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Environmental history of Surrey

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This chapter provides a review of the environmental history of Surrey from the lower Palaeolithic through to the historic periods, and presents a broad agenda for future palaeoenvironmental (including environmental archaeological) research in the county. The existing data suggest that towards the end of the last glaciation cold climatic conditions existed in Surrey, with vegetation similar to present-day steppe tundra or semi desert environments. The transition to the Holocene was characterized by the colonization of warmth-loving vegetation, and there is unequivocal evidence for human exploitation of natural resources on the flood plain of the middle Thames valley and Lower Greensand. After approximately 5500 years before present, there is some evidence to suggest that clearance of woodland created a mosaic of closed and open forest, temporarily cultivated land, grazing land and meadows. During later periods, the data suggest that agricultural intensification occurred against a background of natural environmental changes resulting in a clear decline in woodland cover and soil degradation in some areas. It is proposed that future palaeoenvironmental investigations should be conducted within a regional research framework, with the focus on understanding the precise effects of natural and cultural processes on the landscape of Surrey.

Introduction

In 1987 Macphail and Scaife, in *The archaeology of Surrey to 1540*, presented a review of the 'geographical and environmental background' of Surrey that highlighted the relative importance of natural and cultural processes in shaping the landscape during the past 14,000 years (since the late Upper Palaeolithic). Since 1987, important new investigations have significantly enhanced our knowledge of the environmental history, with a wide variety of scientific techniques used to reconstruct and explain changes in climate, sea level, vegetation cover, soil properties and landscape morphology (eg fossilized biological remains, geomorphology, sedimentology, pedology and geochronology). This chapter first reviews these data to provide a synthesis of the environmental history, and secondly provides an outline agenda for future palaeoenvironmental research in Surrey. The geology and soils of the county are illustrated in figures 1.1 and 1.2. Note that no attempt has been made to review the present day physiographical characteristics since these were detailed in Macphail & Scaife (1987).

Note: Throughout this chapter, radiocarbon dates are quoted as uncalibrated radiocarbon years before present (before 1950 calendar years AD).

Climatic, pedological and ecological background

Before the start of the present interglacial (Holocene) (*c* 10,000 BP) and following the arrival in Britain of modern humans (*Homo sapiens*) during the last glaciation (Devensian in Britain) (*c*40,000 BP), temperatures were approximately 20°C lower than at the present day and ice sheets covered northern Europe. Between Britain and continental Europe a land bridge, due to a global reduction in sea level by approximately 100m, allowed the migration of plant and animal species into the ice-free tundra environment of south-east England. At approximately 16,000 BP, warmer and more arid conditions resulted in a global retreat of ice sheets and a rise in sea level. Deglaciation in Britain between 13,500 and 10,000 BP oscillated between warm and cold conditions, with profound effects on soils and vegetation. During the Windermere Interstadial, between 13,500 and 11,000 BP, summer and winter temperatures increased to approximately 17°C and 0–1°C (respectively), and soil development (eg raw-humus or rendzina-type; see Catt 1979; Kemp, 1986) provided conditions suitable for a succession of vegetation from open grassland to shrubland and finally birch woodland (table 1.1). A climatic deterioration between 11,000 and 10,000 BP (Loch Lomond Stadial) caused a return to periglacial conditions in southern Britain (eg fossil pingos at Elstead Bog), formation of arctic structure soils, colonization by shrub tundra vegetation, and a reduction in summer and winter temperatures to 10°C and −20°C (respectively). Geomorphic instability during the late-glacial to interglacial transition led to increased river discharge and sedimentation, changes in river morphology, and solifluction in lowland dry valleys.

Climatic amelioration during the early postglacial and the attainment of temperatures similar to those of the present day led by 9000 BP to the development of base-rich brown-earth soils (Catt 1979), a closed vegetation cover (first juniper and willow, followed by birch and pine, and finally hazel, oak, lime, elm and ash), and restoration of landscape stability (table 1.1). On river flood plains, mainly fine-grained sediments

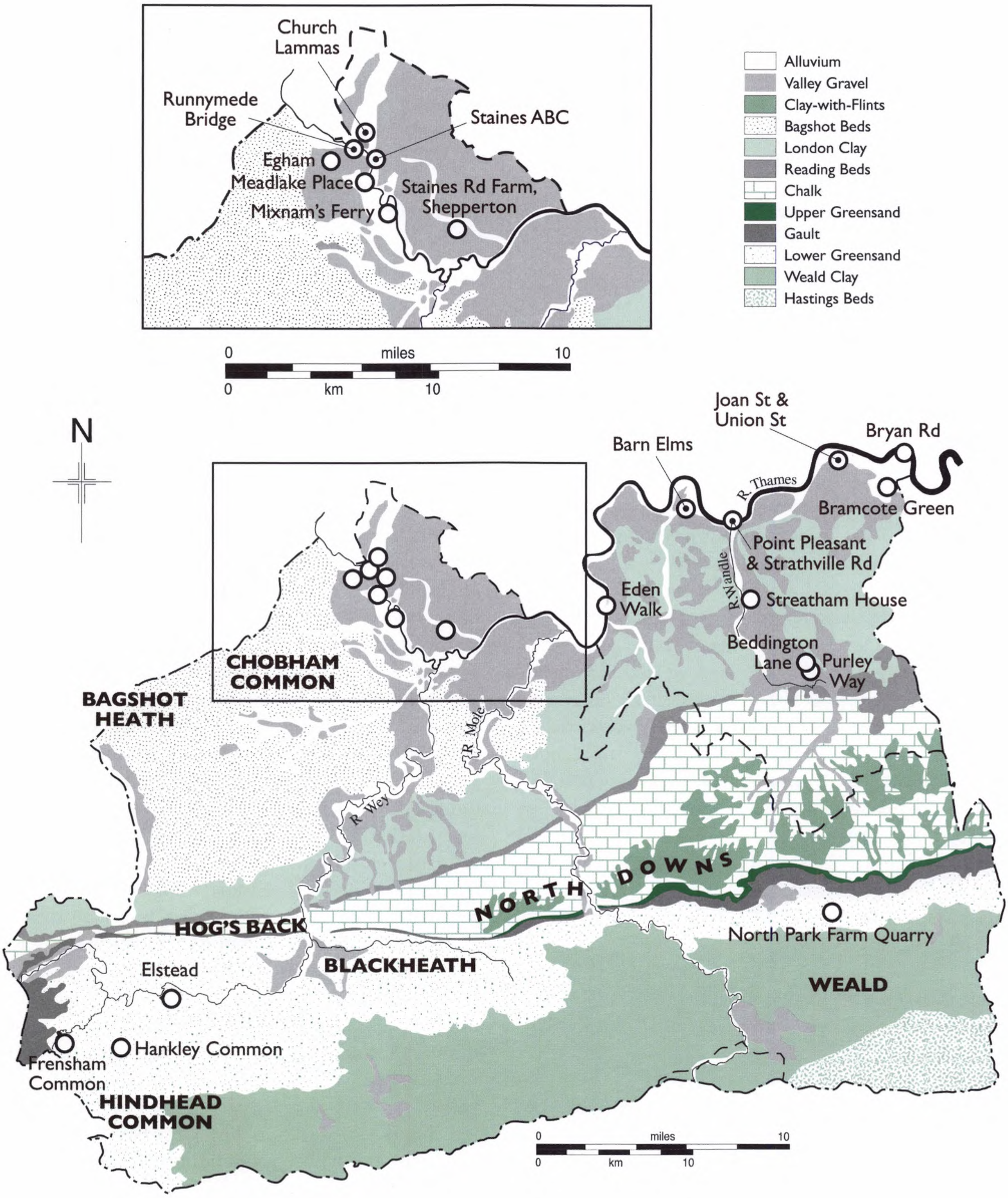

Fig 1.1 Geology of Surrey and location of main sites mentioned in the text

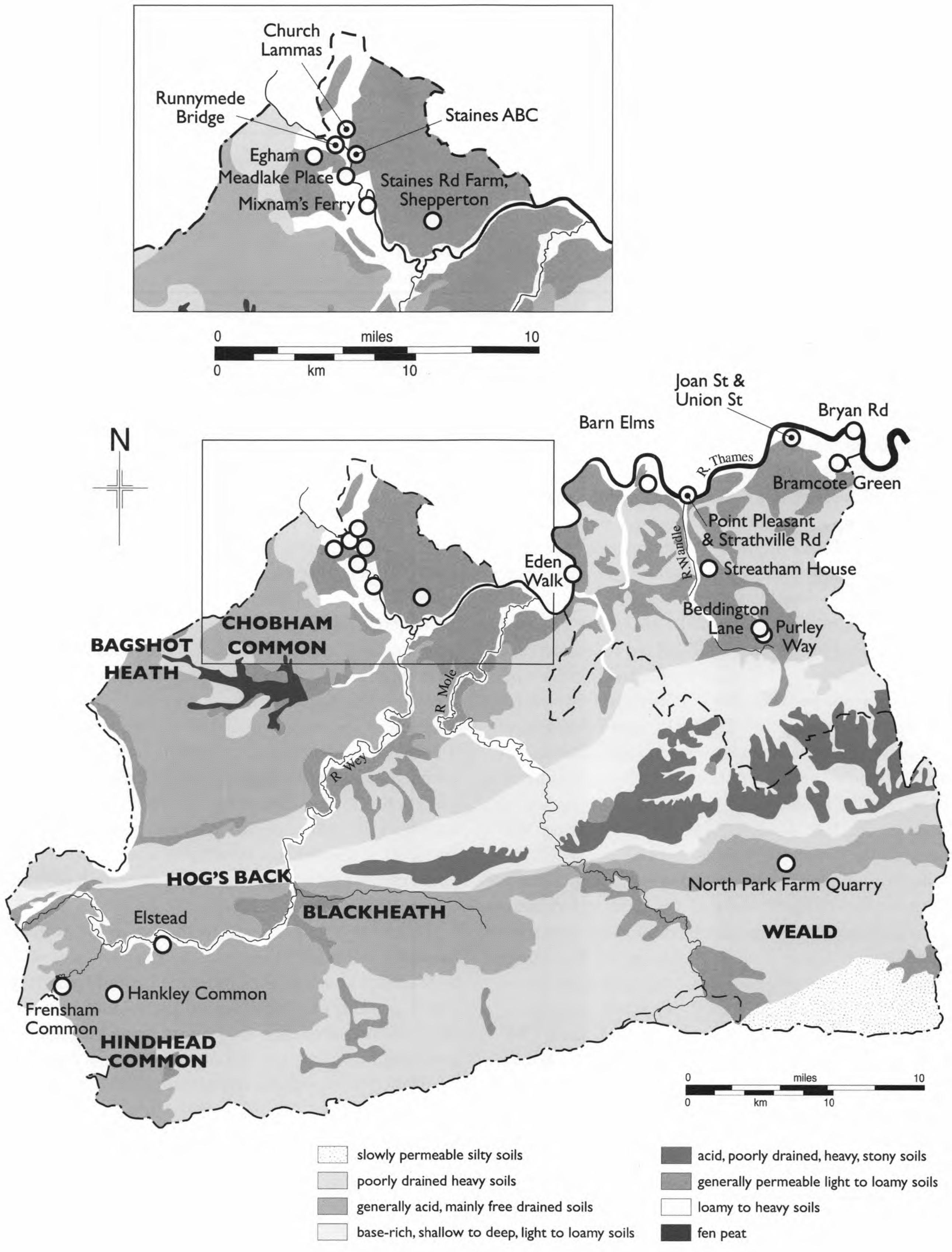

Fig 1.2 Soils of Surrey and location of main sites mentioned in the text

TABLE 1.1 Sequence of pollen zones and approximate ages of zone boundaries for sites in eastern and south-east England (after Bennett 1988, and Branch & Lowe 1994, respectively)

Bennett 1988	eastern England
Betula-Poaceae assemblage	*c* 12,000–9200 BP
Corylus/Tilia-Ulmus assemblage	*c* 9200–7400 BP
Alnus-Tilia assemblage	*c* 7400–6000 BP
Fraxinus assemblage	*c* 6000–4500 BP
Corylus/Myrica assemblage	*c* 4500–2000 BP

Branch & Lowe 1994	south-east England
End of the last glacial stage	>10,000 BP
Upper boundary of *Betula-Pinus-Artemisia* phase	*c* 10,000 BP
Pinus-Betula-Corylus/Myrica phase	*c* 9000–7200 BP
Lower boundary of *Tilia* phase and *Ulmus* decline	*c* 4500 BP *c* 5000 BP
Upper boundary of the *Fraxinus* zone and *Tilia* decline	*c* 3500 BP
Lower boundary of *Salix*-herb assemblage and start of major deforestation	*c* 2000 BP

were deposited or in some cases peat development was initiated. Similar deposits accumulated where lake basins had been created in former periglacial areas, and hydroseral succession led in many cases to the development of fen carr plant communities dominated by alder and willow. Within these early Holocene woodlands, archaeological and palaeoecological data indicate ample resources for human exploitation, including red deer (*Cervus elaphus*), aurochs (*Bos primigenius*), wild boar (*Sus scrofa*), hazelnuts, berries, fruit, fungi and rhizomes (Roberts 1989, 80).

The Climatic Optimum of the Holocene between approximately 8000 and 4500 BP led to an increase in temperatures by 1–2°C, and relatively drier and wetter periods between 8000–6500 and 6500–4500 BP (respectively). After 6500 BP, wetter conditions undoubtedly led to deterioration in soil status, and in lowland areas this was characterized by a continuum from 'argillic brown earth to brown podzolic soil to podzol' (Bell & Walker 1992, 100). During this period, the continuation of global sea-level rise following de-glaciation, and corresponding changes in the vertical displacement of the land, led to inundation of coastal areas, establishment of estuarine conditions in some areas and changes in the configuration of major river systems. According to Devoy (1979), sea level rose in the Thames estuary by approximately 1.3cm yr^{-1} between 8500 and 7000 BP, and 0.5cm yr^{-1} between 6500 and 5000 BP. In many parts of the lower Thames valley, rise in sea level and changes in river gradient during the Holocene led to the progressive burial of the valley floor by mainly fine-grained estuarine and fluvial sediments (D'Olier 1972; Devoy 1977, 1979). These near-surface sediments comprise 'an interbedded sequence of alluvial sediments, dipping and thickening markedly from west to east, collectively referred to as the Tilbury Alluvium' (Gibbard 1985, 33). Against this background of sea-level rise (table 1.2), five separate phases indicating a reduction or stabilization in sea level ('regression') have also been recorded, resulting in extensive formation of peat and wetland 'carr' woodland. This model of rising and falling (or stable) sea level has been used to explain the origin of numerous sedimentary sequences in the boroughs of Southwark and Lambeth, and is based on height above OD and radiocarbon chronologies (Tyers 1988). However such correlations must be viewed with caution, owing to the influence of local factors other than sea level on sediment accumulation in areas near the head of the estuary and further upstream (Rackham 1994, 195; Haggart 1995).

Following the transition to the Neolithic cultural period (*c* 5500 BP), there was a dramatic, and well-recorded, change in the landscape brought about by the incoming of domesticated plants and animals. Agricultural activities may have been based on a system of shifting cultivation, involving temporary clearance of woodland by burning and felling prior

TABLE 1.2 Age and altitude of Holocene (last 10,000 years) marine sedimentary sequences in the lower Thames estuary (Devoy 1977; 1979)

Phase	Radiocarbon date; metres OD		Radiocarbon date; metres OD
Thames I	8200; -25.5 to -13.2	to	6970; -8 to -12.5
Thames II	6575; -6.8 to -12.3	to	4930; -3 to -6.9
Thames III	3850; -1.9 to -6.7	to	2800; -1 to -2
Thames IV	2600; -0.8 to -1.8	to	?; +0.4 to -0.9
Thames V	~1700; +0.44 to -0.75		

to cultivation, abandonment and finally woodland regeneration. The typical duration of this land-use cycle has been difficult to establish, but estimates vary between 50–100 years (Iversen 1941) and 200–600 years (Smith 1970). The main pollen-stratigraphic indicators of shifting cultivation are cereals, plantains, elm, oak and hazel, which fluctuate in percentage values during the cycle. These changes in vegetation cover undoubtedly led to changes in soil status during the Neolithic and Bronze Age, possibly as a consequence of the progressive reduction in nutrients, and resulted in the formation of acid podzolic soils with more humus (Catt 1979). To what extent these changes were due to human activities is uncertain as there is good evidence for a general deterioration in climate to cooler and wetter conditions between 4500 and 3000 BP, with a reduction in temperature of 1–2°C. These climatic and pedological changes may have led to reduction in woodland cover, in particular of elm, lime and hazel and their replacement by grassland and heathland (table 1.1). Alternatively, there is evidence that the changes in vegetation cover were due to disease and human activity, and two of the most commonly cited factors are the asynchronous declines in elm and lime woodland. Both trees are strongly associated with pastoral economies and the gathering of leaves and lopping of branches for fodder and bedding. In addition, clearance of both trees would have been a prerequisite for cereal cultivation and, in the case of elm woodland, this activity may have accelerated the spread of elm disease.

During the later Holocene, archaeological and palaeoecological data indicate that 'the pace and direction of cultural evolution varied between regions' (Roberts 1989, 122). This resulted in regional variations in the timing of both vegetation change (eg lime woodland decline) and landscape change (eg accelerated erosion on the chalklands of southern England). In addition, patterns of cultural change were superimposed on, and responded to, fluctuations in climate. During the medieval warm period or Little Climatic Optimum (AD900–1300) summer and winter temperatures increased by 1–2°C to 16.5°C and 4°C (respectively). Following this relatively warm period, temperatures declined during the Little Ice Age (AD1300–1850) by 1–3°C below those of the present day, resulting in cooler summers, colder and wetter winters and increased storminess.

Lower and Middle Palaeolithic in Surrey

Lower and Middle Palaeolithic occupation in Surrey is recorded entirely in the form of stone artefacts and the environmental dimension of Palaeolithic archaeology is concerned with the contexts in which these artefacts are found, which is not necessarily a reliable indication of the environment in which they were made and used. The principal occurrences are in the terrace gravels of the river Wey near Farnham (Bury 1935; Oakley 1939) and as surface finds on the North Downs around Banstead, Kingswood and Walton on the Hill (Wymer 1968). The oldest artefacts are in gravels underlying Terrace A of the Wey. These sediments are thought to be the product of the Anglian cold stage (Gibbard 1985), and Wymer (1999) suggests that heavily rolled artefacts from this context may be of pre-Anglian age. Artefacts are also present in the lower terraces of the Wey (Terraces B, C and D), including Levallois material in Terrace C. However, none of this material was recorded in a primary context, and the gravels in which it occurs are all braided river sediments typical of those now generally regarded in southern Britain as having been deposited under periglacial climatic conditions. In Terrace D, from which Bury (1935) and Oakley (1939) record handaxes of 'Mousterian' type, faunal remains are present including mammoth and woolly rhinoceros and organic lenses and peat rafts containing a mollusc fauna and plant remains, all indicative of cold climatic conditions (Roe 1981). A radiocarbon date of 36,000 BP has been obtained from this organic material (Wymer 1999).

Upper Palaeolithic in Surrey (*c* 40,000–10,000 BP)

There are few detailed records of the environmental history of Surrey during the Upper Palaeolithic (late Devensian Lateglacial period). Records of Lateglacial vegetation succession associated with human activity (eg burning and the exploitation of animals) have been obtained from Church Lammas, Staines (figs 1.1 and 1.2; TQ 027 721; Jackson *et al* 1997, 211) and Staines Road Farm (figs 1.1 and 1.2; TQ 076 683; Bird *et al* 1989, 211), and provide a valuable insight into the environmental context of human activities during this period. The most complete radiocarbon dated palaeoenvironmental records are from Bramcote Green, Bermondsey (figs 1.1 and 1.2; TQ 349 780; -0.80m OD; Branch & Lowe, 1994) and Elstead Bog, between Farnham and Godalming (figs 1.1 and 1.2; SU 899 422; 54m OD; Seagrief & Godwin 1960; Carpenter & Woodcock 1981). They provide an opportunity to reconstruct and compare vegetation succession in the northern and southern parts of Surrey during this period (figs 1.3 and 1.4). Prior to approximately 11,000 BP (Windermere Interstadial) a calcareous lacustrine environment formed at Bramcote Green (table 1.3; fig 1.3) characterized initially by an open treeless landscape with willow and juniper (BEG2a) and then birch woodland (BEG2b and BEGa). Following this period the pollen records from Elstead

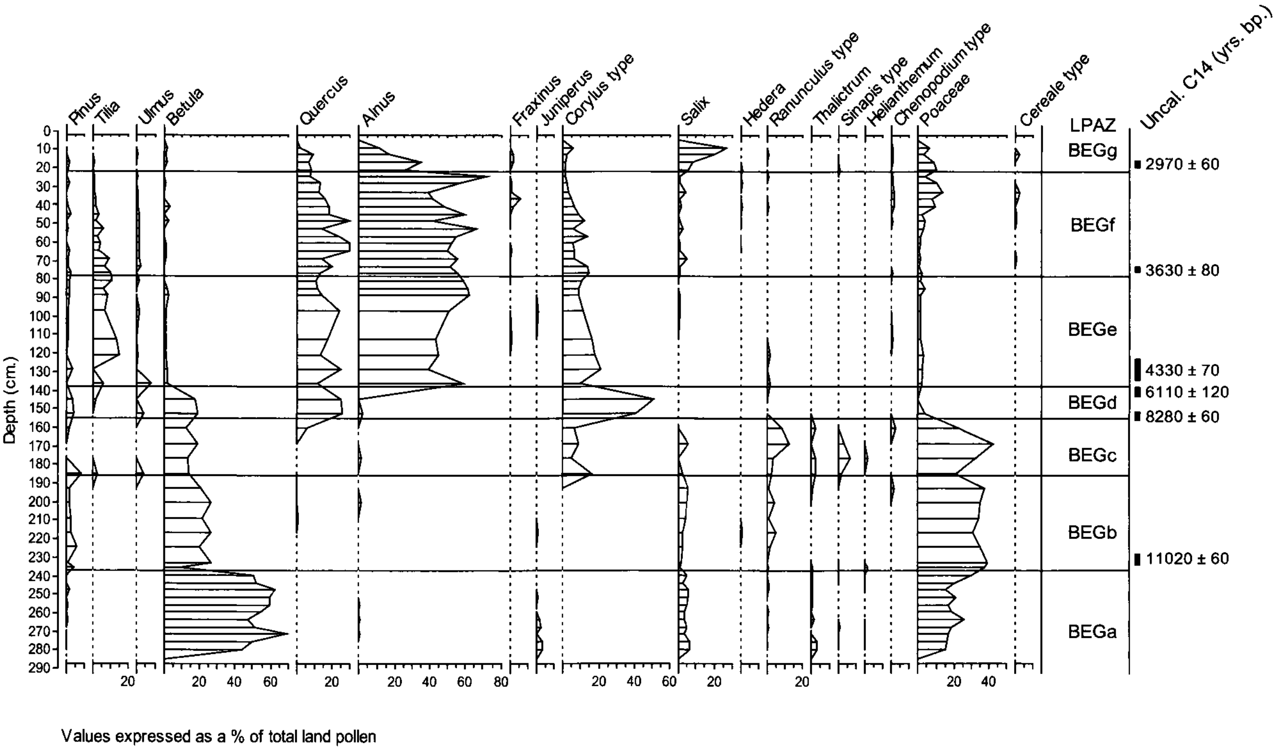

Fig 1.3 Selected taxa pollen diagram from Trench 1, Bramcote Green, London (Branch & Lowe, 1994)

TABLE 1.3 The sedimentary and pollen-stratigraphic sequence at Bramcote Green (Branch & Lowe 1994; Thomas & Rackham 1996)

Metres OD (approx)	Description	Main pollen types/Depth (cm) of local pollen assemblage zones
Trench 1		
-5.00 to -4.45	Dark olive green silt	
-4.45 to -3.18	Dark greyish brown fine calcareous silt with abundant whole shells, discontinuous laminations, some organic and woody inclusions	*Betula, Juniperus*, Poaceae/ BEGa 285–238
-3.18 to -2.38	Very dark brown/grey fine silt, becoming sandy towards base, with occasional organic fragments, some woody matter, occasional shells and rare sub-angular flint clasts	*Betula, Pinus, Artemisia*/BEGb 238–185 *Betula, Corylus, Ranunculus*/BEGc 185–158
-2.38 to -2.18	Black fine silt/clay with woody and fibrous organic matter	*Quercus*/BEGd 158–138
-2.18 to -1.78	Very dark grey/black organic silt/clay	*Alnus, Quercus, Tilia*/BEGe 138–165
-1.78 to -0.80	Black/reddish black peat, moderately humified	*Alnus, Quercus*/BEGf 65–20 *Salix*, herbs/BEGg 20–0
Trench 2		
-3.95 to -3.78	Light olive brown fine calcareous silt, darkening to black fine silt, frequent shell fragments and some faint laminations	*Salix*, herbs/BEG2a 180–168
-3.78 to -3.47	Light olive brown fine calcareous silt, with mottling, patches of laminations, shells and very infrequent organic remains	*Betula, Juniperus*, Poaceae/BEG2b 168–130
-3.47 to -2.78	Very dark brown to grey fine silts/dark yellowish brown sand, with some faint laminations, woody and fibrous organic material, sand and shells	Poaceae, Cyperaceae, herb/BEG2c BEG2c 130–120
-2.78 to -2.25	Yellowish brown sand, flint clasts and woody organic matter	
-2.25 to -2.15	Very dark grey clay, woody and fibrous fine organic matter	*Corylus, Alnus, Tilia*/BEG2d 20–0

Bog, a pingo basin (table 1.4; fig 1.4; EL1 and EL2), and Bramcote Green (BEG2c and BEGb) indicate a vegetation cover consisting of plants commonly associated with cold, harsh environments such as steppe tundra or semi-desert. The presence of short-turf grassland, tall-herb communities (*Helianthemum* (rock rose)), indicator species such as *Plantago lanceolata* (ribwort plantain), *Polygala* (milk-wort), *Polemonium* (Jacob's ladder) and *Koenigia* (Iceland purslane), and isolated trees and shrubs (*Betula, Betula nana* – dwarf birch and *Pinus*), is compatible with records from other parts of south-east England (Gibbard *et al* 1982; Gibbard & Hall 1982; Kerney *et al* 1982). This period may be equated with the Loch Lomond Stadial between 11,000 and 10,000 BP.

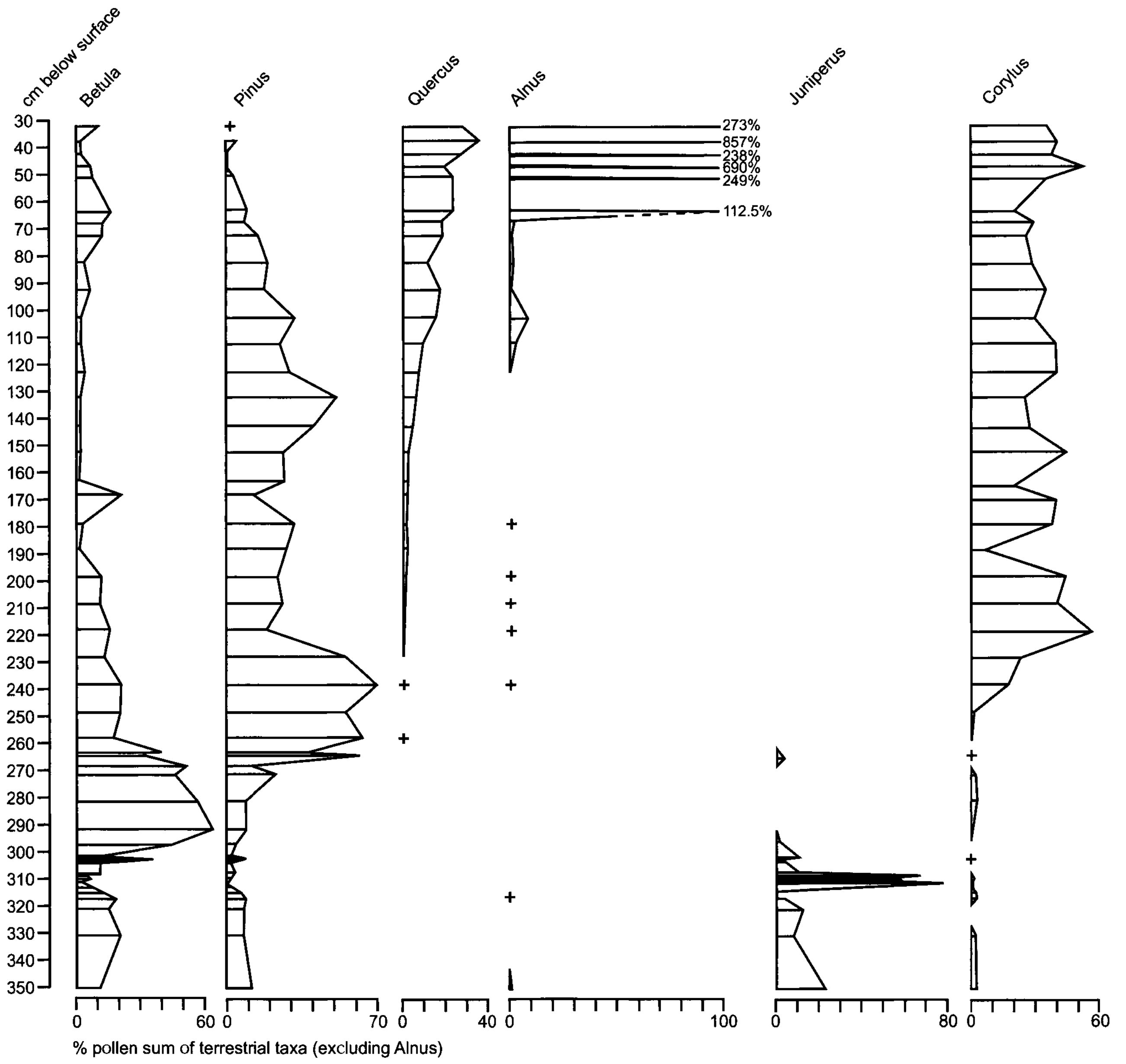

Fig 1.4 Selected taxa pollen diagram from Elstead Bog, Surrey (adapted from Carpenter & Woodcock 1981)

TABLE 1.4 The sedimentary and pollen-stratigraphic sequence at Elstead Bog (Carpenter & Woodcock 1981)

Cm below ground surface	Description	Main pollen types/Depth (cm) of local pollen assemblage zones
295–350	Basal sand and silt	*Juniperus* (juniper), *Empetrum* (crowberry), Ericales (eg heather), Herbs/ EL2 298–318 *Betula, Juniperus*, Poaceae, Cyperaceae/EL1 318–350
237–295	Coarse detrital mud with *Pinus* (pine) and *Betula* wood	*Betula, Pinus*/EL3 266–298
200–237	Detrital mud with wood	*Pinus, Betula*/EL4 222–266
163–200	Detrital mud with *Phragmites* (reed-swamp)	*Pinus, Corylus, Ulmus, Quercus*/EL5 146–222
67–163	Detrital mud with Cyperaceae (sedge) and *Betula* (birch) wood	*Pinus, Quercus, Ulmus* (elm), *Corylus* (hazel)/EL6 64–146
0–67	Highly humified detrital mud with wood	*Alnus* (alder), *Quercus* (oak), *Tilia* (lime)/EL7 0–64

Mesolithic in Surrey (*c* 10,000–5500 BP)

Locations of sites are shown in figures 1.1 and 1.2. Radiocarbon-dated palaeoenvironmental records for the Mesolithic period are confined to five key sites:

1 Bramcote Green (Branch & Lowe 1994; Thomas & Rackham 1996).
2 Elstead Bog (Carpenter & Woodcock 1981).
3 Meadlake Place (TQ 020 705; 14m OD; Branch & Green 2001).
4 Staines (TQ 031 715; 16m OD; Branch *et al* 2003a).
5 Runnymede Bridge (TQ 018 719; 16m OD; Needham 1992; Scaife 2000).

Several other sites have also provided important records of either human exploitation of natural resources, such as woodland and hazelnuts, or organic deposits within palaeochannels of Mesolithic age. These include:

a North Park Farm, Bletchingley (TQ 330 520; Branch *et al* 2003b).
b Hankley Common (SU 877 396; Reynier 2002, 226.
c Barn Elms, Richmond, with radiocarbon dates of 10,150 ±100 BP and 7500 ±150 BP.
d Point Pleasant (river Wandle, Wandsworth) with radiocarbon dates of 9410 ±160 BP and 7620 ±80 BP.
e Strathville Road (Wandle valley, Wandsworth) with radiocarbon dates of 9240 ±60 BP and 9270 ±60 BP.
f Streatham House, Merton, with radiocarbon dates of 9423 ±72 BP (Cowie & Eastmond 1997b, 120)

Unfortunately, these sites have so far produced little or no detailed palaeoenvironmental data.

In the middle Thames valley, sites at Staines, Meadlake Place and Runnymede Bridge, are underlain by sediments forming part of the Staines Alluvial Deposits, a stratigraphic unit that can be traced upstream as far as Pangbourne and downstream as far as the City of Westminster (Gibbard 1985), and almost everywhere overlies the Shepperton Gravel of Late Devensian age. The type-site for the Staines Alluvial Deposits is a palaeochannel fill at Mixnam's Ferry (figs 1.1 and 1.2; TQ 042 685; 14m OD), about 2.9km downstream from Meadlake Place (Gibbard 1985).

The entire sequence at Mixnam's Ferry (table 1.5) is of Holocene age and similar deposits have been described at Penton Hook (TQ 043 692; Cooper 1907, 1922; Howard 1952); Hythe (TQ 032 703; Gibbard 1985); and Bell Weir (TQ 016 721; Kennard & Woodward 1906). At Runnymede Bridge, Needham (1992) described a sequence of cuts and fills, all of which occurred at essentially the same altitude, and which predominantly comprise fossiliferous clayey silts. These sediments incorporate archaeological material of Mesolithic, Neolithic and Bronze Age date. A radiocarbon date from the base of this sediment sequence gives an age of 7790 ±80 BP. The Staines Alluvial Deposits in the Meadlake Place and Staines areas vary considerably in thickness. This is evident in the southern part of the section illustrated by Gibbard (1985, fig 45) based on boreholes along the route of the M25 motorway where it extends along the flood plain between the M3 intersection near Thorpe Green and the river Thames at Runnymede. The Staines Alluvial Deposits reach a maximum thickness of about 3.0m, but may be absent altogether where the underlying Shepperton Gravel comes to the surface. These variations reflect a pattern of channels and intervening bars forming the surface of the Shepperton Gravel. Although the deposits at Staines (table 1.6) are different from those at Mixnam's Ferry, they are also part of the Staines Alluvial Deposits. They overlie the Late Devensian Shepperton Gravel, and their Holocene age is confirmed by three radiocarbon dates located at the base, middle and top of the peat deposit (8960 ±54 BP, 12.05m OD; 8173 ±75 BP, 12.13m OD; 8172 ±46 BP, 12.25m OD). At Staines the sequence of peat overlain by largely un-fossiliferous silty clay suggests a position on the flood plain never affected by flow within, or even near, a river channel, either the river Thames or the river Colne.

TABLE 1.5 The sedimentary sequence at Mixnam's Ferry (Preece & Robinson 1982)

Depth (cm) below ground surface	Description
285–	Orange gravel and sand
275–285	Dark grey organic-rich silts with wood fragments (275–285cm: 8360 ± 100 BP, Q-2042)
265–275	Orange gravel and sand
210–265	Shelly silts and sands, some plant debris
205–210	Gravel
165–205	Shelly sand with several distinct organic seams up to 3cm thick
120–165	Dark grey organic-rich silts with wood fragments, hazel nuts, etc (135–145cm: 665 ± 55 BP, Q-2043)
70–120	Grey, well sorted current-bedded sand
0–70	Brown silty clay, mottled in places

TABLE 1.6 The sedimentary and pollen-stratigraphic sequence at Staines (Branch *et al* 2003)

Metres OD	Description	Main pollen types/Depth (metres OD) of local pollen assemblage zones
11.525–11.625	5Y5/2 olive; sandy, fine to medium gravel of sub-angular flint, becoming more clayey upward; scattered plant debris; acid reaction (calcium carbonate precipitate on clasts); diffuse contact	
11.625–11.695	5Y5/3 olive; fine to medium sand; acid reaction; diffuse contact	
11.695–11.835	5Y5/2 olive grey; predominantly fine sandy gravel of sub-angular flint with some well-rounded quartz, becoming more clayey upward; plant debris throughout; acid reaction; sharp contact	
11.835–11.945	5Y4/2 olive grey; sandy, silty clay with a few flint clasts at 11.915–11.925; structureless; abundant finely divided plant debris; *in-situ* (vertical) roots (1–2mm); numerous worm granules; vivianite; acid reaction in lower part, absent in upper part; diffuse contact	*Pinus*, Cyperaceae, Poaceae Staines 1 11.81–12.05
11.945–11.995	5Y3/2 dark olive grey; slightly sandy silt, passing up into well-humified peat *in-situ* (vertical) roots (1–2mm); no acid reaction; diffuse contact	
11.995–12.205	Peat; sharp contact (8960 ± 54 BP, 12.05m OD) (8173 ± 75 BP, 12.13m OD)	*Salix, Betula, Quercus, Ulmus* Staines 2 12.05–12.21
12.205–12.285	5Y2/1 black passing up to 5Y3/1 very dark grey; silt; structureless; very common finely divided plant debris; *in-situ* (vertical) roots (1–2mm) penetrating downward into peat; no acid reaction; diffuse contact (8172 ± 46 BP; 12.25m OD)	*Tilia, Corylus* Staines 3 12.21–12.28
12.285–12.485	5Y3/1 very dark grey mixed with 5Y3/2 dark olive grey; silt; structureless; no acid reaction; diffuse contact	*Alnus, Salix* Staines 4 12.28–12.38
12.485–12.725	5Y5/1 grey; silt; structureless; near-vertical root channels with iron-stained margins; Mollusca (*Bythinia*); acid reaction; diffuse contact	
12.725–13.315	5Y5/3 olive with patchy Fe staining and black (Mn) speckles; silty clay; structureless; molluscan shell debris, worm granules; acid reaction throughout; diffuse contact	
13.315–13.575	2.5Y4/2 dark greyish brown; stony, silty clay – clasts of weathered sub-angular flint; pottery, tile, brick, mortar	

The peat indicates terrestrial conditions with no input of mineral sediment during its accumulation, and the overlying silty clay suggests deposition from standing or very slow moving flood water. Considering the proximity of the site to both the Thames and the Colne, the lack of evidence for any in- or near-channel activity may seem surprising. However the position of the site between the two rivers is one where the Thames will have tended to divert the main current of the Colne eastward, away from the site, and the Colne will have tended to divert the main current of the Thames southward, away from the site. Thus although the site may have a long history of flooding represented in the thick layer of silty clay alluvium overlying the peat, it has never been occupied by the main channel of either river. The uppermost part of the alluvium seems likely, on the basis of flood plain elevations upstream and downstream from the site, to represent the historic surface of the flood plain prior to urban development.

The sediments recovered from Meadlake Place consist of sandy flint gravel overlain by organic-rich, fine-grained sediments and peat (table 1.7). These deposits are overlain by structureless silty clay in which there is evidence of pedogenic processes, and in which organic (plant) remains are scarce and finely divided. Although the overall geometry of the deposits was not recorded at Meadlake Place, the sediments are likely, by analogy with similar deposits nearby, to represent the fill of abandoned channels, cut into the underlying Shepperton Gravel. It seems probable that during the formation of the channels in which the finer-grained and organic sediments rest, the river was transporting gravel for at least part of the time. Since the radiocarbon dates obtained from the sequence at Meadlake Place indicate deposition in the Mesolithic, it seems likely that the river was reworking the underlying Shepperton Gravel in the early part of the Holocene, and either creating or reshaping a pattern of channels and intervening bars on the valley floor at that time. The radiocarbon date (*c* 9000 BP, 12.43m OD) obtained towards the top of the sequence in one of the channels (column T3) indicates that this channel was already largely filled in the Early Holocene. The later date (*c* 8160 BP, 10m OD) at a lower level in the fill of an adjacent, younger, channel (Borehole 2) may indicate that channels were being actively created and infilled on the valley floor during a period of at least a thousand years in the Early Holocene. Alternatively, both channels were already in existence at the beginning of the Holocene, but differences in the flow of water between channels discouraged fine-grained sedimentation or peat formation in some channels for a longer period in the Holocene. This alternative

TABLE 1.7 The sedimentary and pollen-stratigraphic sequence at Meadlake Place (Branch & Green 2001)

Metres OD	Description	Main pollen types/Depth (metres OD) of local pollen assemblage zones
Borehole 2		
9.00–9.35	5Y3/1 very dark grey; London Clay; numerous pyrite clusters visible under microscope; sharp contact	
9.35–9.74	2.5Y5/6 light olive brown (typical weathered London Clay colour); gravel with clayey matrix in lowermost part, becoming sandier upward and darker in colour (dark grey to black); sharp contact	
9.74–9.81	5Y4/2 olive grey and black organic sand; abundant shell debris; abundant plant debris; wood fragments including bark and root material, seeds, Mollusca including *Bithynia* opercula, fish bones, teeth and scales; sharp contact	
9.81–10.03	Woody peat; scattered shell debris; some mineral material (possibly intrusive); charcoal; insect remains; diffuse contact (10.01–10.03m OD; 8160 ± 50 BP)	
10.03–10.04	Dark grey to black peat; shelly sand; pebble (15mm) present; sharp contact	
10.04–10.06	Peat; diffuse contact	*Pinus, Betula, Quercus, Salix* Meadlake 1 10.10–10.55
10.06–11.07	Irregular alternations of peat and very shelly sand – shell present as debris only; no clear bedding; peat full of twigs and wood fragments; diffuse contact (11.00–11.07m OD; 5860 ± 70 BP)	*Quercus, Ulmus, Alnus, Salix* Meadlake 2 10.55–10.95
11.07–12	Peat; woody debris throughout; peat becoming slightly more humified above 11.75m OD; pockets of sand at 11.24m, 11.32m, 11.43m OD; pebbles at 11.42m and 11.79m OD; scattered mineral grains throughout, becoming less common upward, rare above 11.75m OD; clusters of iron oxide spherules present on woody debris; diffuse contact	Poaceae Meadlake 3 10.95–11.35 *Alnus* Meadlake 4 11.35–11.95
12–12.3	Humified peat – somewhat layered up to 12.15m OD, little layering apparent above 12.15m OD; diffuse contact	Poaceae, *Quercus, Salix* Meadlake 5 11.95–13.00
12.3–12.39	Peat with gradual increase in silt/clay content; discrete lenses of silt from 12.33m OD upward, giving mottled appearance; diffuse contact	
12.39–12.46	5Y5/2 olive grey; silty clay; faint darker mottling; diffuse contact	
12.46–13	5Y4/3 olive with 2.5YR4/8 and 5/8 mottles (red); silty clay; uppermost 15cm penetrated from above by worm holes filled with overlying made-ground material; uppermost 6cm incorporate snail fauna, charcoal, brick, coal	
13–14	Made-ground	
Borehole 3		
11.36–11.4	Dark grey; sandy flint gravel; dark colour associated with organic material; plant debris present as small (<1mm) pieces of recognizable plant tissue	
11.4–11.61	2.5Y4/4 olive brown; sandy flint gravel; recognizable plant debris throughout	
11.61–11.64	5Y4/2 olive grey; sandy clay; plant debris; interrupted by 0.5cm bed of calcareous, medium-fine sand with abundant plant debris; upper surface of sandy clay penetrated from above by vertical piece of wood (?root) that can be traced up from 11.63 to 11.76m OD	
11.64–11.69	Olive brown; coarse sand (cf 11.40–11.61m OD)	
11.69–11.79	5Y5/1 grey; sandy, silty clay; scattered plant debris; penetrated from above by vertical pieces of wood (?root *in situ*); slight acid reaction patchily throughout – one concentration of white sand with strong acid reaction	
11.79–11.9	Transition from silty clay deposition with abundant organic debris to peat with negligible mineral content; horizontal partings indicative of bedding	
11.9–12.37	Peat with negligible mineral content (if any) becoming more woody in uppermost 18cm	
12.37–12.41	Very dark brown to black; well-humified peat with small amount of mineral matter; structureless; sharp contact	
12.41–12.47	10YR4/2 dark greyish brown; peaty clay; finely divided plant material common in the lowermost 2cm, decreasing upward, but some large (15–20mm) fragments present; structureless; diffuse contact	
12.47–12.53	5Y4/2 olive grey and 10YR6/6 brownish yellow patchily mixed; silty clay; organic parting at 12.5m OD; scarce finely divided plant debris; structureless	
12.53–12.57	10YR5/1 grey and 10YR 6/8 brownish yellow patchily mixed; silty clay; very scarce, very small organic particles; structureless	
12.57–12.82	10YR5/1 grey with patches and faint mottles of 7.5YR5/8 strong brown; silty clay; structureless; scarce plant debris, almost all fine but a few larger pieces (2mm); very infrequent granules of flint and quartz in the uppermost 8cm	
12.82–12.99	10YR6/1 light grey with dense mottles of 5YR6/8 brownish yellow; silty clay; structureless; plant debris scarce and small	
12.99–13.35	10YR6/2 light brownish grey with scattered mottles of 5YR5/8 yellowish red; modern roots; structureless; slightly calcareous in the upper part where it interdigitates with made-ground	
13.35–13.95	Made-ground	

TABLE 1.7, *continued*

Metres OD	Description	Main pollen types/Depth (metres OD) of local pollen assemblage zones
Column T2		
12.07–12.27	Peat with gradual increase in silt/clay content; discrete lenses of silt upward, giving mottled appearance; sharp contact	Poaceae, *Quercus, Salix* Meadlake Column T2 1
12.27–12.44	5Y5/2 olive grey; silty clay; faint darker mottling (12.37–12.42m OD; 1920 ± 70 BP)	
Column T3		
12.07–12.16	5Y5/1 grey; sandy, silty clay; scattered plant debris; penetrated from above by vertical pieces of wood (?root *in situ*); slight acid reaction patchily throughout – one concentration of white sand with strong acid reaction; sharp contact	*Pinus*, Cyperaceae, Poaceae Meadlake Column T3 1
12.16–12.43	Peat with gradual increase in silt/clay content; discrete lenses of silt upward, giving mottled appearance; sharp contact	*Salix, Betula, Quercus, Ulmus* Meadlake Column T3 2
12.43–12.49	Wood (8960 ± 130 BP)	
12.49–12.57	5Y5/1 grey; silt; scattered plant debris	

suggestion is supported by a fossil assemblage towards the base of the sequence in Borehole 2 (9.74–10.00m OD) indicating the presence of well-oxygenated, running water and includes numerous fish bones, teeth and scales, and a Molluscan fauna with *Bithynia tentaculata.* The record from Meadlake Place demonstrates the presence of a stable flood plain for much of the Holocene. Peat formation seems to have begun in suitable places on the flood-plain surface at about 9000 BP, and to have continued until *c* 1920 BP (AD 90). The presence of sandy horizons and of freshwater Mollusca within the peat shows that the flood plain remained subject to intermittant flooding during this period, although the influx of mineral material and of shells appears to diminish upward and to cease altogether in the uppermost 30cm of the peat.

In the lower Thames valley, the palaeoenvironmental record from Bramcote Green indicates the formation of a substantial freshwater lake fringed by *Typha latifolia* (reedmace) and species of Poaceae (grass family). At Elstead Bog, the transition to the early Holocene was also characterized by the formation of an open freshwater lake and finally peat formation.

The palaeoenvironmental data from Staines (fig 1.5), Meadlake Place (fig 1.6), Runnymede and Moor Farm (Staines; TQ 027 725; 15m OD; Keith-Lucas 2000) record the following sequence of vegetation change in the middle Thames valley during the Mesolithic:

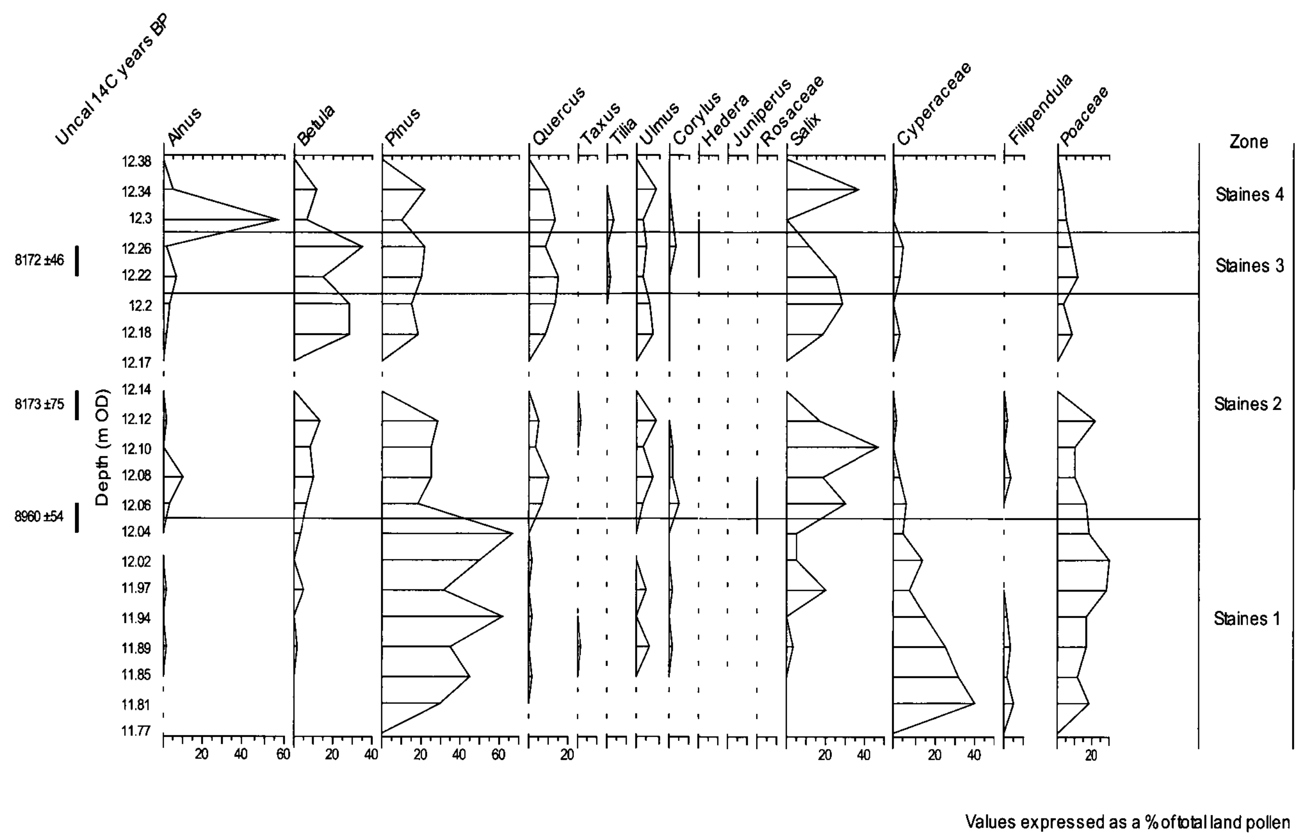

Fig 1.5 Selected taxa pollen diagram from Staines ABC Cinema, Middlesex (Branch *et al* 2003a)

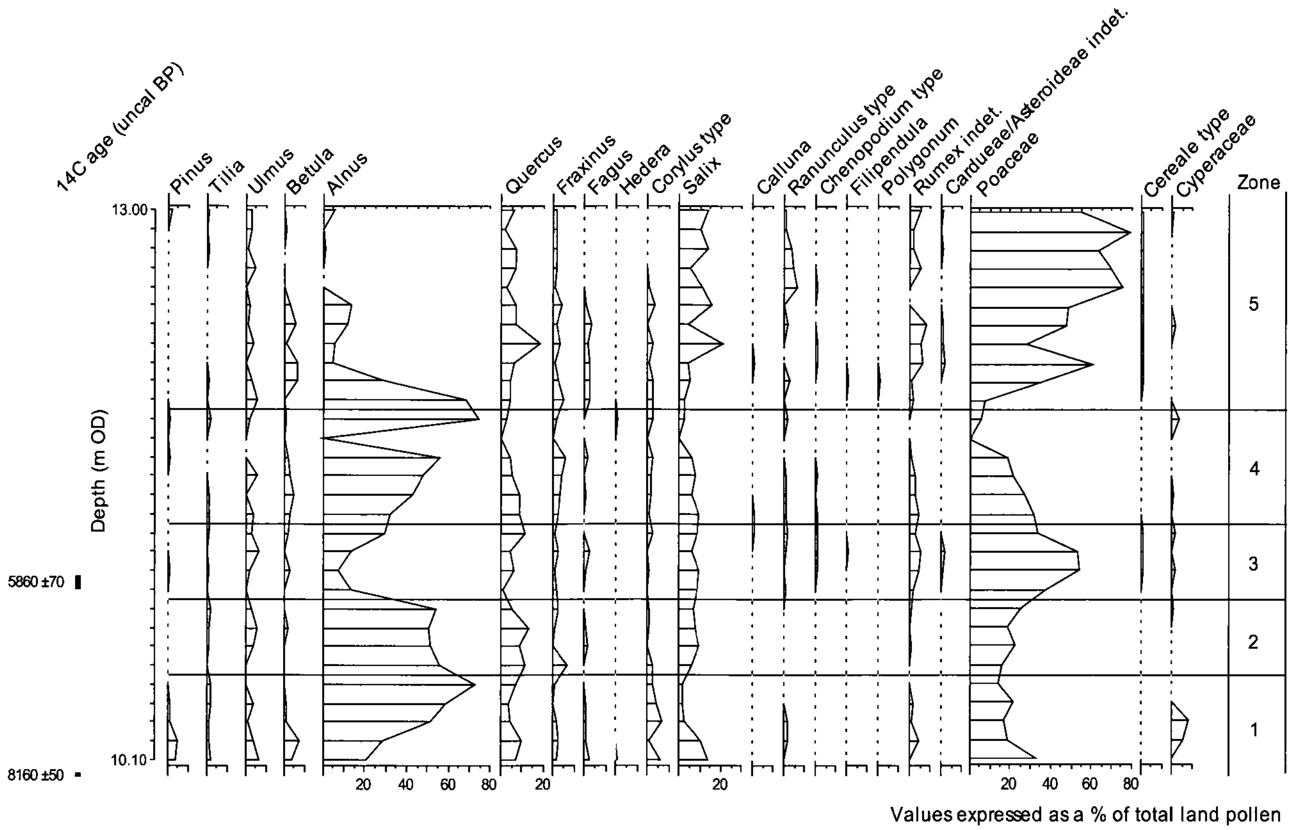

Fig 1.6 Selected taxa pollen diagram from Borehole 2, Meadlake Place, Surrey (Branch *et al* 2001)

a 10,000–9000 BP *Pinus* woodland dominated the surrounding dryland area (eg Staines 1, Meadlake T3 1). Sedge and reed-swamp initially colonized the wetland zones although this was gradually replaced by *Salix* woodland.

b 9000–8000 BP *Quercus*, *Ulmus*, *Betula* and *Corylus* invade the areas occupied by *Pinus* resulting in the formation of mixed deciduous woodland (eg Staines 2 and 3, Meadlake T3 2). The wetland zone was dominated by *Salix* woodland, although there is evidence for isolated trees of *Alnus*.

c 8000–5800 BP *Quercus*, *Ulmus*, *Tilia* and *Corylus* dominated the dryland vegetation cover (eg Staines 4, Meadlake 1 and 2). *Alnus* expanded in the wetland zone resulting in the formation of alder carr woodland.

d 5800–5500 BP Poaceae and a diverse range of herbaceous plant taxa expand during period in which arboreal taxa, such as *Quercus*, *Ulmus* and *Tilia*, indicate a temporary decline (Meadlake 3).

The reduction in arboreal taxa, presence of cereal pollen and microscopic charred particles, and indicators of disturbed ground, such as *Plantago lanceolata*, provides unequivocal evidence for clearance of woodland, probably by burning, and cultivation sometime during the Late Mesolithic–Early Neolithic transition. The temporary decline in *Alnus* woodland and evidence for deposition of mineral-rich sediments at Meadlake Place suggests that the activities of human groups during this period resulted in erosion and re-deposition of sediments and significant changes in the local hydrological regime. The palaeoenvironmental record from Elstead Bog is broadly similar to that of the middle Thames area, showing succession from aquatic plant communities (eg *Potamogeton* (pondweed)) and shrubland dominated by *Juniperus* (juniper) to mixed woodland with *Betula*, *Pinus*, *Corylus* and finally *Quercus*, *Ulmus* and *Tilia* (EL3–7).

At Bramcote Green, the composition and structure of the Mesolithic vegetation cover was broadly similar to that recorded at Elstead Bog, Meadlake Place, Runnymede Bridge and Staines. However, the sequence differs, with *Pinus* never achieving the dominance it attained in the Early Holocene at the other sites, possibly owing to the development of closed *Betula* woodland. The expansion of *Alnus* between approximately 8200 and 6100 BP is broadly similar to that recorded at Staines and Meadlake Place, although it is highly likely that *Alnus* was already present in both areas at 9000 BP, if not before (eg the presence of alder plant macrofossils at Bramcote Green corresponding to pollen zones BEG2c and BEGb). Finally, the pollen-stratigraphic data from Beddington Lane, Sutton (TQ 290 660) provides further confirmation of the presence of *Pinus*, *Quercus*, *Corylus* and *Alnus* woodland in Surrey during the Mesolithic (Heaton & Hearne 1992).

The record from Meadlake Place provides the only direct palaeoecological evidence for human activity during the Mesolithic period, and suggests that Late Mesolithic human groups were having a significant impact on the local environment during this period. The expansion of *Corylus* throughout Europe during this period has also been equated with exploitation of woodland resources (Smith 1970), and the find of charred hazelnuts at Hankley Common provides some support for this interpretation. However, Huntley & Prentice (1993) present an equally strong case for drier climatic conditions during the early Holocene initiating the expansion of *Corylus*. At Elstead Bog, a distinctive charcoal horizon at 68cm corresponds to a temporary reduction in woodland cover (*Betula*, *Pinus*, *Ulmus* and *Quercus*), and the expansion of heliophilous and fire resistant herbs and shrubs such as *Corylus*, *Artemisia* (mugwort) and *Filipendula* (meadowsweet). Although this may be due to human interference, the absence of any direct evidence for human activity at the site suggests that the vegetation changes are due to a natural event.

Neolithic in Surrey (*c* 5500–3800 BP)

The scarcity of palaeoenvironmental data for the Neolithic in Surrey limits any assessment of the impact of natural environmental change and the activities of human groups on the landscape. The pollen-stratigraphic records from the middle and lower Thames valley indicate that the dryland vegetation cover was dominated by mixed deciduous woodland, especially *Ulmus*, *Tilia* and *Quercus*, and that human interference in natural vegetation succession after 5000 BP resulted in temporary clearance of woodland for cultivation and pastoralism. In wetland areas, several sites indicate that *Alnus* carr woodland dominated the vegetation communities.

In the lower Thames valley, unequivocal evidence for a decline in *Ulmus* woodland has been obtained from:

a Bryan Road (TQ 799 365; Sidell *et al* 1995), radiocarbon dated to 5040 ±70 BP.
b Joan Street (Sidell *et al* 2000), radiocarbon dated after 5000 BP.
c Union Street (Sidell *et al* 2000), radiocarbon dated to *c* 4700 BP.
d Bramcote Green (Branch & Lowe 1994), radiocarbon dated to between 6110 ±120 and 4330 ±70 BP.

At Hampstead Heath, unique evidence for woodland clearance and cultivation prior to the elm decline may suggest that human activity accelerated the spread of elm disease through clearance (Girling & Grieg 1985; Girling 1988). However, compatible evidence from other sites is unfortunately lacking. At Bramcote Green, for example, there is no evidence for cereal cultivation prior to, during or immediately following the elm decline, which may suggest that it was due to the localized effects of hydrological change (eg fluvial inundation, BEGe; table 1.3) or to activities associated with pastoralism (gathering of fodder and bedding, and the creation of grazing land for animals; see Rasmussen 1989). At Bryan Road and Joan Street, however, there is unequivocal evidence for cereal cultivation following the elm decline. Sidell *et al* (2002) have suggested that these phases of clearance would have 'transformed north Southwark and Lambeth into a relatively open landscape' (*ibid*, 47). However, the pollen-stratigraphic records from all of the sites discussed above indicate that dryland areas continued to be dominated by *Quercus*, *Tilia* and *Corylus* woodland, with *Alnus* forming closed carr woodland on the flood plain and around ponds and small lakes. It is perhaps more appropriate to view the Early to Middle Neolithic landscape of the lower Thames valley around Southwark and Lambeth as being an ever changing mosaic of closed and open woodland, temporarily cultivated land, grazing land and meadows interrupted by tributary rivers and streams, small ponds and lakes. Indeed the evidence for woodland regeneration during the Late Neolithic and Early Bronze Age in some areas (eg Bryan Road) supports this interpretation.

In the middle Thames valley, pollen-stratigraphic records from Meadlake Place and Runnymede Bridge (Needham 1992; Scaife 2000) provide no evidence for a decline in *Ulmus* woodland. In these areas, the complete absence of palaeoecological evidence for Early–Middle Neolithic human activity tends to suggest that interference in woodland succession may have been of low intensity. Other evidence for human activities, including the exploitation of wild plants, comes from Purley Way, Croydon. Located on the flood plain terrace of the Wandle valley, the site provides evidence for a Late Neolithic cooking pit (3860 ±70 BP), a possible remnant of a Late Neolithic ploughsoil and exploitation of wheat, plum, hazelnut and domestic cattle. This range of palaeoenvironmental data is thought to provide evidence for woodland clearance in Croydon from the Late Neolithic (Tucker 1996, 13; see also Potter 1994). At Eden Walk in Kingston, the presence of red deer antler and horn core, and pollen data indicating the presence of *Alnus*, *Corylus*, *Tilia* and *Betula* and a decline of *Ulmus* clearly supports the records from Southwark and Lambeth (Penn *et al* 1984, 216–19). Although archaeological records for the Neolithic period west of Hammersmith (eg Brentford and Stanwell) indicate that the impact of human activities may have been extensive, very little palaeoenvironmental data is available (see O'Connell 1990; Cowie & Eastmond 1997a, b).

Bronze Age in Surrey (*c* 3800–2800 BP)

In the lower Thames valley, there is good palaeoenvironmental evidence for Bronze Age activities associated with, or in close proximity to, several low gravel islands (eg Horsleydown and Bermondsey eyots). Sedimentary successions overlying or adjacent to the islands indicate complex sequences of estuarine, lacustrine and fluvial sediments, and peat deposits. The most extensive peat unit has been correlated with a reduction/stabilization in sea level during the Bronze Age, and this is overlain and underlain by mineral-rich sediments (clay/silt) thought to represent overbank flooding within a tidal environment (Drummond-Murray *et al* 1994; Rackham 1994). At Bramcote Green (BEGf; table 1.3), pollen-stratigraphic records indicate the continued expansion of wetland vegetation dominated by *Alnus* carr woodland, and the presence of *Quercus*, *Corylus* and *Tilia* on nearby dryland during the Late Neolithic and Early Bronze Age. However, between 3600 and 2800 BP the pollen record from Bramcote Green indicates a progressive reduction in woodland. The decline of *Tilia*, followed by *Quercus*, *Corylus* and finally *Alnus* pollen coincides with the continuous presence of cereal pollen indicating a sustained period of cultivation. The diachronous decline in *Tilia* woodland from the Late Neolithic onwards and its direct association with clearance and cultivation are now well established. However, attempts to explain the decline as a consequence of climatic deterioration (Godwin 1956) or paludification (Waller 1994) have found some support. For example, the first lime decline at Union Street (*c* 4000 BP; Sidell *et al* 2000, 83–6) does not coincide with evidence for cereal cultivation but does occur during a period of peat accumulation. However, by 3000 BP pollen records from Bramcote Green (Branch & Lowe 1994), Union Street, Joan Street and Canada Wharf (Sidell *et al* 2002, 47–50) all indicate a reduction in woodland cover, including lime, with evidence for cereal cultivation. The evidence tends to suggest therefore several phases of clearance and regeneration over a period of approximately 2000 years. Archaeological evidence for Neolithic and Bronze Age plough (ard or nail) cultivation at Phoenix Wharf (dated to 3310 ±40 BP) and Wolseley Street (probably Late Neolithic) has provided important new information on prehistoric farming (Drummond-Murray *et al* 1994) that supports this interpretation.

In the middle Thames valley, evidence for clearance, creation of field systems, cereal production and agricultural intensification during the Late Bronze Age (*c* 3000 BP) is indicated by the archaeological and palaeoenvironmental evidence from Stanwell (O'Connell 1990). At Eden Walk, Kingston, palaeoenvironmental data indicate utilization of red deer, cattle, pig and sheep/goat (Serjeantson *et al* 1991–92, M73). These records are broadly confirmed by the pollen data from Meadlake Place that indicate, between approximately 5800 and 1900 BP, a reduction in *Quercus* and *Tilia* woodland and evidence for cereal cultivation. Therefore, exploitation of seasonally flooded areas on the margins of the river Thames at Meadlake Place and Runnymede Bridge undoubtedly occurred.

In other parts of Surrey, the evidence is equally compelling. Data from Ockley Bog, Thursley Common (Moore & Wilmott 1976) suggests that accelerated erosion occurred as a response to woodland clearance and may have led to the creation of the mire. According to the authors, two phases of clearance, abandonment and woodland regeneration (*Betula*, *Corylus* and Ericaceae (eg heather)) are recorded. Evidence for cultivation of nutrient-poor, podzolic heathland soils during this period is perhaps surprising, although pollen-stratigraphic data from Ascot supports this interpretation (Bradley & Keith-Lucas 1975). In Carshalton (Middleton Road), Croydon (Purley Way) and Sunbury (Vicarage Road) environmental archaeological data indicate clearance associated with field systems and the formation of grassland (Bird *et al* 1989, 216; Bird *et al* 1996, 201, 224).

Iron Age, Romano-British and later periods in Surrey (*c* 2800 BP onwards)

In the lower Thames valley, Sidell *et al* (2002) have conducted an exhaustive review of environmental change during the Late Bronze Age and Iron Age. These data suggest that from the Late Bronze Age (*c* 2900 BP) areas of Southwark and Lambeth on the margins of the river Thames were occasionally being inundated by estuarine mineral-rich sediments eg at Union Street. At Bramcote Green (Branch & Lowe 1994), a reduction in *Alnus* carr woodland from 2970 ±60 BP supports this broad environmental trend with evidence for fluvial inundation and saturation of low-lying soils. Contemporary developments on nearby dry land also indicate a reduction in woodland and the expansion of grassland and cultivation. There is a possibility therefore that extensive deforestation in the lower Thames valley catchment during the Late Bronze Age and Iron Age caused accelerated soil erosion and deposition of suspended sediment on the flood plain. Increased inundation of the flood plain would have resulted in a significant change in the morphology of the river margins and fluvial regime, possibly resulting in reversal downstream of the tidal head. Support for this interpretation may be found in the palaeoenvironmental data from other sites in Southwark and Lambeth, for example Joan Street and Union Street (Sidell *et al* 2000, 83–6). During the Late Iron Age and

Romano-British period archaeological evidence for field boundaries and drainage ditches in Southwark indicates attempts to reclaim low-lying areas, although the presence of fluvial or estuarine sediments overlying these features indicates that rising base levels may have led to their abandonment (Drummond-Murray *et al* 1994, 257). According to Heard (1996, 80) this evidence points to Southwark being part of a managed rural landscape, probably used for market gardening rather than cereal cultivation during the Roman period. However, during the medieval period archaeological evidence suggests that flooding may have led to the land being used for pasture or common land (Drummond-Murray *et al* 1994, 256). In other parts of the borough, there is certainly good evidence for animal exploitation (cattle, sheep and horse) during the Late Iron Age (Heard 1996).

To the south and west of Southwark and Lambeth there is similar Iron Age, Roman and medieval archaeological and palaeoenvironmental evidence for human activities. The evidence indicates farmsteads, ditched field systems, crop husbandry, crop processing (eg emmer wheat), stock breeding (eg cattle, pig, dog, horse) and gardening from East Twickenham, Isleworth, Brentford, Stanwell, Carshalton, Tolworth, Old Malden, Barn Elms and Croydon (eg Beddington sewage works) (O'Connell 1990; Potter 1994; Bird *et al* 1990; 1994; 1996; Cowie & Eastmond, 1997a; Greenwood 1997; Jackson *et al* 1997). However, the timing of woodland clearance and conversion of the landscape into arable or pastureland varies considerably. In Brentford (TQ 184 778), for example, Bishop (2002) records extensive clearance of the landscape during the late Iron Age with archaeological evidence indicating a 'transient community, possibly based around a livestock economy' *(ibid,* 8). During the 1st century AD, the development of a Roman field system for the growing of spelt, barley and possibly oats indicates the use of marginal areas on poorly drained soils for cultivation. It is questionable whether many of these low-lying areas would have been able to sustain arable farming for prolonged periods owing to the poor soils and increasing marshland development for which there is evidence during the late Roman and medieval periods (eg Kingston – Penn *et al* 1984, 219; Serjeantson *et al* 1991–92, 83–8; Croydon – Potter 1994, 235–6).

In the middle Thames valley, the palaeoenvironmental record from Meadlake Place indicates a transition from peat to structureless silty clay during the Iron Age and Romano-British period (table 1.7). The contact is gradual between 12.30 and 12.39m OD, with the mineral content increasing progressively upward. This silty clay unit resembles closely the silty clays that are widely encountered in midland and southern England forming the upper part of Holocene alluvial sequences. They are generally thought to reflect increased rates of soil erosion associated with intensification of agricultural activity from the Neolithic onward. At Meadlake Place this type of sedimentation does not appear to have become dominant until some time after the first century AD. During this period (Meadlake 5, Meadlake T2) the pollen-stratigraphic record provides evidence for a woodland reduction associated with clearance, probably including burning, and cereal cultivation.

At Frensham Common (SU 843 405), near Farnham, the discovery of a palaeosol associated with a buried artificial terrace by David Graham of the Surrey Archaeological Society allowed the reconstruction of vegetation change and land-use history during the late Iron Age and Roman period in this locality (table 1.8; Branch *et al*, 2002).

The age of the palaeosol was established by the excavation of silver and bronze coins, the majority of which date to the periods AD41–54 and AD138–161 (corresponding to the reigns of the emperors Claudius and Antoninus Pius respectively), although a few coins date to the Iron Age and later Roman period (D Graham, pers comm). Examination of the palaeosol revealed the presence of an acid brown earth overlain by a well-developed podzol. Immediately beneath the buried 'A' horizon, the high-resolution pollen record indicates the presence of open mixed deciduous woodland (*Quercus*, *Betula* and *Alnus*) with evidence for heathland, grassland and cereal cultivation (fig 1.7).

Within the buried 'A' horizon, three phases of vegetation succession have been identified:

TABLE 1.8 The soil and pollen-stratigraphic sequence at Frensham Common (Branch *et al* 2002)

Depth (cm) below ground surface	Description
0–12	'A' horizon; dark brown/black; 7.5YR 2.5/1; 2.9–46.6% organic matter
12–23.5	'Ae' horizon; brown; 7.5YR 5/6; 1–6.1% organic matter; sharp boundary
23.5–40.2	'Bh' horizon; dark grey; 5YR 4/1; 1.5–3.9% organic matter; charcoal; sharp boundary
40.2–53	'bAh' horizon; black; 7.5YR 2.5/1; maximum 4.7% organic matter; sharp boundary
53–63.5	'B' horizon; reddish brown; 5YR 4/3; 1–2% organic matter; sharp boundary
63.5–75	'C' (?) horizon; brown; 7.5YR 5/6; 1–2% organic matter; diffuse boundary

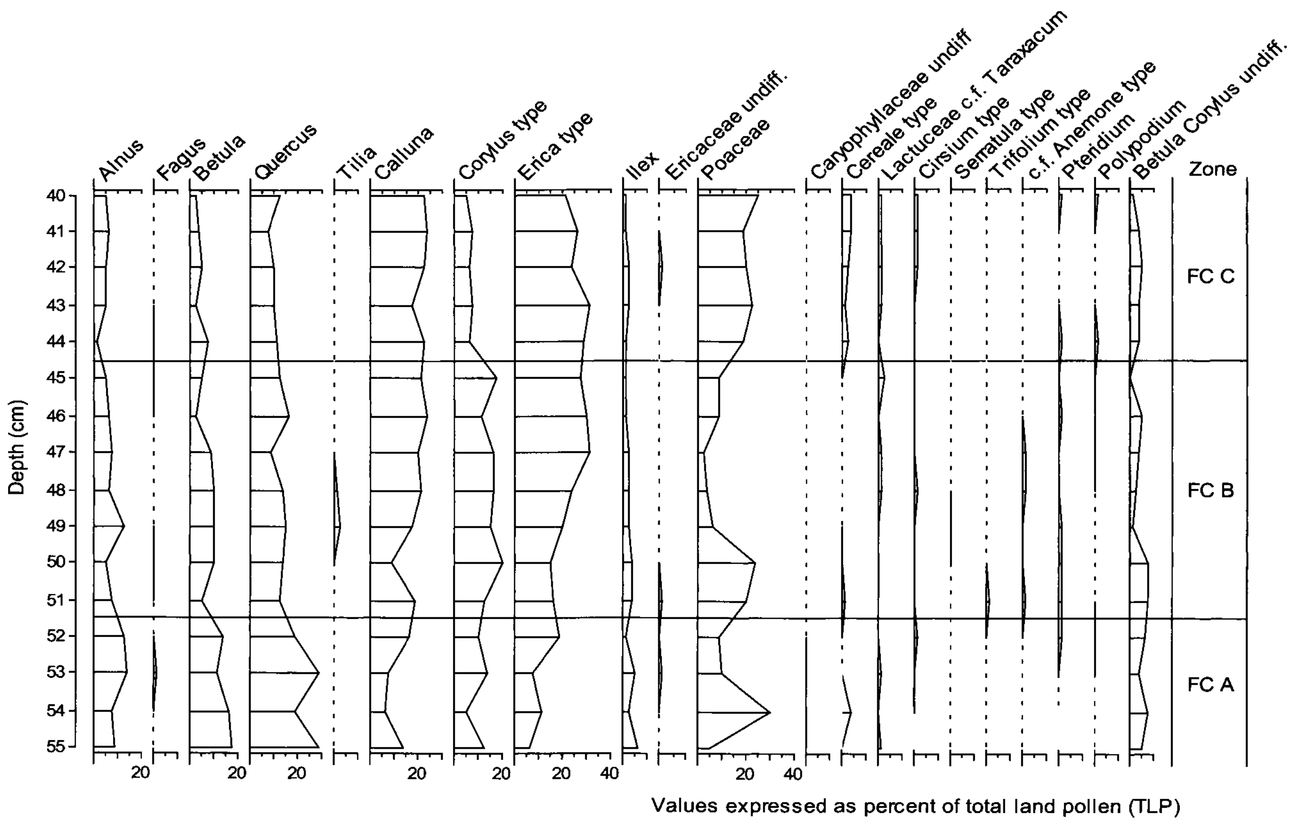

Fig 1.7 Selected taxa pollen diagram from Frensham Common, Surrey (Branch *et al* 2002)

a Heathland, shrubland (*Corylus*) and grassland expansion associated with burning of the vegetation cover and cereal cultivation.
b Heathland expansion and a cessation of cereal cultivation.
c Further evidence for cereal cultivation.

These results are entirely consistent with other records from south-east England that suggest that during the Iron Age and Roman period extensive woodland clearance and intensification of arable agriculture led to accelerated erosion and podzolization of soils (see Macphail & Scaife 1987).

An agenda for the future

If the palaeoenvironmental (including environmental archaeological) record in Surrey is to be enhanced, a major priority for the future is the formulation and initiation of a long-term programme of regional research (Environmental Archaeology Sub-Group 2001). This is necessary for two reasons:

- First, the future threat to the cultural and environmental resource from urban and rural development, and possibly environmental change, will lead to a loss of important information concerning the environmental context of human groups living in Surrey since the Palaeolithic. A research strategy will, by formulating thematic programmes of research, as well as highlighting geographical areas for which little or no information is available, enable archaeologists, planners and scientists to evaluate the impact of development and environmental change on the resource.

- Secondly, Surrey is a highly important geographical area because of its proximity to one of the world's best known river systems, its close relationship with London and its rich cultural heritage, its biogeographical importance with respect to the migration routes of flora and fauna since the end of the last glaciation, the diversity of geological and geomorphological contexts suitable for human settlement and land-use, and the richness of the cultural resource.

We recognize that, in order to achieve our goal, there is a need to collate and archive all the existing palaeoenvironmental data for the county. Storage and access of data from primary and secondary sources (such as excavation and post-excavation reports, and regional and sub-regional surveys, both published and unpublished) will be achieved using a geographical information system (GIS). The use of a GIS has the following advantages: it provides a digital archive; enables two-dimensional spatial modelling of the data to be carried out at various scales; provides a mechanism for layering of the data (temporal modelling); allows analysis of the data and the formulation of new research questions; provides a platform for future management of the environmental archaeological resource.

The wider implications of this approach will be to create a more integrated approach towards the sharing of information, archived records and medium to long term research plans; to raise the quality of the field and laboratory investigative work undertaken in Surrey, through shared facilities and experiences; to bring the environmental archaeology legacy of Surrey to a wider public forum; and to provide an opportunity to train colleagues in new methods of archiving data, managing the cultural resource and carrying out data analysis.

During compilation of the GIS database, a detailed palaeoenvironmental research agenda for Surrey will be formulated and new research programmes initiated. Access to new sites and the creation of new records will be conducted on a proactive (predictive modelling) and reactive (rescue excavation) basis (Environmental Archaeology Sub-Group 2001).

Based on the information contained in this chapter, two broad research themes can be suggested which require detailed morphological, lithological, biological and dating evidence, and full integration of the scientific and archaeological data:

- Understanding the effects of natural environmental processes (climatic, geomorphological, sedimentological, pedological and hydrological) on the activities of human groups.

- Understanding the effects of human exploitation of organic and inorganic resources on the natural environment (eg accelerated soil erosion and podzolization).

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