Impacts of hunter-gatherers on the vegetation history of the eastern vale of pickering, Yorkshire

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Impacts of Hunter-gatherers on the Vegetation History of the Eastern Vale of Pickering, Yorkshire.

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STAR CARR - KEY RESEARCH 1948-2002		
Basis of Publication	**Author/s**	**Key Findings/ Hypotheses**
Discovery	Moore (1950).	Star Carr discovered in Sept 1948, along with 9 other sites.
Excavations 1949-52	Clark (1949, 1950, 1954).	Important artefacts: well preserved bone points; stag antler frontlets; birch bark rolls and birch resin cakes; a possible paddle; potential birch platform. Wide range of fauna e.g. red deer and wild boar, but no fish bones. Occupation took place at margins of reed swamp <5 m from open water. Season of occupation= autumn/winter and spring Age: early Mesolithic, potentially c. 9557±210 ^{14}C yr BP (Q-14, Godwin and Wills 1959). Upper Palaeolithic long-blades also present. Interpreted as a seasonally-occupied hunting camp specialising in red deer.
Re-interpretation	Clark (1972).	After consideration of its wider context Star Carr was interpreted as a 'typical' early Mesolithic winter and spring base camp. Seasonally linked with North York Moors, following red deer migrations in the summer.
Re-interpretations	Caulfield (1978) ; Jacobi (1978); Wheeler (1978); Pitts (1979); Grigson (1981); Lister (1981); Andresen *et al* (1981); Price (1982); Coles and Orme (1983).	A hunting and processing camp/ site or a specialised activity area within a larger site (a toss zone?) Short-term but repeated occupation. Not a base camp. Red deer thought to be less important (not necessarily specialisation). Red deer move in small groups within woodland and therefore do not migrate. Crane bones demonstrate summer occupation in addition to the possible winter occupation. Thus unlikely to be summer links with North York Moors. Birch platform more likely to be due to beaver activity, due to gnawing marks. Lack of fish attributed to insufficient time for migration, following the end of the glaciation.
Re-analysis	Dergerbøl (1961); Klein *et al* (1983); Noe-Nygaarde (1975; 1977; 1988); Rowley-Conwy (1987); Legge and Rowley-Conwy (1988; 1989); Utchiyama (1996).	Presence of summer bird species confirmed. The rest of the data also supported definite occupation during the summer months and late autumn with occupation also potentially occurring during the winter. This last point nullifies the theory of summer links with the uplands. Consensus was that Clark's excavations did not encompassed the whole of the site and therefore it could not be interpreted as a base camp. Focus seems to be on hunting activities.

Table 1.1 Key Research Findings from Star Carr 1948-2002.

STAR CARR - KEY RESEARCH 1948-2002		
Basis of Publication	**Author/s**	**Key Findings/ Hypotheses**
Excavations 1985-86	Schadla-Hall (1988, 1990); Lane (1998); Cloutman and Smith (1988); Mellars and Dark (1998).	Peat had shrunk by c. 2 m. Trench A contained fairly well preserved zone of worked timber associated with flint, bone, charcoal and a barbed point. Earliest planked wood in the world. Activity area much larger than previously envisaged and extends onto eastern promontory. Trench A thought to be synchronous with Clark's site. Charcoal horizon dated to c.9600 ^{14}C yr BP and ends c.9300 ^{14}C yr BP.
New research/analysis	Dumont (1988, 1989a, 1989b); Mellars (1990); Clutton-Brock and Noe-Nygaarde (1990); Day (1996b); Carter (1997); Aveling and Heron (1998).	Microwear analyses show that flint was used for a wide range of economic and industrial activities including a strong wood working component, butchery and working of skins and antlers. Radiocarbon plateau identified at c.9600 ^{14}C yr BP. Isotope analysis of dog bones interpreted as showing links with the coast (despite absence of fish). Isotope analysis of plant remains from a hard water lake could explain previous findings, thus no coastal links necessary. X-ray analysis of roe deer jaws suggest most deer were killed when 10-11 months old. Thus most roe deer killed in March or April— ∴ spring occupation . Analysis of birch bark resin cakes suggest collected in Late April/early May.= late spring or early summer. At least some fish e.g. pike and eel, are likely to have been present in the lake in the early Mesolithic.
Excavations 1989-92	Day and Mellars (1994); Mellars and Dark (1998); Various authors in Mellars and Dark (1998).	All together excavations have revealed 191 barbed points. Site interpreted as a hunting stand with some butchering activities- based on faunal evidence. Interpretation of site is still unclear based on all available evidence e.g. Base camp? Hunting camp? A sterile zone was identified to the east of Clark's original site. Thus there are 2 different sites- i.e. Clark's site and site at Trench A. The palaeoenvironmental analyses in particular, have revealed a huge amount of information: Absolute dates were obtained by successfully 'wiggle matching' the c.9600 ^{14}C yr BP radio-carbon plateau using palaeobotanical remains. There were 3 possible 'phases' or concentrations of activity c.10920-10840 cal BP, c.10740-10610 cal BP and c.10,400-10,150 cal BP. Clark's site is younger than Trench A, with a significant part of the occupation c.9400-9100 ^{14}C yr BP. Possible all year round activity identified using faunal and botanical evidence. Coastal links now suggested 'on *a priori* grounds' (Mellars and Dark 1998:235).

Table 1.1 (continued) Key Research Findings from Star Carr 1948-2002.

RELEVANT ARCHAEOLOGICAL EXCAVATIONS - KEY FINDINGS		
Late Upper Palaeolithic- Flixton Island		
Site Name	**Key Research Findings**	**Age of Occupation/s**
Flixton 1	Located on a low island . Worked flints and several fragments of worked bone, thought to be contemporary with Windermere Interstadial deposits. At least three horse jaws- therefore an open grassland environment. Thus, humans were present in the Vale (at least briefly) during the Windermere Interstadial. The density of finds at Flixton 1 exceeds that of Star Carr—may have been a very significant site or used over a long time span.	Late Upper Palaeolithic $<13\ 000\ ^{14}C$ yr BP but $>9790\pm180\ ^{14}C$ yr BP
Flixton 2	Located on edge of a low clay/gravel island . Remains of at least two horses and one worked flint within a Windermere Interstadial deposit sealed by Late-glacial solifluction. Radiocarbon dating of one of the bones gave a date of $10,413\pm210\ ^{14}C$ yr BP (Q-66). Thus also potentially places humans within the Vale at this early date. Excavations in the 1990s served to demonstrate how much the water table had fallen over the last 40 years as the previously waterlogged deposits had now dried out.	Late Upper Palaeolithic c. $10,413\pm210\ ^{14}C$ yr BP
Late Upper Palaeolithic- Seamer Carr		
Site K	A small scatter of flints sealed beneath aeolian (late-glacial) sand. Flint was characteristic of lithics from the Late Upper Palaeolithic era and was associated with a stone lined hearth and some poorly preserved bone fragments. First Upper Palaeolithic open site to be found in Northern England – '*in situ*' knapping incident. Four radiocarbon dates placed it between c. 10,200-11,300 ^{14}C yr BP (Schadla-Hall 1987a). Additional ^{14}C dates from the bottom and top of the Windermere Interglacial peat place it within the period $12,010\pm130$ BP (CAR-842) to $10,960\pm110$ BP (CAR-841) (Cloutman 1998b), but may be slightly older.	Late Upper Palaeolithic 1 phase, sometime between c. 10,200-11,300 ^{14}C yr BP
Site L	A scatter of c. 10 long-blade flints to the north-west of Site K, possibly associated with the Upper Palaeolithic activity at K. A horse mandible was dated to $9790\pm180\ ^{14}C$ yr BP (BM-2350), which if correct, is the latest example of horse in Britain, just before its postulated extinction (Clutton-Brock and Burleigh 1991).	Late Upper Palaeolithic / Early Mesolithic $\geq$ c. $9790\pm180\ ^{14}C$ yr BP

Table 1.2 Summary of Relevant Archaeological Excavations

RELEVANT ARCHAEOLOGICAL EXCAVATIONS - KEY FINDINGS		
Early Mesolithic- Seamer Carr		
Site Name	**Key Research Findings**	**Age of Occupation/s**
Site C	Located on the northern lake edge. Site C was at the margin of fen carr/reedswamp, approx. 50 m from open water. One stone lined hearth and several burnt scatters of flint suggestive of hearth areas. The knapped flint was obtained from either the Wolds or local till deposits and was indicative of several temporally discrete activities. Faunal remains were fragmentary but had been clearly butchered or chopped (Clutton-Brock 1981). Horse = open grassland; Wild pig = woodland. Occupation occurred in two phases at 9800 ^{14}C yr BP and 9400 ^{14}C yr BP (Lane 1998). Also some backed blades which may be Upper Palaeolithic.	Early Mesolithic At least two phases: c. 9800 ^{14}C yr BP and c. 9400 ^{14}C yr BP and possibly some Upper Palaeolithic occupation
Site D	Appears to have been an isolated knapping episode. The postulated event took place on a small island during the early Mesolithic just to the south-west of Site C. Dates to between c. 9600-9300 ^{14}C yr BP -based on stratigraphy. Cache of tested pebbles—∴ aiming to return to the site or territorial marker? (Conneller 1997; 2000a, 2000b).	Early Mesolithic 1 event sometime between c. 9600-9300 ^{14}C yr BP
Site K	Not fully excavated. At least 3 or 4 stone-lined hearths with related flint and 3 small circular pits about 30 cm in diameter but with no structures. Fragmented faunal remains included domestic dog, horse, aurochs, roe deer and red deer. Flint composition also differed to that found at Site C, suggesting a difference in site function. Located on the edge of a kame along the eastern edge of a lagoon on the north side of the lake. Occupation was at the margin of fen/reedswamp at some distance from open water, edge of a seasonally flooded area? Occupation occurred intermittently over approximately 400 years c. 9950-9550 ^{14}C yr BP. The domestic dog remains were dated to 9940±100 ^{14}C yr BP (Ox-1030). On the basis of the ^{13}C/^{12}C isotope ratios Clutton-Brock and Noe-Nygaarde (1990) suggested that the dog had a diet of mostly marine food –thus settlement movement between the coast and the lake. However, Day (1996b), revealed that the ^{13}C/^{12}C isotopes from the dog bones could just as easily be explained by a diet of predominantly freshwater fish or plants.	Early Mesolithic Intermittent over 400 yrs c. 9950-9550 ^{14}C yr BP.

Table 1.2 (continued) Summary of Relevant Archaeological Excavations

RELEVANT ARCHAEOLOGICAL EXCAVATIONS - KEY FINDINGS		
Early Mesolithic:- The rest of the northern lake edge		
Site Name	**Key Research Findings**	**Age of Occupation/s**
Manham Hill –	Moore's site 6, located 150 m to the east of Site C on a kame hill . Early Mesolithic flints. No faunal remains due to drainage of the peats.	Early Mesolithic
Early Mesolithic:- The south-western lake edge		
Site Name	**Key Research Findings**	**Age of Occupation/s**
VP88D	Very poor preservation of bones.-no statistics were compiled for the assemblage due to their degraded state. Density of finds was higher than even Star Carr or Flixton 1 (Lane 1998) –concentrated and spatially localised ∴ was a significant site/or used over a long time. Range of fauna-roe deer, red deer, elk, wild cattle, wild cat, wild pig. Wild pig = woodland. Bones had 'all the characteristics of settlement debris' as a result of butchering or bone processing (Legge 1989:2). A beach pebble was found amongst the lithics (Conneller 2000a, 2000b) - ∴links with the coast	Early Mesolithic
VP86E	Small site just 150 m to the south-east of VP88D. Positioned on south-western side of narrow promontory projecting eastwards into the lake. 2 discrete scatters of flints. No dates as no faunal remains.	Late Upper Palaeolithic
Later Mesolithic or later – all lake areas		
Site K, Site D, Site B Site F, Barry's Island Flixton School Lingholme Farm	Later Mesolithic and/or Neolithic activity has also been identified at these sites. Site K – later Mesolithic microliths associated with a possible arrow shaft made of poplar/willow (Lane 1998:35).	Later Mesolithic and/or Neolithic

Table 1.2 (continued) Summary of Relevant Archaeological Excavations

PALAEOENVIRONMENTAL RESEARCH – KEY FINDINGS 1948-2002	
Publication	**Outline of Research/Key Findings**
Moore (1950)	Sediments were a result of sedimentation within in a glacial lake and had been interrupted by a period of intense cold (late-glacial).
Walker and Godwin (1954)	A sequence of stratigraphic transects across various parts of the western basin provided a general description of the deposits. Analysis of several pollen profiles from various locations in the area (see Figure 1.7) allowed a broad environmental reconstruction and established a rough chronology for the occupation at Star Carr and Flixton 1. No human related disturbance episodes were discovered but no charcoal analyses were undertaken.
Cloutman (1988a)	Produced a detailed sub-surface contour and palaeo-environmental survey of the north-western and western part of the basin. These stratigraphic results are very useful in setting out with precision, certain lake and vegetational boundaries at different times in the Flandrian. The lake progressively infilled throughout the early Holocene following a natural hydrosere, with the ancient course of the River Derwent being the last to infill. However at c. 7000 ^{14}C yr BP there was a rise in the water table resulting in the replacement of fen carr by reed swamp.
Cloutman (1988b)	A 3-Dimensional study of the palaeoenvironments at Seamer Carr. At the end of the Windermere, open water reached to the lake edge and the environment was relatively open e.g., at Site K. The late-glacial was characterised by intense solifluction and hillwash and sedimentation in the lake was purely composed of marls and minerogenic material. . At the beginning of the post-glacial the environment was still relatively open with incomplete tree cover but by c. 9800 ^{14}C yr BP *Phragmites* was beginning colonise the lake edge and birch, aspen and male fern formed the main terrestrial vegetation. By c. 9650 ^{14}C yr BP the water level in the basin was likely to be in the range of c. 23.0-24.5 m OD and the environment was mostly composed of fen carr woodland with reed swamp fringing the open water. By c. 9300 ^{14}C yr BP the areas of open water were significantly reduced and the areas of fen (mainly birch and willow) had expanded. By c. 9000 ^{14}C yr BP there were large expanses of fen carr at Seamer. Oak appears to have expanded relatively late at several locations at Seamer, with populations absent or insignificant until the alder rise. At Seamer Carr there is a thick band of highly humified acid peat full of microscopic charcoal, dated to c. 6680±90 ^{14}C yr BP (CAR-894) to c. 5550±90 ^{14}C yr BP depending on the site location, which could be linked to an anthropogenic increase in alder (Smith 1970, 1984). However, these analyses demonstrated no appreciable modification of the environment by early Mesolithic hunter-gatherers, but then charcoal analyses were not used.

Table 1.3 Palaeoenvironmental Research in the Vale of Pickering - 1948-2002.

PALAEOENVIRONMENTAL RESEARCH – KEY FINDINGS 1948-2002

Publication	Outline of Research/Key Findings
Cloutman and Smith (1988)	A 3-Dimensional study of the palaeoenvironments around Star Carr. At c. 9650 ^{14}C yr BP there was a large area of reed swamp and a narrow fringe of carr around Star Carr although open water was close to the dry land in places. Birch, aspen and male fern formed the main terrestrial vegetation. During the early Mesolithic occupation, the water level in the basin was likely to be in the range of c. 23.0-24.5 m OD. By c. 9300 ^{14}C yr BP the areas of open water were significantly reduced and the areas of fen (mainly birch and willow) had expanded. These analyses were not able to demonstrate any appreciable modification of the environment by the early Mesolithic hunter-gatherers. This is despite taking a pollen profile from the archaeological trench VP85A at Star Carr, adjacent to the wooden platform which lay directly above a discrete charcoal horizon. However, no charcoal analyses were undertaken.
Innes (1994) Research was undertaken before the research by Day (1993) but the results were not published until later.	Flixton :- re-analysis of Flixton 1 and Flixton 2. Concluded that preservation levels within the peats had deteriorated over the last 30 years but that the peat had become compacted rather than truncated. Flixton 1 (Flixton 1035):- No evidence for early Mesolithic activity but does show the creation of later Mesolithic woodland openings c. 8200 ^{14}C yr BP and c. 7000 ^{14}C yr BP. Woodland clearances may also have caused the deposition of wind blown sand c. 7000 ^{14}C yr BP. Flixton 2 (AK87) :- Deposition commences at c. 10,275 ^{14}C yr BP at the start of the regional rise in birch and ends at the alder rise, presumably c. 7000 ^{14}C yr BP. At Flixton 2 the alder rise is significantly associated with an increase in ruderals e.g. *Plantago lanceolata* and *Pteridium.* VPCG:- Pollen diagram spanned the period c. 9800 ^{14}C yr BP to c. 8800 ^{14}C yr BP and traversed a stratigraphic horizon that included Mesolithic flints located directly below a thick charcoal layer. Pollen analysis suggested the charcoal was associated with a rise in hazel and the occurrence of *P. lanceolata* and other weed species. This potentially provides information on the link between the rise of hazel and human activity as *P* well as providing possible indications of vegetational response to human occupation. VP88D:- Regrettably preservation at the site was so poor that pollen levels were uncountable and no environmental evidence could be determined.
Summary of Research 1954-1992	Up until the late 80s there was no definitive palaeoecological evidence for early Mesolithic human modification of the environment at Star Carr or any of the sites nearby, despite the results of research into the Mesolithic elsewhere by other authors e.g. Smith (1970); Edwards (1989); Behre (1986).

Table 1.3 (continued) Palaeoenvironmental Research in the Vale of Pickering - 1948-2002.

PALAEOENVIRONMENTAL RESEARCH – KEY FINDINGS 1948-2002	
Publication	**Outline of Research/Key Findings**
Day (1993)	Combined pollen, charcoal, macrofossil and sedimentological investigating the effects of human activity during the occupation layer at Star Carr. Using pollen samples estimated to represent 2-4 years in depth she investigated vegetation change in much more detail than achieved during any previous studies. Preliminary results revealed small time scale fluctuations in the woodland and lake edge vegetation which were associated with periods of archaeological activity. Peaks in macro and microscopic charcoal roughly correlated with dips in the frequency of male fern (*Dryopteris filix-mas*) and increases in birch (*Betula*) and grasses (Poaceae). This was provisionally interpreted as human impact at the time of the timber platform (9640±70 ^{14}C yr BP, OxA-3349). This was followed slightly later by an episode of mineral inputs into the lake, suggesting that at some point disturbance was significant enough to have caused soil destabilisation. Human activity is postulated to have disturbed stands of male fern and created areas of bare soil. This provided the opportunity for grasses and birch seedlings to colonise the newly created areas.
Day and Mellars (1994)	Radiocarbon plateaux at c. 9600 ^{14}C yr BP and c. 10,000 ^{14}C yr BP meant that events separated by up to c. 400 calendar years were indistinguishable by radiocarbon dating. Day and Mellars (1994) successfully 'wiggle matched' several closely spaced, carefully selected radiocarbon accelerator dates from the occupation at Star Carr. This enabled periods of early Mesolithic occupation to be 'absolutely dated' for the first time. The two occupation phases occurred at c. 9650 ^{14}C yr BP (c. 10,920 cal BP) lasting for c. 80 calendar years, and at c. 9400 ^{14}C yr BP (c.10,740 cal BP) lasting for c. 120 calendar years.
PhD fieldwork commenced	PhD fieldwork and analysis commenced and continued until Oct 1998.
Day (1996a)	Publication of a long palaeoecological profile from the western end of the lake basin c. 500m to the east of Star Carr (see Figure 1.7). Combined pollen, charcoal and sedimentological analyses to reconstruct the former vegetation and fire history from c. 13,000 ^{14}C yr BP until c. 6515±85 ^{14}C yr BP Provides a broad regional and chronological context for the early Mesolithic human activity within the western end of the lake. Demonstrates: a short-lived climatic deterioration during the Windermere Interstadial but prior to the Loch Lomond Stadial; the problems of dating within calcareous lakes; the potential presence of *Alnus* during the late-glacial and the occurrence of pre-Holocene fire events. Microscopic charcoal peaks that occur at c. 12,000 ^{14}C yr BP are thought to be due to human activity.

Table 1.3 (continued) Palaeoenvironmental Research in the Vale of Pickering - 1948-2002.

PALAEOENVIRONMENTAL RESEARCH – KEY FINDINGS 1948-2002

Publication	Outline of Research/Key Findings
Dark (1998; in Mellars and Dark 1998)	There were at least three phases of occupation near Trench A at Star Carr: c. 9650 ^{14}C yr BP (c. 10,920 cal BP) lasting for c. 80 calendar years; at c. 9400 ^{14}C yrs BP (c.10,740 cal BP) lasting for c. 130 calendar years; and further occupation at Clark's site mostly between c. 9400-9100 ^{14}C yr BP. The 1st two phases of settlement resulted in the disturbance of birch, aspen and fern communities and coincided with peaks in charcoal deposition. The actual nature of the vegetation disturbance during the 3rd phase is unclear. Analysis of the macro charcoal from Trench A indicated burning of reeds (*Phragmites*), willow (*Salix*) and aspen (*Populus*) populations at the lake edge, potentially during the late spring to early summer (Hathers 1998; in Mellars and Dark 1998). Dark suggested that this was either caused by accidental spread of fire from hearths or due to deliberate management of the reed beds at the lake edge. The occupation phases indicated by the charcoal curves varied in intensity throughout the phases of occupation resulting in multi-peaked charcoal deposition. Analysis of the macro charcoal and spatial deposition of charcoal between trenches suggests that most charcoal is deposited fairly locally.
Summary of Research 1993- 1999	Human vegetation disturbance in early Mesolithic requires the combined use of fine resolution pollen and charcoal studies. All research has once again concentrated primarily on Star Carr and its immediate surroundings leaving the majority of the former lake edge unresearched.
Cummins (2000b; 2001)	Two pieces of work which actually concentrate on the very eastern and south-eastern deposits of the Vale. Both profiles, PCC and QAA, were taken from the southern edge of the lake (Figure 1.7). PCC contained the partial skeleton of an early post-glacial *Bos primigenius* which died within a swamp environment . QAA was unassociated with any archaeological artefacts. Both pieces of work reconstructed the lake-edge vegetation and fire history of the Windermere Interstadial, Late-glacial and early Flandrian environments from c.13,000 to 9,000 ^{14}C yr BP. These studies provide the longest Upper Palaeolithic pollen sequences to have been retrieved from the shallow lake-edge peats. They demonstrated at least 3 short-lived declines in birch prior to the late-glacial stadial, which may correspond to possible short-lived temperature declines identified from other palaeoenvironmental data in North-west Europe and Greenland e.g., Björck *et al* 1998. Demonstrated that pre Holocene fires were frequent. Some were highly regional in occurrence whilst others were apparently fairly localised. Unfortunately there was no associated archaeology that could be related to these Upper Palaeolithic fire events. At PCC and QAA there was a significant rise in water level shortly after the beginning of the Late-glacial. There is charcoal evidence to support a period of early Mesolithic human activity close to QAA at c. 9,000 ^{14}C yr BP. This does not occur at PCC.

Table 1.3 (continued) Palaeoenvironmental Research in the Vale of Pickering - 1948-2002.

Depth in cm	***Grid Method***	***Point Count Method***
0	400.0	396.6
1.0	495.4	585.8
2.0	771.0	1101.2
3.0	740.5	622.6
4.0	613.2	878.4
5.0	801.6	1032.5
6.0	506.0	458.3
7.0	416.5	394.0
8.0	297.0	620.3
10.0	338.0	307.4
11.0	266.6	250.5
12.0	227.0	259.4
13.0	269.0	521.1
14.0	267.7	433.9
15.0	260.8	235.7
16.0	267.2	131.6
17.0	291.9	288.6
18.0	453.5	905.5
19.0	366.1	371.6
20.0	177.8	205.2
21.0	171.1	0.0
22.0	195.0	0.0
23.0	188.5	291.0
24.0	148.6	208.4
25.0	110.2	0.0
26.0	92.0	0.0
27.0	107.6	0.0
28.0	185.3	0.0
29.0	116.6	0.0
30.0	95.9	0.0
31.0	115.8	0.0
32.0	69.9	157.2
33.0	46.8	0.0
34.0	81.5	117.4
35.0	76.3	0.0
36.0	75.7	381.4
37.0	204.3	0.0
38.0	156.2	266.5
39.0	181.7	360.7
41.0	143.6	193.5
43.0	116.0	0.0
45.0	102.1	0.0
47.0	129.6	95.4
49.0	159.1	0.0
51.0	103.2	145.1
53.0	91.5	163.3
55.0	114.7	0.0
Mean=	246.9	263.6

Table 2.1 Comparison of the Grid and Point Count Methods for estimating charcoal area for samples from The Bowl (from Backman 1984; Patterson *et al* 1987)

Observations and Generalisations	Researchers
Dispersal is essentially random and unpredictable.	Chandler *et al* (1983); Patterson *et al* (1987); J S Clark (1988a). (Models are based on models of pollen transport or the movement of sand e.g., Bagnold 1941).
Dispersal is determined by a variety of factors e.g. heat; smoke plumes.	
Distribution to some extent reflects wind direction especially for small scale fires.	Clark RL (1983); Rhodes (1996); Whitlock and Millspaugh (1996).
Charcoal deposition is very susceptible to turbulence and eddies and also probably topography, if it is a small scale fire.	
Charcoal deposition conforms to the distance decay principle i.e. quantity and size will decrease with distance travelled.	Patterson *et al* (1987); Clark RL (1983); Clark JS *et al* (1998); Wein *et al* (1987).
Larger heavier particles will be deposited earlier than smaller lighter ones.	Patterson *et al* (1987); Wein *et al* (1987);Clark JS *et al* (1998).
Larger charcoal fragments represent local fires, and these are deposited within c.400m .	Clark (1988a); Wein *et al* (1987); Clark JS *et al* (1998).
Local fires deposit charcoal within a few hundred meters or even 10's of meters.	Rhodes (1996); Moore (2000); Day (1996).
The specific definition of local charcoal particles often varies according to the researcher e.g. >150 μm long Clark (1988a); >50 grid squares Benton and Mannion (1995); >8800 μm^2 (Clark *et al* 1989); >75 μm i.e. 5625μm^2 (Tinner *et al* 1998).	Clark (1988a); Benton and Mannion (1995); Clark *et al* (1989); Tinner *et al* (1998).
Pollen-slide charcoal is considered to reflect regional fire histories.	Clark (1988a); Clark and Royall (1995).
Pollen slide charcoal can originate from local fires or fires within a few kms of a sampling point. Pollen slide charcoal can sometimes reflect the local fire history, better than the regional fire history.	Nichols *et al* (2000) Pitkänen *et al* (1999).
Charcoal in the size class <2800 μm^2 was considered to represent background charcoal.	Wein *et al* (1987).
The majority of charcoal particles deposited by low intensity fires are of the same sizes that are most abundant on pollen slides.	Pitkänen *et al* (1999).
Charcoal from small fires will be deposited locally e.g. domestic hearths generate insufficient energy to inject particles high into the atmosphere, so are not dispersed further than c.200m.	Bennett *et al* (1990b).
Charcoal from large fires will be widespread, giving smooth records that are similar from site to site.	
There is no significant correlation between the area of charcoal and: distance from fire, location, fire area or type.	Clark RL (1983).
Within moorland soils, *in situ* fires and *ex situ* fires can be distinguished based on correlations between charcoal size class distributions.	Rhodes (1996).
An increase in larger charcoal particles and a decrease in particles c.<10 μm in diameter (i.e. 100 μm^2) suggests the occurrence of low intensity local fires.	Pitkänen *et al* (1999).
Small scale fires may only charr the soil or peat to a depth of 1-2 mm	Nichols *et al* (2000)

Table 2.2 Taphonomic factors affecting the atmospheric dispersal of charcoal particles from a fire

Observations and Generalisations	Researchers
Aside from aerial transport, stream transport is also an important contributor of charcoal.	Bonny (1978); Tauber (1977); Nichols *et al* (2000)
Fluvial charcoal may be more abundant in sediments containing large amounts of allochthonous versus autochthonous material.	Patterson *et al* (1987).
A large fire intensity may increase overland flow scouring new rivers and increasing erosion.	Swanson (1981); Nichols *et al* (2000).
A low intensity fire will leave a vegetation mat and cause little erosion and runoff.	
High erosion rates may be responsible for bringing in large amounts of particulate matter into the catchment including charcoal.	e.g. (Swain 1973); Cwynar (1978).
Water transport may result in selective bias in favour of wood charcoal.	Nichols *et al* (2000).

Table 2.3 Taphonomic factors affecting the waterborne transport of charcoal particles

Observations and Generalisations	Researchers
The taphonomic processes affecting the deposition of charcoal in lake sediments have been evaluated mainly through studies of pollen taphonomy.	Davis RB (1967); Davis MB (1968, 1972); Davis and Brubaker (1973); Bonny (1978).
Charcoal like pollen, may be redeposited, demobilised, redistributed, differentially deposited and concentrated or focused before final incorporation.	
Lakes with no inflow or outflow are clearly preferable.	
Large lakes are just as comparable as small lakes in recording fire history.	Whitlock and Millspaugh (1995).
The relationship between lake size and charcoal recruitment area remains unclear and other factors such as water depth and littoral area may be more significant.	
Charcoal recruitment is dependant on lake size.	e.g. Waddington (1969); Swain (1973); Cwynar (1978); Gajweski *et al* (1985); Clark JS (1990); Tolonen (1986); Tolonen (1983); Edwards (1989).
Charcoal fragments of the size counted in sediment cores , soon became saturated and sink rapidly, in contrast to the larger particles which may not.	Skolnick (1958); Davis RB (1967).
The true specific gravity of porous charcoal may be between 0.3-0.6, whereas pollen exines have a specific gravity of 1.4-1.5. Consequently the settling rates for charcoal are likely to be lower than for pollen.	Renfrew (1973).
The degree of sediment mixing in a small lake is directly related to depth and surface area of the lake.	Larsen and MacDonald (1993).
Wind induced water currents affect the ultimate deposition of charcoal particles. Wind can disperse fragments across a lake, altering the deposition pattern and size range of the fragments.	Whitlock and Millspaugh (1996); Bradbury (1996).
The sedimentary record of a single fire may take several years to accumulate due to redeposition and hydrological lag effects (e.g. 5 yr + in Yellowstone National Park and 70 years at Elk Lake).	
However, once the sediment has been compacted, the fire event should register as a peak in the sediment profile and the majority of the charcoal will be concentrated to form a discrete peak with a small stratigraphic span. Millspaugh and Whitlock (1996:12) reported fire peaks spanning 1-3cm in lakes from Yellowstone National Park, while Patterson *et al* (1987) quote a fire peak covering 30 years.	Millspaugh and Whitlock (1996:12); Patterson *et al* (1987).
Shallow water <9m may continue to receive charcoal for some time.	
There is little information available regarding the taphonomy at lake edges.	Whitlock and Millspaugh (1996).
Comparison of the macroscopic and microscopic charcoal profiles from Star Carr (Day 1993), shows that peaks in microscopic charcoal broadly reflect the pattern of the macroscopic charcoal, but there may be (not always) a slight stratigraphic delay.	Day (1993).
To resolve individual fires the sampling interval must be less than the fire frequency and will also depend on the differential charcoal deposition in non fire years.	Clark, J.S. (1988a).
Unless samples are contiguous no method will produce useful estimates of fire frequency as smoothing will occur.	
Even modest sediment mixing will obscure the fire signal.	
Fire frequency cannot be separated from intensity where individual fires have not been resolved (Clark 1988a) and the fire regime remains open as one cannot distinguish when and where the fire occurs.	

<u>Table 2.4</u> <u>The taphonomic processes affecting the deposition of charcoal in lake sediments</u>

Question	Meaning
i. Does it accurately portray the actual age of the sediments or the horizon that is being dated? NB. Unfortunately, the researcher is limited by the material available within the deposits.	Does the material provide a causal link between the archaeology and vegetation changes? Or does it just provide a '*terminus post quem*' (date after which) for the context (see Bowman 1990:50). Does the material come from a short-lived event e.g. a hazelnut rather than a piece of wood which may have been long lived. Short lived events will minimise the potential standard error of the dating result providing a more 'accurate' date.
ii. Is the date a correct age estimate?	Has the material been affected by a hard water error? Was there contamination from the burial environment? e.g. humic acids.
iii. How precise is this measurement?	This relates to the statistical uncertainty. The statistical uncertainty ($\pm\sigma$) indicates the value of one standard deviation of the error about the average (or 68% probability).
iv. Is it comparable to other dates?	When comparing or correlating ^{14}C dates some minor differences might be expected due to inter-lab differences and different counting methods. Pilcher (1991) warns of significant variability in the accuracy between some laboratories.

Table 2.5 Questions that need to be considered during the interpretation of radiocarbon dates

PROFILE D – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
LPAZ D-1	660-604	Poaceae-*Betula*-Cyperaceae-*Artemisia*	Silty/clay deposits give way to silty marls containing low concentrations of pollen along with *Chara* oospores. The dominant pollen taxa are Poaceae, *Betula* and Cyperaceae along with a range of other shrubs and herbs including *Salix*, *Artemisia* type, Rubiaceae and *Rumex acetosa* type. The vegetation appears similar to the bottom half of LPAZ S-1 (Day 1996a), although there are notably higher proportions of *Rumex acetosa* rather than *R. acetosella* and higher percentages of *Plantago maritima.* The latter probably reflects the cold climatic conditions from the preceding stadial (GS-2). Peaks in pre-Quaternary spores suggest that erosion or reworking of the sediments has occurred in keeping with the immature soil status. A suite of herb/ruderal species consistent with the erosional signal peak at the bottom of the sequence e.g., *Silene* type, Compositae Lig. and Tub., *Plantago maritima*, and Brassicaceae.
LPAZ D-2a	604-590	*Juniperus-Thalictrum* subzone	Firstly there is the development of scattered patches of open birch woodland (*Betula* percentages reach 45-50% although pollen concentrations are still fairly low), intermixed with small quantities of *Salix* and *Juniperus* suggesting a warmer than previous climate. Open tracts of land are still very prevalent as implied by the high herb percentages. Extensive areas of grassland with sedges, scrub and heath occurred, with patches of disturbed land suitable for *Artemisia*, Rubiaceae and *Thalictrum.*
LPAZ D-2b	590-564	*Betula-Juniperus-Filipendula* subzone	Open *Betula* woodland is succeeded by *Juniperus* scrub (up to c.18% TLP) over extensive areas along with expanses of grassland, and ericaceous heath. Correspondingly *Betula* and *Salix* percentages decline. This corresponds to an absolute decline in their pollen concentrations. Grassland communities are still extensive as shown by continued abundance of herbs such as Poaceae, Cyperaceae and *Thalictrum.* However, this period of stabilisation is short-lived as almost immediately *Juniperus* values decline and grassland species, *Helianthemum, Hippophäe* and *Artemisia*, species characteristic of disturbed land, increase again. This increase is mirrored by the pollen concentration data. Ruderal taxa e.g., Brassicaceae also increase. This is followed by an increasing re-establishment of *Betula* and also *Salix* and the gradual decline in disturbed ground species as open woodland re-develops in some areas after a period of intense soil destabilisation. Large expanses of ericaceous heath and grassland are still present.

Table 3.2 Profile D – LPAZ D1- D9

PROFILE D – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
LPAZ D-3	564-542	*Betula*-Poaceae-*Filipendula*	Open *Betula* woodland is the pre-dominant vegetation type with small amounts of *Salix* and *Juniperus* scrub and an extensive ground flora of grasses and tall herbs like *Filipendula.* Species characteristic of disturbed soils e.g., *Artemisia*, *Thalictrum* and *Rumex* spp. decline significantly to almost negligible levels, suggesting soil stabilisation, but there is still a persistence of open grassland communities beneath the open woodland. This subzone is equivalent to the latter part of the Windermere Interstadial (GI-1a) with open *Betula* woodland at its peak for this interstadial.
LPAZ D-4	542-500	Poaceae-*Filipendula*	The climatic deterioration and minerogenic input into the lake continue from the end of zone D-3c. The zone starts with high *Pinus,* Poaceae and *Rumex acetosa* and the reappearance of Rubiaceae, *Artemisia, Thalictrum* and ruderals. Suppressed *Filipendula* and *Juniperus* levels suggest that the effects of the Loch Lomond Stadial (GS-1) are still visible. Subsequently a range of different species provide a sequence of pollen peaks, e.g., Poaceae, *Rumex, Salix, Filipendula* and *Empetrum* colonise the bare ground and form grass and herb communities. Gradually, these communities are succeeded by *Betula*, Pteropsida (monolete) undiff. and *Plantago media* which is more thermophilious than *P. maritima* (Clapham *et al* 1987). The beginning of aquatic vegetative production is shown by constant levels for the thermophilious species, *Typha latifolia,* an emergent aquatic which is often the first coloniser of minerogenic substrates at the lake edges (Grime *et al* 1990). This is accompanied by establishment of *Equisetum,* another emergent aquatic common in this period.
LPAZ D-5a	500-494.5	*Betula*-Poaceae-*Filipendula*-subzone	This zone shows the replacement of tall herb grassland communities with open *Betula* woodland and its understorey/woodland edge community of ferns, presumably as a direct result of the continuing amelioration in climate. Initial *Salix* and *Juniperus* scrub was replaced by *Betula* woodland with *Salix* populations persisting on the wetter soils at the lake edges. A suite of ruderal (e.g., *Artemisia,* Brassicaceae) and grassland taxa (Apiaceae, *Ranunculus*) coexist with Poaceae and expanding stands of Pteropsida (monolete) undiff. within the understorey and at the woodland edges, suggesting that some areas of disturbed soils still persisted. Small quantities of *Ulmus, Quercus, Alnus* and *Corylus* pollen may suggest that some outlying individuals are already present within the local area but as yet not able to

Table 3.2 (cont'd) Profile D – LPAZ D1- D9

PROFILE D – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
LPAZ D-5a	500-494.5	*Betula*-Poaceae-*Filipendula*-subzone	expand due to climatic, edaphic or competitive restrictions. The woodland is very open which enables light-demanding shrubs like *Sorbus* to survive.
LPAZ D-5b	494.5-484.5	*Betula*-Poaceae-*Dryopteris filix-mas* subzone	Open *Betula* woodland becomes fully established by the top of the subzone, out- shading *Juniperus* and *Filipendula* and possibly restricting *Salix* (and *Populus*) populations to the wettest soils. Disturbed and open areas still exist and are colonised by small herbs (e.g., *Artemisia*, Apiaceae) and Poaceae presumably at the woodland edge or near the lakeside. The tree canopy is not closed which enables *Sorbus/Crataegus* to flower. Light-demanding *Dryopteris filix-mas* forms an understorey layer.
LPAZ D-5c	484.5-472.5	*Betula*-Pteropsida-***Dryopteris filix-mas*** subzone	*Betula* reaches its peak in this zone with correspondingly lower values for *Filipendula* and ferns, although the herb layer is still diverse. The top half of the zone marks the arrival (rational limit) of *Corylus avellana* in the region. Frequencies remain low until the very top of the zone where there is a sudden population expansion. According to this sequence, at the end of zone D-5c *Corylus* pollen increases sharply to over 50% TLP.
LPAZ D-5d	472.5-465.5	*Betula-Dryopteris filix-mas-Corylus* subzone	This zone records the replacement of open *Betula* woodland with *Corylus* at the lake eges. Here it is able to persist alongside *Salix*. Dense shade no longer favours *Dryopteris filix-mas* which becomes scarcer, though undifferentiated ferns are still consistently present.
LPAZ D-6	465.5-425	*Corylus-Betula-Ulmus*	This zone records the replacement of open *Betula* woodland with *Corylus*, the latter soon attaining values of 75-80% of the TLP. Pollen concentrations are extremely high, reflecting the high pollen productivity of this species. *Betula* c.f. *pubescens* pollen has declined to c. 10% TLP and has probably been replaced by *Corylus* in all but the dampest areas of the catchment. Here it is able to persist alongside *Salix*. Grass and sedge percentages are the lowest to date implying a closed aspect to the woodland, a feature also implied by the large reduction in diversity of herb pollen. Dense shade no longer favours *Dryopteris filix-mas* which becomes scarce, though undifferentiated ferns are still consistently present. *Ulmus* c.f. *glabra,* traditionally thought to favour the fertile dry ground or higher ground (Turner and Hodgson 1979), has begun to spread into the region and now attains a constant presence. *Quercus* is also present but at low

Table 3.2 (cont'd) Profile D – LPAZ D1- D9

PROFILE D – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
LPAZ D-6	465.5-425	*Corylus-Betula-Ulmus*	frequencies in this zone. Its low values and delayed establishment may be attributable to the lack of suitable acidic and infertile soils required for its growth (Bennett 1991). Lake productivity, though still high, shows a slight reduction in aquatic diversity. Species occurrence is more sporadic and this is linked with the fluctuating lake levels implied by *Pediastrum.*
LPAZ D-7	425-319	*Corylus-Ulmus-Quercus*	This zone is a continuation of the previous zone but *Quercus* now becomes firmly established within the region, attaining low but persistent levels in the first half of the zone but increasing to over 10% by the end of the zone which corresponds to the first appearance of *Alnus*. *Ulmus* percentages remain constant at around 10% and *Corylus* levels remain high c 70-80% but are declining slightly by the zone end. Herb totals remain low although reeds and fen sedges are encroaching ever more inwards into the lake and by the top of the zone aquatics such as *Nymphaea* and *Typha angustifolia* are persistently present, perhaps quite nearby. Pteropsida (monolete) undiff, most probably marsh fern (*Thelypteris palustris*), has become established throughout the catchment on the encroaching fen edge deposits. The shallowing of the lake inthe near vicinity is shown by rising *Pediastrum* levels.
LPAZ D-8	319-206	*Corylus-Quercus-Alnus-Ulmus*	Pollen is mainly local as inferred from the detritus stratigraphy. Increased percentages of Cyperaceae and Poaceae are probably reed and sedge in origin. The rapid expansion of *Alnus* continues to the detriment of *Corylus*, although a general increase in woodland tree diversity also contributes. *Alnus* pollen reaches 20% TLP by the top of the zone, although the percentage and concentration fluctuates throughout, as do *Corylus* frequencies. *Corylus* concentrations have fallen markedly, suggesting it has actually been supplanted by *Alnus* and also *Quercus*. *Ulmus* maintains a stable presence throughout the zone while *Tilia* migrates into the local area attaining a reasonable population presence by the middle of the zone. *Fraxinus, Hedera* and *Populus* migrate or re-expand in the local area although their numbers are low but consistent. *Fraxinus* peaks at the top of the zone after what appears to be canopy disturbance. Herb total and diversity also increases through the zone e.g., Ranunculaceae, Compositae Lig. and Apiaceae, perhaps reflecting the

Table 3.2 (cont'd) Profile D – LPAZ D1- D9

PROFILE D – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
LPAZ D-8	319-206	*Corylus-Quercus-Alnus-Ulmus*	woodland disturbance and the vicinity of the fen communities along the lake edges. The local hydrosere succession is clearly shown within the aquatic pollen record as *Nymphaea* and *Typha angustifolia* become locally established and *Pediastrum* values peak and then decline as the water becomes increasingly shallow.
LPAZ D-9	206-200	Cyperaceae-Poaceae-Pteropsida	This zone contains just two samples but documents a period of intense vegetation disturbance in the area. Contemporaneous with a decline in *Ulmus* is the increasing charcoal curve and decreases in *Alnus, Corylus* and *Quercus*, the latter two to a lesser extent. Woodland edge species *Crataegus* and *Sambucus,* occur at the same time as substantial increases in Poaceae and Cyperaceae. Grassland species e.g., Aster type and *Centaurea nigra* and an occurrence of *Plantago lanceolata* also occur. High levels of Pteropsida (monolete) undiff. (i.e. *Thelypteris palustris),* and lower levels of *Typha latifolia* suggest the lake is now almost entirely filled in with swamp and fen vegetation, except in the very deepest areas.

Table 3.2 (cont'd) Profile D – LPAZ D1- D9

Table 3.4. IV and BV values for Selected Taxa in the Regional Profile (D3).

Time Window	Species	IV % (2σ)	BV % (2σ)	BV+IV % $\sqrt{(BV^2+IV^2)}$ (2σ)
Early Mesolithic	*Betula* sp.	±4.1	±9	±9.9
	Poaceae	±2.73	±4.2	±5
	Dryopteris filix-mas	±1.53	±4.2	±4.47
	Pteropsida (monolete) undiff.	±1.93	±5.28	±5.6
	Filipendula sp.	±1.86	±2.7	±3.3
	Salix sp.	±1.8	±3.1	±3.58
	Cyperaceae	±1.12	±1.7	±2.03
Fine Resolution	*Betula* sp.	±4.24	±8.6	±9.7
	Poaceae	±2.95	±4.6	±5.46
	Dryopteris filix-mas	±1.57	±3.2	±3.56
	Pteropsida (monolete) undiff.	±2.06	±3.56	±4.11
	Filipendula sp.	±2.05	±3.2	±3.8
	Salix sp.	±1.77	±2.1	±2.75
	Cyperaceae	±1.15	±1.9	±2.25

PROFILE NM – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
NM-5a	161.5-149	*Betula*-Poaceae-*Filipendula* subzone	Sedimentation changes from sand to marl at the start of the Holocene. Local pollen input is also attested to by the occurrence of large clumps of Poaceae pollen (see GreatRex 1983, Janssen 1986). Low levels of *Pinus* suggest it was not locally present on the island. Lake vegetation is becoming established at the lake edges with floating aquatics e.g., *Myriophyllum ssp.* and *Potamogeton natans* and stands of *Typha latifolia* colonising the minerogenic substrate. High proportions of the freshwater mollusc *Planorbis laevis*, a species with a northern distribution today (Macan 1977), indicate that the water was clear with a stony substrate and poorly developed aquatic vegetation. One occurrence of *Valvata cristata* suggests that reed beds and organic sedimentation are starting to develop in places.
NM-5b	149-130	*Betula*-Poaceae-*Dryopteris filix-mas* subzone	Alongside the dense stands of *Dryopteris filix-mas*, herb diversity remains high. Vegetative productivity is increasing within the lake with sedges, reeds and reedmace already established and colonising the lake edges. A diverse molluscan fauna including *Planorbis laevis, Valvata cristata, V. piscinalis, Lymneae peregra* and *Bithynia tentaculata* suggests that the reed beds have not quite extended out to the sampling point c. 30m from shore, although the water is shallowing. Dense reedswamp separates the dry land from the open water indicated by bands of reed remains in the profile. Higher abundances of the mollusc *Valvata cristata* and the constant presence of *Bithynia tentaculata and Lymneae peregra* infer well developed vegetation within well oxygenated water with a soft muddy substrate. The presence of *Planorbis complanatus* indicates the climate is now temperate, with temperatures perhaps even higher than today (Macan 1977).
NM-5c	130-125	*Betula*-*Corylus* subzone	*Corylus avellana* values rise gradually in a stepwise manner from c.10 to 25% in contrast to sequence LPAZ D-5. The corresponding decline of *Betula* from 77-57% to is just as gradual confirming the hiatus at the end of D-5. Pollen percentages of *Ulmus* c.f. *glabra* are sporadic but *Quercus* values are low and persistent throughout. There is a slight resurgence in Pteropsida (monolete) undiff. values but *Dryopteris filix-mas* percentages decline to less than 1% TLP. Aquatic pollen is on the increase as lake edge infilling continues to progress.

Table 4.2 Profile NM – LPAZ NM 5- NM9

PROFILE NM – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
NM-6	129-109	*Betula-Corylus avellana*	*Corylus avellana* values continue to increase, from 25% to 80% TLP near the top of the zone in contrast to declining *Betula* values. Pollen percentages of both *Ulmus* and *Quercus* are constant but low throughout, although *Ulmus* values rise towards the zone end. *Salix* percentages drop to less than 2% at the start of the zone and never recover along with *Sorbus* type values. Herb diversity and abundance decreases. Marl accumulation becomes increasingly organic until the transition to lake detritus half way through the zone at c.116cm. The concentration of mollusc and ostracods at this boundary infers a local and significant decrease in water level associated with hydrosere development and the transition from open water to reedswamp. The pollen curves suggest sedimentation is slow but uninterrupted. The *in situ* vegetation comprises lesser reedmace (*Typha angustifolia*) with *Phragmites* and sedges in the shallower waters.
NM-7	109-77.5	*Corylus-Ulmus-Thelypteris palustris*	Soon after the start of the zone, *Ulmus* forms a fairly significant part of the woodland canopy with values over 5% TLP. *Corylus avellana* values fluctuate and decline throughout the zone. Meanwhile, *Quercus* percentages have increased slightly but are still low. By the middle of the zone, *Alnus glutinosa* has established a consistent but low background presence and pine is migrating into the area. *Typha angustifolia* percentages remain high while both Poaceae and Cyperaceae increase, probably reflecting the advancing front of the reedswamp and the shallowing of the water as indicated by a peak in *Nympheae alba.* Marsh fen is spreading rapidly across the fen edges.
NM-8a	77.5-52	*Corylus*-Cyperaceae-*Thelypteris*	Ferns and sedge are the local dominants as peat develops over the infilled lake. Small areas of pine are now present alongside hazel. *Quercus* percentages, which have been persistently low for some time undergo expansion in this zone, also associated with the rise in *Pinus* pollen.
NM-8b	52-13	*Corylus*-Cyperaceae-Pteropsida	Outlying populations of *Alnus* are not able to expand further until the top of the zone. Herb abundance and diversity increases with appearances of *Ranunculus ssp.*, Chenopodiaceae, *Urtica* and *Rubiaceae.* Seasonally waterlogged conditions are indicated by the presence of *Hydrocotyle* and *Succisa pratensis.*

Table 4.2 (cont'd) Profile NM – LPAZ NM 5- NM9

PROFILE NM – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
NM-9	13-0	*Corylus-Alnus-Calluna*	Marked reductions in Poaceae, *Pinus sylvestris*, continued reductions in Pteropsida (monolete) undiff., and Cyperaceae and a major increase in *Alnus glutinosa*, *Calluna vulgaris* and *Sphagnum* pollen, mark the development of wet heath/carr woodland on the site. *Pinus sylvestris, Ulmus* and *Quercus* become rarer, with the first probably no longer growing locally. Low levels of *Tilia* pollen attest to the local presence of this tree. Indicators of open land or disturbed land are still abundant e.g., *Pteridium, Silene* type and Lactuceae.

Table 4.2 (cont'd) Profile NM – LPAZ NM 5- NM9

PROFILE NAQ – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
NAQ-5a	209-189	*Betula*-Poaceae-*Filipendula* subzone	*Betula* is the dominant pollen taxon contributing between 35-60% TLP, although it is notable that all pollen percentages fluctuate markedly. *Juniperus* is also present in low quantities. Poaceae makes up a noticeably high percentage of the pollen sum, with values varying between 15-45% TLP before levelling off to 30% by the zone end. *Salix* also fluctuates greatly varying from 1-10% TLP. Pteropsida (monolete) undiff. values do not exceed 7% TLP before the end of the zone. The ground flora is fairly diverse and includes many ruderals e.g., *Thalictrum* and *Rumex acetosa*, indicating an open environment and unstable soils. *Pediastrum* algae and the marl deposits demonstrate that shallow open water prevailed at the site.
NAQ-5b	189-171.5	*Betula*-Poaceae-*Dryopteris filix-mas* subzone	Marl deposits are overlain at 189 cm by a thick clay band containing abundant pieces of manganese. Organic sedimentation resumes slightly later at 184.5 cm with the deposition of lake detritus. All pollen values fluctuate considerably due to the fine resolution sampling, but in general *Betula* attains constant levels of between 50-60% TLP and Poaceae remains high at 30-40%. Inputs from *Corylus* pollen are consistent but low and there is a brief but consistent peak in *Fagus* in the middle of the zone. *Salix* and Cyperaceae values both fluctuate between 5-10 % TLP during the fine resolution phase otherwise remaining remarkably constant. *Juniperus* pollen is negligible by the mid-point of the zone. *Filipendula* declines as *Dryopteris filix-mas* becomes the dominant understorey with spore values reaching over 25% TLP, but there is a lot of variation in spore production. Woodland shrub and herb diversity has also increased notably in this zone. Finally, there is a small but discernible peak in the frequency of shallow water aquatics during this zone e.g., *Nymphaea alba*.
NAQ-5c	171.5-161.5	*Betula*-Poaceae-Cyperaceae subzone	*Betula* pollen percentages decrease to 55% before returning to 70% once more. *Salix* and Cyperaceae levels are maintained at c. 5 % TLP while Poaceae levels decline slightly from 30% down to 20%. *Dryopteris filix-mas* levels also decrease slightly although they remain variable. This zone shows the first substantial increase in *Corylus avellana* pollen although other shrub and herb diversities have declined conspicuously. *Pediastrum* percentages decline as open water gives way to reed peat. At the end of the zone *Betula* drops sharply to 25% as *Corylus avellana* starts to establish and reaches c. 45% TLP by the

Table 5.1 Profile NAQ – LPAZ NAQ 5- NAQ 7

PROFILE NAQ – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
NAQ-5c	171.5-161.5	*Betula*-Poaceae-Cyperaceae subzone	. top of the zone. Cyperaceae and *Typha angustifolia* frequencies both increase while *Pediastrum* values decline further as the hydrosere progresses. *Dryopteris filix-mas* spores peaks once more and herb diversity remains low.
NAQ-6	161.5-154	*Corylus avellana*-Cyperaceae-*Typha angustifolia*	*Corylus avellana* values rise sharply from 45-70% TLP, but levels soon decline to 45% TLP at the end of the zone. Correspondingly, *Betula* levels drop sharply to between 10 and 20% TLP. Peak levels of Cyperaceae and *Typha angustifolia* are also a feature of this zone, with values reaching c.100% and c.200% respectively. The deposition of pollen from *Ulmus* and *Quercus* is low and sporadic and herb pollen is almost non-existent. *Dryopteris filix-mas* spores become sparse but Pteropsida (monolete) c.f. *Thelypteris palustris* spores begin to rise towards the end of the zone.
NAQ-7	154-136	*Corylus avellana*-Cyperaceae-Pteropsida	*Corylus avellana* pollen, although the dominant pollen taxon, fluctuates around an average of 50% TLP. *Pinus* percentages reach to over 25% TLP, while pollen from *Ulmus* and *Quercus* is conspicuous by its absence. Initially, *Thelypteris palustris* is the dominant lake-edge vegetation but Cyperaceae also achieves co-dominance by the top of the zone. *Typha angustifolia* decreases gradually throughout the zone while Poaceae contributes between 10-25 % TLP and *Salix* pollen varies from 0-5%. At the very top of the profile there is a brief peak in *Fraxinus* pollen, perhaps indicating a small opening in the canopy.

Table 5.1 (cont'd) Profile NAQ – LPAZ NAQ 5- NM7

PROFILE NAZ – LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
NAZ-5	47-22	*Betula-Corylus-Dryopteris flix-mas*	Sedimentation begins with a thin band of grey clay deposited over basal grey sands. The clay band can be traced stratigraphically northwards and correlates with the clay band at NAQ. *Betula* starts the zone at 40% TLP but after peaking mid-zone at 55%, values decline to 40% once more. *Corylus avellana* pollen becomes consistently present at 40cm, starting at 5% TLP before rising to 45% at the top of the zone. *Salix* is present only in low numbers and gradually declines through out the zone from 8-2% TLP. Poaceae fluctuates from 30% TLP at the beginning of the zone, peaking at 45% at 41cm, before declining to 10-15% at the end of the zone. *Dryopteris filix-mas* peaks mid zone at 20% before declining to almost negligible values by the top of the zone. The vegetation at the lake edges is composed primarily of *Rumex* undiff. *Typha angustifolia* and Cyperaceae.
NAZ-6	22-10	*Corylus avellana*-Cyperaceae-Pteropsida	*Corylus avellana* values continue to rise until they reach 70% at the top of the zone. The sheer abundance of macro-remains of *Corylus avellana* at the top of the profile reflects the very local presence of the tree/shrub at the very edges of the island. Meanwhile *Betula* values have declined to c.10% where they remain consistent for the rest of the zone, competing alongside *Salix* which has returned to levels of c.5% TLP. *Dryopteris filix-mas* values remain negligible with most low level vegetation composed of *Typha angustifolia*, Cyperaceae and Pteropsida (monolete) undiff (*c.f. Thelypteris palustris*) at the infilling lake margins. Pollen from *Quercus* and *Ulmus* is sparse.

Table 6.1 Profile NAZ – LPAZ NAZ 5- NAZ-6

PROFILE FS- LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
FS-5a	310-299	*Betula*-Poaceae-Pteropsida subzone	This zone marks the beginning of organic sedimentation over chalky gravels and the establishment of ferns on the dry land, especially *Dryopteris filix-mas*. *Betula* values rise from 45 to 60% TLP although they still fluctuate considerably. Poaceae values fluctuate between 15 to 20% TLP and *Filipendula* declines slightly from 10 to 7% TLP by the end of the zone. *Salix* pollen is constant at 10% TLP along with low but consistent numbers of *Juniperus* grains. In addition to ferns and meadowsweet, the ground flora consists mainly of low herbs and ruderals *e.g., Artemisia* type, *Plantago sp. Rumex sp.*, Rosaceae and *Thalictrum,* with occasional stands of heath land taxa on the higher ground. A sparse band of aquatic vegetation e.g., bulrush (*Typha* sp.) has begun to develop around the lake edges.
FS-5b	299-281.5	*Betula-Dryopteris filix-mas* subzone	*Betula* values continue to rise from 60% through to 80% TLP by the top of the zone, although there appears to be a lot of variation in pollen production through time as highlighted by the fine resolution analyses. *Betula* coexists with *Populus,* but *Juniperus* levels have decreased. The deposition of *Corylus* grains is low but almost continual. On the whole, Poaceae and *Salix* populations are relatively stable, although their pollen output is also very variable. *Filipendula* levels decline to 5% TLP coincident with a notable rise in the dominance of ferns (c.f. *Dryopteris filix-mas*) in the understorey, although spore production is erratic varying from 20 to 5% TLP. The woodland shrub layer is quite diverse *e.g., Sorbus, Crataegus* and *Prunus,* as is the ground layer shown by an extensive variety of herbs and ruderals e.g., Rosaceae, *Artemisia* type, *Urtica dioica* and *Potentilla* types. There is an explosion in lake productivity as shown by the appearance of *Nympheae alba, Typha angustifolia, Potamogeton repens* and *Equisetum* in the shallow water.
FS-5c	281.5-269.5	*Betula-Corylus*-Cyperaceae subzone	*Betula* pollen starts the zone at 80% TLP but its values quickly decline to 60% TLP as *Corylus avellana* starts to migrate into the catchment. *Corylus avellana* establishment is fairly rapid with values rising from 0-15% TLP by the top of the zone. Land pollen concentrations drop as sedimentation rates increase and pollen influx increases from the within-lake and lake-edge vegetation. Although the diversity of woodland shrubs declines slightly, there is a superficial expansion in the diversity of the ground flora. Lake

Table 8.2 Profile FS – LPAZ FS 5- FS7

PROFILE FS– LPAZs			
LPA-Zone	**Depth in cm**	**Dominant Taxa**	**Zone Description**
FS-5c	281.5-269.5	*Betula*-*Corylus*-Cyperaceae subzone	productivity continues to increase, demonstrated by a peak in *Myriophyllum verticillatum* accompanied by *Nympheae alba* and the establishment of significant quantities of the emergent aquatic *Equisetum.*
FS-6	269.5-263	*Corylus avellana*-*Betula*-Cyperaceae	There is a dramatic decrease in Cyperaceae pollen and associated lake edge species at the start of this zone. Throughout the zone, Cyperaceae values oscillate severely, but never quite manage to attain their former levels. However, pollen concentration values show this to be misleading, and that Cyperaceae populations actually briefly exceed previous levels. *Betula* values decline progressively throughout the zone as pollen from *Corylus avellana* increases. Pollen from other lake edge plants e.g., *Salix*, *Thelypteris palustris* and Poaceae also declines. By the top of the zone, *Pinus* levels have reached over 20% TLP, although *Pinus* concentrations levels remain static. Fine resolution pollen sampling between 270-267 cm, demonstrates the huge variability in the pollen output from most taxons. The higher sample resolution also causes a conspicuous increase in species diversity, as there is a greater likelihood of detecting poor pollen producers and rare pollen types.
FS-7	263-252	*Corylus avellana*-Pteropsida-*Thelypteris palustris*	*Corylus avellana* is now the dominant canopy species forming 70% of the TLP. *Betula* and *Salix* are now only present in small numbers around the lake edges. Spores of marsh fern (*Thelypteris palustris*) and Pteropsida (monolete) undiff. reach between 175-125% of the TLP, possibly at the expense of stands of Cyperaceae. *Ulmus* and *Quercus* pollen concentrations although consistent, are very low and woodland edge shrubs and herbs are only sporadic.

Table 8.2 (cont'd) Profile FS – LPAZ FS 5- FS7

Table 10.2 Possible explanations for a 'low intensity' occupation phase.

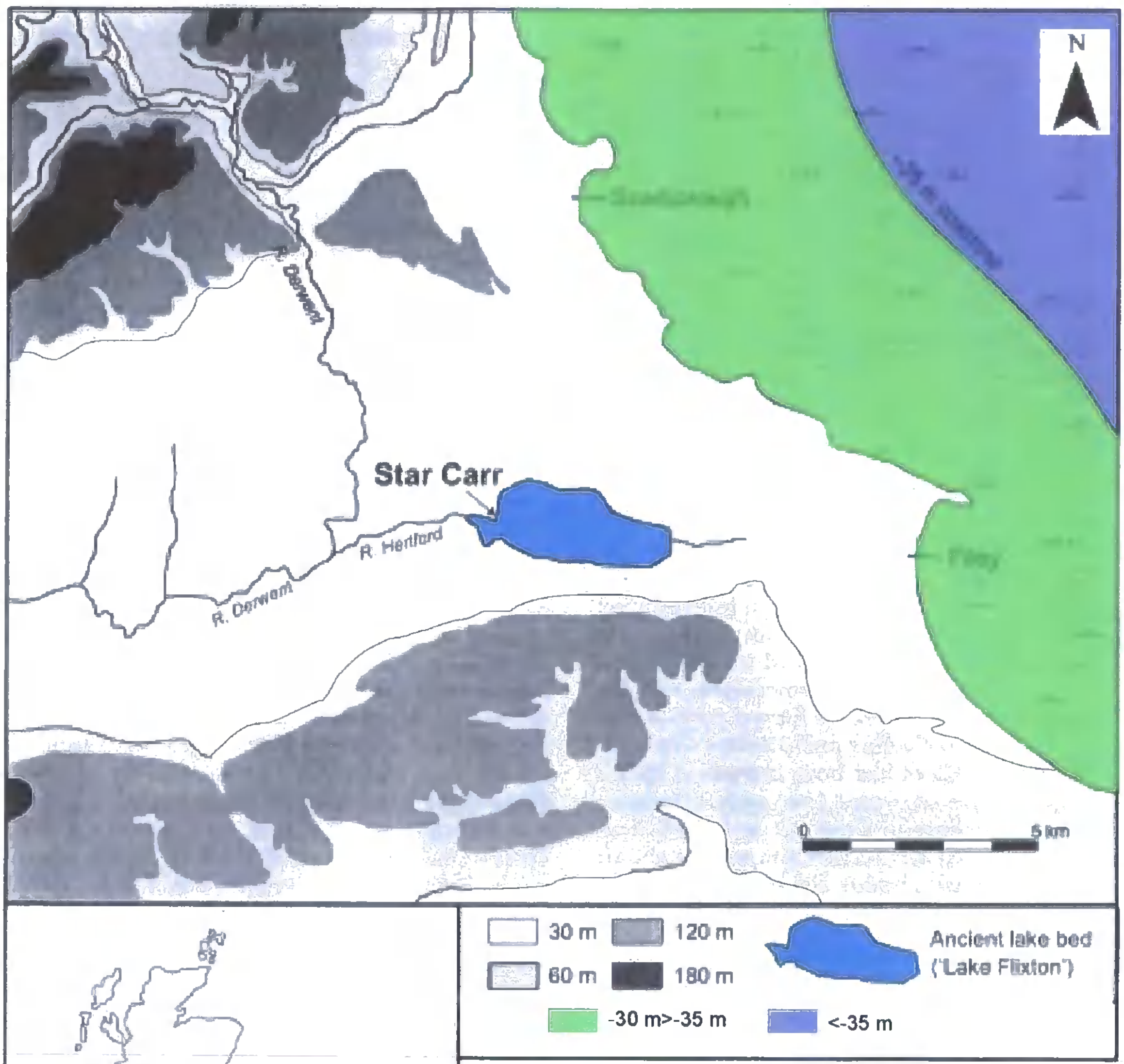
Explanation	Reason
Occupation was local, transitory and non-intensive.	Very little is known about charcoal production, dispersal and taphonomy, so despite the charcoal profile, human occupation may have been very brief indeed.
Occupation was local and longer-term but had little environmental effect.	Only small changes to the pollen rain are visible, simply because very little disturbance took place. If burning of the vegetation was designed to attract game or create vegetation diversity then a 1/10th or even less of the total vegetation would be required to be burnt (Mellars 1976) as larger clearances would be unlikely to attract game. Therefore, only subtle changes to the vegetation (and pollen rain) are likely to have occurred.
Vegetation disturbance occurred at some distance from the sampling spot.	The pollen changes are subtle, but this may be what would be expected from small-scale manipulation of vegetation at 30m (or more) away from the sampling site. A small clearing may be visible if it disturbs the forest edge close to the sampling point but a small clearing away from the forest edge would not be detected in this way (Turner 1964:590). So vegetation clearance may have been at a distance even though the domestic fires were nearby.
Changes in the pollen rain are not proportional to the changes in the vegetation.	Mellars (1976) suggested that a small clearing created to encourage animal browse, would need to be 200-250m in scale, but this poses the question of size of disturbance in relation to pollen impact. Moore *et al* (1979) demonstrated that the percentage of *Molinia* grass pollen is inversely proportional to the percentage of grass cover (see Chapter 6). However, a change in the relative abundance of a population is unlikely to be so easily predicted. More than likely, the changes in the vegetation will be non-proportional to the change in the pollen profile.
The approach is too simplistic.	Actual woodland clearances might be expected to produce a large decrease in pollen percentages. However, this may be too simplistic. It is highly possible that the pollen diagrams are displaying the effects of a cluster of disturbances occurring within a small area. Recurrent fire disturbance in different areas and on different successional vegetation communities would be expected to produce a composite and cumulative change to the pollen rain (Williams 1985), Perhaps even producing contradictory pollen responses so that even relatively intense disturbance appears to have been low key. Or, flowering of the surrounding vegetation may have blurred or completely overshadowed any changes in the pollen rain.

Table 10.2 (cont'd)   Possible explanations for a 'low intensity'occupation phase.

Explanation	Reason
The sensitivity of the ecosystem	"A great deal depends on the sensitivity of the ecosystem to human exploitation and the degree to which this is reflected in the pollen analytical signal. Thus the burning of the forest understorey is more likely to be palynologically recognised if the main beneficiary were the anemophilous *Corylus* with resistant pollen , rather than *Macrozamia* [or *Juncus*] with hardly recognizable and decaying microspores" (Walker and Singh 1993:104,). "Perhaps we should not expect anything but the most extreme impacts to be as clearly recorded".
Flowering may increase due to extra light (Vuorela 1970)	Flowering of the surrounding vegetation may have blurred or completely overshadowed any changes in the pollen rain.
Clearance may increase dispersal of pollen (Smith 1982)	Iversen (1949:21) said that "*the new open forest must have produced much more treepollen than the same area before clearing*".
Tree canopies may remain intact (Mellars 1976)	Repeated fires would be required to actually kill trees
One tree may be replaced by another	Pollen from another tree completely replaces the pollen from the felled tree, so no change is recorded in the sedimentary record.
Filtration of pollen caused by fringe or fen vegetation should not be underestimated (Waller *et al* 1999:25)	Pollen from (etra-local) disturbance areas are completely masked by pollen inputs from *in situ* or very local plants
During increasing tree invasion (in the early Mesolithic) arboreal pollen may mask any decreases in pollen	Increasing population of trees and other plants in the surrounding environment makes up for any local reductions in vegetation cover.

Figures and Illustrations

Chapter One



<u>Figure 1.1</u> <u>The location of the Vale of Pickering and 'Lake Flixton' in North-east England (from Mellars and Dark 1998).</u>
The position of the contemporaneous sea level at c. 9600 ^{14}C yrs BP is estimated at around the –35m contour (University of Durham, Sea-level Research Unit 1998; Van Andel 1998).

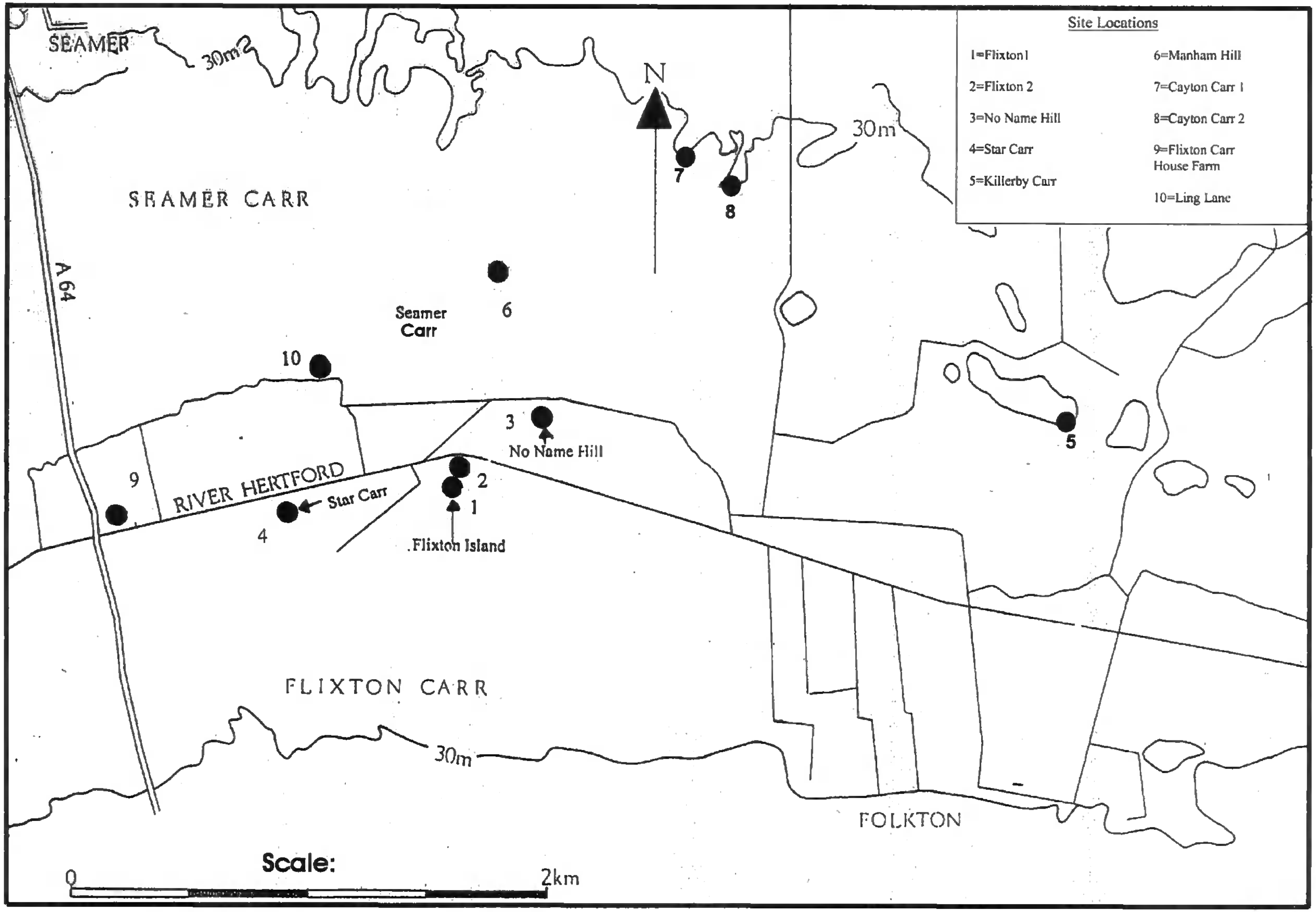


Figure 1.2 **The location of Moore's early Mesolithic sites (Moore 1950; adapted from Schadla-Hall 1987b)**

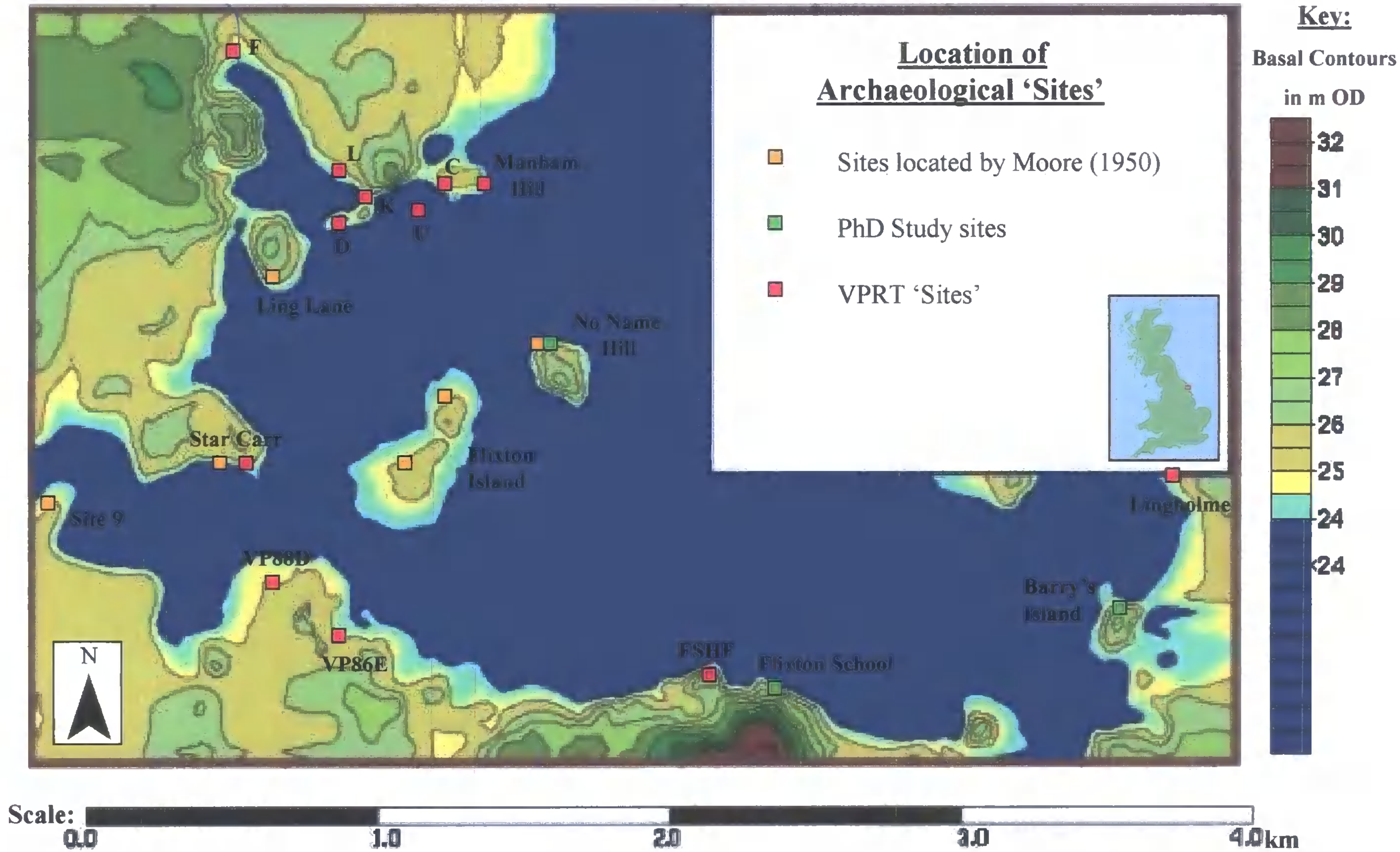
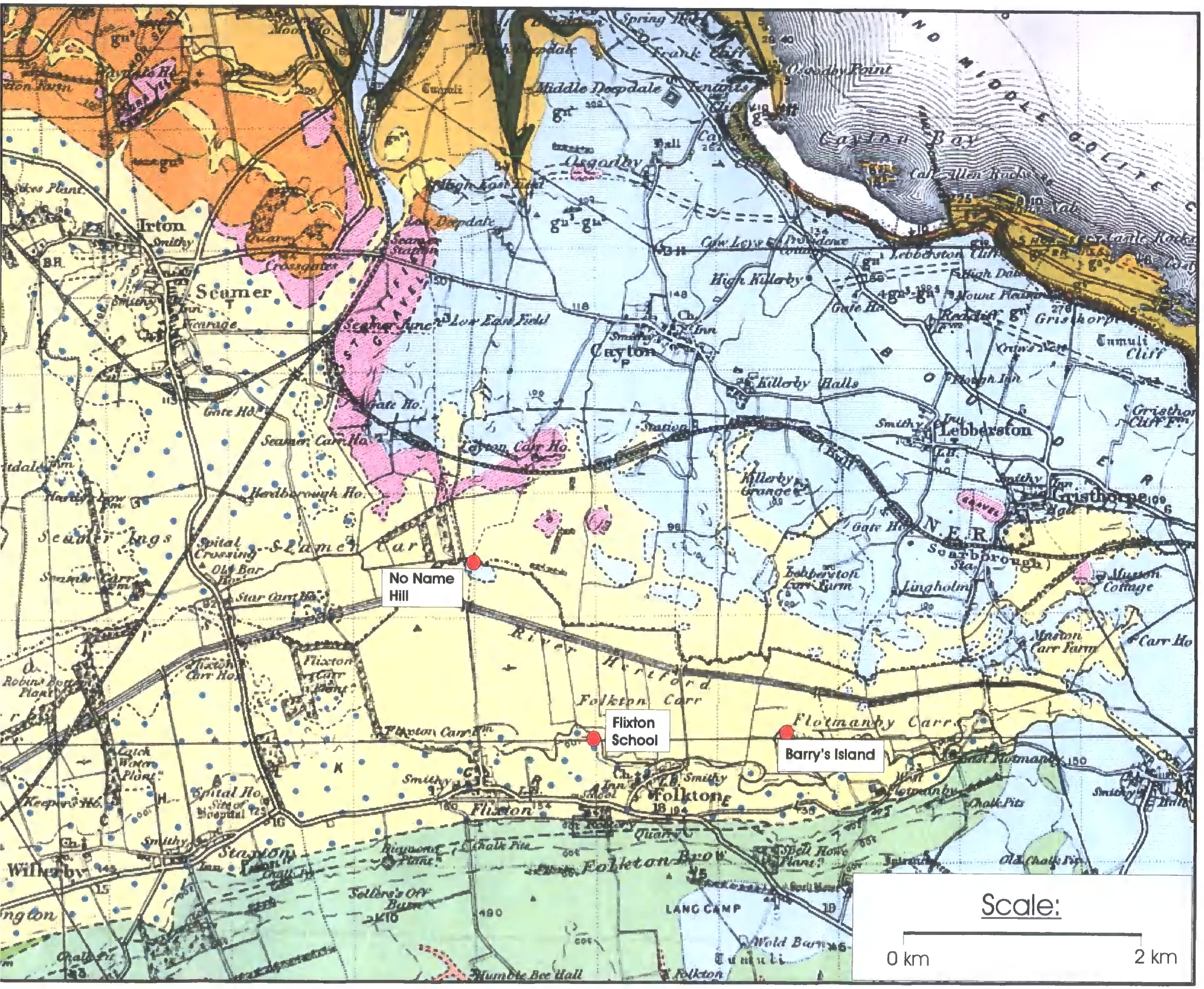


Figure 1.3 The location of archaeological sites around the edges of palaeo-Lake Flixton

Geological Key



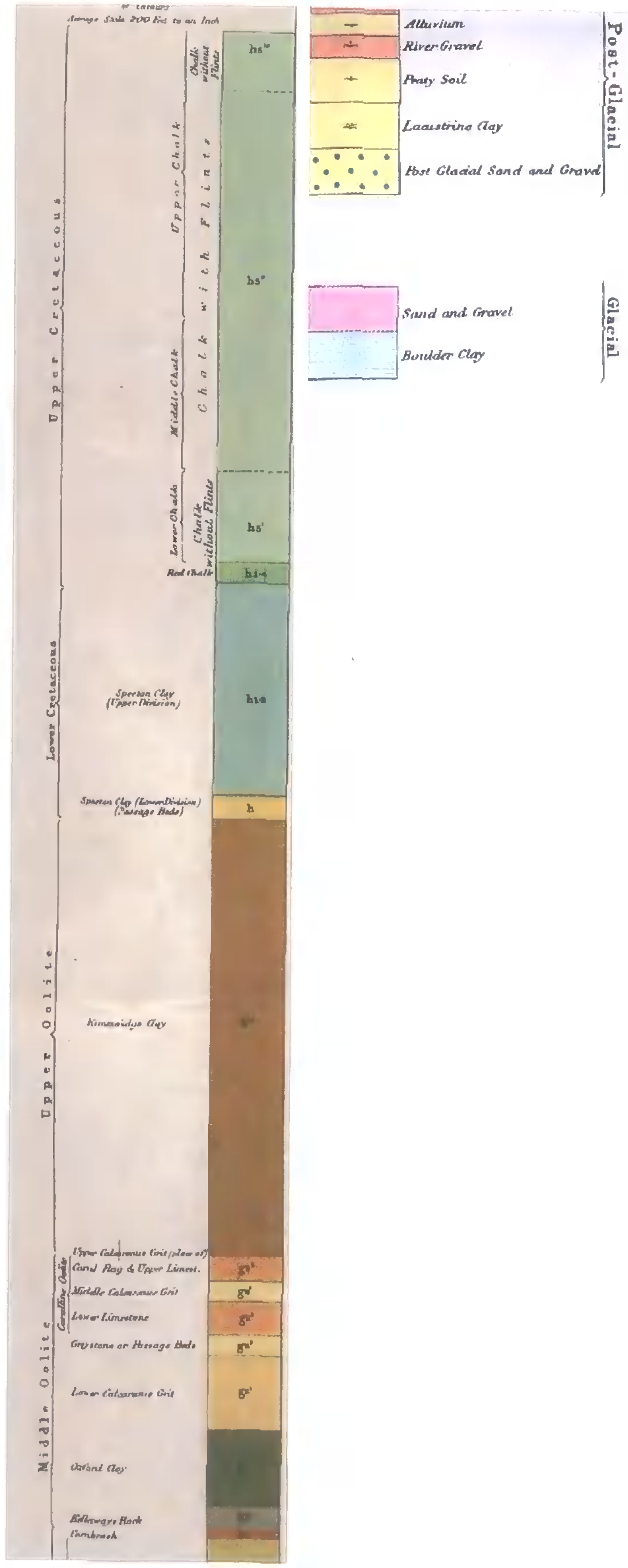


Figure 1.4 **Map Showing the simplified Geology of the Vale of Pickering (Geological Survey 1958)**

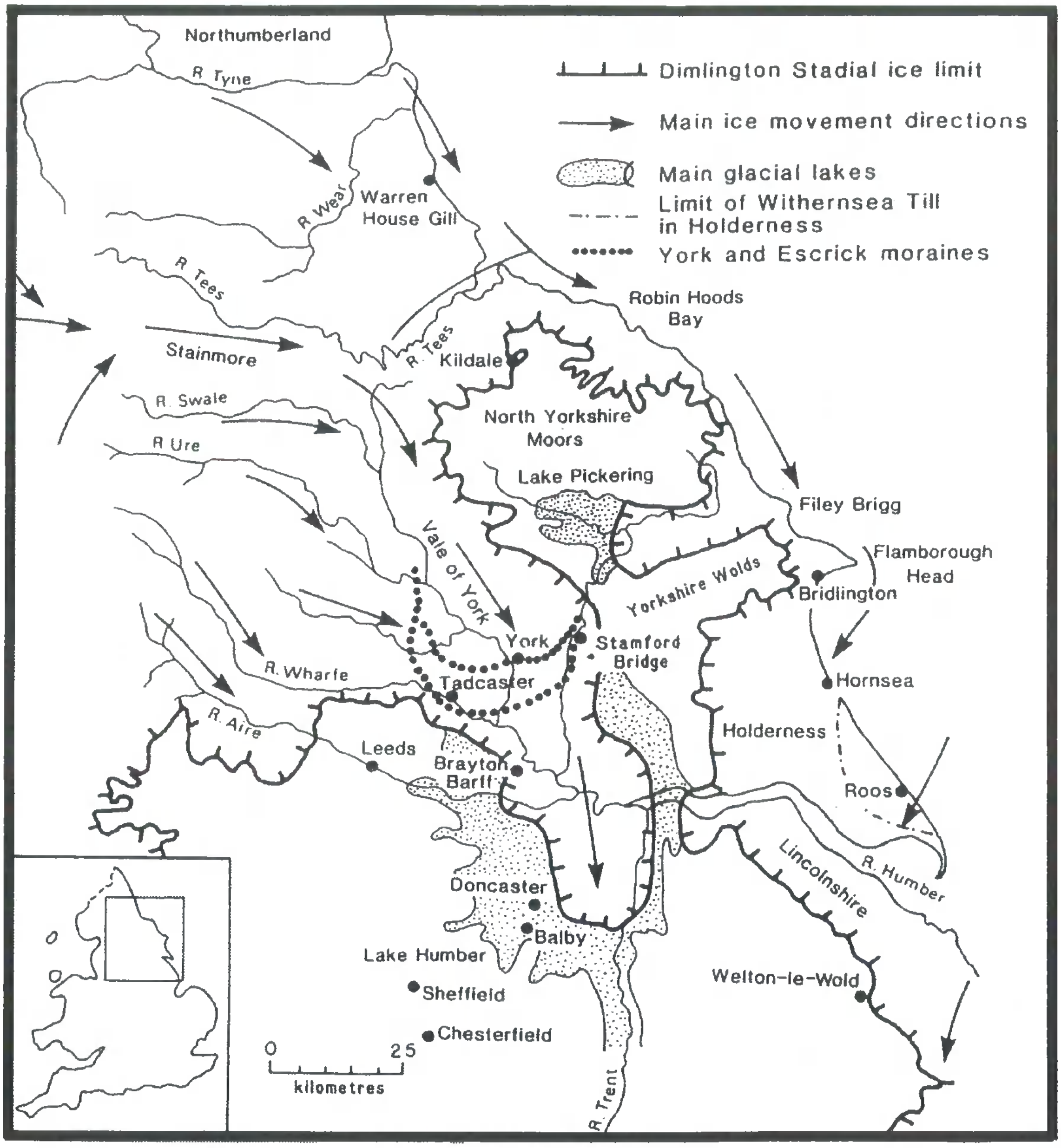
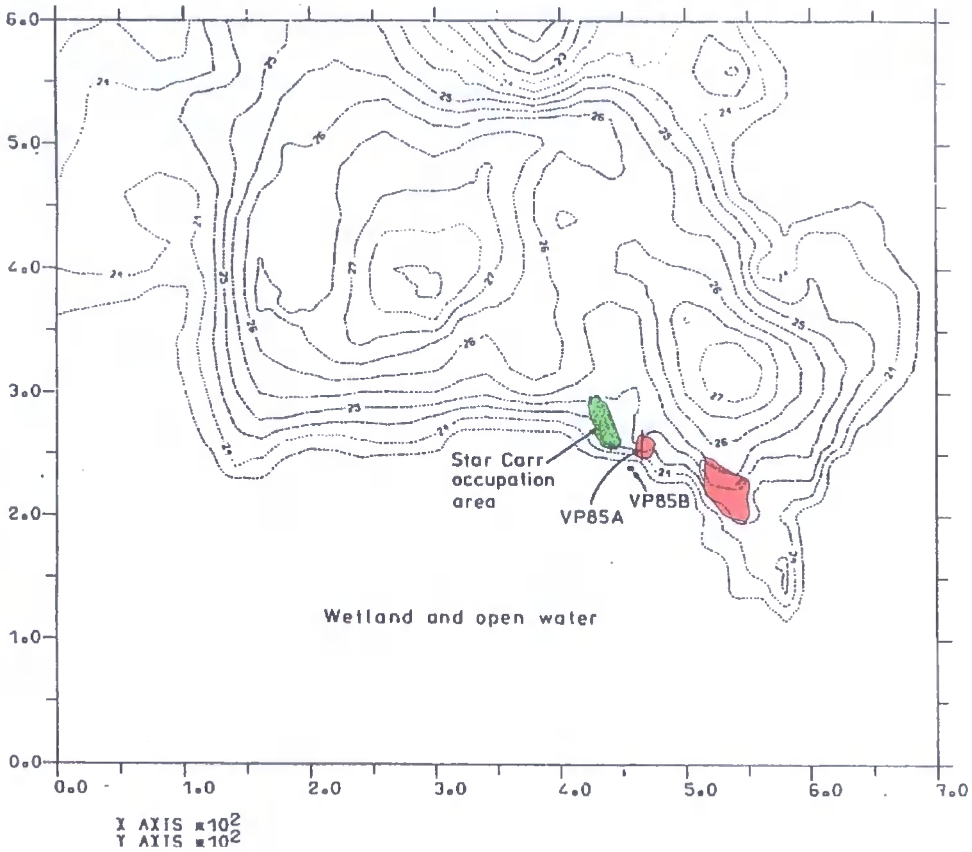


Figure 1.5 **Devensian ice movements in North-east England (Catt 1990)**



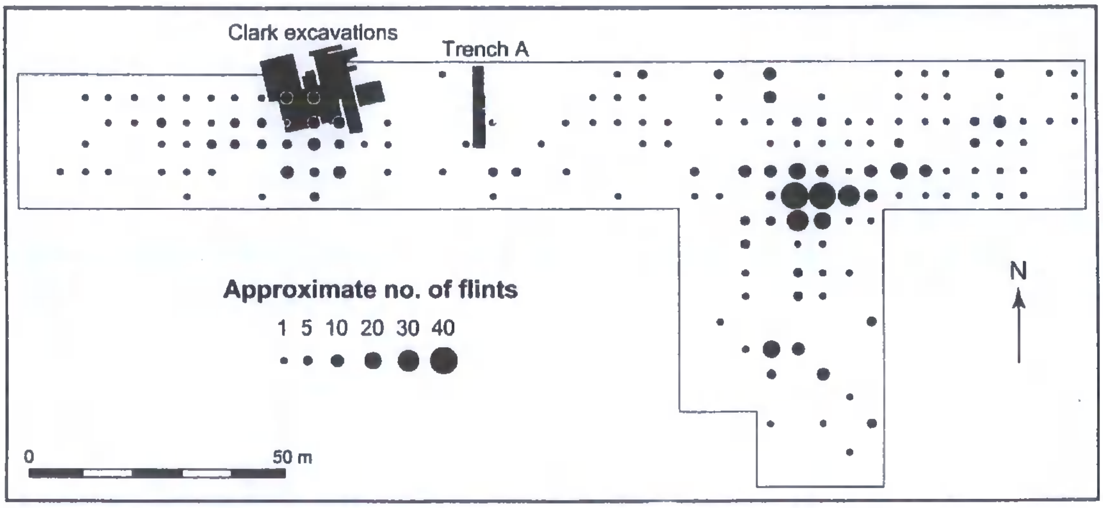


Figure 1.6 The extent of archaeological scatters at Star Carr after excavations in 1948-52 and 1985-1992 [from Cloutman and Smith 1988; from Mellars and Dark 1998].

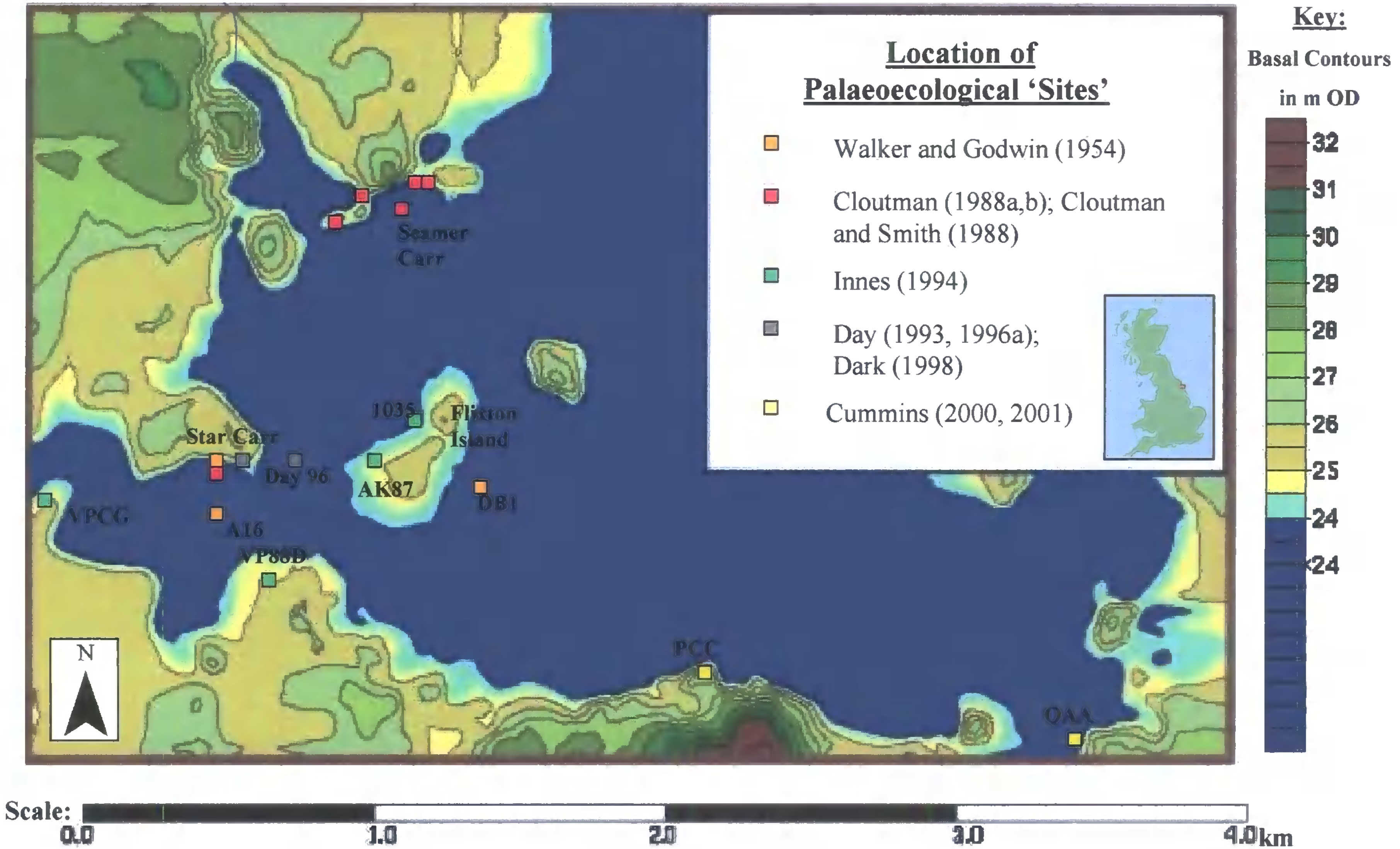


Figure 1.7 The location of palaeoecological sites within and around palaeo-Lake Flixton

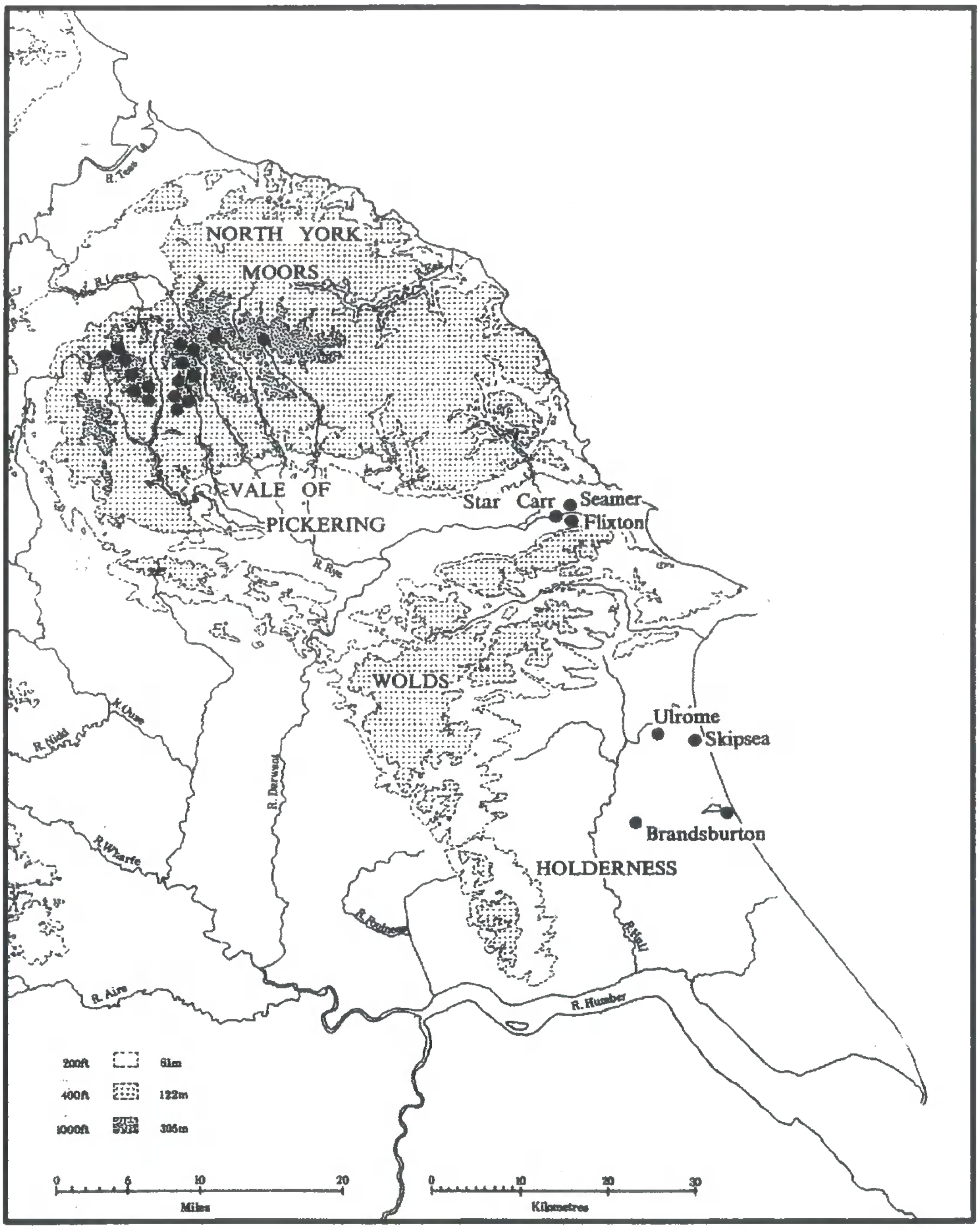


Figure 1.8 **Location of the Vale of Pickering in relation to early Mesolithic sites in North-east Yorkshire (Schadla-Hall 1988)**

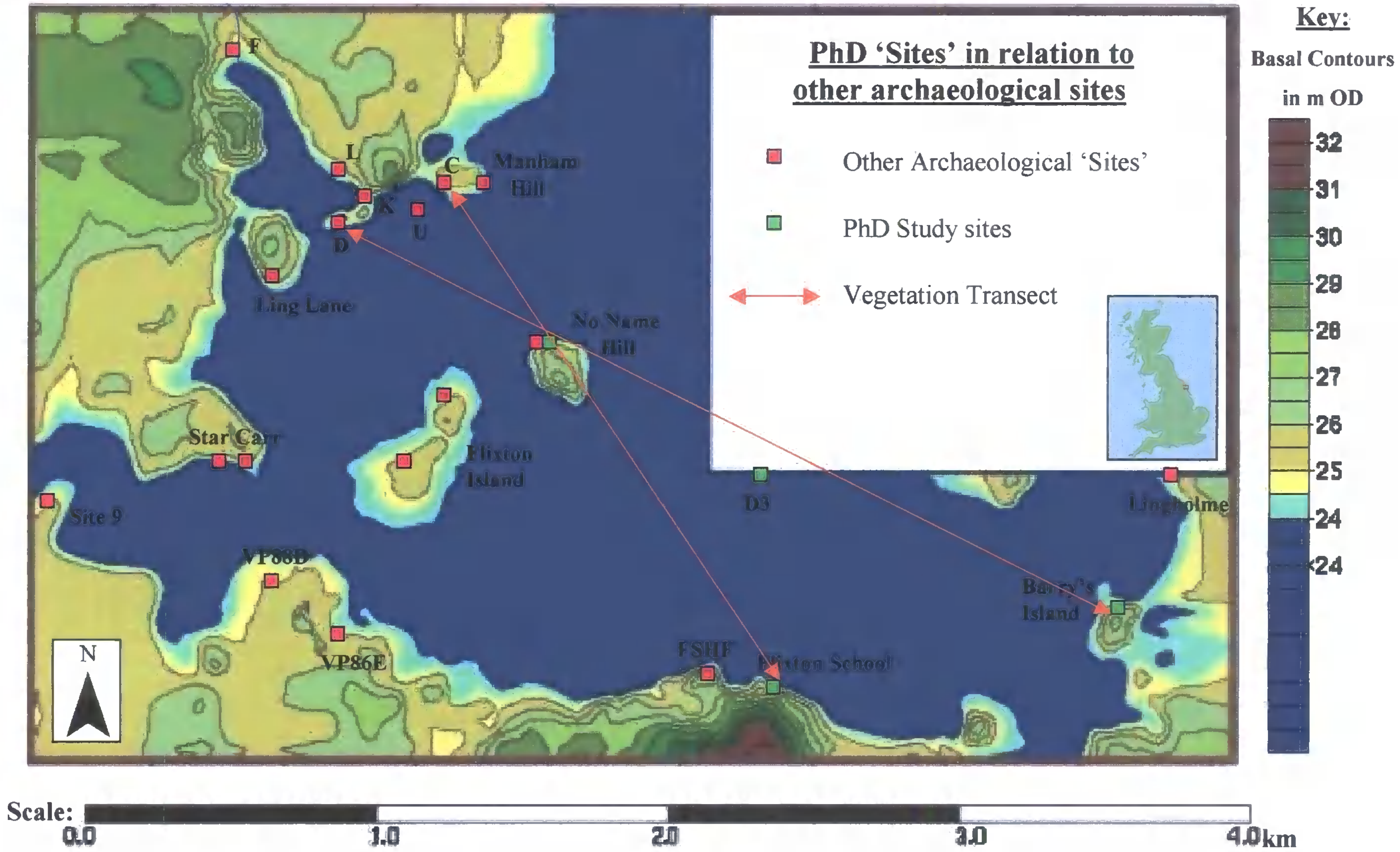


Figure 1.9 Location of PhD 'Sites' in relation to other early post-glacial archaeological sites

Chapter Two

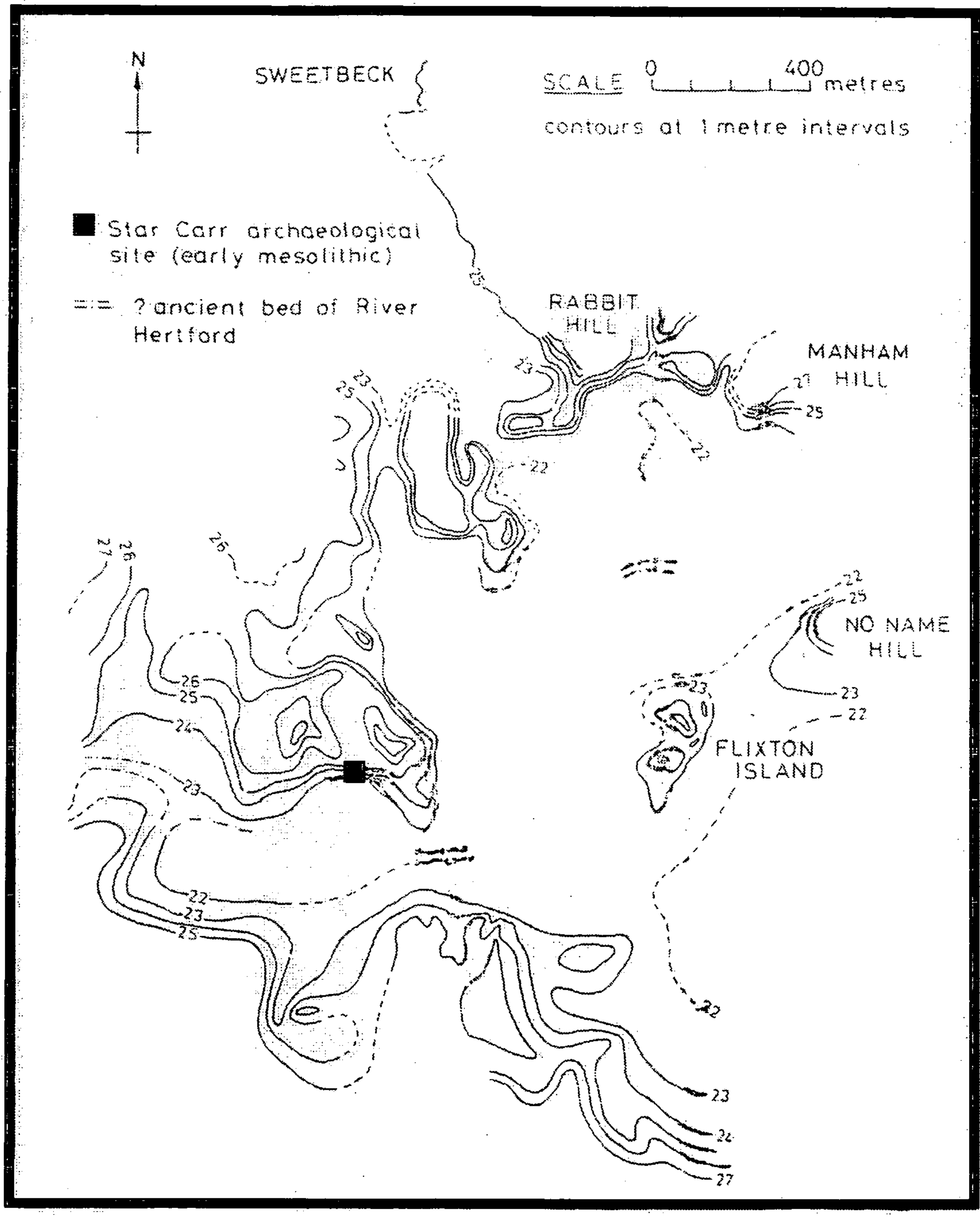


Figure 2.1 Basal contours along the western edge of palaeo-Lake Flixton (from Cloutman 1988a)

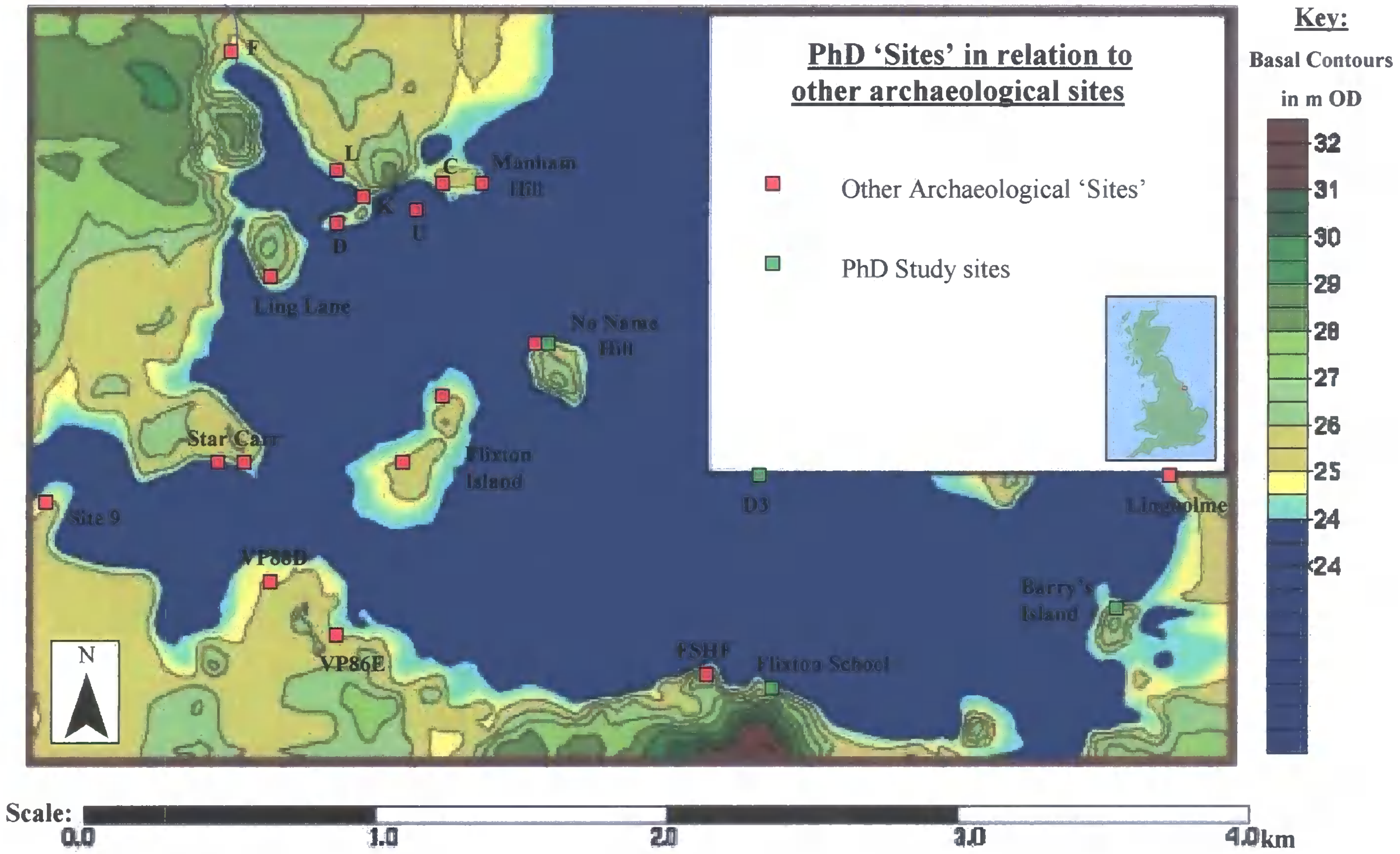


Figure 2.2 Location of PhD 'Sites' in relation to other early post-glacial archaeological sites

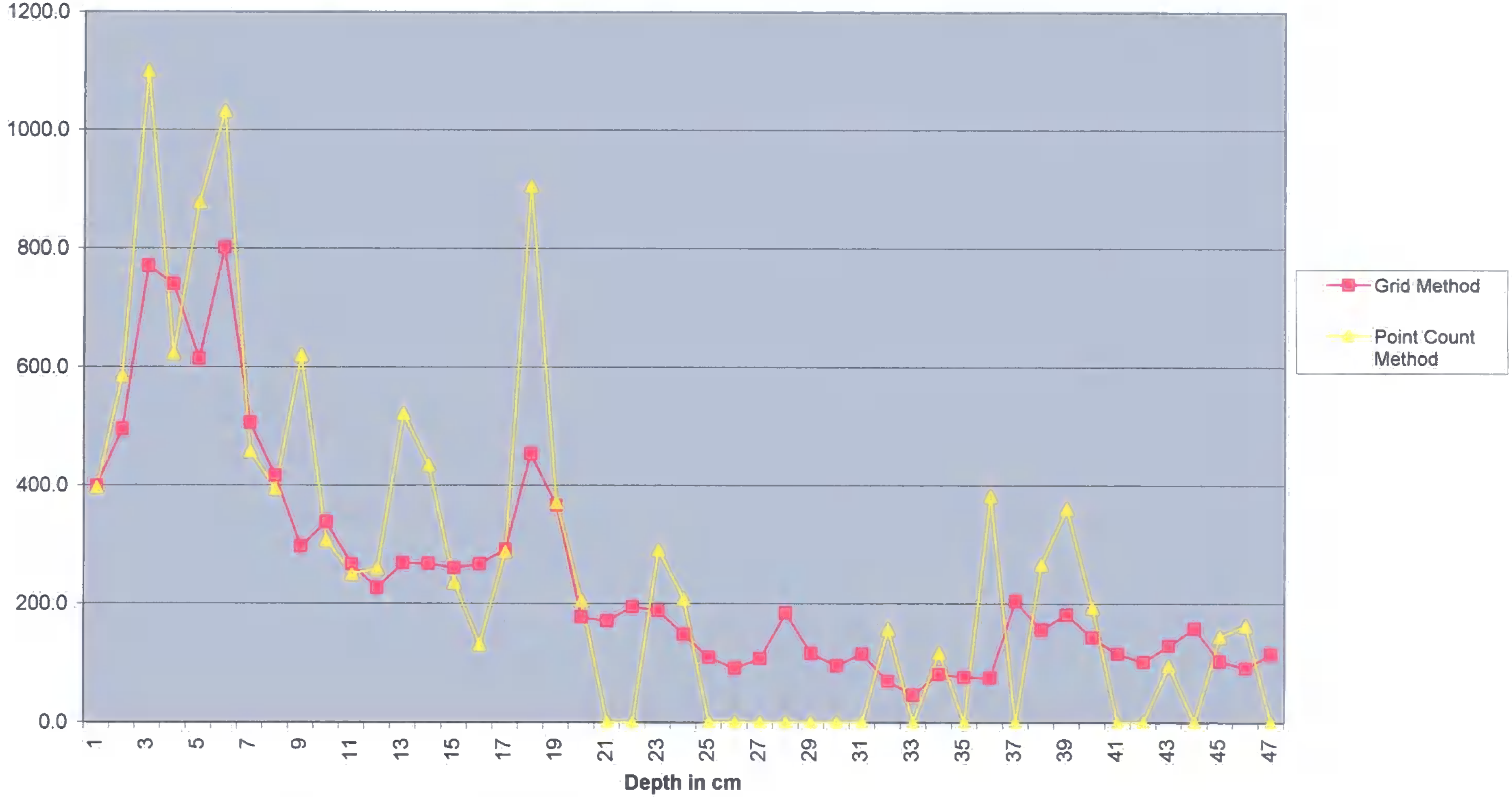


Figure 2.3 Comparison of Grid and Point Count Methods of Charcoal Area estimation from The Bowl (Backman 1984, Patterson *et al* 1987).

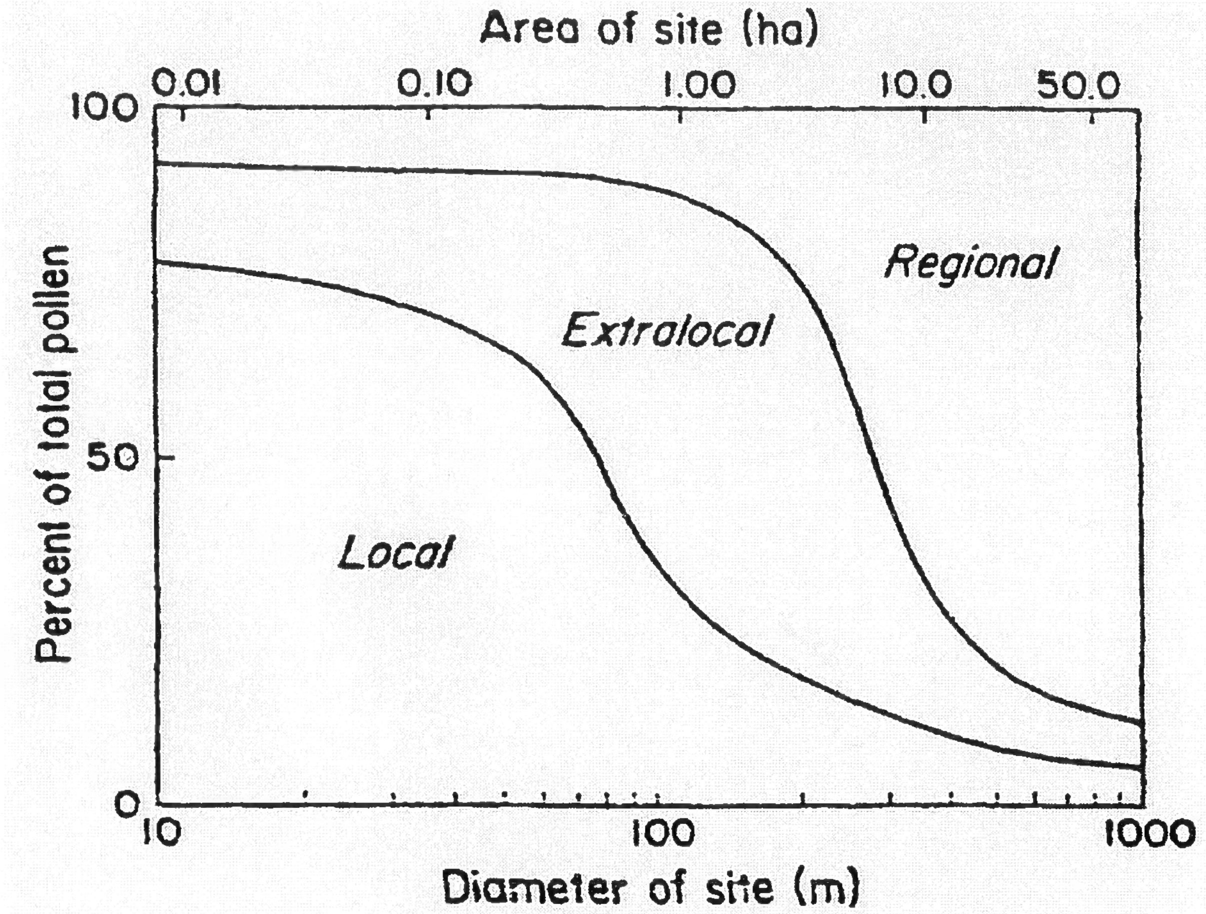


Figure 2.4 Schematic relationship between the size of a lake and relative areal source of pollen (from Jacobson and Bradshaw (1981)

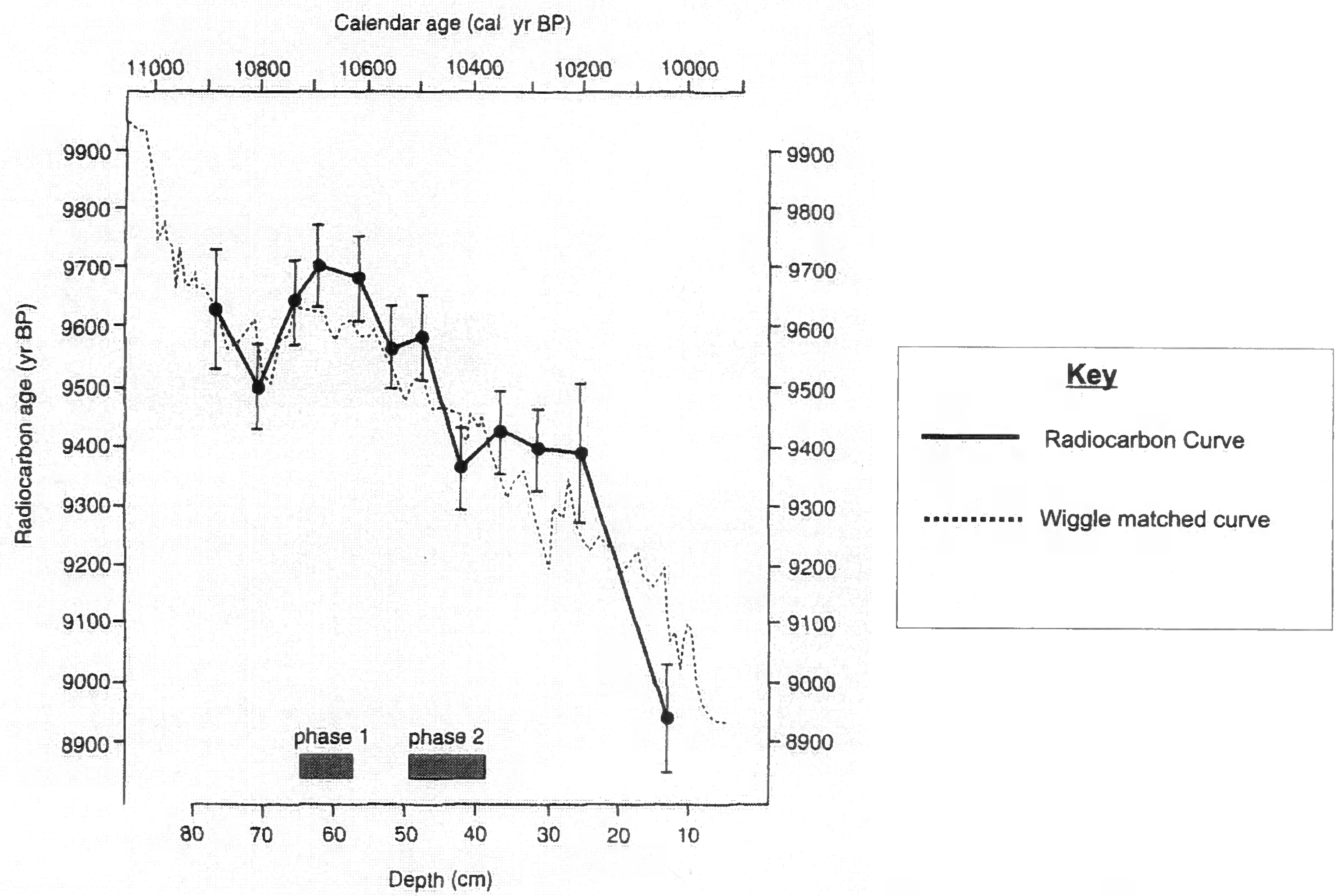


Figure 2.5 **'Wiggle matching' of AMS radiocarbon dates with the 9600 ^{14}C yr BP Radiocarbon Plateau (from Mellars and Dark 1998)**

Chapter Three

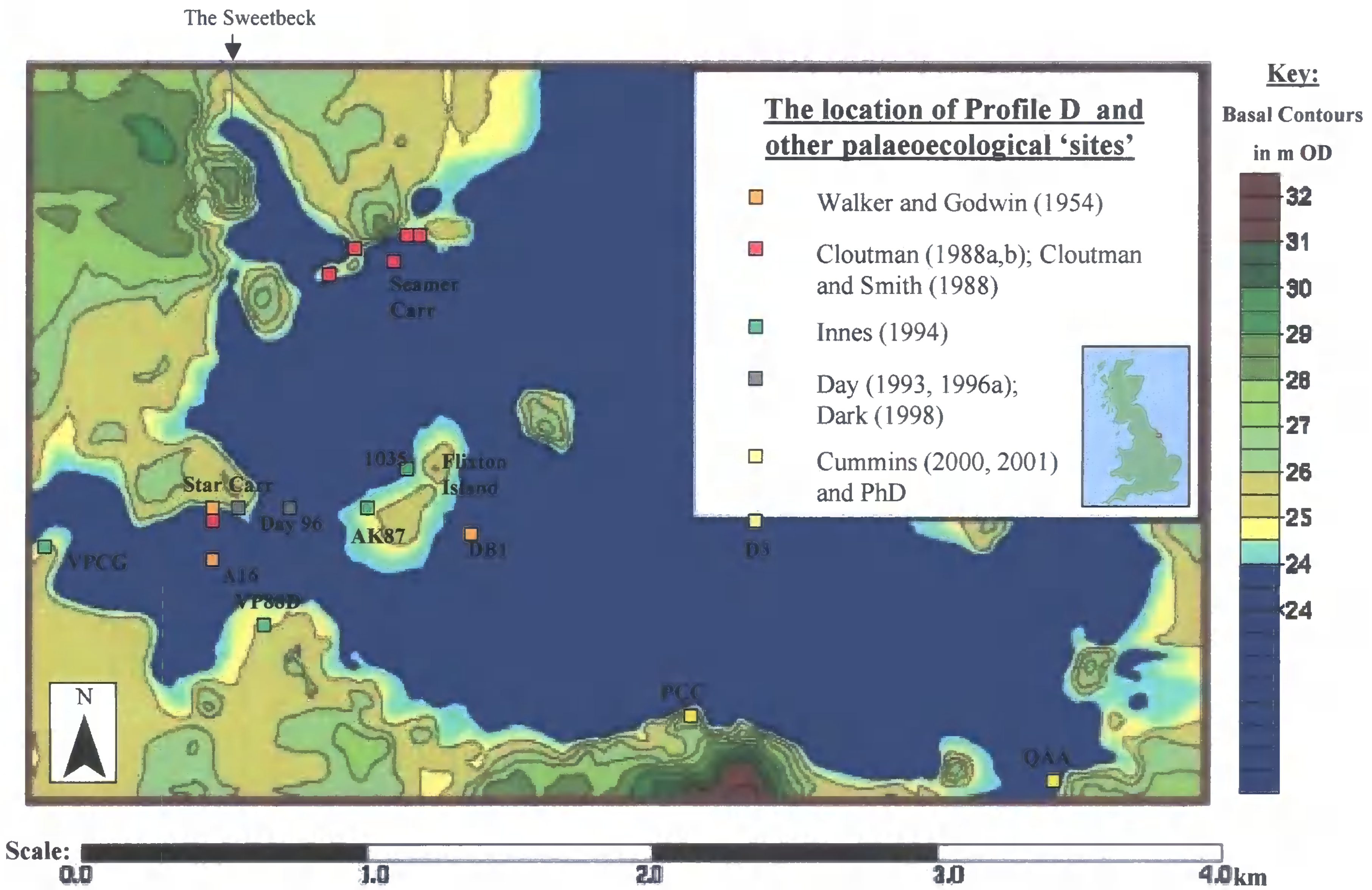


Figure 3.1 The location of Profile D in relation to other palaeoecological sites around palaeo-Lake Flixton

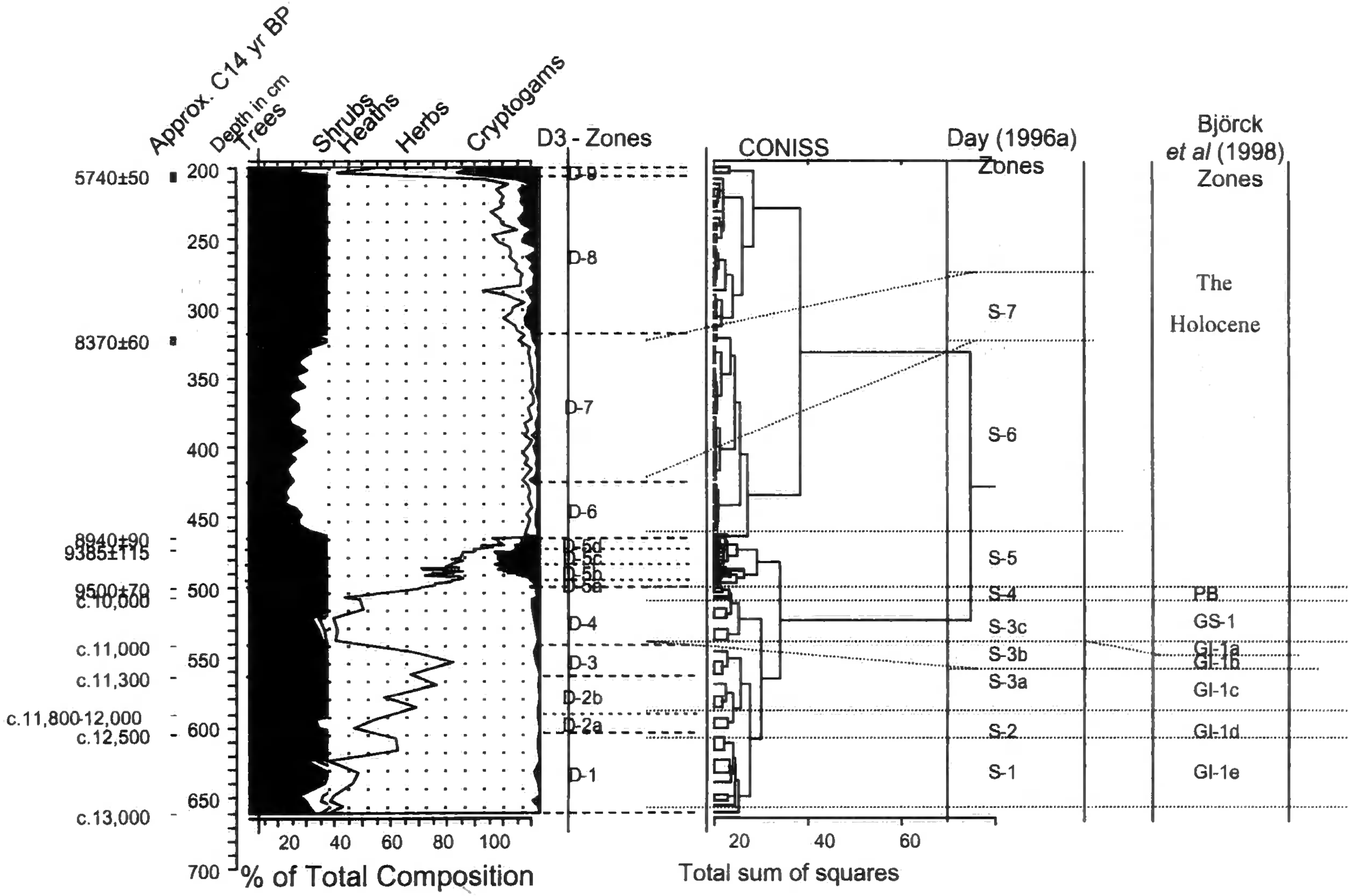


Figure 3.2 Zoning the Regional Profile – D3

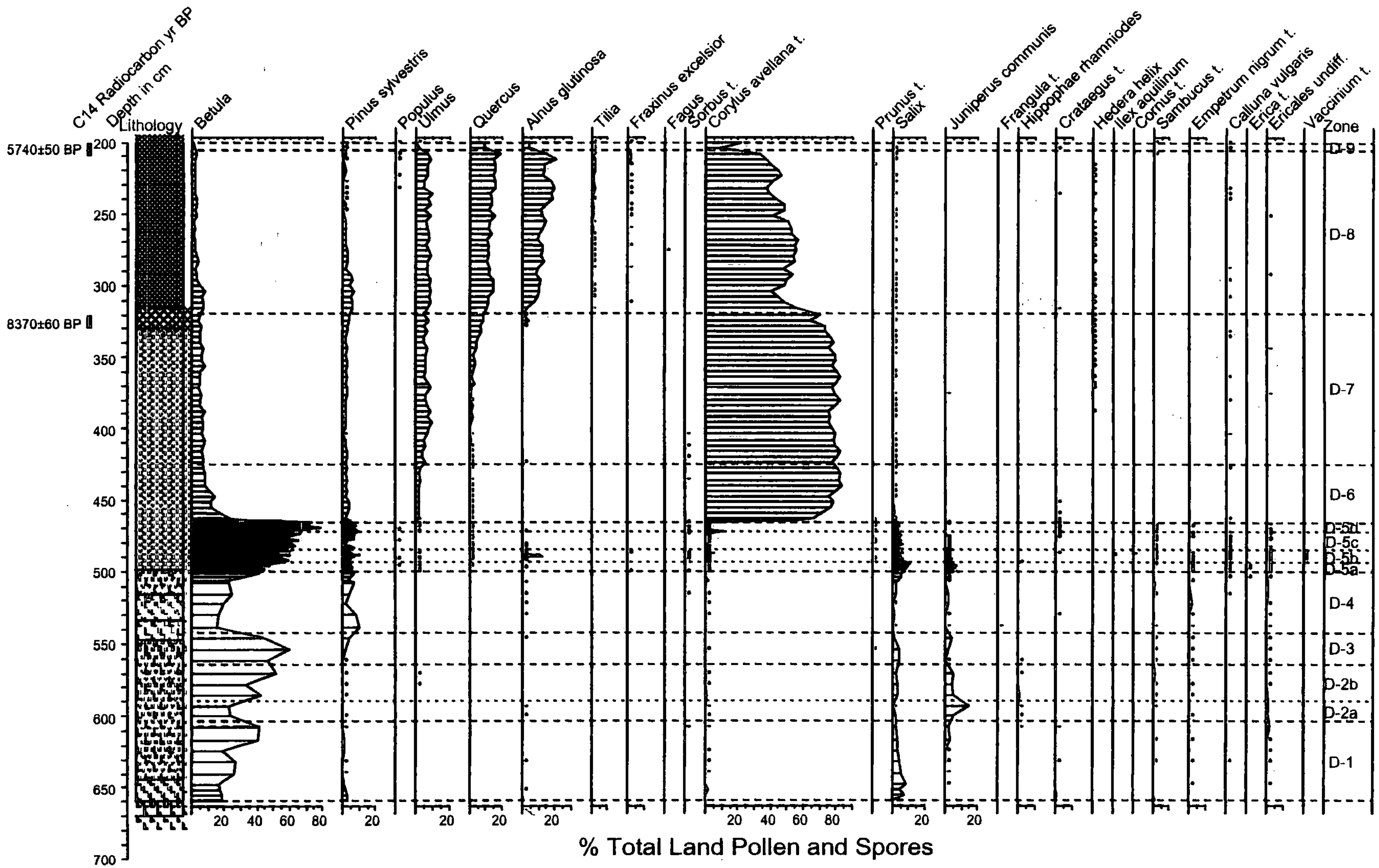


Figure 3.3 The Regional Profile - Tree, Shrub and Heath Taxa

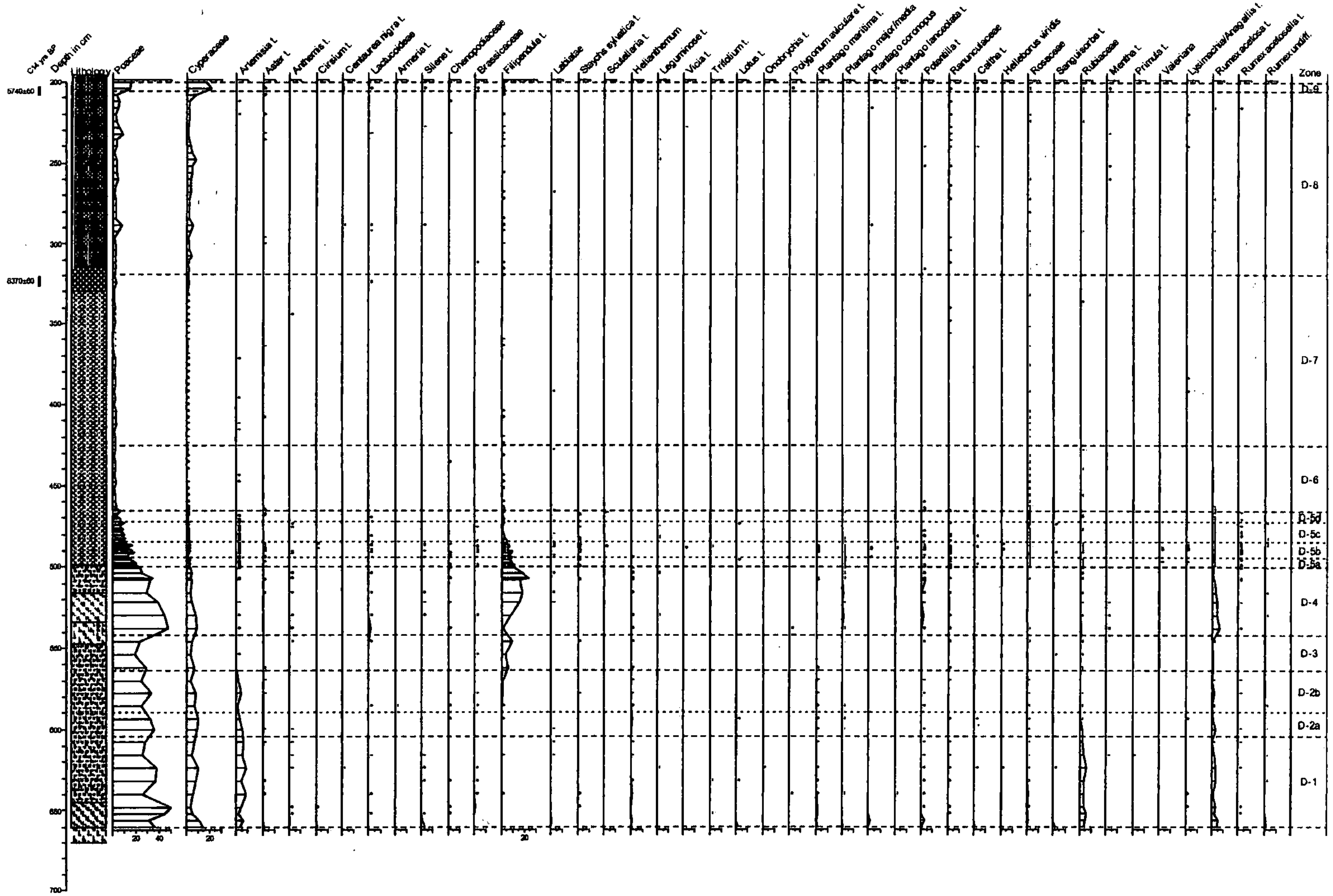


Figure 3.4a The Regional Profile - Herb, Aquatic and Spore Taxa

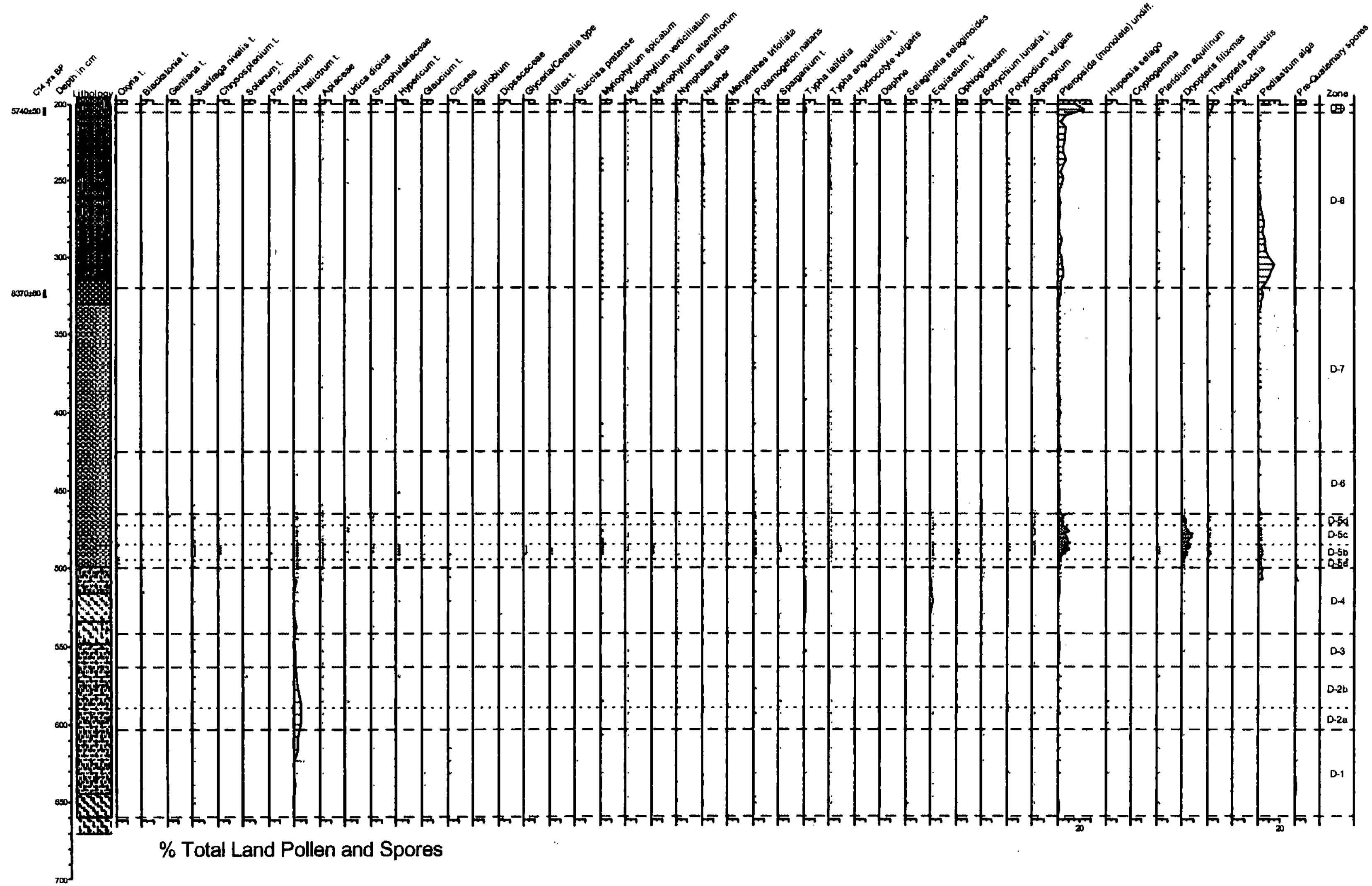


Figure 3.4b The Regional Profile-Herb, Aquatic and Spore Taxa (cont'd)

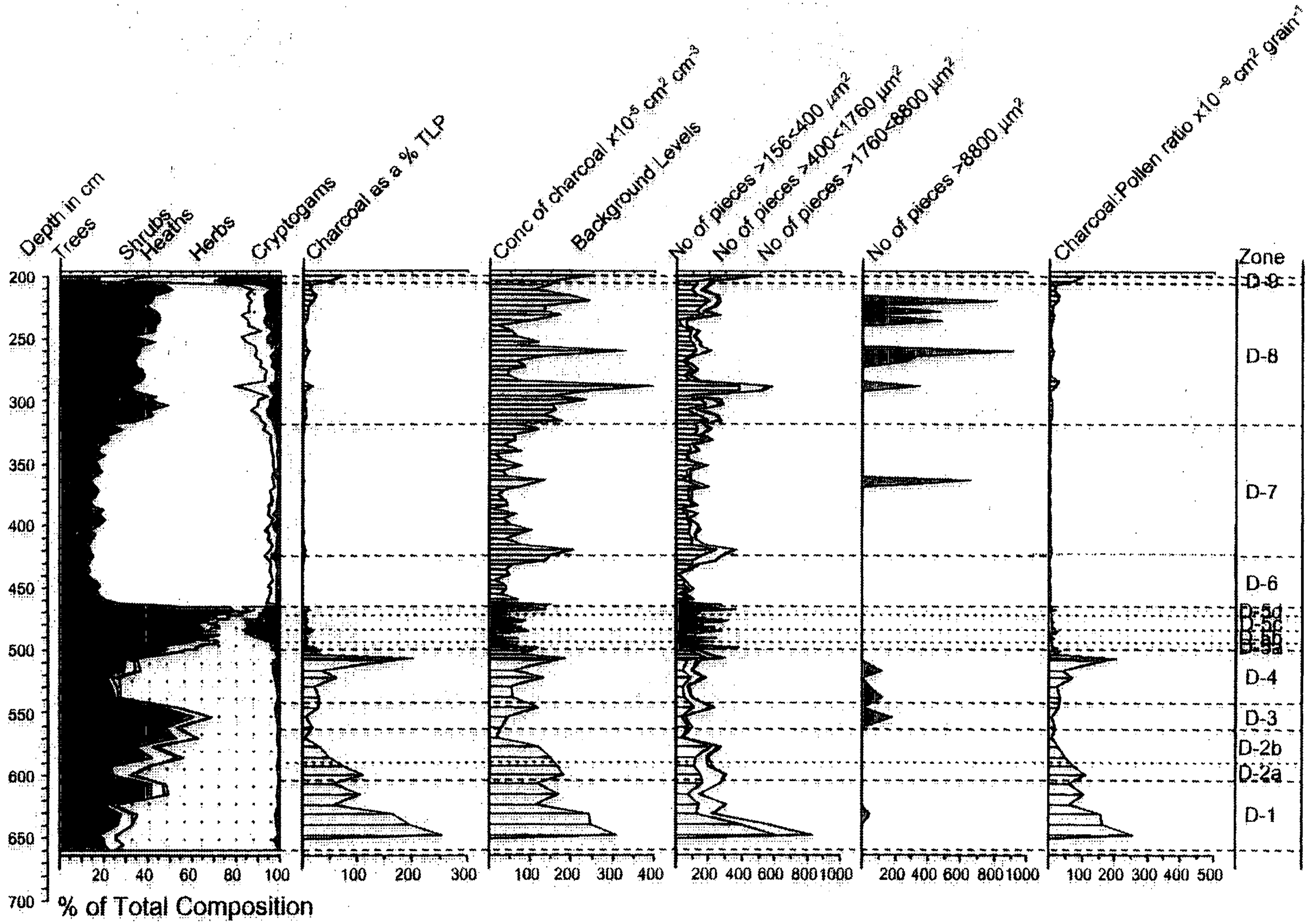


Figure 3.5 The Regional Profile - Summary Diagram

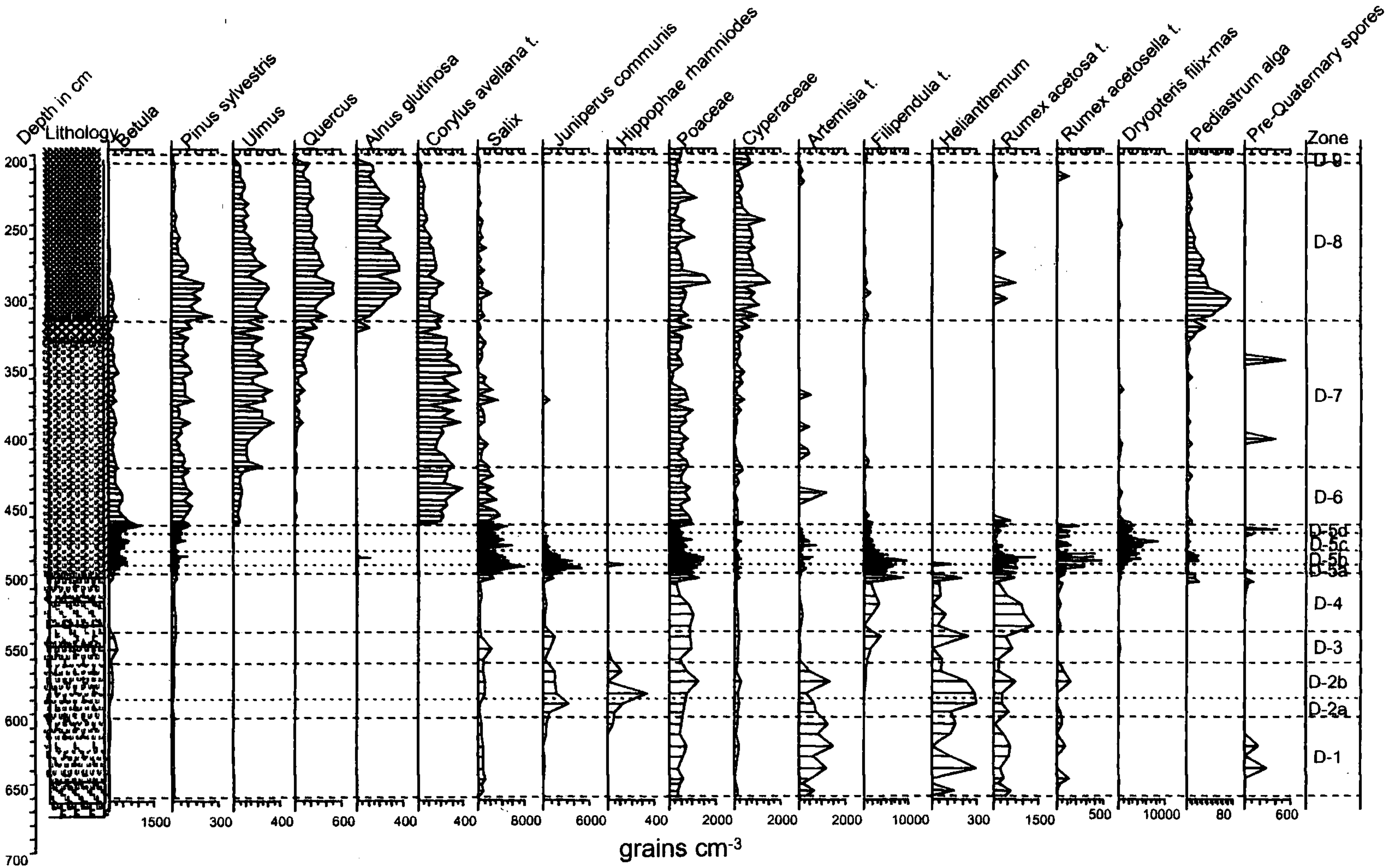


Figure 3.6 Pollen Concentration Curves - Selected Taxa

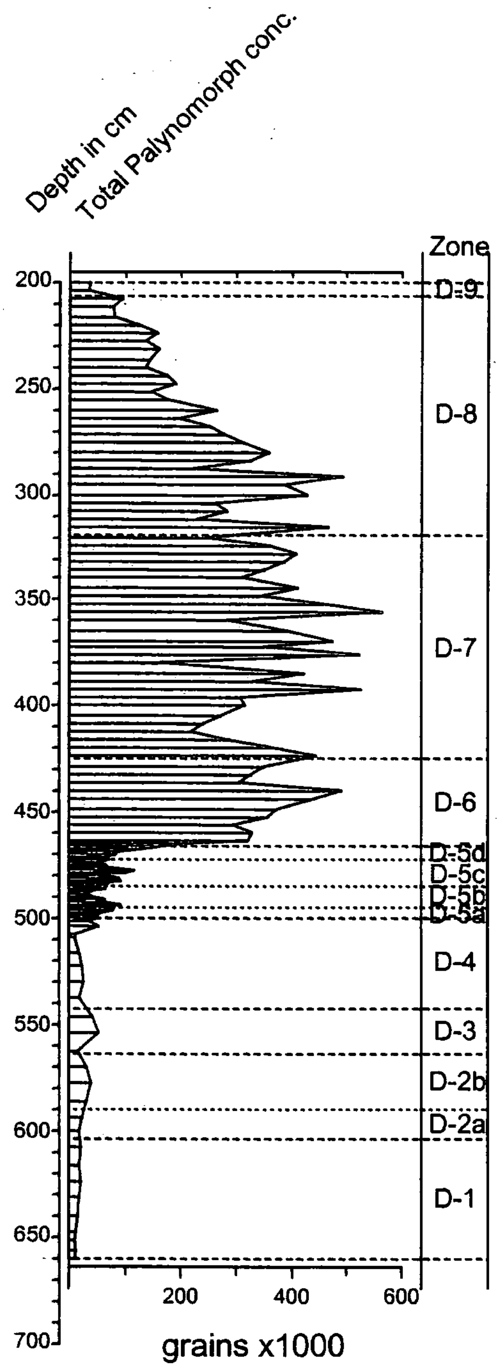
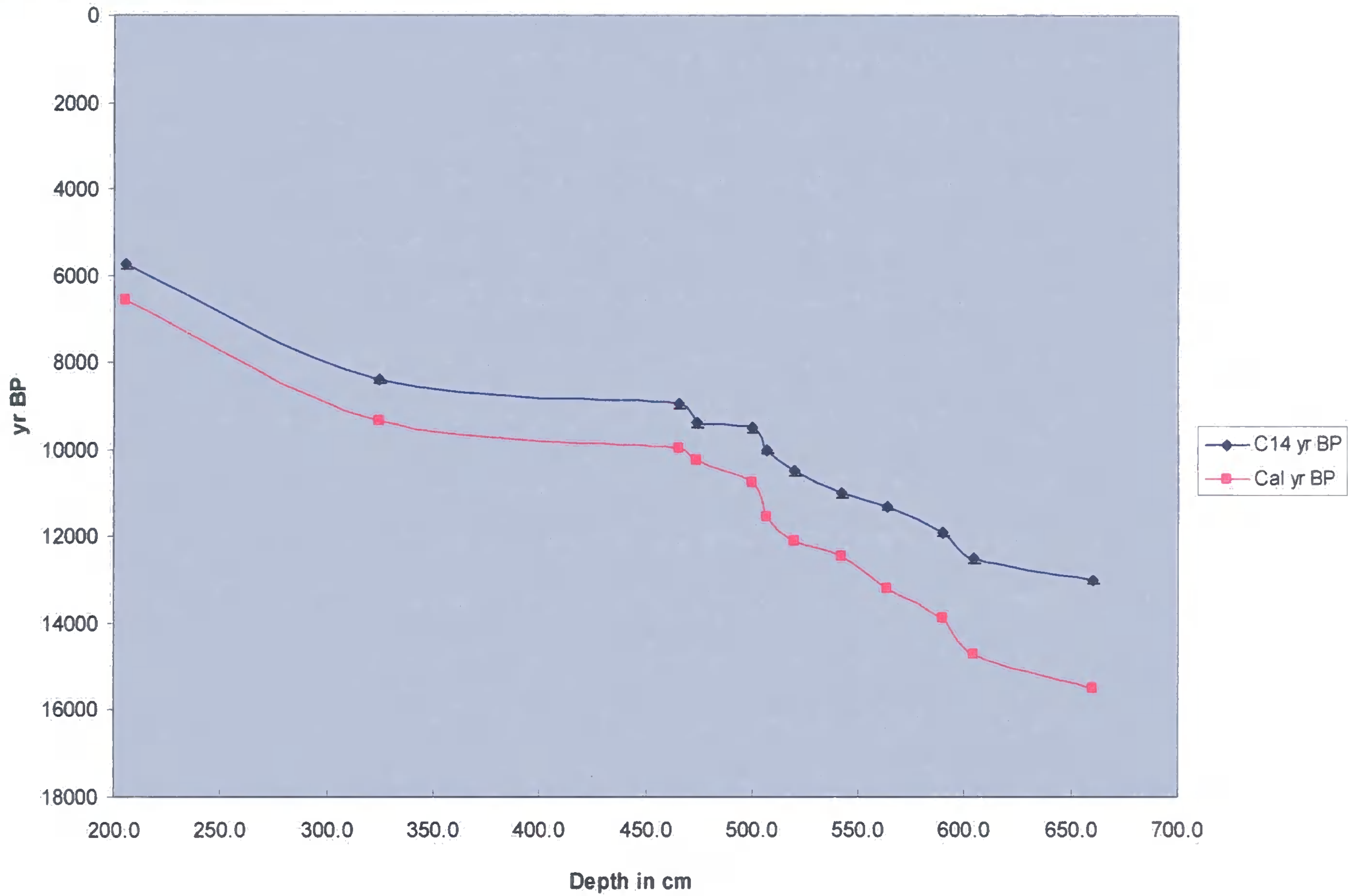


Figure 3.7 The Regional Profile - Pollen Concentration Curve



<u>Figure 3.8</u> <u>Time-Depth curve for The Regional Profile (to 2 SE)</u>

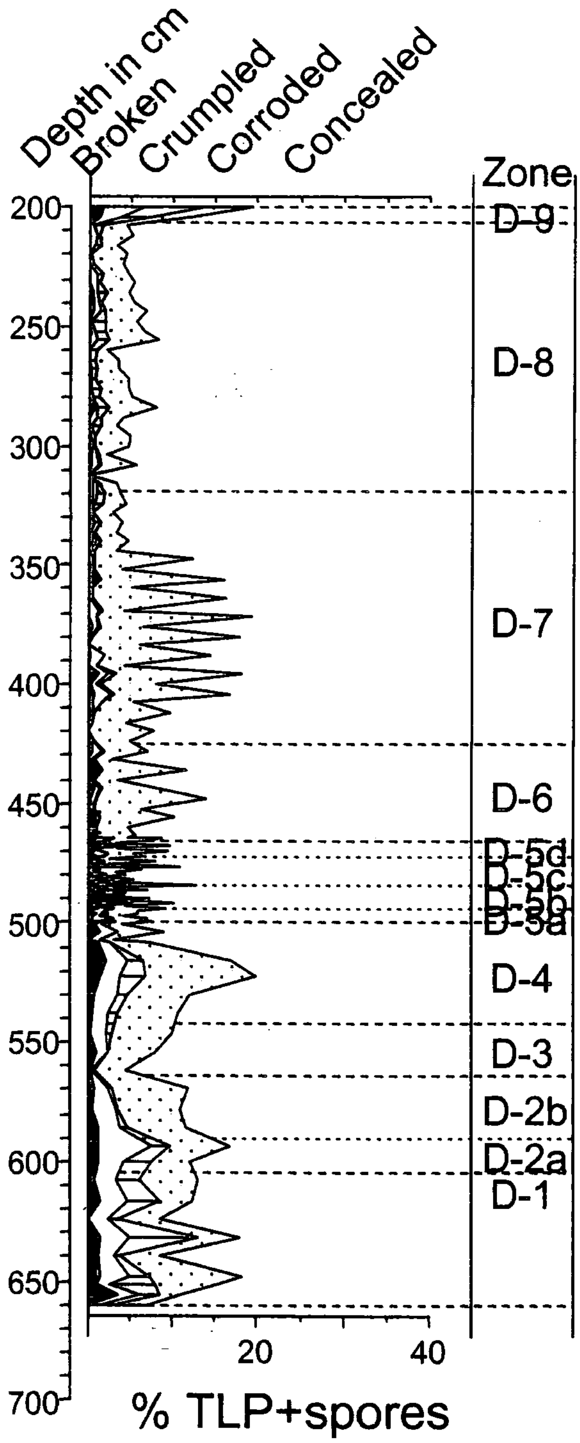


Figure 3.9 The Regional Profile – Pollen Preservation

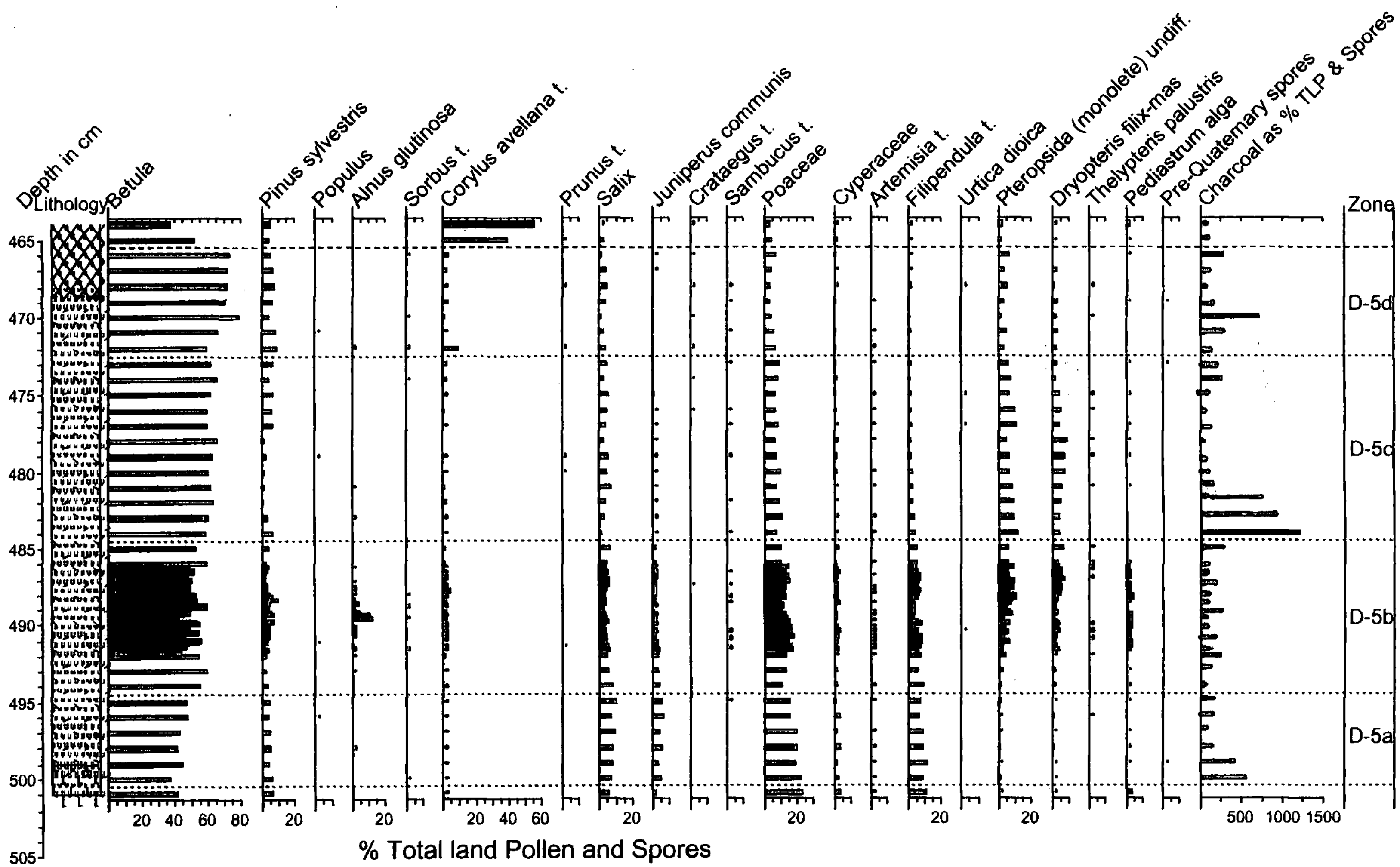


Figure 3.10 The Regional Profile - early Mesolithic only

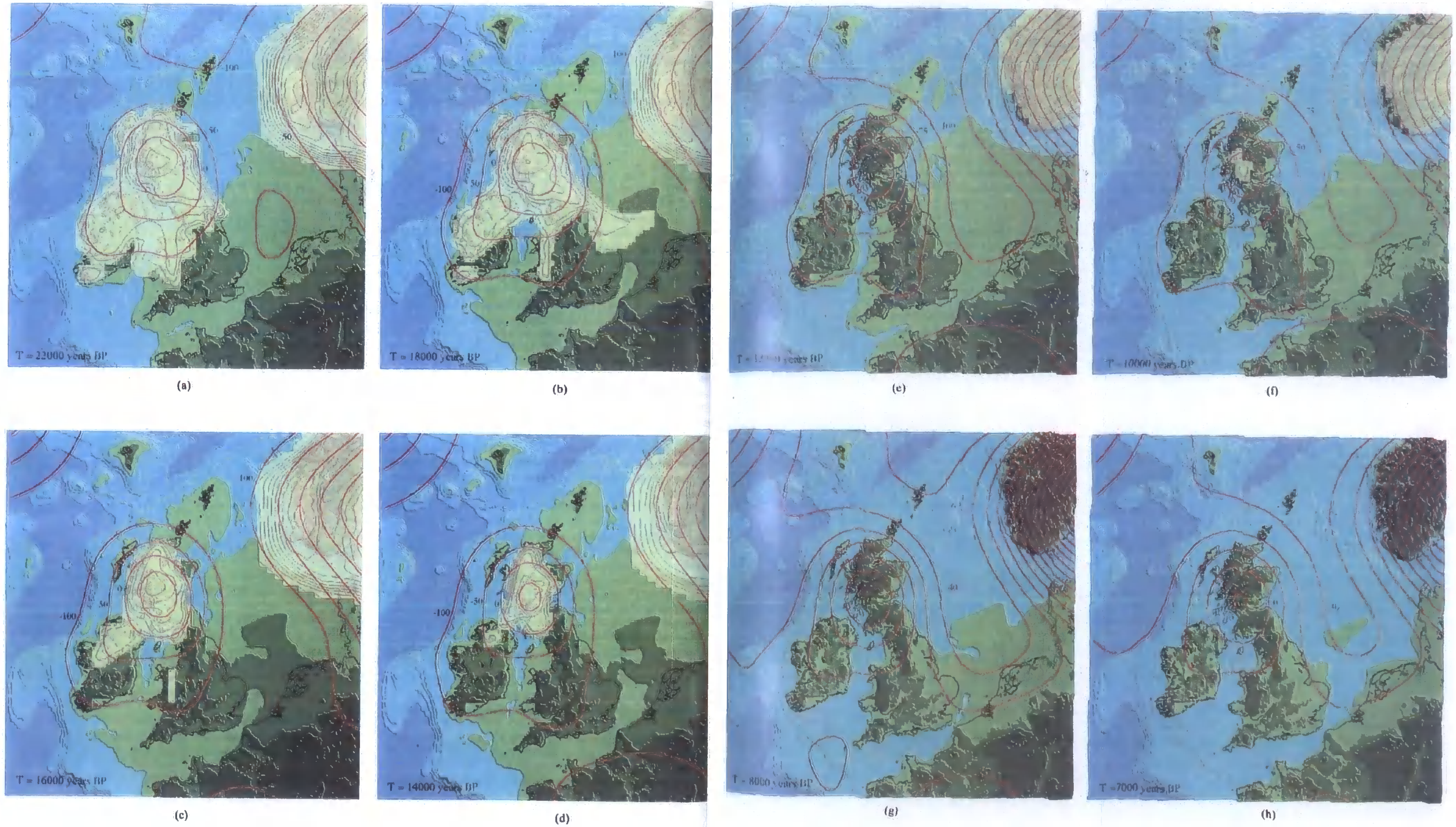


Figure 3.11 **Isobase Maps of Predicted Shorelines and Ice sheet limits for selected epochs from 22,000 yr BP to 7000 yr BP (from Lambeck 1995).**

Figure 3.12 Photograph of Open Birch Woodland. This photo-graph illustrates the low density of the undergrowth which allows ease of movement throughout the woodland. It also show the high percentage of light that is able to filter through the canopy.

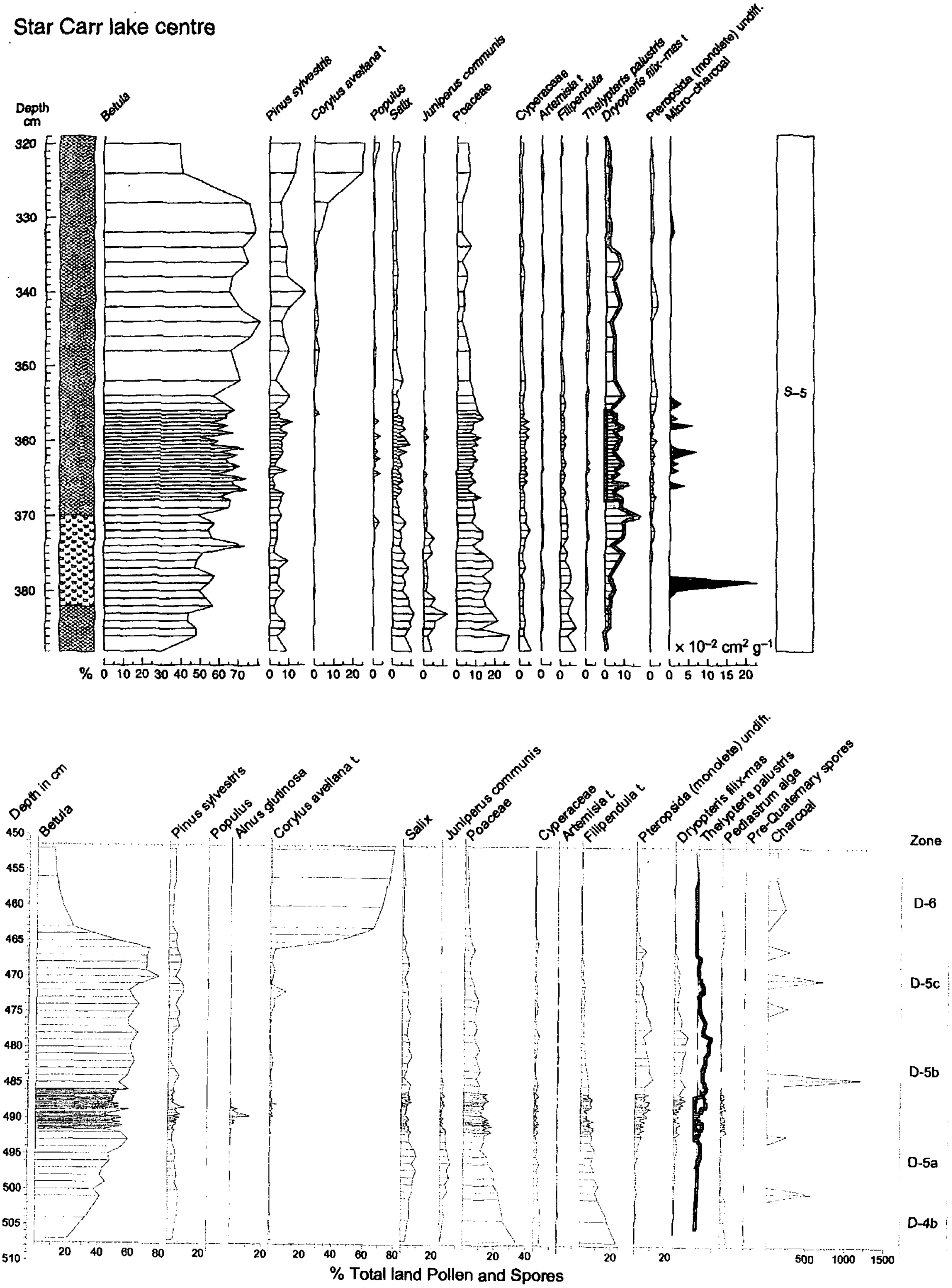


Figure 3.13 **Comparison of Early Mesolithic sediments from near to Star Carr (Day 1996a) and early Mesolithic sediments from Profile D.**

Figure 3.14a The Regional Profile (D3) – Trees and Shrubs, 95% Confidence Limits

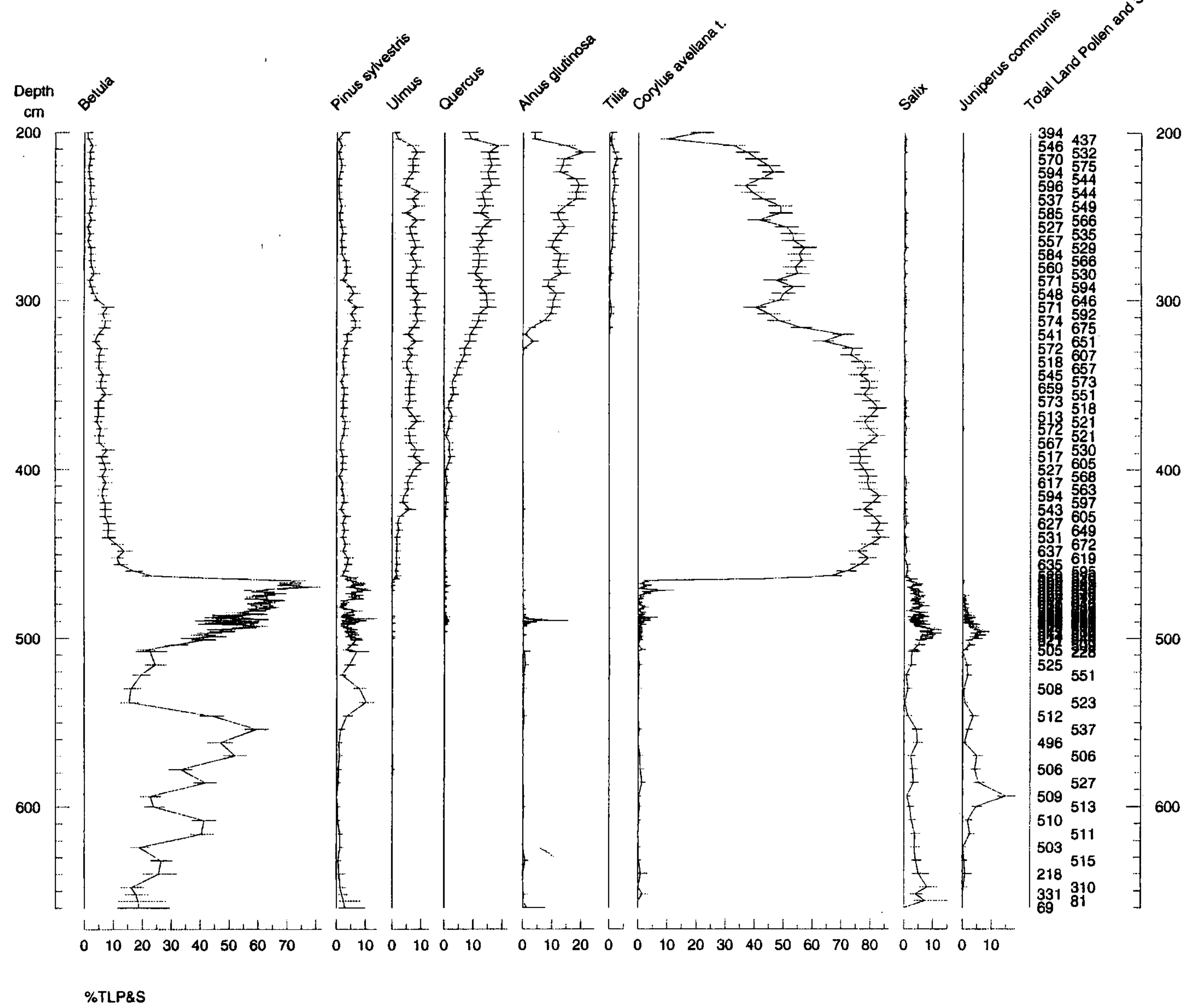


Figure 3.14b The Regional Profile – Herb pollen, 95% Confidence Limits

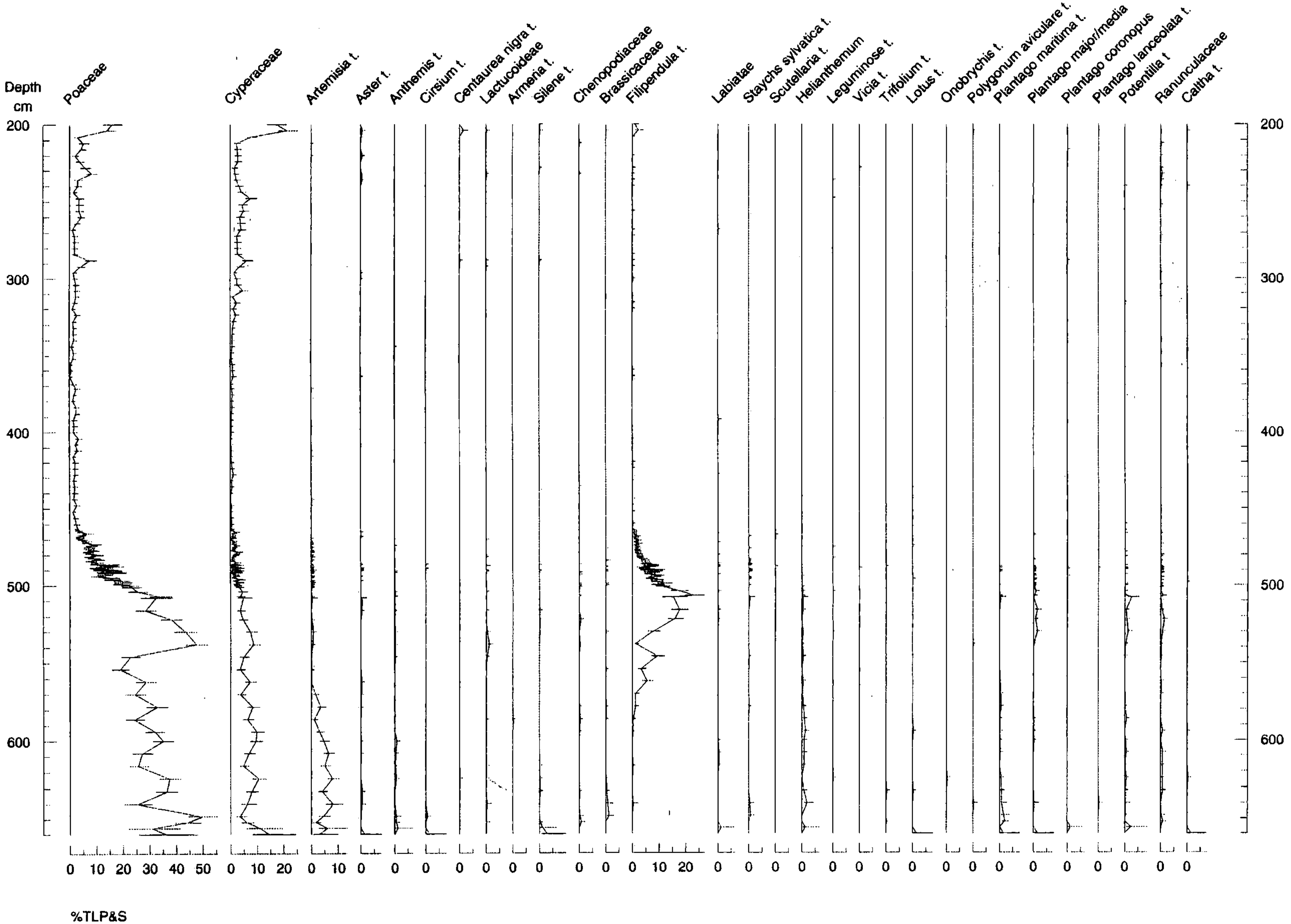


Figure 3.14c The Regional Profile – Herbs, Aquatics and Spores, 95% Confidence Limits

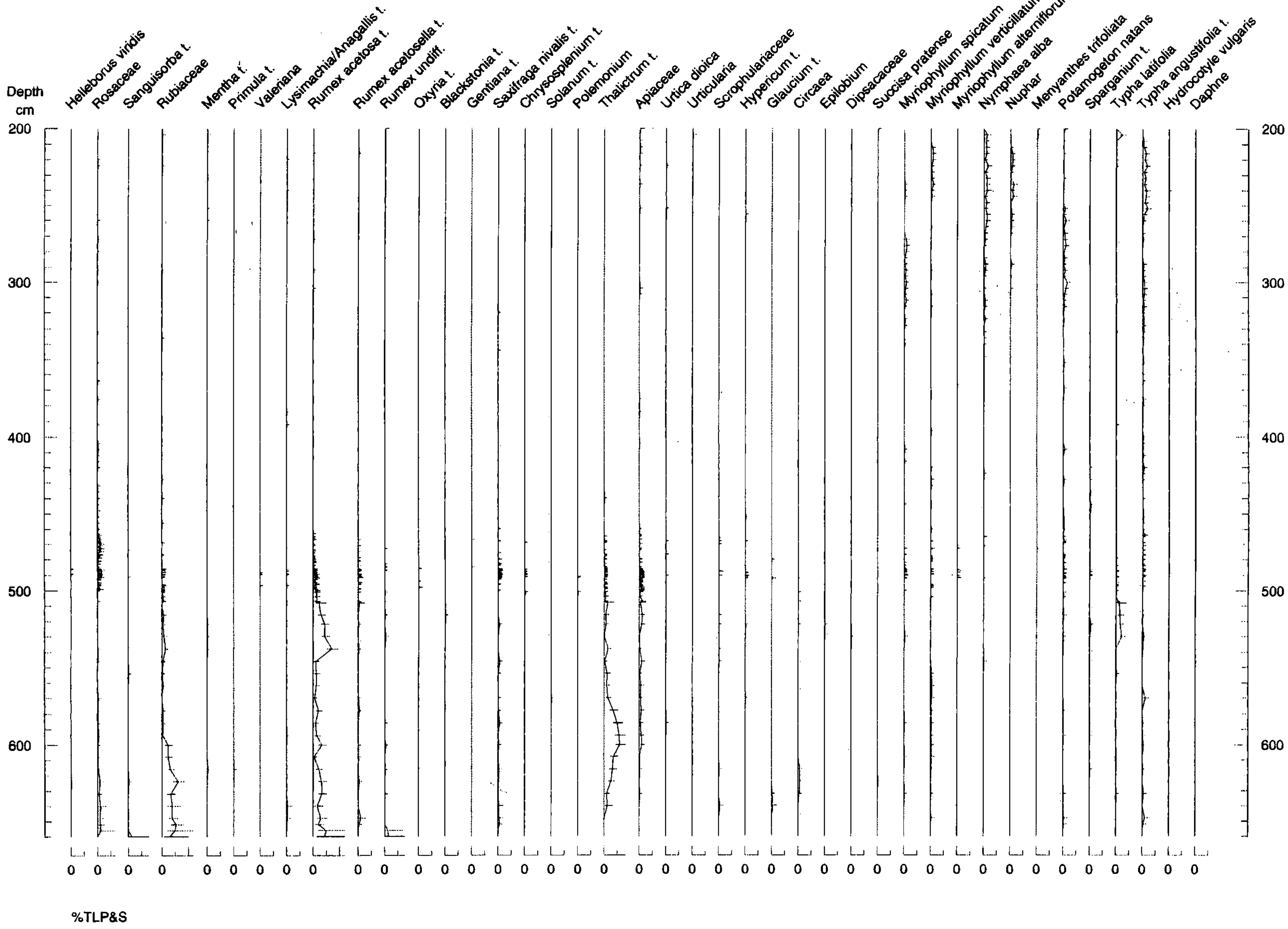


Figure 3.14d The Regional Profile - Aquatics and Spores, 95% Confidence Limits

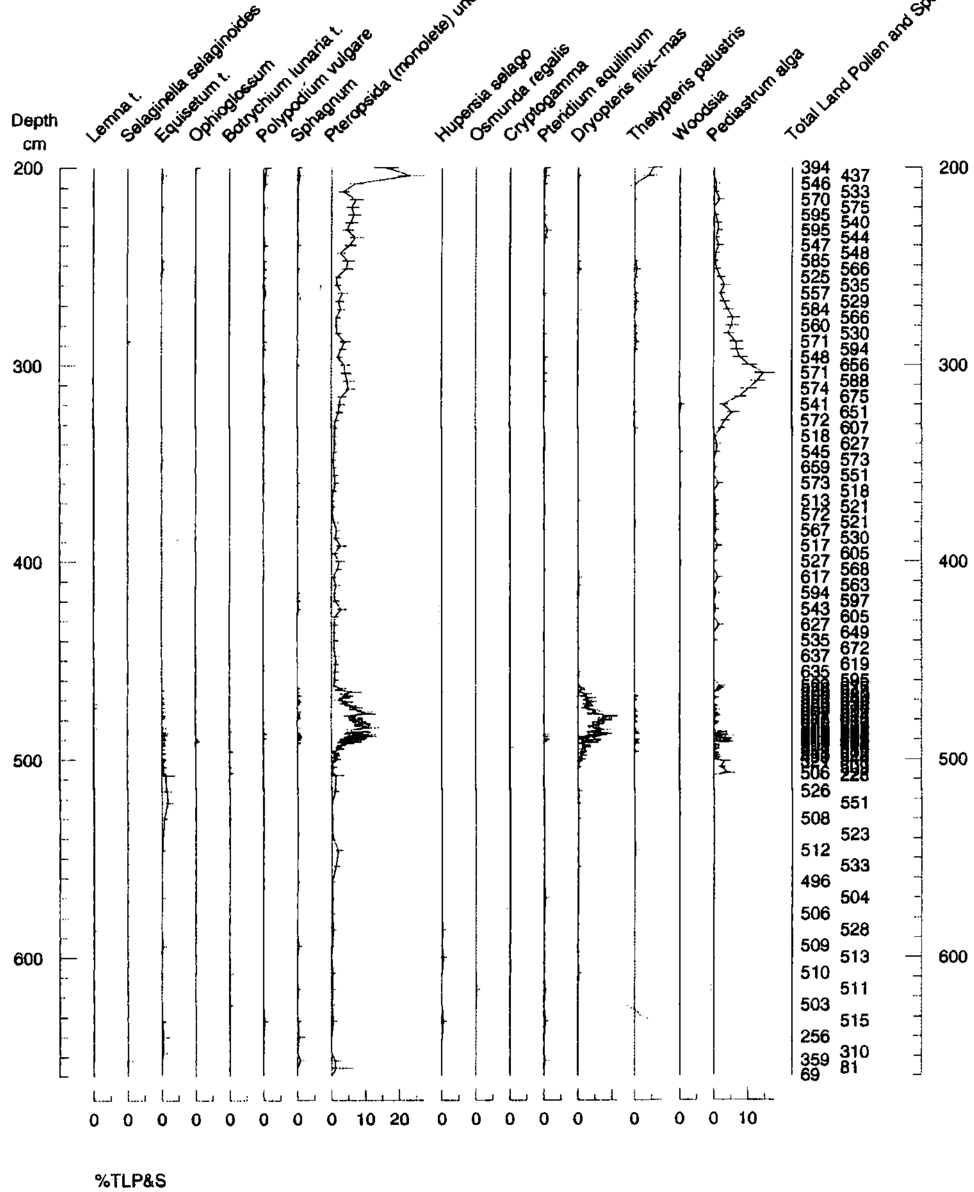


Figure 3.15a The Regional Profile – early Mesolithic, 95% Confidence Limits

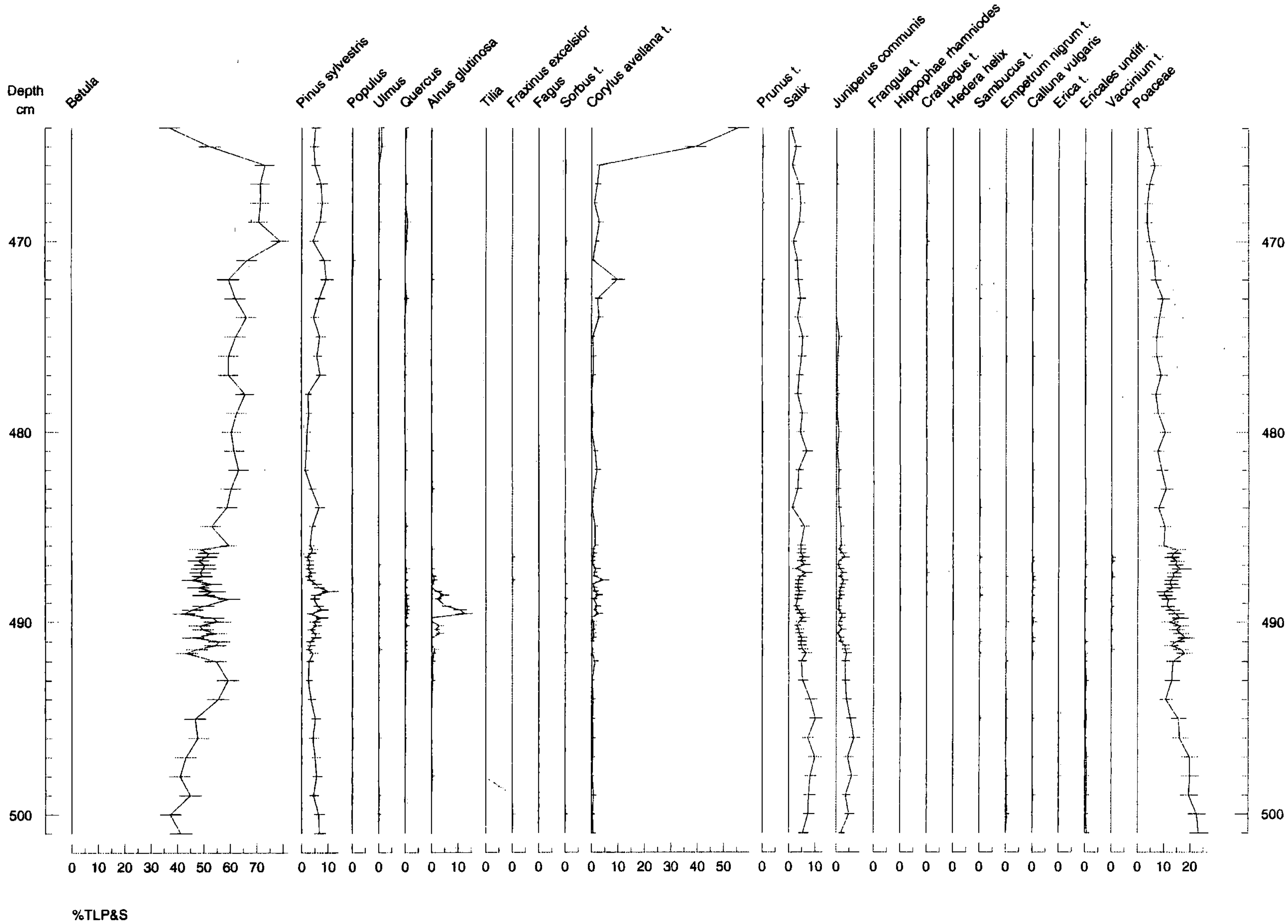
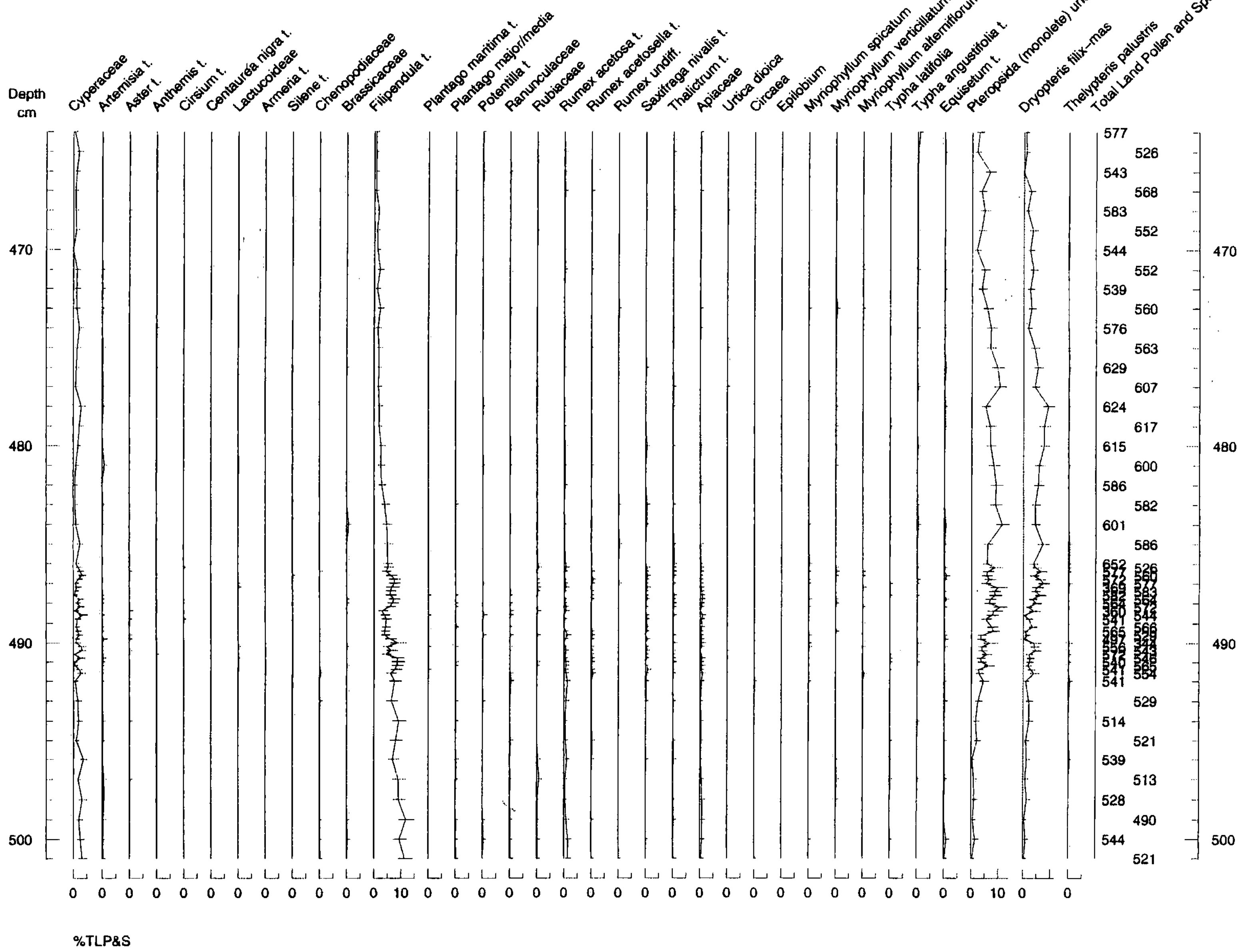


Figure 3.15b The Regional Profile – early Mesolithic, 95% Confidence Limits



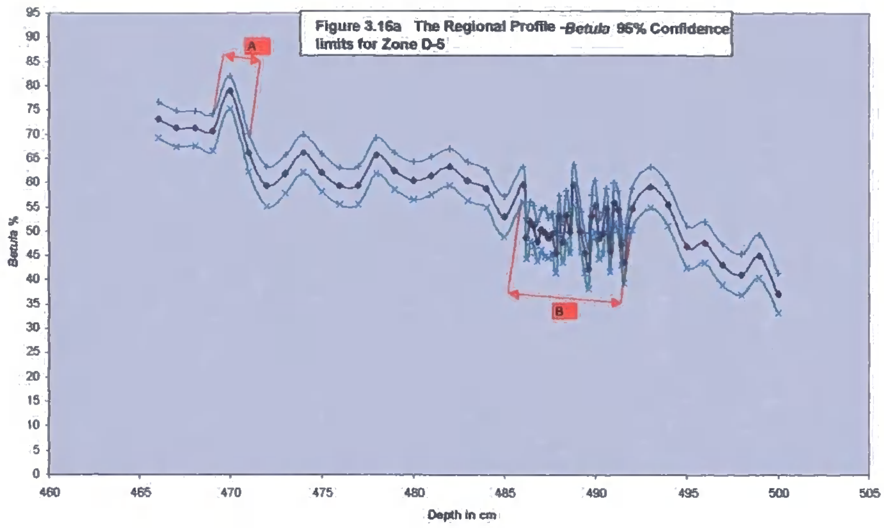


Figure 3.16a The Regional Profile -*Betula* 95% Confidence limits for Zone D-5

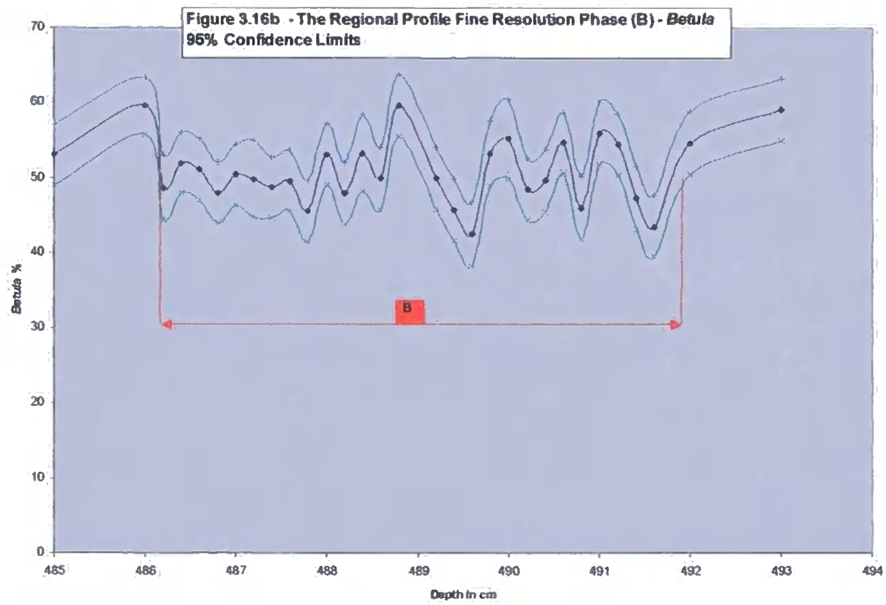


Figure 3.16b - The Regional Profile Fine Resolution Phase (B) - *Betula* 95% Confidence Limits

A

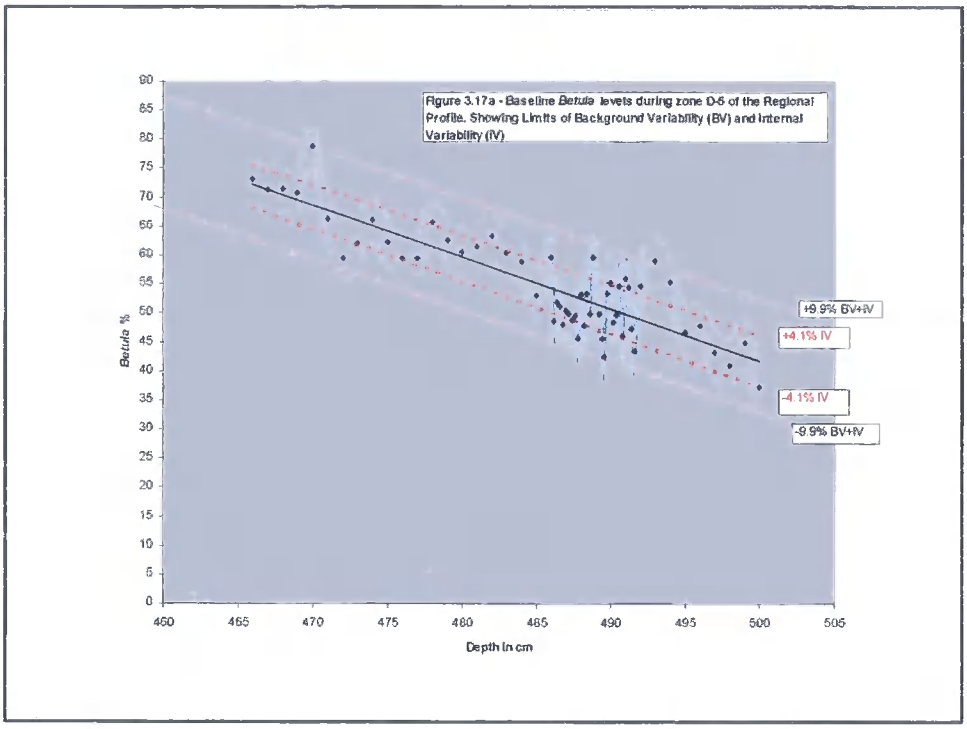


Figure 3.17a - Baseline *Betula* levels during zone D-6 of the Regional Profile. Showing Limits of Background Variability (BV) and Internal Variability (IV)
Betula %
Depth in cm
+9.9% BV+IV
+4.1% IV
-4.1% IV
-9.9% BV+IV

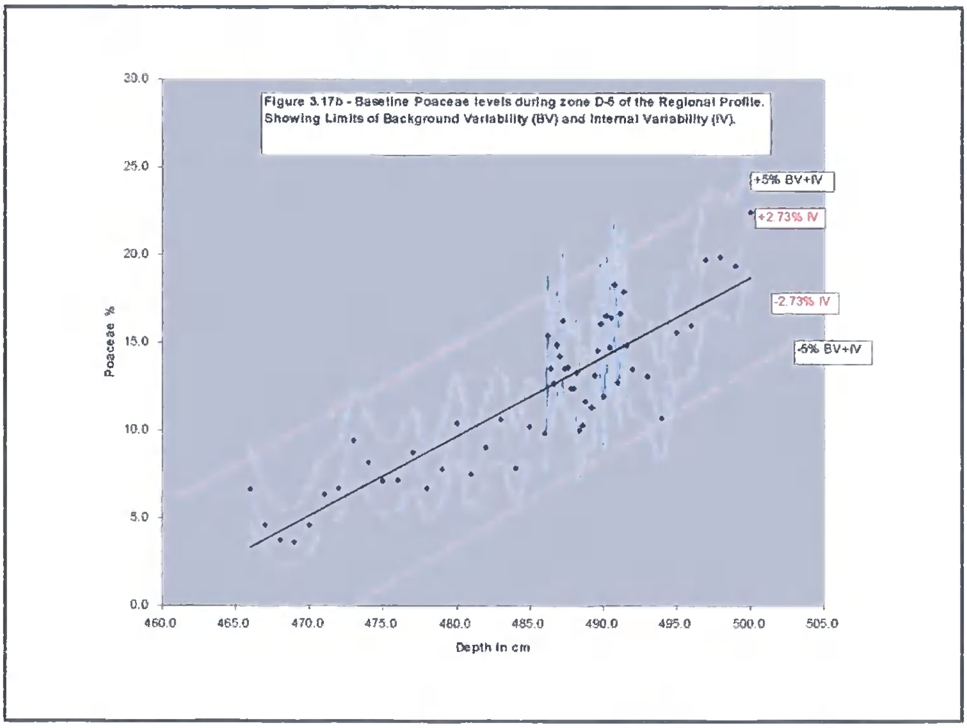


Figure 3.17b - Baseline Poaceae levels during zone D-6 of the Regional Profile. Showing Limits of Background Variability (BV) and Internal Variability (IV).
Poaceae %
Depth in cm
+5% BV+IV
+2.73% IV
-2.73% IV
-5% BV+IV

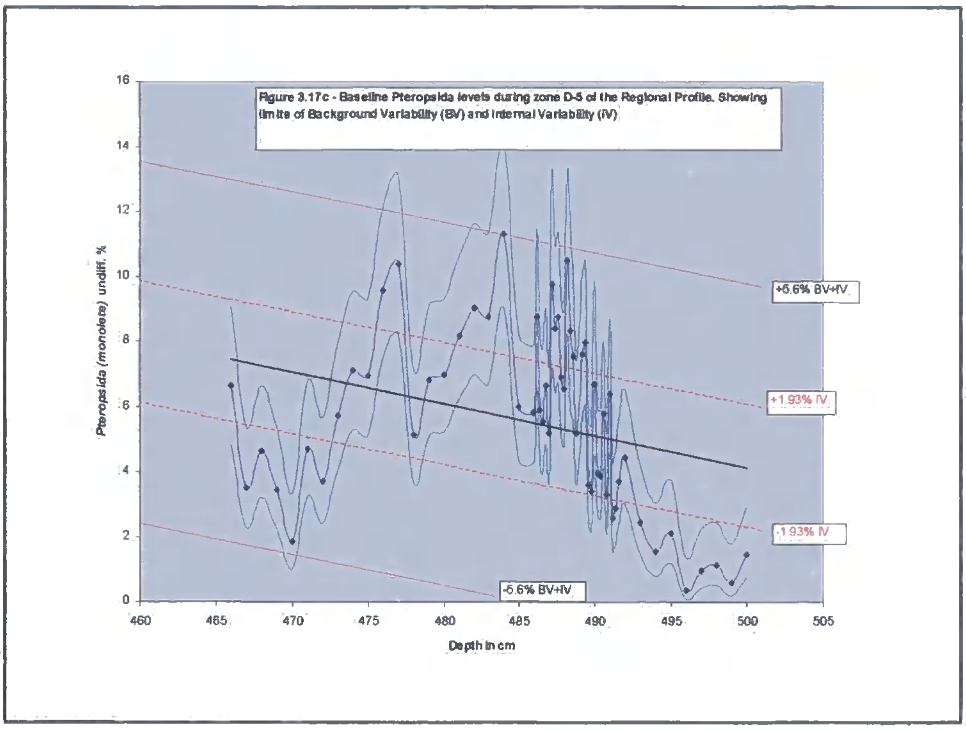


Figure 3.17c - Baseline Pteropsida levels during zone D-5 of the Regional Profile. Showing limits of Background Variability (BV) and Internal Variability (IV)

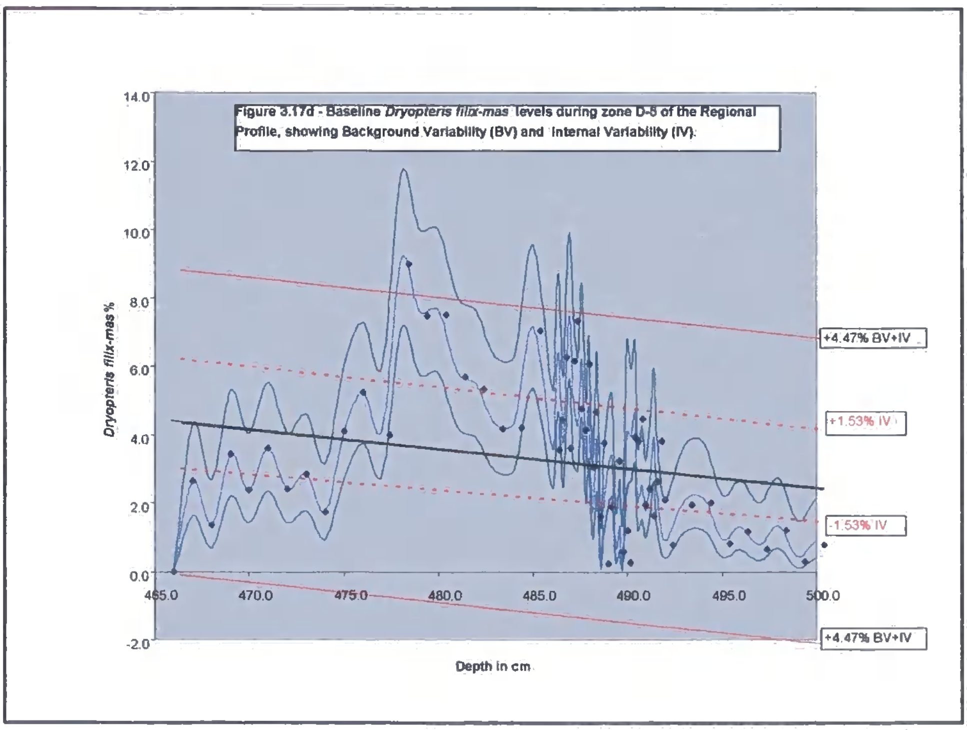


Figure 3.17d - Baseline *Dryopteris filix-mas* levels during zone D-5 of the Regional Profile, showing Background Variability (BV) and Internal Variability (IV).

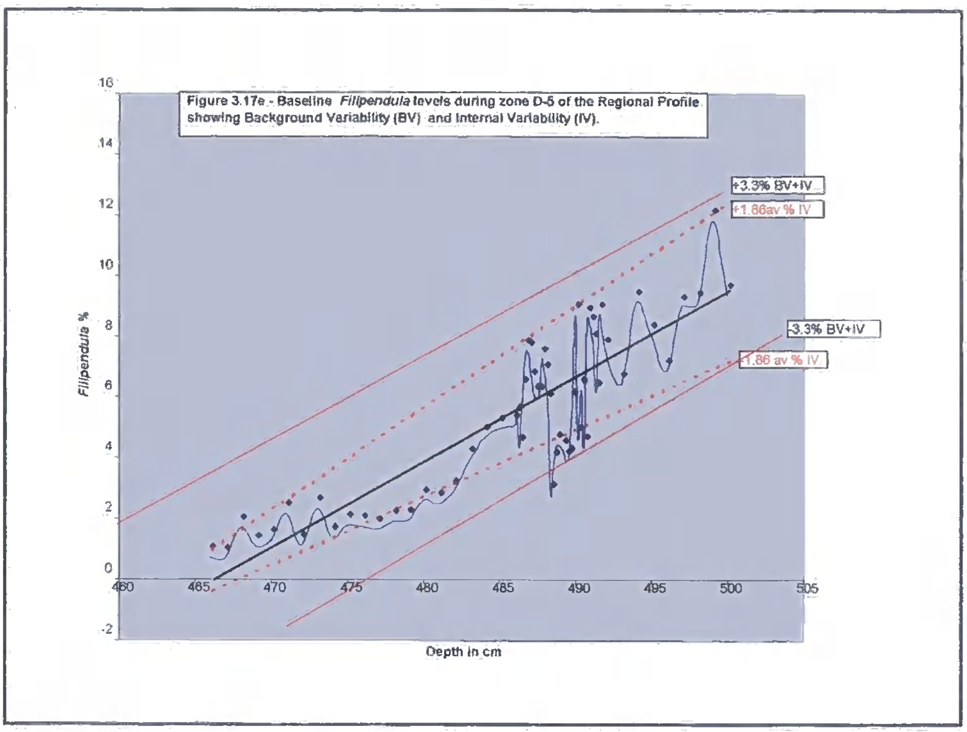


Figure 3.17e - Baseline *Filipendula* levels during zone D-5 of the Regional Profile showing Background Variability (BV) and Internal Variability (IV).

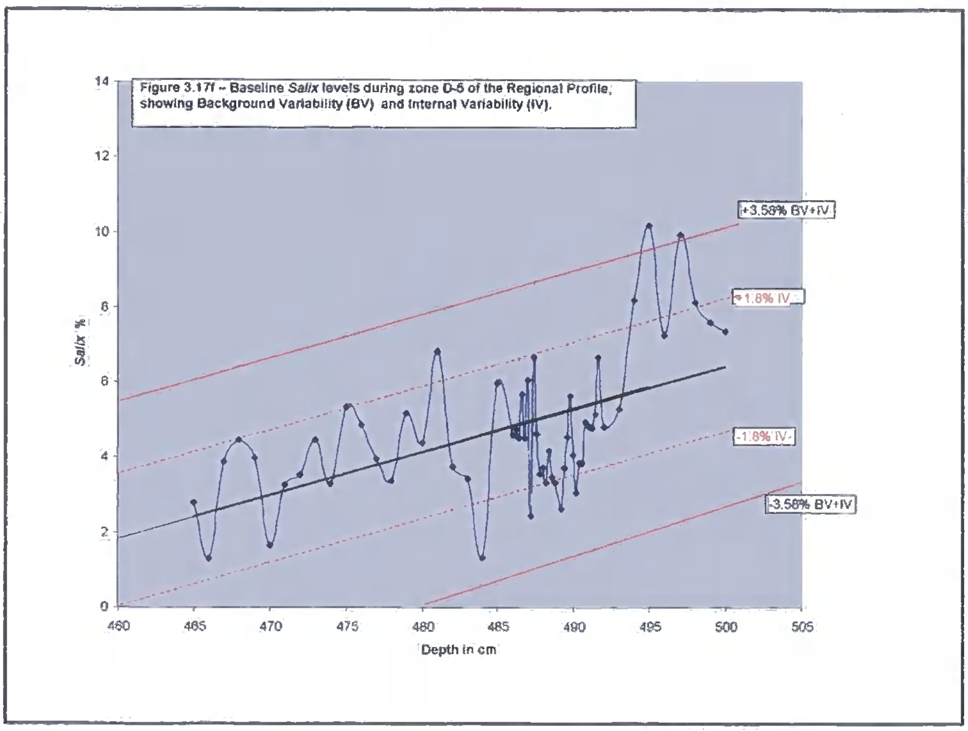


Figure 3.17f – Baseline *Salix* levels during zone D-5 of the Regional Profile, showing Background Variability (BV) and Internal Variability (IV).

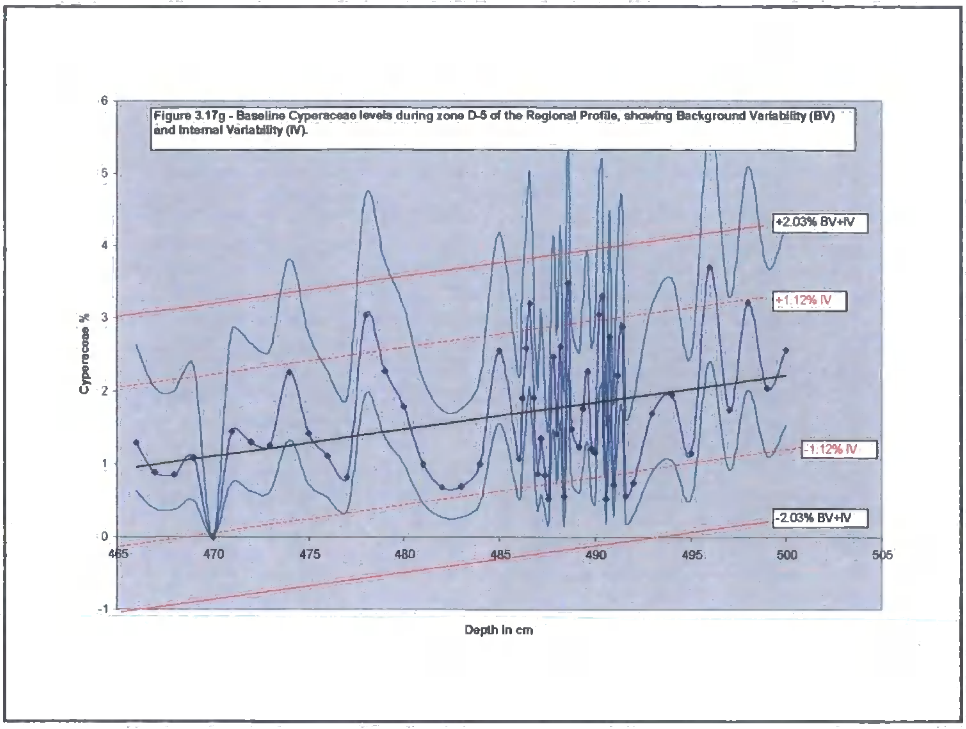


Figure 3.17g - Baseline Cyperaceae levels during zone D-5 of the Regional Profile, showing Background Variability (BV) and Internal Variability (IV).

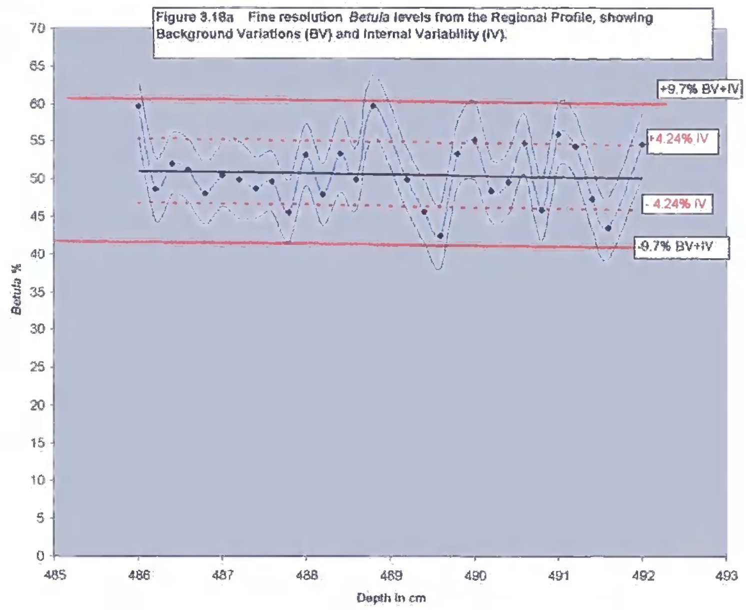


Figure 3.18a Fine resolution *Betula* levels from the Regional Profile, showing Background Variations (BV) and Internal Variability (IV).

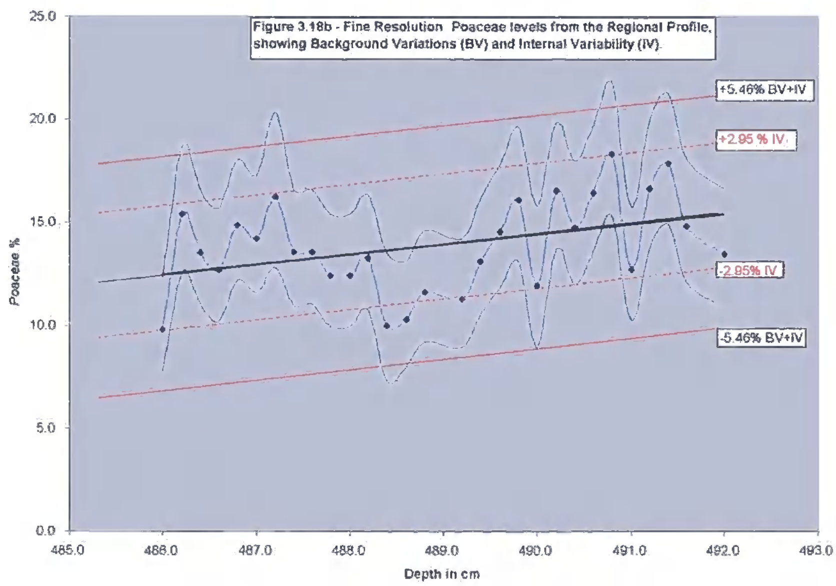


Figure 3.18b - Fine Resolution Poaceae levels from the Regional Profile, showing Background Variations (BV) and Internal Variability (IV).

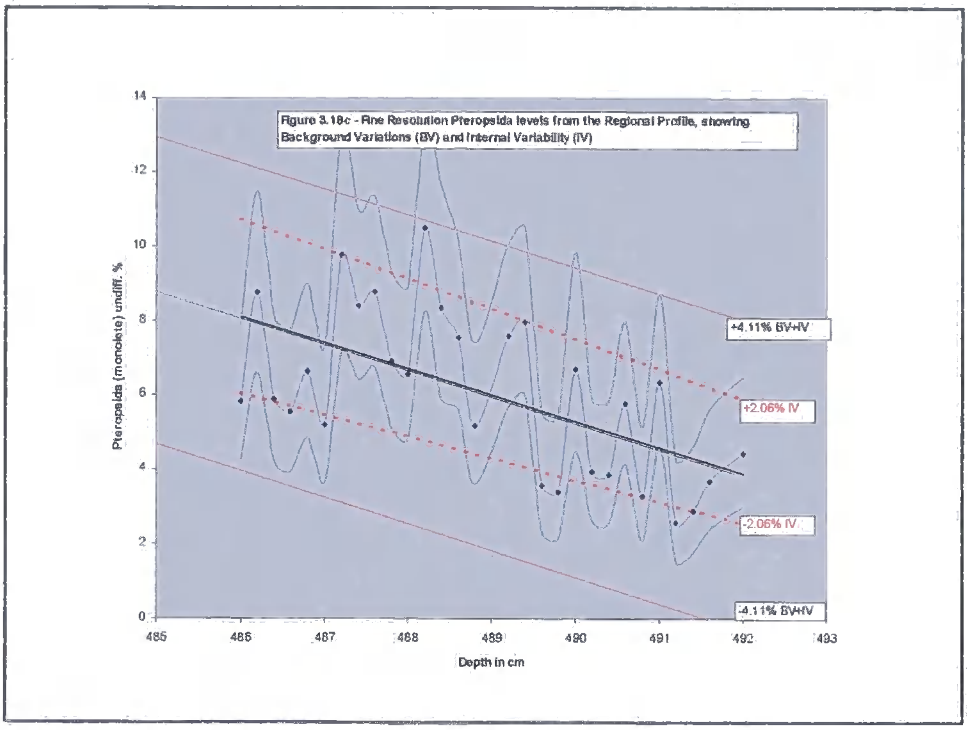


Figure 3.18c - Fine Resolution Pteropsida levels from the Regional Profile, showing Background Variations (BV) and Internal Variability (IV)

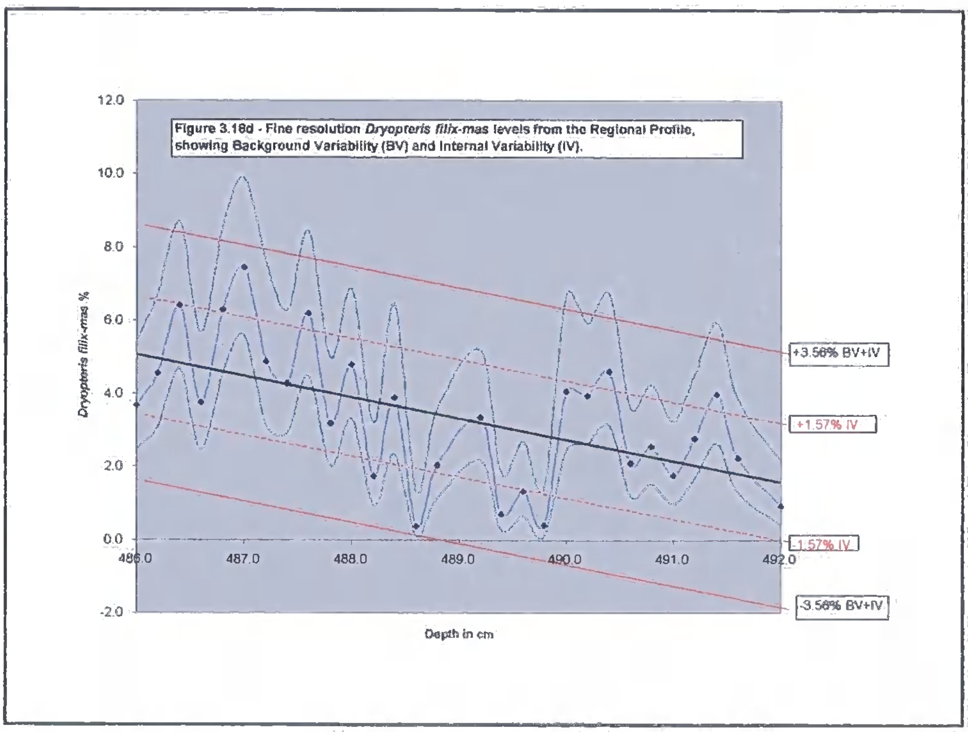


Figure 3.18d - Fine resolution *Dryopteris filix-mas* levels from the Regional Profile, showing Background Variability (BV) and Internal Variability (IV).

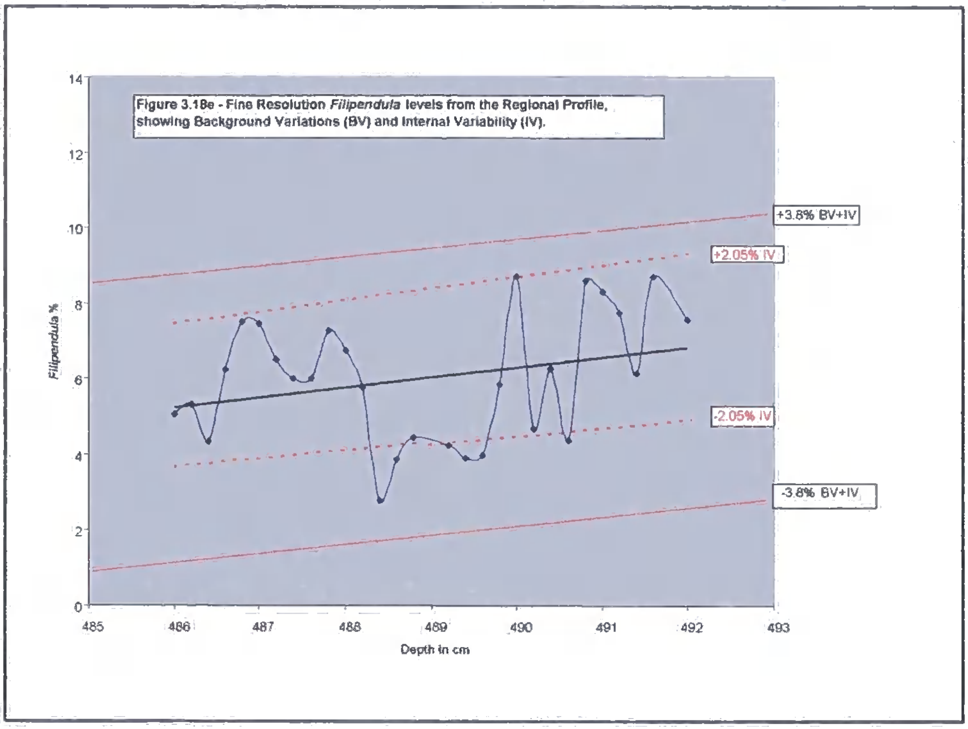


Figure 3.18e - Fine Resolution Filipendula levels from the Regional Profile, showing Background Variations (BV) and Internal Variability (IV).
+3.8% BV+IV
+2.05% IV
-2.05% IV
-3.8% BV+IV
Filipendula %
Depth in cm

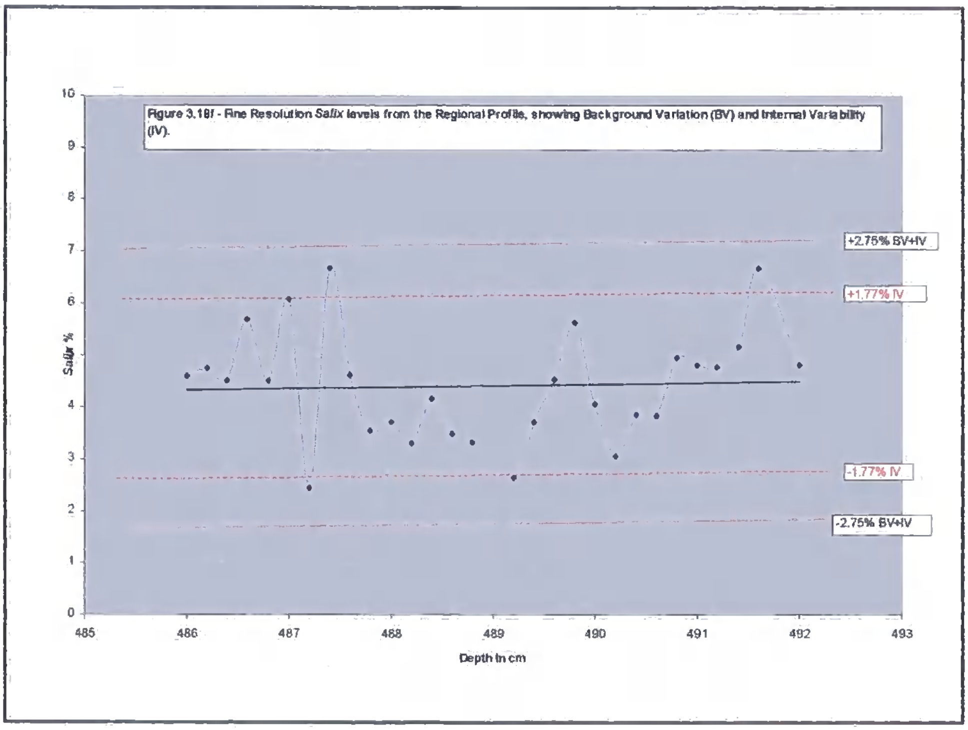


Figure 3.18f - Fine Resolution Salix levels from the Regional Profile, showing Background Variation (BV) and Internal Variability (IV).
+2.75% BV+IV
+1.77% IV
-1.77% IV
-2.75% BV+IV
Salix %
Depth in cm

H

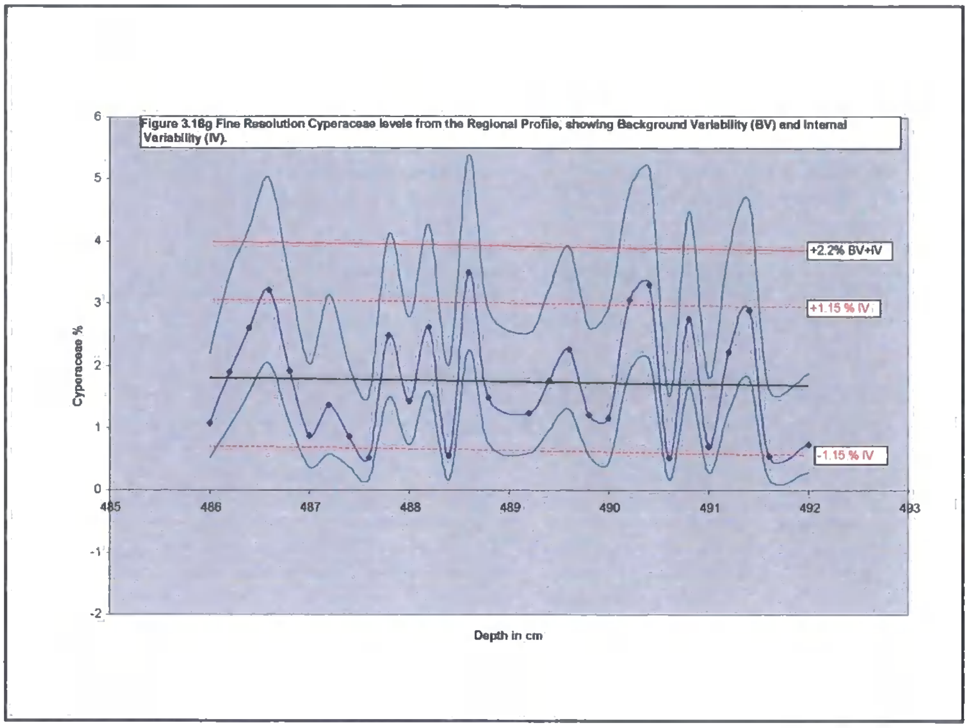


Figure 3.18g Fine Resolution Cyperaceae levels from the Regional Profile, showing Background Variability (BV) and Internal Variability (IV).
+2.2% BV+IV
+1.15 % IV
-1.15 % IV
Cyperaceae %
Depth in cm
6
5
4
3
2
1
0
-1
-2
485
486
487
488
489
490
491
492
493

Chapter Four

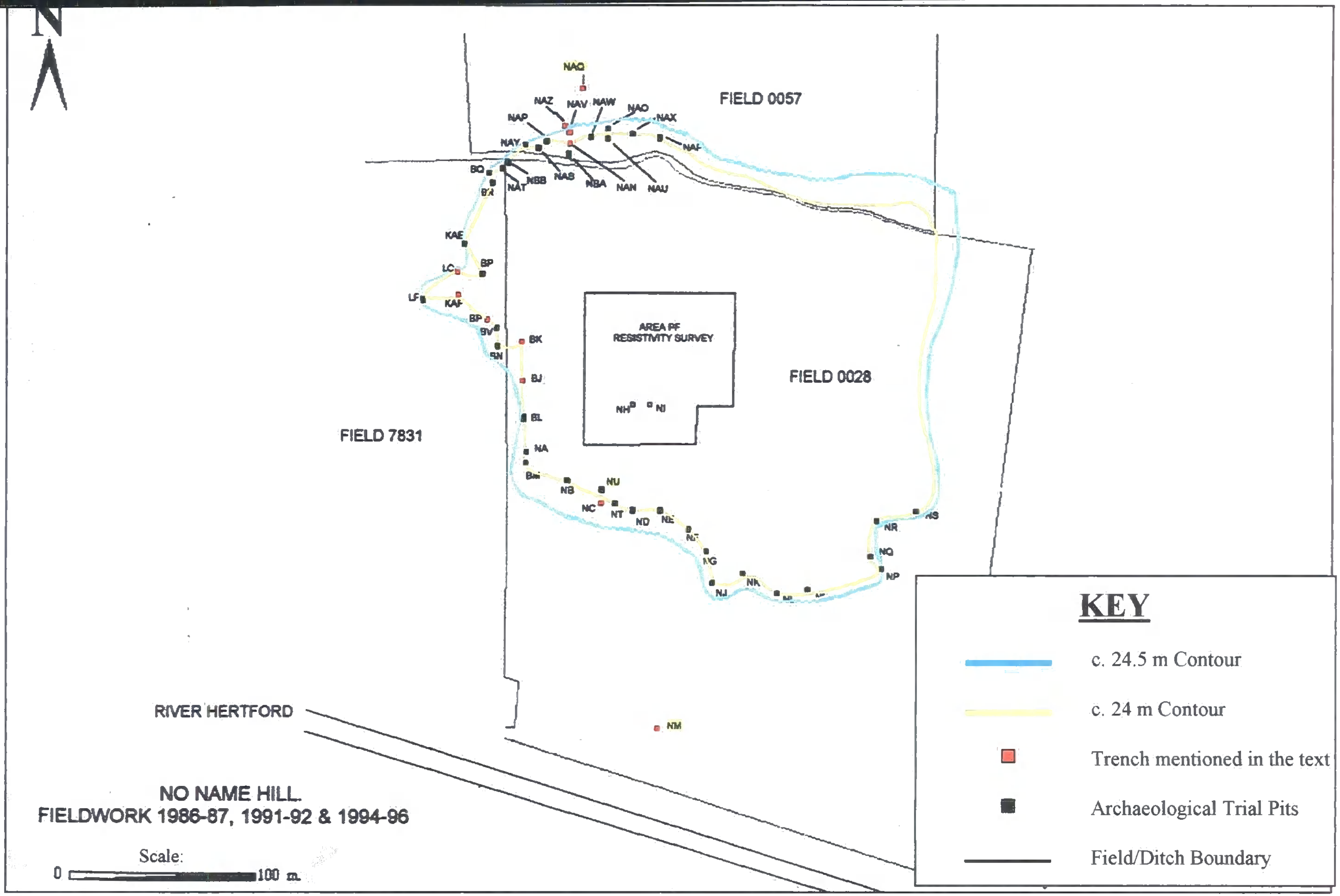


Figure 4.1 Field Map of No Name Hill showing the location of trenches mentioned in the text.

Figure 4.2 The stratigraphy in Trench NM, to the south of No Name Hill, showing the position of the 0.5 m monolith tins.

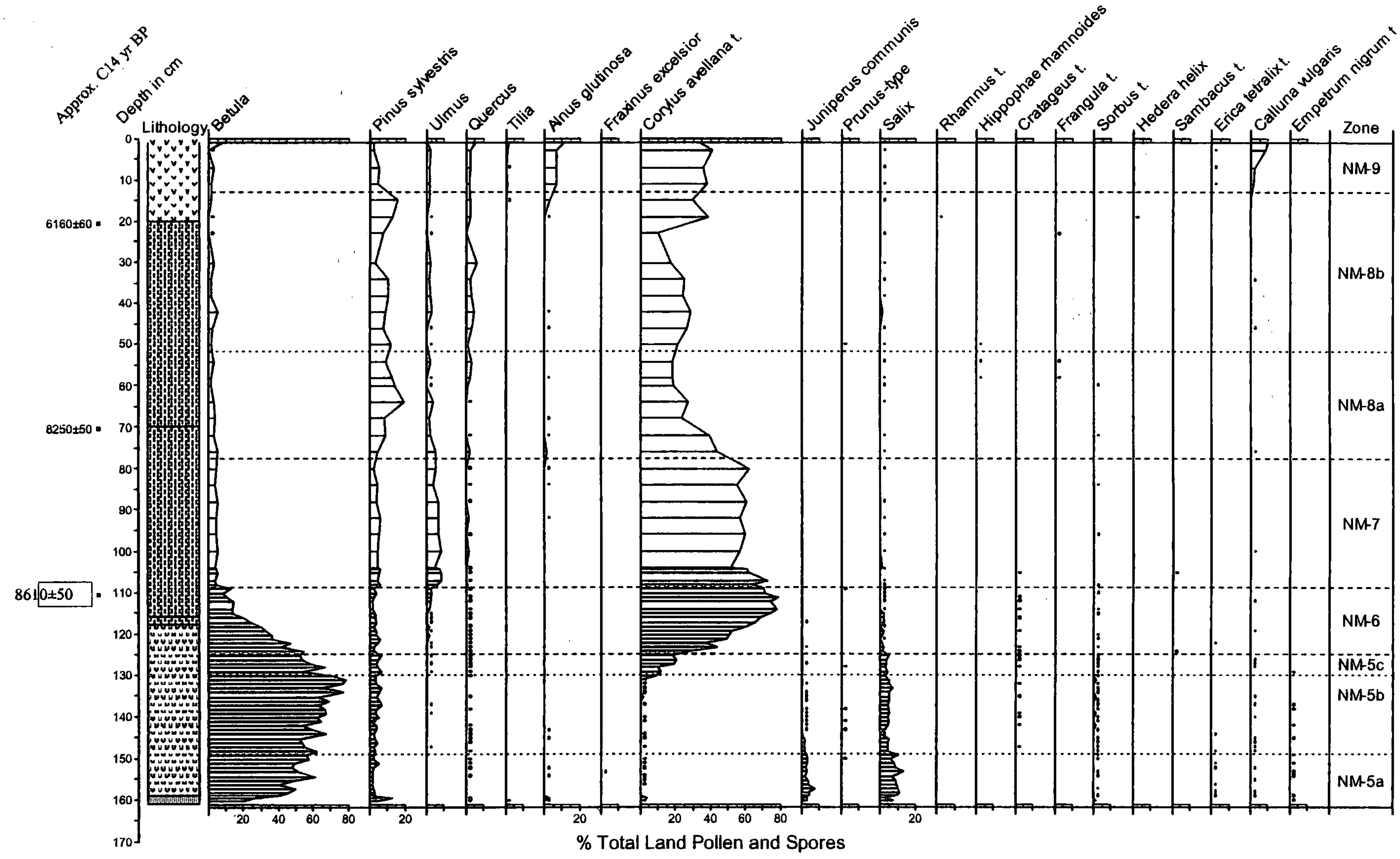


Figure 4.3a NM - Tree, Shrub and Heath Pollen Percentages

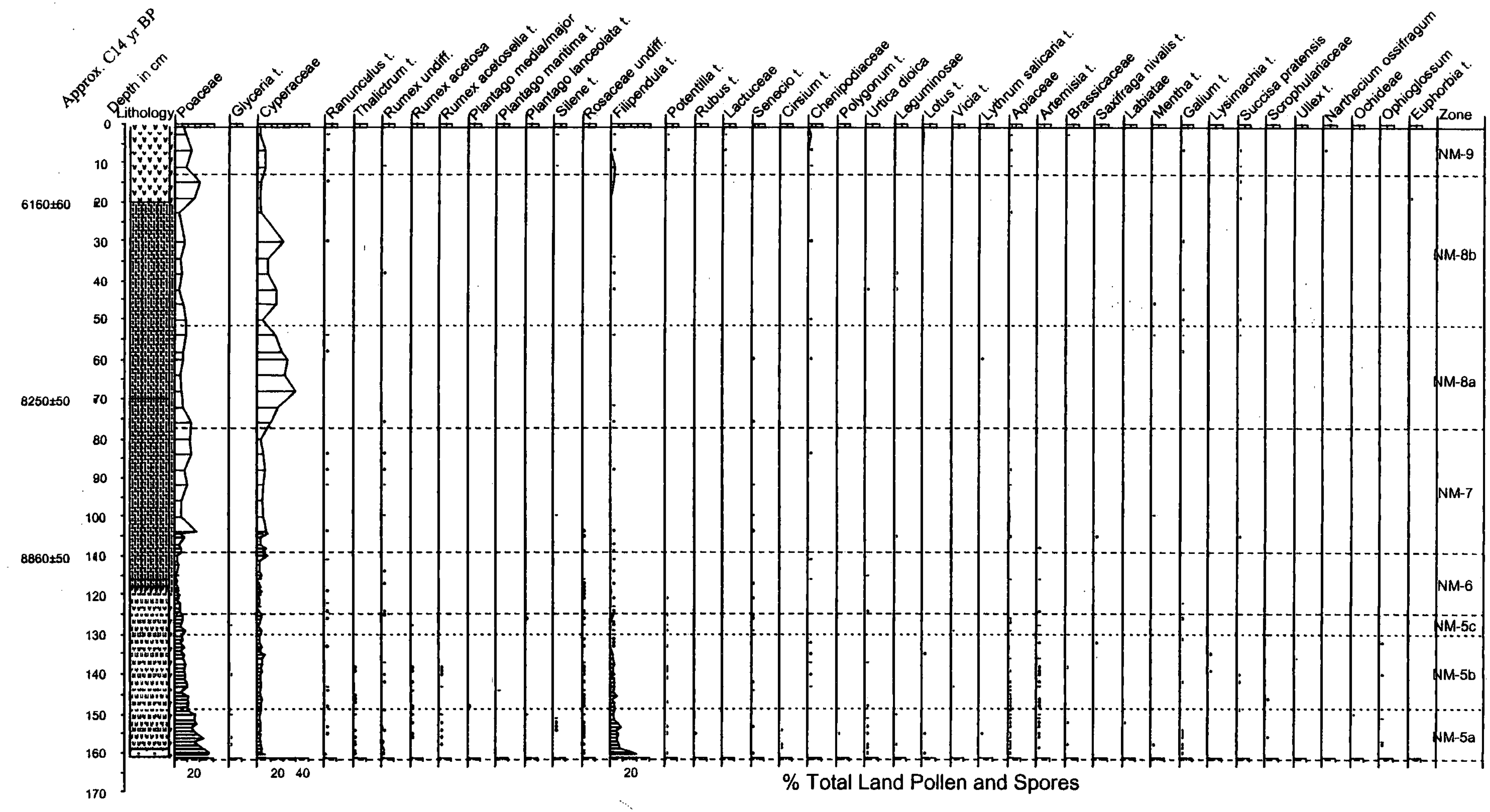


Figure 4.3b NM - Herb Pollen Percentages

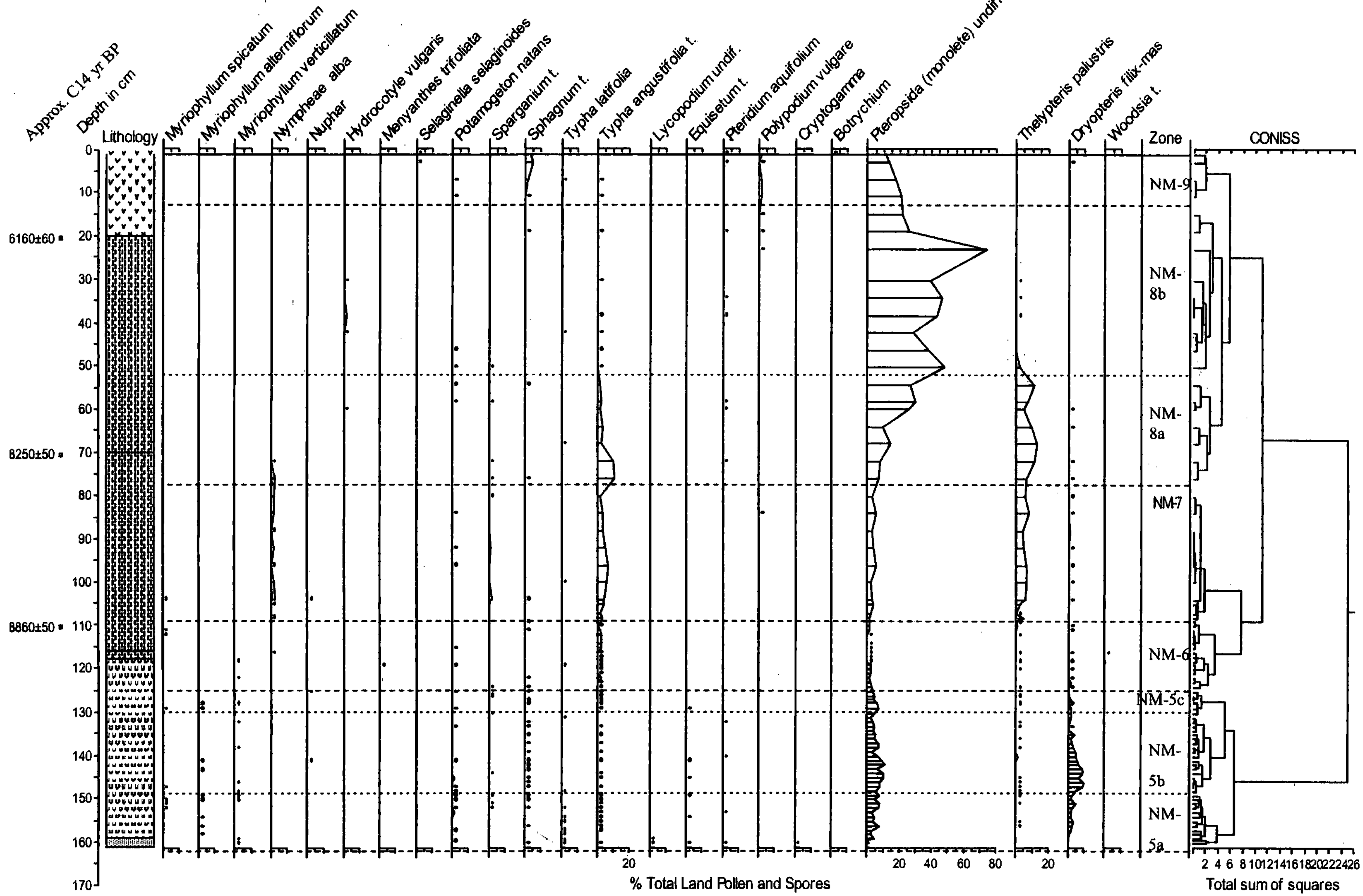


Figure 4.4 NM - Aquatic Pollen and Spore Percentages

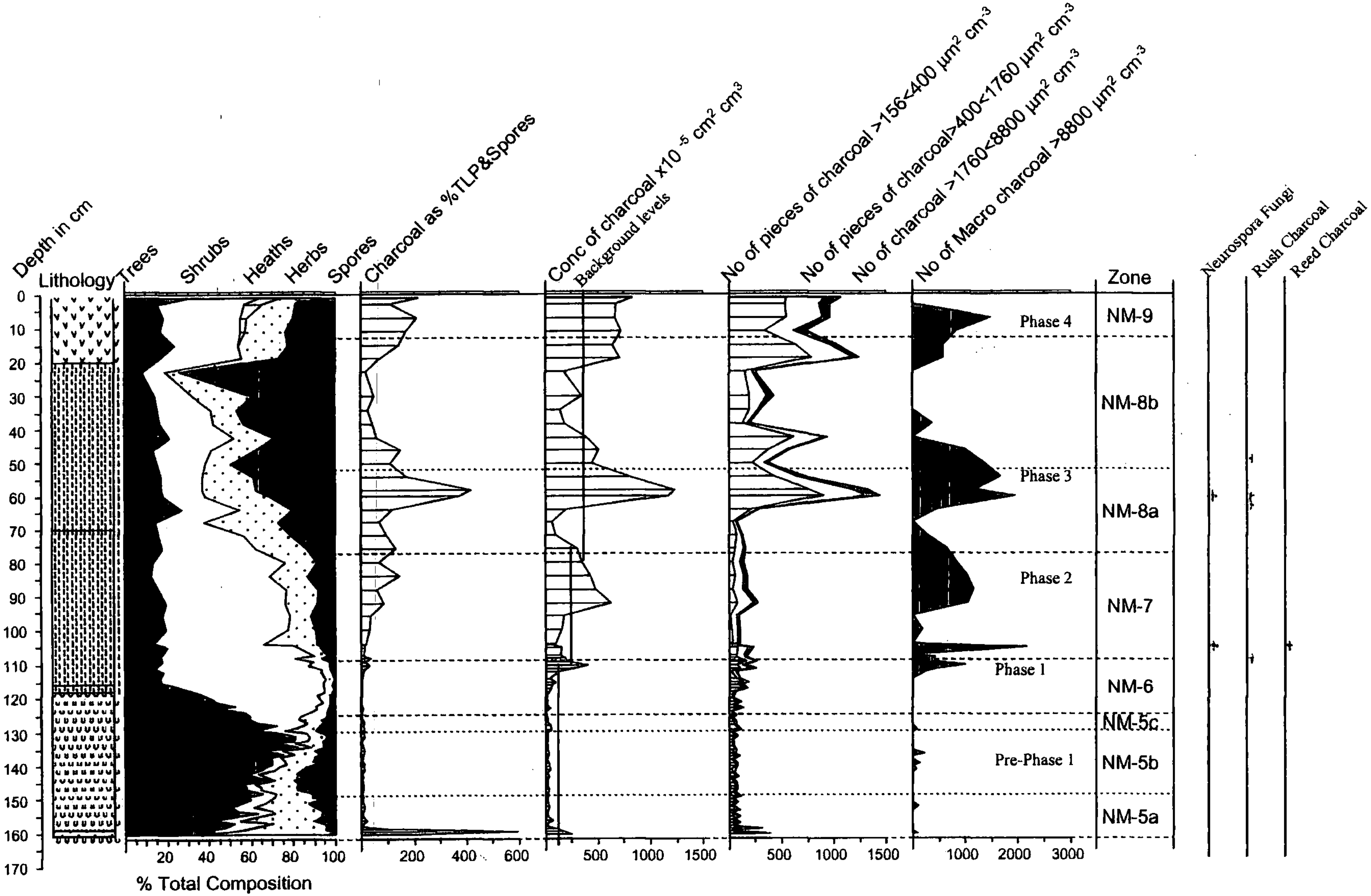


Figure 4.5 NM - Summary Diagram

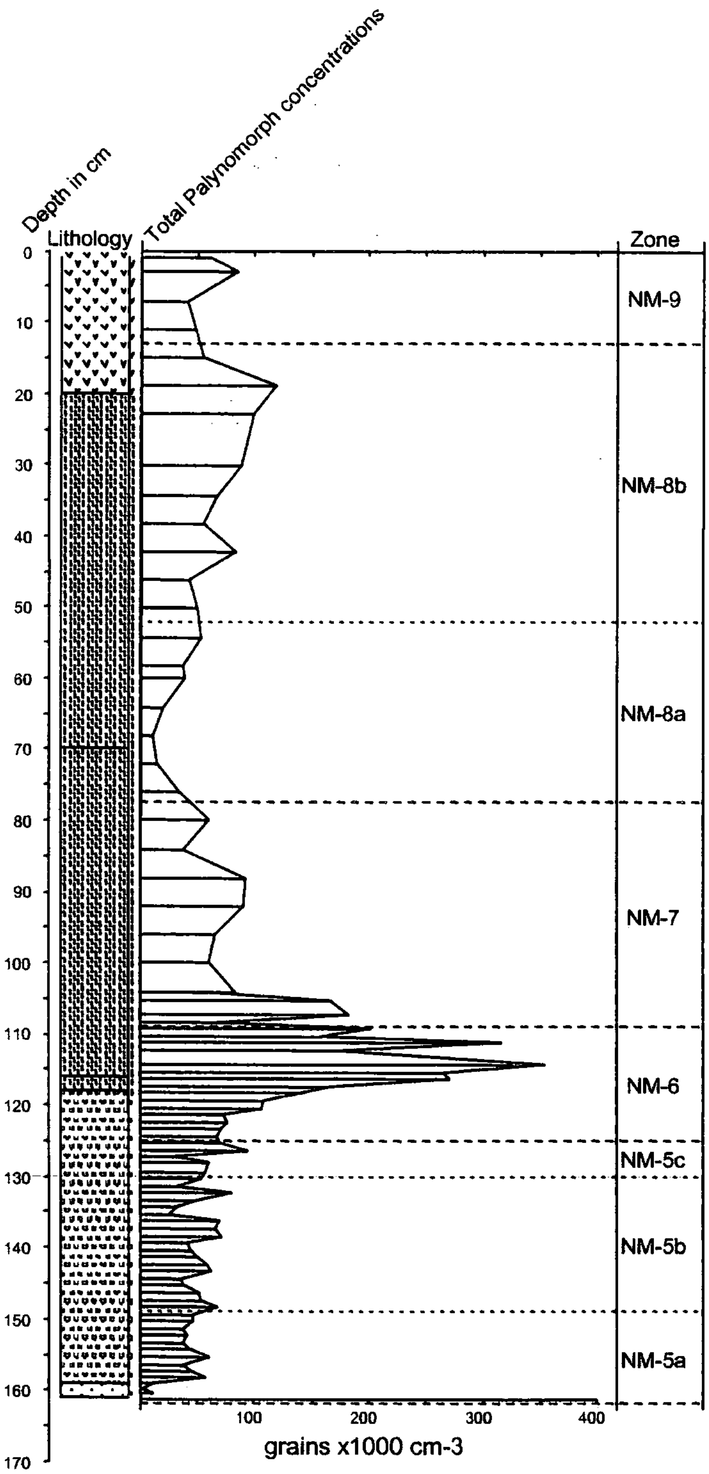


Figure 4.6 NM - Total Palynomorph Concentration Curve

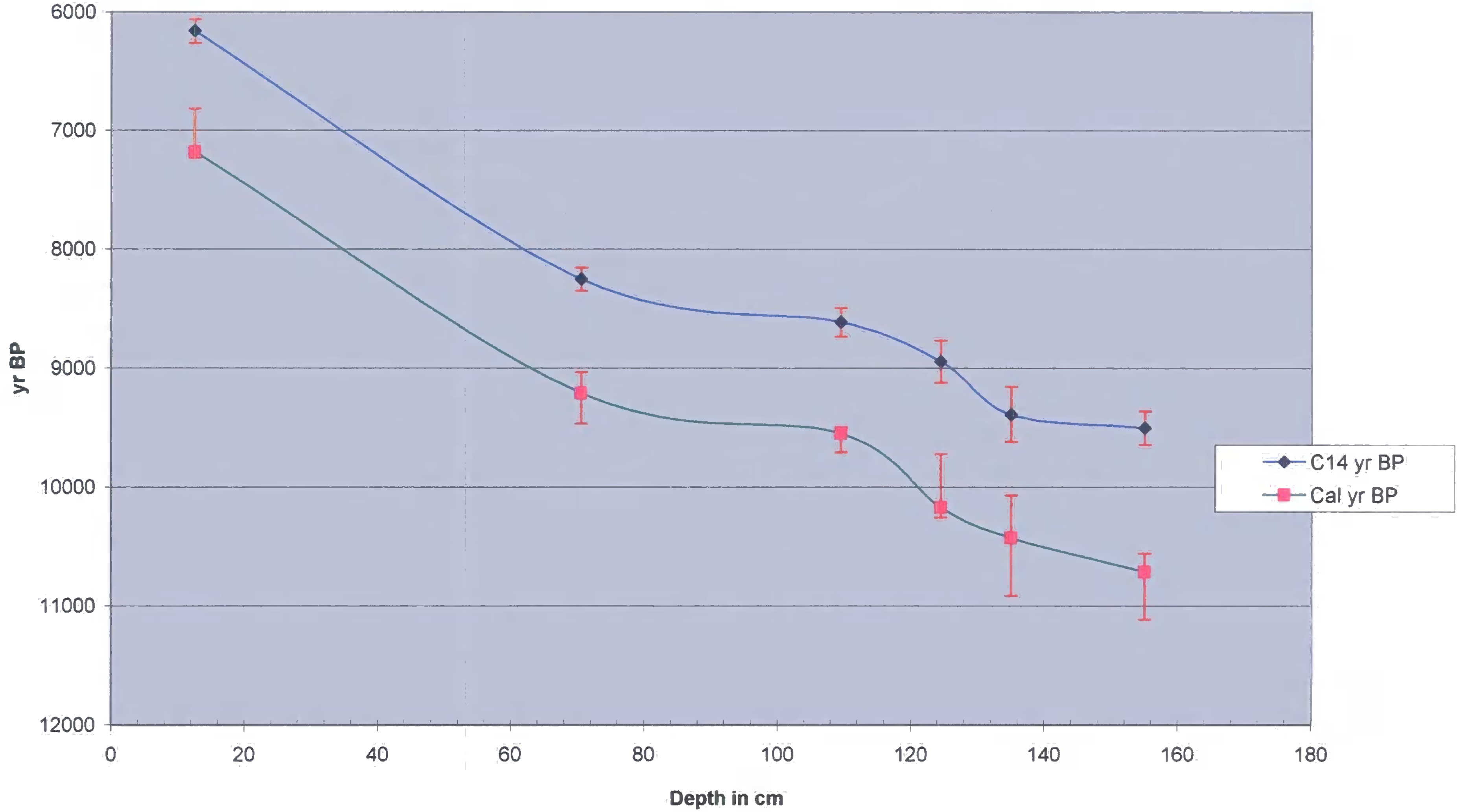


Figure 4.7 NM - Time-Depth Curve (to 2 SE)

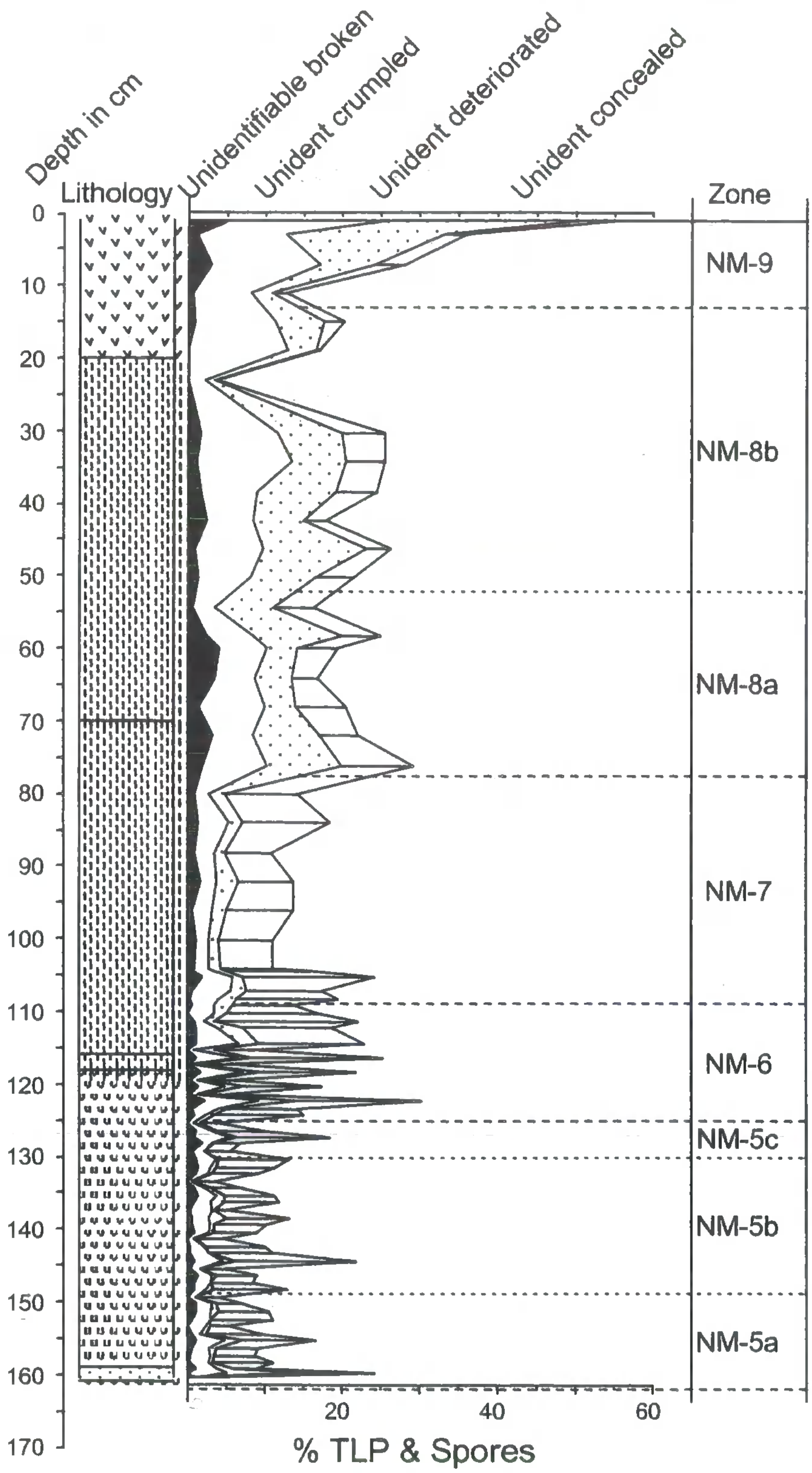


Figure 4.8 NM - Pollen Preservation Curve

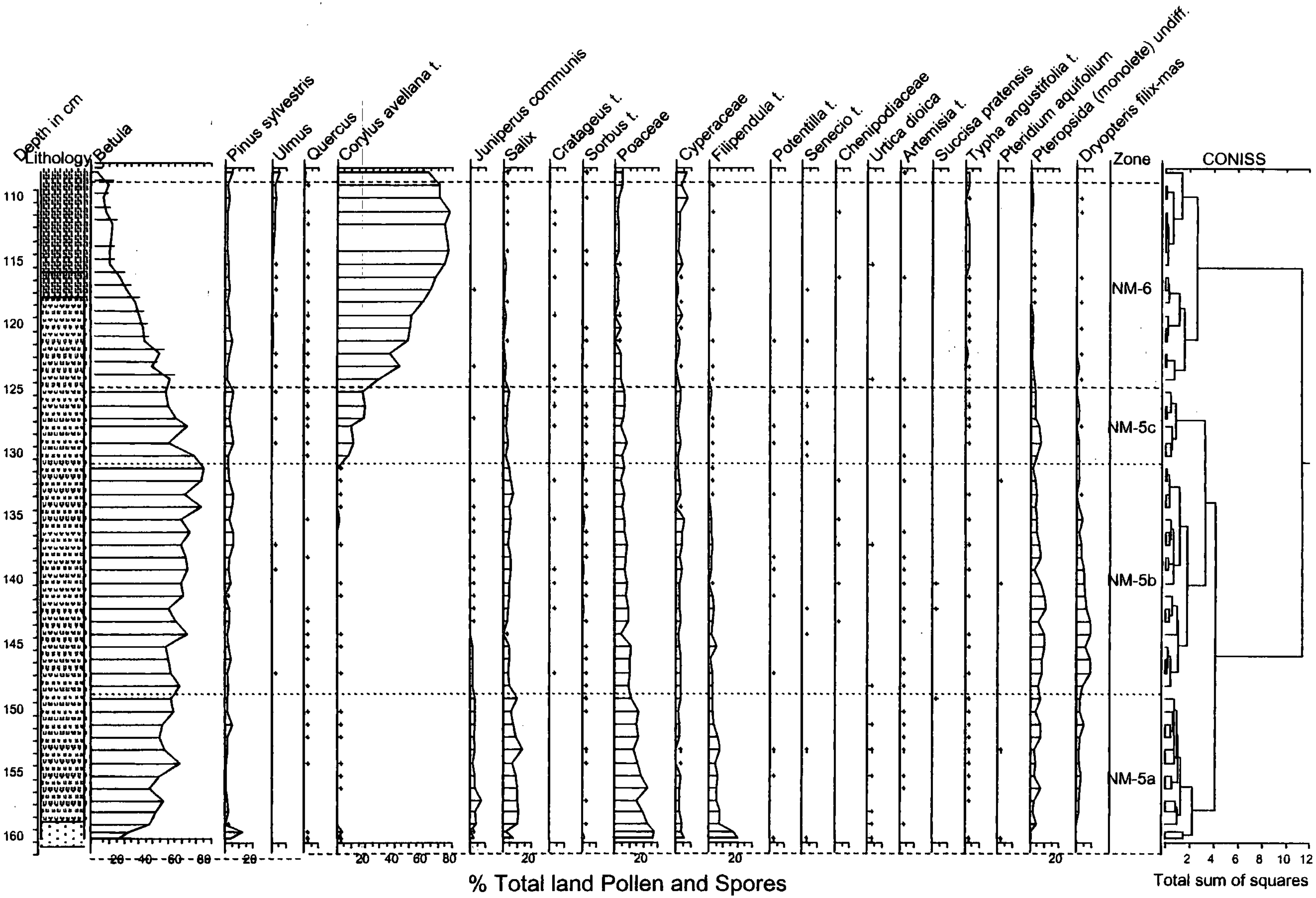


Figure 4.9 NM - Early Mesolithic (selected pollen)

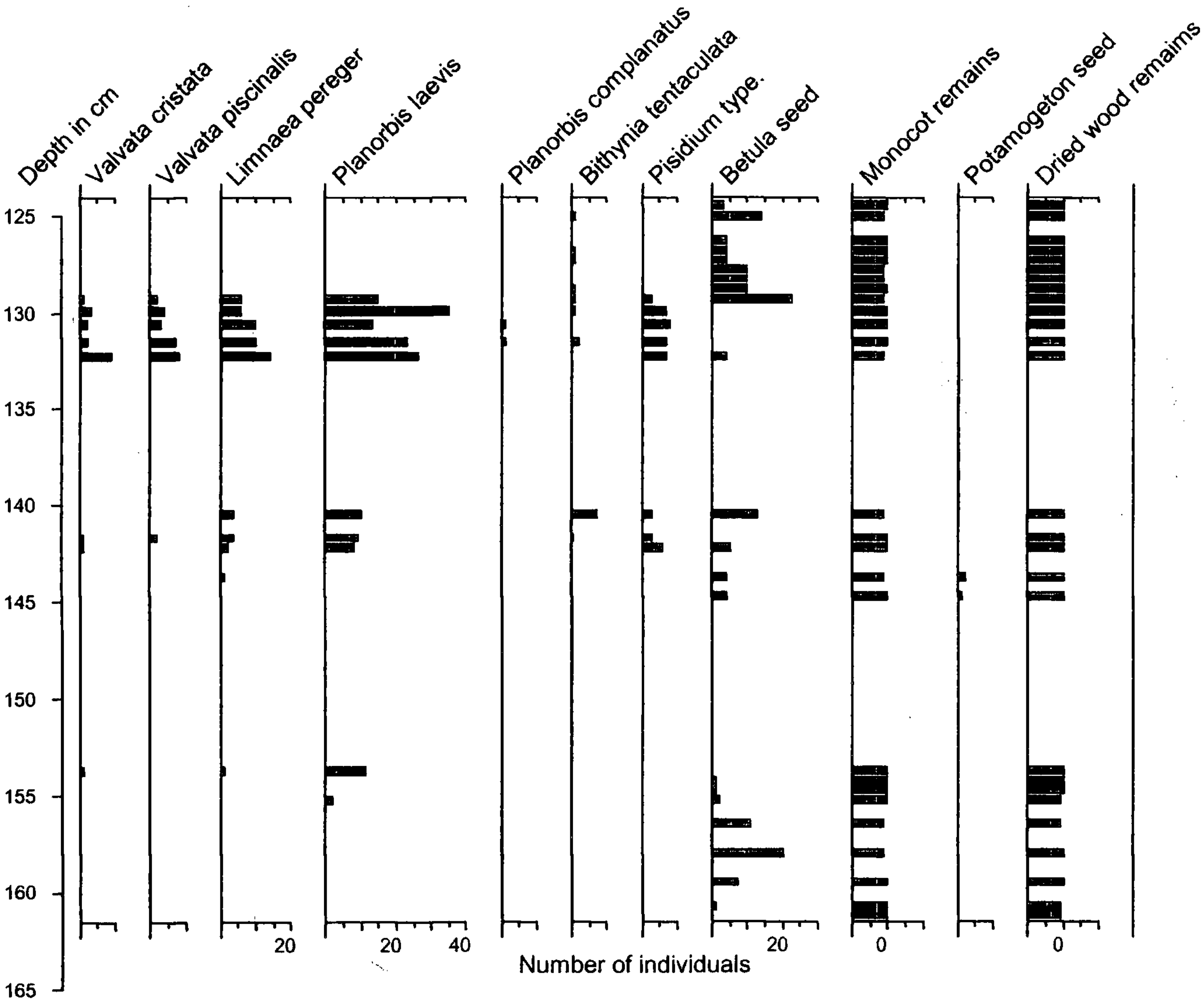


Figure 4.10 NM - Molluscan and Macrofossil record.

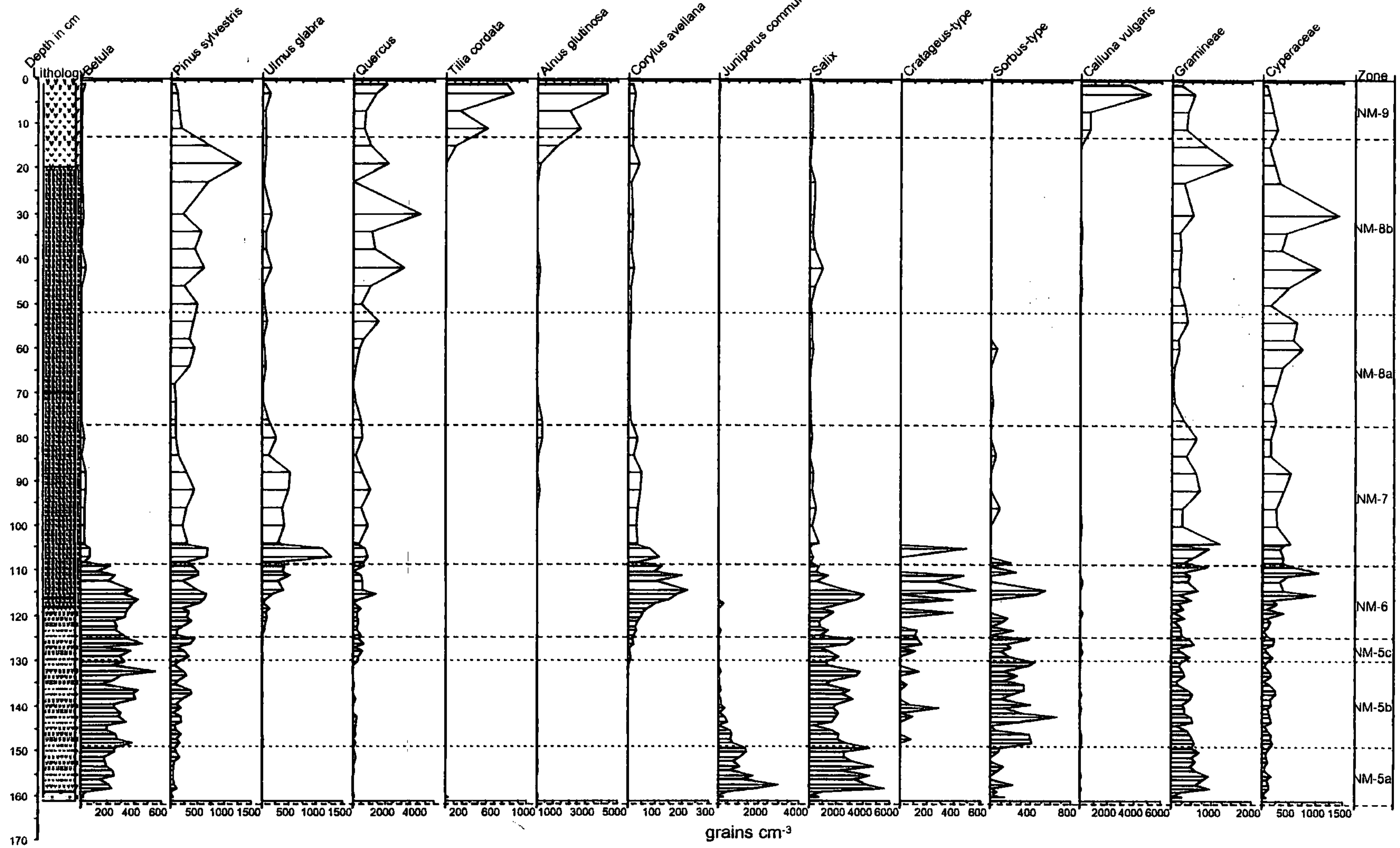


Figure 4.11a NM - Selected Concentrations

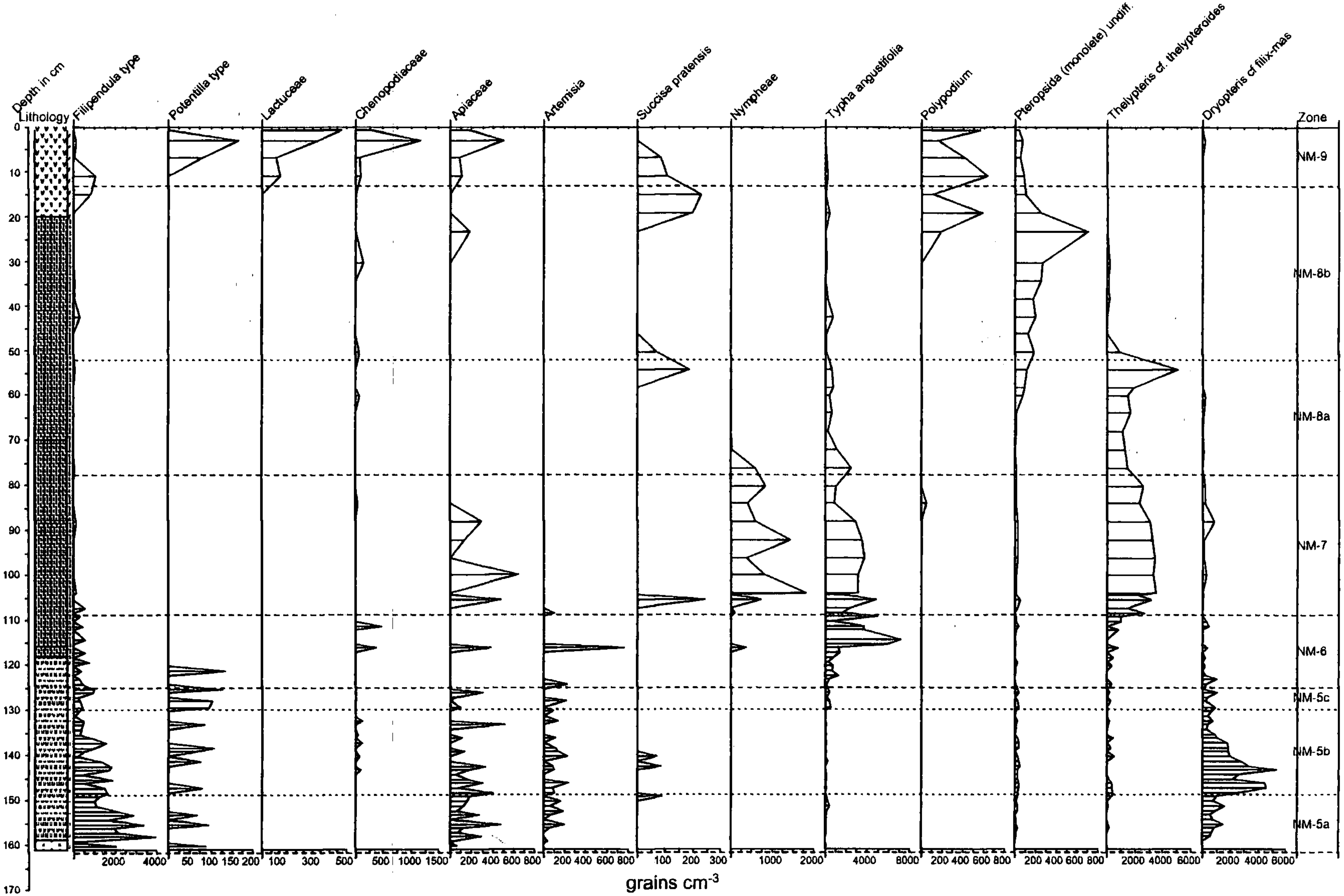


Figure 4.11b NM - Selected Concentrations (continued)

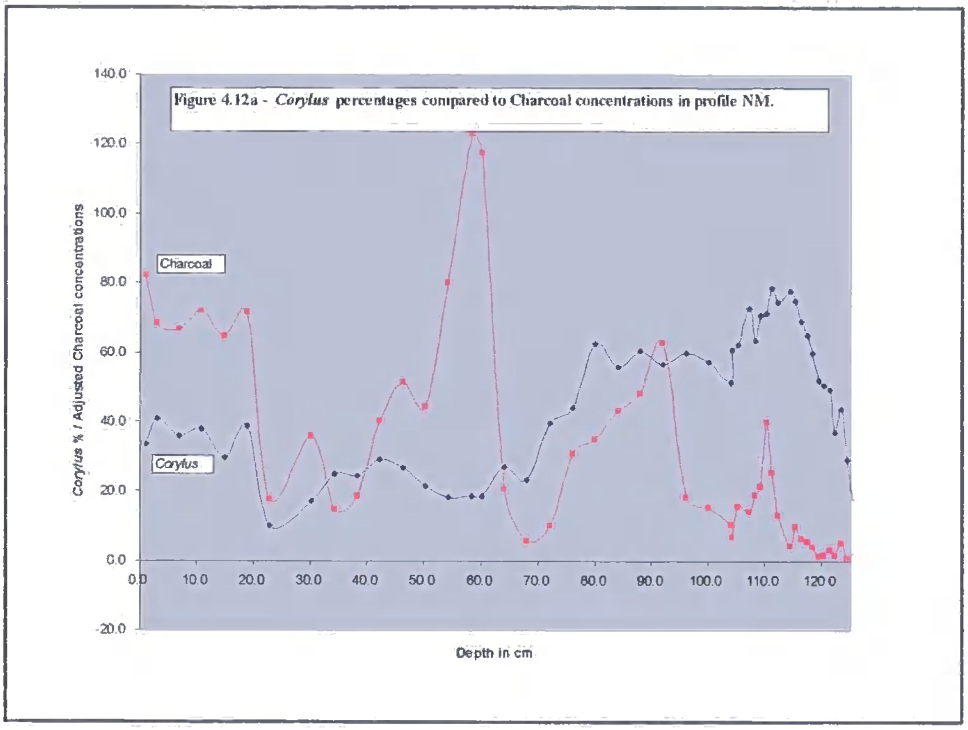


Figure 4.12a - *Corylus* percentages compared to Charcoal concentrations in profile NM.

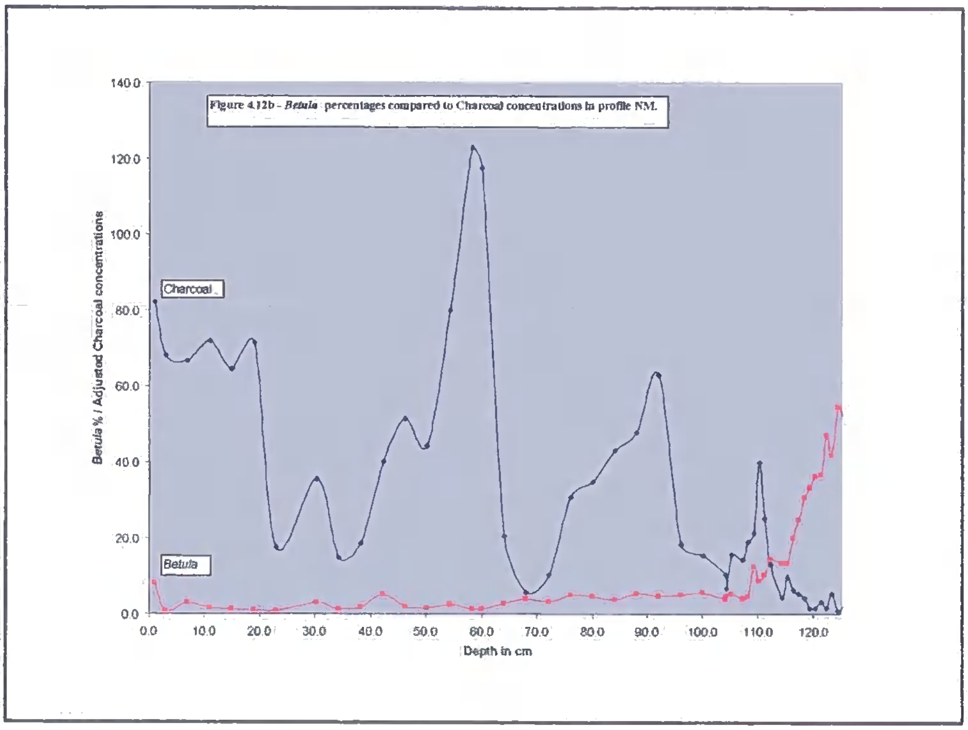


Figure 4.12b - *Betula* percentages compared to Charcoal concentrations in profile NM.

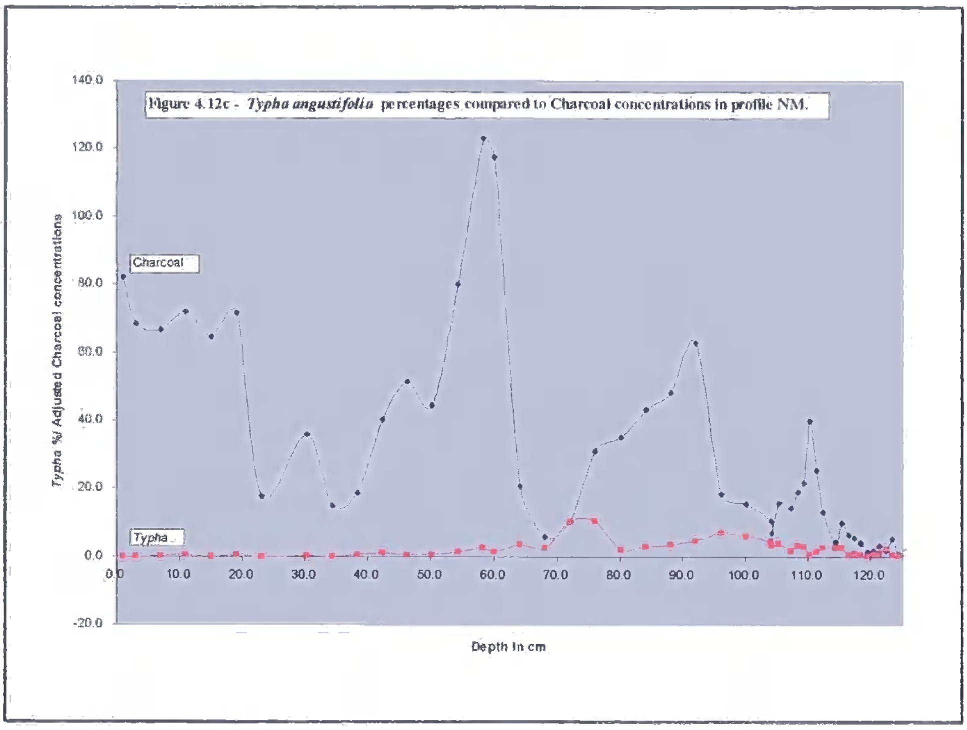


Figure 4.12c - Typha angustifolia percentages compared to Charcoal concentrations in profile NM.
Charcoal
Typha
Typha % / Adjusted Charcoal concentrations
Depth in cm
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0

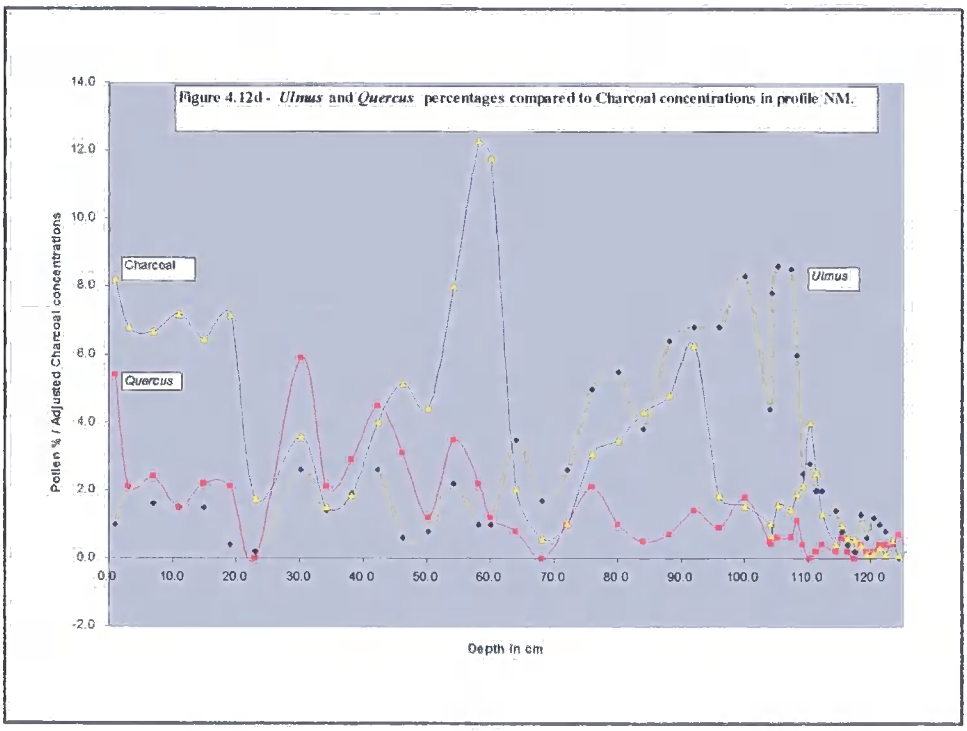


Figure 4.12d - Ulmus and Quercus percentages compared to Charcoal concentrations in profile NM.
Charcoal
Quercus
Ulmus
Pollen % / Adjusted Charcoal concentrations
Depth in cm
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0

13

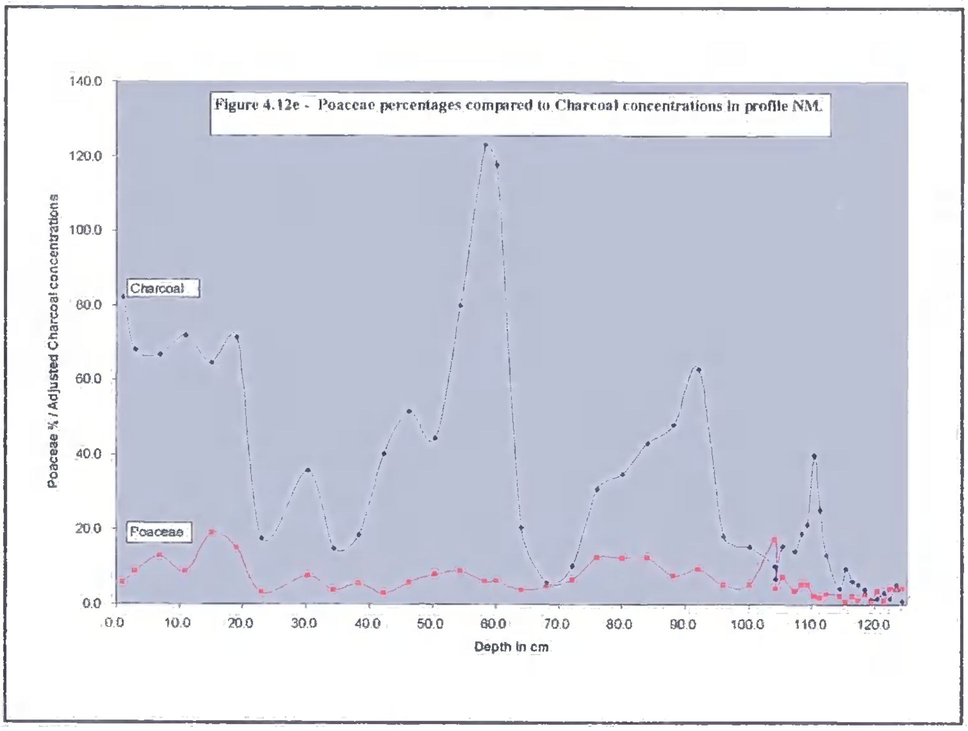


Figure 4.12e - Poaceae percentages compared to Charcoal concentrations in profile NM.
Charcoal
Poaceae
Poaceae % / Adjusted Charcoal concentrations
Depth in cm
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

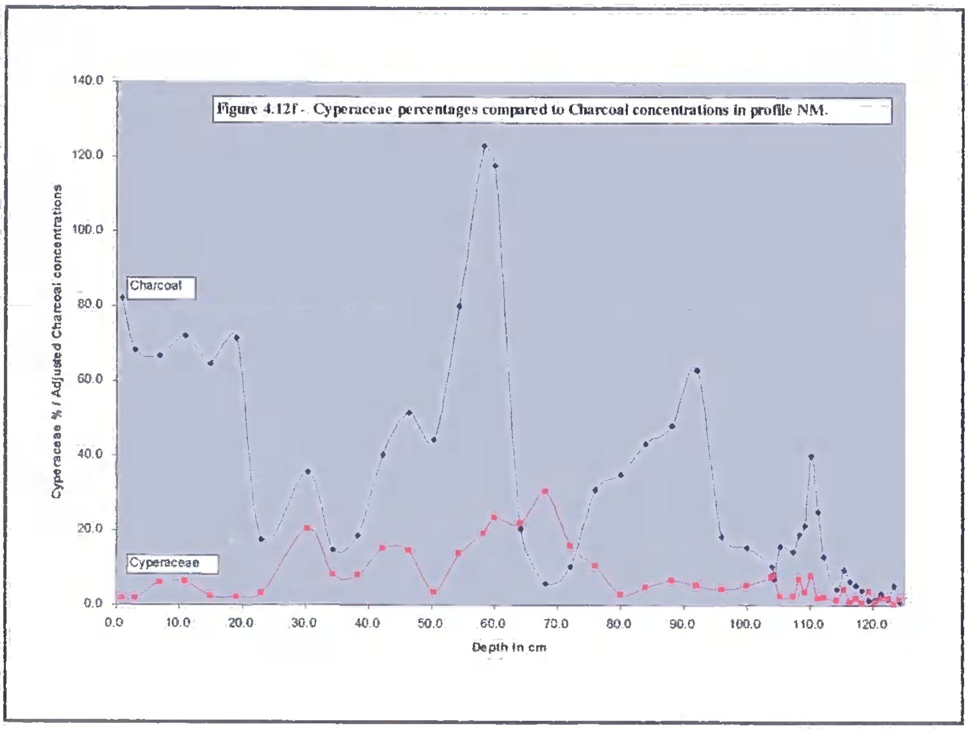


Figure 4.12f - Cyperaceae percentages compared to Charcoal concentrations in profile NM.
Charcoal
Cyperaceae
Cyperaceae % / Adjusted Charcoal concentrations
Depth in cm
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

Figure 4.13a NM – 95% Confidence Limits

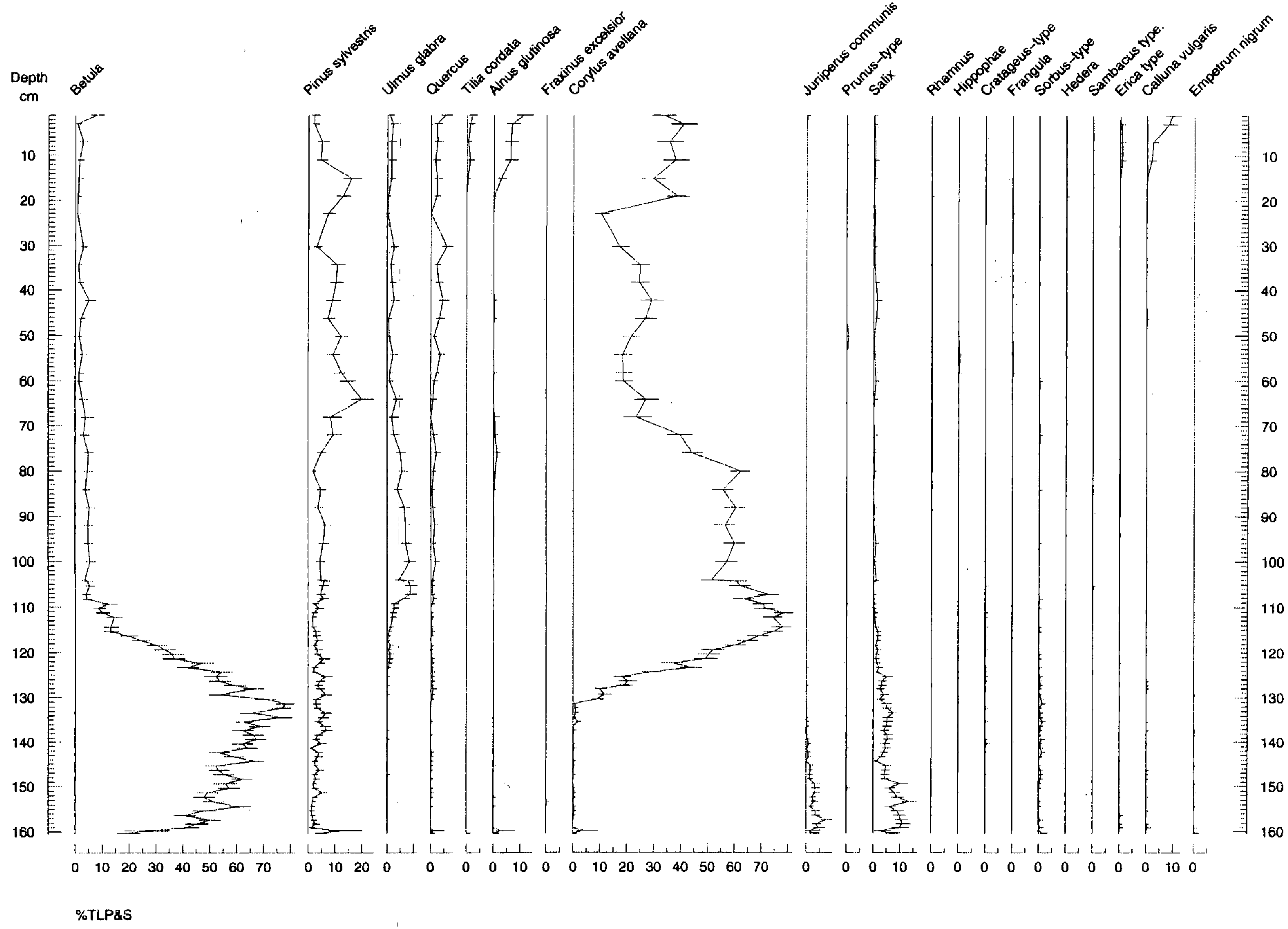


Figure 4.13b NM – 95% Confidence Limits

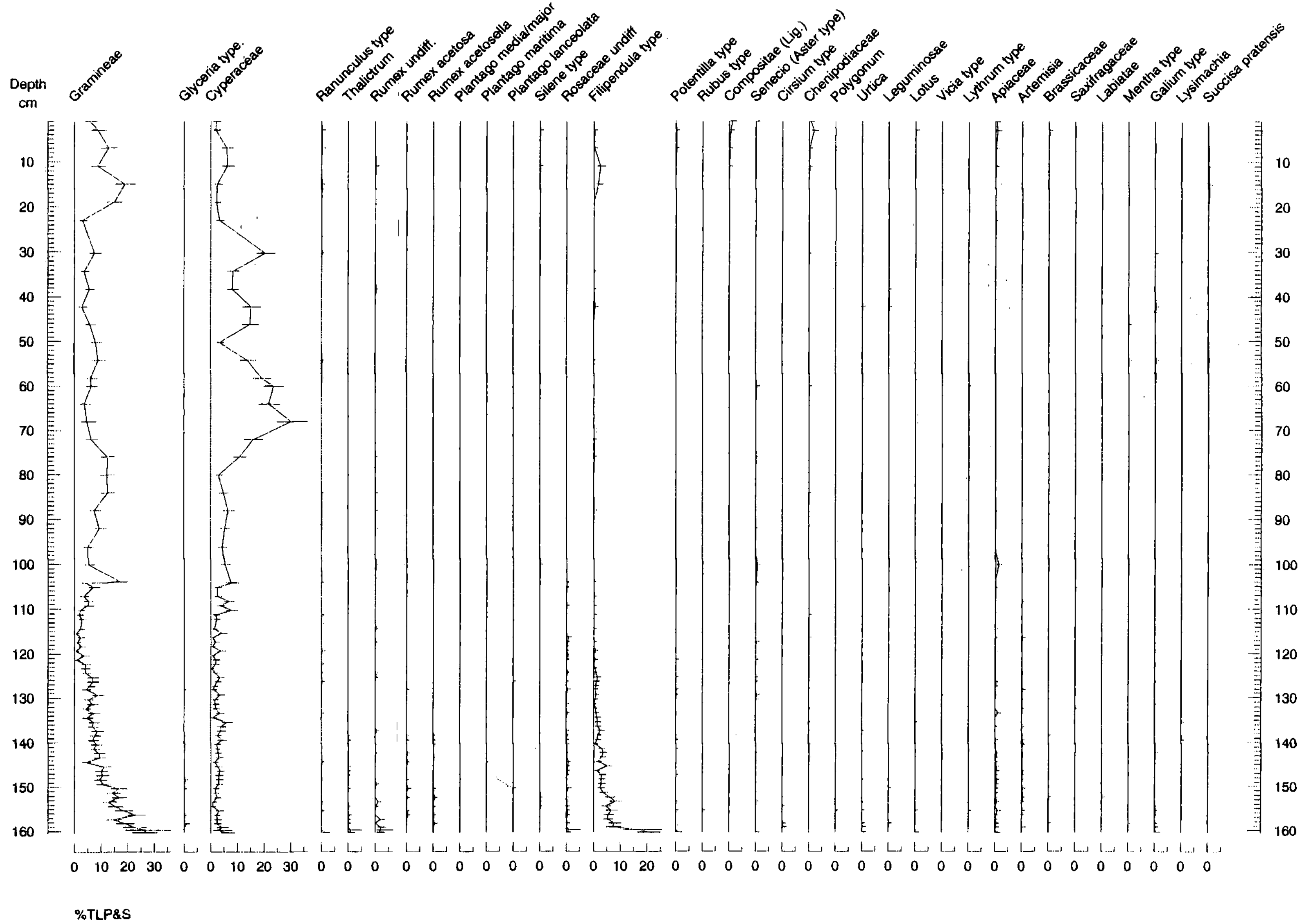
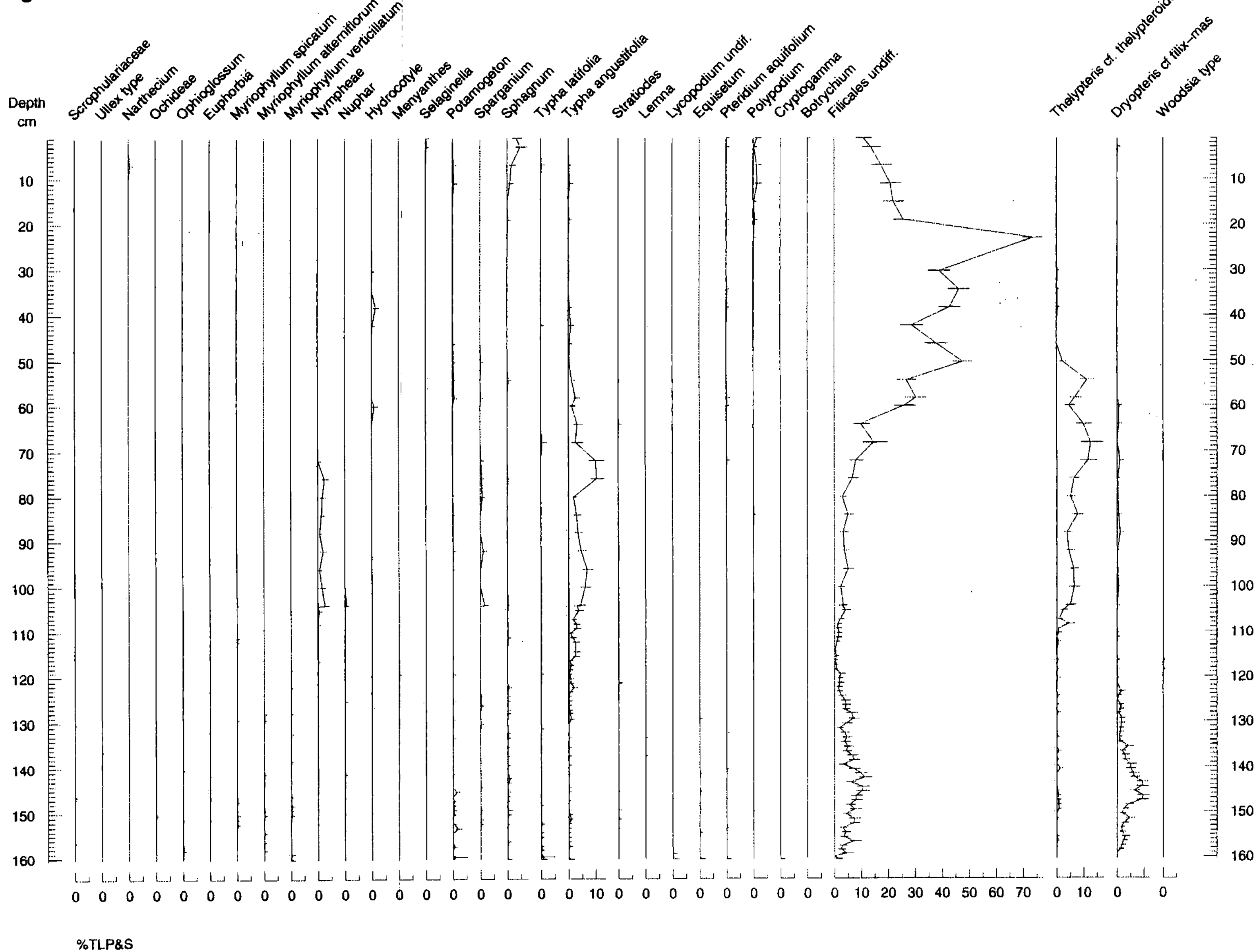


Figure 4.13c NM – 95% Confidence Limits



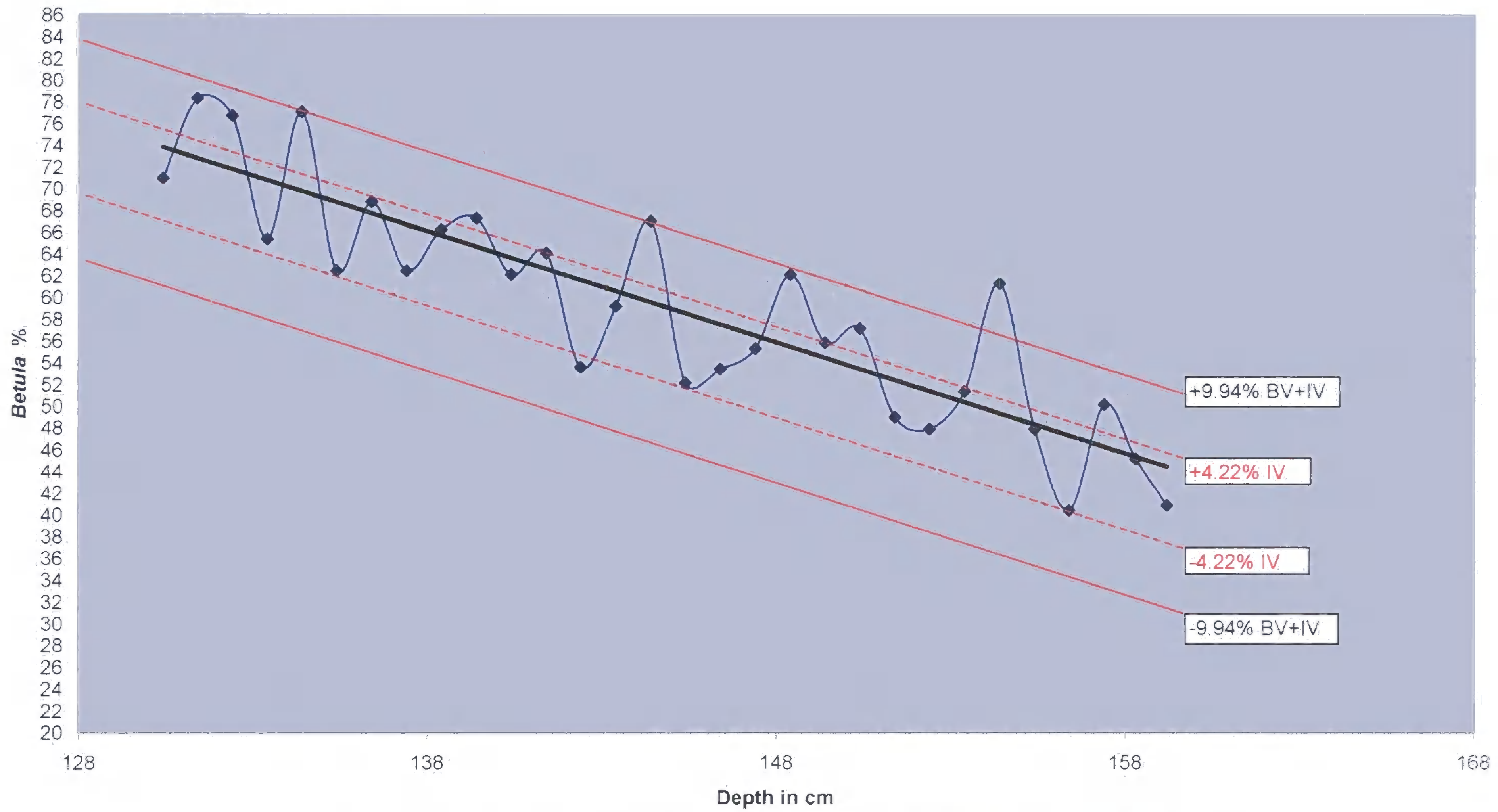


Figure 4.14 *Betula* percentages from profile NM, showing IV and BV

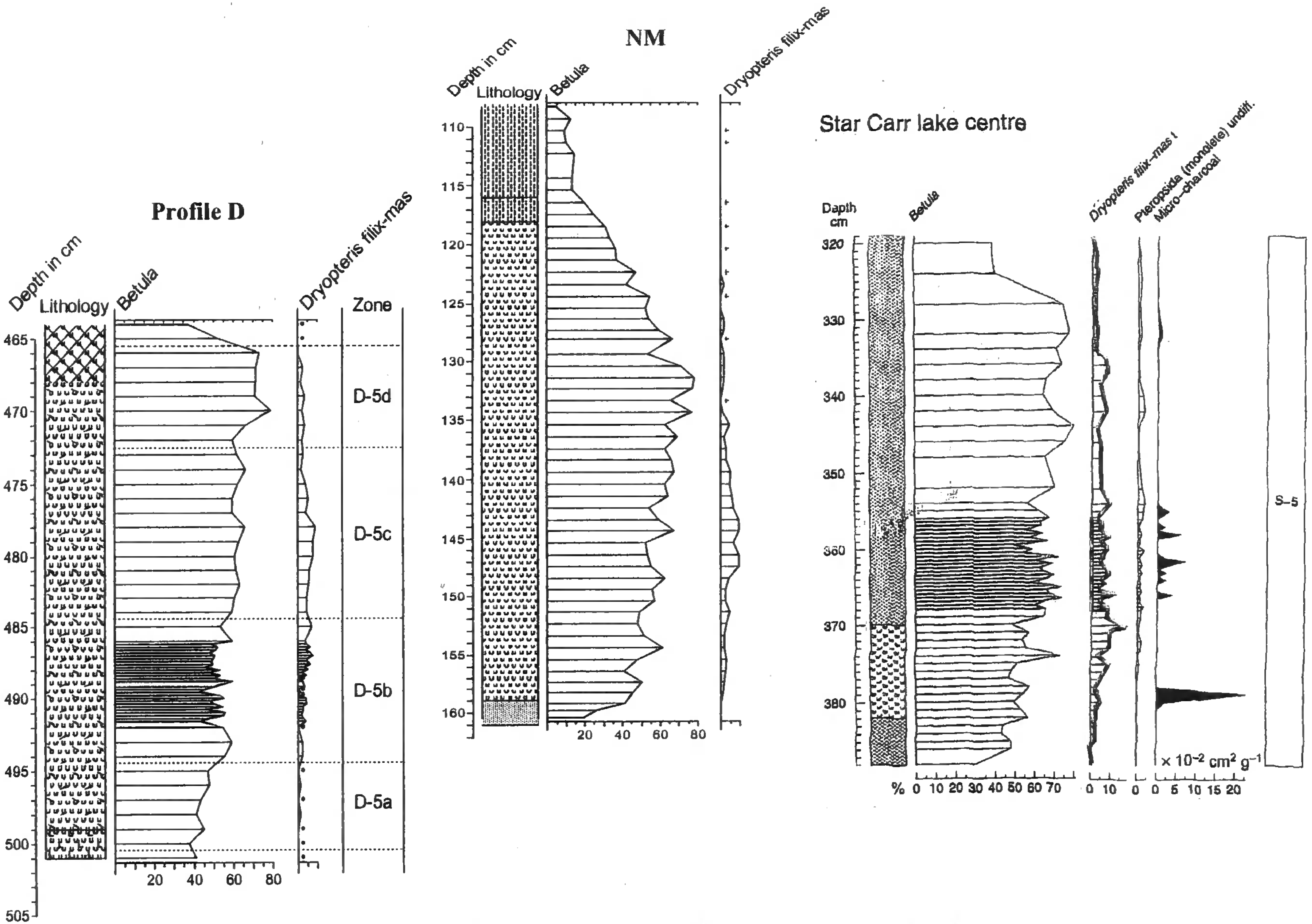


Figure 4.15 Comparison of the birch and male fern curves from Star Carr, NM and Profile D

Chapter Five

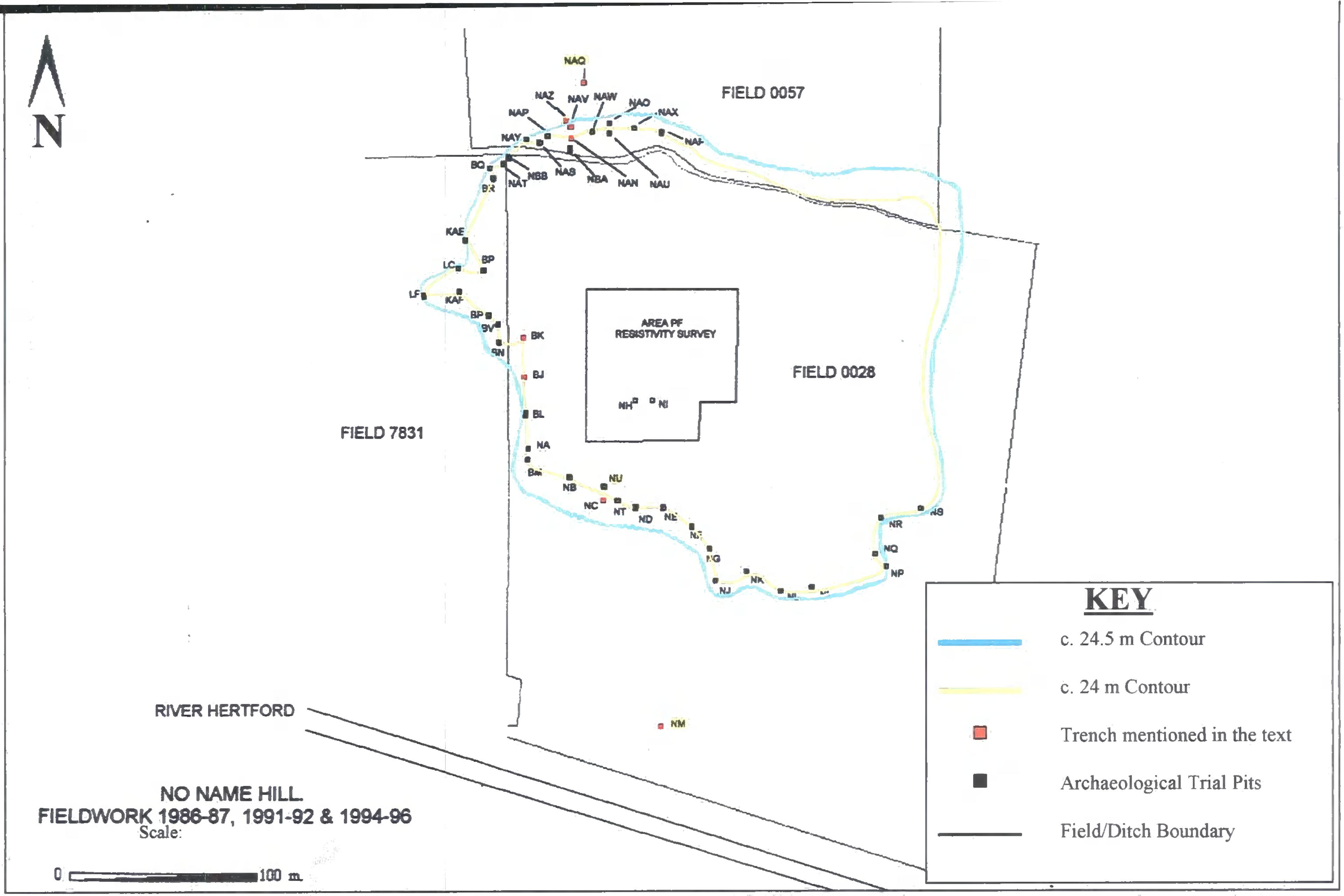


Figure 5.1 The location of early Mesolithic finds at No Name Hill showing the location of trenches mentioned in the text.

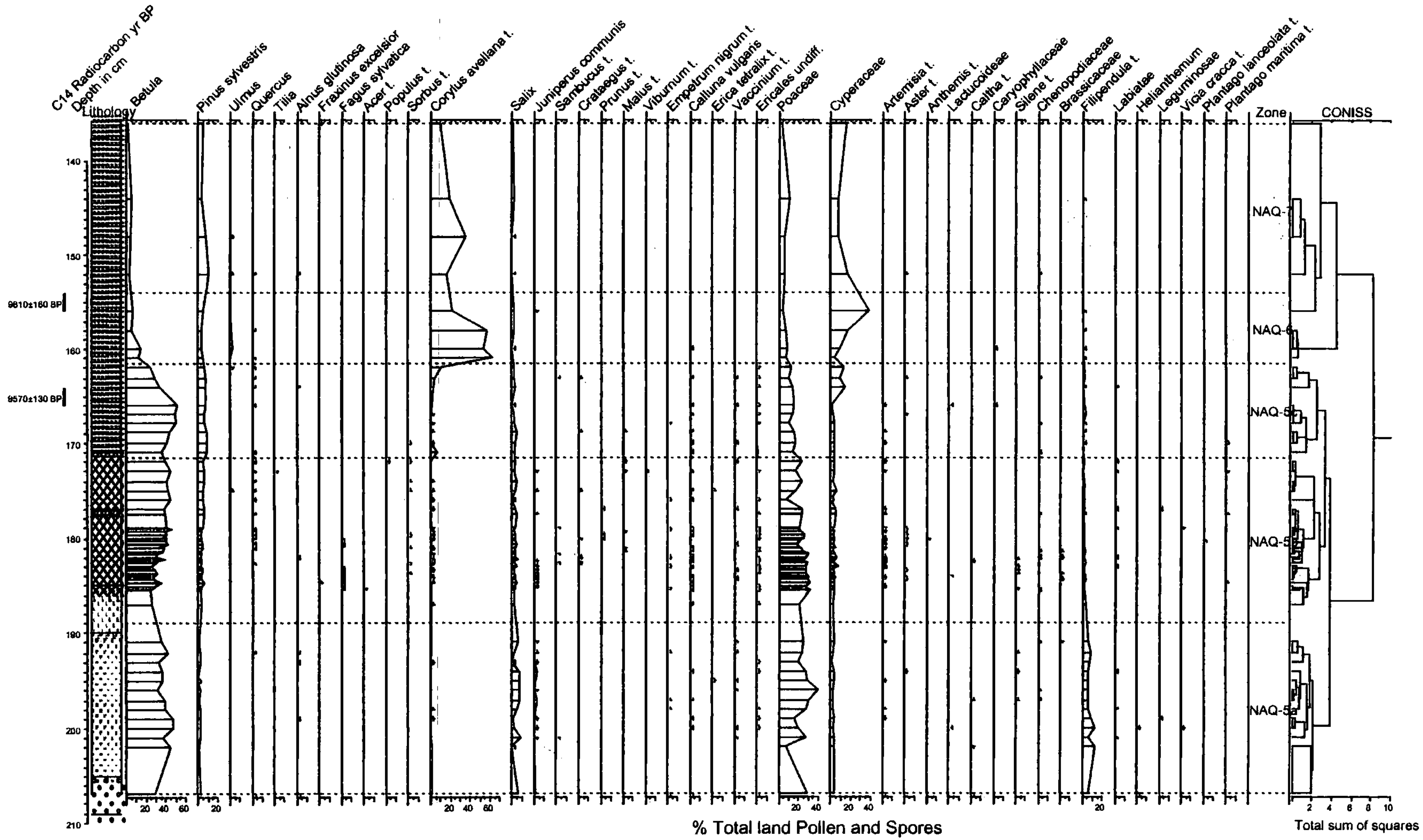


Figure 5.2 NAQ Percentage Pollen Diagram

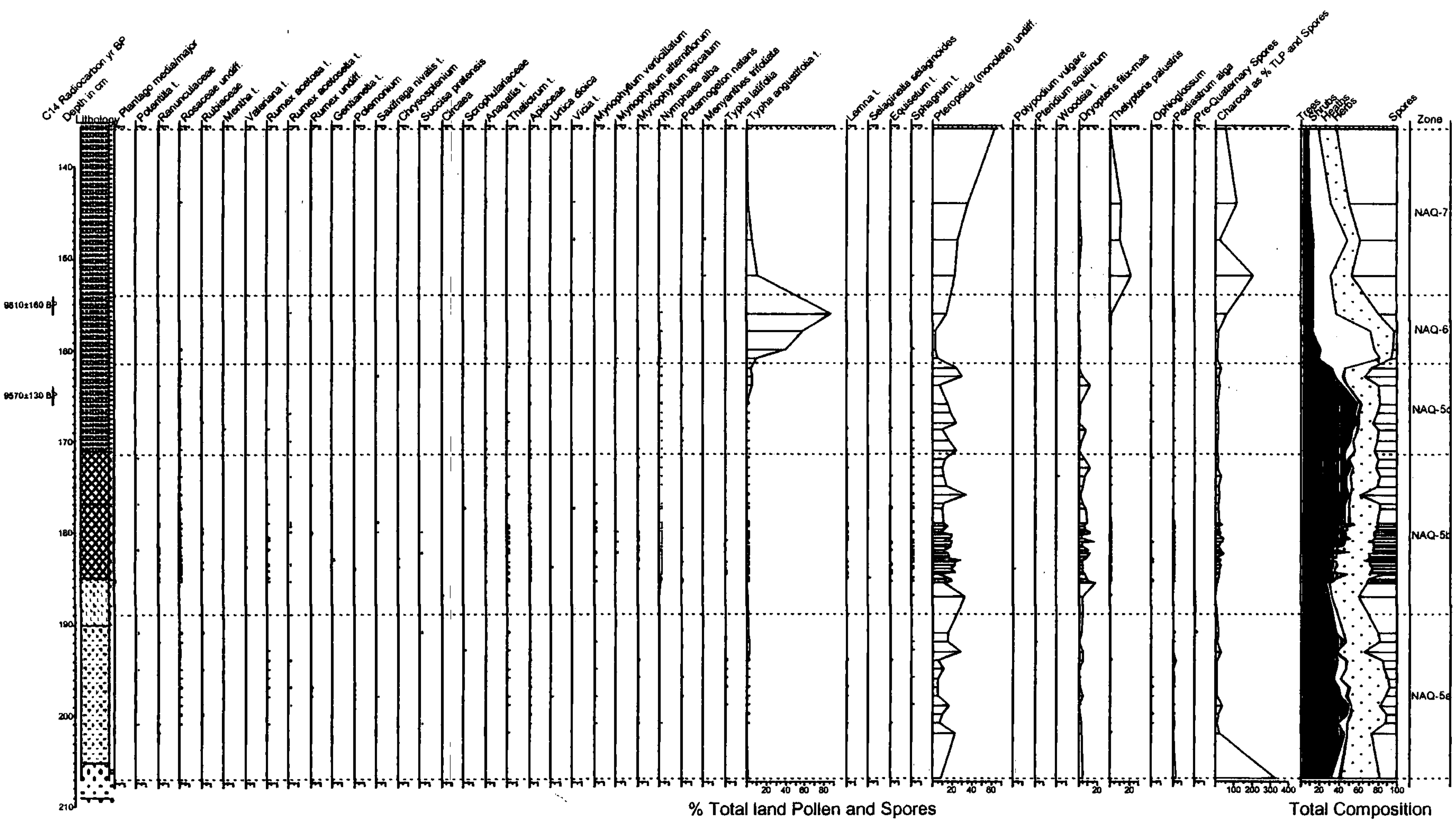


Figure 5.3 NAQ Percentage Pollen Diagram (cont'd)

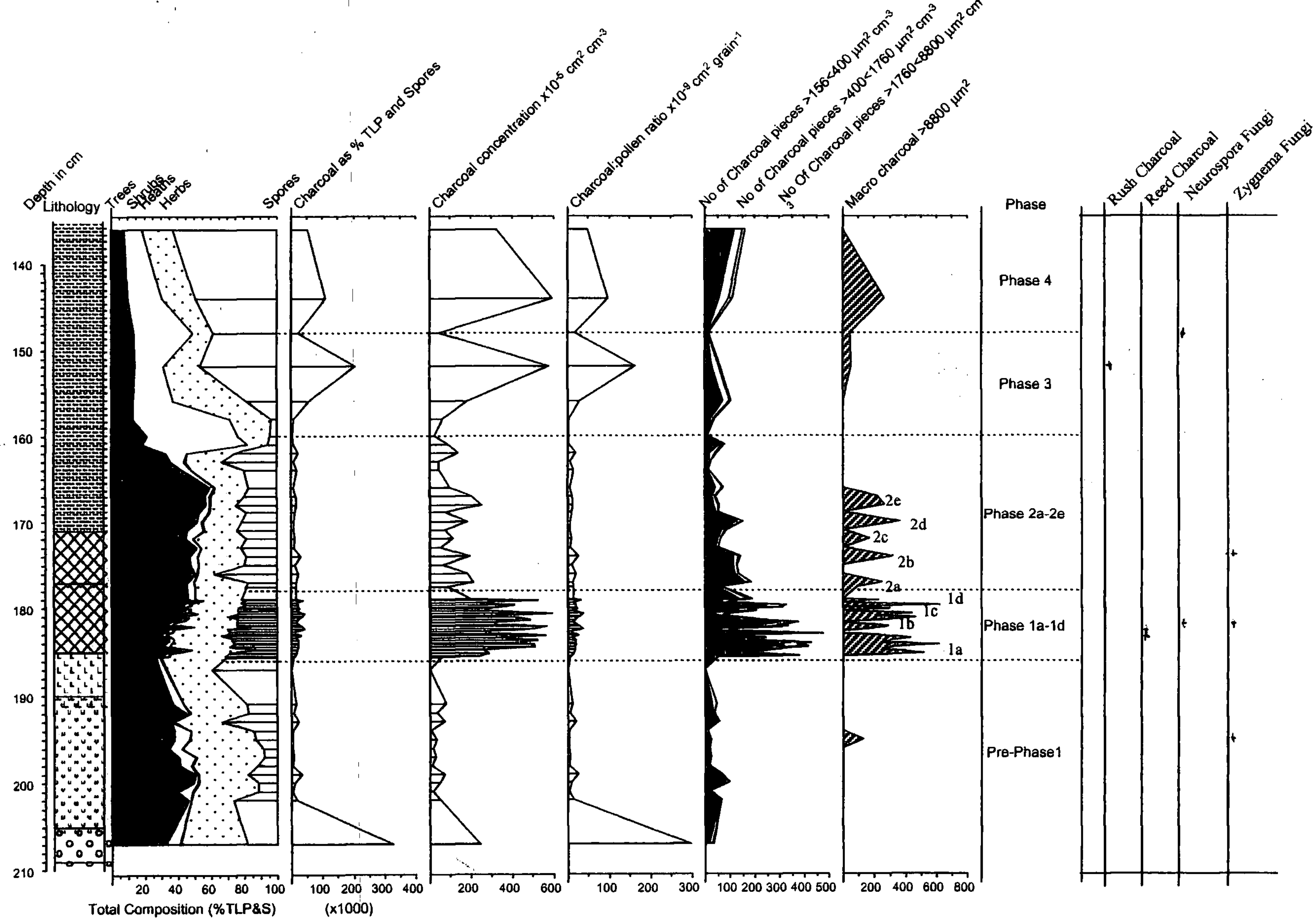


Figure 5.4 NAQ Summary Diagram

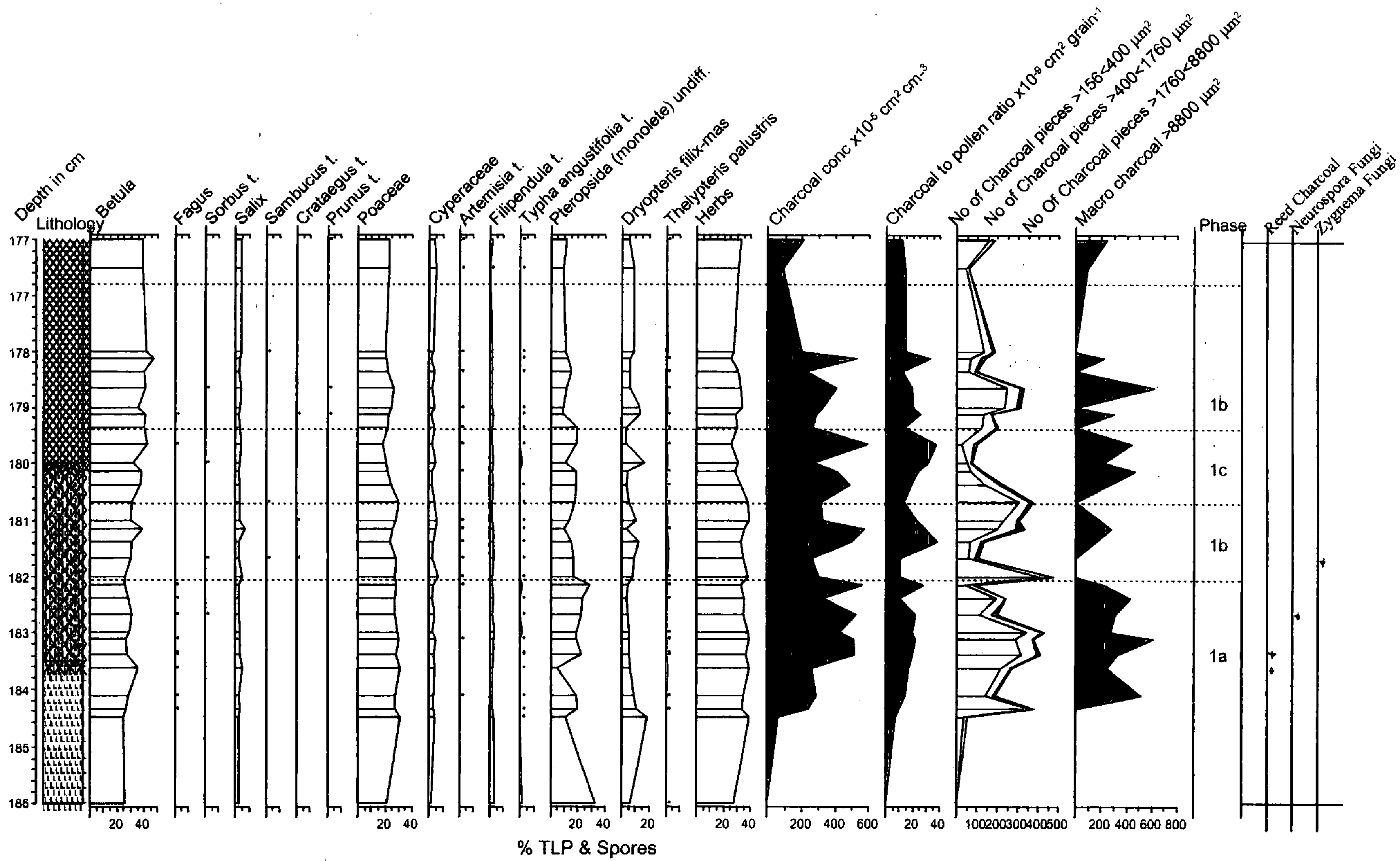
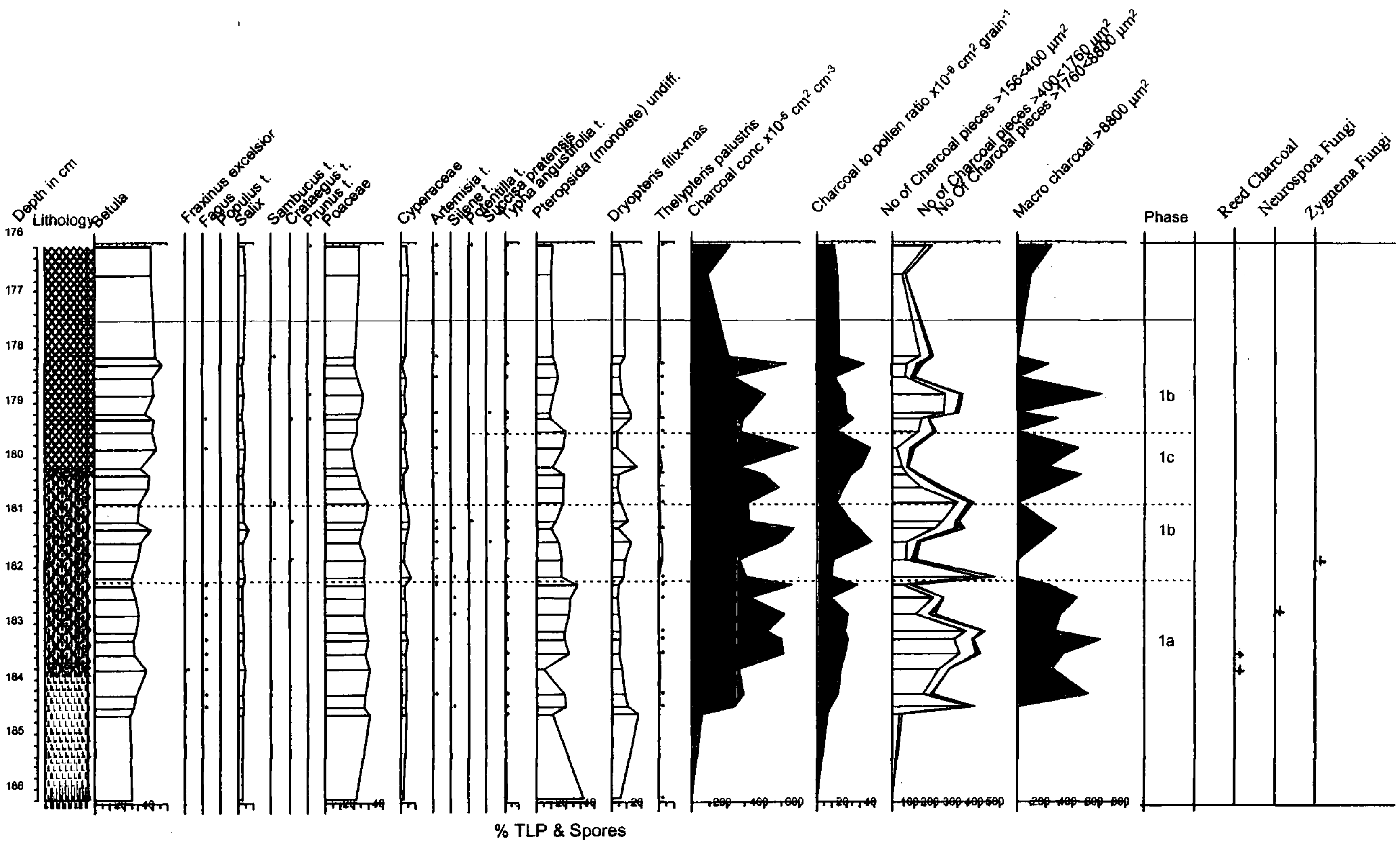


Figure 5.5 NAQ Fine Resolution (% Selected Taxa)



<u>**Figure 5.5b NAQ Fire Phases (% Selected Taxa)**</u>

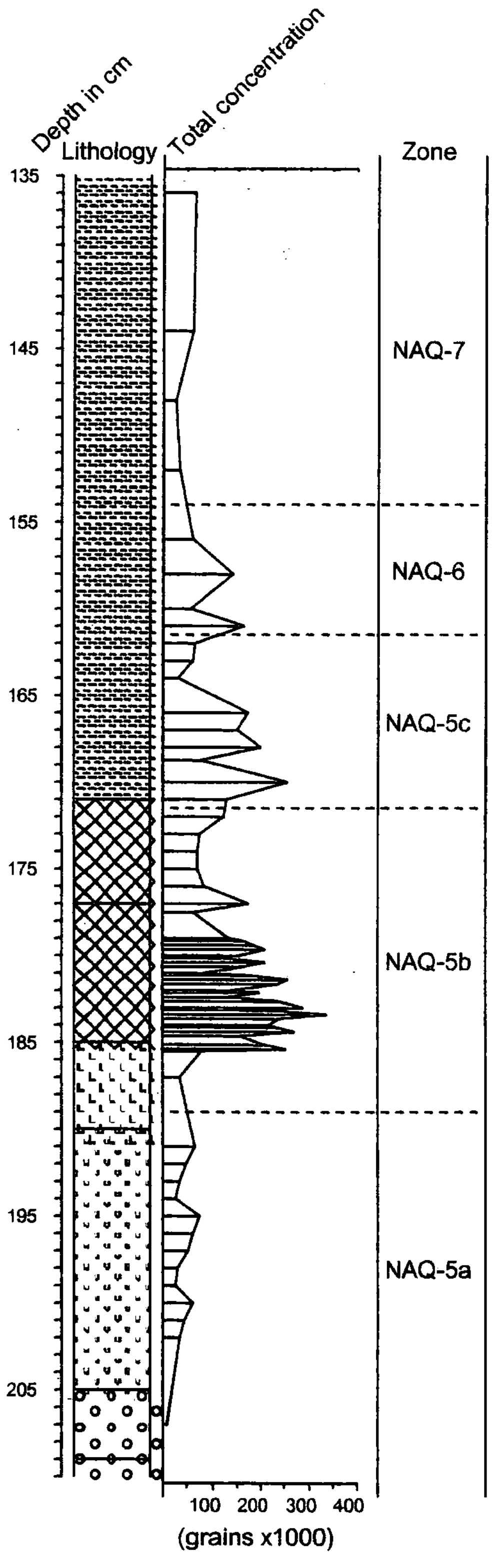


Figure 5.6a NAQ Pollen and Spore Concentration Curve

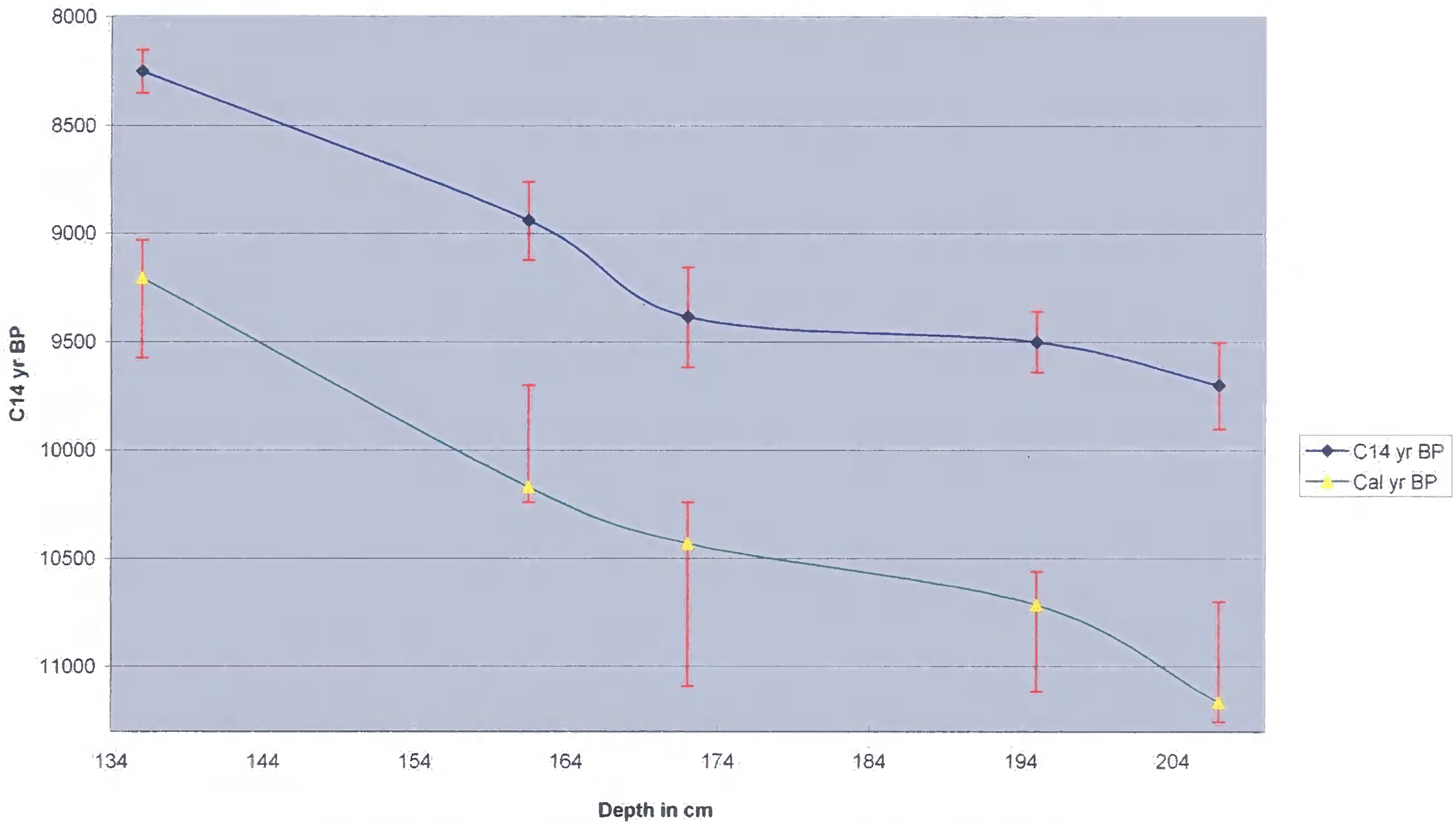


Figure 5.6b Time-Depth curve for NAQ (to 2 SE)

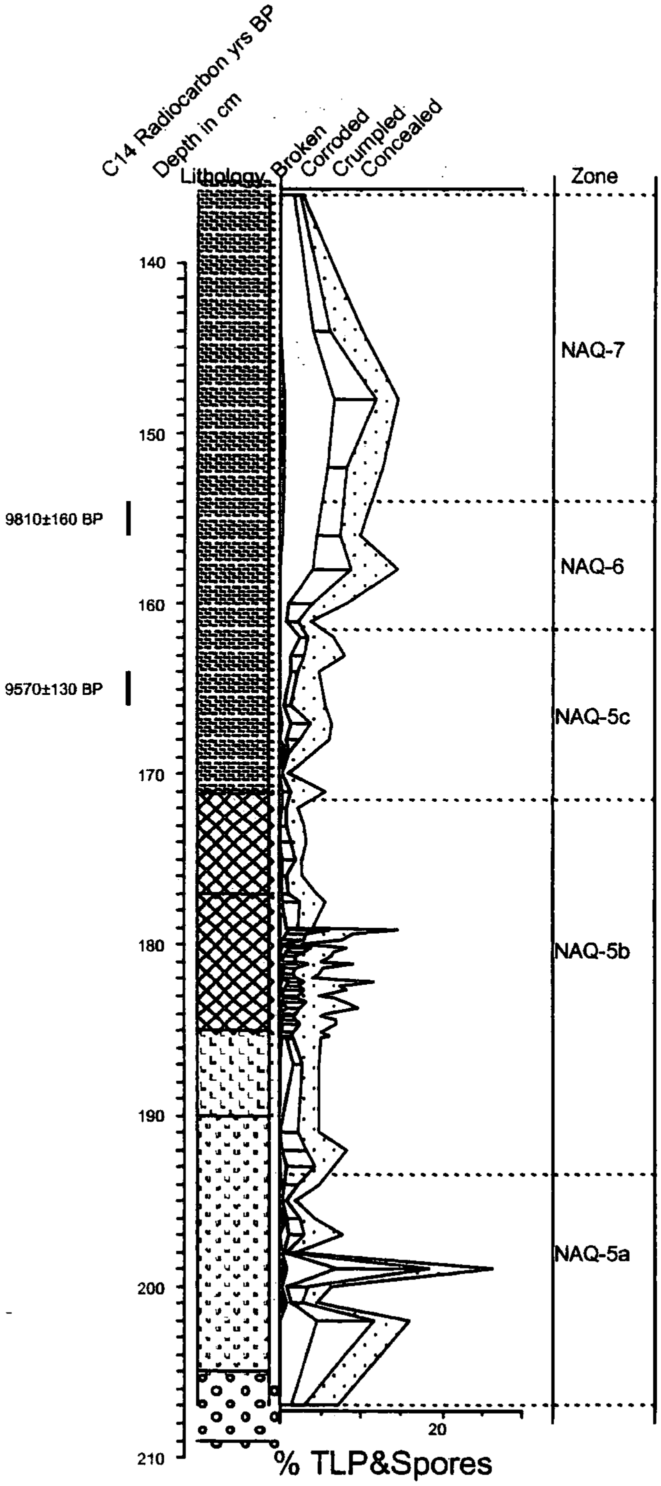
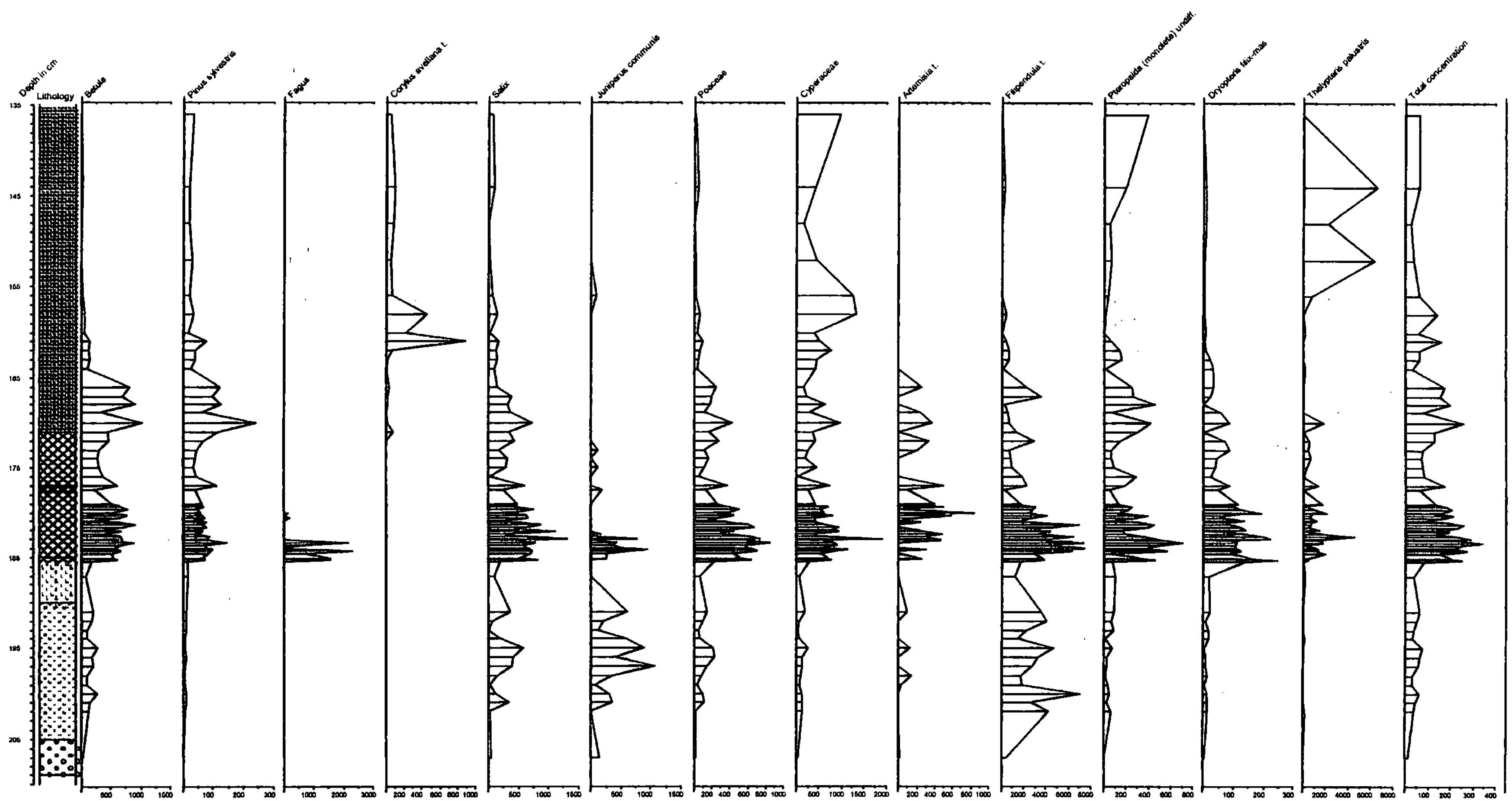


Figure 5.7 NAQ Pollen Preservation



grains cm-3

Figure 5.8 NAQ Selected pollen and spore concentrations

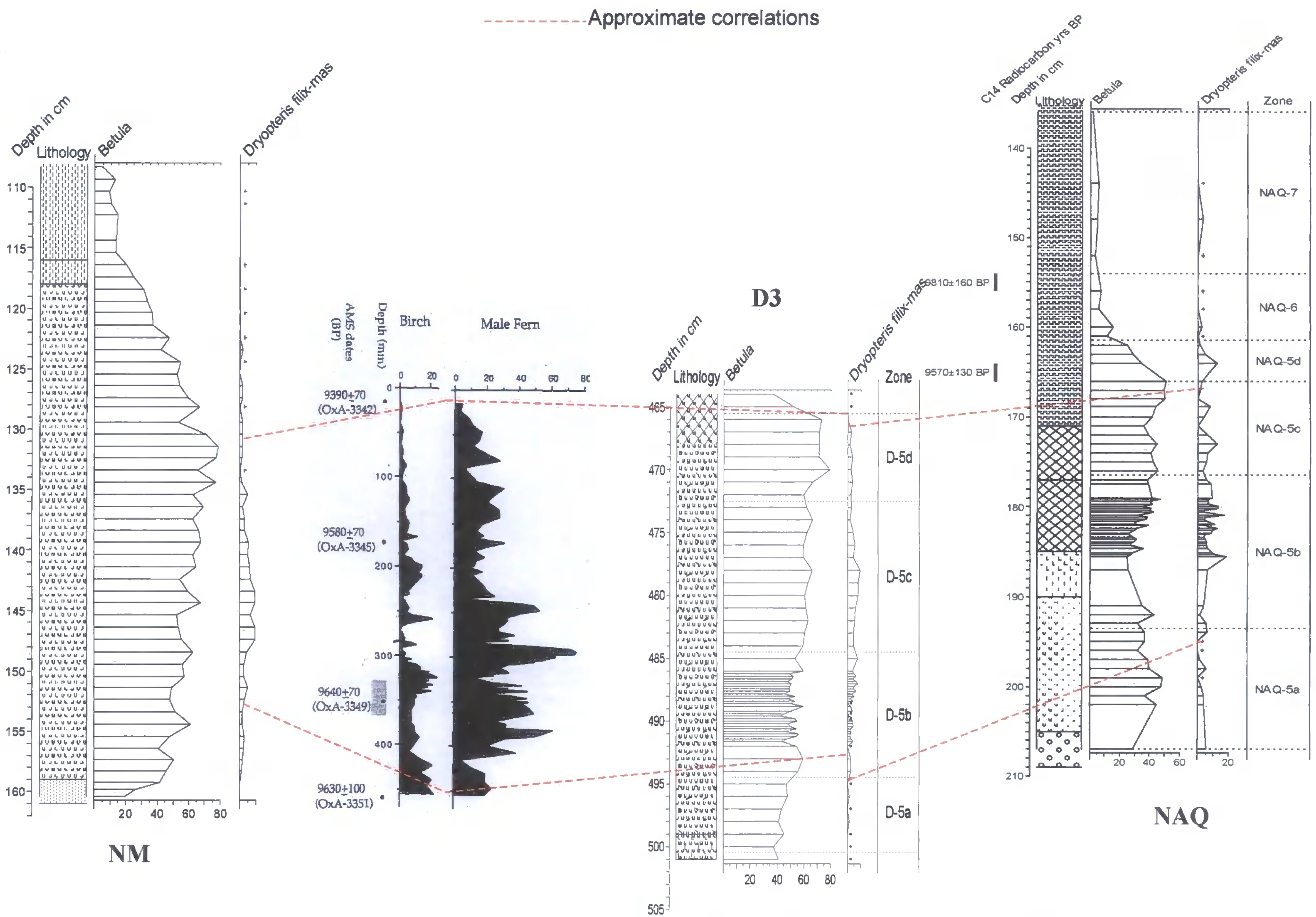


Figure 5.9 Comparison of NM, Star Carr, D3 and NAQ

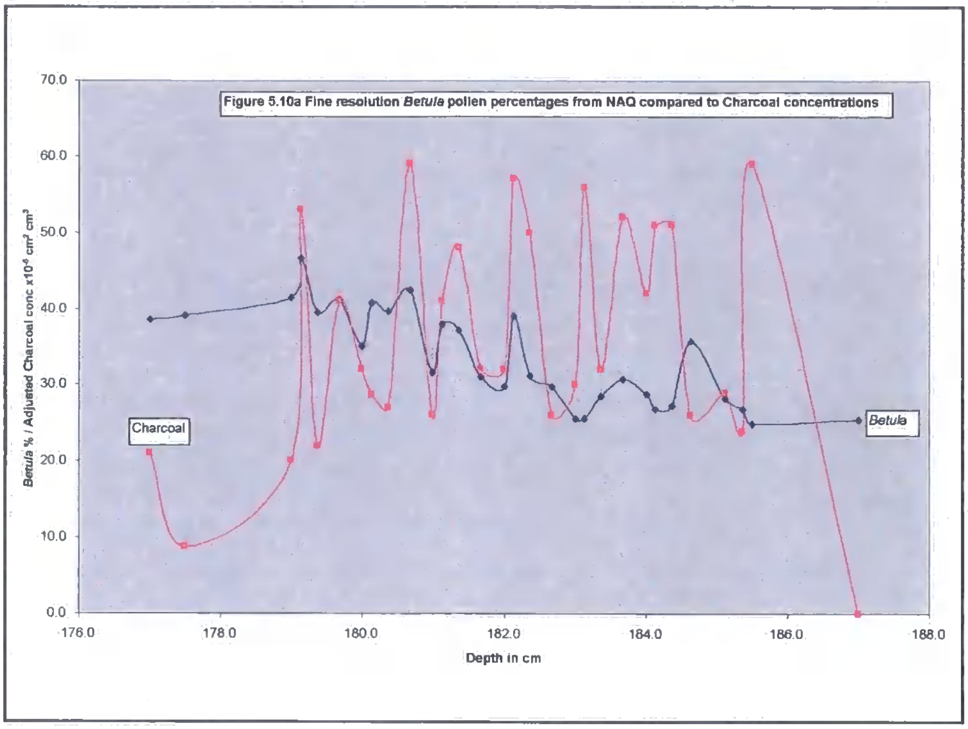


Figure 5.10a Fine resolution Betula pollen percentages from NAQ compared to Charcoal concentrations
Betula % / Adjusted Charcoal conc x10⁴ cm² cm³
Charcoal
Betula
Depth in cm
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
176.0
178.0
180.0
182.0
184.0
186.0
188.0

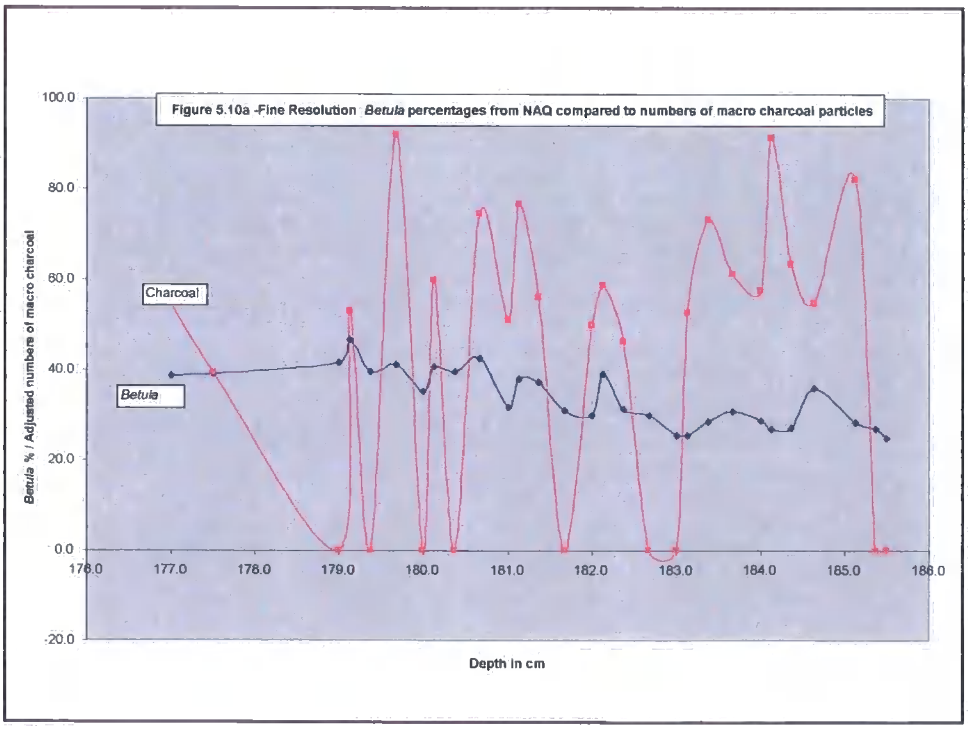


Figure 5.10a -Fine Resolution Betula percentages from NAQ compared to numbers of macro charcoal particles
Betula % / Adjusted numbers of macro charcoal
Charcoal
Betula
Depth in cm
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
176.0
177.0
178.0
179.0
180.0
181.0
182.0
183.0
184.0
185.0
186.0

A

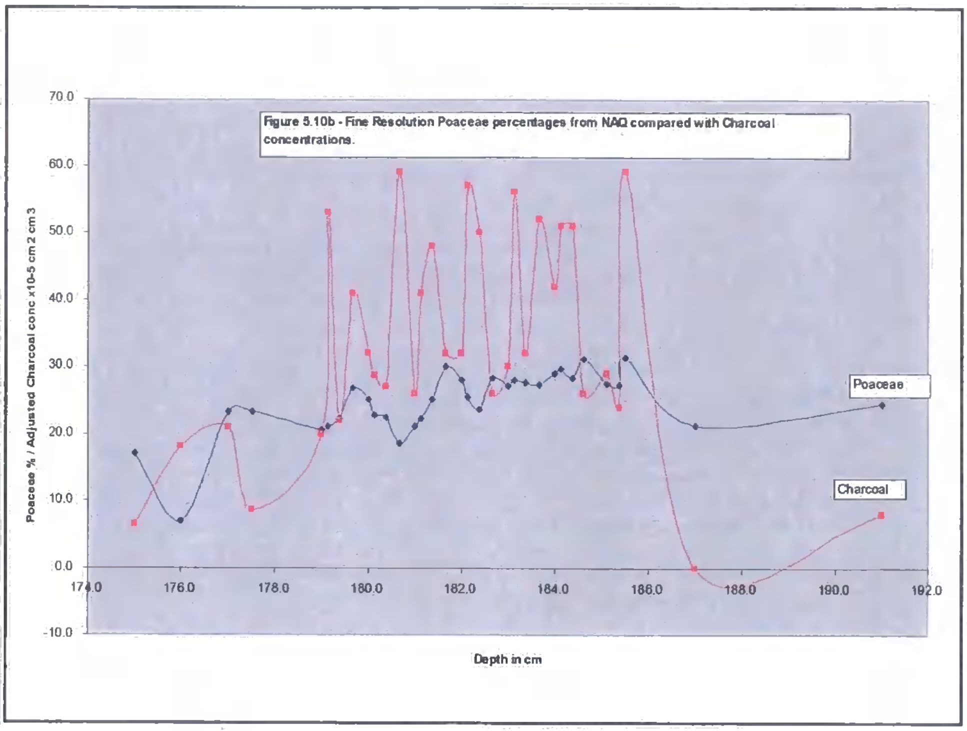


Figure 5.10b - Fine Resolution Poaceae percentages from NAQ compared with Charcoal concentrations.

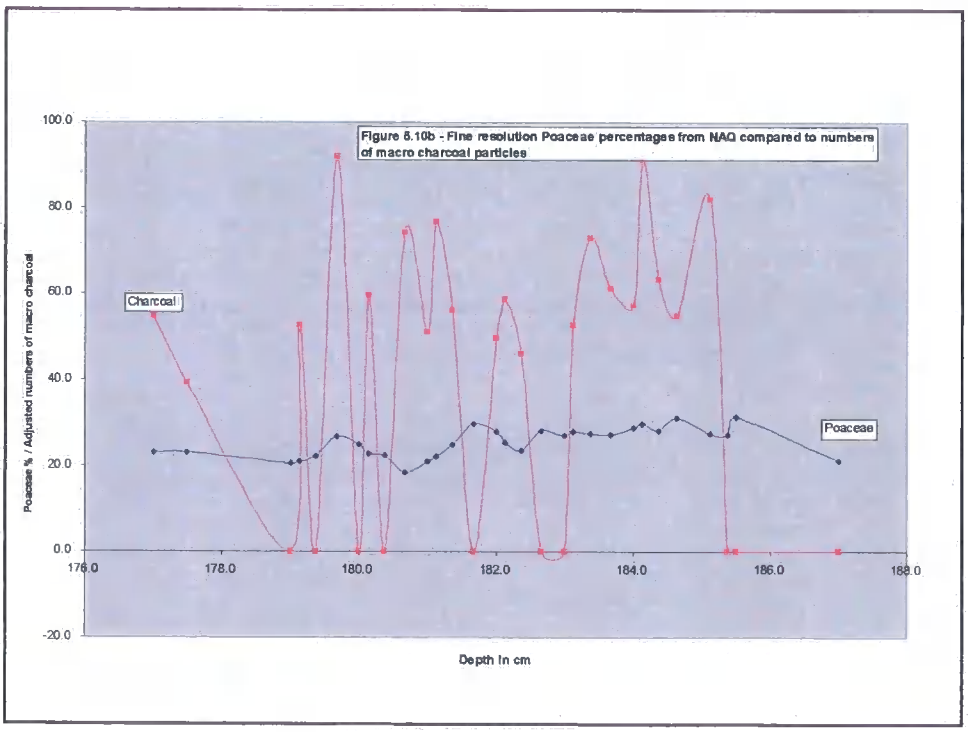


Figure 5.10b - Fine resolution Poaceae percentages from NAQ compared to numbers of macro charcoal particles

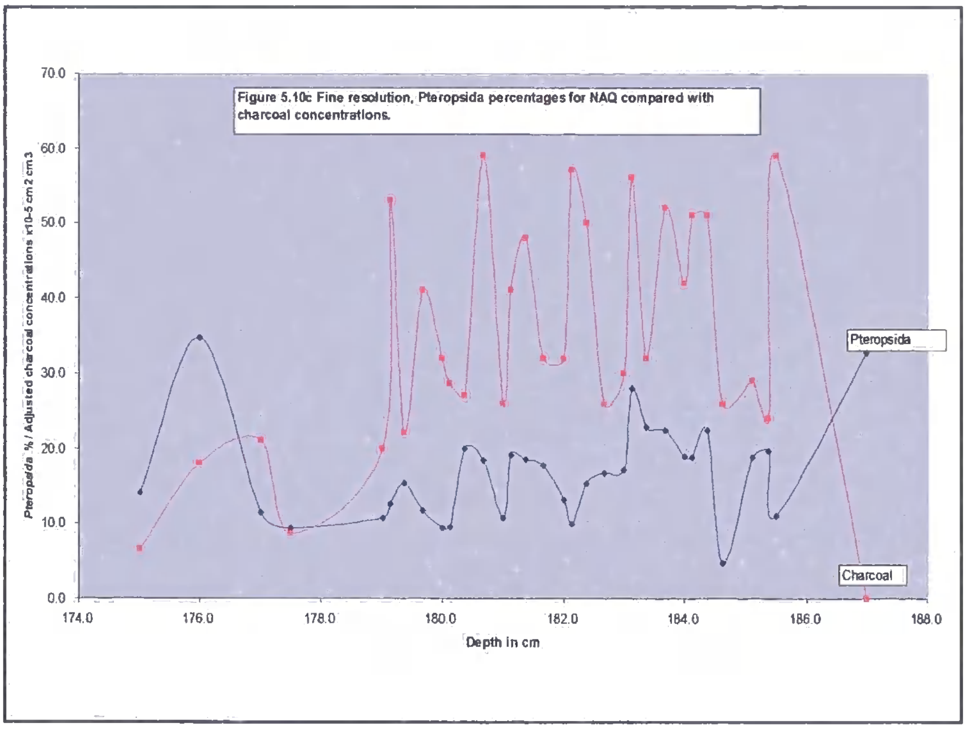


Figure 5.10c Fine resolution, Pteropsida percentages for NAQ compared with charcoal concentrations.
Pteropsida % / Adjusted charcoal concentrations x10-5 cm2 cm3
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
174.0
176.0
178.0
180.0
182.0
184.0
186.0
188.0
Depth in cm
Pteropsida
Charcoal

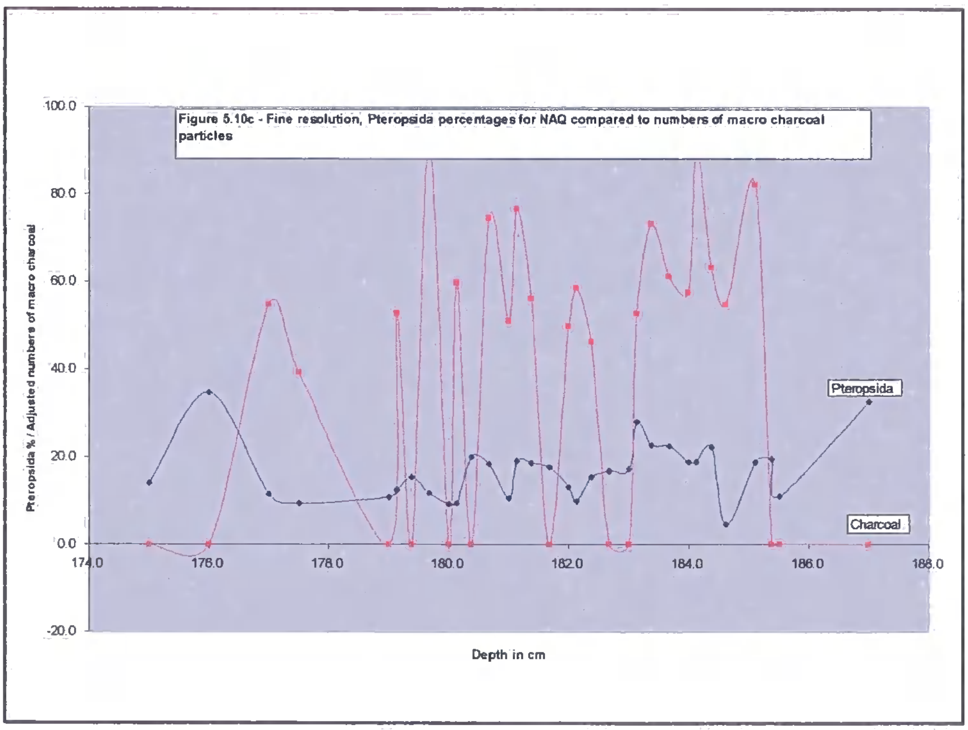


Figure 5.10c - Fine resolution, Pteropsida percentages for NAQ compared to numbers of macro charcoal particles
Pteropsida % / Adjusted numbers of macro charcoal
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
174.0
176.0
178.0
180.0
182.0
184.0
186.0
188.0
Depth in cm
Pteropsida
Charcoal

c

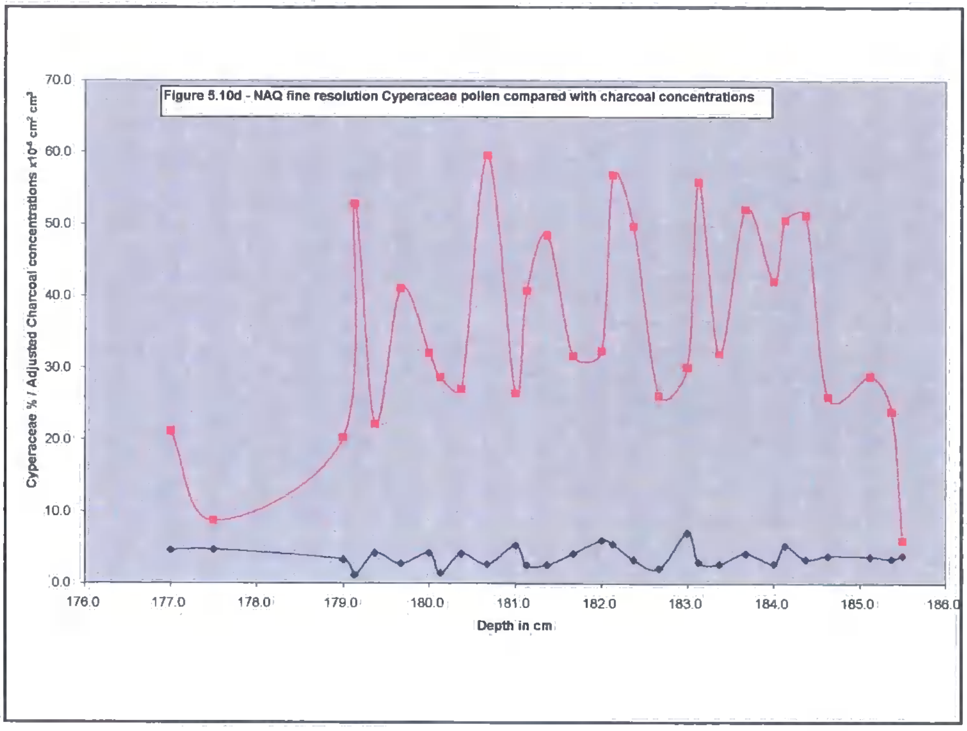


Figure 5.10d - NAQ fine resolution Cyperaceae pollen compared with charcoal concentrations

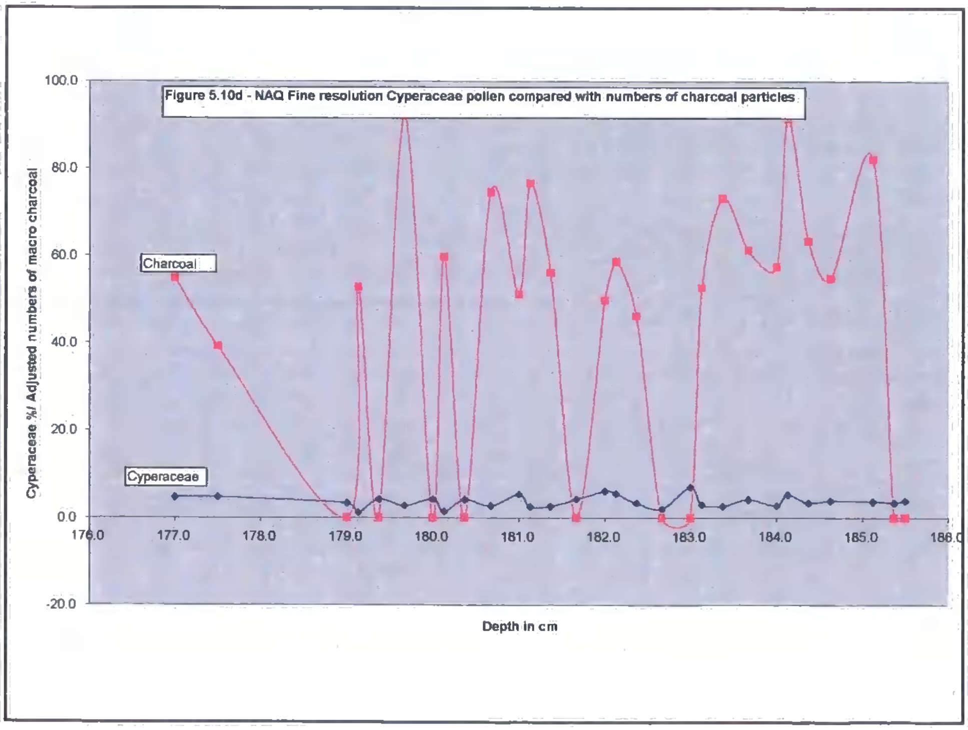


Figure 5.10d - NAQ Fine resolution Cyperaceae pollen compared with numbers of charcoal particles

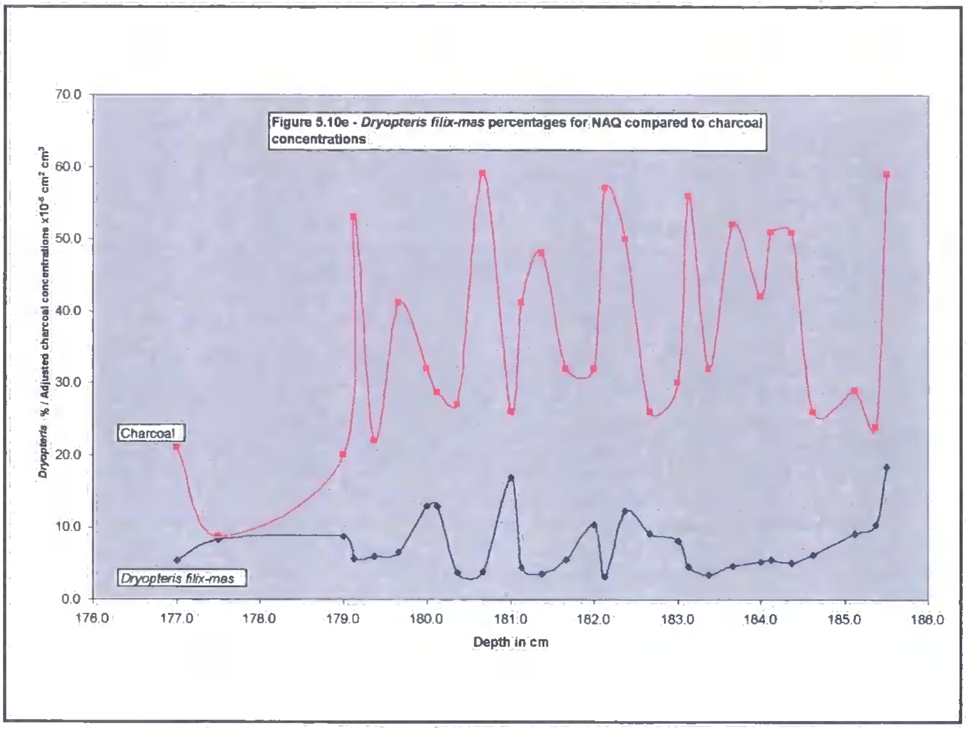


Figure 5.10e - *Dryopteris filix-mas* percentages for NAQ compared to charcoal concentrations

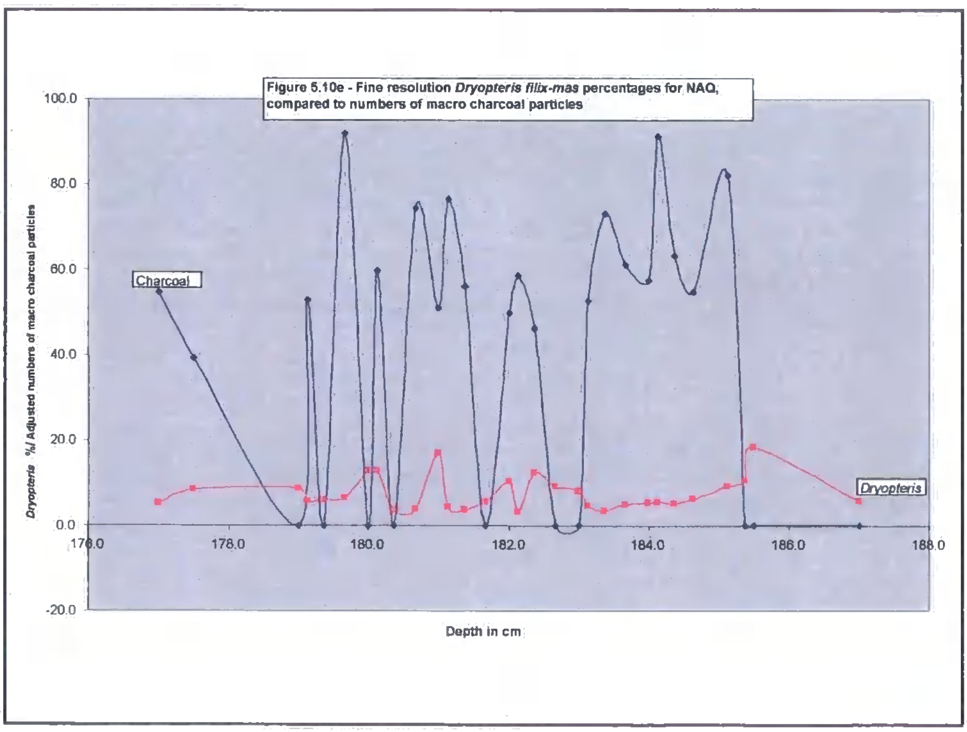


Figure 5.10e - Fine resolution *Dryopteris filix-mas* percentages for NAQ, compared to numbers of macro charcoal particles

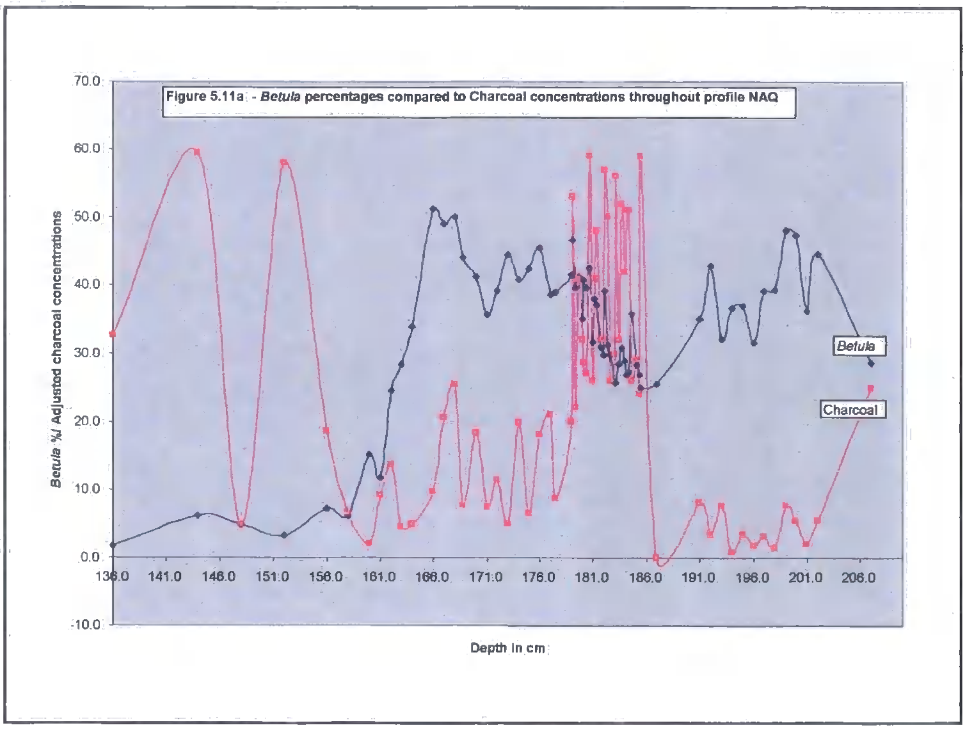


Figure 5.11a - Betula percentages compared to Charcoal concentrations throughout profile NAQ
Betula %/ Adjusted charcoal concentrations
Depth in cm
Betula
Charcoal
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
136.0
141.0
146.0
151.0
156.0
161.0
166.0
171.0
176.0
181.0
186.0
191.0
196.0
201.0
206.0

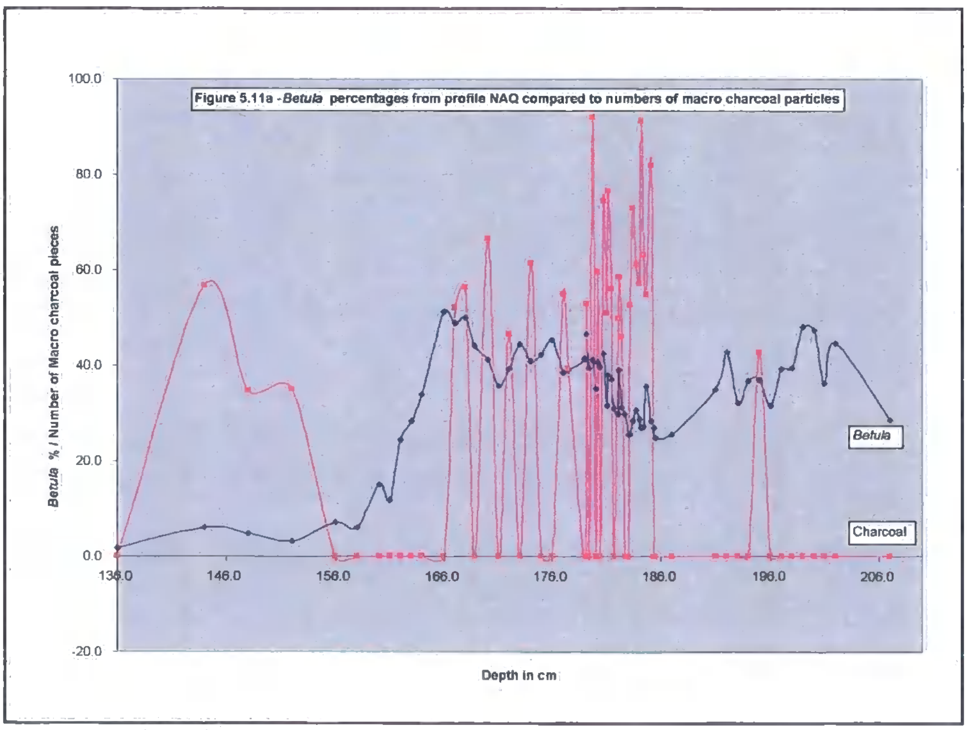


Figure 5.11a - Betula percentages from profile NAQ compared to numbers of macro charcoal particles
Betula % / Number of Macro charcoal pieces
Depth in cm
Betula
Charcoal
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
136.0
146.0
156.0
166.0
176.0
186.0
196.0
206.0

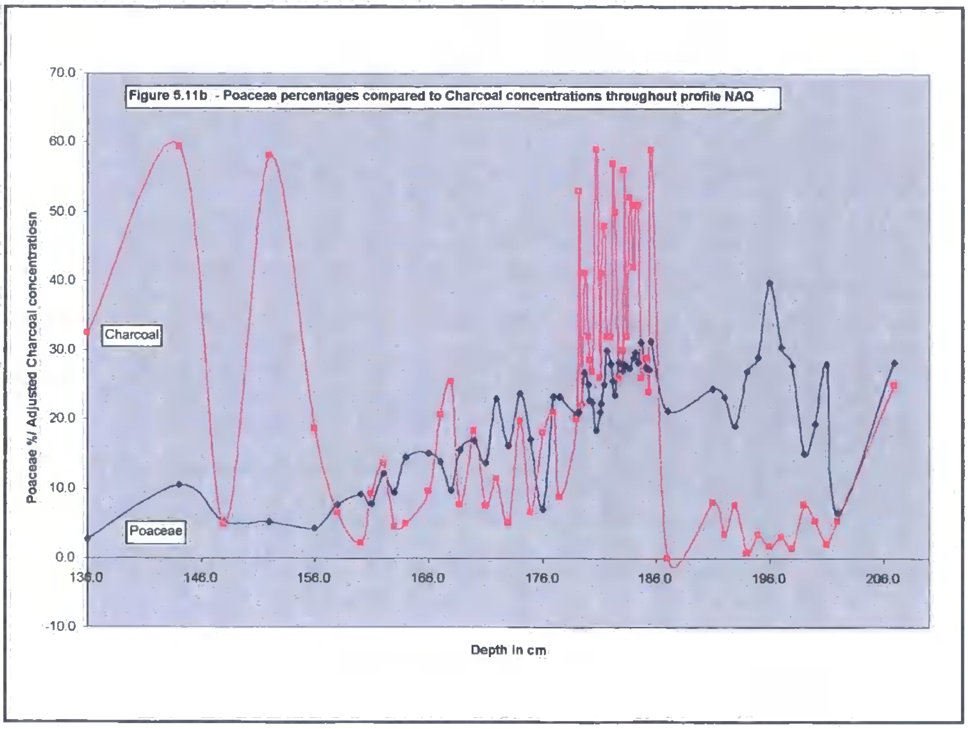


Figure 5.11b - Poaceae percentages compared to Charcoal concentrations throughout profile NAQ
Charcoal
Poaceae
Poaceae %/ Adjusted Charcoal concentratiosn
Depth in cm
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
136.0
146.0
156.0
166.0
176.0
186.0
196.0
206.0

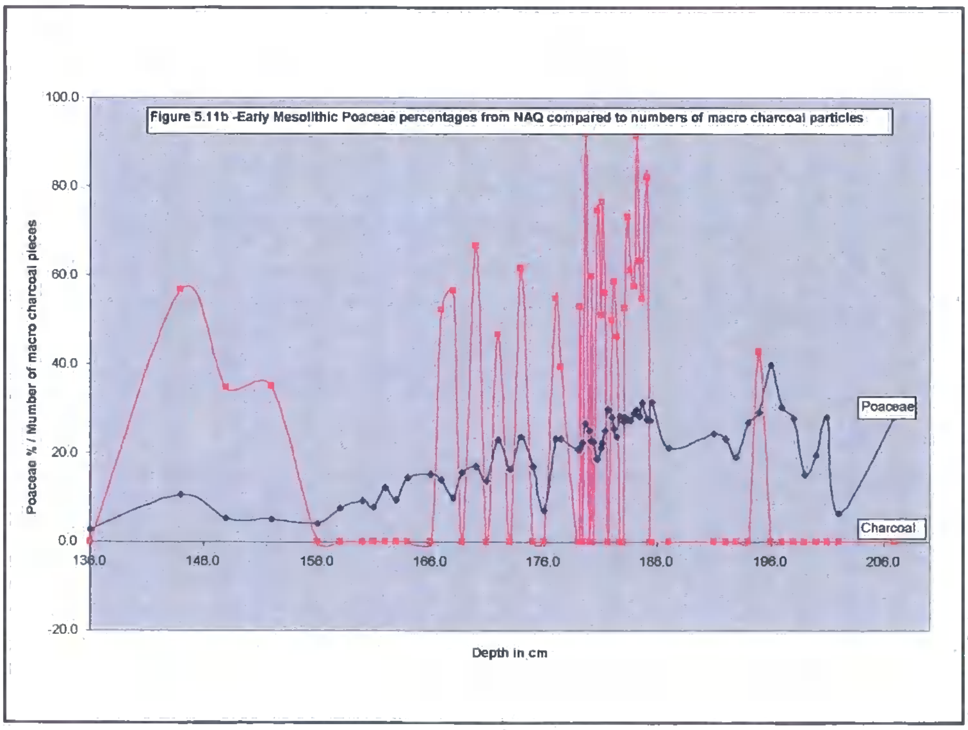


Figure 5.11b -Early Mesolithic Poaceae percentages from NAQ compared to numbers of macro charcoal particles
Poaceae
Charcoal
Poaceae % / Number of macro charcoal pieces
Depth in cm
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
136.0
146.0
156.0
166.0
176.0
186.0
196.0
206.0

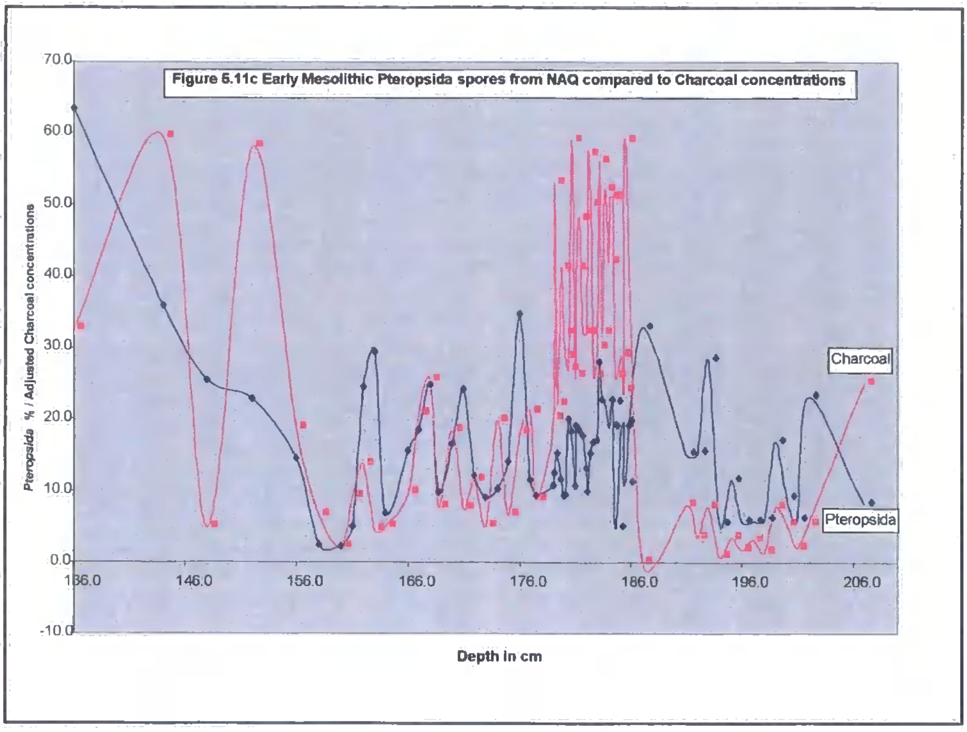


Figure 5.11c Early Mesolithic Pteropsida spores from NAQ compared to Charcoal concentrations
Pteropsida % / Adjusted Charcoal concentrations
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
136.0
146.0
156.0
166.0
176.0
186.0
196.0
206.0
Charcoal
Pteropsida
Depth in cm

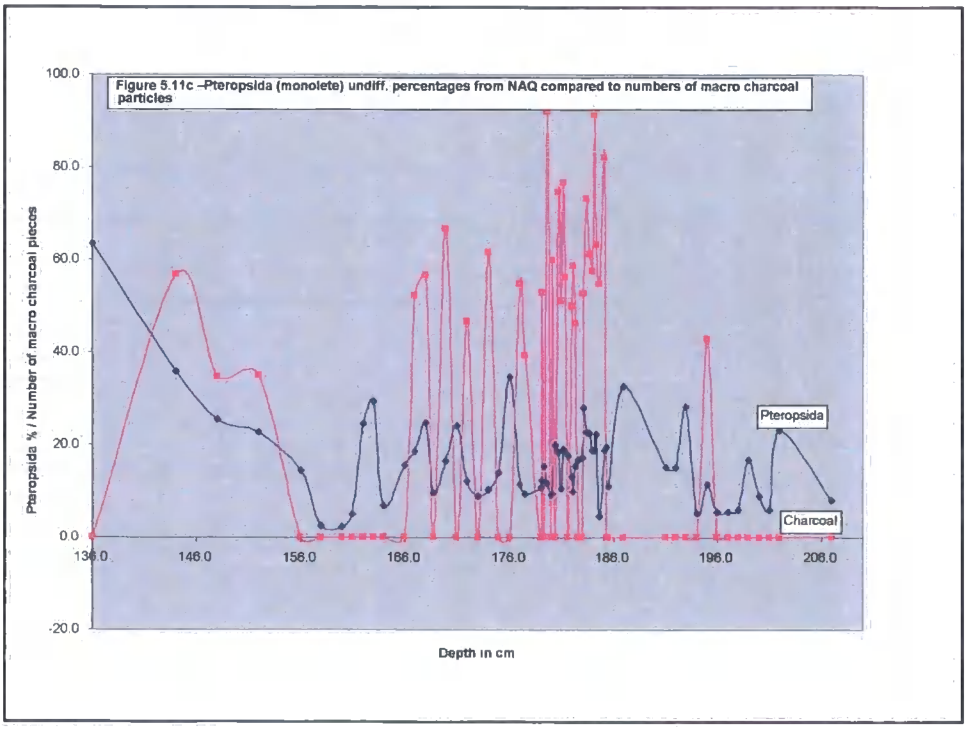


Figure 5.11c –Pteropsida (monolete) undiff. percentages from NAQ compared to numbers of macro charcoal particles
Pteropsida % / Number of macro charcoal pieces
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
136.0
146.0
156.0
166.0
176.0
186.0
196.0
206.0
Pteropsida
Charcoal
Depth in cm

H

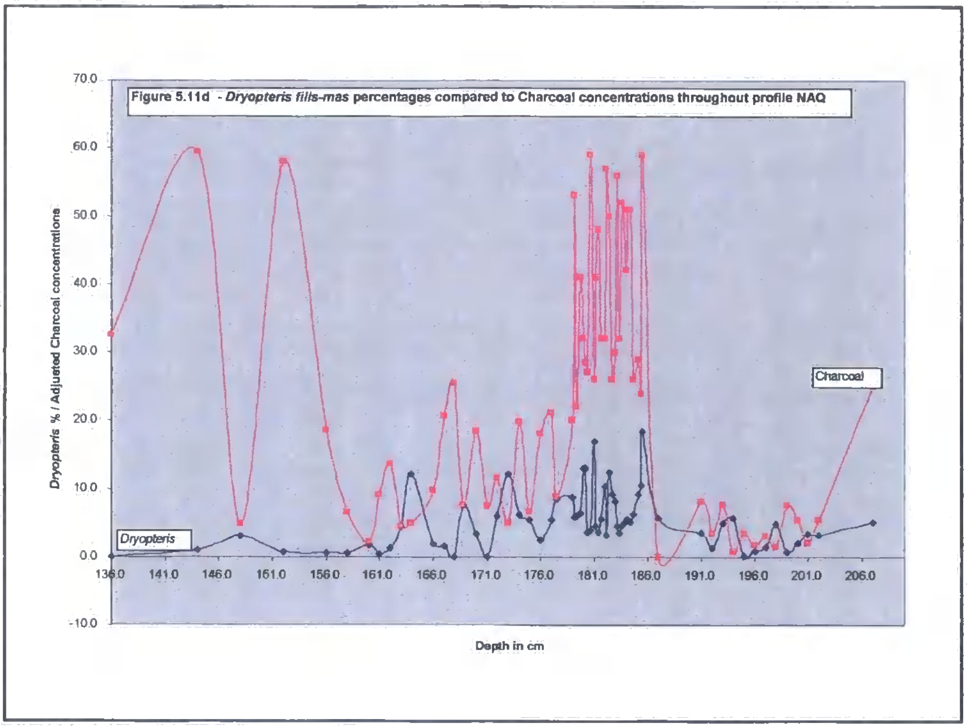


Figure 5.11d - *Dryopteris filis-mas* percentages compared to Charcoal concentrations throughout profile NAQ

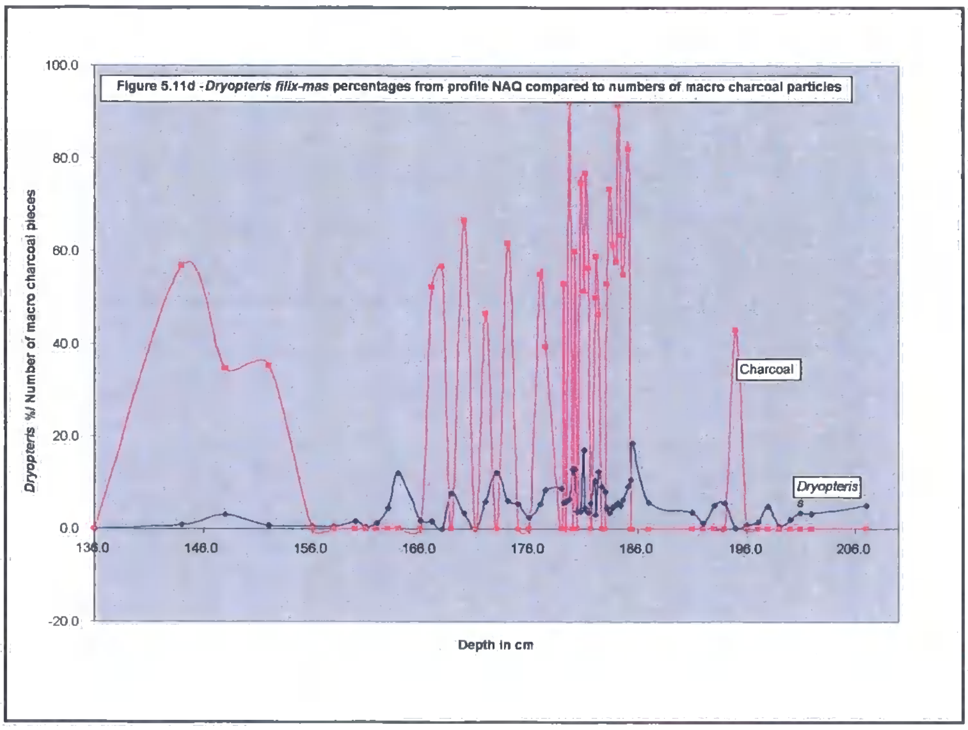


Figure 5.11d - *Dryopteris filix-mas* percentages from profile NAQ compared to numbers of macro charcoal particles

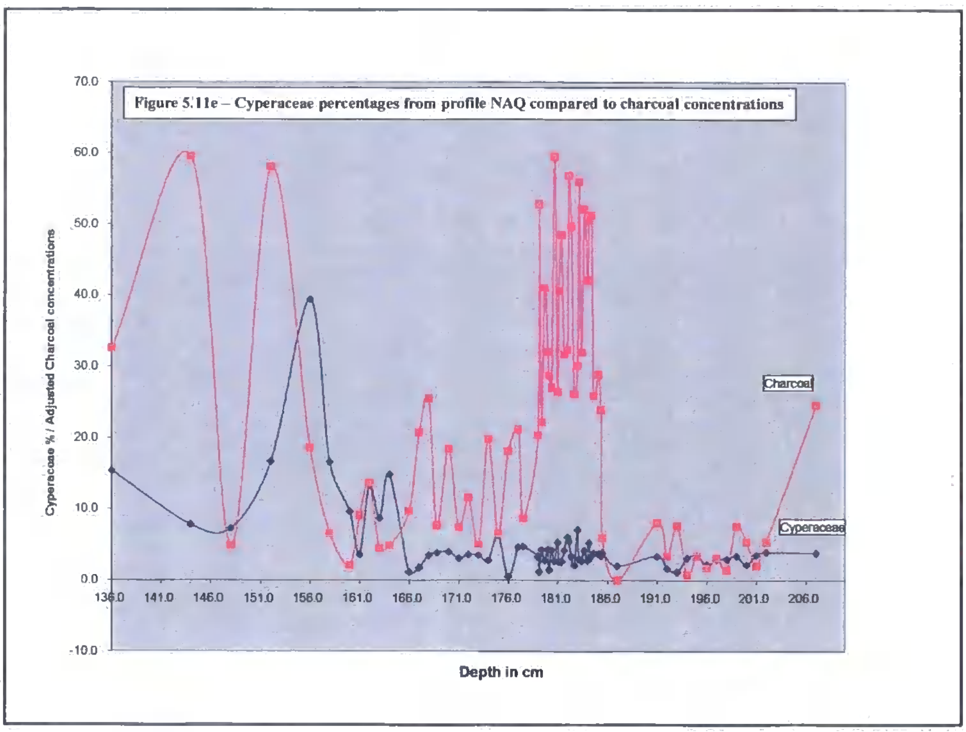


Figure 5.11e – Cyperaceae percentages from profile NAQ compared to charcoal concentrations
Cyperaceae % / Adjusted Charcoal concentrations
Depth in cm
Charcoal
Cyperaceae
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
136.0
141.0
146.0
151.0
156.0
161.0
166.0
171.0
176.0
181.0
186.0
191.0
196.0
201.0
206.0

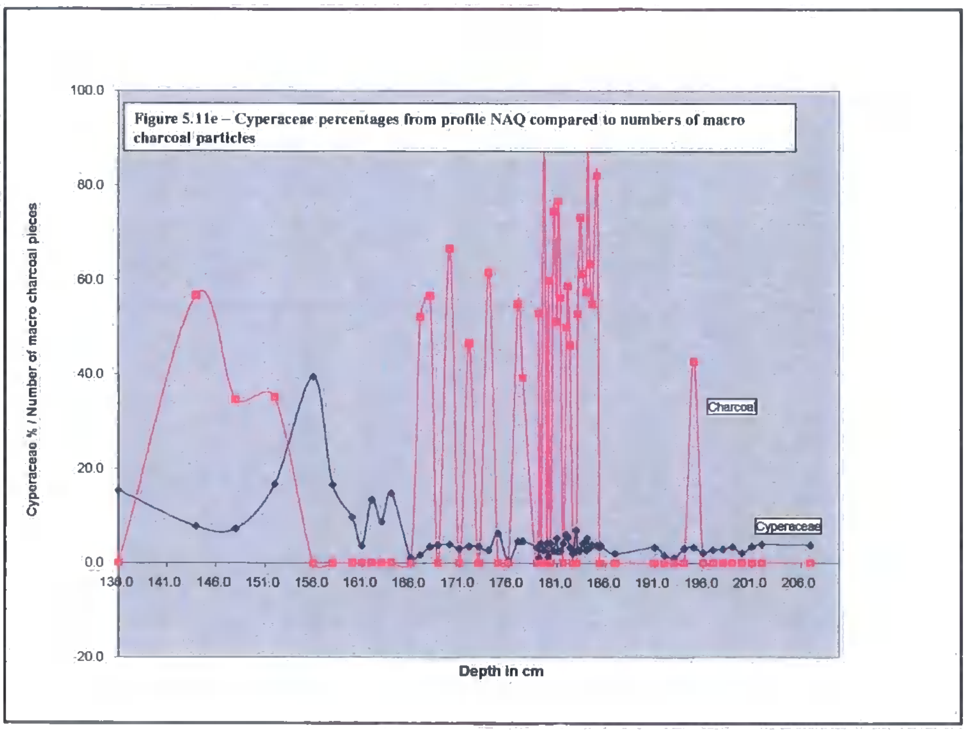


Figure 5.11e – Cyperaceae percentages from profile NAQ compared to numbers of macro charcoal particles
Cyperaceae % / Number of macro charcoal pieces
Depth in cm
Charcoal
Cyperaceae
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
136.0
141.0
146.0
151.0
156.0
161.0
166.0
171.0
176.0
181.0
186.0
191.0
196.0
201.0
206.0

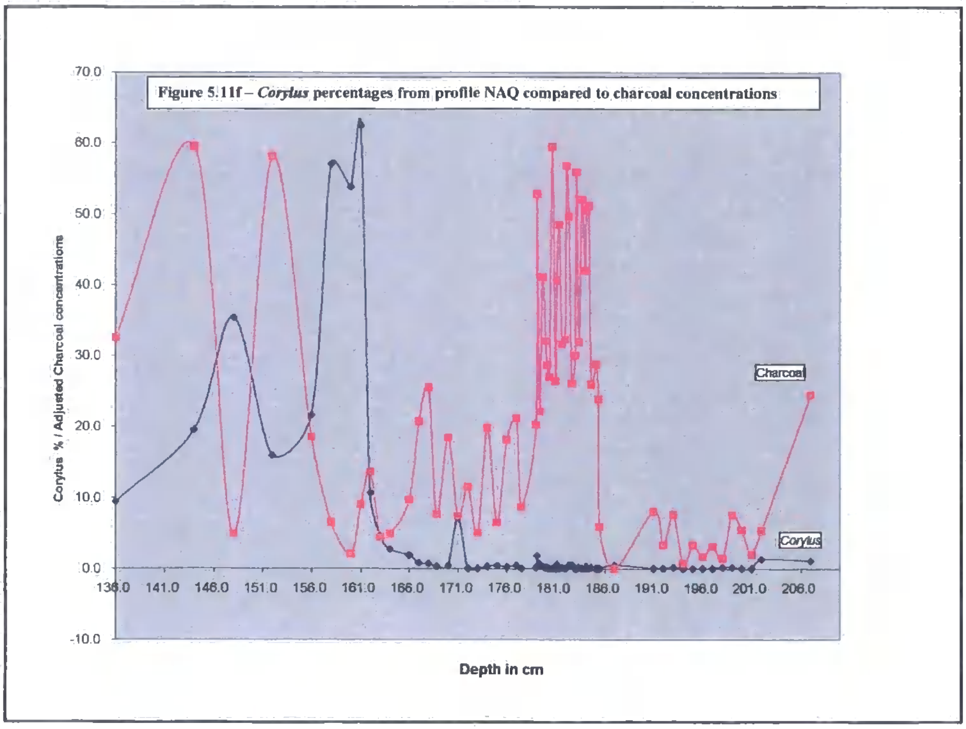


Figure 5.11f – *Corylus* percentages from profile NAQ compared to charcoal concentrations

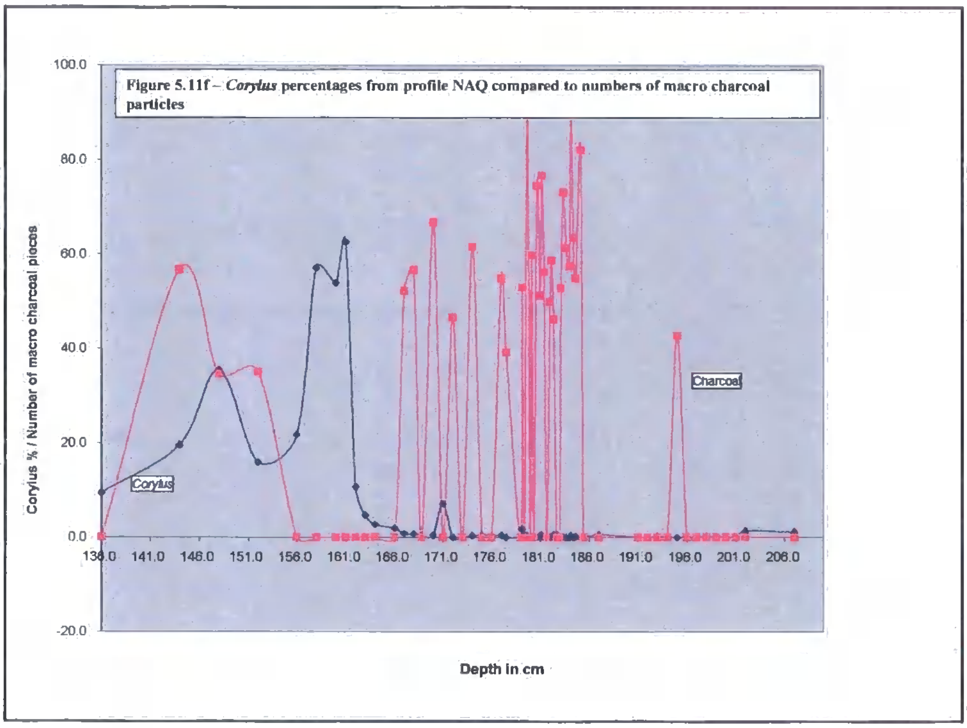


Figure 5.11f – *Corylus* percentages from profile NAQ compared to numbers of macro charcoal particles

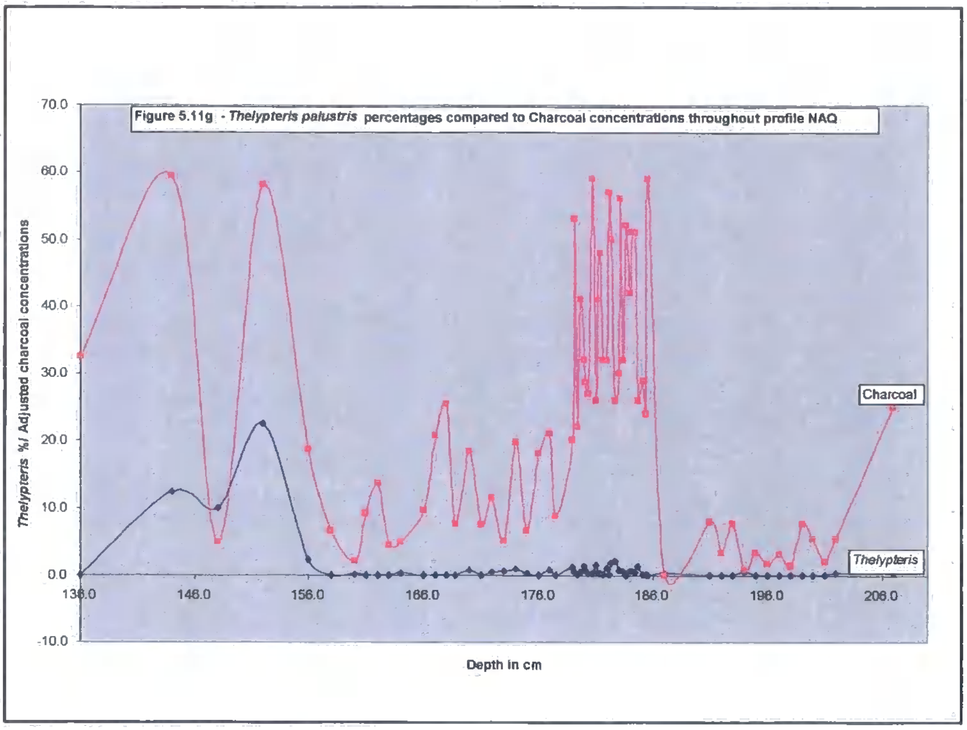


Figure 5.11g - Thelypteris palustris percentages compared to Charcoal concentrations throughout profile NAQ
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
136.0
146.0
156.0
166.0
176.0
186.0
196.0
206.0
Thelypteris %/ Adjusted charcoal concentrations
Depth in cm
Charcoal
Thelypteris

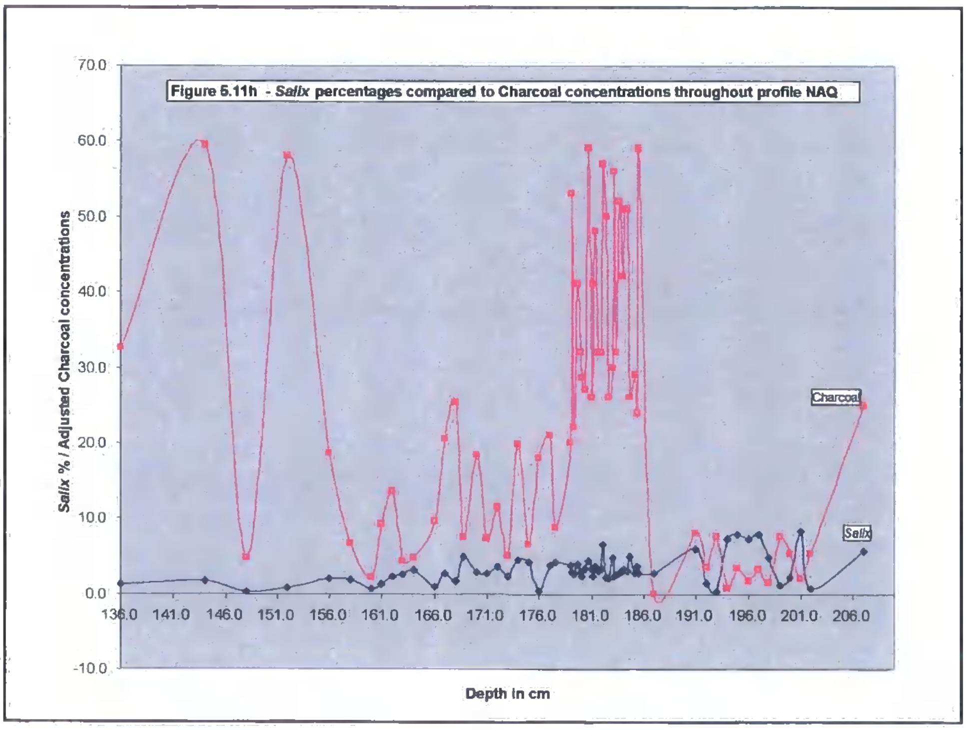


Figure 5.11h - Salix percentages compared to Charcoal concentrations throughout profile NAQ
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
136.0
141.0
146.0
151.0
156.0
161.0
166.0
171.0
176.0
181.0
186.0
191.0
196.0
201.0
206.0
Salix % / Adjusted Charcoal concentrations
Depth in cm
Charcoal
Salix

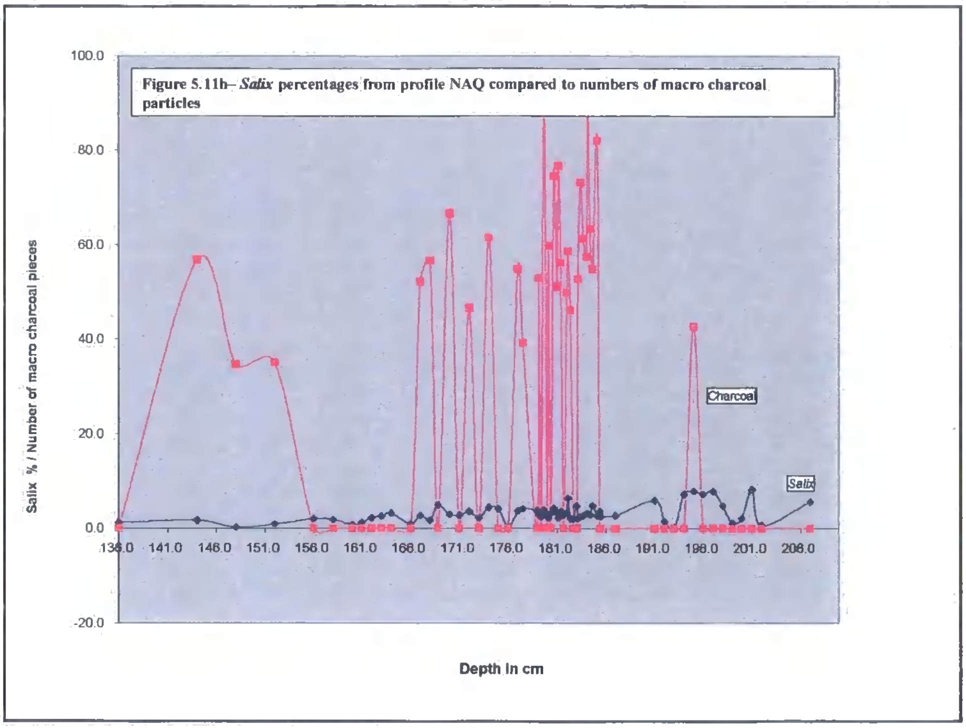


Figure 5.11h– *Salix* percentages from profile NAQ compared to numbers of macro charcoal particles

Figure 5.12a No Name Hill– North side, 95% Confidence Limits

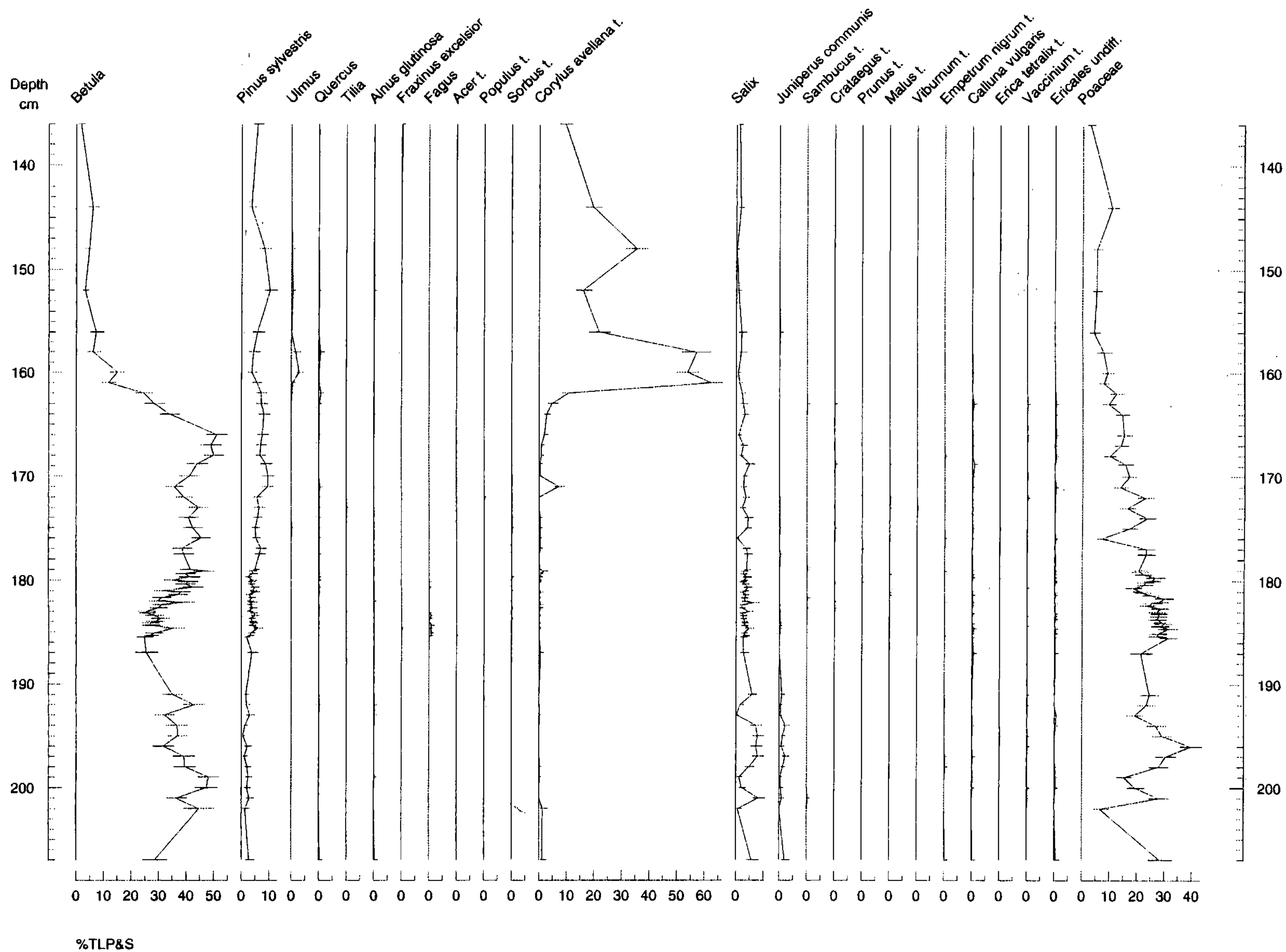


Figure 5.12b No Name Hill– North side, 95% Confidence Limits

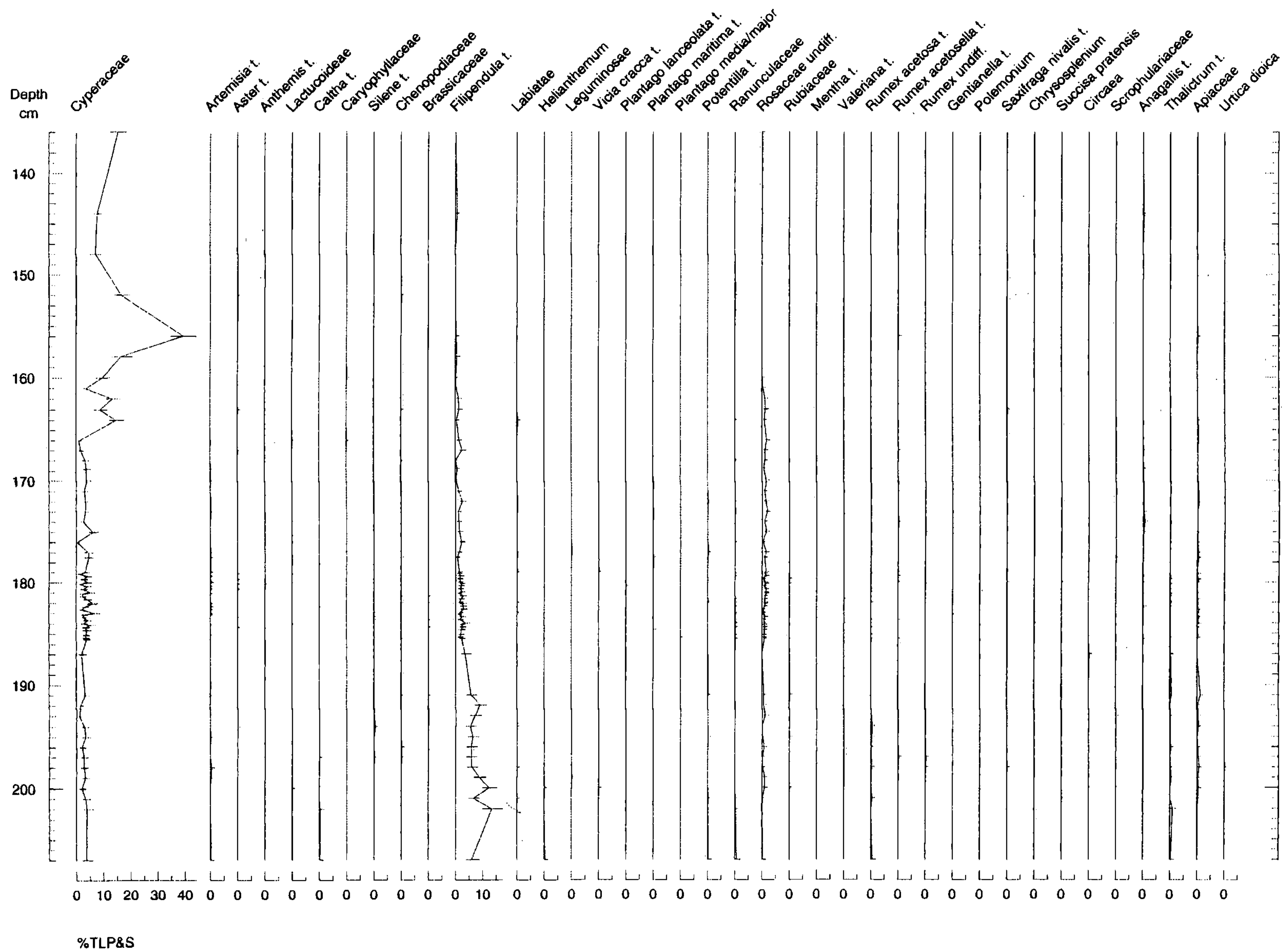


Figure 5.12c No Name Hill– North side, 95% Confidence Limits

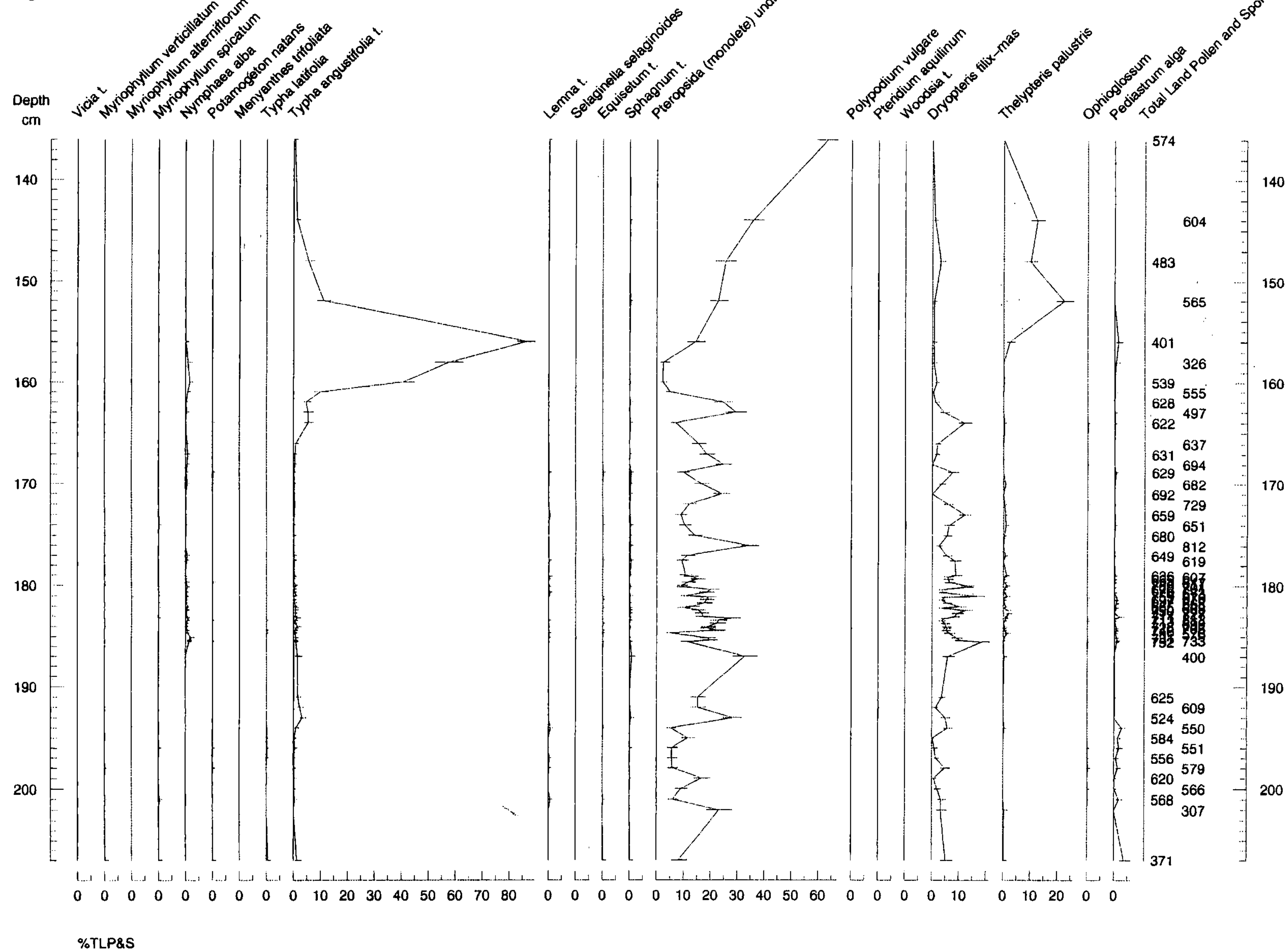


Figure 5.13a No Name Hill– North side, fine resolution 95% Confidence Limits

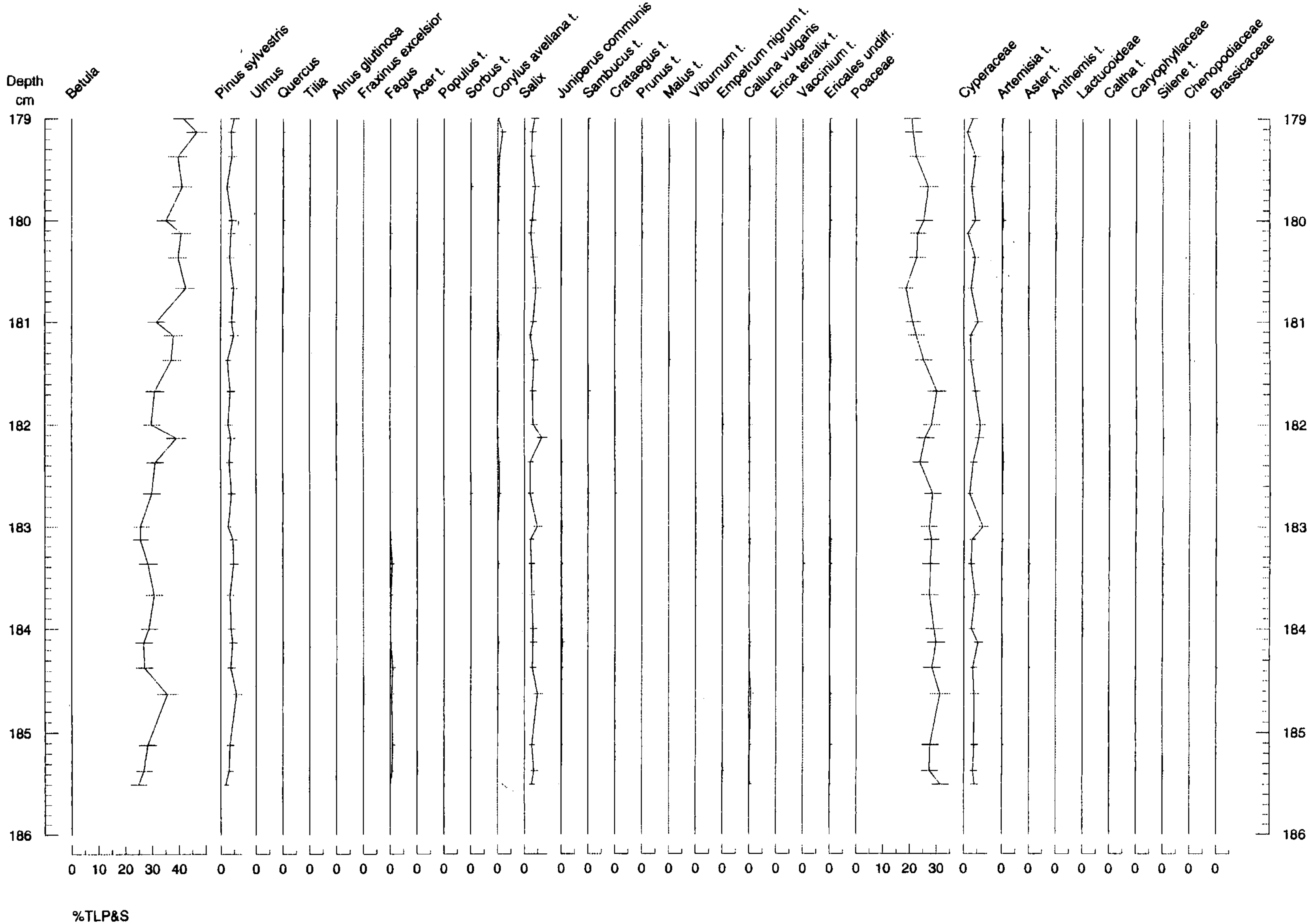


Figure 5.13b No Name Hill– North side, fine resolution 95% Confidence Limits

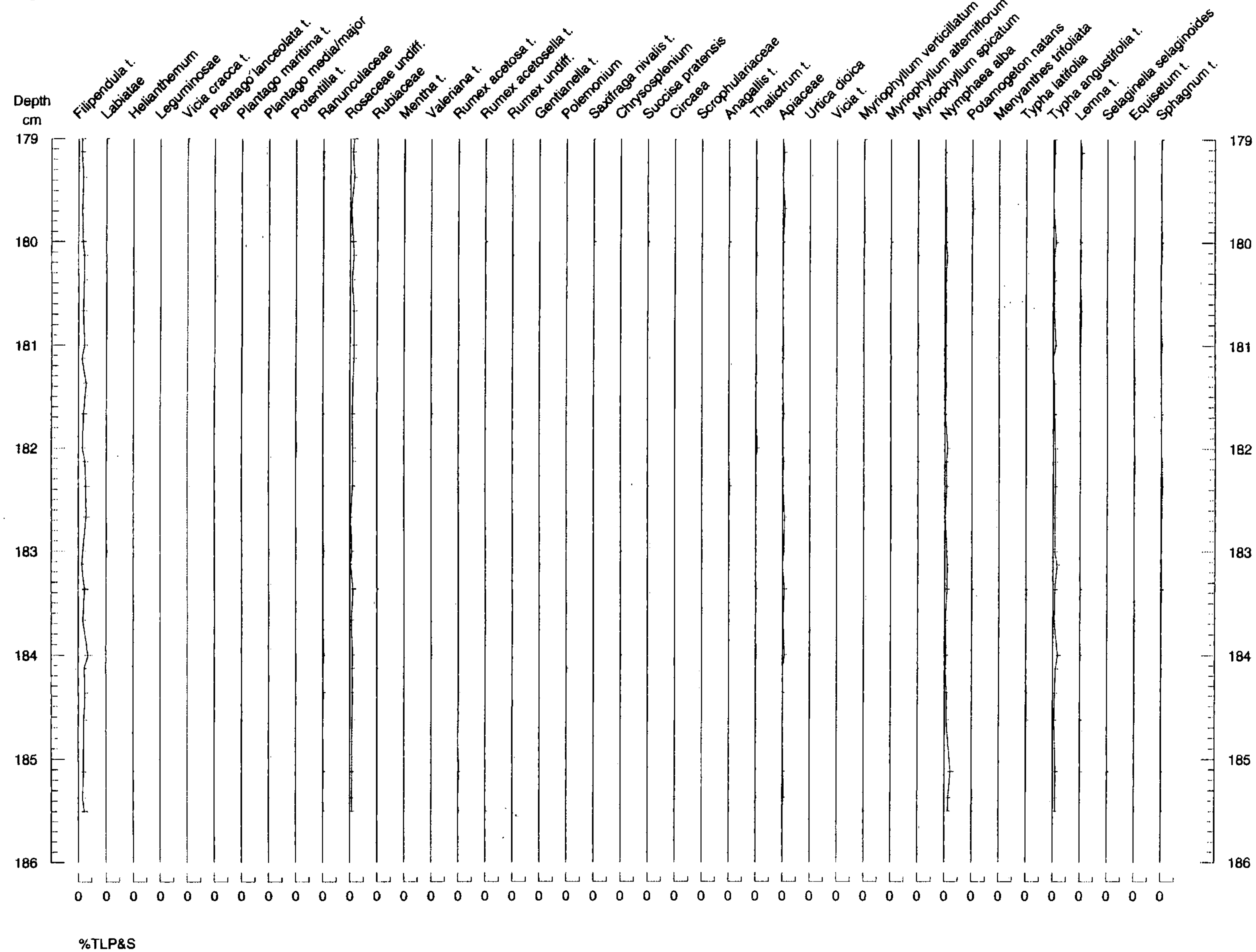
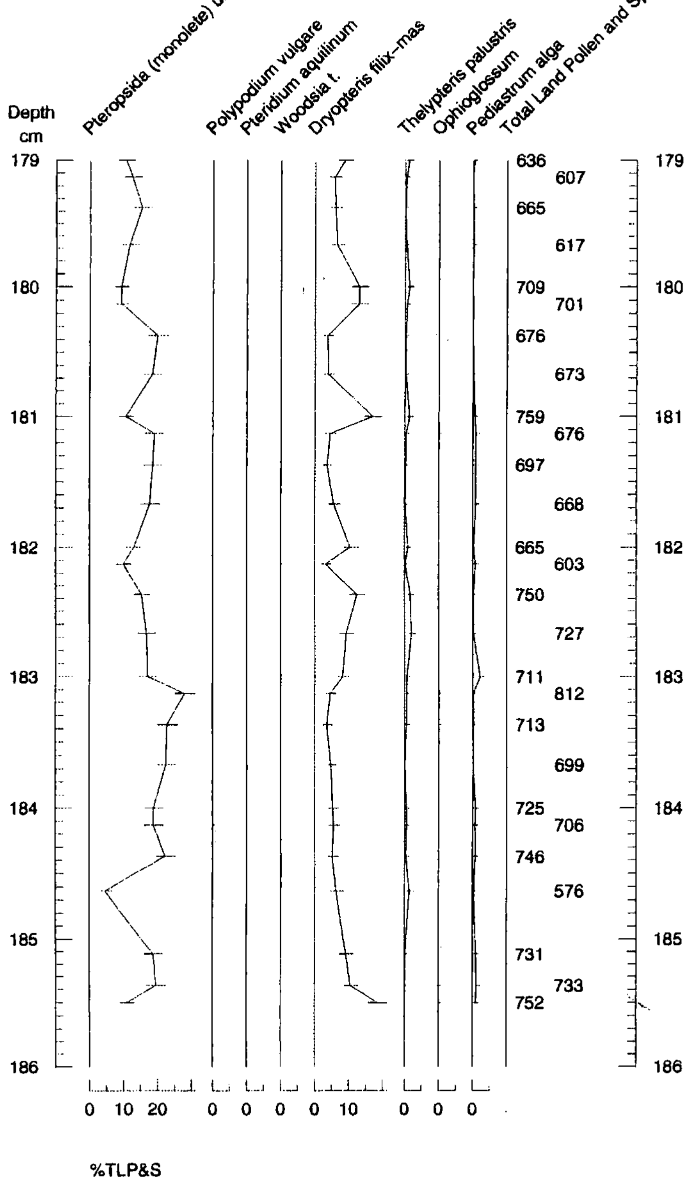


Figure 5.13c No Name Hill– North side, fine resolution 95% Confidence Limits



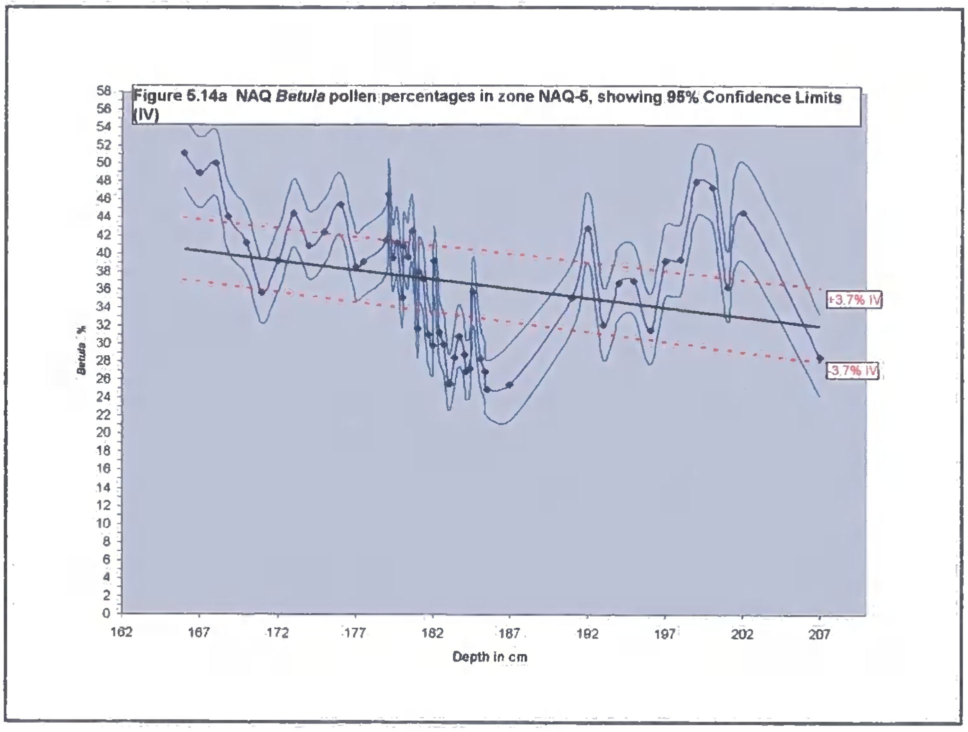


Figure 5.14a NAQ Betula pollen percentages in zone NAQ-5, showing 95% Confidence Limits (IV)
+3.7% IV
-3.7% IV
Betula %
Depth in cm

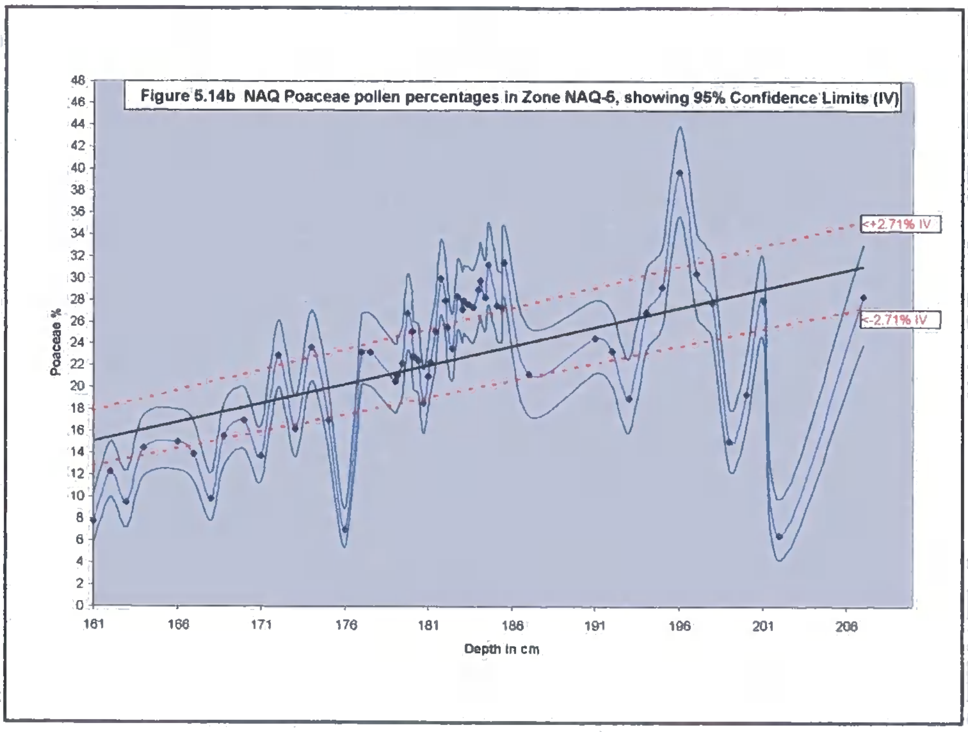


Figure 5.14b NAQ Poaceae pollen percentages in Zone NAQ-5, showing 95% Confidence Limits (IV)
+2.71% IV
-2.71% IV
Poaceae %
Depth in cm

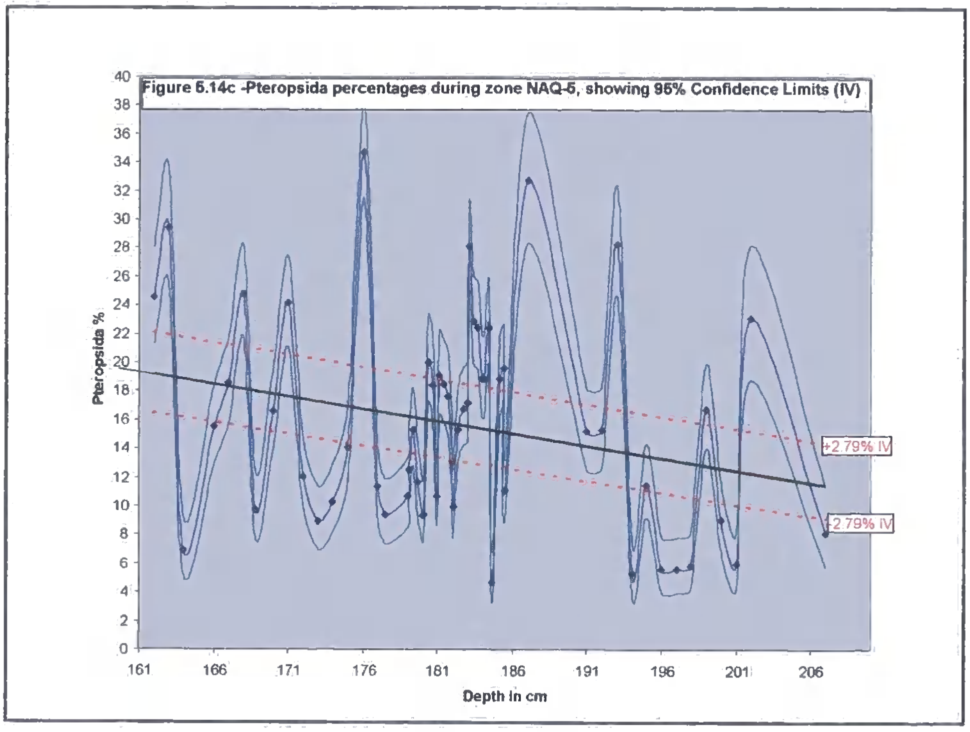


Figure 5.14c -Pteropsida percentages during zone NAQ-5, showing 95% Confidence Limits (IV)
Pteropsida %
Depth in cm
+2.79% IV
-2.79% IV
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
161
166
171
176
181
186
191
196
201
206

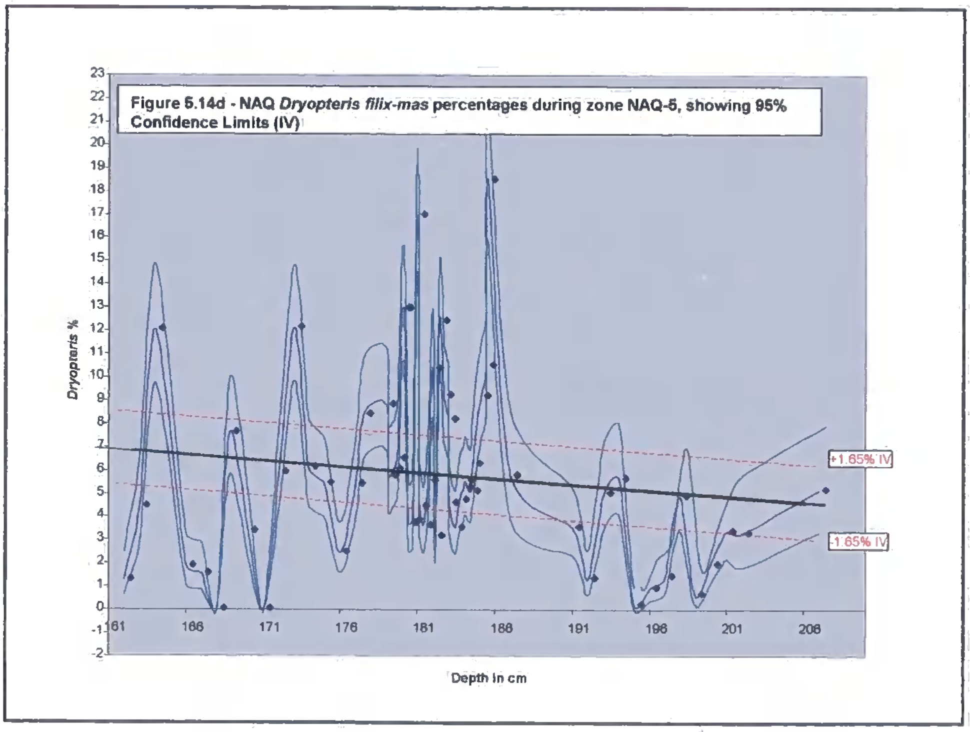


Figure 5.14d - NAQ *Dryopteris filix-mas* percentages during zone NAQ-5, showing 95% Confidence Limits (IV)
Dryopteris %
Depth in cm
+1.65% IV
-1.65% IV
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
161
166
171
176
181
186
191
196
201
206

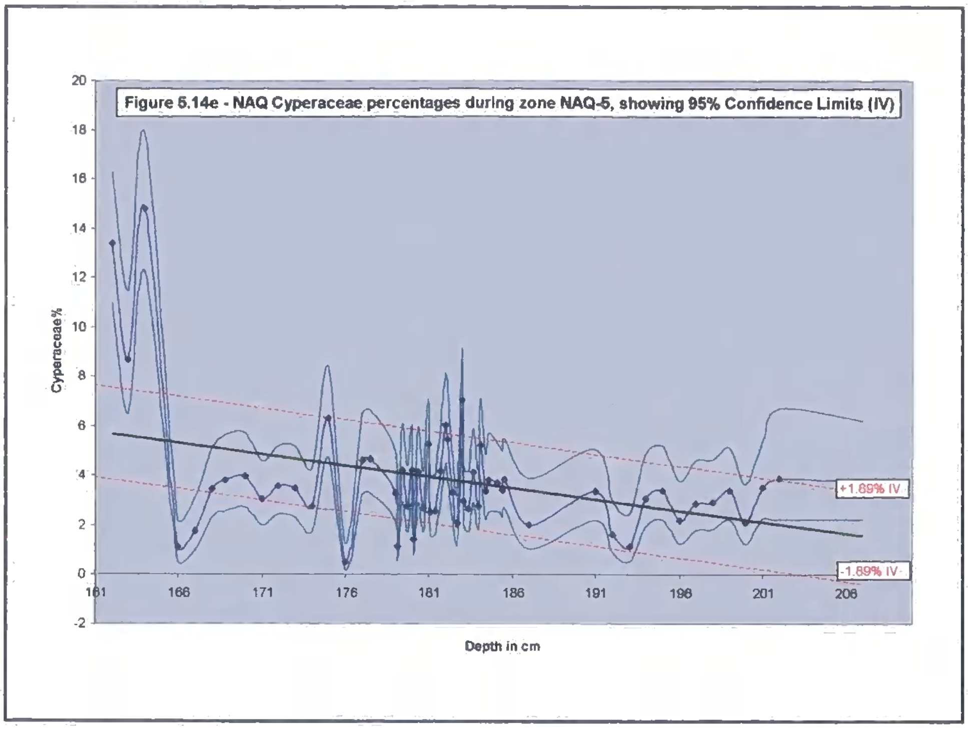


Figure 5.14e - NAQ Cyperaceae percentages during zone NAQ-5, showing 95% Confidence Limits (IV)

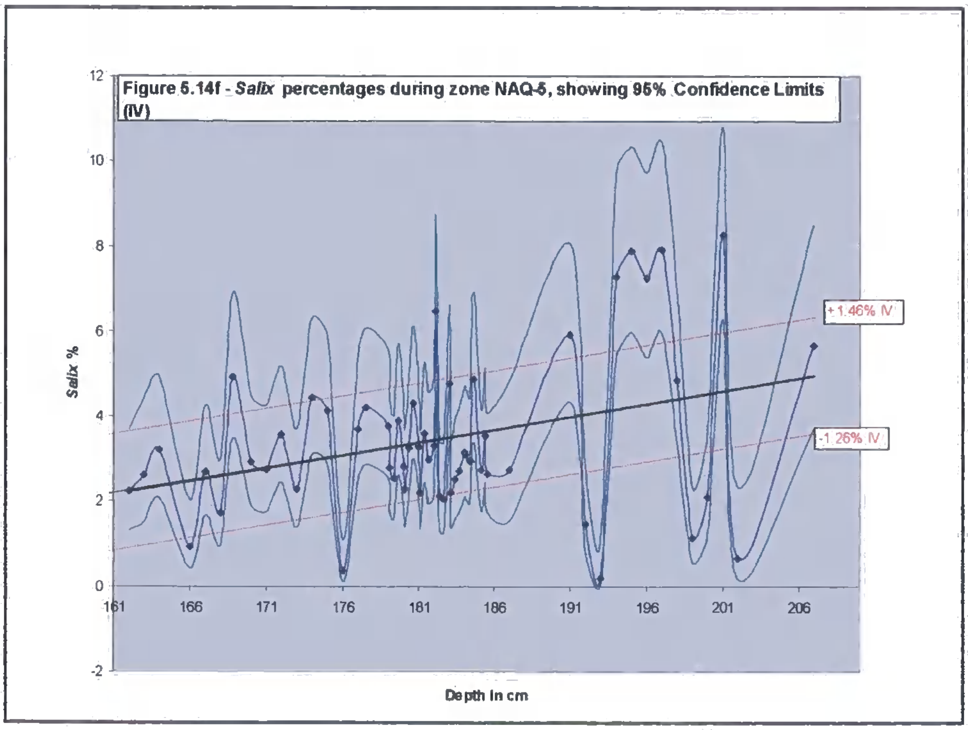


Figure 5.14f - *Salix* percentages during zone NAQ-5, showing 95% Confidence Limits (IV)

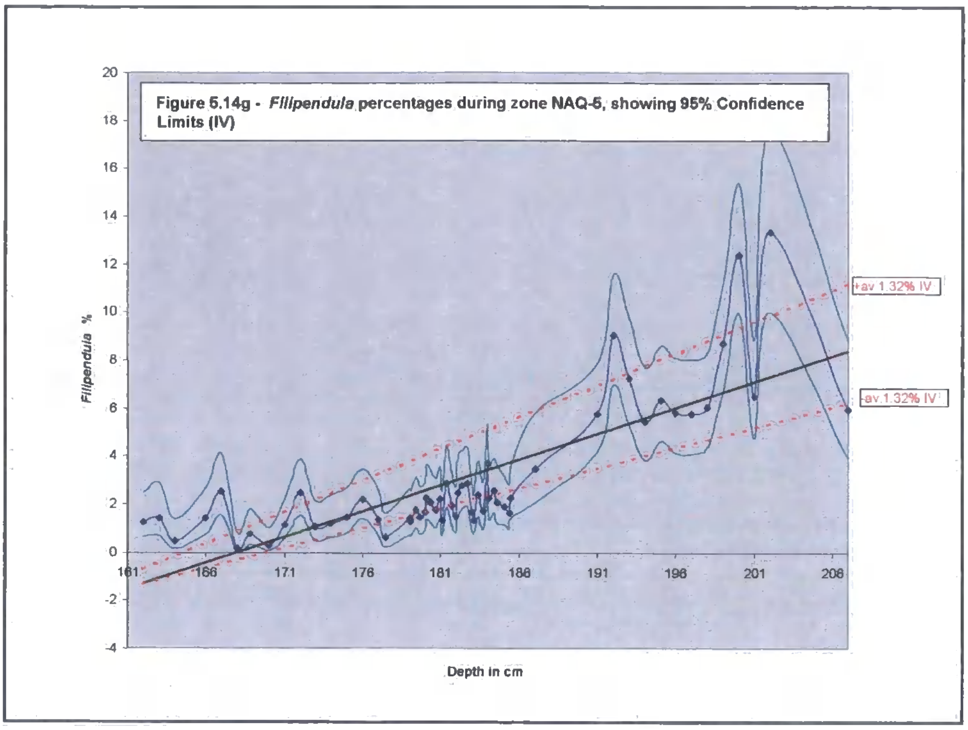


Figure 5.14g - *Filipendula* percentages during zone NAQ-5, showing 95% Confidence Limits (IV)

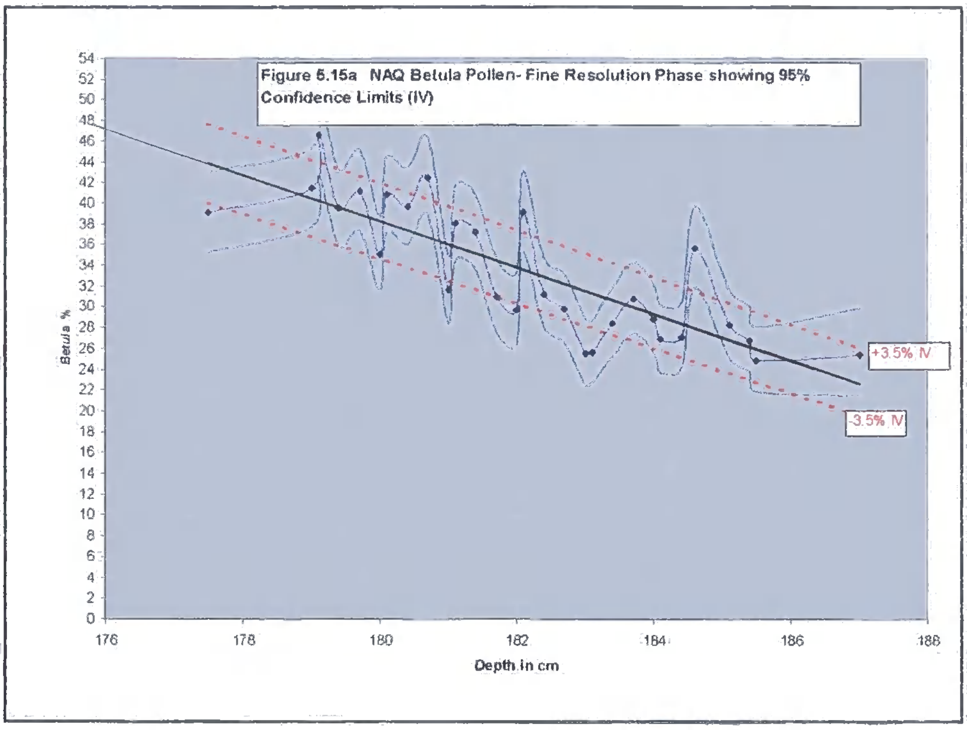


Figure 5.15a NAQ Betula Pollen- Fine Resolution Phase showing 95% Confidence Limits (IV)

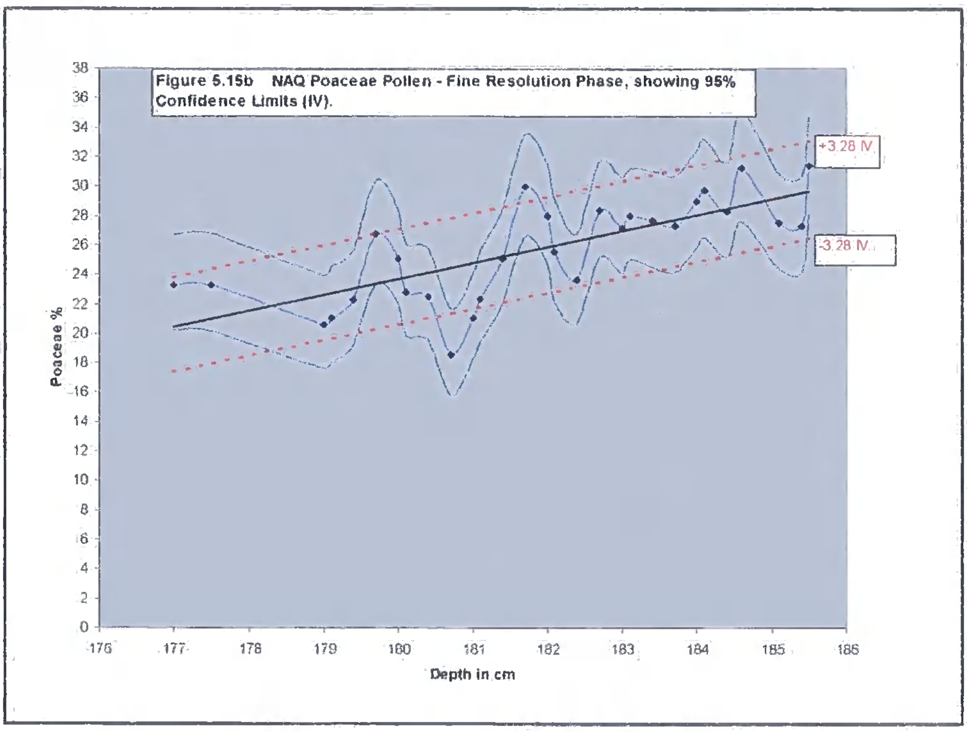


Figure 5.15b NAQ Poaceae Pollen - Fine Resolution Phase, showing 95% Confidence Limits (IV).

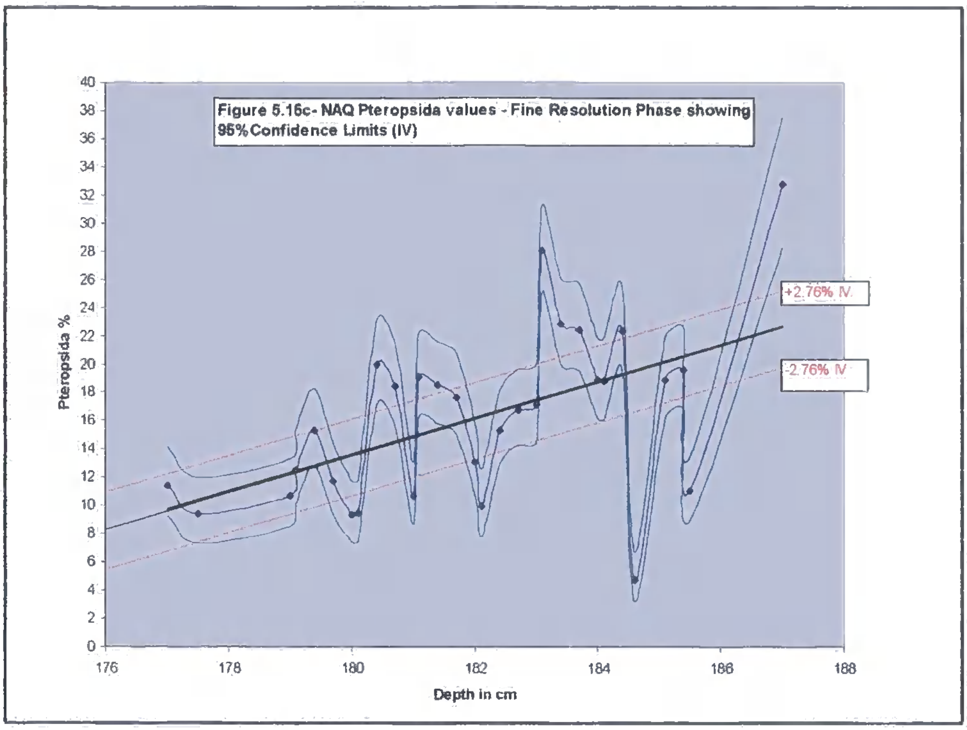


Figure 5.15c- NAQ Pteropsida values - Fine Resolution Phase showing 95% Confidence Limits (IV)
Pteropsida %
Depth in cm
+2.76% IV
-2.76% IV
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
176
178
180
182
184
186
188

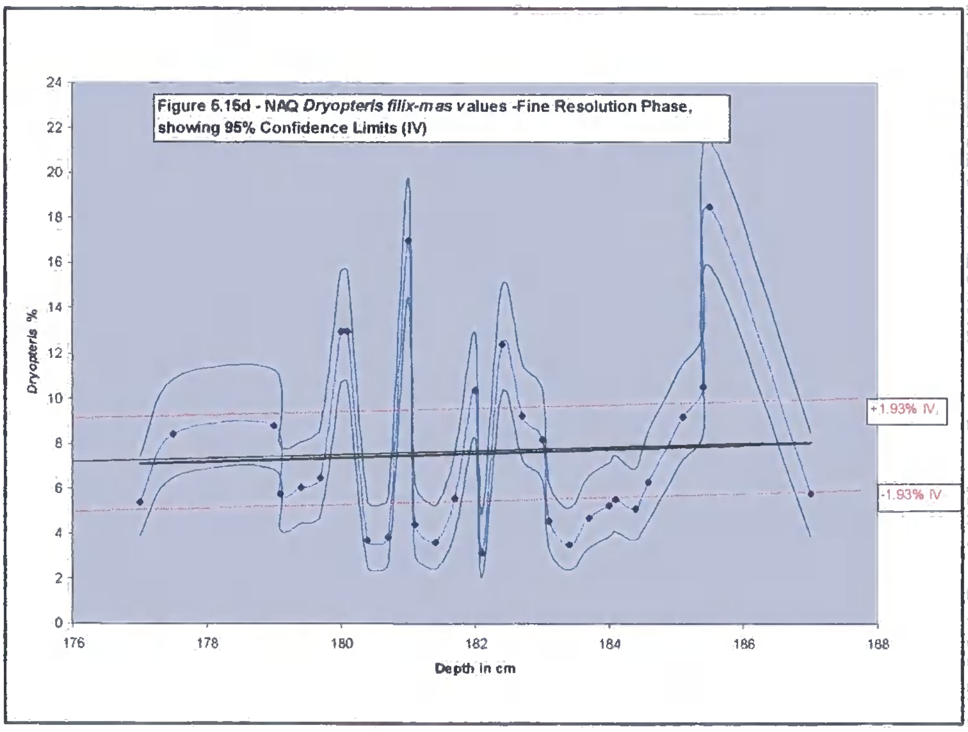


Figure 5.15d - NAQ *Dryopteris filix-mas* values -Fine Resolution Phase, showing 95% Confidence Limits (IV)
Dryopteris %
Depth in cm
+1.93% IV
-1.93% IV
0
2
4
6
8
10
12
14
16
18
20
22
24
176
178
180
182
184
186
188

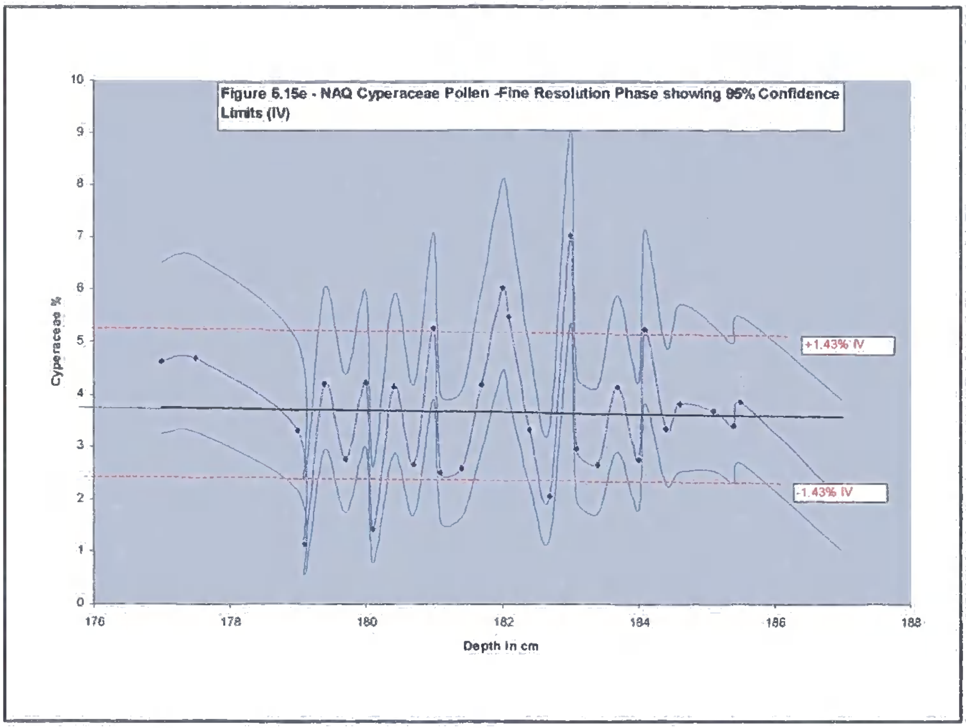


Figure 5.15e - NAQ Cyperaceae Pollen -Fine Resolution Phase showing 95% Confidence Limits (IV)
Cyperaceae %
Depth in cm
+1.43% IV
-1.43% IV

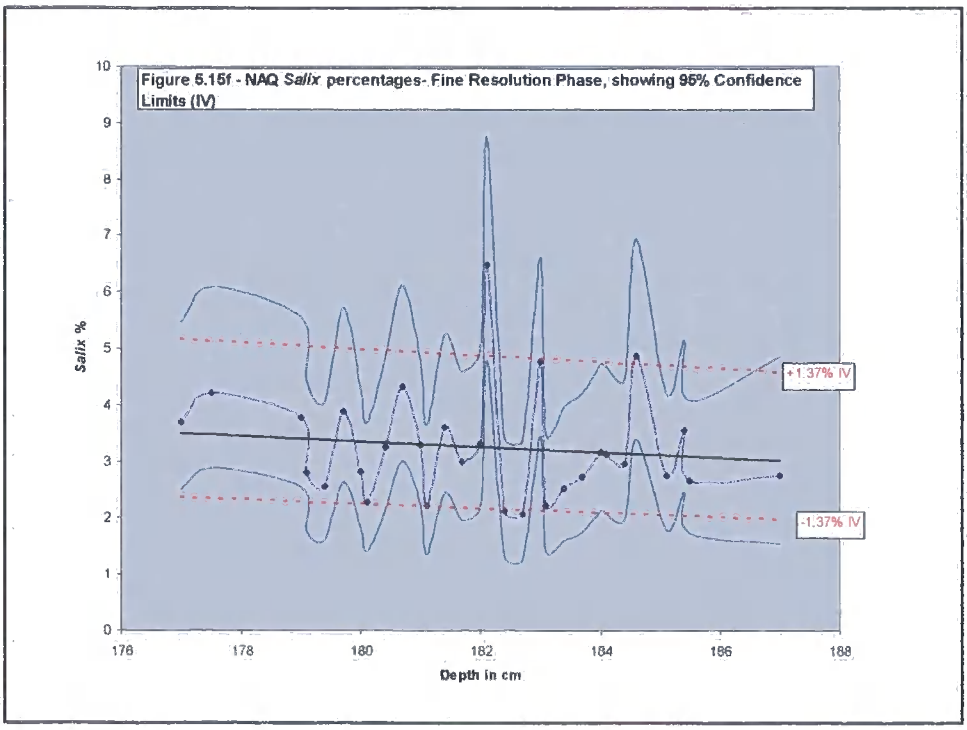


Figure 5.15f - NAQ *Salix* percentages- Fine Resolution Phase, showing 95% Confidence Limits (IV)
Salix %
Depth in cm
+1.37% IV
-1.37% IV

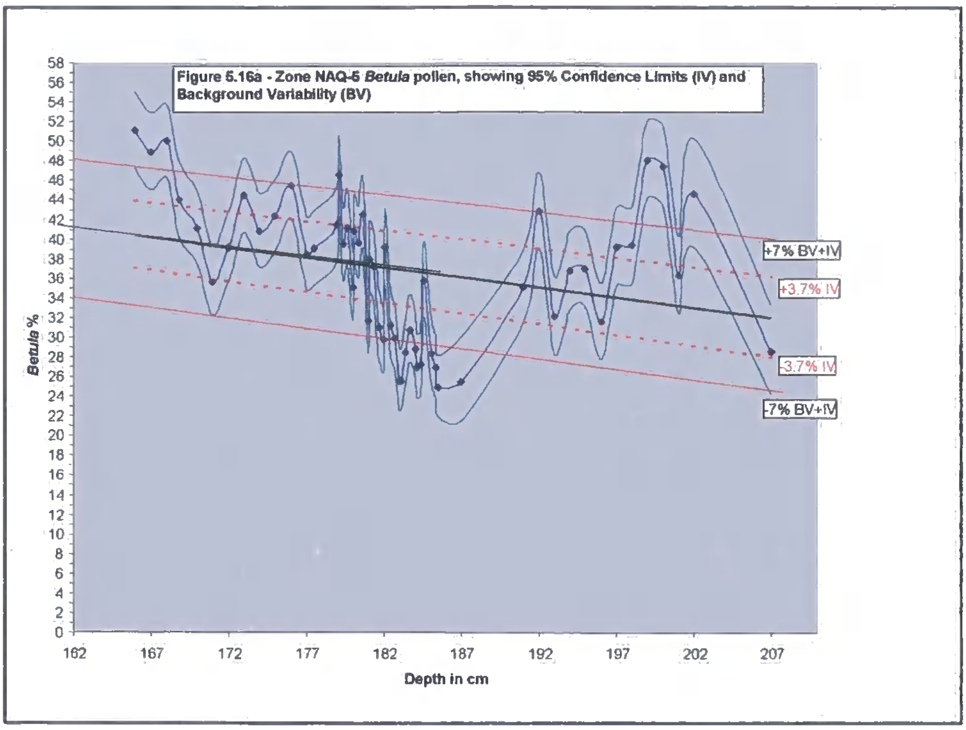


Figure 5.16a - Zone NAQ-5 Betula pollen, showing 95% Confidence Limits (IV) and Background Variability (BV)
Betula %
Depth in cm
+7% BV+IV
+3.7% IV
-3.7% IV
-7% BV+IV

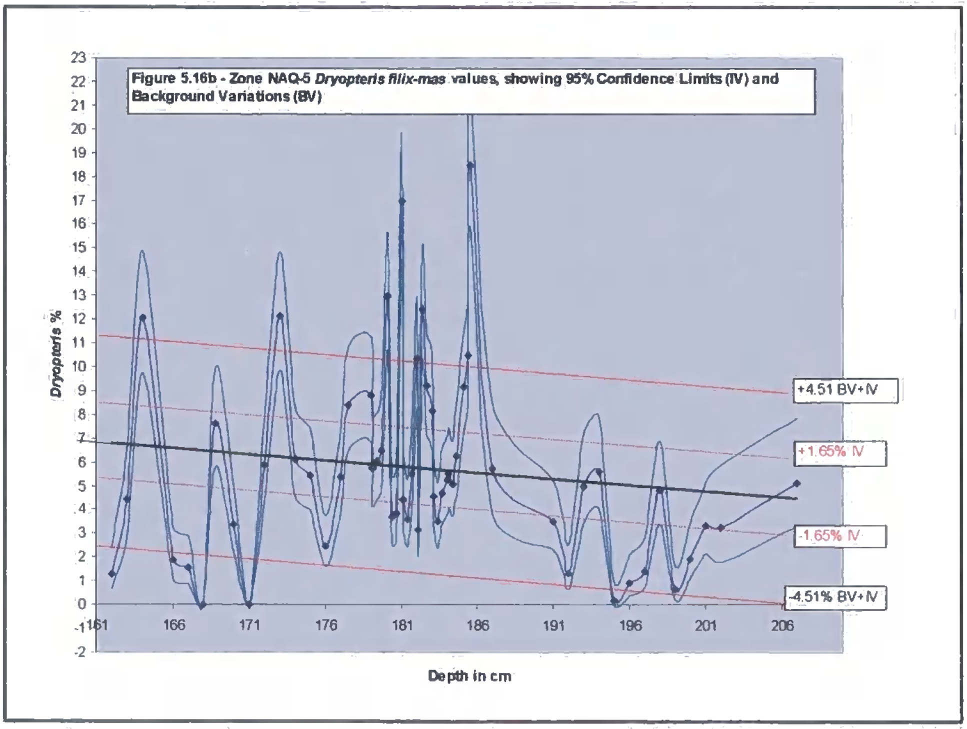


Figure 5.16b - Zone NAQ-5 Dryopteris filix-mas values, showing 95% Confidence Limits (IV) and Background Variations (BV)
Dryopteris %
Depth in cm
+4.51 BV+IV
+1.65% IV
-1.65% IV
-4.51% BV+IV

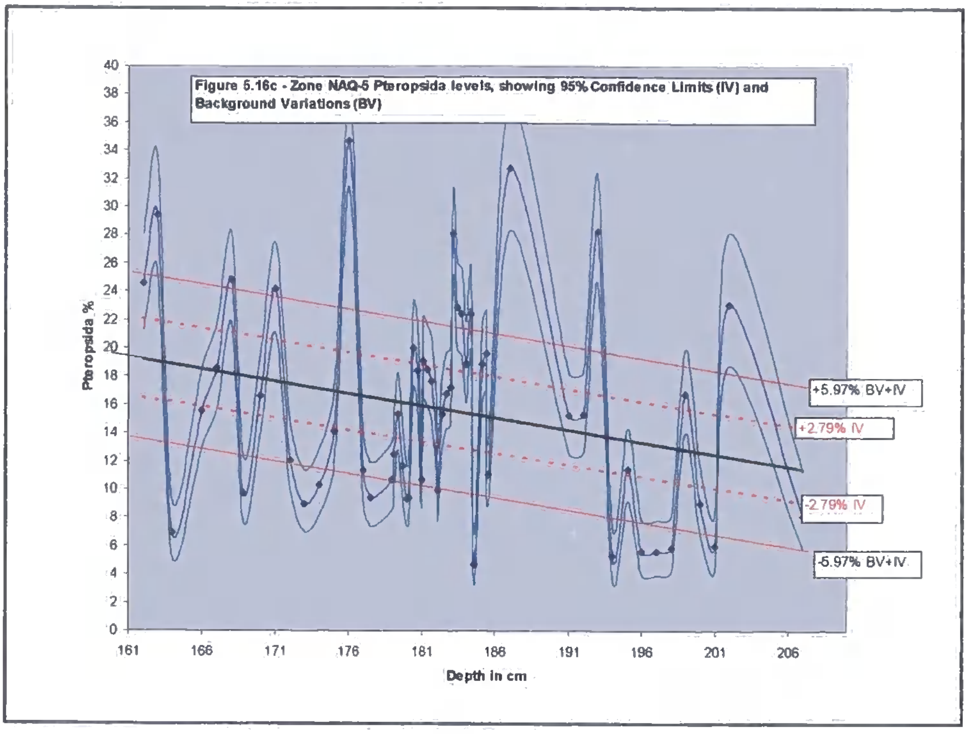


Figure 5.16c - Zone NAQ-5 Pteropsida levels, showing 95% Confidence Limits (IV) and Background Variations (BV)

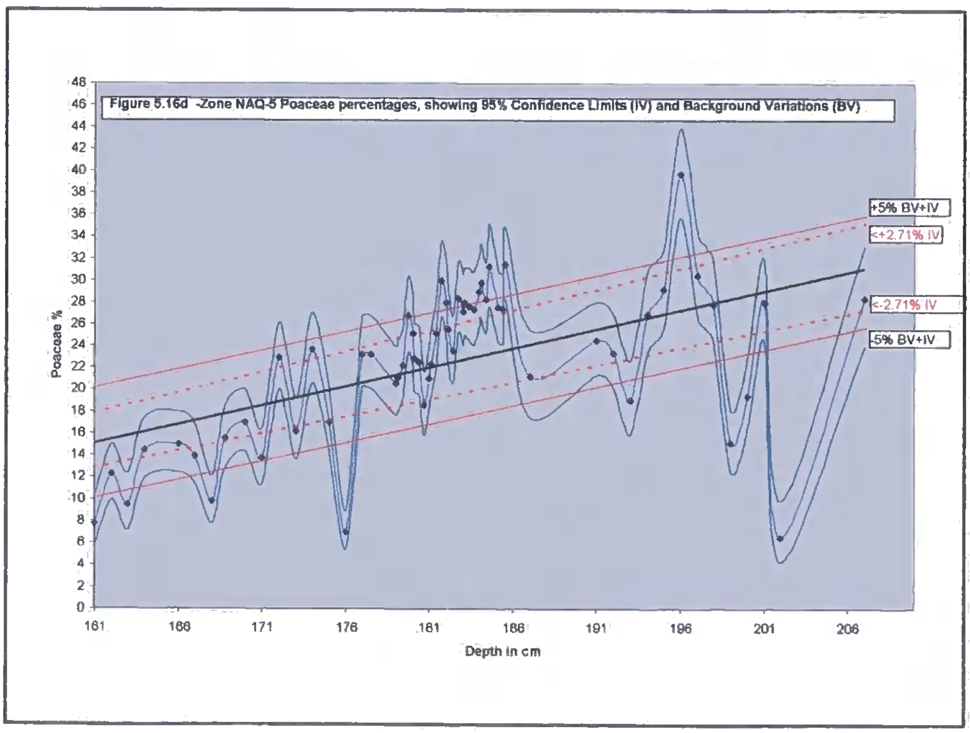


Figure 5.16d -Zone NAQ-5 Poaceae percentages, showing 95% Confidence Limits (IV) and Background Variations (BV)

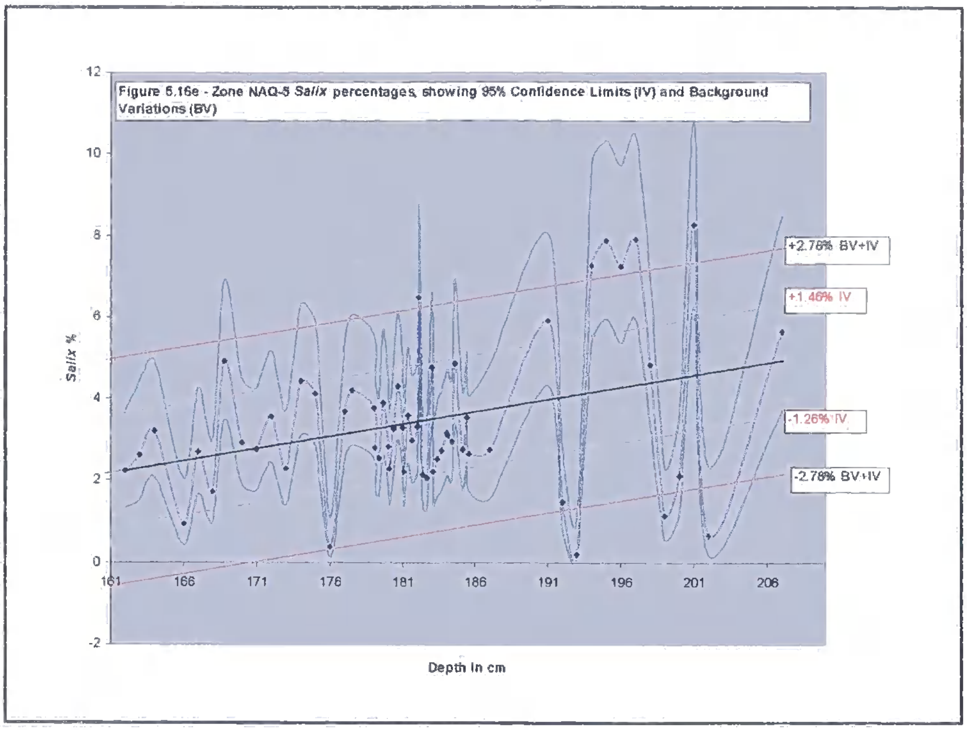


Figure 5.16e - Zone NAQ-5 *Salix* percentages, showing 95% Confidence Limits (IV) and Background Variations (BV)

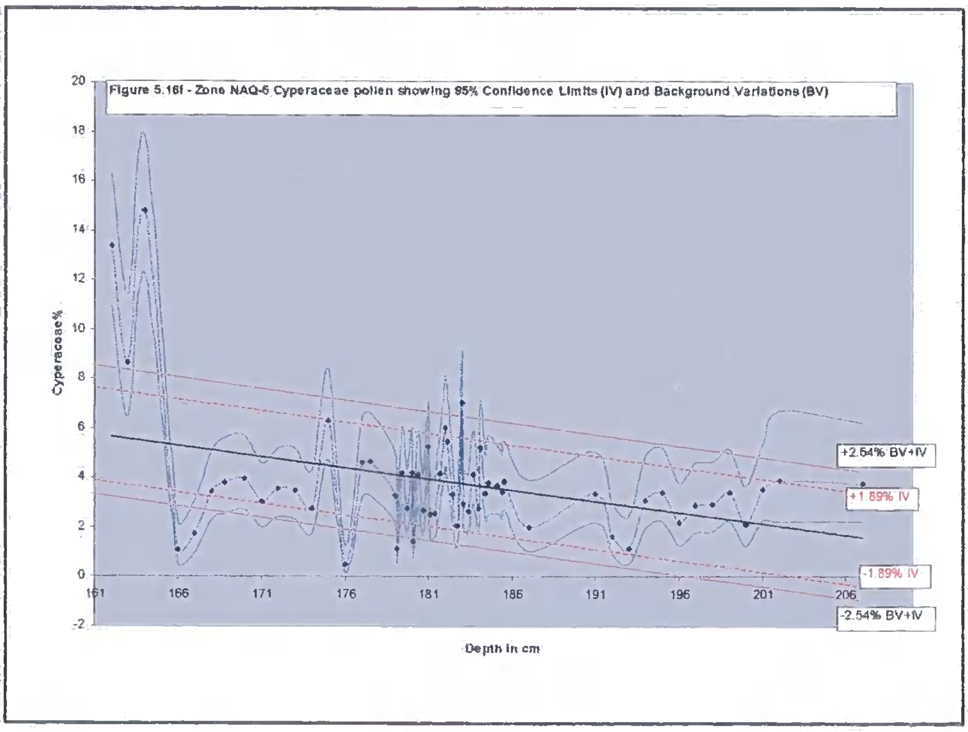


Figure 5.16f - Zone NAQ-5 Cyperaceae pollen showing 95% Confidence Limits (IV) and Background Variations (BV)

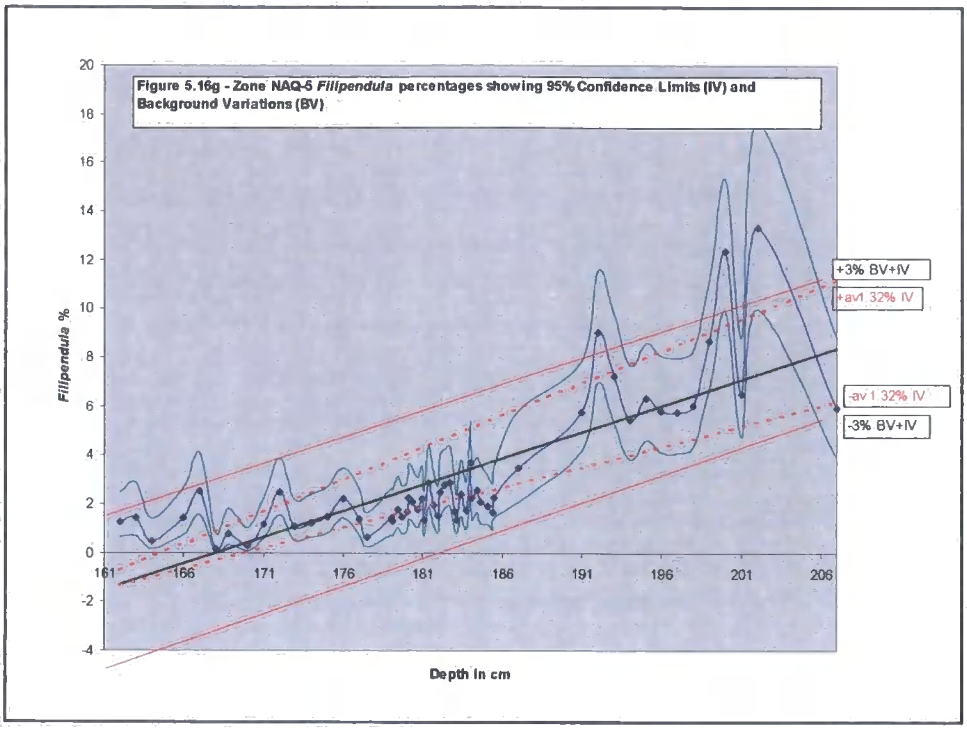


Figure 5.16g - Zone NAQ-5 *Filipendula* percentages showing 95% Confidence Limits (IV) and Background Variations (BV)

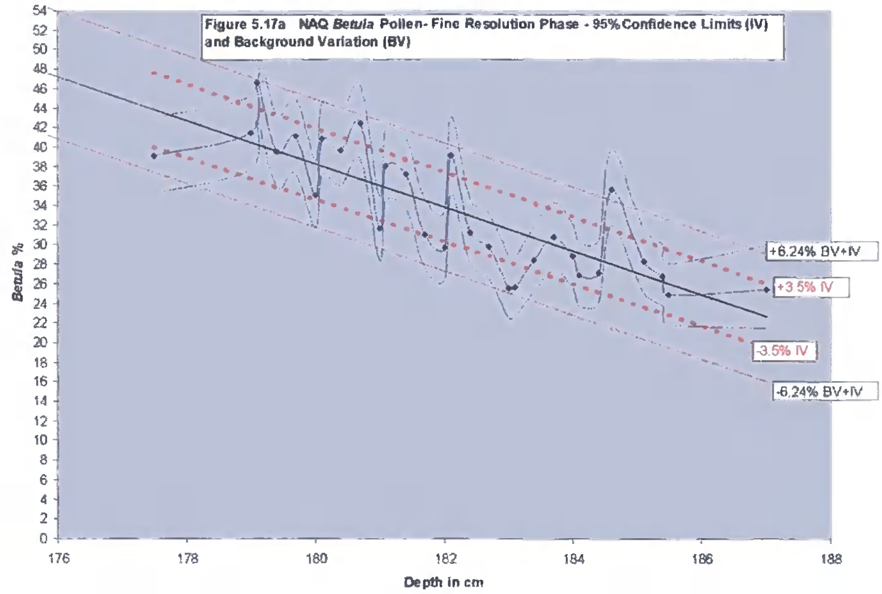


Figure 5.17a NAQ *Betula* Pollen- Fine Resolution Phase - 95% Confidence Limits (IV) and Background Variation (BV)
+6.24% BV+IV
+3.5% IV
-3.5% IV
-6.24% BV+IV
Betula %
Depth in cm

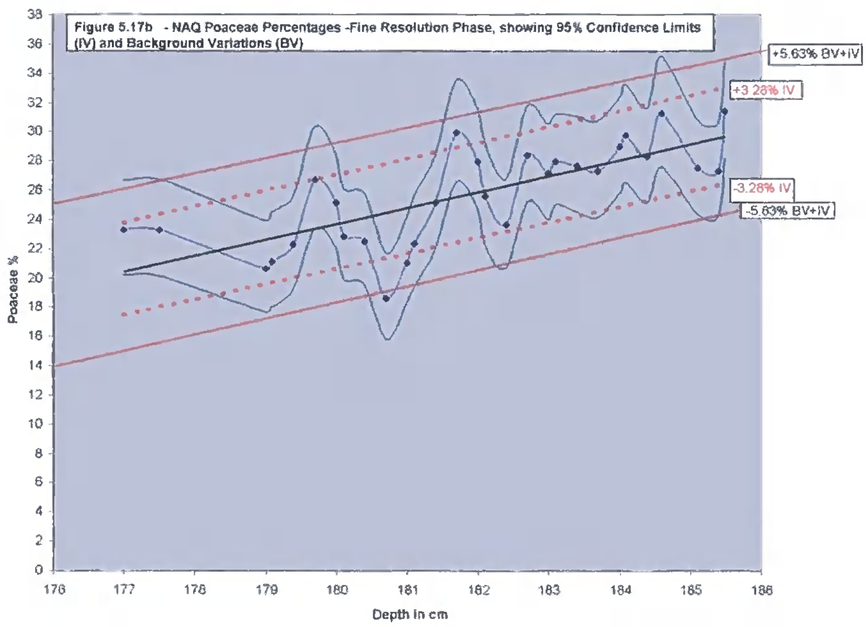


Figure 5.17b - NAQ Poaceae Percentages -Fine Resolution Phase, showing 95% Confidence Limits (IV) and Background Variations (BV)
+5.63% BV+IV
+3.28% IV
-3.28% IV
-5.63% BV+IV
Poaceae %
Depth in cm

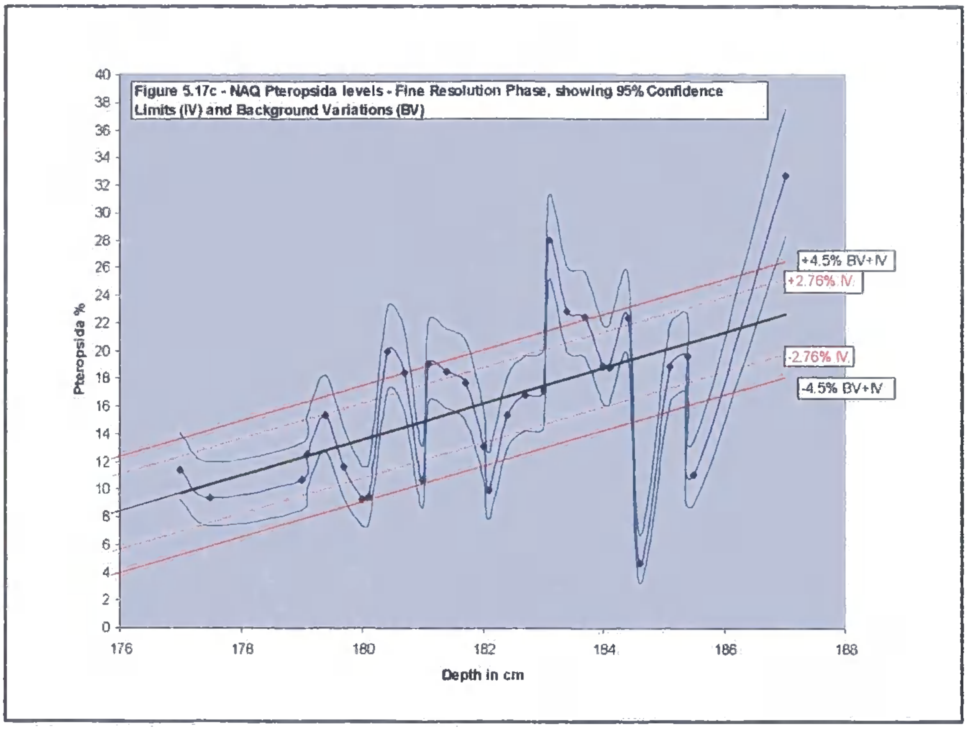


Figure 5.17c - NAQ Pteropsida levels - Fine Resolution Phase, showing 95% Confidence Limits (IV) and Background Variations (BV)
Pteropsida %
Depth in cm
+4.5% BV+IV
+2.76% IV
-2.76% IV
-4.5% BV+IV

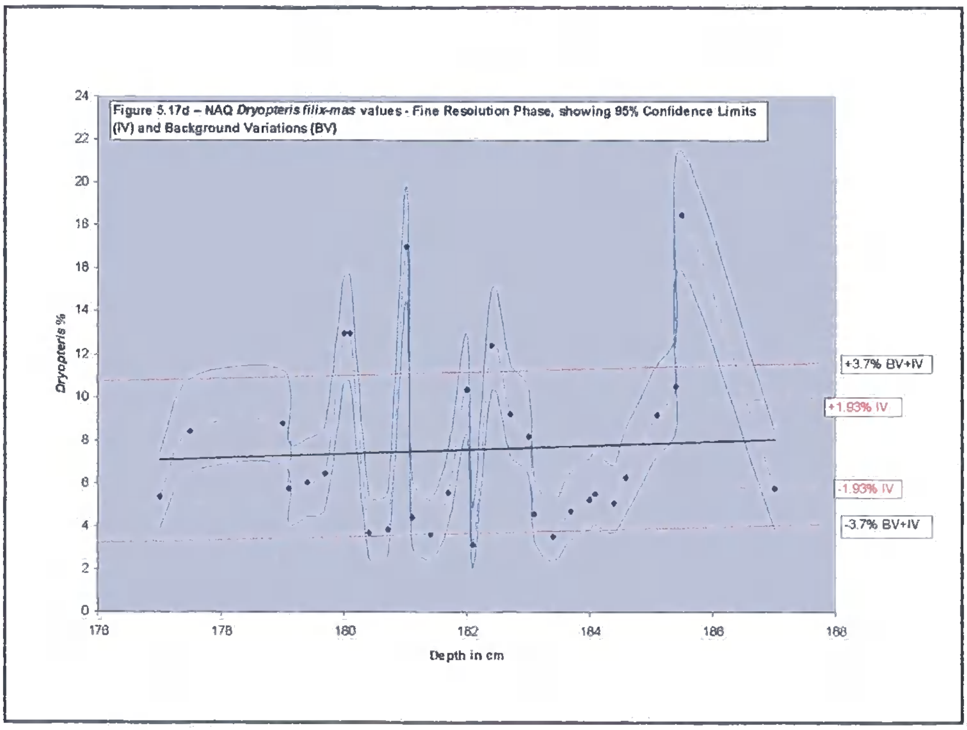


Figure 5.17d – NAQ *Dryopteris filix-mas* values - Fine Resolution Phase, showing 95% Confidence Limits (IV) and Background Variations (BV)
Dryopteris %
Depth in cm
+3.7% BV+IV
+1.93% IV
-1.93% IV
-3.7% BV+IV

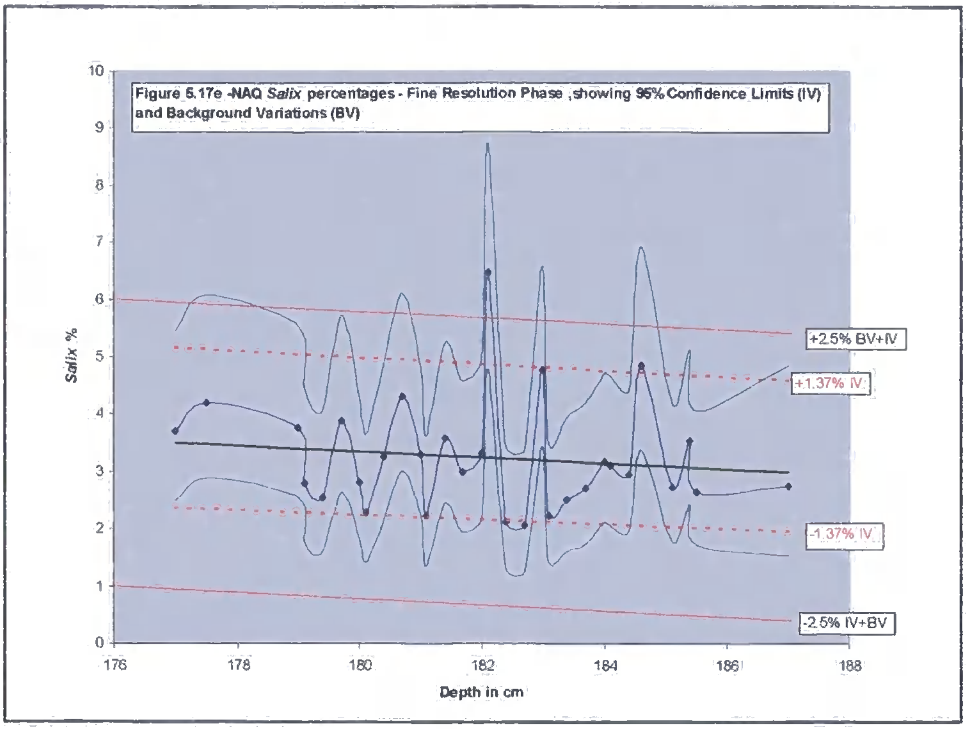


Figure 5.17e -NAQ *Salix* percentages - Fine Resolution Phase ,showing 95% Confidence Limits (IV) and Background Variations (BV)
Salix %
+2.5% BV+IV
+1.37% IV
-1.37% IV
-2.5% IV+BV
Depth in cm

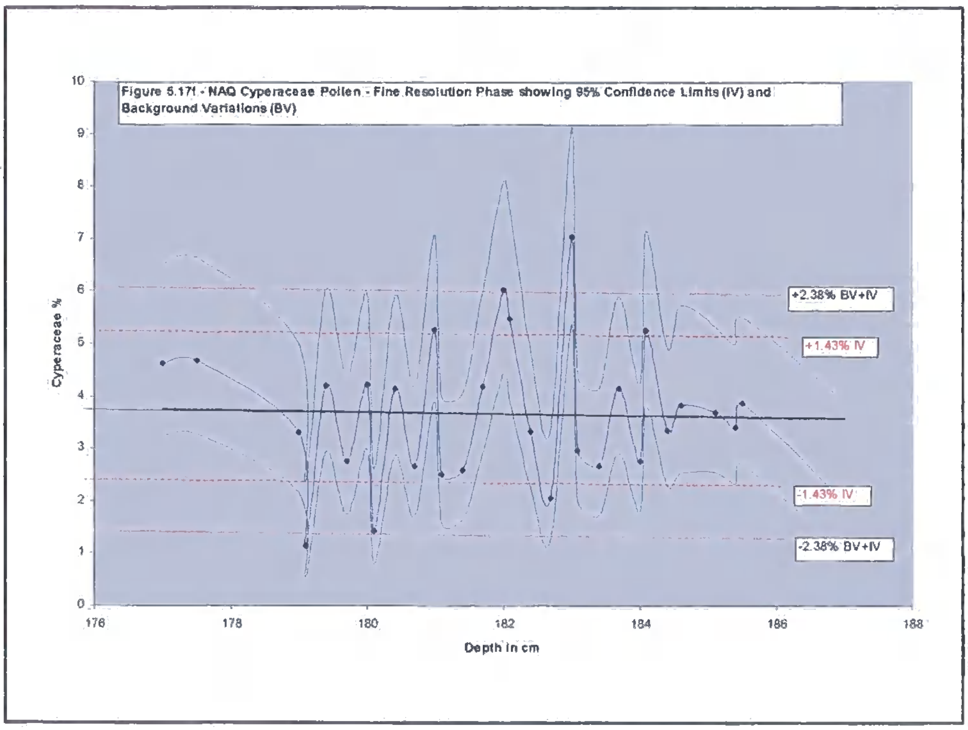


Figure 5.17f - NAQ Cyperaceae Pollen - Fine Resolution Phase showing 95% Confidence Limits (IV) and Background Variations (BV)
Cyperaceae %
+2.38% BV+IV
+1.43% IV
-1.43% IV
-2.38% BV+IV
Depth in cm

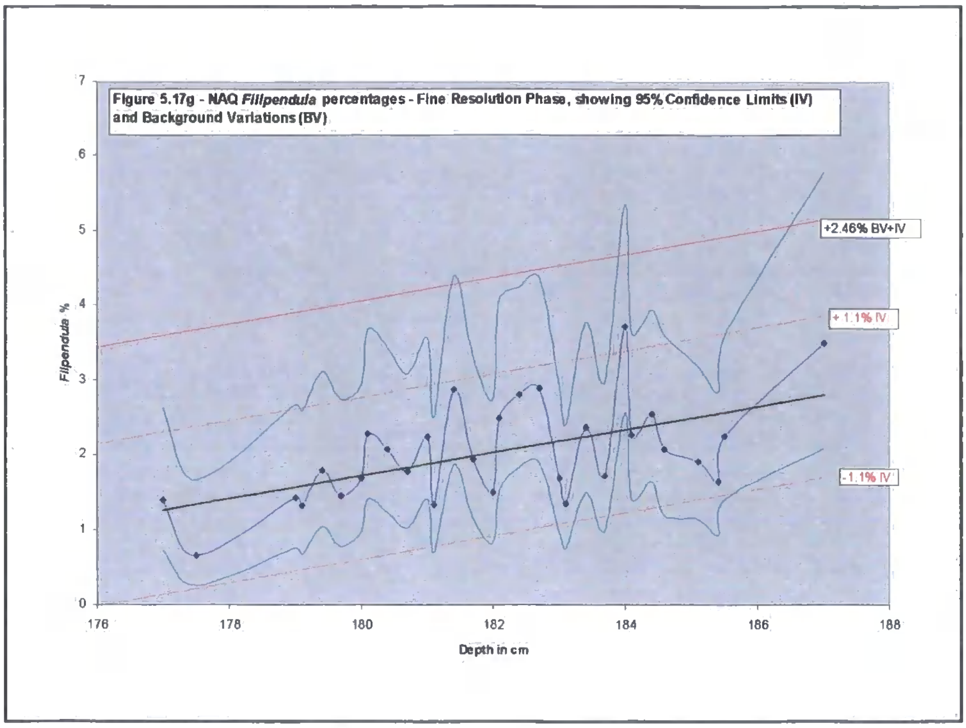


Figure 5.17g - NAQ *Filipendula* percentages - Fine Resolution Phase, showing 95% Confidence Limits (IV) and Background Variations (BV)

Chapter Six

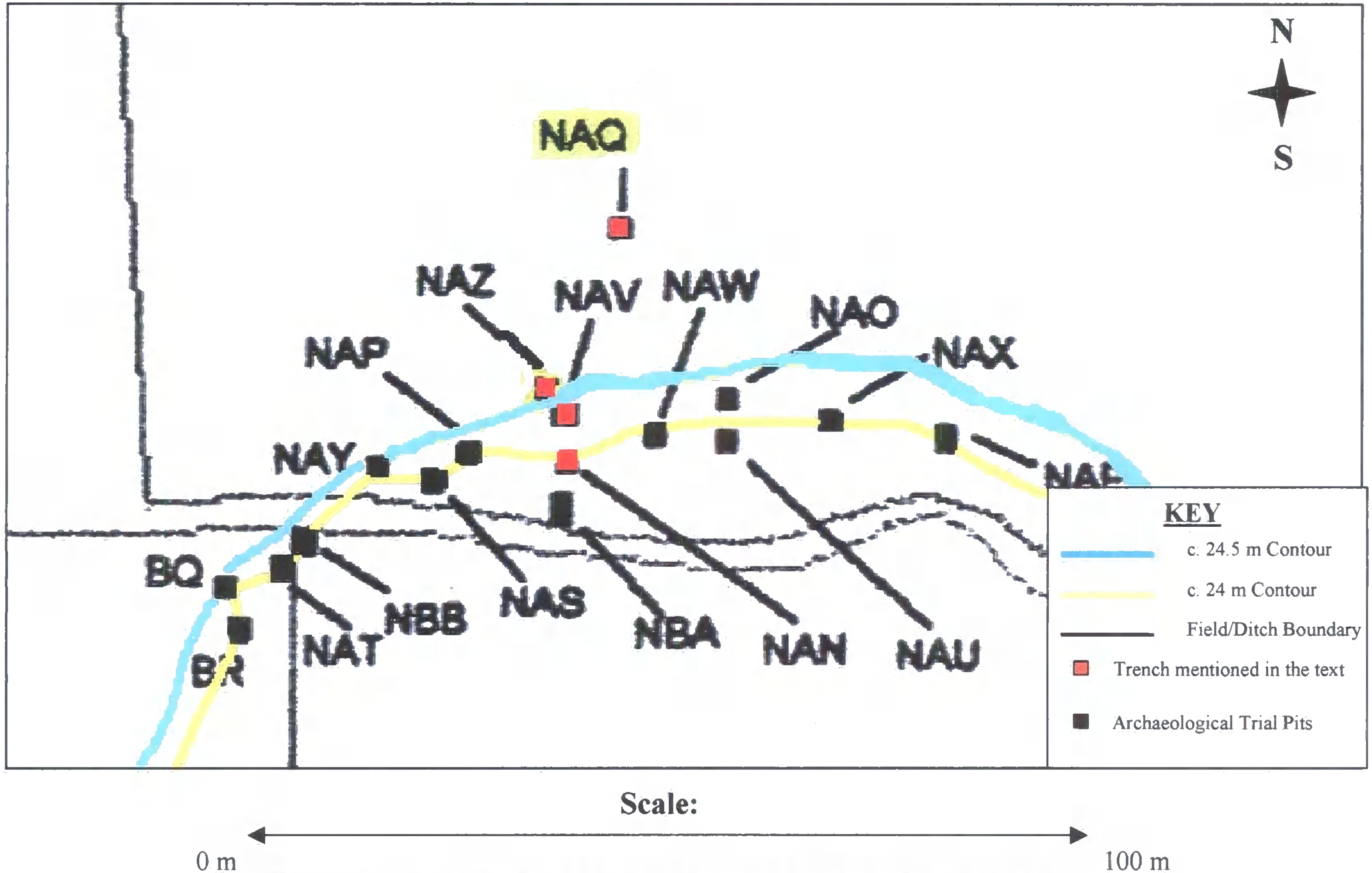


Figure 6.1 The location of trench NAZ at No Name Hill

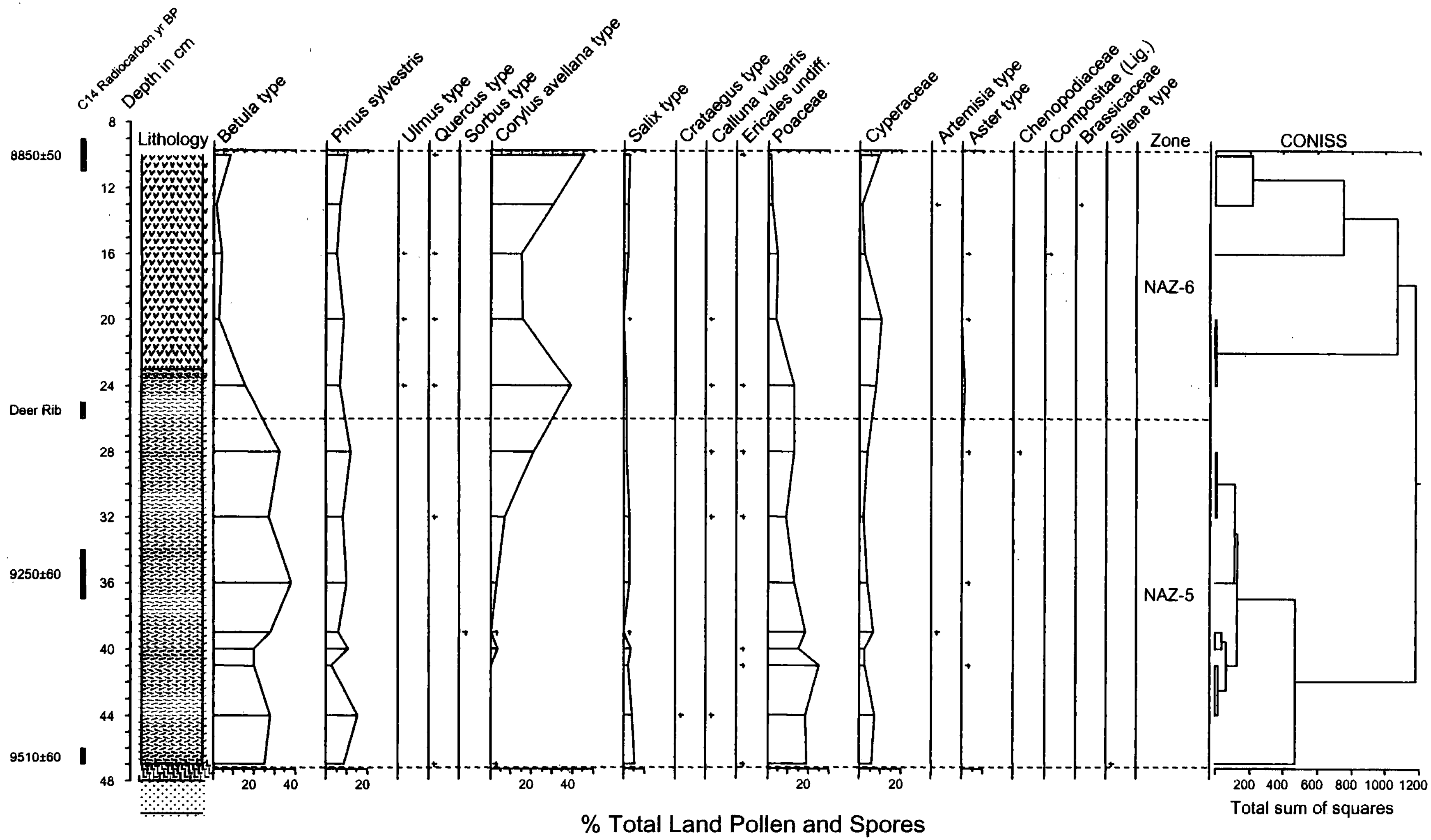


Figure 6.2 NAZ Percentage Pollen Diagram

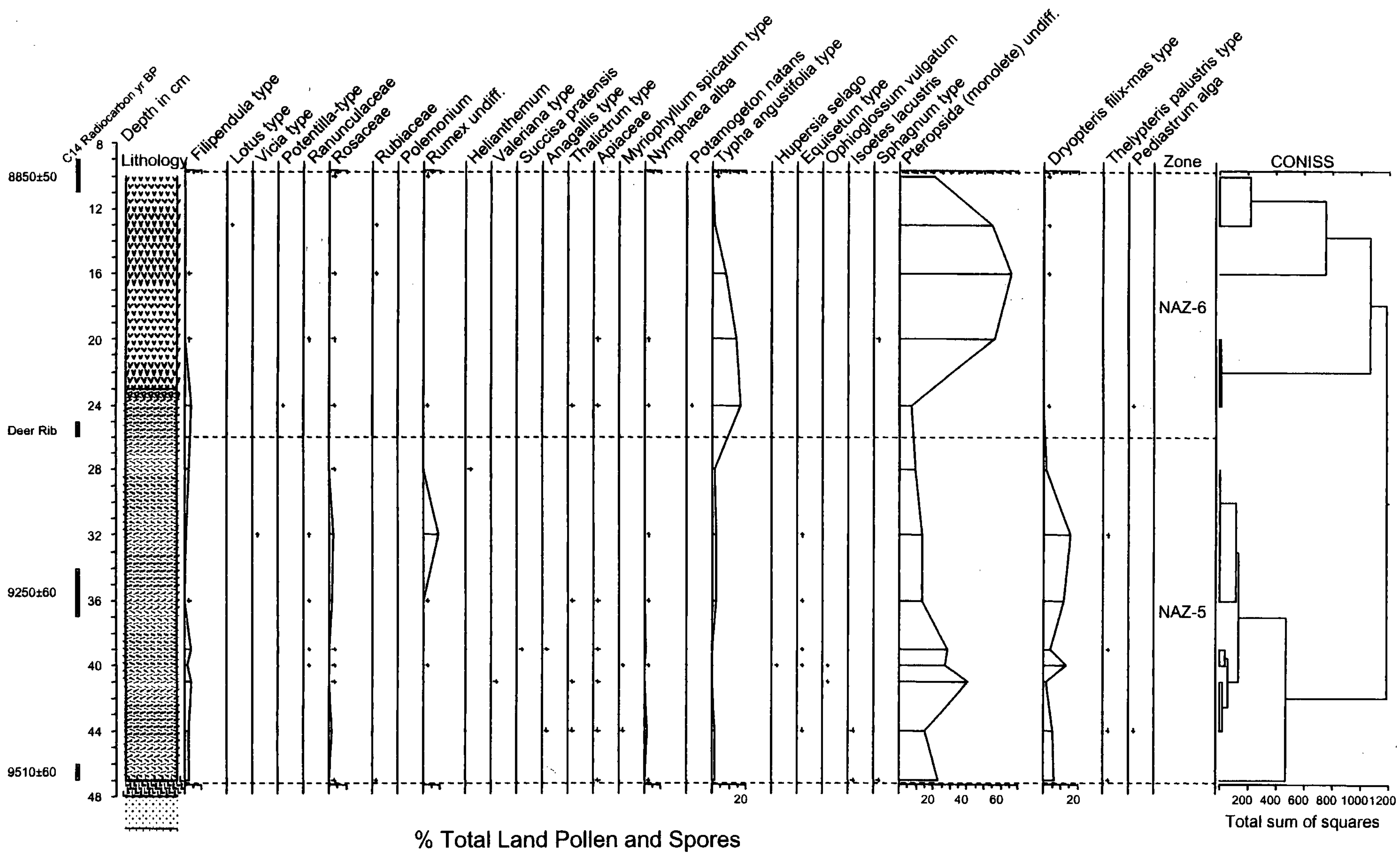


Figure 6.3 NAZ Percentage Pollen Diagram (cont'd)

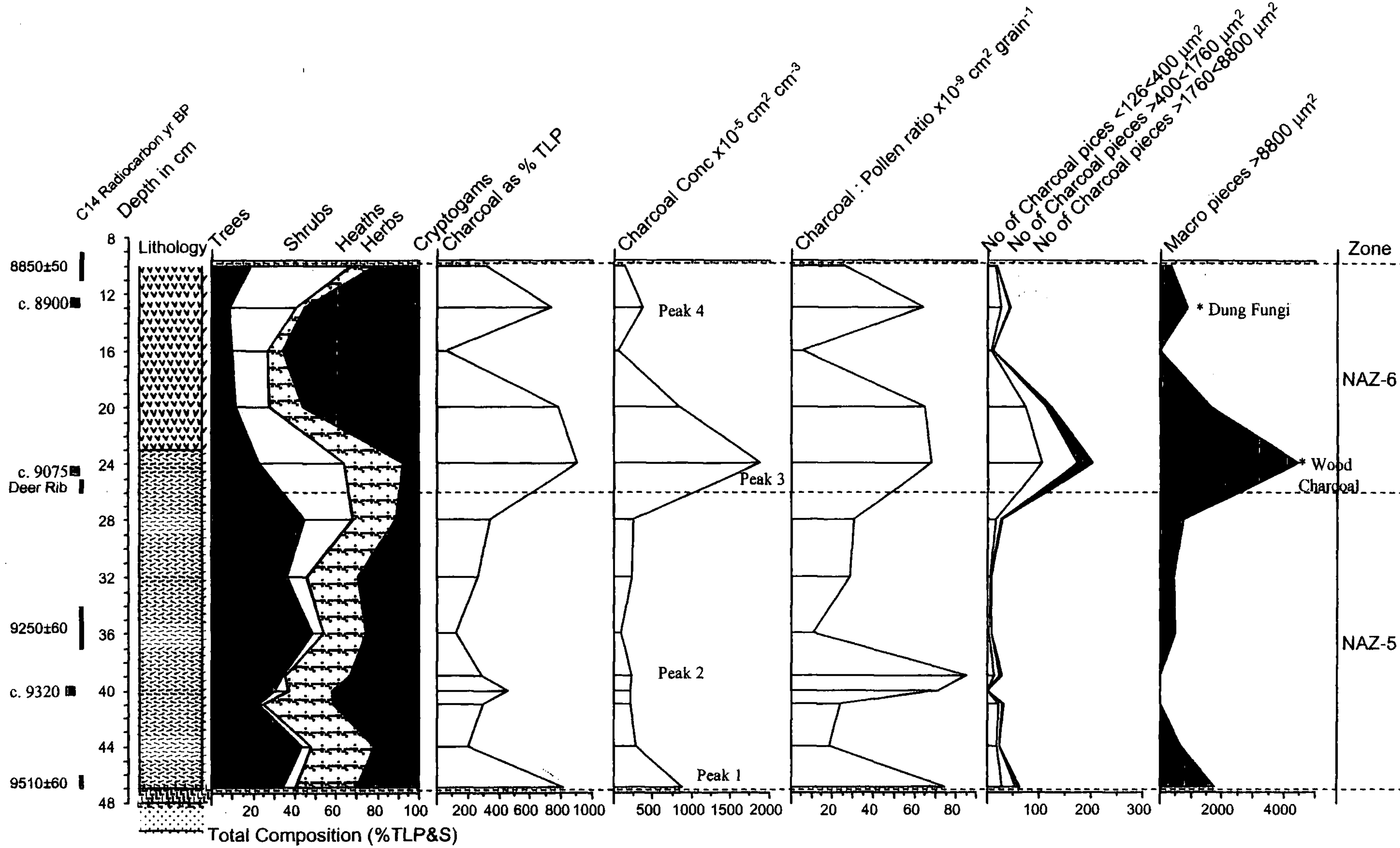


Figure 6.4 NAZ Charcoal Summary Diagram

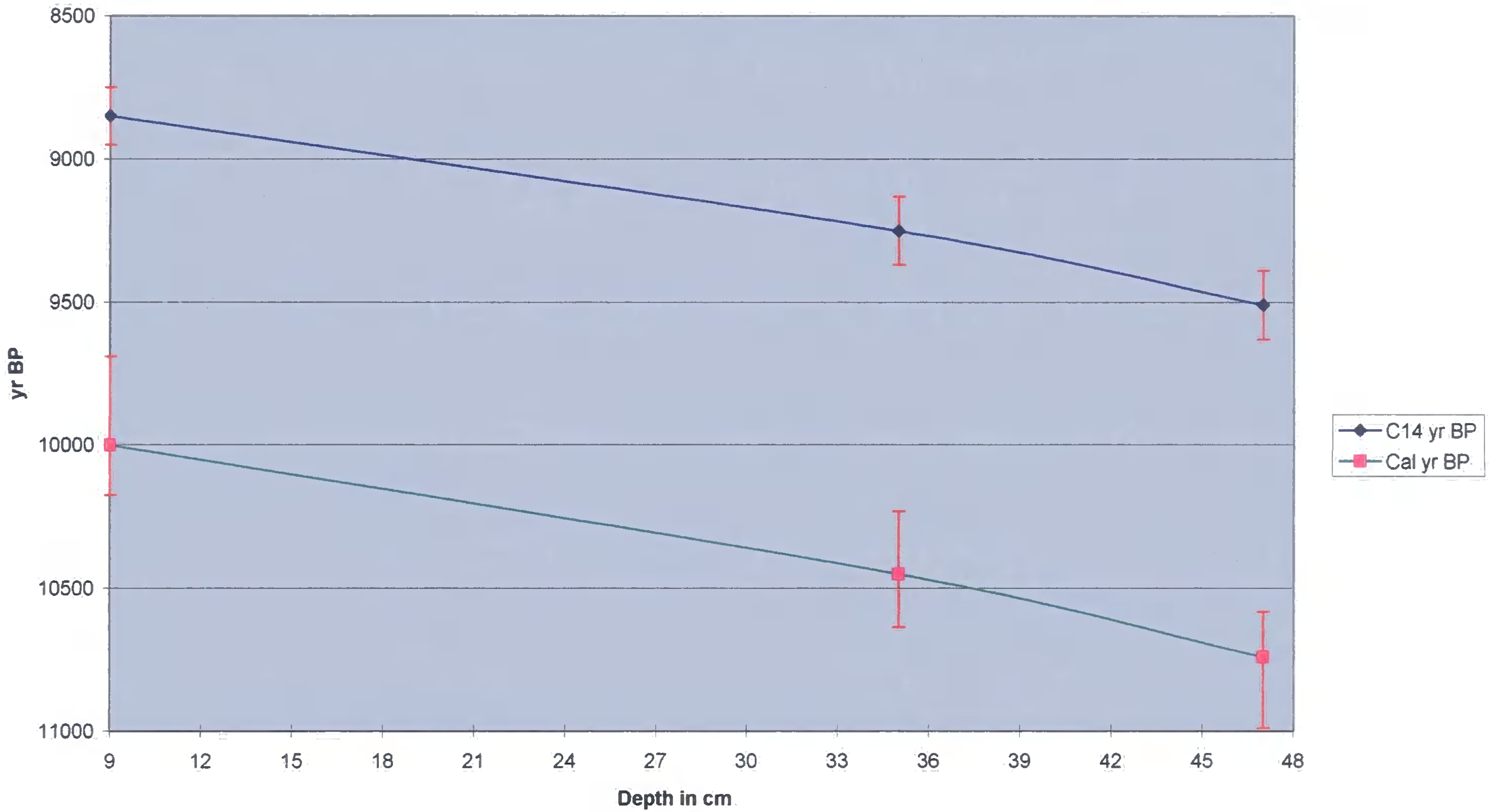


Figure 6.5a Time Depth Curve for NAZ (to 2 SE)

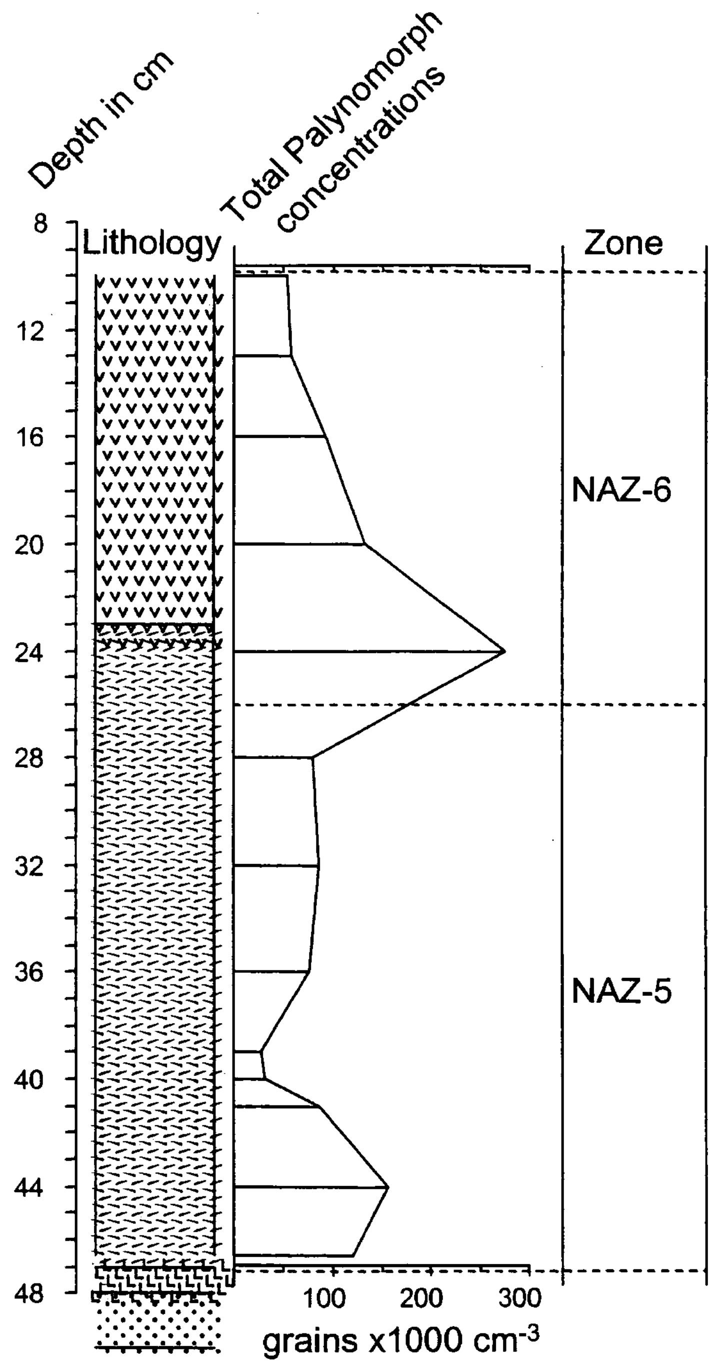


Figure 6.5b NAZ Palynomorph Concentration Curve

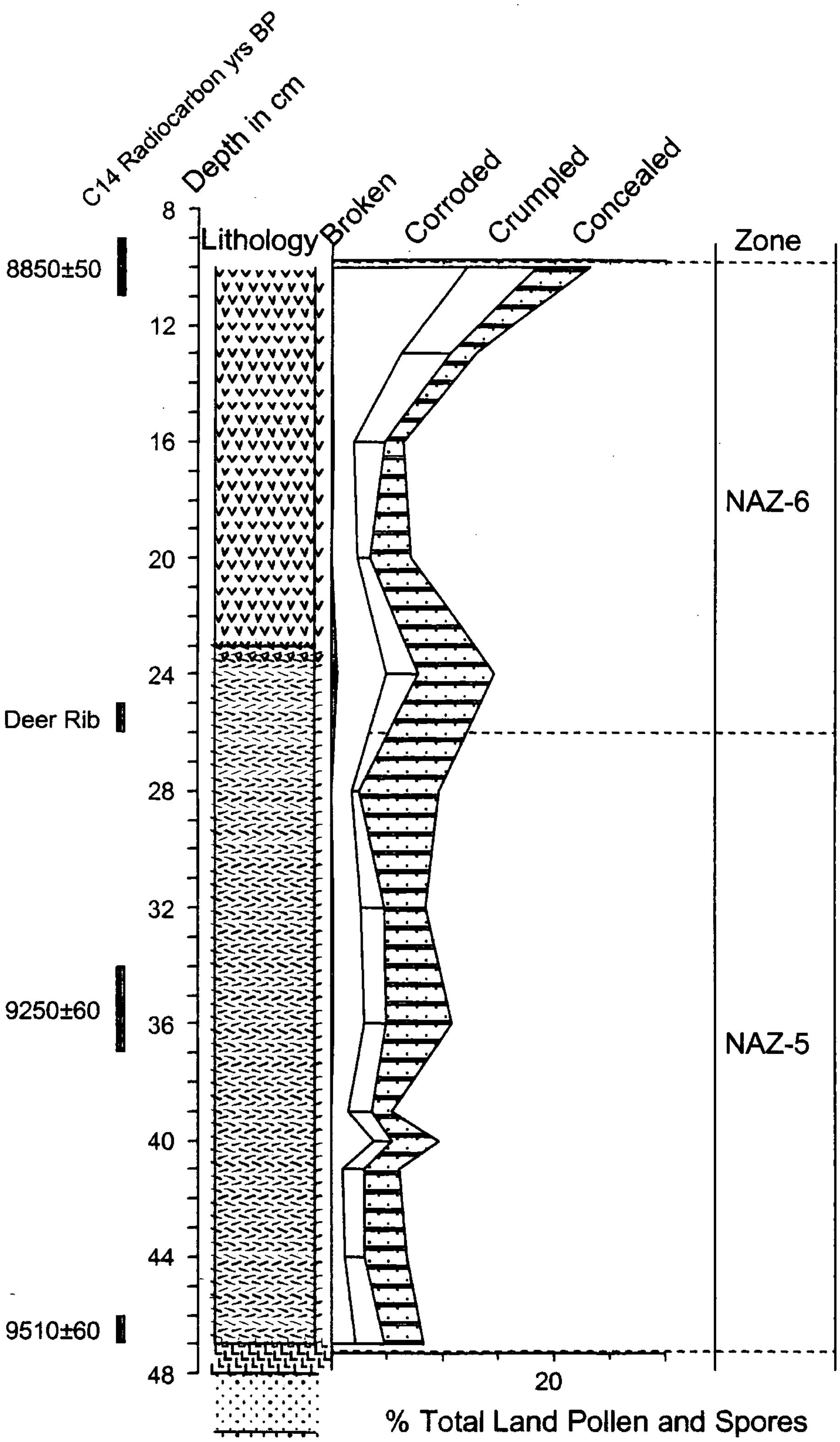


Figure 6.6 NAZ Pollen Preservation Curve

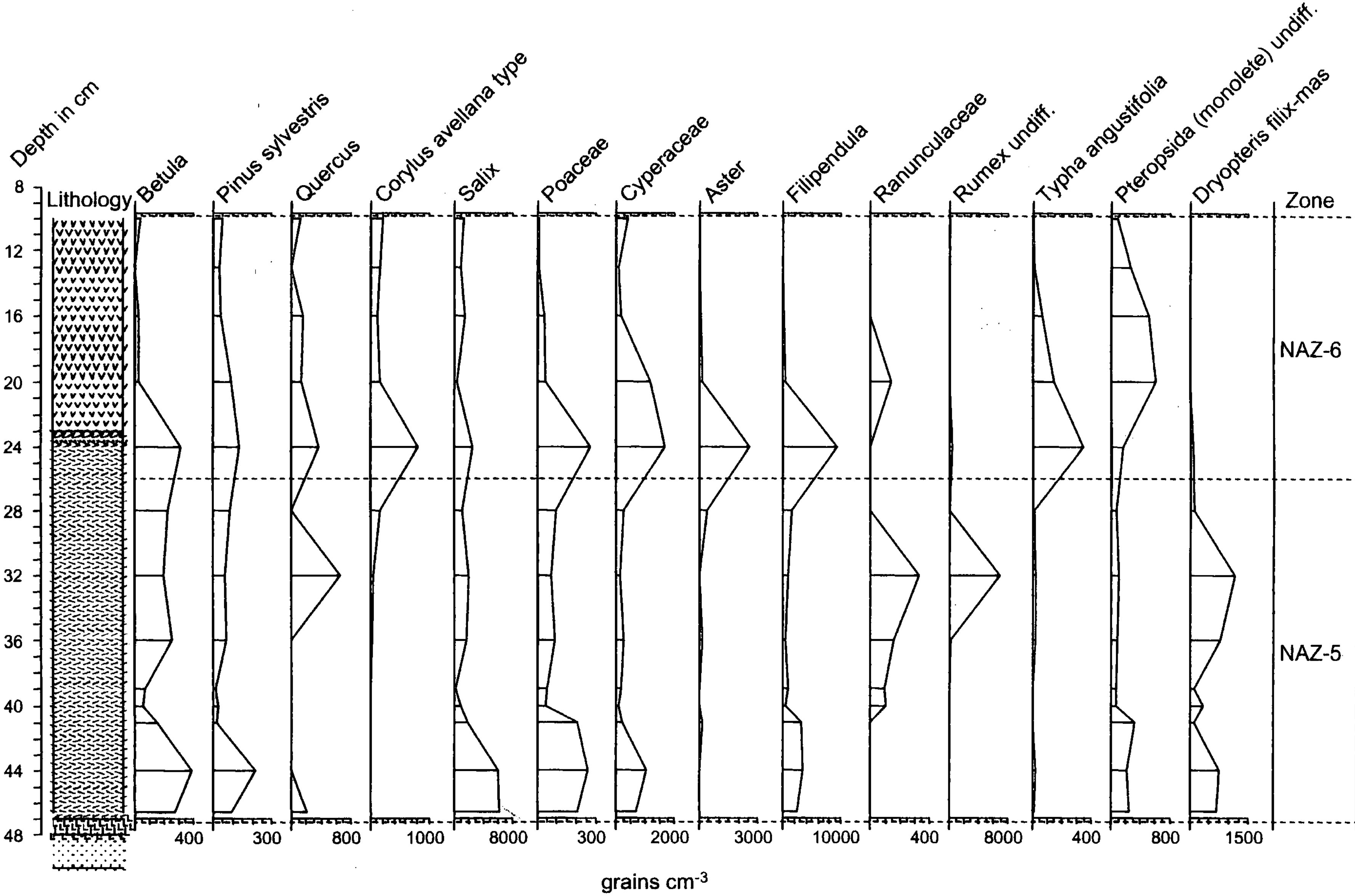


Figure 6.7 NAZ Selected Pollen Concentrations

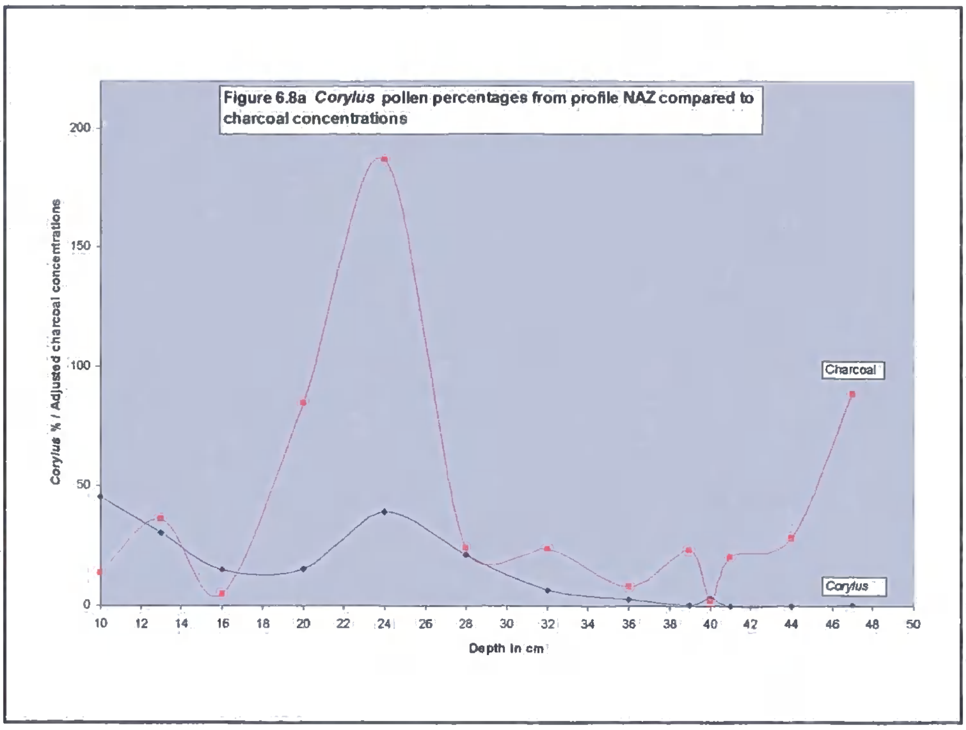


Figure 6.8a Corylus pollen percentages from profile NAZ compared to charcoal concentrations
Corylus % / Adjusted charcoal concentrations
Depth in cm
Charcoal
Corylus

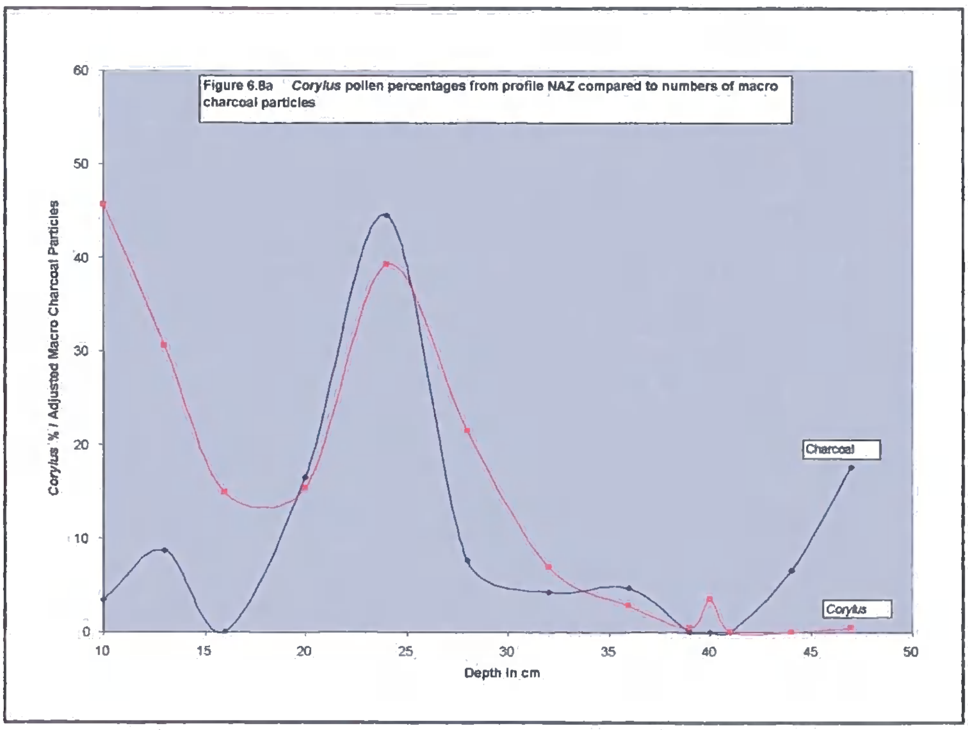


Figure 6.8a Corylus pollen percentages from profile NAZ compared to numbers of macro charcoal particles
Corylus % / Adjusted Macro Charcoal Particles
Depth in cm
Charcoal
Corylus

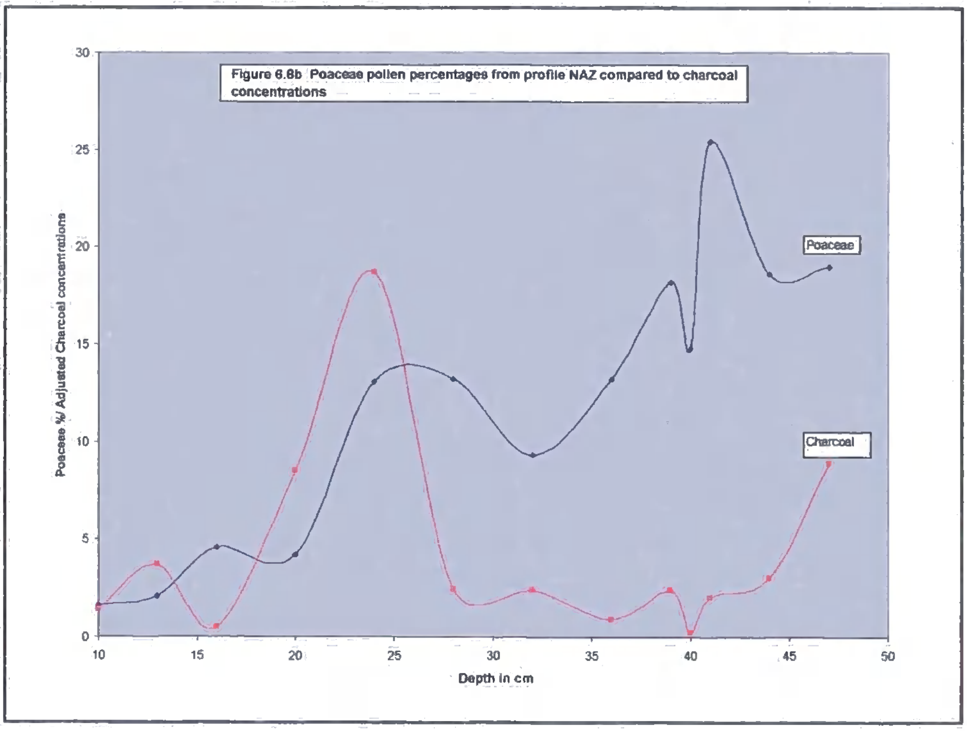


Figure 6.8b Poaceae pollen percentages from profile NAZ compared to charcoal concentrations
Poaceae % / Adjusted Charcoal concentrations
Depth in cm
Poaceae
Charcoal
0
5
10
15
20
25
30
10
15
20
25
30
35
40
45
50

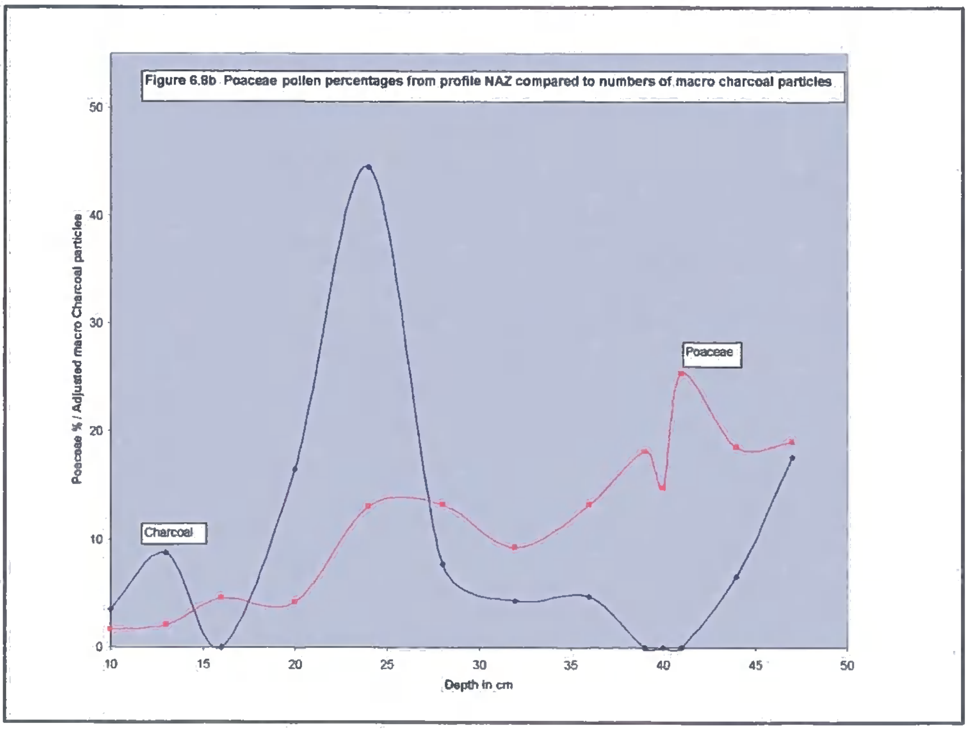


Figure 6.9b Poaceae pollen percentages from profile NAZ compared to numbers of macro charcoal particles
Poaceae % / Adjusted macro Charcoal particles
Depth in cm
Poaceae
Charcoal
0
10
20
30
40
50
10
15
20
25
30
35
40
45
50

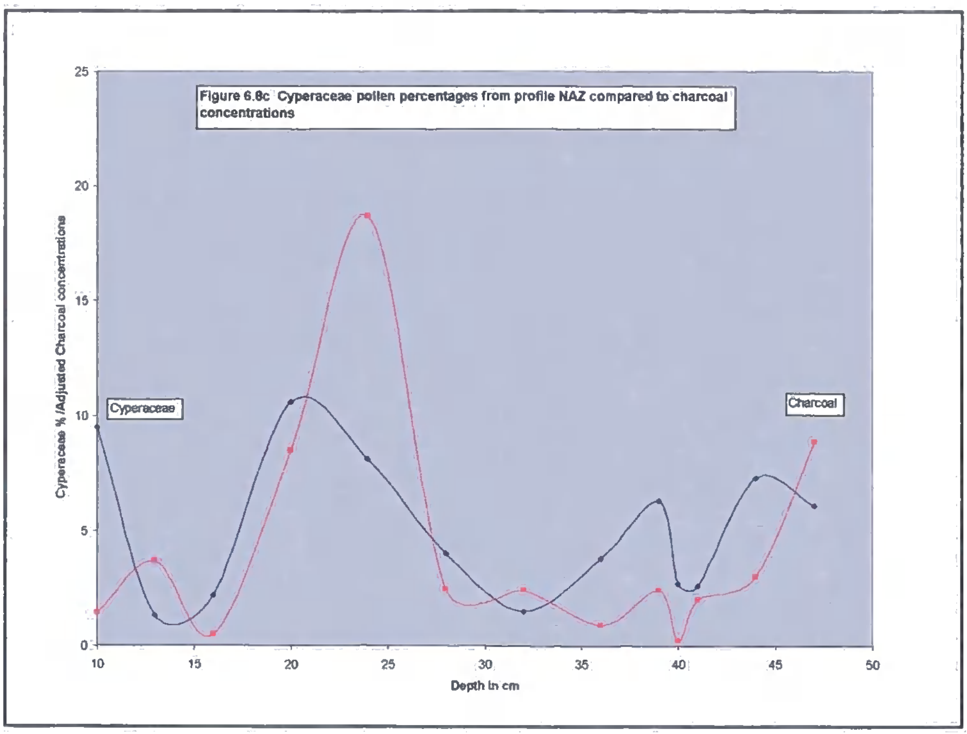


Figure 6.8c Cyperaceae pollen percentages from profile NAZ compared to charcoal concentrations
Cyperaceae % /Adjusted Charcoal concentrations
Cyperaceae
Charcoal
Depth in cm

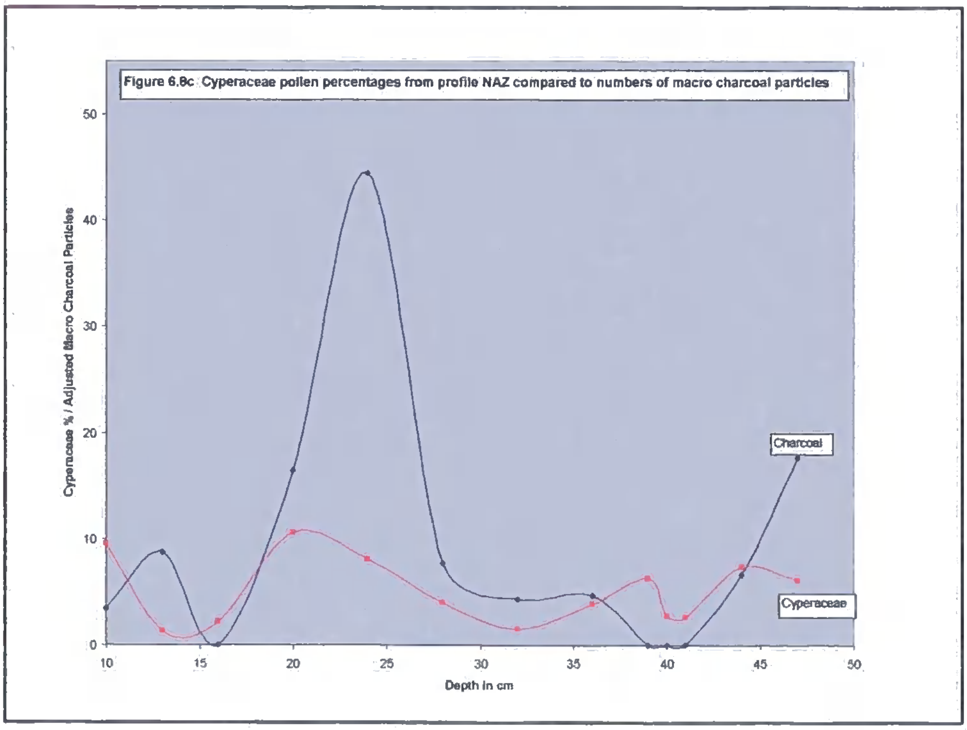


Figure 6.8c Cyperaceae pollen percentages from profile NAZ compared to numbers of macro charcoal particles
Cyperaceae % / Adjusted Macro Charcoal Particles
Charcoal
Cyperaceae
Depth in cm

Figure 6.9a NAZ Pollen Percentages, 95% Confidence Limits

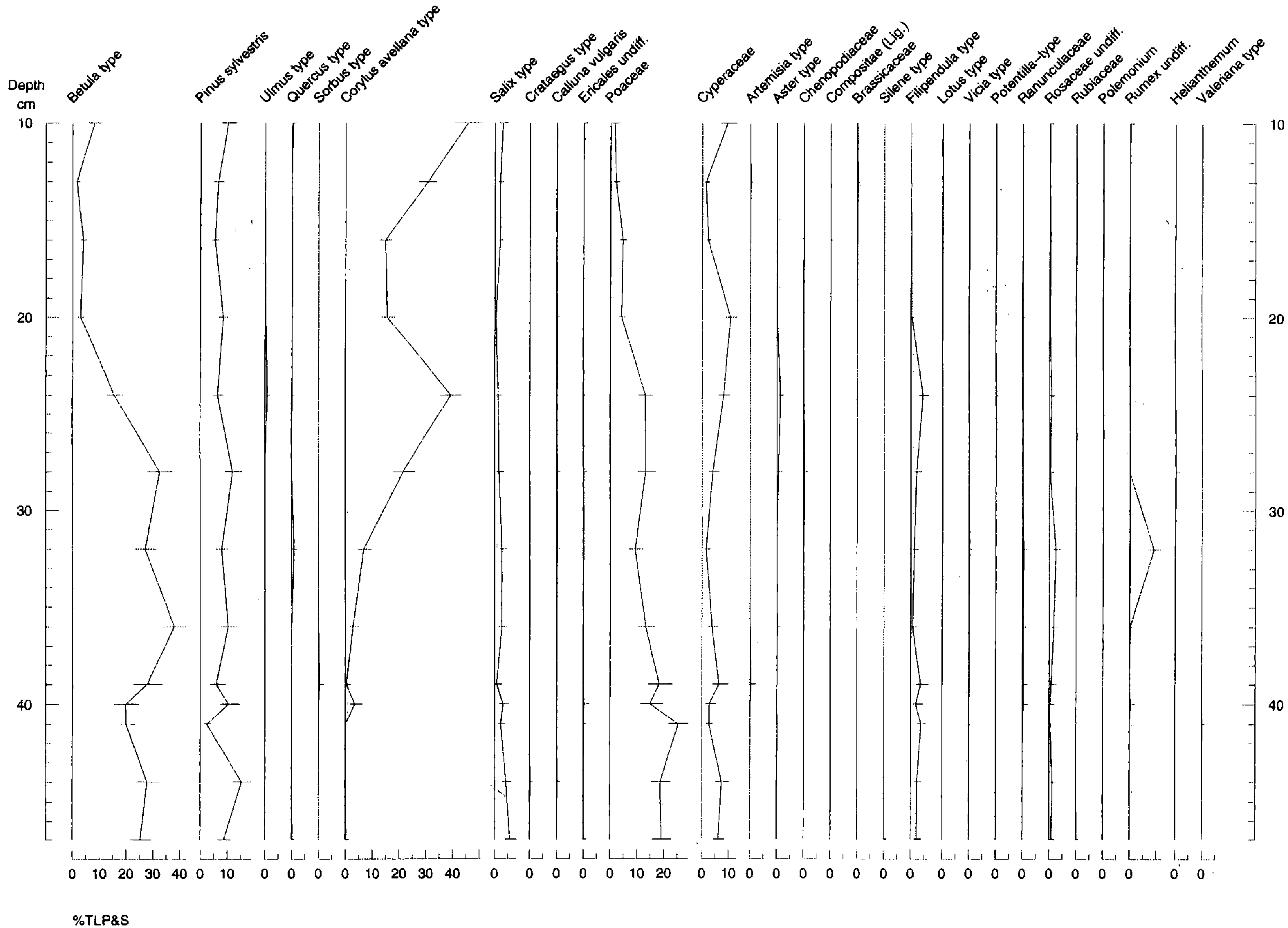
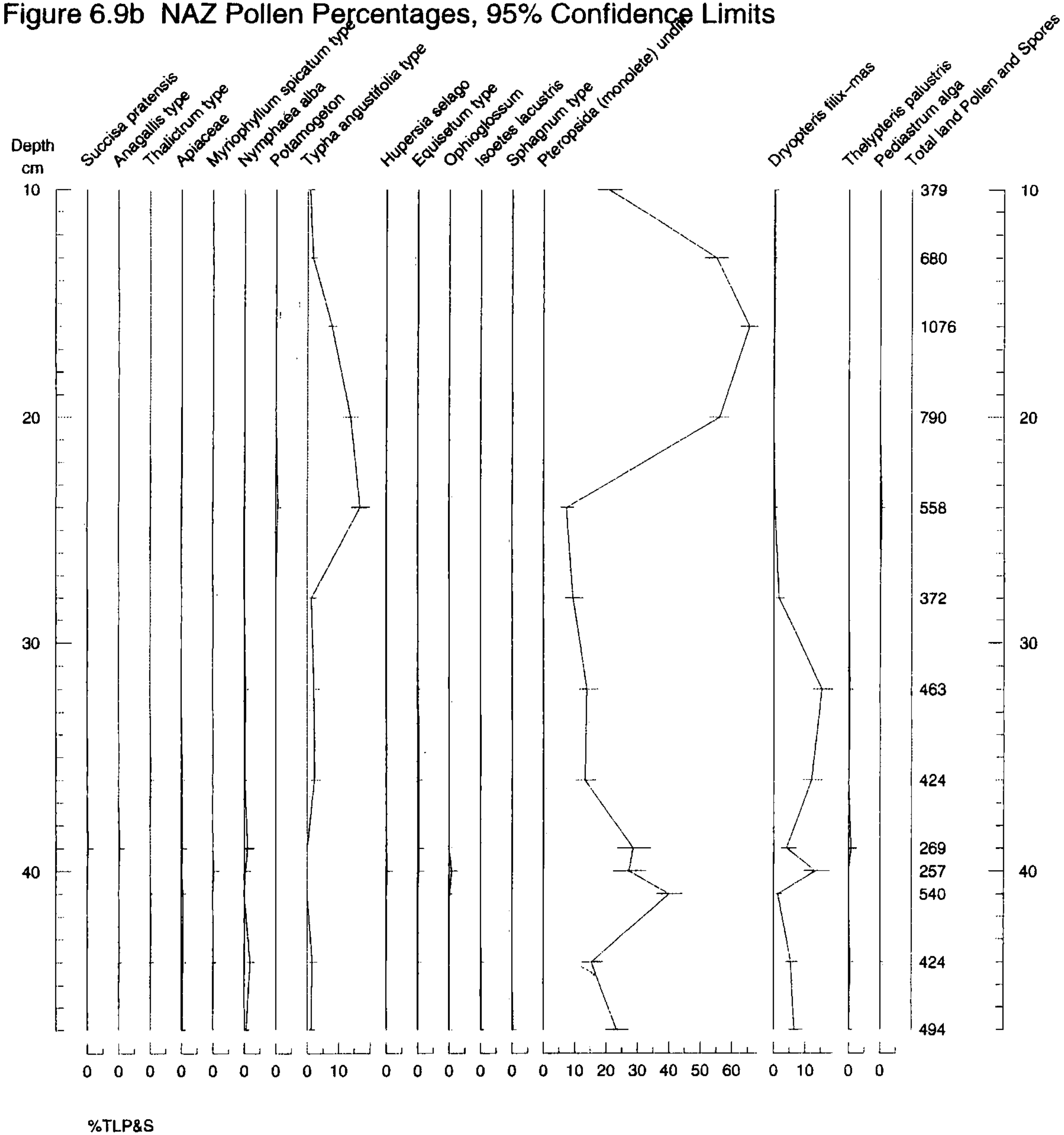


Figure 6.9b NAZ Pollen Percentages, 95% Confidence Limits



Chapter Seven

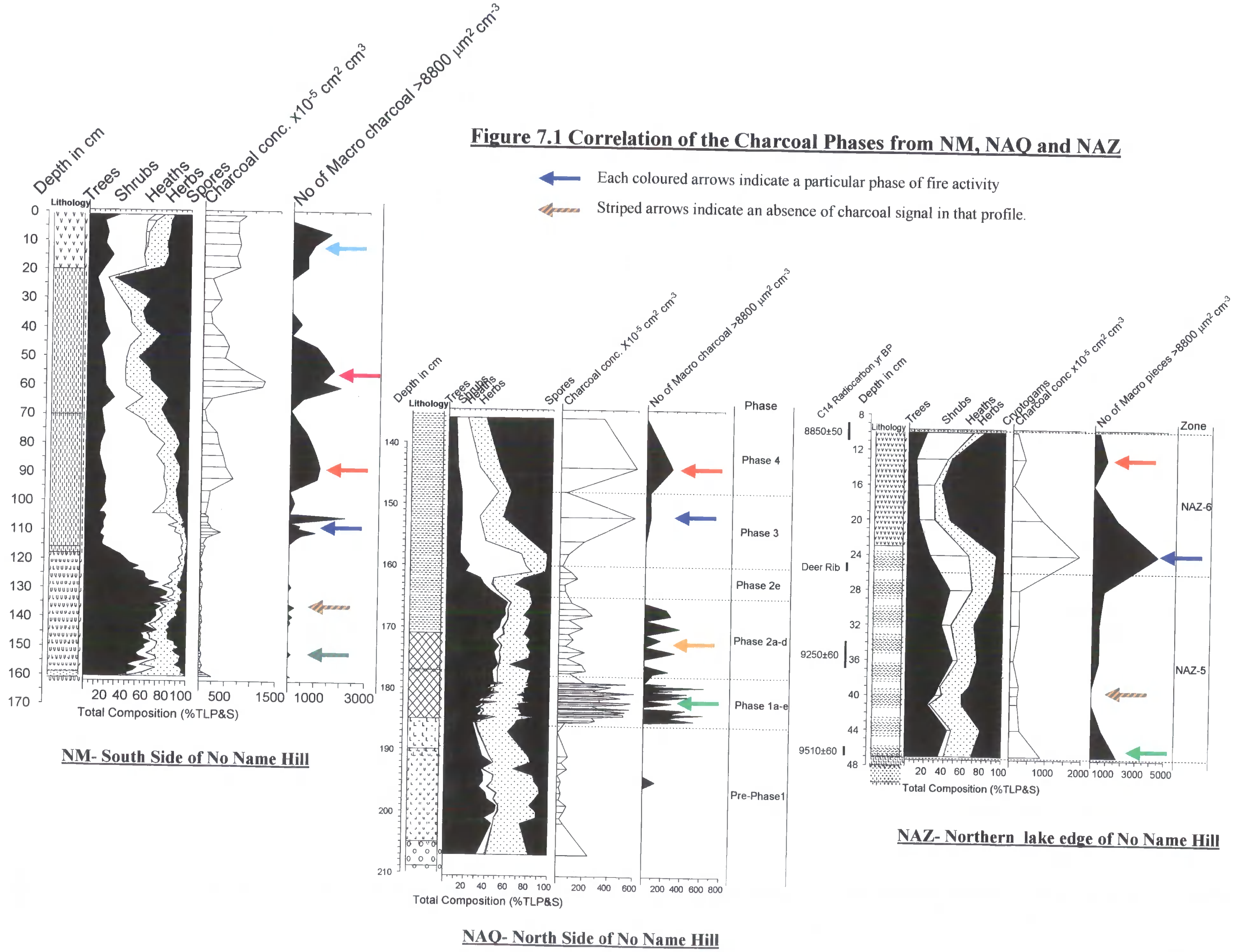


Figure 7.1 Correlation of the Charcoal Phases from NM, NAQ and NAZ

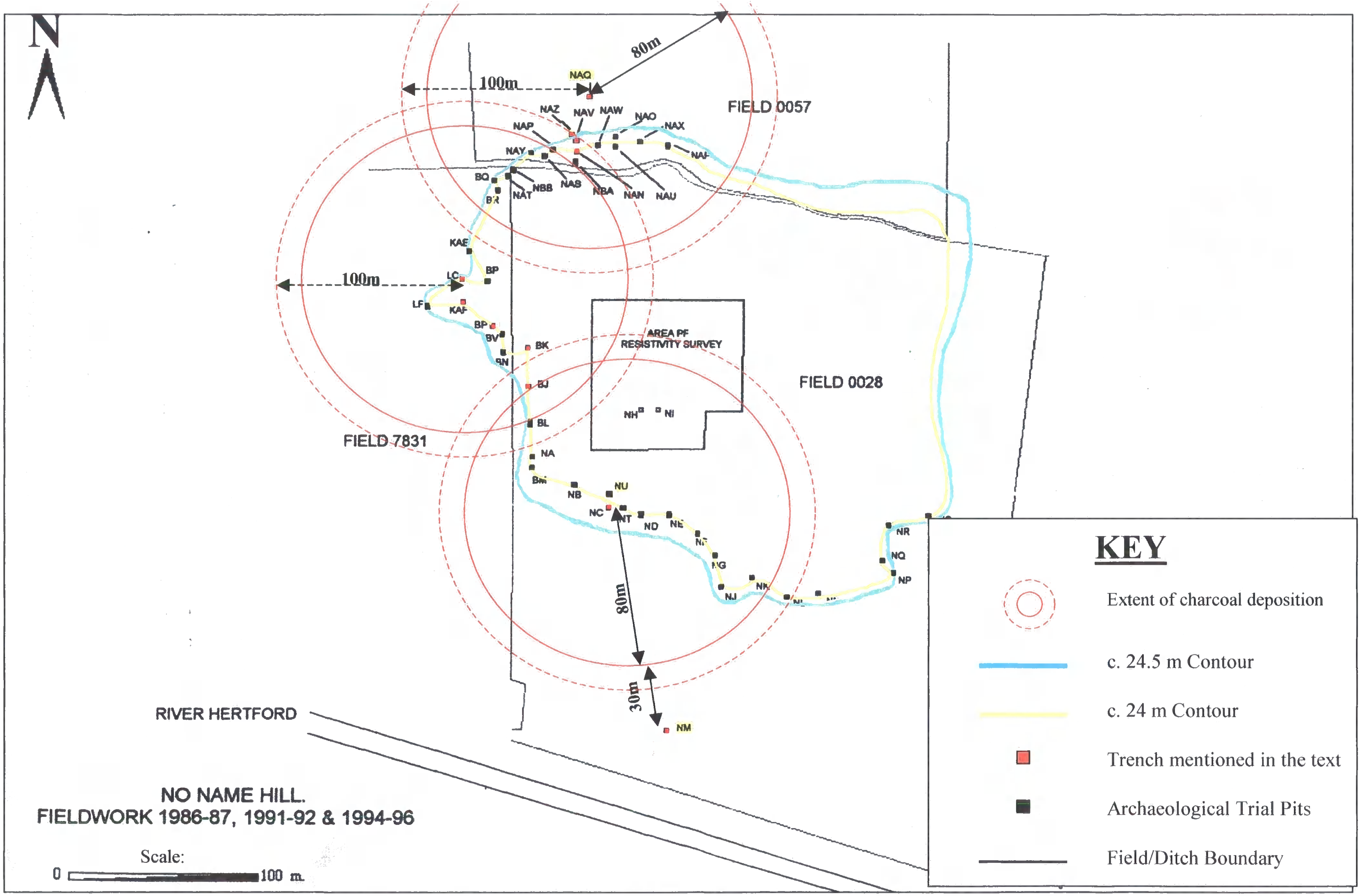


Figure 7.2 The location of early Mesolithic finds at No Name Hill, showing the likely limit of local charcoal deposition.

Chapter Eight

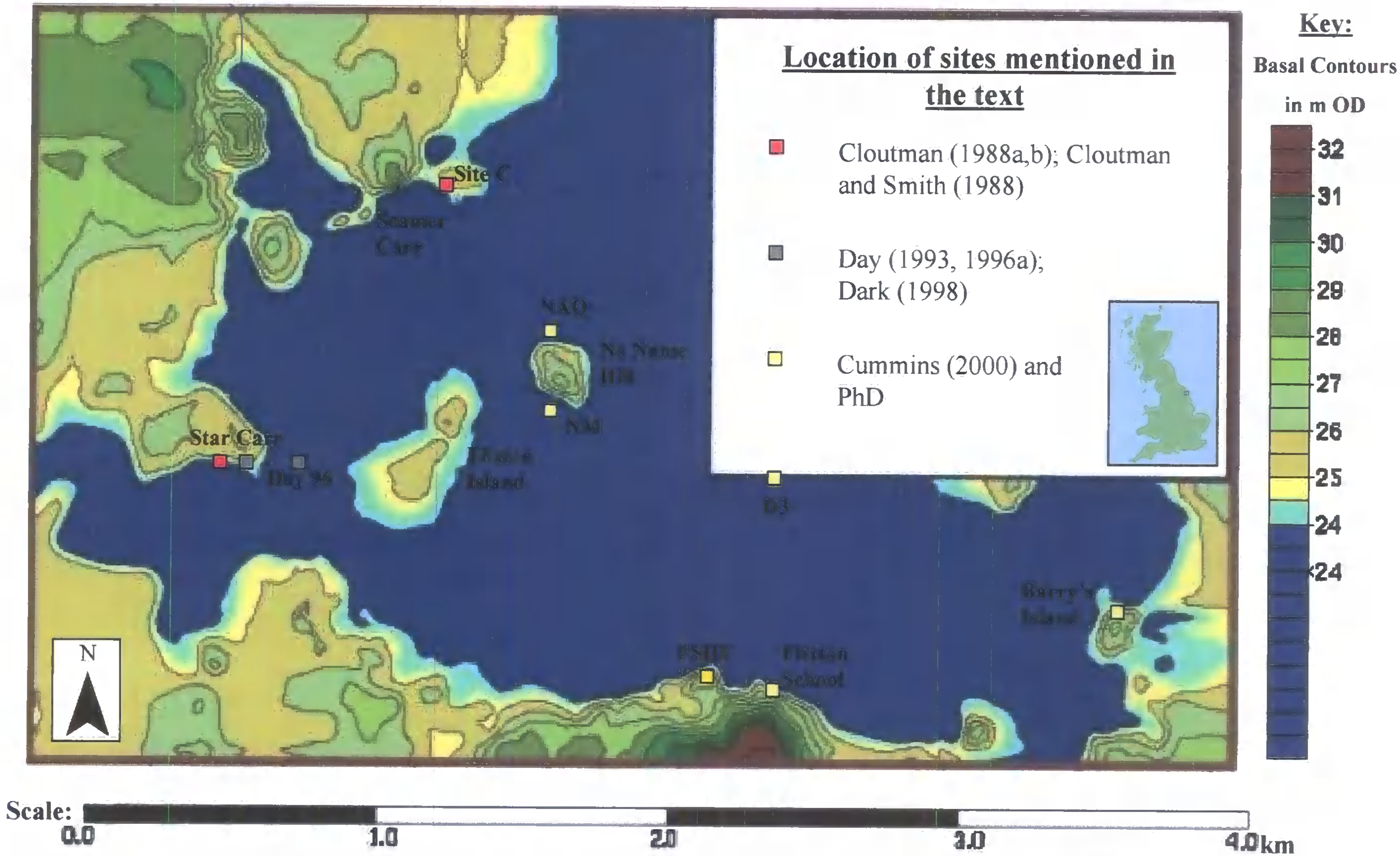


Figure 8.1 The location of Flixton School in relation to palaeo-Lake Flixton and other sites mentioned in the text

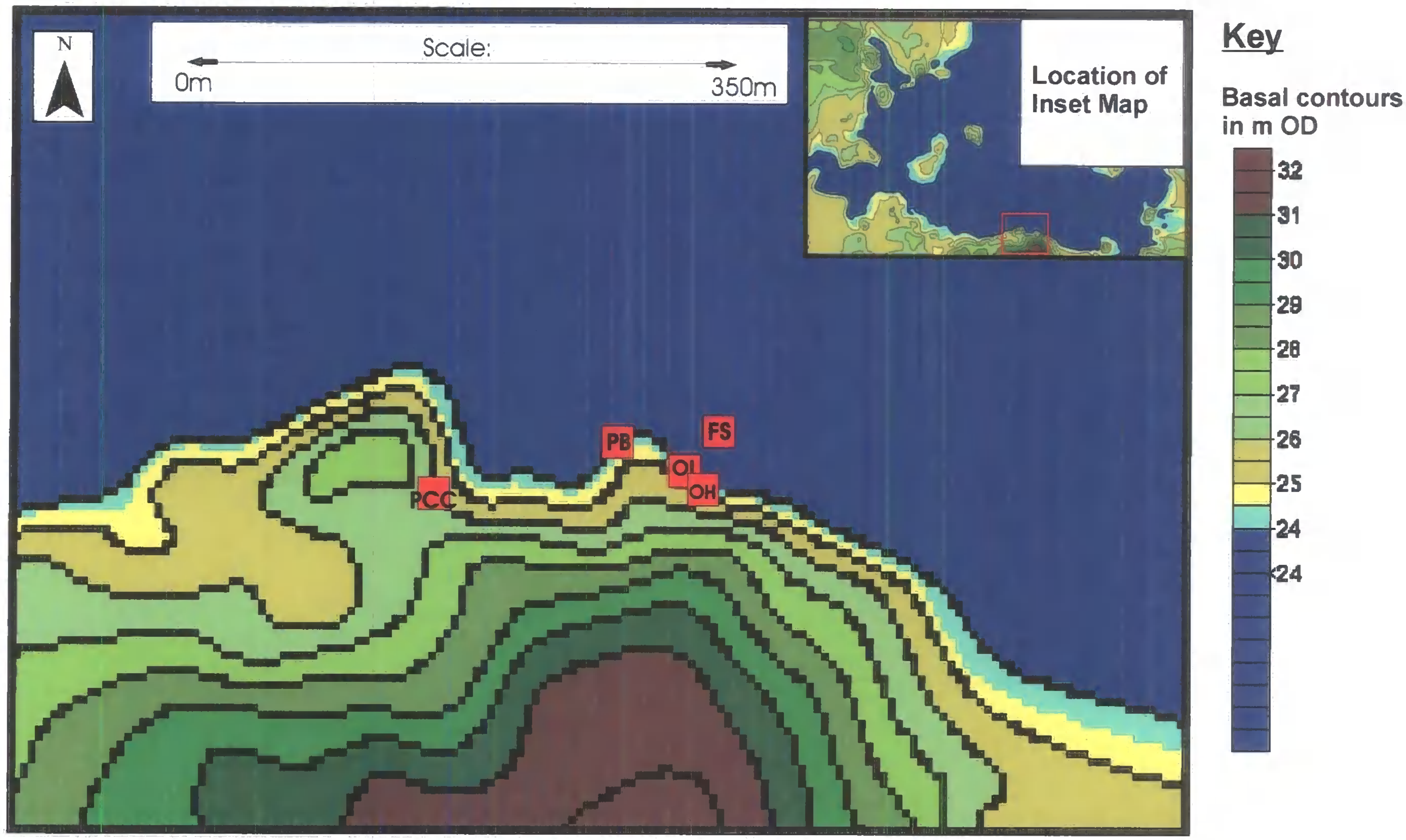


Figure 8.2 The Location of Profile FS in relation to the early Mesolithic shore-line, and archaeological trenches mentioned in the text

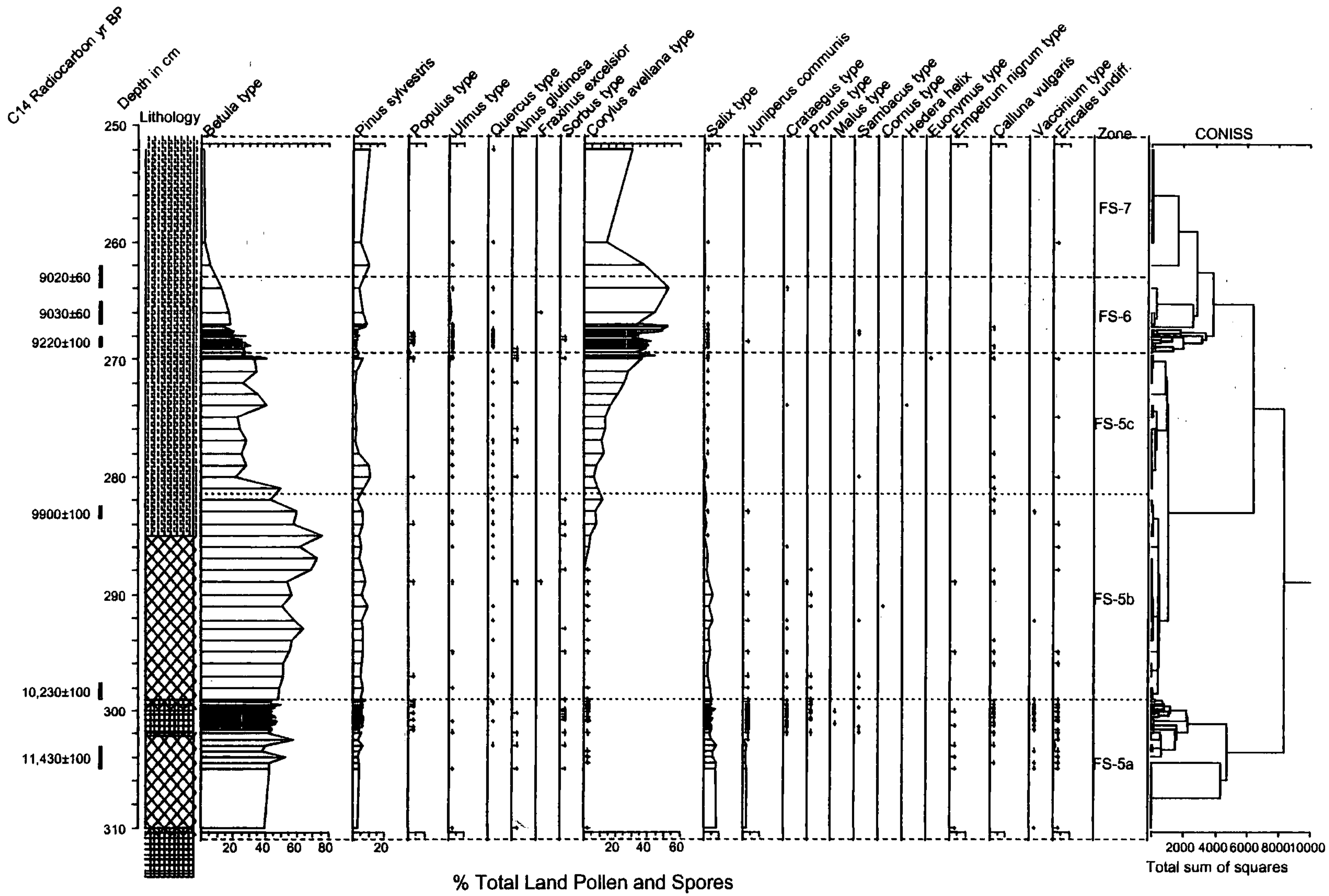


Figure 8.3 Profile FS - Pollen Percentage Diagram showing the results of CONISS

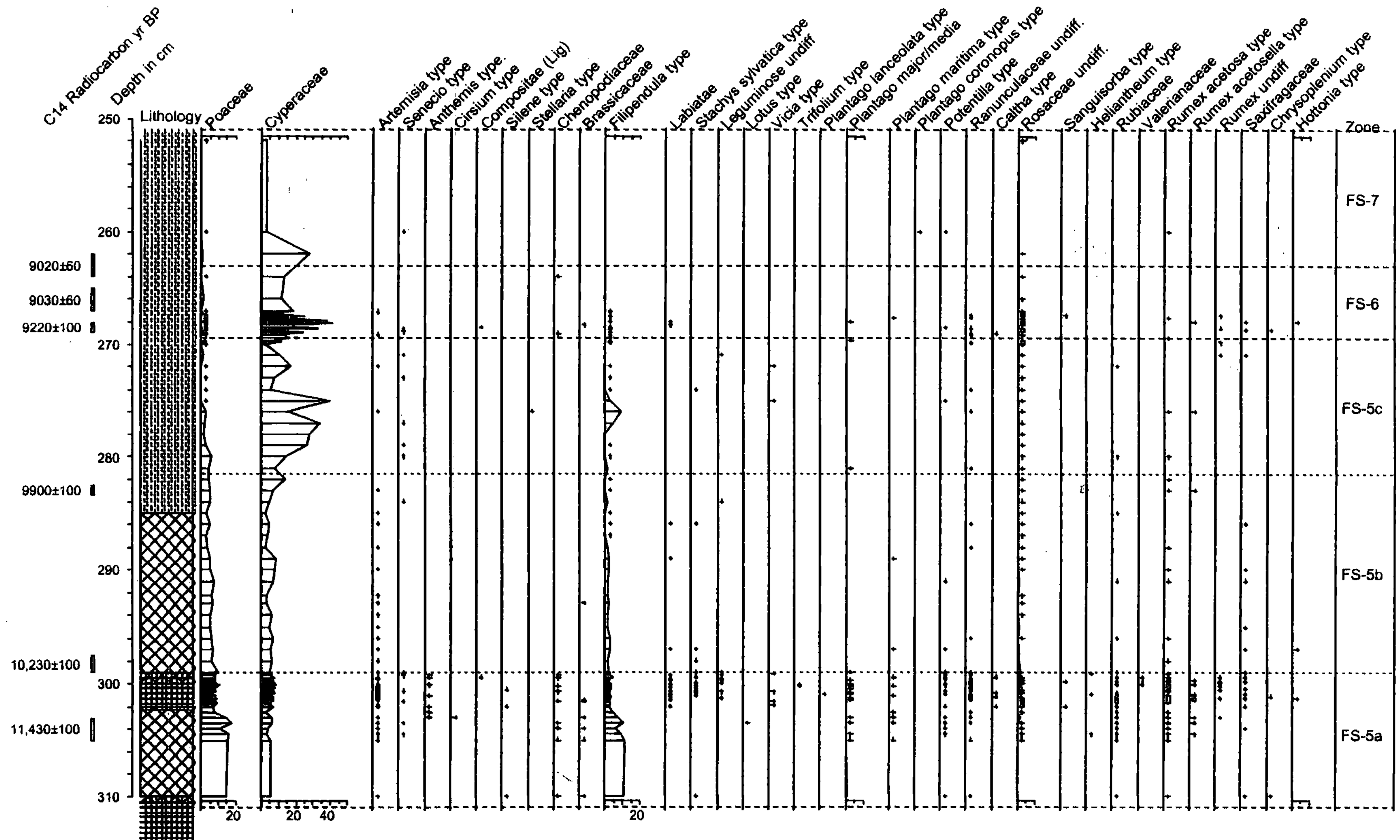


Figure 8.4 Profile FS – Pollen percentage diagram (continued)

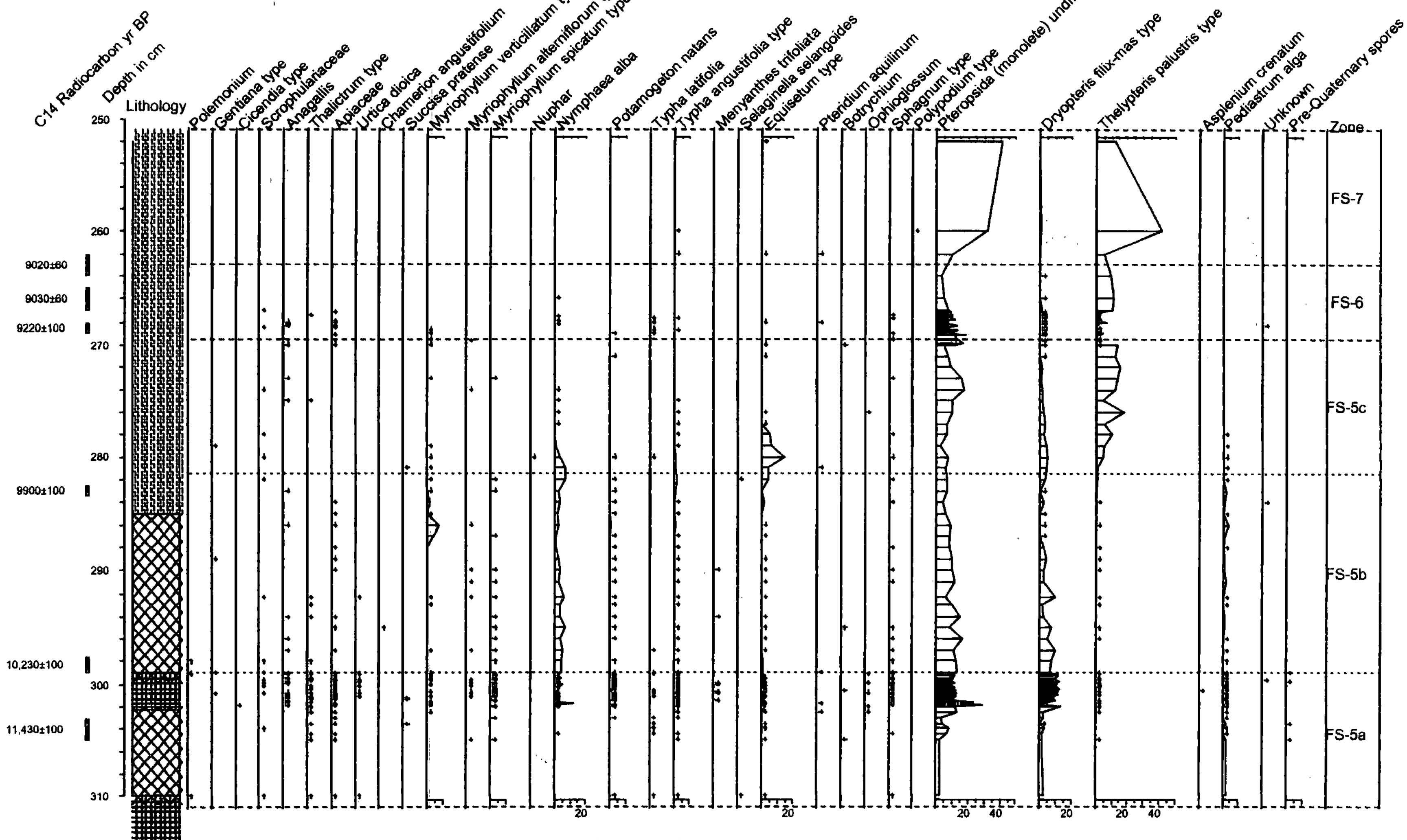


Figure 8.5 Profile FS – Pollen percentage diagram (continued)

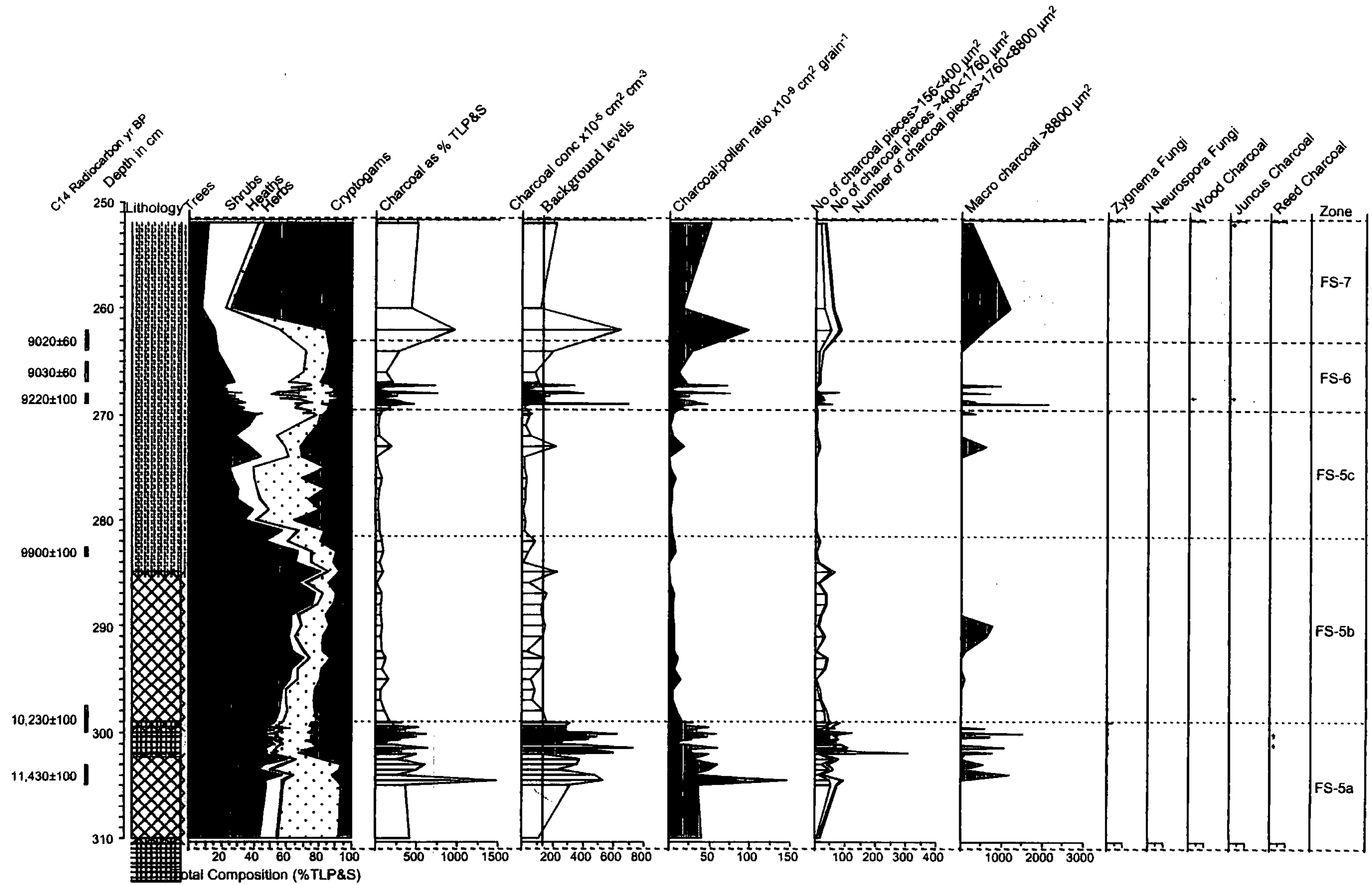


Figure 8.6 Profile FS –Charcoal Summary Diagram

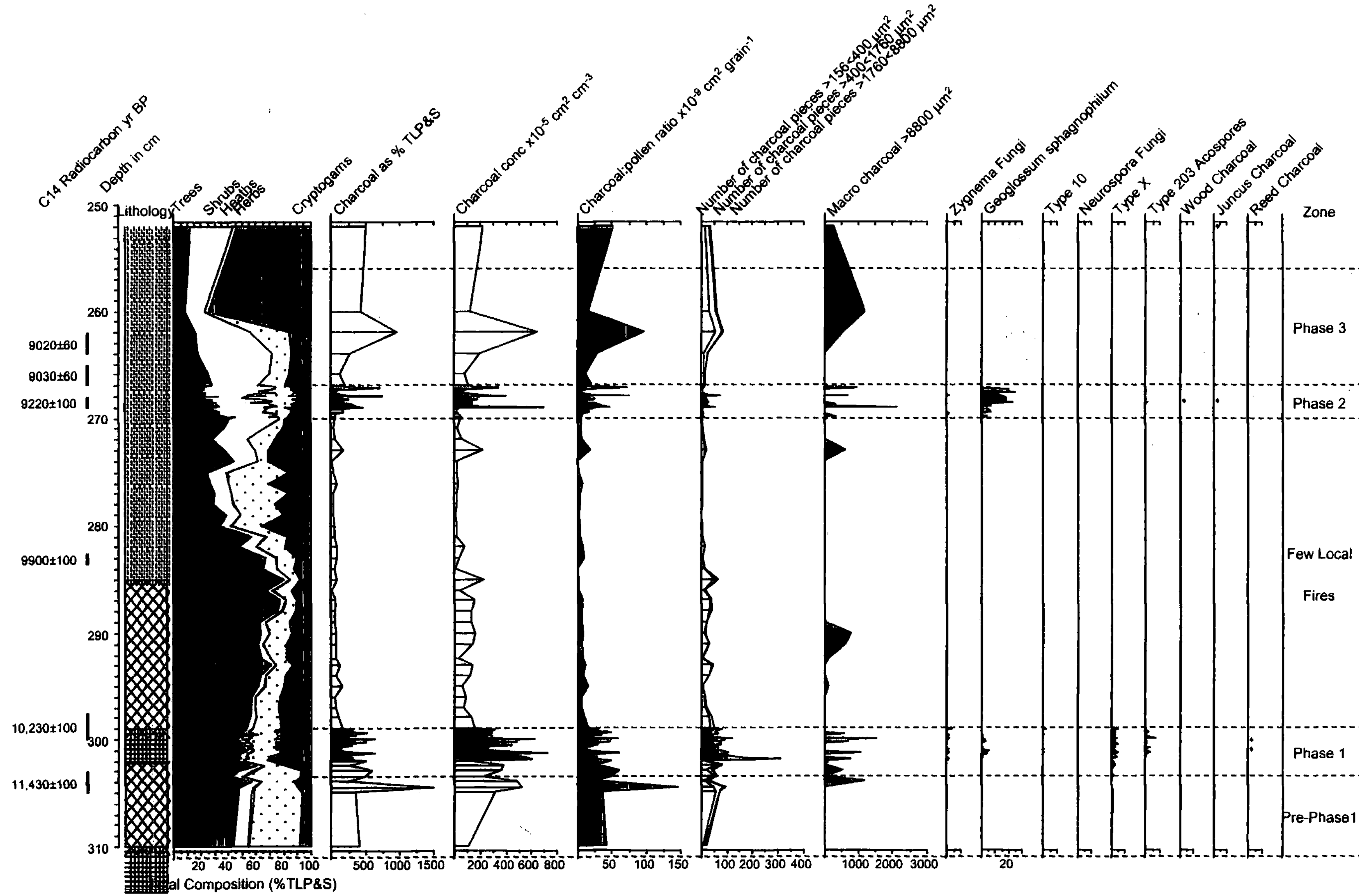


Figure 8.7 Profile FS – Summary Diagram showing Fire Phases

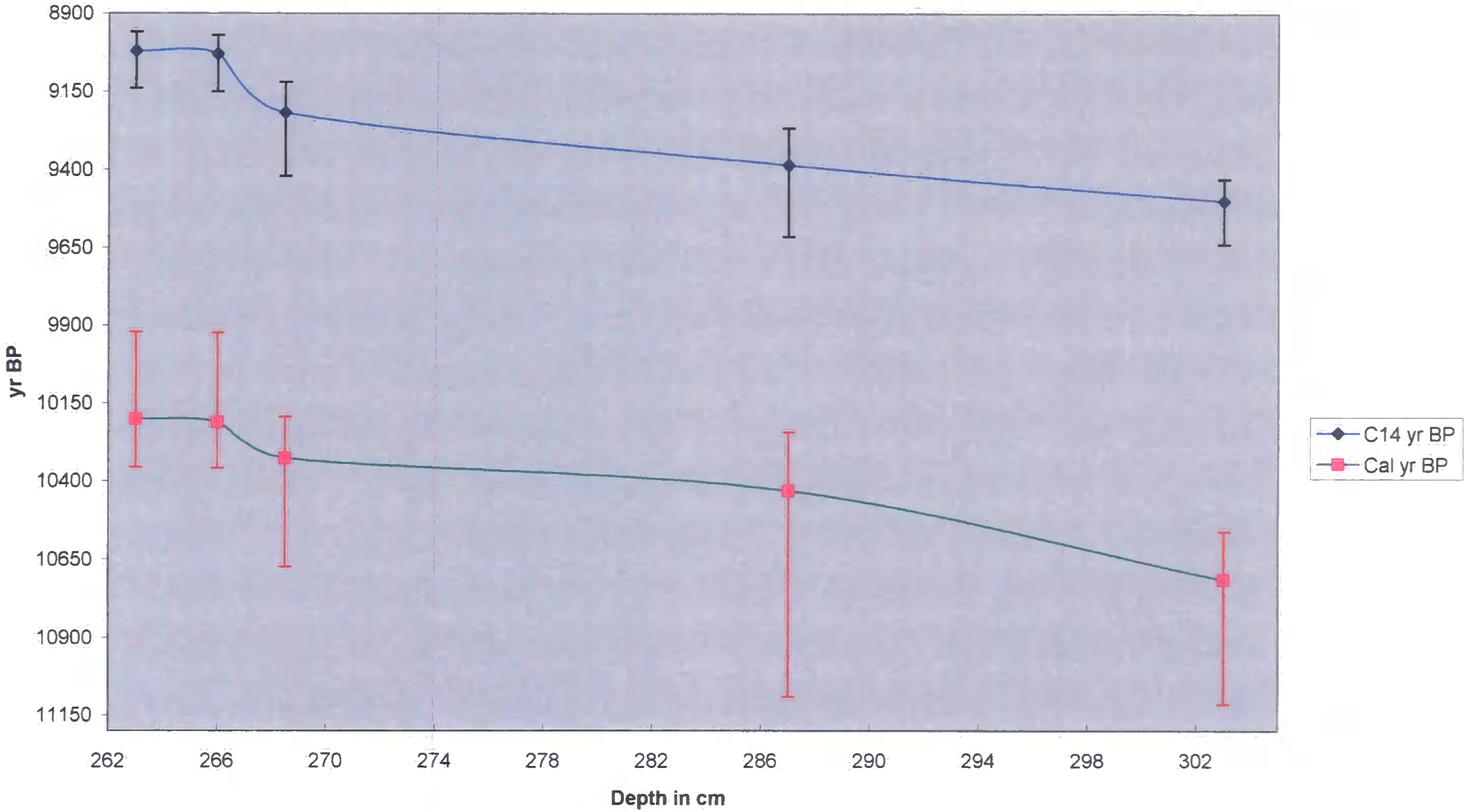


Figure 8.8 Time-Depth Curve for Profile FS (to 2 SE)

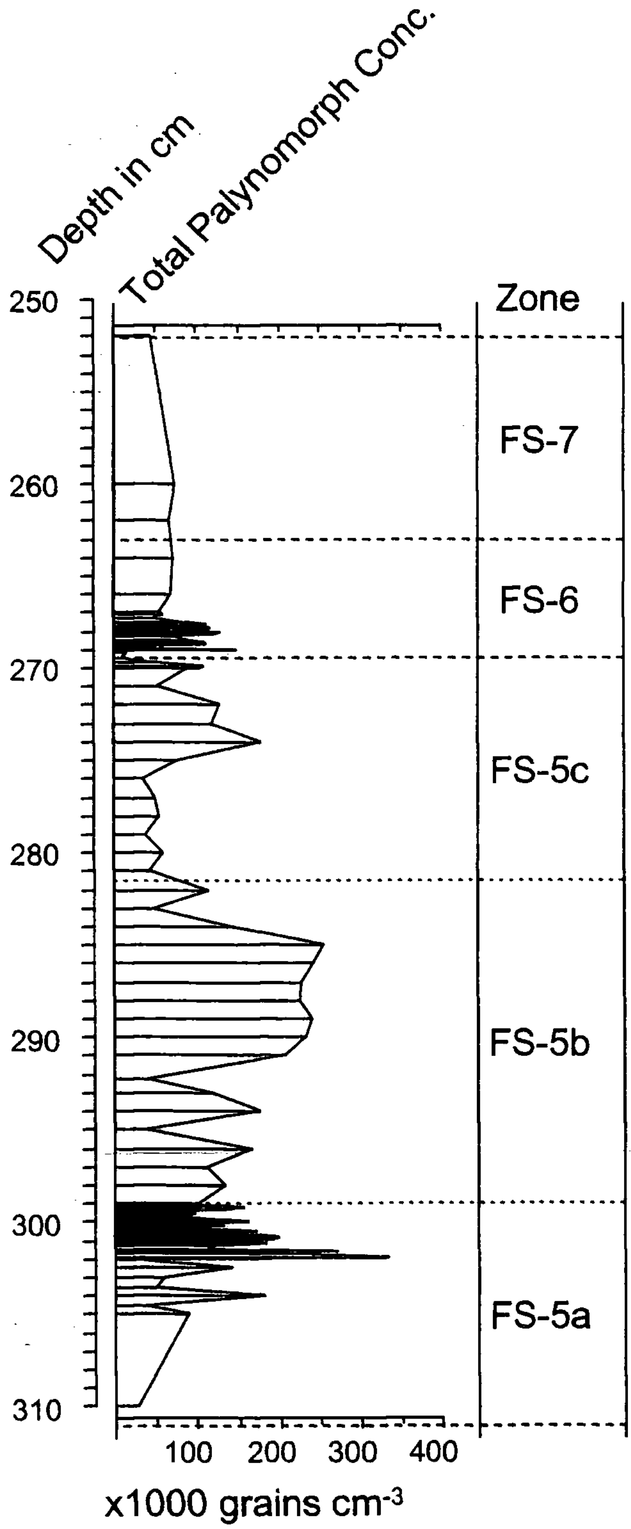


Figure 8.9 FS Palynomorph Concentration Curve

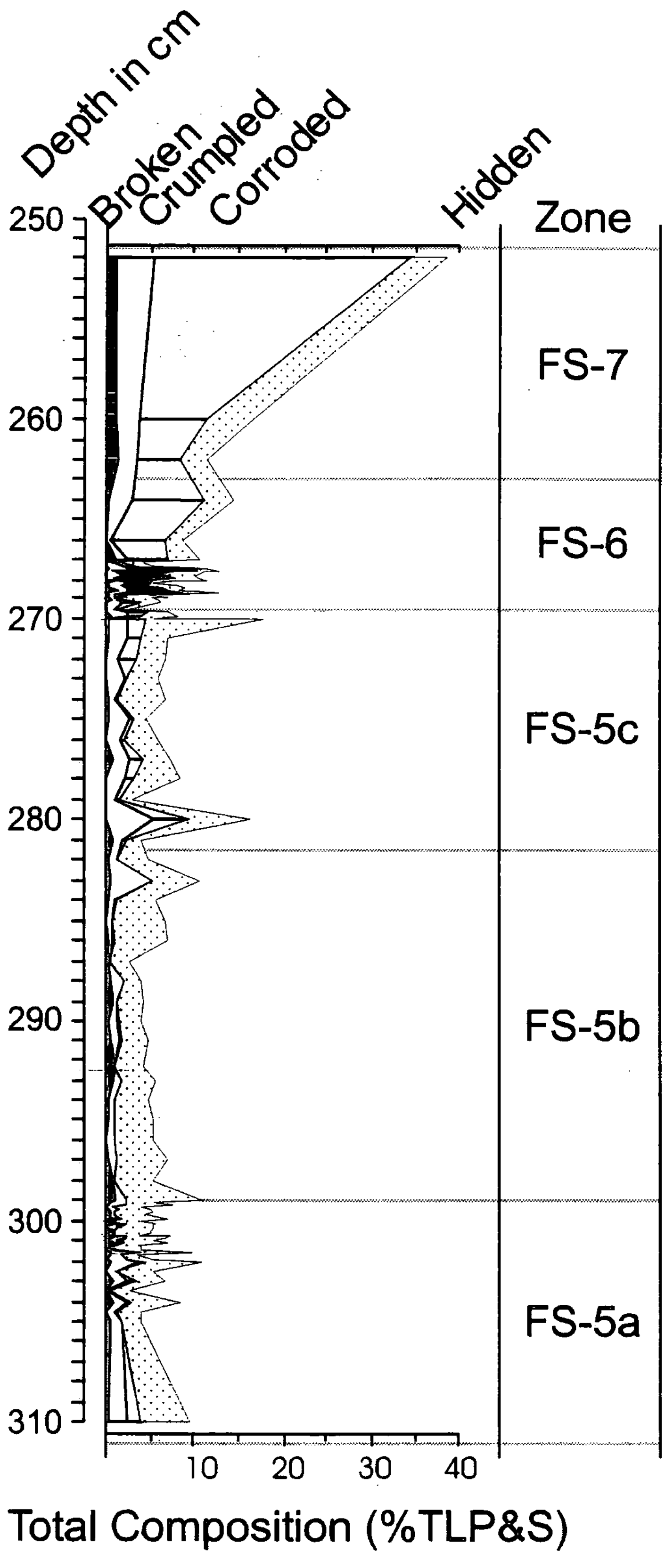


Figure 8.10 FS Pollen Preservation Curve

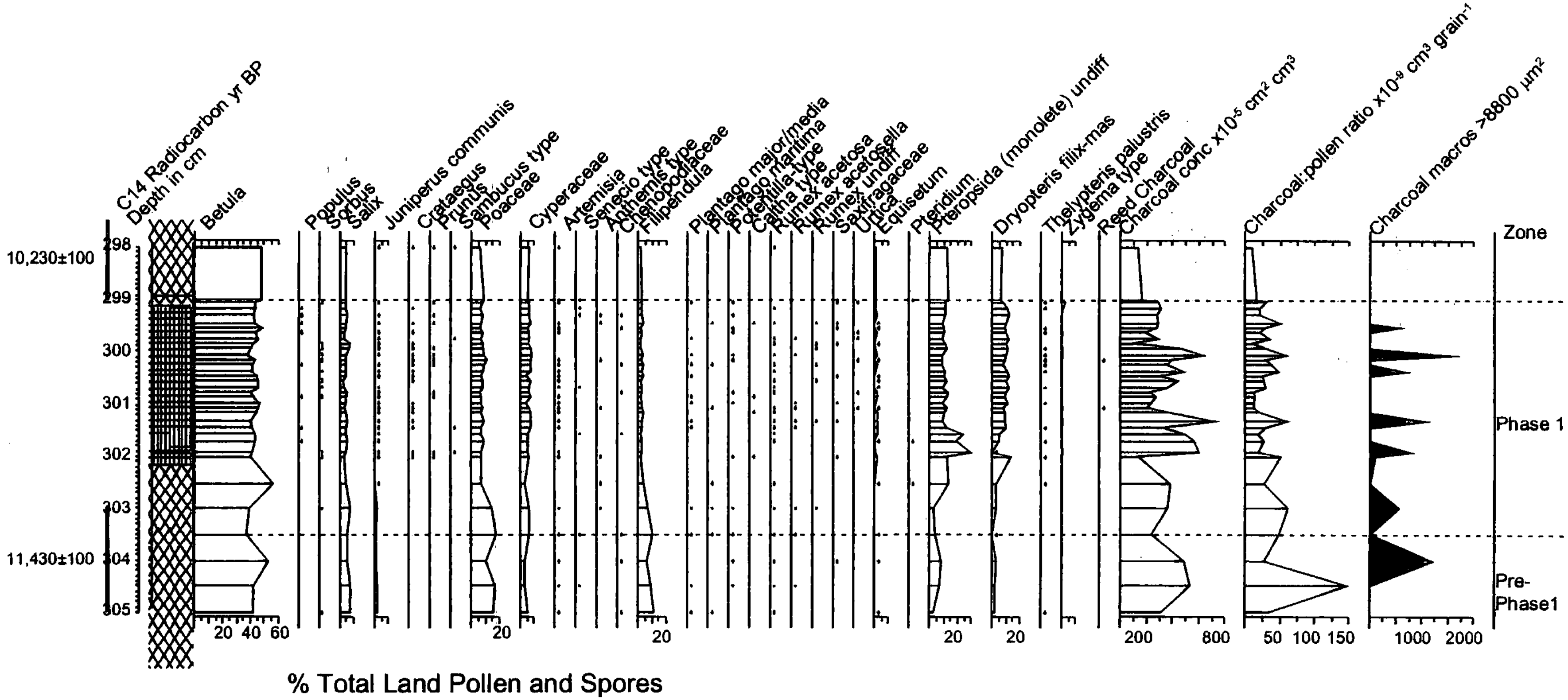


Figure 8.11 Profile FS – Fine Resolution Fire Phase 1

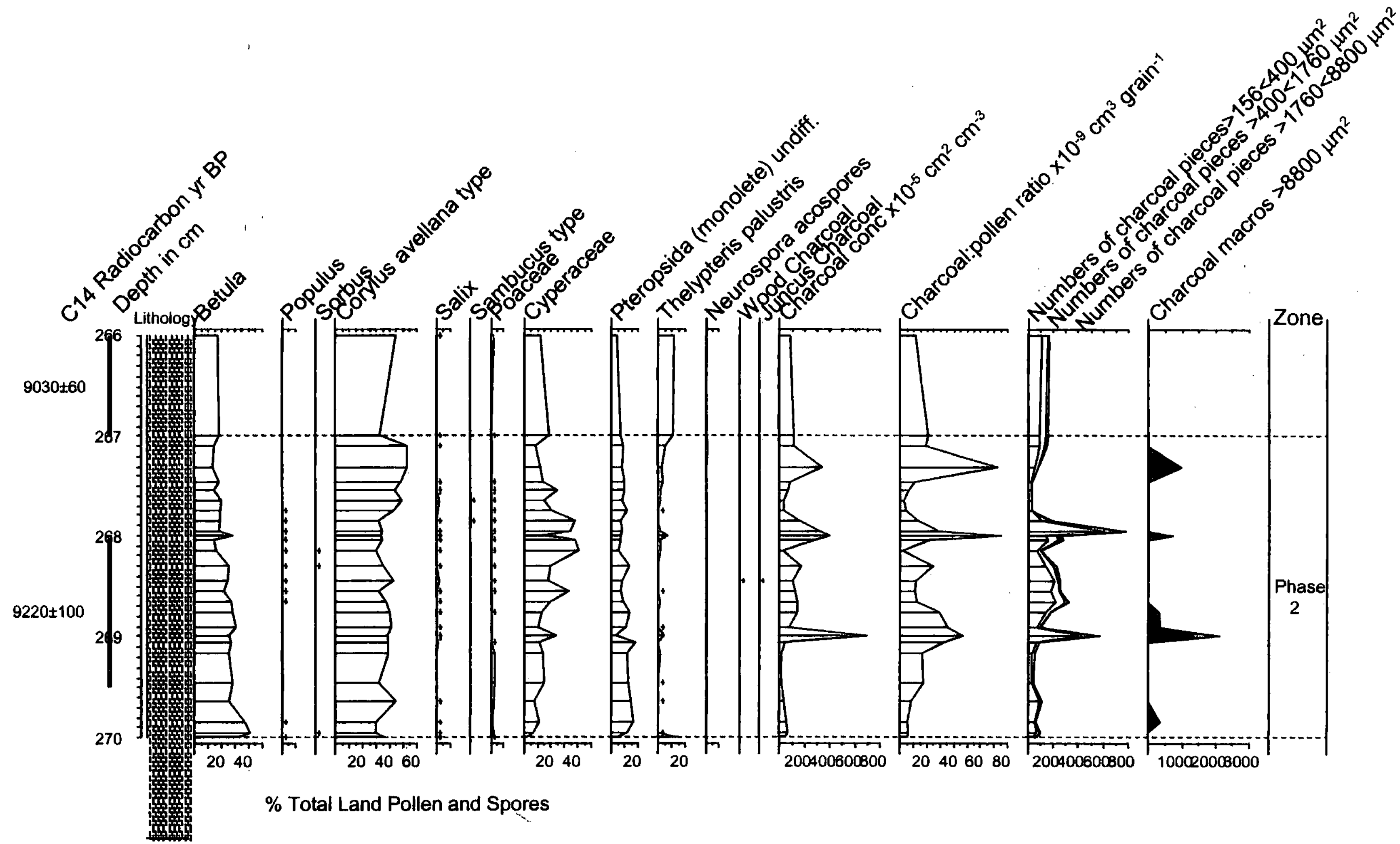


Figure 8.12 Profile FS - Fine Resolution Fire Phase 2

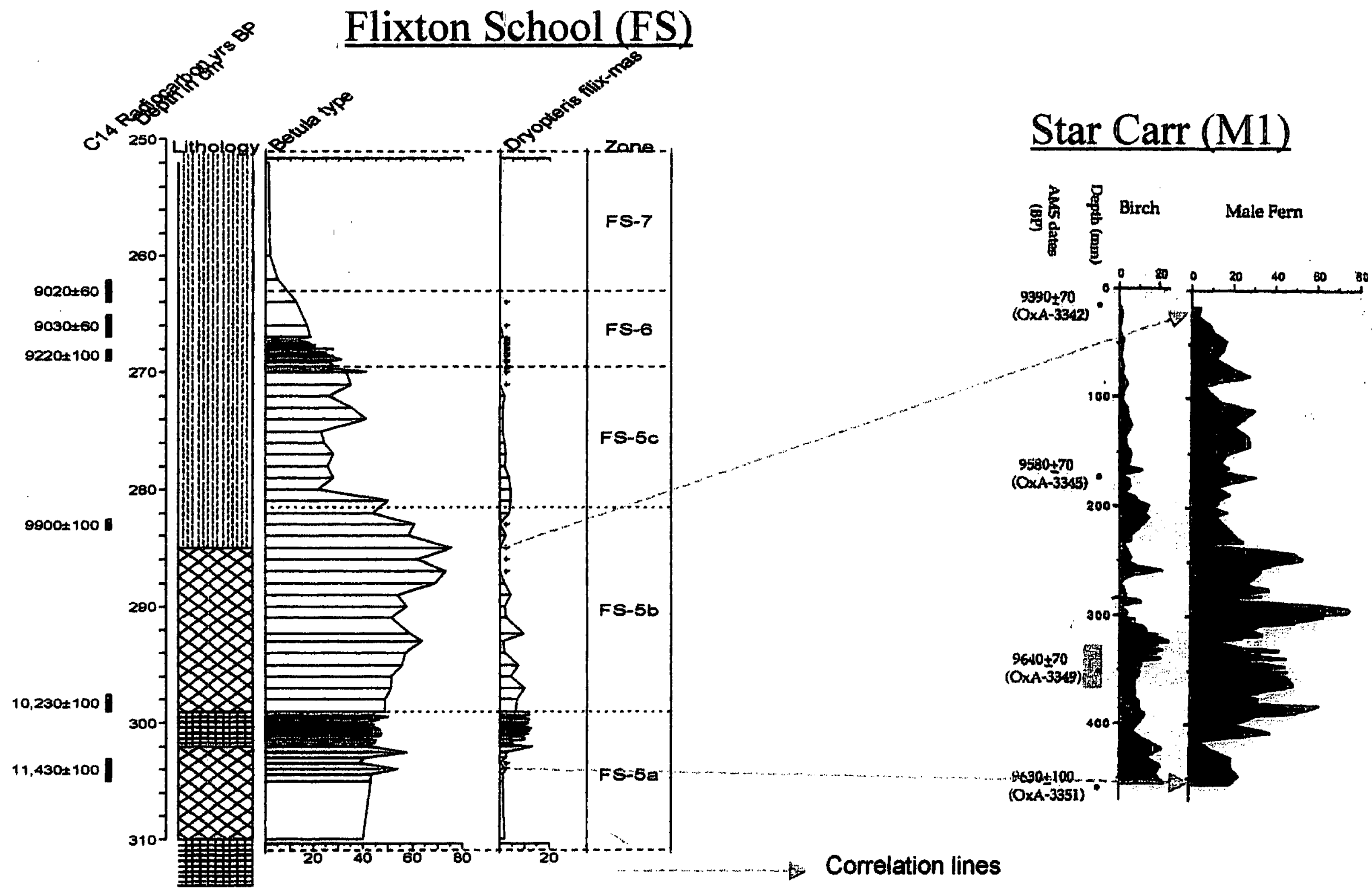


Figure 8.13 Comparison of the *Dryopteris filix-mas* curves between FS and Star Carr (M1)

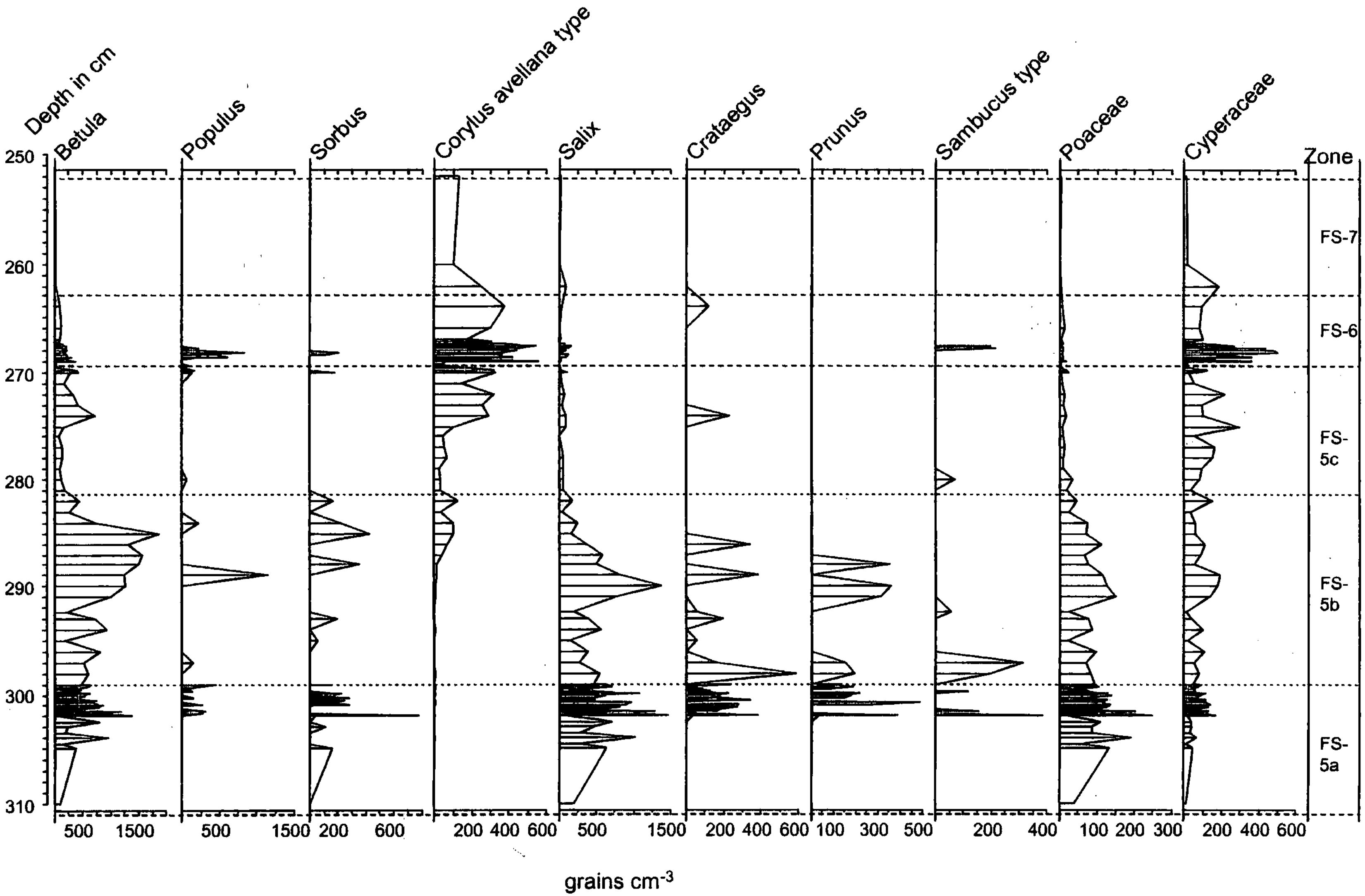


Figure 8.14a Pollen Concentrations in Profile FS

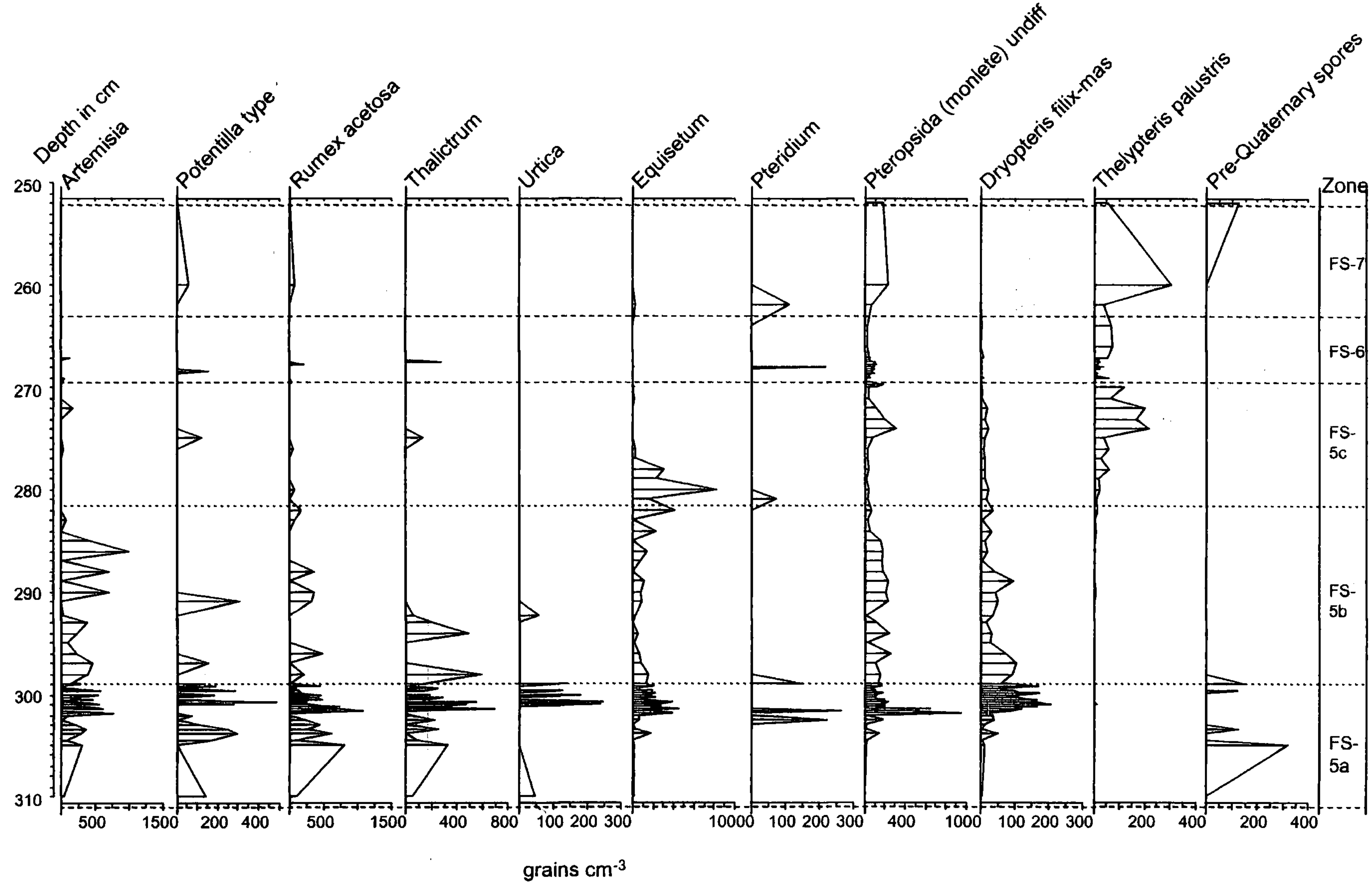


Figure 8.14b Pollen Concentrations in Profile FS (continued)

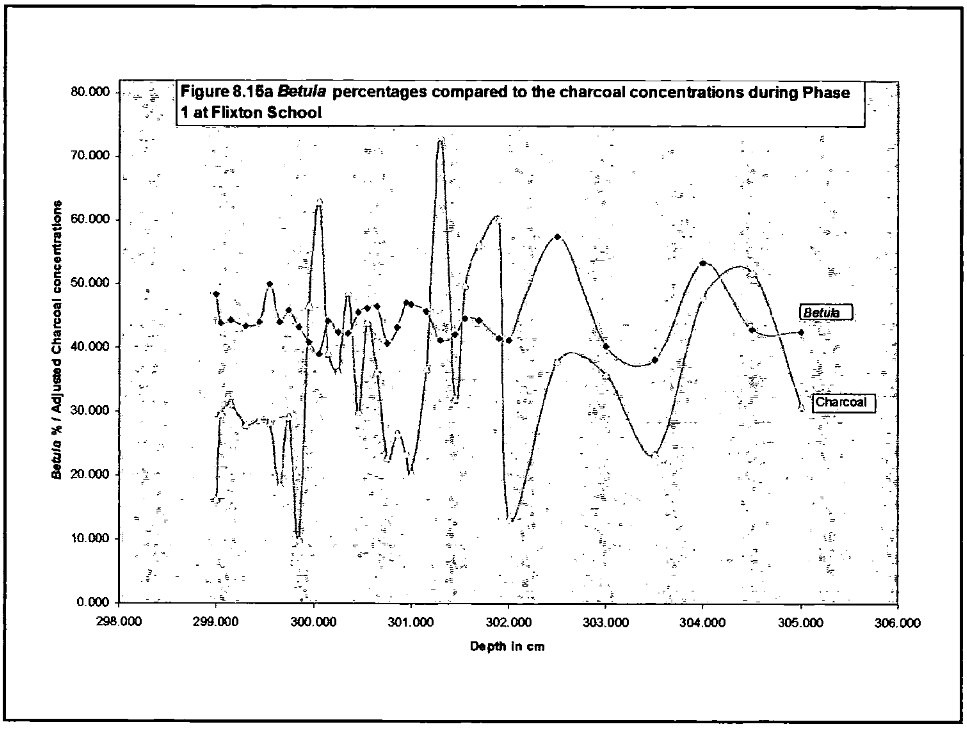


Figure 8.15a *Betula* percentages compared to the charcoal concentrations during Phase 1 at Flixton School

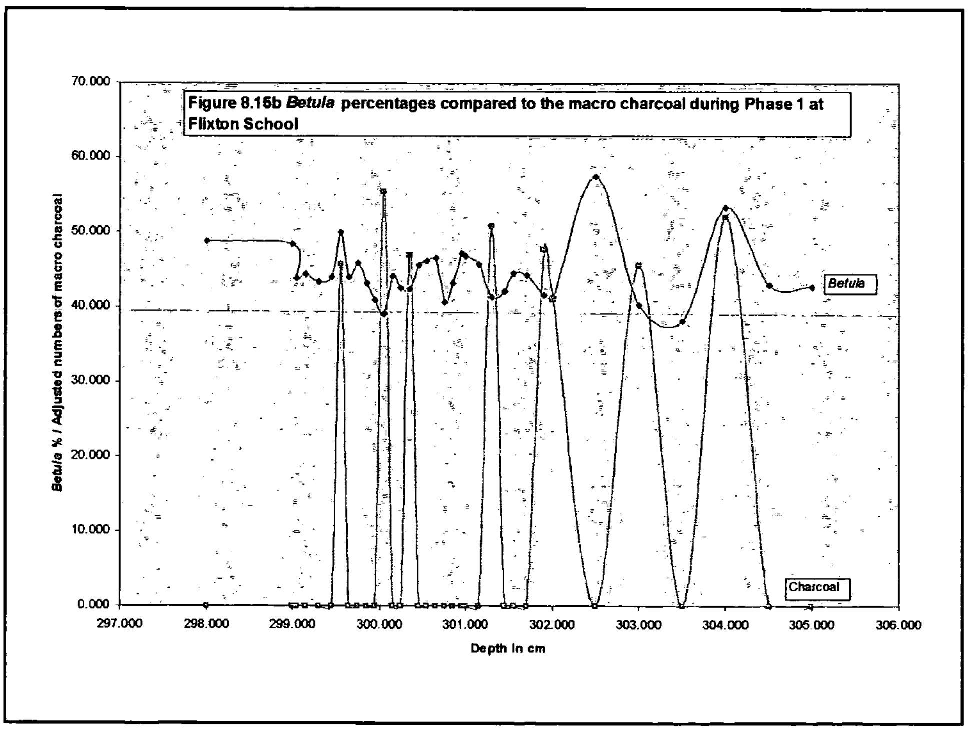


Figure 8.15b *Betula* percentages compared to the macro charcoal during Phase 1 at Flixton School

A

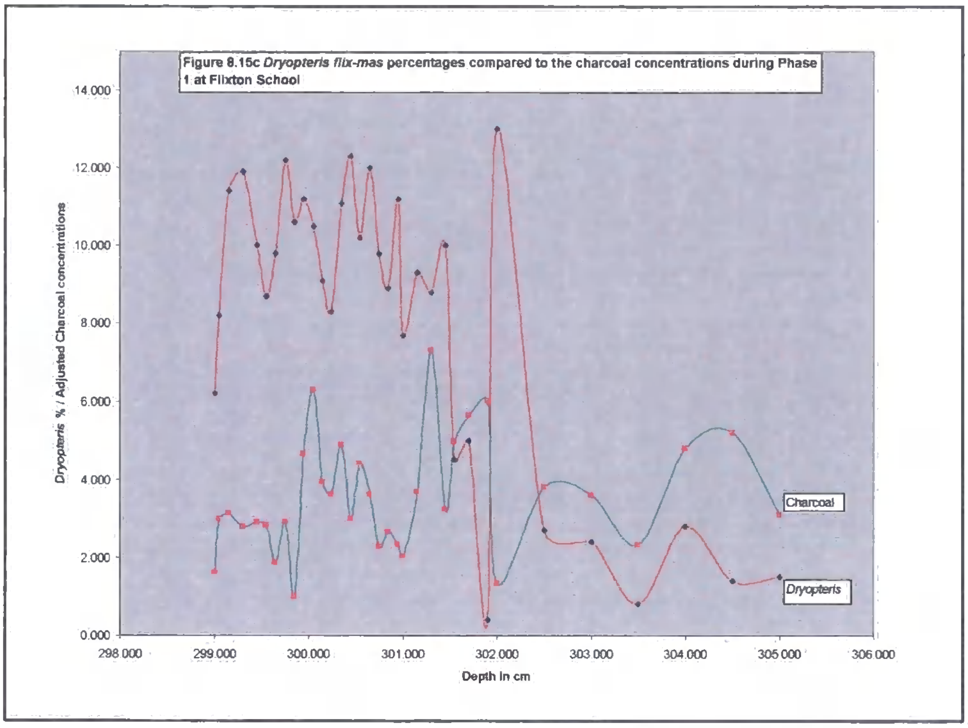


Figure 8.15c ***Dryopteris filix-mas*** **percentages compared to the charcoal concentrations during Phase 1 at Flixton School**

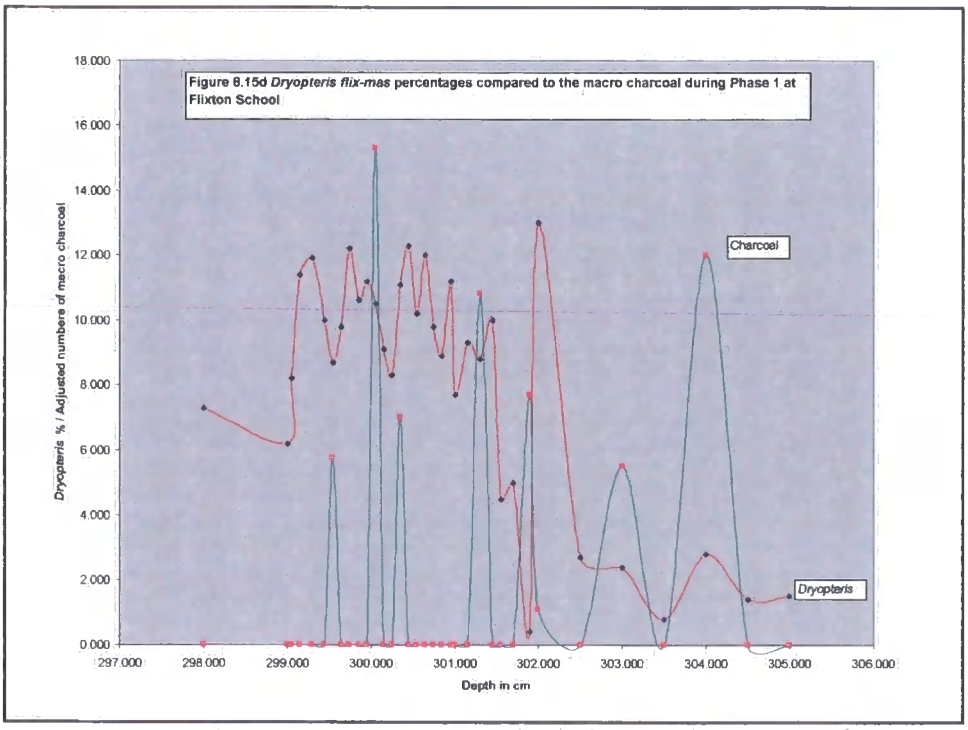


Figure 8.15d ***Dryopteris filix-mas*** **percentages compared to the macro charcoal during Phase 1 at Flixton School**

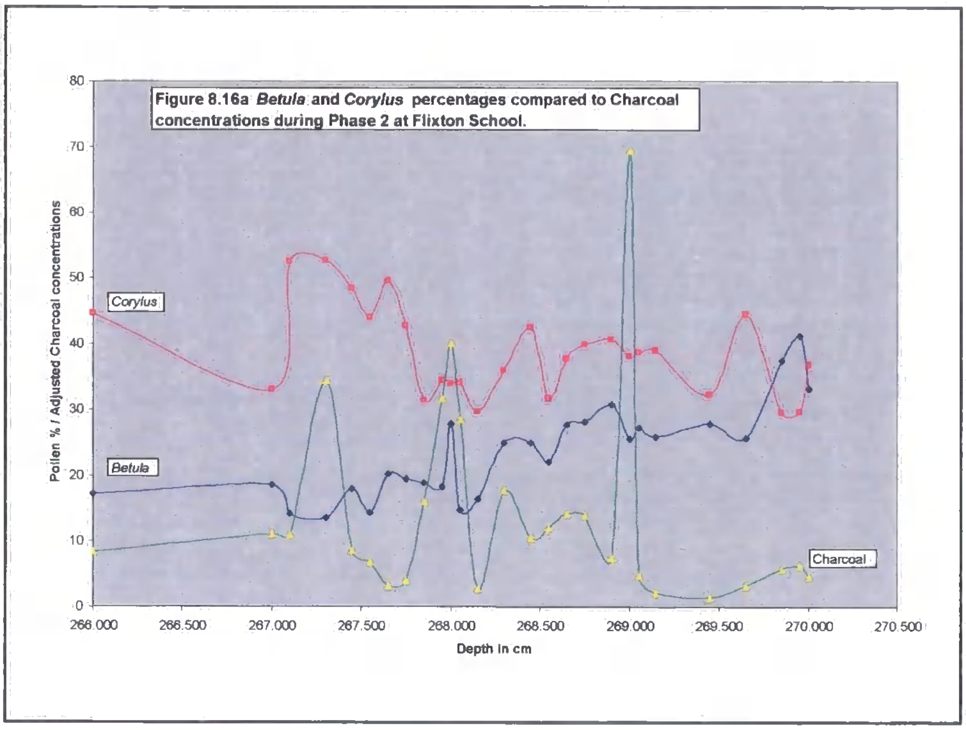


Figure 8.16a *Betula* and *Corylus* percentages compared to Charcoal concentrations during Phase 2 at Flixton School.

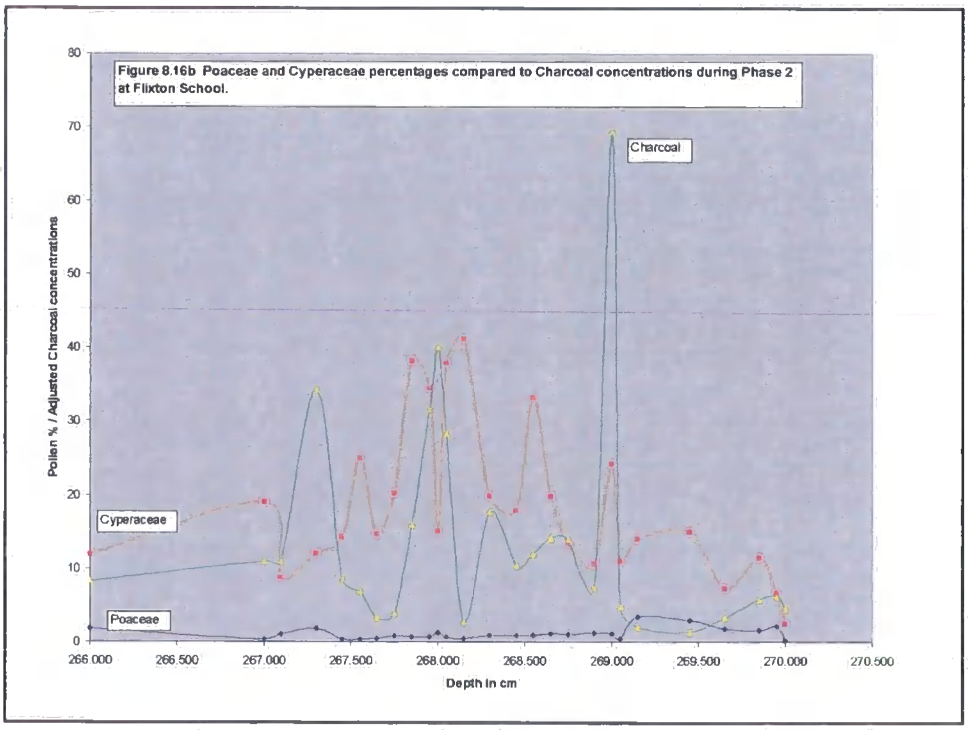


Figure 8.16b Poaceae and Cyperaceae percentages compared to Charcoal concentrations during Phase 2 at Flixton School.

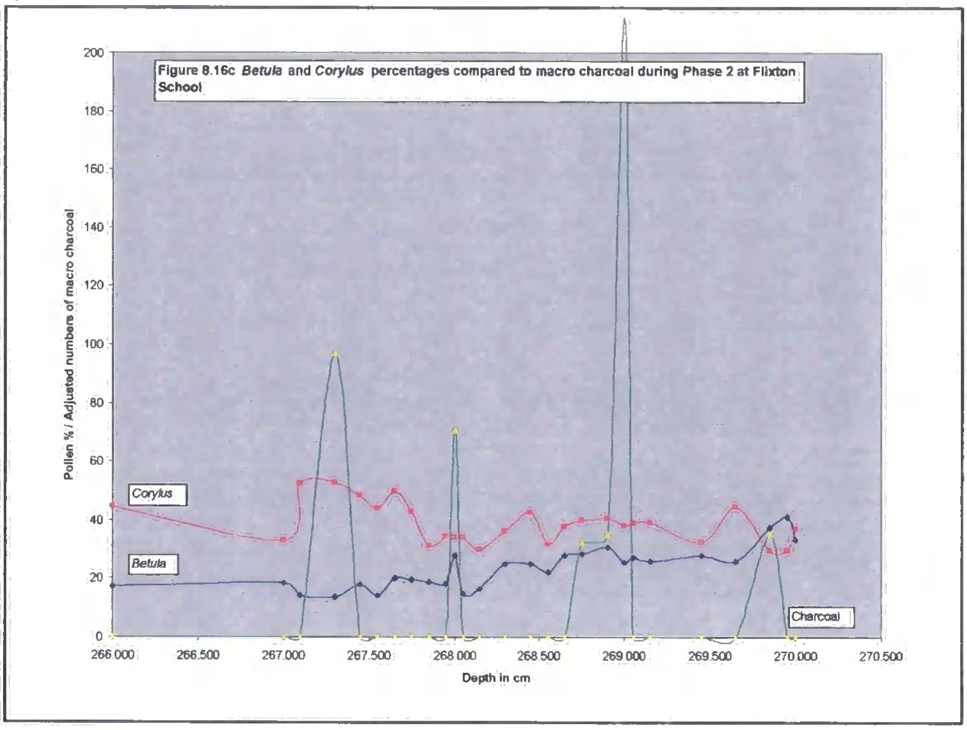


Figure 8.16c Betula and Corylus percentages compared to macro charcoal during Phase 2 at Flixton School
Pollen % / Adjusted numbers of macro charcoal
Depth in cm
Corylus
Betula
Charcoal
0
20
40
60
80
100
120
140
160
180
200
266.000
266.500
267.000
267.500
268.000
268.500
269.000
269.500
270.000
270.500

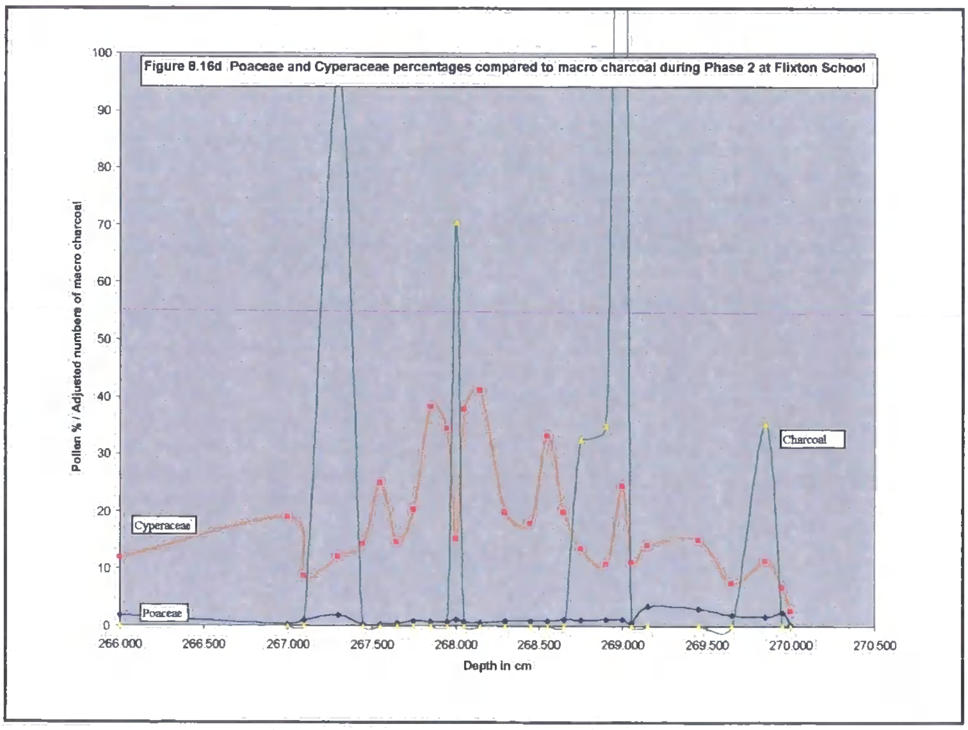


Figure 8.16d Poaceae and Cyperaceae percentages compared to macro charcoal during Phase 2 at Flixton School
Pollen % / Adjusted numbers of macro charcoal
Depth in cm
Cyperaceae
Poaceae
Charcoal
0
10
20
30
40
50
60
70
80
90
100
266.000
266.500
267.000
267.500
268.000
268.500
269.000
269.500
270.000
270.500

Figure 8.17a Flixton School – 95% Confidence Limits

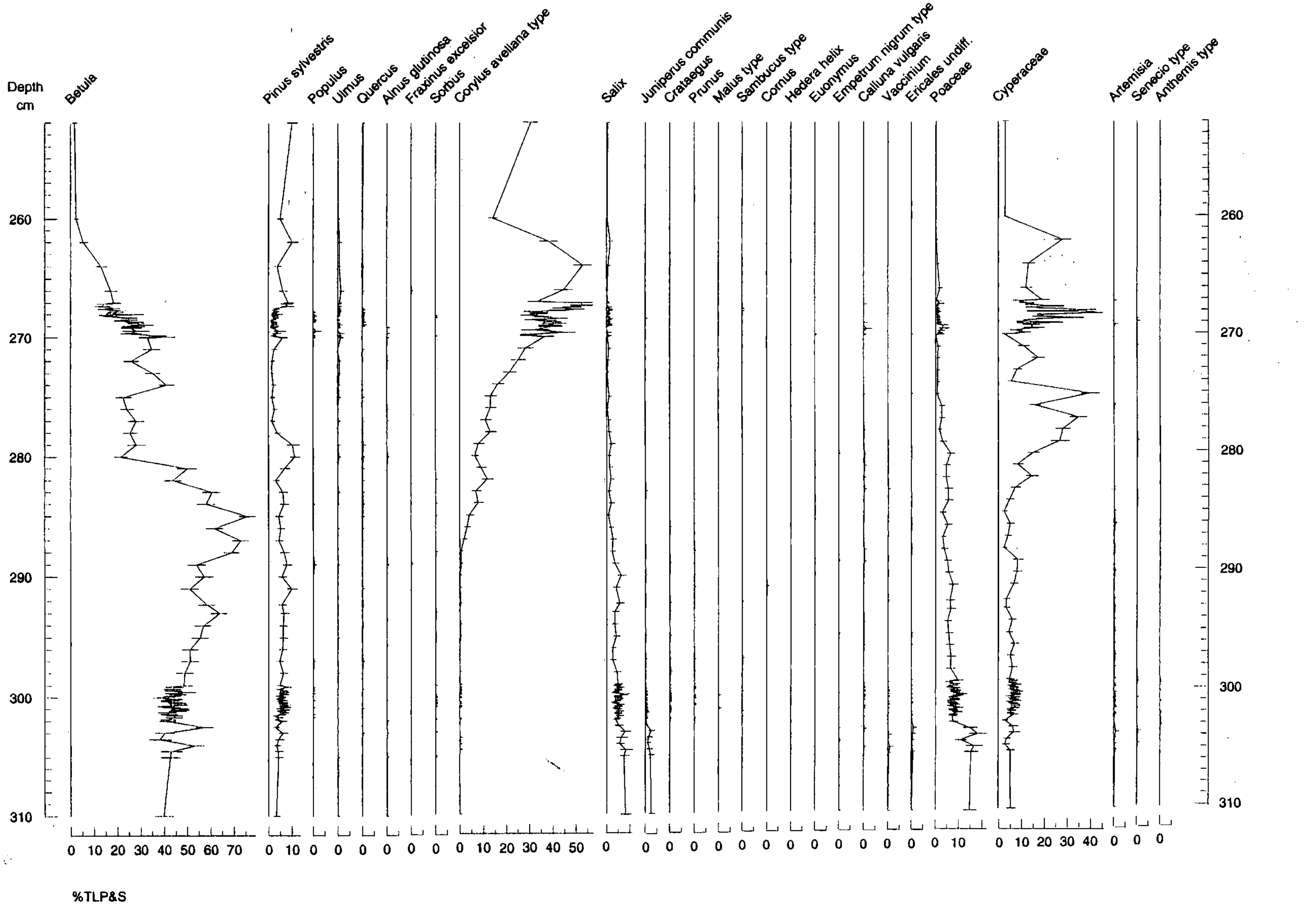


Figure 8.17b Flixton School – 95% Confidence Limits

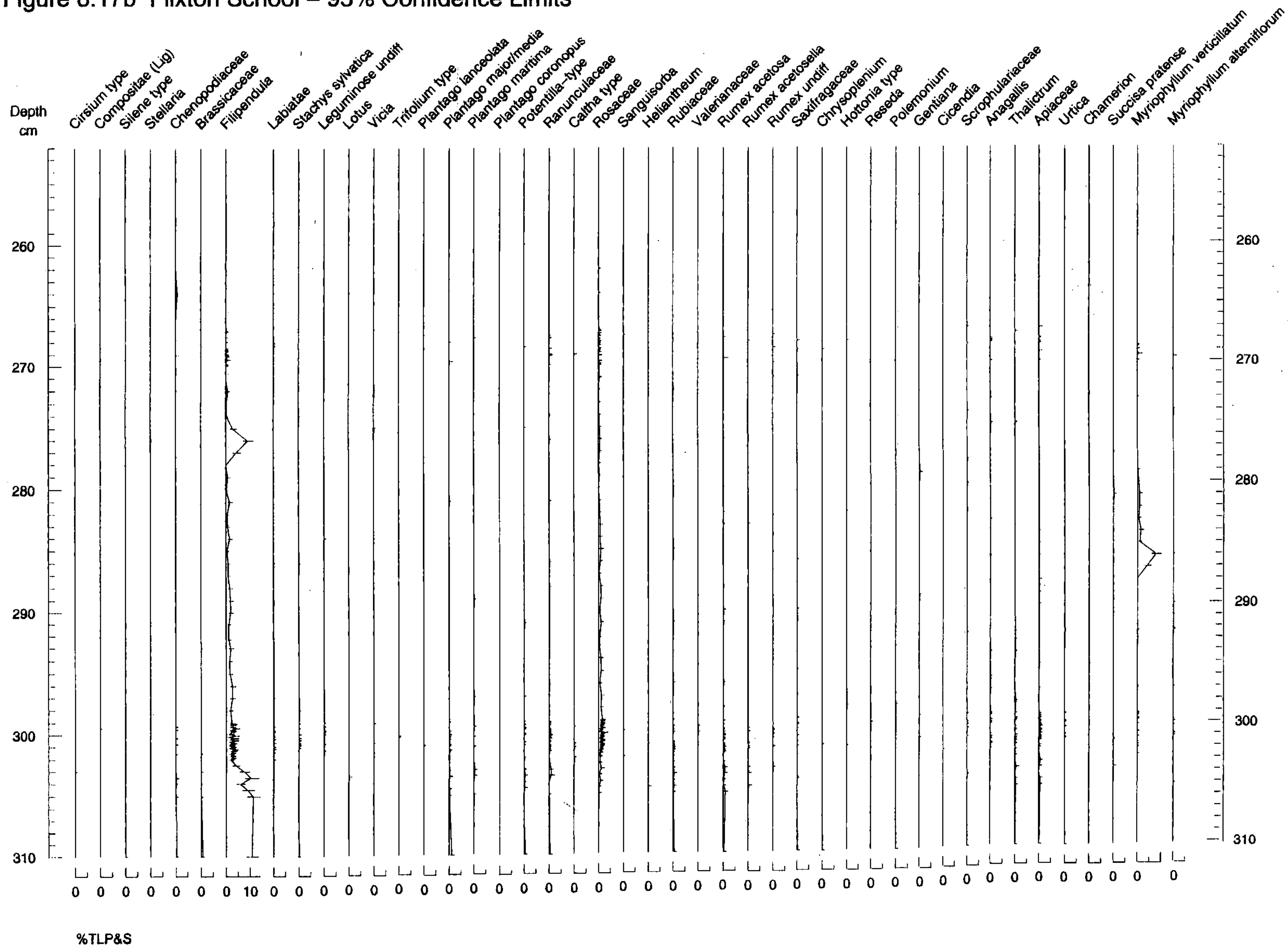


Figure 8.17c Flixton School – 95% Confidence Limits

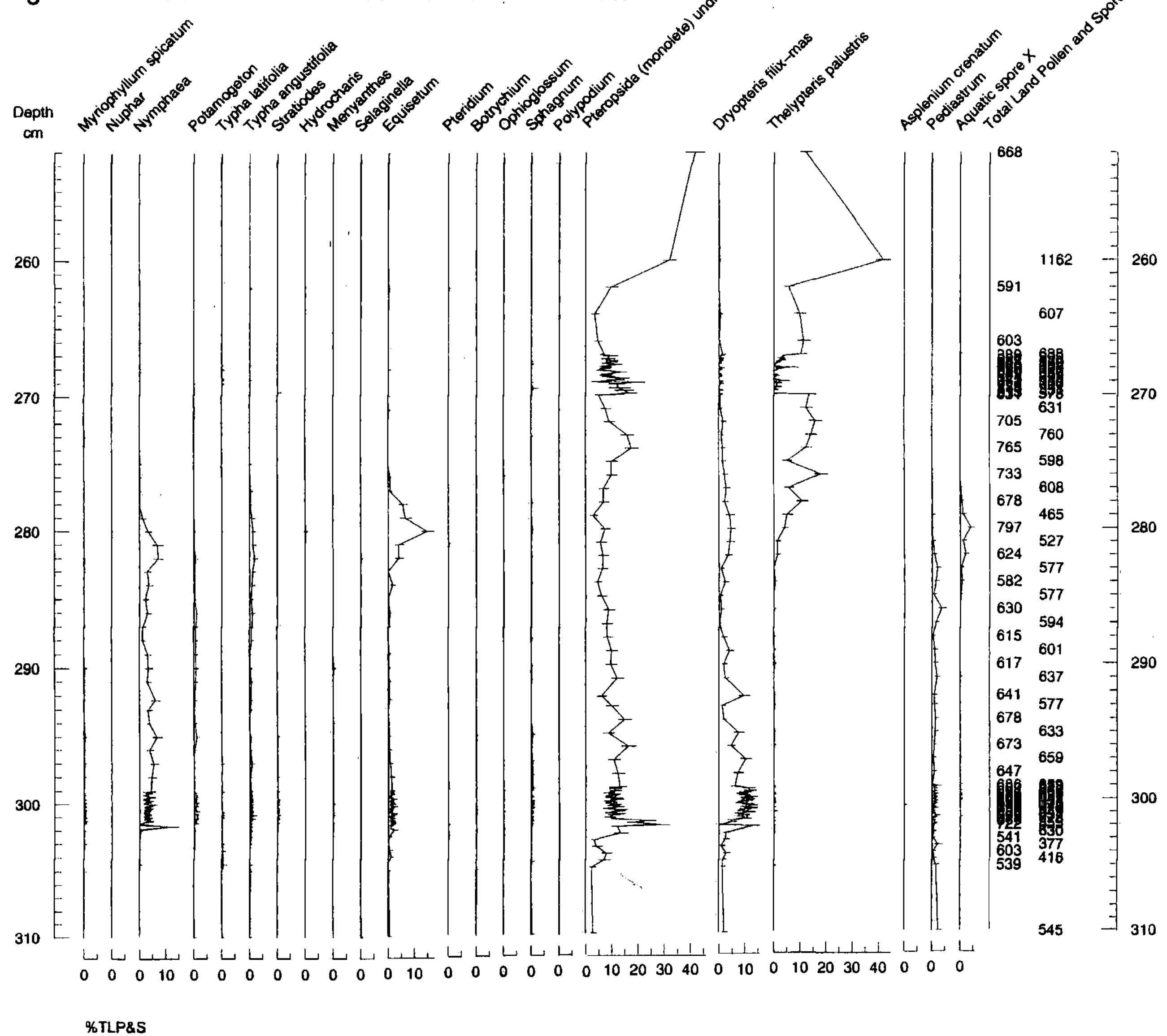


Figure 8.18a Flixton School – Fire Phase 1, 95% Confidence Limits

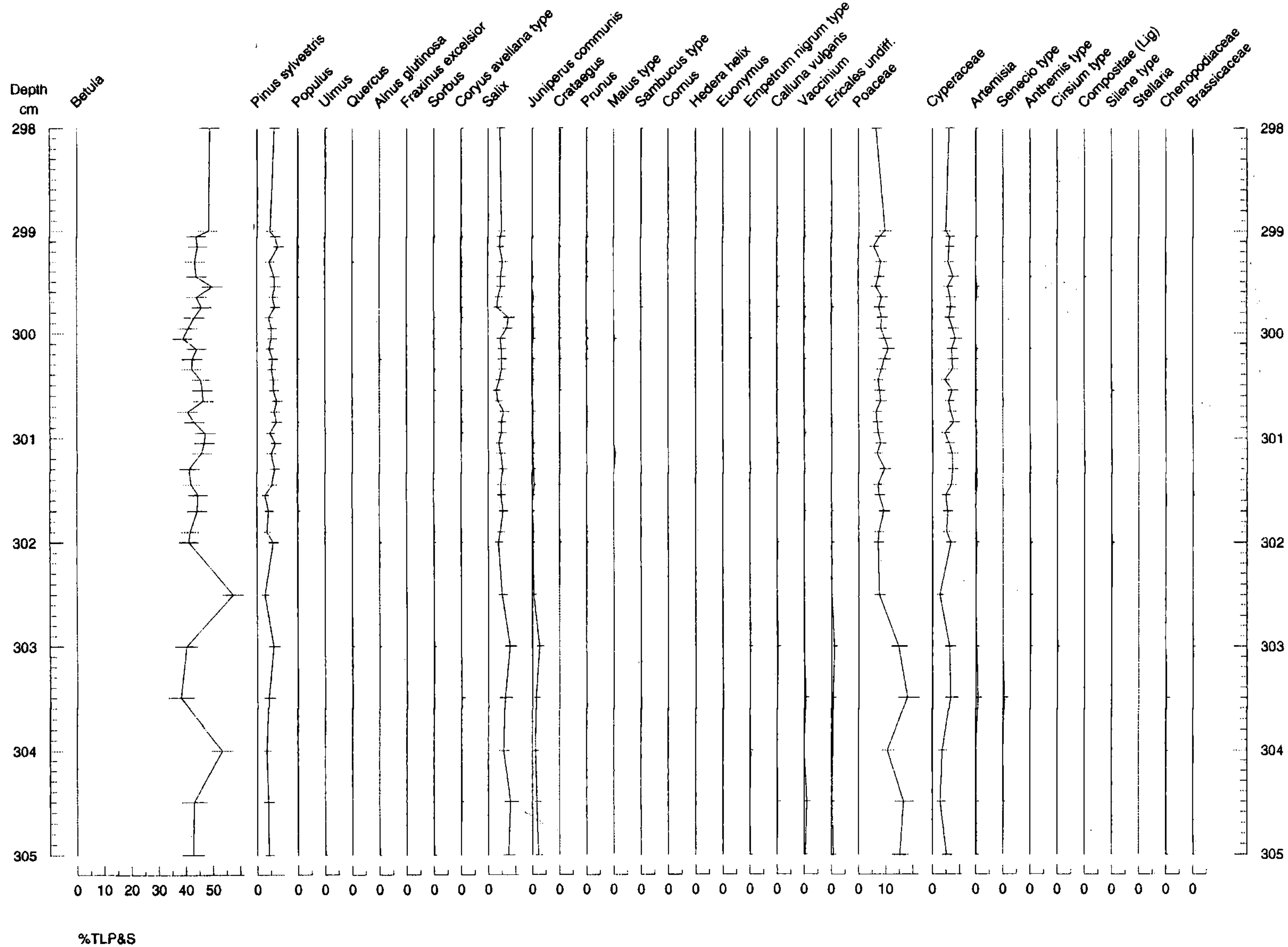


Figure 8.18b Flixton School – Fire Phase 1, 95% Confidence Limits

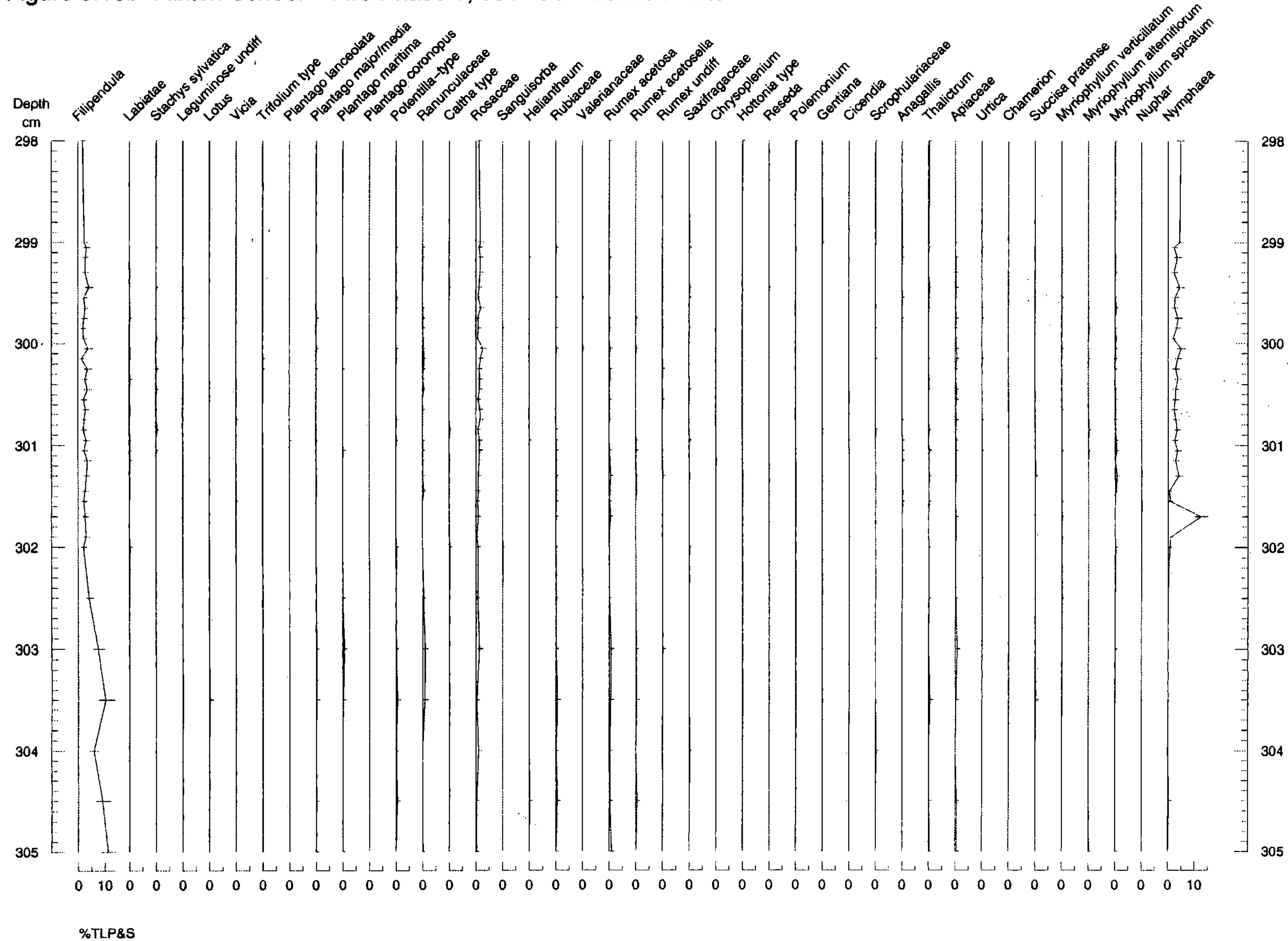


Figure 8.18c Flixton School – Fire Phase 1, 95% Confidence Limits

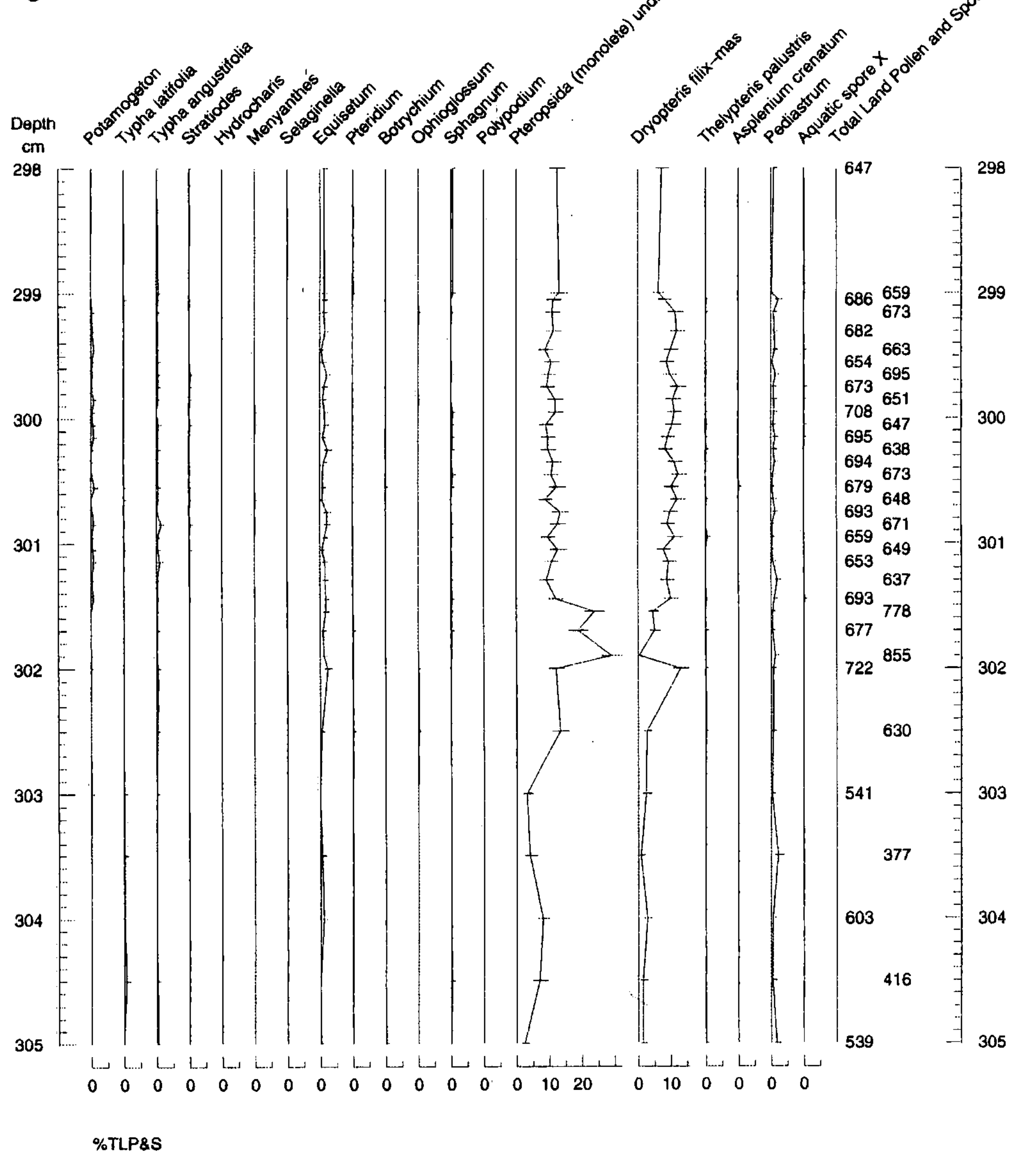


Figure 8.19a Flixton School – Fire Phase 2, 95% Confidence Limits

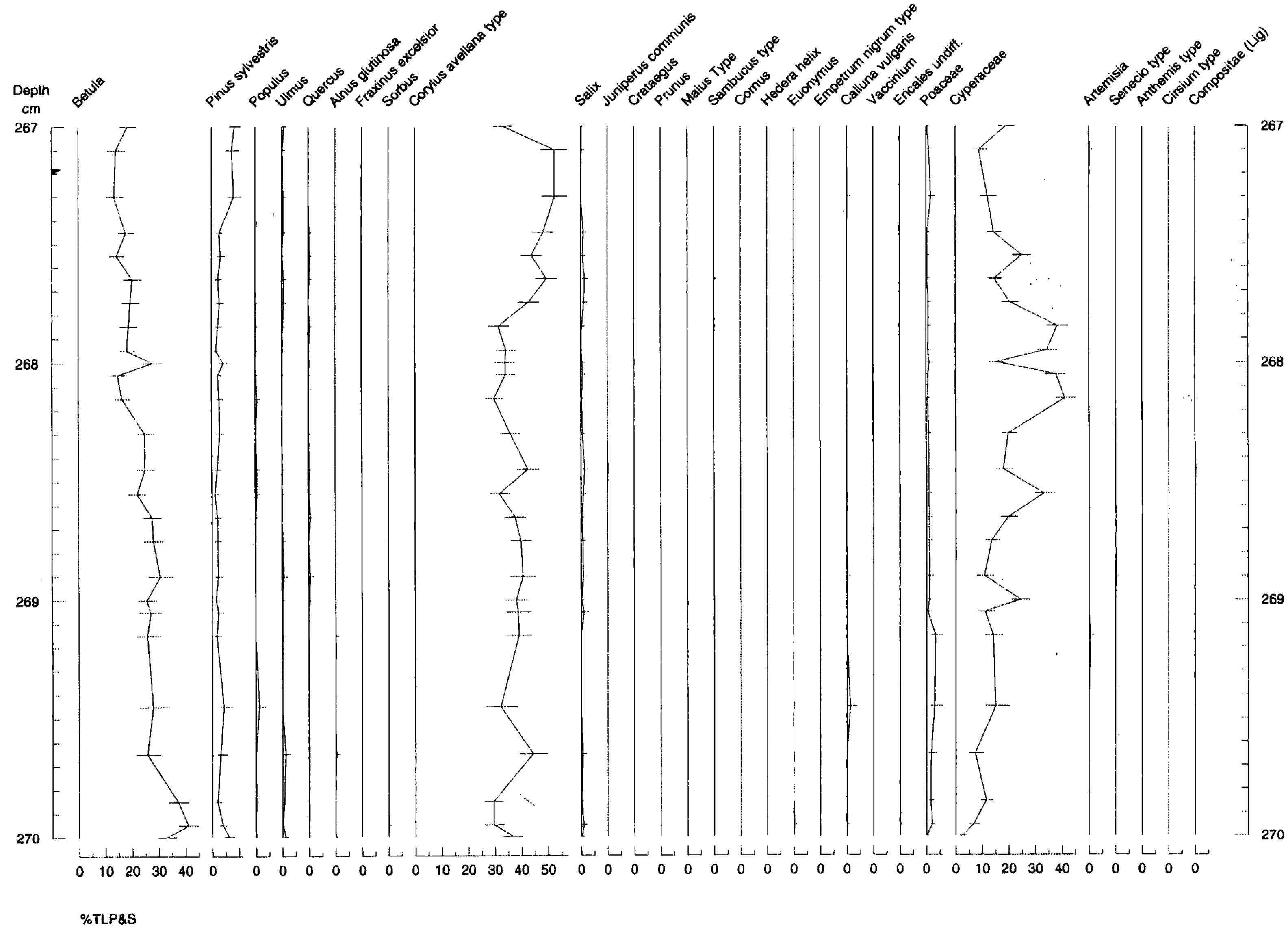


Figure 8.19b Flixton School – Fire Phase 2, 95% Confidence Limits

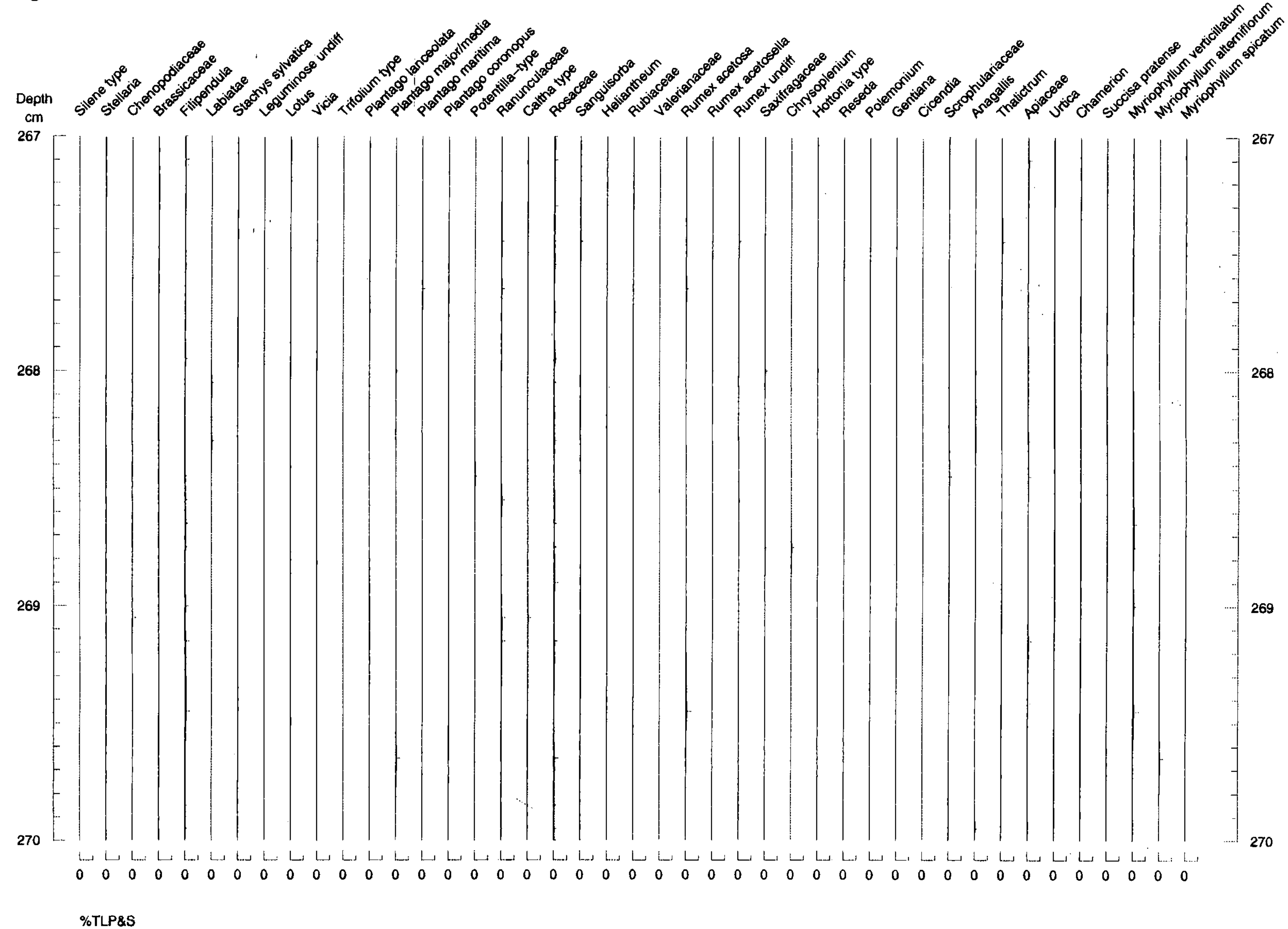
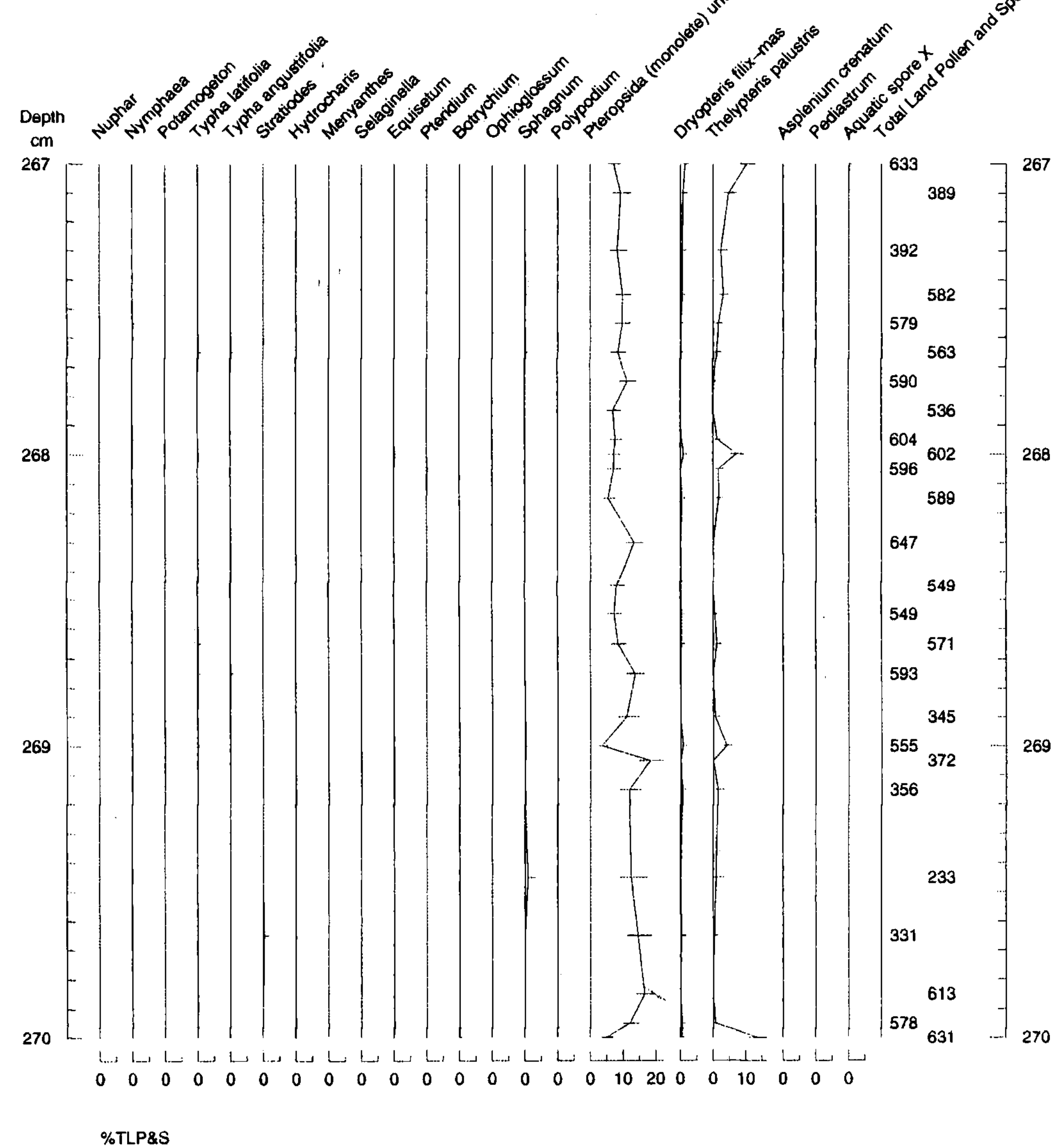


Figure 8.19c Flixton School – Fire Phase 2, 95% Confidence Limits



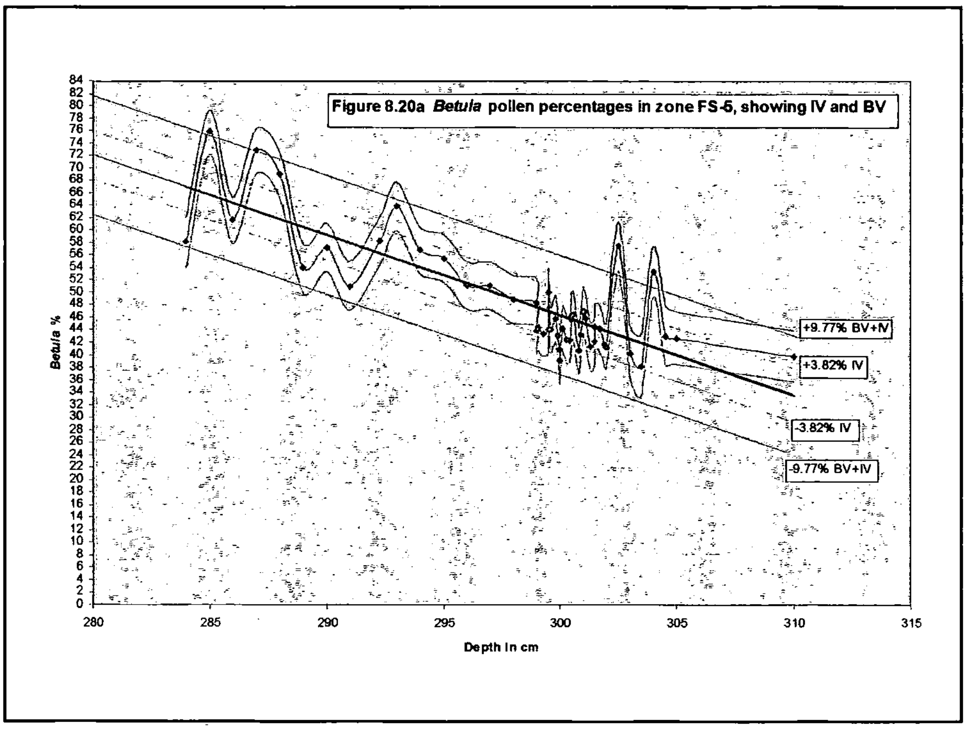


Figure 8.20a *Betula* pollen percentages in zone FS-5, showing IV and BV

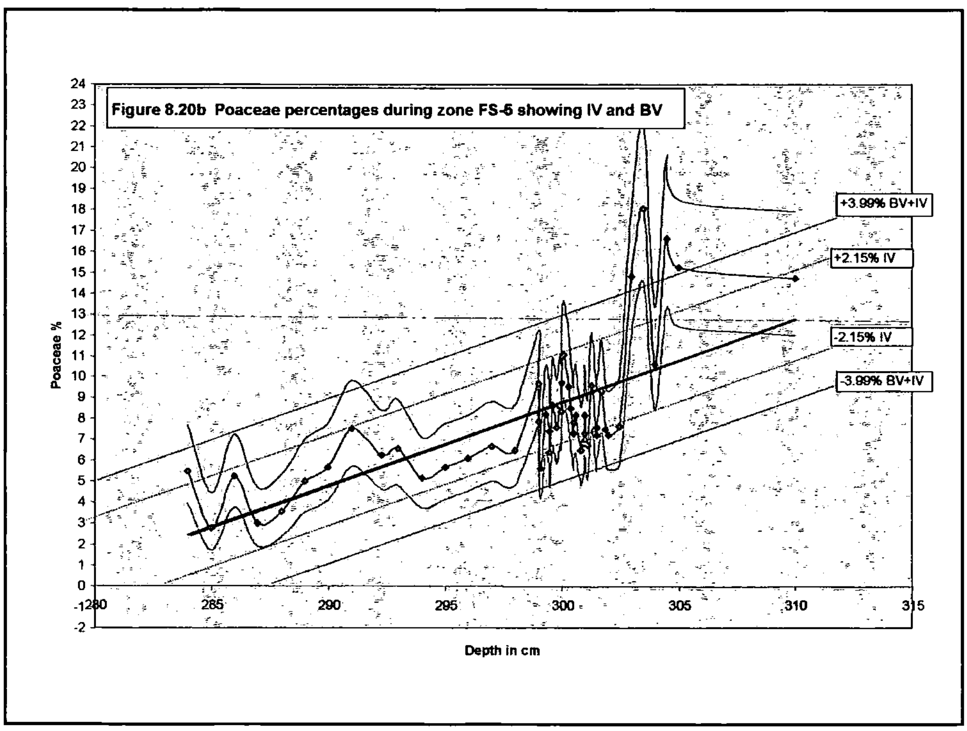


Figure 8.20b Poaceae percentages during zone FS-5 showing IV and BV

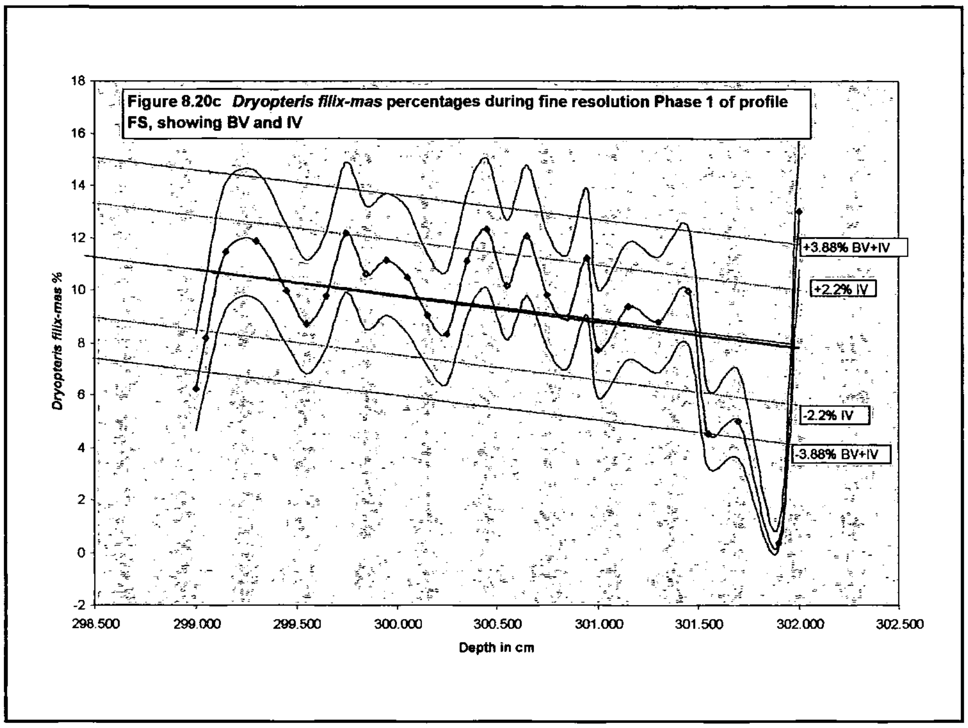


Figure 8.20c *Dryopteris filix-mas* percentages during fine resolution Phase 1 of profile FS, showing BV and IV

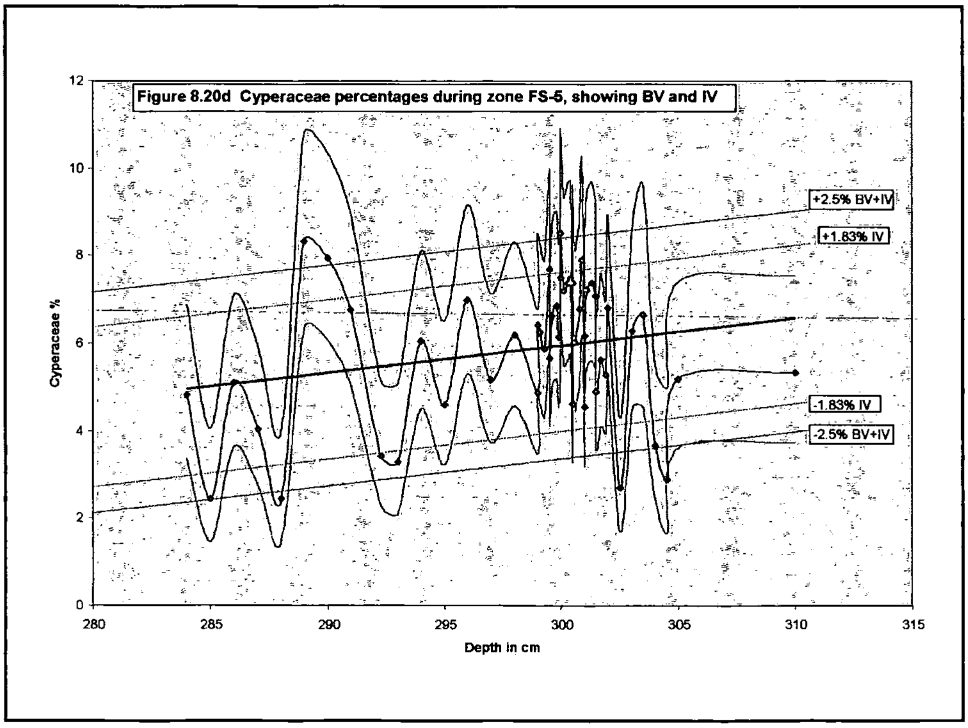


Figure 8.20d Cyperaceae percentages during zone FS-5, showing BV and IV

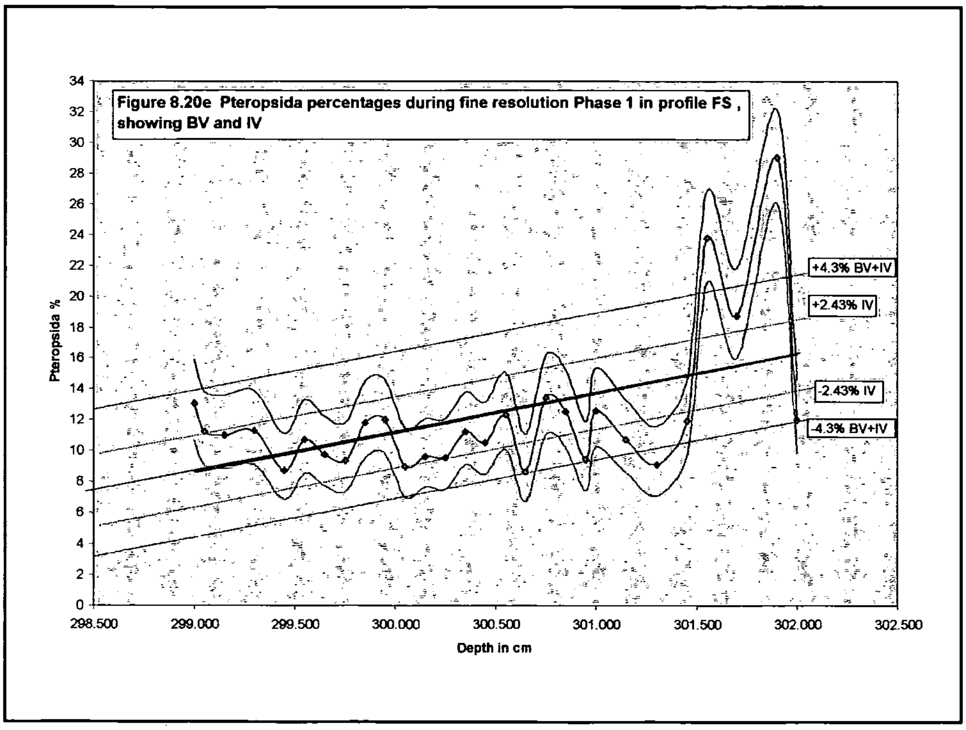


Figure 8.20e Pteropsida percentages during fine resolution Phase 1 in profile FS, showing BV and IV

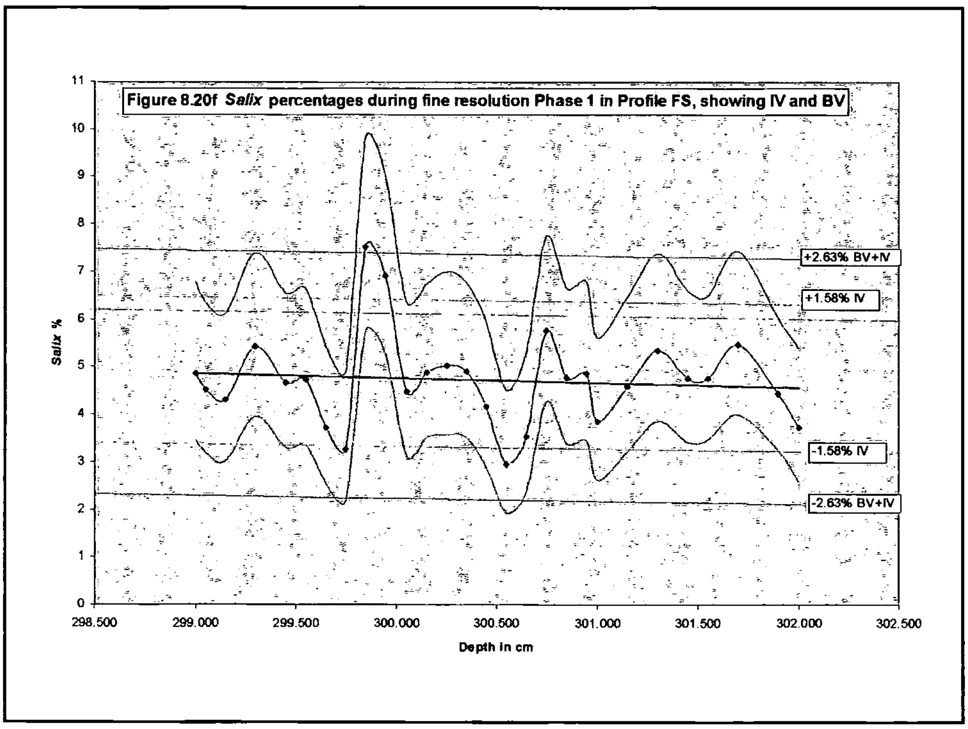


Figure 8.20f *Salix* percentages during fine resolution Phase 1 in Profile FS, showing IV and BV

Chapter Nine

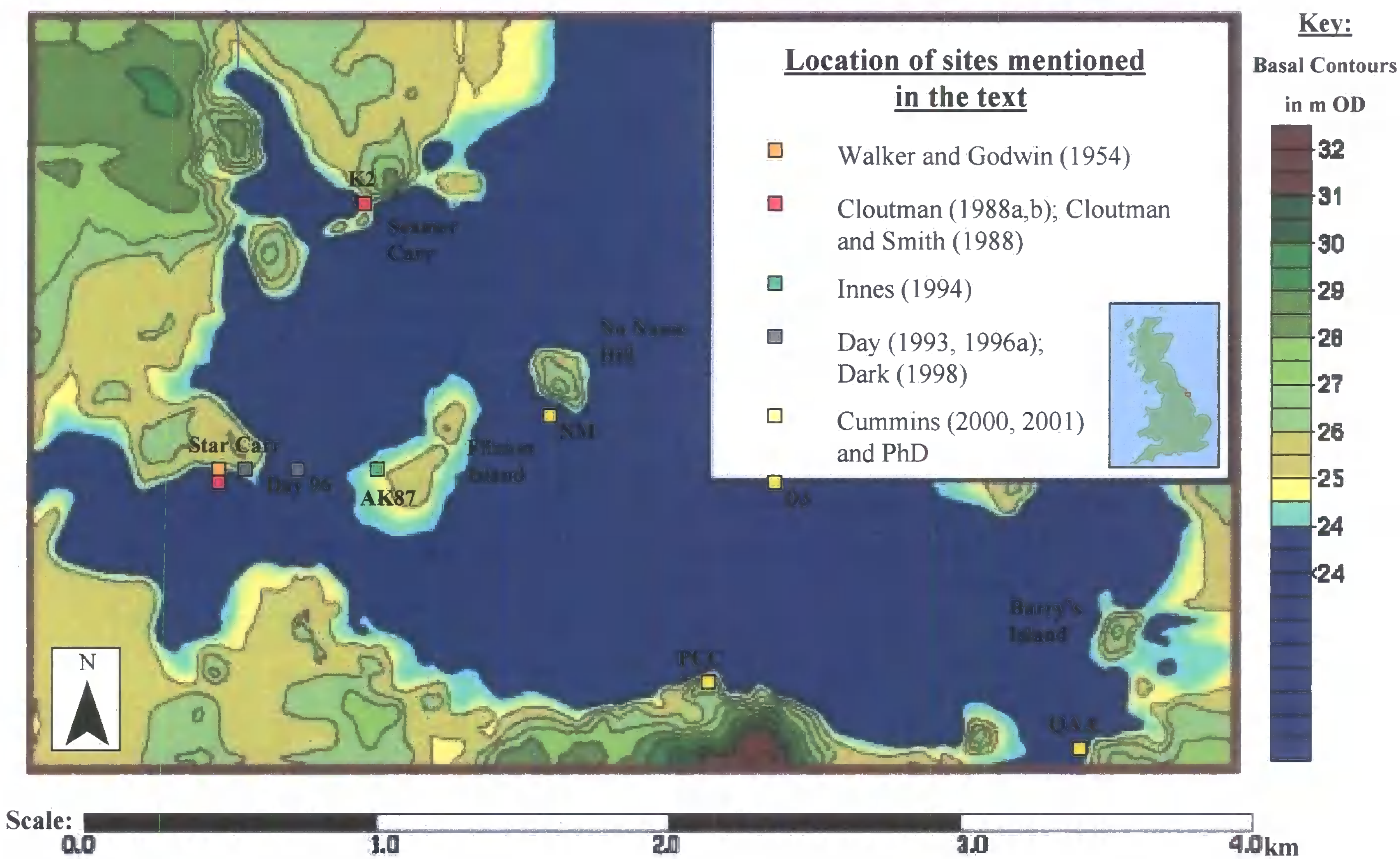


Figure 9.1 The location of Barry's Island in relation to palaeo-Lake Flixton and other sites mentioned in the text

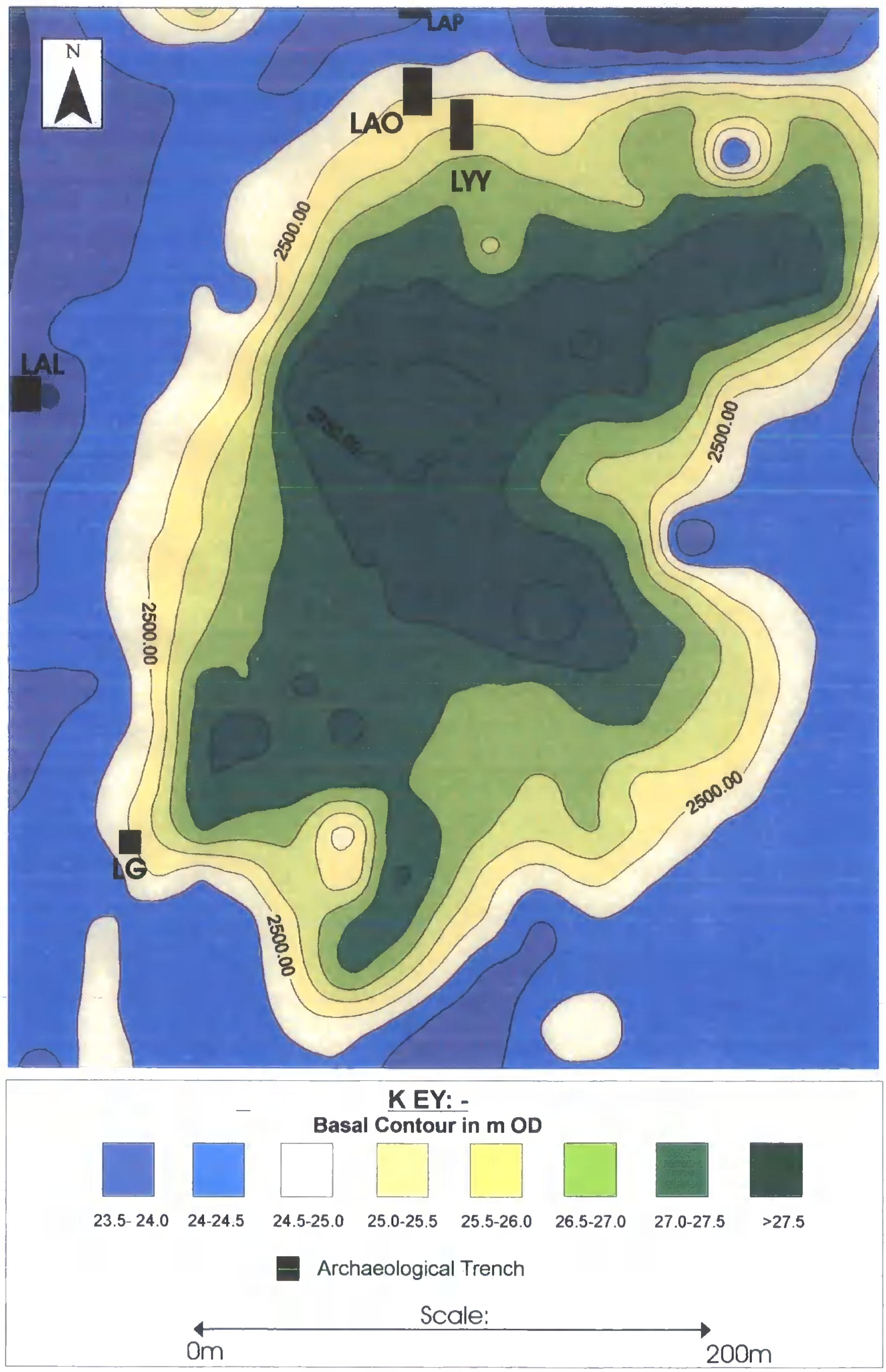


Figure 9.2 **The Location of archaeological trenches containing early Mesolithic flints at Barry's Island and the location of the pollen profiles.**

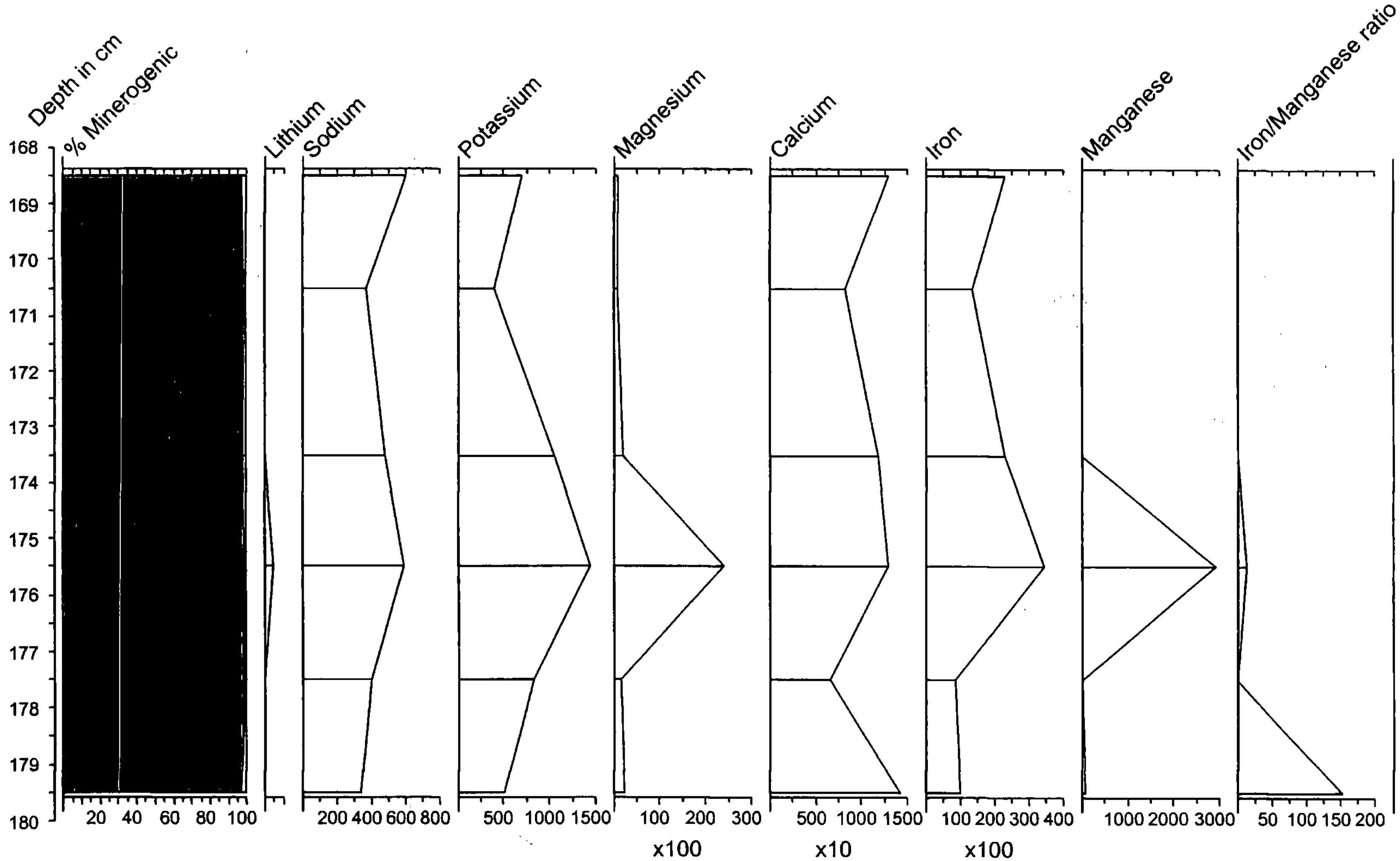


Figure 9.3 LAP Selected Metal Concentrations (PPM)

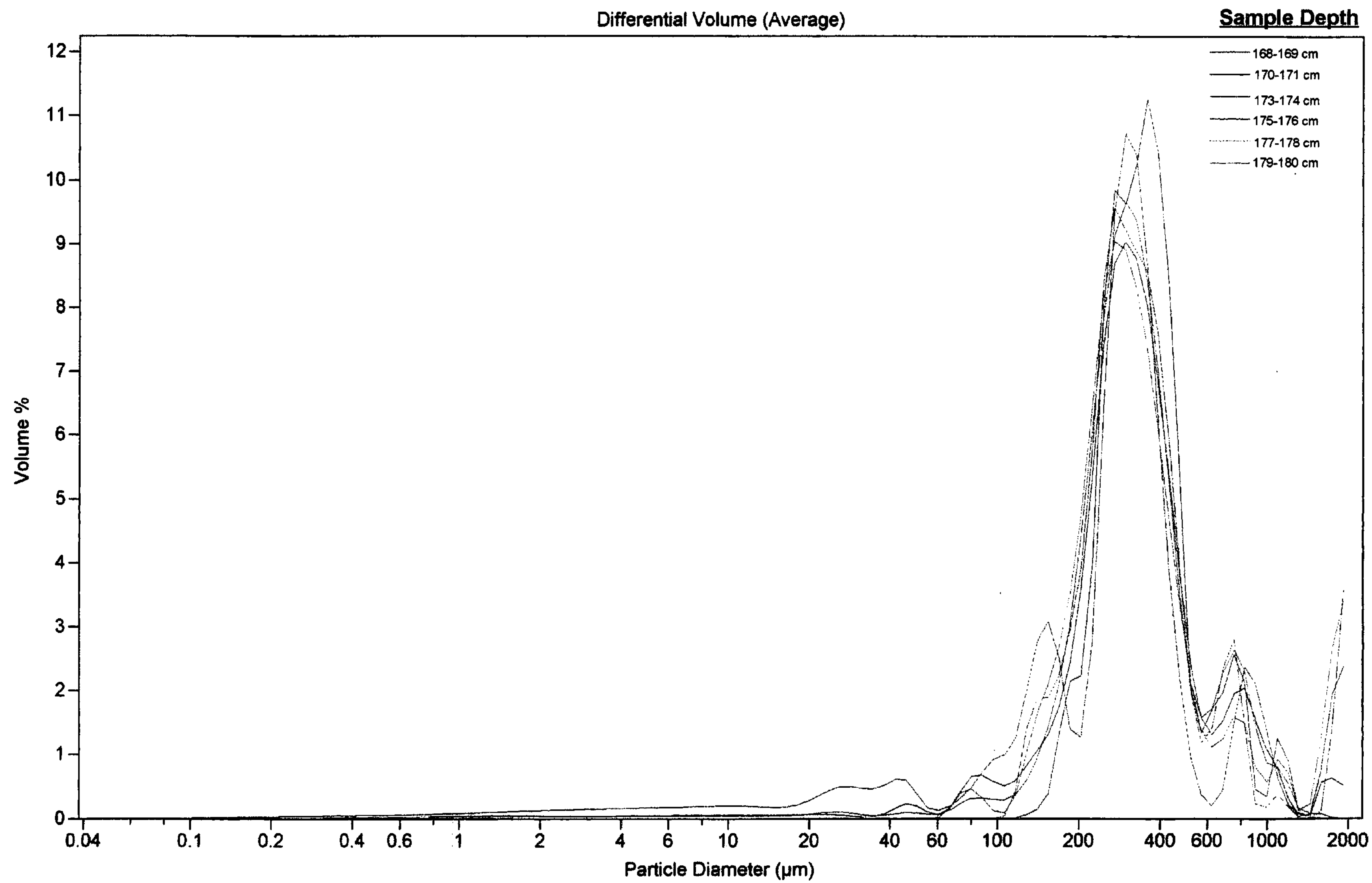


Figure 9.4 **The results of particle size analysis from the sand layer at Barry's Island**

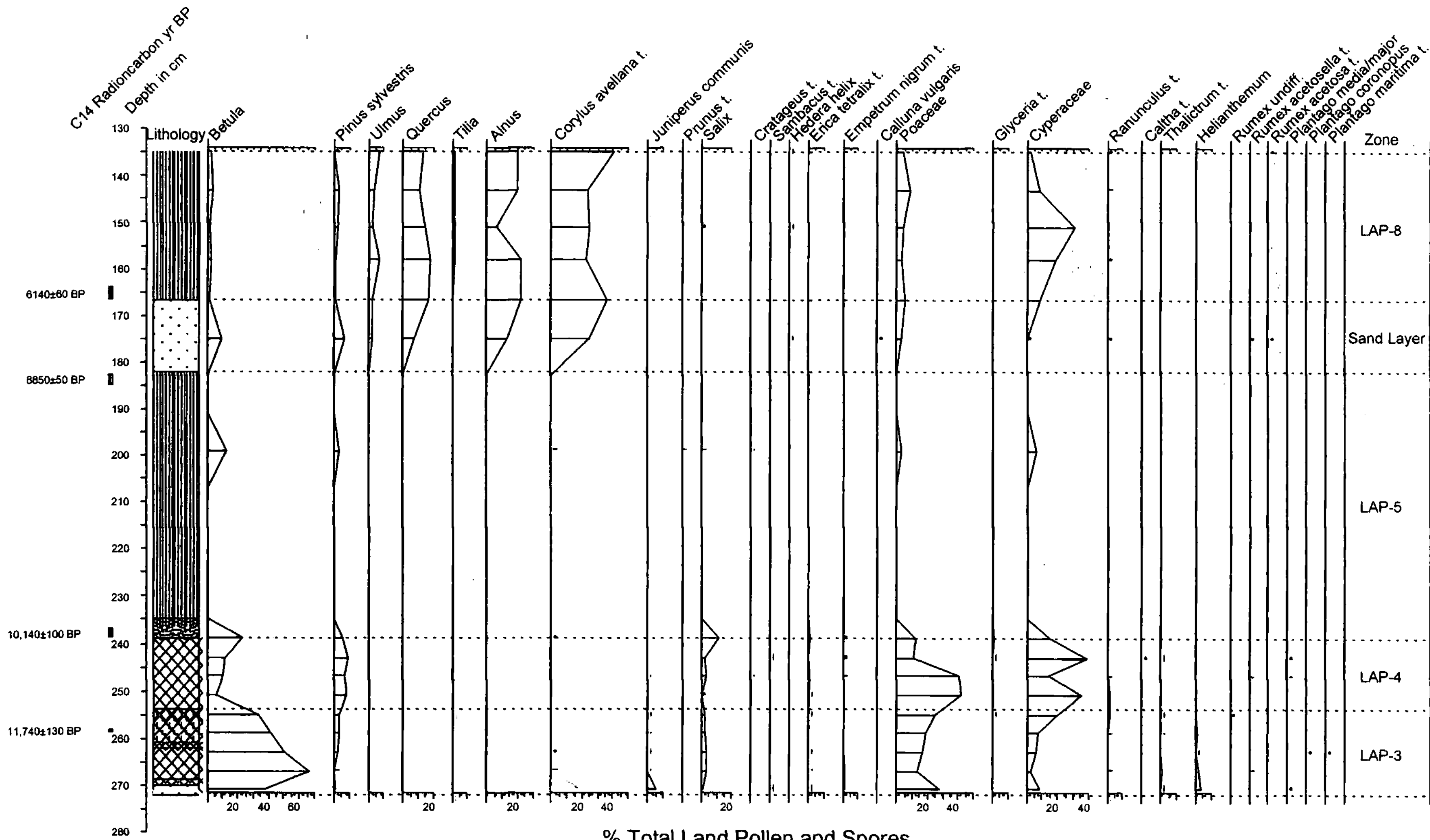


Figure 9.5a LAP - Pollen Percentage Diagram

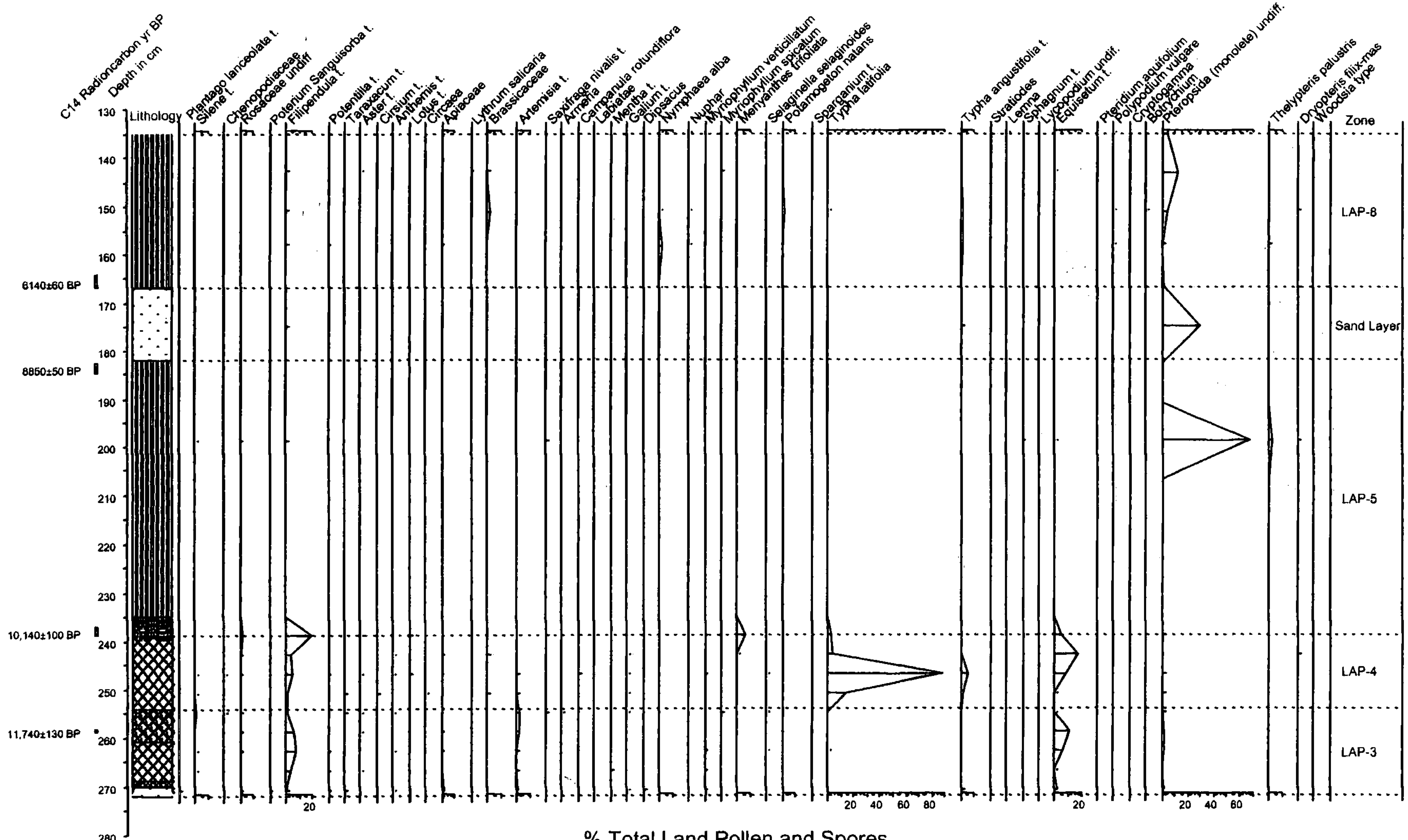


Figure 9.5b LAP - Pollen Percentage Diagram (continued)

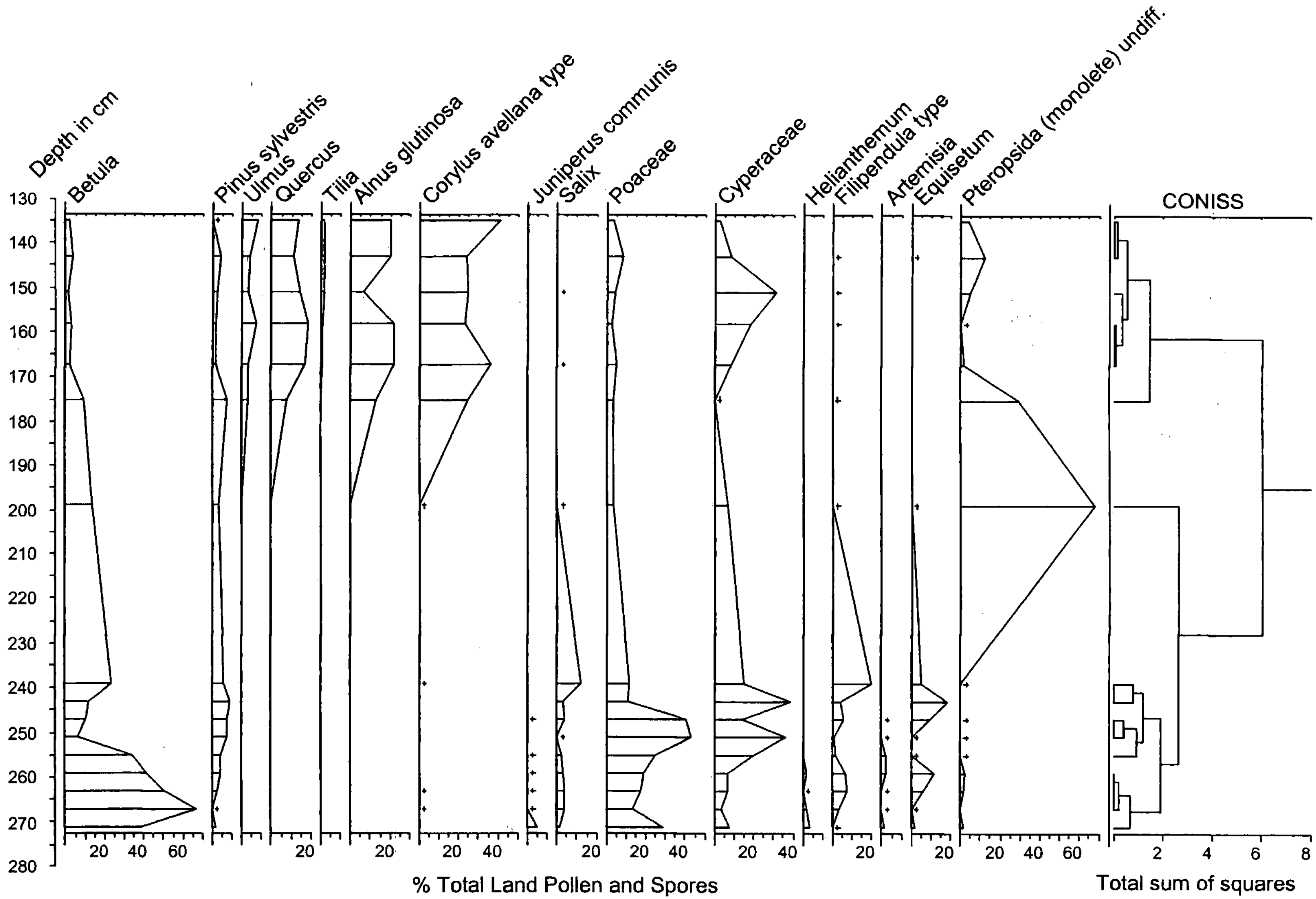


Figure 9.5c LAP - Results of CONISS

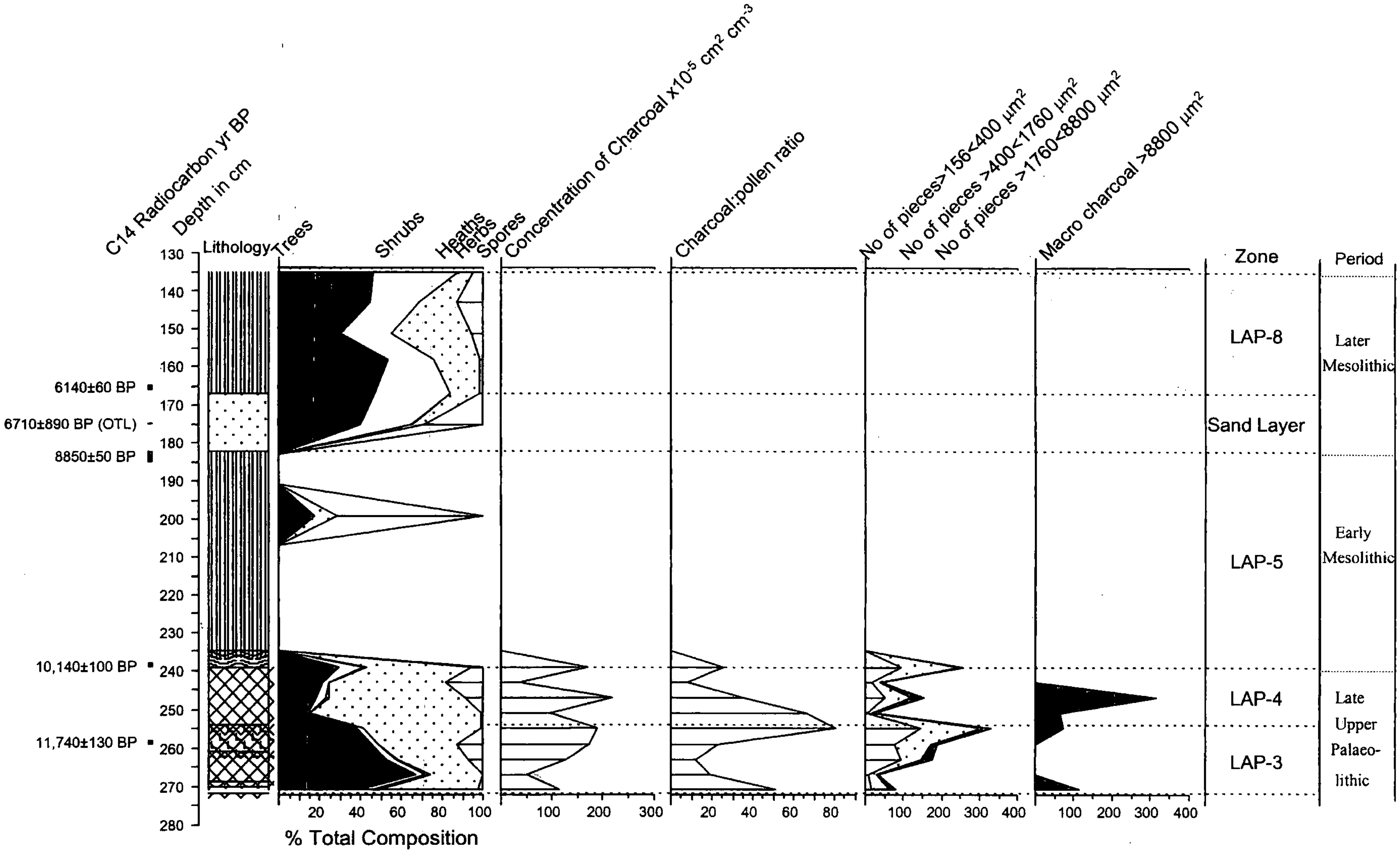


Figure 9.6 LAP - Summary Diagram

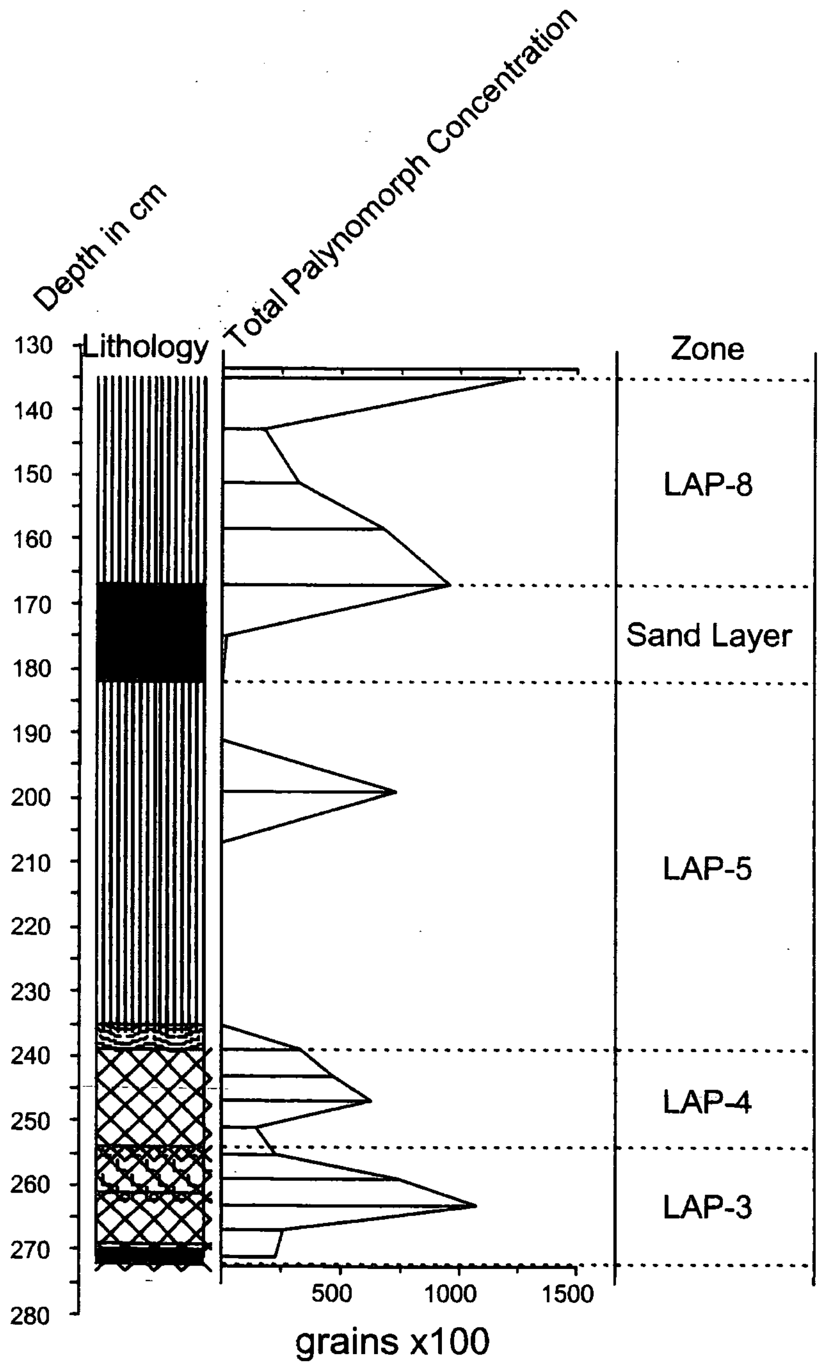


Figure 9.7a LAP Pollen and Spore Concentration Curve

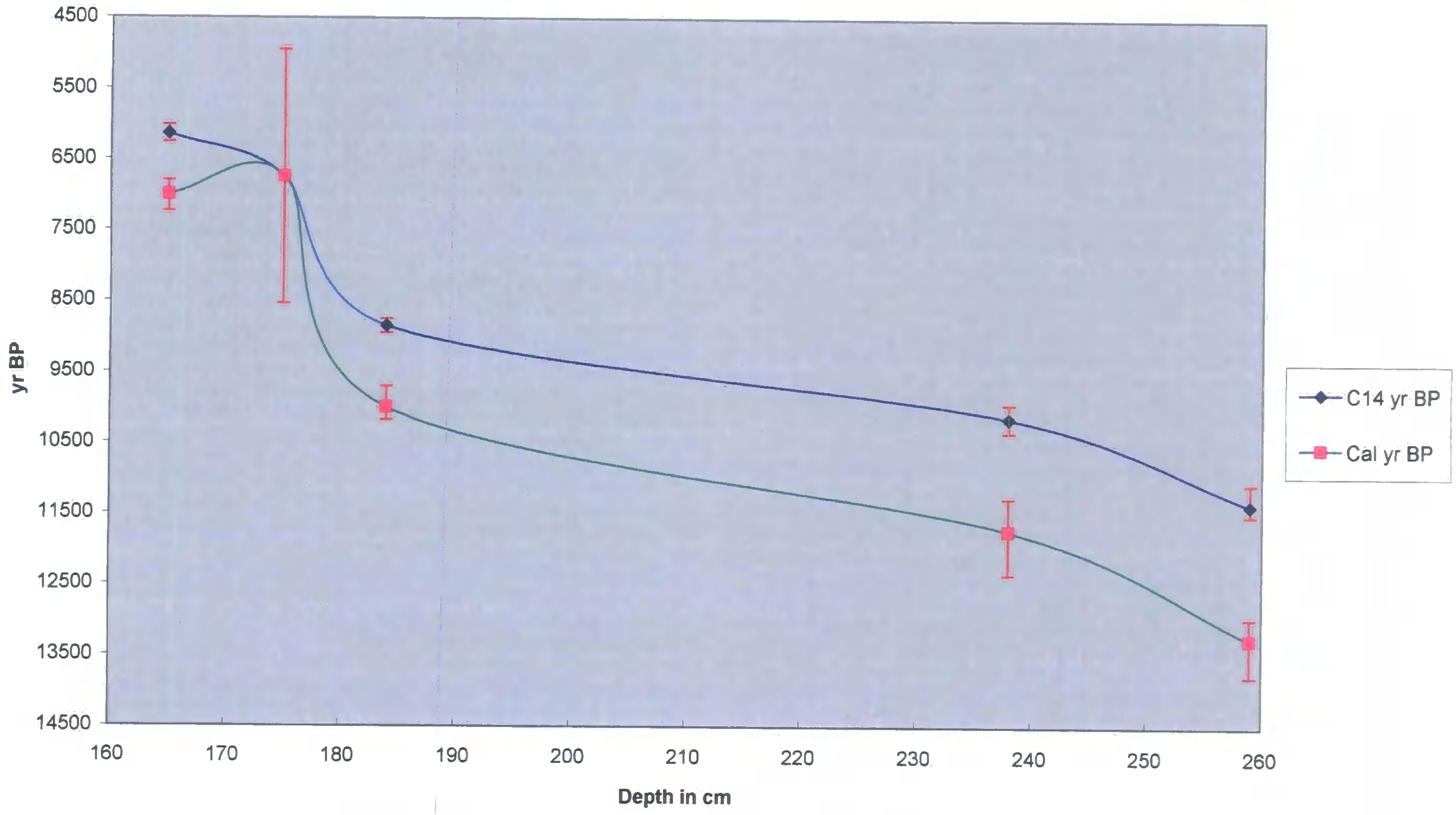


Figure 9.7b Time-Depth Curve for Profile LAP (to 2 SE)

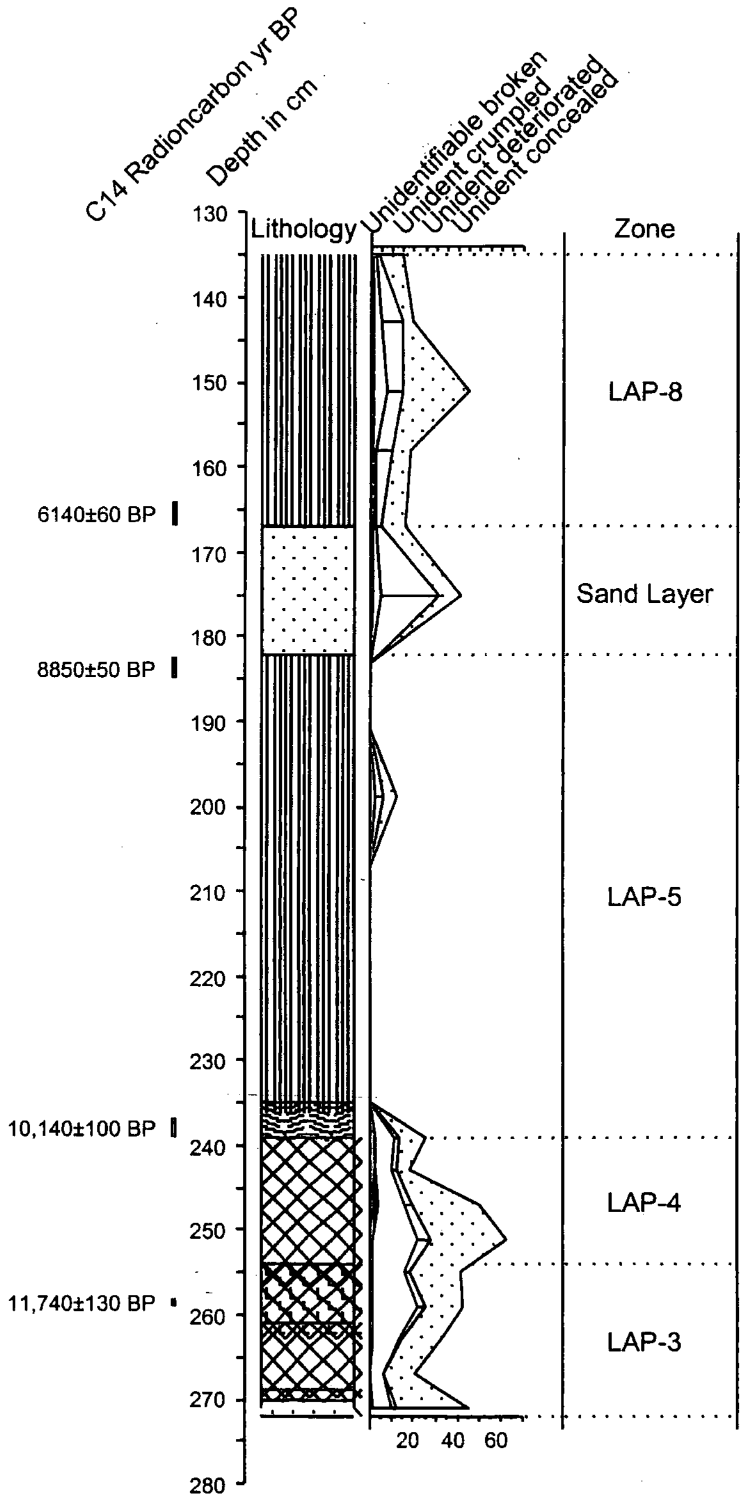


Figure 9.8 LAP - Pollen Preservation Curve

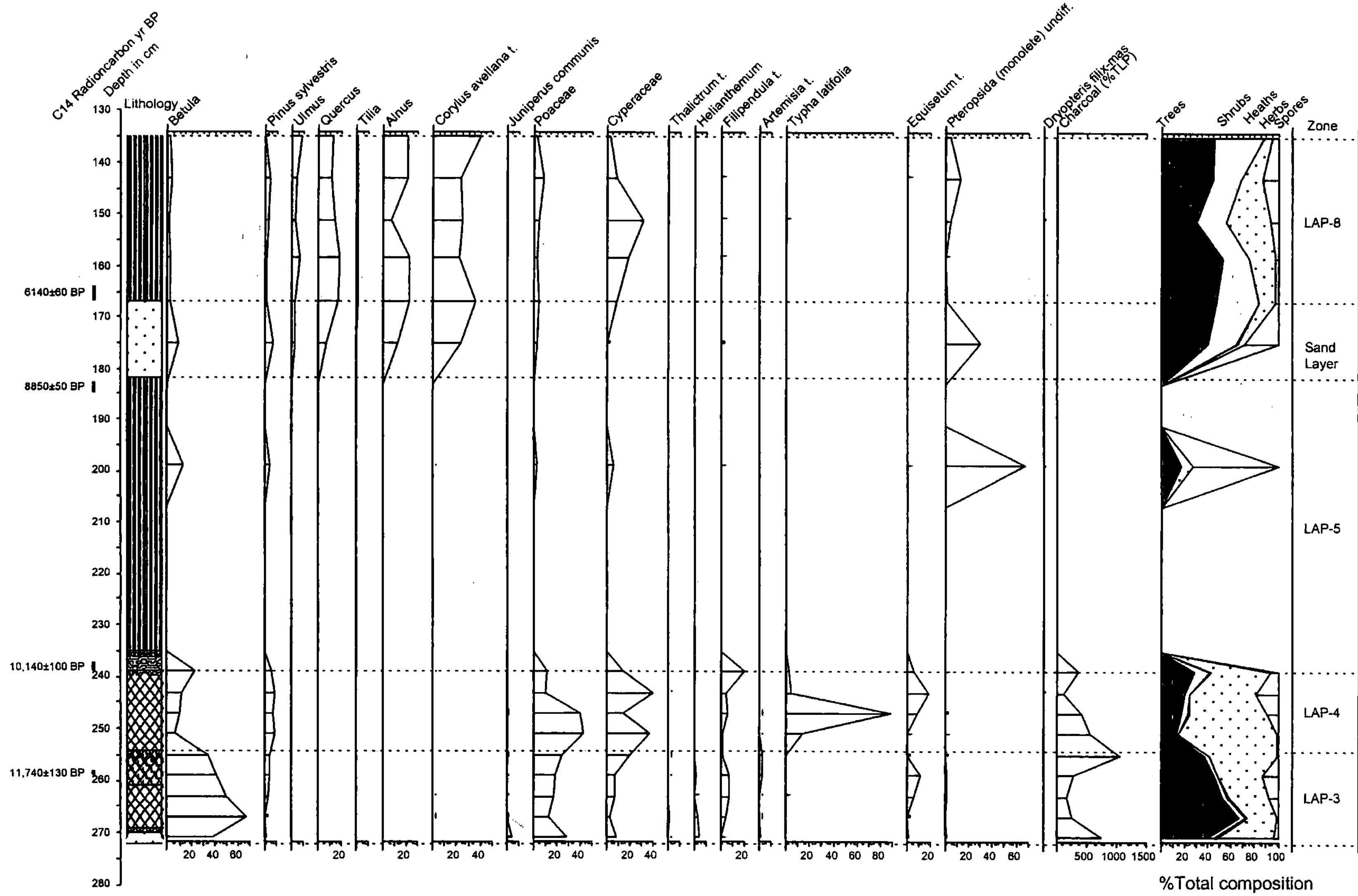


Figure 9.9 LAP - Selected Pollen and Charcoal Diagram

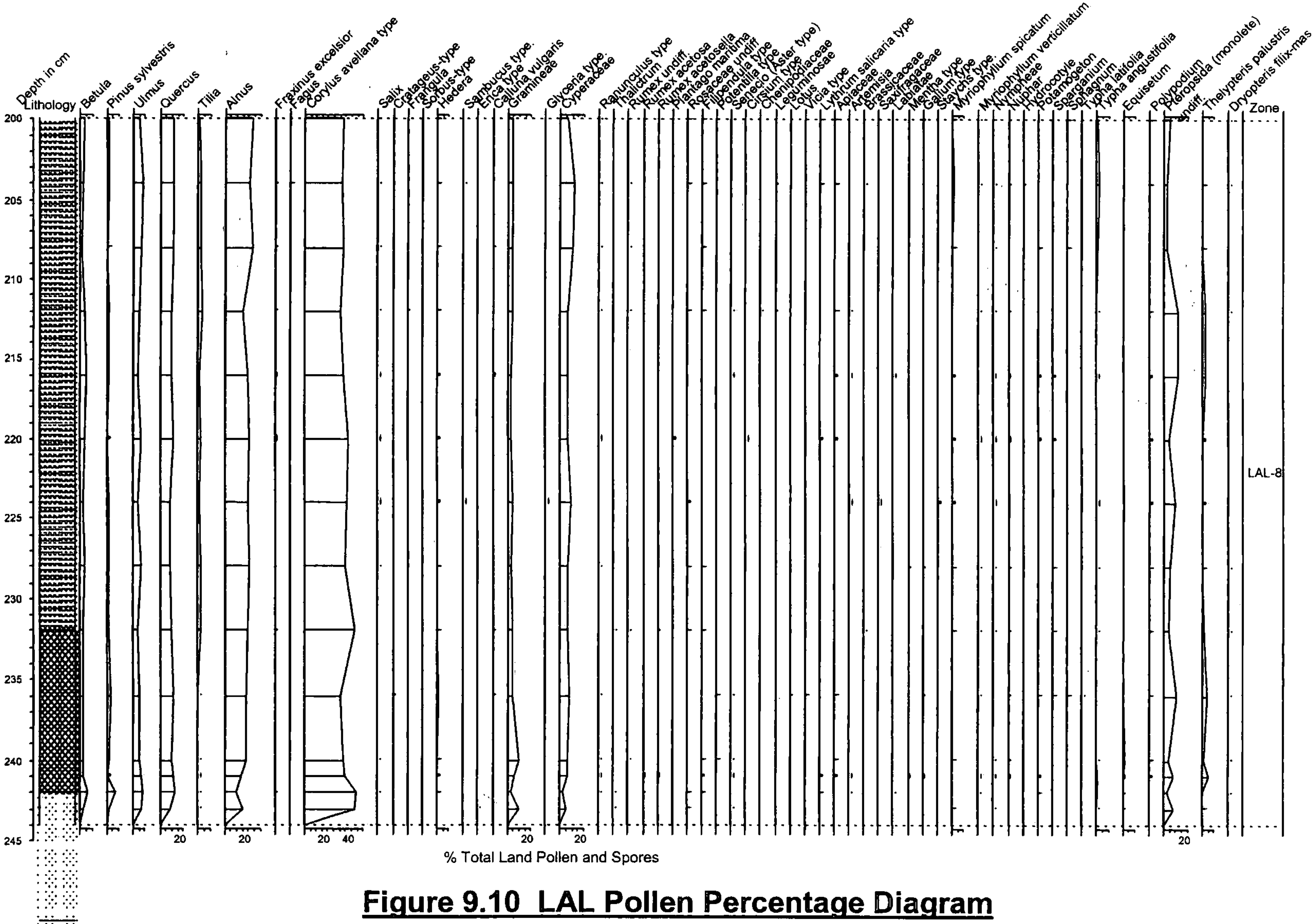


Figure 9.10 LAL Pollen Percentage Diagram

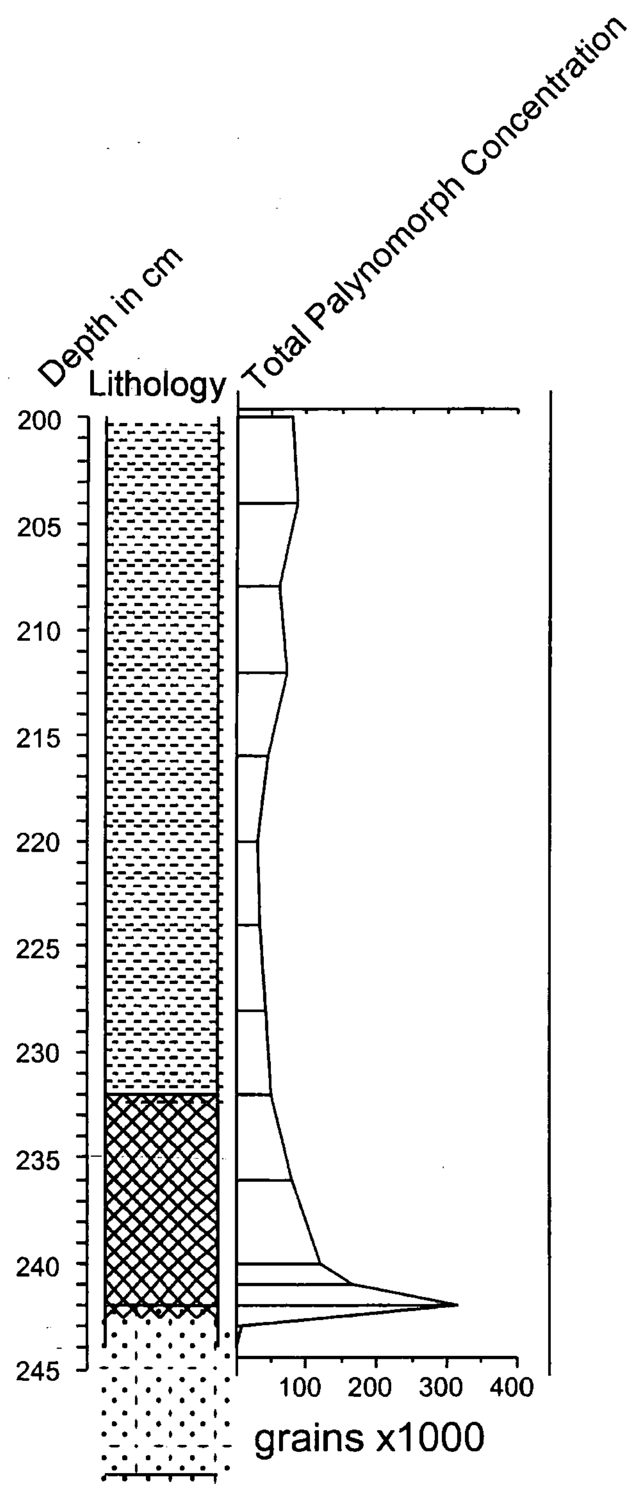


Figure 9.11 LAL - Pollen and Spore Concentration Curve

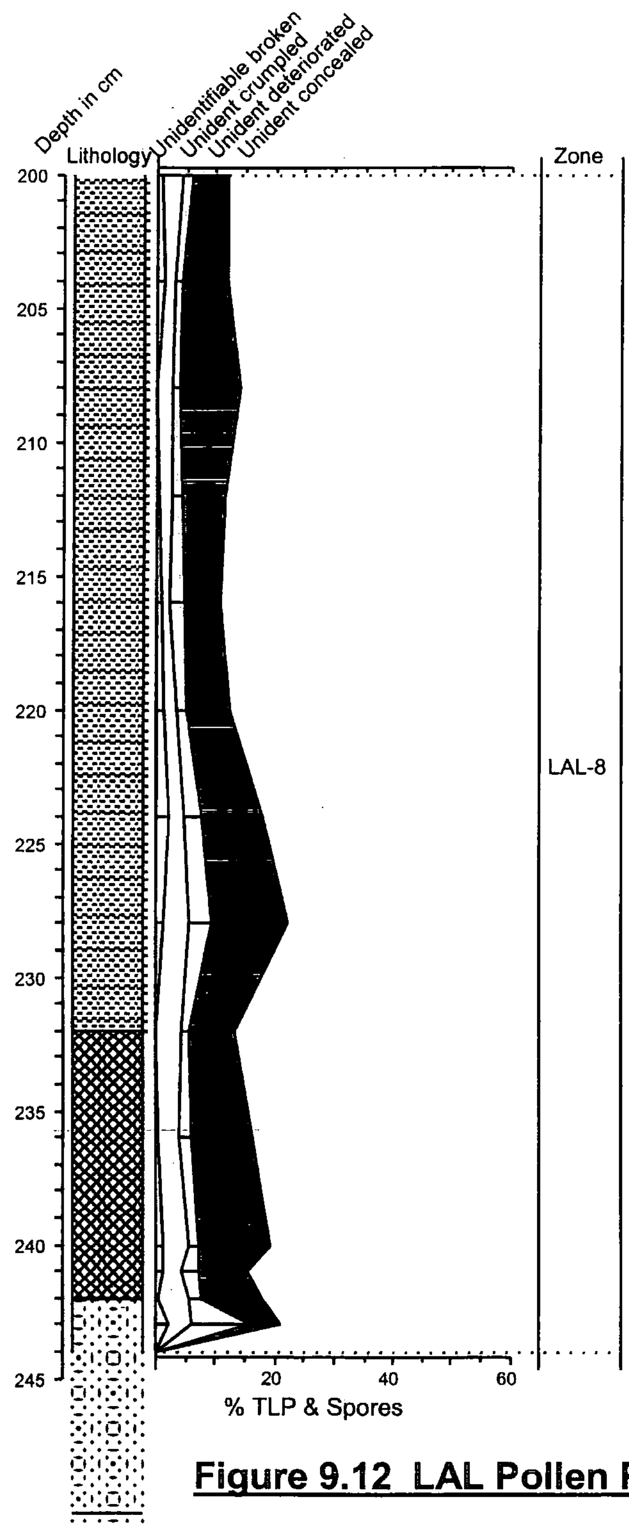


Figure 9.12 LAL Pollen Preservation Curve

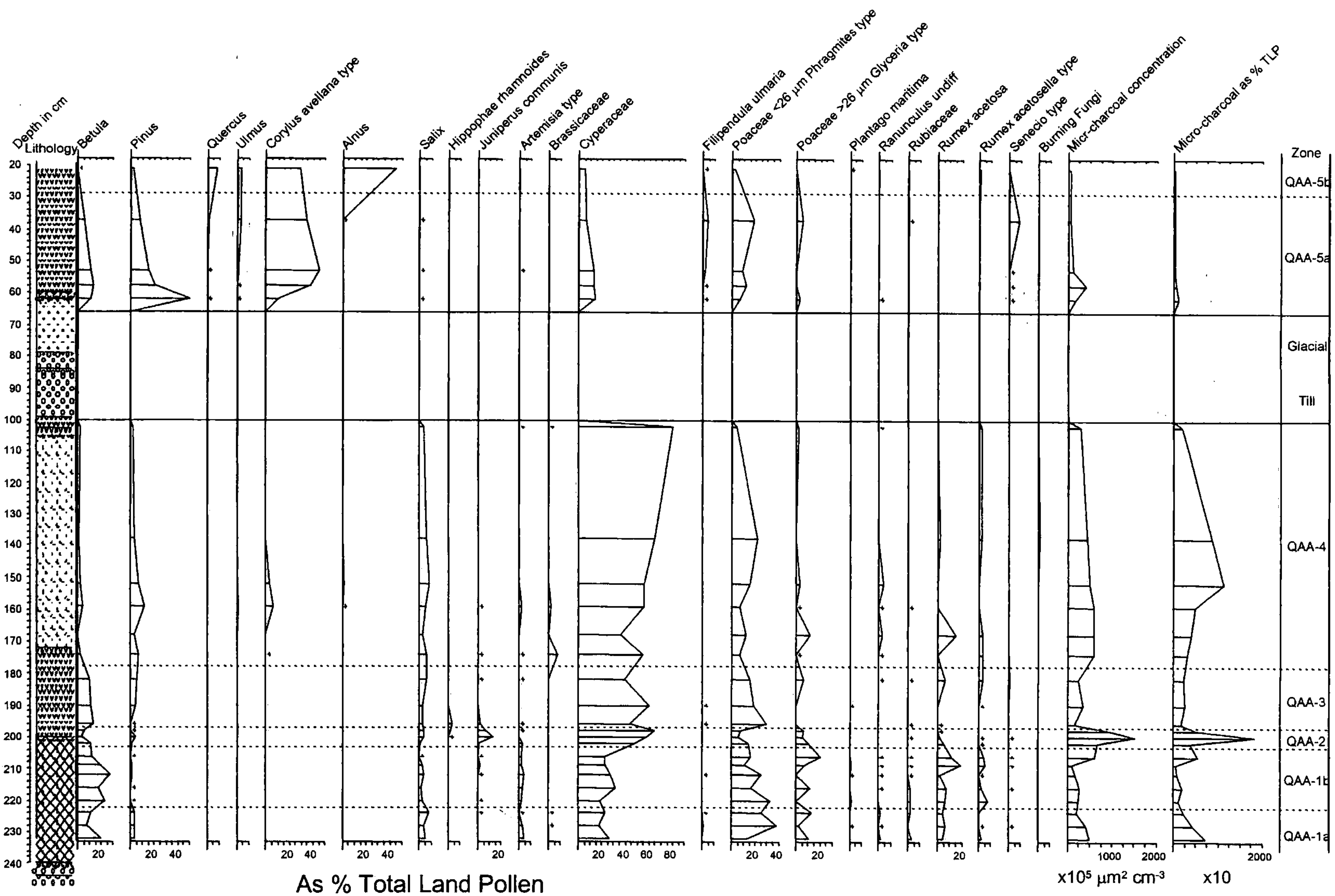


Figure 9.13 Profile QAA - Key Species

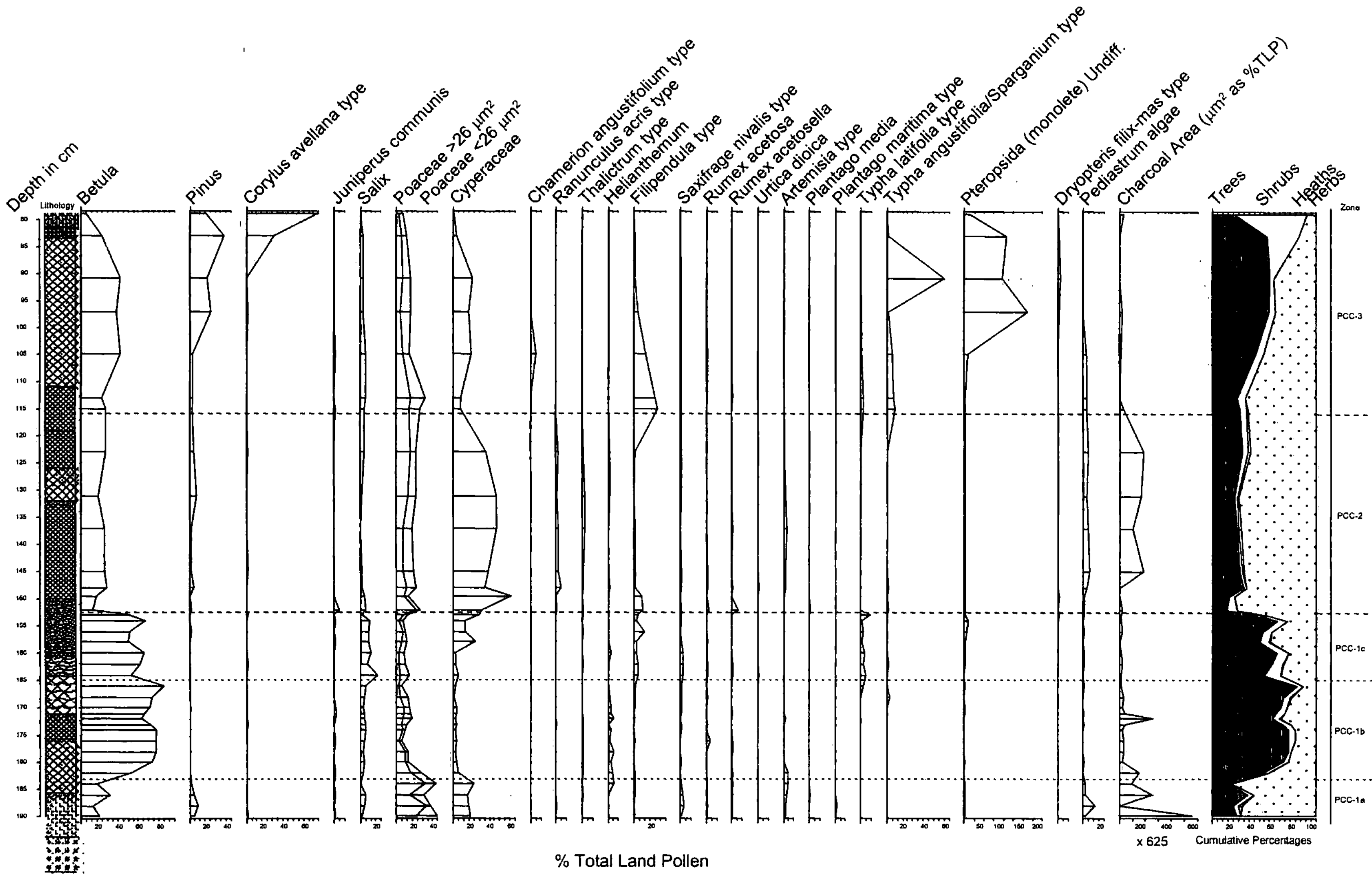


Figure 9.14 Profile PCC - Key Species

Chapter Ten

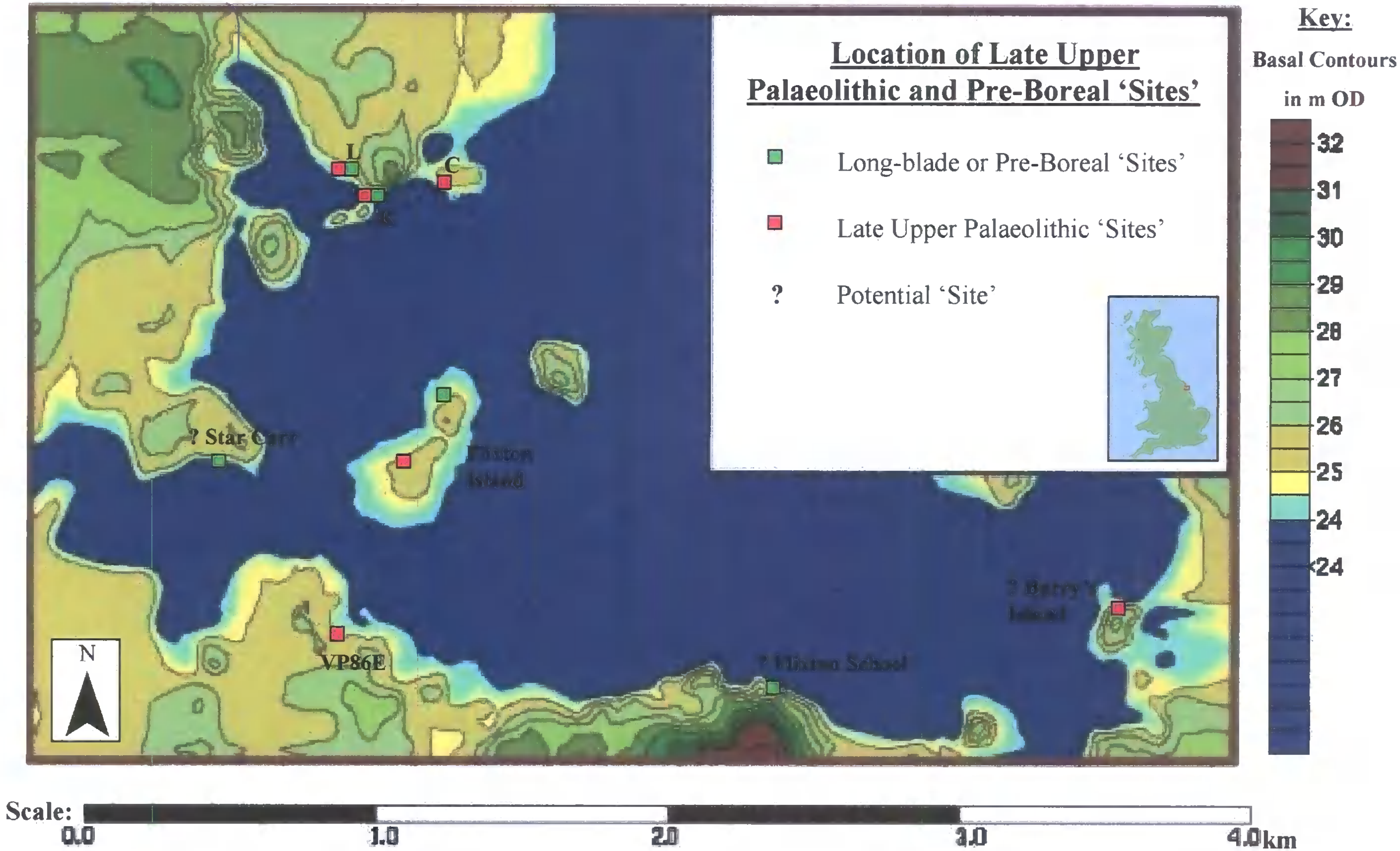


Figure 10.1 Late Upper Palaeolithic and Pre-Boreal sites in relation to palaeo-Lake Flixton

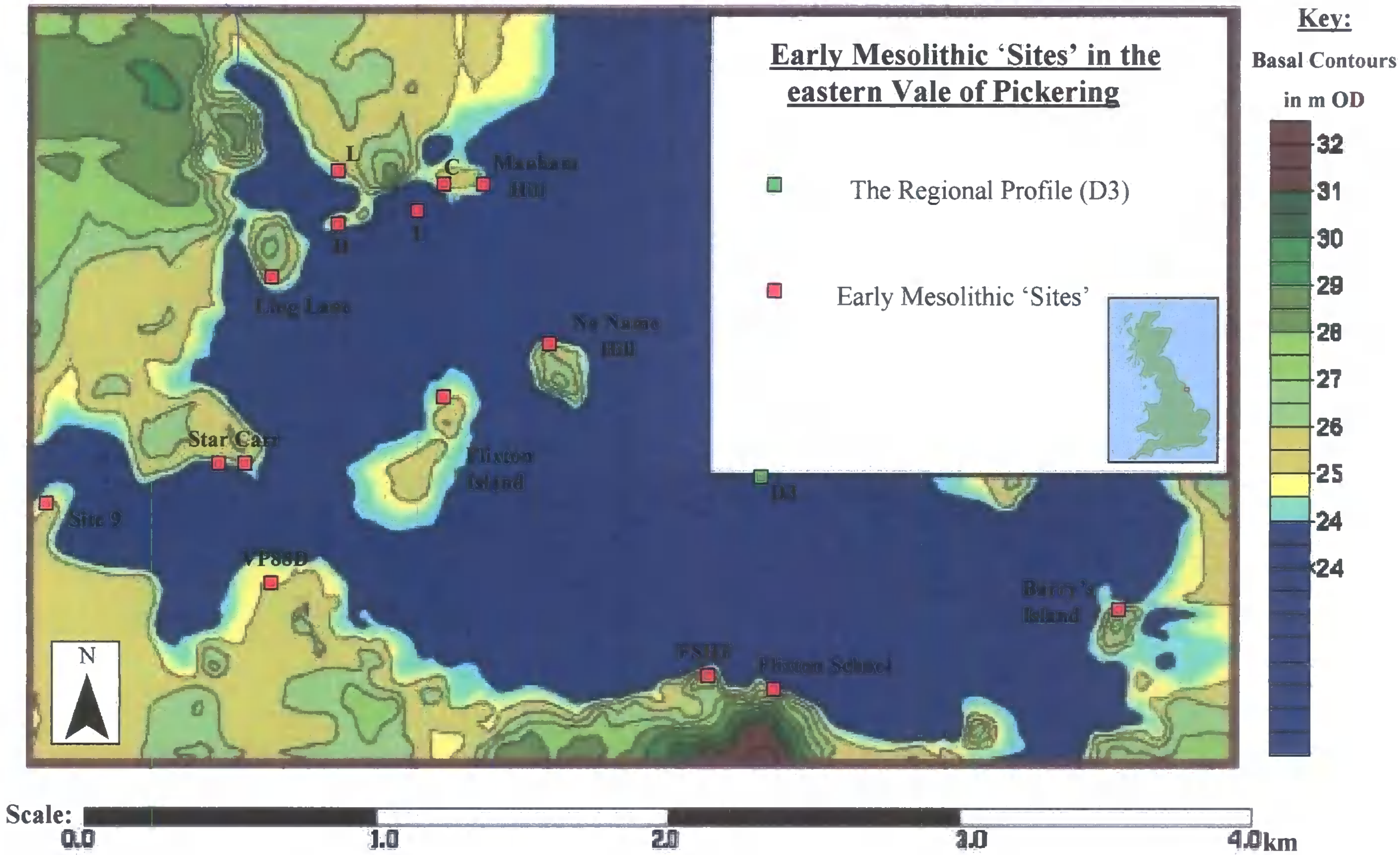


Figure 10.2 Location of early Mesolithic 'Sites' in relation to palaeo-Lake Flixton

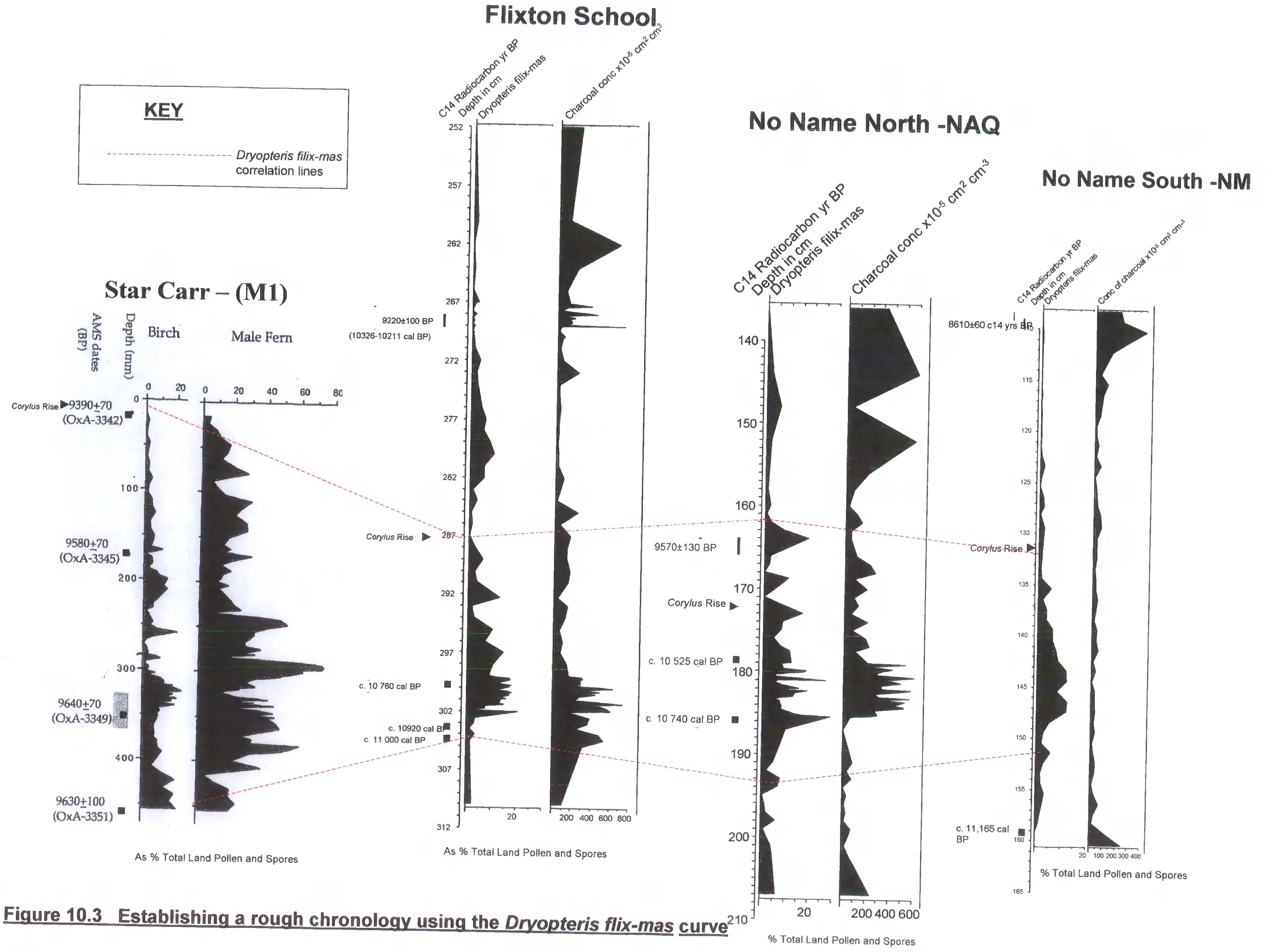


Figure 10.3 Establishing a rough chronology using the *Dryopteris flix-mas* curve

Figure 10.4 Reeds huts constructed by the Dinka Pastoralists of the Sudan (from Mellars and Dark 1998:224)

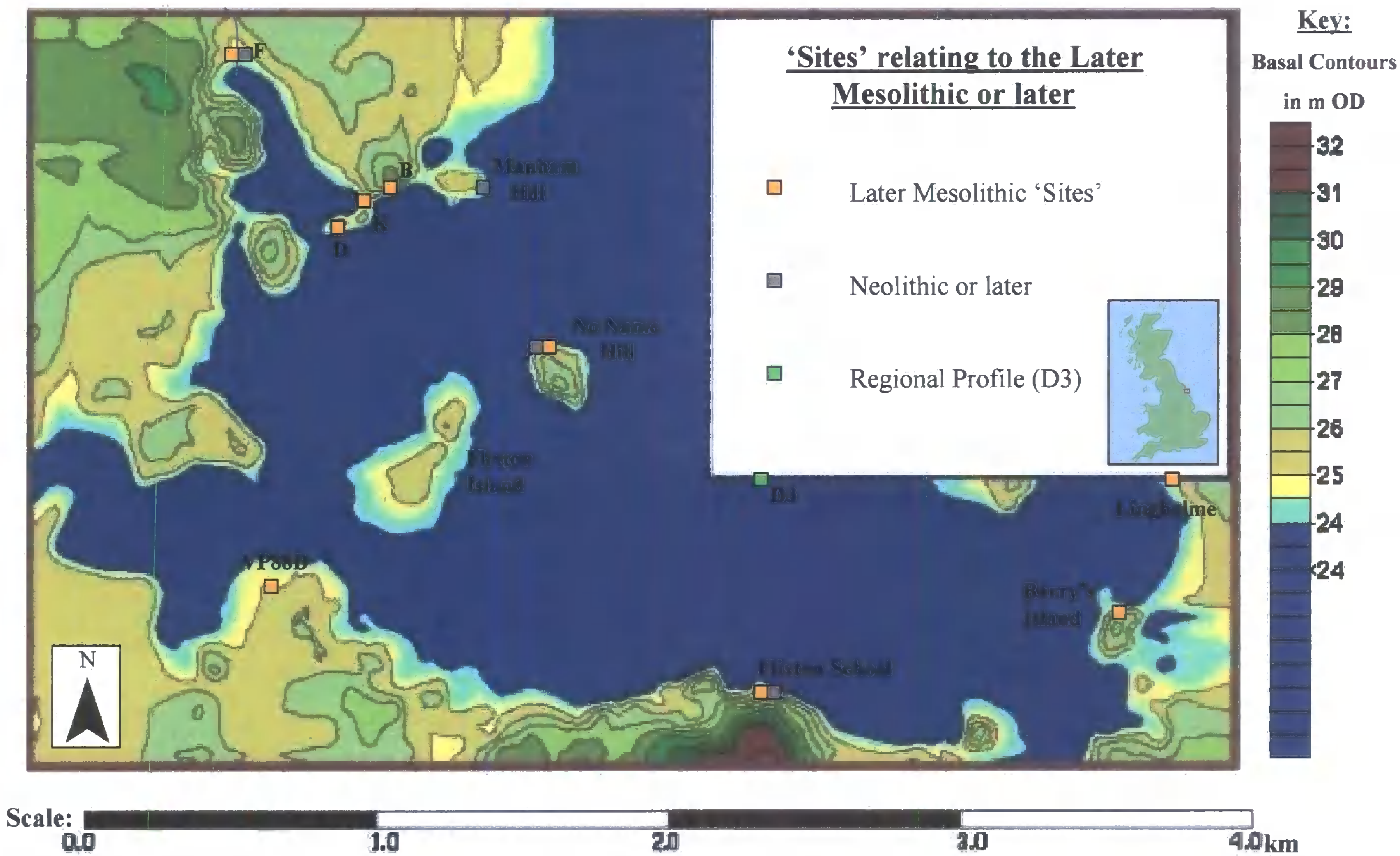


Figure 10.5 Location of 'Sites' dating to the Later Mesolithic or even later

Appendices

Appendix One

LABORATORY PROCEDURE FOR POLLEN ANALYSIS.

1 **Evacuation of Alkali-soluble Organic Compounds**

Add Potassium hydroxide

Heat in boiling water for 30 minutes.Stir occasionally

Decant through 180 micron sieve. Wash residue

Centrifuge .Decant and wash until supernatant liquid is unstained

2 **Hydrofluoric Digestion of Siliceous Material.** Not usually necessary for samples of peat.

Add Hydrofluoric acid
Heat in boiling water until sediment dispenses and stratified sediment appears -1hour

Stir,centrifuge,decant.

Add hydrochloric acid (10% soln) Heat in boiling water for 3 to 5 minutes.

Centrifuge.Decant. Wash with distilled water.Stir. Centrifuge. Decant.

Transfer to small tubes.

3 **Evacuation of Unaltered Lignin and Cellulose.**

Add glacial acetic acid. Stir. Centrifuge. Decant. x1

Add acetylation mixture. Stir well.(1:9 conc. sulphuric acid -acetic anhydride)

Heat in boiling water for 1 minute. Top up with glacial acetic acid

Centrifuge. Decant.

Add glacial acid, stir. Centrifuge. decant.

Add distilled water. Stir. Centrifuge. Decant X2.

4 **STAINING**

Wash with Ethanol X2 (rinse T/Tube walls)to remove water.Centrifuge.Decant.

Add 2mls Tertiary Alcohol, 2 drops of safranin then transfer into small sample vials.Centrifuge.Decant.

Add silicone fluid,same volume as sample.Stir.Plug with cotton wool.