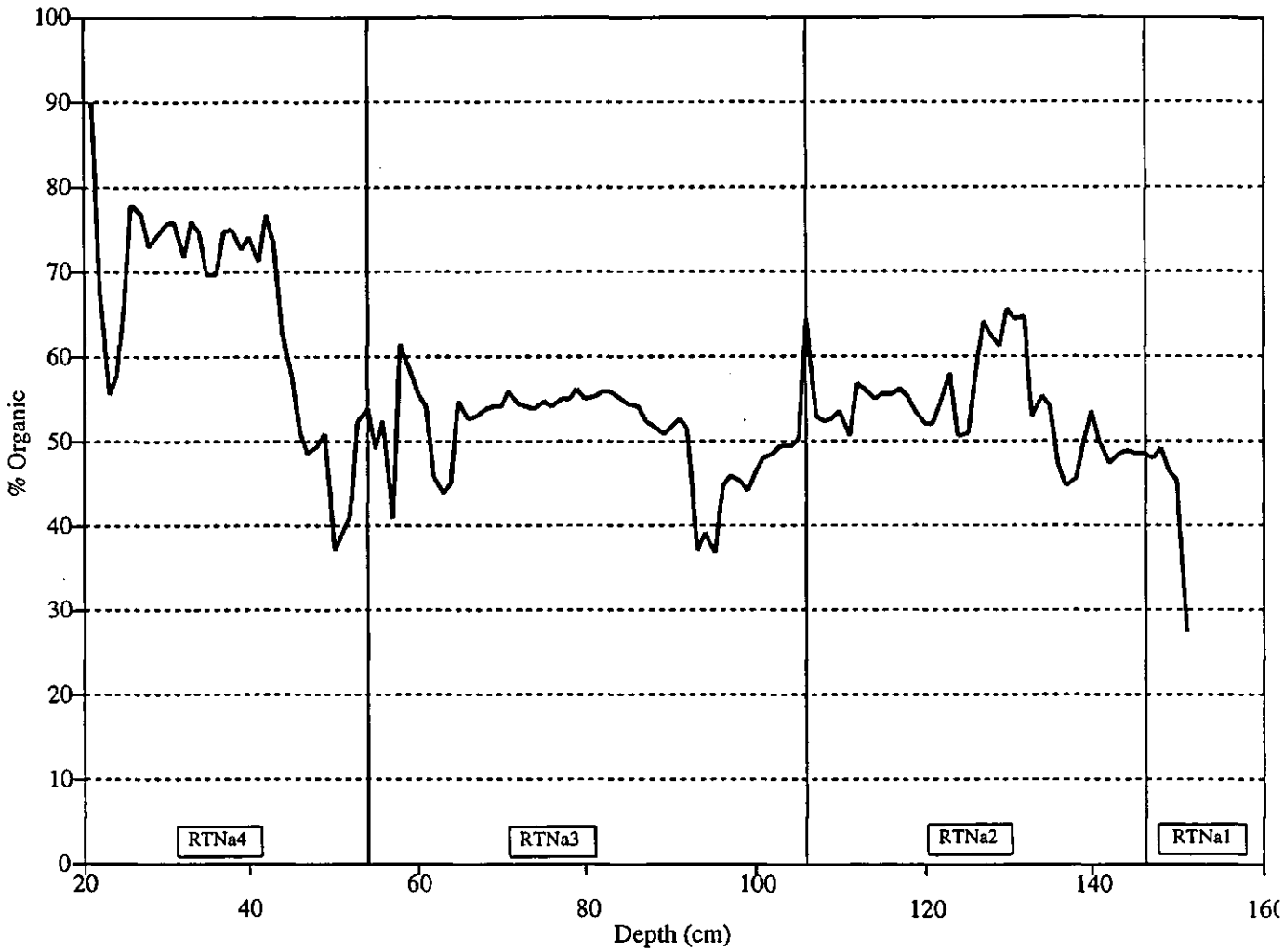


Figure 4.14: Rough Tor north monolith B organic matter determined by loss-on-ignition

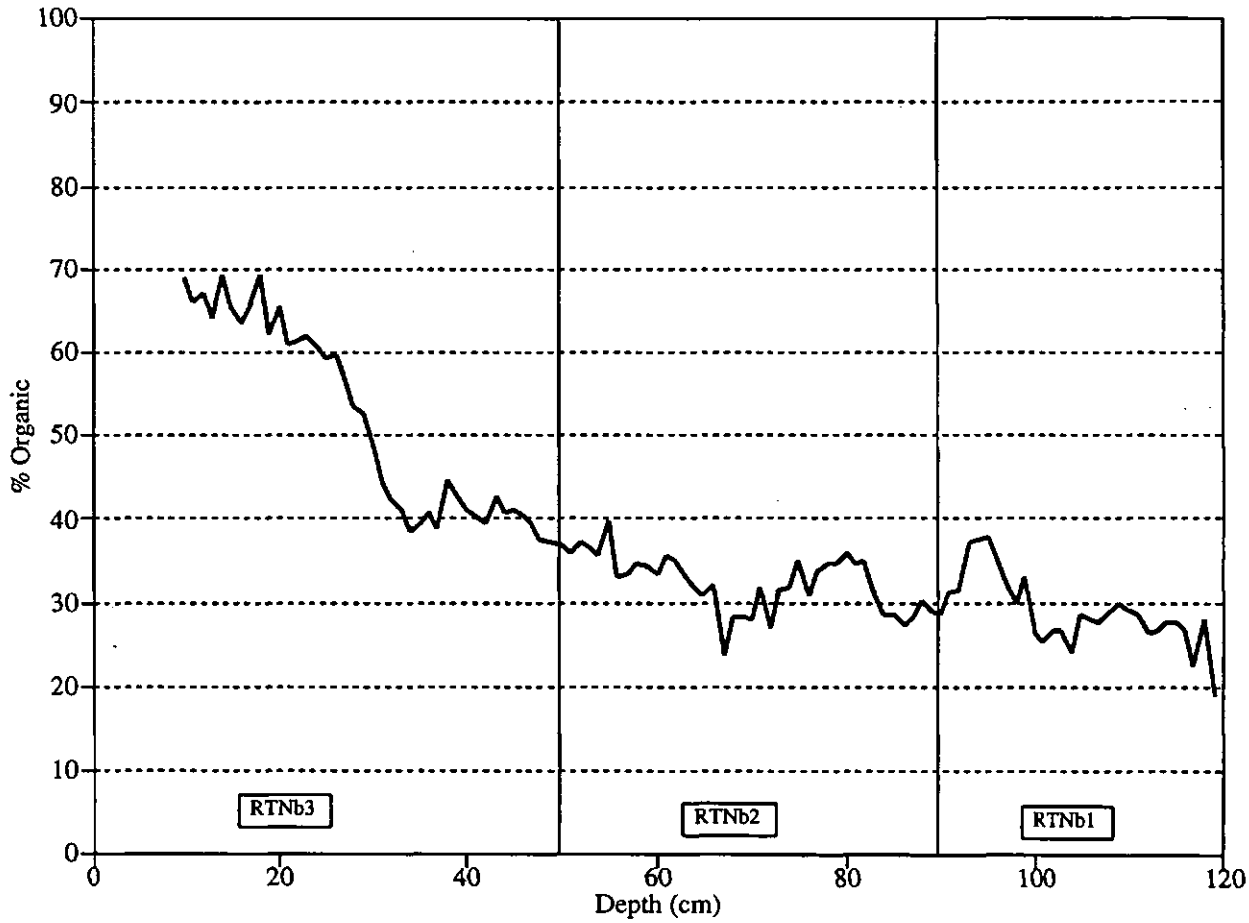
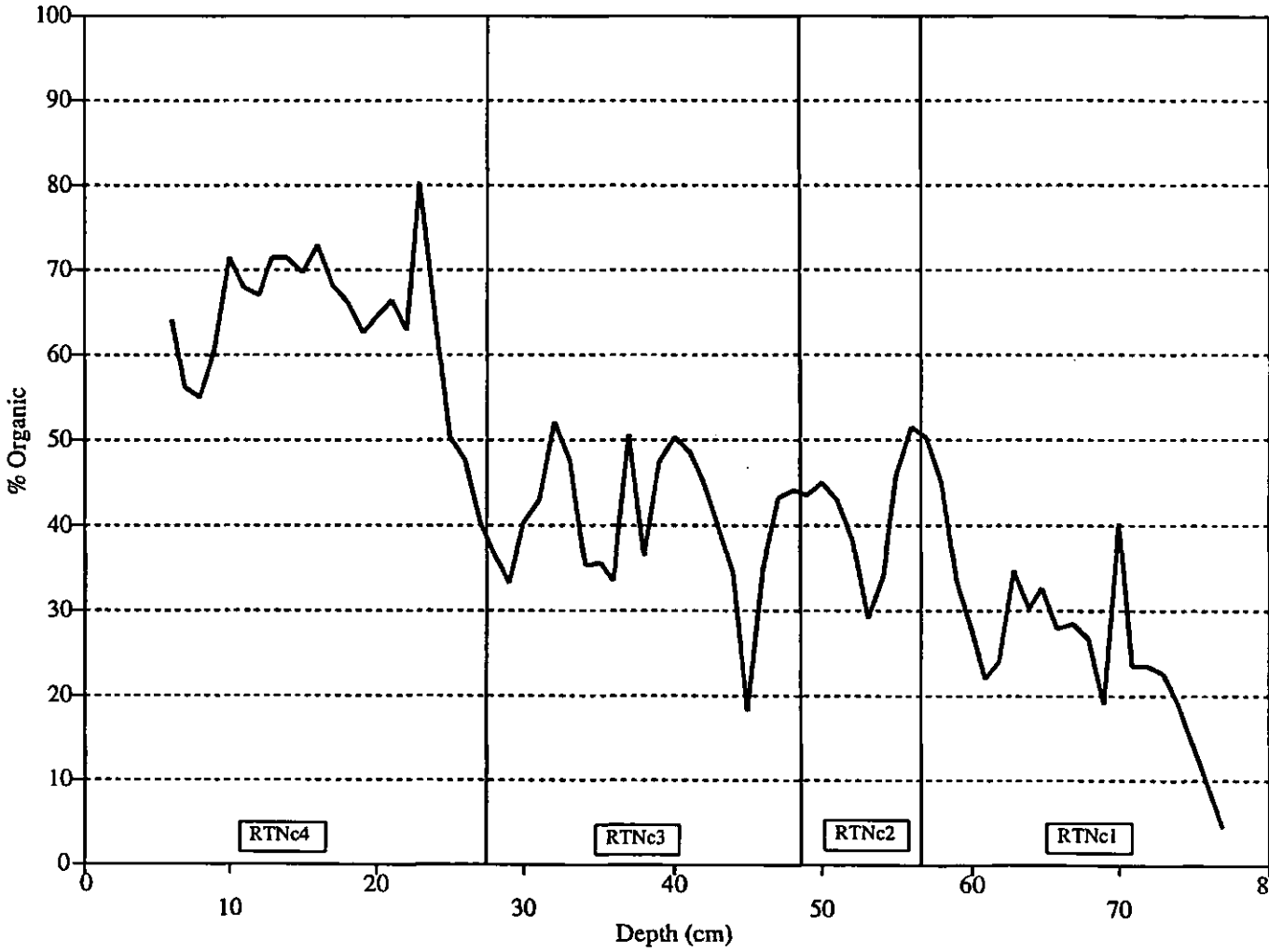


Figure 4.15: Rough Tor north monolith C organic matter determined by loss-on-ignition



4.19 Discussion: interpretation of the monolith pollen diagrams:

Monolith A

The lowest sample (150cm) of this diagram (Figure 4.16) is characterised by *Corylus avellana*-type and high levels of *Alnus*. Goddard (1971, cited in Smith & Cloutman, 1988) found that percentages of 30% and above of *Corylus* pollen were only found in hazel-dominated woodland. Hazel was clearly important in the surrounding vegetation at this stage (RTNa1), with *Alnus* dominant locally around the streamside sampling site. Presumably hazel was present on the better drained hillsides around and above the stream. Other tree pollen is present at only trace levels and neither *Betula*, *Ulmus*, *Quercus* or *Pinus* were significant components of the vegetation at a local scale.

This hazel-alder dominated environment rapidly loses out to the spread of grass and herb communities in the following zone. The concentration diagram (Figure 4.17) shows the magnitude of this fall in *Alnus* from 123 x 10^3 grains/cm^3 to 2.4 x 10^3 grains/cm^3. This occurs shortly before 1890$\pm$70BP (Beta-78543). There is an increase in Poaceae and other herbs also expand as a result of the opening of the local canopy including *Plantago lanceolata*, Lactuceae indet. and *Potentilla*-type. Occasional occurrences of *Cirsium*, Cardueae/Asteroideae and increasing percentages of *Centaurea nigra* reflect the presence of other herbs as part of the expanding grassland. Relatively small but sustained increases in *Calluna* and Ericales pollen suggest the spread of heath communities following the decline of the tree and shrub cover, although ericaceous taxa were clearly not a major component of the local ground flora around the sampling site. *Corylus avellana*-type and *Alnus* remain at values which are probably sufficient to indicate a restricted local presence.

The small increases in *Calluna* and possibly also *Potentilla*, may imply increasingly acid soil conditions. If this is correct, then such conditions may have

Sample	Lab no.	Uncalibrated date Radiocarbon yrs. BP (±1sd)	Calibrated calendrical age (2σ - 95% probability)
Monolith A: 137-141cm	Beta-78540	1890±70	20cal.BC - cal.AD265 and cal.AD 290 - 320cal.AD
Monolith C: 48-52cm	Beta-78541	1840±70	cal.AD 45-380cal.AD
Monolith C: 57.5-62.5cm	Beta-78542	2430±60	780cal.BC - 385cal.BC

Table 4.10: Radiocarbon dates for Rough Tor monoliths A & C.

Figure 4.16: Rough Tor north monolith A percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration is x10.

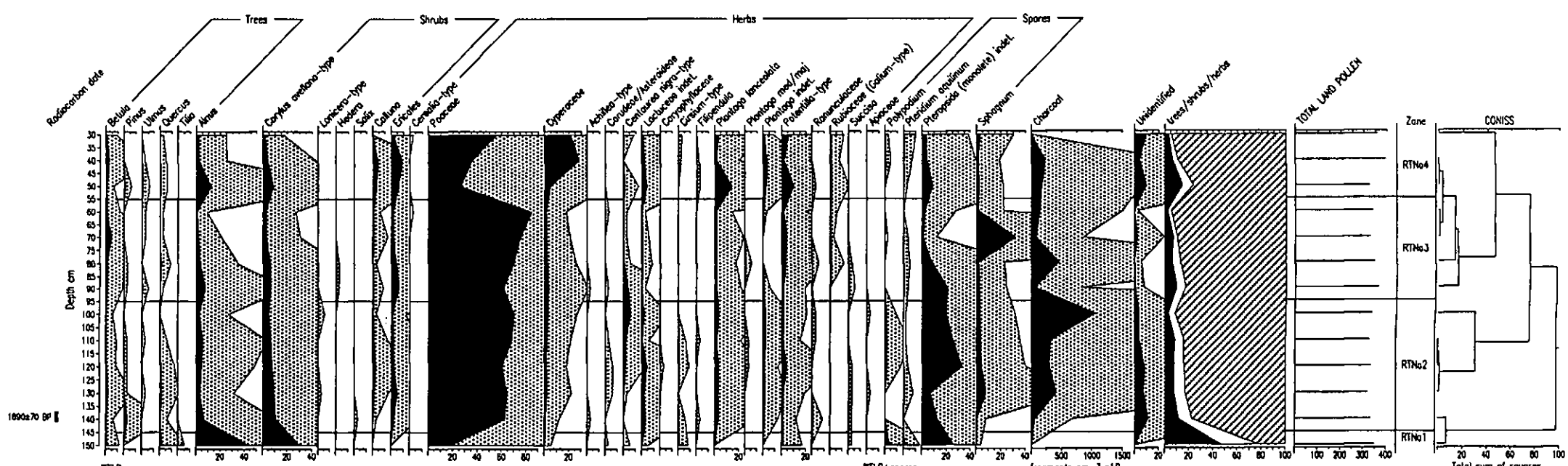
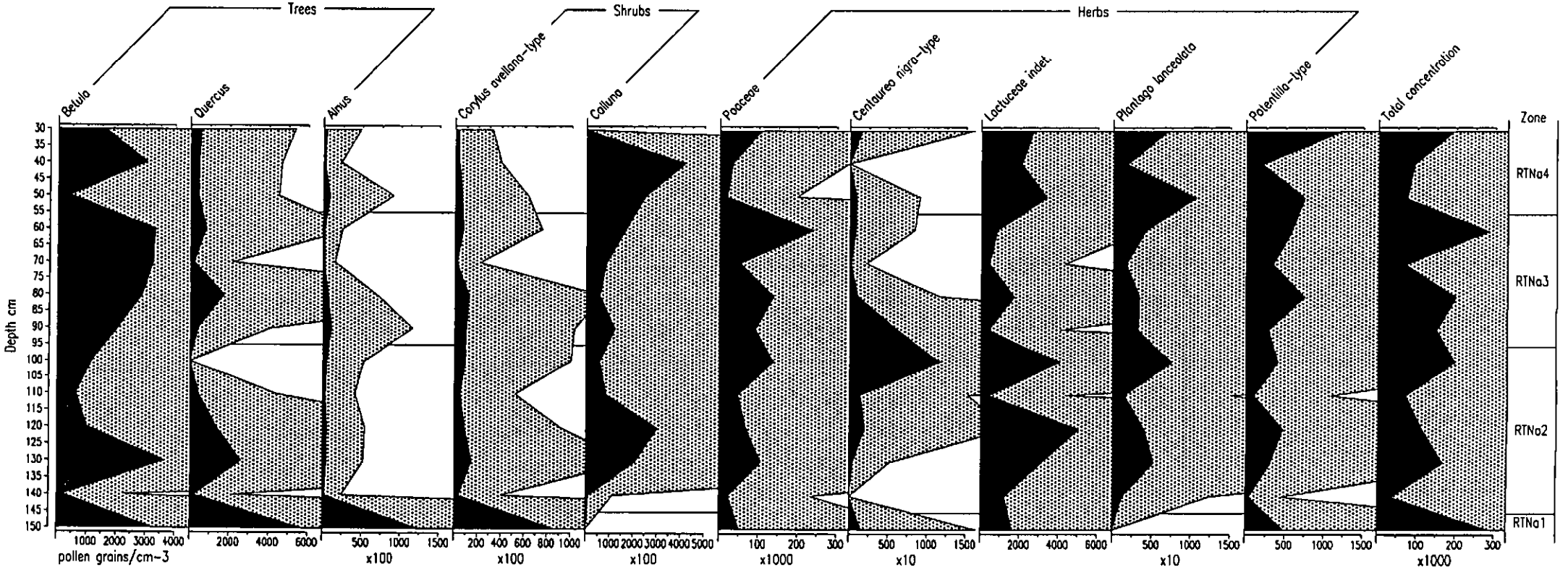


Figure 4.17: Rough Tor north monolith A concentration diagram (selected taxa). Values are of grains cm^{-3}. Exaggeration x10.



Zone	Depth (cm)	Description of main features of zone
RTNa4	30-55	*Alnus* peaks at 12% before falling to 3%. *Corylus avellana*-type increases to 9% then falls to 2%. *Calluna* increases to 5% and Ericales to 9%. Poaceae falls to 27% before increasing to >55%. Cyperaceae increases to >25%. *P.lanceolata* peaks at 15% and *Potentilla* at 10%. Lactuceae indet. increases to 5%. *Cerealia*-type recorded at 30cm.
RTNa3	55-105	Poaceae increases to 85%. *Alnus* falls to 1% and *Corylus avellana*-type to 3%. *C.nigra* increases to 6% then falls to <1%. *Cerealia*-type recorded at 60cm. Pteropsida (monolete) indet. falls from >25% to 2% TLP + spores. *Sphagnum* peaks at >30% TLP + spores.
RTNa2	105-145	*Alnus* falls to 3-8% and *Corylus avellana*-type to 7-9%. Ericales increases to 5%. Poaceae increases to 70%. Lactuceae indet. increases to 3-4%. Other herbs including *Cirsium*, *C.nigra* and *Potentilla* present at low values. Pteropsida (monolete) indet. increases to 30% TLP + spores.
RTNa1	145-150	*Alnus* at >40% and *Corylus-avellana*-type at 30%. Poaceae <20%. Other herbs very low.

Table 4.11: Summary of pollen zones for Rough Tor north monolith A.

been restricted to the more waterlogged substrate around the sampling site. This impression is reinforced by the presence of increased percentages of *C.nigra* pollen in the ensuing zone; *Centaurea nigra* generally grows on acid but reasonably nutrient rich soils (Grime *et al.*,1988). The failure of *Calluna* to increase substantially in a local environment that would appear ideal for the spread of heath had podsolization been much advanced, may also indicate that there was no great deterioration in soil conditions.

There is a change in the composition of the local herb communities in RTNa2, with *Centaurea nigra* becoming a significant element of the ground layer whilst Lactuceae indet. shows a similar decrease in percentages. The maintenance of continuous *Plantago* and *Potentilla* curves across this zone indicates that these taxa were not affected by whatever factors were responsible for the near complete replacement of Lactuceae indet. by *C.nigra*. According to the Poaceae curve, RTNa3 sees grassland reach its maximum extent for the diagram. Both *Corylus avellana*-type and *Alnus* fall to their lowest values at the same level (60cm). The renewed spread of grassland was apparently at the expense of the remaining local tree and shrub cover. Steady declines in *Calluna* and Ericales pollen suggest that areas of heather were also curtailed by this increase in grassland. Ferns are also much reduced in importance by the close of the zone and a peak in *Sphagnum* at 70cm probably reflects increased growth of this species as a result of increased local wetness and perhaps that sedimentary conditions were becoming less basic. By the end of RTNa3, the environment around the sampling site is dominated by grass, with a sparse distribution of *Plantago*, *Potentilla* and a very occasional distribution of other herbs represented by traces of *Galium*, Cardueae/Asteroideae and Ranunuculaceae. A *Cerealia*-type pollen grain is recorded at 60cm, pointing to the existence of arable plots within the landscape mosaic.

RTNa4 sees a reversal in the overall trend of the previous zones. *Alnus* and *Corylus avellana*-type percentages increase briefly at 50cm. Significant changes

in the herbaceous component of the local vegetation are also apparent at this point: Poaceae decreases and both *P.lanceolata* and *Potentilla* reach their highest values for the diagram. Other herbs which show renewed but less marked increases are Lactuceae indet. and *Galium*-type.

The overall impression in this zone is of a short-lived period of tree and shrub regeneration. This expansion in the woody taxa was clearly not sustained, as percentages of both *Corylus avellana*-type and *Alnus* fall to low levels at 40cm. The simultaneous expansion of certain herbaceous taxa may be interpreted as showing that the increase in alder and hazel was more significant on an extra-local, rather than a local scale or that there was no great increase in the areal extent of tree cover. The picture is thus of a predominantly open meadow-like landscape, interspersed with some scattered hazel and alder.

As is observed for the woody taxa, the increase in those herbs named above is reversed in the following sample. Poaceae and Cyperaceae are of increased importance, and *Calluna* and Ericales are able to expand again, although these species also decline toward the top of the zone. The pollen curves across this zone suggest grass/meadow land, steadily declining in species-diversity, to be replaced by grass and sedge communities with patches of heather and heath present in increasingly limited extents. By the close of the diagram, a virtually treeless landscape of damp grassland with only *Plantago* and *Potentilla* being anything other than very occasional components of the sward is envisaged.

The opening of RTNa4 is marked by an increase in organic percentages from *c.*50% to *c.*75% (Figure 4.13). This could reflect the effects of the increasingly damp local environment on sediment humification and perhaps accumulation rates, although there is no clear change in the degree of humification evident in the lithostratigraphy (Table 4.7). A band of less well humified sediment, possibly *Sphagnum*, is recorded at 47.5-48 cm and may reflect the wetter local environment

suggested by the increase in Cyperaceae in RTNa4.

There is therefore a progression from an open, pasture-like grassland to a damper grassy heath in this final zone. Despite evidence for the presence of *Calluna*, the soil resource cannot have degraded too severely prior to the upper half of RTNa4, as both alder and hazel are able to increase in the final zone, which would not have been possible had there been a serious deterioration in soil conditions. The landscape-wide decline in local soil conditions may not have occurred until later, possibly after the increase in Cyperaceae. The nature of the sampling site means that any conclusions other than those concerning local changes in sedimentary conditions must be treated with some caution.

Monolith B

There appears to have been selective preservation of pollen in the monolith B sequence (Figure 4.18). Although there were not particularly large percentages of unidentifiable grains, very high levels of spores resistant to decay (Havinga, 1984), Pteropsida (monolete) indet. and *Polypodium*, are present at all sampled levels. Many of the pollen grains in the lower samples, especially those of *Alnus*, showed signs of degradation. When this site was visited in July 1995, during an extended dry spell, the deposit from which monolith B was sampled had dried out completely, whilst both the monolith A and monolith C sites remained unaffected by the drought conditions (Plate 4.7). This suggests that the spring-line deposit at Monolith B is particuarly susceptible to low precipitation and although the summer of 1995 was exceptional in terms of very low rainfall, the integrity of the palynological record would probably be affected by only a few such periods of dessication. Although the section was cut back prior to sampling, the pollen record from this site should be treated with some circumspection.

Loss-on-ignition values are below 40% for most of the sequence (Figure 4.14) suggesting either a high input of mineral matter into the sediment or the effects of

Plate 4.7: The monolith B sampling site, summer 1995.

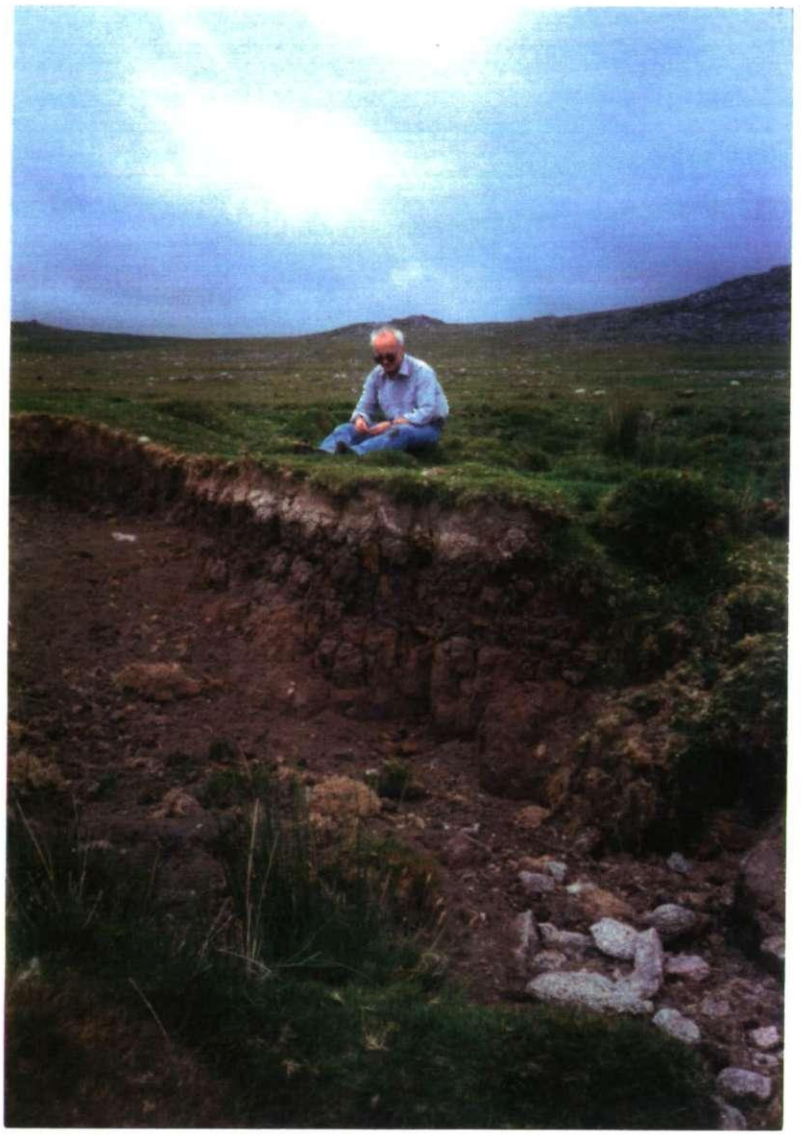


Figure 4.18: Rough Tor north monolith B percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration is x10.

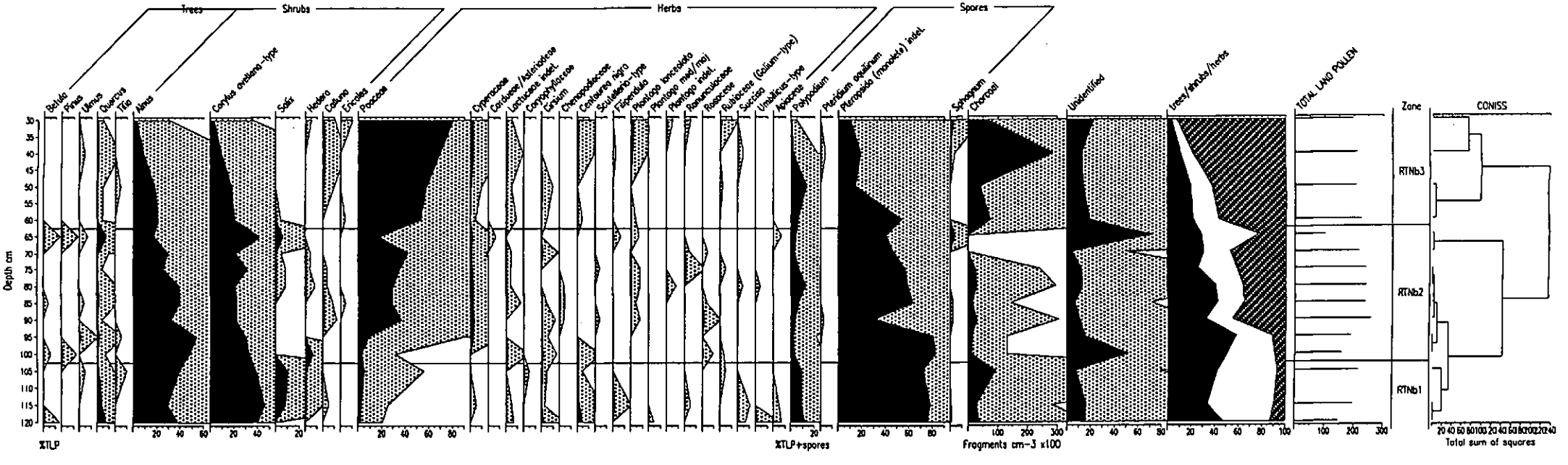
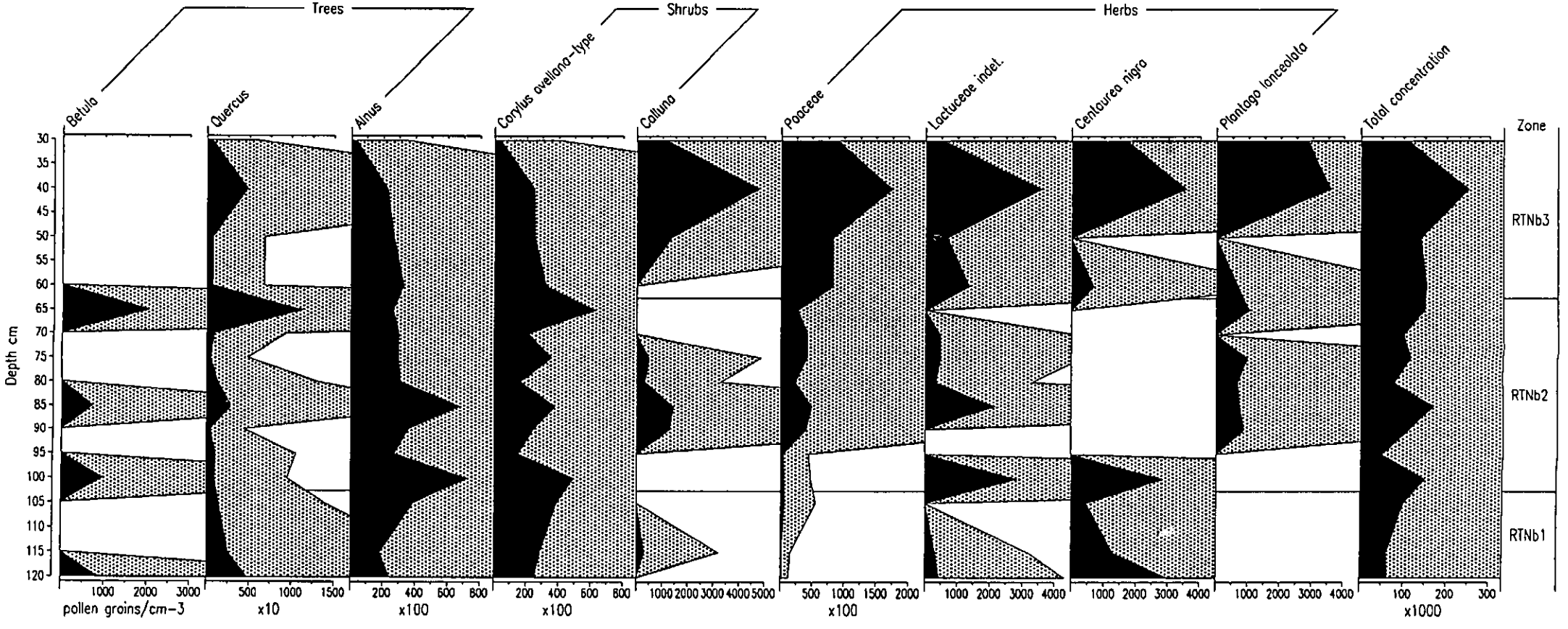


Figure 4.19: Rough Tor north monolith B concentration diagram (selected taxa). Values are of grains cm^{-3}. Exaggeration x10.



Zone	Depth (cm)	Description of main features of zone
RTNb3	30-62.5	*Alnus* falls from 20% to 3%. *Corylus avellana*-type falls from 20% to 3%. Poaceae increases from 50% to 80%. Lactuceae indet. at 1% across zone. *P.lanceolata* increases to 3% by close of zone. *C.nigra* increases to >1%. Other herbs low. Pteropsida (monlete) indet. from >50% to 10% TLP+spores.
RTNb2	62.5-102.5	*Alnus* falls steadily across zone from 30-50%. *Corylus avellana*-type at 20-40%. *Salix* disappears from record. Poaceae increases from <10% to to 30-40%. *P.lanceolata* <1%from 90cm. Other herbs low and sporadic. Pteropsida (monolete) indet. very high at 40-60% TLP+spores.
RTNb1	102.5-120	*Quercus* falls from 7% to 1%. *Alnus* 30-40%. *Corylus avellana*-type falls from 45% to 30% by close of zone. *Salix* increases to 10%. Poaceae low (<5%). *C.nigra* present at 5% falling to 2%. *Filipendula* attains 2% at 115cm. Other herbs low. Pteropsida (monolete) indet. very high at >70% TLP+spores.

Table 4.12: Zonation of Rough Tor north monolith B.

high rates of decay. The formation processes of this deposit and even the major constituents of the sediment remain unclear (Table 4.8). The pollen diagram is described and interpreted below, but no further discussion of this sequence is made following this, nor is there any attempt to integrate this sequence with the other records from Rough Tor.

The lowest zone of monolith B (RTNb1) is characterised by high levels of *Alnus* and *Corylus avellana*-type with *Salix* at around 10%. This indicates that there was dense hazel scrub present, with alder and willow as important elements of the vegetation. The alder and willow were probably dominant in the waterlogged ground around the spring-line sampling site, with hazel scrub more extensive on the surrounding hillside. High levels of Pteropsida (monolete) indet. and *Polypodium* indicate a fern-rich ground flora and the low levels of Poaceae, *Filipendula*, *Succisa*, Lactuceae indet., *Cirsium*, *C.nigra* and *P. Lanceolata* suggest the presence of damp, open and possibly disturbed ground.

There is distinct vegetational change following this first zone. Tree and shrub pollen begins to decline, to be replaced by increasing levels of grass pollen. *Salix* is the most affected and disappears in zone RTNb 2. The decline in *Alnus* and *Corylus avellana*-type is not as marked. Poaceae increases steadily, although herb pollen remains low. Taken collectively, these changes show an increase in open, grassy areas around the monolith B sampling site, although the failure of herbaceous communities to expand and the persistence of tree and shrub pollen suggests that tree and shrub-cover remained on perhaps more then half of the landscape. Some herbs even disappear from the ground flora: *C.nigra* is present at *c.*5% in the lowest sample of RTNb1, but declines across this zone to disappear entirely by RTNb2.

The general pattern of expanding grassland is reversed briefly at the top of RTNb2. *Corylus avellana*-type peaks at 65cm, which corresponds to a fall in

Poaceae. This indicates an expansion of hazel scrub at the expense of grassland. The less pronounced increases in *Salix* and *Quercus* at this level may denote that this change was not just local and the increase in hazel was accompanied by an extra-local expansion in oak and willow.

This is only a short-lived change and the opening of RTNb3 is defined by sustained increases in Poaceae pollen. *Corylus avellana*-type and *Alnus* decline across the zone. Herb pollen remains low, although *P.lanceolata* reaches its highest value for the diagram of 1% by 10cm. *Centaurea nigra* and *Galium*-type also reach 1.5% by this level. Other herbs such as Lactuceae indet., *Cirsium* and *Succisa* occur as low traces and must be present only as minor components of the grassy sward. By the close of this zone, trees and shrubs are absent locally, and the flora is dominated by grass-land, with certain herbs of increasing in importance through time.

Monolith B portrays a landscape dominated by hazel and alder in its earliest phases. Open ground is limited, although some grass and herbs are present. Grassland expands only gradually and alder and hazel remain important elements of the vegetation. A brief period of limited regeneration in hazel scrub and possibly also oak and willow, is followed by renewed increases in grass and the final decline of trees and shrubs. During this later phase, herbs apparently reached their maximum extent.

Monolith C

The lowest zone (RTNc1) of monolith C (Figure 4.16) is characterised by high levels of *Corylus avellana*-type pollen, which as was the case with Monolith B, is probably sufficient to signify hazel-dominated scrub present locally. The nearest source for *Myrica* - if it were present - would be Stannon Marsh, some 200m to the north- west. *Alnus* and *Salix* are also present in moderate proportions in this zone. Other tree pollen, including that of *Quercus, Pinus* and *Betula*, is also

evident at low but consistent levels (all below 10%).

Taken collectively, the record of these pollen types thus almost certainly indicates that the area around the sampling site was dominated by hazel scrub, with alder and willow. Hazel would have been the major woody taxon on the nearby slopes, with the percentages of alder and willow pollen most probably reflecting the presence of these trees on the damper ground around the stream that flows some 10 metres south of the sampling site. Apparently, neither birch, pine or elm were major components of the vegetation at Rough Tor north. *Quercus* is present in slightly greater percentages and this pollen may be derived from occasional local trees or more extensive stands at lower altitudes.

Percentages of Poaceae suggest some open ground but of the other herb pollen types recorded, only *Filipendula* is present in quantities sufficient to confidently ascribe anything other than sparse local occurrence. *Filipendula* was probably present as part of the damp grassland or perhaps fen vegetation on the poorly drained ground around the stream. The local tree and shrub cover did not apparently form a dense, closed canopy, and the structure of the vegetation was such that grassy areas were present nearby and the record of Cyperaceae, *Succisa* and Apiaceae suggest high soil moisture in some locations. Pteropsida (monolete) indet. are present at high percentages during RTNc1. This corresponds with a fall in organic percentages to below 25% (Figure 4.15). The high levels of Pteropsida (monolete) indet. spores which are resistant to decay (Havinga, 1984) and low organic matter values suggests there may have been a certain amount of differential preservation of pollen in this zone. Percentages of unidentified pollen are around 20% during this zone and although the pollen curves make ecological sense, it is difficult to assess the extent to which differential preservation may affect interpretation.

There is an abrupt change in the vegetation with the opening of RTNc2, dated to

Figure 4.20: Rough Tor north monolith C percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration is x10.

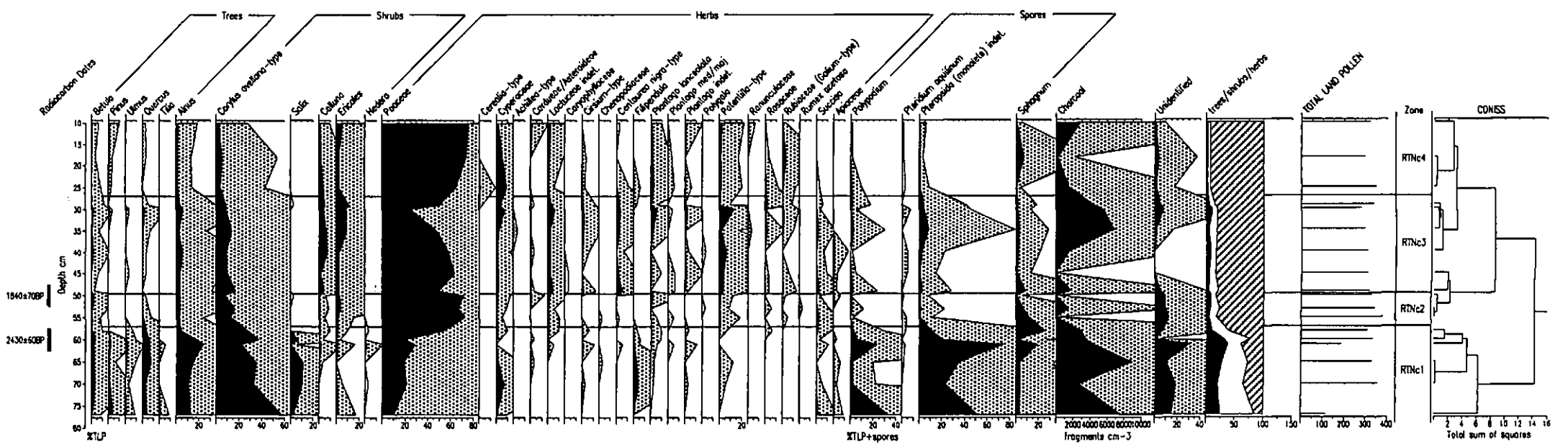
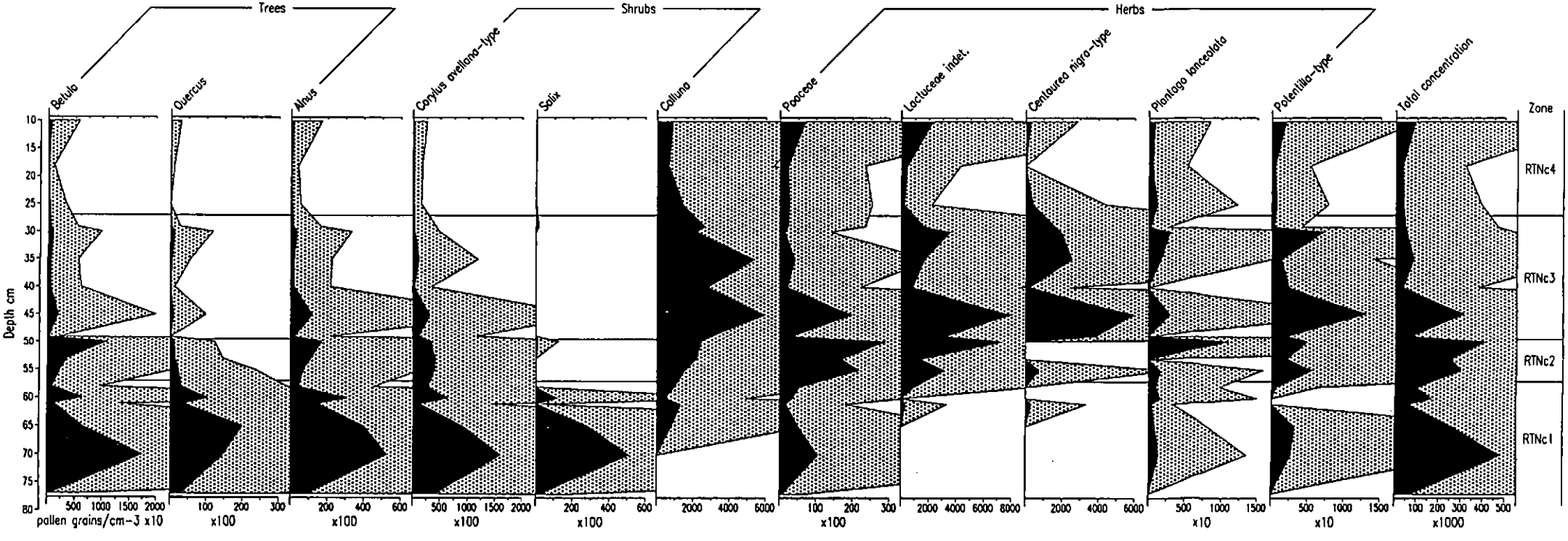


Figure 4.21: Rough Tor north monolith C concentration diagram (selected taxa). Values are of grains cm^{-3}. Exaggeration x10.



Zone	Depth (cm)	Description of main features of zone
RTNc4	10-27	*Corylus avellana*-type falls to <5%. *Calluna* falls to 1-2%. Ericales increase to 5%. Poaceae increases to 75%. Cyperaceae increases to 10% before falling to 1-2%. *Potentilla, P.lanceolata* and Lactuceae indet. low (1-2%) but consistent. *Galium*-type increases slightly to 2-3%.
RTNc3	27-49	*Corylus avellana*-type at 10-15%. *Alnus* at 3-5%. *Calluna* increases to 10% and Ericales to 15%. Poaceae at 55%. Lactuceae indet.at 5% and *C.nigra* at 3-5%. *Potentilla* at 5-10% peaking at 15%. Other herbs low (1-2%) but consistent including *Succisa, P.lanceolata* and *Cirsium*.
RTNc2	49-57	*Quercus* falls to<1%. *Alnus* at 3-4%. *Corylus avellana* falls to 15%. Poaceae increases to 70%. Other herbs low and sporadic.
RTNc1	57-77	*Quercus* at 5%. *Pinus* and *Betula* at 2-3%. *Alnus* increases to 25% before falling to 3-4% by close of zone. *Corylus avellana*-type 30-60%. *Salix* increases to >10% but disappears by close of zone. *Filipendula* peaks at 5%. Other herbs low and sporadic including *Potentilla, P.lanceolata* and *Cirsium*. Pterospida (monolete) indet. peaks at 70% TLP + spores before declining at close of zone. *Polypodium* fluctuates between 5-30% TLP + spores before declining by close of zone. *Sphagnum* increases to 20% TLP + spores.

Table 4.13: Summary of pollen zonation of Rough Tor north monolith C.

2430±60 BP (Beta-78542). All the trees decline significantly; *Alnus* percentages fall to around 5%, *Salix* disappears from the palynological record and *Corylus avellana*-type, *Quercus* and *Pinus* also decline. These changes in the tree and shrub pollen percentages are matched by a sudden increase in Poaceae, although this is the only herb pollen to show a marked response to the changes in tree and shrub pollen in this zone.

Grass has therefore replaced hazel as the dominant taxon at a landscape scale, although the latter species was probably not completely eliminated from the slopes of Rough Tor north at this point. The decreases in alder and willow pollen indicate that they are either no longer present as local components of the vegetation, or are at least much reduced in importance. The reduction of Pteropsida (monolete) indet. and *Polypodium* reflects the opening up of previously shaded and undisturbed scrub/woodland habitats. RTNb2 therefore records a transition from the hazel-dominated scrubland evidenced in the previous zone, to a more open grassy landscape.

There is a change in the stratigraphy between RTNc1 and 2 from dark brown mineral sediment to black, well humified peat (Table 4.8). The LOI data show an increase in organic matter percentages from below 30% to above 45% (Figure 4.15). The disturbance of the local tree cover would have resulted in a decreased transpiration:evaporation ratio and subsequently a wetter local environment and accumulation of peat. The increase in organic matter percentages correlates with an increase in *Sphagnum* at the close of RTNc1, reflecting a raised water table.

The other herbaceous taxa do not begin to expand significantly until RTNc3. The rise in the percentages of Lactuceae indet., *Centaurea nigra*, *Potentilla*, *Plantago lanceolata* and other heliophytes suggest changes in the ground flora, and the spread of species typical of grassland and meadow. The opening of this phase is dated to 1840±70 BP (Beta-78541). Increases in *Calluna* and Ericales to around

5% and around 10% respectively also indicate the presence of open areas, and the spread of some heather and heath communities. Evans & Moore (1985) studied modern surface pollen spectra and suggested that values for *Calluna* of over 20% indicate the local presence of heather. The percentages for this species in RTNc3 therefore implies either fairly sparse local heather, or more extensive areas of heathland at greater distance from the sampling site.

Poaceae remains steady and there are no further marked reductions in tree and shrub pollen percentages. Thus no change in the areal extent of open land is indicated during this period and vegetational changes were largely restricted to the establishment of a higher diversity grassland at Rough Tor north. The peak in *Potentilla* at 30cm must reflect a very localised expansion of this herb onto the surface of the sampling site.

RTNc3 therefore represents the establishment of a meadow-like vegetation at Rough Tor North. Some hazel may have been present locally and perhaps some scattered alder. There is nothing to indicate that significant tree cover remained on anything but a regional scale and grassland and some heath are the dominant habitats. *Cerealia*-type is recorded at 29cm suggesting that arable land was present within the pollen catchment area of monolith C.

The pollen curves across the final zone - RTNc4 - show the final stage in the transition from the hazel scrub, recorded at the opening of the diagram, to the species poor grassland that is the present vegetation in this part of Bodmin Moor. Poaceae are the only taxa to expand significantly during RTNc4; other herbs either disappear or decrease to low levels at the opening of this zone, although *Galium*-type shows a slight increase. The re-appearance of *Cerealia*-type at 25cm suggests that cereals were being cultivated nearby. *Corylus avellana*-type and *Alnus* fall to low values and total tree and shrub pollen is little above 10%, representing an almost totally cleared landscape. A contraction in the area of heath is recorded by

the decrease in percentages of *Calluna* and Ericales undiff.. An increase in organic percentages from 50% to 65% is recorded at the opening of RTNc4 (Figure 4.11). This corresponds to a change in lithostratigraphy from well humified peat to poorly humified peat (Table 4.8) suggesting lower rates of decay either as a result of increased accumulation rates or a wetter local environment.

4.20 Interpretation of the monolith charcoal records

Charcoal levels increase across RTNa2, before rising slightly at the start of RTNa3 and peaking at 80cm (Figure 4.16). There is a slight increase in *Plantago lanceolata* and Poaceae at this level and fall in Pteropsida (monolete) indet., so the increase in charcoal is perhaps related to an intensification of anthropogenic activity. Charcoal falls at the opening of RTNa4 reflecting a reduction in burning locally.

Microscopic charcoal is high in RTNc1 2 (Figure 4.20), but falls at the opening of RTNc2 . The origin of this charcoal is unclear, as there is little evidence for human activity in this zone. The fall in charcoal in RTNc2 may be unrelated to direct changes in fire frequency, as there is a fall in pollen concentration at the close of the first zone. The decline in charcoal concentration may therefore be related to a change in sediment accumulation rates. Levels begin to rise steadily at the opening of RTNc3 and peak at 35cm, which point to an increase in burning in the catchment of monolith C. Levels fall in RTNc4, suggesting that fire frequency and extent were much curtailed.

4.20 Vegetation change at Rough Tor North

The early woodland cover (RTNa1, RTNc1)

The earliest vegetation cover recorded by the Rough Tor monoliths is hazel scrub,

with alder and willow also present in certain parts of the landscape. Other canopy-forming species, such as pine, elm and birch are not components of the local vegetation, whilst oak may have had a restricted local presence. Some open, grassy areas are evidenced in the pollen record, with few herbaceous taxa present in the earliest zones.

The radiocarbon dates suggest some diachroneity. The close of RTNc1 is dated to 2430±70BP (780-385cal.BC) whilst the early stages of RTNa2 are dated to 1890±70BP (20cal.BC-cal.AD265 & cal.AD290-cal.AD320). The latter date is above the zone boundary and the samples are above the basal mineral-organic transition, so accumulation rates could be high. Both factors could push the date for the RTNa1-RTNa2 boundary back by several hundred years. The date is not thought to be in error as it was taken above the main mineral-peat contact (cf. Caseldine & Maguire, 1986; Smith & Cloutman, 1988; Charman, 1992a)

There is evidence for human-induced disturbance to the vegetation from the opening zones of both diagrams, although the moderate levels of tree and shrub pollen and low levels of ruderal herbs, such as *P.lanceolata* and *Cirsium*, do not indicate a high level of impact. After Poaceae, *Filipendula* is the most abundant of the herb pollen types in RTNc1. As *Filipendula* does not grow in heavily disturbed habitats (Grime *et al.*, 1988), this further suggests a low level of human activity. Any activity on the higher slopes of Rough Tor north might not be clearly reflected in the pollen record from the RTNc site.

Anthropogenic activity and the demise of local woodland (RTNa2, RTNc2)

The first unequivocal evidence of human impact is found in RTNc2, dated to 780-385cal.BC. Poaceae pollen rises in all three zones and tree and shrub pollen frequencies begin to fall. Substantial open areas have appeared at the expense of the woody taxa *Corylus avellana*-type, *Alnus* and *Salix*, the latter taxon disappearing entirely from the pollen record at this stage. Anthropogenic

indicators remain low and intermittent in RTNc2 and the pollen spectra are dominated by Poaceae until 45-380cal.AD. Percentages of *Corylus avellana*-type and *Alnus* are similar in both RTNa2 and RTNc2 and are probably sufficient to indicate a restricted persistence of alder and hazel locally.

There is little evidence for further scrub/woodland clearance in RTNc3 and RTNa2/3, although the failure of the woody elements of the vegetation to regenerate suggests continuing pressure on the local environment. This is reinforced by the changes in the ground flora: increases in *Calluna* and Ericales pollen indicate the presence of these taxa, and percentages of Lactuceae indet., *Centaurea nigra*, *Cirsium* and *Plantago lanceolata* show the presence of these herbs as part of the grassland. The levels of *Calluna* pollen may reflect increasingly acid soil conditions, although the presence of *Centaurea nigra* suggests an acid but reasonably nutrient-rich substrate (Hughes & Huntley, 1988).

The development of grassland

The previously hazel-dominated woodland is therefore converted by human clearance activity into a grassland with little wood/scrub land remaining. This is dated to 1840±70BP (cal.AD45-380). This grassland is characterised by *P.lanceolata*, *Cirsium*, *Succisa*, *Galium*-type, *Filipendula* and *Centaurea nigra*. These species would be distributed across the landscape according to various natural and anthropogenically mitigated factors. Herbs characteristic of damp, less disturbed ground, such as *Succisa* and *Filipendula* would be prevalent on the moister soils near to the stream and damper field edges. Better drained slopes would be characterised by more extensive occurrences of *Plantago* and *Galium*.

The palynological record indicates that both *C.nigra* and Lactuceae indet. were important as part of the grassland mosaic. Such grassland has no direct analogy in the contemporary vegetation of the Rough Tor moors. A modern analogue for the grassland suggested by the pollen record across RTNc3 and RTNa2/3 may be

found in the *Cynosurus cristatus-Centaurea nigra* grassland described by Rodwell (1992). This grassland type is characterised by various grasses, sedges and a substantial proportion of dicotyledons, including *Plantago lanceolata, Lotus corniculatus* and *Trifolium repens*. Other species found include *Taraxacum officinale, Rumex* spp., *Lotus corniculatus, Potentilla* and *Succisa*. *Calluna vulgaris* is also found, especially where grazing is not intensive. Not all these species are represented in the pollen record, but the palaeoecological picture is of a grassland very similar to this.

This grassland community is the major grassland type included within the category of 'old meadow', a term usually applied to lowland meadow vegetation resulting from "..and maintained by a traditional low-input system." (Hughes & Huntley, 1988:107-108). Although usually found on circumneutral soils in the lowland zone, sub-communities can extend on to the uplands on superficially acid, although not podsolized soils. Modern examples of this grassland type are found on medieval fields showing ridge and furrow, although the characteristic history of the community is of treatment consisting of grazing, the taking of a light hay crop, and the light application of fertilizers (Rodwell, 1992:61-62). This suggests that in the aftermath of tree and shrub clearance early in the first millennium BC, a relatively low intensity pastoral farming was practised at Rough Tor north, probably for at least 1000 years.

There is a change in the form and species composition of this grassland in RTNa4 and RTNc4. *Centaurea nigra* and *Succisa* disappear, and Lactuceae indet. declines to a low level. *Calluna* and Ericales area also decline in RTNa4, whilst there is an increase in both grass and sedges. The continuing presence of *Potentilla, Plantago lanceolata* and *Galium*-type in the pollen record indicate that these herbs remained as part of the ground layer. There is thus a change to a damper grassland, with lower species diversity. The palynological impression is of a vegetation community similar to the *Festuca-Agrostis* grassland which is presently

typical of this and other parts of Bodmin Moor. The vegetation of such grassland includes various grasses including *Agrostis capillaris* and *Festuca rubra* with only *Galium saxatile* and *Potentilla erecta* as constants, although *P.lanceolata, Veronica riviniana, V.officinalis* and other herbs can also be present (Rodwell, 1992). This grassland is widespread on base-poor mineral soils, where increased rainfall enhances leaching. The grassland is used as and maintained by grazing.

A transition from a comparatively species rich grassland, to a community more similar to that typically found on the present day grazed uplands of south-west Britain, is recorded in monolith A and monolith C. Heavy grazing will lead to a decrease in the richness of a sward (Rodwell, 1992), a factor which can also result in an expansion of rosette hemicryptophytes. *Plantago lanceolata* remains as a component of the grassland in RTNa4 and RTNc4, with percentages increasing slightly in the latter zone. This may be regarded as supporting an hypothesis of increased grazing. The decline in heather is probably also related to increased grazing intensity. Grant & Armstrong (1993) pointed out that heather is low in the hierarchy of grazing preference for sheep, and is usually grazed mainly in the winter months. However, when the proportion of grass by area increases, the full exploitation of the grass by increasing numbers of sheep will also lead to overgrazing of the heather; this can lead to a 40-50% reduction in the production of new shoots within 5 years of increased grazing (Grant & Armstrong, 1993:83-84). The final decline in the remaining trees and shrubs in RTNa4 and RTNc4 is quite probably related to the grazing and trampling of animals preventing the regeneration of woodland as well as the use of wood for domestic purposes. Tables 4.14 & 15 summarise the vegetational changes and inferred human activity for the Rough Tor north monoliths A & C.

4.21 Summary

This part of the chapter has discussed the results of the analysis of three monolith sequences from Rough Tor north. The implications of these sequences for later Holocene landscape change at north Rough Tor have been discussed. Radiocarbon dates indicate that two of the sequences cover later Holocene landscape change. One of the sequences is thought to be unreliable due to differential preservation. The next chapter will be a synthesis of the palaeoenvironmental data from Rough Tor south and north and an integration of the archaeological and palaeoecological data.

Zone/depth cm	Main ecosystem represented	Inferred human impact/activity
RTNa4 *30-55*	Damp grassland with hazel and alder spreading in some locations. Increase in heath land.	Increased pastoral activity. Local cultivation possible. Reduction in burning.
RTNa3 *55-105*	Grassland/meadow. Some hazel and alder present locally.	Low intensity pastoral activitypossibly intensifying toward top of zone
RTNa2 *105-145*	Open grassland. Some hazel and alder remaining .	Clearance of hazel and alder. Low intensity pastoral activity. Increase in burning.
RTNa1 *105-150*	Alder/hazel scrub. Some open, grassy areas	Little evidence of human impact or burning.

Table 4.14: Summary of interpretation of Rough Tor north monolith A pollen diagram

Zone/depth cm	Main ecosystem represented	Inferred human impact/activity
RTNc4 *10-27*	Acid grassland.	Intensified pastoral activity. Shortlived local cultivation possible. Reduction in burning
RTNc3 *27-49*	Meadow/grassland with heath. Some hazel and possibly alder remaining locally.	Low intensity pastoralism. Seasonal land-use probable. Burning increasing.
RTNc2 *49-57*	Grassland with patches of hazel scrub.	Clearance of scrub. Low intensity pastoralism .
RTNc1 *49-77*	Alder-hazel scrub with some willow and perhaps oak also present. Open, damp areas locally.	Little evidence of activity. Burning activity low.

Table 4.15: Summary of Rough Tor north Monolith C pollen diagram

Chapter Five:
Settlement History and Environmental Change - Integrating the Palaoenvironmental and Archaeological Records at Rough Tor

5.1 Introduction

This chapter discusses the correlation and integration of the palaeoecological sequences from Rough Tor north and south. To help in the comparison of the palaeoecological sequences and to provide a more objective comparison of the records, detrended correspondence analysis (DCA) was implemented using the program CANOCO (see Chapter 2). Following a discussion of the implications of this analysis, a correlation of the archaeological with the palaeoecological record is undertaken.

Ordinations were carried out on the pollen data from Rough Tor south core (RTS) and monolith A (RTNa) and monolith C (RTNc) from Rough Tor north. Monolith B (RTNb) was excluded from the analysis due to the problems of pollen preservation associated with this sequence. Rough Tor Marsh (RTC) was also excluded from the ordination due to its isolation from the location of human activity. The ordination of the three sequences is discussed below followed by a discussion of the ordination of the two sequences from Rough Tor north, as radiocarbon dates indicate they cover approximately the same temporal depth.

5.2 Interpretation of the DCA plots

Rough Tor south core and the Rough Tor north monoliths

Pollen taxa plot

Figure 5.1 is a plot of the pollen taxa scores for the first two axes of the pollen taxa ordination. Axis one differentiates between relatively undisturbed wood/shrub land and open habitats. Woodland taxa including *Quercus*, *Corylus avellana*-type and *Betula* are grouped at the top right hand corner of the diagram. *Ulmus* is also included in this group apparently confirming that elm was present as a component of the woodland near to Rough Tor. *Tilia* also appears in this group which implies that lime may also have been present in the vegetation. This group also includes *Succisa* and Ranunulaceae suggesting the presence of these herbs in open canopy or woodland edge habitats. Taxa typical of open grass and heath habitats such as Poaceae, Rubiaceae (*Galium*-type), *Plantago* spp. and *Calluna* plot to the left of the diagram. *Pteridium* is not included in this group but plots with the woodland taxa, indicating that this species did not spread significantly from its original woodland habitat following disturbance to the tree cover.

The proximity of *Alnus* to the herbaceous taxa indicates that alder is associated more with open, possibly anthropogenically disturbed vegetation at Rough Tor than with the other woodland taxa such as *Quercus* and *Corylus avellana*-type. The association of *Pinus* with this group points to the likelihood that this species was not present in the local woodland and its pollen is more likely to have been derived from the long-distance component, the representation of which would be expected to increase following the opening up of the vegetation (Tauber, 1965).

Figure 5.1: DCA pollen taxa scores for the Rough Tor sequences. Dotted lines indicate taxa groupings referred to in text.

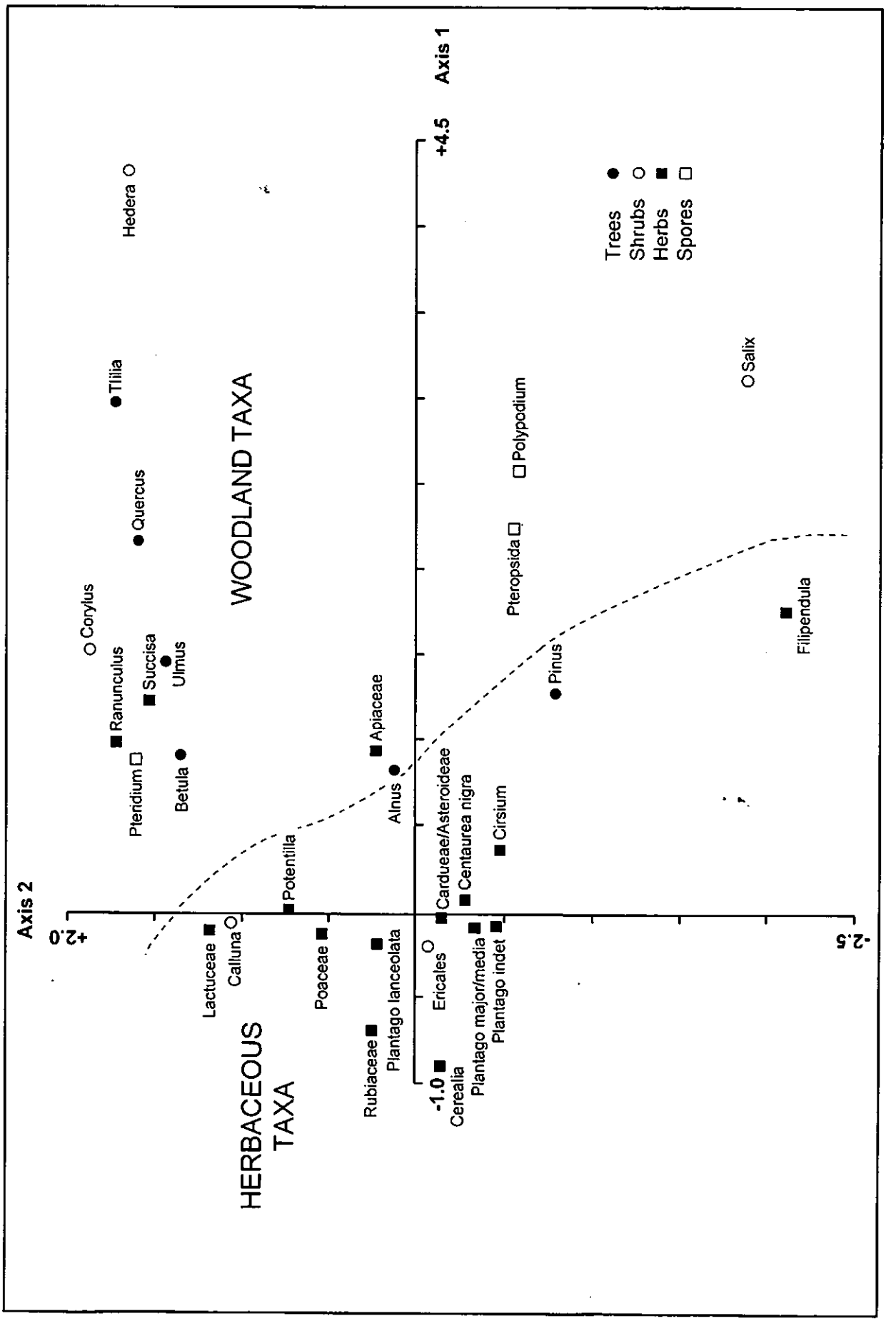
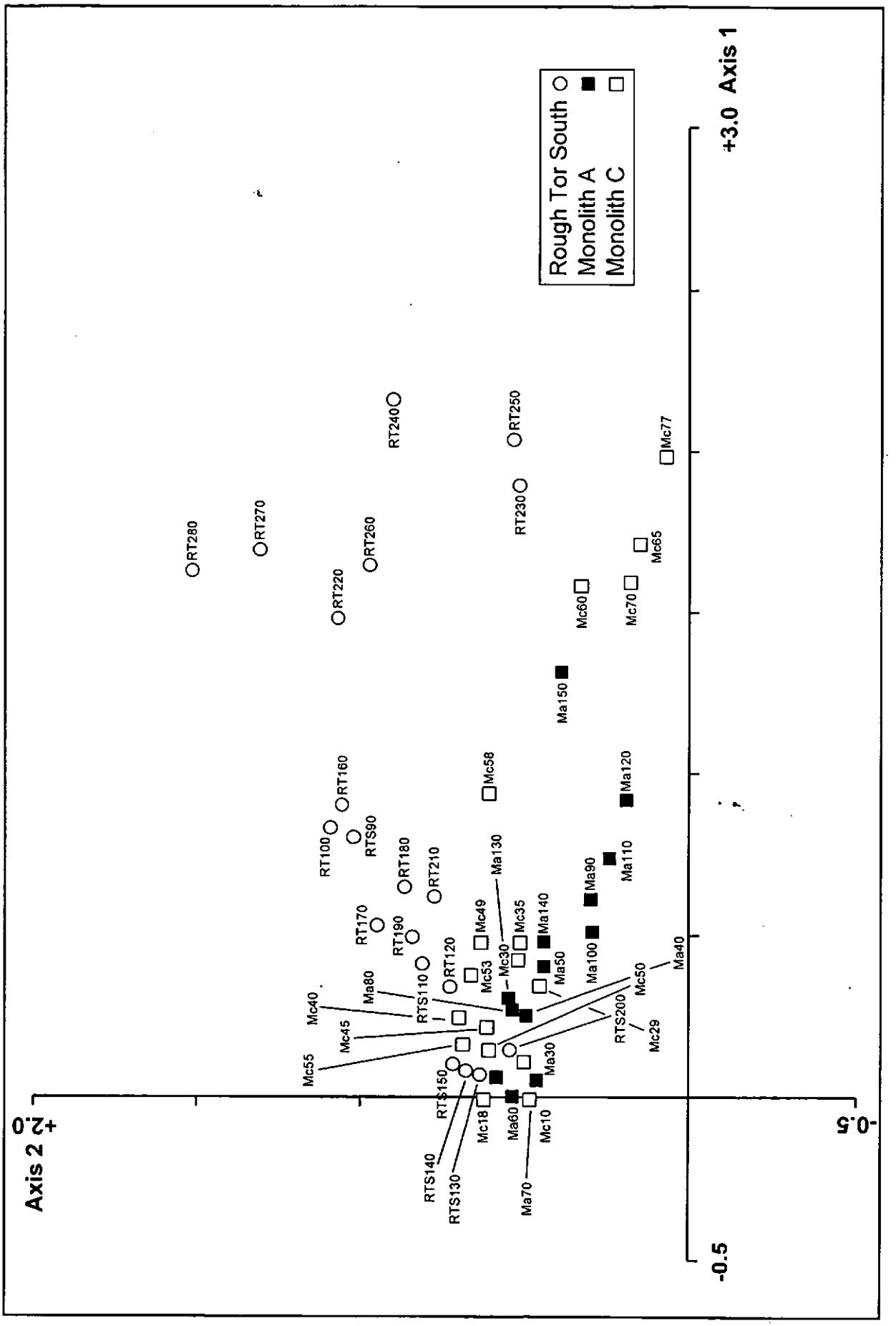


Figure 5.2: DCA sample scores for the Rough Tor sequences. NB. Not all samples are included on plot.



The second axis is more difficult to interpret, but seems to reflect hydrological conditions. Taxa associated with higher positive values, such as most of the tree and shrub taxa, *Pteridium*, *Calluna* and Lactuceae indet., may be relecting relatively dry habitats, whilst those associated with lower values, *Salix*, *Polypodium* and *Filipendula* for example, may be reflecting damper conditions.

Sample plot

Figure 5.2 shows the scores for the first two axes of the sample ordination. The samples characterised by high levels of wood/shrub land taxa plot out toward the right of the diagram and are very different in total composition from those representative of more open grassland vegetation. The diagram also shows that there are major vegetational changes between zones RTS 1 and 2 and RTNa and RTNc 1 and 2. The lowest samples from the Rough Tor south core form a distinct group, indicating that the woodland vegetation represented by zone RTS1 has no immediate parallel in the monolith sequences from Rough Tor north. This also tends to be the case for the samples from RTS2, which form a distinct group in the centre left of the diagram. The samples from the final two zones of Rough Tor south are included within the group on the left side of the plot, which also comprises samples from the final three zones of the Rough Tor monoliths (RTNa2-4 and RTNc2-4)

Rough Tor north monoliths

Pollen taxa plot

A separate ordination was carried out on monoliths A and C. As for the previous taxa ordination, axis one (Figure 5.3) differentiates between generally wooded and open conditions. Taxa typical of the former plot to the right of the diagram whilst Poaceae and herbs typical of open, disturbed habitats tend to plot on the left.

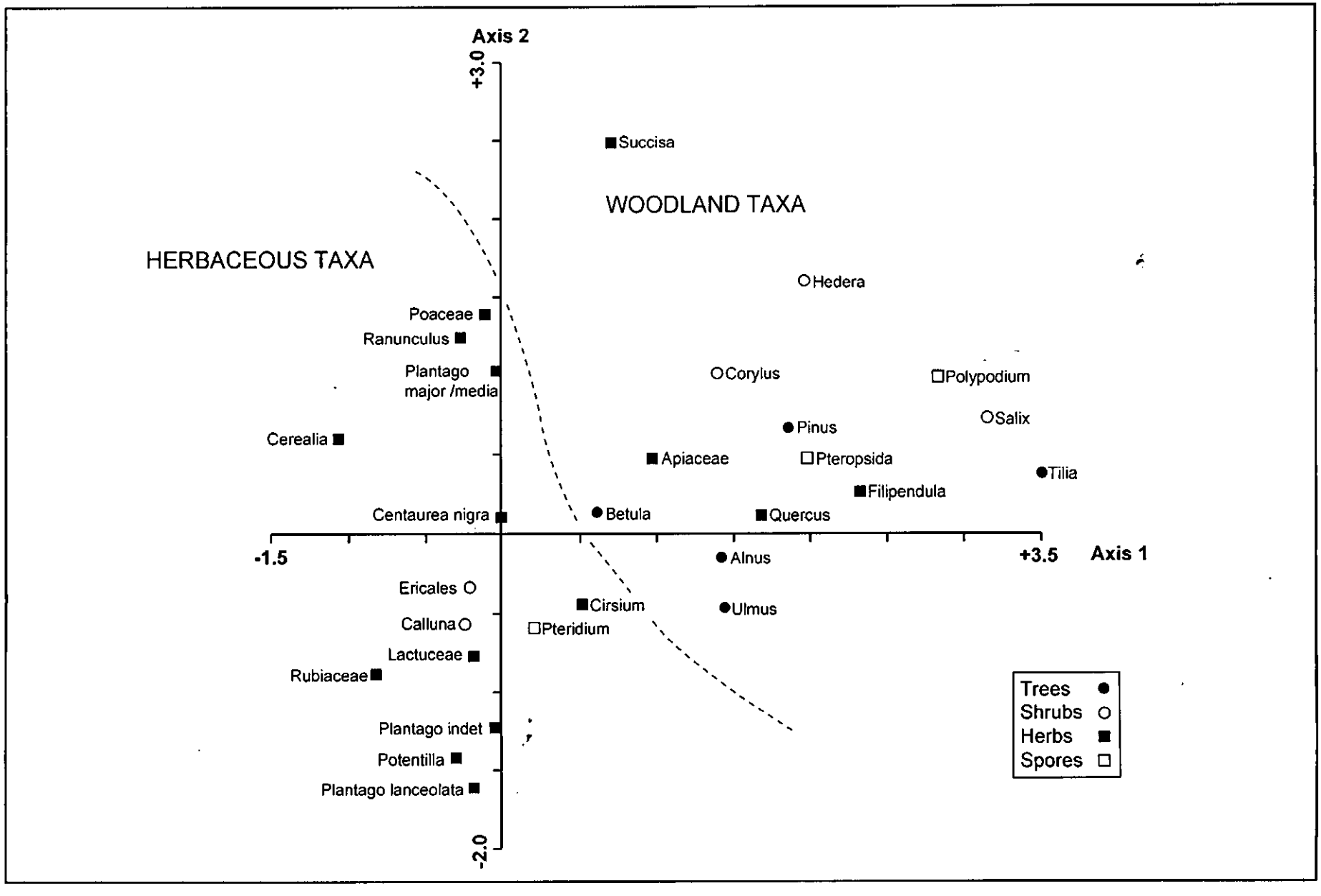
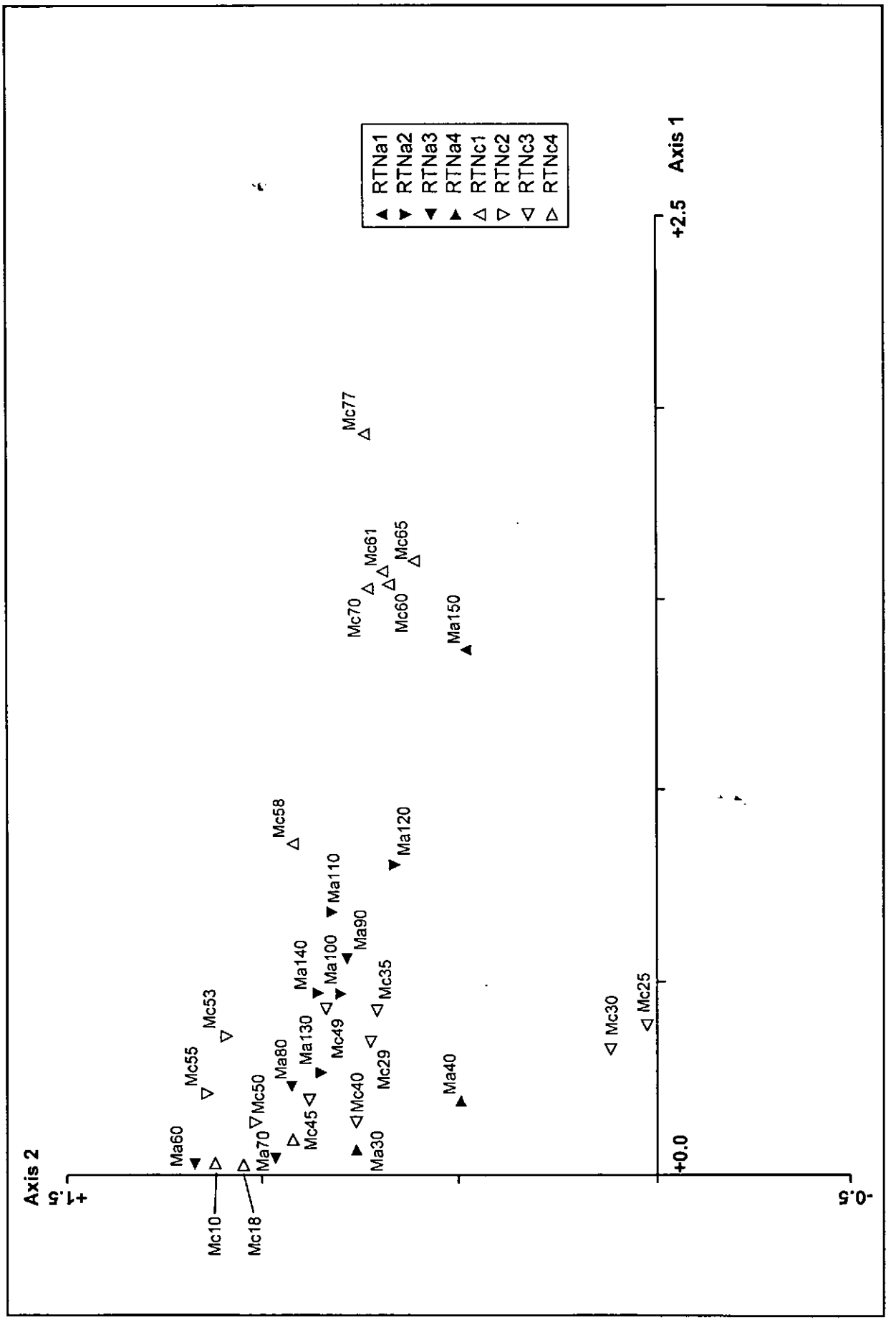


Figure 5.3: DCA pollen taxa scores for the Rough Tor north monolith sequences. Dotted lines indicate taxa groupings referred to in text.

Figure 5.4: DCA sample scores for the Rough Tor north monolith sequences



The woodland group includes *Quercus*, *Corylus avellana*-type and *Alnus*. *Pinus* is included in this group suggesting that pine may have been a component of the vegetation. *Betula*, on the other hand, plots close to the herbaceous taxa, indicating that birch was either more typical of open conditions or that *Betula* was mainly derived from the increased representation of the extra-local or regional pollen signal following the demise of the previously dominant arboreal species. The damp, open nature of this woodland is reflected by the presence of the tall herbs, *Filipendula* and Apiaceae and *Succisa*. Poaceae, *Plantago major/media*, Ranunculaceae and Asteroideae/Cardueae appear in a group in the middle left of the plot. This suggests a differentiation between 'sweeter' grassland habitats and more acid communities implied by the grouping of species such as *Calluna*, Ericales and Rubiaceae in the lower left corner of the diagram.

Sample plot

The close similarity between the pollen spectra of the two monoliths is shown in Figure 5.4. (monolith A - solid triangles; monolith C - open triangles). The four pollen zones derived with the aid of CONISS are shown by the direction of the triangles in the key on Figure 5.4. The samples from RTNc1 and RTNa1 - the lowest zones from both the monolith diagrams - appear in the far right hand corner of the diagram, indicating the similarity of the pollen spectra in these zones. The two uppermost zones (RTNa4 and RTNc4) appear on the left of this group. The interim zones tend to be distributed as a continuum on the centre left of the plot.

5.3 Correlation of the Rough Tor pollen diagrams

Utilising the radiocarbon dates, CONISS zonings and sample ordination plots, it is possible to suggest a correlation of the pollen diagrams from Rough Tor north and south (Table 5.1). The radiocarbon dates show that the Rough Tor south core

- the longest sequence from this part of the moor - covers a greater temporal depth than either of the monoliths from Rough Tor north.

The ordination plots suggest that in terms of the similarities in vegetational composition, the monolith pollen sequences are closest to the latter two zones of the Rough Tor south core. The radiocarbon dates confirm that the monolith diagrams begin slightly before the palynological record at Rough Tor south ceases and therefore include information about the later phases of landscape development that are absent from the Rough Tor south site.

The radiocarbon dates show that the two monoliths from Rough Tor north cover approximately the same length of time. The sample ordination plots suggest that RTNa1 corresponds to RTNc1 (acknowledging the difference in dates, discussed above). RTNa2 is believed to correspond to RTNc3, but there is a gradation either side of this into RTNa3 and RTNc2. The results indicate the close similarity of these pollen zones, allowing for the spatial variation in plant communities and differences in pollen spectra arising from variations in sediment accumulation rates and/or random differences between the two monoliths.

<table>
<tr><th>Rough Tor South</th><th>Rough Tor North
Monolith A</th><th>Rough Tor North
Monolith C</th></tr>
<tr><td rowspan="4"></td><td>RTNa4
Poaceae-Cyperaceae</td><td>RTNc4
Poaceae-Cyperaceae</td></tr>
<tr><td>RTNa3
Poaceae-C.nigra-herbs</td><td rowspan="2">RTNc3
Poaceae-Calluna-herbs</td></tr>
<tr><td rowspan="2">RTNa2
Poaceae-Lactuceae
indet.-herbs
20BC-AD265 & AD290-320</td></tr>
<tr><td>AD45-380
RTNc2
Poaceae</td></tr>
<tr><td>RTS4
Corylus avellana-
Alnus-herbs
AD240-440</td><td>RTNa1
Corylus avellana-
Alnus</td><td>780-385BC
RTNc1
Alnus-Corylus
avellana</td></tr>
<tr><td>RTS3
Poaceae-herbs
1690-1440BC</td><td colspan="2" rowspan="3"></td></tr>
<tr><td>RTS2
Poaceae-Corylus
avellana-Alnus
3700-3340BC</td></tr>
<tr><td>(7580-9100BC)
RTS1
Corylus avellana-
Betula-Quercus
(5050-4720BC)</td></tr>
</table>

Table 5.1: Correlation of Rough Tor South and Rough Tor North pollen diagrams. Dashed line indicates correlation is uncertain. Calibrated radiocarbon dates are included. Brackets indicate that the dates may be in error.

It is difficult to correlate the Rough Tor Marsh core with the sequence of environmental change recorded by the sequence from Rough Tor south. This is due to the fact that the marsh is spatially isolated from the location of anthropogenic activity and has a wider pollen source area than the smaller deposits at Rough Tor itself. Although there is evidence of human activity in the Rough Tor marsh sequence, there is no way to identify the location of this clearance in the landscape due to the size of the pollen source area of the marsh. The clearance of hazel in RTC2 may correspond with the clearance of hazel in RTS2, but may also represent disturbance to the vegetation in another locality in the pollen catchment of the marsh. As the archaeological sequences demonstrate that human interest began around Rough Tor itself, it may have been some time before clearance spread to the slopes around Rough Tor Marsh, producing a spatial and temporal disparity in the representation of both woodland and clearance indicators in the pollen record from this site (cf. Edwards, 1979). The marsh sequence is therefore inadequate for characterising the effects of activity represented by the archaeological sequences at Rough Tor and will not be utilised to describe the human-environment relations in this part of the moor.

5.4 Integrating palaeoenvironmental and archaeological data at Rough Tor - problems and potential

The palynological sequences from Rough Tor north and south provide extensive data on the nature and timing of environmental change during the Holocene. The proximity of the sampling site to the field archaeology enables the vegetational changes documented in the palaeoecological record to be compared to the cultural changes interpreted from the various phases of prehistoric settlement in the Rough Tor area and used to create the model of human-environment relations in Chapter 3 (section 3.8). This exercise must be approached with the following *caveats*:

i) no excavation has been carried out at Rough Tor. The dating of the archaeological sequences therefore remain conjectural. There is the danger of relying on the present interpretations of the field archaeology in this part of Bodmin Moor (Johnson & Rose, 1994) to explain observed changes in the palaeoecological record, leading to a circularity of argument;

ii) the selective nature of cultural landscape preservation means that the early phases of settlement may be obliterated by later activity. This means that clearance phases in the palynological record may not correspond with the extant archaeological systems at Rough Tor. In other words, the period of maximum activity observed in the *palaeoecological record* may not necessarily correlate with the period of maximum activity as interpreted from the *archaeological record.*

The integration of archaeology and palaeoenvironment attempted below is intended to act as a working model, to be modified as and when further data, either palaeoecological or archaeological, become available. This can then be compared and contrasted with the model proposed in Chapter 3. The potential sources of error listed above are acknowledged, but remain insurmountable in the absence of archaeological excavation.

The radiocarbon dates for the Rough Tor south core covers a greater temporal depth than the Rough Tor north monoliths and the discussion of the relationship of human impacts to archaeological sequences therefore begins with this diagram. The basal date of 5945±65BP (OxA-6011) for this sequence is anomalous. If the date for the opening of RTS2 (8410±90BP) is regarded as correct and not too old, then a date of *c.*10 000BP might be assumed for the base of the core, although the woody components of the vegetation are better established than would be expected in the light of Brown's (1977) Lateglacial/early Holocene pollen diagrams.

Evidence for Mesolithic disturbance - RTS1:

The pollen curves during RTS1 portray a little disturbed environment. Hazel scrub is the dominant habitat and probably formed a dense layer on the hillsides in this part of the moor. Birch and oak are present as part of the local woodland, although probably more widespread at lower altitudes and may have formed extensive stands on the lower slopes around the wide basin between Rough Tor, Brown Willy and Louden Hill.

The suggestion was (section 4.14) that the brief increases in these light-demanding taxa at 260 and 240cm resulted from small-scale clearance(s) in the local shrub/woodland. In the first case, this affected hazel and in the second, both oak and hazel populations. The extent of impact cannot have been too great at this time, as the spread of herbs is not sustained and the woody taxa are able to regenerate.

These disturbances are not sufficiently extensive to indicate permanent local settlement but may be a product of early human disturbance. Gatherer-hunter activity in this area is attested by the probable Mesolithic flint scatters from locations within a few hundred metres of the Rough Tor south sampling site, including Louden Hill (SX1419 7979) and Brown Willy west (SX1543 7911) and further afield at Brown Willy east. These flint scatters are assumed to represent short-term, or in some cases, home-base camps, which may have been returned to on a regular or periodic basis by the gatherer-hunter groups that created them (Herring & Lewis, 1992). The disturbance to the local environment by these camps must have been only very slight.

The possible disturbances to the woodlands in RTS1 may therefore be the result of the activities of small bands of early gatherer-hunter communities, creating or maybe extending small openings in the vegetation for the short-term camps that are witnessed by the flint scatters in this part of the moor. In this period, the

communities may have used the moor seasonally as part of a cyclical movement through central eastern Cornwall (Herring & Lewis, 1992: 11).

The Neolithic-Mesolithic transition: The Louden long cairn, the Rough Tor enclosure and early pastoral activity at Rough Tor south

The earliest archaeological monument on the Rough Tor moors is thought to be the Louden long cairn, which is situated less than 250 metres north-west and uphill of the Rough Tor south sampling site. Excavations of long cairns elsewhere in the country have shown they are of Neolithic date, and are repositories for multiple burials (see Chapter 3 section 3.3). Todd (1987) suggested that these collective tombs represented ancestral claims to parts of the upland that were used as communal grazing and may reflect territorial division of the uplands from an early date (Rose, in press). These 'uncertainly settled' groups may not have lived on the moors, but perhaps used the uplands for the seasonal grazing of their flocks (Herring & Lewis, 1992:12). No archaeological data exist to back up these assertions. The Rough Tor enclosure is also undated but a Neolithic date for this structure is also thought possible (see Chapter 3 section 3.3).

The clearance of hazel and resulting spread of grassland in RTS2 may initially be a result of natural factors and human induced disturbance may not begin until later in the zone. Presumably, the landscape was being opened up as part of the more intensive expolitation of the uplands envisaged by Mercer (1986) following the increase in population at the end of the Mesolithic. The construction of the long cairn may occur later in the upper half of RTS2, when the human community that laid claim to this part of the upland had been grazing their animals on this part of the moor for several hundred years. Use of the uplands for seasonal grazing may be seen as consistent with the palynological evidence, as the levels of anthropogenic indicators and microscopic charcoal are not felt to be sufficient to indicate a permanent human presence in this period. The appearance of *Plantago lanceolata* at 190cm is undated, but a date of 4710±80BP (OxA-6009) is available

for 175cm. This is calibrated to 3700-3340cal.BC, indicating a Neolithic date. The beginning of human activity at Rough Tor south may therefore be tentatively assigned to the earliest Neolithic.

The persistence of trees and shrubs suggests that there was not yet intensive exploitation of the area. This is consistent with projected population levels and the magnitude and character of landuse for the Neolithic on Bodmin Moor, which points to unintensive use of the uplands (D.Hooley, pers.comm.). There is possible evidence at the top of RTS2-opening of RTS3 for a slackening of pressure on the land-resource toward the close of this period or a shift in the location of human activity away from the sampling site. Although this is not dated, it occurs approximately mid-way between the dates of 4710±80BP (1690-1440cal.BC) at 175cm and 3275±50BP (3700-3340cal.BC) at 150cm suggesting that it belongs roughly in the mid-second millennium (cal.) BC and probably therefore the latest Neolithic.

The re-appearance of a continuous *Plantago lanceolata* curve at the opening of RTS3 indicates continuing creation of grassy areas and the spread of herbs typical of grazed areas. The increases in alder and hazel are not matched by recovery in oak or birch, both of which remain at low levels across this zone. This may mean that tree and shrub regeneration was limited to marginal parts of the landscape, such as lower lying areas with damper soils and more exposed areas with thinner soil cover, which favoured alder and hazel growth. If this is the case, then this is further evidence that both human activity and grazing pressure were comparatively light, since there was no need to resort to the exploitation of these marginal soils.

The Rough Tor enclosure may belong to a later phase of the Neolithic than the long cairn and possibly replaced the Louden cairn as the focus of activity in this part of the moor (Johnson & Rose, 1994), although this assertion is based solely on the similarities between this site and the excavated site of Carn Brea (Mercer,

1981). The possibility that the clearance activity at Rough Tor south corresponds to a period of activity that led to the development of the Rough Tor enclosure cannot be either proved or disproved. Without direct dating evidence from both of these monuments, there is no way of separating the two events in the palaeoenvironmental record, assuming that an early date for both long cairn and enclosure is correct. The first appearance of *P.lanceolata* in RTS2 may be best interpreted as the opening of the period that led to the construction of the long cairn, considering the proximity of this feature to the sampling site and the probability that the site where the cairn was constructed was under dense hazel cover similar to that at the sampling site.

The vegetation on the summit of Rough Tor might have been fairly open grass/heather communities and its construction may not be expected to be clearly represented in the pollen record. The presence of hut platforms has been interpreted as showing that this structure belongs in an earlier, rather than later, phase of settlement:

> "The presence of very many hut stances for wooden structures suggests that large amounts of timber were easily available in the vicinity." (Johnson & Rose, 1994:48)

Without excavation to confirm this, there are no unambiguous clues in the palaeoenvironmental record as to the period in which the enclosure was constructed. As was demonstrated by the palaeoecological investigations at Rough Tor north, areas of woodland remained in the later prehistoric period. If the platforms in the enclosure were for wooden structures, then they could equally have been constructed in a later rather than earlier period.

Bronze Age Activity at Rough Tor

RTS3/RTS4 is thought to represent the period of major local activity at Rough Tor south. After recovering at the close of the previous zone, tree and shrub pollen

percentages fall. This zone therefore sees the almost complete demise of trees and shrubs. Grassy pasture land has become established, facilitating the increased flowering and pollen dispersal of ribwort plantain and other low growing herbaceous species. The date of 3275±50BP (1690-1440cal.BC) at 150cm indicates that this occurred in the Bronze Age. The extent of the changes in the palynological record makes it reasonable to infer that the first local hut and field settlements were established in this period. Hut circles are situated within 200 metres of the sampling site and the extension of open land witnessed by the increase in grass pollen and the increase in charcoal in this zone suggests that local anthropogenic activity increased to reach a peak.

There are a large number of huts and fields of presumed Bronze Age date within an area of around one square kilometre of the Rough Tor south sampling site. These farms represent the maximum extent of prehistoric settlement, and must have been established over a number of centuries. Barnett (1982) described the field archaeology in this part of the moor as indicating that the landscape was "filling up in a gradual but informal manner"; a description that would seem to summarise the palaeoecological evidence of human impact. Johnson & Rose (1994) point out that huts in this part of the moor, especially the larger ones, would have required substantial numbers of roof timbers, as well as large areas of thatch. The impact of a sizable settlement of huts on the local woodland resource would have been considerable.

There is no evidence of the cultivation of cereals in this period, either in the form of cereal pollen, or the pollen of weeds of cultivated land. Absence of proof is not proof of absence, particularly where the detection of cultivation in the palynological record is concerned. The closest field that bears evidence of cultivation in the form of lynchets is at Rough Tor north, over 500m away (see Chapter 3 section 3.4) and due to the poor dispersal of cereal pollen, any crops grown in these fields would not be expected to register in the pollen record at

Rough Tor south. The possibility that some crops were grown locally cannot be discounted, but a predominantly pastoral landscape is portrayed, at least in the proximity of the Rough Tor south sampling site.

There is no way to identify in which zone the construction of the ritual monuments at Rough Tor belong, but a few general observations are possible. The majority of the cairns in the area, both funerary and clearance cairns, probably belong in RTS3, the period of maximum settlement activity. One of the few other radiocarbon dates available for the Rough Tor Moors is that from charcoal from the excavation of a cairn on Stannon Down: this produced a date of 3440±70BP (HAR-5130) (Harris *et al.*, 1984). No radiocarbon dates were produced by Mercer's (1970) excavations at Stannon although pottery discovered during the excavations was assigned to the mid-Bronze Age (*c.*3400BP). These dates and that of 3275±50BP (OxA-6008) for RTS3 implies that the fourth millenium BP was a period of significant clearance and settlement activity in the Rough Tor area.

The end of settlement at Rough Tor south

There was apparently a decline in local activity towards the top of RTS4, leading to the regeneration of hazel and alder shortly after, at the expense of grassland. There is no interruption to the *P.lanceolata* or *Potentilla* curve in this zone, suggesting that open areas were maintained both near to the sampling site and on the drier areas of the local environment. However, that *Corylus avellana*-type is able to recover suggests a major hiatus in the extent of local anthropogenic activity. The fall in charcoal concentrations at the opening of this zone, indicating reduced fire frequency, would seem to reinforce the impression of much reduced human activity.

The end of the Bronze Age (*c.*2500BP) is usually assumed to be the close of large scale settlement activity on the south-western uplands:

"Since the Neolithic, the economic progress of south-western communities had been steady. Now came interruption, probably recession..." (Todd, 1987: 151).

Little archaeological data exist to support this but the climatic deterioration that appears to mark the end of the Bronze Age on the other uplands of Britain is thought to be the major factor in the abandonment of settlement (Bell, 1984), although there is little palaeoenvironmental data to support this assertion.

The opening of RTS4 appears to mark the cessation of local activity, allowing some regeneration of the previously dominant hazel cover of the area. This is dated to 1675±45BP (ADcal.240-440) pointing to tree and shrub regeneration during the Romano-British period. This is clearly much later than the supposed Bronze Age abandonment of the moors, although identifying the precise level at which abandoment of local settlement begun is not possible. It may have begun slightly earlier around 120cm, the point at which *Corylus* first begins to recover. If this is the case, then the date for the first reductions in human activity may belong to the later Bronze Age.

There is no clear evidence in the palynological record to implicate climatic deterioration as a factor in the decline of local settlement. The increase in *Alnus* may be related to wetter conditions and the spread of *Calluna* to soil deterioration, but these events occur apparently well after the end of permanent local settlement.

Whether or not climatic factors played a role in the abandonment of the settlements at Rough Tor, continuing use of the moors is attested by the persistence of *Plantago lanceolata* and other herbs as part of the ground flora. This was probably in the form of the intermittent grazing of animals on the damp, meadow-like vegetation, allowing some patches of tree and shrub cover to become re-established. The presence of a number of rough structures on the Rough Tor moors, which have been interpreted as post-prehistoric transhumance huts, provides support for use of the uplands as rough pasture during the summer months as part

of a system that has probably been maintained through the historic period, until the present day (Johnson & Rose, 1994).

Later activity at Rough Tor: the monolith records

The discussion now shifts to the Rough Tor north monoliths, due to the absence of a record from the top 90cm of the Rough Tor south sequence. The monolith sequences apparently begin just before the close of the diagram from the former location. No date is yet available for the base of monolith C, but the palaeoecological record at this site begins prior to 2430±60BP (Beta-78542). Although in broad detail the environmental changes may have been similar at Rough Tor south and north, there was almost certainly a degree of local variation.

The evidence of clearance activity between 780-385cal.BC suggests anthropogenic disturbance of the vegetation in the late Bronze Age or Iron Age periods and therefore covers the period when it is usually assumed that abandonment of the Cornish uplands was largely complete (Todd, 1987). However, as Christie (1986) has pointed out, continuing activity on Bodmin Moor is possible. The hazel/alder woodland recorded in RTNa1 and RTNc1 probably represents the wood/shrubland that had regenerated following the abandonment of local settlement at the end of earlier Bronze age occupation in the area and may even be part of the increasing area of woodland that is recorded in the lower half of RTS4.

The palynological evidence indicates renewed intensification of landuse in the Rough Tor moors in the Iron Age and Romano-British periods. This clearance may have been for a number of reasons including farming, settlement and/or for the exploitation of wood for construction or other economic purposes. Without excavation, the possibility that the construction of some of the huts at Rough Tor north occurred during this later period cannot be discounted, although it seems unlikely that the majority of the huts at Rough Tor were actually built at this time. The dating evidence from the morphologically similar settlements at nearby

Stannon implies a Neolithic date for the earliest phases (Mercer, 1970) and the relationship of the settlements at Rough Tor north to Bronze Age ritual monuments suggests the majority of the structures at Rough Tor have their genesis in the earlier rather than later prehistoric periods and as was pointed out above, many, if not the majority of them, probably correspond to a similar phase of the settlement to that evidenced by the clearances at Rough Tor south in RTS2-3.

This anthropogenic activity led to the development of vegetation typical of a meadow during the Romano-British period (ADcal.45-380). As suggested above (Chapter 4 section 4.20), the likelihood is that the palynological episodes that both dates refer to in RTNa2/RTNc2 are the same event. The picture at Rough Tor south is slightly different during this period. Woodland seems to have been spreading around ADcal.240-440, although the maintenance of a *Plantago lanceolata* curve and record of *Centaurea nigra* at this location indicates that meadow and pasture land was present within the pollen catchment of the site. Grazing must have been of a fairly low intensity to permit the re-establishment of trees and shrubs in some parts of the landscape.

Although the general picture for Bodmin Moor and the south-western uplands in general is that settlement had retreated from the uplands by the Romano-British period (Todd, 1987), there is archaeological evidence that interest in the higher moorland, probably as a grazing resource, continued into the Romano-British period in the Rough Tor area (Johnson & Rose, 1994). An excavated settlement at Garrow yielded second century AD pottery (Silvester, 1979) and appears to represent permanent settlement in the first millennium BC (see Chapter 4). It is tempting to relate the evidence for second century activity at Garrow to a similar phase of settlement in the Rough Tor area that is associated with the clearance activity demonstrated in the monolith diagrams.

Closer to the study area, a sub-rectangular hut at Rough Tor south (see Chapter

4) and an elongated hut at Stannon have been described as having no obvious local parallel and this may also represent settlement in the first millennium BC (Johnson & Rose, 1994). Other field evidence demonstrating a later interest has been identified, including a group of small huts at Louden that overlay one of the large block boundaries and that are laid out like strings of beads (Figure 4.1). Johnson & Rose (1994) suggest that the lay-out of these huts implies they were intended to overlook an area of communal grazing.

On the basis of the pollen data, it is unlikely that the clearance in RTNa2 and RTNc2 was for permanent local settlement. The meadow flora indicates some form of active management and therefore at least semi-permanent or seasonal occupation rather than periodic grazing. The final clear phase of re-organisation in this part of the moor appears to be the division of the landscape into blocks by the extensive boundary works (Chapter 3, Figure 3.5). Whether this is the event-horizon witnessed as the clearance in the palaeoecological record is a matter of conjecture, although if this is the case, then this would place the construction of these boundaries in a very much later period than the Dartmoor reaves with which the Rough Tor boundaries are often compared (see Chapter 3 section 3.6). The boundaries may also be linked with the possible Romano-British structure at Stannon south, although this is thought unlikely as the boundaries would have required a considerable investment of labour (Johnson & Rose, 1994:72).

As was stressed above (section 5.4), there is an obvious danger of a circularity of argument from relying on unexcavated archaeological sequences to explain observed palaeoecological events. The palaeoecological evidence for clearance is nevertheless interpreted here as relating to the use of the Rough Tor moors for seasonal grazing and possibly for hay production in the first millennium BC through into the first millennium AD. The evidence for the spread of grassland in RTNc3 and RTNa2/3 suggests that this interest continued into what must have been well into the historical period. These conclusions would appear to support

Johnson & Rose (1994:76) in their tentative interpretation of the archaeological field evidence that

"...in broad outline the pattern of settlement, and perhaps its economic base, may have been similar at the end of the first millennium BC and a thousand years later."

Why renewed activity on the uplands should commence in the later prehistoric period, following what seems to have been abandonment of the moorland leading to the regeneration of tree and shrub cover, is unclear. The role of population increase forcing the greater utilisation of the higher tracts of moorland is one possible factor. The population of Roman-Britain as a whole is thought to rise dramatically after the second century AD (Salway, 1981:554) and although it is unclear to what extent this affected the south-west, the renewed activity on the Rough Tor moors may be related to the effects of such an expansion on the local land resource. There is extensive evidence for Iron Age activity around the fringes of the moor (Silvester, 1979; Johnson & Rose, 1994) and this must have involved the seasonal exploitation of the moor for grazing of cattle.

This pastoral activity must have continued well into the historical period. There is documentary evidence for use of the Rough Tor moors for grazing in the 13th century: Maclean (1873:355) related that in 1288:

"Henry Cauvel took out a writ of disseizin against Hugh Peverell and David Wof of common pasture in Hamathethy, which he claimed as pertaining to his free tenement in Lauden [Louden]. Henry did not appear and judgement was given for Hugh and David."

Henry may have been claiming grazing rights on Rough Tor (Johnson & Rose, 1994). The higher tracts of moorland evidently remained important components of the local subsistence economy at this time.

It seems likely that the transition to a species-poor grassland with evidence of

cereal cultivation in RTNc3/4 and RTNa4 corresponds to the medieval settlement of the Rough Tor moors. The extensive settlement at Brown Willy and the existence of areas of ridge and furrow at Rough Tor north testify to the colonisation of substantial areas of this part of the moor at some time between the 11th to 14th centuries (Johnson & Rose, 1994). The monolith C sampling site lies very close to the medieval tenement boundary of Louden. The medieval intensification in landuse, that would have included both increased grazing, as well as local cultivation, would have resulted in increased pressure on the vegetation and soils of the area. The decline in species diversity at RTNc4 and increase in the area of grassland probably resulted from increased grazing pressure. The record of cereal pollen at 25cm at monolith C may relate to the local ridge and furrow cultivation, an area of which is evident some 50m to the east of monolith A and 500m to the north-east of monolith C (Figure 4.1). Considering that the likely source areas for a depositional location of the extent of monoliths A and C are probably quite small and the limited dispersal capacities of cereal pollen (Hall, 1988; Behre, 1981; Vuorela, 1970), a local rather than an extra-local source for the cereal pollen is considered most likely

The correlation between the precise timing of local settlement and farming activity recorded in RTNa3/4 and RTNc3/4 is unclear. Only one cereal pollen grain was recorded at RTNa3, at 60 cm, although monolith A is closer to the ridge and furrow on Louden hill than monolith C and any cultivation at this location would therefore be expected to be best represented at the former site. Either the diagrams are recording different cultivation episodes, or the main episode of cultivation recorded in RTNc3 falls between the sampled levels of monolith A. Other anthropogenic indicators remain steady at 60cm in RTNa3, with an increase in *Plantago lanceolata* occurring in the above level. There is no comparable increase in *P.lanceolata* recorded in RTNc4 suggesting that this was a local change in the ground flora. How this relates to specific changes in landuse and settlement at Rough Tor north is uncertain. The peak in charcoal at the close of RTNc3 may

relate to the increased domestic burning that accompanied the expansion of local settlement. If this is the case, it is unrecorded at monolith A as charcoal levels fall at the close of RTNa3 and opening of RTNa4. This may be due to the influence of localised factors on charcoal dispersion and deposition.

5.5 Testing the model

The palynological record

A tentative model of human impact and environmental change was put forward in Chapter 3, based on the archaeological interpretations of the extant field data. This model can now be tested against the results of the palaeoenvironmental investigations at Rough Tor. Table 5.2 compares the predictions of the model to the results of the pollen analytical sequences from Rough Tor south and north.

In Chapter 3, the Mesolithic period was predicted to have been characterised by high arboreal pollen percentages with little evidence of open or anthropogenically disturbed ground. The palaeoecological record confirms this, at least as far as the Rough Tor south area is concerned. There is unequivocal evidence to point to small-scale disturbances to the woodland. Overall, this seems to suppport archaeological assertions that exploitation of the moor by gatherer-hunter communities was occasional and of low intensity (Herring & Lewis, 1992); although this is based on the results of the analysis of a single sequence.

The Neolithic period is seen to be the earliest phase of settlement at Rough Tor and the model envisaged evidence of human clearance of tree and shrub cover to be apparent in the form of falling AP and increasing NAP, although any increases in heliophytes were predicted to be intermittent. These predictions are in agreement with the palaeoecological record. The greater number of the archaeological sequences on the Rough Tor moors are thought to belong to the Bronze Age and this period was therefore projected to have the maximum evidence of impact. Again, these assertions appear to be met in part by the palynological data. However, there is no evidence of the cultivation possibly taking place at this time and activity in the Iron Age/Romano-British period is more intensive.

Period/ yrs. BP appx.	Postulated impact/land-use	Predicted evidence of impact in palaeo-record	Observed evidence of impact in palaeo-record
Medieval 1000 -	High impact. Clearance of any remaining tree/shrub cover. Pastoral and arable farming.	Final fall in AP and increases in grass and other NAP esp. pastoral indicators. Cereal pollen possible. *Charcoal*: increases in micro	Reductions in tree and shrubs. Demise of meadow and spread of acid grassland. Cereal pollen recorded. *Charcoal*: Increase in micro. Macro- absent
Romano-British Iron Age	Low. Unintensive pastoral activity possible.	Some recovery in AP possible. Increase in heath and grassland. *Charcoal*: fall in micro and macro levels	Recovery in AP followed by clearance of tree and shrub. Spread of meadow. *Charcoal*: micro-increasing across period Macro- absent
Bronze Age 4000 -	'High tide' of upland settlement. Landscape opened up. Cultivation ? and pastoral activity. Pastoral emphasis dominant in later phases	Marked fall in AP. AI increasing to max.levels. High species diversity. *Charcoal*: high macro- and micro.	Fall in AP. Spread of grassland and increase in AI. *Charcoal*: increase in micro-, macro- absent
Neolithic 6000-	Low. Transhumance/early activity. Limited clearance and exploitation of local resources	Falling AP and some increases in NAP. Increase in diversity. Evidence of grassland. AI low but increasing. *Charcoal*: low macro-and micro.	Reductions in AP (*Quercus-Betula*) Persistence of *Corylus* and spread of *Alnus*. Grassland. AI low and sporadic. Hiatus in activity possible later in period. *Charcoal*: micro-increasing. Macro-absent.
8000 + *Mesolithic*	Very low. Possible small scale, temporary breaks in tree/shrub cover.	Natural sequence of tree migration. High AP low NAP. Low diversity. AI absent or sporadic. *Charcoal*: low micro- and macro-absent.	Dense *Corylus* scrub with *Quercus-Betula* woodland. Little open ground. AI absent. Any impacts small scale and temporary. *Charcoal:* low micro-, macro-.

Table 5.2: Summary of expected and observed evidence of human impact in the palaeoenvironmental record from Rough Tor.

The predominantly pastoral basis envisaged for farming in both the Neolithic and Bronze Age is confirmed by the suite of ruderal pollen present, although the increase in diversity in the pollen record suggested in Chapter 3 is less marked than was predicted, given the proximity of the sampling site to the archaeological sequences.

The only significant diversion from the character and extent of environmental changes modelled from the archaeological data is in the later prehistoric period. This is thought to be a period of abandonment following the 'high tide' of upland settlement in the Bronze Age and reduced activity on Bodmin Moor, although continuing use of the uplands for grazing is thought likely. The model therefore envisaged increasing evidence of heather and heath communities as likely in this period, with limited tree and shrub regeneration possible. The palaeoecological data suggest that although there was a brief abandonment leading to an increase in tree and shrub populations, probably in the later Bronze Age, there was renewed clearance in the Iron Age/Romano-British periods. This activity was quite probably to extend the area available for pasture, indicating renewed interest in the upland land-resource at this time.

The view of widespread abandonment of the uplands at the end of the Bronze Age, followed by little activity until the medieval period, may therefore be an over-simplification of the existing archaeological evidence in the Rough Tor area. The implications of this for the status of the possible Iron Age/Romano-British structures and possibly also the block boundaries at Stannon and Rough Tor to local settlement patterns on the Rough Tor moors appear to need some revision and may be more significant in terms of the development of the cultural landscape than they are presently given credit for. The colonisation of the moorland witnessed by the extensive medieval field systems and envisaged as being represented by the final spread of acid grassland is confirmed by the monolith

sequences. The record of cereal pollen that was predicted is also present.

The charcoal record

The model predicted that the record of microscopic charcoal would increase roughly in line with palynological evidence of human impact. This is generally the case, with fire frequencies low in the early phases of settlement and peaking during the period of maximum local activity. This trend changes slightly in the early historic-medieval period with the palynological evidence of the medieval colonisation of the moor accompanied by an increase in microscopic charcoal at the monolith C site but apparently not at monolith A.

The most significant difference between the model and the results is in the representation of macroscopic charcoal. Following considerations of charcoal taphonomy, it was predicted that local settlement should produce enhanced levels of macroscopic charcoal. In fact, no macroscopic fragments were encountered, apart from a single record in the monolith B sequence, which has been discounted as being possibly unreliable. This serves to underline the difficulties behind the use of charcoal in palaeoenvironmental reconstruction. There must have been local burning that produced this size class of charcoal, but through taphonomic processes or sampling bias, this was not preserved in the sediment samples from Rough Tor.

5.6 Summary

This chapter has described the analysis of the Rough Tor south and Rough Tor north pollen records. The diagrams have been correlated and the relationship between the archaeological record and the palaeoecological data have been put forward. The Rough Tor south core is thought to cover a greater span of time than the monoliths from Rough Tor north, although the monoliths contain evidence of later landscape change that is absent from the longer sequence. The modelled

observed aspects of the palaeoecological data have been compared and discussed. Evidence of earlier prehistoric activity (Mesolithic-Bronze Age) in the palaeoecological record seems to correspond in form and intensity to that suggested by the archaeological record. The next chapter introduces the second area investigated - the East Moor.

Chapter Six:
The East Moor - Archaeology, Settlement History and the Palaeoecological Record

6.1 Introduction

The first part of this chapter describes the reasons for the selection of the East Moor for palaeoenvironmental research. This is followed by a description of the physical environment of the East Moor and the archaeological sequences found on this part of Bodmin Moor. Following this, a series of hypotheses are formulated concerning:

i) the nature of the palaeovegetation that would be expected to be present in each location prior to human interference;
ii) the character and extent of anthropogenic impact that would be anticipated from the palaeoecological record.

The first will be based on the previous palaeoenvironmental investigations at Rough Tor, whilst the second will be derived from interpretation of the archaeological data.

6.2 Selection of sites for palaeoenvironmental research on the East Moor

The East Moor was the second area chosen for further palaeoenvironmental investigation on Bodmin Moor. There were two main reasons behind this selection:

i) the importance of examining the palaeoenvironmental history of a part of the moor that was different in both physical environment and in archaeological remains from Rough Tor;

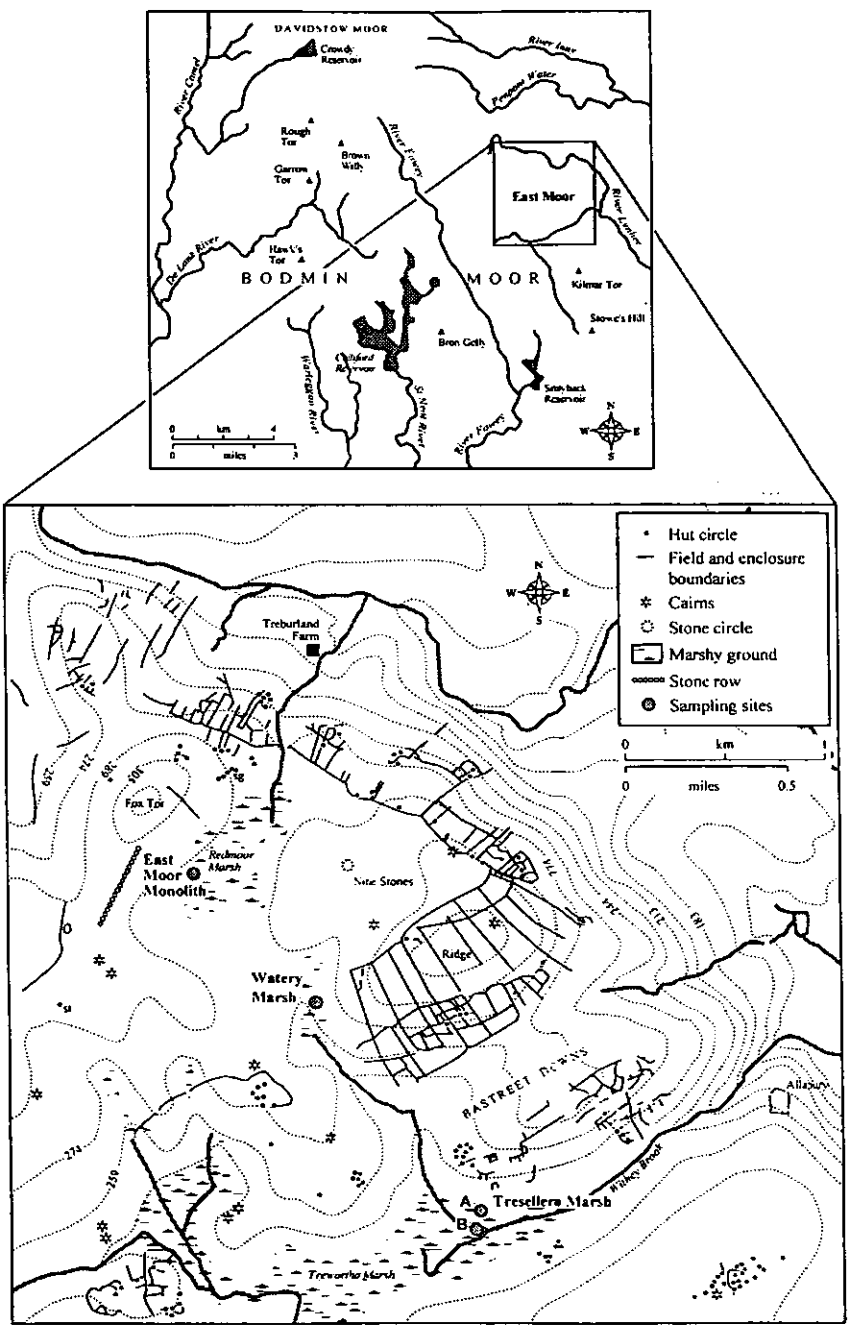
ii) the availability of deposits. Other areas of the moor had interesting archaeological sequences but were lacking in any suitable palaeoenvironmental repositories (see Chapter 2 section 2.4).

The East Moor was selected due to the excellent preservation of the archaeology, that over the last few years has been the subject of extensive survey and interpretational work by English Heritage. Field reconnaissance located several potential sampling sites. Redmoor Marsh in the middle of the East Moor has been streamed for tin and test coring revealed that the sediments had been disturbed and would probably be unsuitable for an unbroken sequence. Other deposits, such as a small soligenous deposit on the eastern edge of the moor were too shallow to be of great use.

Three suitable sites were located - Tresellern Marsh, Watery Marsh and a deposit on the northern edge of Redmoor Marsh (East Moor monolith) (Figure 6.1). These sites lie along a 2.5 km transect that stretches from Tresellern Marsh in the south-east to East Moor I in the north-west. The sampling locations represent a range of depositional basins across an altitudinal range of some 50m, over a horizontal distance of 2.5 km.

The dynamics of this environmental gradient between the upland slopes and valley bottom during the Holocene can be examined. The relation of the sampling sites to the archaeological sequences in this part of the moor and the variations in environmental change revealed in the palaeoenvironmental record allowed a detailed reconstruction of the spatial and temporal patterns of human-environment relations across the fossil landscape.

Figure 6.1: The archaeological systems on the East Moor and the East Moor and Withey Brook Valley sampling sites.



6.3 Physical environment of the East Moor

The East Moor of Bodmin may be defined as stretching from the Withey Brook valley in the south to the line of the A30 in the north (Figure 6.1). The area slopes away steeply to the east as a scarp slope. This part of the moor is very different in physical appearance from the Rough Tor Moors. The topography is more gently rounded than the steep, rugged profiles of Brown Willy and Rough Tor and the tors themselves do not dominate the skyline in the same way as those in the north-west. The highest point at 330m OD is that of Ridge (SX243778), whilst the wide expanse of the East Moor plateau (Plate 6.1) is generally over 250m OD and is dominated by Redmoor Marsh.

6.4 Archaeological sequences on the East Moor

The main feature of the archaeology is the East Moor co-axial field system (Figure 6.1). The monument is unusual because it contains

"...a co-axial field system at a relatively low level and running along a valley side, the significance of which is increased by the adjacent survival, preserved by modern field boundaries, of parts of the broadly contemporary Ridge co-axial system on an axis at right angles to that in this monument." (D.Hooley, unpublished report to English Heritage).

Other monuments in this part of Bodmin Moor include the Nine Stones stone circle, a stone row, numerous cairns and extensive medieval field systems.

The East Moor is therefore as rich as the Rough Tor area in terms of the spatial extent of prehistoric remains. However, the field remains are considerably less complex than those found around Rough Tor and do not appear to have the same temporal depth. The morphology of prehistoric land-division and settlement is also different in the latter area. The co-axial system on the East Moor contrasts with

the large scale division of the landscape into blocks that is evident in the Rough Tor-Stannon-Louden area, which has little evidence of fields developing to any great extent within these blocks. The East Moor system does not have such large boundaries and the terminal banks of the system are not usually any larger than the subdividing banks within the fields.

6.5 The East Moor and Ridge co-axial field system

General description

The East Moor co-axial field system (Figure 6.1) is visible for over 2.9km along the north-eastern edge of East Moor, although it is broken in two places by modern enclosure and clearance. The system on Ridge Hill is also part of this prehistoric land division. It takes the form of long strip fields subdivided by parallel walls (the co-axial boundaries), which run up to a transverse boundary that defines the upper end of the system (Plate 6.2). Six roughly contemporary regular aggregate field systems containing 19 stone hut circles, with another nine huts scattered throughout the system, including two in an enclosure at the eastern edge of the monument, are also part of the system. Another enclosure at the northern edge contains six hut platforms. The monument includes four funerary cairns and medieval clearance cairns. Medieval fields, enclosures, extensive areas of ridge and furrow, peat stack platforms and part of a row of parish boundary stones, as well as modern field boundaries to the southern, eastern and north-western edges of the moor, contribute to the cultural palimpsest visible in this part of the moor. The co-axial system has been split into three sections by modern clearance (Figure 6.1). These sections are described separately below. There is also evidence for medieval utilisation of the moor, which is described below, alongside the prehistoric remains. Unless otherwise indicated, the archaeological data in this chapter were obtained from the English Heritage Scheduled Monument Reports.

Plate 6.1: The East Moor plateau looking south-east across Redmoor Marsh towards The Ridge.

Plate 6.2: The terminal boundary of the East Moor co-axial field system looking north.

Treburland Farm and Fox Tor

The Treburland Farm section is the north-western part of the co-axial system and includes a hut circle settlement, an enclosure and four other dispersed huts. A further 17 dispersed huts (Plate 6.3) and a prehistoric stone setting survive on the slopes of Fox Tor. A boundary work crosses Fox Tor from the south-east, defining the extent of the unenclosed huts and another boundary joins this, approaching from the north-east through the settlement. Near to the south-eastern end of the boundary is a medieval settlement (described below).

The modern moor edge hedgebank of Treburland farm and a medieval ditch and bank defines the terminal boundary of the system. The parallel walls that run downslope along a north-east/south-west axis survive up to 1.5m wide and 0.5m high. The area of infill in this section of the system includes at least 15 rectilinear field plots of 0.13-0.5 hectares, which are created by cross-walls running across the co-axial walls at right-angles. Further walls define two prehistoric trackways in the central part of the system, 7.5-15m wide and 130m apart. The south-eastern trackway runs onto the moor from a settlement containing six hut circles, spaced over 0.3 hectares. These walls are betweeen 3.5 to 8.2m in diameter. Two of the smaller huts adjoin the north-east wall of a 17m diameter circular enclosure. The south-eastern part of this system includes another four huts of between 4 to 8m in diameter.

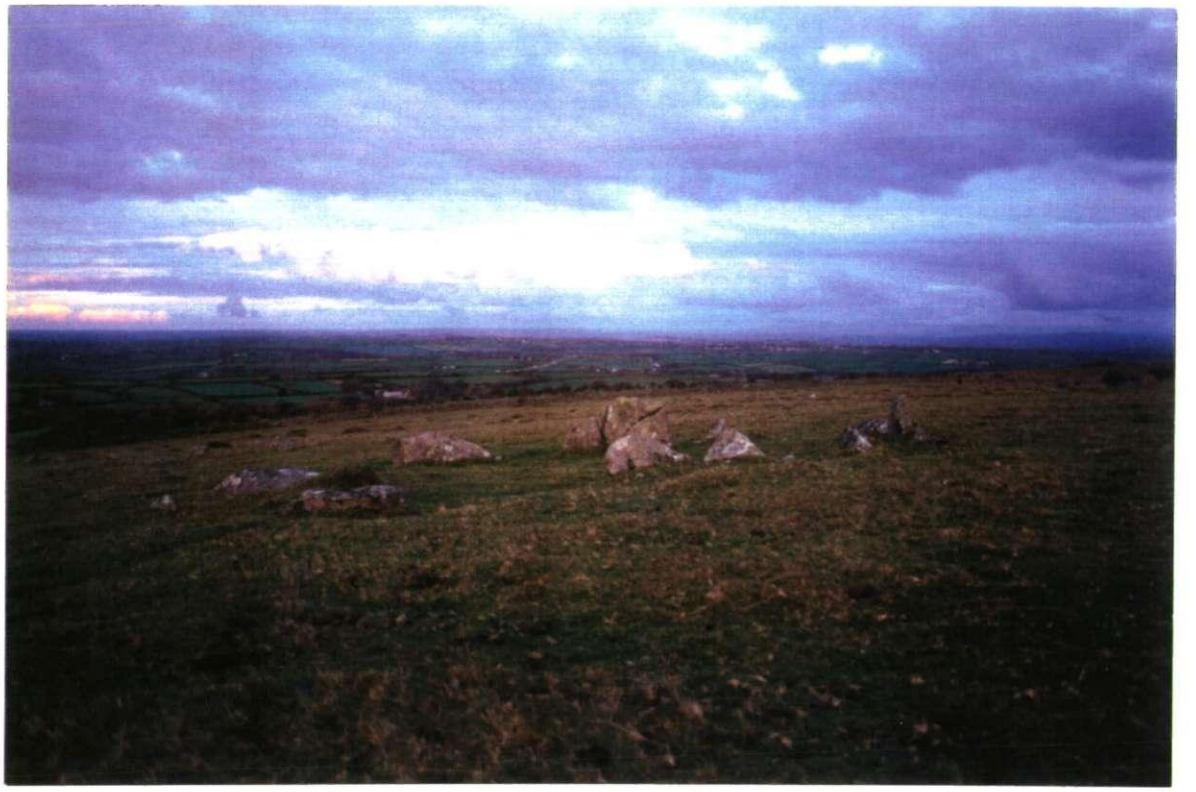
There is another unenclosed hut settlement over 5 hectares on the north-eastern slope of Fox Tor (Figure 6.1). A total of 17 huts between 6 to 30m apart, and of 4.5 to 9m diameter are visible (Plate 6.3), although some have been affected by medieval clearance. Three groups of huts have been recognised:

i) a west-north-west/east-south-east aligned linear group of seven huts over 230m of the NE edge.

ii) a curved line of five hut circles over 140m of the south edge.

iii) a nucleated group of five hut circles on the west edge.

Plate 6.3: One of the unenclosed huts in the settlement on the south-eastern slopes of Fox Tor, looking east.



This last group has rubble walling linking four of the five huts. This walling forms two small plots of 0.01 and 0.03 hectares to the immediate west of the huts. A nearly straight boundary running for 285m in a south-easterly direction from the summit of Fox Tor separates these huts from the contemporary ritual and funerary monuments on Fox Tor and East Moor. The south-eastern end of the boundary has been modified by medieval use, and changes from heaped rubble to a rubble bank in the vicinity of the medieval farm. Another boundary begins 31m below the end of this one, and divides hut groups i) and ii) from group iii): this wall is visible for 243m, after which medieval clearance has disturbed its exact line, although occasional orthostats follow its alignment toward the edge of the moor.

A prehistoric stone setting is situated among group ii). This survives as a slight oval cairn of heaped rubble measuring 7m north-west/south-east and 0.1m high, with peripheral and end-set slabs.

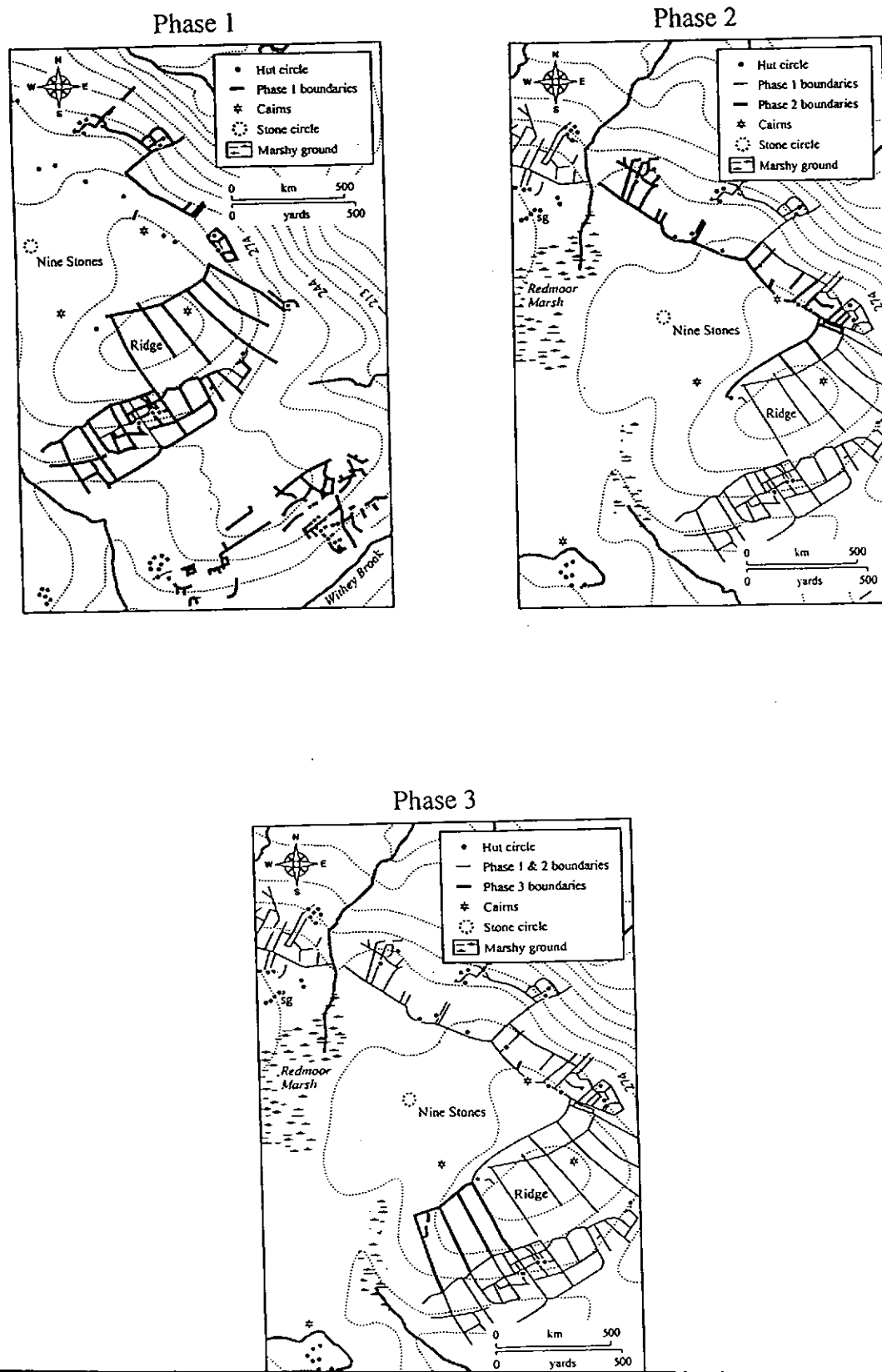
The north-eastern periphery

This includes the eastern 1.7km of the system and is adjoined to the south-west by the Ridge hill part of the system. It is separated from the Treburland Farm section by a break 40m wide at its junction with the moor and widening downslope as part of the clearance for the fields of Treburland farm.

The field system survives as heaped rubble walling up to 2m wide and 0.6m high. The near parallel walls are mostly between 30-80m apart, although they can be up to 150m apart and have a south-west/north-east axis. The terminal boundary follows the north-east crest of the plateau, even though this means it descends west of the crest into the valley that drains Redmoor Marsh.

Staggered wall junctions demonstrate that the system was expanded at some point across and up the hill slope. The field evidence has been interpreted in the following way (Figure 6.2):

Figure 6.2: Suggested phasing of the East Moor and Ridge co-axial field system (see also Figure 6.1). Based partly on English Heritage unpublished scheduled monument data.



i) a co-axial block was laid out in the north-west sector, with a terminal boundary at *c*.275m OD. This was later extended uphill to the crest of the slope at 295-305m OD by a further co-axial block (Phase 1 and 2).

ii) expansion onto the slopes to the south-east by a boundary ending at 290-300m OD, which was later moved to the crest of the slope at 300-312m OD.

The sequence further east is obscured by medieval clearance and post-medieval activity. Excavation by Brisbane & Clewes (1979) of Clitters Cairn and the terminal boundary which abuts onto it showed that the cairn was the earlier feature.

Bastreet Downs

The co-axial system is visible in this part of the moor as near six parallel walls of turf covered rubble up to 1.5m wide and 0.6m high, running for 1.1km east-north-east/west-south-west along the contour of the Downs (Figure 6.1 and Figure 6.2: Phase 1). The uppermost is near the crest of the hill, and the lowest just above the valley floor. The walls are between 50-110m apart in the eastern half of the monument, where part of the walls have been preserved by modern walling. The walls converge slightly to range from 35 to over 78m apart at their western end, where recent clearance disrupts their junction with Tresellern Marsh. Another break in the centre of the Downs is apparent, where dense clitter prevented the second to fourth lowest walls from being constructed.

Two areas of regular aggregate infill are evident. One of these areas is in the south-eastern part of the system, where the lower three co-axial boundaries were linked at intervals of between 50-100m by walling running downslope to form sub-rectangular plots of 0.3 - 0.7 hectares. Further subdivision of the western three plots by walls across and along the contour forms plots of 0.06 - 0.2 hectares. The other area of infill is at the western end of the system, where

subdividing walls between the third and fifth co-axial boundaries from the valley floor create a row of rectangular plots of 0.06 - 0.15 hectares along the west, south and east sides of a large rectangular plot of 0.9 hectares between the fourth and fifth boundaries.

Two hut circle settlements are located within the system (Figure 6.1). One of these is in the sub-divided western part of the south-eastern regular system: six hut circles are present, in the form of two pairs situated 70m apart on the contour, and two single huts 47m north-west and 35m south-east of the western pair. The western pair are in a sub-rectangular plot of 0.04 hectares, whilst the others abut onto field boundaries. The internal diameters of these huts range from 4 to 7.5m in diameter.

The second settlement is north-west of the western end of the system, and is formed of a cluster of eight hut circles over an area of 1 hectare and a ninth 62m to the south-east. These huts range in internal diameter from 6.5 to 10m. Some evidence of walling exists between the huts. Two further huts are situated 72m apart along the contour, near to the upper co-axial boundary and have been partly robbed by recent clearance.

The Ridge Hill system

The relation of the Ridge Hill system to that of the East Moor might find expression in the modern field banks preserving the alignments of the co-axials. The south-west/north-east orientation of the East Moor fields is apparent in modern field banks from opposite Upton Castle in the north-west to the Stonaford-Lemarne area in the south-east. The alignment of the Bastreet Downs system is also evident in this last area. This suggests that the Bastreet system is an extension of the East Moor system along the side of the Witheybrook valley (Figure 6.1). The north-west axis of the Ridge system is preserved by the walls of Bowda farm up until the north-west co-axial of the Bastreet Downs system, which quite probably

indicates that the Ridge system is the final in-filling of the corner created by the Bastreet Downs and East Moor system.

The Ridge system extends for 1.2km south-west from the south-east sector of the East Moor systems terminal boundary, and incorporates almost all of Ridge Hill. The parallel boundaries run along a north-west/south-east axis and pass over the top of the ridge to meet a north-east/south-west terminal boundary on the north-west slopes of the hill. The ten near parallel walls are 75-175m apart and survive as heaped rubble walling up to 2.5m wide and 0.5m high.

Five of the co-axial boundaries in the southern sector of the monument are overlain in part by modern field banks. The largely dismantled remains of an earlier prehistoric field system are visible in the south-western part of the Ridge system.

There is evidence of at least two phases in the Ridge Hill system (Figure 6.2). The western four co-axial boundaries are a discrete block that was apparently added to the earlier co-axial system to the north-east (Figure 6.2: Phase 3). The terminal wall stops 2m short and is stepped 20m south-east of the earlier systems terminal. A remnant of the early phase co-axial, running south-east from the early terminal, is robbed by the north-eastern co-axial of the later block, shortly after the stepped junction, to create a short droveway. The terminal boundary of the early phase block has a marked lynchet against its uphill side.

A third phase terminal boundary has also been suggested (Figure 6.2). This lacks surviving co-axials and was formed by a north-west/south-east wall running into Watery Marsh from near the north-west corner of the later block. Further evidence of modification is found in the early phase block: a wall transects the co-axials behind the terminal boundary, following the course of the terminal, 120m behind at the north-east end of the block, but converging on it towards the south-west,

where its end has been robbed. This wall post-dates the three central co-axials, although it pre-dates the block's north-east co-axial wall, which forms a droveway with the terminal boundary of the East Moor section of the system. A north-easterly extension of the Ridge's system terminal wall appears to follow next in the sequence, its curve mirrors the subsidiary wall creating a large sub-rectangular field and probably matches the upslope extension of the East Moor terminal (Figure 6.2: phase 2). The last section was the creation of the north-eastern of the two co-axials of the surviving Ridge system, which completed the pattern and formed the droveway which is apparent between the junction of the Ridge and East Moor systems (Plate 6.4). A further length of wall which has apparently been robbed at both ends may also be a later development: this creates a droveway within the co-axial system beside the co-axial west of the Ridge cairn. Brisbane & Clewes (1979) surveyed this section and obtained soil samples from beneath its north-east and south-west ends for pollen analysis (Chapter 1, section 1.7).

Two areas of regular settlement infill are evident in the system. The largest of these is 7.5 hectares and survives as a broad strip around 160m wide on the south-eastern facing slopes of ridge. It is visible running for 630m west-south-west/east-north-east, and spanning six co-axial boundaries.

The system is strongly influenced in its layout by the co-axial boundaries: cross walls link the co-axial walls to encompass blocks of up to 1.5 hecatres. Further subdivision by rubble walls creates a grid pattern forming blocks of 0.04 to 0.3 hectares. This area includes 11 hut circles of between 3 to 7.5m in diameter. These huts are arranged along a nearly straight line which runs the length of the system and are built on or near the systems cross-walls.

Plate 6.4 (top): The droveway between Ridge Hill and East Moor field system, looking north-east.

Plate 6.5 (bottom): The cairn on Ridge Hill.

A medieval field system encroaches on the eastern part of the infill, and further clearance to the west and south further obscure the original extent of the system.

Another area of field system infill is apparent at the north-eastern edge of the Ridge, but is only visible over 0.1 hectares having been affected by modern clearance. The only extant remains in this area are one cross wall linking co-axial boundaries and a plot of 0.06 hectares. One other hut circle remains in the ridge system and is built into an earlier funerary cairn behind the terminal boundary.

A large sub-circular prehistoric enclosure survives at the south-east end of the north-west/south-east junction between the East Moor and Ridge co-axial field systems. This enclosure extends 53m north-south and 44m east-west, and forms part of the junction of a prehistoric droveway, narrowing and following the course of this junction opposite the remains of the regular field system of the ridge co-axial system. A modern field bank overlies the south-western third of the enclosure wall. Two huts of 8m diameter are contained in the western part of the enclosure.

Another ovoid enclosure is situated 300m north-north-west of the first. This survives with a boulder and rubble wall 1.5m wide and 0.6m high, encompassing an internal area 40m east-west and 65m north-south. Six sub-circular house platforms up to 8m in diameter are contained in the enclosure and another 3 similar platforms, up to 11 by 15m are evident to the north-west of the enclosure.

Two of the four funerary cairns are found in the Ridge system. One of these is that mentioned above and includes a later hut circle. The other is the Ridge cairn situated 100m east-north-east of the summit of Ridge Hill. It survives as a mound of heaped rubble 22.7m in diameter and up to 1.3m high (Plate 6.5). Stone robbing and excavation in the 19th century revealed a central slab over a cremation burial. The central rubble has been largely cleared to form a modern

shelter.

6.6 Medieval and later sequences

Fox Tor

This settlement is recorded as 'Foxtorre' in a document from AD1327 (P.Rose, pers.comm.) and is situated near the base of the east-south-east slope of the Tor. It consists of two longhouses 40m apart on a north-east/south-west axis. The north-eastern house measures 11 by 4m and the other 9 by 4.5m. Both have the distinctive lay-out of a medieval longhouse with a lower cattle byre divided from the living quarters by a cross-passage.

Extensive areas of ridge and furrow, measuring 2-3m from crest to crest and up to 0.2m high, are apparent across the slopes of Fox Tor. That area which is associated with this settlement is visible over 13 hectares, bounded to the west by Redmoor marsh and to the west by dense scree. The ridging is orientated along a west-north-west/east-south-east axis, apart from a block of 2.5 hectares on a north-north-east/south-south-west axis.

Two trackways run through the ridging linking the settlement to the moor edge, and from here down through the co-axial system. Further ridge and furrow is apparent in the prehistoric system, using the prehistoric walls for subdivision. Post-medieval features include a leat crossing the northern part of the co-axial system, three peat-stack platforms and a scatter of second world war bomb craters.

Bastreet Downs

A curving medieval boundary of heaped rubble up to 1.5m wide and 0.7m high with an outer ditch crosses into the north-eastern part of the co-axial system,

passing across the prehistoric co-axial boundaries. The area within this boundary contains evidence of ridge and furrow.

6.7 Human activity on East Moor and Ridge: summary

The surviving remains of the East moor system demonstrate both the variable intensity of prehistoric settlement and the nature and extent of land-use during the prehistoric period in this part of Bodmin Moor. There has been no firm dating of any of the archaeological sequences on the East Moor and the interpretations below are therefore based largely on assumptions regarding the morphology of settlement patterns and comparisons with other dated sites in the south-west (D.Hooley, pers.comm.).

Neolithic pastoral activity

The earliest human activity in this part of the moor is represented by the dispersed and largely heavily robbed hut circles that occur within the co-axial system, as well as other such huts scattered on the open moorland. One collection of these huts is on the south-east slopes of Fox Tor. Another five are visible in the zone between the early and later levels of the co-axial's terminal boundary. It seems likely that these huts belong to a phase of settlement earlier than the co-axial system for several reasons, as opposed to being contemporary with it, but disturbed by the medieval activity in this part of the moor. Firstly, two of the huts are in areas with little trace of cultivation ridges and one has well-preserved prehistoric walling nearby that runs along the axis of the ridging. Furthermore, another group of huts associated with prehistoric settlements along the line of the early terminal boundary are within areas of medieval cultivation, yet have survived well, apparently being avoided by medieval cultivators rather than cleared. Certain curvilinear elements within the co-axial systems suggest the remains of an earlier field system, that may have belonged to these huts.

These huts and possible fields have been tentatively assigned to late Neolithic pastoral activity (D.Hooley, pers.comm.). The ritual monuments such as Nine Stones Stone circle possibly also belong to this first phase of activity on the uplands. The dispersed nature of the settlement suggests that there was not heavy pressure on the land resource at this stage, a picture which is apparently confirmed by the pattern of other probable Neolithic settlement on Bodmin Moor

Bronze Age land-division

The Bronze Age and the construction of the co-axial systems on East Moor and Ridge are assumed to represent the period of major settlement and utilisation of the uplands on Bodmin Moor. Work on Dartmoor (Fleming,1978;1983;1988) has shown that the co-axial 'reave' systems on that upland began about 3700 BP and continued in use until around 3000 BP. These systems have been interpreted as representing wholesale division of the uplands under the direction of some form of authority with control over all of Dartmoor and its environs (see Chapter 1 section 1.6). The similarity between the Dartmoor reaves and the East Moor system suggests they belong in the same period. The comparison between the systems is not entirely accurate, as the Dartmoor reaves were apparently laid out through a single action, whilst the East Moor system was the product of a series of accretions.

Although there is some evidence of cultivation in the form of clearance cairns and slight lynchetting in some of the fields: "...a predominantly pastoral context for the East Moor system seems appropriate, with controlled grazing in the fields and common grazing beyond." (Johnson & Rose, 1994:65).

The medieval period

There is extensive evidence for the medieval settlement of the East Moor and Witheybrook valley between the 11th to 14th centuries. This pattern is common to the rest of the moor, although the precise time-scale for settlement is largely

unknown (Johnson & Rose, 1994). There is evidence for the cultivation of cereals in the form of ridge and furrow features, although this may have been very brief in some places (P.Rose, pers.comm.), as well as for the use of the surrounding moors for the grazing of animals.

6.8 Modelling natural and human factors in environmental change on the East Moor during the Holocene

Approach

A series of hypotheses can be formulated concerning the palaeoenvironmental record from the different sites on the East Moor, as summarised in Table 6.1. These include the nature of the vegetation communities prior to human interference, inferred from the character of the depositional basin and its topographic and altitudinal position. Secondly, predictions concerning the nature and extent of human impact, inferred from the archaeological sequences present near to the sampling sites can also be made. The results of the palaeoenvironmental investigations at Rough Tor can be used to aid the modelling of human-environment relations on the East Moor. The models assume that each site contains a full Holocene record, which may not necessarily be the case.

The approach to the construction of hypotheses regarding environmental change on East Moor is slightly different to that employed prior to the Rough Tor investigations. More detailed predictions concerning the precise nature and extent of human-induced environmental impact were made at Rough Tor. This was possible due to the sampling strategy and the nature of the depositional locations under investigation: the examination of five profiles in a relatively small area ($2km^2$) and the close location of four of these sequences to the archaeological remains made the formulation of hypotheses pertaining to specific archaeological systems possible.

Sampling site	*Predicted pre-human impact vegetation*	*Archaeology*	*Postulated impact*
Tresellern Marsh SX23/476 230mOD	High AP. Oak/birch/hazel woodland on valley sides with alder/willow carr on sampling site. Low NAP although mire taxa (eg.Cyperaceae) prevalent over dry land herbs	Bastreet Downs co-axial system to north of marsh (BA). Other huts and fields evident to south and west (N/BA). Medieval fields on Bastreet Downs and settlement of Smallacombe to west	Gradual decline in AP and increase in NAPin N-BA. Any early, small scale activity poss. obscured due to influence of on-site vegetation. Decline in activity in later prehistoric period. Medieval activity and cultivation evident through later increases in pastoral and ?arable indicators *Charcoal:* Low micro-and macro. Micro increasing gradually with increased macro- as settlement spreads
Watery Marsh SX2377 275m OD	Moderate AP. Oak/birch. Higher shrub and NAP reflecting influence of more open grass/heath-land at higher altitudes	East Moor co-axial system (BA). Other remains including stone circle, huts and other ritual monuments within 1km of marsh (N/BA). Medieval fields immediately to south and east.	Little evidence of impact until BA. Disturbance and clearance marking construction of co-axial system. High NAP esp grass and pastoral indicators. Evidence of cultivation and increase in pastoral indicators in medieval period *Charcoal*: Steady increase in micro- to peak during BA. Macro-low. Subdued levels after BA increasing to mark medieval activity
East Moor Monolith SX2278 285m OD	Subdued AP. High shrub and NAP. Evidence of grass/heath-land on higher plateau	Within postulated area of communal grazing of co-axial system (BA). Other huts, boundary works and ritual monuments within 0.5km (N/BA). Within 200m of Fox Tor medieval settlement.	Gradual decline in shrub-AP and increase in NAP inN/ BA. High levels of pastoral indicators. *Charcoal*: Low micro- and macro-although increase during period of maximum activity possible.

Table 6.1: Table summarising predictions concerning the palaeoenvironmental record from the East Moor. AP- arboreal pollen; NAP - non-arboreal pollen; N - Neolithic; BA - Bronze Age

On the East Moor, the palaeoecological investigations included two valley mires. The pollen source areas of such sites is likely to be large (Jacobson & Bradshaw, 1981; Sugita, 1994) and the distance from the archaeology is greater than at Rough Tor, meaning that local environmental changes can be recognised less clearly in the palynological record derived from such locations than from the kind of deposits from which the Rough Tor monoliths were sampled. Moreover, the archaeological sequences indicate one main phase of activity on East Moor and are therefore less complex than those on Rough Tor.

The palynological record

Tresellern Marsh (230m OD) is a north-east/south-west orientated valley mire around 400m across at its widest point, narrowing to under 100m at its north-eastern end and 1.5 km long (Figure 6.1). Its south-western end has been extensively disturbed by tin streaming and peat cutting. The Withey Brook flows into its westerly end and out of its easterly end into the River Lynher. Watery Marsh drains into the northern side of the marsh.

At 230m OD, Tresellern Marsh is the lowest site investigated during the course of this project. Caseldine (1980), discussing the results of Brown's (1977) pollen-analytical studies, postulated that oak and birch woodlands would have been more extensive in the early Holocene in the lower valleys around the edge of the moor. Although he does not define exactly what altitude his 'lower' valleys are at, the Tresellern valley may be considered a good example of a sheltered valley, where it might be expected that extensive oak and birch woodlands would have developed on the valley sides. Considering the presence of alder/willow carr at higher and more exposed positions on the northern slopes of Rough Tor, then carr woodland would be expected on the marshy floor of the valley. In terms of the palynological record, high values of tree and shrub pollen would be expected in the early environmental history of the marsh. In particular, *Alnus*, *Salix* and local NAP input might be expected: other tree pollen, such as *Quercus* and *Betula*, could

therefore be masked by these local values. Low herbaceous and shrub pollen would also be a consequence of this.

The Bronze Age is assumed to be the major period of settlement on the moor and the Bastreet Downs section of the East Moor system is situated on the slopes to the north of Tresellern Marsh. The construction of this system would be expected to be a very marked event in the palaeoenvironmental record, in the form of sustained falls in tree and shrub pollen and the expansion of graminaceous and herbaceous communities. The beginnings of soil deterioration and the increase in heathland might also be expected to begin during this period. The possible late Neolithic settlement on the East Moor may mean that clearance activity may have begun some time prior to the Bronze Age. Significant areas of grassland may already have been created before the systematic division of land began later in the Bronze Age.

Following the Bronze Age, evidence of human presence should decline and possibly some regeneration of tree and shrub pollen occur although the presence of the round at Allabury, just over a kilometre from the sampling site, suggests that the moor might have continued to be utilised in the later prehistoric period.

The medieval period should be clearly recorded in the pollen record: extensive field systems are present on the northern edge of the marsh and the construction and utilisation of these fields would be expected to be very evident in the pollen record. Remaining tree and shrub pollen frequencies should fall and ruderal pollen frequencies increase, possibly substantially. Any arable activities being carried out in the fields might result in cereal pollen, or at least levels of the pollen of herbs associated with arable agriculture. This period may be the most marked in the Holocene in terms of a clear human presence in the pollen record. The end of activity in these systems may result in the increase in NAP from the spread of species following agricultural abandonment.

Clearance for settlement and agriculture will result in a complex landscape mosaic that may not be clearly visible in the pollen record of sites with large pollen source areas, even when they are situated only a relatively short distance from the location of the activity. For this reason, the palaeoenvironmental investigations at Watery Marsh and on the East Moor itself may be more reliable indicators of the timing and nature of vegetational impacts resulting from the construction and exploitation of the East Moor field system.

Watery Marsh (275m OD) is also a valley mire, orientated north-west/south-east. At under 400m in length and 125m wide (Figure 6.1), it is smaller than Tresellern Marsh and would be expected to have a correspondingly smaller pollen source area. It has no inlet streams, so any pollen incorporated in its sediment will be derived from direct atmospheric deposition and surface run-off. Thus the pollen record from this site should reflect local events with a proportion derived from a larger source area.

The valley is quite sheltered and the early Holocene vegetation would be expected to consist of some pocket woodland, at least on the slopes around the marsh. The mire surface may also have supported some alder/willow carr. The pollen record might therefore be dominated by AP, although possibly in lower percentages than Tresellern Marsh. Increased levels of shrub and herbaceous pollen may reflect the influence of the vegetation of the higher moorland plateau.

Watery Marsh lies at the western end of the Ridge field system and seems to define this end of the system. This field system is by far the most extensive prehistoric archaeological sequence near to the marsh: other remains in the form of cairns and the Nine Stones stone circle lie within one kilometre of the mire. The construction of the East Moor system should be clearly reflected in the palynological record by a marked fall in AP and increases in NAP and anthropogenic indicators. Prior to this period (Late Bronze Age?), possible

Neolithic utilisation of the upland plateau for seasonal grazing and the construction of the dispersed hut circles may be apparent by reductions in AP and increases in grass and herbs indicative of disturbance and grazing.

Brisbane & Clewes (1979) suggest that the East Moor system was in use for centuries rather than decades, an impression which is re-inforced by the expansion of the system through time. The palynological record would be expected to reflect an extended period of activity. The abandonment of the field system might be apparent through decreases in anthropogenic indicators and perhaps some regeneration of tree pollen. Considering the probable use of the uplands for grazing in the post-prehistoric period, attested by both the archaeological data and by the palaeoecological investigations at Rough Tor, there may be no clear palynological signals for the cessation of activity in this part of the moor. A pollen diagram from a soil pit associated with the excavation of Clitters' Cairn (Brisbane & Clewes, 1979) displays an increase in *Pteridium* just below the onset of peat growth, which is taken as indicating that by this time, settlement and agriculture in the area had ceased, or at least decreased in intensity, allowing the expansion of bracken. The authors suggest that the climatic deterioration that led to the growth of peat and the expansion of vegetation typical of wetter heath (*Potentilla*, Rubiaceae) may have been roughly contemporaneous with the end of settlement in this part of the moor, but was '..coincidental rather than causative'. These assertions may all be examined in the light of the pollen record.

The post-prehistoric period may see the expansion of heathland, although the area was most probably utilised for seasonal grazing into the historic period, so grassland may be more important than heather communities. Heather never formed more than a minor component of the vegetation at Rough Tor and whether this was also the case on the East Moor may be investigated. On Dartmoor there is an east-west gradient in the vegetation, with the former area characterised by more extensive heather than the latter. This may also have been the case on Bodmin

Moor earlier in the Holocene. The medieval period (late 11th or 12th to the early 14th centuries) that saw the establishment of settlements on the high moors, as well as tin streaming activities, should be apparent in the form of a decrease in any remaining areas of trees and shrubs. Ruderal herbs should expand and there may be possible evidence of arable agriculture apparent in the form of cereal pollen and herbs associated with cultivation.

East Moor monolith (285m OD) is a peat bank around 10m across, situated on the edge of Redmoor Marsh (Figure 6.1). It is not actually part of the marsh itself presently but may have been prior to the reduction of the marsh by peat cutting. The small size of this deposit means that its pollen source area will be small and will reflect mainly local vegetational changes on the slopes above.

Brisbane & Clewes (1979) postulated that the East Moor plateau supported hazel scrub, with alder favoured on the damper soils. They envisaged oak as more dominant on the sheltered escarpment at the edge of the plateau. If this was the case, the pollen record should be dominated by *Corylus* pollen and NAP - grass and other herbs - with AP possibly at the lowest percentages for the three sites. The pollen record should clearly indicate the period of maximum human activity, as the vegetation communities respond to clearance and grazing pressure. The small pollen source area should give a good picture of the local vegetational structure resulting from these activities. As was noted above (section 6.6), the plateau may have been used for communal grazing from the Neolithic onwards and the construction of the East Moor system may therefore be the culmination of activity in this part of the moor. If this is a correct assessment, then it is possible that the exploitation of this area during the Bronze Age may not be especially marked in the pollen record, as clearance might have been progressing steadily since earlier in the Holocene.

The charcoal record.

Some of the problems in the interpretation of Holocene charcoal records were outlined in Chapter 2 (section 2.5).

Tresellern Marsh would be expected to receive microscopic charcoal from a fairly wide source area. In the early stages of the Holocene, microscopic levels would be expected to be low, increasing steadily to reach a peak around the Bronze Age reflecting the input of local and regional burning activity. Macroscopic levels should remain low, unless natural or anthropogenic burning of the mire surface occurred. Considering the almost complete absence of macroscopic charcoal from the Rough Tor sequences, then a similar situation might be anticipated for the East Moor.

Charcoal levels should fall off in the late- prehistoric period, increasing again to mark the onset of local medieval settlement, before falling to moderate levels derived from regional burning activity. A similar picture would be expected from the Watery Marsh and the East Moor monolith site, although macroscopic charcoal would be expected to be absent from the latter site, as it lies some distance from any areas of either prehistoric or historic settlement. The possibility of macroscopic levels resulting from firing of the moorland cannot be discounted.

6.7 Summary

This chapter has described the rationale behind the selection of the East Moor for palaeoenvironmental research. The archaeological sequences on this part of the moor have been described and tentatively interpreted. A series of hypotheses concerning the palaeoecological record have been put forward. The following chapter will describe the results of the palaeoecological investigations on the East Moor.

Chapter Seven
Palaeoenvironmental Research on the East Moor
Part I:
The East Moor Plateau

7.1 Introduction

The previous chapter described the archaeological sequences on the East Moor and the sampling sites selected for palaeoecological research. A series of hypotheses concerning vegetational change and human impact were proposed. This chapter describes the results of the palaeoecological research on the East Moor. The first part concerns the sites on the East Moor plateau itself, the East Moor monolith and Watery Marsh. The second part discusses the investigations at Tresellern Marsh in the Withey Brook valley.

7.2 The East Moor monolith: methods

Sampling, loss-on-ignition, stratigraphic description and pollen sub-sampling and preparation followed the procedures described in Chapter 2. Plates 7.1-7.2 show the excavation and sampling of the East Moor site.

Radiocarbon dates

The samples submitted from the East Moor monolith for radiocarbon dating are listed in Chapter 2, Table 2.1.

Plate 7.1: Excavating the East Moor Monolith sampling site.

Plate 7.2: Positioning the monolith tins to sample the East Moor deposit.

7.3 Results

Lithostratigraphy

The lithostratigraphy of the East Moor monolith is described in Table 7.1. The monolith consists of basal dark grey clay trending into highly humified black peat. No macrofossils apart from rootlets were identified in the sequence either during cleaning and subsampling or retained on the sieve during pollen preparations

Loss-on-ignition

The results of the loss-on-ignition determinations are presented as a graph (Figure 7.1). Organic percentages are low (<10%) at the base of the East Moor monolith, but increase steadily to above 70% by 80cm. Values remain generally above 60%, although fluctuations at 60cm and 35cm see percentages drop to 50%. The highest values of the sequence of over 80% are found in the top 10cm of the sequence.

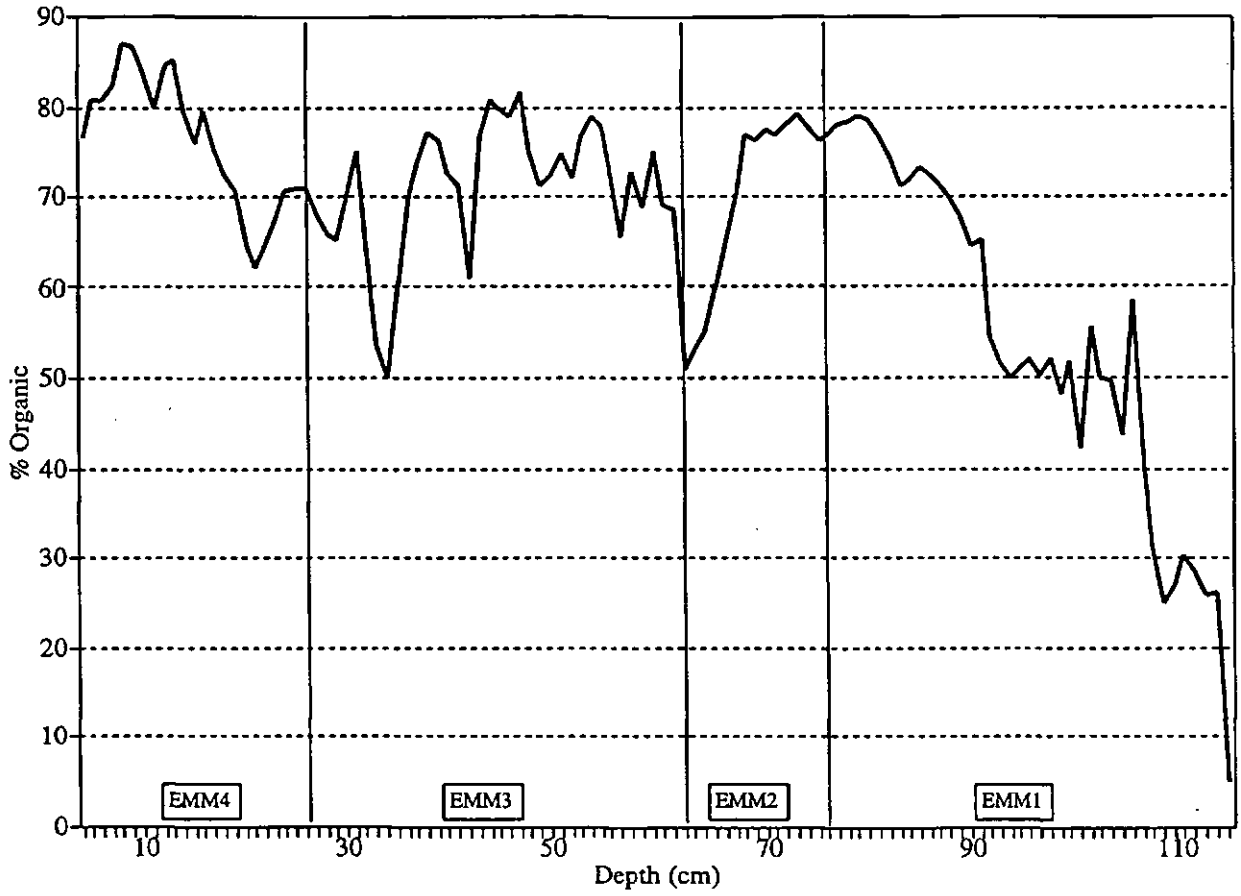
Pollen analysis

The results of the pollen analysis are presented as percentage and concentration graphs (Figures 7.2 and 7.3). The zonation of the diagram is summarised in Table 7.2.

Depth (cm)	Description	Troels-Smith
10-70	Peaty turf trending into black peat. Many rootlets.	Th3/Sh1 Nig.2 Strf.0 Elas.0 Sicc.2 Humo.2/3
70-117	Black, well humified peat becoming increasingly damp and greasy. 107cm: rootlets stop.	Sh4 Nig.3 Strf.0 Elas.1 Sicc.2 Humo.4
117-121	Black peat trending into dark grey clay.	As4 Nig.1 Strf.0 Elas.0 Sicc.3

Table 7.1: Lithostratigraphy of East Moor monolith.

Figure 7.1: East Moor monolith organic matter determined by loss-on-ignition



7.4 Discussion: interpretation of the East Moor monolith pollen diagram

Composition of the early vegetation cover on the East Moor plateau

Assuming that the *Corylus avellana*-type pollen in EMM1 is mainly that of *Corylus*, the high levels (>70%) of this pollen indicate the presence of dense hazel scrub around the sampling site (Figure 7.2). Birch is a high pollen producer and thus the levels of *Betula* are regarded as insufficient to indicate the presence of birch as a significant component of the vegetation, although it was probably present locally. *Pinus* does not achieve the 20% TLP usually taken to indicate the local presence of pine (Bennett, 1984), whilst *Ulmus* may be underrepresented in the pollen record (Andersen, 1973). Some scattered elm was probably present on the East Moor. The likelihood is that soil conditions and/or exposure did not favour the extensive local spread of these canopy forming species, although it is probable that they attained greater stature in the lowlands to the east.

Quercus is the only tree taxon to reach percentages sufficient to indicate a major local presence. Heim (1970) noted a wide difference of opinion on the representation of *Quercus* in pollen taphonomic studies, which he explained was due to the diversity of *Quercus* species and the variety of sampling techniques. Tinsley & Smith (1974) and Bradshaw (1981) both found that the percentages of *Quercus* in samples from woodland reflected its status in the surrounding vegetation well. Considering that the pollen catchment for the East Moor site was probably fairly small, the percentages of *Quercus* are regarded as sufficient to reflect the presence of oak trees locally. A landscape dominated by hazel with occasional stands of oak is therefore envisaged for EMM1.

Figure 7.2: East Moor monolith percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration x10.

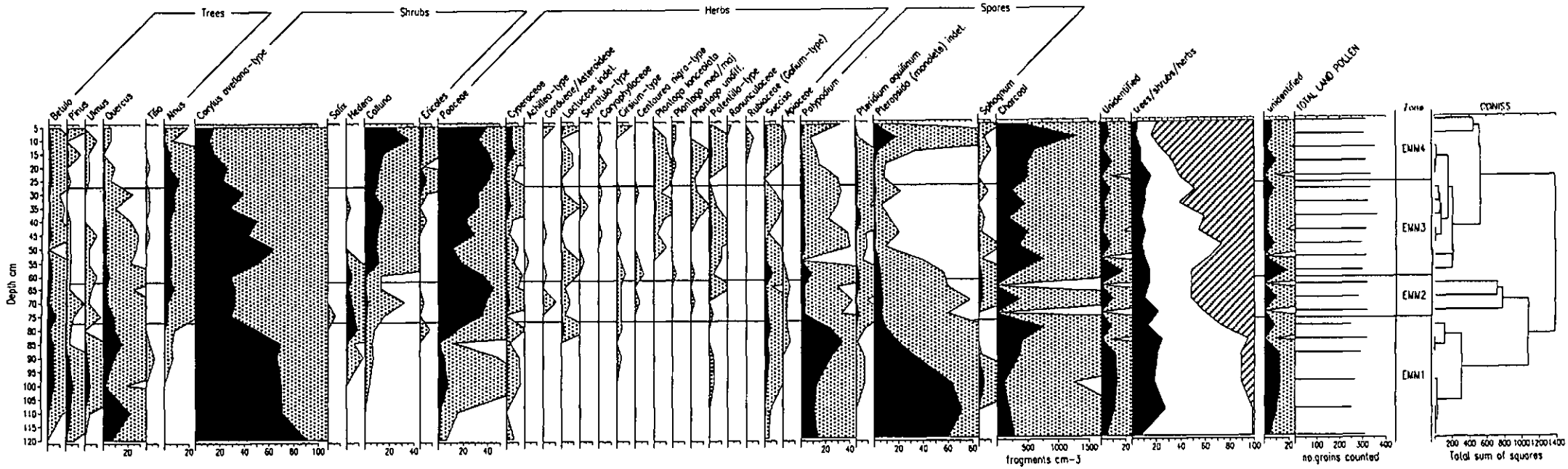
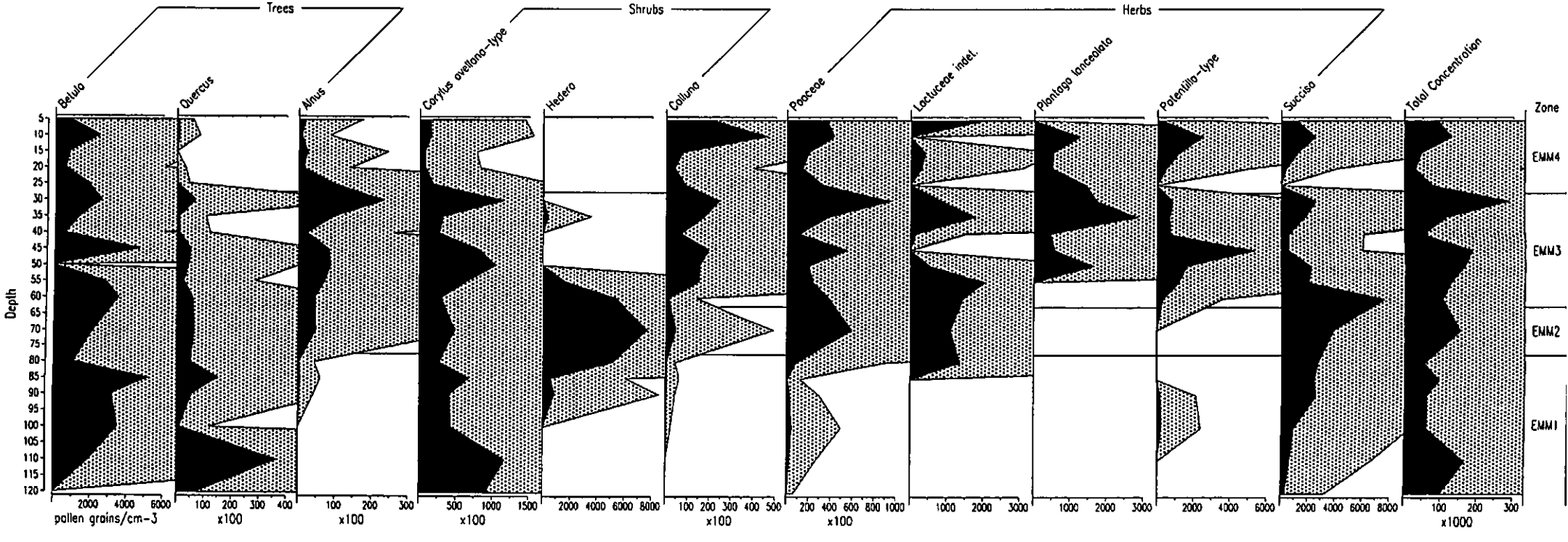


Figure 7.3: East Moor monolith pollen concentration diagram (selected taxa). Values are of grains cm^{-3}. Exaggeration x10. NB. change in horizontal scales.



Zone	Depth/cm	Description of main features of zone
EMM4	27.5-5	Arboreal pollen falls to below 10%. *Corylus avellana*-type falls to <15%. *Alnus* falls to <5%. Poaceae peaks at 45%. *Calluna* peaks at 35%. Herb pollen low. Cyperaceae peaks.
EMM3	62.5-77.5	*Corylus avellana*-type fluctuates but declines to 25%. Alnus increases to >10%. Further decline in *Quercus* to 5%. Poaceae fluctuates but increases to >40%. Herb pollen sporadic. *Potentilla* curve begins. *Plantago* sp. low but consistent across zone. *Calluna* increases to 15%.
EMM2	77.5-62.5	*Corylus avellana*-type falls but remains>30%. AP falls to <10%. *Quercus* falls to <5%. *Alnus* at low values <5%, increasing across zone. Poaceae rises to 35%. Herb pollen (Lactuceae indet., *Cirsium*, & *Plantago* indet.) at low values. *Succisa* increases to reach highest value for diagram. Spores fall to low values.
EMM1	120-77.5	*Corylus avellana*-type >70%. *Polypodium* >30% TLP+spores and Pteropsida (monolete) indet. >60% TLP+spores. *Quercus* peaks at >20%. *Ulmus, Betula* and *Pinus* all reach highest values for diagram. Poaceae low. Herb pollen low except for *Succisa* and *Potentilla*. *Sphagnum* peaks >25% TLP+spores.

Table 7.2: Zonation of the East Moor monolith pollen diagram

The low percentages of *Succisa* (3-4%), Poaceae (7-8%) and Cyperaceae testify to the existence of limited openings in the scrub cover that permitted the development of a damp, grassy ground layer. *Corylus* thickets can be dense and cast heavy shade and as the flowering of plants on the woodland floor is reduced by the shade cast by tree or shrub cover, there may have been a somewhat more extensive distribution of herbs below the canopy than is shown by the palynological record.

Pteropsida (monolete) indet. and *Polypodium* are present in very high quantities across this zone. The dominance of these highly resistant spore types (Havinga, 1984) might suggest a degree of differential preservation. Pteropsida (monolete) indet. decline after 100cm. This corresponds closely to an increase in organic matter from below 50% to above 70% (Figure 7.1) suggesting that the high levels of Pteropsida (monolete) indet. are related to to differential preservation due either to inwash of material from secondary sources or to microbiological activity in the sediment. Percentages of unidentified pollen remain reasonably low at this stage and the pollen curves make ecological sense, so the pollen spectra in the samples from this zone are regarded as generally reliable.

The general impression of the local environment during this zone is of a largely undisturbed wood/shrubland habitat. Hazel dominates the vegetation, with oak the only tree significant locally. Open areas are restricted in extent. The occasional grains of *Calluna* present from 105cm to the top of EMM1 may have originated from patches of heather present on more extensive open areas around the summit of Fox Tor. The sampling site is just on the edge of Redmoor Marsh; the exact character of the vegetation in this area is unclear, although it seems likely that the formation of this marsh began fairly early in the Holocene and therefore the trees would have been largely restricted to the drier ground around its edges.

There is possibly some evidence of disturbance to this vegetation. *Quercus* falls

from 25% to 5% at 100cm, corresponding to a slight increase in Poaceae and the appearance of low quantities of *Potentilla*-type and *Pteridium*. This might indicate an opening in the canopy, resulting in the spread and/or increased flowering of these light-demanding species. *Sphagnum* peaks at this level, which may point to a wetter surface locally. Whether this was related to the fall in *Quercus* is unclear. These are not permanent changes, as *Quercus* recovers to *c.*15% at 85cm. Poaceae shows a corresponding fall to 1-2% and *Sphagnum* declines to similarily low levels. Organic percentages increase sharply from the base of the sequence but there are sharp fluctuations in organic percentages between 95-105cm and a fall to just over 40% at 100cm (Figure 7.1). This might be related to increased levels of slope wash due to the disturbance to the vegetation cover on the nearby slopes. Alternatively, the changes recorded in this sample might be due to the effects of differential preservation on the representation of different taxa in the pollen record than to actual vegetational changes.

Woodland clearance, the expansion of grassland and the Alnus rise (EMM2)

EMM2 opens with falls in all the arboreal and shrub pollen curves. These falls are concurrent with an increase in Poaceae, reflecting the spread of grassland following woodland recession. *Succisa* also responds to the reduction of canopy-forming species, increasing steadily across the zone to reach a peak of *c.*7% by 60cm. These changes are confirmed by the concentration data (Figure 7.3): *Quercus*, for example, falls from 15.3 x 10^3 grains/cm^3 at 85cm to 0.54 x 10^3 at 80cm, whilst *Pinus* decreases from 1.5 x 10^3 grains/cm^3 at 90cm to 0.2 x 10^3 by 80cm. In contrast, *Succisa* concentration increases from 2.4 x 10^3 grains/cm^3 to 7.5 x 10^3 by 60cm.

Low but consistent traces of Lactuceae indet., *Pteridium* and *Cirsium* pollen suggest that these herbs were also spreading as a result of the opening up of the woodland cover. The rise of other herbaceous pollen is not very marked at this point, although the presence of small quantities of *Centaurea nigra* and *Plantago*

undiff. show the presence of these herbs as part of the expanding grassy areas. *Polypodium* declines sharply at the opening of this zone: this reduction corresponds with the falls in *Quercus*, suggesting that this taxon was related epiphytically to the local oak trees.

EMM2 opens with declines in the representation of *Betula*, *Pinus* and *Ulmus*, raising questions regarding their status in the vegetation cover of the East Moor. The small area of the sampling site means that over 90% of pollen deposited should be derived locally (Jacobson & Bradshaw, 1981; Sugita, 1994) and therefore the clearance of hazel in this zone is most likely to have been on a local level. If the above trees were not present in the local vegetation, but were more extensive at lower altitudes and their pollen signal is therefore a regional one, then it would be expected that local clearance would not affect their representation in the East Moor I pollen record. If anything, an increase in the percentages of arboreal pollen types, whose source lies outside the local woodland would be expected, following Tauber's (1965) hypothesis that as a cleared area is increased, an enhanced proportion of pollen deposited at that point will be derived from distant sources.

Two hypotheses may be advanced to explain the decline in the representation of these trees alongside that of hazel: elm and pine were components of the lowland woodland and clearance of hazel on the East Moor plateau corresponds to clearance activity in the lowland zone. Alternatively, these trees were present in limited extents as part of the East Moor vegetation; hence the record of their reduction in the pollen record alongside that of the dominant hazel. The first seems unlikely, as it would have involved the more or less simultaneous clearance of a very extensive area of both moor and lowland. The hypothesis advanced here is the second one: the record of arboreal pollen at East Moor monolith is of predominantly local and extra-local origin and pine and elm were present as minor components of the vegetation on and around the East Moor. These trees were no

doubt present in greater numbers at lower altitudes, but it would be unwise to draw conclusions regarding activity on the lowlands from the East Moor monolith palynological record.

The *Alnus* curve begins to increase at 70cm. The concentration diagram demonstrates the increased representation of *Alnus* from 0.45 x 10^3 grains/cm^3 at 80cm to 4.7 x 10^3 by 60cm. Pollen taphonomic studies disagree over the significance and interpretation of *Alnus* percentages in pollen diagrams: Tinsley & Smith (1974) found that deposition of *Alnus* pollen was highly erratic on woodland and moorland on the North York moors and concluded that percentages of as high as 20% TLP in pollen diagrams might have little significance in terms of the vegetation immediately around the site. Other workers have found a fairly local dispersal of this pollen: Goddard (1981: cited in Smith & Cloutman, 1988:167) recorded a fall from 28% TLP to 3% tlp over a distance of 15m across an alder to birchwood transition.

Although it should not be expected that pollen taphonomic situations will always be directly comparable from one environment to another (cf. Gearey & Gilbertson, in press), it seems probable that the sustained nature of the rise in *Alnus* across EMM2 points to the pollen record registering the local establishment of alder. This was probably in the first instance on the marsh, with the tree later expanding onto other favourable parts of the landscape.

The expansion of alder in EMM2 is related in part to the advent of climatic and/or edaphic conditions favouring its spread, but also coincides closely with the disturbance to the dominant hazel and oak cover. The requirements for the establishment of alder were discussed above (Chapter 4 Part II section 4.4) and it seems possible that the spread of this tree on Bodmin Moor was connected, at least in part, to the effects of human-induced disturbance and the opening of the woodland cover. This has been observed as a feature of the mid-Holocene

establishment of alder in other pollen diagrams from the British Isles (cf. Smith, 1984).

Hedera helix also increases at the opening of EMM2. The concentration data (Figure 7.4) show the sudden expansion of this pollen type from 0.61 x 10^3 grains/cm^3 at 85cm to 5.2 x 10^3 grains/cm^3 at 80cm. The appearance and increase of this pollen may be related to a number of factors: ivy will not flower in heavily shaded conditions and its increased representation may be due to the opening-up of the local vegetation. Climatic factors may also be responsible, as ivy requires average summer temperatures of at least 13 °C to flower and is susceptible to low winter temperatures (Iversen, 1941). Brown (1977) interpreted the presence of this pollen as indicating climatic amelioration. Although the possible role of climatic change cannot be ruled out, it is probable that the record of *Hedera* is a result of the disturbance to the local canopy.

The pollen curves during EMM2 suggest a landscape of hazel scrub with grassland spreading at the expense of the woody taxa. Alder is gradually becoming established as a feature of the local vegetation and oak is probably also still present, although in much reduced extent to EMM1. The beginning of a continuous *Calluna vulgaris* curve reinforces the picture of an increasing area of open land in the vicinity of the sampling site and the presence of some areas of heather locally. Heath and grassland may have been present previously at higher altitudes and the opening up of the local vegetation in EMM2 has permitted increased representation of extra-local sources of pollen.

The establishment of Calluna heathland (EMM3 & 4)

Corylus avellana-type recovers at the opening of EMM3, corresponding to a decrease in Poaceae. This is a shortlived change, as *Corylus avellana*-type falls again at 45cm and Poaceae recovers to 40%. This might be taken to indicate a brief regeneration of hazel and a decrease in the area of open land. Although

Poaceae decreases, the *Calluna* curve increases at 55cm. The record of other herbaceous pollen is already low and sporadic making it difficult to characterise the nature of vegetational change in this period, but the *Plantago lanceolata* curve begins at 45cm and *Potentilla* percentages seem little affected. The pollen data are therefore reflecting a spatial disparity between local shrub recovery, whilst the increase in *Calluna* and appearance of *P.lanceolata* reflect the creation of open ground on an extra-local scale (cf. Edwards, 1979; Hirons & Edwards, 1986). Alternatively, hazel populations were regenerating on a more extensive landscape level, but this regeneration of patches of hazel scrub was interspersed with stretches of open ground maintained by continuing anthropogenic activity. These two possibilities will be considered further below.

Poaceae also increases across EMM3, but there are few other changes in the ground flora recorded in the pollen record. *Plantago lanceolata* and *Potentilla* remain at low but consistent levels, but they do not increase in response to the continuing falls in *Corylus avellana*-type. If the opening up of the scrubland led to local increases in herbs other than grass, then this is not recorded in the palynological record. *Calluna* can form a dense canopy in areas of vigorous growth, leading to the complete exclusion of other herbaceous species (Grime *et al.*, 1988:144). Dense heather growth around the sampling site might explain in part why there is no marked expansion in other heliophytes during EMM3. More extensive open areas dominated by grass and other herbaceous taxa must have existed some way from the sampling site. The continuing local spread of alder is reflected by the *Alnus* curve, which increases across this zone.

The percentage diagram shows further reductions in *Ulmus*, *Pinus* and *Quercus* at the opening of EMM3. The concentration diagram indicates that actual reductions in the influx of these taxa do not occur until later in the zone at 40cm for *Ulmus* and *Pinus* and at 25cm for *Quercus*. The almost complete destruction of remnants of pine, elm and oak woodland that were present in the East Moor monolith pollen

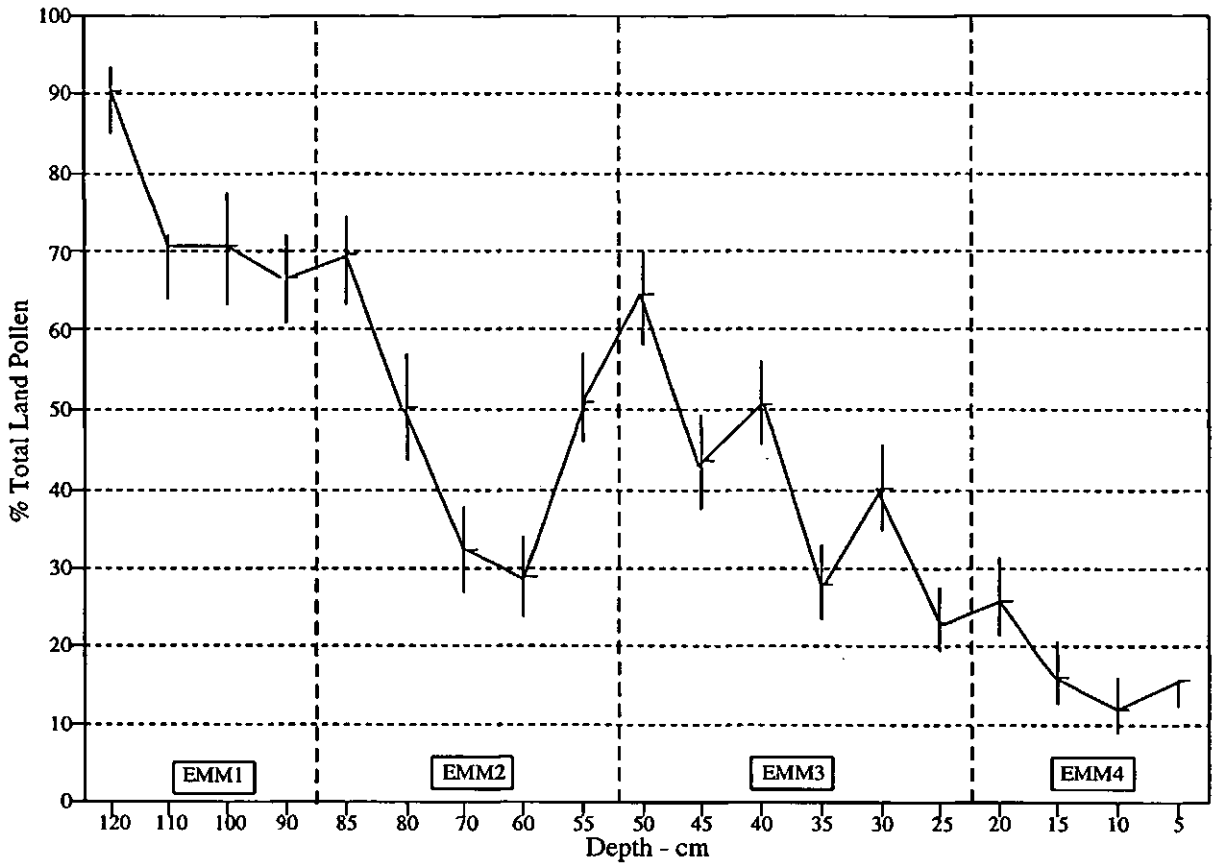
catchment area has therefore occurred by the upper half of EMM3. Very slight increases in *Pinus* and *Ulmus* concentrations at 25cm could reflect woodland regeneration on a regional level.

The *Calluna* rise, the major feature of this zone, indicates both the continuing expansion in the area of open land locally and probably also progressive soil acidification due to podsolization, although heather may have been expanding on the nearby surface of Redmoor Marsh. The beginning of the more or less continuous *Potentilla*-type (probably *P.erecta*) curve possibly also suggests the advent of such conditions, although podsolization under those areas of remaining hazel cover seems unlikely, due to the mineral cycling that would have been occurring (cf. Smith & Cloutman, 1988:170).

The beginning of the *P.lanceolata* curve at values of between 1-2% and the sporadic appearance of other herb pollen, including Lactuceae indet., *Serratula*-type, *Cirsium* and Caryophyllaceae, record the presence of these herbs, although grassland was apparently losing out to the spread of heath at this point. The pollen spectra during EMM3 therefore indicate a landscape mosaic consisting of patches of hazel, decreasing steadily in extent to be replaced by *Calluna*-dominated heath and grassland. Herb pollen remains perhaps surprisingly low, considering the evidence for open areas, but some species were spreading as a result of the removal of the hazel cover. *Alnus* continues to increase steadily and peaks toward the top of the zone, indicating the maximum expansion of alder locally.

There is a slight recovery in hazel at the close of EMM3, with percentages increasing from 28% to 40%. The confidence limits for *Corylus avellana*-type percentages (Figure 7.4) show that this represents a statistically significant change in the palynological data. This points to a period of shrub regeneration, although

Figure 7.4: 95% Confidence limits for *Corylus avellana*-type percentages. Calculated using the nomograms of Maher (1972).



this did not lead to a marked contraction in the area of grassland. *Corylus avellana*-type falls again at the start of EMM4 and Poaceae and *Calluna* pollen remain dominant. *Alnus* also falls at the opening of the zone to 5% and again at 10cm to 1-2%, suggesting reductions in local alder populations. Herb pollen values remain at similar levels to the previous zone. *Calluna* peaks at 35% at 10cm and it may be inferred from this that *Calluna* heath reached its maxium extent locally by this point. This is not maintained, as the *Calluna* curve falls to below 25% by the close of the diagram, indicating a reduction in heather communities. The slight increases in *Ulmus* and *Pinus* that began at the top of the previous zone are unaffected reflecting the continued presence of woodland in lowland habitats.

By this stage, the landscape was largely cleared of tree and shrub cover, although some alder and hazel may have remained, at least in the first half of the zone. The Poaceae curve may be interpreted as indicating that grassland reached its fullest extent for the diagram at the opening of the zone, shortly before the peak in *Calluna* pollen. The spread of *Calluna* apparently takes place at the expense of the remaining woody components of the vegetation and also perhaps in the extent of grassland.

7.5 Interpretation of the charcoal record

Microscopic charcoal frequencies demonstrate little fluctuation in the East Moor monolith sequence (Figure 7.2). The only marked peak is at 10cm, which corresponds with a reduction in *Alnus* and a peak in *Calluna*. This may suggest an anthropogenic agency is responsible for increased local burning, probably from domestic sources. Apart from this instance, there is no clear correlation between microscopic charcoal content and changes in landuse and vegetation as described by the pollen record. No macroscopic charcoal was present in the sediment.

7.6 Vegetation change and human impact on the East Moor plateau

Early human activity on the East Moor

The lowest zone of the East Moor monolith pollen diagram portrays a landscape of oak and hazel-dominated woodland. There is no unambiguous evidence for a human presence locally. The decrease in oak pollen and increases in grass pollen and bracken spores at 100cm may indicate disturbance to the vegetation, involving the clearance of oak trees leading to an increase in grass. If this is the case, the clearance activity apparently did not affect the dominant hazel cover. The fall in oak pollen is quite marked, whilst the corresponding increases in non-arboreal taxa are comparatively small. These features may be explained in two ways: either the effect on the oak populations was not as drastic as the *Quercus* curve suggests, or the response in the light-demanding taxa is, for some reason, more subdued than would be expected. *Quercus* recovers subsequently and Poaceae falls to low percentages at the same point, so any impact upon the local oak woodland was clearly not sustained. It is difficult to know which explanation is the more likely.

EMM1 must predate the construction of the majority of the prehistoric monuments on the East Moor, so if there is human-induced disturbance to the vegetation in this zone, it must be attributed to gatherer-hunter communities. There is no evidence in the form of flint scatters reported for this part of the moor, although Herring & Lewis (1992) point out that the discovery of Mesolithic flints in random find spots and in residual contexts from excavations of Bronze Age features on Bodmin Moor hints at the probable utilisation of much of the upland area across the earlier Holocene by bands of gatherer-hunters.

Anthropogenic clearance activity on the East Moor: EMM2.

The first clear evidence of anthropogenically-induced vegetation change in the East Moor pollen diagram is at the opening of EMM2. *Corylus avellana*-type, *Quercus* and other arboreal pollen percentages begin to fall and increases in Poaceae

indicate the creation of open, grassy areas at the expense of the woody components of the vegetation. The beginning of a more or less continuous Lactuceae undiff. curve and occurrences of *Cirsium*, *Plantago* undiff., Apiaceae and an expansion in the *Succisa* curve suggest a grassy, slightly damp meadow environment around the sampling site. The expansion in herbaceous pollen is not very marked and *Corylus avellana*-type remains at moderate percentages. This indicates that either the hazel cover remained locally quite dense, or that aside from grass, the herbaceous taxa failed to become major components of the ground flora, at least close to the sampling site. This may possibly have been a result of comparatively subdued pressure on the land resource by human communities: the failure of *P.lanceolata* to expand at this stage may be significant.

The impression of an environment that is not under sustained pressure from anthropogenic activity is reinforced by the increase in *Succisa*, a herb type that is not associated with heavily disturbed sites (Grime *et al.*, 1988). Similarily, the persistence of *Hedera helix* across EMM2, either as an epiphyte on the woody components of the vegetation, or as a ground layer, does not point to a heavily disturbed environment. *Hedera* will not persist in biotopes that are subject to sustained pressure and is absent from highly disturbed situations (Grime *et al.*, 1988:314). Alder was also able to become established during this period: alder will only flourish in infrequently disturbed vegetation and like *Hedera* is absent from vegetation subject to severe stress or disturbance (Grime *et al.*, 1991:74). The collective record of these species during EMM2 therefore reinforces the impression of an environment that was probably only subject to light pressure by human communities, although the failure of hazel to increase following its initial clearance, suggests that the nature of this pressure was sustained enough to prevent regeneration of shrubland.

Clearance activity in EMM3 led to the creation of a patchwork landscape with hazel scrub remaining in some locations and increasing areas of grassland with an

open, low structure sufficient to facilitate the dispersal of the pollen of ribwort plantain and other herbs such as Lactuceae indet. and Caryophyllaceae. Heather is also present and alder is the only tree growing locally, probably on and around Redmoor marsh. The impression is of an environment under fairly light but sustained pressure from human activities. The representation of ruderal taxa in the palaeoecological record is poor, with only *Plantago lanceolata* and Lactuceae indet. as constants.

A break in the *Plantago lanceolata* curve and increase in *Corylus avellana*-type at the close of EMM3 suggests a halt in human activities. However, renewed reductions in *Corylus avellana*-type across EMM4 and the recovery in the *P.lanceolata* curve points to a renewal of anthropogenic disturbance. There is also evidence for two periods of recession in alder, with a fall at 20cm and another at 10cm that leads to its almost complete disappearance from the pollen record. There is little response to the reduction in *Corylus avellana*-type and *Alnus* from the ground flora recorded in the pollen record. *Calluna* is the only species to respond clearly, probably as a result of increasing deterioration in the soil resource. Assuming that alder was established on the marsh, as seems probable, then whatever form human activity took at this point had spread to the more marginal areas of the landscape. Table 7.3 summarizes the interpretation of the East Moor monolith diagram.

7.7 Summary

This section has described the results of the analysis of a sequence from the East Moor. The implications of this sequence for the vegetation history and anthropogenic role in environmental change have been discussed. The next section concerns the palaeoenvironmental investigations of a core from Watery Marsh.

Zone/depth cm	Main ecosystem represented	Inferred human impact/activity
EMM4 *5-25*	Acid grassland-heath. Alder-hazel decreasing.	Pastoral activity. Local settlement possible. Peak in burning.
EMM3 *25-62.5*	Grass-heath land with patches of hazel. Alder expanding.	Local settlement. Clearance of scrub. Pastoral activity. Increase in burning.
EMM2 *62.5-77.5*	Open scrub/damp grassland.	Clearance begins.Unintensive pastoral activity. Burning low
EMM1 *77.5-120*	Dense hazel scrub with with oak and perhaps some birch and elm.	Small scale disturbance possible. Burning low.

Table 7.3: Summary of East Moor Monolith pollen diagram

7.8 The Watery Marsh Core: Introduction

This section will discuss the analysis of a sequence from Watery Marsh on the north-eastern edge of the East Moor plateau (Figure 6.1). The site was described in further detail in Chapter 6.

7.9 Methods

Survey followed the procedure described in Chapter 2. Sampling was in part dictated by the evidence of disturbance to the marsh in the form of peat cutting. This was particularly evident on the western fringes of the mire, but other areas of the bog also bore signs of disturbance. In an attempt to avoid coring in a location that had been cut for peat, attention was focused on the apparently least disturbed part of Watery Marsh. A core was extracted from the deepest part of the mire. A Wardennar corer (Wardennar, 1987) was used to remove the top metre of peat (Plate 7.3), and a standard Russian corer to sample the bottom 50cm. Stratigraphic description, pollen sub-sampling and preparations followed the standard procedures described in Chapter 2.

Radiocarbon dating

One sample has been submitted from the base of the Watery Marsh diagram for radiocarbon dating (Chapter 2, Table 2.1).

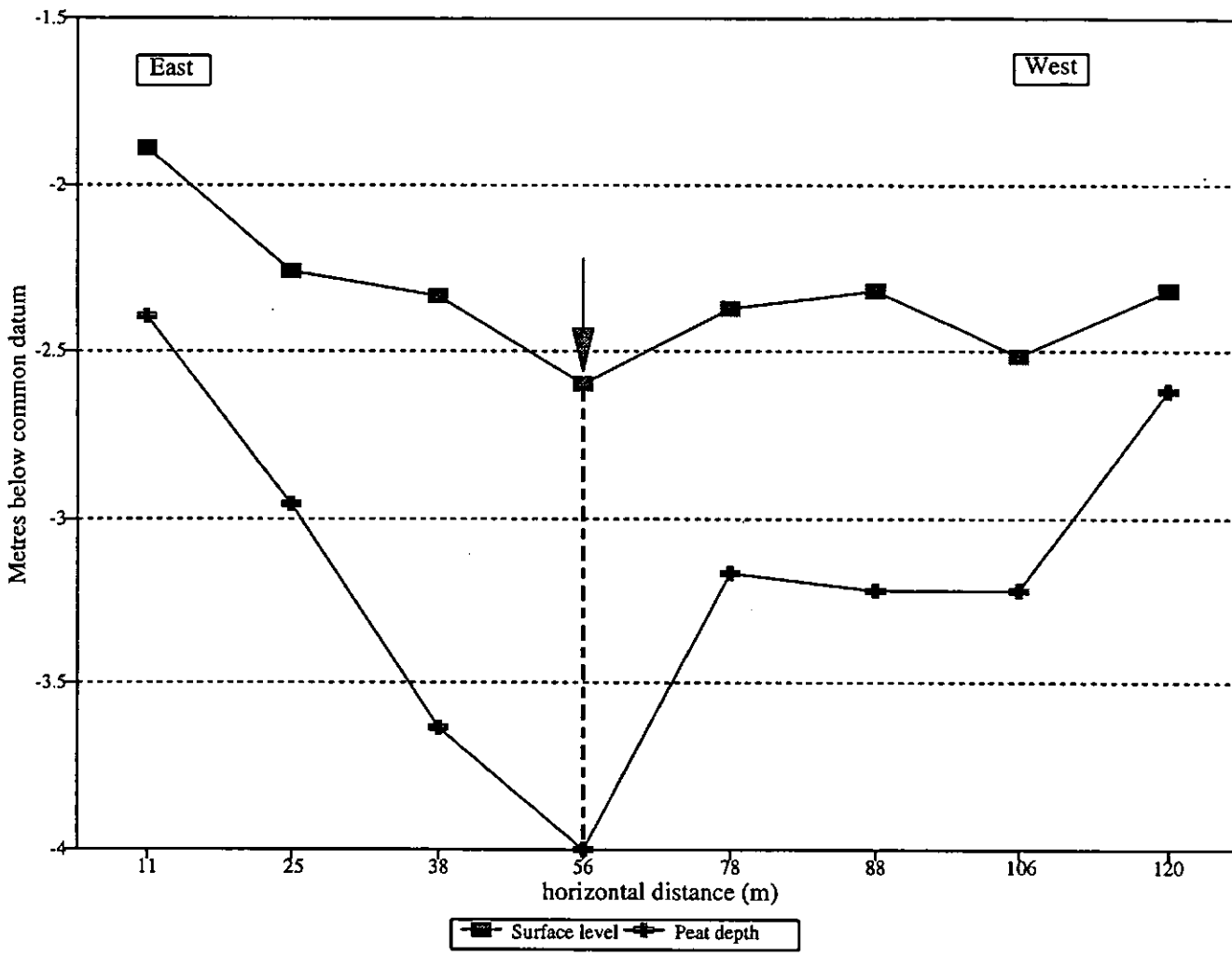
7.10 Results

Survey

The survey transect of the marsh are presented as a graph (Figure 7.5). The sampling site is marked with an arrow.

Plate 7.3: The Wardennar corer in operation at Watery Marsh.

Figure 7.5: The survey transect (east-west) of Watery Marsh. Coring location is marked with an arrow.



Lithostratigaphy

The lithostratigraphy of the core is described in Table 7.4. The core consisted of well humified brown peat with gravel at the base of the sequence. There were no identifiable macrofossils in the sediment, except rootlets and fragments of Cyperaceae.

Loss-on-ignition

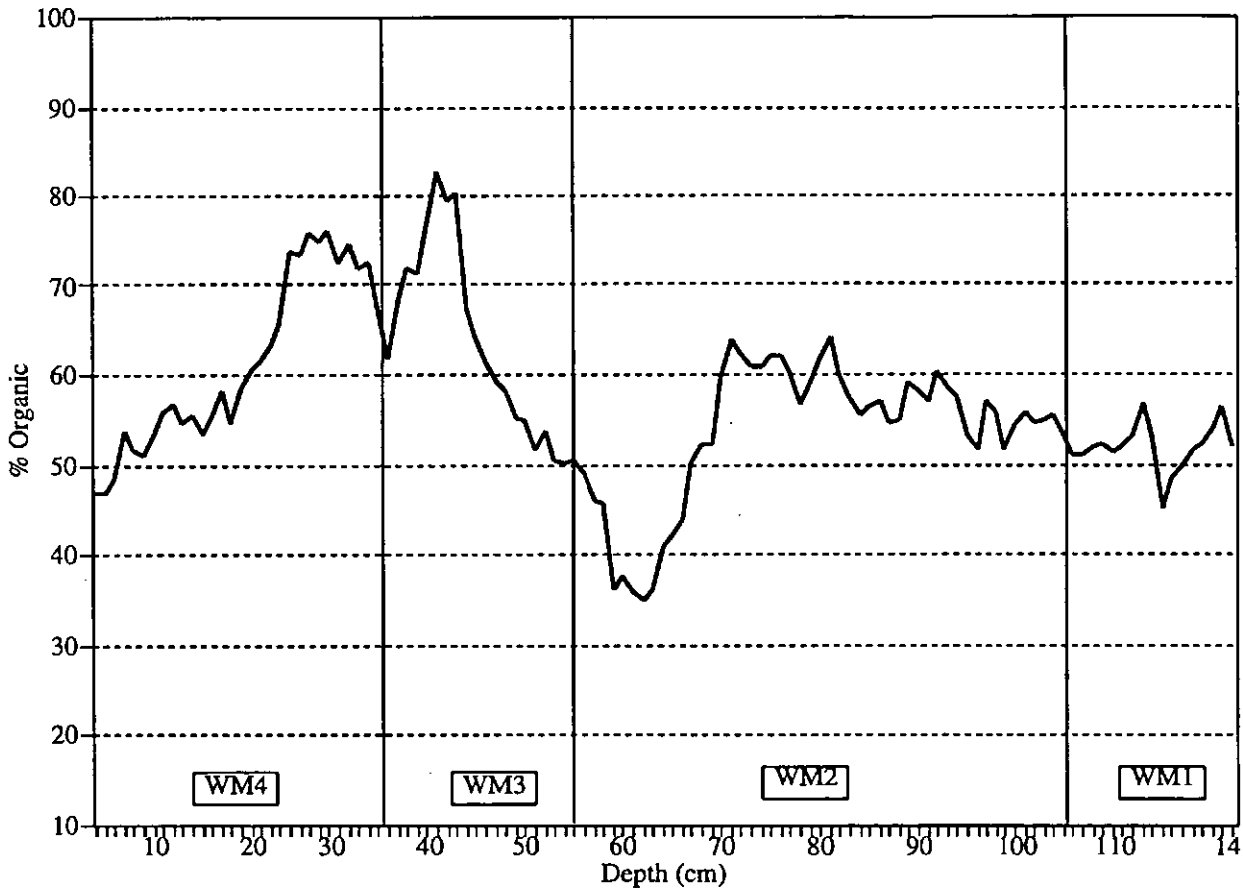
The results of the loss-on-ignition determinations are presented as a graph (Figure 7.6). Organic matter percentages are generally between 50-60%. There is a fall in values from 70cm to below 40% by 60cm that might suggest increased flushing of mineral material onto the mire surface. This is followed by a gradual recovery to a peak of over 80% by 40cm. Following this there is a steady fall in organic percentages to below 50% by the top of the sequence. The significance of these results is discussed further below.

Pollen analysis

The results of the pollen analysis are presented as a percentage diagram (Figure 7.7) and a concentration diagram (Figure 7.8) created using the computer program TILIA (Grimm, 1991). The zonation of the diagram is summarised in Table 7.5.

Large numbers of spores, especially *Sphagnum* and low pollen concentration, made counting 300 pollen grains difficult at certain levels of the core. Preservation was generally good suggesting that the low pollen concentrations were due mainly to this inclusion of large numbers of the pollen of taxa growing on the sampling site and not to post-depositional processes, such as differential decomposition. In these cases, one complete slide was counted. This resulted in counts as low as 150 grains at some levels, but it was thought that any information that would be obtained from carrying on to a count of 300 was not worth the extra time spent counting. The low proportions of terrestrial pollen (excluding Poaceae) are probably significant in terms of the status of the local presence of trees and other

Figure 7.6 Watery Marsh Core organic matter determined by loss-on-ignition.



Depth(cm)	Description	Troels-Smith
0-140	Brown peat, increasingly humified with depth. Some rootlets.	Sh3/Th1 Nig.2 Strf.0 Elas.2 Sicc.2 Humo.3
140-152	Brown well humified *Sphagnum* peat trending into gravel at base of core.	Sh2/Tb2 Nig.2 Strf.0 Elas.2 Sicc.2 Humo.4 Sh3 Gg(maj)+

Table 7.4: Lithostratigraphy of the Watery Marsh core

dry land taxa around the marsh.

7.11 Discussion: interpretation of the Watery Marsh pollen diagram

The status of local tree and shrub cover

Total arboreal pollen in the lowest sample (150cm) of WM1 is 30%, of which *Alnus* makes up 24% (Figure 7.7). The interpretation of *Alnus* percentages in pollen diagrams has been the subject of some debate (see section 7.4). The interpretation advanced here is of a scattered local presence of alder on the damper soils around the fringes of the marsh. The other arboreal pollen component comprises *Betula*, *Ulmus* and *Quercus*. None of these levels are sufficient to indicate the presence of anything but a very sparse occurrence of elm or oak in the vicinity of Watery Marsh and these percentages probably represent the regional pollen rain. Some birch may have been present. More extensive areas of woodland may have been present at some distance from the sampling site.

It is not clear whether *Corylus avellana*-type in WM1 represents *Myrica gale* or *Corylus*. Considering the nature of the sampling site, the possibility that *Myrica* was growing on the bog surface cannot be discounted. The evidence for the presence of hazel cover during the Holocene from other sites on the East Moor (East Moor Monolith, this study; Brisbane & Clewes, 1979) can be taken as indicating that at least some of the pollen in this case can be attributed to *Corylus*. If this is the case, then some hazel scrub on the better drained slopes around the marsh is envisaged.

Herbaceous pollen increases from 50% to above 70% during WM1, the major contribution to this coming from Poaceae. *P.lanceolata* is present as a continuous curve from 150cm, and *Potentilla*, Lactuceae indet. and other herbs such as *Galium*-type, Caryophyllaceae and *Artemisia* are also recorded. The herb pollen

Figure 7.7: Watery Marsh core percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration x10.

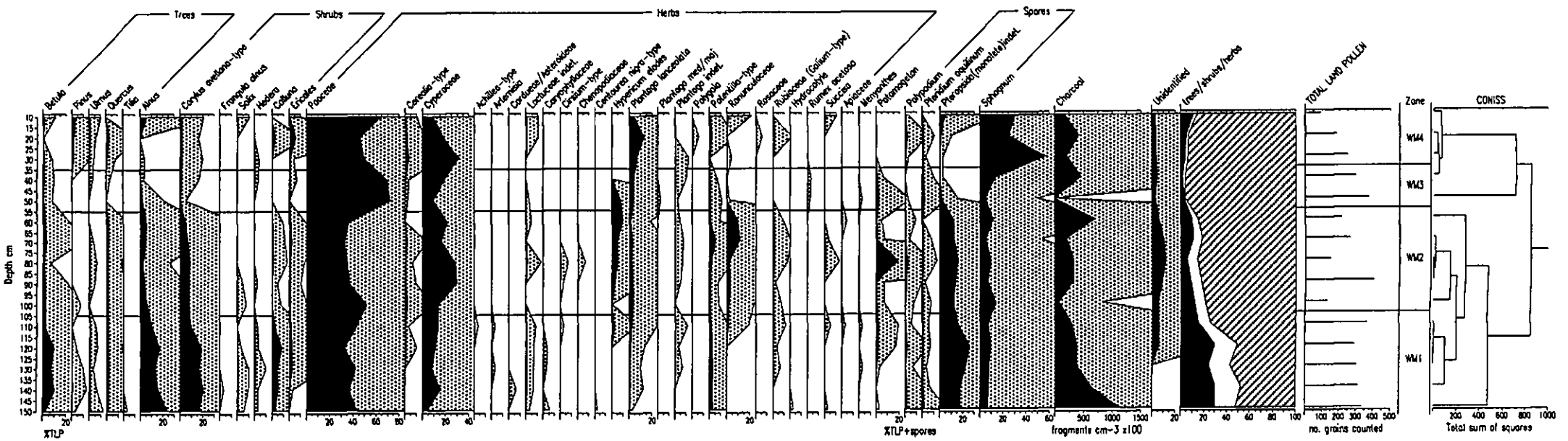
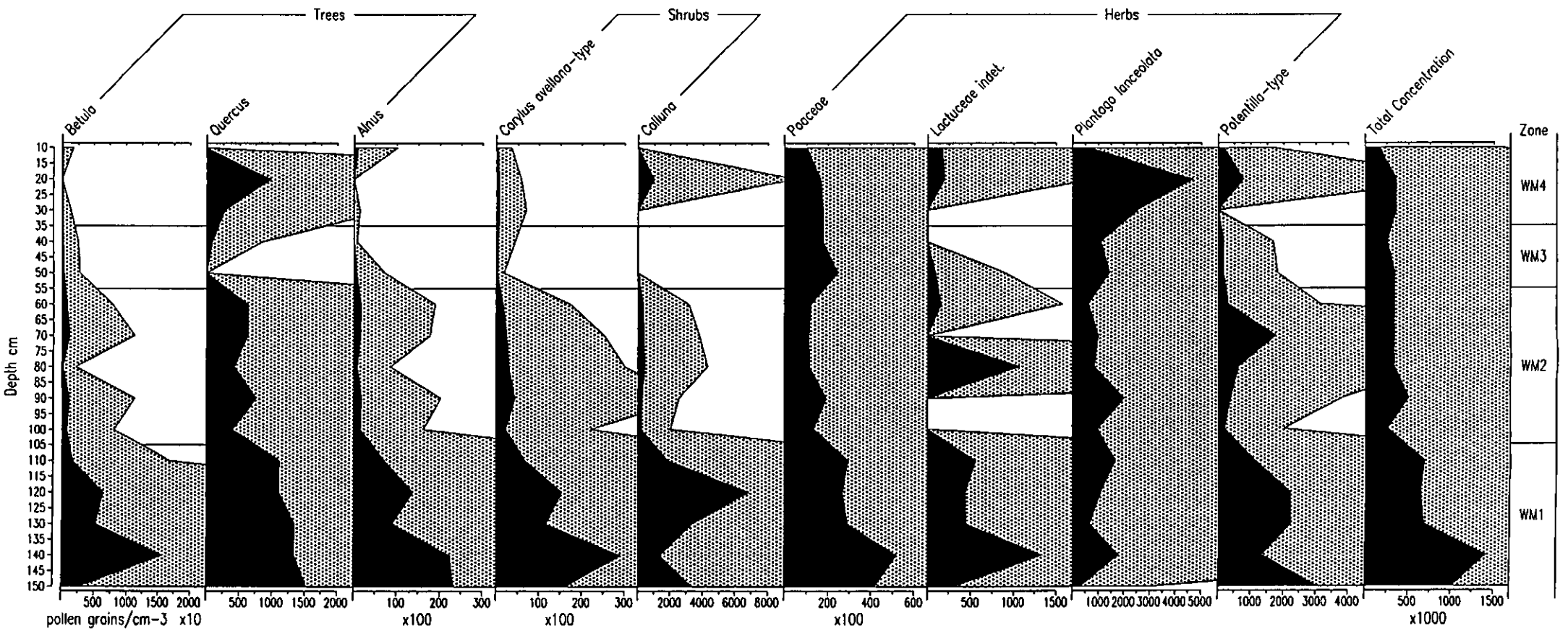


Figure 7.8: Watery Marsh core concentration diagram (selected taxa). Values are of pollen grains cm^{-3}. Exaggeration x10. NB. change in horizontal scale.



Phase	Depth (cm)	Description of Main Features of Zone
WM4	10-35	Poaceae falls at opening of zone to 45%, before recovering to >60%. Herb pollen low, except *P.lanceolata* which increases to 13% before falling again to 4%. Cyperaceae peaks for diagram at >30%, before declining to <10%. Tree pollen very low, although *Alnus* increases to 6% and *Pinus* to 3% by close of diagram. *Sphagnum* peaks at 137% TLP+spores.
WM3	35-55	Poaceae peaks at > 70%. Other herbs low. *Hypericum elodes* and Ranunculaceae disappear from record. Filicales fall to <2% TLP+spores. Tree and shrub pollen fall to very low percentages.
WM2	55-105	Poaceae steady at c.35% across zone. *P.lanceolata* consistent at 2-4%. *Hypericum elodes* increases to peak at 10%. Ranunculaceae increases peak at 11%. Other herbs very low. Cyperaceae fluctuates between 15-30%. *Potamogeton* peaks at 20% before falling to below 1%. Tree and shrub pollen low. Filicales steady at 15-20% TLP+spores.
WM1	105-148	*Alnus* at 20% falling to 10% by close of zone. Coryloid at 14%, falling to 10%. Poaceae increases to >40%. *P.lanceolata* increases to 2%. Ranunculaceae increases to 4% before falling to <2%. Cyperaceae steady at 10-15%. Filicales at 50% at base of zone falling to 21%.

Table 7.5: Zonation of the Watery Marsh core pollen diagram

component would have been derived from two sources: the vegetation growing on the surface of Watery Marsh and from open areas on the land around the mire. Certain taxa are more likely to represent to the on-site component, such as Cyperaceae, whilst herbs such as *Plantago lanceolata* are rarely found in wetland environments. Poaceae could have originated from both sources, so changes in its percentages are more difficult to interpret in terms of vegetation change at a landscape scale.

A generally open grassland environment is portrayed by the pollen record during WM1 although there is some alder and birch probably growing on or around the mire and perhaps hazel on the surrounding slopes. Pteropsida (monolete) indet. are recorded across the zone suggesting fern communities nearby, perhaps as the understorey vegetation of the woodland. *Calluna vulgaris* increases across WM1 from 4% to 8% by 120cm. The concentration diagram (Figure 7.8) shows that *Calluna* concentrations double from 3.4 x 10^3 grains/cm^{-3} at 130cm to 6.8 x 10^3 grains/cm^{-3} at 140 cm, despite a decline in total concentration from 68.6 x 10^3 grains/cm^{-3} to 64.7 x 10^3 grains/cm^{-3}. Considering the poor dispersal properties of the pollen of the entomophilious *Calluna*, it seems likely that there was a certain area of heather present as part of the landscape mosaic. *Pteridium* is present at low values of 1-2%, but considering this taxons preference for better draining soils, bracken communities present at some distance from the sampling site would not be clearly reflected in the palaeoecological record. The occurence of *Cerealia*-type pollen at 120cm suggests the presence of arable land nearby.

The decline in local woodland

There is a fall in the pollen of the arboreal taxa at the close of WM1 and opening of WM2. Some alder and hazel probably remained near the marsh during this zone, although the contribution of more extensive stands of these trees at greater distances from the marsh cannot be discounted.

Heliophytes also take advantage of the increase in open areas, including Ranunculaceae. Ranunuculaceae could have been present either as part of the marsh vegetation or on the nearby grassy areas; either way the increase in this pollen is concurrent with the fall in the tree taxa at the opening of the zone and probably reflects the spread of herb communities, following the reduction in the extent of local woodland.

There are also changes in the marsh vegetation: *Hypericum elodes* increases steadily across the zone and *Potamogeton* also displays a sudden peak at 80cm. The presence of this pollen type indicates an increase in areas of standing water on the mire surface. The species represented is probably *Potamogeton natans*, which is able to grow in peaty, acidic and nutrient poor sites. The sudden peak and equally sudden fall in its percentages is consistent with its transient occurrence in mires (Grime *et al.*, 1988:458), although the continuing record of this pollen type suggests the persistence of pondweed as part of the mire vegetation.

The only dry-land herb to show a slight increase is *P.lanceolata.* Poaceae remains steady, despite the fall in tree pollen and rise in the pollen of ribwort plantain. The failure of Poaceae to increase substantially could indicate that there was little expansion in grassland, although the continuous representation of *P.lanceolata* shows the maintenance of open areas. Moore *et al.* (1986) demonstrate that although there is linear relationship between the representation of grass pollen and the abundance of grasses within 1 m of a sampling spot, grass pollen does not increase in proportion to the percentage of grasses. In view of this, open areas may have continued to expand but this process is not reflected in the percentages of Poaceae at the sampling spot.

The sparse record of Lactuceae indet. and *Galium*-type indicates the presence of other herbs as part of the grassy areas during WM2. The poor representation of these taxa in the pollen record is presumably due both to the swamping effect of

the pollen of local vegetation and the poor dispersal of the pollen of many of the low-growing herbs. The record of *Cerealia*-type pollen indicates the continuing cultivation of cereals in the pollen catchment of Watery Marsh. There is a fall in organic matter percentages from over 60% at 70cm to below 40% by 60cm suggesting increased flushing of mineral matter onto the mire surface (Figure 7.6). This may be related to the migration of a watercourse across the marsh: after heavy rain the marsh carries a great deal of drainage, during which sand and silt is often deposited on the mire surface. The course of these channels must change gradually over time, although it is not clear what role human disturbance might have in this.

The final spread of grassland

WM3 opens with an increase in Poaceae and corresponding falls in tree and shrub pollen. These changes are confirmed by the concentration data (Figure 7.8): Poaceae influx almost doubles from 12.3 x 10^3 grains/cm^3 at 60cm to 24.5 x 10^3 at 50cm, whilst *Quercus* decreases from 0.62 x 10^3 grains/cm^3 at 60cm to 0.08 x 10^3 by 40cm and *Betula* from 0.78 x 10^3 to 0.25 x 10^3.

As in the previous zone, there is little response from the herbaceous taxa apart from *P.lanceolata*, which increases to over 4%. The decline in *H.elodes* and Ranunculaceae indicates the reduction of these species on the bog surface. The reasons for these latter changes are unclear, although the effect of human disturbance is a possible explanation. There is also a sharp fall in Pteropsida (monolete) indet. percentages at the opening of WM3 that is closely related to the demise of the woodland taxa, *Alnus* and *Corylus avellana*-type. This would seem to support the suggestion made above that the ferns were part of the woodland habitat either as part of the ground layer or epiphytically associated with the trees.

WM3 therefore sees the final demise of any trees remaining in the pollen catchment of the marsh. Grassland has become the dominant habitat, with ribwort

plantain the only other significant component of the flora testified to in the palaeoecological record. A fall in Cerealia-type pollen may represent a reduction in the extent of cultivated land, although the increase in *P.lanceolata* suggests the continued maintenance of open areas. A decline in the species diversity of the local bog vegetation is recorded, although a single grain of *Menyanthes* at 50cm probably originated from this species growing on the surface of the marsh.

The high percentages of Poaceae in WM3 are not maintained into the final zone of the percentage diagram. This change is not as marked in the concentration data (Figure 7.8). Poaceae concentration remains fairly steady at 17.7 x 10^3 grains/cm^3 indicating that the increased representation of other land pollen is more responsible for the reduction in Poaceae percentages than an actual change in the extent of grasses, assuming a constant peat accumulation rate. *P.lanceolata* increases to reach its highest value for the diagram. This increase is also reflected in the concentration diagram: *P.lanceolata* concentrations rise from 2.5 x 10^3 grains/cm^{-3} at 30cm to 4.6 x 10^3 grains/cm^{-3} at 20cm. There is a slight increase in *Potentilla* to 1-2% at the same level, which is also confirmed by the concentration data: with an increase to 0.7 x 10^3 grains/cm^{-3} by 20cm. Other herb taxa continue to make only sporadic appearances in the pollen record, although the presence of *Galium*-type, *Polygala*, Lactuceae indet. and slight increases in *Calluna* and Ericales undiff. portray a damp, acid grassland environment, with perhaps some expansion in heathland. An increase in *Cerealia*-type to a peak of 3% at 30cm may imply an intensification in arable farming.

WM4 sees slight increases in *Pinus, Alnus* and there is also a subdued expansion in *Ulmus* and *Quercus*. The concentration data indicate a marked increase in *Quercus* concentrations from 0.2 x 10^3 grains/cm^{-3} at 30cm to 0.9 x 10^3 grains/cm^{-3} The small scale of these figures and the fact that the representation in herb pollen is not significantly affected provides the impression that any increase in woodland was occurring on an extra-local or regional scale. Increases in Cyperaceae and

Sphagnum might be due to increasingly damp conditions on the surface of the mire, perhaps due to a rise in the watertable. The precise mechanisms responsible for these hydrological changes on the bog are unclear but are possibly related to peat cutting of the bog surface.

The Watery Marsh pollen diagram charts the development of the vegetation in this part of the East Moor from a generally open grassland, with some alder and birch on the moister soils and perhaps hazel on the better draining slopes, to an acidic grassland with few herbs other than *Potentilla* and *Galium* as constants. By the final zone of the diagram, trees are probably only present in scattered copses in more sheltered locations.

7.12 Interpretation of the charcoal record

Microscopic charcoal is present at consistently low levels in the Watery Marsh sequence. There was no macroscopic charcoal evident, either in the form of fragments encountered during cleaning and sub-sampling of the sediment, or retained on the sieve during pollen preparations.

There is a fall in microscopic charcoal levels during WM1. This might be related to a reduction in anthropogenic activity early in the zone. If this is the case, it is not clearly reflected in the pollen data. There is no increase to mark the intensification of human activity in WM2 and charcoal levels remain fairly uniform for much of the rest of the sequence. The peak in charcoal at 60cm corresponds to a drop in organic matter to 35% - its lowest value for the sequence. Both events may be linked with human activity in the marsh's catchment.

7.13 Vegetational change and human impacts at Watery Marsh

The timing of peat inception at Watery Marsh: possible implications for early tin streaming activity

There is evidence for a human presence from the basal zone of the Watery Marsh pollen diagram in the form of low levels of tree and shrub pollen, high percentages of Poaceae and the occurence of pollen of ruderal taxa. If this is a correct assumption, then peat accumulation at this site began very much later in the Holocene than would be expected for a valley mire.

Two hypotheses for such a late date for peat inception can be put forward. Firstly, the accumulation of sediment did not begin at Watery Marsh until much later than is the case in other valley mires on Bodmin Moor. The alternative hypothesis is that there was earlier peat accumulation which was destroyed or removed resulting in a renewed build-up of sediment subsequent to the period of disturbance. There is nothing to suggest that the Watery Marsh basin would have been any more or less ideal for peat accumulation than the other valley mire sites containing longer temporal sequences that have been investigated during the course of this project (see Chapter 4 part I, Rough Tor Marsh, and Chapter 7 part II, Tresellern Marsh). The first hypotheses may therefore be provisionally discounted, leaving the suggestion that previous peat accumulations at this site were destroyed or removed in some way.

The most probable cause of such destruction is tin-streaming. Palaeoecological investigations accompanying the archaeological excavation of tin works at Colliford, St.Neot centred on a peat sequence from a valley mire containing a similar depth of sediment to Watery Marsh (150cm). The basal peats were not dated, but a date of AD 600-700 for the initiation of peat accumulation was extrapolated from a radiocarbon date from higher up the profile. It was postulated

that tin-streaming had removed the original body of sediment. If this is the case, then peat evidently starts accumulating on valley floors very rapidly following the abandonment of old tin workings (Austin *et al.*, 1989:225).

In the absence of radiocarbon dates, it is not possible to provide a precise date for peat inception at Watery Marsh. If tin streaming was responsible for the destruction of earlier peat at this site, then radiocarbon dating of the base of the sequence has the potential to provide direct evidence for the exploitation of tin from a very early (late prehistoric?) date on Bodmin Moor.

Palynological evidence for farming activity

The basal pollen assemblage zone reflects a landscape of open grassland with limited wood and scrub cover. The decreasing percentages of *Alnus* and possibly *Corylus* and gradual increase in Poaceae and other grassland indicators suggests that anthropogenic clearance activity was responsible for reducing the local tree populations. There is evidence for agricultural activity in the form of *Cerealia*-type pollen and 'pastoral indicators' such as *P.lanceolata.*

Large Poaceae pollen grains were observed at many levels of the Watery Marsh sequence, some of which have been identified as *Cerealia*-type (based on the criteria described in Chapter 2 section 2.5) (Plates 7.5-7.9 & Table 7.6). Some may have been derived from wild grasses (*Elymus* sp., *Agropyron* sp.) and reeds (*Glyceria, Phragmites*), but other grains satisfied the identification criteria for cereal pollen. Cereals are low pollen producers (Behre, 1981) and are not usually dispersed far beyond where the cereals are growing (Vuorela, 1973; Sergerstrom, 1991). Hall (1988; 1994) found that percentages of cereal pollen fell from between 9-23% from surface samples obtained from beneath a cereal crop to 1% at distances greater than 1.5m from the edge of the cultivated field.

Depth (cm)	Average size (µm)	Annulus diameter (µm)	Pore diameter (µm)
10	42.5	10	5
20	42.5	15	-
30	46.5 37.5 - 45.7 45.7 47	12 7.5 15 12.5 12.5 12.5	- - 5 5 7.5 5
40	46.5	15	-
50	44	13	6
70	41.5 38.75 37.5 39.6	12.5 12.5 10 -	- - 5
80	50	12.5	-
90	37	10	-

Table 7.6: Table summarising *Cerealia*-type pollen grains recorded in the Watery Marsh diagram. '-' indicates measurement was not possible due to orientation of grain.

Plates 7.4 (top) & 7.5 (bottom): Photomicrographs of *Cerealia*-type grains from Watery Marsh core. Magnification x1000.

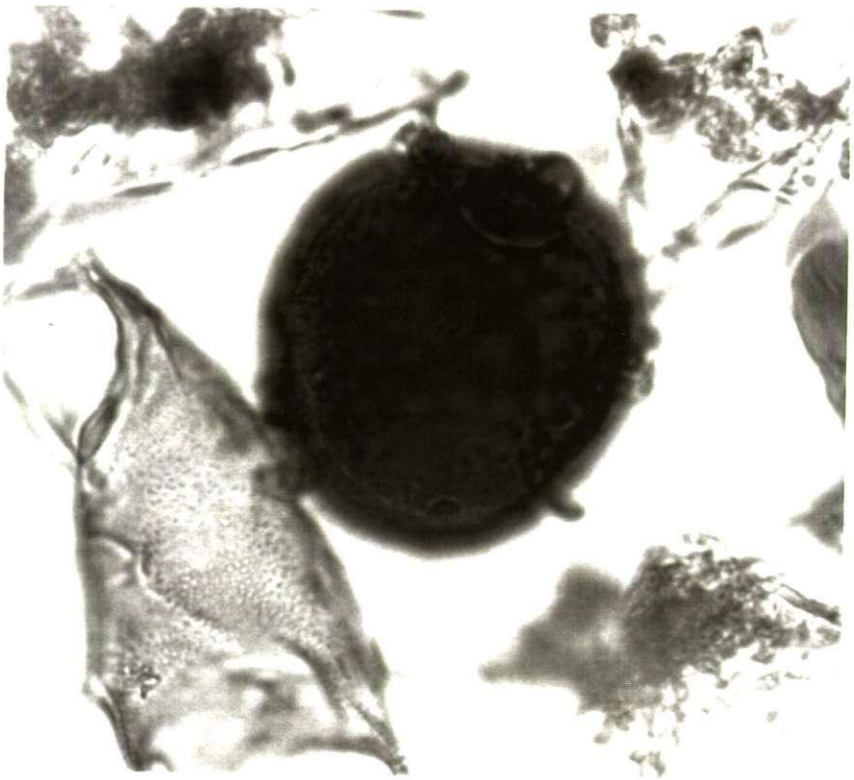
7.4: Depth - 10cm; size - 42.5µm; Annulus - 10µm; Pore - 5µm.

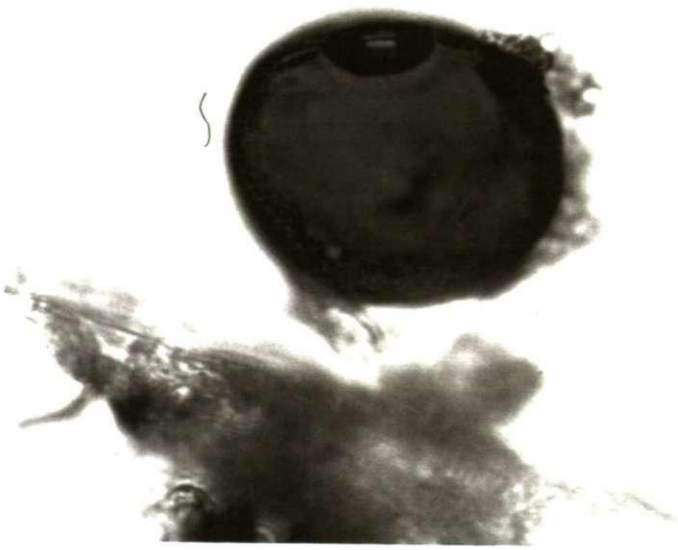
7.5: Depth -30cm; size - 44µm; Annulus - 10µm.

Plates 7.6 (top) & 7.7 (bottom): Photomicrographs of *Cerealia*-type grains from Watery Marsh core. Magnification x1000.

7.6: Depth - 50cm; size - 44µm; Annulus - 13µm; Pore - 6µm.

7.7: Depth - 70cm; size - 37.5µm; Annulus - 12µm; Pore - 5µm.





The presence of *Cerealia*-type pollen therefore suggests that the cultivation of cereals was being carried out in the pollen catchment area of the sampling site. There is no consistent record of the pollen of weeds typical of arable land, although it is possible that certain taxa, such as Chenopodiaceae and *Cirsium* were present as weeds of cultivated land or that species such as ribwort plantain were present on the edges of arable fields. Other ruderals, such as *Galium*-type and *Potentilla*-type are rarely found in arable contexts

Although care must be taken in attributing ecological preferences to taxa in prehistory (Behre, 1981), the suite of weed pollen present in the Watery Marsh diagram is typical of pasture and meadow-land. These taxa include *Plantago lanceolata, Potentilla, Galium*-type and probably also Ranunculaceae and Lactuceae indet. *Potentilla* (probably *P.erecta*) is often found in heavily grazed pasture (Behre, 1981), particularly as it is unpalatable to stock (Grime *et al.*, 1988:460). *Plantago lanceolata* is probably also a weed of pasture, although its presence alongside *Cerealia*-type pollen might imply that it is related more generally to the maintenance of grassy areas, whether meadow, the fringes of arable fields or fallow land. The steady but sustained nature of the decline in *Alnus* and perhaps *Corylus* may be as much a result of grazing pressures restricting the regeneration of saplings as the direct cutting of wood for firewood or other domestic purposes. The charcoal record does not suggest that fire was involved in the clearance process: the use of fire would have been unneccesary in view of the sparse distribution of trees.

There is an increase in *Plantago lanceolata* and Poaceae in WM3 and decrease in *Cerealia*-type pollen. Tree and shrub pollen reaches its lowest representation for the diagram. This may imply that there was an intensification in anthropogenic activities, especially pastoral farming, although there are reductions in the percentages of indicators of damp pasture such as *Potentilla* and *Galium*-type. *Rumex* makes its only appearance for the diagram in this zone, possibly indicating

the development of more acid pastures. The peak in *P.lanceolata* in WM4 may also indicate an increase in the intensity of grazing activity, although there is also a rise in *Cerealia*-type pollen suggesting a renewed emphasis on cultivation. The interpretation of the Watery Marsh pollen diagram is summarised in Table 7.7.

Problems of interpretation of the cereal pollen record

A feature of the Watery Marsh pollen diagram is the more or less consistent representation of *Cerealia*-type pollen. The very poor dispersal capacity of cereal pollen mentioned above means that the presence of quantities of this pollen type in the palaeoecological record is usually taken to indicate arable agriculture within a short distance of the sampling site.

If the record of cereal pollen at Watery Marsh is interpreted in this way, then it raises questions concerning both the chronological depth of the sequence and the history of land-use on the East Moor. The only definite archaeological field evidence for cultivation near to Watery Marsh is that of the medieval period. The field systems of Bowhayland some 200m to the south of Watery Marsh probably belong to this period and there is also evidence for medieval out-field cultivation in the form of ridge and furrow immediately to the east of the marsh, although this was probably very transient (P.Rose, pers.comm.). There is no unambiguous evidence for cultivation during the prehistoric period, although Brisbane & Clewes (1979) point out that a cultivation phase prior to construction of the co-axial boundaries cannot be ruled out.

Zone/depth cm	Main ecosystem represented	Inferred human impact/activity
WM4 *10-35*	Grassland.	Intensification of pastoral activity. Some local cultivation possible.
WM3 *35-55*	Grassland.	Clearance of remaining hazel-alder.Pastoral activity.
WM2 *55-105*	Grassland with patches of hazel-alder scrub.	Clearance of alder, hazel and birch. Sporadic cultivation locally. Pastoral activity.
WM1 *105-150*	Hazel-alder scrub with some birch. Open, grass and heath areas.	Any human activity small scale or at some distance from sampling site. Decrease in burning.

Table 7.7: Summary of the interpretation of the Watery Marsh pollen diagram

Several hypotheses may be generated to account for the continuous record of cereal pollen at Watery Marsh. The first is that the palaeoecological record is recording local cultivation and the growth of cereal has been in progress locally for longer than is usually assumed. Secondly, the palynological record covers considerably less time than might be expected and the cereal pollen in the diagram is the product of a single cultivation phase (medieval?). Alternatively, a more extensive span of time is involved and the cereal pollen curve is recording regional as opposed to local cultivation.

7.14 Summary

Palaeoecological research on the East Moor plateau has focused on two sites: the East Moor monolith and Watery Marsh. The monolith diagram appears to represent the longest temporal sequence, whilst the sequence from Watery Marsh is interpreted as representing later peat accumulation following the removal of earlier sediments, probably by tin-streaming. The second part of this chapter will be concerned with palaeoecological research in the Withey Brook valley and will discuss the analysis of two cores from Tresellern Marsh.

Chapter Seven:
Part II
Palaeoecological Research on the East Moor - the Withey Brook Valley

7.15 Tresellern Marsh: Introduction

This part of the chapter describes the results of the analysis of two cores from Tresellern Marsh (Plate 7.8) in the Withey Brook valley (Figure 6.1; Plate 7.9). Further details of the site are given in Chapter 6. The present vegetation of the marsh is dominated by *Molinia caerulea* with *Carex nigra* and *Lotus uliginosus*. The drier parts of the marsh are characterised by *Potentilla erecta, Festuca ovina* and *Juncus effusus*, whilst *Sphagnum* sp., *Narthecium ossifragum, Succisa pratensis, Menyathes trifoliata, Cirsium palustre, Galium palustre* and *Salix* sp. are present in the damper areas.

7.16 Methods

Sampling and other techniques were carried out according to the standard procedure described in Chapter 2. The western end of the marsh had clearly been disturbed by peat cutting, whilst removal of peat was also apparent in certain parts of the eastern part of the mire. This restricted the choice of coring site. Two cores were extracted using a Russian corer and following the standard sampling process outlined earlier - one from close to the northern edge (SX244764: TMA) and another from near to the centre of the marsh (SX243764: TMB). By sampling two cores, it was hoped to improve the chances of identifying any peat cutting activity that might have curtailed the sequences.

Plate 7.8 (top): Tresellern Marsh looking south-west.

Plate 7.9 (bottom): The Withey Brook valley looking south-west from Bastreet Downs. Tresellern Marsh is visible in the middle distance.

Six samples were submitted for radiocarbon dating on the basis of pollen-stratigraphical changes.

7.17 Results

lithostratigraphy

The lithostratigraphy of the cores is described in Table 7.8 and 7.9.

Both cores were brown, well humified peat with no identifiable macrofossils except rootlets. The basal section of TMA was grey clay but that of TMB consisted of black, very well humified peat, although this core was longer.

Magnetic susceptibility

The results of the Tresellern Marsh B core magnetic susceptibility measurements are presented as a graph (Figure 7.9) The Tresellern Marsh B core has negative susceptibility readings, reflecting the diamagnetic nature of both the sediment and the plastic tubing the core was contained in whilst the susceptibility readings were being carried out. A low peak of 0.05 is recorded at 48cm but cannot be related to the effects of vegetational changes or human impacts on catchment soils as the pollen record from this core is incomplete (see below). Another slight increase from -0.2 to 0 is recorded at 94cm. The loss-on-ignition data (Figure 7.11) show that the sediment around this level is 90% organic, implying that it is unlikely that this increase in susceptibility is a result of increased inwash of eroded material onto the marsh surface. It is probable that the loss-on-ignition data are a better proxy measure of the relative mineral content of the sediment.

Loss-on-ignition

The results of the loss-on-ignition determinations are presented as graphs (Figures 7.10 and 7.11).

Depth (cm)	Description	Troels-Smith
0-72	Dark brown well humified peat. Some rootlets present.	Sh3/Th1 Nig.3 Strf.0 Elas.3 Sic.2 Hum.3
72-87	Grey minerogenic clay trending into gravel at base.	Ag4 Nig.1 Strf.0 Elas.0 Sic.2

Table 7.8: Stratigraphy of Tresellern Marsh A Core

Depth (cm)	Description	Troels-Smith
1-45	Dark brown peat. Many rootlets present.	Th3 Nig.3 Strf.0 Elas. 1 Sic.2 Hum.2
45-96	Dark brown well humified peat.	Sh 3 Nig.3 Strf.0 Elas. 1 Sic.2 Hum.3
96-125	Black very well humified peat.	Sh3 Nig.4 Strf.0 Elas. 1 Sic.1 Hum.4

Table 7.9: Stratigraphy of Tresellern Marsh B Core

Figure 7.9: Magnetic susceptibility of the Tresellern Marsh B core. Units are of uncalibrated volume mass suseptibility (dimensionless units).

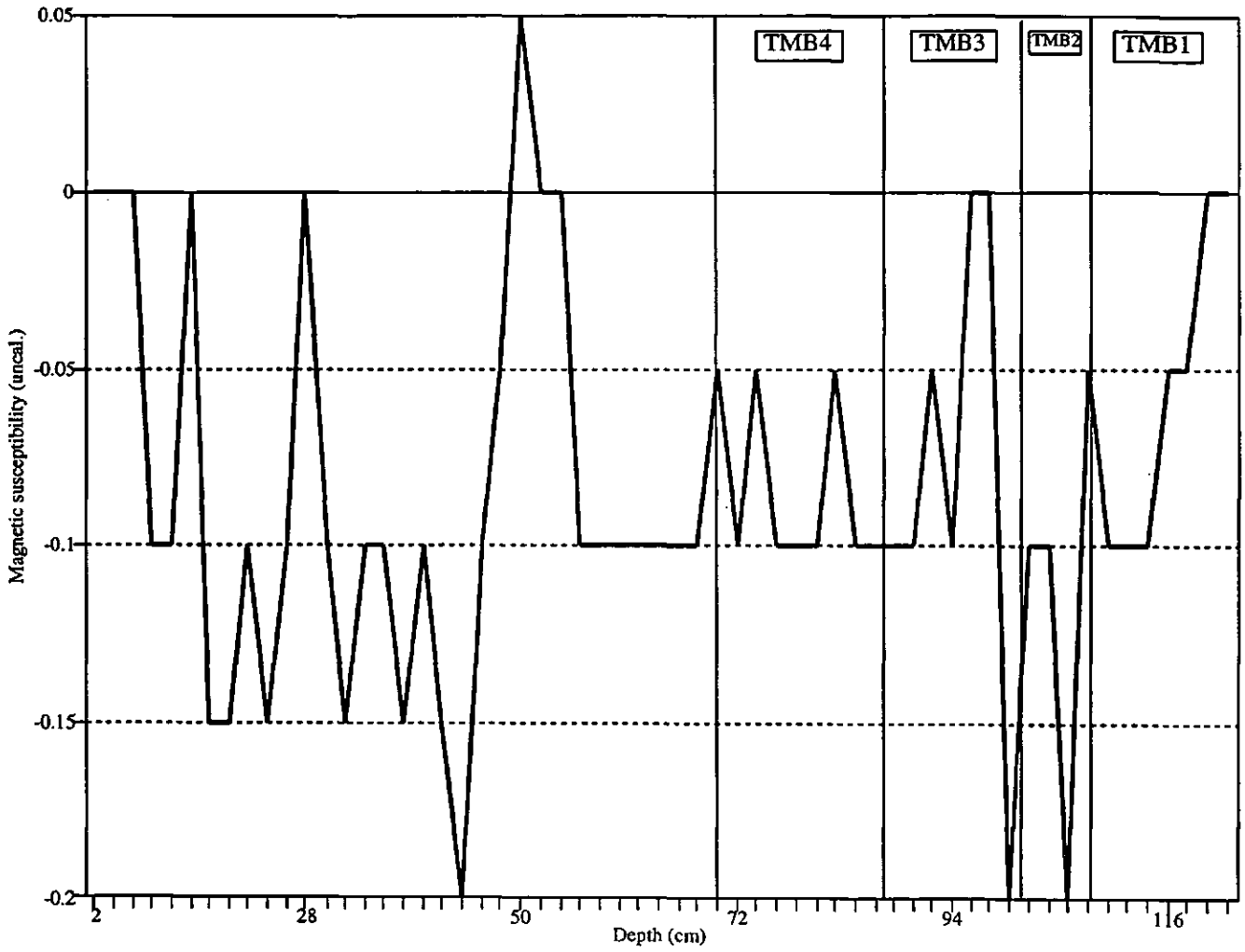


Figure 7.10: Tresellern Marsh A core organic matter determined by loss-on-ignition.

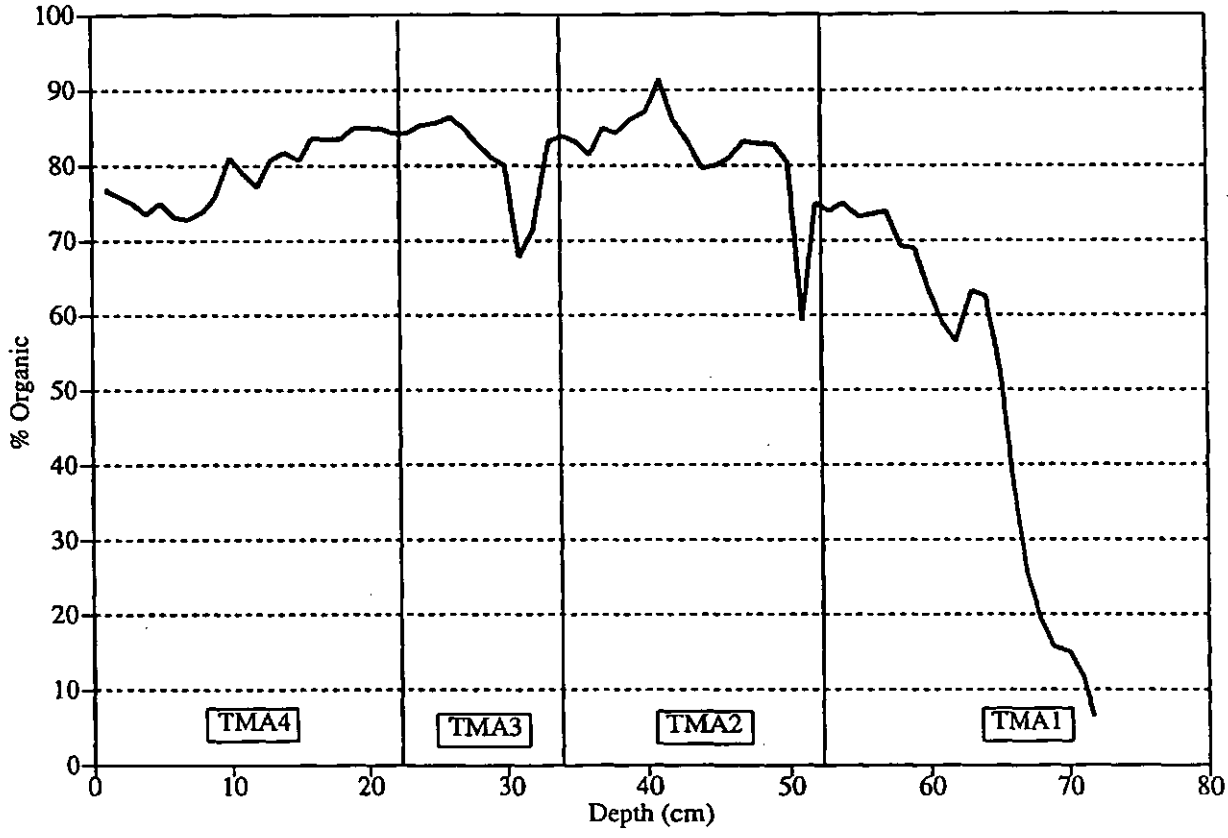


Figure 7.11: Tresellern Marsh B core organic matter determined by loss-on-ignition.

Sample/depth-cm	Lab. no.	Uncalibrated date Radiocarbon yrs. BP (±1sd)	Calibrated calendrical age (2 sigma -95% probability)
TMA 10-20	Beta-84823	990±80	cal.AD890-1225
TMA 25-35	Beta-84824	1830±70	cal.AD45-380
TMA 40-50	Beta-84825	2880±60	1130-940cal.BC
TMB 104-109	Beta-84826	920±60	cal.AD1065and1075 and cal.AD1155
TMB 78-82	Beta-84827	3360±60	1705-1535cal.BC
TMB 93-100	Beta-84828	4080±80	2865-2810cal.BC & 2695-2485cal.BC

Table 7.10: Radiocarbon dates for Tresellern Marsh A and B cores.

Tresellern Marsh A core: Organic values increase from below 10% at the base of TMA core to above 60% by 60cm. The values are generally over 80%, although there is a fall to below 70% at 30cm and a steady decline to below 80% after 10cm. The basal sediment is a grey minerogenic clay which presumably represents early inwash into the valley, before vegetation cover had stabilised the soils on the valley sides.

Tresellern Marsh B core: Organic values fluctuate between 65-80% at the base of the TMB core before increasing to stabilise at over 85% at the opening of TMB2. There is a fall in organic percentages to below 80% at 90cm. Values recover to above 90% at around 85cm. There is another fall to below 80% at 80cm and a recovery to 95% before a sharp fall to below 65% at 70cm.

Radiocarbon dating

The radiocarbon dates are given in Table 7.10. The samples from the TMA core were 10cm thick in order to obtain sufficient material for dating. The lowermost date from Tresellern Marsh B core is younger than the two above it. This is probably due to contamination by later rootlet penetration and the date is therefore regarded as anomalous. It is unlikely that the other two dates have been affected by the inwash of older carbon.

Pollen Analysis

The results of the pollen analysis are presented as graphs produced using the computer program TILIA and TILIA*GRAPH (Grimm, 1991). A percentage diagram (Figures 7.12 and 7.14) and concentration diagram (Figures 7.13 and 7.15) is presented for each. The pollen diagrams have been zoned (Tables 7.11 and 7.13) for interpretation.

Pollen concentrations were found to be too low to provide reasonable counts in the top 70cm of TMB core. This is probably a result of only partially anaerobic

conditions in the upper layer of peat, due either to the rapid accumulation of loosely compacted peat (cf. Walker, 1982) or the drying out of the mire surface following a fall in the watertable (cf. Lowe, 1982). The effects of peat cutting and/or tin streaming further down the valley on the hydrology of the bog may be responsible. The results of the pollen analysis of each core will be discussed separately before an attempt is made to integrate the palaeoecological record from each location.

7.18 Discussion: interpretation of the Tresellern Marsh A Core pollen diagram

Alder carr in the Tresellern Valley: TMA 1

Alnus is present at very high percentages in the lowest sample (70cm) of this diagram (Figure 7.12) whilst other tree pollen percentages are very low. Allowing for the 'swamping' effect of the pollen of the local alder growth, birch and oak may have been present as minor components of the vegetation on the land around the mire. The concentration diagram (Figure 7.13) confirms the increase in *Corylus avellana*-type at 60cm and also indicates increased concentrations of Lactuceae indet. and *Betula*. *Corylus avellana*-type increases from 12.5 x 10^3 grains/cm^3 at 70cm to 45 x 10^3 grains/cm^3 at 77cm and *Betula* demonstrates a large increase from 0.9 x 10^3 grains/cm^3 to 4.9 x 10^3 grains/cm^3 over the same levels.

There was apparently a reduction in both alder and oak populations at this stage, although the absence of significant increases in the herbaceous taxa suggests that this was either on a small scale locally or was happening at some distance from the site. Presumably *Corylus* was taking advantage of the reduction in *Quercus* on better drained soils, whilst *Betula* was responding to the reduction of *Alnus* on the peatier soils of the lower lying areas on and around the valley floor.

Figure 7.12: Tresellern Marsh A core percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration x10.

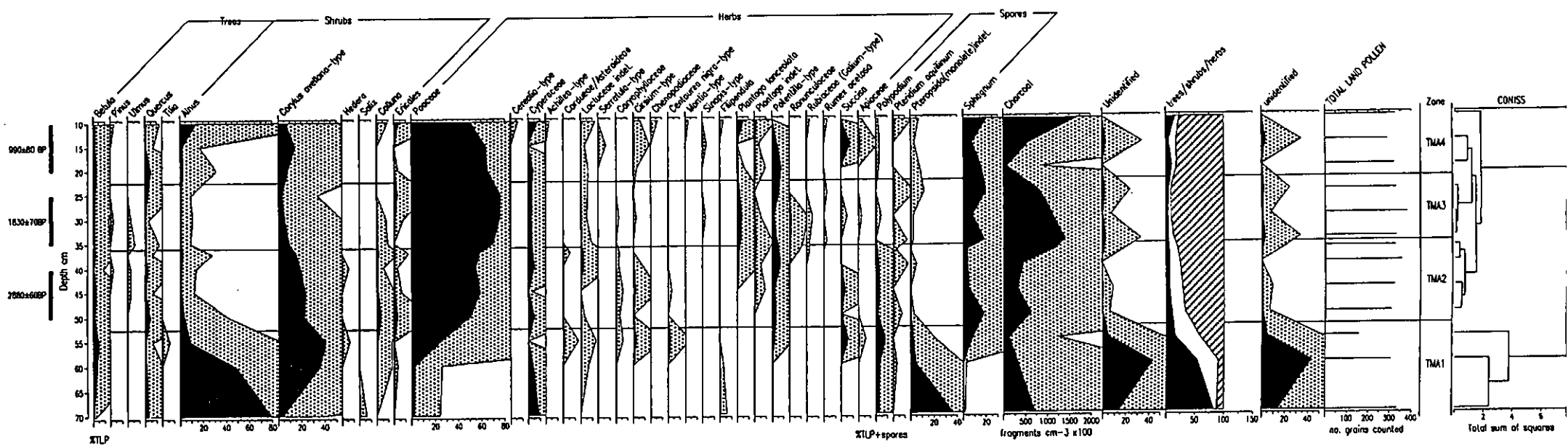
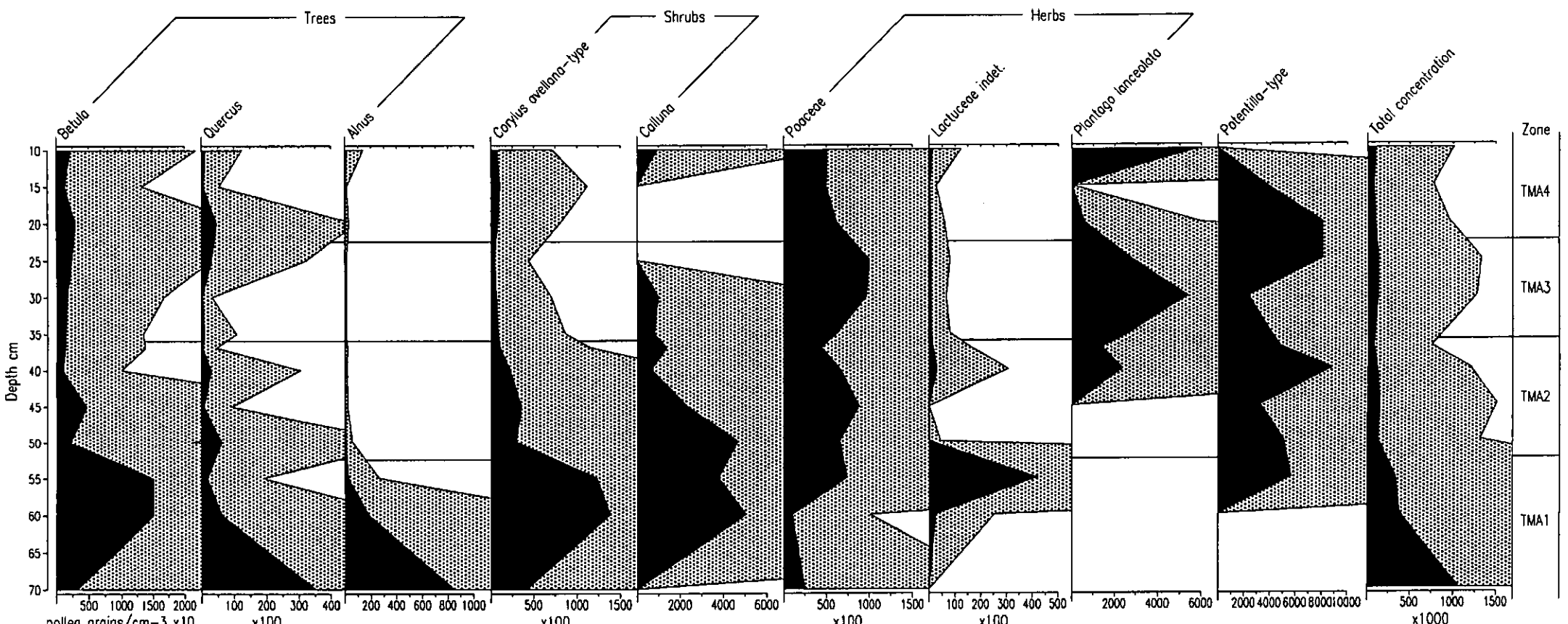


Figure 7.13: Tresellern Marsh A core pollen concentration diagram (selected taxa). Values are of pollen grains cm^{-3}. Exaggeration x10.NB. change in horizontal scales.



Zone	Depth (cm)	Description of Main Features
TMA 4	17.5-10	*Corylus avellana*-type increases slightly to 14% before falling to 7%. *Alnus* also increases to 14% by close of diagram. Poaceae falls slightly to 50%. *Succisa* peaks at 8%. *Potentilla* peaks at 8% then disappears. *Cerealia*-type < 1% at 10cm.
TMA 3	17.5-36	*Corylus avellana*-type falls to <10%. Poaceae peaks at 76%. *P.lanceolata* increase to 2-4%. Other herbs present including *Plantago* indet. and Lactuceae undiff. *Succisa* declines to below 1%.
TMA 2	36-57.5	*Alnus* falls to very low levels (2%). *Corylus avellana*-type peaks at 40% then falls to 20%. Poaceae increases to >50%. Other herbs increase including *Potentilla*-type (2-3%) and *Succisa* (2-3%). *Sphagnum* increase to 22% TLP+spores. Pteropsida (monolete) indet. and *Polypodium* both fall.
TMA 1	57.5-70	*Alnus* very high at base (80%) falling to 48% by close of zone. *Corylus avellana*-type increasing from 4% to 35%. Other tree pollen very low. Herb pollen low: Poaceae at 3%. Cyperaceae at 5-10%. Pteropsida (monolete) indet. high (>60%TLP+spores) at base but falling to 5%. *Polypodium* 3-5%.

Table 7.11 : Summary of pollen diagram zonation of Tresellern Marsh A core.

The on-site alder carr must have had quite a dense structure, as total herbaceous pollen is only 15% across TMA1. Percentages of Poaceae and Cyperaceae suggest a dominance of sedges over grasses near to the sampling site. Other herbs are very low, although occasional grains of *Filipendula* indicate fen conditions. High percentages of Pteropsida (monolete) indet. are probably associated with the existence of a fern-rich ground flora. The sparse record of taxa such as *Pteridium* and Lactuceae indet. probably originate from open areas around the mire, although the exact extent or location of any such areas is unclear.

Clearance of alder and the spread of grassland:TMA 2

Major reductions in the local alder populations are recorded by the fall in *Alnus* at the opening of TMA2. This is accompanied by an increase in Poaceae and the appearance of a number of herbs including Caryophyllaceae, *Cirsium*, *Succisa* and *Potentilla*. *Succisa* and *Potentilla* attain the highest percentages. The percentages of these pollen types in the palaeoecological record reflects the dominance of these taxa in the vegetation around the sampling site, especially since both these herbs are entomophilious. Evidence for the creation of open areas on the area around, as opposed to on the valley floor, is confirmed by the beginning of the *Plantago lanceolata* curve at a value of 2% at 50cm, concurrent with a decrease in *Corylus avellana*-type. The beginning of the *Plantago lanceolata* curve is dated to 2880± 60BP (Beta-84825) although the thickness of the dated sample makes the temporal resolution poor.

Sphagnum begins as a continuous curve at the opening of TMA2, reflecting an increasingly wet bog surface. This was probably a result of a rise in the local watertable following the removal of local tree cover. The demise of shady, relatively undisturbed habitats is also recorded by the fall in both *Polypodium* and Pteropsida (monolete) indet. indet. to low levels during TMA2. *Pteridium* - a spore type which might be expected to increase as a result of the opening of wood/scrubland habitats - shows no change during this zone, making only sporadic

appearances at values of less than 1%. *Calluna vulgaris* and Ericales undiff. also increase slightly at the opening of TMA2, although both remain at subdued levels across this zone and for the remainder of the diagram. *Calluna* peaks at 4% at 50cm. This is insufficient to reflect local presence but may be reflecting the spread of heath on the valley sides and the tor summits.

By the close of TMA2, the palaeoecological record indicates that the valley floor was almost entirely cleared of alder, although some scattered individuals probably remained. Substantial areas of open ground around the mire are suggested by the presence of *P.lanceolata* and other herbs, although the persistence of *Corylus avellana*-type at 15% indicates that some patches of hazel remained.

Further falls in *Corylus avellana*-type and increases in Poaceae and *P.lanceolata* suggest the continuing destruction of this remaining shrub cover in TMA3. Concentrations of *P.lanceolata* increase from 0.8 x 10^3 grains/cm^3 at 35cm to 1.4 x 10^3 grains/cm^3 at 30cm (Figure 7.13). Lactuceae indet. remains as a low but consistent trace across this zone (below 1%) and the record of other herbs such as *Rumex*, Apiaceae and *Galium*-type indicate the spread of herb communities, typical of meadow and pasture land. The decline in *Succisa* to very low values during this zone points to a reduction in this herb around the sampling site. These events are dated to 1830$\pm$80BP (Beta-84824) although as was mentioned above, there is the problem of the poor temporal resolution resulting from the depth range of the dated sample

There is a fall in organic matter percentages at the opening of TMA3 to below 70% by 30cm (Figure 7.10). This corresponds to the peak in *P.lanceolata* mentioned in the above paragraph, which may reflect an intensification of anthropogenic activity on the slopes near to the sampling site. The loss-on-ignition curve could be reflecting increased erosion and deposition of minerogenic material on the mire surface as a result of this disturbance to the vegetation cover.

If this is the case, the recovery in organic percentages to above 80% after 30cm indicates that soils immediately upslope had ceased to be affected by erosional processes.

The Poaceae curve shows that open grassland reaches its maximum extent by the top of TMA3. Only very restricted areas of tree or shrub cover could have remained in the vicinity of the coring location. Grass and sedge communities dominate the area around the sampling site on the valley floor, whilst open meadow and pasture communities are present on the surrounding slopes.

Evidence for limited woodland regeneration:TMA4

The clear trend of decreasing levels of tree and shrub pollen and increasing percentages of Poaceae and other herbaceous taxa over the two previous zones is reversed briefly at the opening of TMA4. Poaceae fall to 64% by 20cm, whilst *Corylus avellana*-type, *Quercus* and *Betula* also demonstrate slight increases. *P.lanceolata* falls to below 1% at the same level. The concentration data confirm these changes. A period of woodland regeneration is therefore recorded by the pollen record, consisting of a recovery in oak and birch and a reduction in grassland. Despite these changes, the continuing record of *Cirsium* and Lactuceae indet. indicates that grassland remained the major habitat within the Tresellern Marsh pollen source area. Increases in *Potentilla* and *Succisa* are also recorded. There was apparently no reduction in the extent of open land on the mire surface; whatever factors resulted in the regeneration of woodland, also appear to have favoured the renewed growth of herbs around the sampling site. This is probably related to anthropogenic activity.

Alnus recovers in the final zone, which is interpreted as reflecting a renewed spread of alder on or around the mire. These percentages cannot be easily related to the areal extent of tree growth, but there is a slight fall in Poaceae at 10cm and the disappearance of *Potentilla* and *Succisa* at the same level suggests a

curtailment of open habitats as a result of the increase in the local alder population. Alternatively, human disturbance may be partly responsible. The re-appearance of *Filipendula* at 10cm, absent from the pollen record since TMA1, is probably associated with the regeneration of alder carr. These changes are dated to 990±80BP (Beta-84823).

Quercus falls back to low levels of around 1% by the upper half of the zone, whilst *Betula* steadies at 2%. *P.lanceolata* re-appears at a value of 6% at 10cm and concentrations of this herb reach a peak for the diagram of 1.8 x 10^3 grains/cm^3 at the same level. The record of *Rumex*, *Galium*-type, Chenopodiaceae and *Cerealia*-type also points to a renewed creation of ruderal habitats. This was apparently at the expense of the oak woodland, although the expansion in *P.lanceolata* and other herbs is probably as much a result of the renewed exploitation of already cleared land as of the opening up of undisturbed areas.

By the final level of the diagram, a predominantly open landscape is envisaged. Tree cover is restricted to limited patches of alder on the valley floor, with perhaps some individuals of birch and hazel. Grass dominates both around the mire sampling site and on the hillsides. The presence of pasture and meadow land is suggested, with perhaps some cultivation of cereals. There is only a slight fall in loss-on-ignition values (Figure 7.10) in response to this renewal of anthropogenic disturbance from 80% to around 75%: the local agricultural activity was either not directly upslope of the sampling site and/or had no significant effect on the stability of the local soils. Considering the date of 990±80BP for 10-20cm, unless accumulation rates have been very low for the last 1000 years, it seems likely that the sequence has been curtailed by peat cutting and the top 10cm of sediment represents peat accumulation since this occurred.

7.19 Interpretation of the charcoal record

No macroscopic charcoal was observed in the core during the description of its stratigraphy, nor were any identifiable fragments retained on the sieve during pollen preparations. Microscopic concentrations are fairly low in TMA1 (Figure 7.12), which may represent a low level of regional and/or local burning, although the physical barriers of trunks and branches of what was apparently quite dense alder carr probably restricted the deposition of fragments of microscopic charcoal in the same way that the extra-local pollen component can be 'screened out' by local vegetation around a sampling site. If this is the case, then there was possibly more extensive fire activity - either humanly induced or natural - than is recorded by the charcoal record.

Microscopic frequencies increase slightly during TMA2, although this may be due to increased extra-local influx following the removal of the alder cover surrounding the sampling site. There is no evidence in this zone that fire was being used to clear vegetation, as there is no marked charcoal peak accompanying the *Alnus* decline at 55cm. The deliberate firing of alder woodland would be unlikely.

Increases in the recorded levels of microscopic charcoal at the opening of TMA3 at 35cm corresponds to declines in *Corylus avellana*-type. This could indicate that fire was being used as a clearance method on the dominant hazel scrub of the valley sides. An equally plausible explanation is that both events are a product of increased human activity in the form of the destruction of vegetation for settlement and farming. This could be accompanied by increase in anthropogenic and/or natural burning regionally and locally.

An increase in tree and shrub pollen at 20cm, including that of *Corylus avellana*-type, *Quercus* and *Alnus* is accompanied by a fall in charcoal levels fall to a very

low value. The pollen data were interpreted as indicating an increase in tree and shrub communities and the synchronous fall in charcoal points to a significant reduction in fire frequency. Microscopic charcoal levels recover in the final zone of the diagram to reach their highest recorded levels for the diagram at 10cm. This corresponds to the peak in *P.lanceolata*, suggesting that charcoal is related to a local expansion in farming and settlement.

7.20 Anthropogenic impact and vegetational change in the Withey Brook valley

There is little evidence for human influence in the palynological record of the lowest zone of Tresellern Marsh A core. There was clearly very little or no disturbance to the alder carr of the valley floor at this point. If settlement and/or farming activity had been taking place on the hillsides around the marsh, but had not yet affected the vegetation around the coring location, then this would not be clearly reflected in the local pollen record, due both to the high representation of taxa growing on and around the site and the 'screening effect' of the trunks and branches of the alder trees. Some suggestion of open and perhaps anthropogenically disturbed habitats might be found in the occurrence of low levels of *Pteridium* and Lactuceae indet., although bracken may very well have formed the understorey of the hazel cover on the valley sides.

The destruction of alder communities on the valley floor

The sustained fall in *Alnus* that marks the opening of TMA2 indicates clearance of the local alder-carr by human communities. Although the pollen record suggests a significant reduction in alder population at this time, there is no marked expansion in anthropogenic indicators. Aside from Poaceae, *Potentilla*-type and *Succisa* are the only other herb taxa to make significant increases. These herbs are typical of infertile and relatively undisturbed habitats (Grime *et al.*, 1988). Caryophyllaceae also appears as a low but consistent trace across this zone.

Although this pollen type has not been identified to species, most of the members of this taxon are more typical of habitats such as meadows and open woodlands than of heavily disturbed ruderal environments.

Although clearance activity at the opening of TMA2 resulted in the removal of what was probably the greater part of alder over a fairly short time span, there is no evidence of intensive exploitation of the land opened up in this way. Disturbance to the vegetation must have been sustained enough to prevent the regeneration of alder. The two herbs that characterise the record in this period are *Succisa* and *Potentilla*. *Succisa* often flourishes where potential dominants are supressed by grazing, and *P.erecta* is similarily typical of grazed acid grassland. The predominance of these taxa in the palynological record may therefore indicate that Tresellern Marsh was used as rough grazing following the clearance of the alder woodland from the site. Initial clearance may have been either for the procurement of timber for construction and domestic purposes or for the use of the land thus opened up for farming, or more likely a combination of the two.

Human activity on the valley sides

The beginning of a more or less continuous *Plantago lanceolata* curve corresponds to further reductions in *Corylus avellana*-type in the upper half of TMA2. This is dated to 1250-980cal.BC pointing to a late Bronze Age episode of activity. Assuming that the *Corylus avellana*-type curve reflects the presence of hazel scrub on the slopes around the marsh, then the opening up of the vegetation on the valley sides to an extent sufficient to allow the spread of and/or pollen dispersal of ribwort plantain did not commence until after the clearance episode(s) that had removed the alder dominated woodland on the valley floor. Two hypotheses may be advanced to account for this; initial clearance in this part of the Withey Brook Valley was restricted to the valley floor and later spread up onto the slopes of Bastreet Downs and Hawk's Tor. Alternatively, clearance had begun at a similar time or earlier on the upper slopes of Ridge to that on the valley bottom, but did

not spread down to affect the vegetation on the lower slopes, at least to a palynologically detectable degree, until later.

There is no indication of arable farming in the pollen record. Considering the problems connected with the identification of cereal cultivation in the palaeoecological record and also the low resolution of the pollen record at this site, then it is not possible to rule out completely the possibility of some arable activity. The spectra of herb pollen that probably originated from the dry land around the marsh - *Plantago lanceolata*, *Cirsium*, Lactuceae indet.- is suggestive of non-specific ruderal habitats or a pastoral regime.

The spread of grassland and local settlement

The fall in *Corylus avellana*-type percentages indicates the almost complete removal of hazel cover and its replacement by grassland during TMA3. The radiocarbon date of 1830±80 BP (Beta-84824) is calibrated to cal.AD 100-265 and cal.AD 290-320 implying that this intensification is probably related to a Romano-British phase of activity in the Withey Brook valley. *P.lanceolata* reaches its highest representation, although there is little response from other herbs to the demise of local shrub cover. The increased mineral accumulation relected by the fall in loss-on-ignition values in TMA3 (Figure 7.10) may reflect the close proximity of clearance activity upslope. An intensification of activity on the valley floor as well as on the surrounding slopes, is therefore implied by the pollen record. The herb pollen spectra suggests this was probably in the form of increasing use of the area for grazing.

The nature and magnitude of the changes in the palynological record indicates that this zone represents the zenith of human impact on the environment of the Withey Brook valley. The land around the marsh is dominated by grassland, with tree and shrub cover restricted to perhaps the occasional copse on the less intensively exploited areas of the landscape. The beginning of the *Plantago lanceolata* and

Plantago undiff. curve reflects the initiation of a farming regime that led to the creation and maintenance of open grassy areas dominated by plantains and other herbs. The nature of the local activity must have been fairly intense, as *Corylus avellana*-type percentages follow a sustained downward trend.

There is a cessation in human activity at the opening of the final zone of the Tresellern Marsh A pollen diagram. Slight increases in oak and birch woodland are recorded, alongside a fall in anthropogenic activity, as reflected by the *Plantago lanceolata* curve. If Tresellern Marsh was being utilised as rough grazing, then the increases in *Potentilla* followed by *Succisa* points to a reduction in local grazing intensity, allowing an increase in the herbs present as part of the sward. The date of 890-1225cal.AD for 10-20cm suggests this reduction in activity occurred in the Dark Age-medieval period. Further falls in tree pollen and increases in certain herbaceous taxa point to the re-initiation of anthropogenic activity near to the top of the diagram. This corresponds to the only appearance of *Cerealia*-type pollen in the diagram (10cm), that may suggest local arable activity. Although it would be unwise to draw firm inferences from the occurrence of a single grain of cereal pollen, the record of other ruderal herbs including *Rumex acetosa* and *Montia*-type and an increase in *P.lanceolata* at the same level indicates increased human activity in the area which may have included cultivation of cereals. Some increase in alder woodland is also registered in the pollen record, possibly as a result of a change in the land-use regime leading to less intense utilisation of the marsh for grazing and permitting the limited re-establishment of alder. A slight reduction in open habitats may also be reflected in the fall in the percentage and concentration values of Poaceae at 10cm, although *P.lanceolata* appears at its highest concentration for the diagram at the same level. Table 7.12 provides a summary of the interpretation of the TMA pollen diagram.

Zone/Depth cm	Main Ecosystem Represented	Inferred Human Impact/Activity
TMA4 *10-22.5*	Limited oak/birch woodland giving way to Grass/pasture land	Reduction in intensity at first but increasing across zone. Local/extra-local clearance of oak/birch cover. Pastoral emphasis. Some arable possible.
TMA3 *22.5-36*	Grass/pasture land	High level of activity. Local clearance of scrub Pastoral emphasis
TMA2 *36-57.5*	Grassland with hazel scrub.	Local clearance of alder. and later hazel. Intensifying across zone. Pastoral emphasis
TMA1 *57.5-70*	Alder Carr. Hazel scrub on hillsides.	Little evidence for local activity

Table 7.12: Summary of Tresellern Marsh A Core Pollen Diagram.

7.21 Discussion: interpretation of the Tresellern Marsh B core pollen diagram

Alder carr establishment in the Withey Brook Valley

The high percentages of *Alnus* in TMB1 indicates that alder was becoming established on the valley floor during this zone (Figure 7.14). The presence of *Filipendula* and *Potentilla* and perhaps Apiaceae imply fen conditions nearby, although *Sphagnum* is very low and Poaceae dominates over Cyperaceae. The overall palynological impression is of a damp grassy vegetation around the coring site, with some tall herb communities and fen-like sites present, although the spread of alder carr is reducing the area of open ground around the sampling site. The fall in the number of pollen types recorded alongside the high alder values after 115cm is probably not entirely due to the 'drowning out' effect of the *Alnus* percentages, but reflects a fall in species diversity associated with on-site alder carr development (Brown, 1988).

The very low levels of other arboreal pollen are due partly to the dominance of *Alnus* in the local pollen rain. *Corylus avellana*-type remains fairly steady across the zone (10-20%), most probably reflecting the presence of hazel scrub on the better drained soils and it might be assumed that had oak been present as a significant component of the vegetation on the valley sides *Quercus* percentages would be expected to reflect this. Allowing for the comparatively low pollen productivity of *Quercus* (Bradshaw, 1981), the presence of oak on the valley sides is possible.

Decline in alder and the spread of birch

TMB2 opens with a fall in *Alnus* and increase in *Betula*. Alder has declined in local importance and birch is rapidly colonising the open areas resulting from its clearance. The sudden increase in *Betula* reflects the rapid expansion of birch in an environment that must have been ideal for its spread.

Figure 7.13: Tresellern Marsh B core percentage pollen diagram. Percentages are of TLP and TLP+spores. Exaggeration x10.

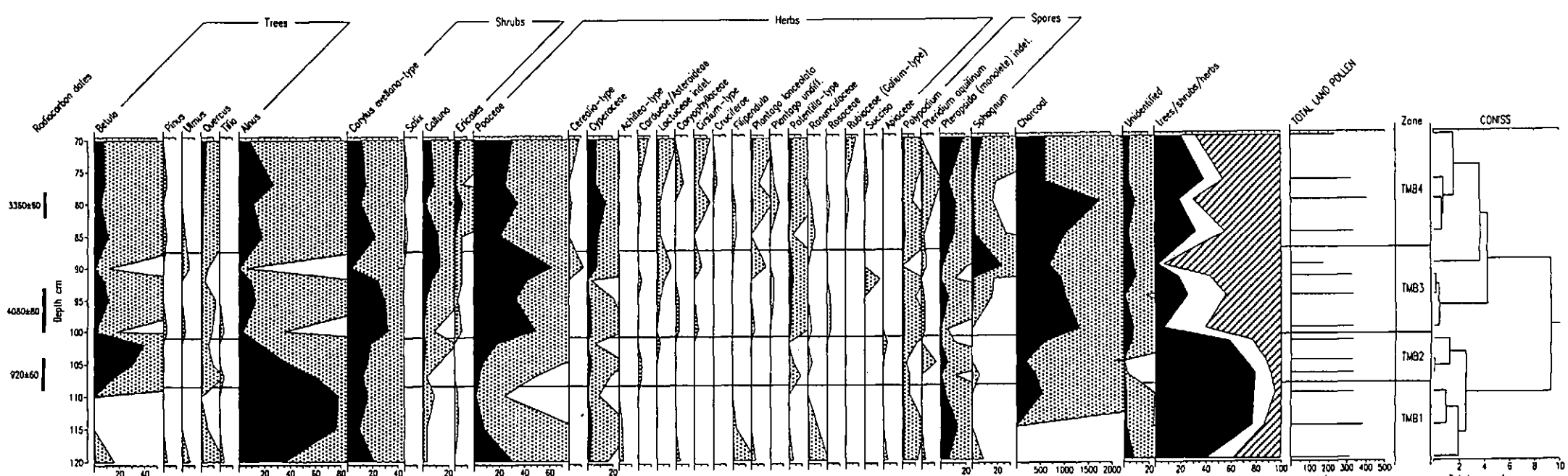
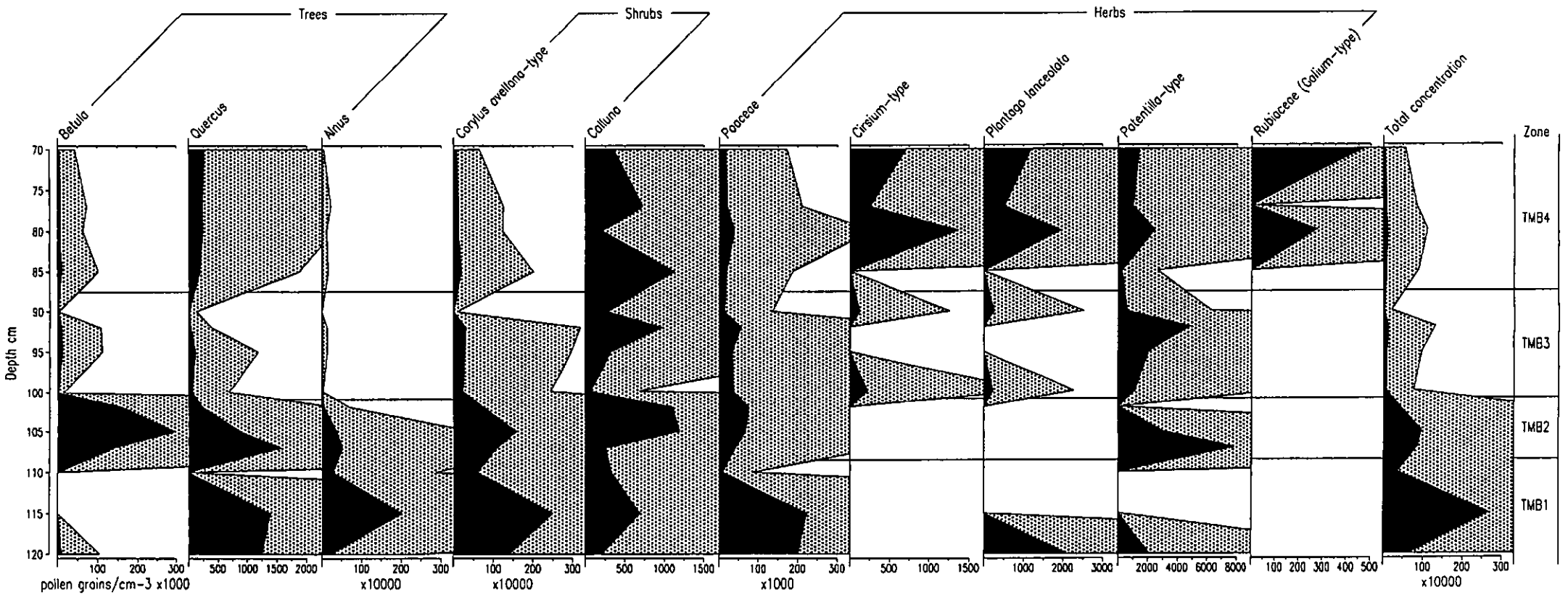


Figure 7.15: Tresellern Marsh B core pollen concentration diagram. Values are of pollen grains/cm^{-3}. Exaggeration x10. NB: Change in horizontal scales.



Zone	Depth (cm)	Description of Main Features
TMB4	70-87.5	*Alnus* increases to 25% but falls to below 10% by close of diagram. *Corylus avellana*-type falls to below 15%. *Quercus* increases slightly to 5%. *P.lanceolata* and *Potentilla* increase to 3%. Other herbs appear including *Cirsium* and *Galium* type. Cyperaceae increases to 15%. Pteropsida (monolete) indet. increase to 30% TLP+spores.
TMB3	87.5-101	*Alnus* falls to below 5%. *Betula* falls to below 10%. Poaceae increases to 45%. *Corylus avellana*-type increases to 30%. *Calluna* increases to 15%. *Potentilla* begins and increases to 3-4%. Other herbs low and sporadic. *Sphagnum* increases to 15% TLP+spores.
TMB2	101-108	*Alnus* declines to 15%. *Betula* increases to 45%. *Corylus avellana*-type increases slightly to 25%. Herbs low.
TMB1	120-108	*Alnus* increases to 75%. Other trees very low. Poaceae falls to <10%. *Filipendula* at 2% at base of diagram but disappears from record. Other herbs low. Pteropsida (monolete) indet. increases to 15% before falling to <5%.

Table 7.13: Summary of pollen diagram zonation of Tresellern Marsh B core.

Betula concentrations increase from 140 x 10^3 grains/cm^3 at 107cm to 298 x 10^3 grains/cm^3 at 105cm (Figure 7.15).

There is no clear response from the non-arboreal taxa to this opening of the local alder woodland in the percentage diagram, but the concentration diagram suggests increased influx of *Calluna* and Lactuceae indet.. This may be because the removal of alder during this zone mainly involved trees around but not actually on the sampling site and the canopy remained dense enough locally to prevent any marked spread of herbaceous species.

The spread of grassland

The opening of TMB3 is dated to sometime earlier than 4080±80BP (Beta-84828). There is an increase in Poaceae and other herb taxa are also recorded including *Cerealia*-type at 90cm. There is a fall in total concentration at the opening of the zone, from 358 x 10^3 grains/cm^3 at 102cm to 74.8 x 10^3 grains/cm^3 at 100cm, reflecting the loss of the contribution of the woody taxa to the on-site pollen rain. There is a sharp fall in organic percentages from above 90% to below 80% at 90cm (Figure 7.11): this corresponds to a peak in Poaceae and falls in percentages of *Alnus*, *Corylus avellana*-type and *Betula*. The pollen sum falls to below 200 land pollen at this level due to low concentrations of pollen. An episode of mineral deposition on the mire surface is therefore suggested by the palaeoenvironmental data, possibly as a result of disturbance to the up-slope terrestrial environment. This may be related to the erosion of soils as a result of local cultivation of cereals suggested by the record of *Cerealia*-type. This phase of mineral accumulation is shortlived, as organic percentages recover to above 90% by the close of TMB3.

Decline in the local alder population continues during TMB3 and reductions in *Betula* shows that birch is also affected. Although an increase in *Corylus avellana*-type is indicated in the percentage diagram, the concentration data

indicate that *Corylus avellana*-type influx remains steady across TMB3. The spread of the light-demanding herbs is clear in both the percentage and concentration data, and demonstrates the creation of open areas as a result of woodland recession. The record of both *Succisa* and *Potentilla* suggest moist, relatively infertile and undisturbed conditions on the valley floor at this time. The beginning of the *Calluna* curve indicates the spread of heathland and might reflect a deterioration in soil conditons, although heather growth may have been restricted to the bog surface.

During this zone, declines in alder and birch populations are associated with the spread of grassland. The valley floor was probably entirely cleared of tree and shrub cover, although some scattered birch may have remained on the fringes of the mire. Hazel remains apparently unaffected by these changes. The impression during this zone is of a landscape of heath and grassland, interspersed with patches of hazel scrub, with the valley floor dominated by grasses, sedges and some herbs.

Alnus increases during TMB4, before falling at 70cm. There is a marked increase in Cyperaceae and *Sphagnum* by the close of the zone. These changes point to increasingly damp, acid conditions in the valley mire and a renewed expansion of alder. The increase in Pteropsida (monolete) indet. by the close of the zone is probably also related to an increase in alder carr. Whether the increasingly damp substrate was due to changes in local hydrological conditions or to climatic factors is unclear.

There is a slight increase in *Quercus*, whilst *Corylus avellana*-type remains fairly steady as does *Betula*. *Plantago lanceolata* begins as a continuous curve at 85cm and other herbs including *Cirsium*, Cruciferae and *Galium*-type also appear, but none of these herbs demonstrate sustained rises. *Cerealia*-type is recorded at 90cm suggesting that some arable land was present in the marsh's pollen catchment.

P.lanceolata only begins as a continuous curve when *Corylus avellana*-type percentages fall to below 15%, and achieves its highest values when *Corylus avellana*-type reaches its lowest values. This association suggests that the open areas were being created mainly at the expense of hazel, probably not because hazel was being sought out for clearance, but because hazel was the predominant component of the local vegetation. These changes are dated to 3360±60 BP (Beta-84827). Both *Quercus* and *P.lanceolata* reach their highest values at the same level (70cm). The concentration diagram (Figure 7.15) shows that *P.lanceolata* concentrations double from 0.5 x 10^3 grains/cm^3 at 77cm to 1.1 x 10^3 grains/cm^3 at 70cm. The increase in *Quercus* concentrations is less marked, from 2.4 x 10^3 grains/cm^3 at 77cm to 2.6 x 10^3 grains/cm^3 by 70cm. This may be because the *Quercus* curve is relecting a predominantly extra-local trend or there was only a very limited increase in oak populations locally. Both explanations indicate that oak cannot have been a very significant part of the flora of the Withey Brook valley.

The beginning of the *P.lanceolata* curve and the appearance of the pollen of other heliophytes indicates the creation of open areas near to the sampling site. The increases in *P.lanceolata* and also in Lactuceae indet. is less clear in the percentage diagram than it is in the concentration diagram, whilst there is no change in Poaceae concentrations evident. The failure of grass to increase alongside other herbaceous species might be interpreted as indicating that the major source of Poaceae was derived from grasses growing on and around the sampling site, where there was little or no expansion in graminoid communities.

Increased concentrations of Lactuceae indet. and *Potentilla* are also a feature of TMB4. Lactuceae concentration peaks at 70cm, whilst *Galium*-type appears at 80cm. These low-growing herbs have very restricted pollen dispersal ranges and the more or less continuous record of their presence alongside that of *P.lanceolata* probably reflects the creation of and maintenance of a substantial area of open,

disturbed ground within a short distance of the sampling site. The record of *Cerealia*-type at 70cm and 77cm suggests that some arable land may also have been present locally. There is a fall in organic percentages from above 90% at the opening of the zone to just above 75% by 80cm (Figure 7.11). Percentages recover to 90-95% by 85cm before falling sharply to below 65% at 70cm. As in the previous zone, this may reflect increased flushing of mineral matter onto the bog surface as a result of soil disturbance due to the cultivation on the slopes of Bastreet Downs.

Some regeneration of oak woodland is recorded by the increase in *Quercus*. This may either reflect a limited increase in oak populations locally or a more extensive spread at some distance from the sampling site. Considering the evidence for expansion in open areas locally, then the latter may be seen as the more likely.

The pollen record in the final zone suggests a wetter environment on the valley floor. There was some scattered alder on the mire surface, although open ground dominated with sedges, grasses and ferns in the vegetation. The slopes to the north and south probably bore hazel and birch scrub, although grassland with herb communities including plantains, thistles and other herbs typical of disturbed environments, was increasing in extent.

7.22 Interpretation of the Tresellern Marsh B core charcoal record

As was the case with TMA core, no macroscopic charcoal was identified either during sub-sampling or pollen preparation. Microscopic charcoal levels are very low in TMB1 and TMB2 (Figure 7.14) pointing to a low level of burning activity, although the signal may be masked by the screening effect of the vegetation around the sampling site.

There is a rise and levelling off in charcoal levels at the opening of TMB3. This is probably partly due to an increase in charcoal influx from natural and human fires from extra-local, local and regional sources due to the opening up of the local vegetation. The increase also accompanies the expansion of open ground around the sampling site, as recorded by the Poaceae and *Calluna* curves and the reductions in *Alnus* and *Betula* percentages: an increased incidence of local fire events resulting from an expansion in local settlement is probably also responsible for the observed increase in microscopic charcoal. There is a further increase in microscopic charcoal at the opening of TMB4 increasing to a peak at 80cm. Increases in *P.lanceolata* and Poaceae and falls in *Corylus avellana*-type and *Alnus* at the same level suggest that the charcoal peak is related to an expansion in clearance activity. The fall in charcoal that follows at 77cm is accompanied by reductions in these herbaceous taxa and increases in the woody species.

The inverse relationship between increased levels of charcoal and herbaceous pollen and decreased levels of arboreal pollen that are observed in the TMB diagram implies that the mechanisms responsible for both were the same. The most likely mechanism is an anthropogenic one. As the volume and intensity of local settlement increased in the vicinity of the marsh, grass and herb communities expanded at the expense of wood and shrub land. Increased levels of microscopic charcoal accompanied such expansion, due to a greater concentration of local burning. As population levels and settlement/farming activity contracted, open habitats were reduced as trees and shrubs expanded. A corresponding decrease in local fires resulted in decreased microscopic charcoal input from local sources, although the extra-local and regional signals would continue to contribute to the palaeoecological record.

7.23 Anthropogenic impact and vegetational change

The possible human role in the spread of alder

The establishment of dense alder cover around the sampling site is an indication that there cannot have been intensive human activity on the valley floor, as *Alnus* seedlings cannot become established in frequently disturbed vegetation (Grime *et al.*, 1988). However, there is some indication both at this site and elsewhere on Bodmin Moor that human disturbance may have facilitated the post-glacial spread of alder (cf. Smith,1984).

Poaceae percentages and the record of other herbaceous taxa, including *Potentilla* indicate a damp, grassy environment on the local mire surface prior to the alder rise, whilst the record of *P.lanceolata* and *Pteridium* at 120cm and *Calluna* at trace levels across the zone points to the presence of openings in the wood/scrub cover around the marsh. There is insufficient palynological evidence to attribute a definite human origin to the creation of this open ground; natural openings in the shrub/woodland canopy, or clearings created and/or maintained by wild herbivores are both possible ribwort plantain habitats. The possibility remains that there was some form of anthropogenic impact on the local environment in the lowest sample of TMB1 and this may have facilitated the spread of alder.

The palynological signal of any human activity that may have been taking place on the land around the mire during TMB1 is obscured by the high *Alnus* values after 115cm. If there was settlement and/or any form of farming activity taking place during this zone, then it did not affect the alder carr on Tresellern marsh and must have been restricted to the higher slopes of the valley sides. The sustained falls in *Alnus* at the opening of TMB2 portrays a major clearance of alder carr by human communities. The clearance episode that led to the destruction of the greater part of the alder populations did not apparently affect *Corylus avellana*-type and the expansion in *Betula* in this zone indicates that birch was able to exploit

the newly opened habitat niche. These palynological events suggest that although there was fairly large scale clearance of alder across this zone, birch woodland was able to become established and the hazel scrub that probably grew on the higher valley slopes was largely unaffected, at least to any palynologically detectable degree. This is interpreted as a phase of relatively low intensity pressure on the land resource. The subdued response from Poaceae and absence of any anthropogenic indicators (*sensu* Behre, 1981) is a further sign that the impact of human communities remained muted following the initial clearance of alder.

Two hypotheses may be advanced to account for this: the alder was being cleared primarily to provide timber for construction and/or domestic purposes, as opposed to opening up the land for farming and the communities responsible were small enough and/or far enough from the marsh to be 'invisible' in terms of a clear palynological signal. Alternatively, there was activity nearby, but this remained restricted to the fringes of the marsh and permitted the establishment of birch on areas of the mire cleared of alder. The location of the coring site near to the centre of the marsh may be significant here, as this part of the mire might be expected to be less affected in the initial stages of clearance.

Two main stages of activity may be recognised in TMB3: the first marks the opening of the zone and involves the continuing demise of alder and the clearance of birch. The appearance of the pollen of certain herbaceous taxa further implies the spread of open habitats, but those species best represented (*Succisa*, *Potentilla*) are not indicative of heavy pressure on the environment. As was discussed above, both these herbs are associated with acid grassland subject to light to moderate grazing pressures. The use of the marsh for grazing may therefore be tentatively inferred.

A further phase of activity commences in the top half of the zone, although this

seems to represent as much a shift in emphasis, rather than a great intensification of land-use: previously the non-arboreal spectra were characterised by *Potentilla*, *Succisa* and to a lesser extent Lactuceae indet.. A different herbaceous pollen spectrum appears around 90-92cm: there is an increase in *Calluna* and the appearance of low levels of *Plantago lanceolata*, *Cerealia*-type, Chenopodiaceae. These low percentages of herbaceous pollen and the persistence of moderate percentages of *Corylus avellana*-type indicate that settlement/farming activity was either taking place at some distance from the sampling site or was only on a small scale locally, although the fall in organic percentages at 90cm (Figure 7.11) might be due to an episode of disturbance on the nearby slopes.

The increase in alder and fern spores at the opening of TMB4 points to a period of tree regeneration on the marsh, although the rise in Cyperaceae and continuation of the *Potentilla* curve indicates that there cannot have been a great reduction in open habitats. The former phases of human impact seem to have been concentrated on Tresellern Marsh itself, whilst there is change in emphasis in this zone to the land on the surrounding hillsides. This is suggested by the beginning of the *P.lanceolata* curve and the appearance of the pollen of other taxa typical of ruderal habitats such as *Galium*-type, Cardueae/Asteroideae and perhaps also *Cirsium*. The latter taxon is present as part of the contemporary vegetation of the marsh and the record of its pollen might therefore relate to its establishment on the mire. The record of these herbs portray the creation of open, grassy areas near to the marsh and the sporadic record of low quantities of *Cerealia*-type indicates arable plots may have been included in the developing landscape mosaic. This zone appears to represent the most sustained period of local human activity. The continuous *P.lanceolata* curve may reflect the creation of enclosed pasture land that was utilised and maintained to an extent that permitted the growth and pollen dispersal of ribwort plantain. In the previous zones, *P.lanceolata* was not a palynologically significant component of the local vegetation: this was probably because the clearances of the local tree/shrub cover were insufficiently extensive

to allow the widespread establishment of plantains. A fairly steady pressure on the environment due to a levelling off in population levels or farming activity is envisaged as both *Corylus avellana*-type and *Betula* percentages remain consistently represented impying a persistence in wooded areas. Table 7.14 provides a summary of vegetational change and human impact represented in the Tresellern Marsh B pollen diagram.

7.24 Summary

This chapter has described the analysis of two cores from Tresellern Marsh in the Withey Brook valley. The implications of the palaeoecological record for environmental change and human impact have been discussed. The following chapter will be concerned with the numerical analysis of the pollen records from the East Moor, the comparison and correlation of the sequences and integration with the archaeological record

Zone/Depth cm	Main Ecosystem Represented	Inferred Human Impact/Activity
TMB4 70-87.5	Open grassy areas. Areas of hazel scrub remaining. Increase in alder.	Local settlement and pastoral/arable farming.
TMB3 87.5-101	Grass/herb communities spreading at expense of hazel.	Clearance of hazel for settlement. Pastoral regime possibly with increasing emphasis on arable.
TMB2 101-108	Birch expanding to take advantage of reduction in alder.	Clearance of alder around sampling site. Little evidence for local farming/settlement activity.
TMB1 120-108	Alder-carr spreading on mire. Hazel scrub on better drained soils.	Little/no activity. Some evidence for minor disturbance early in zone.

Table 7.14: Summary of Tresellern Marsh B Core Pollen Diagram.

Chapter 8:
Correlation and Comparison of the East Moor Palaeoecological Records and the Integration of Environmental Change and Archaeological Sequences

8.1 Introduction

This chapter discusses the correlation of the palaeoecological sequences from the East Moor. Following this, suggested correlations between the palaeoenvironmental and the archaeological sequences are made for the sites on the East Moor plateau and the Withey Brook valley.

8.2 Statistical correlation of the sequences: the DCA plots

In order to compare and correlate the palaeoecological sequences, the pollen data have been analysed using detrended correspondence analysis (DCA) (see Chapter 2). Utilising statistical techniques to display relationships within sequences from the East Moor is slightly more difficult than it was for Rough Tor for two main reasons:

i) the Rough Tor sequences were obtained from a relatively small area (2 sq. km) and therefore there were less likely to be major differences in vegetation than in the larger area (4sq.km) of the East Moor;
ii) the Rough Tor sequences were obtained from similar deposits in broadly the same altitudinal range. The East moor sites include two valley mires

and the monolith site and cover an altitudinal range of over 50m.

This difference in area and nature of the palaeoenvironmental repositories means that, although zones might be contemporary, they also could have very different local vegetation producing very different palynological signatures in the palaeoecological record. This is obviously desirable in terms of detecting variations in natural and anthropogenically induced vegetation patterns, but less so in comparing diagrams for the purpose of temporal correlations in the absence of radiocarbon dates.

Pollen taxa scores

Figure 8.1 is the plot of the pollen taxa scores for the East Moor sequences. Axis one accounts for most of the variation. The first axis differentiates between taxa typical of open conditions and tree and shrub dominated environments. The latter group plot to the left of the diagram. This group includes *Ulmus* and *Pinus* indicating the presence of these trees as part of the woodland on the East Moor. Pteropsida (monolete) indet. and *Polypodium* also plot near to this group pointing to the association of these taxa with wooded conditions, either as part of the ground layer or epiphytically associated with the trees. *Alnus* plots separately from this group near to *Filipendula*, indicating the association of these species as carr vegetation.

Taxa characteristic of open ground and disturbed vegetation plot in a broad group on the right of the diagram. This group includes Poaceae, *P.lanceolata*, Ranunculaceae and other heliophytes. There is a trend toward the arboreal species, with certain taxa, in particular *Pteridium* and Apiaceae, located roughly in between the two groups. This might point to the presence of openings in the tree cover or vegetation typical of a woodland edge, as would be found in the early stages of woodland recession.

Figure 8.1: DCA pollen taxa scores for the East Moor sequences. Dotted lines indicate taxa groupings referred to in text.

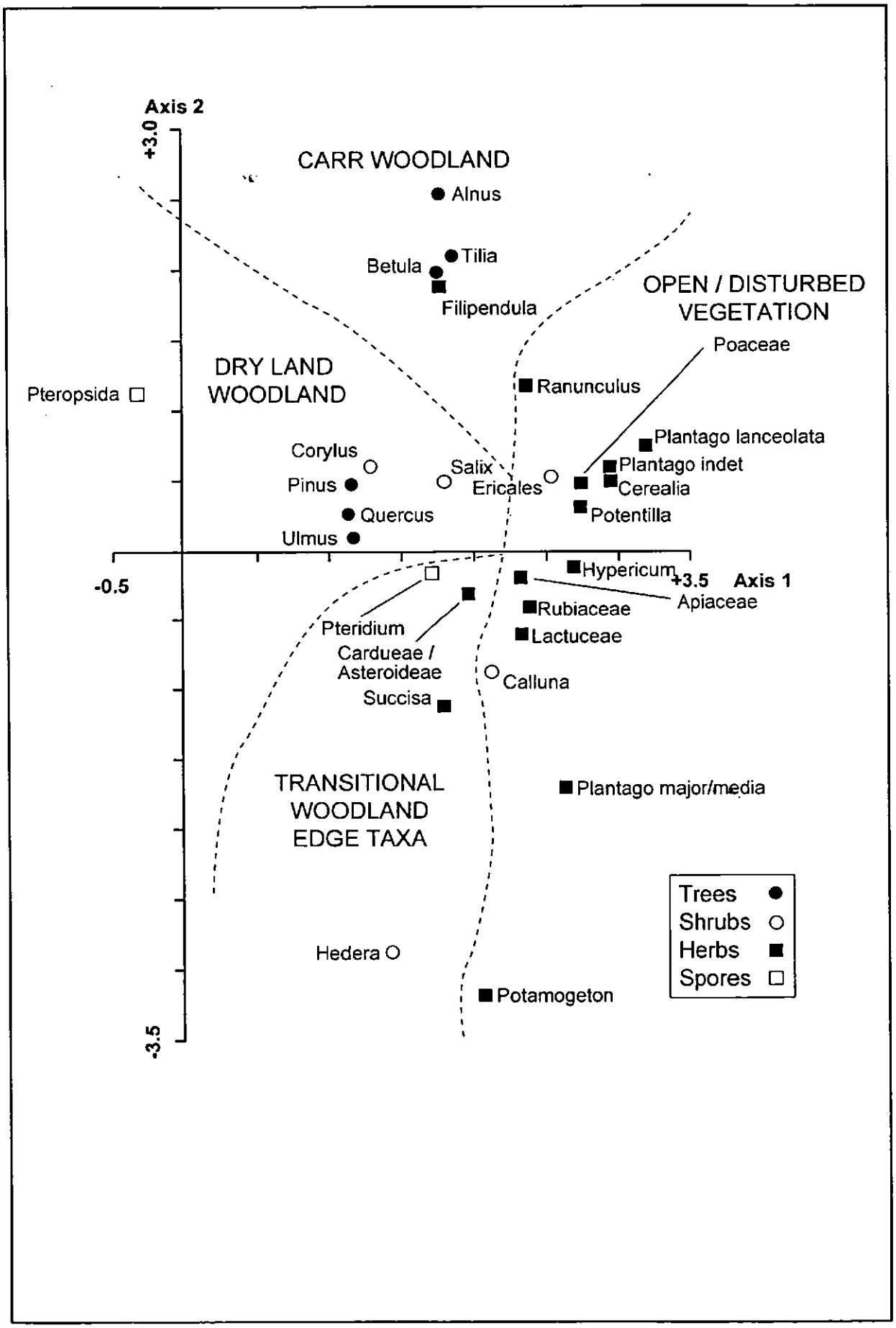
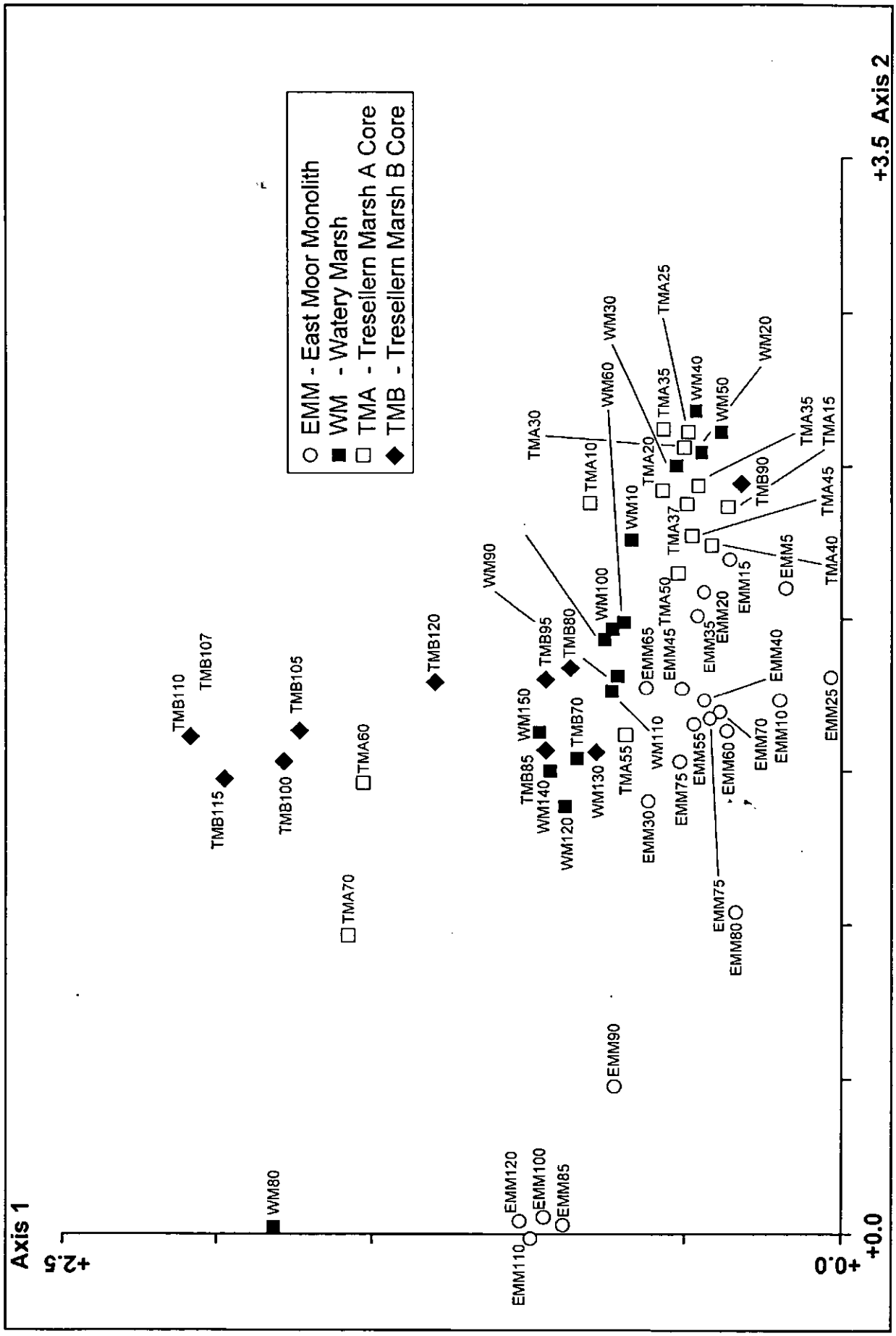


Figure 8.2: DCA samples scores for the East Moor sequences. NB. Not all samples are included on the plot.



Sample scores

Figure 8.2 shows the ordination plot for the first two axes of the East Moor samples. Three main groups are recognised. The first is on the left of the diagram and consists of samples from the first zone of the East Moor monolith.

The second is in the top centre of the diagram and consists mainly of samples from the lowest zone of Tresellern Marsh B core, although two samples from the lowest zone of Tresellern Marsh A core are associated with this group. The third and final group is in the centre right of the diagram and includes the remainder of the samples from the East moor sequences and all of the Watery Marsh samples.

Several features are important. The vegetation represented by the lowest zone of the East Moor monolith (EMM1) has no equivalent in the other diagrams from this part of the moor. The same may be said of the lowest zone of the Tresellern Marsh B core, although TMA 60 and 70 are the most similar. There is distinct vegetational change from the first to second zones of these diagrams, although this transition is apparently smoother in the East Moor Monolith sequences than it is at Tresellern Marsh. The vegetation represented by the Watery Marsh diagram is clearly more similar to the later zones of the other diagrams, confirming this sequence does not have the temporal depth of either EMM or TMA/B.

The large group that includes the majority of the samples indicates the broad similarity in habitats resulting from human disturbance to the vegetation. Within this general trend, certain features can be recognised. The EMM samples form a cluster that does not include samples from any of the other sequences. This is interpreted as showing the different character of the vegetation on the East Moor plateau from that which was typical of the valley mires of Watery Marsh and Tresellern Marsh. The Watery Marsh samples tend to plot in between the East Moor samples and those of Tresellern Marsh, suggesting the character of the vegetation at this site had components of both areas. This is not surprising

considering its position on the edge of the East Moor plateau just above Tresellern Marsh. The lowest samples from Watery Marsh are located near to samples from TMB3/4, indicating that the later zones of this diagram may be broadly contemporary with those from the earliest zones at Watery Marsh. In terms of the similarity of the Watery Marsh sequence to the East Moor monolith, it may be inferred from the plot that the former sequence is likley to commence in the upper half of EMM3. This is based on the proximity of samples from EMM3 to those of Watery Marsh.

Tresellern Marsh A and B

The two cores from Tresellern Marsh were recovered from within 100m of each other. TMB is longer than TMA, so in terms of the vegetational record, the latter core might be expected to yield a shorter and/or less detailed record. However, due to the poor preservation in the top half of TMB, TMA effectively contains a more complete record. The records may therefore be amalgamated to produce a composite picture of environmental change in the Withey Brook valley. This neccesitates correlating these records separately from those of the other East Moor sampling sites (Figures 8.3 & 8.4).

Pollen taxa scores

Alnus, Betula, Filipendula and other species typical of damp, shady habitats plot on the right hand side of the plot, demonstrating the association of these taxa as carr vegetation on the mire surface. Open ground taxa including Poaceae, *P.lanceolata* and *Pteridium* tend to appear on the left of the diagram. *Ulmus, Quercus* and *Pinus* plot near to this group, suggesting both the association of these species with dry land communities and the increased representation of their pollen following the opening up of the carr vegetation around the sampling site.

Figure 8.3: DCA pollen taxa scores for the Tresellern Marsh sequences. Dotted lines indicate taxa groupings referred to in text.

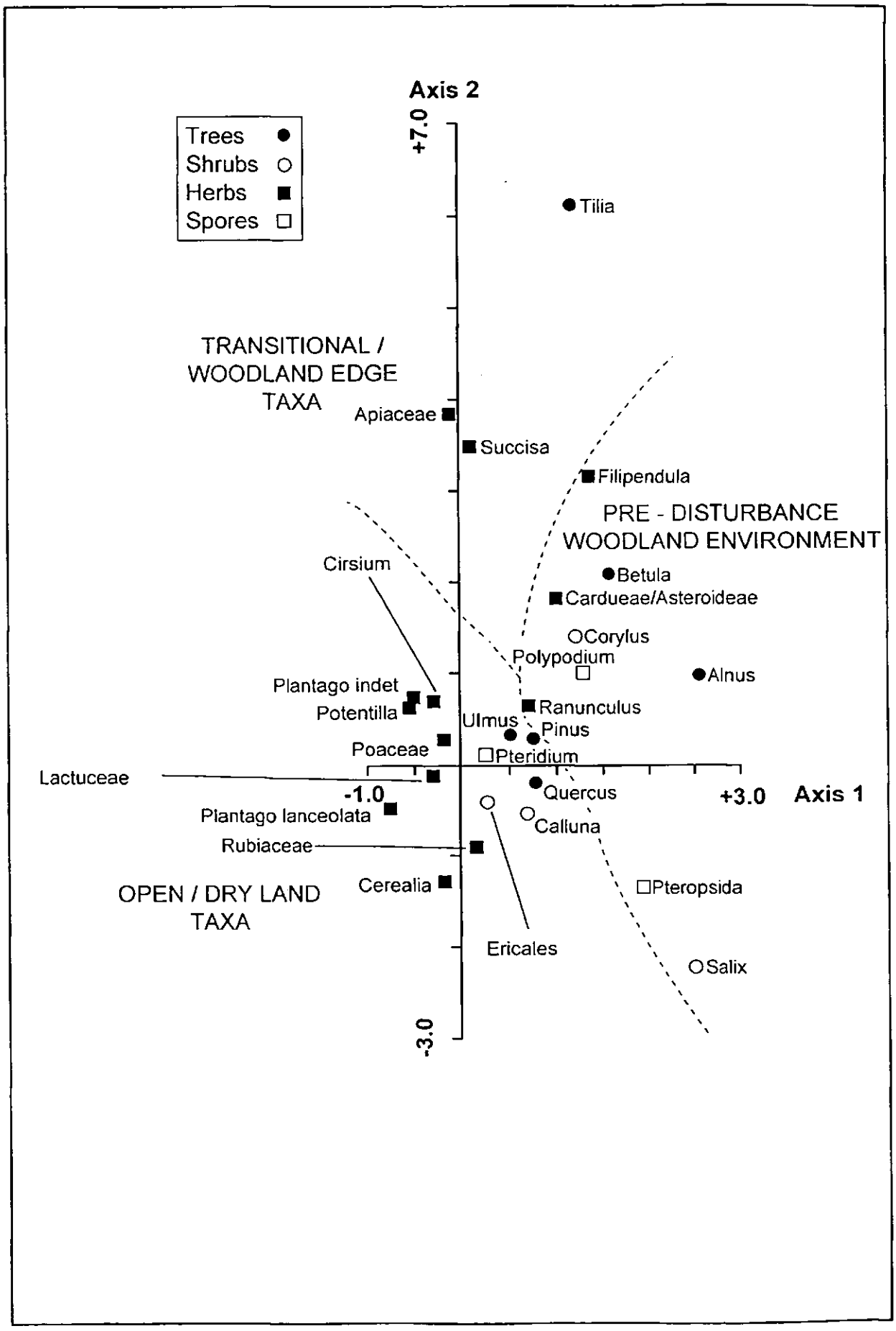
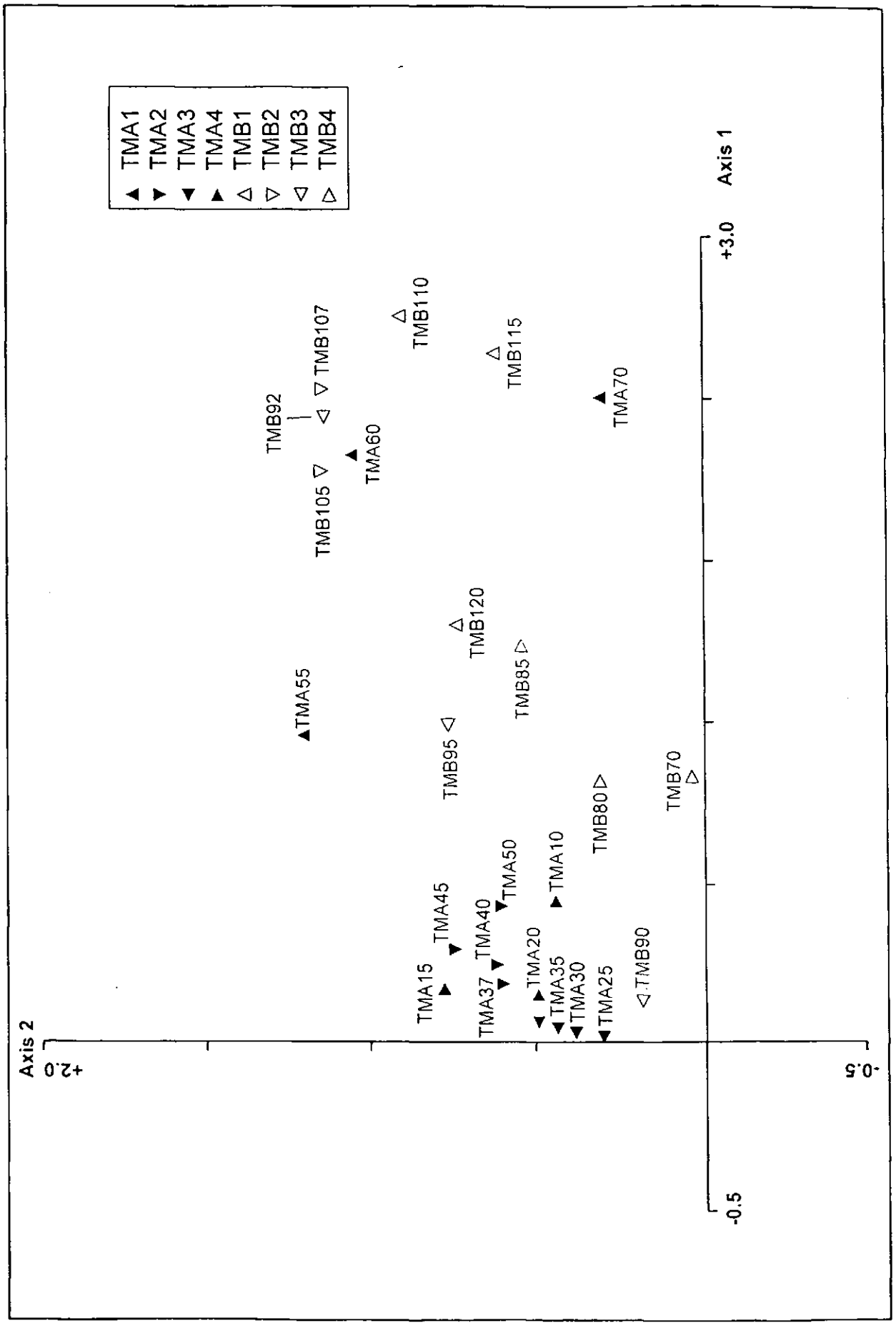


Figure 8.4: DCA samples scores for the Tresellern Marsh sequences.



Sample scores and radiocarbon dates: integrating the records

Figure 8.4 shows the plot of TMA and TMB cores. The sample ordination shows that the lowest zone of TMA plots near to the lowest zone of TMB, pointing to comparable vegetation in both zones. The lowest sample from TMB is not included in this group and suggests a slightly earlier beginning for the palaeoecological record at this location. The samples from the remaining three zones of each diagram do not appear to be very similar in terms of their groupings on the plot. The radiocarbon dates demonstrate that the diagrams may not overlap chronologically. The earliest date from TMA (TMA2 40-50cm) is 2880±60 BP (Beta-84824) and the latest date from TMB (TMB3 78-82cm) is 3360±60 BP (Beta-84827). The DCA plot suggested that the high levels of *Alnus* and low levels of herbaceous pollen that are a feature of both TMA1 and TMB1 were similar in terms of sample composition. A date is not available for the decline in alder at the close of TMA1, but this occurs prior to 4080±80BP (Beta-84828) in the TMB sequence. Unless there is a hiatus in TMA1/2 or accumulation rates are very slow in the upper half of TMA1, then it seems unlikely that the either the high levels of *Alnus* in TMA1 and TMB1 and the major declines in this taxa at the close of TMA1 and in TMB2, are the same event. If this is the case, then a period of alder regeneration between the close of TMB diagram and opening of the TMA diagram must be inferred. Alternatively, there is an overlap between the top section of TMB4 with the lower section of TMA1, but there is a spatial discrepancy between the representation of *Alnus* at the centre of the marsh (10-25% in TMB4) and the edge (60-80% in TMA1).

The correlation of the East Moor pollen diagrams utilising DCA and the radiocarbon dates is shown in Table 8.1.

East Moor	Watery Marsh	Tresellern Marsh A	Tresellern Marsh B
EMM4 Poaceae-*Calluna*	WM4 Poaceae-*P.lanceolata*	AD890-1225 TMA4 Poaceae-*Corylus avellana*-type-herbs	
	WM3 Poaceae		
	WM2 Poaceae-Cyperaceae		
EMM3 Poaceae-*Alnus*-herbs	WM1 *Alnus-Betula-Corylus avellana*-type	TMA3 Poaceae-herbs AD100-265 & AD290-320	
		TMA2 *Corylus avellana*-type-Poaceae 1130-940BC	
		TMA1 *Alnus-Corylus avellana*-type	
			TMB4 Poaceae-*Calluna*-herbs 1705-1535BC
			TMB3 Poaceae-*Corylus avellana*-type (AD1065-1075 & AD1155)
			TMB2 *Betula-Corylus avellana*-type 2865-2810BC & 2695-2585BC
			TMB1 *Alnus-Corylus avellana*-type
EMM2 Poaceae-*Hedera*			
EMM1 *Corylus avellana*-type-*Quercus*			

Table 8.1: Correlation of the East Moor pollen diagrams. Dotted lines indicate precise correlation is uncertain. Calubrated radiocarbon dates are included. Brackets indicate that date is thought to be in error.

8.3 Integrating environmental change and the archaeological systems on the East Moor

This exercise is approached with an awareness of the problems inherent in an area in which there has been little archaeological excavation as discussed above (Chapter 5 section 5.3) The archaeological sequences on the East Moor (Chapter 6) can be divided into three main phases:

i) scattered and heavily robbed hut circles, possibly associated with fragmentary curvilinear field systems on the East Moor plateau and also on the slopes of Trewortha Tor and Bastreet Downs. This may represent late Neolithic activity;
ii) the East Moor, Ridge and Bastreet Downs co-axial field system, assumed by analogy with Dartmoor to be middle-Bronze Age;
iii) medieval settlement on the south-east slopes of Fox Tor and in the Withey Brook valley.

The East Moor plateau: East Moor monolith and Watery Marsh

The earliest zone of the East Moor monolith (EMM1) diagram portrays an environment that is under little pressure from human communities. This must therefore predate any of the settlement or ritual monuments on the East Moor. There is some evidence for small scale disturbance to the oak woodland, although the precise nature and extent of this is unclear. The rise in grass and other herbaceous taxa and the declines in arboreal pollen in EMM2 indicate local clearance activity, although the environment that was not yet under intensive pressure. The evidence for the earliest human activity is largely obscured by the co-axial field system, which incorporates much of Ridge Hill and the edges of the East Moor plateau. There is archaeological field evidence a little further south, on Stowes Hill and the Langstone Downs, for unintensive clearance-plot agriculture that has been assigned to the later Neolithic. The huts and possible fields that pre-date the co-axial system on East Moor may very well be contemporary with this,

although they are connected with pastoral activity (D.Hooley, pers.comm.).

The beginning of the *Plantago lanceolata* curve alongside more frequent occurrences of other herb pollen in EMM3 suggests that this period sees the beginning of sustained local activity. This presumably is a result of the disturbance created by the laying-out of the co-axial field system. The establishment of permanent fields, grazed for most of the year, would have led to ideal conditions for the establishment and dispersal of the pollen of plantains. Prior to this, the failure of this taxon to become established presumably relates to grazing and clearance pressures that were sufficiently uneven and unsustained to open up the ground-layer adequately enough to allow the widespread establishment of ribwort plantain.

The palynological impression is of predominantly pastoral farming activities on the East Moor, which is consistent with the interpretation of the East Moor plateau as an area of communal grazing during the Bronze Age (Brisbane & Clewes, 1979). There is no evidence for cultivation, but the nearest extant field systems where arable agriculture could have been taking place, are over one kilometre away. If crops were being grown in these fields, then it would not be expected that this would be reflected in the pollen rain at the sampling site.

A period of reduced activity would be expected to mark the end of prehistoric activity and the abandonment of the co-axial system. This may be represented by the regeneration in *Corylus avellana*-type and falls in *Plantago lanceolata* and Lactuceae indet. at the close of EMM3. The continuing use of the uplands for seasonal grazing across and into the historic period is probable (Johnson & Rose, 1994) and is quite possibly reflected by the demise of *Corylus avellana*-type and expansion in grass and heather communities across EMM4. The decline in alder, apparently the only tree to be unaffected by clearance activity up until this point, is evident at the opening of EMM4. There are two falls in *Alnus* apparent in the

palaeoecological record: the first marks the opening of EMM4 and the second at 10cm sees its more or less complete disappearance from the palynological record. One of these phases may represent the establishment of the medieval settlement on the East Moor plateau and the other may be due to the effects of the tinners who streamed Redmoor Marsh.

On the basis of the DCA plots the Watery Marsh sequence appears to correspond to the upper half of EMM3 and EMM4. Both WM1 and EMM3/EMM4 portray a patchwork landscape with predominantly open grassland, but with some hazel remaining and alder also present in suitable locations. Heather is also a component of the vegetational mosaic. The remaining trees and shrubs are being cleared in WM2 and WM3 and EMM4 leading to the final spread of acid grassland typical of the East Moor plateau today. Both diagrams have different characteristics: *Calluna* is more important at East Moor monolith than at the Watery Marsh site. The latter diagram also features more evidence of an anthropogenic presence in the form of higher percentages of *P.lanceolata* and *Cerealia*-type pollen. These variations will be due to different pollen source areas, the proximity of the sampling sites to different vegetation communities and variations in land-use.

A comparatively late date for peat accumulation has therefore been proposed for the Watery Marsh sequence (see above, Chapter 7 part I section 7.12). The record of cereal pollen has been put forward as evidence of cultivation in the vicinity of Watery Marsh. Pastoral activity was probably also taking place. This agriculture may only have been unintensive or of a limited extent as trees and shrubs persist until WM3 when the final demise of woodland takes place.

A late prehistoric date (*c*.2500BP) for the base of the sequence is assumed. There is some evidence of anthropogenic activity in the lightly wooded landscape, probably of a pastoral nature in the early stages. The clearance in WM2 leads to

what is probably an intensification of grazing pressures and also some cultivation of cereals. The majority of later colonisation of Bodmin Moor is thought not to be until after *c.* AD1100 and it seems unlikely, on the basis of probable accumulation rates, that the clearance and cultivation in WM2 corresponds to this period. This leaves the possibility that there was some form of permanent local settlement in this part of the East Moor in an earlier period, perhaps as early as the Romano-British/Dark Age periods. The evidence from Tresellern Marsh A core for activity between the first to fourth centuries AD (see above Chapter 7 part II section) may be significant in this respect although there is no evidence of cultivation in the Tresellern Marsh sequence in this period, nor is there any identified archaeological sequence to correlate with this palaeoenvironmental evidence. The later medieval clearance and cultivation in this area may overlie any earlier activity, especially if this was of a limited extent. The basal date for the Watery Marsh sequence will indicate the approximate timing of the inferred cultivation phases in this diagram and its relation to the Tresellern Marsh sequences.

The increase in *Plantago lanceolata* and reduction in tree and shrub pollen in WM3 suggests an increase in the area of pasture, although this herb does not peak until the final zone when an increase in *Cerealia*-type also occurs. Two phases are recognised; the first resulted in the decline of the remaining tree cover and expansion of grassland. This might be contemporary with the first decline in alder that marks the opening of EMM4 and, considering the subdued evidence for agricultural expansion, this may relate to the impact of tin-streaming at Redmoor Marsh. The second phase saw renewed arable cultivation and probably also further increases in pasture. The activity in WM4 therefore probably corresponds to the period of colonization of the East Moor at some time from the 11th to 14th centuries that is represented by the field systems and farms of Bastreet Downs and Tresellern.

Evidence for anthropogenic activity in the Withey Brook Valley (Tresellern Marsh)
Any form of activity in TMB1 must have been either on a small scale locally or was occurring at some distance from the marsh itself. This must therefore predate the construction of any of the major archaeological sequences in the valley, although it is not possible to preclude the possibility that human communities were exploiting the higher moorland. The very low charcoal levels may be a further indication that there was little settlement in the area, although as was discussed above, other factors may be partly responsible for the subdued charcoal frequencies in this zone. A date for this zone is not available, although the *Alnus* rise at Dozmary Pool, some 5km to the west of Tresellern valley, is dated to 6451 BP by Brown (1977) and it is tentatively inferred that this event must post-date this.

The destruction of alder in TMB2 illustrates the beginning of human exploitation of valley habitats on the moor and hence an interest in the more marginal parts of the upland environment. This may have been to utilise the timber or to open up more land for farming or other purposes, although as was pointed out above, both are possible. There is little palynological evidence for local human activity following the disturbance to the local alder populations. The lack of any sustained rise in microscopic charcoal during this zone is a further suggestion that any settlement in the charcoal source area was not extensive enough to produce a clear signal in the palaeoecological record. One hypothesis to account for this is that communities settled at some distance from the site and possibly off the uplands completely. If this is the case, a complex relationship between local resources, land use and settlement patterns is implied. Alternatively, the palynological record is not providing an accurate picture of local human-environment relations, although there is no clear reason to believe this to be the case.

There is evidence for continuing expansion in open habitats in TMB3 and the appearance of *Plantago*. A rise in charcoal during this zone indicates increased burning activity. This zone may very well represent the beginning of local

settlement, although it was apparently limited in scope at this point. The radiocarbon date of 2885-2450cal.BC (Beta-84828) for the start of this zone indicates this may be linked with the later Neolithic activity on the uplands (Chapter 6 section 6.7). This may have been on a transhumant basis. The scattered groups of huts, of which the closest are less than 200m to the south-east of the edge of the marsh, have been interpreted as shieling sites; herdsmens' shelters while tending summer grazing stock (D.Hooley, pers.comm.). This interpretation fits in well with the pollen data which suggests a pastoral landscape not yet exploited on an intensive basis.

The appearance of *Cerealia*-type and evidence for further increases in open habitats later in the zone may relate to a change in the nature of local settlement. Assuming that the record of cereal pollen may be taken to indicate local cultivation, as opposed to long-range transport from lowland arable fields, then a shift from a use of the upland as a grazing resource to one on which crops were being cultivated is recorded, although grazing must have also continued.

There is archaeological field evidence some three to four kilometeres south of Tresellern Marsh, for unintensive clearance plot agrictulture on Langstone Downs and Stowes Hill, partly overlain by field systems that are probably Bronze Age in date. Similar cultivation phases might also be expected to have been taking place in the vicinity of the marsh. Whether the first appearance of cereal-type pollen represents the event horizon at which this early experiment in cultivation both here and further afield on the moor occurred, or belongs to an altogether different phase and one which is invisible or yet to be located in the archaeological record, is impossible to identify. The general impression from the pollen record is of the relatively unintensive pressure on the land resource, which is consistent with the postulated later Neolithic/early Bronze Age phase of activity on Bodmin Moor.

Another change in the magnitude and emphasis of prehistoric land-use seems to occur in TMB4. The date for the opening of this zone is 1705-1535cal.BC (Beta-84827). The mid-point of this calibrated range is 1645BC, at the very end of the earlier Bronze Age (Christie, 1986). Although there is no major clearance event to match that of alder in TMB2, gradual declines in *Corylus avellana*-type and the beginning of the *Plantago lanceolata* curve begins were interpreted above as reflecting the establishment of enclosed fields that would have provided the ideal ecological niche for the establishment of ribwort plantain. If this interpretation is correct, then this zone may refer to the formative phases of the East Moor field system. Fire frequency, as inferred from microscopic charcoal, also reaches a peak in this zone, although it does fall and level off in the upper half of the zone, alongside a slight reduction in *Plantago lanceolata* values. The close association between the *Plantago lanceolata* curve and microscopic charcoal frequencies suggests that the charcoal record is related, at least in part, to the burning activities of local human communities. A slight reduction in human activity may therefore be tentatively inferred in the upper half of TMB4.

A number of distinct phases are apparent in the layout of this co-axial system and Brisbane & Clewes (1979) envisage the system being in use for centuries rather than decades. Without the top half of the palaeoecological record from this location, it is difficult to establish which phase of the layout is represented here and whether the construction of the the Bastreet Downs sequence - the nearest part of the system to Tresellern Marsh and hence that which would be expected to provide the clearest palynological signal - belongs at this point or later.

A predominantly pastoral function for the East Moor system is probable (Johnson & Rose, 1994), a conclusion that is supported by the palaeoecological record, despite the limitations regarding the identification of cultivation phases with such data. The sporadic record of cereal pollen suggests cultivation might have been continuing locally, perhaps in arable plots that were part of the co-axial system.

Extra-local or regional cultivation may be responsible for this. The only conclusion that may be advanced is that any local cultivation must have been on a small scale. This raises questions regarding the relationship between upland and lowland in the period of maximum prehistoric activity (Bronze Age?). Since there was probably not enough land under cultivation to support a sizable human population on the uplands, either the people who were responsible for the construction of the East Moor system used the uplands grazing as part of a palaeoeconomy that included the cultivation of cereals in the lowlands, or they were reliant on other communities to provide grain as part of some form of barter-exchange system.

The problems with correlating the TMA and TMB sequences were discussed above. The date of BC cal.1250-980 (Beta-84825) for TMA2 indicates continuing Bronze Age activity in the Withey Brook valley. The main episode of pastoral activity occurs in TMA3 and is dated to 100-265 and 290-320 cal.AD. This period between the first to fourth centuries AD falls within the Romano-British period and thus in a period for which there is little archaeological evidence for settlement in the valley itself, although the round at Allabury is located just off the moor at the end of the valley (see Chapter 6: Figure 6.1 & Chapter 1: section 1.6). In terms of the representation of anthropogenic indicators and declines in tree and shrub pollen, this episode of activity had a greater ecological impact in the Withey Brook valley than the preceeding Bronze Age settlement. Whether there was any form of permanent settlement in the valley at this time, or if communities living off the moor were involved in this activity, cannot be easily demonstrated without archaeological excavation, although it seems probable that the inhabitants of the Allabury round were utilising the valley and moor for summer grazing. The evidence of farming activity in the undated zones of the Watery Marsh diagram (WM2-3) may be significant here, although whether the cultivation at this site was synchronous with the apparently predominantly pastoral activity near Tresellern Marsh can only be demonstrated through radiocarbon dating.

A reduction in the intensity of activity is recorded at the close of TMA3 and opening of TMA4. The radiocarbon date of 890-1225cal.AD for 10-20cm suggests that this inferred reduction occurred in the Dark Age-earlier medieval period. The increase in pastoral and arable indicators at 10cm may reflect the medieval colonisation of the Withey Brook valley and the establishment of the extant field systems on Bastreet Downs and elsewhere in the valley. If this is the case, then either peat accumulation has been low since this period or else the upper layer of the peat has been removed through peat cutting. The latter may be regarded as more likely considering the proximity of the marsh to the medieval and later settlements.

8.4 Predicted and observed evidence of environmental change on the East Moor

Chapter 6 put forward a series of predictions concerning the palaeoenvironmental record, based on the nature of the sampling sites and the archaeological sequences. Table 8.2 is a summary of these predictions and the observed evidence of human impact in the palaeoenvironmental records from the East Moor. Certain aspects of the predictions appear to be met by the palaeoenvironmental data: the high levels of *Alnus* at Tresellern Marsh sampling site and low representation of NAP is born out by the pollen data. There is little evidence of Mesolithic activity, but this may be due to the high representation of on-site taxa. Microscopic charcoal is also low during this period. As was predicted, declines in AP and the spread of grassland and increase in anthropogenic indicators begins in the Neolithic and continues into the Bronze Age.

A major discrepancy between observed and predicted palaeoenvironmental data occurs after this point. The Iron Age and later was thought to have been a period of reduced activity following the abandonment of the uplands that is seen to be a feature of this period (see Chapter 1 section 1.6).

Site	*Predicted Vegetation*	*Predicted Impact*	*Observed evidence*
Tresellern Marsh	Alder/willow carr Oak/birch/hazel woodland on valley sides. Low NAP.	Early (M-N) impacts small scale Clearance in BA. Gradual decline in AP and rise in NAP. Pastoral emphasis Decline in activity in later prehistoric period. Medieval activity: arable? and pastoral indicators *Charcoal*- low micro- and macro-. Micro increasing as settlement spreads	High AP (Alnus) low NAP. N clearance. AI low. BA clearance/pastoral activity with some arable possible. Intensified pastoral activity in IA. Medieval cultivation/pastoral activity. *Charcoal*- macro absent, micro- increasing with clearance
Watery Marsh	Moderate AP. Oak/birch woodland. Higher NAP reflecting more open grass/heath communities at higher levels.	M-N impacts small scale. BA clearance. High NAP and pastoral indicators. Cultivation pastoral activity in medieval period. *Charcoal*-Steady increase to peak in BA. Macro-low. Subdued levels until medieval activity	Scattered alder/birch/hazel woodland with heathy understorey. Clearance and arable/pastoral activity. Timing unclear, poss. IA and later. *Charcoal* - macro- absent, micro- little variation.
East Moor Monolith	Subdued AP. High shrub and NAP reflecting dominance of grass-heath land on plateau.	M-N little evidence. BA clearance and pastoral activity. Medieval pastoral/arable activity. *Charcoal*-low micro- and macro-. Increase in micro- poss. during periods of max. activity	Small scale M impact possible. N clearance. AI remaining low and sporadic. BA intensification, but low AI. Later clearance of alder in medieval period. *Charcoal* - macro-absent. Little fluctuation in micro- until peak during medieval activity

Table 8.2: Table summarising expected and observed evidence of vegetation and human impact in the palaeoecological records from the East Moor. M- Mesolithic; N- Neolithic; BA- Bronze Age; IA- Iron Age. AP- Arboreal pollen; NAP- Non-arboreal pollen. AI- Anthropogenic indicators (*sensu* Behre, 1981).

The TMA diagram indicates a period of significant ecological impact in the Romano-British period (TMA3). Increases in both anthropogenic indicators and microscopic charcoal are more marked than those in the corresponding Bronze Age levels. The palaeoenvironmental record therefore implies that the nature and intensity of human activity during this period is greater than the present archaeological interpretations of the field evidence suggest.

The Watery Marsh sequence is as yet undated, but does not appear to contain a full Holocene record. The extent of tree cover at this location in earlier phases of landscape development cannot therefore be established, but considering the evidence from the East Moor monolith sequence, it may have been considerable.

Until the radiocarbon dating evidence is available for this core, it is difficult to relate the palaeoenvironmental sequence to the archaeology. The implications of the record of *Cerealia*-type pollen at this site were discussed earlier (Chapter 7 part I section 7.13). Cereals were predicted to be recorded only around the medieval period, but the Watery Marsh record may suggest that sporadic cultivation was taking place for some time in this part of the moor. Microscopic charcoal frequencies show little fluctuation.

Arboreal pollen was predicted to have been subdued at the East Moor site with high levels of NAP reflecting increasingly open land at higher, more exposed elevations. Shrub pollen percentages are high at this site but there is also evidence that oak and perhaps other trees were also present suggesting tree cover on the more exposed upland plateaus. There is no evidence of the heathland that was expected on the plateau and *Calluna* appears to spread later as a result of human activity. Radiocarbon dates are not yet available for the monolith sequence, but clearance activity appears to begin in the Neolithic and intensify in the Bronze Age. Pastoral indicators are low and subdued during the period of inferred Bronze Age activity (EMM3), which is at odds with the high levels that were predicted

for this period. Charcoal levels remain generally subdued across the diagram, although the peak in EMM4 may be related to the medieval settlement on the East Moor.

8.5 Summary

This chapter has described the analysis of the sequences from the East Moor. The diagrams have been correlated and the relationship between the archaeological record and the palaeoecological data have been put forward. The East Moor monolith appears to cover the greatest temporal depth, whilst that from Watery Marsh may represent sediment accumulation following previous destruction of peat through tin streaming activity. Clearance activity begins in the Neolithic at Tresellern marsh and intensifies in the Bronze Age and Romano-British periods. Later regeneration of trees is followed by renewed activity in the medieval period. The palaeoenvironmental data were compared to the model of environment and human impact put forward in Chapter 6. The next chapter presents a synthesis of the data from Rough Tor and the East Moor.

Chapter Nine: Human-Environment Relations on Bodmin Moor during the Holocene

9.1 Introduction

This final chapter of the thesis, presents a synthesis of the data from the East Moor and the Rough Tor moors. The implications of the palynological data for the vegetation of the uplands and for the prehistoric settlement and landuse on the moor are discussed and the results are examined in the light of Holocene environmental change on other English uplands, including those of the southwest and areas further afield. The various techniques employed in the course of this study and the success of the sampling strategy are evaluated. Finally, the prospects for further palaeoenvironmental investigation on Bodmin Moor are discussed in the light of the conclusions of this work.

9.2 Palaeoecological techniques and the sampling strategy

Sampling strategy and sites: problems and potential

The original sampling strategy described in Chapter 3 had three main aims:

i) the identification and characterisation of the human impact on the environment of the moor

ii) the detection of the variation in environmental conditions and human impacts on these

iii) the minimisation of the dangers of hiatuses caused by peat cutting and tin streaming.

The sampling strategy has been broadly successful in realising these aims. The only serious shortcoming has been the differences in accumulation rates between sites and the resulting temporal depth and resolution of the sequences. This is illustrated at Rough Tor, where the Rough Tor south core covers a greater period of time than the monoliths and therefore no information is available to compare and contrast early human impacts at Rough Tor south and Rough Tor north.

On the East Moor, the monolith sequence covers a long span of time in a short sequence (1.2m): this is partly off-set by the fact that the other sequences (Watery Marsh, Tresellern Marsh) 'fill in' the picture in more detail for specific periods of the Holocene. This produces a composite picture of human-environment relations on the East Moor. This may be seen as defeating the aim of employing multiple profiles to identify spatial variation in vegetation and anthropogenic impacts (cf. Chapter 4), but is an unfortunate consequence of the nature of the sediments available for palaeoecological investigation on Bodmin Moor. Another problem is that of pollen preservation. This was found to be the case with both the Rough Tor south and Tresellern Marsh B core and, as a result, the top section of the pollen record at each is incomplete. This was another problem which made the comparison of complete diagrams impossible and further necessitated the amalgamation of sequences described above.

Problems of pollen preservation

The exact cause of the preservational problems is unclear. The formation processes of the deposits such as those from which the Rough Tor south core was sampled are obscure and the effect of factors such as climatic change on their hydrology can only be speculated upon. The effects of peat cutting and tin streaming on mire hydrology are also unknown. The unconsolidated sediments observed at Redmoor Marsh during field reconnaissance (Chapter 3) suggest that tin streaming may have had significant effects on areas of a mire that were not directly disturbed by tin streaming activities. Other factors, such as the rapid

accumulation of loosely consolidated peat, may also account for problems of pollen preservation. If this is the case, why the sediments in the centre of the mire should be affected and not those at the edge is unclear.

The sediment comprising the monoliths (Rough Tor monoliths and East Moor monolith) tended to be highly humified, amorphous organic matter, recorded as *Substantia humosa* (Sh) utilising the Troels-Smith (1955) system. Apart from rootlets no macrofossils were identified in the sequences either during cleaning and subsampling or retained on the sieve during pollen preparations. The effect of changes in local hydrology on accumulation rates and processes discussed above might be significant here. However, apart from in the highly minerogenic sediment at the base of the East Moor monolith and the Rough Tor monoliths, there is no evidence of bias through differential preservation or unconformities in the record due to hiatuses. The exception to this is in the Rough Tor north monolith B sequence, where high percentages of fern spores at every sampled level were counted, probably as a result of a high degree of biological activity or deposition of material derived from secondary contexts.

Site characterisitics and scales of analysis

The perceived lack of suitable palaeoenvironmental repositories is one of the main reasons for the previous neglect of Bodmin Moor as an area for palaeoecological study (Caseldine, 1980). As this thesis has shown, conformable deposits with considerable potential do exist in certain areas. Those with the greatest utility in terms of relating environmental change to archaeological sequences take the form of sequences such as those at Rough Tor south and north. The small area of these deposits not only means that a greater proportion of the pollen incorporated in the sequences are likely to have been from local vegetation (Jacobson & Bradshaw, 1981; Sugita, 1994), but they are less likely to have been subject to human disturbance by peat cutting. The close relationship of these deposits to the field archaeology places the integration of palaeoenvironmental and archaeological

changes on a firmer basis than large valley mires that are spatially isolated from the sites of human activity.

The recognition of vegetational changes on the hillsides, where settlement and farming activities actually took place can be located at a fine spatial scale. This is contrasted by the vegetational record at Rough Tor Marsh, Watery Marsh and Tresellern Marsh where the location and nature of dryland communities is considerably less certain due to the valley mire sampling sites.

The record of *Cerealia*-type at Rough Tor monoliths A and C (Chapter 4 part III) is instructive with respect to scales of analysis, especially in relation to the identification of arable activities. The limited disperal capacity of cereal pollen is well documented (Behre, 1981; Hall, 1988; Vuorela, 1973) but the interpretation of records of cereal pollen with respect to local agriculture remains dependent upon the nature of the sampling site in question. The appearance of cereal pollen in the Rough Tor north sequences probably illustrates the medieval cultivation of the moor represented by the areas of ridge and furrow at both Rough Tor south and north. The distance from these areas (north-east slopes of Louden Hill) demonstrates that small deposits up to several hundred metres from cultivated areas can be useful for detecting arable activities. Unfortunately, the monolith records do not include more of the earlier prehistoric sequence of settlement at Rough Tor North. Their sensitivity in detecting later cultivation suggests that, had there been any significant period of arable farming at Rough Tor north in the formative stages of settlement, then there would have been a good chance that it would have been detected by these sequences.

The other records of cereal pollen are at Rough Tor Marsh, Watery Marsh and Tresellern Marsh A and B. Except in the case of Watery Marsh, this consists of only one to two grains in a similar number of samples in each sequence. The larger pollen source area of these marsh deposits and low numbers of identified

grains means that it is difficult to identify whether the pollen was derived from local cultivated fields or more distant arable plots.

The use of the deposits at Rough Tor north and south and the East Moor is not without problems or limitations. Although a small pollen source area is desirable in terms of spatially specific human impacts, the utilisation of the data can be hampered by the lack of the picture of vegetational change on a wider landscape scale, such as can be derived from deposits with larger pollen source areas. The utility of small hollows in detecting localised human impacts has been remarked upon by other researchers (eg. Andersen, 1973; 1978; 1988; Aaby, 1988; Ammann, 1988), especially where a number of different types of palaeoenvironmental repositories with different pollen catchments are available to identify and compare the palynological signals of vegetation on different scales (cf. Janssen, 1986; Tolonen & Tolonen, 1988). This lack of a wider palynological context occasionally hampered interpretation of the record from the smaller hollows. On the East Moor, for example, it is unclear to what extent the high levels of *Corylus avellana*-type and *Calluna* in EMM2 are representative of the vegetational development across the whole of the East Moor plateau.

The palaeoecological data from such deposits have limitations with regard to identifying climatic change. The susceptibility of small topogeneous deposits to changes in local hydrology means that vegetational changes recorded in the palynological record may be unrelated to macroclimatic changes. Until more is known about the precise formation processes of spring line deposits, such as those at Rough Tor, the application of palaeoenvironmental data derived from these repositories to questions of climate change should be approached with circumspection.

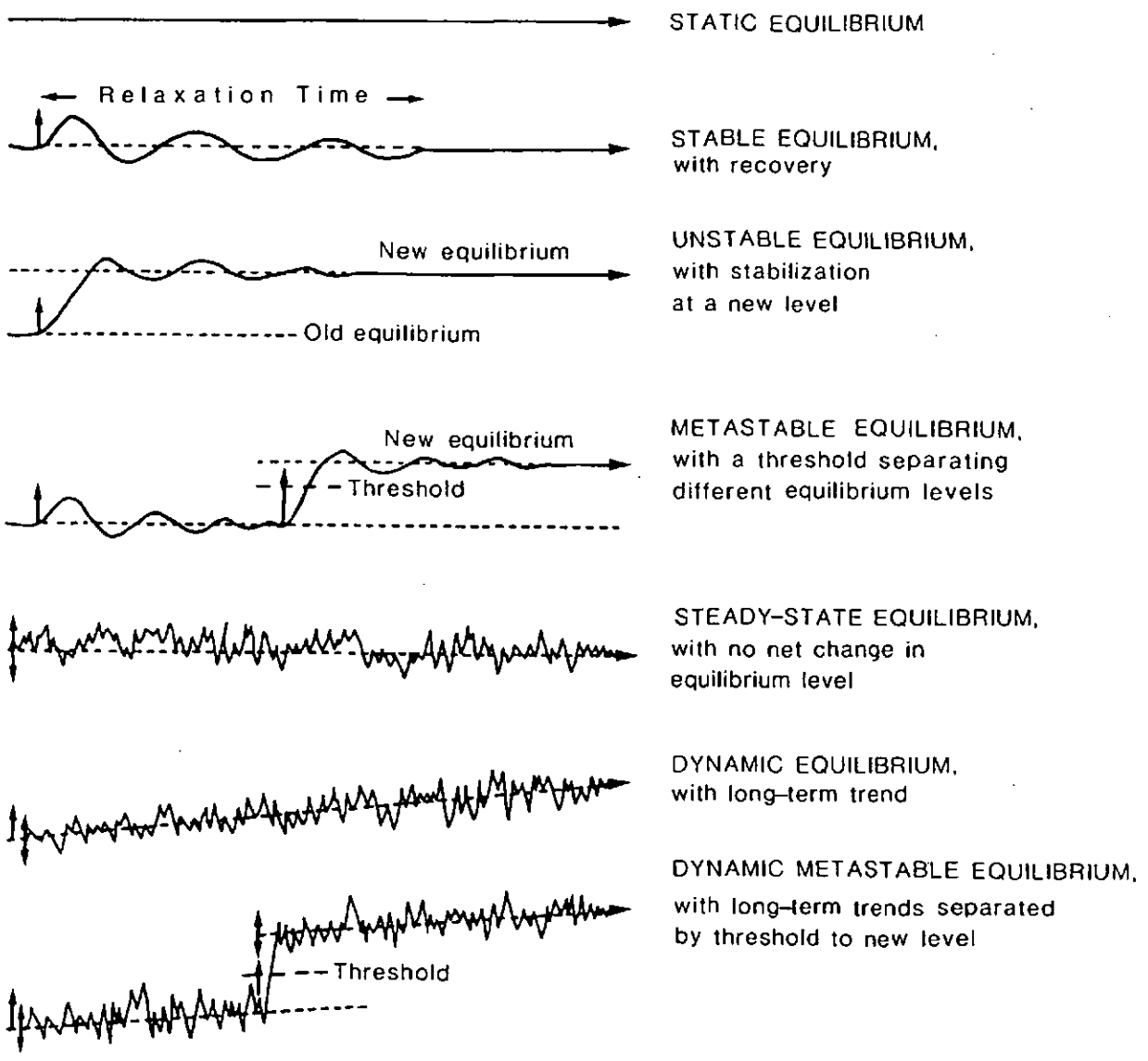
Loss-on-ignition (LOI) and environmental magnetism

LOI was employed as a means of identifying periods of mineral deposition

corresponding to periods of increased erosion due to vegetation clearance and human impact. The organic material comprising the sampled sequences is often highly minerogenic, especially in the case of those sites such as the Rough Tor monoliths and the East Moor monolith. The majority of monolith A core does not increase above 60% organic. Monoliths B and C have lower organic contents with percentages generally below 40% and 50% respectively. These percentages are well below the 95% level that may be used to define ombrotrophic peat growth (Charman,1992a). The valley mire cores have higher organic percentages: Tresellern Marsh A core is largely above 70% organic and Tresellern Marsh B core over 75%, although this latter core shows a greater range of values than the former. Rough Tor Marsh displays the highest percentages of organic matter at over 90%. This is probably because the size of the marsh means that the sampling site in the centre of the deposit is over 250m from the edge and would thus be less influenced by the material deposited by slope wash processes than a sampling sites closer to the edge.

Changes in the organic component of sedimentary sequences can be related to a number of environmental variables. Variations in accumulation rates, as well as in the deposition of eroded material, will affect the percentage of the organic component of a given sequence. Changes in the hydrology of a body of sediment may alter the redox potential and thus rate of decay of organic matter. The changes in organic percentages of sediment as determined by LOI are therefore the result of a dynamic interplay between several controlling variables. The nature of this balance will determine what state of equilibrium the system is in (Figure 9.1). The more stable the system in question is, then the greater the degree of confidence in the identification of periods of instability. For example, the accumulation of organic matter in a raised mire will generally be in stable or static equilibrium, due to the absence of input of inorganic matter. Any disturbance or change to the controlling variables of such a system that leads to the increased deposition of inorganic matter, will be clear in any determination of the relative

Figure 9.1: States of equilibrium (from Butzer, 1982:22). Vertical arrows indicate changes in controlling variables.



organic/inorganic fractions. The Rough Tor monoliths and the East Moor monolith display significant fluctuations in organic matter, with no clear relation between LOI and vegetational changes recorded in the pollen record. This will be due in part to the nature of the sampling sites: their position at the base of slopes means that the accumulating sediment would always receive a net deposition of eroded top soil material due to slope wash.

The deposition of mineral matter may or may not be related to human activity such as vegetation clearance, but the state of equilibrium that the monolith sequences are in makes it difficult to separate any erosion resulting directly from human activities from the 'background' signal derived from natural processes. This is further complicated by possible changes in accumulation rates: a decrease in accumulation rates could produce the same effect as an increase in mineral deposition.

Possible changes in sedimentation and erosional episodes were identified in the valley mire sequences that could be more clearly related to environmental changes identified in the pollen record (Watery Marsh, Tresellern Marsh and Rough Tor Marsh). The fluctuations in organic percentages vary between cores. In the case of Watery Marsh, the most marked phase of mineral accumulation consisted of a steady decline in organic percentages from over 60% to below 40% between 72cm - 62cm. This is of a different form from the sudden fluctuations observed in, for example, the Tresellern Marsh A core where organic percentages dip sharply from above 80% to below 70% and back to over 80% between 31-34cm.

No visible minerogenic layers were recorded in the sequences, as has been reported in valley and blanket peat sequences from other areas including, for example, the North York Moors (Simmons & Innes, 1988 a, b), the Outer Hebrides (Birks & Madsen, 1979) and Scotland (Edwards *et al.*, 1991). There is not always a clear correspondence between falls in organic percentages and intensified

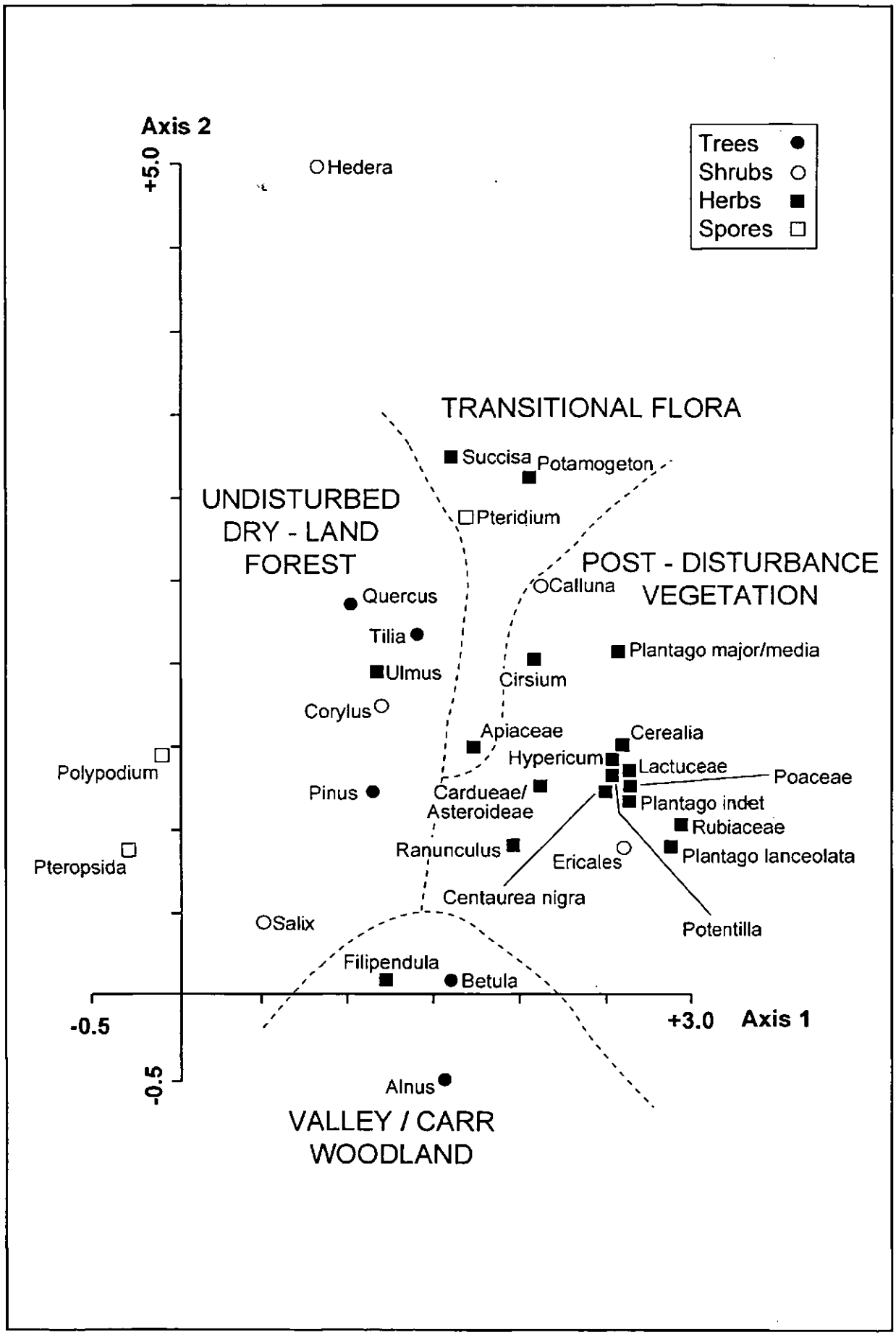
disturbance to dryland habitats recorded in the pollen record from the sequences in this project. Further research needs to be carried out into the extent to which the deposition of eroded material resulting from catchment disturbance is registered at different distances from the mire edge, although the intensity of disturbance necessary to produce a clear signal in a change in organic percentages in a given sequence must depend on local variations in substrate stability and erodability of mineral matter.

Magnetic susceptibility measurements were carried out on two of the sequences (Rough Tor south core and Tresellern Marsh B core) as another possible method of detecting mineral inwash. As with LOI, this technique did not yield very useful results, due at least in part to the technique of measurement employed. Magnetite can survive dissolution in minerotrophic peats and where enough has survived magnetic measurements can identify and characterise the inwash (F.Oldfield, pers.comm.), but the core scanning loop sensor utilised in this case for measurement of susceptibility is not very sensitive in the identification of magnetic signatures in generally diamagnetic sediment such as peat (S.Hutchinson, pers.comm.). Other magnetic measurement techniques might have proved more suitable (cf. Tipping, 1995a, b).

9.3 Rough Tor and the East Moor: comparison of the pollen records

In order to compare, contrast and correlate the palynological data derived from the sequences from both Rough Tor and the East Moor, all eight sequences were subject to detrended correspondence analysis utilising the CANOCO computer program (see Chapter 2).

Figure 9.2: DCA pollen taxa scores for the Rough Tor and East Moor sequences. Dotted lines indicate taxa groupings referred to in text.



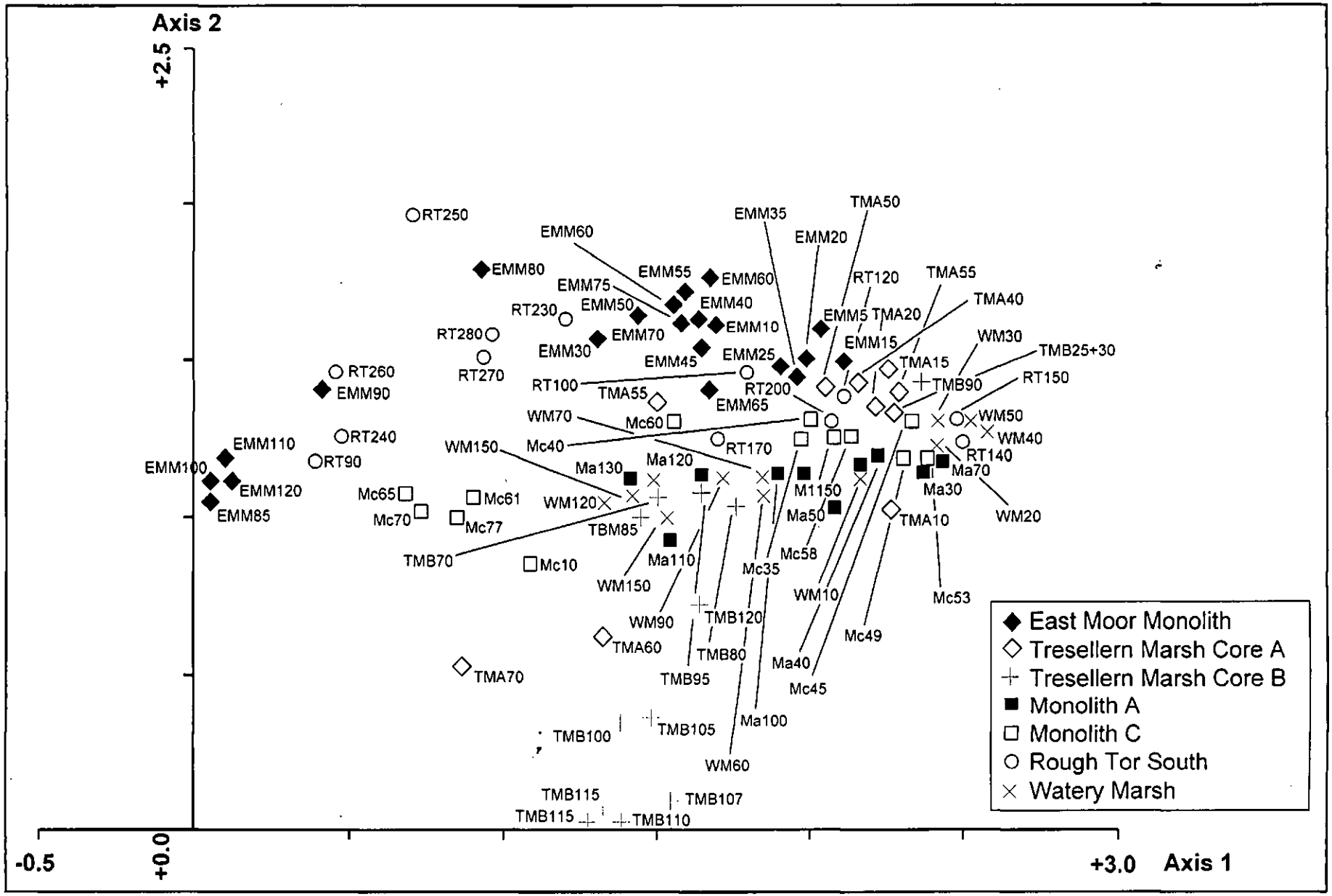


Figure 9.3: DCA sample scores for the Rough Tor and East Moor sequences. NB. Not all samples are included on the plot.

Pollen taxa scores

Figure 9.2 is the plot of the first two axes for the pollen taxa. Axis one differentiates between the taxa that are characteristic of the early Holocene woodland cover on the moor and taxa typical of post-disturbance vegetation. Both *Ulmus* and *Pinus* are included in the former group, suggesting that these trees were part of the Holocene woodland. Pteropsida (monolete) indet. and *Polypodium* are also present, confirming both a fern-rich ground layer and epiphytic flora.

Ruderals and other herbs characteristic of the disturbed, open grass and heather communities that spread as a result of woodland recession, tend to plot on the right side of the diagram. Certain taxa are present inbetween these two main groups, namely Apiaceae, *Succisa* and *Pteridium*. These taxa are probably associated either with conditions typical of a woodland edge or with openings in the canopy, with *Succisa* in the damper areas and *Pteridium* on the drier soils. In the case of Apiaceae, it might also reflect the development of tall herb communities in the transition from woodland to grassland. *Betula*, *Alnus* and *Filipendula* plot in a separate group. The proximity of these taxa suggests that birch and alder tended to form carr communities on the damper soils and valleys of the moor. The association of *Betula* with this group indicates that birch was more typical of damp and open tall herb vegetation than the denser mixed hazel/oak woodland present on the freer draining soils of the moor.

Sample scores

Figure 9.3 shows the results of the sample scores for each site for the first two axes. The lowest zones from Rough Tor south core and East Moor monolith (RTS1 and EMM1) plot toward the left of the diagram indicating both the broad similarity of these zones and their overall difference from the majority of the other sequences. The lowest samples from TMB and TMA plot in the lower centre of the diagram, demonstrating the distinctive nature of the valley vegetation communities from those of the higher slopes and plateau. The occurrence of the

samples from the lower zone of Rough Tor Monolith C between these groups points to the later persistence of communities that shared charcteristics of the earliest vegetation of the hill sides with elements of the vegetation of lower valleys. The remainder of the samples appear in the large group in the centre right of the diagram indicating the trend in all the sequences to broadly similar open habitats as a result of anthropogenic impacts. The close grouping of the East Moor monolith samples shows the distinctive character of the East Moor plateau vegetation from the valley and slope communities.

9.4 Discussion: the character of the early vegetation cover on Bodmin Moor.

Early Holocene vegetational succession

The pattern of post-glacial vegetational succession, as established by Brown (1977) and partly confirmed by Walker & Austin (1985) was described in Chapter 1. Birch was the first tree to become established, followed by oak and hazel at c.7000BP. The Rough Tor south sequence does not include a late-glacial orearly Holocene sequence of vegetational development, as hazel is already established in the lowest levels with birch and oak apparently expanding locally. The absence of the context of the earliest Holocene vegetation pattern means that it is difficult to establish the full sequence of succession in this instance but there are marked differences in the early Holocene tree spread in this area compared to Brown's (1977) and Walker & Austin's (1985) studies and also to other parts of the south-west in the early Holocene (eg. Caseldine & Maguire, 1986). The early spread of birch is a consistent feature of pollen records from the British Isles and is attributable to its edaphic requirements and rate of immigration (Huntley & Birks, 1983) and the early spread of oak is also a feature of other pollen diagrams from the south-west (Conolly *et al.*, 1950; Simmons, 1964; Brown, 1977; Beckett, 1981).

Two hypotheses may explain this: either the Rough Tor south sequence is not recording the earliest vegetational development in the Rough Tor area but rather later, local woodland development. Alternatively, the early Holocene sequence of tree growth was different at Rough Tor compared to other areas of Bodmin Moor and the south-west. The first may be regarded as more likely, considering the number of other studies, including the palynological data from the Rough Tor Marsh core which indicate that *Betula* was established in the Rough Tor area from what was an early stage in the Holocene. This leaves the hypothesis that the palynological record at Rough Tor south portrays a later phase of development unrelated to the earlier establishment of the tree. If the diagram therefore records a period of later birch and oak spread into what is apparently early, undisturbed Holocene *Corylus* scrub, this in turn raises questions of the possible causes of this later expansion at what is probably an early date. The radiocarbon dates should help to reject one of these hypotheses.

Evidence for the status of the tree taxa on Bodmin Moor

Table 9.1 shows the maximum recorded percentages of the tree taxa from the Rough Tor and East Moor sequences. The discussion of the earliest vegetation of the moor involves two of the eight sequences examined, Rough Tor South and the East Moor monolith. Table 9.2 shows ratios of tree pollen for the six main tree taxa (including *Corylus*), which may be compared with ratios for early Atlantic woodland of Dartmoor (Simmons, 1964; Beckett, 1981) and those Brown (1977) calculated from his diagrams from Dozmary Pool.

Quercus

The highest representation of *Quercus* are in pre-human disturbance zones EMM1 and RTS1 (Table 9.1). The DCA plot (Figure 9.3) confirms the association of this taxon with *Corylus* indicating these were the major components of the woodland communities on the hillsides. The maximum percentages of *Quercus* in EMM1 and RTS1 are similar: 22% at East Moor and 28% at Rough Tor. The ratios in

Site	*Quercus*	*Betula*	*Alnus*	*Ulmus*	*Tilia*	*Corylus*
Rough Tor south	28 RTS1	15 RTS1	17 RTS2	2 RTS1	1 *	92 RTS1
Rough Tor MA	2 RTNa1	2 RTNa2	43 RTNa1	1 *	1 *	30 RTNa1
Rough Tor MC	8 RTNc1	4 RTNc1	20 RTNc1	1 *	1 *	35 RTNc1
East Moor Monolith	22 EMM1	6 EMM1	12 EMM3	5 EMM1	1 *	91 EMM1
Watery Marsh	3 WM4	3 WM1	25 WM1	1 *	1 *	21 WM1
Tresellern Marsh A	5 TMA2	5 TMA2	80 TMA1	1 *	1 *	36 TMA2
Tresellern Marsh B	5	31	79	1	1	30

Table 9.1: Comparison of the maximum percentages of arboreal pollen recorded at Rough Tor and the East Moor with corresponding assemblage zone.'*' indicates the maximum value is recorded in more than one zone.

Site	*Quercus*	*Betula*	*Alnus*	*Ulmus*	*Fraxinus*	*Tilia*	*Corylus*
East Moor Monolith	12	4	-	2	-	*	73
Rough Tor south	12	5	1	1	-	*	65
Brown (1977)	7	8.5	3	1	*	*	28
Blacka Brook Beckett (1981)	14	9	2	2	1	1	25
Blacklane Brook (Simmons 1964)	11	1	4	4	1	1	29

Table 9.2: Comparison of the ratios of tree pollen from sites on Bodmin Moor and Dartmoor. '-' signifies taxon not recorded. '*' indicates ratio below 1.

Table 9.2 confirm the similar status of this tree in the vegetation of both areas. Oak was clearly a significant component of the tree cover on the higher, south facing slopes on Bodmin Moor (both sites face south at 290m OD). Whether this tree acheived a similar status at the same altititude on more exposed west-facing slopes is unknown. However, the oak woodland on Dartmoor at Black Tor copse and Wistman's Wood are both in high, exposed positions demonstrating that the status of this tree may not always be dependent on exposure (Barkham, 1978).

Brown (1977) recorded *Quercus* percentages of 10-15% at his sampling sites. Despite the lower altitudes of Dozmary Pool (265m) and the Parsons Park and Hawks Tor deposits (229m) sampled by Brown (1977) they were probably some distance from the nearest woodland edge. The nature of the Rough Tor south and East Moor sampling sites means they would have been comparatively close to the hill-side woodland. A more accurate picture of the status of those trees present on the better draining soils is therefore derived from these records.

Unfortunately, the sampling sites that are at the lower altitudes, where it is assumed that oak would have formed more extensive woodland, do not include sufficient evidence of the pre-disturbance vegetation. *Quercus* never reaches more than 5% in the Tresellern Marsh diagrams. If oak was more prevalent in the earlier woodland in such locations, then it would probably have been previously affected by anthropogenic activities and thus the low levels of *Quercus* in the Watery Marsh and Tresellern cores probably do not reflect the original status of oak on the valley sides. Another consideration is that any oak woodland in the Withey Brook valley would have been on the sides of the valley and thus some distance from the sampling sites at Tresellern Marsh. Tinsley & Smith (1974) demonstrate that fall-off in *Quercus* pollen beyond a woodland edge can be quite rapid and under these circumstances, stands of oak present in the valley might not produce a clear palynological signal at a sampling site only a short distance from

distance from the woodland edge. Caseldine's (1980) hypothesis, that oak woodland would have been dominant in more sheltered areas post-7000BP, cannot either be proved or refuted, although this seems likely on the basis of its status at higher altitudes at Rough Tor and the East Moor.

Corylus

Corylus avellana-type percentages (assumed to be mainly *Corylus avellana)* tend to be very high in the earliest pre-human impact phases, even when the other species that are components of the woodland canopy are established. Percentages attain over 90% in RTS1 and EMM1 (Table 9.1) and are significantly higher than the figures for Dartmoor and the 20-30% Brown (1977) recorded. Hazel was clearly the most dominant component of the hillside woodland. The apparently dense nature of the hazel-dominated woodland on sheltered southern facing slopes at Rough Tor south and the East Moor suggests that hazel scrub may have extended almost up to and perhaps even onto tor summit areas.

Corylus avellana-type percentages are between 30-40% in the valley mire sampling sites of Tresellern Marsh: similar figures to those recorded by Brown (1977) and interpreted as reflecting scattered hazel cover on the hillsides. As the very high percentages of this taxon at Rough Tor south and East Moor demonstrate, the hazel cover was probably very dense and the lower percentages recorded at Tresellern Marsh and also by Brown (1977) are due to taphonomic factors. Hazel was well established on the higher slopes and probably enjoyed a similar status on the more sheltered valley sides. As is the case on western slopes at higher altitudes, hazel scrub was probably dense on the sides of the more sheltered valleys prior to human disturbances.

Alnus

The predominance of alder in the valley bottoms is confirmed by the high *Alnus* percentages in the Tresellern Marsh diagrams (Table 9.1). This taxon peaks at

around 80% in both diagrams (TMA1 and TMB1). The record of *Alnus* at 17% in the Rough Tor south diagram suggests it was present as a component of the hill side tree cover, although it was clearly not able to achieve the same status that it did in the valleys. Its presence on the higher slopes and plateaus of the moor would have been restricted to the damper substrate on the lower slopes as is also confirmed by percentages at monoliths A and C.

Bush & Hall (1987), Brown (1988), Chambers & Elliot (1989) and Bennett & Birks (1990) have discussed the Holocene palaeoecology of *Alnus*. The expansion of *Alnus* has been linked to anthropogenic disturbance to the Holocene woodlands by Mesolithic peoples (Smith, 1984; Chambers & Price, 1985). *Alnus* is competitively inferior in comparison to other tree taxa (Bennett, 1986) and the effects of destruction of the dominant tree taxa is seen as facilitating the spread of the tree in certain areas. The expansion of *Alnus* in the Rough Tor south core (RTS2) and East Moor monolith (EMM2) coincides with reductions in *Corylus avellana*-type and other tree pollen and increases in Poaceae and indicators of open habitat. The rise of *Alnus* at Rough Tor south is dated to 8410±90 (OxA-6010) which is considerably earlier than the date of 6451±65 BP (Q-1025) for this event at Dozmary Pool (Brown, 1977); although this date may be in error (see Chapter 4 part II section 4.12).

Betula

Betula percentages peak at 15% at Rough Tor south but only 6% at East Moor monolith (Table 9.1), where it was limited in local extent and, despite the altitude, was apparently not as prevalent as oak. A similar situation was remarked on at Pinswell on Dartmoor (Caseldine & Hatton, 1993). Brown (1977) recorded *Betula* percentages of between 10-20% with a peaks of up to 30% at Dozmary Pool. The most significant evidence for birch establishment on Bodmin Moor is in the Tresellern valley (TMB core) where *Betula* attains 30%. This seems to confirm Caseldine's (1980) contention that this tree was able to attain greater stature in the

lower valleys around the edge of the moor. However, the increase in birch at Tresellern Marsh appears to be a successional response to the clearance of alder on the surface of the marsh. As is the case with oak, it is difficult to establish how prevalent birch was prior to this, as the sequence does not record a sufficiently detailed earlier phase. Nevertheless, a significant presence is likely. Although accumulation rates are not known, the nature of the increase in *Betula* in the Tresellern Marsh B diagram suggests that the tree spread very rapidly and although *Betula* is a fast growing taxon, its rapid establishment at this site may also have been facilitated by a significant local presence.

Other tree taxa: Ulmus, Pinus, Salix and Tilia

Elm, pine, willow or lime did not form significant components of the Holocene woodland on Bodmin Moor. Neither *Ulmus* or *Tilia* increase above 1-2% although the former achieves 5% in EMM1. Some elm is thought possible on the East Moor plateau, although it was clearly not thriving. As Brown (1977) suggested, the distribution of elm and lime on the moor was probably restricted by the lack of base rich soils and perhaps also exposure.

The only diagram that suggests an unequivocal evidence of the local presence of willow is the Rough Tor north monolith A diagram, where *Salix* is recorded at 10% in RTNa1. *Salix* tends to be under-represented in pollen diagrams (Bradshaw, 1981) and it is possible that willow was a subordinate member of the Holocene woodland with its presence only clear when it was growing very close to the sampling site. A low peak in this taxon is recorded in the Rough Tor Marsh diagram which declines with the rise in *Alnus*. *Salix* may have been outcompeted by *Alnus* in mire areas in the earlier Holocene, although there is no evidence that willow was present on Tresellern Marsh prior to the spread of alder. *Pinus* remains very low in all the diagrams and nowhere does it reach the 20% taken to infer local presence (Bennett, 1984). A peak in the lowest zone of the Rough Tor Marsh diagram is interpreted as indicating that some pine may have

been present in the earlier Holocene but was outcompeted by alder.

The upland vegetation, the tree line and human communities

Brown (1977) interpreted the percentages of *Corylus* in his diagrams as indicating that the vegetation on Bodmin Moor was largely open, particularly in higher and more exposed areas. Brown also reinterpreted Simmons' (1964) pollen diagrams from Dartmoor as indicating that tree cover was never extensive on this upland, a view which can be regarded as incorrect in the light of subsequent palaeoenvironmental study (eg. Caseldine & Maguire, 1981; Beckett, 1981; Caseldine & Hatton, 1993). Despite this, Brown's (1977) conclusions have tended to dominate discussion of the Holocene vegetation of Bodmin Moor (eg. Caseldine, 1980; Mercer, 1986; Todd, 1987; Johnson & Rose, 1994), although Birks (1988b) suggested that Bodmin Moor was probably forested up to its highest altitudes.

The high percentages of hazel and low percentages of non-arboreal pollen in the early zones at Rough Tor south and East Moor monolith have been interpreted in this thesis as showing that, although this shrub was the main component of the woodland in these areas, the vegetation was not necessarily 'open' in the sense that grass and heathland were the dominant habitats. Hazel can grow in dense thickets and it seems likely, on the basis of the high percentages of *Corylus avellana*-type, low levels of Poaceae and other herb pollen in RTS1 and EMM1, that hazel scrub formed a closed canopy cover over many of the hillsides. The high levels of *Corylus avellana*-type at 280m at Rough Tor south may even suggest that hazel scrub may have reached up to and over the top of some tors, especially on lee slopes.

The high percentages of grass in Brown's (1977) pollen diagrams were probably derived as much from on-site grass growth as from the open areas he envisaged

as being present on the dry land around his sampling sites. The probability that these sites were some way from the woodland edge was mentioned above and there is no secure way to separate the palynological signal of grass growth on the mire surface at, for example, Dozmary Pool from that of any naturally open ground on the hillsides around the site. However, high levels of on-site Poaceae pollen would be expected on an extensive mire on the edge of open water at 265m.

The extent of areas of more open grass and heath-dominated communities on the moor is unknown. Western-facing slopes *may* have had a much thinner cover of trees and shrubs. Caseldine & Maguire (1981) warn against extrapolating palaeoenvironment from pollen data over wide areas and thus until more sampling sites on Bodmin Moor are investigated, vegetational differences resulting from aspect remain speculative.

Establishing the vertical extent and position of the altitudinal tree-line is difficult palynologically (Maher, 1982; Maguire & Caseldine, 1985). Birks' (1988b) criteria are the presence of tree macrofossils or tree pollen percentages in excess of 50% TLP. The macrofossil evidence from Bodmin Moor points to the presence of trees up to at least 244m (Ussher cited in Brown, 1977). No macrofossils were identified in the sequences investigated during this project, but arboreal pollen percentages peak at 50% in RTS1 at Rough Tor south, suggesting that woodland including both oak and birch was present at up to 270-280m in this area. The picture of an open situation on the moor may therefore be somewhat misleading and although 'true' woodland may not have been the major community on most hillsides, it was probably anything but an 'open' landscape that faced the earliest gatherer-hunter communities on Bodmin Moor (cf. Todd, 1987:64).

The nature and composition of the woodland must have varied with altitude. The dominance of *Alnus* and probably also *Betula* and *Quercus* in valley areas has

been mentioned. In some places, there may have been a gradual transition from deciduous woodland, comprising oak and birch to the increased stature of hazel observed at Rough Tor south. In other areas, the division between hazel and oak-birch dominated communities may have been more marked and sudden. The altitude at which hazel became the less significant component of the woodland community and was relegated to an understory shrub is unclear, but topography was almost certainly one controlling factor. There was probably a steady transition from hazel dominance to oak and other deciduous trees as the main canopy forming species in some areas, whilst in other areas there may have been a sharp division. The East Moor plateau may be a good example of the latter situation. Oak and perhaps some birch, elm and pine may have been present on the plateau itself, but hazel was clearly the dominant component. The change from a hazel-dominated scrub/woodland to the taller woods of the lowlands may have been delineated by the steep scarp slope of the East Moor plateau.

Palynological indicators of anthropogenic impact

A marked feature of the palynological record from both of the study areas is the comparatively sparse record both of anthropogenic indicators and of herb taxa in general, despite the proximity of several of the sampling sites to the location of activity as represented by the archaeological remains. The only so-called 'anthropogenic indicator' that consistently appears as a result of tree and shrub clearance is *Plantago lanceolata*. This herb is absent or appears in only low and sporadic quantities in early periods of human activity, suggesting an absence of areas that were insufficiently utilised to create the high light habitats that this herb requires (eg. RTS2; EMM2; TMB3). The increase of this species is interpreted as showing the creation of permanently open areas, in the first instance through the direct removal of tree cover and later through the maintenance of these areas primarily by grazing, although as Grime *et al.* (1988:438) demonstrate, this herb is present in a number of habitats including rocky outcrops, wasteland, waysides, spoil heaps, pasture and meadow.

Site	Mean%	Max% (depth cm/zone)	AP%
Rough Tor S.	3	6 (140/RTS3)	15
Rough Tor Monolith A	3	14 (15/RTNa4)	23
Rough Tor Monolith C	2	5 (30/RTNc3)	19
East Moor Monolith	1	2 (35/EMM3)	74
Watery Marsh	4	13 (20/WM4)	48
Tresellern Marsh A	2	6 (10/TMA3)	24
Tresellern Marsh B	1	2 (70/TMB4)	7

Table 9.3: Comparison of *P.lanceolata* data from East Moor and Rough Tor sequences. AP% is the percentage of arboreal pollen at the level at which the *P.lanceolata* curve begins.

Some researchers use the fluctuations in the percentages of this species as a direct indication of the scale of farming in pollen diagrams: O'Connell *et al.* (1988) state that percentages of *P.lanceolata* are "...the most reliable indicator of the extent of open areas without heath or bog development." and Gaillard *et al.* (1994) similarily use changes in *P.lanceolata* percentages as a direct indication of changes in the areal extent of pasture land. Other scholars have pointed out that the occurrence of *P.lanceolata* may not necessarily be a reliable indicator of human presence. Bennett *et al.* (1990a:294-295) discuss the palaeoecological record of this herb on the isle of South Uist in the Outer Hebrides and point out that as the species' modern distribution around the sampling site is limited to ungrazed rocky ledges, the date of its appearance in the pollen record may have little more significance than the date of its introduction to the island. Groenmann-van-Waateringe (1986) suggested that *P.lanceolata* could have belonged partly to the suite of arable weeds in pre- and proto-historic times in the Netherlands, based on the observation that charred grains of cereal from archaeological conexts were often found with macrofossils of *P.lanceolata*, particularly at sites on poor, sandy soils (van Zeist, 1979). These examples serve to illustrate the importance of the local ecology of a species in the interpretation of palynological data and the uncritical use of 'anthropogenic indicators' to assess past landuse, although there is always the problem of assigning ecological preferences to taxa in prehistory on the basis of modern comparisons (Behre, 1981).

Table 9.3 is a comparison of the percentages of *P.lanceolata* at the eight sites from Rough Tor and the East Moor. Use of percentage figures in order to assess the relative intensity of clearance and farming activity in different parts of the moor is difficult for several reasons: *P.lanceolata* is susceptible to predation of flowering heads, especially by sheep and is vulnerable in its vegetative and regenerative form to trampling (Grime *et al.*, 1988:438). An increase in grazing intensity could theoretically lead to a fall in percentages of this herb and an incorrect assessment of the status of local farming activity. This is further

herb and an incorrect assessment of the status of local farming activity. This is further affected by both the proximity of the area of activity to the sampling site (cf. Edwards, 1979) and the nature of that activity, as extensive and intensive grazing regimes may have different effects on the composition of the ground flora (Groenman-van Waateringe, 1986). *P.lanceolata* is a prolific pollen producer, although it has been shown that its pollen has a tendency to remain in large clumps, possibly limiting its dispersal (Tonsor, 1985). These considerations warn against the utilisation of changes in the representation of *Plantago lanceolata* as a proxy measure of changes in the scale of farming in an area.

Whilst the range of average percentages is comparatively small, at between 1-4%, maximum percentages show a greater range of 2-14%. The highest values (monolith A and Watery Marsh) occur in the later zones of these diagrams. The zones are thought to correspond to medieval and possibly later phases of activity at Watery Marsh. The highest values in the prehistoric disturbance phases are 6% at Rough Tor south and Tresellern Marsh A. The higher mean at TMA compared to that of TMB is due both to the fact that the latter diagram does not include later phases of disturbance and also the proximity of TMA to the edge of the marsh and thus improved representation of adjacent dry-land pollen. The low mean of 1% and maximum of 2% at East Moor reflect the generally subdued representation of ruderal pollen at this site. Higher percentages of indicators of pasture were expected for this site during the Bronze Age, due to its probable status as an area of communal grazing in this period.

The percentage of arboreal pollen (including *Corylus avellana*-type) shows a wide range of levels for the beginning of the *Plantago lanceolata* curve. The very high percentage at East Moor (74%) is due to the high vales for *Corylus avellana*-type and that at Watery Marsh (48%) is due mainly to *Alnus*. Excluding these components due to their probable on-site presence reduces the figures to 10% and 24% respectively. This produces a range of AP% that are all below 25%. This

corresponds to the figure given by Groenmann-Van Waateringe *et al.* (1986) as being representative of open ground.

The pronounced peaks in *Plantago lanceolata* observed in RTNa4 and WM4 are accompanied by increases in tree pollen percentages. This increase is probably related primarily to a regional signal of woodland, but increases in *Alnus* suggest some expansion in local tree populations near to the sampling sites. The increase in *P.lanceolata* therefore represents a change in the composition of the local ground flora, rather than an actual increase in the area of open land as a result of woodland recession. This may reflect the reclamation of cleared but previously unintensively used land. The significance of the magnitude of the peaks is difficult to interpret, but they may indicate that in comparison to the prehistoric levels, later pastoral activity was more intense than that in the Bronze Age (cf. Beckett, 1981).

Succisa often increases as a result of the opening up of woodland in the diagrams from Rough Tor and the East Moor. The DCA plot has been interpreted as showing the association of this herb with partially open woodland environments. This herb reaches its highest values following initial disturbances to the local woodland cover and tends to decline with intensified clearance and the beginning of the *Plantago lanceolata* curve. *Succisa* reaches 8% at 250cm in the Rough Tor south sequence and is sporadically recorded before the anthropogenic activity increases in RTS3. Percentages recover to 1% following the regeneration of tree and shrub cover in RTS4. The behaviour of the *Succisa* curve follows a similar pattern in the East Moor monolith with a peak of 7% in EMM2 followed by a fall to 1-2% with the expansion of *Plantago lanceolata.* The close association of the curves of these taxa suggest that both are related to processes that affect the composition of the ground flora. The occurrence of *Succisa* where grazing suppresses the growth of potential dominants and its persistence in only lightly disturbed habitats has already been mentioned (Grime *et al.*, 1988:556). The

percentages and intensified clearance and *P.lanceolata* suggests that the early dominance of *Succisa* is closely related to anthropogenically modified habitats, probably typically lightly grazed woodland edge communities in damper areas.

Potentilla also demonstrates marked increases in the pollen zones following woodland recession (eg. RTNc3, RTS3). *Potentilla* is insect-pollinated and therefore its consistent presence in the palynological record denotes local presence. The flowering of this herb is greatly enhanced by grazing (Moore *et al.*, 1986), and high levels of its pollen in several of the sequences are probably associated with grazing on the contemporary sampling site surface (cf. Moore & Chater, 1969).

Lactuceae indet. and Ranunculaceae are both commonly present as a result of disturbance but as they include a large number of species, it is difficult to relate changes in their percentages to land-use patterns. Other herbs are probably a result of anthropogenic activity (eg. *Rumex*, Chenopodiaceae, Cardueae/Asteroideae, *Artemisia*) but generally make only sporadic appearances and do not demonstrate consistent appearances during disturbance phases. This may partly be due to the size of the counts; higher counts of 500-1000 grains would probably have increased the record of species but it is doubtful whether they would have served to indicate significant vegetational changes that are unclear at smaller counts and would merely serve to confirm the dominance of certain taxa in the pollen record.

The nature of the sampling sites may partly explain the low species diversity recorded, as on-site taxa would be best represented, whilst other species some distance away from the sampling location would be only poorly or not at all represented.

Site/study	Frequent (>70% samples)	Occasional (40-70%)	Rare (<40%)
Rough Tor/East Moor (this study)	*P.lanceolata, Potentilla, Succisa,* Lactuceae indet., Ranunculaceae, *Cirsium, Galium*-type	*C.nigra,* Cardueae/Asteroideae, *Filipendula, P.major/media,* Apiaceae	Chenopodiaceae, Caryophyllaceae, *Artemisia, Achillea*-type, *Rumex, Polygala, Serratula*-type, *Cerealia*-type
Stannon Mercer & Dimbleby (1978)	*Potentilla,* Ranunculaceae, Rubiaceae, *Succisa, P.lanceolata,* Lactuceae indet. Campanulaceae, *P.major/media*	*Cirsium,* Cardueae/Asteroideae, *Cerealia*-type, *Rumex,* Apiaceae	*Polygala,* Caryophyllaceae, Chenopodiaceae Urticaceae, *Humulus, Rubus*-type
Colliford Maltby & Caseldine (1984)	*Succisa, Rumex, P.lanceolata, Potentilla,* Lactuceae indet.	Rubiaceae, Ranunculaceae	*Urtica, Polygonum, Ononis*-type, Labiatae, Cruciferae, Caryophyllaceae, Campanulaceae, *Artemisia, Cirsium, C.nigra, Cerealia*-type, Leguminosae, *Trifolium*-type, *Rhamnus*-type, Apiaceae, Rubiaceae,
East Moor Brisbane & Clewes (1979)	*P.lanceolata,* Campanulaceae Lactuceae indet., Cardueae/Asteroideae, *Succisa*	Ranunculaceae, *Potentilla,*	Caryophyllaceae, *Artemisia*
King Arthur's Downs Straker (in prep.)	*Plantago* spp., Lactuceae indet., Rubiaceae		*Potentilla, C.nigra,* Apiaceae

Table 9.4: Table comparing records of herb pollen recorded at different sites on Bodmin Moor. Frequency is based on the approximate percentage of sample levels the taxa are recorded in and not on actual magnitude of occurrences. Full data are not available from King Arthur's Downs and the range of taxa identified may be slightly greater.

Where herbs which usually have poor pollen dispersal reach comparatively high representation, such as Lactuceae indet., which reaches 10% in RTS3, these taxa were clearly present on and around the sampling site, implying that the absence of certain other species is due primarily to the lack of these species near to the sampling site, rather than to counting bias.

The question remains as to what extent the low diversity of taxa is a result of sampling bias or is an accurate representation of the range and extent of herbaceous flora on the moor. Comparison of the Rough Tor and East Moor records with the palynological analyses of old ground surfaces and other sediments in excavated contexts, shows that the limited range of ruderal taxa recorded in the sequences examined in this thesis are typical of the palaeoenvironmental record on Bodmin Moor. Table 9.4 is a comparison of the range of herb taxa recorded by different studies on the moor, excluding Poaceae and Cyperaceae.

Both Straker (in press) and Brisbane & Clewes (1979) recorded a lower diversity of herbs. The range of taxa recorded by Mercer and Dimbleby (1978) in the occupation layers of the settlement at Stannon, with that from the Rough Tor south core shows that few additional species are recorded at any significant frequency in the on-site sequence. The most common taxa are broadly the same at both sites (*P.lanceolata*, *Potentilla*, *Succisa*, Rubiaceae) The pollen zone at Rough Tor south that corresponds to the Stannon layers is unknown, but is most probably either RTS2-3. Although the Stannon settlement is around 2km from the Rough Tor site, there is little difference in the predominant ground flora. In terms of anthropochores, the only significant difference is the representation of *Cerealia* and perhaps *Humulus* at Stannon and these taxa are present in only very low quantities. Maltby & Caseldine (1984) identified a wider range of herb pollen in the sequences from Bronze Age features connected with the Colliford excavations, but the most frequently occuring taxa are again generally the same. Low species diversity may therefore have been a feature of the vegetation on Bodmin Moor

throughout the Holocene, both prior to and subsequent to human impacts (cf Caseldine, 1980). The diversity of the ground flora in all six sites considered shows little variation in terms of the predominant species. Local variations due to the analysis of sediments directly connected with anthropogenic activity are apparent in the presence of cereal pollen in sediments closely connected with settlement (Stannon, Colliford), but the increases in species as a result of woodland clearance are generally restricted to *Plantago* spp., Lactuceae indet., Rubiaceae and a few others. The low range of herbs makes it difficult to characterise and differentiate between anthropogenic impacts in different parts of the moor.

9.5 Environmental and cultural change on Bodmin Moor: local and regional contexts

This section compares the palaeoeological records from Rough Tor and the East Moor in terms of the evidence for the nature and extent of settlement in the prehistoric period. Both the local and regional context of settlement and palaeoenvironmental change will be considered. Figures 9.4 and 9.5 show the sequence of environmental and cultural changes in the East Moor and Rough Tor areas.

The Mesolithic

The archaeological evidence for a Mesolithic presence on Bodmin Moor was summarised in Chapter 1. Models of Mesolithic land-use in the British uplands have stressed hunting, particularly of red deer, and the gathering of resources, especially hazel nuts (Simmons, 1975; Jacobi *et al.*, 1976; Simmons *et al.*, 1981), whilst Jacobi (1979) constructed a model for the south-west, based on seasonal availability of resources.

The models of postulated environmental impact advanced for Rough Tor (Chapter

3 section 3.6) and the East Moor (Chapter 6 section 6.8) predicted that there would be little, if any, evidence of Mesolithic activity in the palaeoecological record. This seems to be confirmed by the palynological data: there is only circumstantial evidence in RTS1 and EMM1 for a Mesolithic presence on Bodmin Moor. These disturbances, if they are human induced, are on a small scale. There is no evidence in the charcoal record to indicate the periodic burning of the upland vegetation, as a method of creating browse and encouraging the concentration of ungulates, as has been attested for a number of other early Holocene pollen sequences. However, the temporal resolution of the sequences means that conclusions regarding disturbances that would have been small in scale might not be clearly recorded.

Unlike many of the other uplands in the United Kingdom where gatherer-hunter activity is suggested in the palaeoenvironmental record but less well represented in the archaeological data, there is considerable evidence for a Mesolithic presence on Bodmin Moor in the form of lithic material both in random spots and in residual contexts in excavations (Wainwright, 1960; Jacobi, 1979; Berridge & Roberts, 1986; Christie, 1988; Herring & Lewis, 1992). Jacobi's (1979) model for Mesolithic landuse in the south-west stressed that this use of the uplands was probably mainly in the mid- to late-summer for the hunting of deer and Todd (1987:66) suggests that as few as two to three hunting bands, perhaps as few as one hundred people, might have been able to support themselves on the resources of the south-western peninsula in this period. These hypotheses may find support in the conclusions of Herring & Lewis (1992) that the majority of the find spots on Bodmin Moor represent short-stay kill/butchery sites.

Figure 9.4: Summary of archaeological and palaeoecological data from Rough Tor. AP/NAP is a generalised curve of the ratio of arboreal to non-arboreal pollen. Years BP are calendrical.

Yrs BP (approx)	Palaeoecology	AP/NAP	*Archaeology*/Inferred activity	Period
0			Intensive grazing on Rough Tor moors	
	Spread of acid grassland *RTNa4, RTNc4*		*Hamlet->single farm.*	
	Clearance of remaining local tree/scrub. Demise of meadow vegetation & spread of grassland		*Local settlement and fields.* Cultivation and increased pastoral activity at Louden & Rough Tor.	*Medieval*
	Meadow/grassland. Scattered alder/hazel scrub remaining *RTNc3 RTNa2-3*		Low intensity pastoralism	*Romano-British*
2000-	Reduction in alder/hazel *RTNc2*		*Transhumance huts* Increasing pastoral activity	*Iron Age*
	Some regeneration in alder-hazel wooland *RTNc1, RTNa1, RTS4*		*Transhumance settlements* End of local settlement. Reduced pastoralism	*Bronze Age*
	Clearance of hazel scrub. Spread of grass-meadow land *RTS3*		*Establishment of huts and fields at Rough Tor north-south and further-afield. Ritual monuments.* Intensive pastoralism. Local settlement.	
4000-	Grassland with some hazel. Alder expanding locally		Reduced local activity	
			Some huts & early fields Louden long cairn/Rough Tor enclosure?	
	Clearance of hazel, oak and birch woodland. *RTS2*		Unintensive/transhumance activity	
6000-				*Neolithic*
	Hazel dominated woodland. Oak-birch increasing locally. Little open land. Temporary clearings possible. *RTS1*		*Flint scatters.* Small scale seasonal use of uplands?	*Mesolithic*
8000+				

Figure 9.5: Summary of archaeological and palaeoecological data from the East Moor. AP/NAP is a generalised curve of the ratio of arboreal to non-arboreal pollen. Years BP are calendrical.

Yrs BP	Palaeoecology East Moor Plateau	Palaeoecology Witheybrook Valley	AP/NAP	*Archaeology*/Inferred Activity	Period
	Acid grassland *WM3-4*	Meadow/grass-land		*Hamlet->single farm*	
				Hamlets & fields Pastoral activity and cultivation in valley. Peat cutting/tin streaming.	*Medieval*
	Clearance of alder & remaining hazel *EMM4/WM1-2*	Clearance of remaining tree cover *TMA4* Demise in trees & shrubs Grassland /meadow. *TMA3* Grassland/ meadow. Woodland declining in extent *TMA1-2, TMB4*		Increase in activity in Witheybrook valley. High intensity pastoralism. *Allabury round?*	*Romano-British*
2000-					*Iron Age*
				Co-axial system on East Moor plateau and Bastreet Downs. Clearance of woodland. Medium intensity pastoralism.	*Bronze Age*
	Grassland/heath Some hazel & alder *EMM3*	Spread of grassland/heath *TMB3*		Possible decline in activity on plateau	
4000-		Expansion of birch *TMB2*			
				Early transhumance huts/settlements. Low intensity pastoralism /transhumance. Limited cultivation in valley? Clearance of alder/hazel woodland begins	*Neolithic*
	Alder spreading on damper soils *EMM2*	Alder spreading onto mire areas *TMB1*			
6000-					
	Hazel-oak dominated woodland *EMM1*			*Flint scatters?* Seasonal use of uplands?	*Mesolithic*
8000+					

The character of the postulated disturbances at Rough Tor and on the East Moor and the nature of this evidence for a Mesolithic presence, in some cases very close to the sampling sites (see Chapter 5 section 5.4), would appear to confirm that any disturbances to the woodland and therefore the site creation rate and the number of gatherer-hunter communities utilising the moorland, were very low. Bearing in mind the probable absence of fully developed deciduous woodland in some areas of the moor, then Mesolithic communities may have restricted their summer movements on the upland to these locations where deer might have concentrated naturally, making burning of the moorland to create browse unneccessary. The focus of areas such as Dozmary Pool for both human (Jacobi, 1979) and perhaps also ungulate communities may be relevant in this context.

Neolithic environments

The first unequivocal evidence of woodland clearance and therefore of a human presence occurs in RTS2, TMB2-3 and EMM2. The radiocarbon dates from RTS2 and TMB3 show these zones are broadly contemporary and it is likely that EMM2 belongs to the same period. TMB3 is dated to 4080±80 BP (Beta-84828) which is calibrated to 2865-2810cal.BC & 2695-2485cal.BC. A later Neolithic period of activity is therefore suggested. The anthropogenic impacts take the form of falling arboreal and shrub pollen and the spread of grassland and other herb communities. Charcoal levels also increase at Rough Tor, although it is not thought that fire was being used to clear the vegetation. The main woody species present at both sites are *Corylus avellana*-type and *Quercus*. Oak is an extremely useful multi-purpose timber for building, artifacts and fuel and hazel wood also has many uses, including bowstaves, axe handles and other artifacts including fencing, basketry, fuel and hedging. No doubt the wood from the felled trees was put to such uses, making the direct destruction of woodland by fire unneccessary.

The form and character of the clearance and the resulting environment is similar at both Rough Tor and the East Moor, with the spread of grassland but with

scrubland persisting and even increasing in the later phases. The behaviour of the ruderal herbs is also similar in both instances. Occurrences of anthropogenic indicators remain low and *P.lanceolata* in particular is not yet apparent as a continuous curve. Light and/or sporadic utilisation of the moorland is envisaged in both areas. The presence of Apiaceae indicates tall herb communities at East Moor, which may indicate that there was less intensive disturbance at this site, compared to the predominance of generally low growing species at Rough Tor, typical of a more closely grazed sward. A similar picture is presented for Dartmoor in the Neolithic: Simmons' (1964) and Beckett's (1981) pollen diagrams show that there was only minor intereference with the vegetation in this period, with tree and shrub pollen remaining high and ruderal herbs low and sporadic. A pastoral basis for the economy is indicated with any arable activity restricted to the lowlands (Beckett, 1981:260).

The nature of the transition from Mesolithic to Neolithic in Cornwall remains obscure (Silvester, 1979). The character of these earliest significant clearances suggest that colonisation of these areas proceeded rapidly and was not preceeded by an interlude of sporadic activity. The impression is of a relatively rapid phase of woodland clearance, perhaps as a result of increased population and subsequent demand on resources during the later Mesolithic. The nature of landuse at this time seems to have been unintensive pastoralism in both locations, with grazing pressures sufficiently uneven to allow the persistence and recovery of scrub and tree cover. A system of transhumance seems to be the best explanation of the palaeoeconomy in this period, with local settlement considered unlikely, at least on any extensive basis, although the construction of some of the hut settlements at Rough Tor north cannot be ruled out.

Christie (1988:156) postulated that the identification of Grooved Ware pottery at Davidstow:

"...gives good indications that Cornwall, far from being an isolated mainstream in the later 3rd and early 2nd millenia BC (uncal.), was in the mainstream of activities."

Mercer's (1970) excavations at Stannon and the discovery of diagnostic pottery on Davidstow and lithic material in a number of contexts indicated a Neolithic presence on the moor. Table 9.5 summarises the radiocarbon dates available from archaeologically excavated contexts on Bodmin Moor. Although it would be unwise to place too much reliance on this comparatively small number of dates, the range confirms that activity began in the third millennium BC and peaked in the second millennium BC. The radiocarbon dates from Rough Tor also indicate that human activity began in the north-western part of the moor in the fourth millennium BP at the latest and probably earlier. The date for the early disturbance at Tresellern Marsh suggests a similar phase of earlier activity in the east of the moor and it is thought that the forthcoming radiocarbon dates (see Chapter 2) will confirm that Neolithic actvity was also taking place on the East Moor plateau.

There is no evidence that any cultivation was taking place in the vicinity of either Rough Tor south or the East Moor and the palynological evidence is interpreted as showing that the majority of the field systems were not laid out until later. No doubt some corralling of stock was needed and may be represented by the fragmentary systems on the East Moor that seem to precede the construction of the co-axial system. Several tribal groups were probably utilising the uplands and in such a case, intercommoning would have developed, with the Rough Tor area probably a focus for just one of these groups. How this activity fitted into early arable agriculture that may have been proceeding is unclear. Presumably the use of the grazing resource on the uplands was complemented by cereal cultivation elsewhere. Whether this system involved communities living in lowland Cornwall and if so, how far they were settled from the moor, is hard to determine (cf. Fleming, 1988:100). Mercer's (1970) recognition of a cultivated soil layer at

Site	Context	Lab.code	Date BP(±1 sd)	cal.BC (mean)
Davidstow XXVI (22)	Phase 1	HAR-6643	4130±70	2740
Davidstow III(8)	primary	HAR-6640	3740±90	2162
Colliford CRII	?primary	HAR-2624	3610±70	1970
Davidstow V2	?secondary	HAR-6635	3580±70	1936
Colliford CRIVC	primary	HAR-2991	3580±80	1936
Davidstow I	primary	HAR-6634	3520±70	1883
Colliford CRIVA	primary	HAR-2994	3510±80	1830
Watch Hill	primary	HAR-654	3470±70	1820
Davidstow XXIV (16)	primary	HAR-8098	3440±100	1746
Stannon cairn 2	primary	HAR-5130	3440±70	1746
Watch Hill	primary	HAR-655	3420±80	1740

Table 9.5: Details of Radiocarbon dates from excavated contexts on Bodmin Moor (After Christie, 1988:164).

analysis of the sediment (Mercer & Dimbleby, 1978) and, although there is an absence of further evidence for an early cultivation phase in this part of the moor, the possibility that cultivation on the moor was a part of the subsistence strategy cannot be ruled out.

The method of cereal cultivation in the Neolithic has been the subject of some discussion. The presence of shade-tolerant weeds with the charred remains of cereals from Neolithic contexts has been taken as indicating that cultivation was carried out in clearings in woodland with an interrupted tree canopy overhead (Behre, 1981). This fact, coupled with the poor dispersal of cereal pollen may explain the absence of cereal and weed pollen from pollen sequences adjacent to known settlements. Although the tall canopy components had been largely cleared earlier in this period, the same considerations concerning cereal pollen dispersal apply and the hazel scrub around the sampling site would serve to screen out any large cereal pollen grains.

Although cultivation may have been an element of early farming at Rough Tor, seasonal or intermittent use of the uplands during the Neolithic on Bodmin Moor therefore is adopted here as the best explanation of the palynological data. Some scholars have suggested that Neolithic populations in general may have been less sedentary than has previously been assumed (Zevlebil & Rowly-Conwy, 1984; Armit & Finlayson, 1992). The role of constructions such as the Louden long cairn may be significant here. Bender (1985) argued that the building of monuments is not necessarily a feature of sedentary, agrarian communities and the construction of tombs and other such structures may provide 'monumental permanence' for a transient population that returned periodically to a site.

There is a reduction in the pressure on the land resource towards the top of RTS2/EMM2 allowing the regeneration of hazel at both sites and a peak in the local expansion of alder at Rough Tor. The fact that this is a feature of the pollen

local expansion of alder at Rough Tor. The fact that this is a feature of the pollen record at both sites implies that this is more than a local change in the location of activity relative to the sampling sites, but is part of a regional shift in the pattern of landuse that resulted in a reduction in the exploitation of the uplands. It was estimated (Chapter 5, section 5.4) that this occured around the mid-second millennium cal.BC at Rough Tor south.

Evidence from Dartmoor also supports the probability of a hiatus in activity in the later Neolithic. Beckett (1981) discussed both his pollen diagrams and those of Simmons (1964) and concluded that the palynological data provided:

"...clear evidence throughout the region for a period toward the end of the Neolithic when human activity at best did not increase and some areas of cleared woodland were able to re-establish themselves." (Beckett, 1981:260).

There are some archaeological data to support such a change in the later Neolithic. The evidence for the 'cultural unity' of the earlier Neolithic (later fourth to earlier third millennium BC) tradition in the form of sites such as Carn Brea, Hembury and perhaps also the Rough Tor enclosure is contrasted by a fragmented and incoherent evidence for settlement in the later Neolithic, described by Todd (1987:81) as making "...the distinction of a later Neolithic cultural horizon difficult, almost impossible." The same author also argues that as colonization of the south-west proceeded, smaller and more diverse social groups may have emerged (Todd, 1987:81), leading to a change in settlement patterns that involved a shift in focus from the uplands to valleys and the lowlands. This might find support in the concentration of later Neolithic and early Bronze Aged flints on the lower slopes of valleys and the coastal lowlands (Miles, 1976), although this must be balanced against evidence that indicates that there was some form of later Neolithic presence on Bodmin Moor (Christie, 1988).

The radiocarbon date from Tresellern Marsh B (TMB3) demonstrates that there

may have been activity in the later Neolithic in the Withey Brook valley. This may be contrasted with the evidence of a reduction in activity in RTS3 and perhaps also EMM2. This may support Todd's (1987:81) hypothesis that the focus of later Neolithic activity shifted from the higher areas of the moor, such as Rough Tor and the East Moor plateau, to the lower valleys such as the Withey Brook on the fringes of the moor. The forthcoming radiocarbon dates for the East Moor monolith (see Chapter 2) will permit the timing of the events recorded at Tresellern Marsh to be put into a framework of cultural and environmental change that includes the higher areas of land on the East Moor.

The hypothesis advanced here is that there was a hiatus in the evolution of settlement in the latter part of the period represented by RTS2/EMM2, probably the later Neolithic. This may have been a fairly brief interlude and the focus of activity may have shifted closer to the valleys around the fringes of the moor. The evidence from Dartmoor suggests a similar phenomenon was taking place there, indicating that this may have been a regional rather than local event.

The Neolithic was predicted to be the first period to demonstrate evidence of human impact on both the East Moor (Chapter 6 section 6.8) and at Rough Tor (Chapter 3 section 3.6). The palaeoecological evidence supports the archaeological predictions of significant activity on Bodmin Moor in this period. There is no way without excavation that specific archaeological sequences can be linked with the disturbance phases demonstrated in the palaeoecological record. The Rough Tor enclosure, for example, may just as well belong to the later as to the earlier periods of activity. Only excavation can clarify this.

The Bronze Age

This period of reduced anthropogenic activity is followed by the Bronze Age 'high tide' of upland settlement. The radiocarbon dates demonstrate that this period is represented by the clearances in RTS3, TMA2 and TMB2-4. The forthcoming

radiocarbon dates will probably also confirm that the activity recorded in EMM3 belongs to the Bronze Age. The clearances led to the almost complete removal of the hazel cover on the higher hillsides, although more extensive areas of scrub may have persisted on the East Moor plateau, with the opening up of the alder wetland communities on the valley bottoms and damper parts of the landscape. The beginnings of continuous *Plantago lanceolata* curves in the above zones and the appearance of other heliophytes are interpreted as reflecting the establishment of fields utilised on a regular basis and the advent of probably the greater part of local settlement represented by the hut circles and field systems. Again, a predominantly pastoral landscape is envisaged, although there was possibly some cultivation of cereals in the Withey Brook valley (Chapter 7 part II section 9.3).

The radiocarbon dates that are available from excavated barrows on Bodmin Moor point to a period of maximum activity in the second millennium BC (Table 9.5). The radiocarbon dates for the pollen zones from Rough Tor south and Tresellern Marsh confirm human activity was taking place during this period. A number of phases are apparent in the archaeological sequences at both Rough Tor and the East Moor (see Chapters 3 and 7) although these cannot presently be recognised in the palaeoecological records at either Rough Tor or the East Moor. Two different phases are recognised in the TMB diagram that may correlate with the development of the East Moor co-axial system.

The possibility that many of the stone hut circles and boundaries in the study areas merely represent the last phase in occupation is highlighted both by the excavations of remains on Dartmoor (Balaam *et al.*, 1982; Fleming, 1988) and by the discovery of an alder stake beneath a prehistoric boundary on King Arthurs Down (P.Rose, pers.comm.). This is a *caveat* against trying to allocate precise sequences represented by surface remains to periods of clearance in the palaeoecological record, but the likelihood is that both the huts and fields at Rough Tor and the co-axial systems on the East Moor belong to this broad period.

Although it is possible that there was some small scale cultivation of cereals reflected by the identification of cereal pollen at Tresellern Marsh, both the palaeoecological and archaeological data portray a predominantly pastoral emphasis in the Bronze Age. A very similar situation is found on Dartmoor, where Beckett's (1981) pollen diagrams show marked increases in ruderal pollen. The species represented in the diagrams from both upland areas tend to be the same, with *P.lanceolata* the most abundant and other herbs such as *Ranunculus* and *Potentilla* common components of the ground flora. Other ruderals, such as *Rumex*, absent or very scarce on Bodmin, are represented, as is cereal pollen in low quantities in certain diagrams. This picture is confirmed by Simmons' (1964) diagrams from Dartmoor. The overall impression for both moors is of a greatly increased clearance activity and a predominance of pastoral farming during the Bronze Age.

The same problems regarding subsistence strategies therefore apply in the Bronze Age as in the Neolithic. There is no secure way that intensive seasonal use of the uplands can be distinguished from year-round local habitation in the palaeoecological record. Since it is improbable that sufficient crops were cultivated on the uplands to support a sizable local population and that a purely pastoral basis to human subsistence seems unlikely, then cultivation of crops somewhere else seems probable. Two different hypotheses may explain this. Either the local settlements were occupied permanently on a year-round basis or they were the summer base for communities that used the uplands seasonally. The first hypothesis involves some form of exchange/barter system between those groups that produced meat and other products of a pastoral economy and those that grew crops on the lowlands. Since the inhabitants of settlements such as that at Rough Tor were either not self-sufficient or used the uplands for seasonal grazing, then the settlement patterns at Rough Tor must be a component of a system that cannot now be clearly perceived.

A similar situation for the morphologically similar Bronze Age settlements on Dartmoor is remarked upon in the context of the excavation of the Shaugh Moor settlement. Balaam *et al.* (1981:258) concluded that this settlement had a largely pastoral basis and was unlikely to have been self-supporting, necessitating a form of exchange, which may have been tin:

"Metal, in ingot form, could have been exchanged for cereals and animal products, flint, stone, timber and even finished metal goods."

The possible role of tin in the palaeoeconomy of the south-west in prehistory has been discussed recently (Price, 1993; Budd *et al.*, 1994). The potential evidence from Watery Marsh for tin streaming was discussed above (Chapter 7 part I section 7.12) and the forthcoming radiocarbon date for the base of this deposit may shed some light on the exploitation of alluvial tin resources in prehistory.

This is not the place to rehearse at length the arguments for and against the status of Bronze Age settlement on the south-western uplands, but whilst acknowledging Fleming's (1987) arguments that the upland settlement patterns do not necessarily represent "...distorted or incomplete versions of lowland settlement patterns.", the possibility that settlement at Rough Tor and probably also the East Moor is part of pattern of settlement that is now incomplete must have some bearing in such arguments. The unique status of Cornwall with regard to its proximity to the sea, no place in the county is more than 29 km from the coast, may be significant with regard to the later prehistoric palaeoeconomy. The possibility that Bronze Age communities were involved in cyclical exploitation of the uplands, the lowlands and the coast - possibly a refined version of that suggested for the Mesolithic (Jacobi, 1979) should be considered. The discovery of a crustacean, beach flint and other pebbles at Davidstow in later (fourth millennium BP) contexts may be significant here. Christie (1988) presented this as evidence of time spent near the coast, perhaps as part of a seasonal use of resources. The palaeoecological data are certainly interpretable in terms of seasonal use of the uplands, although as was

discussed in the context of the Neolithic, a number of other models may be advanced to fit the data.

The connections between upland and lowland in prehistory remain obscure in the south-west due to the imbalance between known and excavated sites in the latter area compared to those of the former. There have been some advances in this recently. The discovery of a late Neolithic henge at Bow, mid-Devon (Griffith, 1985) is important in this context, but the most significant excavation of recent times is that of Trethellan farm, Newquay (Nowakowski, 1991). The site was revealed to be a small Bronze Age farming community which had been occupied between 1200-975 BC. The extensive environmental evidence testified to the cultivation of a number of crops, including Barley (*Hordeum* sp.), Oats *(A vena* sp.) and probably also Celtic Bean (*Vicia fabia*) and Flax *(Linum usitatissimum*). Evidence for animal husbandry was also present and the probability is that the local economy was a mixed arable and stock farming one. The excavation of this settlement provides a glimpse of the nature of activity in the lowlands during the Bronze Age. In the present state of knowledge, the connection, if there was any, between the inhabitants of settlements such as Trethellan who practised mixed farming in the lowlands and the pastoralists of settlements such as that at Rough Tor on the uplands remains hypothetical.

Late prehistoric abandonment

The reasons for the abandonment of settlement on the south-western uplands are a pertinent archaeological question that has been little addressed in the context of Bodmin Moor. The usual explanation is that climatic deterioration at the end of the Bronze Age coupled with soil deterioration, based largely on Brown's (1977) assertions, led to a movement back to the lowlands (Quinell, 1986; Todd, 1987: 151; Rose, in press). There is little palaeoecological evidence to support this for Bodmin Moor and the dating and effect of these changes on landuse has not been well established (Christie, 1986:85).

Although it must be stated that the nature of most of the sampling sites in this study makes them generally unsuitable for the precise quantification and detection of climatic changes (see above, section 9.2), they provide proxy evidence of soil development in the later prehistoric period. Suggestions that deterioration in grazing quality was a factor in the abandonment of the uplands (Balaam *et al.* 1982:259) are not backed up by the palynological data from Bodmin Moor. Increases in heather in RTS4 at Rough Tor south (Chapter 4 part II section 4.7) *may* suggest a deterioration in soil conditions during the Bronze Age, but this could very well have been a local change (cf. Maltby & Caseldine, 1982; 1984). Moreover, the biggest increase in *Calluna* in this diagram does not occur until the close of the zone, after the cessation of activity, as indicated by the recoveries in tree and shrub pollen. As *Corylus* tends to prefer well-drained brown earths, as opposed to gleys or podsols, the likelihood is that soil deterioration was not well advanced prior to cessation of local settlement. The continuation of a *P.lanceolata* curve and the later development of meadow at Rough Tor north also indicates that soil deterioration was not far advanced on a landscape scale by the later prehistoric period and the quality of the sward remained fairly good.

Evidence from elsewhere on the moor - both palynological and pedological - shows that podsolization was well advanced in some areas by the Bronze Age (Brisbane & Clewes, 1979; Maltby & Caseldine, 1982, 1984; Christie, 1988) and heather seems to have been spreading on the East Moor and in the Withey Brook valley from around this period (TMB3). There is no unequivocal evidence in the East Moor monolith or the Tresellern Marsh diagrams to link these vegetational changes to a climatic factor; the increase in heather and alder in EMM3/4 seems to be the culmination of a long process, possibly unrelated to the direct effects of increased precipitation or falling temperatures.

A very similar pattern of vegetational change in the late Bronze Age/early Iron Age to that at Rough Tor south and the East Moor is found in pollen diagrams

from Dartmoor. Beckett (1981) recorded increases in *Alnus* and *Corylus* and falls in *P.lanceolata* and other ruderal herbs, whilst *Calluna* is able to increase, probably as a result of decreased grazing pressure. Herb pollen percentages such as *Plantago lanceolata* are present at reduced levels. Simmons (1964) also commented on the maintenance of percentages of ruderal pollen but suggests that they represent intensified clearances on the lowlands. As Beckett (1981:265) pointed out, it seems doubtful that clearance of lowland sites would be as clearly represented in upland sequences. The probability is that, as is apparent on Bodmin Moor, low intensity pastoral farming continued in the later prehistoric period on Dartmoor.

In the present state of ignorance regarding the timing of the bulk of prehistoric and later occupation on the moors, the role of climatic deterioration cannot be discarded as a determining factor. However, it should not be automatically assumed that this was the main, or possibly even a significant factor, in these apparent shifts in settlement patterns on both Bodmin Moor and Dartmoor at the end of the Bronze Age (cf. Todd, 1987). In many respects, the search for any one factor to explain the end of extensive Bronze Age settlement is over-simplistic and is a product of the general lack of knowledge concerning both environmental and cultural factors and their respective roles in forcing changes in settlement patterns. An interplay of socio-economic and environmental factors may be responsible for the shift in emphasis from upland to lowland, if the archaeological data base has been correctly interpreted as showing this. Brisbane & Clewes' (1979) conclusion that the increase in damp, acid grassland evidenced in their soil pollen diagrams and the abandonment of the East Moor co-axial system may have been coincidental rather than causative can be highlighted here. A similar question of cause and effect can be identified on Dartmoor. Although it is suggested that climatic deterioration made "...marginal land unusable and turned good land into marginal land." (Balaam *et al.*, 1982:259), pedological work on Shaugh Moor indicated that in this area stagnopodzol and stagnohumic gleys had developed by

the Bronze Age and the present soil type distribution is similar to that pertaining in later prehistoric times (Keeley & Macphail, 1981).

The key point to be made is not that there was *no* climatic deterioration around the Bronze Age/Iron Age transition on Bodmin Moor and the other south-western uplands, or that it had no effect on vegetation and soils and thus a role in the end of Bronze Age occupation, but the processes of cause and effect remain vague at best. Until there is further expansion in the state of knowledge of the timing of cultural and settlement changes, then the danger of using palaeoenvironmental data to explain temporally and spatially inexact events remains a tempting but uncertain process.

The sequences examined in the course of this project provide circumstantial evidence for a decline in soil quality that may have begun as early as the Neolithic in some areas, probably as a result of centuries of exploitation, but this process operated at a different rate and probably also on a different scale in the two areas of the moor investigated and no doubt elsewhere on the moor (cf. Maltby & Caseldine, 1982, 1984). The role of these processes in late prehistoric abandonment are probable but remain somewhat equivocal at present.

The Iron Age and later

Both models of environmental change for activity on the East Moor (Chapter 6) and at Rough Tor (Chapter 3) correctly predicted that human settlement and land-use would intensify in the Bronze Age and would be followed by evidence of abandonment at the end of this period. However, the ensuing late prehistoric and Romano-British periods were projected to be periods of low and sporadic activity on the uplands. The palaeoecological record in both areas shows significant diversions from the expected palynological evidence. Some archaeological evidence exists for continuing permanent settlement in some parts of the moor

(Chapter 4 part II section 5.4) and although some scholars have suggested that continuing occupation of the uplands may have continued during the Iron Age, albeit on a smaller scale than the Bronze Age (Quinell, 1986:113), this view has not found widespread recognition (Todd, 1987:155). Silvester (1979:180) pointed out that there are no *morphological* criteria for distinguishing between first and second millenia settlement making the recognition of changes in settlement from unexcavated remains all the more tentative and has also stated that

"...the possibility of later prehistoric agriculture on the central part of Bodmin Moor cannot be discounted."

The Rough Tor north monoliths provide the most detailed information about human-environment relations in this period (RTNc3; RTNa2-3), with evidence from the East Moor mainly in the form of the Tresellern Marsh A core and perhaps the Watery Marsh core (WM1-2). The radiocarbon dates from monolith A and monolith C show the renewed clearance of the woodland in the Romano-British period following a period of woodland regeneration at the end of the Bronze Age and recorded in RTS4 at Rough Tor south. The Tresellern Marsh diagram also indicates that there was a sustained period of activity in the Withey Brook valley in the first-fourth centuries AD, which appears to have been more significant in terms of the intensity of farming activity than the preceding Bronze Age episode of settlement.

There is little archaeological evidence for this period, although a Romano-British tin bowl from Parson's Park suggests some form of interest in the moor in the earlier half of the first millennium AD (Griffith, 1984). This interest may have been related to the mineral resources of the area, although the palaeoenvironmental evidence indicates that there was intensified agricultural interest in the upland subsequent to the reduction in activity at the end of the Bronze Age. Pearce (1970) postulated that heightened interest in tin sources in Cornwall may be reflected in the appearance of later Roman (late third-fourth millennium AD) coin

hoards. Tin ingots are difficult to date, but those that have been dated seem to belong to the fourth millennium AD (Todd, 1987:226). Also potentially significant in this context is that:

"...the Roman rural population of the peninsula, especially at the western end was greater than it is today and perhaps at any time since AD 400."

The precise population dynamics in the area of Bodmin Moor are unknown, but it is possible that pressure on the lowlands resulted in renewed interest in the moor. This was clearly not just restricted to the more accessible valleys around the edge of the moor, such as the Withey Brook, but also included the higher tracts of the moor, as the Rough Tor north monoliths demonstrate.

Although more definite conclusions must await further palaeoenvironmental and archaeological study, it seems that activity in the later prehistoric and Romano-British period on Bodmin Moor may have been more extensive and significant in the human and ecological history of the moor than is presently acknowledged. This discrepancy is partly because the high visibility and extent of apparently earlier remains suggests extensive activity during the Bronze Age with little material evidence of later (Iron Age/Romano-British) settlement. This leads to the assumption that in terms of human-environment relations, the preceeding period should be the more significant. A shift in settlement patterns and increase in population in the later period may have resulted in an intensification of upland landuse which may have had a greater impact on the land resource than that of the Bronze Age.

The evidence for activity on the uplands during the Iron Age and Romano-British period is by no means restricted to Bodmin Moor. Although there is only patchy evidence from Dartmoor for this period, studies from Exmoor (Merryfield & Moore, 1974; Francis & Slater, 1992) demonstrated clearance and farming activity on this upland in the later first millennium BC and former half of the first

millennium AD. The picture that is emerging, therefore, suggests that the view of the Iron Age and Romano-British period as being one of overall abandonment of the uplands of the south-west may be a gross over-simplification of the actual patterns of activity. Locally, there may have been as much variation in intensity and nature of human activity on the uplands as there was during the Bronze Age. Absence of remains on Bodmin Moor, Dartmoor and Exmoor does not neccessarily equate with an absence of anthropogenic interest in these areas.

Both Bodmin Moor and Dartmoor seem to have been utilised in the later prehistoric, up until the medieval settlement of the moor at some time between the 11th and 14th centuries for grazing. Also, some small scale, intermittent cultivation occurred on the East Moor. Again, late prehistoric cultivation of marginal land is suggested by cultivation terraces excavated on Wotter Common and dated to 2120±80 BP (Smith *et al.*, 1981:271). The vegetation of the moor seems to have been very similar at the end of the first millenia and by the time the first medieval farmsteads began to spread onto the uplands.

The maintenance of grazing on the uplands indicated by the palaeoecological record through most of the historical period, is supported by a number of other sources. The Domesday book records that the manors on the granite - Hamathethy, Halvana and Draynes - have huge areas of pasture attached to them, presumably on the moorland (Ravenhill,1967). The extent of pastureland at Hamathethy is five leagues by two and although the length of the Domesday league is uncertain, between 1.3-1.5km is possible (Johnson & Rose, 1994:77). Place name studies shed further light on this pattern. Habitative names such as *tre* (estate, farmstead), **bod* (dwelling) and **hendre* (winter homestead, home farm) form a ring around the fringes of the moor which avoids the granite. These are Cornish names that are unlikely to have been used to describe new places after *c.*1100 (Padel, 1985:4,224) and therefore give an idea of the pattern of pre-conquest settlement. Further information about the nature of settlement in this

period is provided by the manor of Hamathethy in St Breward. This name includes the Cornish element **havos* (shieling), a compound of *haf* (summer) and **bod* (Padel, 1985:127). As is also found in Wales, **havos* has been paired with **hendre* to suggest the summer and winter components in a system of transhumance (Davies,1979; Padel,1985; Johnson & Rose, 1994).

Medieval colonisation

The use of Bodmin Moor as seasonal grazing appears to have continued up until some point in the 11th to 14th centuries when there was first large-scale settlement on the moor since the Bronze Age. This colonisation is probably related to a general expansion of both population and economy at around this time but relaxation of grazing controls that had previously kept the moor as an area of common grazing may also be involved (Platt, 1978; Johnson & Rose, 1994:114). Although Cornwall's other economic forces including ship building, tin-streaming, textiles and quarrying would have competed with agriculture in the labour market, they would probably also have provided a stimulus by expanding the market for agricultural produce (Hatcher, 1970).

This expansion was predicted to have been evident in the palaeoecological record from both Rough Tor (Chapter 3 section 3.6) and the East Moor (Chapter 6 section 6.8) and is witnessed by the palaeoecological record at Rough Tor north (RTNa3-4; RTNc3-4) and on the East Moor (EMM4; WM2-3; TMA4). The final removal of the upland tree and shrub cover occurs in both areas and the record of cereal pollen at Rough Tor north, Watery Marsh and probably Tresellern Marsh (TMA4) testifies to the cultivation of the upland. No systematic attempt to identify the *Cerealia*-type to species has been made, but the main crop being grown at this time was probably oats, perhaps also with rye. Not only are oats a dual-purpose crop supplying both grain and straw, but they grow better on poorer acid soils, where summer temperatures tend to be rather low (Beresford, 1979:143).

The expansion in pasture is also apparent in increases in Poaceae, *Plantago lanceolata* and other herbs of grassland. The temporal resolution of the East Moor Monolith is poor and there is little evidence beyond a final decline in *Alnus* in EMM4, compared to the record from Watery Marsh which shows the final decline in both *Betula* and *Alnus* and increases in pastoral indicators. The end of the medieval interlude is probably marked by the disappearance of cereal pollen from the palaeoecological record at Rough Tor. Medieval colonisation was also occuring on Dartmoor, as is testified by the similar concentrations of farms on the uplands (eg Beresford, 1979). A pollen zone from Blacka Brook (Beckett,1981) bracketed by radiocarbon dates of 1130±70 BP (HAR-3593) and 740±80 BP (HAR-3377), shows final declines in tree and shrub pollen and increases in Poaceae, *P.lanceolata* and *Cerealia*-type attributed to medieval cultivation.

The decline of the moorland hamlets and their replacement by the single farm occurs from the late 14th century onwards but the precise period of contraction remains unknown (Johnson & Rose, 1994:114). Climatic deterioration and the Black Death are probably both responsible (Beresford, 1979) but soil deterioration has also been identified as a possible factor. The process is complicated by the fact that, although some farms were abandoned, others were established (Preston-Jones & Rose, 1986; Johnson & Rose, 1994). The pollen evidence from the East Moor and Rough Tor provides some details about the effects of landuse. The species-rich meadowland at Rough Tor that had been produced and maintained by the unintensive use of the moors for over one millennia disappeared in what was probably a comparatively brief period of time. The acid grassland that replaced it was a result of over-intensive grazing and cultivation. A similar process is evident in less detail at Watery Marsh and in the Withey Brook valley. The likelihood is that the environment was already in a delicate balance. Anthropogenic exploitation and the effects of the land-use during the medieval period served to disrupt this fragile equilibrium and initiate a final decline in soil conditions. How far this process contributed to the abandonment of many farms

and to what extent it was merely conicidental with their abandonment for other reasons is unclear - it may have been more significant in some areas than others. The Black Death was also probably a factor, not necessarily because the upland communities were decimated by the plague, but due to increased availability of land in lowland areas (Johnson & Rose, 1994).

Following the medieval period the moor reverted back to its former use as an area of seasonal grazing on poor acid heath and grassland. Carew (1602) wrote that:

"the middle part of the shire lieth waste and open, sheweth a blackish colour, beareth heath and spiry grass, and serveth in a manner only to summer cattle."

The palaeoenvironmental evidence is in accord with this observation, although some sporadic cultivation may have continued near to Watery Marsh.

The previous extent and decline of heather moorland: some observations

Heather is presently most frequently found growing in association with the *Molinietum* on Bodmin Moor, with its frequency directly related to the grazing pressure and possibly also the use of fire as a land management tool (Brewster, 1977). Evidence from historical sources has been taken to portray a decline in the extent of *Calluna* over the last few hundred years.

Leland (1543) described the moor as "8 miles by morish and hilly ground and a great scarsitie of wood, in so much that the counterey thereabout brennith firres and heath". Carew (1602) recorded that the moor grew "...heath and spiry grasse". Later sources seem to imply that heather was becoming increasingly sparse on the moor. Daniell (1854) recorded the vegetation of Caradon Hill as "grass, short furze and a few fine heaths" and Malan (1888) stated that the vegetation of Brown Willy consisted of "...no heather, very little furze and no other cover sufficient to screen a mouse.". Malim (1936) summed up the vegetation of the moor as a whole as "...long coarse grass with both dwarf and ordinary gorse, a little heather

spread about the hillside and the usual bracken amongst the scattered granite rocks.".

The palaeoecological record provides a picture of the longer term change in *Calluna*. At Rough Tor south (Chapter 4 part II), *Calluna* appears at the time of the first clearances (RTS1) but was not a significant component of the vegetation at this time, at least in the vicinity of the sampling site. Heather seems to have been becoming more prominent following the reduction in activity at the close of the Bronze Age (RTS4) but unfortunately the record is curtailed at this location. At Rough Tor north (Chapter 4 part III), *Calluna* attains its maximum percentages in RTNc3, following the clearance activity in the Romano-British period. The spatial extent of heathland during this period seems to have been fairly small: percentages at monolith A site confirms that *Calluna* was present at this site but in a smaller extent than at monolith C. *Calluna* declines at Rough Tor north with the intensification of land-use in the medieval period (RTNc3), probably as a result of over-grazing and perhaps burning. The history of moor burning, or 'swaling' as it is called in Cornwall, is unknown, although Brewster (1977) recorded that older inhabitants of the moor could recall deliberate firing of the moor earlier this century.

Calluna expands following woodland clearance in the Bronze Age in the East Moor monolith diagram (EMM3) and apparently remained a component of the ground flora until the medieval period, when renewed clearance led to its almost complete elimination from this part of the moor. A slightly different picture is observed at Watery Marsh: *Calluna* is present at its maximum percentages in WM1 where it appears to have formed part of the ground flora of a scrubby, alder-hazel woodland, but declines with intensified pastoral activity in WM2. Maltby & Caseldine (1982, 1984) concluded that *Calluna* was an element of the scrubby, open woodland that existed prior to the construction of the Colliford barrows in the Bronze Age. Its demise at this site was suggested as due to over-grazing,

possibly in conjunction with burning.

In the Withey Brook valley, *Calluna* increases following the opening up of the woodland in the later Neolithic (TMB3) but declines with renewed activity in the Bronze Age (TMB4). Heather may have been growing on the drier marsh surface in this period and the extent of heather on a landscape scale is unclear: TMA core has only low percentages of *Calluna* throughout the diagram.

The palaeoecological record thus provides some support for the documentary sources that suggested a decline in heather over the last 4-500 years, although the precise pattern of this at a finer temporal scale is obscure. Other palaeoecological study has identified a pattern of *Calluna* in other upland areas in the British Isles, probably associated with increased grazing pressure and repeated burning (Stevenson & Thompson, 1993). *Calluna* seems to have been more extensive in the past at Rough Tor and its demise is almost certainly linked with over-grazing. The East Moor monolith suggests that *Calluna* might have been part of the vegetation of the East Moor plateau until fairly recently and a similar cause of its decline may be postulated. There was, no doubt, a fair amount of spatial and temporal variation in the pattern and further more detailed study is required to identify and quantify this.

9.6 Charcoal and the fire record on Bodmin Moor

Charcoal levels remain very uniform in some of the sequences (East Moor Monolith, Watery Marsh) and do not appear to be related directly to local landscape vegetational changes. Charcoal records from Rough Tor south and Tresellern Marsh A & B cores seem to be more closely related to anthropogenic impacts as recorded by falls in tree and shrub pollen and increases in grass and ruderal herbs. There is little evidence at either Rough Tor or the East Moor that charcoal levels are related to the direct use of fire to clear vegetation and rising charcoal frequencies are seen, if and when they may be ascribed to an anthropogenic origin, as being derived from increased levels of domestic burning. Charcoal taphonomy was discussed in Chapter 2 and these considerations can be applied to the interpretation of the charcoal records. Although a direct comparison of charcoal and pollen taphonomy is not accurate, the likelihood is that the source areas of microscopic charocoal and pollen are broadly similar, especially in the case of palaeorecords derived from peat (Patterson *et al.*, 1987). Working on this basis, sites with a small area such as those at Rough Tor south and the East Moor will derive the greater part of their microscopic charcoal input from a catchment area of some 20-30m diameter (Jacobson & Bradshaw, 1981). The situation for a valley mire is more complicated, as a larger catchment area would be anticipated. However, settlement would be expected to produce a signal, especially it it was near to the sampling site.

A fire of $1m^2$ will have a heat out-put of $2x10^4$ cal s^{-1} producing a plume of smoke up *c.*18m high, at a wind speed of $1ms^{-1}$ (Clark, 1988). Under these circumstances charcoal will be deposited within several hundred metres of the source of the burning. Bigger fires, such as result from natural and anthropogenic forest fires, have considerably greater heat output and disperse charcoal for many hundreds of kilometres. Small fires such as domestic hearths for cooking and warmth would have been burning more or less continuously at settlements such as Rough Tor and

in the Withey Brook valley during the periods of maximum activity. Such sources are likely to be reflected in the enhanced levels of charcoal during periods of settlement as inferred from the pollen record. Charcoal fragments found during archaeological excavations can be related to a number of on and off-site practices, economic, functional and environmental (Cartwright in Christie, 1988). The hypothesis adopted here is that where there are marked increases in the microscopic charcoal record, as at Rough Tor south, this is predominantly a record of such local sources (cf. Edwards, 1979; Edwards & Ralston, 1984; Bennett *et al.*, 1990). A regional 'background' component would also be included but this would be low compared to the representation of the local levels (cf. Simmons & Innes, 1981).

This hypothesis explains why charcoal remains at low frequencies in the East Moor monolith sequence and only demonstrates one marked peak in EMM4. Prehistoric huts are situated some distance from this site due to its probable status as an area of communal grazing during the Bronze Age (Brisbane & Clewes, 1979) and a comparatively low level of burning would therefore have been carried out in the catchment area of this sequence. The closest settlement is that of the Fox Tor medieval long house (see Chapter 7). The increase in charcoal at 15cm corresponds to the fall in alder and both events are probably related to the establishment of the local settlement. The consistent levels prior to this represent the 'regional' signal. Working on this basis, the uniform levels in the Watery Marsh core suggest few changes in the fire regime around the sampling site.

9.7 The prehistoric settlement of Bodmin Moor: a national context

Mesolithic impacts in the British uplands

Palynological evidence for woodland recession associated with evidence of burning in the form of macroscopic and microscopic charcoal from an increasing number

of areas in Great Britain including the North York Moors (eg. Jones, 1966; Squires, 1978; Chambers, 1978; Simmons & Innes, 1988 a & b), the Pennines (eg. Jacobi *et al.*, 1976; Sturludottir & Turner, 1985; Rowell & Turner, 1985), Scotland (Hirons & Edwards, 1990), Wales (Smith & Cloutman, 1988) and the Lake District (Pennington, 1975) has been suggested as evidence of deliberate burning of vegetation by Mesoilthic gatherer-hunter communties, although some workers have urged caution in the interpretation of the available data in this way (Edwards, 1990). To this list may be added those studies from the south-west that also implicate the earliest human peoples in the disturbance to Holocene woodland (Simmons, 1964; Caseldine & Maguire, 1986; Caseldine & Hatton, 1993). The effects of these disturbances are invariably seen as leading to the creation of scrub and later heath communities, soil deterioration and the initiation of blanket peat formation.

The palaeoecological records from Rough Tor and the East Moor have been interpreted as showing that Mesolithic impacts on Bodmin Moor were small in scale and had little role in accelerating processes of deterioration that may have been inherent in the ecosystem (cf. Simmons & Innes, 1988a, b). There is no evidence in the charcoal record that clearly implicates deliberate firing of the vegetation in those disturbances that have been suggested in the Rough Tor south and East Moor monolith sequences. Brown's (1977) suggestion that deliberate burning was unnecessary, due to the open nature of the woodland, has been questioned in view of the probably quite dense scrub-wood cover in certain areas of the moor. The precise cause and effect relationship between Mesolithic population levels, the nature of the Holocene vegetation cover and deliberate burning of woodland in different areas, is unclear.

The evidence of burning at Dozmary Pool may or may not be due to deliberate anthropogenic burning (Smith, 1970). Until more sites on the moor have been examined in detail, all that may be stated in this context is that there is no

evidence to link gatherer-hunter communities with significant disturbances to the early Holocene woodland at the sites investigated. This provides a sharp contrast to sites from other uplands in the United Kingdom. Suggested models of Mesolithic land-use involving burning of the uplands (Jacobi *et al.*, 1976) therefore seem inapplicable in the present state of knowledge of early Holocene environments on Bodmin Moor, although this is based on only two sequences with a low sampling resolution in comparison to other studies that specifically aimed to identify small-scale Mesolithic disturbances (eg. Simmons *et al.*, 1990).

Transhumance in prehistory: the Neolithic and later

The Neolithic is thought to be the period during which there was the first significant evidence for human activity on Bodmin Moor, probably as part of occasional or seasonal land-use. After the Mesolithic impacts discussed above, the Neolithic has received somewhat less emphasis in palaeoecological studies. The Neolithic tends to see less human activity in this period in some regions, such as the south Pennines (Simmons & Innes, 1988a) and is characterised by the regeneration of woodland in many areas before the intensification of activity in the Bronze Age. The deforestation of many parts of southern England began in the Neolithic (Waton, 1982)). There is a certain degree of local variation within this broad trend. Both the archaeological and palaeoecological record from northern Cumbria, indicate that there was an almost complete lack of clearance during the Neolithic, with only small scale clearances during the Bronze Age (Davies & Turner, 1979). In this area, the major episode of woodland destruction did not occur until much later with the Roman invasion and the construction of Hadrians Wall (Barber *et al.*, 1992; Dumayne & Barber, 1994)

Although much work has concentrated on the Mesolithic and Bronze Age landscape changes, little palaeoecological work has been specifically aimed at assessing the nature of Neolithic landuse and in particular the validity of 'transhumance' landuse in later prehistory in Britain. Although it is possible to

tentatively identify transhumance landuse through palaeoecological data, it is very difficult to support it directly from archaeological data (Fleming, 1988:103), although Parker-Pearson (1990:22) concluded that the distribution of Bronze Age pottery styles from Dartmoor and Devon suggested the upland was a "...frontier zone rather than a rigidly demarcated boundary" and may have been a "permeable frontier" exploited seasonally.

Chambers *et al.* (1988) described palaeoenvironmental investigations as part of the excavation of late-prehistoric hut circle settlements in Meirionyddshire, North Wales which set out to assess the evidence for prehistoric transhumance. Clearance began in the Neolithic *c.* 5195 and 4725 BP and intensified in the Bronze Age from *c.* 3715 BP leading to the development of a generally open landscape by late-prehistory. However, although the site in question lay beyond the historical *hendref* area, the excavation pointed to a year-round settlement with a mixed-farming basis rather than a summer dwelling concerned solely with pastoralism. The authors concluded that a model of historical land-use zones, based on the distinction between *hendref* (winter base) and *hafod* (summer dwelling) did not seem to apply to late prehistoric land-use and they describe the palaeoecological support for Jacobi's (1980) model as 'circumstantial' (Chambers *et al.*, 1988:346). The excavation of a Bronze Age ring cairn on Moel Goedog in North Wales produced bone-bearing soil that when analysed mineralogically, was found to be similar to coastal soil, suggesting the re-burial of bone from the lowland on the uplands (Lynch, 1984). The author discussed the possibility that this represented a system of transhumance in the Bronze Age.

In mid-Wales, Moore (1981) found little evidence for Neolithic cultivation of cereals and suggested that a transhumance system may have been a feature of land-use during this period. This conclusion may be supported by further archaeological evidence from Powys. The excavation of two round barrows at Trelystan, Powys revealed a complex sequence of late Neolithic and early Bronze

Age funerary structures and traces of late Neolithic settlement (Britnell, 1982). These barrows had been set down in pasture that may have been in existence for some time before their construction, although there was some evidence of earlier cultivation. The lack of evidence of settlement that was contemporaneous with the later cemetery was interpreted as indicating that "...some form of seasonal or periodic land-use is the most plausible explanation" with the surrounding hill slopes used "...in a periodic or specialized manner..." (Britnell, 1982:190). Transitory occupation at this site was also inferred from the flint work which testified to both a high proportion of tools and a predominance of more readily transported tool blanks.

These examples indicate that a transhumance system, suggested as being a feature of the south-western uplands both by this thesis and other scholars (Smith *et al*, 1981; Fleming, 1988) could also have been a similar feature of other areas of England in the Neolithic-Bronze Age. Factors of relief, climate and population levels in these locations made the use of upland areas most desirable only during certain times of the year. Clearly parallels between some areas of the United Kingdom can be made such as Cornwall and Wales, although the dangers of interpreting palaeoeconomies in the absence of archaeological excavation are illustrated by Chambers *et al.* (1988).

In other areas of the British Isles, it may have been more normal for pasture to succeed cultivation, a pattern suggested by some Irish pollen diagrams (Pilcher *et al.*, 1971), although the interpretation of the evidence in this way has been questioned more recently (Edwards, 1988). Stocking rates in wooded environments tend to be low and thus animals may only have made a significant contribution to the economy as the area of open grassland increased, with the expansion of settlement and cultivation (Champion *et al.*, 1984:129). Transhumance is a variation on this pattern and would have allowed the utilisation of those areas of land available on the less densely wooded and thus more easily

cleared uplands, where stocking rates could be improved (Fleming, 1972). Seasonal grazing may not have been restricted to the uplands. The early interest in the Somerset Levels has been suggested as being due to an interest in their spring and summer grazing resources (Champion *et al.*, 1984: 129).

The national context of abandonment of the uplands at the end of the Bronze Age has already been mentioned, but cessation of clearance activity is not always a feature of upland landscape change at this time. Later Bronze Age/early Iron Age human activity that stretched into the Romano-British period in some areas is attested at a number of sites in upland Wales (Chambers, 1983; Smith & Cloutman, 1988; Mighall & Chambers, 1993; Walker, 1993) and may have been intensive in certain locations (Price & Moore, 1984). This surge in activity is attributed to more extensive use of the uplands for pastoral farming, possibly as a result of increasing population pressure in lowland areas (Walker, 1993:181).

9.8 Summary: regional and national patterns

There is a degree of correspondence between settlement patterns and environmental impacts between the two areas on Bodmin Moor investigated during this project and the evidence that is available for other areas in both the south-west and elsewhere in the British Isles. The general pattern to emerge is one of intermittent activity on the uplands in the Mesolithic and Neolithic, leading to a period of intensive settlement in the Bronze Age. Mesolithic landuse seems to have been of a different form and extent on Bodmin Moor, with little evidence of the systematic burning of vegetation inferred elsewhere.

The interpretation of the pollen spectra from the East Moor and Rough Tor areas in the main periods of activity in the Neolithic and later is of increased clearance of *Corylus*, *Alnus* and *Betula* and the herbaceous pollen, in particluar *P.lanceolata*,

Ranunculus, *Galium*-type and *Potentilla* indicating a dominance of pastoral farming. Comparison with the Dartmoor palynological records (Simmons, 1964,1969; Beckett, 1981) suggests a certain degree of local variation, but the uniform theme is that of a vegetation community created and maintained by heavy grazing pressure. Evidence for arable farming is either very sparse or entirely absent, although taphonomic considerations dictate that some cultivation cannot be ruled out entirely. The problems regarding settlement - permanent or cyclical - are relevant to both areas. Neolithic impacts are more similar in some parts of the country, such as Wales, than others such as the Pennines and North York Moors where there is less evidence of activity in this period. The Bronze Age is a period of intensive settlement in many other areas of the British Isles and is testified by a large body of data both palaeoecological and archaeological from Wales, Scotland, southern and northern Britain.

The abandonment of Bodmin Moor at the end of the Bronze Age is a phenomenon that cannot be seen in isolation from similar processes that occur on other uplands both regionally and nationally. The 'traditional' causes of this are climatic deterioration, increasing soil acidity and the spread of blanket peat, although the latter factor is not as relevant to Bodmin Moor. The problems with this issue have been discussed. Settlement moves off the moor in the later prehistoric period, although the Rough Tor profiles demonstrate a certain amount of variation within this overall picture, with evidence for clearance and the spread of meadow in the Romano-British period. Similar phases are apparent in other areas of the United Kingdom, particularly Wales, although whether similar causes of population increase are also responsible, can be speculated upon but not easily demonstrated. Bodmin Moor continued to be used as seasonal grazing until some time in the medieval period when a variety of economic and environmental factors led to the re-settlement and cultivation of certain parts of the moor. This pattern is also observed on Dartmoor and in both areas it resulted in the clearance of remaining woodland and the expansion of indicators of both pasture and arable farming.

Since the end of this interlude, acid grassland has continued to spread on Bodmin Moor and heather moorland on Dartmoor.

9.9 Continuity and change: Bodmin Moor and human-environment relations during the Holocene

A major problem with the study of any landscape is the scale of investigation and of defining a unit of sufficient integrity with limits that will be sufficient to address the questions being asked. This problem occurs with both archaeological and palaeoecological study. Isolating any area from its wider context raises many questions regarding the orginal relationships within and between the different parts of the landscape. In the earliest Holocene, there was no 'Bodmin Moor', but an area of higher ground that was only distinguished from the lowlands by its less dense tree cover and perhaps more open tracts of land on the higher summits and more exposed slopes. The palaeoecological record demonstrates the presence of human communities on Bodmin Moor from an early date as a component of a palaeoeconomy that probably involved both upland and lowland. The character of the relation between human communities and Bodmin Moor is obscure in its detail and only becomes clearer in broad outline much later in the Holocene. Whether this land was regarded as 'marginal' by the earliest inhabitants is a matter of debate and has been discussed briefly above: the main issue is what defined the 'value' of land in the Bronze Age and earlier, and notions of value may or may not have been based upon the capacity for cereal cultivation (cf. Fleming, 1988:107)

The palaeoecological evidence indicates that the constant theme in human-environment relations during the Holocene is pastoralism. Use of the moor for grazing begins in the Neolithic and intensifies in the Bronze Age. Cultivation, tin streaming and peat cutting were occasional components of the moorland resource, but always against a background of pastoral landuse. This is not to suggest that

the moor was only ever seen as a vast area of rough grazing. The long cairns, barrows, stone rows and stone circles of prehistory testify to the importance of the uplands in the ritual and social life of early communities. Later, as seasonal use of the moor continued with the spread of acid grass and heathland into the historic period, the fundamental landscape relationship would have been "...a complex interdependence between upland and lowland with no concept of waste or unpossessed land." (Austin *et al.*, 1989:234).

9.10 Conclusions and prospects for further palaeoenvironmental research on Bodmin Moor

These investigations have confirmed in part the nature and character of the Holocene tree cover, as established by previous studies. Hazel was the dominant woody taxon on the moor with oak and birch as other components of the woodland. Elm and possibly pine were subordinate components of the vegetational mosaic, with alder later becoming established in the valleys and also on damper soils at higher altitudes. Other trees such as ash and lime never formed a significant component of the tree cover on the moor. The hazel cover was probably dense and there is no evidence to support hypotheses that grass and heathland were the dominant features of the early upland landscape. Future work should attempt to extend this knowledge of the the character of the vegetational mosaic on the higher slopes and in particular to establish how typical the dense hazel cover envisaged for the East Moor and Rough Tor was a feature of the wider environment of the moor. The status of arboreal taxa, such as oak and birch, both on the more exposed northern slopes and also in sheltered valley areas, is also an issue. Low species diversity is suggested as being typical of the moor.

A model of human-environment relations during the Holocene can be constructed that should be tested by future work. Mesolithic impacts were small scale and did

not involve the burning of woodland that may be evidenced on uplands elsewhere in the British Isles. The first significant evidence of anthropogenic activity begins in the Neolithic, with unintensive transhumance and the creation and maintenance of open areas in certain locations. Activity reaches a peak in the Bronze Age, with a peak in pastoral activity, followed by a reduction in settlement and the recovery in tree and shrub pollen, although continuing use of the uplands for grazing is probable. Reasons for late Bronze Age reduction in activity are unclear and there is only circumstantial evidence that it can be linked to climatic deterioration and soil degradation due to an over-exploitation of the land resource. Later activity (Iron-Age/Romano-British) may have been more significant in extent in some areas than others. A number of different pathways may have been followed in the transition from tree/shrub cover to the present day acid grassland. The medieval settlement of the moor resulted in the final demise of woodland and emergence of the modern upland landscape. The predominant landuse has been one of pastoralism for much of the past 6,000 years and prehistoric cultivation can only have been on a very limited scale. The fire record is interpreted as reflecting an absence of burning as a technique of land management and increases in charcoal generally reflect domestic burning.

Future work should aim to test these hypotheses at a range of sites in other areas of the moor, both where there is extensive evidence for settlement and also at sites where the archaeological record suggests a lower level of activity. The potential links between upland and lowland remain unknown, particularly in the prehistoric phases of activity and subsequent research should be designed to elucidate this relationship with an emphasis on sites near to and below the modern moorland edge.

Certain aspects of human-environment relations can only be adequately answered by archaeological excavation, particularly as regards the timing and extent of settlement. The palaeoecological record provides an excellent template for future

archaeological excavation which need not be extensive. The examination of structures such as the Louden long cairn or Rough Tor enclosure would expand the interpretation of both environmental and cultural change. Small-scale investigation of sections of key areas of enclosure and boundary walls and huts also has the potential to expand the level of understanding of cultural and environmental change modelled from the palaeoecological records. Unfortunately, it must be recognised that few chances to excavate on the moor will occur.

All future palaeoenvironmental work is, of course, dependent on the location of suitable deposits. This thesis has demonstrated that sediments exist on Bodmin Moor from which undisturbed records can be derived, but low accumulation rates and problems of pollen preservation may further affect the interpretation of the palaeoenvironmental data base in those areas where conformable sequences exist. The investigation of fragments of sequences of valley bogs that have been cut for their peat, with smaller topogeneous and soligeneous deposits may be necessary in future investigation. In this way, the amalgamation of discrete pockets of palaeoenvironmental data could be used to build up the record of vegetational change and human activity. Palaeoenvironmental study on Bodmin Moor will never be as straightforward as it is on many of the other uplands in the United Kingdom, but this should not discourage future attempts to extend and refine the present data base.

Appendices

Appendix 1 Lithostratigraphic description: The Troels-Smith Method

Appendix 2 Pollen preparation

Appendix 1

Lithostratigraphic description-The Troels-Smith Method

The Troels-Smith (1955) method of stratigraphic description is a widely used descriptive system for Quaternary sediments. Three key features of any sedimentary unit are recognised:

i) *Physical features*: the appearance and mechanical properties
ii) *Humicity*: the degree of decomposition of organic matter
iii) *Components*: the nature and proportion of each constituent

These are estimated on a scale of 1-4 (0 = absent, 1 = 25%, 2 = 50% etc.). Traces are indicated by +. In addition to these, a brief description of the sediment is given.

i) *Physical features*

a) *Nigror* (Nig.): Degree of darkness (0+white, 4 = black)

b) Stratification (Strf.): Degree of layering (0 = completely homogeneous,4 = thin layers)

c) *Elasticias* (Elas.): Degree of elasticity: ability to retain original shape after compression. (0 = fresh Sphagnum peat, 4 = plastic clay)

d) *Siccitas* (Sicc.): Degee of dryness (0 = clear water, 4 = air dry peat)

ii) *Humicity*

0 = plant structure fresh, clear water on squeezing
1 = plant structure well preserved. Turbid water on squeezing.
2 = plant structure partly decayed but distinct. 1/4 matrix squeezed out.
3 = plant structure well decayed but distinct. 1/2 matrix squeezed out.
4 = plant structure indiscernible or absent. Most of matrix squeezed out.

iii) *Components*

Many different components are listed. The ones used in this thesis are listed below:

Sh - Substantia humosa. Highly decayed organic matter

T - *Turfa.* Peats of mosses and plant roots

Tb - *Turfa* bryopytica: moss peat

Tl - *Turfa lignosa*: wood peat

Th - *Turfa herbacea.* Herbaceous plant peat

A - Argilla. Clays

As - *Argilla steatoides*: Fine, v.plastic clays

Ag - *Argilla granosa*: Coarser, less plastic clays

G - Grana. Solid particles > 0.06mm

Ga - *Grana arenosa*: silt

Gs - *Grana saburralia*: sand

Gg (min): *Grana glareosa minora*: gravel (2-6mm)

Gg (maj): *Grana glareosa majora*: gravel (6-20mm)

Appendix 2

Pollen preparations

Pollen preparations followed a standard chemical procedure adapted from Moore *et al.* (1991):

i) Addition of *Lycopodium* tablets: to allow the calculation of pollen concentrations.

a) One cm^{-3} sediment samples were measured by fluid displacement and transferred to a test tube.

b) Three *Lycopodium* spore tablets were added. Hydrochloric acid was added until effervescence ceased.

ii) Sodium hydroxide digestion: to remove humic acids and disaggregate acid peats.

a) 10ml NaOH was added to the sample which was then mixed and placed in a boiling water bath for 30-40minutes.

b) The sample was drained through a 180μm sieve and the residue rinsed with distilled water

c) The sample was centrifuged for 5 minutes, rinsed with distilled water and centrifuged again

iii) Hydroflouric acid treatment: to remove silica (this treatment was undertaken only if the sample had a high inorganic fraction).

a) The sample was transferred to a polypropylene tube. 6-8ml of 60 % hydroflouric acid was added and the sample mixed with a polypropylene rod.

b) The tube was placed in a water bath at 100°C for 15 minutes. The sample was the checked for grittiness and left in water bath if necessary.

c) The tubes were centrifuged and decanted into a polypropylene safety vessel and neutralised with NaOH.

d) 10-20ml HCl was added and the sample warmed for 1minute to remove any silicoflorides formed during HF treatment.

e) The sample was washed with distilled water, centrifuged and decanted.

iv) Acetylation: to remove cellulose.

a) 5-10ml glacial acetic acid was added to the sample which was centrifuged and decanted.

b) Concentrated sulphuric acid was added to acetic anhydride drop by drop in the appropriate proportion.

c) 10-15ml acetylation mixture was added to the sample which was mixed and placed in a boiling water bath for 3-4 minutes. Longer periods of acetylation can damage certain spore types (Charman, 1992b).

d) 10-15ml glacial acetic acid was added and the sample was centrifuged and decanted.

e) Glacial acetic acid was added, the sample was centrifuged and decanted.

f) Distilled water was added, the sample was centrifuged and decanted. This step was repeated until the sample was as clean as possible.

v) Mounting. The samples were mounted in silicon oil as glycerol causes grains to swell so that size criteria cannot be applied in identification of pollen grains (Moore *et al.*, 1991)

a) 1-3 drops of safranin stain were added, 2-5ml distilled water and the sample was centrifued and decanted.

b) 5ml of ethanol was added and the sample centrifuged and decanted into a waste bottle.

c) 1-2ml of Toluene was added and the sample transferred to a specimen vial.

d) The sample vial was centrifuged and decanted into a waste bottle.

e) 1-6 drops of silicon oil were added and the vials left open in the fume cupboard for 24 hours to allow the volatile component to evaporate.

f) The sample was mixed and a drop of concentrate placed on a glass slide. A coverslip was placed on top and the edges sealed with clear nail

varnish.

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