THE PATTERN OF VEGETATION DEVELOPMENT ON EXMOOR

RALPH FYFE AND HEATHER DAVIES

Abstract

Research on and around Exmoor in the late 1990s and early 2000s has greatly enhanced the understanding of vegetation development and environmental change in this upland landscape. Prior to 1995 palaeoecological evidence was limited to blanket peat sequences covering the last 3000–4000 years; however, small spring mire sites and floodplain mires, the focus of more recent work, has extended the temporal coverage, and records now exist that cover the last 10,000 years. Whilst the vegetation of the Mesolithic period was characterised by the development of mixed deciduous woodland, human impact on the landscape really becomes evident in the palaeoenvironmental record in the Neolithic period, with the clearance of woodland and the increase in areas of open grassland. The Bronze Age was the most formative period for the development of the modern Exmoor landscape, as the most intensive phase of woodland clearance of the upland, which continued into the later medieval period.

Introduction

Palaeoenvironmental work in south-west England is dominated by the study of Dartmoor: there are 38 recorded pollen diagrams from the upland, although only eleven of these have radiocarbon chronologies (Caseldine 1999). Research on Dartmoor started in the 1960s with the work of Ian Simmons (Simmons 1964) and subsequent studies have led to a reasonable understanding of the vegetation and landscape of this archaeologically rich moorland. In contrast, until recently the environmental history of Exmoor was based upon just three dated pollen sequences: The Chains (Merryfield and Moore 1974; Moore *et al.* 1984), Hoar Moor (Francis and Slater 1990) and Codsend Moor (Francis and Slater 1992), augmented by four undated sites: Alderman's Barrow, Hoar Tor, Brendon Common (Merryfield 1977) and Pinkery Canal (Maltby and Crabtree 1976). The paucity of research in areas away from Dartmoor had lead to an over-reliance on these sequences to infer the vegetation of the region and of other uplands (eg Birks 1989). However, it is reasonable to assume that the patterns and pathways of change are not the same in either the lowlands of the South West, which, with the exception of the Somerset Levels (Coles and Coles, 1986), are at present poorly understood, or on other uplands (including Exmoor). This is further discussed in the period-based reviews of environmental archaeology in Webster (2008).

In contrast to the environmental history, the state of archaeological research on Exmoor is well understood as a result of the publication of the comprehensive English Heritage survey (Riley and Wilson-North 2001). Unfortunately this review does not include palaeoenvironmental work, and although the review by Straker and Crabtree (1995) includes all published work on Exmoor to 1995, a cursory glance at the distribution of sites (Straker and Crabtree 1995, fig. 12) demonstrates the dearth of research to that date. The late 1990s and 2000s have seen a resurgence of palaeoecological research that has improved the understanding of the past environment of Exmoor. It is the purpose of this paper to review the current knowledge of the development of vegetation on Exmoor. Although studies have been carried out on palaeoenvironmental sequences on the Exmoor coastline (eg Jennings *et al.* 1998), this contribution does not deal with this work, instead focusing solely on upland vegetation development.

Archaeological periods on Exmoor

Precise definition of the timing of archaeological periods on Exmoor is problematic owing to a lack of well-dated excavations to constrain periods or monument typologies. In order to facilitate comparison between this review and the archaeology presented by Riley and Wilson-North (2001) the chronology used here follows that used in the English Heritage survey. Broadly speaking, these are the Upper Palaeolithic (to 10,000 BC), the Early Mesolithic (10,000–8000 BC), the Late Mesolithic (8000–4000 BC), the Neolithic (4000–2000 BC), the Bronze Age (2000–700 BC), the Iron Age (700 BC–43 AD), the Romano-British period (43 AD–410 AD), and the medieval period (410–1500 AD). All dates that are mentioned in this paper have been calibrated to calendar years AD/BC using the CALIB version 5.0 Radiocarbon Calibration programme (Stuiver and Reimer 1993; Stuiver *et al.* 1998).

Methods and site locations

The various types of analysis that are carried out on palaeoenvironmental sites are dependent on both the questions that are being asked in a research project, and the nature of the soils and sediments available. The condition of these places a control on the preservation of various palaeoenvironmental proxies. The most common questions concern reconstruction of the past vegetation around a site and in the wider area, which is undertaken through pollen analysis. This allows ideas of land use and landscape change to be developed. Changes in past sea-levels may be reconstructed at coastal sites using a combination of pollen and diatom analysis (eg Jennings *et al.* 1998). Other questions that have been addressed recently include aspects of woodland management through analysis of charcoal from archaeological sites (eg Juleff 1997) and changes in recent land-cover and climate by analysis of peat macrofossils and testate amoebae (Chambers *et al.* 1999). The dominant reconstruction technique that has been used though is pollen analysis, and as a result this review will focus on pollen data. Crucial to the understanding of past vegetation change is the application of radiocarbon dating to the sequences. This review must therefore focus mainly on those sites which include dating evidence, although mention will be made of recent work from other sequences.

The palaeoenvironmental sites from Exmoor summarised in this review are detailed, alongside a number of undated sites, in Table 1 and their geographical location is shown on Fig. 1. Table 1 includes details of the site type at each location. Understanding the type of site that has been used is critical to reconstructing the past environment. All pollen sites preserve pollen from local sources (bog plants), extra-local sources (plants around the bog in the immediate landscape) and regional sources (an amalgamation from plants in the wider landscape). The proportion of these sources varies with site size, a good rule of thumb being the larger the site, the more regional the picture becomes (Jacobsen and Bradshaw 1981). Broadly speaking, there are three main palaeoenvironmental site types that have been used on Exmoor: blanket peat, spring mires and floodplain mires. Blanket mires have formed on the higher parts of Exmoor. As a rule the pollen from these sites reflects the broad region, including lowlands to the west of Exmoor. Blanket mires rarely extend back beyond the Neolithic period (4000–2000 BC). Spring mires are much smaller sites, which have formed at and around spring lines and the tops of coombes. The small pollen catchment of these sites means that they are more suitable for projects which aim to assess 'human scale' impacts on the landscape, as data reflect the local and extra-local vegetation patterns. The varied processes which lead to the formation of these small mires mean that records for up to the last 10,000 years can be obtained in some cases, and in others, very high resolution data may be obtained from fast-accumulating mires. To date, small spring mires have provided information from the Later Mesolithic (8000–4000 BC) onwards. Similarly, floodplain mires tend to be small and provide data which reflect the local landscape. The time period covered by these sites can be very varied.

It is not possible within this review to provide a detailed account of each pollen sequence on Exmoor, but summary diagrams have been made for key sequences that show the relative proportions of tree, shrub, herb and grass pollen (see Fig. 2). These show the broad environmental changes on Exmoor over the last 10,000 years, but should not be read as direct representations of the relative cover of these broad vegetation types. Pollen production and dispersal is variable between different plant species (Broström et al. 2008), and it has been shown that simple ratios of arboreal to non-arboreal pollen are not straightforward indicators for landscape openness (Sugita et al. 1999). Table 2 presents details of all radiocarbon dates from these sequences.

Vegetation history of Exmoor

Late Upper Palaeolithic (late-glacial 12,000–10,000 BC

Only one site in the Exmoor region covers the Late Upper Palaeolithic period. Although Exbridge (Fig. 1, site 7) lies to the south of the upland area, it is included here as the only site that incorporates an Upper Palaeolithic and Early Mesolithic record. Here, the landscape was dominated by cold-loving grassland species (Fyfe *et al.* 2003a). The floodplain environment included fen-species such as valerians, meadowsweet and bedstraws. Conditions would have been extremely cold in the periglacial environment, with moving ground, as would be expected in arctic-steppe conditions. Birch and pine were present in the wider landscape at this time although trees were unlikely to have been growing locally. The tree pollen was most likely to have been blown across from continental Europe, some distance from the periglacial conditions. The entire upland would have been covered in steppe grassland during this intensely cold period. Evidence for the preceding warm interstadial period is lacking, but it is likely that birch woodland may have spread into the Exmoor area.

Early Mesolithic (10,000–8000 BC)

The rapid increase in temperatures at the end of the Late-Glacial (Horsfield *et al.* 2008) led to a change in the vegetation on and around Exmoor. Pine and birch woodland developed in the Exebridge area (Fyfe *et al.* 2003a), and this pattern would have been repeated across Exmoor. Open, species-rich, grassland continued to be an important element of the landscape, possibly maintained by large grazing herbivores. It is possible that small populations of hazel were present within the vegetation during the Early Mesolithic, despite not being recorded in pollen diagrams: Tallintire (2002) has argued that although hazel might not be represented in north-west European pollen diagrams, it was likely to have been locally present in the early Mesolithic landscape, reproducing vegetatively before conditions became ideal for flowering. Archaeological evidence of early Mesolithic populations is absent from Exmoor (Riley and Wilson-North 2001); however, no doubt the landscape would have supported an early Mesolithic population engaged in hunting-gathering-fishing activities.

Late Mesolithic (8000–4000 BC)

The start of the Late Mesolithic was marked by the expansion of deciduous woodland on and around Exmoor, migrating in from continental Europe (Birks 1989). Palaeoenvironmental evidence shows that open land was extremely limited, with woodland covering the majority of Exmoor. Sequences from Brightworthy and Exbridge (Fyfe *et al.* 2003a), Long Breach and Gourte Mires (Fyfe *at al.* 2003b), and Hoar Moor (Francis and Slater 1990) indicate that mixed oak-hazel woodland was dominant, for example in the Barle Valley at Brightworthy (Fyfe *et al.* 2003a) and Landacre Bridge (Badger 2000). Peat development began at Comerslade shortly before 6350–6080 cal BC, and the presence of predominantly hazel woodland is demonstrated by the large wood remains visible in section (Fyfe *et al.* 2008). However, there is also evidence of pine, alder, elm, and birch pollen, suggesting that species composition of woodland during this period was spatially diverse, as a function of soils, aspect and exposure. For example, significant stands of pine woodland persisted throughout the later Mesolithic around Hoccombe Combe (Wessely 2002), and much smaller pine stands are recorded to the south of Exmoor at Exebridge (Fyfe *et al.* 2003a). There is also evidence of the establishment of alder woodland early in the Later Mesolithic at Exbridge with this type of vegetation only becoming established much later (4450–4250 cal BC) around Brightworthy, in the Barle Valley. Although elm pollen is seldom recorded from sequences on Exmoor, some locations seem to have been favourable for the establishment of elm woodland, as it made up a significant part of

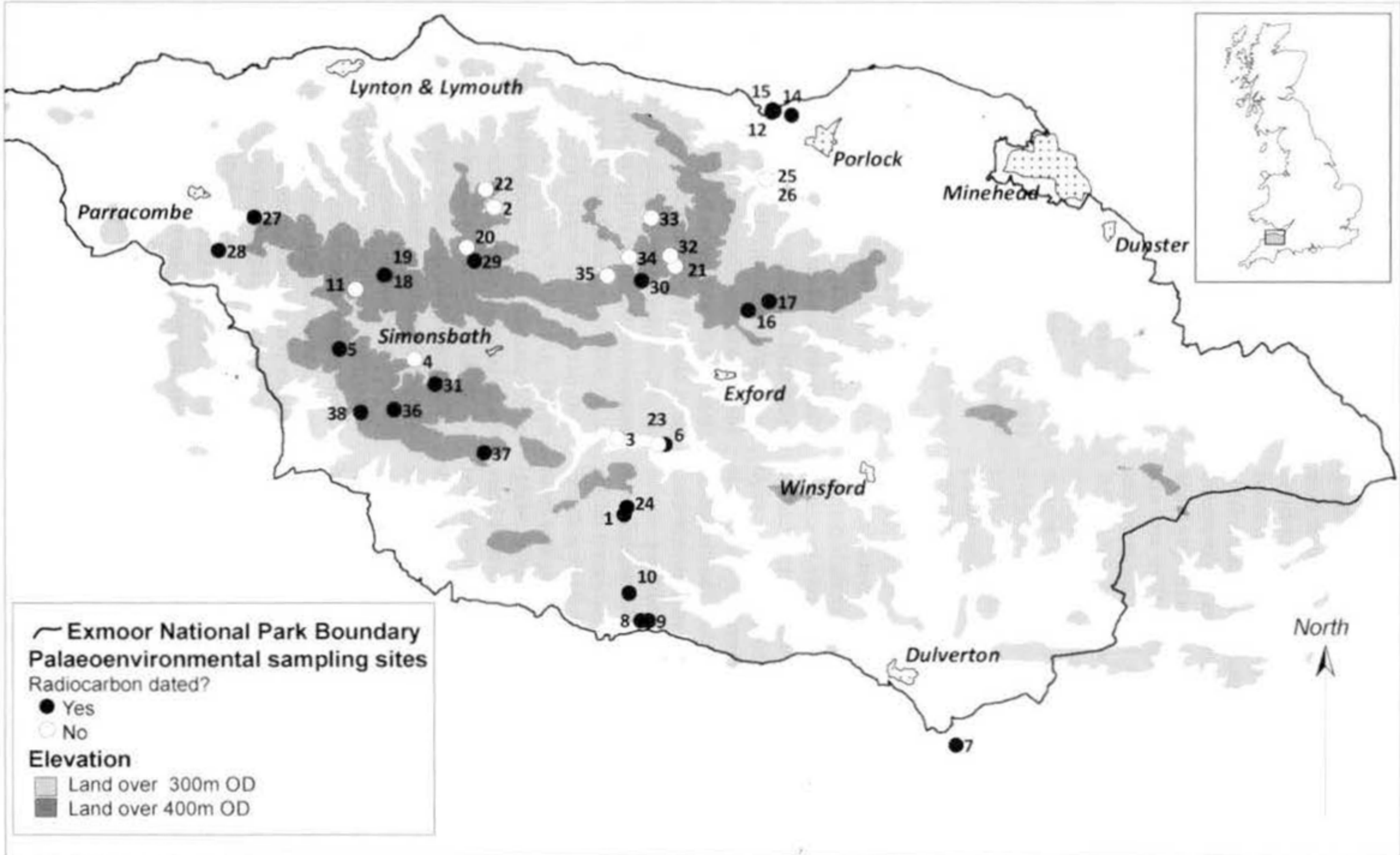

Fig. 1 Location of palaeoenvironmental sites on Exmoor (see Table 1 for site details)

TABLE 1: PALAEOENVIRONMENTAL SITES ON EXMOOR (NOS AS ON FIG. 1)

	site	proxy	Site type	dated	reference
1	Halscombe Allotment	pollen	spring mire	yes	Carter 2002
2	Hoccombe Combe	pollen	spring mire	no	Wessely 2002
3	Landacre Bridge	pollen	floodplain mire	no	Badger 2000
4	Black Hill (Squallacombe)	pollen	blanket peat	no	Albutt 2000
5	Moles Chamber	pollen, testate amoebae	spring mire	yes	Fyfe 2000
6	Brightworthy Farm 1	pollen	floodplain mire	yes	Fyfe *et al.* 2003a
7	Exebridge	pollen	floodplain mire	yes	Fyfe *et al.* 2003a
8	Gourte Mires	pollen	spring mire	yes	Fyfe *et al.* 2003b
9	Anstey's Combe	pollen	spring mire	yes	Fyfe *et al.* 2003b
10	Long Breach (Molland)	pollen	spring mire	yes	Fyfe *et al.* 2003b
11	Pinkery Canal	pollen	buried soil	no	Maltby & Crabtree 1976
12	Porlock Marsh (PM4)	pollen, diatoms	Marsh	yes	Jennings *et al.* 1998
13	Porlock Forest Bed (FB7)	pollen, diatoms	Marsh	yes	Jennings *et al.* 1998
14	Porlock Forest Bed (FB4)	pollen, diatoms	Marsh	yes	Jennings *et al.* 1998
15	Porlock Forest Bed (FB2)	pollen, diatoms	Marsh	yes	Jennings *et al.* 1998
16	Hoar Moor	pollen	blanket peat	yes	Francis & Slater 1990
17	Codsend Moor	pollen	blanket peat	yes	Francis & Slater 1992
18	The Chains	pollen	blanket peat	no	Straker & Crabtree 1995
19	The Chains	pollen	blanket peat	yes	Merryfield & Moore 1974
20	Hoar Tor	pollen	blanket peat	no	Merryfield 1977
21	Alderman's Barrow	pollen	blanket peat	no	Merryfield 1977
22	Brendon Common	pollen	blanket peat	no	Merryfield 1977
23	Brightworthy Farm 2	pollen	spring mire	no	Fyfe 2000
24	Halscombe Allotment	pollen	spring mire	yes	Jennings 1997
25	Hawkcombe Head	pollen	spring mire	no	Jackson 1997
26	Hawkcombe Head	pollen	Spring mire	no	Slade 1997
27	Higher Holworthy	pollen	spring mire	yes	Rippon *et al.* 2006
28	Twineford Combe Head	pollen	spring mire	yes	Rippon *et al.* 2006
29	Lanacombe	pollen, macrofossils	blanket peat	yes	Chambers *et al.* 1999
30	Larkbarrow	pollen, macrofossils	blanket peat	yes	Chambers *et al.* 1999
31	Roman Lode	pollen, geochemistry	blanket peat	yes	Fyfe 2008
32	Madacombe	pollen	spring mire	no	Fyfe 2005
33	Hoscombe	pollen	spring mire	no	Fyfe 2005
34	Larkbarrow	pollen	spring mire	no	Fyfe 2005
35	Swap Hill	pollen	spring mire	no	Fyfe 2005
36	Comerslade	pollen,macrofossils, testate	spring mire	yes	Fyfe *et al.* 2008
37	Long Holcombe	pollen, macrofossils testate amoebae	spring mire	yes	Fyfe *et al.* 2008
38	North Twitchen Springs	pollen, geochemistry	spring mire	yes	Fyfe (unpub)

the deciduous woodland at Halscombe Allotment (Carter 2002).

During the Late Mesolithic, we begin to get evidence of human inhabitation of Exmoor in the archaeological record, represented by a number of flint scatters, notably at Hawkcombe Head (Riley and Wilson-North 2001). However, the evidence from palaeoenvironmental sequences for human impact is limited on Exmoor in comparison to Dartmoor (Horsfield *et al.* 2008). Evidence of tree clearance, indicated by charcoal and reduced tree/increased plant species has been identified at Brightworthy around 6500 and 5000 cal BC. Also, evidence from Exebridge shows later Mesolithic woodland disturbance on the valley floor (Fyfe *et al.* 2003a). Deliberate manipulation of the vegetation

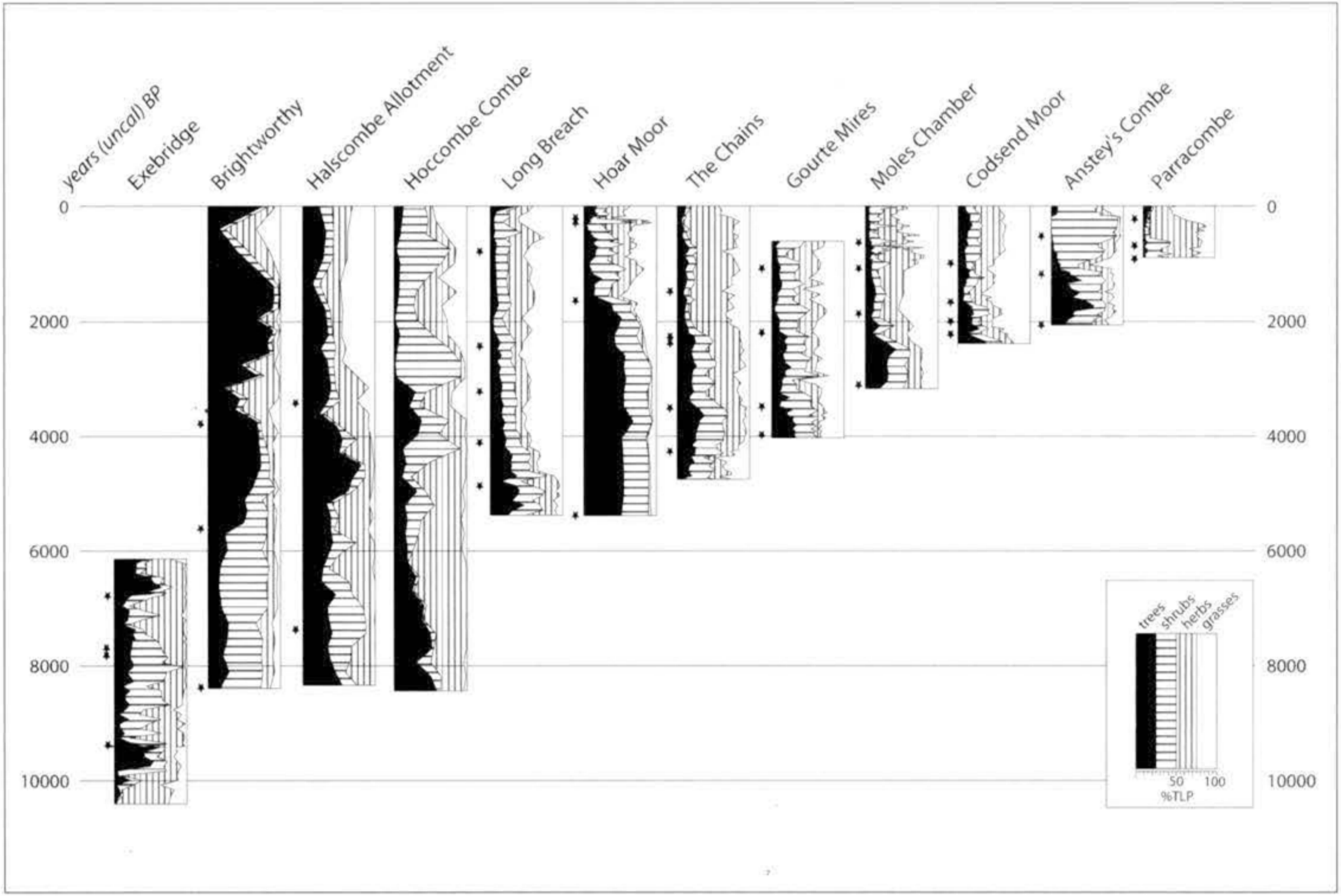

Fig. 2 Summary diagrams showing proportions of tree, shrub, herb and grass pollen from selected Exmoor palaeoenvironmental sequences. The position of radiocarbon dates is shown by stars to the left of the relevant sequence

TABLE 2: ^{14}C DATES FROM EXMOOR POLLEN SEQUENCES

Site	Depth	Lab code	Date (BP)	Calibrated date
Hoar Moor	11–19	I-15546	240±80	Cal AD 1470–1950
	35–43	I-15547	380±80	Cal AD 1410–1660
	65–75	I-15548	1760±80	Cal AD 80–430
	100–108	I-15549	5410±110	4460–3980 cal BC
Codsend Moor	17–25	I-16104	930±140	Cal AD 780–1380
	55–63	I-16091	1660±130	Cal AD 80–650
	63–71	I-16086	1990±160	390 cal BC–cal AD 400
	81–89	I-16087	2270±150	790 cal BC–cal AD 50
The Chains	58	UB-816	1500±60	Cal AD 420–660
	100	UB-817	2215±90	410–5 cal BC
	130	UB-819	2335±260	1000 cal BC–cal AD 230
	200	UB-820	3505±120	2190–1520 cal BC
	240	UB-821	4170±75	2910–2500 cal BC
Exebridge	61–62	CAMS-65905	6760±40	5730–5560 cal BC
	120–121	WK-9601	7540±60	6470–6240 cal BC
	140–141	WK-9602	7710±60	6650–6440 cal BC
	319–320	CAMS-65904	9530±50	9160–8650 cal BC
Brightworthy	77–82	BETA-142642	3700±50	2270–1940 cal BC
	114–115	BETA-142643	550±50	4450–4250 cal BC
	151–152	UtC-9606	8510±60	7600–7390 cal BC
Moles Chamber	160	UtC-9181	680±40	Cal AD 1280–1400
	224	UtC-9182	710±110	Cal AD 1040–1430
	267–272	BETA-140872	1050±60	Cal AD 890–1160
	312	UtC-9183	1086±40	Cal AD 890–1020
	326–329	BETA-140873	1820±40	Cal AD 80–320
	346	UtC-8620	3170±60	1600–1310 cal BC
Halscombe Allotment	84–86	WK-10648	3550±60	2110–1690 cal BC
	156–158	WK-10647	7080±60	6060–5805 cal BC
Long Breach	24–29	WK-10624	650±60	Cal AD 1270–1420
	55–60	WK-10623	2380±60	770–370 cal BC
	94–99	WK-10622	3220±60	1630–1320 cal BC
	125–130	WK-10621	4190±60	2900–2580 cal BC
	149–154	WK-10620	4700±60	3640–3360 cal BC
Gourte Mires	28–33	WK-10619	1020±60	Cal AD 890–1170
	80–85	WK-10618	2230±70	410–90 cal BC
	150–155	WK-10617	3560±60	2120–1730 cal BC
	190–195	WK-10616	3960±60	2630–2280 cal BC
Anstey's Combe	35–40	WK-10613	420±60	Cal AD 1410–1640
	82–87	WK-10612	1160±70	Cal AD 680–1020
	145–150	WK-10610	1920±60	50 cal BC–cal AD 240
Parracombe	113–115	WK-12540	755±38	Cal AD 1210–1300
	103–105	WK-12541	786±47	Cal AD 1160–1300
	77–79	WK-12542	282±43	Cal AD 1480–1670
North Twitchen Springs	24–26	BETA-202087	1430±40	Cal AD 560–670
	44–46	BETA-202086	2260±40	400–200 cal BC
	64–66	BETA-202085	2950±40	1290–1020 cal BC
	84–86	BETA-202084	3380±40	1750–1540 cal BC
	104–106	BETA-202083	3620±40	2120–1890 cal BC
Higher Holworthy	113–115	WK-12540	755±38	Cal AD 1210–1300
	103–105	WK-12541	786±47	Cal AD 1160–1300
	77–79	WK-12542	282±43	Cal AD 1480–1670
Twineford Combe Head	174–176	WK-12543	441±39	Cal AD 1400–1520
	107–108	WK-12544	153±46	Modern
	74–75	WK-12545	93±43	Modern
Roman Lode (Burcombe)	10–11	OxA-15750	106.5±0.3%	Modern
	10–11	OxA-15825	106.6±0.3%	Modern
	52–53	OxA-15827	2184±29	362–267 cal BC
	52–53	OxA-15865	2127±26	346–55 cal BC
	52–53	Weighted mean	2153±19	350-115 cal BC

on the floodplain and around the fringes of the mire, probably using fire, maintained open sedge-rich vegetation. This would have enhanced hunting strategies by making the location of grazing animals more predictable. The evidence for Mesolithic activity around the southern part of Exmoor is extremely limited; however, the evidence from palaeoecological data has been able to improve our knowledge of later Mesolithic activity around the upland.

Neolithic (4000–2000 BC)

The Neolithic of British uplands is often characterised by standing monuments, commonly attributed a ritual function, rather than sites that we would recognise as settlements. An abundance of standing stones and stone settings, attributed to the late Neolithic and Early Bronze Age can be found on Exmoor, and it is usually accepted that these monuments, common on many British uplands, were placed within an open, cleared, pastoral landscape (Simmons 2003). Blanket peat inception during this period on Exmoor has provided much potential for palaeoecological research (Wilkinson and Straker 2008), and evidence from the early phases of blanket peat sequences in the upland areas, particularly at The Chains (Moore *et al.* 1984; Crabtree and Straker 1995) and Hoar Moor (Francis and Slater 1990) indicate largely open grassy landscapes. At both Hoccombe Combe (Wessely 2002) and Halscombe Allotment (Carter 2002) there were small increases in grassland at the expense of woodland species such as elm, suggesting the removal of woodland to create cleared spaces in upland areas. Also, at Long Breach the start of the Neolithic was marked by a significant increase in burning, suggesting management of the upland vegetation for grazing (Fyfe *et al.* 2003b). This evidence for human manipulation of vegetation supports the idea that monument construction may have taken place in landscapes which were at least partially open. In contrast, the sequences from Landacre Bridge (Badger 2000) and Brightworthy (Fyfe *et al.* 2003a) in the Barle valley show very little disturbance of the valley floor and valley side woodland: during this period valleys were dominated by alder, oak, and hazel woodland. Although there is evidence of some open areas in these locations throughout the Mesolithic and Neolithic, they are likely to have remained wooded due to their positions on wet floodplains or steep valley sides. Alternatively clearings may have been created as a result of geomorphic activity on the valley floor. The palaeoenvironmental evidence seems to indicate that the high uplands were more open than the valleys, where woodland appears to have been preserved.

Bronze Age (2000–700 BC)

The Bronze Age was a period which had a very marked impact on the Exmoor landscape, with very visible standing archaeology, including both sites traditionally considered 'ritual' to field systems and settlement sites. It also represents one of the more critical periods in the formation of Exmoor's landscape as we see it today. Similarly, the period represents a peak of human activity on both Bodmin Moor (Johnson and Rose 1994) and Dartmoor (Fleming 1988). The dating evidence for palaeoenvironmental data from the period is not comprehensive, although eight sites include a radiocarbon date that falls within the Bronze Age (Brightworthy Farm, Halscombe Allotment, The Chains, Moles Chamber, Gourte Mires, Long Breach, Comerslade, and North Twitchen Springs). The archaeology of the period is marked by increased funerary monument construction across Exmoor. Prehistoric field systems are recorded sporadically on the high unenclosed moorland (Patterson and Salisbury 1989; Riley and Wilson-North 2001), although none of these remains are securely dated. Morphologically at least some are similar to co-axial systems dated to the Middle Bronze Age from Dartmoor (Fleming 1988), but until targeted excavation and chronologies are established dating of the Exmoor evidence remains speculative. The location of the surviving field systems often coincides with land enclosed in the modern period, and therefore may be under threat from agriculture. The location and concentration of field systems suggests that the Bronze Age use of the upland was intense.

The environmental data support the view of an open landscape by the Bronze Age. There is evidence of further expansion of grassland and reduction in woodland in high upland areas where clearance activity began in the Neolithic period, for example, The Chains and Hoar Moor (Merryfield and Moore 1974; Francis and Slater 1990). Evidence from small spring mires at the heads of coombes, such as Hoccombe Combe (Wessely 2002), also shows that clearance of the tops of the coombes continued. Clearance cairns are common around the top of Hoccombe Combe, and the pollen evidence suggests a dramatic reorganisation of the landscape. At present evidence for cereal cultivation in the environmental sequences is limited, and although cereal cultivation cannot be ruled out, the dominant land use was likely to be pastoral based on the pollen assemblages. Pollen sequences from smaller mires at the upland fringes, however, give a more nuanced picture of greater variability within the landscape. Evidence from Gourte Mires and Long Breach (Fyfe *et al.* 2003b) at the southern fringes of the moorland shows that there may be more diversity than previously supposed. Within a small geographical area, there can be patches of heath, and grazing land, but also areas of woodland concentrated in the valleys and the tops of some coombes. On the Brightworthy floodplain, changes in valley floor vegetation (a shift from alder carr to sedge-dominated vegetation) strongly suggests a period of increased alluviation, which may reflect upland clearance. Clearance would have made soils unstable, the resulting erosion generating sediment that would then be deposited downstream on the floodplain. By the end of the Bronze Age woodland cover on Exmoor was greatly reduced, and woodland would only have persisted in river valleys, and possibly the tops of coombes (Fyfe *et al.* 2003b).

Iron Age/Romano-British (700 BC–AD 410)

Literature on environmental change commonly alludes to climatic deterioration during the Late Bronze to Early Iron Age (Roberts 1998; van Geel and Renssen 1998). This period has therefore been seen as one of retreat from high moorland areas in Britain (Simmons 2003; Dark 2000). Archaeological investigation of the Iron Age in the South West has focussed, throughout the 20th century, on hillforts as the focus of Iron Age society (Fitzpatrick 2008), and the visibility of the Bronze Age settlement evidence in the uplands has tended to overshadow the little that is known about settlement patterns in the Iron Age. Human-induced soil degradation and climatic changes noted from peat stratigraphy (indicating a colder and wetter climate) are often cited as the cause for the abandonment of upland field systems (Caseldine 1999; Barnatt 1999; Simmons 2003; Amesbury *et al.* 2007). However, a decline in upland settlement is not apparent from the archaeological and palaeoenvironmental record from Exmoor. For example there are a number of enclosed settlements and hillforts, including Wind Hill, the Myrtleberrys, Sweetworthy, Bury Castle, Shoulsbury Castle, Bat's Castle, and Gallox Hill (Riley and Wilson-North 2001). However, the poor dating of these sites may mean that they can tell us little about upland abandonment. Exmoor's palaeoenvironmental record during this period seems to indicate continued openness in the landscape. For example, evidence from The Chains in the high moorland suggests that agricultural use of these areas continued into the modern period (Merryfield and Moore 1974; Moore *et al.* 1984; Crabtree and Straker 1995). However, the start of peat growth at Codsend Moor may be a sign that a changing climate caused environmental changes, to which local communities had to adapt (Francis and Slater 1992). This general pattern contrasts with that on Dartmoor and Bodmin Moor, where there is evidence of woodland regeneration and scrub regeneration (Caseldine 1999; Gearey *et al.* 2000) indicating a decline in agricultural use of the uplands at the end of the Bronze Age. In the mid to late Iron Age, dramatic woodland clearance, and an increase in species-rich grassland (typical of rich grazing land) is seen at a number of sites across Exmoor, including Moles Chamber (Fyfe 2000), Gourte Mires and Long Breach (Fyfe *et al.* 2003b), as well as potentially (although undated) at North Twitched Springs (Fyfe 2003). This may indicate population expansion or agricultural intensification. In the late Iron Age (410–90 BC), an intensive phase of clearance is evident at Gourte Mires and Long Breach, but not at Ansteys Combe, suggesting that woodland persisted in steeper sided valley contexts, perhaps managed for fuel or timber (Fyfe *et al.* 2003b). From the later 1st millennium BC into the historic period, the palaeoenvironmental record indicates continuing clearance on Exmoor, the causes of which are not obvious from the environmental data alone. However, the changes are likely to reflect a general expansion of population and agricultural intensification within the mid to late Iron Age, including technological advances allowing heavier soils to be cultivated and the start of mineral exploitation of the upland. The Romano-British period on Exmoor is remarkably unremarkable, and implies that although there was a Roman presence in the region (as represented by several enclosures on Exmoor), the influence on the broader landscape and agricultural use of the upland was negligible (Fyfe and Rippon 2004).

Medieval (AD 410–1500)

The environmental sequences on Exmoor contradict the theory that climate change caused the abandonment of upland settlement in the late prehistoric period (Dark 2000), and suggest continuous use of the upland into the later medieval period. The paucity of archaeological evidence for the early medieval period is well attested (Riley and Wilson-North 2001); however, the environmental evidence can be used as a proxy for this difficult aceramic period and later (Rippon *et al.* 2006). The majority of environmental sequences from Exmoor cover the medieval period, and this evidence suggests that the early medieval landscape of Exmoor is one of unchanging open damp grassland, with heath vegetation on the higher and wetter parts of the upland. Mires around the southern margins of Exmoor on Molland Common, Long Breach and Gourte Mires show evidence of an expansion of arable cultivation onto the upland by around AD 1100 (Fyfe *et al.* 2003b), probably as part of a system of convertible husbandry, whereby short periods of arable (around 2–3 years) are accompanied longer periods of ley (around 5–10 years) on a field-rotation system (Rippon *et al.* 2006). Field evidence from the English Heritage survey of Exmoor has demonstrated large areas of relict medieval field systems, covering Molland Common, Withypool Hill and Winsford Hill (Riley and Wilson-North 2001), which strongly suggest landscape reorganisation in the medieval period. The combined evidence points to significant areas of Exmoor which were likely to be used at least occasionally for arable cultivation. Cultivation appears to continue until well into the post-medieval period around Molland Common, and it is likely that this is representative of the other areas which preserve evidence of relict field systems.

Conclusions

This review has highlighted the recent improvement in our understanding of the environment of Exmoor. In particular, it has shown how use of 'non-typical' pollen sites such as spring mires and small peat basins can fill in the voids left by blanket mire sequences, by often providing us with older or higher resolution palaeoenvironmental records, and allowing us to build up a picture of the mosaic of landscapes across a region. The palaeoenvironmental record for Exmoor now extends back to the end of the last Glacial period. There are several sites which begin in the later Mesolithic and appear to continue to accumulate peat to modern times (eg Hoccombe Combe, Halscombe Allotment). Most sequences cover the last 3000 years, due in part to the formation of blanket peat across the high moorland. The formative period for the modern Exmoor landscape appears to have been the Bronze Age, where woodland clearance, which began during the Neolithic, was finally finished, leaving an upland dominated by either wet grassland or heathland. After this, land use has been relatively stable, with the exception of a change to a system characterised by both arable and pastoral agriculture around the upland fringes. Further exploration of Exmoor should show that sites such as Hoccombe Combe and Halscombe Allotment are not unique in extending back from present times into the Mesolithic. Use of sites such as these, and routine radiocarbon dating of sequences, will allow us to fill in gaps in our knowledge through increasing the temporal resolution of our analyses. Use of floodplain sites such as those in the Barle valley will also allow us to examine the differences in the landscape, and potential land use, between the high uplands and the incised river valleys.

The past environment of Exmoor has been shown to be diverse, both spatially and temporally. This simple statement is archaeologically important, as spatial and temporal diversity will affect the availability of resources for communities that have used the Exmoor upland. The environmental evidence can, and is, being used to augment archaeological data and lead to a fuller understanding of human activities on the upland. This review does not mark the end of research on Exmoor, and much remains to be explored. Priorities should include attempts to further develop the understanding of the archaeology of Exmoor through integrated palaeoenvironmental and archaeological work. We now have a better overview of the general pattern of vegetation from a range of the landscape contexts on Exmoor, but still lack the detailed understanding of precisely when, how, and why most of the changes discussed here occurred.

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Author contact

School of Geography, Earth, and Environmental Science, University of Plymouth, Drake Circus, Plymouth, PL4 8AA
e-mail: ralph.fyfe@plymouth.ac.uk

References

Albutt, T., 2000. *Pollen Analysis from Black Hill, Exmoor,* unpub dissertation, Department of Geography, Univ Exeter.

Amesbury, M.J., Charman, D.J., Fyfe, R.M., Langdon, P.G., and West, S., 2007. 'Bronze Age upland settlement decline in southwest England: testing the climate change hypothesis', *J Archaeol Sci* 35(1), 1–12.

Badger, J., 2000. *A Palaeoenvironmental Reconstruction of The River Barle Valley, Landacre Bridge, Exmoor*, unpub Dissertation, Univ Exeter.

Barnatt, J., 2000. 'To each their own: later prehistoric farming communities and their monuments in the Peak', *Derbyshire Archaeol J* 120, 1–86.

Birks, H.J.B., 1989. 'Holocene isochrone maps and patterns of tree-spreading in the British Isles', *J Biogeography* 16, 503–40.

Broström, A., Nielsen, A.B., Gaillard, M-J., Hjelle, K., Mazier, F., Binney, H., Bunting, J., Fyfe, F., Meltsov, V., Poska, A., Rasanenen, S., Soepboer, W., von Stedingk, H., Suutari, H., Sugita, S., 2008. 'Pollen productivity estimates of key European plant taxa for quantitative reconstruction of past vegetation: a review', *Vegetation History and Archaeobotany* 17, 461–78.

Carter, V., 2002. *Pollen analysis from Halscombe Allotment, Exmoor,* unpub Dissertation, Univ Exeter.

Caseldine, C.J., 1999. 'Archaeological and environmental change on Prehistoric Dartmoor – current understandings and future directions', *J Quaternary Science* 14, 575–83.

Chambers, F.M., Mauquoy, D., and Toss, P.A., 1999. 'Recent rise to dominance of *Molinia caerulea* in environmentally sensitive areas: new perspectives from palaeoecological data', *J Applied Ecology* 36, 719–33.

Coles, B., and Coles, J., 1986. *Sweet Track to Glastonbury. The Somerset Levels in Prehistory,* London.

Dark, P., 2000. *The Environment of Britain in the first millennium AD,* London.

Fitzpatrick, A., 2008. 'Later Bronze Age and Iron Age', in Webster 2008, 117–44.

Fleming, A., 1988. *The Dartmoor Reaves,* London.

Francis, P.D., and Slater, D.S., 1990. 'A record of vegetation and land use change from upland peat deposits on Exmoor. Part 2: Hoar Moor', *SANH* 134, 1–25.

Francis, P.D., and Slater, D.S., 1992. 'A record of vegetation and land use change from upland peat deposits on Exmoor. Part 3: Codsend Moor', *SANH* 136, 9–28.

Fyfe, R.M., 2000. *Palaeochannels of the Exe catchment: their age and an assessment of their archaeological and palaeoenvironmental potential*, unpub PhD Thesis, Univ Exeter.

Fyfe, R.M., 2003. *Sherracombe Ford and North Twitchen Springs, Exmoor: Analysis of pollen and microscopic charcoal from mires associated with Sherracombe Ford (ExFe),* unpub report for ENPA.

Fyfe, R.M., 2005. *The Palaeoecological Potential of Exmoor Moorlands: Moorland units 7 and 13,* unpub report for ENPA.

Fyfe, R.M., 2008. *Roman Lode, Burcombe, Exmoor, North Devon. Pollen analysis of blanket peat deposits,* English Heritage Research Department Report series no. 24-2009.

Fyfe, R.M., Brown, A.G., and Coles, B.J., 2003a. 'Mesolithic to Bronze Age vegetation change and human activity in the Exe Valley, Devon, UK', *Procs Prehist Soc* 69, 161–81.

Fyfe, R.M., Brown, A.G., and Rippon, S.J., 2003b. 'Mid- to late- Holocene vegetation history of Greater Exmoor, UK: estimating the spatial extent of human-induced vegetation change', *Vegetation History and Archaeobotany* 12, 215–32.

Fyfe, R.M., and Rippon, S.J., 2004. 'A landscape in transition? Palaeoenvironmental evidence for the end of the 'Romano-British' period in southwest England', in R. Collins and J. Gerrard (eds), *Debating Late Antiquity in Britain, AD 300-700,* BAR Brit Ser 365, 33–42.

Fyfe, R.M., Gehrels, M., and Vickery, E., 2008. *Palaeoenvironmental analyses from MIRE project sites: Comerslade and Long Holcombe, Exmoor,* unpub. report for ENPA

Gearey B., Charman, D., and Kent, M., 2000. 'Palaeoecological evidence for the prehistoric settlement of Bodmin Moor, Cornwall, Southwest England Part II: Land use changes from the

Neolithic to the present', *J Archaeol Sci* 27, 493–508.

Horsfield, R., Straker, V., and Gardiner, P., 2008. 'Palaeolithic and Mesolithic', in Webster 2008, 23–62.

Jacobsen, G.L., and Bradshaw, R.H.W., 1981. 'The selection of sites for palaeovegetation studies', *Quaternary Research* 16, 80–96.

Jackson, S., 1997. *The Analysis of Pollen Diagrams from Hawkcombe Head, Exmoor, with respect to both climatic and anthropogenic influences upon the local area vegetation,* unpub report, School of Geography and Biology, Univ Bristol.

Jennings, H., 1997. *Pollen Analysis from a Profile in the Peat at Halscombe Allotment, Exmoor,* unpub report, School of Geography and Biology, Univ Bristol.

Jennings, S., Orford, J.D., Canti, M., Devoy, R.J.N., and Straker, V., 1998. 'The role of relative sea-level rise and changing sediment supply on Holocene gravel barrier development: the example of Porlock, Somerset, UK', *The Holocene* 8, 165–81.

Johnson, N., and Rose, P.G., 1994. *Bodmin Moor - An Archaeological Survey. Volume 1: The Human Landscape to c. 1800,* RCHME and English Heritage, London.

Juleff, G., 1997. *Earlier Iron-working on Exmoor: preliminary survey,* ENPA and National Trust survey report.

Maltby, E., and Crabtree, K., 1976. 'Soil organic matter and peat accumulation on Exmoor: a contemporary and palaeoenvironmental evaluation', *Trans Institute British Geographers* 1, 259–78.

Merryfield, D.L., 1977. *Palynological and stratigraphical studies on Exmoor*, unpub PhD Thesis, Univ London.

Merryfield, D.L., and Moore, P.D., 1974. 'Prehistoric human activity and blanket peat initition on Exmoor', *Nature* 250, 439–41.

Moore, P.D., Merryfield, D.L., and Price, M.D.R., 1984. 'The vegetation and development of blanket mires', in P. Moore (ed.), *European Mires*, 203–35.

Patterson, P., and Sainsbury, I.S., 1989. 'Prehistoric earthworks on Codsend and Hoar Moors, Somerset', in M. Bowden, D. Mackay, and P. Topping (eds), *From Cornwall to Caithness: some Aspects of British Field Archaeology*, BAR Brit Ser 209, 79–91.

Riley, H., and Wilson-North, R., 2001. *The Field Archaeology of Exmoor,* Swindon.

Rippon, S.J., Fyfe, R.M., and Brown, A.G., 2006. 'Beyond villages and open fields: the origins and development of a historic landscape characterised by dispersed settlement in South West England', *Medieval Archaeol* 50, 31–70.

Roberts, N., 1998. *The Holocene: An Environmental History,* Oxford.

Simmons, I.G., 1964. 'Pollen diagrams from Dartmoor', *New Phytologist* 63, 165–80.

Simmons, I.G., 2003. *The Moorlands of England and Wales: An Environmental History 800 BC – AD 2000,* Edinburgh.

Slade, S., 1997. *Pollen Analysis of Hawkcombe Head, a Mesolithic site on Exmoor,* unpub report, School of Geography and Biology, Univ Bristol.

Straker, V., and Crabtree, K., 1995. 'Palaeoenvironmental studies on Exmoor: past research and future potential', in H. Binding (ed), *The Changing Face of Exmoor,* Tiverton, 43–51.

Stuiver, M., and Reimer, P.J., 1993. 'Extended 14C database and a revised CALIB radiocarbon calibration program', *Radiocarbon* 35, 215–30.

Stuiver, M., Reimer, P.J., Bard, E., Beck, J.W., Burr, G.S., Hughen, K.A., Kromer, B., McCormac, F.G., van der Plicht, J., and Spurk, M., 1998. 'INTCAL98 Radiocarbon age calibration 24,000 – 0 cal BP', *Radiocarbon* 40, 1041–83

Sugita, S., Gaillard, M-J., and Broström, A., 1999. 'Landscape openness and pollen records: a simulation approach', *The Holocene* 9(4), 409–21.

Tallintire, P.A., 2002. 'The early-Holocene spread of hazel (*Corylus avellana* L.) in Europe north and west of the Alps: an ecological hypothesis', *The Holocene* 12, 81–96

Van Geel, B., and Renssen, H., 1998. 'Abrupt climate change around 2650 BP in North-West Europe: evidence for climatic teleconnection and a tentative explanation', in A. Issar and Brown, N. (eds), 1998. *Water, Environment and Society in Times of Climatic Change ... ,* New York.

Webster, C.J. (ed.), 2008. *The Archaeology of the South West, South West Archaeological Research Framework, Resource Assessment, and Research Agenda*, Somerset Heritage Service, Taunton.

Wessely, H., 2002. *Pollen analysis from Hoccombe Combe, Brendon Common, Exmoor,* unpub Dissertation, Univ Exeter.

Wilkinson, K., and Straker, V., 2008. 'Neolithic and Early Bronze Age environmental background', in Webster 2008, 63–74.