A high resolution palynological study of the Holocene vegetational development of central Holderness, eastern Yorkshire, with particular emphasis on the detection of prehistoric human activity

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Wood and Rome (1868)	Bisat (1939)	Madgett and Catt (1978)
Basement Purple Hessle	Basement Drab Lower Purple Upper Purple Hessle	Basement Skipsea (≡Drab); present throughout Holderness. Withernsea (≡Purple); present in southeast Holderness only

Table 2.1: till divisions in Holderness (deepest deposit first).

Pollen component	Source distance (Janssen, 1966)	Source distance (Jacobson and Bradshaw, 1981)
Local	< 20 m	< 20 m
Extra-local	20 m - 2 km	20 m - several hundred m
Regional	2 km - 200 km	> several hundred m
Extra-regional	> 200 km	Not specified

Table 3.1: pollen rain components and the distances from the lake shore that they originate from.

The sites should:
1. Be located in central Holderness.
2. Be situated on elevated ground or otherwise isolated from valley bottoms.
3. Be infilled lake basins of *ca* 2-4 ha in size.
4. Be isolated with no obvious stream inputs.
5. Be of broadly similar character i.e. steep-sided and of probable kettlehole origin.
6. Contain areas of deposit that are undisturbed and relatively undesiccated.
7. Contain a significant depth of Holocene deposit that covers as much of the period as possible.

Table 3.2: summary of chosen site criteria.

Attribute code	Attribute	Details of calculation method/accuracy
A	Length of longest grain axis (µm)	Longest axis of grain (see Plate 5.1), measured to nearest 1 µm. Only grains with a longest axis of >37 µm were measured.
B	Length of grain axis at 90° to A (µm)	Measured to nearest 1 µm.
C	Mean grain size (µm)	=(A+B)/2. Stated to nearest 0.5 µm.
D	Pollen index	Ratio of A to B (i.e. A/B). Stated to two decimal places.
E	Annulus diameter (µm)	Total diameter of annulus, measured to nearest 1 µm.
F	Pore diameter (µm)	Total diameter of pore, measured to nearest 1 µm.
G	Ratio of annulus diameter to pore diameter.	=E/F. Stated to two decimal places.
H	Annulus protrusion	Height of annulus (in polar view) compared to the thickness of the exine (see Plate 5.2 for exact measurement technique). Stated as 1 (>2x exine thickness; Plate 5.2) or 0 (<2x exine thickness; Plate 5.3).
I	Annulus boundary type	Subjective assessment of the clarity of the outer annulus boundary (in equatorial view). Stated as S (sharp i.e. clearly separable from the rest of the grain surface; Plate 5.4) or D (diffuse i.e. not clearly separable; Plate 5.5).

Table 5.1: characteristics noted from all large Poaceae grains (where possible).

Study site	**Total sample size (n_{tot})**	**Sample size: data complete (n_{comp})**	**Sample size: data incomplete (n_{incomp})**
Cess Dell	97	22	75
Gilderson Marr	61	60	1
Sproatley Bog	360	285	75
The Bog at Roos	181	172	9
Totals	**699**	**539**	**160**

Table 5.2: details of the numbers of large Poaceae grains located from each study site, see text for explanation.

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
CD-1	430	9975	41	38	39.5	1.08	8	3	2.67	0	D	HG	SPT	No
CD-2	430	9975	42	34	38	1.24	8	3	2.67	0	D	HG	SPT	No
CD-3	430	9975	47	40	43.5	1.18	12	5	2.4	1	S	ATG	CT	Yes
CD-4	428	9950	40	29	34.5	1.38	8	5	1.6	0	D	HG*	SPT	No
CD-5	420	9845	40	35	37.5	1.14	10	5	2	1	D	HG	SPT	No
CD-6	420	9845	45	30	37.5	1.5	9	5	1.8	0	D	HG	SPT	No
CD-7	284	7500	57	46	51.5	1.24	10	7	1.43	0	D	Nofit	GT	No
CD-8	280	7400	43	35	39	1.23	8	4	2	0	D	HG	SPT	No
CD-9	272	7190	42	35	38.5	1.2	10	4	2.4	0	D	HG	SPT	No
CD-10	238	6885	37	37	37	1	10	5	2	0	D	HG	SPT	No
CD-11	238	6885	37	35	36	1.06	10	5	2	0	D	HG	SPT	No
CD-12	160	6410	37	30	33.5	1.23	10	5	2	0	D	HG	SPT	No
CD-13	160	6410	37	28	32.5	1.32	10	5	2	0	D	HG*	SPT	No
CD-14	126	6110	37	37	37	1	10	5	2	1	S	HG	SPT	No
CD-15	124	6090	37	30	33.5	1.23	10	4	2.5	0	D	HG	SPT	No
CD-16	124	6090	39	33	36	1.18	10	5	2	0	D	HG	SPT	No
CD-17	124	6090	37	35	36	1.06	9	5	1.8	0	D	HG	SPT	No
CD-18	122	6070	37	35	36	1.06	9	3	3	0	D	HG	SPT	No
CD-19	120	6055	45	36	40.5	1.25	12	5	2.4	1	S	ATG	CT	Yes
CD-20	76	5660	38	30	34	1.27	10	5	2	1	S	HG*	SPT	No
CD-21	76	5660	38	30	34	1.27	10	5	2	1	S	HG*	SPT	No
CD-22	76	5660	40	38	39	1.05	10	5	2	1	S	HG	SPT	No

Table 5.3: large Poaceae pollen: (n_{comp}) data for Cess Dell. For explanation of columns A-I see Table 5.1, for Andersen types see Table 5.7 and for Küster types see Table 5.8. An asterisk next to the Andersen type denotes a distorted (compressed) grain (see 5.3.1 for explanation). A yes in the species overlap column indicates that the species groups suggested by the two keys overlap.

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
GM-1	364	9800	43	42	42.5	1.02	11	4	2.75	0	D	ATG	BHT	Yes
GM-2	362	9785	43	38	40.5	1.13	8	4	2	0	S	HG	Nofit	No
GM-3	362	9785	46	40	43	1.15	12	4	3	1	S	ATG	CT	Yes
GM-4	362	9785	45	38	41.5	1.18	11	4	2.75	1	S	ATG	CT	Yes
GM-5	362	9785	43	35	39	1.23	11	4	2.75	0	D	Nofit	SPT	No
GM-6	362	9785	40	35	37.5	1.14	10	3	3.33	1	D	HG	SPT	No
GM-7	360	9770	40	36	38	1.11	9	3	3	1	S	HG	SPT	No
GM-8	358	9760	40	38	39	1.05	12	7	1.71	0	S	Nofit	SPT	No
GM-9	358	9760	45	37	41	1.22	11	5	2.2	0	S	ATG	Nofit	No
GM-10	358	9760	40	38	39	1.05	11	5	2.2	1	S	Nofit	SPT	No
GM-11	356	9745	37	32	34.5	1.16	8	3	2.67	1	S	HG	SPT	No
GM-12	356	9745	39	37	38	1.05	9	3	3	0	S	HG	SPT	No
GM-13	354	9730	47	45	46	1.04	11	5	2.2	0	S	ATG	Nofit	No
GM-14	350	9700	45	30	37.5	1.5	10	3	3.33	0	S	HG*	SPT	No
GM-15	350	9700	40	35	37.5	1.14	8	3	2.67	0	S	HG	SPT	No
GM-16	342	9650	50	37	43.5	1.35	13	5	2.6	0	D	ATG*	BHT	Yes
GM-17	184	8040	37	30	33.5	1.23	10	7	1.42	0	D	HG	SPT	No
GM-18	136	7160	59	59	59	1	17	8	2.13	1	S	ATG	CT	Yes
GM-19	136	7160	50	50	50	1	15	6	2.5	1	S	ATG	CT	Yes
GM-20	134	7085	40	38	39	1.05	10	4	2.5	1	D	HG	Nofit	No
GM-21	132	7010	41	37	39	1.11	10	4	2.5	1	D	HG	SPT	No
GM-22	132	7010	57	46	51.5	1.24	15	5	3	0	S	ATG	Nofit	No
GM-23	130	6930	43	36	39.5	1.19	12	5	2.4	0	S	Nofit	SPT	No
GM-24	128	6850	50	39	44.5	1.28	14	5	2.8	1	S	ATG*	CT	Yes
GM-25	128	6850	48	41	44.5	1.17	11	6	1.83	0	D	ATG	GT	Yes
GM-26	128	6850	38	31	34.5	1.23	11	4	2.75	1	S	Nofit	SPT	No
GM-27	102	5850	50	46	48	1.09	13	5	2.6	0	S	ATG	Nofit	No
GM-28	88	5310	44	40	42	1.1	10	5	2	0	D	HG	BHT	Yes
GM-29	84	5155	41	36	38.5	1.14	11	3	3.67	1	D	Nofit	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
GM-30	82	5080	57	50	53.5	1.14	12	4	3	0	S	ATG	Nofit	No
GM-31	78	4925	49	45	47	1.09	14	5	2.8	1	S	ATG	CT	Yes
GM-32	74	4770	52	37	44.5	1.41	11	5	2.2	0	D	ATG*	BHT	Yes
GM-33	72	4690	40	35	37.5	1.14	12	5	2.4	0	D	Nofit	SPT	No
GM-34	72	4690	50	45	47.5	1.1	13	5	2.6	1	S	ATG	CT	Yes
GM-35	72	4690	40	31	35.5	1.29	8	4	2	0	D	Nofit	SPT	No
GM-36	70	4615	39	39	39	1	9	4	2.25	1	S	HG	SPT	No
GM-37	70	4615	66	58	62	1.14	20	11	1.81	1	S	ATG	Nofit	No
GM-38	68	4540	41	39	40	1.05	10	4	2.5	0	S	HG	Nofit	No
GM-39	68	4540	39	36	37.5	1.08	8	4	2	0	S	HG	SPT	No
GM-40	66	4460	48	46	47	1.04	13	6	2.17	0	S	ATG	Nofit	No
GM-41	66	4460	48	38	43	1.26	12	4	3	0	S	ATG*	Nofit	No
GM-42	66	4460	52	38	45	1.37	12	5	2.4	1	S	ATG*	CT	Yes
GM-43	66	4460	62	43	52.5	1.44	15	6	2.5	1	S	ATG*	CT	Yes
GM-44	66	4460	45	40	42.5	1.13	11	6	1.83	1	D	ATG	GT	No
GM-45	64	4380	37	31	34	1.19	8	3	2.67	0	D	HG	SPT	No
GM-46	64	4380	37	29	33	1.28	9	3	3	0	D	HG*	SPT	No
GM-47	64	4380	52	48	50	1.08	14	5	2.8	1	S	ATG	CT	Yes
GM-48	64	4380	38	37	37.5	1.03	9	3	3	0	S	HG	SPT	No
GM-49	64	4380	40	36	38	1.11	14	5	2.8	1	S	Nofit	SPT	No
GM-50	64	4380	48	47	47.5	1.02	11	4	2.75	1	S	ATG	CT	Yes
GM-51	64	4380	52	47	49.5	1.11	14	6	2.33	1	S	ATG	CT	Yes
GM-52	64	4380	50	38	44	1.32	12	5	2.4	1	S	ATG*	CT	Yes
GM-53	64	4380	37	30	33.5	1.23	10	5	2	0	D	HG	SPT	No
GM-54	64	4380	50	47	48.5	1.06	12	5	2.4	1	S	ATG	CT	Yes
GM-55	62	4310	54	42	48	1.29	13	5	2.6	0	S	ATG*	Nofit	No
GM-56	62	4310	37	35	36	1.06	10	5	2	0	S	HG	SPT	No
GM-57	60	4230	52	52	52	1	12	4	3	0	S	ATG	CT	Yes
GM-58	60	4230	41	40	40.5	1.03	13	4	3.25	1	S	ATG	CT	Yes
GM-59	60	4230	40	35	37.5	1.14	10	4	2.5	1	S	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
GM-60	59	4190	40	37	38.5	1.08	10	5	2	1	S	HG	SPT	No

Table 5.4: large Poaceae pollen: (n_{comp}) data for Gilderson Marr. For explanation of columns A-I see Table 5.1, for Andersen types see Table 5.7 and for Küster types see Table 5.8. An asterisk next to the Andersen type denotes a distorted (compressed) grain (see 5.3.1 for explanation). A yes in the species overlap column indicates that the species groups suggested by the two keys overlap.

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-1	402	Pre-9600	37	32	34.5	1.16	8	3	2.67	0	S	HG	SPT	No
SB-2	168	Pre-1470	40	30	35	1.33	8	4	2	1	S	HG*	SPT	No
SB-3	168	Pre-1470	45	37	41	1.22	8	4	2	1	S	HG	CT	Yes
SB-4	168	Pre-1470	40	30	35	1.33	8	4	2	1	S	HG	SPT	No
SB-5	168	Pre-1470	45	37	41	1.22	8	4	2	1	S	HG	CT	Yes
SB-6	154	Pre-1470	41	37	39	1.11	9	5	1.8	0	D	HG	SPT	No
SB-7	154	Pre-1470	43	40	41.5	1.08	10	3	3.33	1	S	HG	AT	Yes
SB-8	154	Pre-1470	44	43	43.5	1.02	11	3	3.67	0	S	ATG	AT	No
SB-9	148	Pre-1470	62	42	52	1.48	12	6	2	1	S	SC	CT	Yes
SB-10	148	Pre-1470	50	37	43.5	1.35	12	6	2	1	S	SC	CT	Yes
SB-11	148	Pre-1470	57	55	56	1.04	13	5	2.6	1	S	ATG	CT	Yes
SB-12	148	Pre-1470	47	40	43.5	1.18	13	4	3.25	1	S	ATG	CT	Yes
SB-13	148	Pre-1470	50	37	43.5	1.35	11	5	2.2	1	S	SC	CT	Yes
SB-14	148	Pre-1470	42	37	39.5	1.14	10	3	3.33	1	S	HG	SPT	No
SB-15	140	Pre-1470	60	50	55	1.2	15	8	1.88	1	S	ATG	CT	Yes
SB-16	140	Pre-1470	50	45	47.5	1.11	12	6	2	1	S	ATG	CT	Yes
SB-17	140	Pre-1470	52	38	45	1.36	10	6	1.67	1	S	SC	Nofit	No
SB-18	140	Pre-1470	52	42	47	1.24	13	5	2.6	1	S	ATG	CT	Yes
SB-19	132	Pre-1470	50	50	50	1	12	6	2	1	S	ATG	CT	Yes
SB-20	132	Pre-1470	49	37	43	1.32	11	3	3.67	1	S	SC	AT	No
SB-21	124	Pre-1470	37	32	34.5	1.16	8	4	2	1	S	HG	SPT	No
SB-22	124	Pre-1470	37	30	33.5	1.23	8	4	2	1	S	HG	SPT	No
SB-23	124	Pre-1470	40	33	36.5	1.21	10	5	2	1	S	HG	SPT	No
SB-24	124	Pre-1470	50	45	47.5	1.11	15	6	2.5	1	S	ATG	CT	Yes
SB-25	124	Pre-1470	37	30	33.5	1.23	9	4	2.25	1	S	HG	SPT	No
SB-26	124	Pre-1470	42	35	38.5	1.2	10	3	3.33	1	S	HG	SPT	No
SB-27	124	Pre-1470	50	40	45	1.25	13	5	2.6	1	S	ATG	CT	Yes
SB-28	124	Pre-1470	38	31	34.5	1.23	11	5	2.2	0	S	Nofit	SPT	No
SB-29	124	Pre-1470	38	37	37.5	1.03	10	5	2	1	D	HG	SPT	No
SB-30	124	Pre-1470	37	37	37	1	10	5	2	1	S	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-31	120	Pre-1470	47	37	42	1.27	10	5	2	1	S	SC	CT	Yes
SB-32	120	Pre-1470	40	37	38.5	1.08	12	6	2	1	S	Nofit	SPT	No
SB-33	120	Pre-1470	46	42	44	1.1	11	4	2.75	1	S	ATG	CT	Yes
SB-34	120	Pre-1470	47	37	42	1.27	10	5	2	1	S	SC	CT	Yes
SB-35	120	Pre-1470	40	37	38.5	1.08	12	6	2	1	S	Nofit	SPT	No
SB-36	120	Pre-1470	42	30	36	1	10	3	3.33	1	D	HG	SPT	No
SB-37	116	Pre-1470	45	43	44	1.05	12	5	2.4	1	S	ATG	CT	Yes
SB-38	116	Pre-1470	50	47	48.5	1.06	15	7	2.14	1	S	ATG	CT	Yes
SB-39	116	Pre-1470	47	41	44	1.15	12	5	2.4	1	S	ATG	CT	Yes
SB-40	116	Pre-1470	37	37	37	1	10	5	2	0	D	HG	SPT	No
SB-41	116	Pre-1470	42	37	39.5	1.14	11	4	2.75	1	S	Nofit	SPT	No
SB-42	116	Pre-1470	48	39	43.5	1.23	10	5	2	1	S	HG	CT	Yes
SB-43	116	Pre-1470	50	30	40	1.67	8	3	2.67	1	S	SC	AT	Yes
SB-44	116	Pre-1470	40	30	35	1.33	10	5	2	1	S	SC	SPT	No
SB-45	116	Pre-1470	37	30	33.5	1.23	6	3	2	0	D	WGG	SPT	Yes
SB-46	116	Pre-1470	49	42	45.5	1.17	13	5	2.6	1	S	ATG	CT	Yes
SB-47	116	Pre-1470	52	40	46	1.3	12	6	2	1	S	SC	CT	Yes
SB-48	116	Pre-1470	45	35	40	1.29	8	4	2	1	S	SC	CT	Yes
SB-49	108	Pre-1470	50	45	47.5	1.11	11	5	2.2	1	S	ATG	CT	Yes
SB-50	108	Pre-1470	55	50	52.5	1.1	14	6	2.33	1	S	ATG	CT	Yes
SB-51	108	Pre-1470	42	32	37	1.31	10	5	2	1	S	SC	SPT	No
SB-52	108	Pre-1470	42	28	35	1.5	8	3	2.67	0	D	SC	SPT	No
SB-53	108	Pre-1470	42	42	42	1	10	5	2	0	D	HG	BHT	Yes
SB-54	108	Pre-1470	45	43	44	1.05	13	6	2.17	1	S	ATG	CT	Yes
SB-55	108	Pre-1470	47	42	44.5	1.12	12	4	3	1	S	ATG	CT	Yes
SB-56	108	Pre-1470	37	30	33.5	1.23	8	4	2	0	D	HG	SPT	No
SB-57	108	Pre-1470	58	32	45	1.81	12	6	2	1	D	SC	Nofit	No
SB-58	108	Pre-1470	53	50	51.5	1.06	14	5	2.8	1	S	ATG	CT	Yes
SB-59	104	Pre-1470	44	27	35.5	1.63	7	3	2.33	0	S	SC	SPT	No
SB-60	104	Pre-1470	44	40	42	1.1	13	6	2.17	1	S	ATG	CT	Yes
SB-61	104	Pre-1470	40	29	34.5	1.38	9	3	3	0	S	SC	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-62	104	Pre-1470	41	26	33.5	1.58	8	3	2.67	0	S	SC	SPT	No
SB-63	104	Pre-1470	40	25	32.5	1.6	8	2	4	0	S	SC	SPT	No
SB-64	100	Pre-1470	41	27	34	1.52	8	3	2.67	1	S	SC	SPT	No
SB-65	100	Pre-1470	41	28	34.5	1.46	8	3	2.67	1	S	SC	SPT	No
SB-66	99	Pre-1470	37	37	37	1	12	5	2.4	1	S	Nofit	SPT	No
SB-67	99	Pre-1470	50	45	47.5	1.11	13	6	2.17	1	S	ATG	CT	Yes
SB-68	99	Pre-1470	41	40	40.5	1.03	13	6	2.17	0	D	ATG	BHT	Yes
SB-69	99	Pre-1470	46	36	41	1.28	8	3	2.67	0	S	SC	Nofit	No
SB-70	99	Pre-1470	37	33	35	1.12	10	5	2	1	S	HG	SPT	No
SB-71	99	Pre-1470	41	40	40.5	1.03	8	3	2.67	0	S	HG	Nofit	No
SB-72	99	Pre-1470	37	33	35	1.12	10	5	2	0	S	HG	SPT	No
SB-73	99	Pre-1470	44	33	38.5	1.33	9	4	2.25	1	S	SC	SPT	No
SB-74	99	Pre-1470	37	34	35.5	1.09	10	5	2	1	S	HG	SPT	No
SB-75	99	Pre-1470	37	35	36	1.06	9	4	2.25	0	S	HG	SPT	No
SB-76	99	Pre-1470	49	35	42	1.4	11	5	2.2	1	S	SC	CT	Yes
SB-77	98	Pre-1470	37	37	37	1	10	5	2	1	S	HG	SPT	No
SB-78	98	Pre-1470	37	35	36	1.06	10	5	2	1	S	HG	SPT	No
SB-79	98	Pre-1470	38	37	37.5	1.03	9	4	2.25	1	S	HG	SPT	No
SB-80	98	Pre-1470	37	35	36	1.06	10	3	3.33	1	S	HG	SPT	No
SB-81	98	Pre-1470	46	40	43	1.15	13	7	1.86	1	S	ATG	Nofit	No
SB-82	98	Pre-1470	53	47	50	1.13	12	5	2.4	1	S	ATG	CT	Yes
SB-83	98	Pre-1470	50	29	39.5	1.72	8	3	2.67	1	S	SC	SPT	No
SB-84	98	Pre-1470	49	30	39.5	1.63	8	4	2	1	S	SC	SPT	No
SB-85	98	Pre-1470	45	35	40	1.29	10	6	1.67	0	D	SC	GT	No
SB-86	97	1470	37	35	36	1.06	9	5	1.8	0	S	HG	SPT	No
SB-87	97	1470	48	30	39	1.6	8	3	2.67	1	S	SC	SPT	No
SB-88	97	1470	37	36	36.5	1.03	10	5	2	0	D	HG	SPT	No
SB-89	97	1470	38	32	35	1.19	10	3	3.33	1	S	HG	SPT	No
SB-90	97	1470	45	36	40.5	1.25	8	3	2.67	0	D	HG	GT	Yes
SB-91	97	1470	42	36	39	1.17	10	3	3.33	1	S	HG	SPT	No
SB-92	97	1470	37	37	37	1	10	5	2	0	D	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-93	97	1470	37	33	35	1.12	8	4	2	1	S	HG	SPT	No
SB-94	97	1470	45	32	38.5	1.41	10	5	2	1	S	SC	SPT	No
SB-95	97	1470	53	50	51.5	1.06	15	8	1.88	1	S	ATG	Nofit	No
SB-96	97	1470	53	42	47.5	1.26	12	6	2	1	S	ATG	CT	Yes
SB-97	96	1465	41	30	35.5	1.37	8	3	2.67	1	S	SC	SPT	No
SB-98	96	1465	41	30	35.5	1.37	10	3	3.33	1	S	SC	SPT	No
SB-99	96	1465	40	28	34	1.43	10	3	3.33	1	S	SC	SPT	No
SB-100	96	1465	50	30	40	1.67	8	3	2.67	1	S	SC	AT	No
SB-101	96	1465	45	28	36.5	1.61	10	3	3.33	1	S	SC	SPT	No
SB-102	92	1440	57	40	48.5	1.43	10	5	2	1	S	SC	CT	Yes
SB-103	92	1440	43	37	40	1.16	12	6	2	1	S	ATG	CT	Yes
SB-104	92	1440	58	50	54	1.16	15	8	1.88	1	S	ATG	Nofit	No
SB-105	92	1440	40	40	40	1	12	6	2	1	S	ATG	CT	Yes
SB-106	92	1440	45	40	42.5	1.13	14	6	2.33	1	S	ATG	CT	Yes
SB-107	92	1440	45	40	42.5	1.13	12	6	2	1	S	ATG	CT	Yes
SB-108	92	1440	42	38	40	1.11	12	6	2	1	S	ATG	CT	Yes
SB-109	92	1440	51	40	45.5	1.28	11	5	2.2	1	S	SC	CT	Yes
SB-110	92	1440	57	45	51	1.27	10	3	3.33	1	S	SC	AT	No
SB-111	92	1440	41	37	39	1.11	13	5	2.6	1	S	Nofit	SPT	No
SB-112	92	1440	50	37	43.5	1.35	12	5	2.4	1	S	SC	CT	Yes
SB-113	92	1440	55	45	50	1.22	16	8	2	1	S	ATG	CT	Yes
SB-114	88	1410	53	48	50.5	1.1	15	8	1.88	1	S	ATG	Nofit	No
SB-115	88	1410	62	40	51	1.55	10	5	2	1	S	SC	CT	Yes
SB-116	88	1410	42	37	39.5	1.14	12	6	2	1	S	Nofit	SPT	No
SB-117	88	1410	60	50	55	1.2	12	6	2	1	S	ATG	CT	Yes
SB-118	88	1410	44	40	42	1.1	10	4	2.5	1	S	HG	CT	Yes
SB-119	88	1410	54	28	41	1.93	10	5	2	1	S	SC	CT	Yes
SB-120	88	1410	65	50	57.5	1.3	12	6	2	1	S	SC	CT	Yes
SB-121	88	1410	37	37	37	1	12	5	2.4	1	S	Nofit	SPT	No
SB-122	88	1410	60	42	51	1.43	10	5	2	1	S	SC	CT	Yes
SB-123	88	1410	42	40	41	1.05	12	6	2	1	S	ATG	CT	Yes

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-124	88	1410	37	35	36	1.06	10	5	2	1	S	HG	SPT	No
SB-125	88	1410	40	40	40	1	12	6	2	1	S	ATG	CT	Yes
SB-126	84	1385	50	35	42.5	1.43	12	5	2.4	1	S	SC	CT	Yes
SB-127	84	1385	53	29	41	1.83	8	4	2	1	S	SC	CT	Yes
SB-128	84	1385	53	30	41.5	1.77	10	4	2.5	1	S	SC	CT	Yes
SB-129	84	1385	47	30	38.5	1.57	8	3	2.67	1	S	SC	SPT	No
SB-130	84	1385	50	40	45	1.25	10	5	2	1	S	HG	CT	Yes
SB-131	84	1385	37	36	36.5	1.03	10	6	1.67	0	D	HG	SPT	No
SB-132	84	1385	51	40	45.5	1.28	9	3	3	1	S	SC	AT	Yes
SB-133	80	1360	46	43	44.5	1.07	11	5	2.2	0	D	ATG	BHT	Yes
SB-134	80	1360	47	43	45	1.09	11	3	3.67	1	S	ATG	AT	No
SB-135	80	1360	60	43	51.5	1.4	14	6	2.33	0	S	SC	Nofit	No
SB-136	80	1360	44	40	42	1.1	10	5	2	0	S	HG	Nofit	No
SB-137	80	1360	54	41	47.5	1.32	15	6	2.5	0	S	SC	Nofit	No
SB-138	80	1360	60	37	48.5	1.62	10	4	2.5	1	S	SC	CT	Yes
SB-139	80	1360	60	40	50	1.5	12	6	2	1	S	SC	CT	Yes
SB-140	80	1360	53	41	47	1.29	12	6	2	1	S	SC	CT	Yes
SB-141	80	1360	52	45	48.5	1.16	13	6	2.17	1	S	ATG	CT	Yes
SB-142	80	1360	70	60	65	1.17	17	8	2.13	1	S	ATG	CT	Yes
SB-143	76	1330	40	35	37.5	1.14	10	5	2	1	S	HG	SPT	No
SB-144	76	1330	58	40	49	1.45	10	6	1.67	1	D	SC	GT	No
SB-145	76	1330	50	30	40	1.67	12	6	2	1	S	SC	CT	Yes
SB-146	76	1330	50	50	50	1	15	8	1.88	1	S	ATG	Nofit	No
SB-147	76	1330	55	35	45	1.57	10	4	2.5	1	S	SC	CT	Yes
SB-148	76	1330	37	37	37	1	8	4	2	1	S	HG	SPT	No
SB-149	76	1330	50	50	50	1	15	8	1.88	1	S	ATG	Nofit	No
SB-150	76	1330	48	30	39	1.6	8	4	2	1	S	SC	SPT	No
SB-151	76	1330	55	55	55	1	14	6	2.33	1	S	ATG	CT	Yes
SB-152	76	1330	50	33	41.5	1.52	10	5	2	1	S	SC	CT	Yes
SB-153	76	1330	53	40	46.5	1.32	10	5	2	1	S	SC	CT	Yes
SB-154	76	1330	45	45	45	1	12	6	2	1	S	ATG	CT	Yes

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-155	76	1330	50	45	47.5	1.11	14	6	2.33	1	S	ATG	CT	Yes
SB-156	76	1330	45	35	40	1.29	12	8	1.5	1	S	SC	Nofit	No
SB-157	76	1330	47	44	45.5	1.07	13	5	2.6	1	S	ATG	CT	Yes
SB-158	76	1330	45	40	42.5	1.13	12	5	2.4	1	S	ATG	CT	Yes
SB-159	76	1330	45	37	41	1.22	10	5	2	1	D	HG	Nofit	No
SB-160	72	1305	37	37	37	1	12	6	2	1	S	Nofit	SPT	No
SB-161	72	1305	40	40	40	1	10	5	2	1	S	HG	CT	Yes
SB-162	72	1305	43	40	41.5	1.08	12	6	2	1	S	ATG	CT	Yes
SB-163	72	1305	46	42	44	1.1	12	5	2.4	1	S	ATG	CT	Yes
SB-164	72	1305	50	37	43.5	1.35	12	6	2	1	S	SC	CT	Yes
SB-165	72	1305	62	42	52	1.48	12	6	2	1	S	SC	CT	Yes
SB-166	72	1305	40	40	40	1	10	5	2	1	S	HG	CT	Yes
SB-167	72	1305	47	45	46	1.04	15	6	2.5	1	S	ATG	CT	Yes
SB-168	72	1305	50	40	45	1.25	14	6	2.33	1	S	ATG	CT	Yes
SB-169	72	1305	50	37	43.5	1.35	13	6	2.17	1	S	SC	CT	Yes
SB-170	72	1305	60	55	57.5	1.09	14	5	2.8	1	S	ATG	CT	Yes
SB-171	72	1305	62	42	52	1.48	8	3	2.67	0	D	SC	AT	No
SB-172	72	1305	51	32	41.5	1.59	12	5	2.4	0	S	SC	Nofit	No
SB-173	68	1280	40	35	37.5	1.14	10	6	1.67	0	D	HG	SPT	No
SB-174	68	1280	48	37	42.5	1.3	10	4	2.5	1	D	SC	Nofit	No
SB-175	68	1280	40	37	38.5	1.08	12	6	2	1	S	Nofit	SPT	No
SB-176	68	1280	42	42	42	1	12	6	2	1	S	ATG	CT	Yes
SB-177	68	1280	53	39	46	1.36	12	6	2	1	S	SC	CT	Yes
SB-178	68	1280	41	36	38.5	1.14	12	6	2	1	S	Nofit	SPT	No
SB-179	68	1280	42	42	42	1	11	6	1.83	1	S	ATG	Nofit	No
SB-180	68	1280	50	37	43.5	1.35	13	6	2.17	1	S	SC	CT	Yes
SB-181	68	1280	40	35	37.5	1.14	10	5	2	0	D	HG	SPT	No
SB-182	68	1280	40	40	40	1	10	5	2	0	D	HG	BHT	Yes
SB-183	68	1280	46	37	41.5	1.24	11	4	2.75	1	S	ATG	CT	Yes
SB-184	64	1255	47	46	46.5	1.02	12	6	2	1	S	ATG	CT	Yes
SB-185	64	1255	47	29	38	1.62	10	5	2	1	S	SC	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-186	64	1255	50	37	43.5	1.35	13	6	2.16	1	S	SC	CT	Yes
SB-187	64	1255	50	40	45	1.25	13	6	2.17	1	S	ATG	CT	Yes
SB-188	64	1255	37	37	37	1	12	6	2	1	S	Nofit	SPT	No
SB-189	64	1255	58	40	49	1.45	10	5	2	1	S	SC	CT	Yes
SB-190	64	1255	46	45	45.5	1.02	13	6	2.17	1	S	ATG	CT	Yes
SB-191	64	1255	45	26	35.5	1.73	12	6	2	1	S	SC	SPT	No
SB-192	64	1255	50	37	43.5	1.35	12	6	2	1	S	SC	CT	Yes
SB-193	64	1255	37	36	36.5	1.03	11	6	1.83	1	S	Nofit	SPT	No
SB-194	64	1255	59	40	49.5	1.48	11	4	2.75	1	S	SC	CT	Yes
SB-195	64	1255	45	45	45	1	12	5	2.4	1	S	ATG	CT	Yes
SB-196	62	1240	45	42	43.5	1.07	10	5	2	0	D	HG	BHT	Yes
SB-197	62	1240	45	40	42.5	1.13	12	6	2	1	S	ATG	CT	Yes
SB-198	62	1240	50	43	46.5	1.16	10	5	2	1	D	Nofit	Nofit	No
SB-199	62	1240	41	41	41	1	10	5	2	1	S	HG	CT	Yes
SB-200	62	1240	40	40	40	1	8	4	2	0	D	HG	BHT	Yes
SB-201	62	1240	37	35	36	1.06	10	5	2	0	D	HG	SPT	No
SB-202	62	1240	37	36	36.5	1.03	10	5	2	1	S	HG	SPT	No
SB-203	62	1240	49	40	44.5	1.23	13	5	2.6	1	S	ATG	CT	Yes
SB-204	62	1240	46	40	43	1.15	11	3	3.67	1	S	ATG	AT	No
SB-205	62	1240	41	35	38	1.17	10	6	1.67	0	D	HG	SPT	No
SB-206	62	1240	38	31	34.5	1.23	10	5	2	0	S	HG	SPT	No
SB-207	62	1240	49	32	40.5	1.53	10	3	3.33	1	S	HG	AT	Yes
SB-208	60	1225	43	38	40.5	1.13	8	4	2	1	S	HG	CT	Yes
SB-209	60	1225	40	36	38	1.11	9	3	3	1	S	HG	SPT	No
SB-210	60	1225	42	30	36	1.4	9	3	3	1	S	SC	SPT	No
SB-211	60	1225	54	33	43.5	1.64	11	5	2.2	1	S	SC	CT	Yes
SB-212	60	1225	37	36	36.5	1.03	11	6	1.83	1	S	Nofit	SPT	No
SB-213	60	1225	45	42	43.5	1.07	10	3	3.33	1	S	HG	AT	Yes
SB-214	60	1225	49	40	44.5	1.23	8	3	2.67	0	S	HG	AT	Yes
SB-215	60	1225	48	30	39	1.6	8	3	2.67	0	S	SC	SPT	No
SB-216	60	1225	42	37	39.5	1.14	10	5	2	1	S	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-217	60	1225	45	37	41	1.22	10	5	2	1	S	HG	CT	Yes
SB-218	60	1225	45	29	37	1.55	10	4	2.5	1	S	SC	SPT	No
SB-219	60	1225	50	40	45	1.25	12	6	2	1	S	ATG	CT	Yes
SB-220	60	1225	45	37	41	1.22	12	6	2	1	S	ATG	CT	Yes
SB-221	60	1225	52	37	44.5	1.41	11	5	2.2	1	S	SC	CT	Yes
SB-222	60	1225	37	37	37	1	12	5	2.4	0	D	Nofit	SPT	No
SB-223	60	1225	45	35	40	1.29	12	4	3	1	S	SC	CT	Yes
SB-224	60	1225	50	30	40	1.67	10	4	2.5	1	S	SC	CT	Yes
SB-225	60	1225	50	35	42.5	1.43	12	5	2.4	1	S	SC	CT	Yes
SB-226	60	1225	45	28	36.5	1.61	13	6	2.17	1	S	SC	SPT	No
SB-227	58	1215	40	32	36	1.25	12	6	2	1	S	Nofit	SPT	No
SB-228	58	1215	50	35	42.5	1.43	10	4	2.5	1	S	SC	CT	Yes
SB-229	58	1215	42	28	35	1.5	6	3	2	1	S	SC	SPT	No
SB-230	58	1215	40	30	35	1.33	11	6	1.83	1	S	SC	SPT	No
SB-231	58	1215	50	34	42	1.47	11	4	2.75	1	S	SC	CT	Yes
SB-232	58	1215	49	33	41	1.48	11	5	2.2	1	S	SC	CT	Yes
SB-233	58	1215	42	28	35	1.5	6	2	3	1	S	SC	SPT	No
SB-234	58	1215	38	38	38	1	12	6	2	1	S	Nofit	SPT	No
SB-235	56	1200	52	35	43.5	1.49	10	5	2	1	S	SC	CT	Yes
SB-236	56	1200	50	42	46	1.19	12	6	2	1	S	ATG	CT	Yes
SB-237	56	1200	44	44	44	1	10	5	2	1	S	HG	CT	Yes
SB-238	56	1200	44	42	43	1.05	13	5	2.6	1	S	ATG	CT	Yes
SB-239	56	1200	50	35	42.5	1.43	10	4	2.5	1	S	SC	CT	Yes
SB-240	56	1200	58	47	52.5	1.23	13	7	1.86	1	S	ATG	Nofit	No
SB-241	56	1200	50	27	38.5	1.85	9	5	1.8	1	S	SC	SPT	No
SB-242	56	1200	52	37	44.5	1.41	10	5	2	1	S	SC	CT	Yes
SB-243	56	1200	42	42	42	1	12	6	2	1	S	ATG	CT	Yes
SB-244	56	1200	53	47	50	1.13	8	5	1.6	1	S	Nofit	Nofit	No
SB-245	56	1200	40	40	40	1	10	4	2.5	0	D	HG	BHT	Yes
SB-246	56	1200	51	36	43.5	1.42	11	4	2.75	1	S	SC	CT	Yes
SB-247	56	1200	49	43	46	1.14	12	7	1.71	1	S	ATG	Nofit	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-248	56	1200	44	44	44	1	10	5	2	1	S	HG	CT	Yes
SB-249	56	1200	43	43	43	1	11	6	1.83	1	S	ATG	Nofit	No
SB-250	56	1200	52	37	44.5	1.41	13	7	1.86	1	S	SC	Nofit	No
SB-251	56	1200	57	47	52	1.21	13	7	1.86	1	S	ATG	Nofit	No
SB-252	56	1200	50	28	39	1.79	9	4	2.25	1	S	SC	SPT	No
SB-253	56	1200	52	37	44.5	1.41	10	5	2	1	S	SC	CT	Yes
SB-254	56	1200	42	42	42	1	12	5	2.4	1	S	ATG	CT	Yes
SB-255	56	1200	40	39	39.5	1.03	10	5	2	0	D	HG	SPT	No
SB-256	56	1200	50	44	47	1.14	8	4	2	1	S	Nofit	CT	Yes
SB-257	52	1175	45	37	41	1.22	9	3	3	1	S	HG	AT	Yes
SB-258	52	1175	50	33	41.5	1.52	10	4	2.5	1	S	SC	CT	Yes
SB-259	52	1175	50	50	50	1	13	6	2.17	1	S	ATG	CT	Yes
SB-260	52	1175	37	30	33.5	1.23	11	5	2.2	0	S	Nofit	SPT	No
SB-261	52	1175	53	40	46.5	1.33	10	4	2.5	0	D	SC	BHT	No
SB-262	52	1175	45	29	37	1.55	10	3	3.33	1	S	SC	SPT	No
SB-263	52	1175	38	37	37.5	1.03	10	4	2.5	1	S	HG	SPT	No
SB-264	52	1175	55	32	43.5	1.72	11	5	2.2	1	S	SC	CT	Yes
SB-265	52	1175	48	32	40	1.5	8	4	2	0	S	SC	Nofit	No
SB-266	52	1175	40	35	37.5	1.14	10	4	2.5	0	S	HG	SPT	No
SB-267	52	1175	45	35	40	1.29	10	4	2.5	1	S	SC	CT	Yes
SB-268	52	1175	37	35	36	1.06	11	4	2.75	1	S	Nofit	SPT	No
SB-269	52	1175	38	30	34	1.27	11	5	2.2	1	S	SC	SPT	No
SB-270	52	1175	43	35	39	1.23	9	3	3	1	S	HG	SPT	No
SB-271	52	1175	45	26	35.5	1.73	6	2	3	0	S	SC	SPT	No
SB-272	52	1175	47	40	43.5	1.18	12	4	3	1	S	ATG	CT	Yes
SB-273	48	1150	41	40	40.5	1.03	12	5	2.4	1	S	ATG	CT	Yes
SB-274	48	1150	50	33	41.5	1.52	10	4	2.5	1	S	SC	CT	Yes
SB-275	48	1150	51	43	47	1.19	8	3	2.67	0	D	Nofit	AT	No
SB-276	48	1150	48	36	42	1.33	11	6	1.83	1	S	SC	Nofit	No
SB-277	48	1150	45	36	40.5	1.25	10	5	2	1	S	HG	CT	Yes
SB-278	48	1150	40	37	38.5	1.08	10	5	2	1	S	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
SB-279	48	1150	55	37	46	1.49	16	8	2	1	S	SC	CT	Yes
SB-280	48	1150	50	40	45	1.25	12	6	2	1	S	ATG	CT	Yes
SB-281	48	1150	50	40	45	1.25	12	6	2	1	S	ATG	CT	Yes
SB-282	48	1150	40	40	40	1	10	5	2	1	S	HG	CT	Yes
SB-283	48	1150	40	40	40	1	12	6	2	1	S	ATG	CT	Yes
SB-284	48	1150	42	35	38.5	1.2	11	5	2.2	1	S	Nofit	SPT	No
SB-285	48	1150	48	47	47.5	1.02	12	5	2.4	1	S	ATG	CT	Yes

Table 5.5: large Poaceae pollen: (n_{comp}) data for Sproatley Bog. For explanation of columns A-I see Table 5.1, for Andersen types see Table 5.7 and for Küster types see Table 5.8. An asterisk next to the Andersen type denotes a distorted (compressed) grain (see 5.3.1 for explanation). A yes in the species overlap column indicates that the species groups suggested by the two keys overlap.

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
RBO-1	612	10,090	41	37	39	1.11	10	5	2	0	S	HG	SPT	No
RBO-2	612	10,090	37	35	36	1.06	8	4	2	0	D	HG	SPT	No
RBO-3	612	10,090	45	37	41	1.22	10	6	1.67	1	D	HG	GT	Yes
RBO-4	612	10,090	42	29	35.5	1.45	10	5	2	0	D	HG*	SPT	No
RBO-5	612	10,090	37	33	35	1.12	9	3	3	0	S	HG	SPT	No
RBO-6	612	10,090	40	35	37.5	1.14	8	2	4	0	D	HG	SPT	No
RBO-7	612	10,090	45	35	40	1.29	12	8	1.5	0	D	HG*	BHT	Yes
RBO-8	610	10,050	45	42	43.5	1.07	8	5	1.6	0	D	HG	GT	Yes
RBO-9	608	10,010	40	40	40	1	10	4	2.5	0	S	HG	Nofit	No
RBO-10	608	10,010	41	32	36.5	1.28	8	3	2.67	0	D	HG*	SPT	No
RBO-11	608	10,010	48	36	42	1.33	11	6	1.83	0	S	HG*	GT	Yes
RBO-12	608	10,010	40	40	40	1	10	3	3.33	0	D	HG	AT	Yes
RBO-13	608	10,010	41	40	40.5	1.03	12	5	2.4	0	S	ATG	Nofit	No
RBO-14	608	10,010	49	42	45.5	1.17	11	4	2.75	1	S	ATG	CT	Yes
RBO-15	608	10,010	42	37	39.5	1.14	11	4	2.75	0	S	Nofit	SPT	No
RBO-16	606	9970	37	35	36	1.06	9	5	1.8	0	S	HG	SPT	No
RBO-17	606	9970	42	36	39	1.17	9	3	3	0	S	HG	SPT	No
RBO-18	606	9970	37	35	36	1.06	8	3	2.67	0	S	HG	SPT	No
RBO-19	604	9930	42	38	40	1.11	8	3	2.67	0	S	HG	AT	Yes
RBO-20	604	9930	45	36	40.5	1.25	9	3	3	0	S	HG	Nofit	No
RBO-21	592	9690	38	30	34	1.27	9	3	3	0	S	HG*	SPT	No
RBO-22	588	9615	38	31	34.5	1.23	10	5	2	0	D	HG	SPT	No
RBO-23	376	7400	48	43	45.5	1.12	10	6	1.67	0	D	Nofit	GT	No
RBO-24	320	5360	38	35	36.5	1.09	10	4	2.5	0	S	HG	SPT	No
RBO-25	317	5270	47	42	44.5	1.12	11	6	1.83	0	D	ATG	GT	No
RBO-26	274	4780	37	37	37	1	10	4	2.5	0	S	HG	SPT	No
RBO-27	274	4780	42	40	41	1.05	11	5	2.2	0	D	ATG	BHT	Yes
RBO-28	274	4780	43	39	41	1.1	10	5	2	1	S	HG	CT	Yes
RBO-29	274	4780	41	35	38	1.17	11	5	2.2	0	D	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
RBO-30	274	4780	41	33	37	1.24	8	3	2.67	0	D	HG	SPT	No
RBO-31	274	4780	56	45	50.5	1.24	16	6	2.67	1	S	ATG	CT	Yes
RBO-32	270	4730	37	30	33.5	1.23	10	5	2	0	D	HG	SPT	No
RBO-33	266	4685	50	42	46	1.19	14	5	2.8	1	S	ATG	CT	Yes
RBO-34	264	4660	56	45	50.5	1.24	13	6	2.17	1	S	ATG	CT	Yes
RBO-35	264	4660	37	29	33	1.28	8	5	1.6	0	S	HG	SPT	No
RBO-36	260	4615	37	35	36	1.06	9	4	2.25	0	S	HG	SPT	No
RBO-37	260	4615	38	37	37.5	1.03	11	6	1.83	0	S	Nofit	SPT	No
RBO-38	260	4615	41	40	40.5	1.03	9	3	3	0	S	HG	Nofit	No
RBO-39	254	4545	40	35	37.5	1.14	8	3	2.67	0	D	HG	SPT	No
RBO-40	254	4545	39	36	37.5	1.08	8	3	2.67	0	S	HG	SPT	No
RBO-41	254	4545	53	42	47.5	1.26	12	5	2.4	0	S	ATG*	Nofit	No
RBO-42	254	4545	40	38	39	1.05	12	6	2	0	S	Nofit	SPT	No
RBO-43	252	4520	53	41	47	1.29	13	6	2.17	1	S	SC	CT	Yes
RBO-44	252	4520	38	37	37.5	1.03	10	4	2.5	0	S	HG	SPT	No
RBO-45	252	4520	37	35	36	1.06	10	5	2	0	S	HG	SPT	No
RBO-46	228	4240	38	35	36.5	1.09	9	3	3	1	S	HG	SPT	No
RBO-47	176	3640	42	35	38.5	1.2	9	3	3	0	S	HG	SPT	No
RBO-48	176	3640	41	35	38	1.17	8	4	2	0	S	HG	SPT	No
RBO-49	176	3640	37	34	35.5	1.09	9	3	3	1	S	HG	SPT	No
RBO-50	160	3450	37	37	37	1	9	3	3	1	S	HG	SPT	No
RBO-51	152	Pre-1980	50	40	45	1.25	13	4	3.25	1	S	ATG	CT	Yes
RBO-52	152	Pre-1980	37	28	32.5	1.32	10	3	3.33	1	S	SC	SPT	No
RBO-53	150	Pre-1980	40	34	37	1.18	11	7	1.57	0	D	Nofit	SPT	No
RBO-54	150	Pre-1980	42	37	39.5	1.14	8	4	2	0	S	HG	SPT	No
RBO-55	148	Pre-1980	37	36	36.5	1.03	11	3	3.67	1	S	Nofit	SPT	No
RBO-56	148	Pre-1980	58	53	55.5	1.09	13	4	3.25	1	S	ATG	CT	Yes
RBO-57	148	Pre-1980	49	49	49	1	12	5	2.4	0	S	ATG	Nofit	No
RBO-58	148	Pre-1980	40	36	38	1.11	8	3	2.67	0	S	HG	SPT	No
RBO-59	148	Pre-1980	37	36	36.5	1.03	11	4	2.75	0	S	Nofit	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
RBO-60	146	Pre-1980	48	36	42	1.33	12	4	3	1	S	SC	CT	Yes
RBO-61	144	Pre-1980	38	37	37.5	1.03	10	3	3.33	1	S	HG	SPT	No
RBO-62	140	Pre-1980	45	37	41	1.22	12	4	3	1	S	ATG	CT	Yes
RBO-63	140	Pre-1980	38	38	38	1	8	3	2.67	0	D	HG	SPT	No
RBO-64	140	Pre-1980	39	33	36	1.18	9	3	3	0	D	HG	SPT	No
RBO-65	140	Pre-1980	38	34	36	1.12	9	4	2.25	0	D	HG	SPT	No
RBO-66	132	Pre-1980	50	35	42.5	1.43	10	3	3.33	1	S	SC	AT	No
RBO-67	120	1945	37	33	35	1.12	10	6	1.67	1	D	HG	SPT	No
RBO-68	120	1945	53	53	53	1	15	6	2.5	1	S	ATG	CT	Yes
RBO-69	120	1945	48	40	44	1.2	10	5	2	0	D	HG	BHT	Yes
RBO-70	108	1800	50	38	44	1.32	10	3	3.33	1	S	SC	AT	No
RBO-71	108	1800	39	30	34.5	1.3	8	3	2.67	0	S	HG	SPT	No
RBO-72	108	1800	41	35	38	1.17	10	5	2	0	D	HG	SPT	No
RBO-73	92	1600	44	40	42	1.1	11	7	1.57	0	D	ATG	GT	No
RBO-74	78	1415	47	42	44.5	1.12	10	4	2.5	0	S	HG	Nofit	No
RBO-75	78	1415	42	37	39.5	1.14	13	5	2.6	0	D	Nofit	SPT	No
RBO-76	78	1415	38	37	37.5	1.03	10	3	3.33	1	S	HG	SPT	No
RBO-77	64	1150	50	40	45	1.25	12	5	2.4	1	S	ATG	CT	Yes
RBO-78	64	1150	45	42	43.5	1.07	13	6	2.17	0	S	ATG	Nofit	No
RBO-79	64	1150	45	42	43.5	1.07	12	8	1.5	0	S	ATG	Nofit	No
RBO-80	64	1150	38	27	32.5	1.4	9	3	3	0	D	HG	SPT	No
RBO-81	64	1150	55	50	52.5	1.1	12	4	3	1	S	ATG	CT	Yes
RBO-82	60	1070	42	42	42	1	13	5	2.6	1	S	ATG	CT	Yes
RBO-83	60	1070	49	46	47.5	1.07	13	5	2.6	1	S	ATG	CT	Yes
RBO-84	60	1070	41	33	37	1.24	9	3	3	0	S	HG	SPT	No
RBO-85	60	1070	47	39	43	1.21	11	3	3.67	1	S	ATG	AT	No
RBO-86	60	1070	50	45	47.5	1.11	12	4	3	1	S	ATG	CT	Yes
RBO-87	60	1070	39	38	38.5	1.03	8	4	2	0	D	HG	SPT	No
RBO-88	60	1070	45	37	41	1.22	11	4	2.75	1	S	ATG	CT	Yes
RBO-89	60	1070	53	45	49	1.18	13	5	2.6	1	S	ATG	CT	Yes

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
RBO-90	60	1070	37	36	36.5	1.03	10	5	2	1	S	HG	SPT	No
RBO-91	60	1070	40	35	37.5	1.14	8	3	2.67	1	S	HG	SPT	No
RBO-92	60	1070	46	37	41.5	1.24	11	5	2.2	1	S	ATG	CT	Yes
RBO-93	60	1070	38	32	35	1.19	8	2	4	0	S	HG	SPT	No
RBO-94	60	1070	45	42	43.5	1.07	13	4	3.25	1	S	ATG	CT	Yes
RBO-95	60	1070	37	30	33.5	1.23	10	6	1.67	0	D	HG	SPT	No
RBO-96	60	1070	43	33	38	1.3	12	5	2.4	1	D	HG	SPT	No
RBO-97	58	1030	44	42	43	1.05	12	3	4	1	S	ATG	AT	No
RBO-98	58	1030	45	40	42.5	1.13	11	3	3.67	0	D	ATG	AT	No
RBO-99	58	1030	45	39	42	1.15	10	3	3.33	0	D	HG	AT	Yes
RBO-100	58	1030	45	43	44	1.05	11	3	3.67	0	D	ATG	AT	No
RBO-101	58	1030	37	35	36	1.06	10	4	2.5	0	D	HG	SPT	No
RBO-102	56	995	42	40	41	1.05	12	3	4	1	S	ATG	AT	No
RBO-103	54	955	40	35	37.5	1.14	11	4	2.75	1	D	Nofit	SPT	No
RBO-104	54	955	44	35	39.5	1.26	11	4	2.75	1	S	SC	SPT	No
RBO-105	54	955	39	35	37	1.11	11	5	2.2	0	S	Nofit	SPT	No
RBO-106	54	955	52	36	44	1.44	8	4	2	0	D	SC	BHT	No
RBO-107	52	915	38	37	37.5	1.03	8	3	2.67	0	D	HG	SPT	No
RBO-108	52	915	37	30	33.5	1.23	8	4	2	0	D	HG	SPT	No
RBO-109	52	915	42	33	37.5	1.27	8	3	2.67	0	D	SC	SPT	No
RBO-110	50	880	40	38	39	1.05	10	3	3.33	1	S	HG	SPT	No
RBO-111	48	840	37	30	33.5	1.23	10	4	2.5	1	S	HG	SPT	No
RBO-112	44	765	37	34	35.5	1.09	11	4	2.75	0	S	Nofit	SPT	No
RBO-113	44	765	50	46	48	1.09	13	8	1.63	0	S	ATG	Nofit	No
RBO-114	44	765	50	48	49	1.04	15	7	2.14	1	S	ATG	CT	Yes
RBO-115	44	765	48	45	46.5	1.07	12	5	2.4	1	S	ATG	CT	Yes
RBO-116	44	765	51	33	42	1.54	5	2	2.5	0	D	SC	BHT	No
RBO-117	44	765	37	30	33.5	1.23	10	5	2	1	S	HG	SPT	No
RBO-118	40	690	50	35	42.5	1.43	11	3	3.67	1	S	SC	AT	No
RBO-119	40	690	45	30	37.5	1.5	10	3	3.33	1	S	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
RBO-120	36	610	44	35	39.5	1.26	11	5	2.2	0	S	SC	SPT	No
RBO-121	36	610	47	37	42	1.27	12	4	3	1	S	SC	CT	Yes
RBO-122	36	610	50	50	50	1	8	2	4	0	S	Nofit	Nofit	No
RBO-123	36	610	38	37	37.5	1.03	10	5	2	0	S	HG	SPT	No
RBO-124	32	535	48	45	46.5	1.07	13	5	2.6	1	S	ATG	CT	Yes
RBO-125	32	535	37	35	36	1.06	12	5	2.4	0	S	Nofit	SPT	No
RBO-126	32	535	55	48	51.5	1.14	13	6	2.17	1	S	ATG	CT	Yes
RBO-127	32	535	47	38	42.5	1.24	8	4	2	0	S	HG	Nofit	No
RBO-128	32	535	43	37	40	1.16	9	4	2.25	0	D	HG	BHT	Yes
RBO-129	32	535	37	33	35	1.12	8	3	2.67	1	S	HG	SPT	No
RBO-130	32	535	37	32	34.5	1.16	10	3	3.33	1	S	HG	SPT	No
RBO-131	28	460	53	36	44.5	1.47	11	4	2.75	1	S	SC	CT	Yes
RBO-132	28	460	49	33	41	1.48	10	3	3.33	0	D	SC	AT	No
RBO-133	28	460	50	47	48.5	1.06	15	6	2.5	1	S	ATG	CT	Yes
RBO-134	28	460	53	37	45	1.43	11	4	2.75	1	S	SC	CT	Yes
RBO-135	28	460	47	35	41	1.34	11	4	2.75	1	S	SC	CT	Yes
RBO-136	28	460	49	37	43	1.32	12	4	3	1	S	SC	CT	Yes
RBO-137	28	460	58	37	47.5	1.57	10	3	3.33	0	D	SC	AT	No
RBO-138	28	460	45	40	42.5	1.13	13	5	2.6	1	S	ATG	CT	Yes
RBO-139	24	380	42	37	39.5	1.14	8	3	2.67	1	S	HG	SPT	No
RBO-140	24	380	47	37	42	1.27	9	2	4.5	0	S	SC	Nofit	No
RBO-141	24	380	45	37	41	1.22	10	3	3.33	0	S	HG	Nofit	No
RBO-142	24	380	40	30	35	1.33	10	4	2.5	0	D	SC	SPT	No
RBO-143	24	380	53	50	51.5	1.06	16	5	3.2	1	S	ATG	CT	Yes
RBO-144	24	380	41	30	35.5	1.37	8	2	4	0	S	SC	SPT	No
RBO-145	24	380	47	30	38.5	1.57	8	3	2.67	0	S	SC	SPT	No
RBO-146	24	380	50	42	46	1.19	12	4	3	1	S	ATG	CT	Yes
RBO-147	24	380	53	37	45	1.43	12	3	4	1	S	SC	AT	No
RBO-148	24	380	43	37	40	1.16	10	3	3.33	0	S	HG	Nofit	No
RBO-149	20	305	37	37	37	1	9	3	3	0	S	HG	SPT	No

Grain code	Depth (cm)	Age (BP)	A	B	C	D	E	F	G	H	I	Andersen type	Küster type	Species overlap?
RBO-150	20	305	50	38	44	1.32	13	5	2.6	1	S	SC	CT	Yes
RBO-151	20	305	42	38	40	1.1	12	5	2.4	0	S	ATG	Nofit	No
RBO-152	20	305	45	33	39	1.36	11	3	3.67	1	S	SC	SPT	No
RBO-153	20	305	53	45	49	1.18	11	5	2.2	0	S	ATG	Nofit	No
RBO-154	20	305	49	40	44.5	1.23	13	4	3.25	1	S	ATG	CT	Yes
RBO-155	20	305	42	35	38.5	1.2	10	4	2.5	0	D	HG	SPT	No
RBO-156	20	305	51	47	49	1.09	15	5	3	1	S	ATG	CT	Yes
RBO-157	20	305	46	38	42	1.21	9	3	3	0	S	HG	Nofit	No
RBO-158	20	305	42	37	39.5	1.14	12	5	2.4	1	S	Nofit	SPT	No
RBO-159	16	230	50	40	45	1.25	8	3	2.67	0	D	HG	AT	Yes
RBO-160	16	230	45	38	41.5	1.18	8	3	2.67	0	D	HG	AT	Yes
RBO-161	16	230	40	33	36.5	1.21	8	4	2	0	D	HG	SPT	No
RBO-162	16	230	40	38	39	1.05	8	4	2	0	S	HG	SPT	No
RBO-163	12	150	58	40	49	1.45	11	6	1.83	1	S	ATG	Nofit	No
RBO-164	8	75	60	47	53.5	1.28	14	5	2.8	1	S	SC	CT	Yes
RBO-165	4	0	49	49	49	1	15	8	1.87	1	S	ATG	Nofit	No
RBO-166	4	0	38	37	37.5	1.03	8	3	2.67	0	D	HG	SPT	No
RBO-167	4	0	60	49	54.5	1.22	14	6	2.33	1	S	ATG	CT	Yes
RBO-168	4	0	53	50	51.5	1.06	15	5	3	1	S	ATG	CT	Yes
RBO-169	4	0	45	38	41.5	1.18	11	4	2.75	1	S	ATG	CT	Yes
RBO-170	1	0	52	47	49.5	1.11	15	6	2.5	1	S	ATG	CT	Yes
RBO-171	1	0	37	37	37	1	8	4	2	0	S	HG	SPT	No
RBO-172	1	0	60	58	59	1.03	13	5	2.6	1	S	ATG	CT	Yes

Table 5.6: large Poaceae pollen: (n_{comp}) data for The Bog at Roos. For explanation of columns A-I see Table 5.1, for Andersen types see Table 5.7 and for Küster types see Table 5.8. An asterisk next to the Andersen type denotes a distorted (compressed) grain (see 5.3.1 for explanation). A yes in the species overlap column indicates that the species groups suggested by the two keys overlap.

Pollen type	Characters	Taxa included
Wild Grass Group (WGG)	Mean pollen size <37 µm. Mean annulus diameter <8 µm. Surface pattern scabrate or verrucate.	Most wild grass species.
Hordeum group (HG)	Mean pollen size 32-45 µm. Mean annulus diameter 8-10 µm. Surface pattern scabrate.	*Ammophila arenaria, Elymus repens (Agropyron repens), Elymus farctus (A. junceiforme), Leymus arenarius (Elymus arenarius), Glyceria fluitans, G. plicata, Bromus inermis* and *Hordeum jubatum.* ***H. murinum, H. vulgare, Triticum monococcum.***
Avena-Triticum group (ATG)	Mean pollen size >40 µm. Mean annulus diameter >10 µm. Surface pattern verrucate.	*Avena fatua,* ***A. sativa, A. nuda, Triticum aestivum, T. polonicum, T. spelta, T. dicoccum, T. compactum, T. durum.***
Secale cereale (SC)	Pollen index >1.26. Surface pattern scabrate.	***Secale cereale.***

Table 5.7: Andersen (1979) Poaceae pollen types. Initials in parentheses refer to the abbreviations used in Tables 5.3-5.6 and cultivated taxa are shown in bold. Species names in brackets refer to former names.

Pollen type	Characters	Taxa included
Small Poaceae-type (SPT)	Grain <40 µm, most clearly smaller.	*Brachypodium, Dactylis, Deschampsia, Cynosurus, Festuca, Hierochloe, Molinia, Phleum, Poa, Piccinellia, Seslaria, Agrostis, Lolium, Alopecurus, Bromus arvensis, B. erectus, B. ramosus.*
Glyceria-type (GT)	Grain >40 µm. Annulus diameter less than double the pore diameter. Diffuse (indistinct) outer annulus boundary.	*Elymus, Glyceria fluitans, G. plicata, Holcus, Hordelymus, Setaria, Spartina, Anthoxanthum, Phragmites.*
Arrhenaterum-type (AT)	Grain >40 µm. Annulus diameter greater than double the pore diameter. Pore diameter <4 µm (most clearly smaller).	*Digitaria, Panicum, Arrhentaerum, Bromus secalinus, B. mollis, Elymus repens (Agropyron repens), Glyceria maxima.*
Zea mays	Grain >80 µm. Annulus diameter greater than double the pore diameter. Pore diameter >4 µm.	***Zea mays*** Not expected in this study.
Bromus hordeaceus-type (BHT)	Grain >40 µm. Annulus diameter greater than double the pore diameter. Pore diameter >4 µm. Outer annulus boundary diffuse. Annulus not appreciably thicker than the rest of the exine.	*Avenula, Avena fatua, Bromus commutatus, B. benehenii, B. tectorum, B. inermis, B. hordeaceus, Anthoxanthum, Hordeum maritimum.*
Cerealia-type (CT)	Grain >40 µm. Annulus diameter greater than double the pore diameter. Pore diameter >4 µm. Outer annulus boundary sharp. Annulus appreciably thicker than rest of exine (>3 times thickness).	***Triticum, Avena, Hordeum, Secale,*** *Elymus caninus (Agropyron caninum), Hordeum murinum, Hordeum secalinum, Avena fatua.*

Table 5.8: Küster (1988) Poaceae pollen types. Initials in parentheses refer to the abbreviations used in Tables 5.3-5.6 and cultivated taxa are shown in bold. Species names in brackets refer to former names.

Group code	Approximate age range (BP)	Notes
1	10,100-9600	Grains dating to the earliest Holocene and clearly too old to originate from cultivated taxa. Almost certainly reflect the growth of wild species (but see Edwards, 1989).
2	8100-6800	Grains clearly too old to originate from cultivated taxa and associated with distinct events within the pollen record (the expansion of *Alnus glutinosa* to become an important woodland component within the site catchments and a possible climatic deterioration; chapters 6, 7 and 9). Almost certainly reflect the growth of wild species.
3	6100-2000	This group includes grains occurring during the Neolithic Period, the Bronze Age and the Iron Age. Also covered are grains found <1000 ^{14}C yr prior to the traditional elm decline (*ca* 6100-5100 BP). Cereal-type grains have been found within this timespan by a number of authors (e.g. Edwards and Hirons, 1984; O'Connell, 1987; Edwards and McIntosh, 1988; Innes and Tomlinson [in Innes, 1990];) and may represent early periods of woodland-based cultivation (Edwards and Hirons, 1984; Edwards, 1998). Note that two grains from the Cess Dell profile dated to 6400 BP (CD-12 and CD-13) have also been included within this category. It is possible that these grains could originate from cultivated or wild taxa.
4	2000-0	Grains dating from the Roman and Historical Periods. It is possible that these grains could originate from cultivated or wild taxa.

Table 5.9: interpolated age ranges for the four main groups of large Poaceae grains located during the study and notes upon their possible origins.

Species (Latin name)	**Species (common name/s)**	**Andersen (1979) type**	**Küster (1988) type**	**Habitat**
Ammophila arenaria	Marram	HG	X	Sand dunes (coastal)
Elymus farctus (Agropyron juriceiforme)	Sand couch	HG	GT	Sand by the sea (coastal)
Leymus arenarius (Elymus arenarius)	Lyme grass	HG	GT	Sand dunes and sandy shores (mainly coastal)
Glyceria fluitans	Floating sweet-grass	HG	GT	In and by still and slow-flowing fresh-water. Hybridises with *G. plicata.*
Glyceria plicata	Plicate sweet-grass	HG	GT	Freshwater margins and other wet places, avoiding poor, acid waters.
Elymus caninus (Agropyron caninum)	Bearded couch	WGG	CT	Woods and other shady places or rocky places on hills. Often on damp ground.
Avena fatua	Wild oat	ATG	CT	Arable fields and waste ground, often growing with oats, barley or wheat.
Bromus inermis	Hungarian brome	HG	BHT	Bare, often sandy ground.
Elymus repens (Agropyron repens)	Common couch, twitch	HG	AT	Widespread on waste and cultivated ground
Hordeum murinum	Wall barley	HG	CT	Waste ground, waysides.
Hordeum secalinum	Meadow barley	X	CT	Established grassland, meadow or pasture, on heavy soils.

Table 5.10: non-cultivated Poaceae species included within categories of Andersen (1979) and Küster (1988) that also contain Cerealia: Latin and common names, and habitat data (based on Fitter *et al.* [1995], Grime *et al.* [1995] and Stace [1997]). X denotes taxon not included in respective study. Note that the table is split according to habitat type.

Characters	Andersen (1979) type	Küster (1988) type	Possible species
Mean pollen size 32-45 µm. Mean annulus diameter 8-10 µm. Annulus diameter less than double the pore diameter. Diffuse (indistinct) outer annulus boundary.	HG	GT	**Species group A** *Elymus* *Glyceria fluitans* *Glyceria plicata*
Mean pollen size 32-45 µm. Mean annulus diameter 8-10 µm. Annulus diameter greater than double the pore diameter. Pore diameter <4 µm (most clearly smaller).	HG	AT	**Species group B** *Elymus repens* *(Agropyron repens)* *Glyceria maxima*
Mean pollen size 32-45 µm. Mean annulus diameter 8-10 µm. Annulus diameter greater than double the pore diameter. Pore diameter >4 µm. Outer annulus boundary diffuse. Annulus not appreciably thicker than the rest of the exine.	HG	BHT	**Species group C** *Bromus inermis*
Mean pollen size 32-45 µm. Mean annulus diameter 8-10 µm. Annulus diameter greater than double the pore diameter. Pore diameter >4 µm. Outer annulus boundary sharp. Annulus appreciably thicker than rest of exine (>3 times thickness).	HG	CT	**Species group D** *Hordeum murinum* ***Hordeum vulgare*** ***Triticum monococcum***

Table 5.11: separation of taxa within the *Hordeum* group of Andersen (1979): pollen characteristics and species groupings. Species names in brackets refer to former names and cultivated taxa are shown in bold.

Category	**Andersen (1979) type**	**Küster (1988) type**	**Genus/species**
Species not included in the study of Andersen (1979), but included in that of Küster (1988).		GT GT GT AT AT AT AT BHT BHT CT	*Hordelymus* *Setaria* *Spartina* *Digitaria* *Panicum* *Arrhentaerum* *Bromus mollis* *Avenula* *Bromus commutatus* *Hordeum secalinum*
Species not included in the study of Küster (1988), but included in that of Andersen (1979).	HG		*Ammophila arenaria*

Table 5.12: details of Poaceae genera/species that are not included in both the studies of Andersen (1979) and Küster (1988).

Variables included in analysis	**PCA code used in text and figures**	**Principal component (PC) codes used in text and figures**
A, B, D, E	PCA-a	PC-1a (first PC) PC-2a (second PC) PC-3a (third PC) PC-4a (fourth PC)
A, B, D, E, F, G	PCA-b	PC-1b (first PC) PC-2b (second PC) PC-3b (third PC) PC-4b (fourth PC)
A, B, D, E, F, G, H, I	PCA-c	PC-1c (first PC) PC-2c (second PC) PC-3c (third PC) PC-4c (fourth PC)

Table 5.13: details of the principal component analyses performed and codes used in the text. For variable codes see Table 5.1.

Parameter/variable	PC-1a	PC-2a	PC-3a	PC-4a
Eigenvalue	2.1928	1.3974	0.4018	0.0080
Proportion of variance accounted for by PC	0.548	0.349	0.100	0.002
Cumulative proportion of variance accounted for	0.548	0.898	0.998	1.000
A	0.465	-0.583	0.349	0.568
B	0.633	0.170	0.439	-0.614
D	-0.222	-0.794	-0.138	-0.548
E	0.578	-0.023	-0.816	0.005

Table 5.14: PCA-a: details of the principal components data obtained by eigenanalysis of the correlation matrix.

Parameter/variable	PC-1b	PC-2b	PC-3b	PC-4b
Eigenvalue	2.7756	1.4128	1.3232	0.4548
Proportion of variance accounted for by PC	0.463	0.235	0.221	0.076
Cumulative proportion of variance accounted for	0.463	0.698	0.919	0.994
A	-0.357	0.640	-0.006	0.375
B	-0.496	-0.006	-0.404	0.461
D	0.183	0.674	0.439	-0.139
E	-0.515	0.107	-0.161	-0.676
F	-0.516	-0.152	0.379	-0.240
G	0.248	0.319	-0.689	-0.336

Table 5.15: PCA-b: details of the principal components data obtained by eigenanalysis of the correlation matrix.

Parameter/variable	PC-1c	PC-2c	PC-3c	PC-4c
Eigenvalue	3.0326	1.7224	1.3412	0.9986
Proportion of variance accounted for by PC	0.379	0.215	0.168	0.125
Cumulative proportion of variance accounted for	0.379	0.594	0.762	0.887
A	0.378	0.320	-0.170	-0.555
B	0.452	-0.133	0.379	-0.278
D	-0.110	0.489	-0.592	-0.256
E	0.501	-0.017	0.125	-0.089
F	0.454	-0.325	-0.328	0.097
G	-0.178	0.435	0.580	-0.247
H	0.308	0.397	-0.041	0.424
I	0.241	0.433	0.124	0.517

Table 5.16: PCA-c: details of the principal components data obtained by eigenanalysis of the correlation matrix.

Andersen group (true group)	Total number of grains in category	Number put into HG by DA	Number put into ATG by DA	Number put into SC by DA	Number correctly assigned by DA	Proportion correctly assigned by DA
HG	184	178	0	6	178	0.967
ATG	153	13	138	2	138	0.902
SC	132	10	2	120	120	0.909
Grand totals	**469**	**201**	**140**	**128**	**436**	**0.930**

Table 5.17: discriminant analysis: summary of results (see text for detail).

Grain code	Age group	Probability that grain belongs to the HG	Probability that grain belongs to the ATG	Probability that grain is SC	Predicted group
GM-5	A	0.598	0.179	0.223	HG
GM-8	A	0.668	0.330	0.002	HG
GM-10	A	0.816	0.183	0.002	HG
GM-23	B	0.430	0.464	0.105	ATG
GM-26	B	0.826	0.065	0.109	HG
GM-29	C	0.680	0.282	0.038	HG
GM-33	C	0.642	0.333	0.025	HG
GM-35	C	0.912	0.001	0.087	HG
GM-49	C	0.055	0.941	0.004	ATG
CD-7	B	0.247	0.136	0.617	SC
SB-28	D	0.872	0.043	0.085	HG
SB-32	D	0.648	0.347	0.005	HG
SB-35	D	0.648	0.347	0.005	HG
SB-41	D	0.725	0.252	0.023	HG
SB-66	D	0.650	0.350	0.000	HG
SB-111	D	0.165	0.828	0.007	ATG
SB-116	D	0.568	0.408	0.023	HG
SB-121	D	0.650	0.350	0.000	HG
SB-160	D	0.743	0.257	0.000	HG
SB-175	D	0.648	0.347	0.005	HG
SB-178	D	0.656	0.320	0.024	HG
SB-188	D	0.743	0.257	0.000	HG
SB-193	D	0.955	0.045	0.001	HG
SB-198	D	0.626	0.306	0.067	HG
SB-212	D	0.955	0.045	0.001	HG
SB-222	D	0.650	0.350	0.000	HG
SB-227	D	0.569	0.164	0.267	HG
SB-234	D	0.629	0.371	0.000	HG
SB-244	D	0.895	0.087	0.018	HG
SB-256	D	0.945	0.040	0.015	HG
SB-260	D	0.881	0.034	0.086	HG
SB-268	D	0.919	0.080	0.002	HG
SB-275	D	0.876	0.041	0.083	HG
SB-284	D	0.792	0.120	0.089	HG
RBO-15	A	0.725	0.252	0.023	HG
RBO-23	B	0.745	0.239	0.017	HG
RBO-37	C	0.927	0.072	0.001	HG
RBO-42	C	0.571	0.427	0.002	HG
RBO-53	D	0.929	0.035	0.036	HG
RBO-55	D	0.829	0.170	0.001	HG
RBO-59	D	0.895	0.104	0.001	HG
RBO-75	D	0.145	0.841	0.014	ATG

RBO-103	D	0.843	0.136	0.021	HG
RBO-105	D	0.918	0.075	0.007	HG
RBO-112	D	0.932	0.064	0.003	HG
RBO-122	D	0.204	0.795	0.001	ATG
RBO-125	D	0.780	0.218	0.002	HG
RBO-158	D	0.462	0.516	0.022	ATG

Table 5.18: discriminant analysis: predicted Andersen groups of grains not fitting Andersen's characteristics.

Depth below ground surface (cm)	Core description
0-15	A-horizon.
16-58	Medium brown clay.
59-76	A-horizon.
77-90	Red-brown peat.
91-220	Red-brown peat with abundant wood fragments and twigs.
221-285	Dark brown peat.
286-423	Dark brown gyttja.
424-433	Medium brown gyttja.
434-720 (core not bottomed)	Laminated dark blue/grey, light grey and pink/grey clays. Laminations increase in thickness towards base.

Table 6.1: Cess Dell: core description.

Depth range (cm)	LDPAZ	Dominant deterioration types	Estimated age span (BP)	Estimated age span (cal BP)
436-420	CDDET-A	Broken	10,050-9860	11,520±175-11,240±60
420-389	CDDET-B	Type-1 corrosion, broken	9860-9440	11,240±60-10,660±100
389-309	CDDET-C	Type-1 corrosion	9440-8040	10,660±100-8940±95
309-162	CDDET-D	Broken	8040-6430	8940±95-7370±55
162-76	CDDET-E	Type-1 corrosion, crumpled, type-2 corrosion	6430-5660	7370±55-6450±55

Table 6.2: Cess Dell: local deteriorated pollen assemblage zone depth ranges, dominant deterioration types and interpolated ages.

Estimated time range (BP)	**LDPAZ**	**Summary of pollen preservation analysis**
10,050-9860	CDDET-A	Pollen preservation good, but erosive inwash may have introduced an older reworked component.
9860-9440	CDDET-B	Pollen preservation generally good. Type-1 corrosion increased, perhaps reflecting an elevated long-distance component or the activity of similar processes as hypothesised for CDDET-C.
9440-8040	CDDET-C	Pollen preservation fair to poor. Type-1 corrosion levels high, possibly due to an increased streamborne component. The pollen catchment may subsequently have been distorted in the direction of the stream. Alternatively, high levels of inwashing may have occurred. The fact that little palynological change occurs across the CDDET-C/CDDET-D boundary suggests that the events recorded in the preservation data had little effect on the overall palynological signal.
8040-6430	CDDET-D	Pollen preservation good, record seems reliable.
6430-5660	CDDET-E	Pollen preservation poor. High levels of corrosion suggest that the more susceptible pollen types may have been partially lost, but the data are unclear. The corrosion probably results from drying of the deposit during or after formation.

Table 6.3: Cess Dell: summary of the main conclusions of the pollen preservation analysis.

Depth range (cm)	**LPAZ**	**Dominant pollen types**	**Estimated age span (BP)**	**Estimated age span (cal BP)**
436-391	CD-1	*Betula*-Poaceae	10,050-9470	11,520±175-10,700±70
436-421	CD-1(a)		10,050-9850	11,520±175-11,220±40
421-403	CD-1(b)		9850-9650	11,220±40-11,120±55
403-391	CD-1(c)		9650-9470	11,120±55-10,700±70
391-297	CD-2	*Corylus avellana*-type-*Ulmus*	9470-7840	10,700±70-8670±115
391-345	CD-2(a)		9470-8730	10,700±70-9690±90
345-297	CD-2(b)		8730-7840	9690±90-8670±115
297-267	CD-3	*Alnus-Quercus* (*Betula*)	7840-7060	8670±115-7880±65
267-170	CD-4	*Alnus-Quercus* (*Corylus avellana*-type)	7060-6500	7880±65-7400±75
170-131	CD-5	*Quercus-Alnus-Tilia*	6500-6160	7400±75-7020±80
131-76	CD-6	*Quercus-Tilia*-Cyperaceae	6160-5660	7020±80-6450±55

Table 6.4: Cess Dell: local pollen assemblage zone and subzone depth ranges, dominant pollen types and interpolated ages.

Depth (cm)	Approximate TLP scanned (to nearest 100 grains)	Number of Poaceae pollen grains of longest axis > 37 µm located	Grain code/s for n_{comp} grains (see Table 5.3 for identifications)	Interpolated age (yr BP)
120	5500	0		
122	5600	1	CD-18	6070
124	5800	2	CD-16, CD-17	6090
125	5400	0		
126	5000	0		
128	5100	0		
130	8800	0		
132	6000	0		
136	6400	0		
140	5200	0		
144	6000	0		
148	6100	0		
151	10,100	0		
156	10,400	0		
160	10,000	0		
164	10,400	0		
264	10,100	0		
266	10,000	0		
268	10,800	0		
270	10,500	0		
272	10,900	1	CD-9	7190
274	10,600	0		
276	10,000	0		
278	10,000	0		
280	10,200	1	CD-8	7400
281	10,400	0		
282	10,600	0		
284	10,400	1	CD-7	7500
286	10,000	0		
288	10,700	0		
290	10,600	0		
292	10,900	0		
294	10,500	0		
296	10,900	0		
298	10,300	0		
300	10,000	0		

Table 6.5: Cess Dell: levels scanned for large Poaceae grains and the numbers and interpolated ages of all grains located.

Approximate age yrs/BP	LPAZ	Vegetational history: Dominant vegetation	Vegetational history: Main events	Erosional history	Charcoal abundance	Human impact?
10,000	CD-1(a)	Open birch/birch-willow woodland. Area covered by woodland, or canopy density, increased with time.	Local expansion and subsequent contraction of hazel (and possibly oak, elm and alder). Climatic shift?	Considerable erosion.	Very high. Inwashed?	
	CD-1(b)			Erosion reduced. Soils stabilised, or any erosional signal offset by increasing organic matter production within the basin.	High. Inwashing and flammability of vegetation?	
	CD-1(c)		Local expansions of hazel and elm.			
9,000	CD-2(a)	Catchment dominated by hazel-elm woodland. Birch much reduced in representation. canopy density continued to increase.	Oak present locally at low population levels?		Declining. Inwashing reduced.	
	CD-2(b)	Oak-elm-hazel woodland dominant with ash and birch as lesser components.	Major, local oak expansion.			None visible.
8,000			Local expansion of alder and possibly lime.		Low. Vegetation of low flammability and/or decreased insolation.	
	CD-3	Alder, oak and elm dominant, with hazel much reduced. Lime possibly locally present. Increased representation of wetland taxa.	Climatic shift?			
7,000	CD-4	Alder and oak the dominant tall trees, with elm and lime also abundant. Ash,willow and alder buckthorn rarer components.	Alder growing on basin surface, possibly throughout the rest of the record.			
	CD-5	Catchment continued to be dominated by woodland. Hazel may have decreased in representation.				
6,000	CD-6	Wetland and open areas increased in extent. Hazel and elm possibly reduced. Woodland cover relatively complete away from the area affected by the expanding wetland.	Increase in local water-table. Fen, open water and damp grassland communities expand. Climatic shift, impeded drainage due to rising sea-level or damming of a nearby stream?		Increased. Reduction in amount filtered by vegetation, or real change in fire regime.	Limited clearance of hazel and elm possible, but seems unlikely.

Table 6.6: Cess Dell: summary table of the vegetational and wider development of the catchment

Depth below ground surface (cm)	Core description
0-58	Medium brown clay.
59-129	Dark brown peat.
130-136	Dark brown peat with wood fragments.
137-183	Dark brown peat.
184-248	Medium brown *Phragmites* peat.
249-359	Dark brown gyttja.
360-540	Laminated light grey and pink/grey clays.
541-600 (core not bottomed)	Dark brown gyttja.

Table 7.1: Gilderson Marr: core description.

Depth range (cm)	LDPAZ	Dominant deterioration types	Estimated age span (BP)	Estimated age span (cal BP)
364-311	GMDET-A	Type-1 corrosion, crumpled	9800-9390	11,210-10,600
311-249	GMDET-B	Broken, crumpled	9390-8400	10,600-9400
249-211	GMDET-C	Type-1 corrosion, type-2 corrosion	8400-8140	9400-9080
211-79	GMDET-D	Type-1 corrosion	8140-4960	9080-5680
79-59	GMDET-E	Broken	4960-4190	5680-4700

Table 7.2: Gilderson Marr: local deteriorated pollen assemblage zone depth ranges, dominant deterioration types and interpolated ages.

Estimated time range (BP)	LDPAZ	Summary of pollen preservation analysis
9800-9390	GMDET-A	Pollen preservation good, but erosional inwash may have introduced an older reworked component.
9390-8400	GMDET-B	Pollen preservation fair to good. Type-1 corrosion increased, perhaps due to erosional inwash of damaged grains, limited stream interaction, or drying of basin-edge deposits. There is little evidence for significant alteration of the pollen record.
8400-8140	GMDET-C	Pollen preservation poor. Type-1 and type-2 corrosion high, probably due to drying of the deposit during or after formation. Drops in pollen concentrations likely to be the result of loss of pollen after deposition within the basin.
8140-4960	GMDET-D	Pollen preservation good, record seems sound.
4960-4190	GMDET-E	Pollen preservation fair to good, but type-1 corrosion and crumpling increased. The increase in type-1 corrosion possibly reflects the input of damaged (possibly older) pollen during erosional inwash and/or limited deterioration due to drying of the deposit during or after formation. The elevated crumpling may be due to mechanical damage during inwash. It is possible that taxa with poor aerial dispersal may be relatively over-represented due to inwash from the soil/litter layer.

Table 7.3: Gilderson Marr: summary of the main conclusions of the pollen preservation analysis.

Depth range (cm)	LPAZ	Dominant pollen types	Estimated age span (BP)	Estimated age span (cal BP)
364-317	GM-1	*Betula*-Poaceae	9800-9470	11,210-10,410
317-267	GM-2	*Corylus avellana*-type-*Ulmus*	9470-8850	10,410-10,100
317-297	GM-2(a)		9470-9200	10,410-10,330
297-267	GM-2(b)		9200-8850	10,330-10,100
267-207	GM-3	*Corylus avellana*-type-Poaceae-*Quercus*	8850-8140	10,100-9080
207-137	GM-4	*Corylus avellana*-type-*Quercus*	8140-7200	9080-8000
137-91	GM-5	*Alnus-Betula*	7200-5430	8000-6240
91-59	GM-6	*Alnus-Betula-Quercus*	5430-4190	6240-4700

Table 7.4: Gilderson Marr: local pollen assemblage zone and subzone depth ranges, dominant pollen types and interpolated ages.

Depth (cm)	Approximate TLP scanned (to nearest 100 grains)	Number of Poaceae pollen grains of longest axis > 37 μm located	Grain code/s for n_{comp} grains (see Table 5.4 for identifications)	Interpolated age (yr BP)
60	10,100	2	GM-57, GM-58	4230
62	10,400	1	GM-55	4310
64	11,000	8	GM-45-GM-52	4380
66	11,100	4	GM-40-GM-43	4460
68	10,900	2	GM-38, GM-39	4540
70	10,900	1	GM-36	4615
72	11,200	1	GM-33	4690
74	11,200	1	GM-32	4770
76	10,000	0		
78	10,900	1	GM-31	4925
80	10,900	0		
82	10,800	1	GM-30	5080
84	10,800	1	GM-29	5155
86	10,000	0		
88	10,700	0		
89	10,500	0		
90	10,200	0		
92	10,000	0		
94	10,200	0		
96	11,000	0		
98	9800	0		
100	10,000	0		
102	11,000	1	GM-27	5850
104	10,400	0		
106	10,100	0		
108	11,100	0		
110	10,000	0		
112	11,200	0		
114	11,000	0		
116	10,900	0		
118	10,900	0		
120	10,600	0		
122	10,100	0		
124	10,000	0		
126	11,200	0		
128	10,000	3	GM-24-GM-26	6850
130	10,200	1	GM-23	6930
132	10,900	2	GM-21, GM-22	7010
134	10,800	1	GM-20	7085
136	10,000	1	GM-18	7160
137	10,300	0		
138	9600	0		

140	9800	0		
142	10,400	0		
144	10,100	0		

Table 7.5: Gilderson Marr: levels scanned for large Poaceae grains and the numbers and interpolated ages of all grains located.

Characteristic	**Phase-1**	**Phase-2**
Depth range (cm)	91-79	79-59
Age range (yr BP)	*ca* 5430-4960	*ca* 4960-4190
Duration (^{14}C yr)	*ca* 470	*ca* 770
Mean total herb pollen value	3.8 % TLP.	8.2 % TLP.
Poaceae undiff.	<2 % TLP throughout.	3.5-7.7 % TLP throughout.
Poaceae pollen >37 µm	Present in several levels, mostly located during low magnification scanning.	Located in all levels by low magnification scanning, but also present in most routine counts from *ca* 4690 BP onwards.
Frequent herb types	*Ranunculus acris*-type, *Rosa.*	*Plantago lanceolata, Ranunculus acris*-type, Chenopodiaceae undiff., *Artemisia*-type, Lactuceae undiff.
Occasional herb types	Caryophyllaceae undiff., Chenopodiaceae undiff., *Plantago lanceolata* (after *ca* 5155 BP).	Brassicaceae undiff., *Rumex acetosella, Gentianella campestris*-type, *Rosa, Filipendula, Potentilla*-type.
Pteridium aquilinum	Occasional grains only.	Present in all levels.
Aquatics	Sparse. *Sparganium emersum*-type and Potamogetonaceae undiff. at several levels.	Frequent and more diverse. *Sparganium emersum*-type present in all levels and *Myriophyllum alterniflorum* in several.
Percentage LOI	Declines steadily from *ca* 90-50 %.	Stable at *ca* 45-50 %.
Charcoal influx	Low-moderate, but variable.	Consistently high.

Table 7.6: Gilderson Marr: details of the two disturbance phases hypothesised for the LPAZ GM-6.

Approximate age yrs/BP	LPAZ	Vegetational history: Dominant vegetation	Vegetational history: Main events	Erosional history	Charcoal abundance	Human impact?
9,800	GM-1	Open birch/birch-willow woodland. Hazel a minor component towards end.	Local expansion of hazel. Local expansion of elm.	High erosion. Erosion very low.	High, but declining. Inwashed?	None visible.
	GM-2(a)	Hazel-elm woodland expands and becomes dominant, birch much reduced. Canopy density increases with time.	Oak present locally at low population levels?	Slight erosion.	Low. Moderate. Inwashed?	
9,000	GM-2(b)			Erosion very low. Slight.	Very low.	
	GM-3	Oak-elm-hazel woodland dominant with some birch, perhaps as a gap-phase taxon.	Major oak expansion. Common reed growing on basin surface.		Vegetation of low flammability, low inwash and possibly decreased insolation.	
8,000	GM-4	Oak-elm-hazel woodland continues to be dominant, with ash as a rarer component. Hazel declines in importance from 7570 BP. Heathland community also expands close to, and perhaps onto the site.	Expansion of heathland community close to (and perhaps onto) the basin. Decline in hazel, perhaps in response to a climatic shift? Local expansions of alder and lime.	Erosion very low. Catchment soils stable and/or high organic matter production within the basin.	High, but variable. Natural or anthropogenic burning of a susceptible vegetation type. i.e the heathland community?	
7,000 6,000	GM-5	Alder, oak and elm the dominant tall trees, with lime and hazel important. Birch and open ground taxa expand, suggesting increased disturbance during the first part of the zone. Wetland and damp-ground species also increase in representation.	Increased disturbance within the dryland vegetation.		Low. Absence of a susceptible vegetation type and/or anthropogenic burning? Varies between low and high.	Human disturbance of the dry-land vegetation possible. No visible disturbance.
5,000	GM-6	Elm and hazel decline leaving oak, lime and alder as the dominant tall trees. Whilst woodland cover remains important, the area of open/disturbed ground and woodland edge increases. Disturbance important in determining vegetation composition. Wetland area expands.	'Elm decline' and lime re-expansion. Considerable disturbance within dryland vegetation.	Erosion steadily increasing. Erosion levels very high and stable.	Linked to the abundance of susceptible vegetation, or variation in human activity? Moderate to high and relatively stable. Anthropogenic burning?	Possible human activity on the slopes around the site. Intensity of land-use increases after ca 4960 BP.

Table 7.7: Gilderson Marr: summary table of the vegetational and wider development of the catchment

Depth below ground surface (cm)	Core description
0-15	Soil A-horizon
16-45	Medium brown and dark brown clay, slightly peaty in lowest 5 cm.
46-165	Dark brown gyttja.
166-185	Dark brown peat.
185-210	Very light brown peat containing abundant *Sphagnum* fragments.
211-272	Dark brown peat.
273-305	Dark brown peat with abundant twigs and wood fragments.
306-315	Dark brown gyttja.
316-330	Greyish brown clay-rich gyttja.
331-404	Dark brown gyttja.
405-632 (core not bottomed)	Greyish brown and light brownish grey sandy clay, with numerous bands of yellow brown and light yellow brown pure clay. Particularly sand rich and grey in colour between 405-412 cm, 424-430 cm, 450-464 cm, 489-495 cm.

Table 8.1: Sproatley Bog: core description.

Depth range (cm)	LDPAZ	Dominant deterioration types	Estimated age span (BP)	Estimated age span (cal BP)
496-270	SBDET-A	Broken, corrosion (undiff.)	Pre-10,200-8070	Pre-11,520-9030
270-212	SBDET-B	Corrosion (undiff.)	Post-8070	Post-9030
212-170	SBDET-C	Broken	Unclear	Unclear
170-48	SBDET-D	Broken, crumpled, corrosion (undiff.)	Pre-1470-1150	Pre-1360-1030

Table 8.2: Sproatley Bog: local deteriorated pollen assemblage zone depth ranges, dominant deterioration types and interpolated ages.

Estimated time range (BP)	**LDPAZ**	**Summary of pollen preservation analysis**
Pre-10,200-8070	SBDET-A	Pollen preservation good. Whilst it is possible that erosional inwash may have introduced an older reworked component prior to *ca* 10,200 BP, the pollen preservation data are unclear.
Post-8070	SBDET-B	Pollen preservation poor. Corrosion (undiff.) levels high to very high, probably due to post-depositional drying of the deposit. It is possible that the pollen record may have been altered due to the loss of the more corrosion susceptible pollen types. Evidence for a depositional hiatus at *ca* 222 cm also suggests that the record is non-continuous within the zone.
Unclear	SBDET-C	Pollen preservation variable between good and moderate, although there is evidence for a second depositional hiatus prior to 180 cm.
Pre-1470-1150	SBDET-D	The combined pollen and stratigraphical data suggest that part of the record may be missing below *ca* 164 cm, and that some mixing of deposits may have occurred between *ca* 164 cm and 148 cm. Above 148 cm, the record appears continuous. Whilst pollen preservation is only moderate, no one deterioration category is particularly frequent, suggesting that the record is generally sound. It is possible that the long-distance and inwashed components are relatively higher than during SBDET-B, SBDET-C and the latter part of SBDET-A.

Table 8.3: Sproatley Bog: summary of the main conclusions of the pollen preservation analysis.

Depth range (cm)	**LPAZ**	**Dominant pollen types**	**Estimated age span (BP)**	**Estimated age span (cal BP)**
496-405	SB-1	Poaceae-*Betula*-Cyperaceae	pre-10,200-10,200	pre-11,520-11,520
405-372.5	SB-2	*Betula*-Poaceae	10,200-9570	11,520-10,830
372.5-315.5	SB-3	*Corylus avellana*-type-*Betula*	9600-9500-8980	10,870-10,470-10,180
372.5-357.5	SB-3(a)		9600-9500?	10,870-10,470?
357.5-347.5	SB-3(b)		9600-9500?	10,870-10,470?
347.5-334.5	SB-3(c)		9590-9290	10,830-10,470
334.5-315.5	SB-3(d)		9290-8980	10,470-10,180
315.5-218	SB-4	*Corylus avellana*-type-*Quercus* (*Ulmus*)	post-8980	post-10,180
218-184	SB-5	*Corylus avellana*-type-*Quercus* (*Betula*)	unclear	unclear
184-162	SB-6	*Quercus*-*Alnus*	unclear	unclear
162-48	SB-7	Poaceae-Cyperaceae	pre-1470-1150	pre-1360-1030
162-96.5	SB-7(a)		pre-1470-1470	pre-1360-1360
96.5-48	SB-7(b)		1470-1150	1360-1030

Table 8.4: Sproatley Bog: local pollen assemblage zone and subzone depth ranges, dominant pollen types and interpolated ages.

Depth (cm)	**Sample size**	**Number of grains with pores protruding >1 μm**	**Percentage of grains likely to be from *Cannabis sativa* (calculated after Whittington and Gordon, 1987)**
136	20	15	78
120	20	16	84
108	20	14	73
96	100	78	81
92	100	82	80
88	100	78	81

Table 8.5: Sproatley Bog: *Cannabis*-type pore form data.

Family/genus/species	**Habitat data**
Anacaena sp.	Numerous species found on damp ground or detritus, and in stagnant or slowly flowing water including pools, ponds and vegetation-rich standing water (Harde, 1984; Friday, 1988; Koch, 1989).
Donacia thalassina?	Freshwater ponds, lakes or ditches, associated with *Sparganium* (Hyman, 1992) and Cyperaceae (Hyman, 1992; Bullock, 1993).
Dryops sp.	Bogs, pools, standing water and in *Sphagnum* and other mosses (Koch, 1989).
Eubrychius velutus	Slow moving and stagnant water on *Myriophyllum spicatum* and *M. verticillatum* (Hyman, 1992)
Haliplus confinis	Clear, stagnant water (Holmen, 1987), ditches, pools and streams (Friday, 1988).
Helophorus sp.	Numerous species on Brassicaceae (Koch, 1989), *Triticum* (Bullock, 1993) and in stagnant (often vegetation-rich) water (Friday, 1988).
Hydrobius fuscipes	In standing water (Koch, 1989), ponds and bogs (Dillon and Dillon, 1972) and slow-moving water (Hansen, 1987). Particularly abundant in eutrophic water (Hansen, 1987).
Laccobius sp.	In stagnant water or flowing water (Koch, 1989).
Plateumaris discolor/sericea	*P. discolor:* Associated with *Sphagnum* and *Eriophorum* on raised bogs, swampy lake and pond shores (Koch, 1992) and *Sphagnum* bogs (Lane, 1992). *P. sericea:* Boggy meadows, fens and swampy pond, pool or stream banks (Koch, 1992). Found on numerous aquatic/semi-aquatic plants including *Sparganium* and *Typha latifolia* (Stainforth, 1944) and *Carex* (Lane, 1992; Bullock, 1993).

Table 8.6: Sproatley Bog: Summary habitat data for Coleopteran remains identified to genus level or above.

Approximate age yrs/BP	LPAZ	Vegetational history: Dominant vegetation	Vegetational history: Main events	Erosional history	Charcoal abundance	Human impact?
Post-11,000	SB-1	Open grassland with some birch, willow and juniper scrub. Both dwarf and tree birches likely to be present.		High erosion.	Very high. High inwashed component. Some natural burning possible?	None visible.
10,000	SB-2	Open birch/birch-willow woodland. Hazel an increasing component towards the end of the zone.	■ Major local expansion of tree birch. ■ Mid SB-2: local expansion of hazel and perhaps elm.	Initially high, but rapidly decreasing.	Steadily declining. Reduction in inwashed component?	
	SB-3(a) SB-3(b) SB-3(c)	Hazel woodland dominant during SB-3(a) and SB-3(c), open birch woodland during SB-3(b).	■ SB-3(b): decline in hazel and perhaps elm. Climatic shift? ■ SB-3(c): recovery of hazel and perhaps elm.	Very low during SB-3(a)/(c) low during SB-3(b).	Low.	
9,000	SB-3(d)	Open hazel woodland with some birch. Considerable disturbance of the woodland canopy.	Severe disturbance of dryland vegetation. Hazel much reduced.	Erosion high.	Moderate to very high. Anthropogenic burning?	Human disturbance of vegetation possible
~8,000	SB-4	Oak-elm-hazel woodland dominant with birch and ash as lesser components. Ivy consistently present. Canopy density higher than in previous zones.	■ Recovery of hazel and major local expansions of elm and oak.	Erosion very low. Catchment soils stable.	Very low. Cessation of anthropogenic burning and vegetation of low natural fire susceptibility.	None visible.
Pre-1,470	SB-7(a)	Arboreal representation low, with any woodland likely to have been fragmented and of limited spatial extent. Landscape largely cleared and dominated by grassland and disturbed ground taxa.	Arboreal representation steadily declining, suggesting a gradual increase in the proportion of cleared ground.	Erosion moderate to high and steadily increasing.	High and stable. Anthropogenic burning?	Mixed arable cultivation indicated, with hemp and flax probably also grown locally. Grassland taxa may suggest locally occuring meadow/ pasture.
1,450 1,350 1,250 1,150	SB-7(b)		Hemp input markedly increased. Retting carried out within basin, increased in frequency or volume, or a greater proportion of male plants used?	Erosion moderately high and stable.	Moderate and stable. Reduction in level of anthropogenic burning?	

Table 8.7: Sproatley Bog: summary table of the vegetational and wider development of the catchment

Depth below ground surface (cm)	Core description
0-10	Possible faint soil A-horizon within a dark brown peat matrix.
11-85	Dark brown peat.
86-90	Void.
91-109	Dark brown peat.
110-113	Very light brown peat containing abundant *Sphagnum* fragments.
114-260	Dark brown peat.
261-275	Dark brown gyttja.
276-305	Dark brown peat.
306-315	Dark brown peat with wood fragments.
316-610	Medium/dark brown gyttja.
611-670 (core not bottomed)	Light grey clay, becoming pink towards base. Occasional laminations.

Table 9.1: The Bog at Roos: core description.

Depth range (cm)	LDPAZ	Dominant deterioration types	Estimated age span (BP)	Estimated age span (cal BP)
616-393	RBODET-A	Broken, type-1 corrosion	10,170-7625	11,800-8410
393-371	RBODET-B	Type-1 corrosion	7625-7215	8410-8000
371-306	RBODET-C	Broken, type-1 corrosion	7215-5065	8000-5820
306-275	RBODET-D	Broken	5065-4780	5820-5530
275-251	RBODET-E	Crumpled, type-1 corrosion	Uncertain. 4780-4520?	Uncertain. 5530-5120?
251-162	RBODET-F	Broken, crumpled	Uncertain. 4520-3480?	Uncertain. 5120-3760?
162-122	RBODET-G	Type-1 corrosion, type-2 corrosion	Uncertain. 3840-1980?	Uncertain. 3760-1930
122-1	RBODET-H	Broken, crumpled	1980-present	1930-present

Table 9.2: The Bog at Roos: local deteriorated pollen assemblage zone depth ranges, dominant deterioration types and interpolated ages.

Estimated time range (BP)	**LDPAZ**	**Summary of pollen preservation analysis**
10,170-7625	RBODET-A	Pollen preservation generally good, but erosional inwash may have introduced an older reworked component, particularly below 608 cm.
7625-7215	RBODET-B	Pollen preservation good to moderate, although the proportion of corroded *Corylus avellana*-type grains is increased, perhaps due to increased inwashing of the pollen type, although the data are unclear. There is little evidence for significant alteration of the pollen record during this period.
7215-5065	RBODET-C	Pollen preservation is good and the record appears sound with the exception of 312-308 cm (perhaps *ca* 5170-5220 BP) where type-1 corrosion is increased. This may reflect seasonal drying of the deposit during formation, or perhaps post-depositional drying due to a drop in the local water-table. It is possible that limited loss of the more corrosion susceptible pollen types may have occurred during this period.
5065-4780	RBODET-D	Pollen preservation is good and the record appears sound.
Uncertain. 4780-4520?	RBODET-E	Pollen preservation moderate and the record seems reliable. It is possible that the inwashed component may have increased.
Uncertain. 4520-3480?	RBODET-F	Pollen preservation is good and the record appears sound.
Uncertain. 3840-1980?	RBODET-G	Pollen preservation variable, but generally poor with corrosion levels significantly increased. It is possible that some post-depositional loss of pollen may have occurred between *ca* 162 cm and 154 cm and again between *ca* 136 cm and 124 cm. There is also evidence for a depositional hiatus at 154 cm.
1980-present	RBODET-H	Pollen preservation is good to moderate and the record seems generally sound. Limited post-depositional pollen loss may have occurred sporadically during the period, although the data are unclear.

Table 9.3: The Bog at Roos: summary of the main conclusions of the pollen preservation analysis.

Depth range (cm)	**LPAZ**	**Dominant pollen types**	**Estimated age span (BP)**	**Estimated age span (cal BP)**
616-583	RBO-1	*Betula*-Poaceae	10,170-9520	11,800-11,000
583-379	RBO-2	*Corylus avellana*-type-*Ulmus-Quercus*	9520-7500	11,000-8330
583-549	RBO-2(a)		9520-9010	11,000-10,190
549-379	RBO-2(b)		9010-7500	10,190-8330
379-318.5	RBO-3	*Alnus-Quercus-Tilia*	7500-5290	8330-6050
318.5-275	RBO-4	*Alnus-Quercus*	5290-4790	6050-5530
275-241	RBO-5	*Alnus-Tilia*	Uncertain. 4790-4390?	Uncertain. 5530-4950?
241-153	RBO-6	*Quercus-Corylus avellana*-type-*Betula*	Uncertain. 4390-3380?	Uncertain. 4950-?
153-1	RBO-7	Poaceae-Cyperaceae-*Plantago lanceolata*	Uncertain. 2660?-present	Uncertain. 2800?-present
153-102	RBO-7(a)		Uncertain. 2660?-1725	Uncertain. 2800?-1630
102-86	RBO-7(b)		1725-1520	1630-1420
86-14	RBO-7(c)		1520-190	1420-180
14-1	RBO-7(d)		190-present	180-present

Table 9.4: The Bog at Roos: local pollen assemblage zone and subzone depth ranges, dominant pollen types and interpolated ages.

Depth (cm)	Approximate TLP scanned (to nearest 100 grains)	Number of Poaceae pollen grains of longest axis > 37 μm located	Grain code/s for n_{comp} grains (see Table 5.6 for identifications)	Interpolated age (BP)
392	10,000	0		
388	10,100	0		
384	10,000	0		
380	11,000	0		
376	10,400	1	RBO-23	7400
372	11,000	0		
368	11,200	0		
364	10,000	0		
360	10,200	0		
356	10,100	0		
352	11,800	0		
348	10,800	0		
344	10,500	0		
340	10,200	0		
336	11,100	0		
332	10,500	0		
328	11,300	0		
324	10,500	0		
320	10,800	1	RBO-24	5360
319	10,200	0		
318	11,200	0		
317	10,000	1	RBO-25	5270
316	10,500	0		
312	10,000	0		
308	10,200	0		
304	10,000	0		
300	9800	0		
296	10,000	0		
292	11,000	0		
288	11,100	0		
284	11,000	0		
280	10,900	0		
276	10,400	0		
275	10,100	0		
274	10,600	5	RBO-26-RBO-30	4780
272	11,000	3		4755
270	10,200	2	RBO-32	4730
268	10,900	2		4710
251	10,200	0		
250	10,000	0		
248	11,000	0		
246	10,000	0		

244	10,100	0		
242	10,000	0		

Table 9.5: The Bog at Roos: levels scanned for large Poaceae grains and the numbers and interpolated ages of all grains located.

Depth (cm)	Longest axis (μm)	Pore protrusion (+ = >1 μm; - = <1 μm)
58	32	+
58	35	+
58	23	-
54	35	+
54	30	+
50	30	+
48	30	-
44	25	+
44	30	-
40	26	+
36	30	-
32	27	+
32	28	+
32	28	+
32	24	+
32	25	+
20	25	+
20	20	+
20	28	+
20	36	+
16	30	-
16	27	+

Table 9.6: The Bog at Roos: *Cannabis*-type grain size and pore form data.

Approximate age yrs/BP	LPAZ	Vegetational history: Dominant vegetation	Vegetational history: Main events	Erosional history	Charcoal abundance	Human impact?
10,000	RBO-1	Open birch/birch-willow woodland with hazel also important from the mid-part of the zone onwards.	Local expansion and subsequent contraction of hazel. Climatic shift?	High erosion. Erosion low to very low.	Very high, inwashed? Declining, inwashing reduced.	
	RBO-2(a)	Hazel-elm woodland dominant. Birch much reduced in representation.	■ Local expansion of elm and major expansion of hazel.	Soils within the water-catchment stabilised, or high organic matter production within the basin.		
9,000 – 8,000	RBO-2(b)	Catchment dominated by mixed oak-elm-hazel woodland with birch as a lesser component. Canopy density increased cf. previous zones.	■ Major local expansion of oak.		Low.	
7,000 – 6,000	RBO-3	Oak, elm and alder the dominant tall trees, with lime also important. Hazel reduced in frequency.	■ Local expansions of alder and perhaps lime. ■ Major local expansion of lime. Reduction in hazel. Competitive exclusion or climatic shift?		Vegetation of low flammability and little anthropogenic burning within catchment.	
5,000	RBO-4	Elm and lime decline, leaving oak, hazel and alder as dominant woodland taxa.	■ Local declines of elm and lime.			Possible, but unclear
	RBO-5	Increased open ground, but woodland remains important.	■ Elevated disturbance of the dryland vegetation, re-expansion of lime and increase in the local water-table.		Moderate. Anthropogenic burning?	Probable.
4,000	RBO-6	Disturbance less intense, but canopy remains incomplete and areas of open ground persist. Heath and grassland communities expand towards the top of the zone.			Generally low.	Limited disturbance possible, but data unclear.
2,000	RBO-7(a)	Arboreal representation low, suggesting that the catchment was largely cleared. Any woodland is likely to have been fragmented and of limited spatial extent.		Erosion low.	High. Predominately anthropogenic burning?	
	RBO-7(b)		Expansion of grassland		Low.	
1,000	RBO-7(c)	Record dominated by grassland and disturbed ground taxa. Low levels of oak and hazel suggest that the taxa may have been present as patchy scrub and it is likely that areas of heath also existed within the catchment.	Minor expansions of oak, hazel and birch. ■ Arboreal and heathland taxa decline in frequency.		Moderate and relatively stable. Anthropogenic burning?	
	RBO-7(d)		Birch-willow carr growing on ■ basin surface.			

Table 9.7: The Bog at Roos: summary table of the vegetational and wider development of the catchment

Approximate age yrs/BP	Cultural Period	Dominant vegetation: The Bog at Roos	Dominant vegetation: Sproatley Bog	Dominant vegetation: Gilderson Marr	Dominant vegetation: Cess Dell
Post-11,000	Upper Palaeolithic		Open grassland dominant with some birch (both dwarf and tree birches), willow and juniper scrub. Limited areas of heath present and damp and disturbed ground herbs important.		
10,000	Early Mesolithic	Open birch/birch-willow woodland with a diverse open ground flora. Hazel present from the mid-part of the period onwards.	Open birch/birch-willow woodland with a diverse ground flora. Hazel also present for the latter part of the period.	? – – – ?	Open birch/birch-willow woodland with a diverse open ground flora. Hazel present from the mid-part of the period onwards.
			Open hazel woodland (SB-3[a] and SB-3[c]) and open birch woodland (SB-3[b]) dominant.	Open birch/birch-willow woodland. Hazel frequent towards end of period.	
9,000		Hazel-elm woodland with some birch.	Open hazel woodland with some birch.	Hazel-elm woodland with some birch.	Hazel-elm woodland with some birch.
		Oak-elm-hazel wood-land dominant with low levels of birch.	Oak-elm-hazel wood-land with low levels of birch and ash also present.	Oak-elm-hazel woodland with low levels of birch. Areas of heath also present from 8140 BP onwards.	Oak-elm-hazel wood-land with low levels of birch and ash also present.
8,000			Depositional hiatus		
7,000	Late Mesolithic	Catchment dominated by mixed woodland. Oak, elm, lime and alder frequent with hazel also present, but at reduced frequencies (cf. above).		Catchment dominated by mixed woodland. Oak, elm, lime and alder frequent with hazel also present, but at reduced frequencies (cf. above). Birch and open/disturbed ground taxa frequent prior to 6005 BP.	Catchment dominated by mixed woodland. Oak, elm, lime and alder frequent with hazel also present, but at reduced frequencies (cf. above).
6,000					Hazel and elm reduced and open/disturbed ground taxa frequent. Woodland cover reduced but catchment still mostly wooded.

Table 10.1: Summary of the vegetational histories of the study sites between 11,000 and 5500 BP

Approximate age yrs/BP	Cultural Period	Dominant vegetation: The Bog at Roos	Dominant vegetation: Sproatley Bog	Dominant vegetation: Gilderson Marr
5,000	Early Neolithic	As previous Elm and lime reduced, but woodland cover remains relatively complete with no evidence for a significant increase in the area of open ground. ? Woodland cover reduced due to declines in hazel and oak. Expansions of open and disturbed ground and heathland. ?		As previous Woodland frequent, but areas of open/disturbed ground and woodland edge increased. Elm and hazel reduced in frequency. Areas of heath, grassland and disturbed ground present within the catchment.
4,000	Late Neolithic	Catchment dominated by mixed woodland with oak, hazel, alder and lime frequent. Disturbance less intense, but woodland cover remains incomplete, with areas of grassland and disturbed ground persisting. Heath and grassland taxa expand towards the end of the period.		
	Early Bronze Age	? (3380 BP?)		
3,000	Late Bronze Age	Depositional hiatus (2660 BP?) ?		
2,000	Iron Age	Landscape largely cleared, with any woodland or scrub likely to have been fragmented. Grassland and disturbed (perhaps cultivated) ground frequent. Heath and limited areas of hazel and/or oak scrub also present.		
1,000	Roman and Historical Periods	Expansion of grassland. Minor expansions of oak, hazel and birch, perhaps as scrub, but landscape remains very open. Arboreal and heath taxa decline suggesting reductions in the areas of scrub and heathland. Landscape very open and dominated by grassland and disturbed (perhaps cultivated) ground.	(pre-1470 BP) ? Landscape largely cleared, with any woodland or scrub likely to have been fragmented and of limited spatial extent. Grassland and cultivated ground frequent.	

Table 10.2: Summary of the vegetational histories of the study sites from 5500 BP until present

Vegetational event	**Start date and duration of event at Cess Dell**	**Start date and duration of event at Gilderson Marr**	**Start date and duration of event at Sproatley Bog**	**Start date and duration of event at The Bog at Roos**
Initial sustained *Betula* expansion	*ca* 10,050 BP *ca* 260 ^{14}C yr	Pre-9650 BP Duration unclear.	Pre-9600 BP Duration unclear.	*ca* 10,050 BP *ca* 170 ^{14}C yr
Initial sustained *Corylus avellana* expansion	9490±70 BP (AA-30870) *ca* 180 ^{14}C yr	9645±80 BP (AA-32302) *ca* 260 ^{14}C yr	9510±120 BP (AA-30881) Duration unclear.	9525±90 BP (AA-32289) *ca* 180 ^{14}C yr
Initial sustained *Ulmus* expansion	9490±70 BP (AA-30870) *ca* 410 ^{14}C yr	*ca* 9500 BP *ca* 400 ^{14}C yr	*ca* 8965 BP Duration unclear.	*ca* 9500 BP *ca* 480 ^{14}C yr
Initial sustained *Quercus* expansion	*ca* 8940 BP *ca* 490 ^{14}C yr	*ca* 9150 BP *ca* 525 ^{14}C yr	*ca* 8965 BP *ca* 390 ^{14}C yr	9010±85 BP (AA-32290) Unclear, but perhaps *ca* 360 ^{14}C yr
Initial sustained *Alnus glutinosa* expansion	7830±60 BP (AA-30873) *ca* 360 ^{14}C yr	*ca* 7270 BP *ca* 260 ^{14}C yr		*ca* 7470 BP *ca* 435 ^{14}C yr
Initial sustained *Tilia* expansion	7830±60 BP (AA-30873) Duration unclear.	*ca* 7380 BP *ca* 295 ^{14}C yr		*ca* 7250 BP Duration unclear.

Table 10.3: timings and durations of the initial sustained Holocene expansions of the major arboreal taxa within the pollen catchments of the study sites.

Event	Cess Dell	Gilderson Marr	Sproatley Bog	The Bog at Roos
Start of initial hazel rise			9570±75 BP (AA-30878)	
Centre of initial hazel rise	9360±70 BP* (AA-30877)		9250±100 BP* (AA-30879)	
Early hazel decline			9680±80 BP (AA-30880)	
Start of sustained hazel rise	9490±70 BP (AA-30870)	9645±80 BP (AA-32302)		9525±90 BP (AA-32289)
End of sustained hazel rise (early maximum)		9480±115 BP (AA-32303)	9510±120 BP (AA-30881)	

Table 10.4: details of radiocarbon dates obtained for events within the *Corylus avellana* expansion. An asterisk denotes a date that is felt to be too young.

Taxon	**Cess Dell**	**Gilderson Marr**	**The Bog at Roos**
Alnus glutinosa	Expands between *ca* 7830-7470 BP.	Expands between *ca* 7270-7010 BP.	Expands between *ca* 7470-7035 BP.
Tilia	Expands, duration of expansion unclear.	Expands between *ca* 7380-7085 BP.	Expands, duration of expansion unclear.
Corylus avellana	Declines between *ca* 7830-7045 BP and then recovers.	Initially unchanged, but declines in representation between *ca* 7160-6160 BP.	Declines between *ca* 7470-6740 and then recovers.
Quercus	Expands between *ca* 7830-7045 BP.	Unchanged.	Unchanged.
Ulmus	Unchanged.	Declines between *ca* 7200-6005 BP and then recovers.	Possibly reduced in frequency?
Betula	Expands between *ca* 7765-7450 BP and then declines to former levels.	Expands between *ca* 7200-6160 BP and then declines to former levels.	Possibly reduced in frequency?
Other notes	Increased local wetness?	Increased disturbance within catchment. Expansion of damp ground communities.	
Charcoal frequency	Unchanged and very low.	Variable, moderate to high between *ca* 7160-6780 BP, low after 6780 BP.	Unchanged and low.

Table 10.5: vegetational changes occurring during the local expansions of *Alnus glutinosa* and *Tilia* within the pollen catchments of Cess Dell, Gilderson Marr and The Bog at Roos.

RPAZ (estimated time span [BP] after Flenley, 1987)	**Dominant pollen type/s**	**Upper and lower boundary designations**	**Radiocarbon dates available from within RPAZ prior to this study**
Betula-Pinus (*ca* 10,200-9000)	*Betula* dominant and *Pinus sylvestris* present at low levels. Herb pollen diverse with *Filipendula* frequent.	Lower: Earliest Holocene *Betula* rise. Upper: Initial *Corylus/Myrica* rise.	Base of zone dated as shortly after 10,120±180 BP (Birm-405) at The Bog at Roos (Beckett, 1975).
Corylus/Myrica-Ulmus (*ca* 9000-7000)	*Corylus/Myrica* pollen dominant, *Ulmus, Pinus sylvestris, Quercus* and *Betula* frequent, and herb pollen sparse.	Upper: Initial *Alnus glutinosa* rise.	Approximate centre of zone dated at Gransmoor as 8507±55 BP (SRR-230; Beckett, 1975)
Alnus-Ulmus (*ca* 7000-5000)	Arboreal pollen (notably *Alnus glutinosa, Quercus, Ulmus* and *Corylus/Myrica*) dominant and herb pollen scarce.	Upper: Decline of *Ulmus* to <5 % TDLP (=TLP).	Elm decline (end of zone) dated as 5099±50 BP (SRR-229) at Gransmoor by Beckett (1975).
Alnus-Quercus (*ca* 5000-2500)	Arboreal pollen again dominant. *Ulmus* scarce, with *Quercus* and *Alnus glutinosa* the most frequent taxa. Low levels of herb pollen present.	Upper: Increases of Poaceae and *Plantago lanceolata* to >5 % TDLP (=TLP).	
Alnus-Poaceae (*ca* 2500-present)	Herb pollen frequent, with arboreal input much reduced. Poaceae and *Plantago lanceolata* pollen frequent, and *Betula* and *Quercus* present at low levels.		

Table 10.6: details of the Holocene RPAZs proposed by Beckett (1981), radiocarbon dates available from morainic Holderness prior to this study, and the estimated time periods assigned to each zone by Flenley (1987). The type locality for all zones is Hornsea Old Mere.

RPAZ (estimated time span [BP] after Flenley, 1987)	**LPAZs covered (age span [BP]): Cess Dell**	**LPAZs covered (age span [BP]): Gilderson Marr**	**LPAZs covered (age span [BP]): Sproatley Bog**	**LPAZs covered (age span [BP]): The Bog at Roos**
Betula-Pinus (*ca* 10,200-9000)	CD-1(a) CD-1(b) CD-1(c) (*ca* 10,050-9470)	GM-1 (*ca* 9800-9470)	SB-2 (*ca* 10,200-9570)	RBO-1 (*ca* 10,170-9520)
Corylus/Myrica -Ulmus (*ca* 9000-7000)	CD-2(a) CD-2(b) (*ca* 9470-7840)	GM-2(a) GM-2(b) GM-3 GM-4 (*ca* 9470-7200)	SB-3(a) SB-3(b) SB-3(c) SB-3(d) SB-4 (*ca* 9570-post 8980)	RBO-2(a) RBO-2(b) (*ca* 9520-7500)
Alnus-Ulmus (*ca* 7000-5000)	CD-3 CD-4 CD-5 CD-6? (*ca* 7840-5660)	GM-5 (*ca* 7200-5430)		RBO-3 (*ca* 7500-5290)
Alnus-Quercus (*ca* 5000-2500)	CD-6?	GM-6 (*ca* 5430-4190)		RBO-4 RBO-5 RBO-6 (*ca* 5290-3380?)
Alnus-Poaceae (*ca* 2500-present)			SB-7(a) SB-7(b) (*ca* pre-1470-1150)	RBO-7(a) RBO-7(b) RBO-7(c) RBO-7(d) (*ca* 2660?-present)

Table 10.7: correlation of the LPAZs (and time ranges) for the study sites with the RPAZs of Beckett (1981).

RPAZ	Start and end dates of zone (mean ages) (BP)	Notes
Betula-Pinus	Start: 10,170, 10,120 (10,150) End: 9570, 9520, 9470, 9470 (9510)	The start date is likely to be similar throughout Holderness. It is less certain how variable the end date may be.
Corylus/Myrica-Ulmus	End: 7840, 7500, 7200 (7510)	The end date of this zone is likely to be highly variable.
Alnus-Ulmus	End: 5430, 5290, 5100 (5270)	The end date of this zone is likely to be fairly consistent.
Alnus-Quercus	End: between *ca* 3380 BP? and 2600 BP	The start date of this zone remains uncertain and may be expected to vary across Holderness. At The Bog at Roos, a start date within the mid-late Bronze Age is probable.
Alnus-Poaceae	End: present day	Start date uncertain and likely to be variable (see above).

Table 10.8: summary of the of the proposed age ranges of the RPAZs (based upon all currently available radiocarbon dates) and concluding comments. All dates are rounded to the nearest 10 ^{14}C yr.

Approximate age yrs/BP	Cultural Period	The Bog at Roos	Sproatley Bog	Gilderson Marr	Cess Dell
		Evidence of possible human impact			
Post-11,000	Upper Palaeolithic		None visible.	?	
10,000	Early Mesolithic	None visible.		?	None visible.
9,000			Limited clearance of hazel and perhaps elm possible. Disturbed ground herbs frequent and charcoal levels moderate to very high.	None visible.	
	Late Mesolithic		None visible.		
8,000			Depositional hiatus		
7,000				Limited clearance of oak and elm possible. Open and disturbed ground herbs, birch and ash pollen more frequent suggesting opening of the woodland canopy and an increase in the area of woodland edge. Charcoal levels high prior to 6780 BP.	
6,000				None visible.	Limited clearance of oak and elm possible. Large grass pollen may reflect arable cultivation, but data unclear and could be natural in origin. Charcoal levels moderate.

Table 10.9: Summary of the evidence for potential human activity between 11,000 and 5500 BP

Approximate age yrs/BP	Cultural Period	Dominant vegetation: The Bog at Roos	Dominant vegetation: Sproatley Bog	Dominant vegetation: Gilderson Marr
5,000	Early Neolithic	None visible. Elm and lime reduced and whilst this may (at least in part) reflect anthropogenic activity, the declines could have entirely natural origins. Charcoal low. — — — ? — — — Limited clearance of oak and hazel possible. Open and disturbed ground herbs and heath taxa more frequent. Charcoal levels moderate. Possible arable cultivation close to site.		As previous Hazel and elm influx reduced and open/disturbed ground herbs abundant, suggesting fragmentation of woodland cover (although woodland still frequent). It is likely that this is at least in part a reflection of human clearance activity. Arable cultivation may have occurred on the slopes surrounding the basin. Charcoal levels moderate to high.
4,000	Late Neolithic	Disturbance less intense, but no significant woodland regeneration. Continued human activity within the pollen catchment possible. Charcoal levels initially low, but increase after 3700 BP.		
	Early Bronze Age	— — — ? — — — (3380 BP?)		
3,000	Late Bronze Age	Depositional hiatus (2660 BP?) — — — ? — — —		
2,000	Iron Age	Landscape almost entirely cleared. Grassland (probably including meadow and/or pasture) frequent and arable cultivation likely to have occurred (at least intermittently) within the pollen catchment. Hemp grown locally at low levels between 1030 BP and 230 BP. Charcoal levels variable, but generally high.		
1,000	Roman and Historical Periods	Although slight variations in the levels of oak and hazel (perhaps as scrub) are evident, the highly open nature of the vegetational landscape suggests that sustained human activity occurred within the catchment from the Iron Age onwards.	(pre-1470 BP) ? — — — — — — Landscape largely cleared, with grassland (probably including meadow and/or pasture) and cultivated ground frequent. Hemp and flax probably grown locally.	

Table 10.10: Summary of the evidence for potential human activity from 5500 BP until present

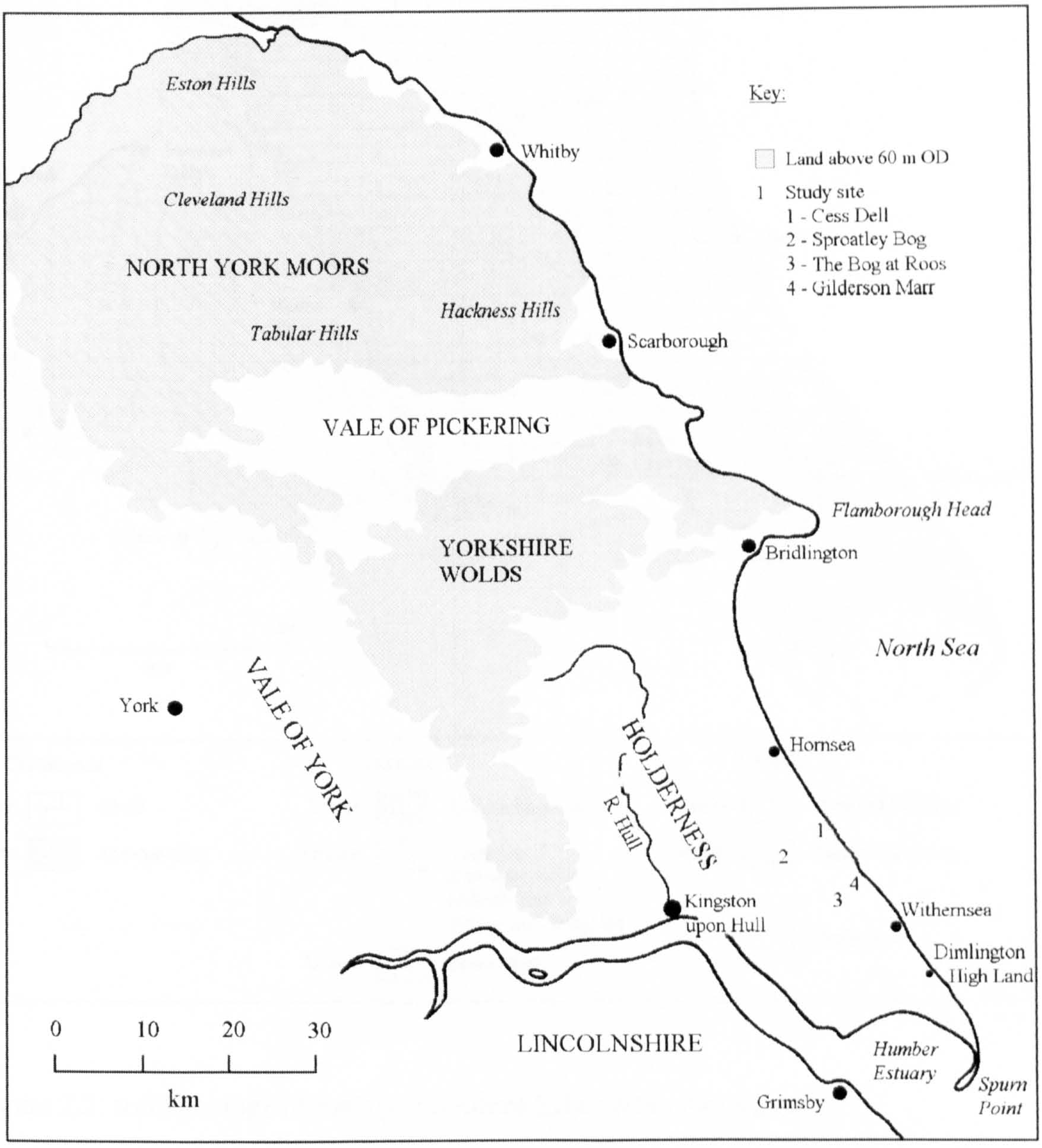


Figure 2.1: map of Holderness and surrounding regions

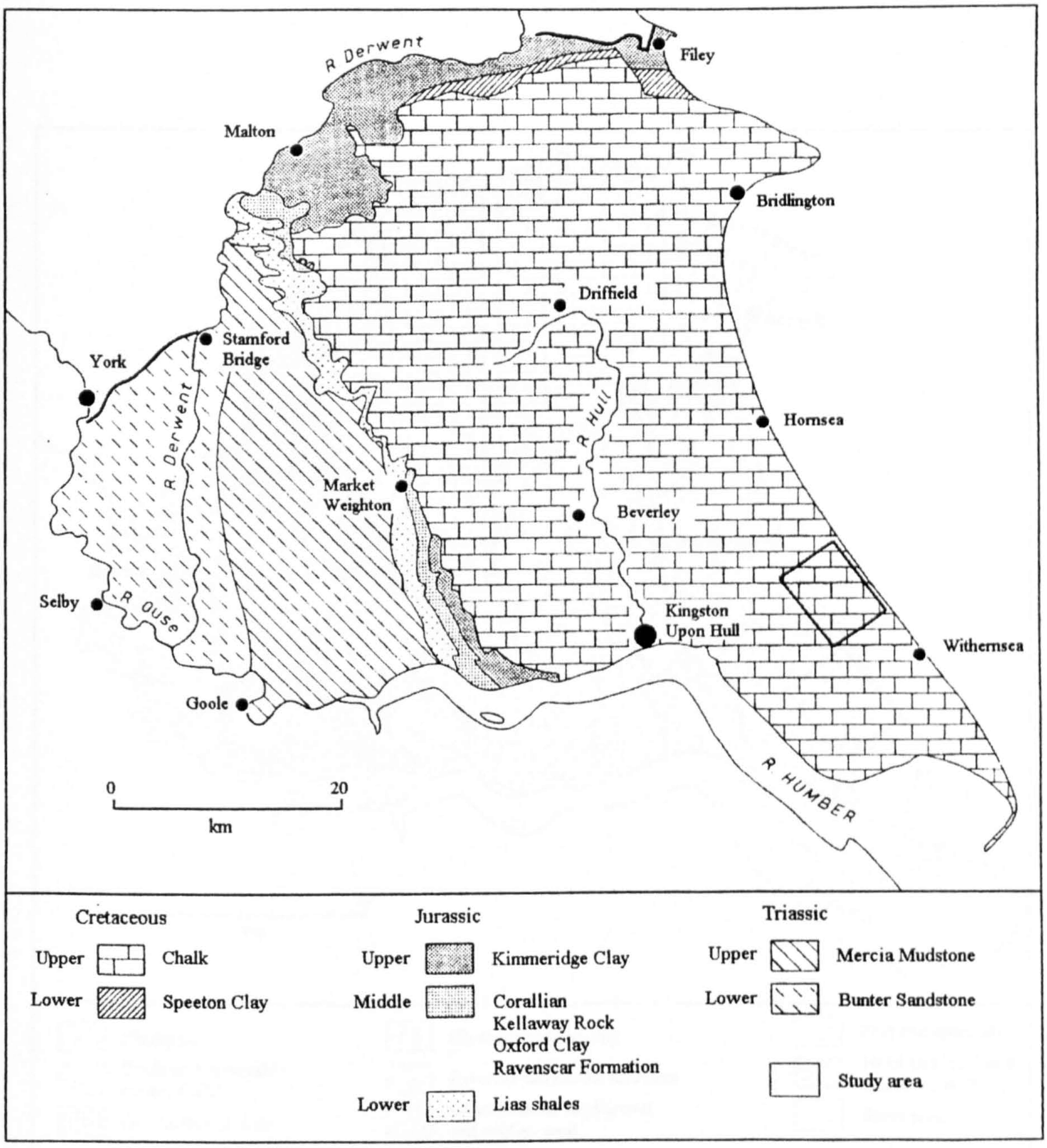


Figure 2.2: solid geology of eastern Yorkshire (taken from Arnett, 1990)

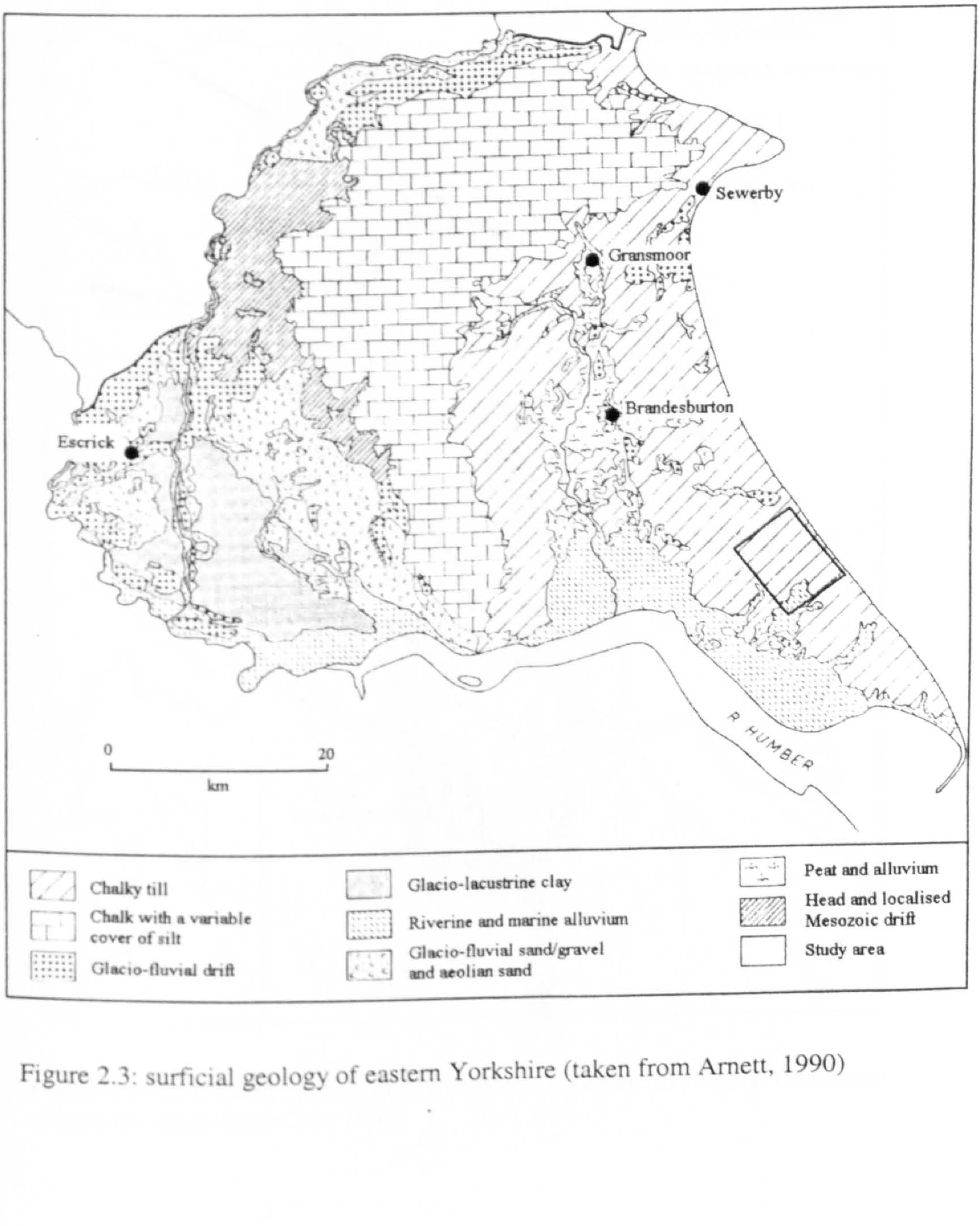


Figure 2.3: surficial geology of eastern Yorkshire (taken from Arnett, 1990)

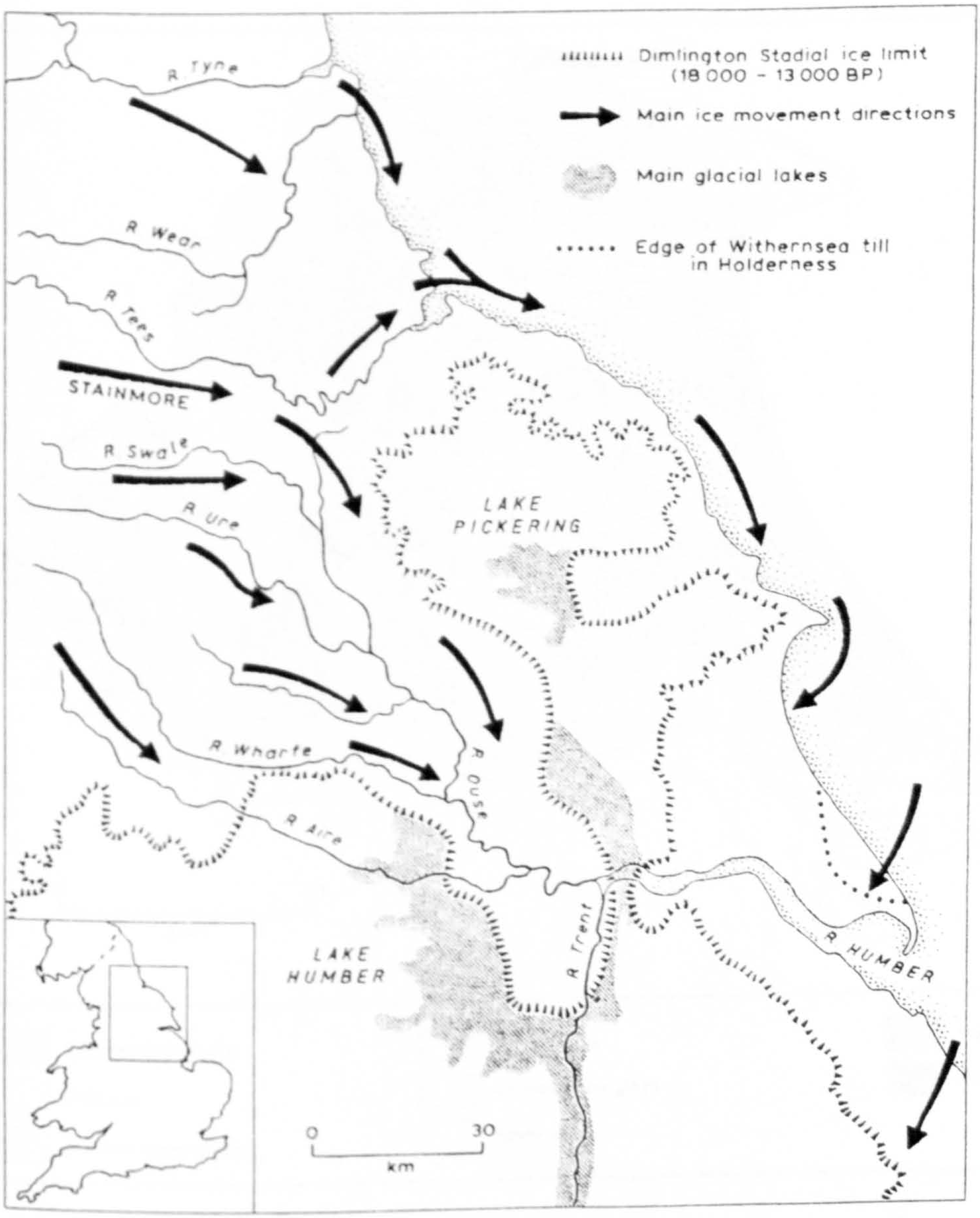


Figure 2.4: ice movement directions in eastern Yorkshire during the Devensian maximum (taken from Catt, 1990)

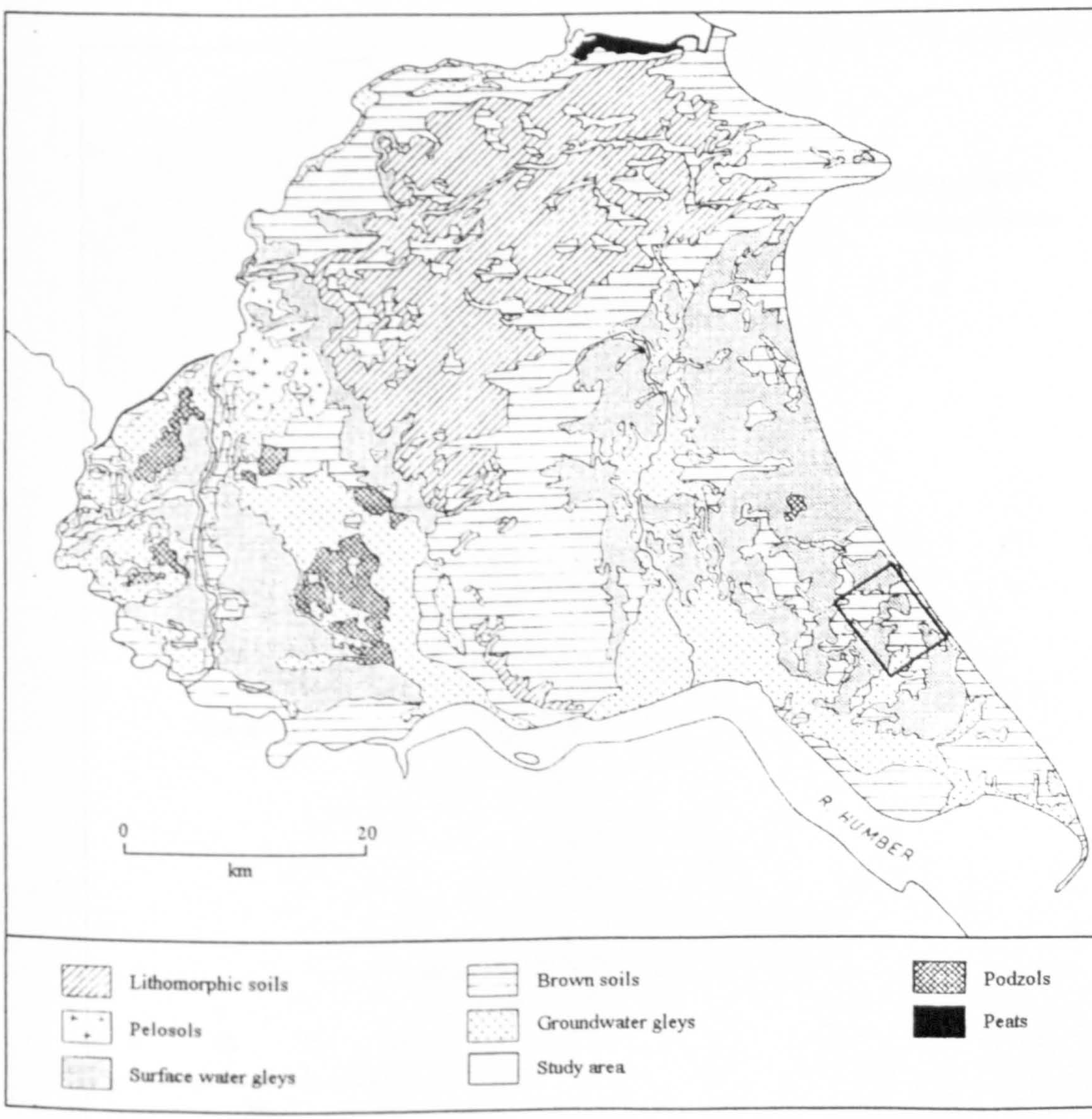
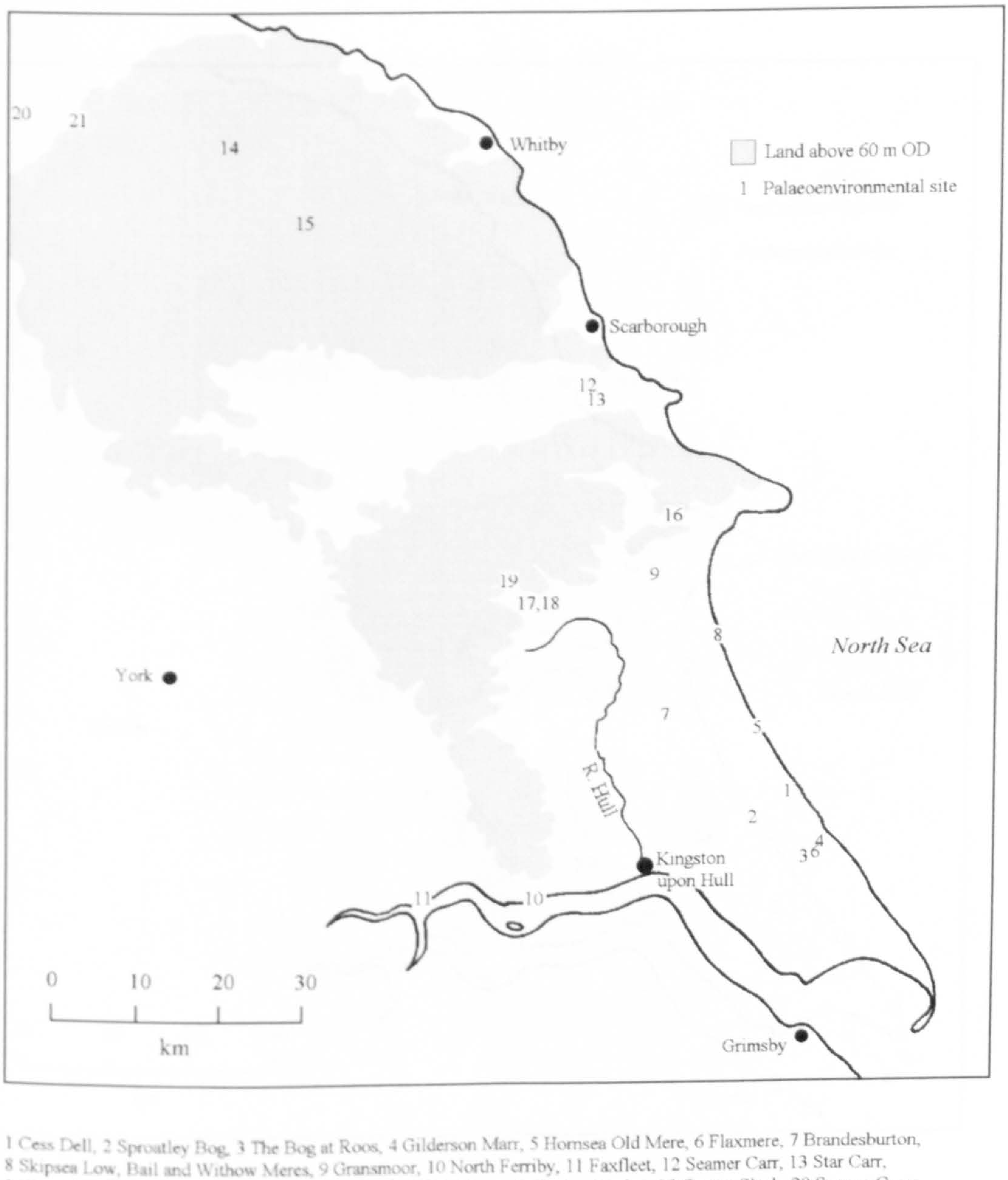
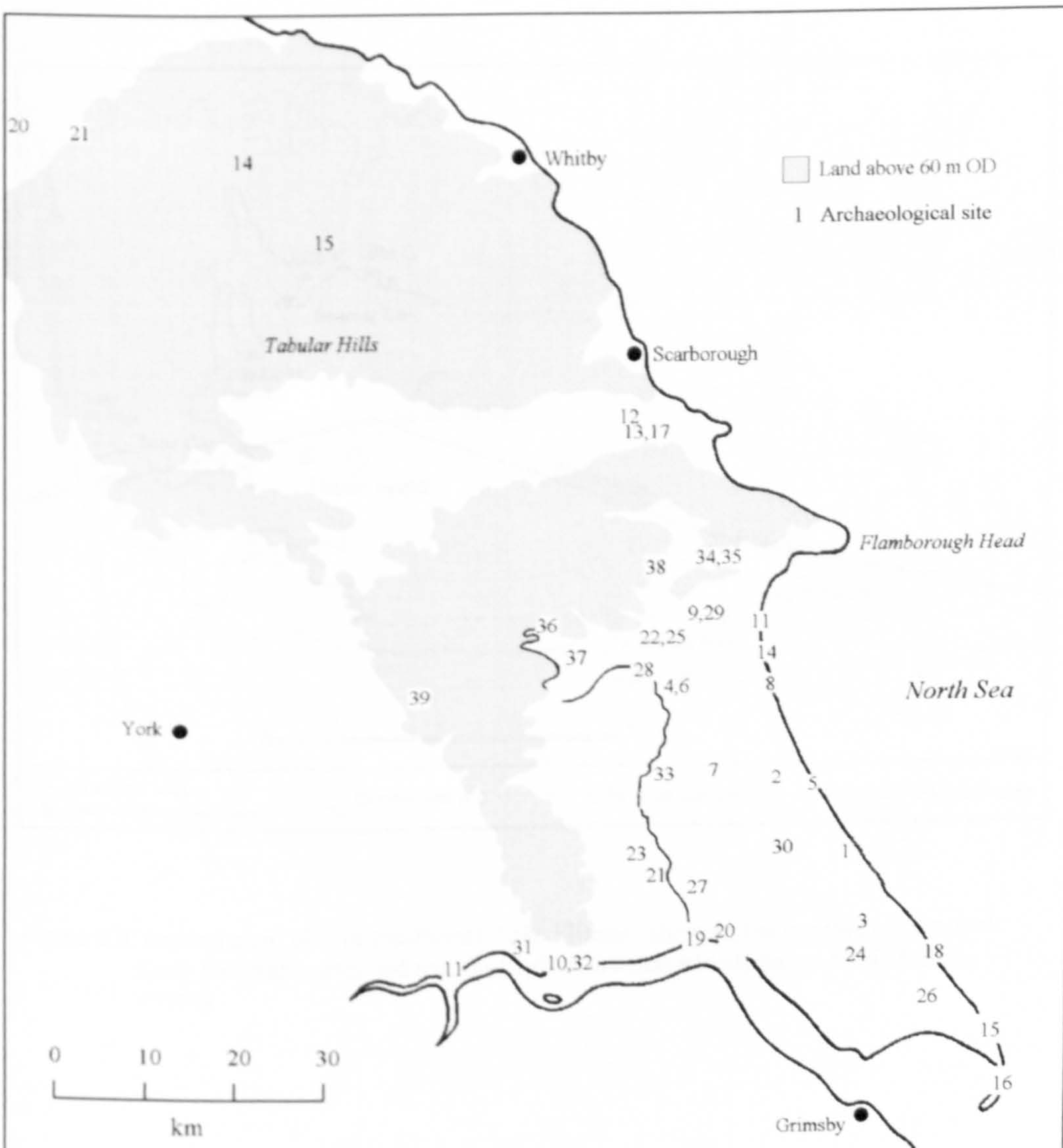


Figure 2.5: principal soil types of eastern Yorkshire (taken from Arnett, 1990)



1 Cess Dell, 2 Sproatley Bog, 3 The Bog at Roos, 4 Gilderson Marr, 5 Hornsea Old Mere, 6 Flaxmere, 7 Brandesburton, 8 Skipsea Low, Bail and Withow Meres, 9 Gransmoor, 10 North Ferriby, 11 Faxfleet, 12 Seamer Carr, 13 Star Carr, 14 Ewe Crag Slack, 15 North Gill, 16 Willow Garth, 17 Kirkburn, 18 Garton Station, 19 Garton Slack, 20 Seamer Carrs, 21 Kildale Hall

Figure 2.6: map showing the palaeoenvironmental sites referred to in the text



1 Aldbrough, 2 Seaton, 3 Roos, 4 Brigham, 5 Hornsea, 6 North Frodingham, 7 Brandesburton, 8 Skipsea, 9 Gransmoor, 10 North Ferriby, 11 Barmston, 12 Seamer Carr, 13 Star Carr, 14 Ulrome, 15 Easington, 16 Kilnsea, 17 Flixton Carr, 18 Withernsea, 19 Hull, 20 Hedon, 21 Beverley, 22 Driffield, 23 Leconfield, 24 Halsham, 25 Nafferton, 26 Patrington, 27 Meaux, 28 Skerne, 29 Burton Agnes, 30 Lambwath Mere, 31 Brough, 32 Redcliff, 33 Watton, 34 Burton Fleming, 35 Rudston, 36 Wetwang Slack, 37 Garton, 38 Thwing, 39 Grimthorpe

Figure 2.7: map showing the archaeological sites referred to in the text

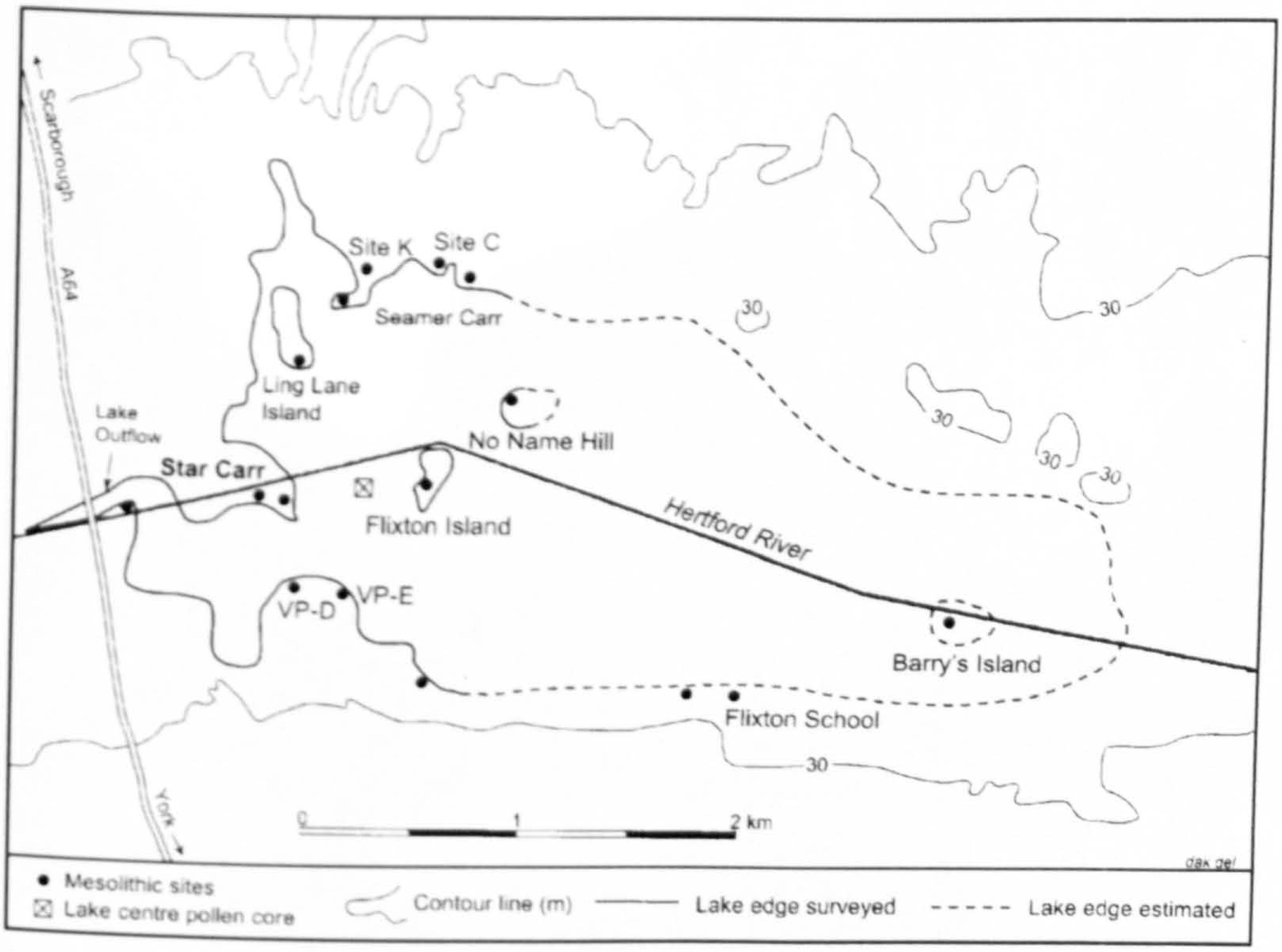
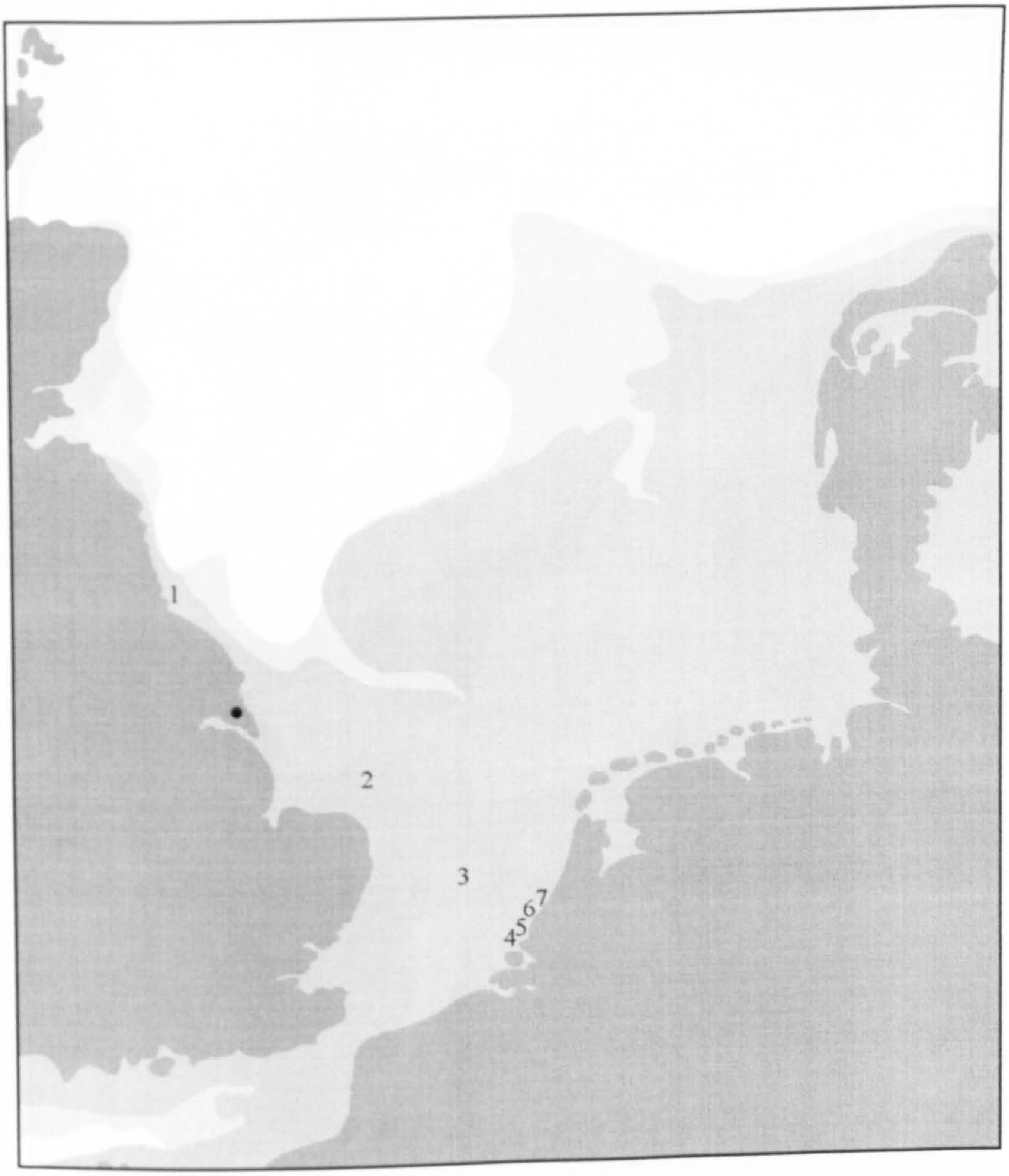


Figure 2.8: reconstructed plan of Pre-Boreal 'Lake Flixton', showing the location of principal Early Mesolithic sites and associated shoreline and islands (taken from Mellars, 1998b)



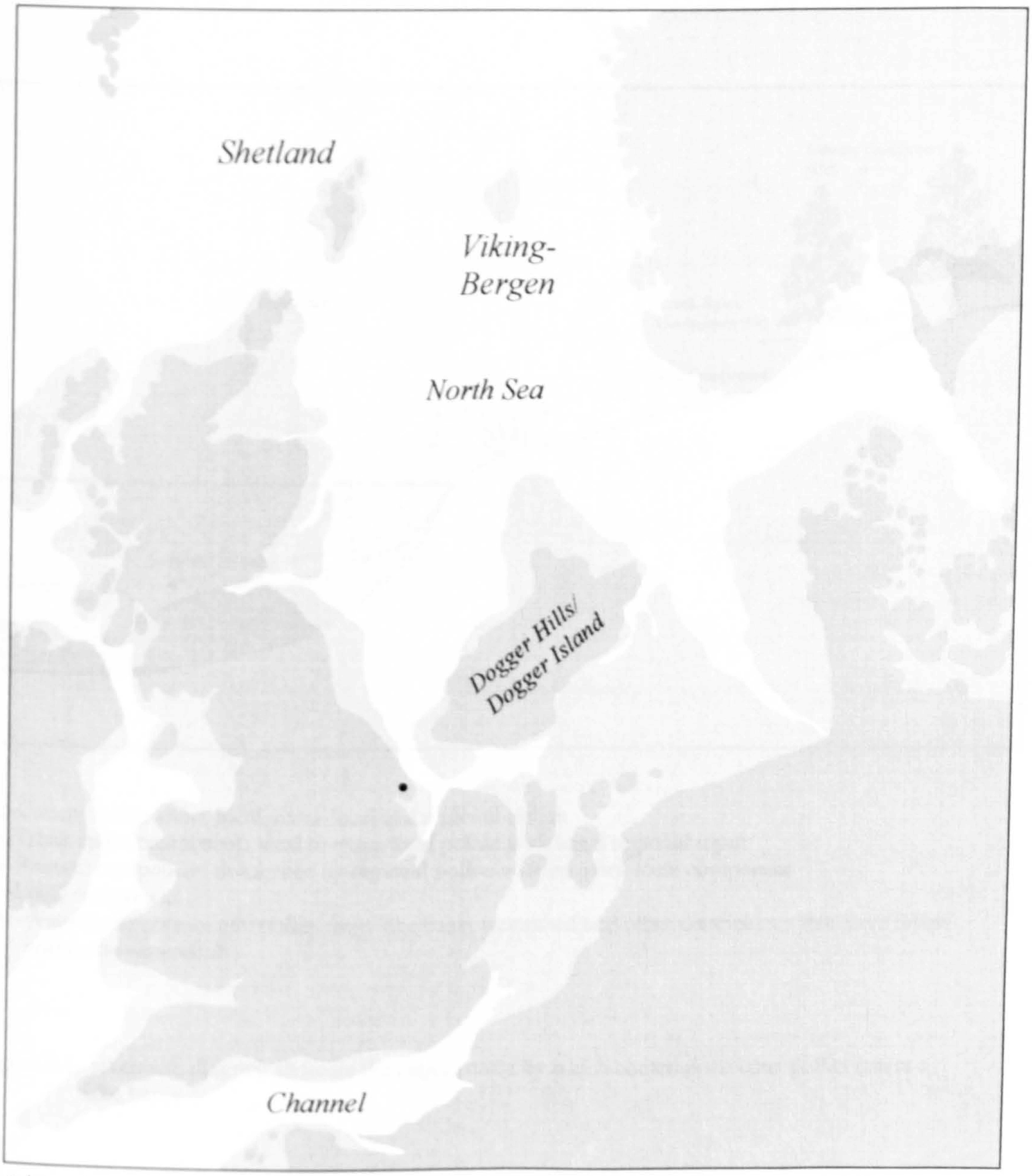
• Study area

Open water
Exposed land at 10,300 BP
Exposed land at 9000 BP
Present day exposed land mass

1 Whitburn (Mellars, 1970)
2 Leman and Ower Banks (Burkitt, 1932)
3 Brown Bank (Louwe Kooijmans, 1972)
4 Europoort (Verhart, 1995)
5 Hook of Holland (Verhart, 1995)
6 Scheveningen (Verhart, 1995)

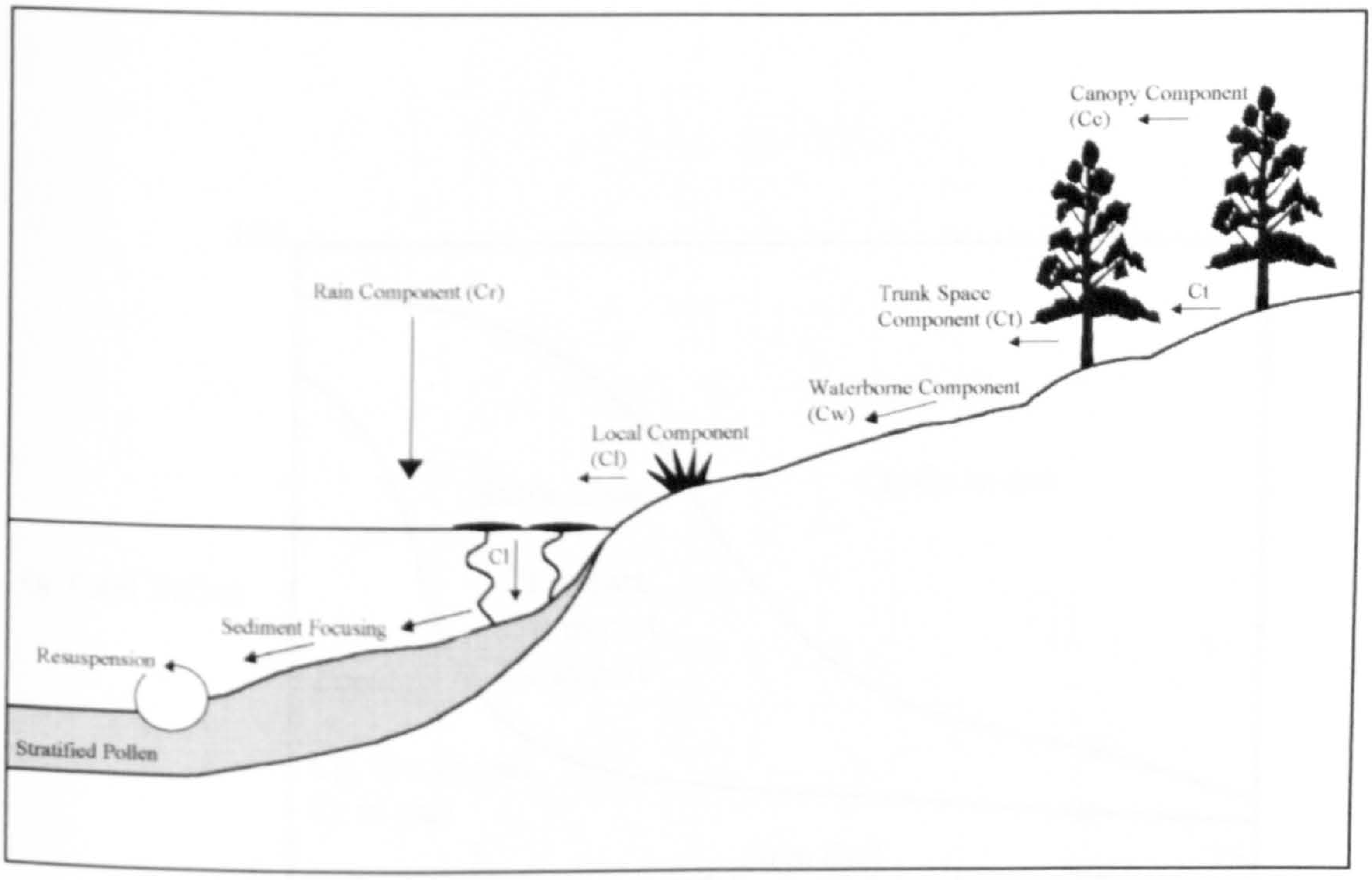
Figure 2.9: reconstruction of the North Sea Basin: exposed land surface at 10,300 BP, 9000 BP and the present day (based upon Jelgersma, 1979)

Figure 2.10: reconstruction of the North Sea Basin: exposed land surface at 8700 BP, 8300 BP and the present day (based upon Jelgersma, 1979)



• Approximate position of study area
▯ Exposed land in the earlier Holocene (prior to 5000 cal BC) ▯ Exposed land at 5000 cal BC

Figure 2.11: reconstruction of North Sea Basin: exposed land surface during the earlier Holocene and at 5000 cal BC (based upon Coles, 1998)



Cc-Canopy component: local, extra-local and regional pollen
Ct-Trunk space component: local to extra-local pollen with some regional input
Cr-Rainout component: dominated by regional pollen with an extra-local component
Cl-Local component
Cw-Waterborne component: pollen from lake basin watershed and other components that have fallen within the watershed

Figure 3.1: schematic diagram showing the major routes by which contemporaneous pollen enters a lake basin

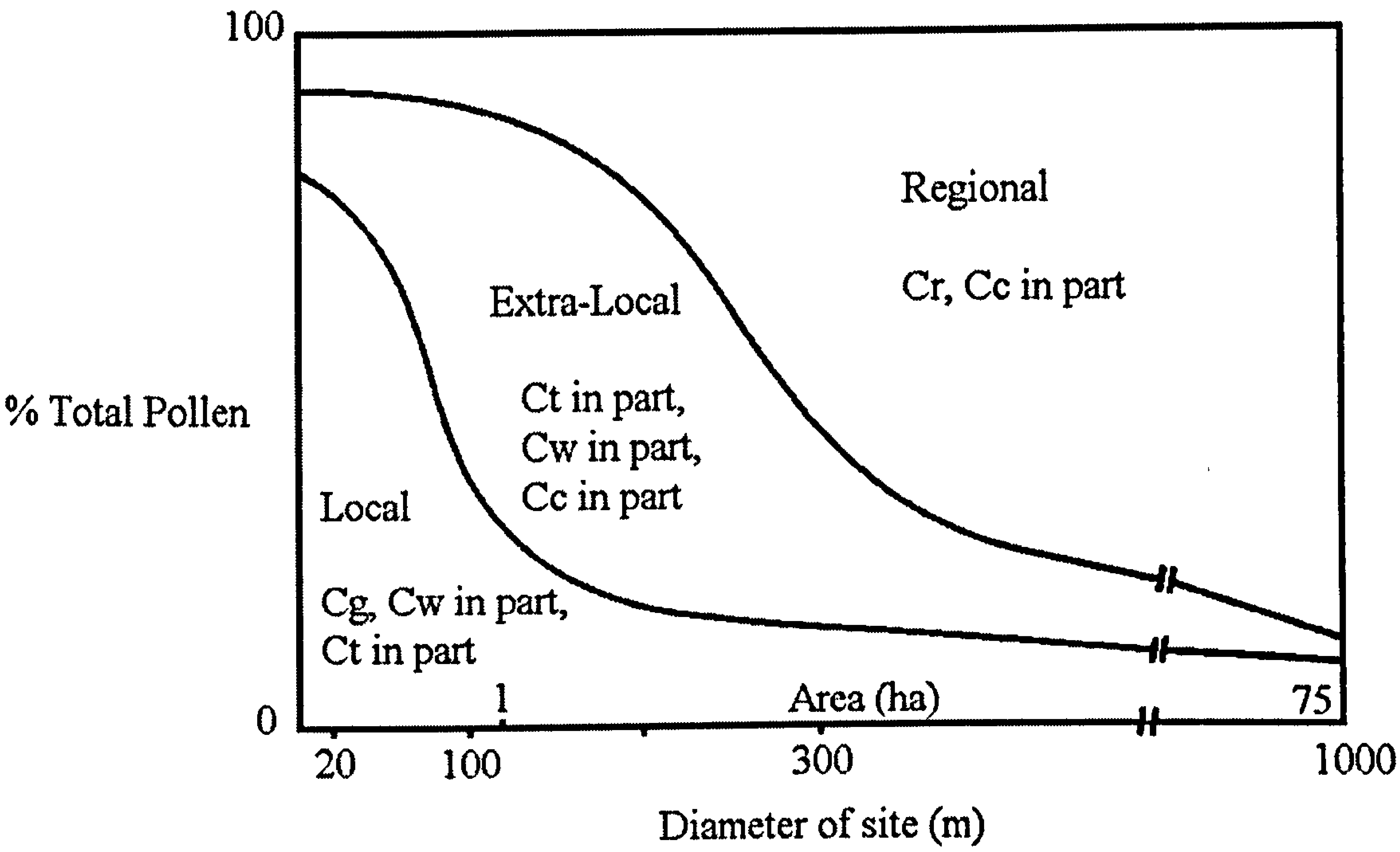


Figure 3.2: graph showing the relationship between the size of an enclosed basin and the relative proportions of pollen originating from different areas around the site (taken from Jacobson and Bradshaw, 1981)

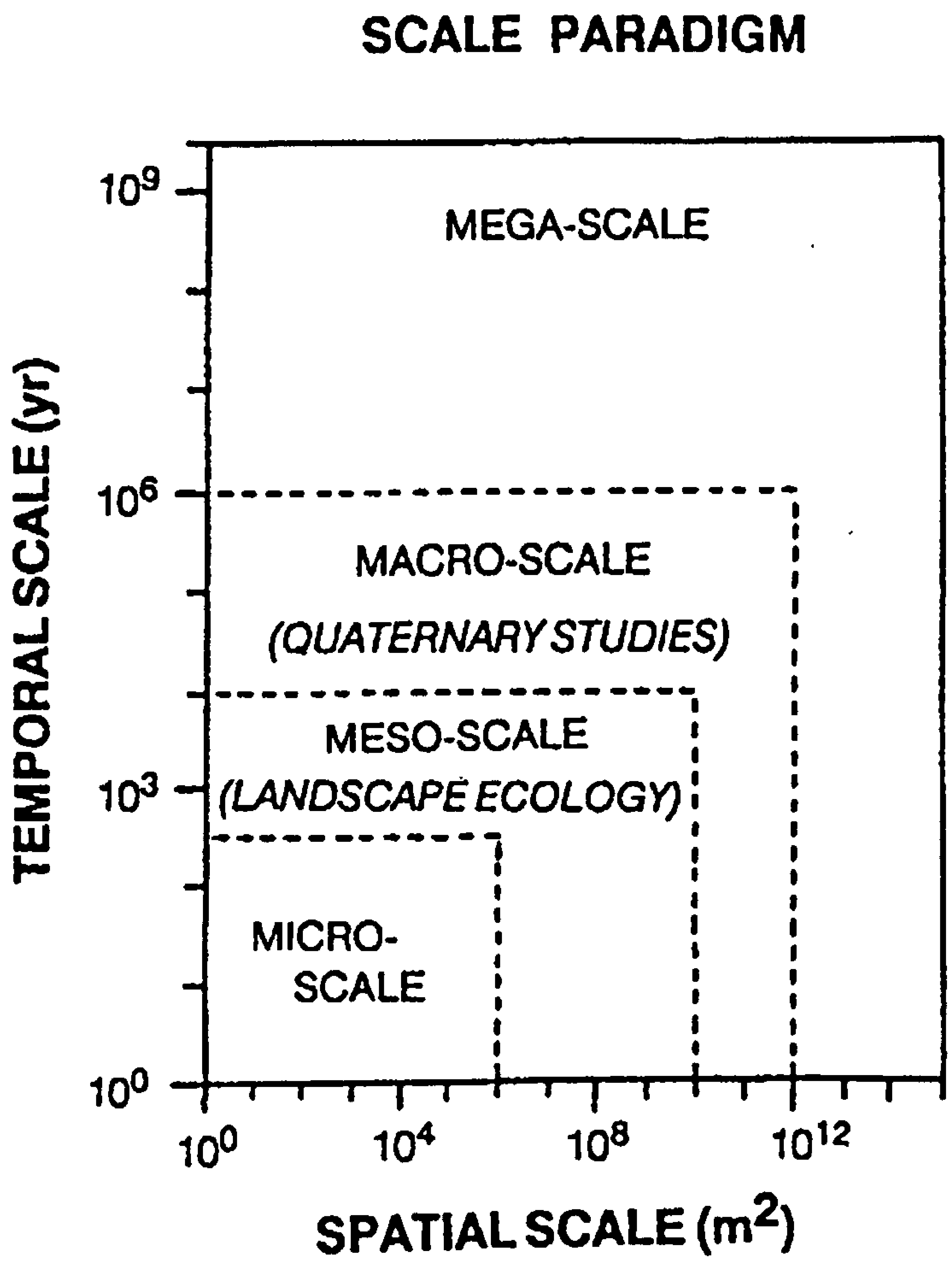


Figure 3.3: the hierarchical system of spatio-temporal domains as suggested by Delcourt and Delcourt (1988)

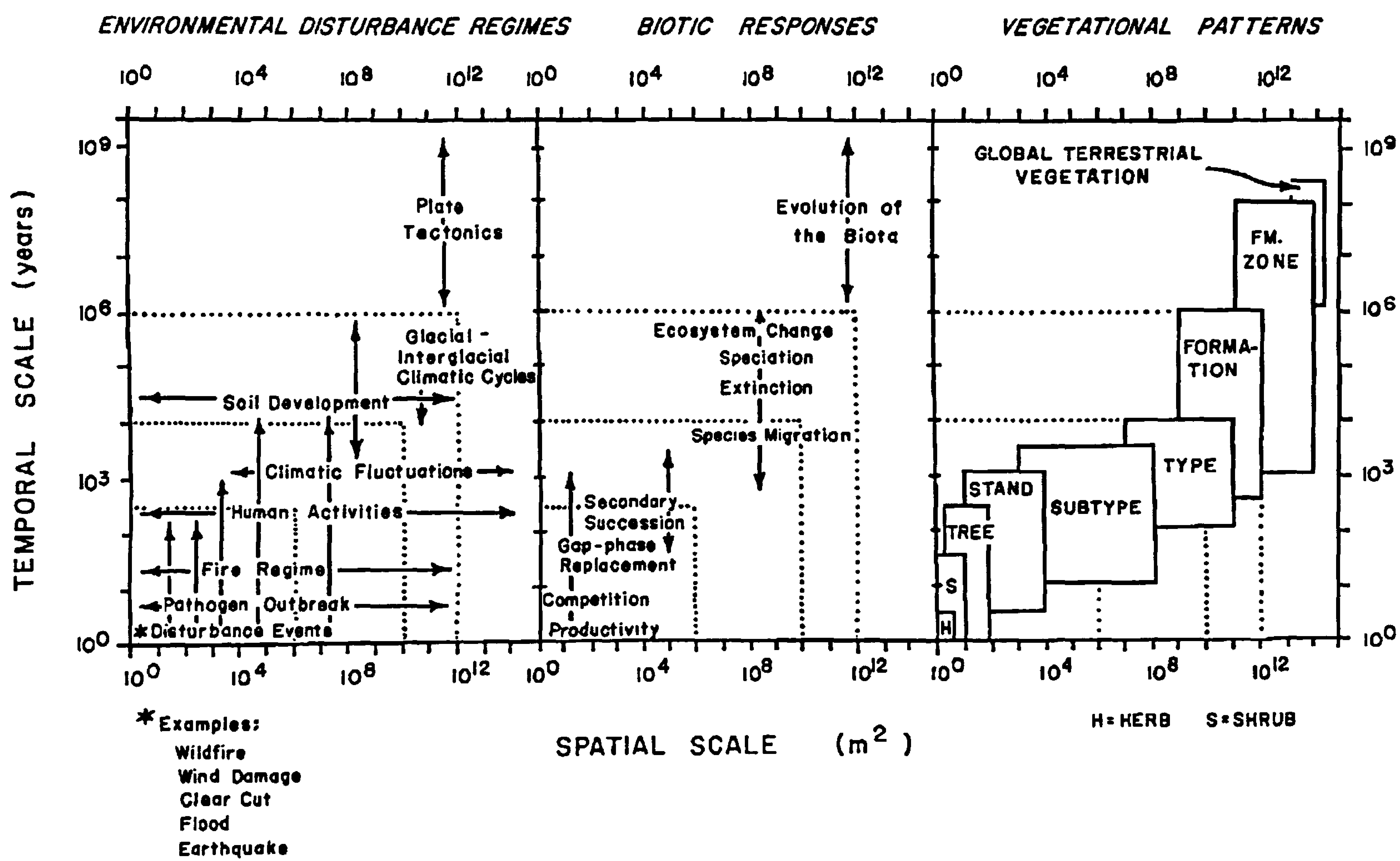


Figure 3.4: disturbance regimes, biotic responses and vegetational patterns in association with the spatio-temporal domains outlined in Figure 3.3 (taken from Delcourt and Delcourt, 1981)

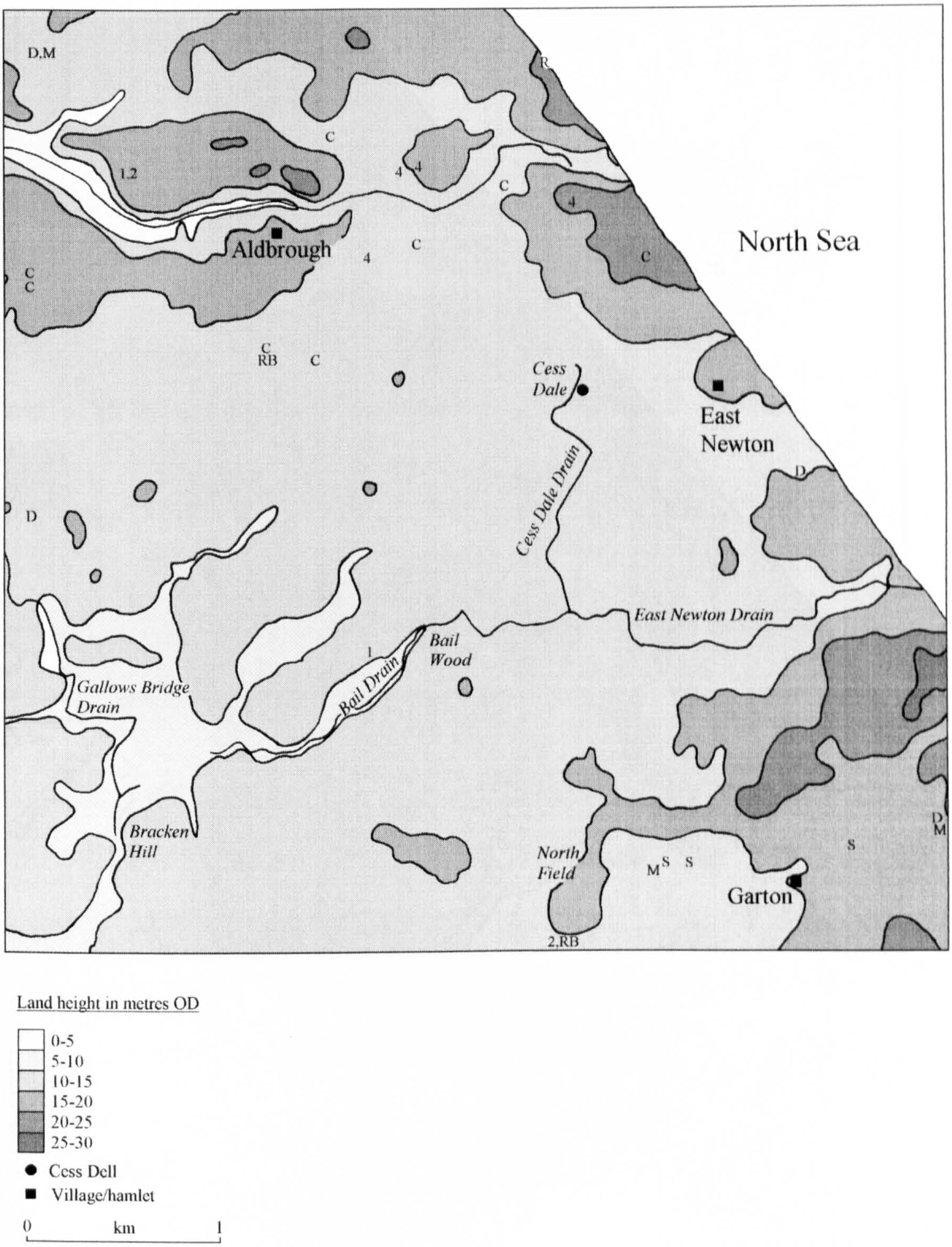


Figure 3.5: map showing the location of Cess Dell and archaeological finds from the surrounding area (see Figure 3.9 for key)

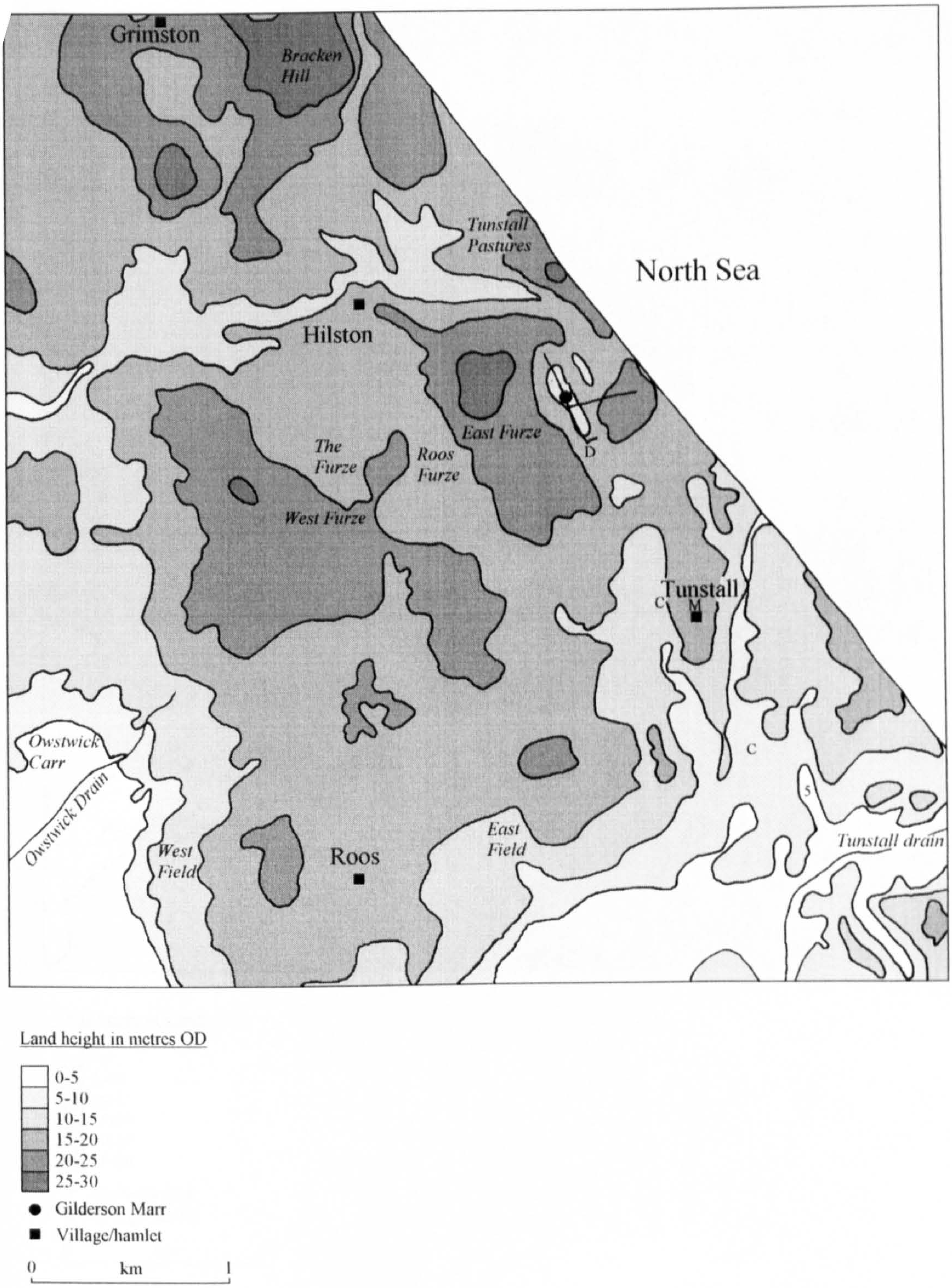


Figure 3.6: map showing the location of Gilderson Marr and archaeological finds from the surroundi area (see Figure 3.9 for key)

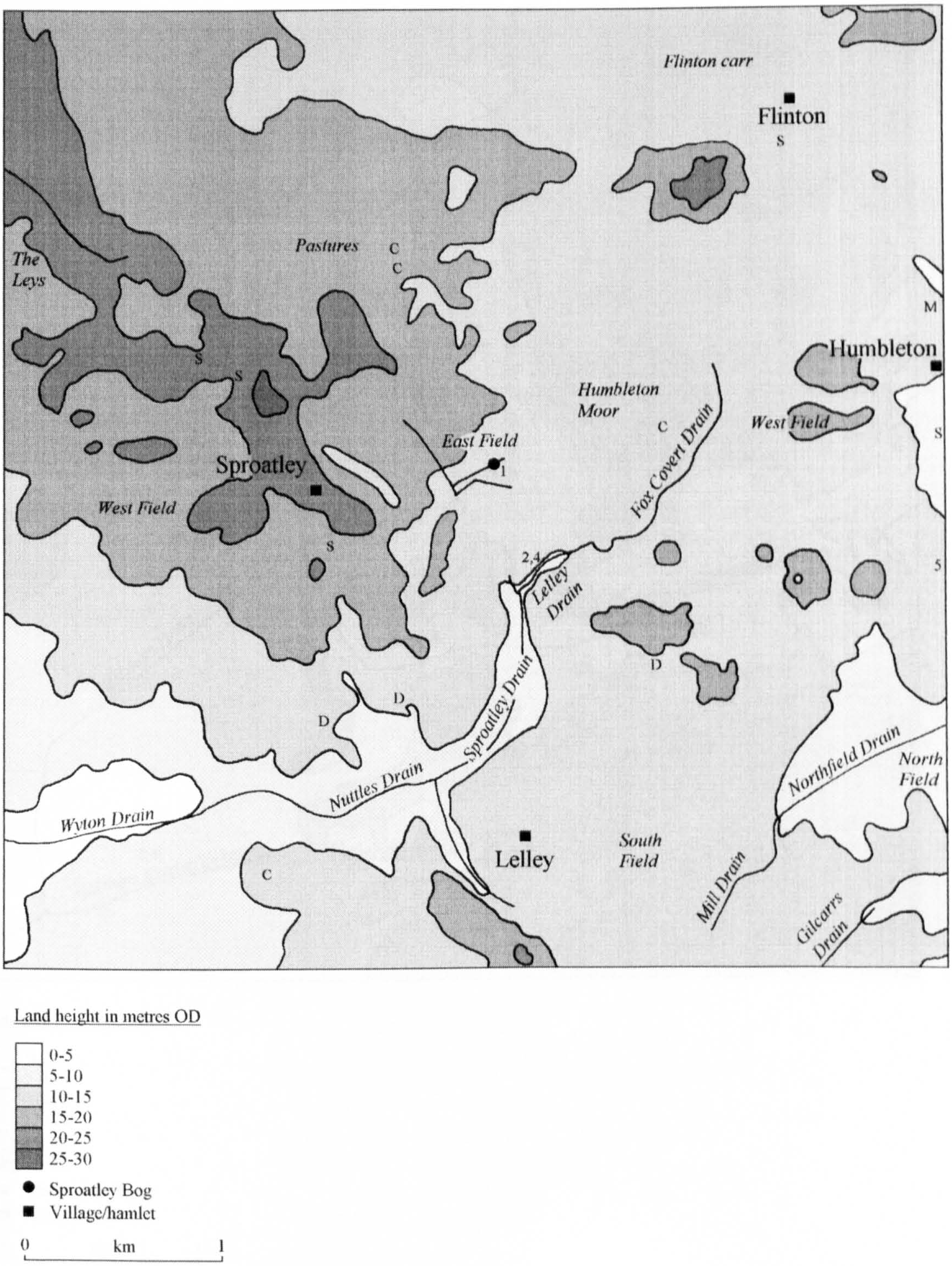


Figure 3.7: map showing the location of Sproatley Bog and archaeological finds from the surrounding area (see Figure 3.9 for key)

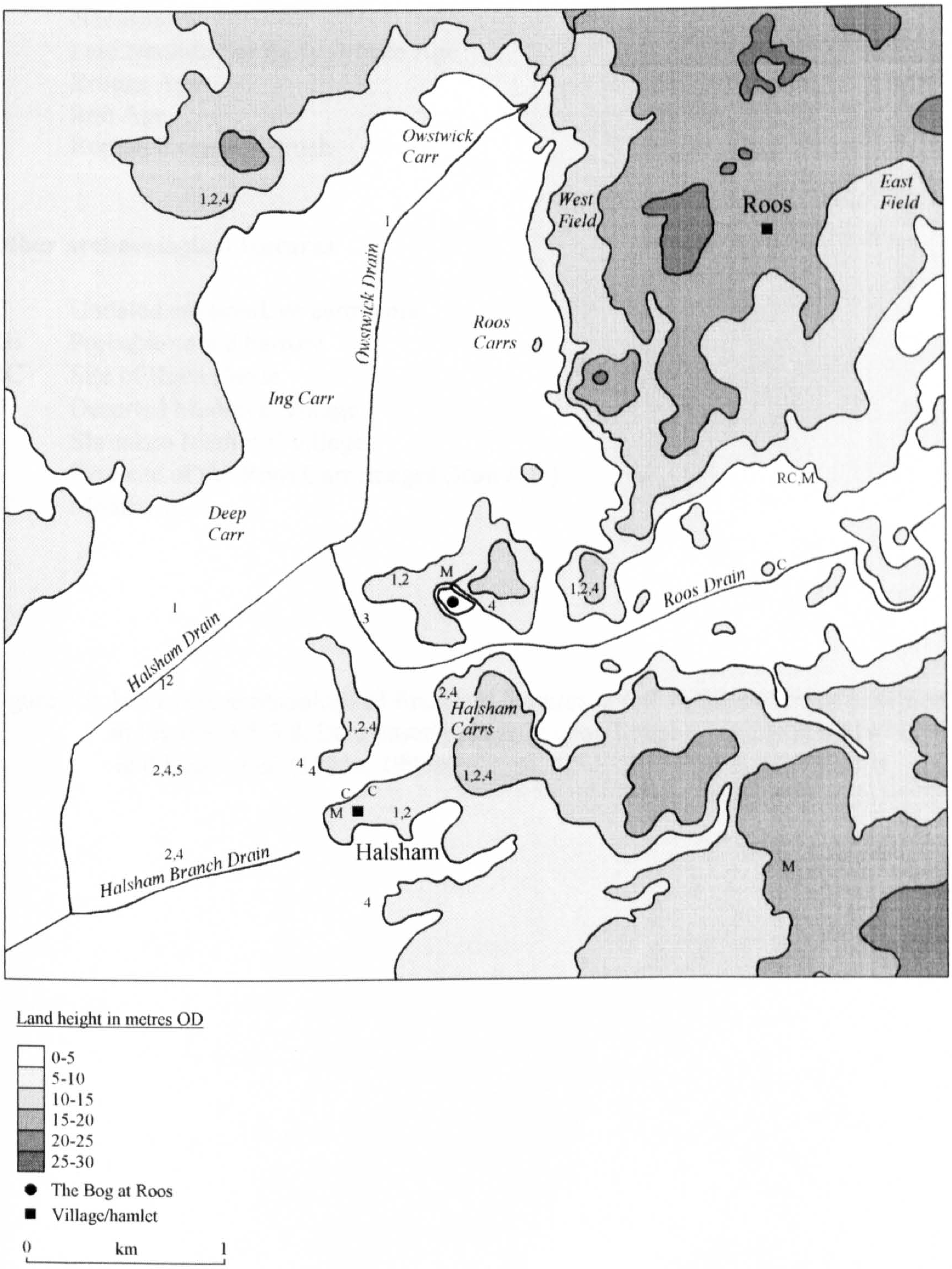


Figure 3.8: map showing the location of The Bog at Roos and archaeological finds from the surrounding area (see Figure 3.9 for key)

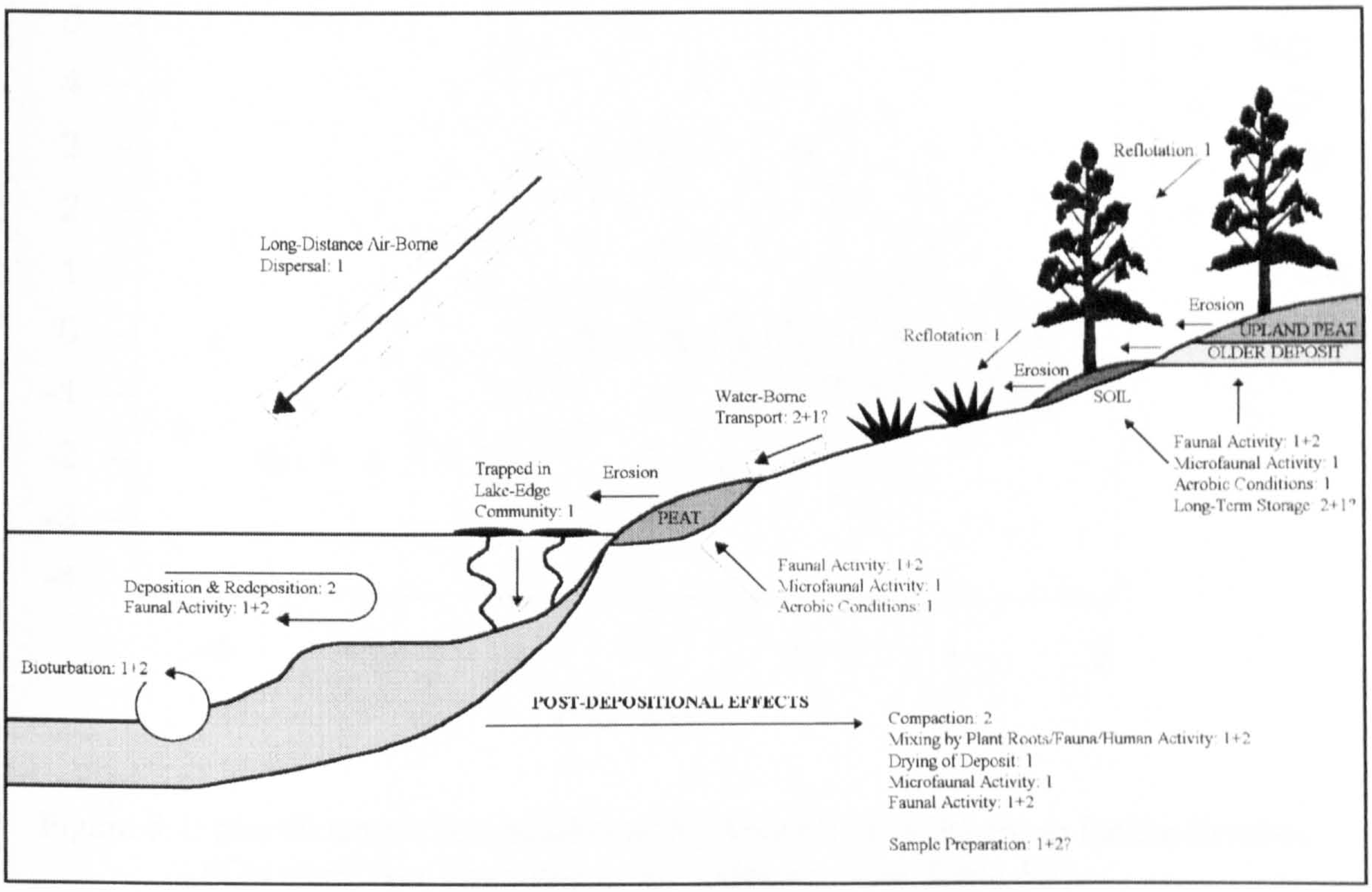
Artefact scatters (primarily flint and pottery)

1	Mesolithic
2	Neolithic
3	Late Neolithic or Early Bronze Age
4	Bronze Age
5	Iron Age
6	Roman/Romano-British

Other archaeological features

C	Undated cropmark or earthwork
RB	Probable round barrow
RC	Site of Roos Castle
D	Deserted Medieval village
S	Shrunken Medieval village
I	Find site of the Roos Carr Images (Iron Age)
M	Moated site

Figure 3.9: key to the archaeological finds and features noted on the site maps provided in Figures 3.5-3.8. Data based primarily upon Loughlin and Miller (1979) and Head *et al.* (1995a, 1995b).



1=Chemical or biochemical alteration: corrosion, degradation?
2=Physical alteration: breakage, crumpling, degradation
?=Possible, but not shown experimentally

Based upon the work of a number of authors (see text for details)

Figure 4.1: Schematic diagram showing the possible causes of pollen deterioration

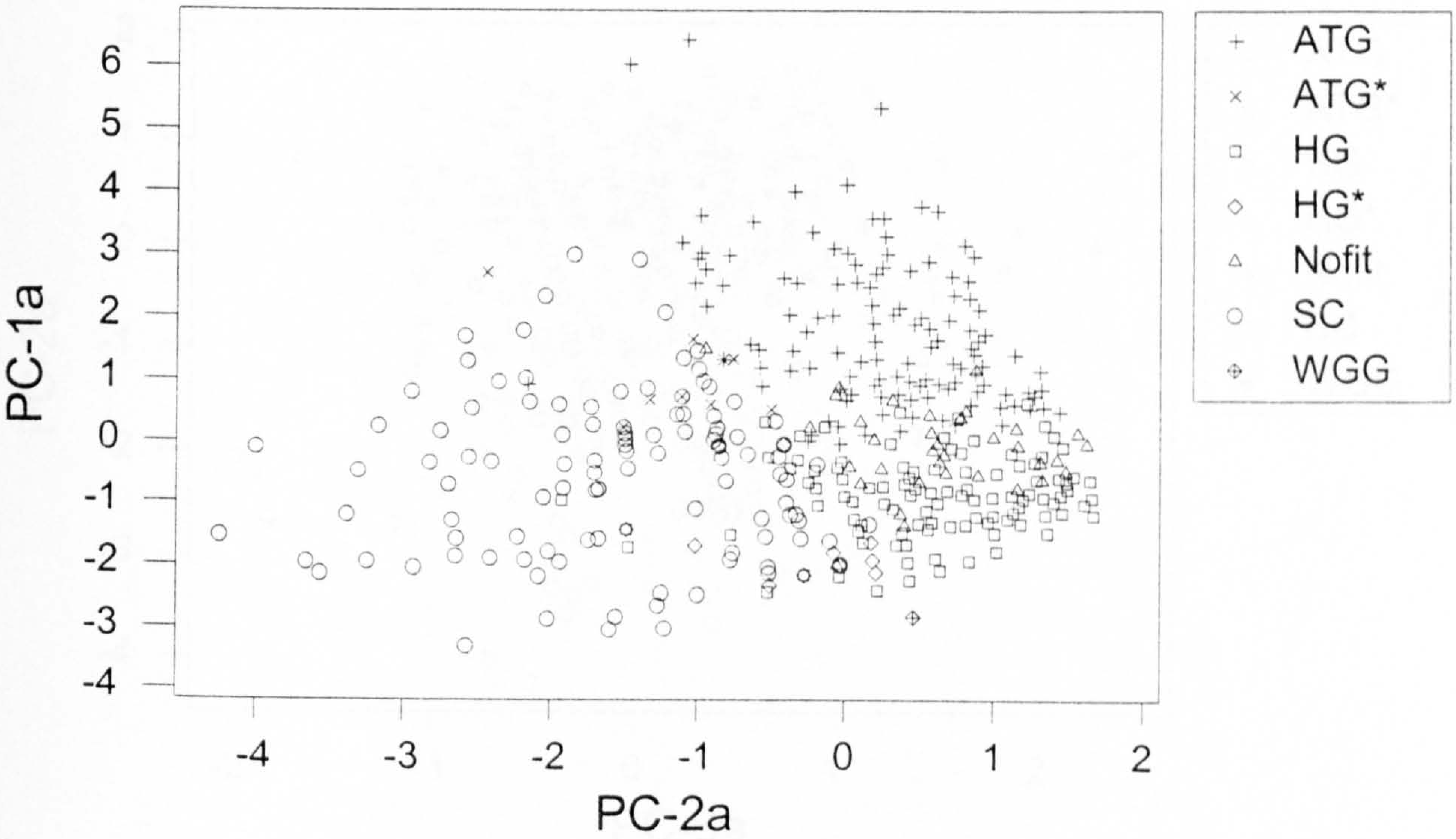


Figure 5.1: plot of sample scores labelled by Andersen (1979) group for the first two PC's of PCA-a. For a key to the codes used see Table 5.7.

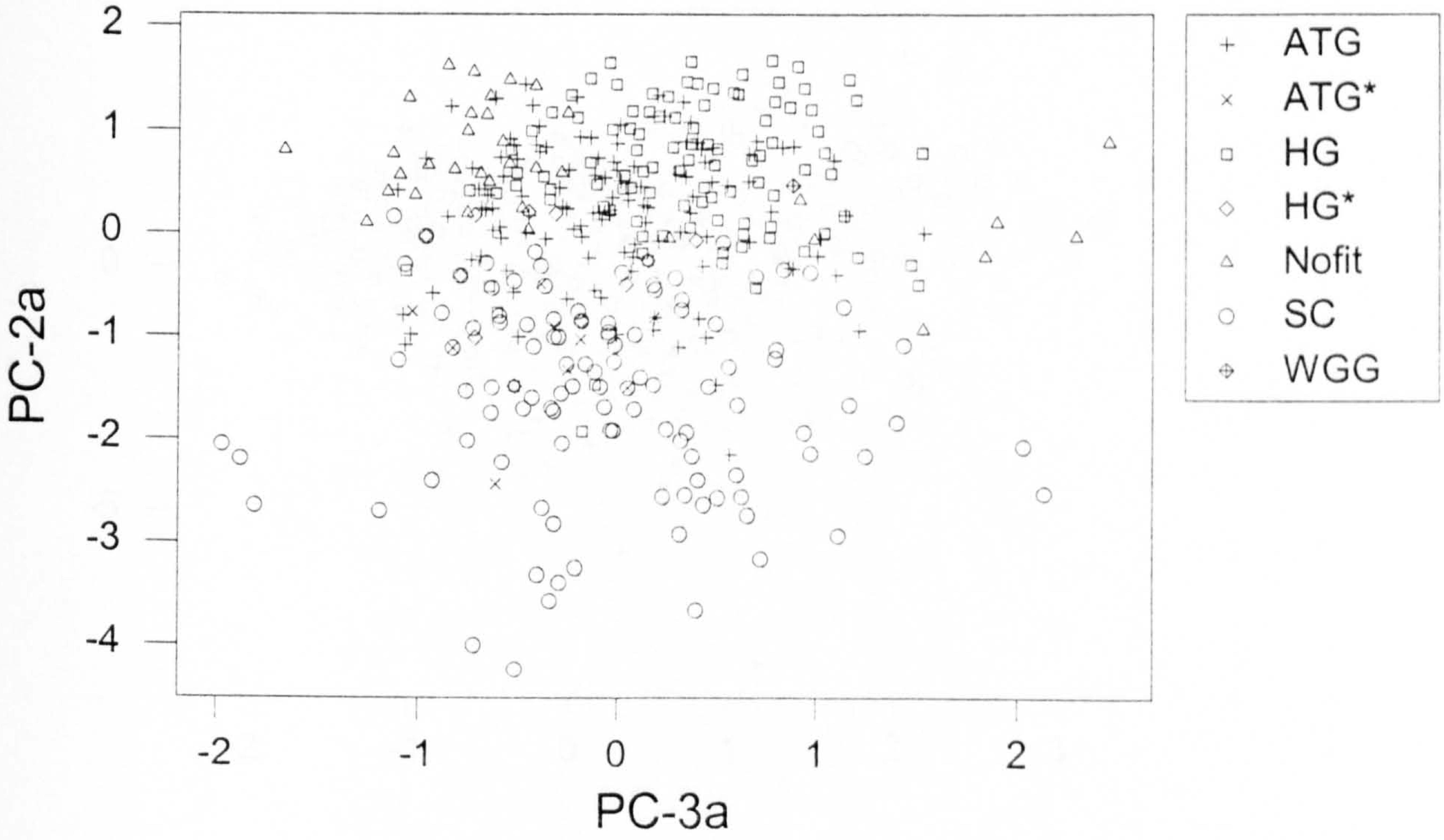


Figure 5.2: plot of sample scores labelled by Andersen (1979) group for the second and third PC's of PCA-a. For a key to the codes used see Table 5.7.

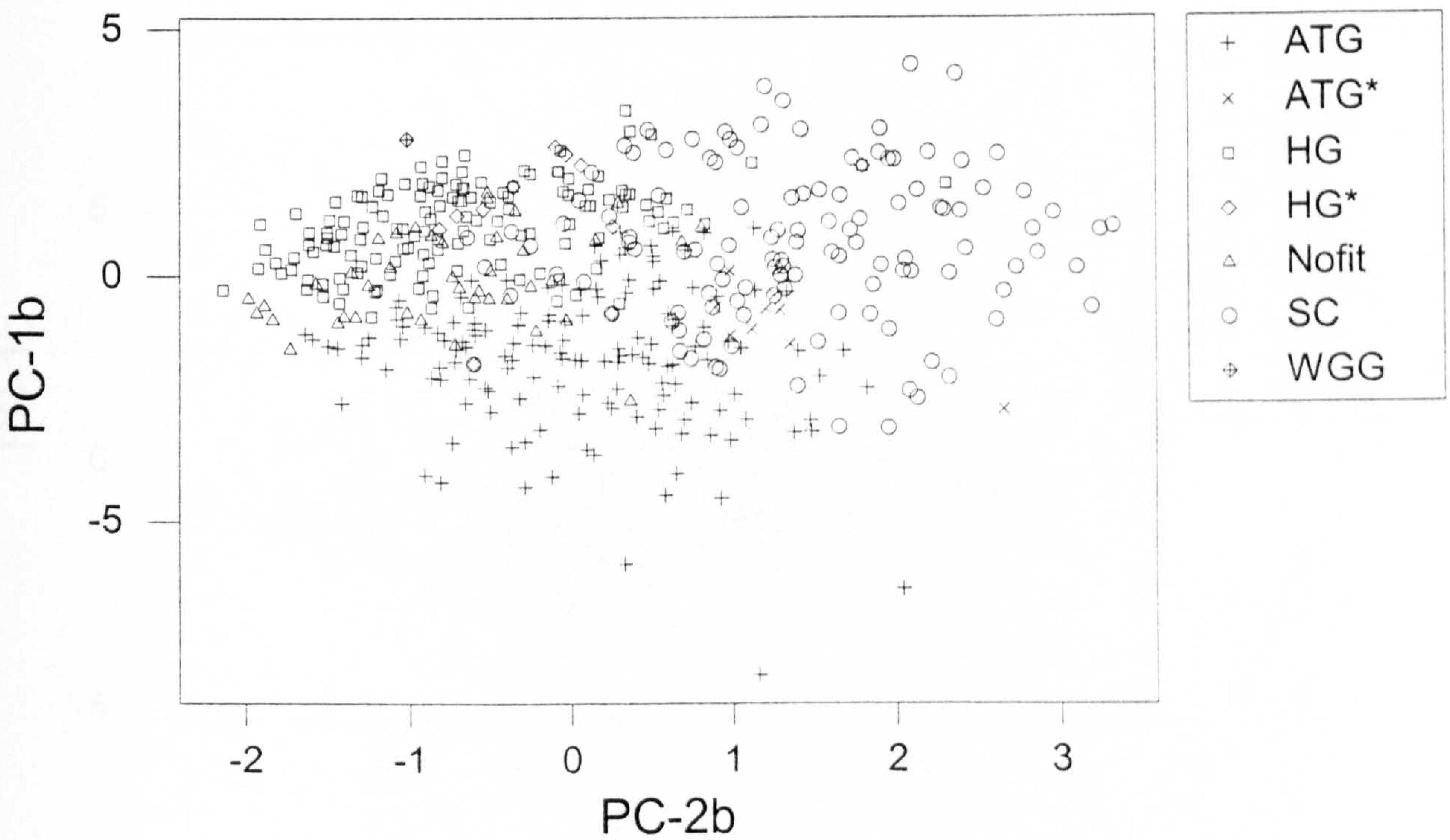


Figure 5.3: plot of sample scores labelled by Andersen (1979) group for the first two PC's of PCA-b. For a key to the codes used see Table 5.7.

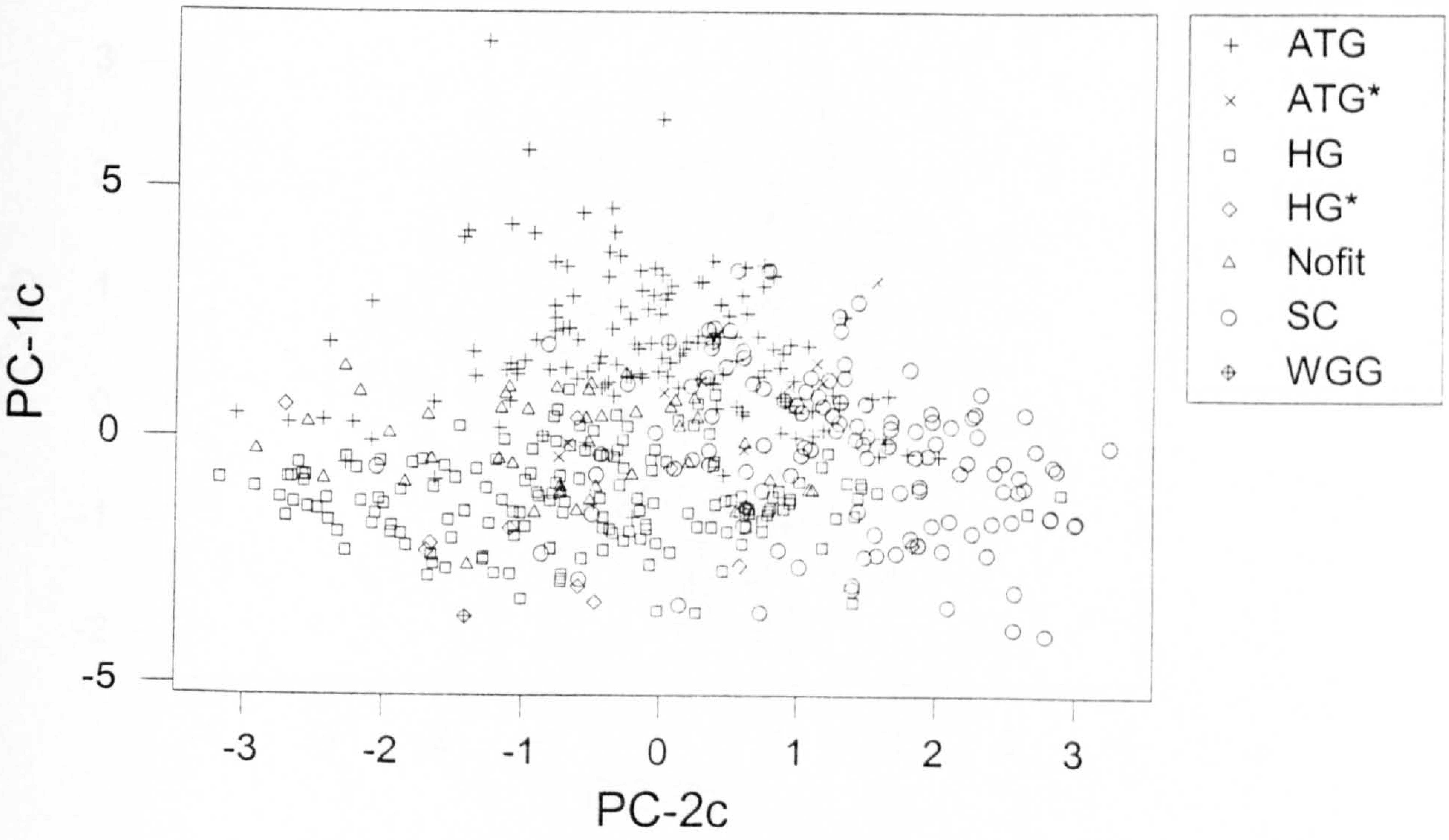


Figure 5.4: plot of sample scores labelled by Andersen (1979) group for the first two PC's of PCA-c. For a key to the codes used see Table 5.7.

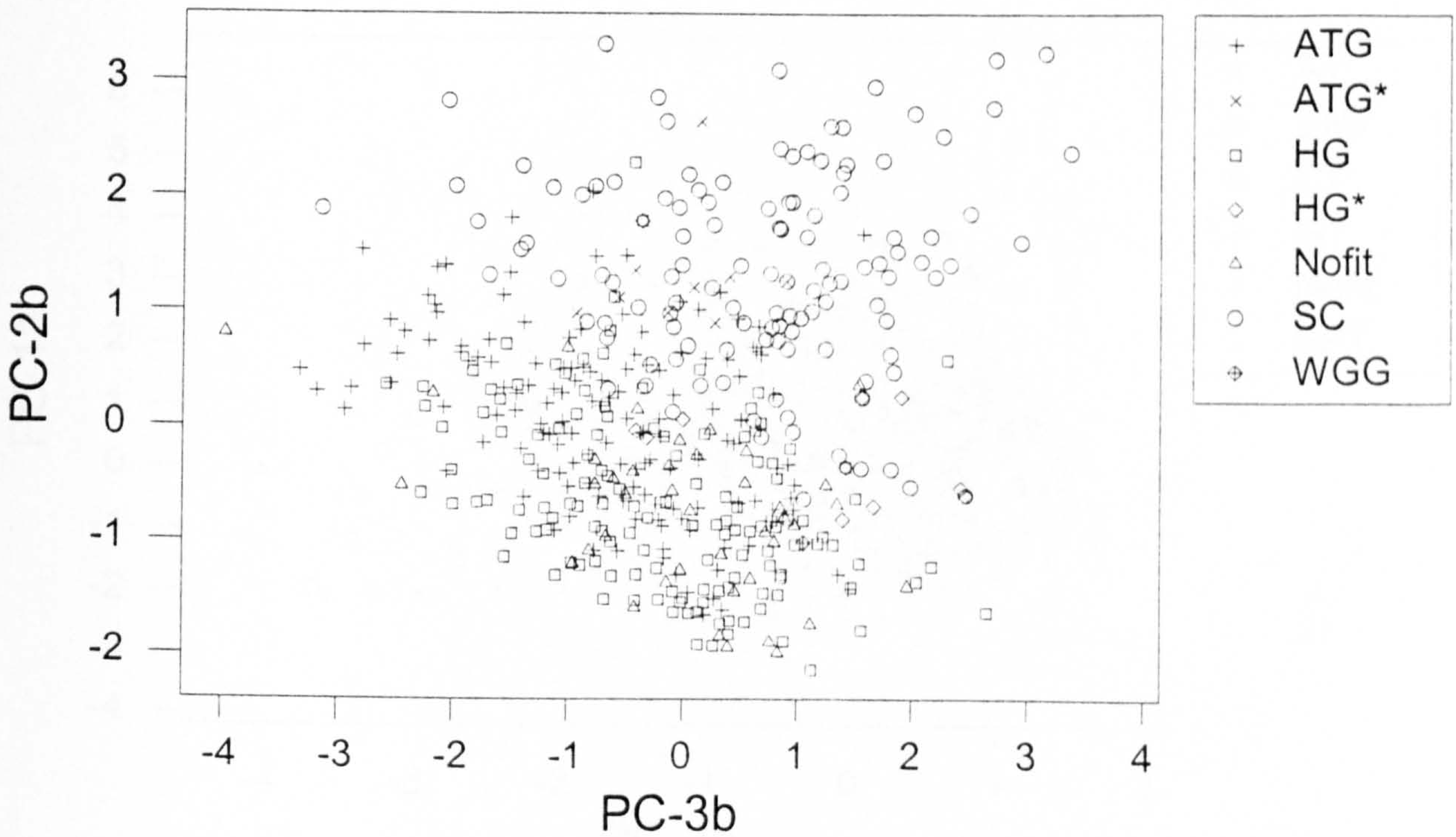


Figure 5.5: plot of sample scores labelled by Andersen (1979) group for the second and third PC's of PCA-b. For a key to the codes used see Table 5.7.

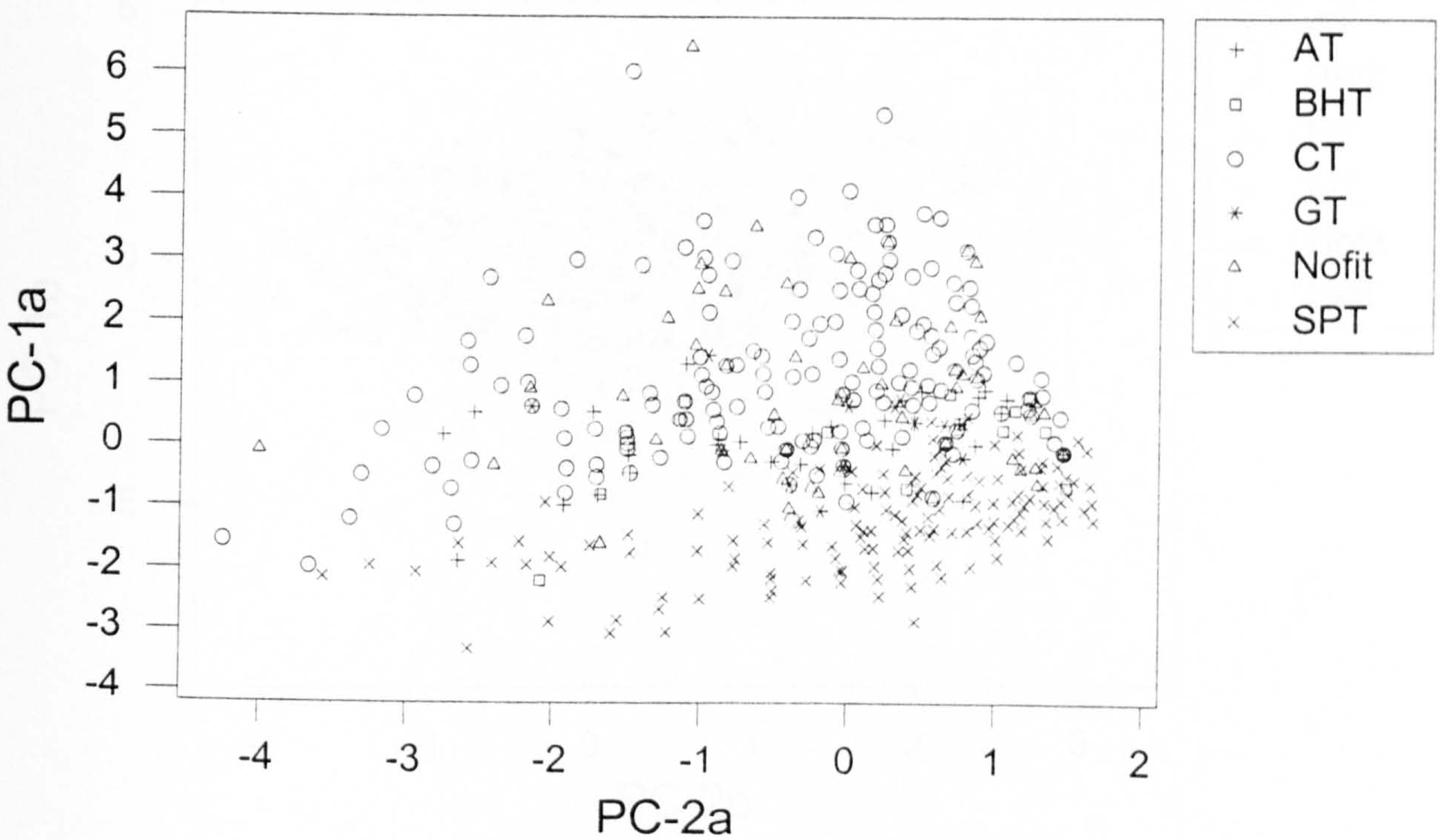


Figure 5.6: plot of sample scores labelled by Küster (1988) group for the first two PC's of PCA-a. For a key to the codes used see Table 5.8.

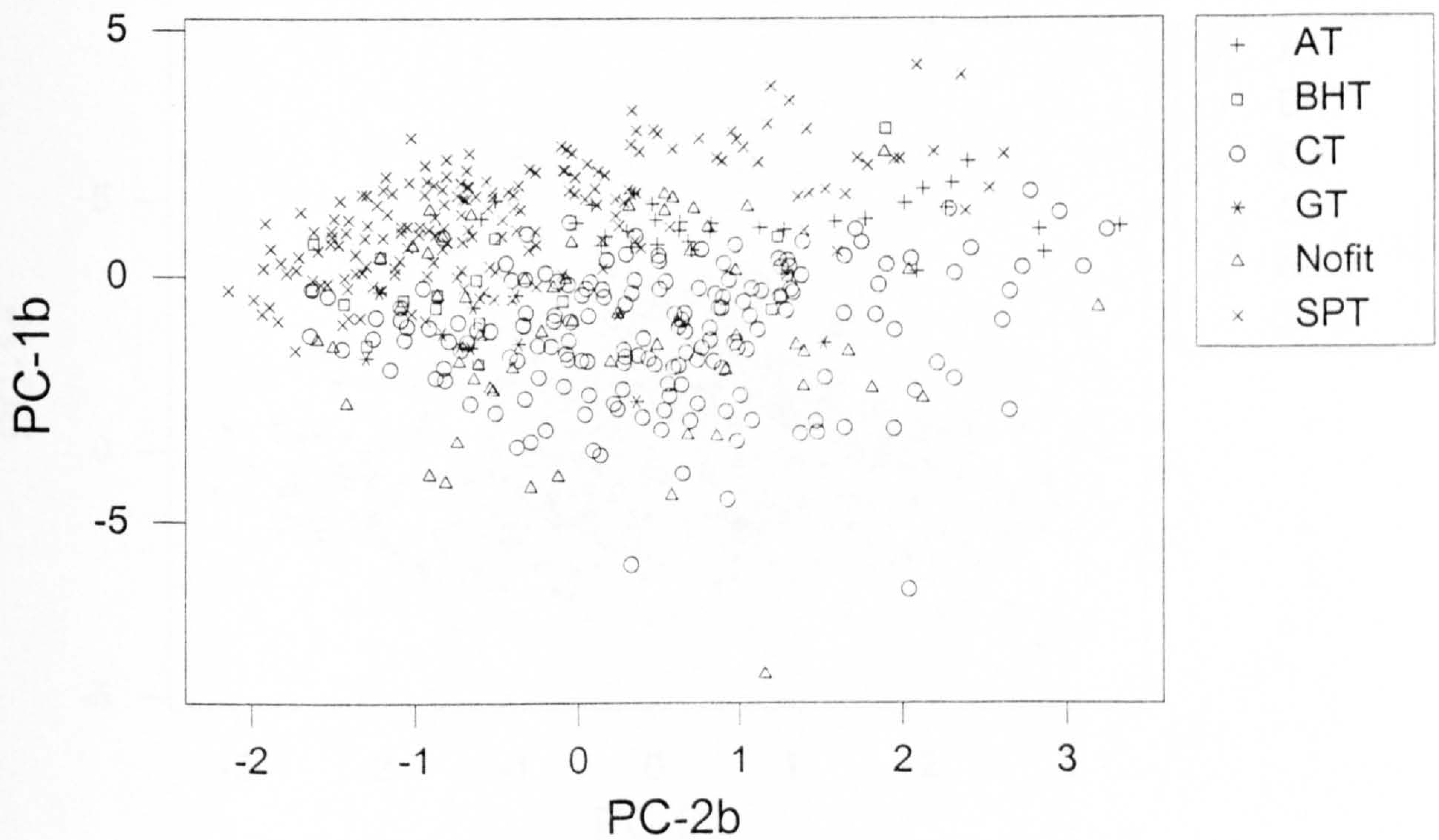


Figure 5.7: plot of sample scores labelled by Küster (1988) group for the first two PC's of PCA-b. For a key to the codes used see Table 5.8.

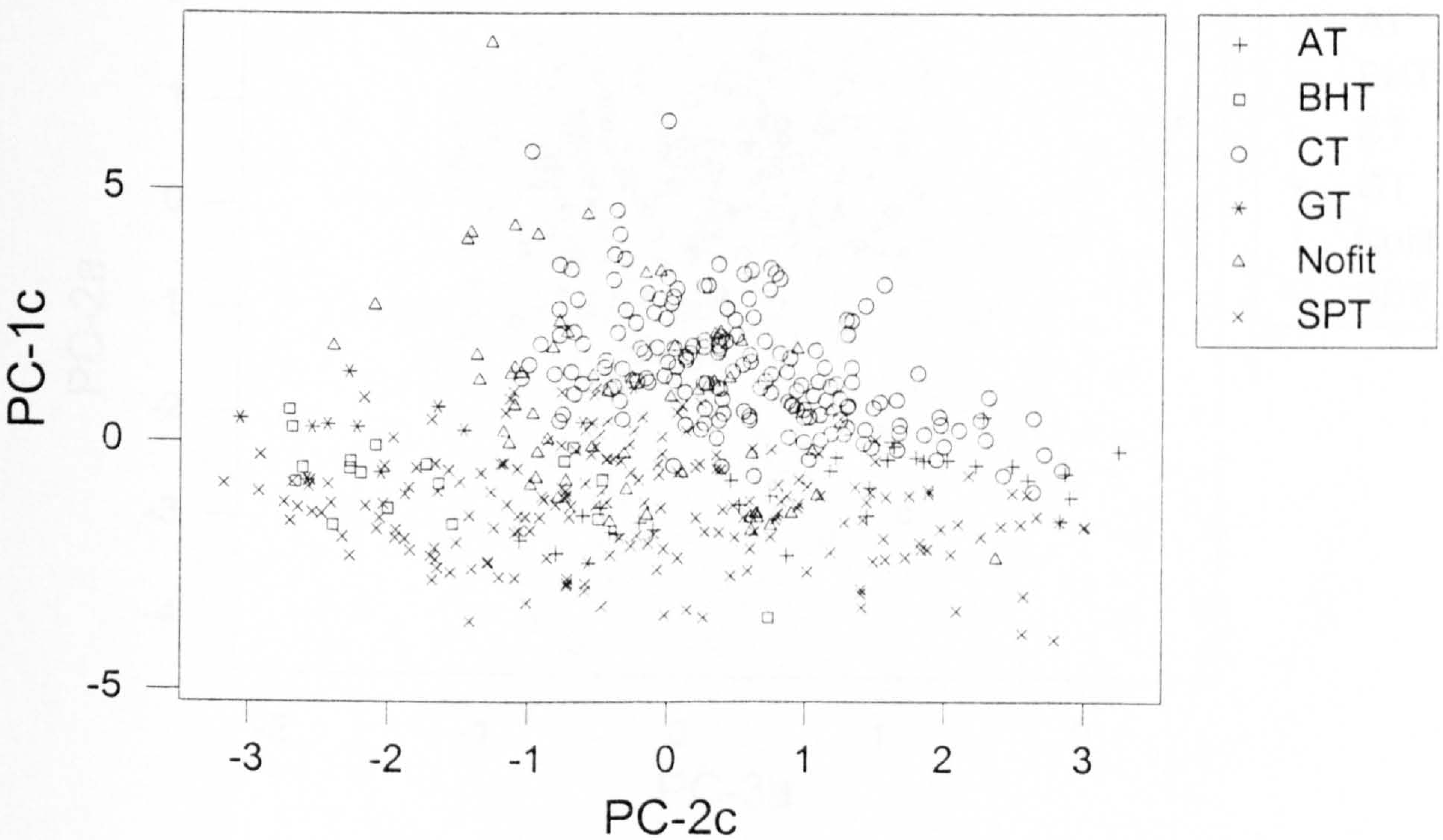


Figure 5.8: plot of sample scores labelled by Küster (1988) type for the first two PC's of PCA-c. For a key to the codes used see Table 5.8.

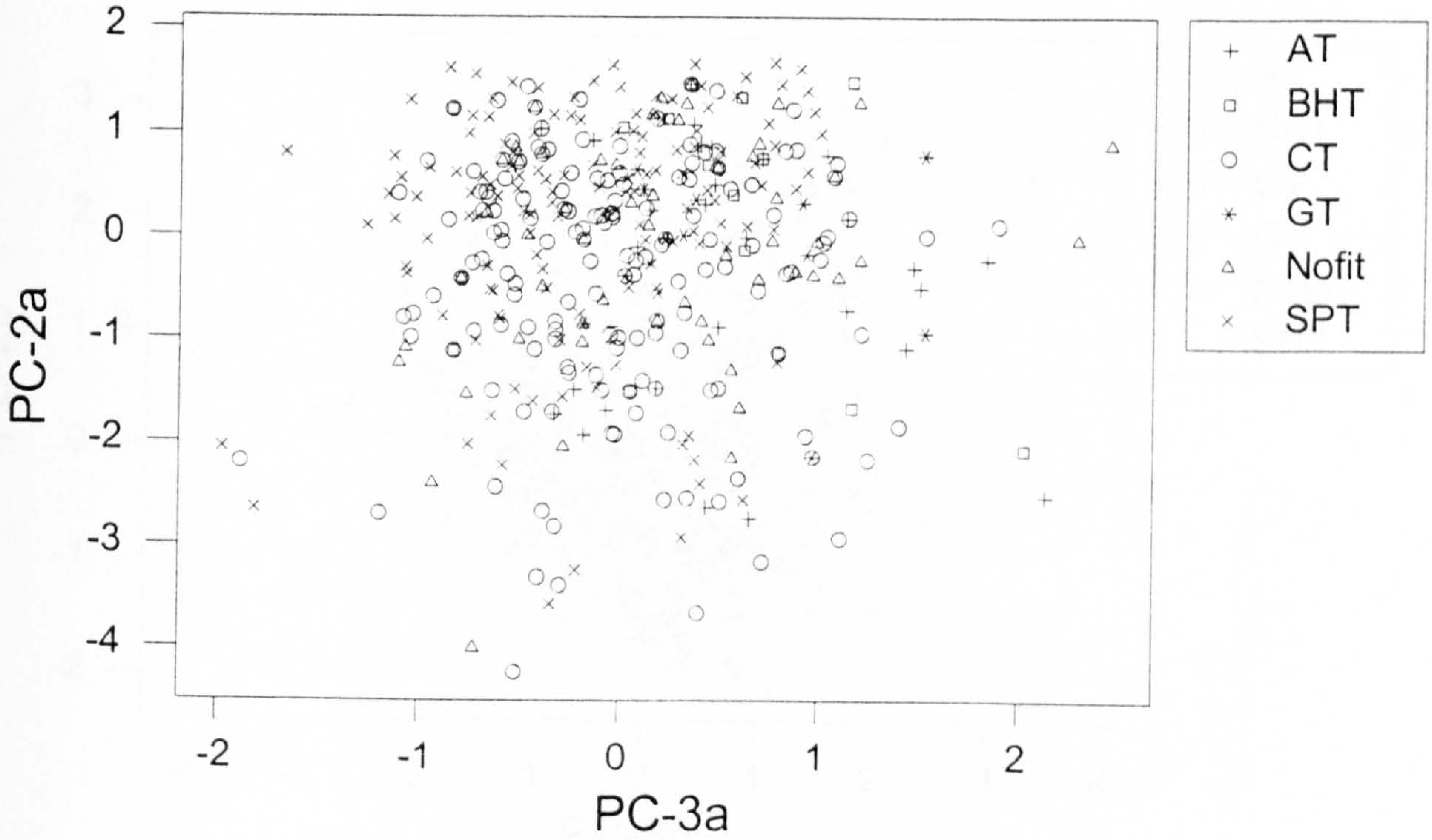


Figure 5.9: plot of sample scores labelled by Küster (1988) type for the second and third PC's of PCA-a. For a key to the codes used see Table 5.8.

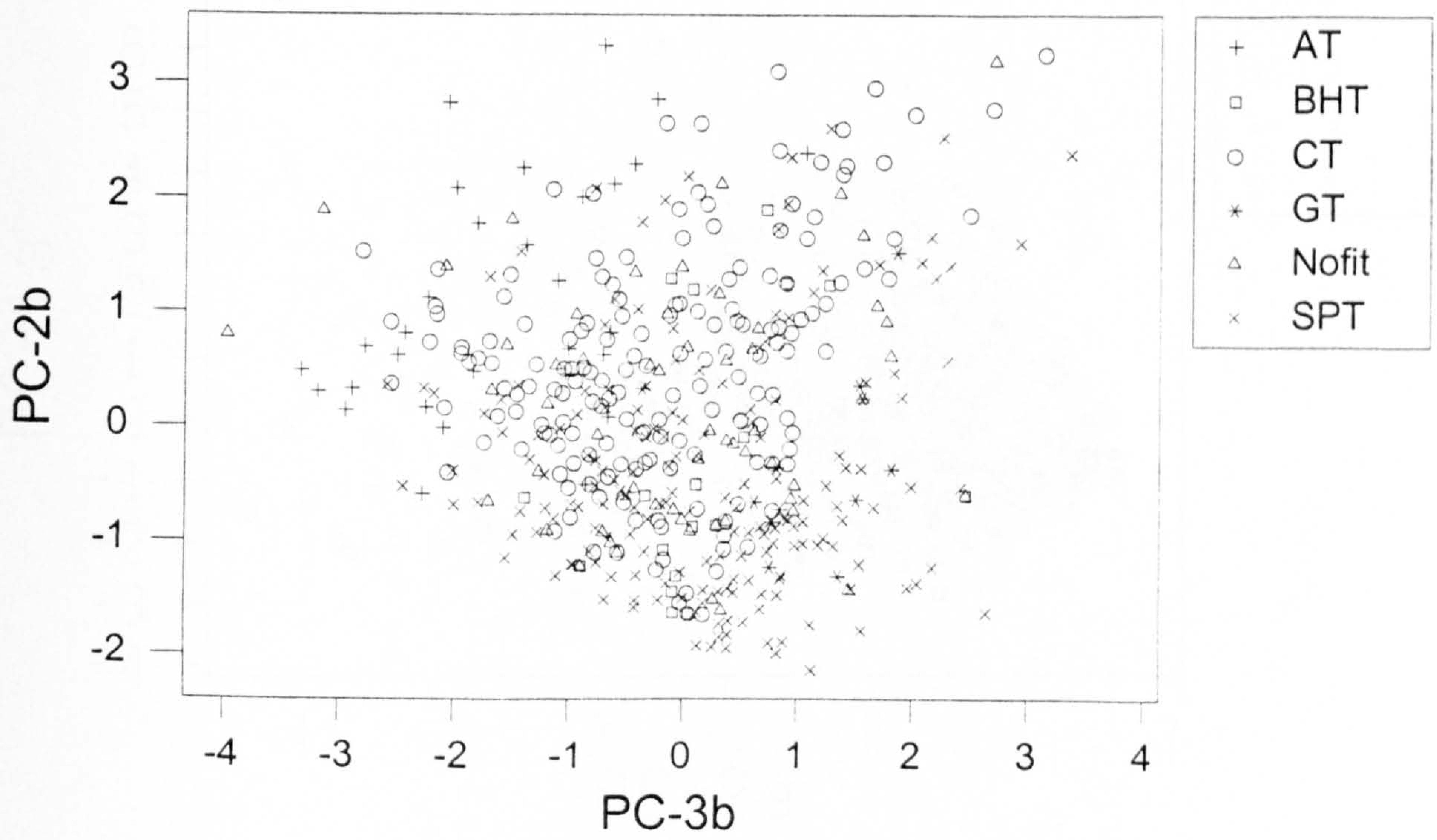


Figure 5.10: plot of sample scores labelled by Küster (1988) type for the second and third PC's of PCA-b. For a key to the codes used see Table 5.8.

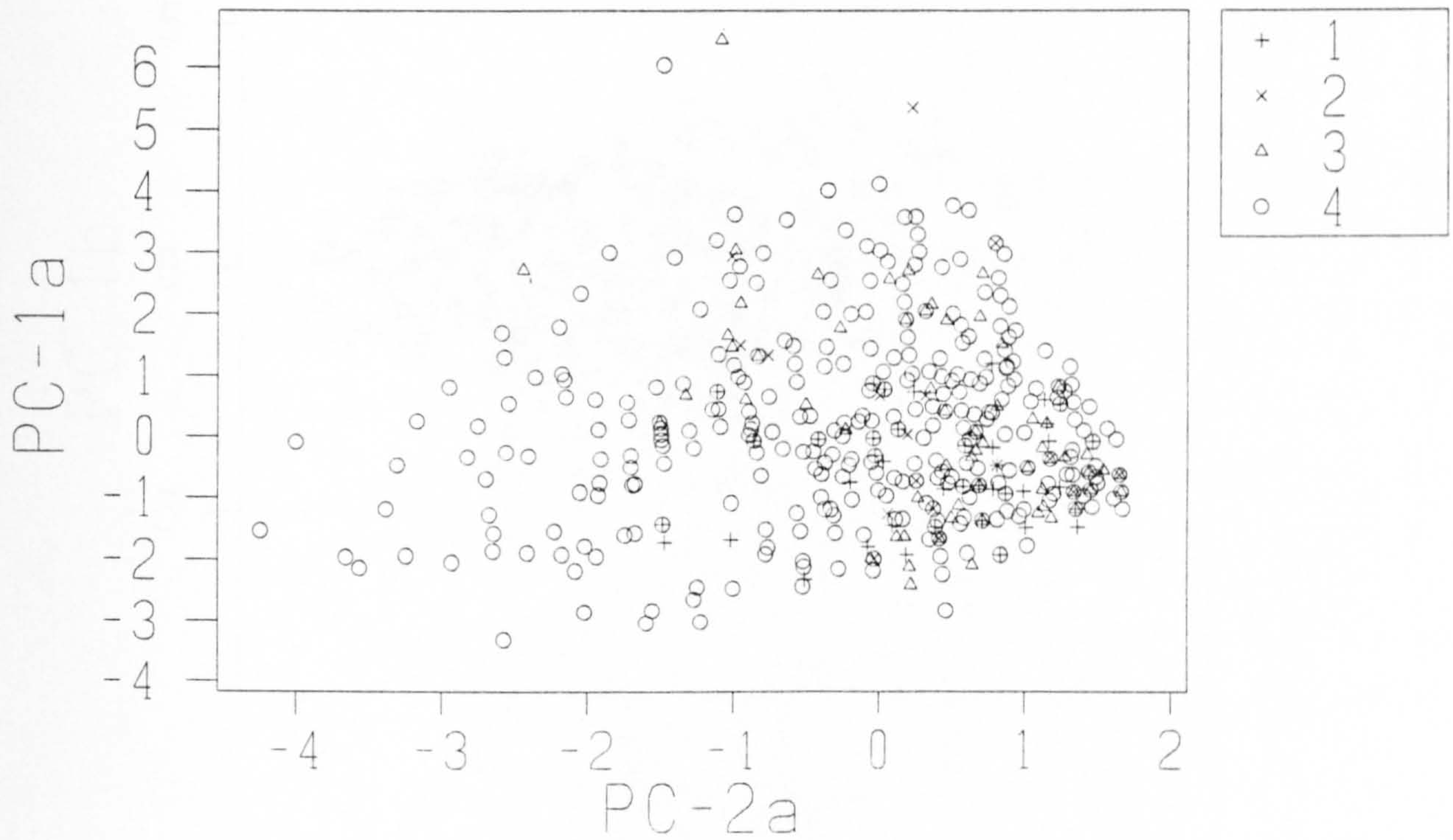


Figure 5.11: plot of sample scores labelled by age group for the first two PC's of PCA-a. For details of the age groups see Table 5.9.

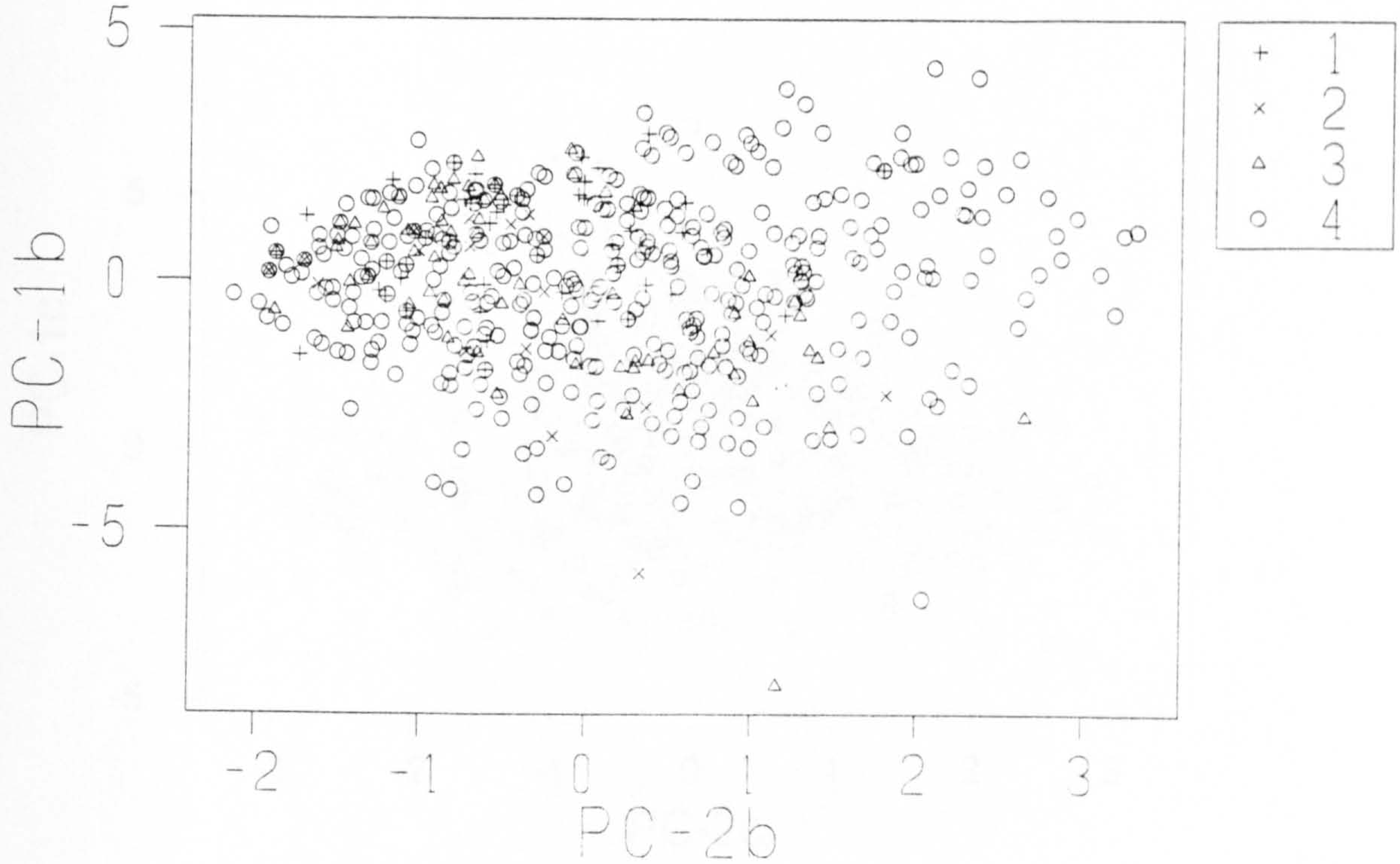


Figure 5.12: plot of sample scores labelled by age group for the first two PC's of PCA-b. For details of the age groups see Table 5.9.

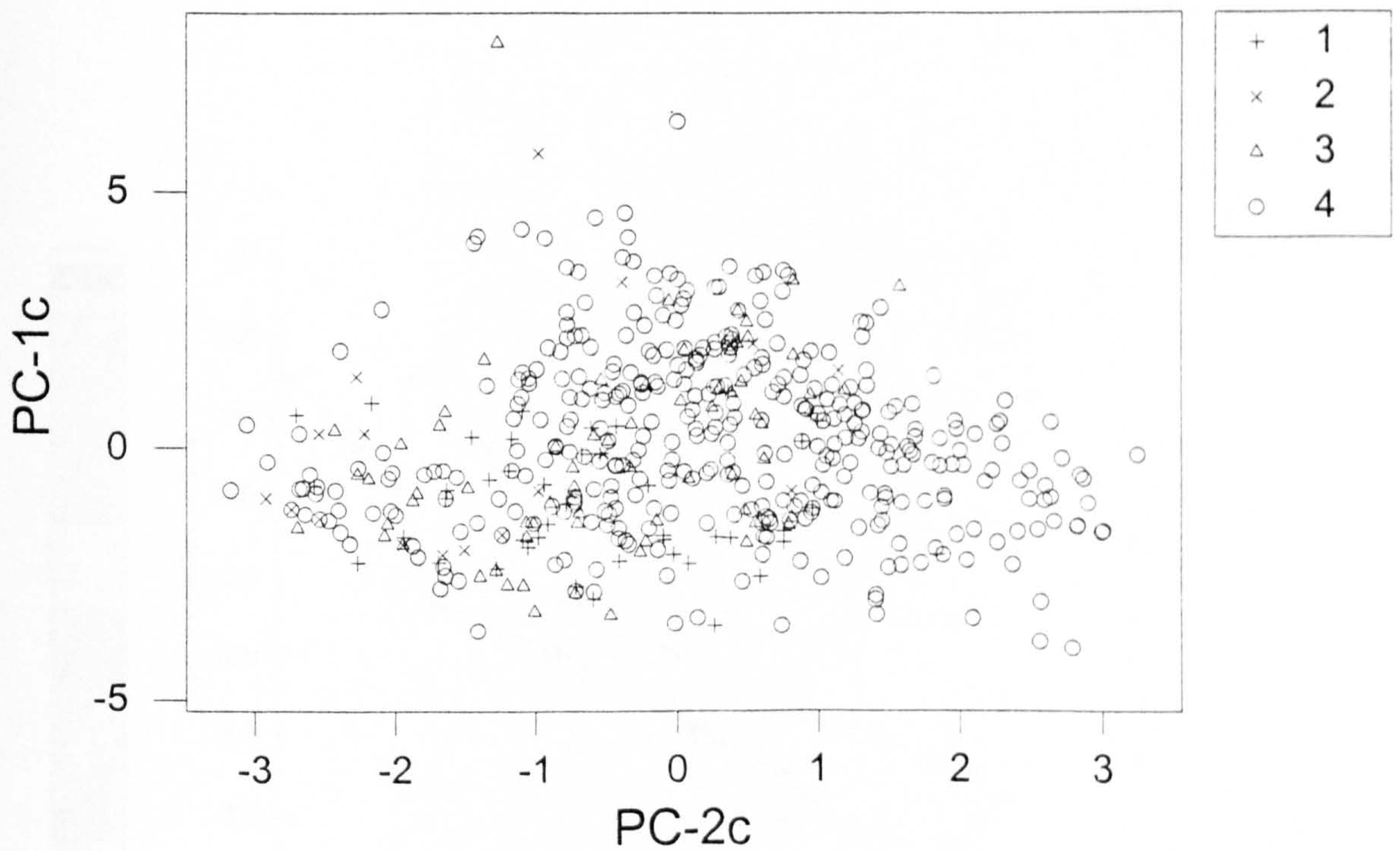


Figure 5.13: plot of sample scores labelled by age group for the first two PC's of PCA-c. For details of the age groups see Table 5.9.

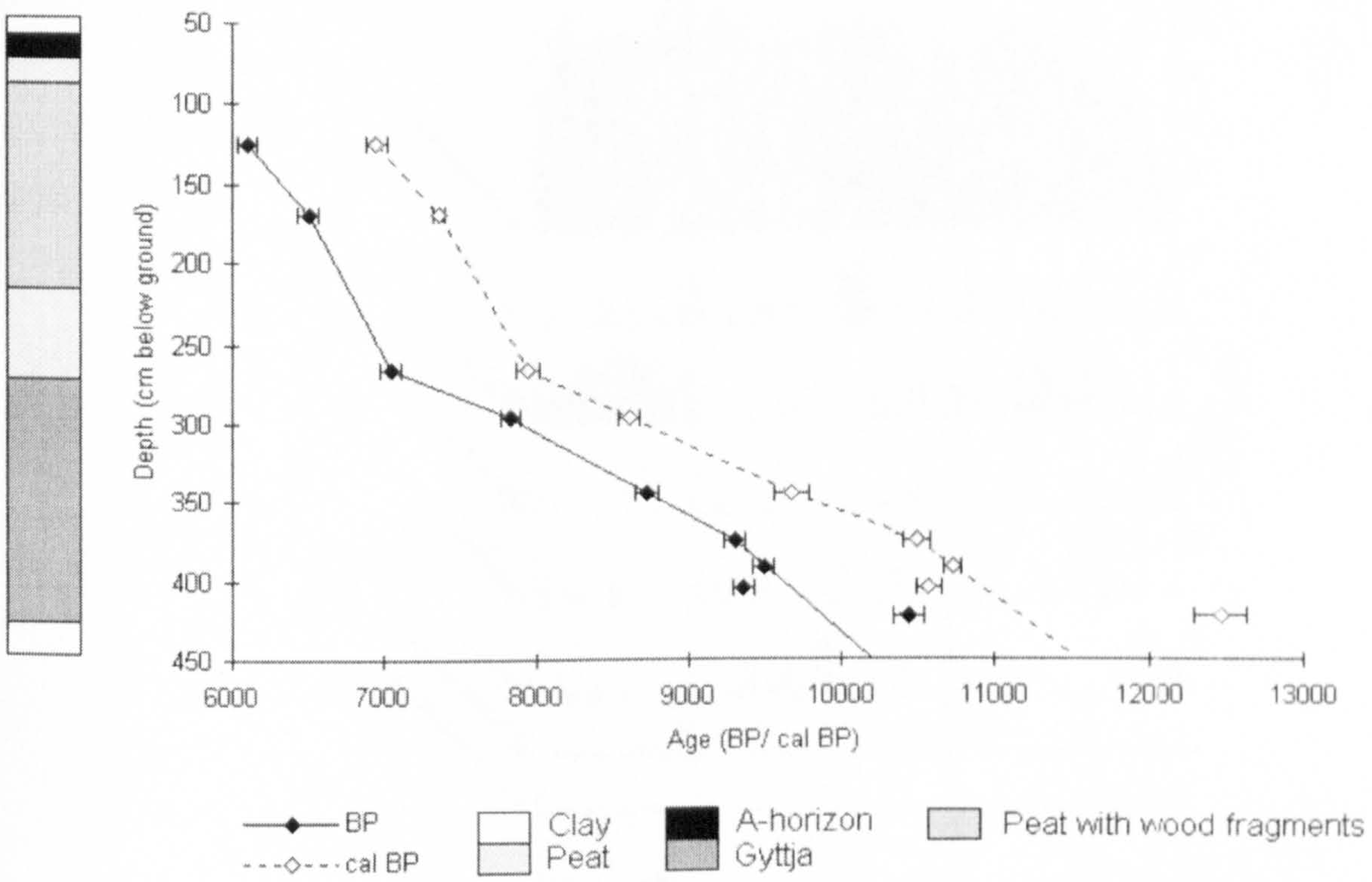


Figure 6.1: Cess Dell: age-depth curve of calibrated and uncalibrated BP dates

Figure 6.2: Cess Dell: Pollen preservation 1: totals by type indeterminable and miscellaneous data

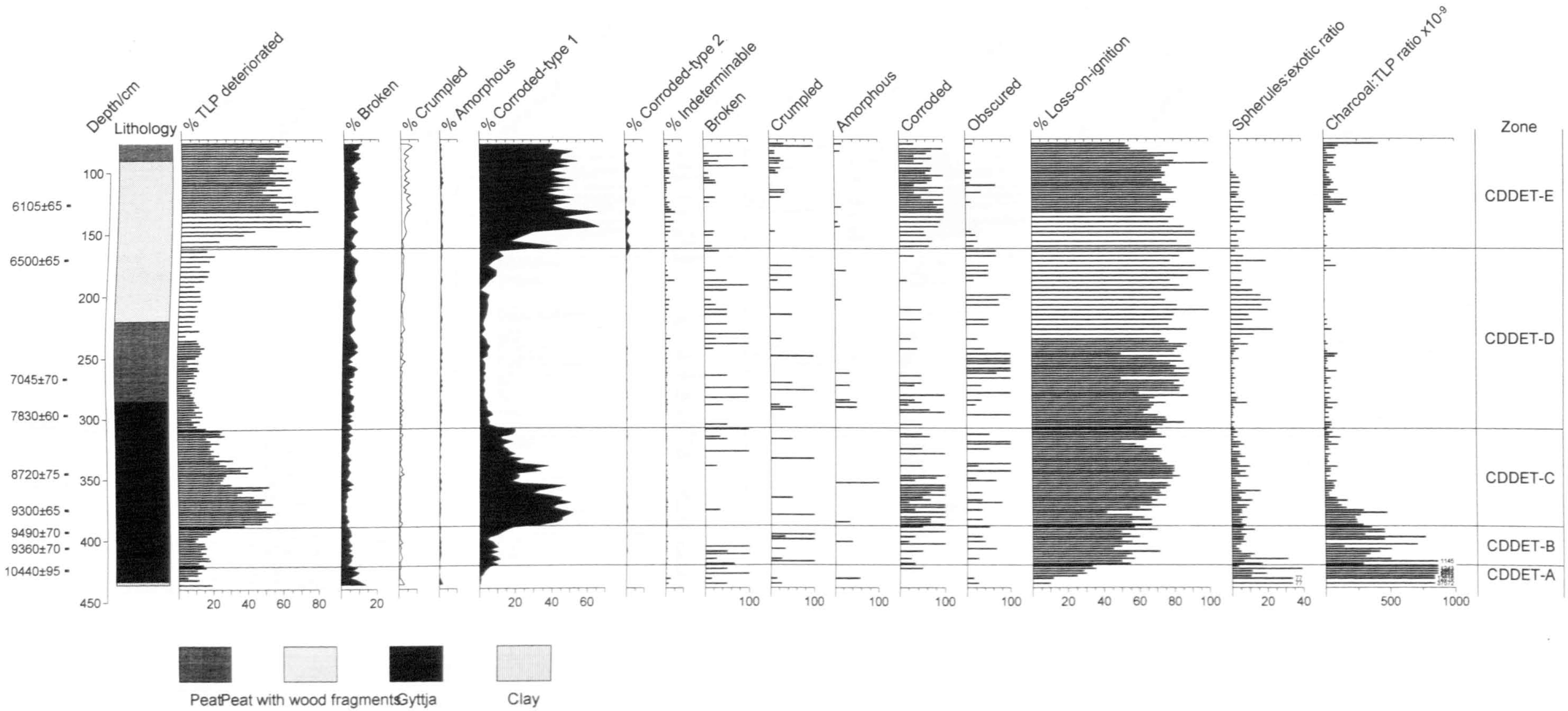
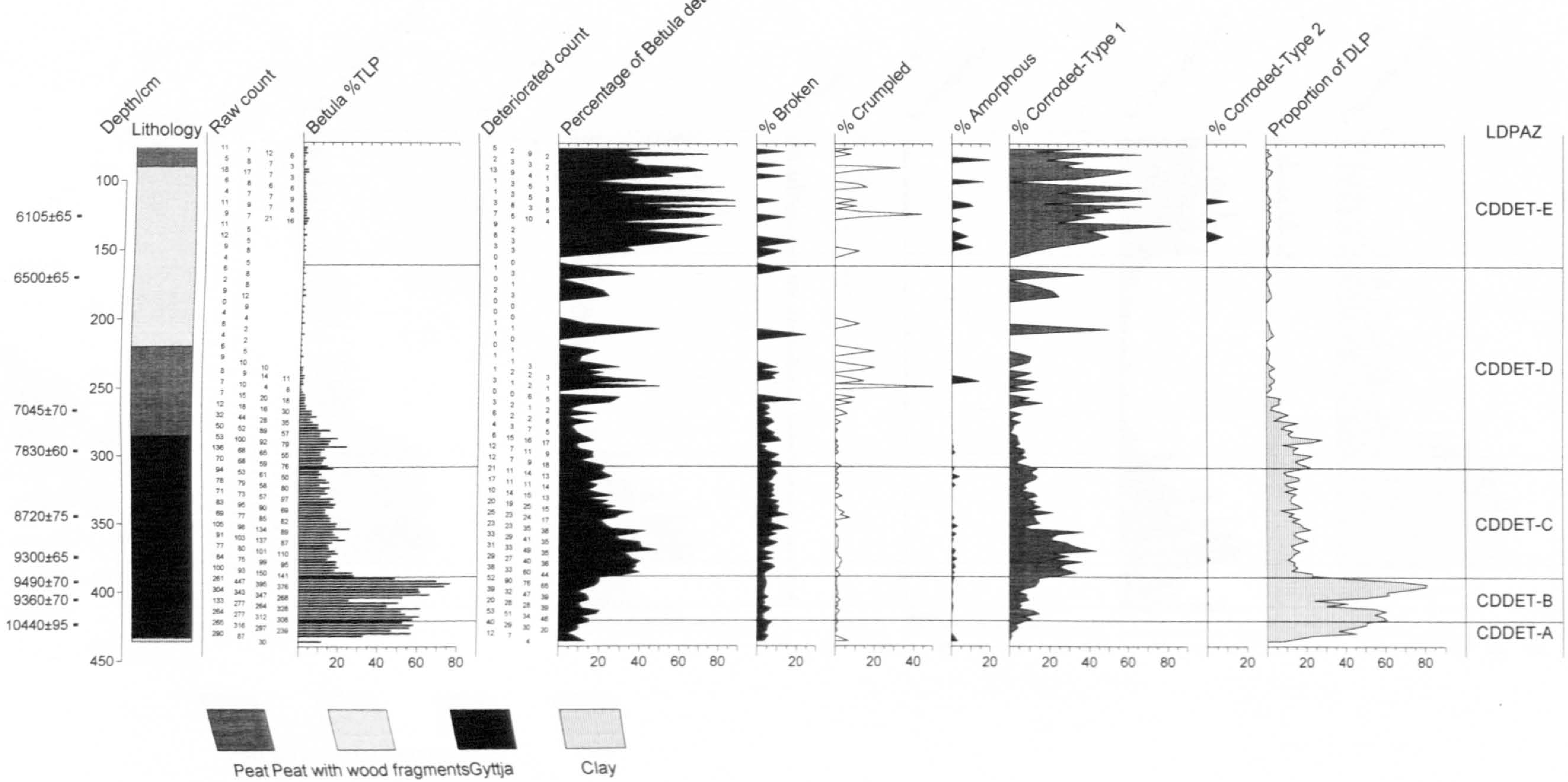


Figure 6.3: Cess Dell: Pollen preservation 2: Betula



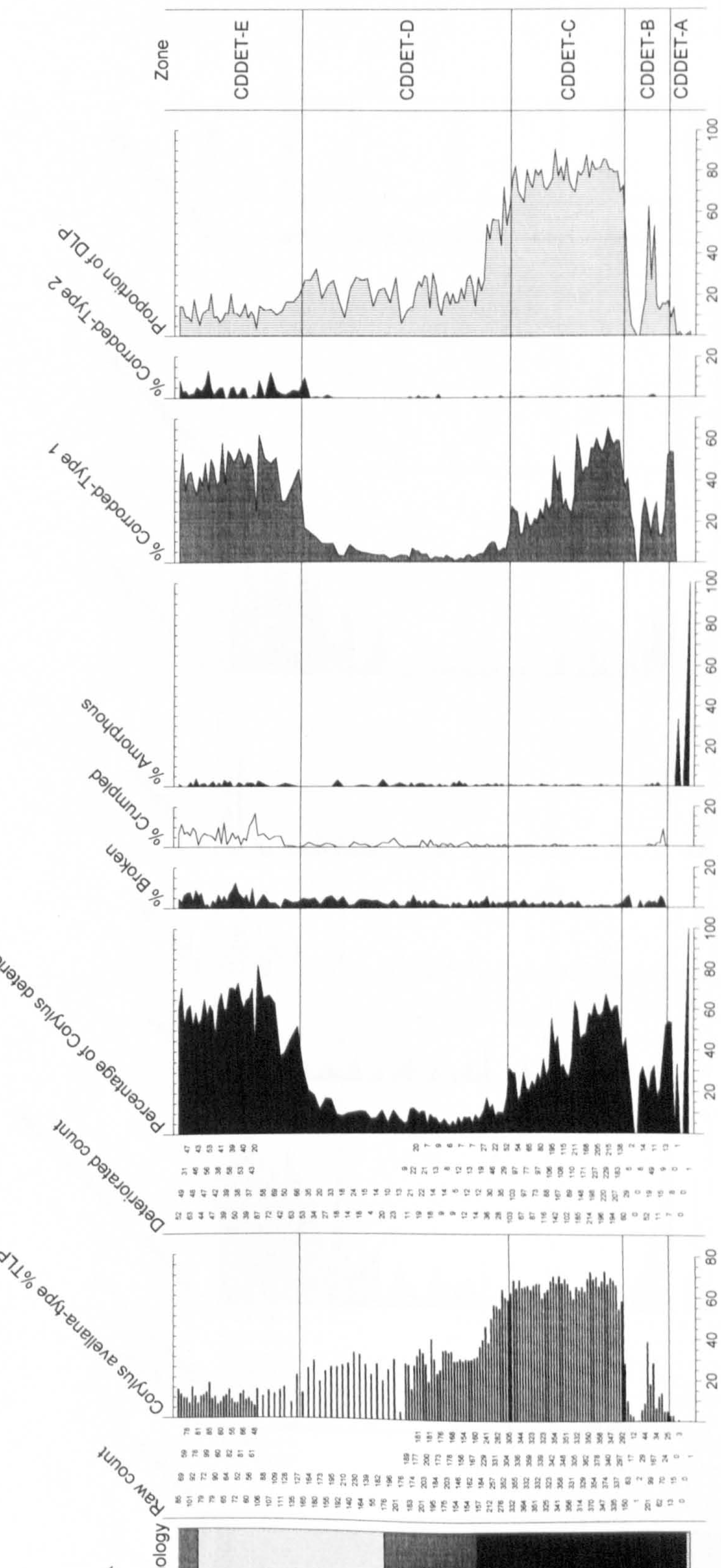


Figure 6.4: Cess Dell: Pollen preservation 3: Corylus

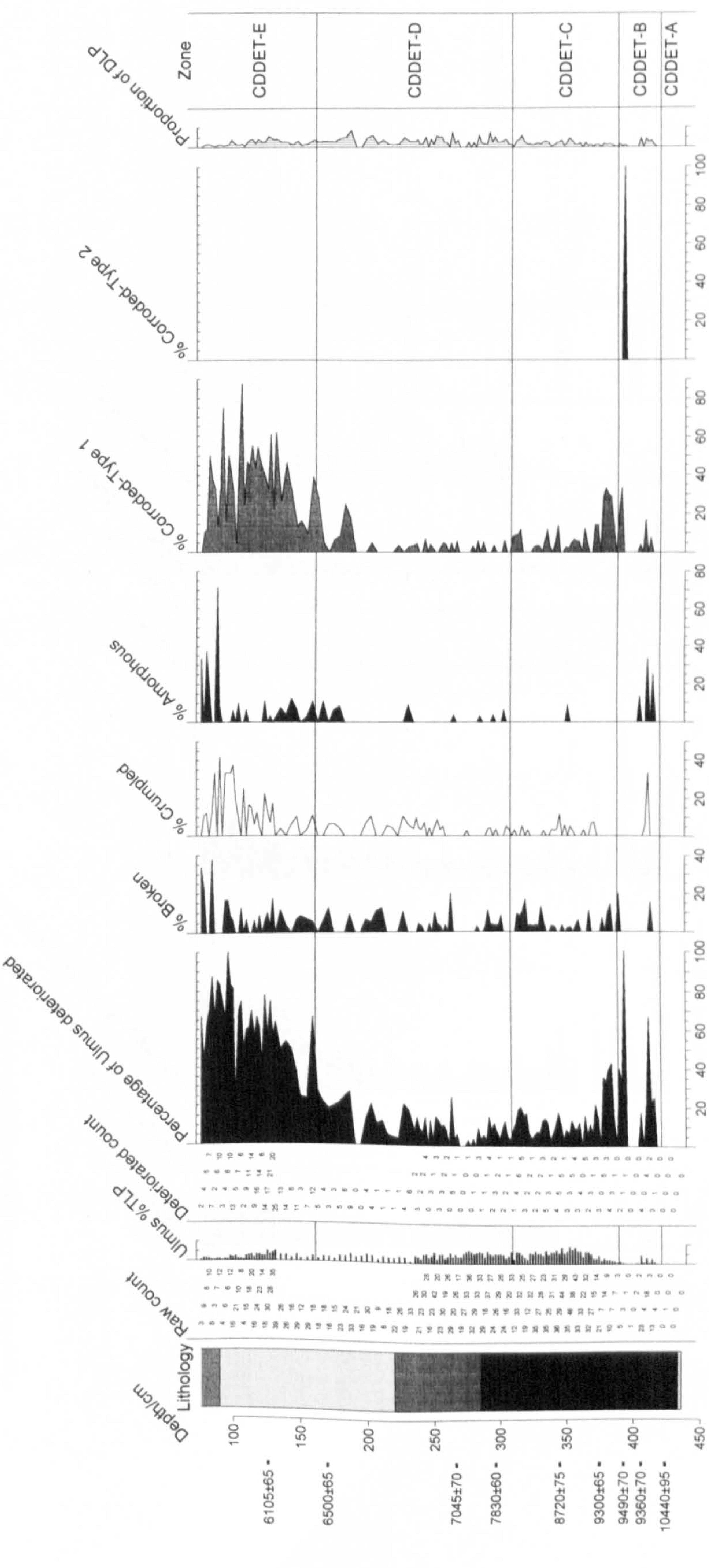


Figure 6.5: Cess Dell: Pollen preservation 4: Ulmus

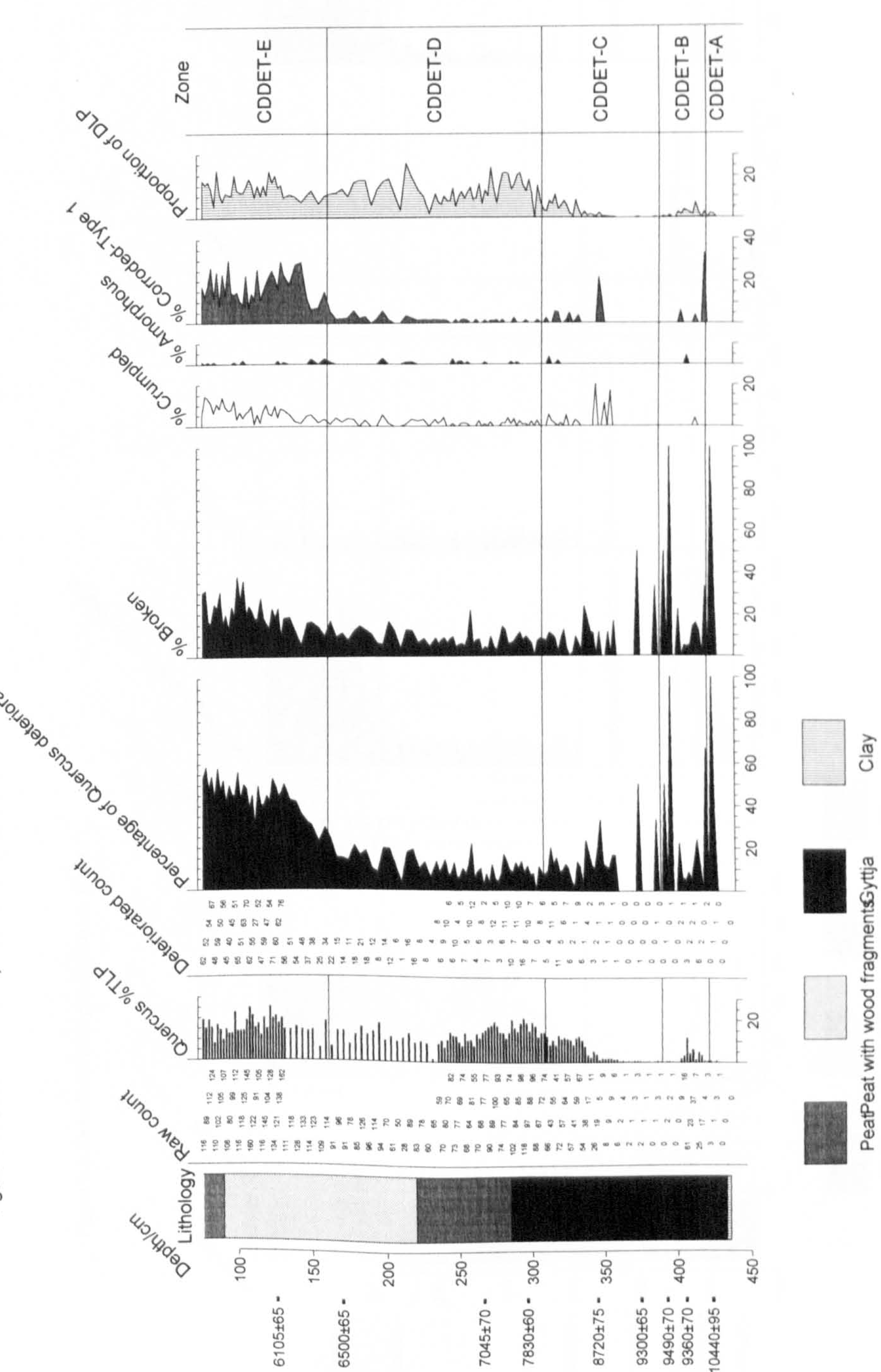
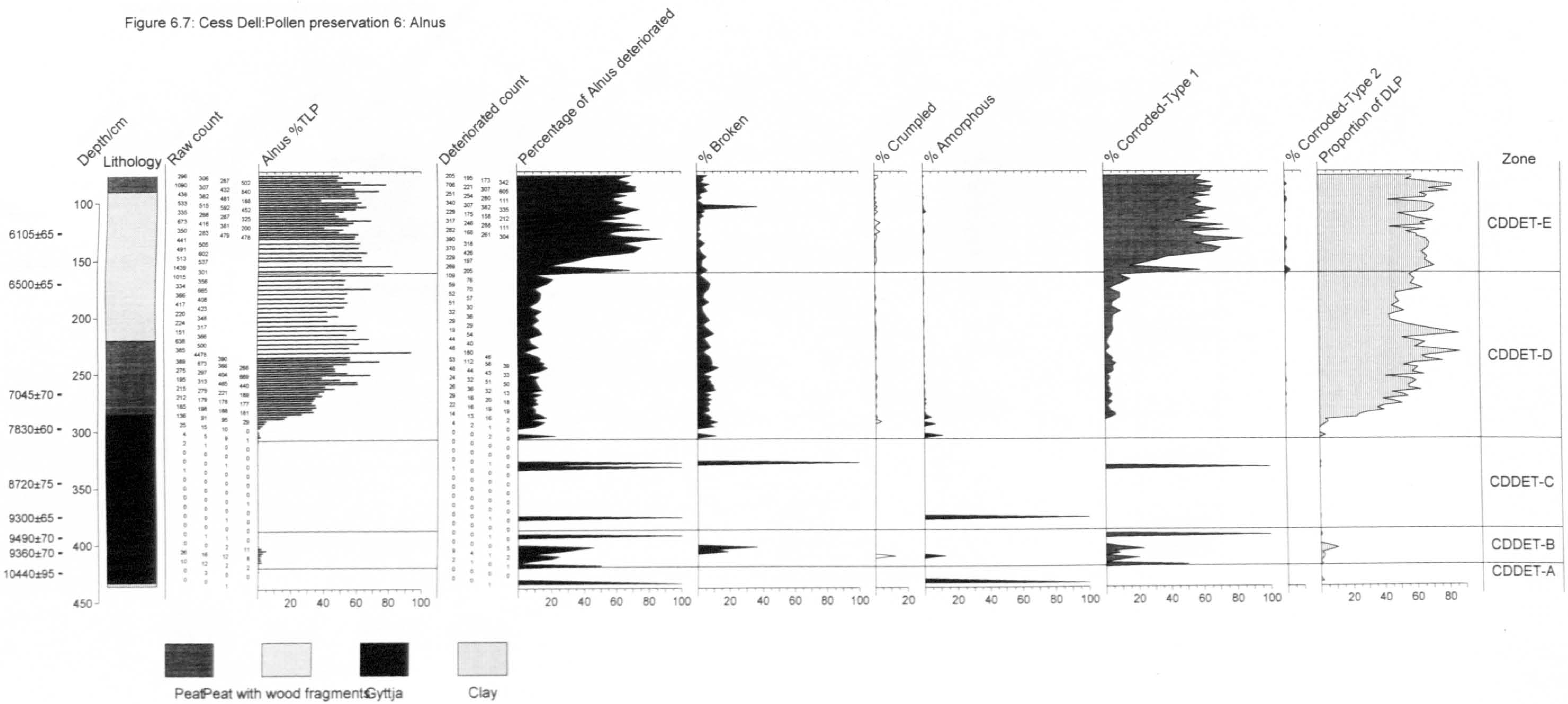


Figure 6.6: Cess Dell: Pollen preservation 5: Quercus

Figure 6.7: Cess Dell:Pollen preservation 6: Alnus



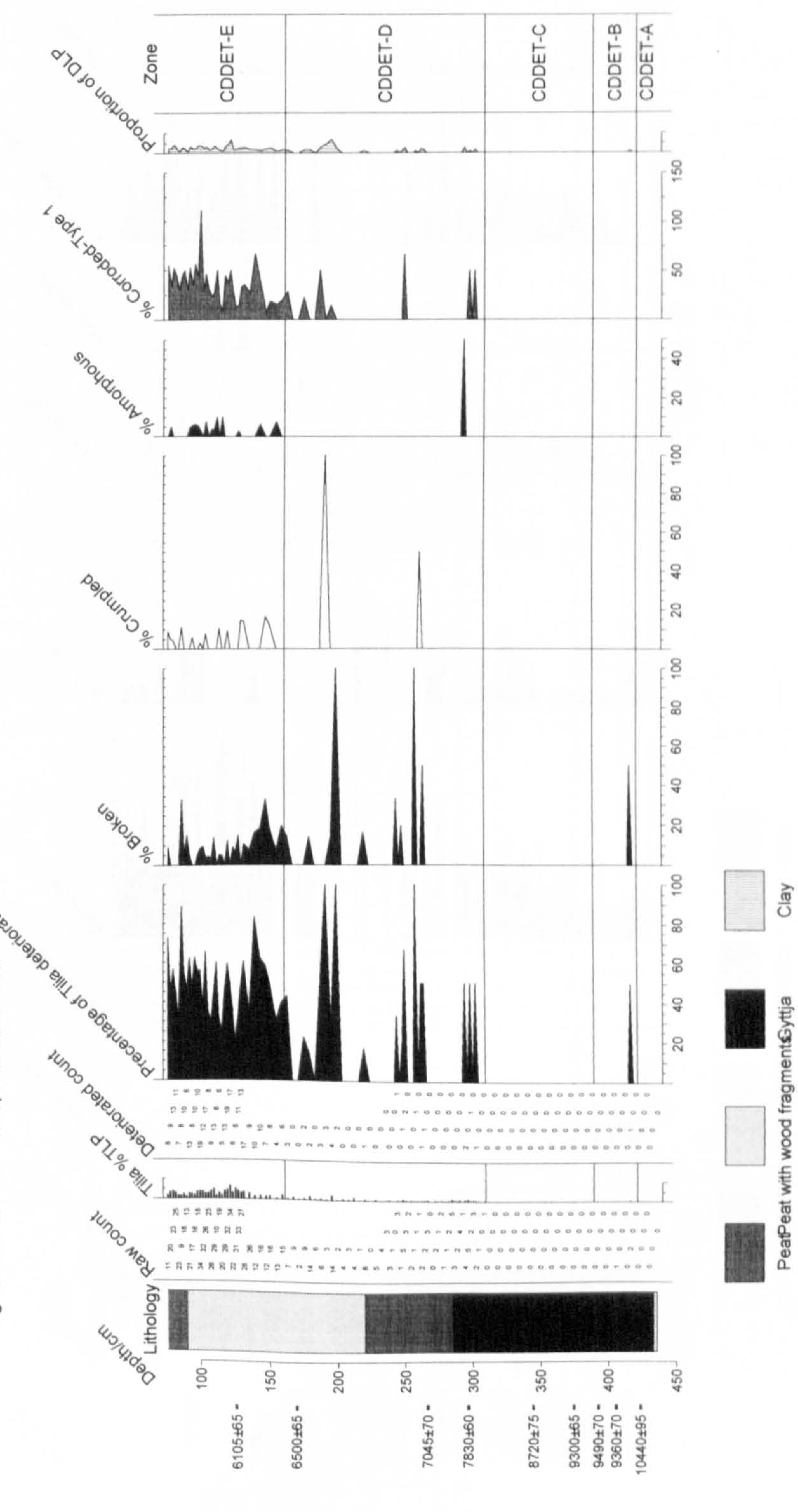


Figure 6.8: Cess Dell: Pollen preservation 7: Tilia

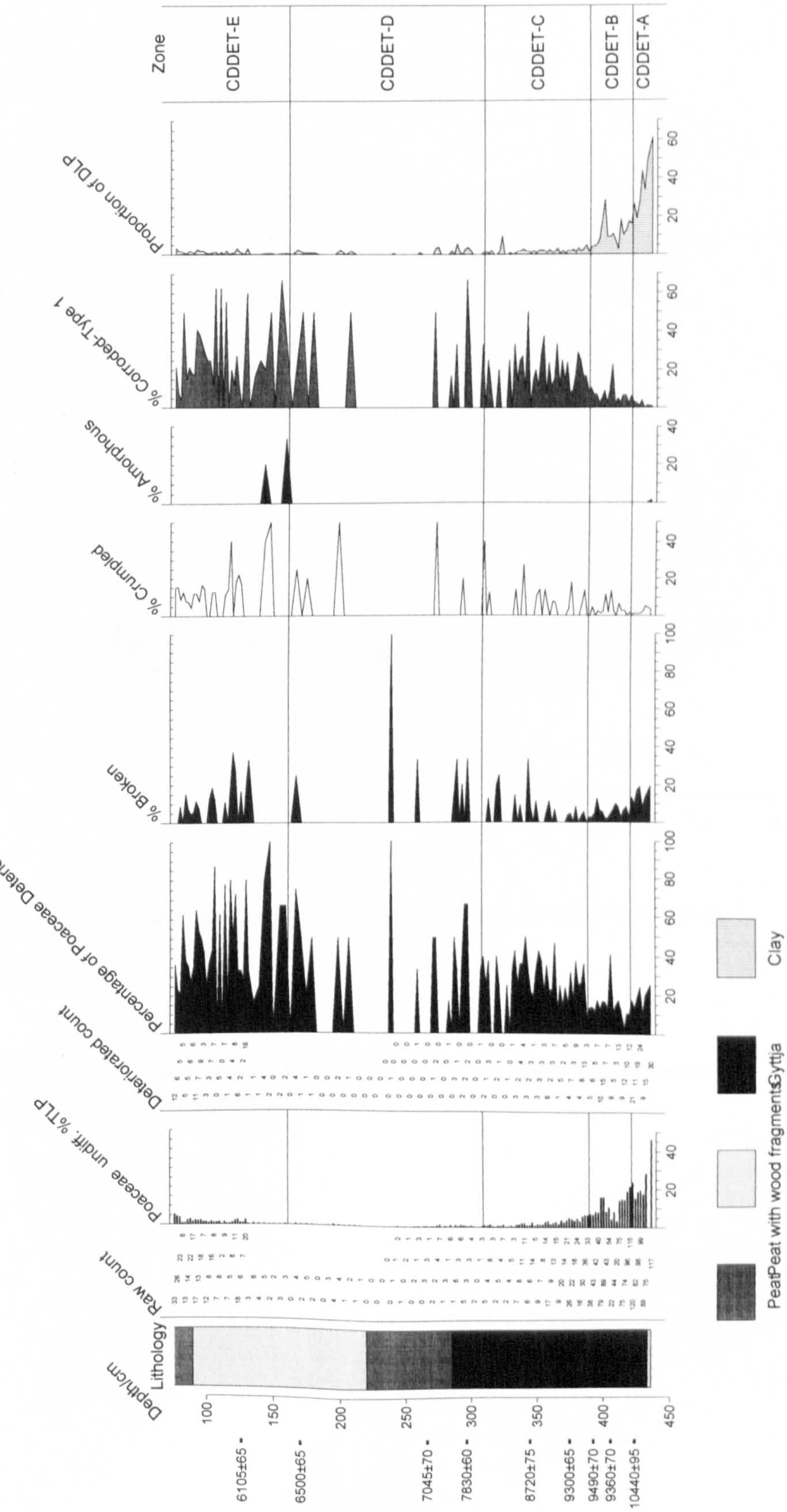
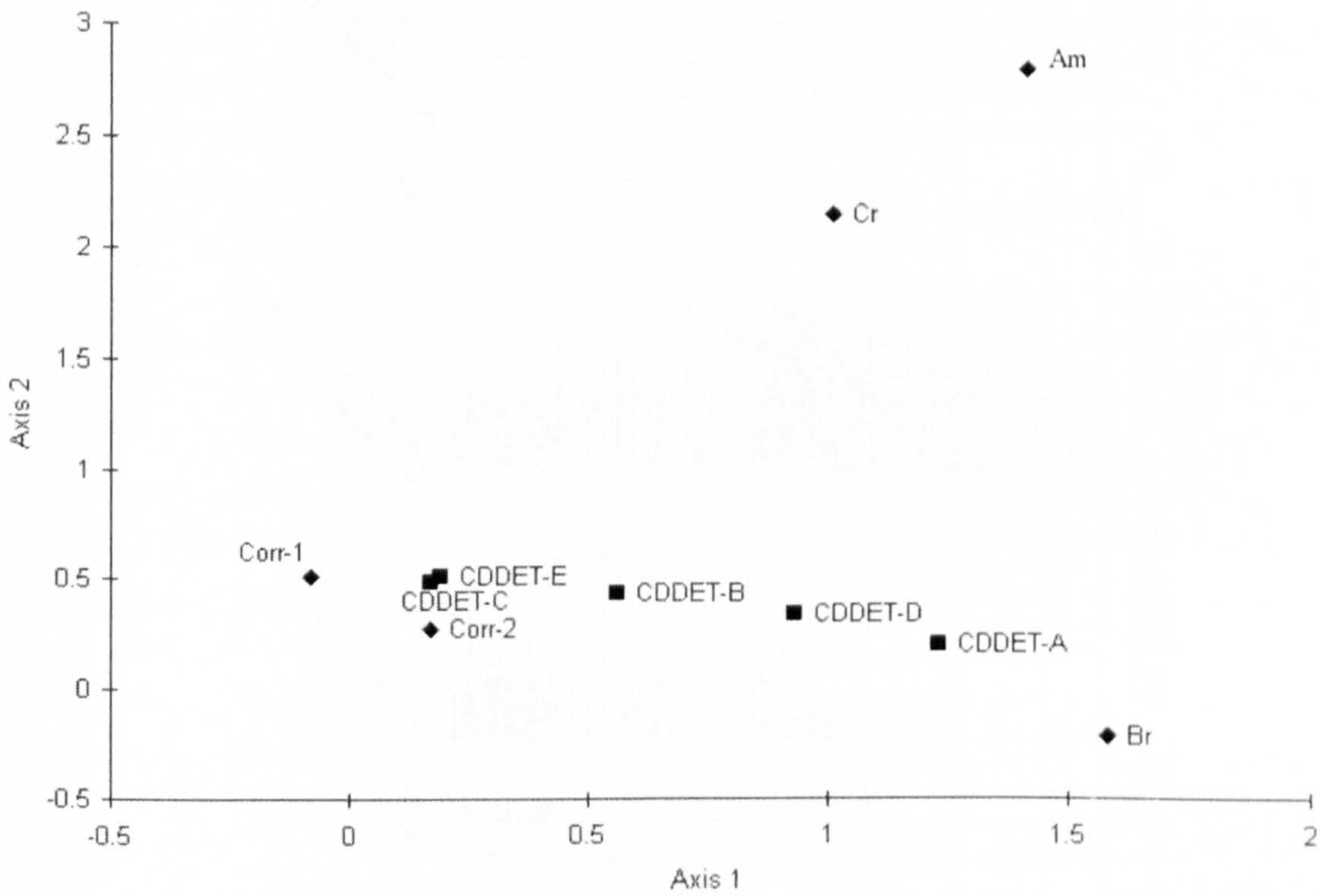


Figure 6.9: Cess Dell: Pollen preservation 8: Poaceae undiff.



Key to abbreviations used: Br, broken; Corr-1, type-1 corrosion; Corr-2, type-2 corrosion; Cr, crumpled; Am, Amorphous.

Figure 6.10: Cess Dell: DCA plot of deterioration type scores and mean sample scores for each LDPAZ for the first two axes of the ordination

Figure 6.11: Cess Dell: percentage diagram of trees and shrubs

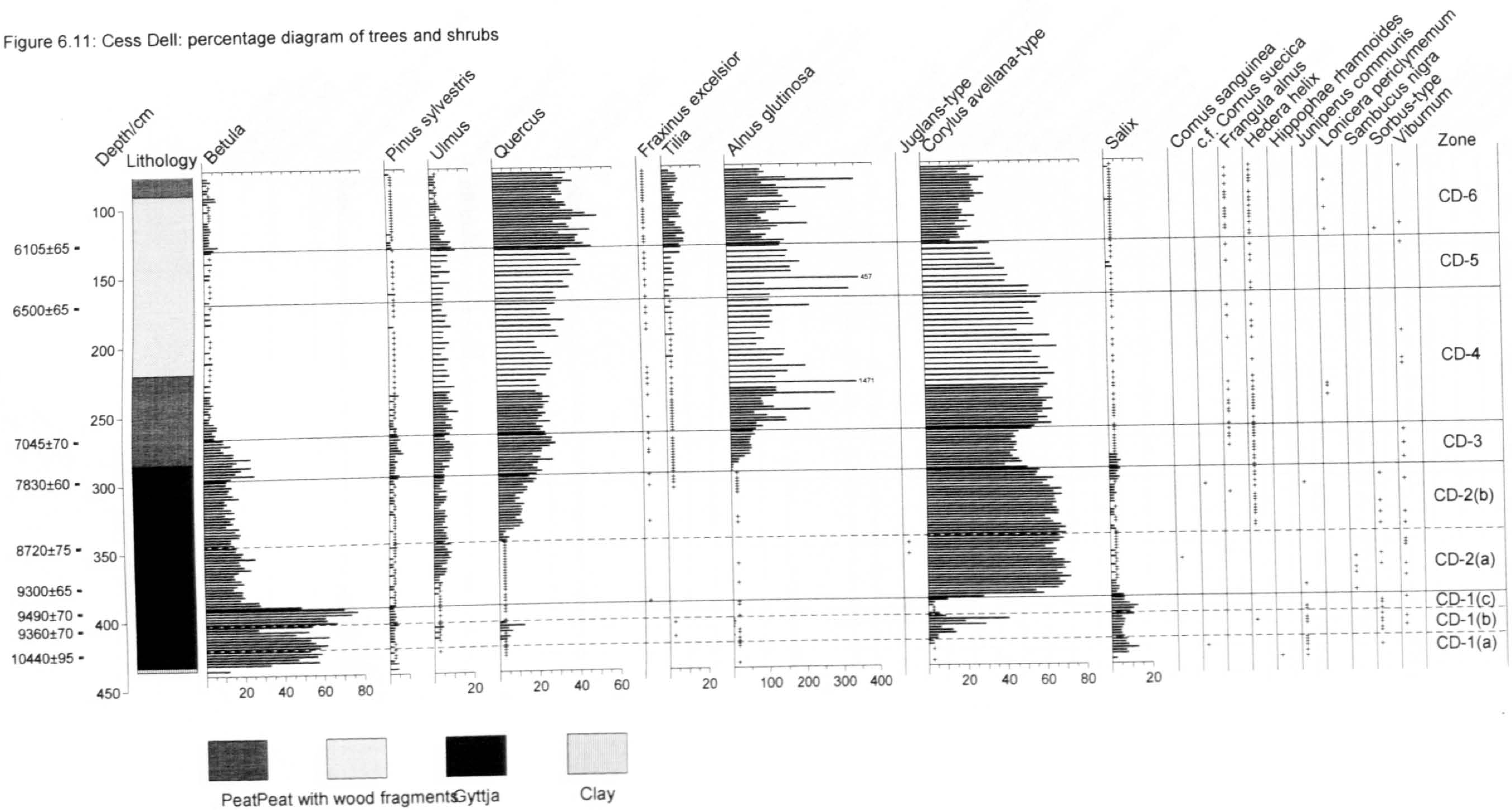


Figure 6.12: Cess Dell: percentage diagram of heaths and herbs (1)

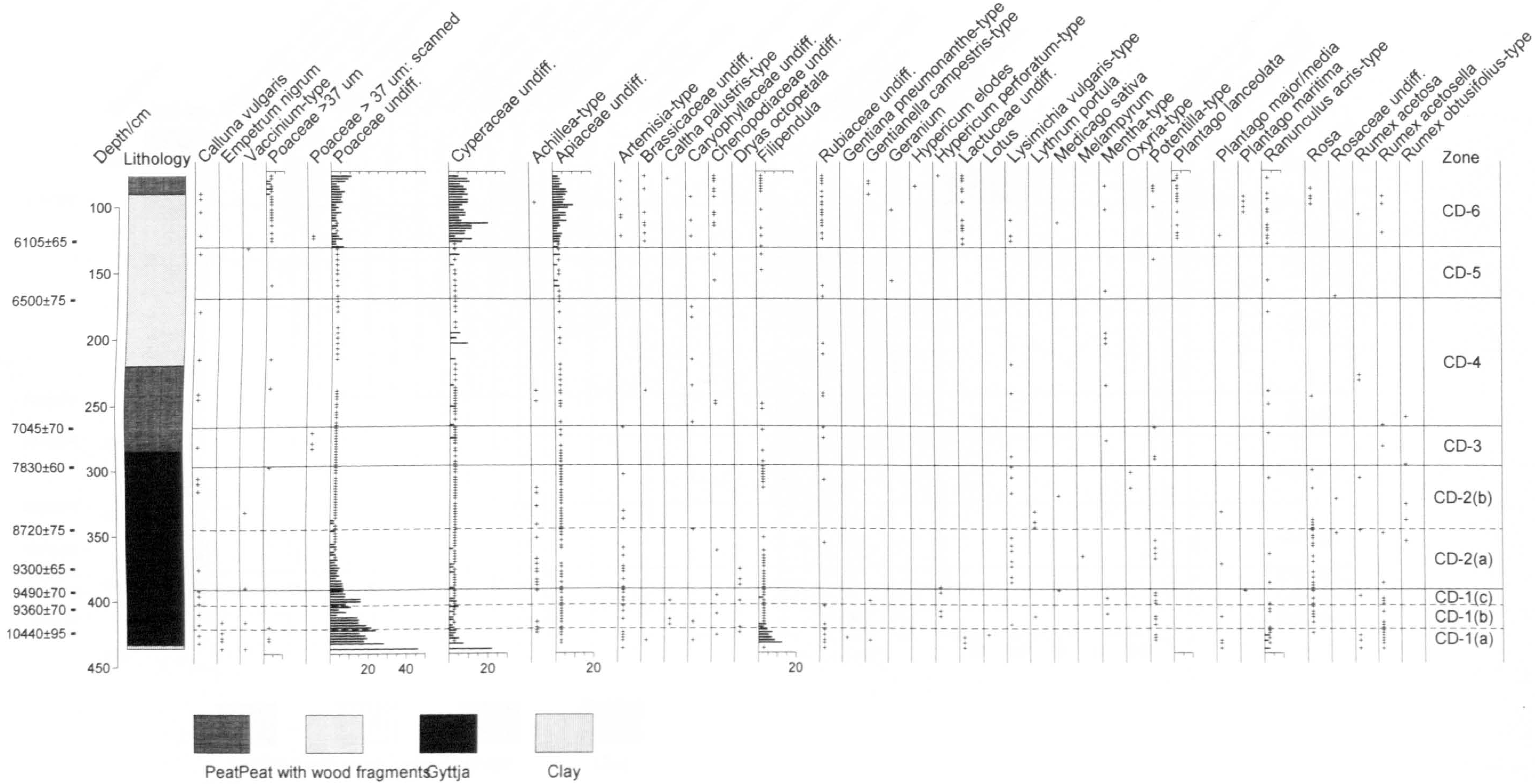


Figure 6.13: Cess Dell: percentage diagram of herbs (2), aquatics and spores

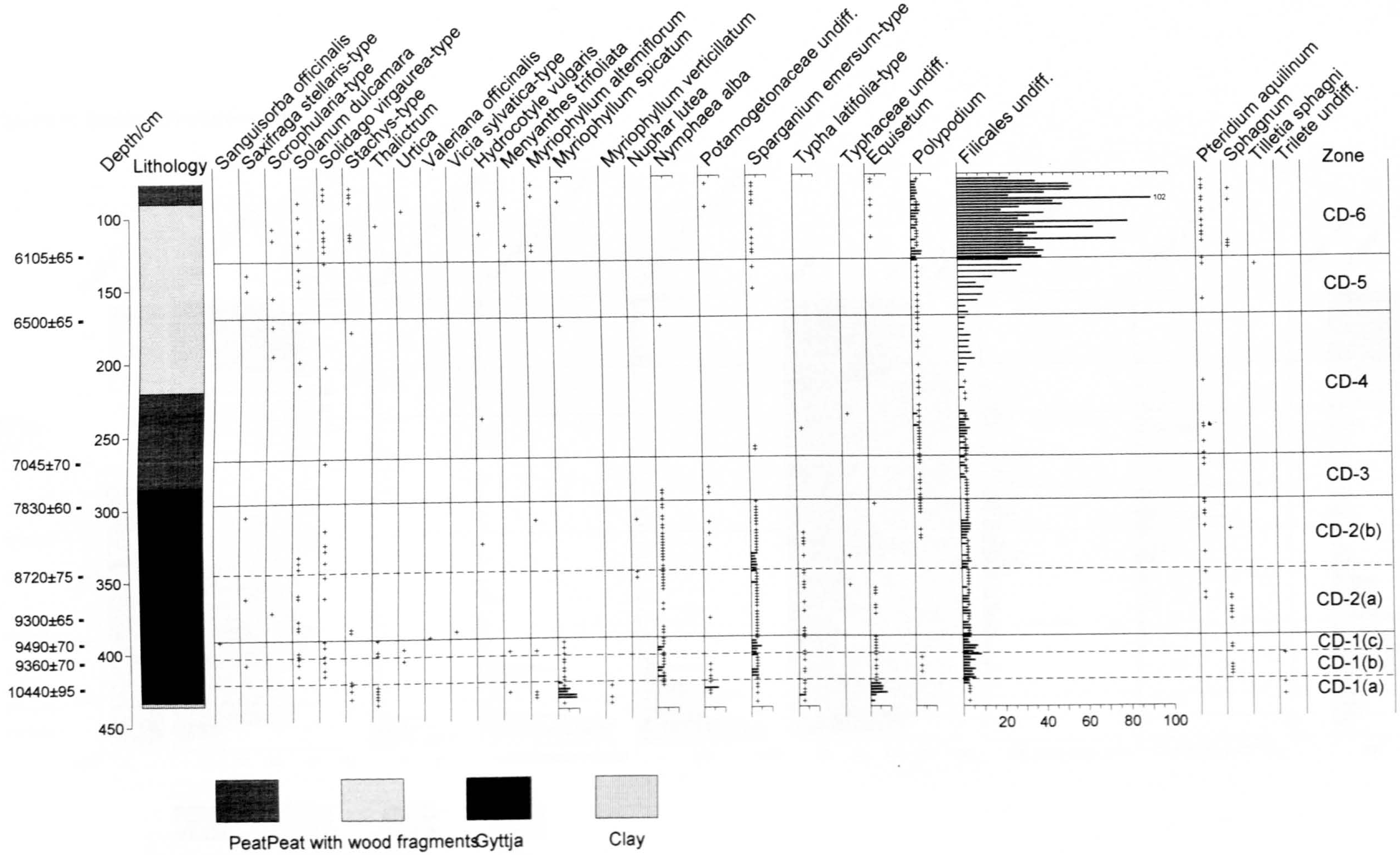


Figure 6.14: Cess Dell: Miscellaneous data

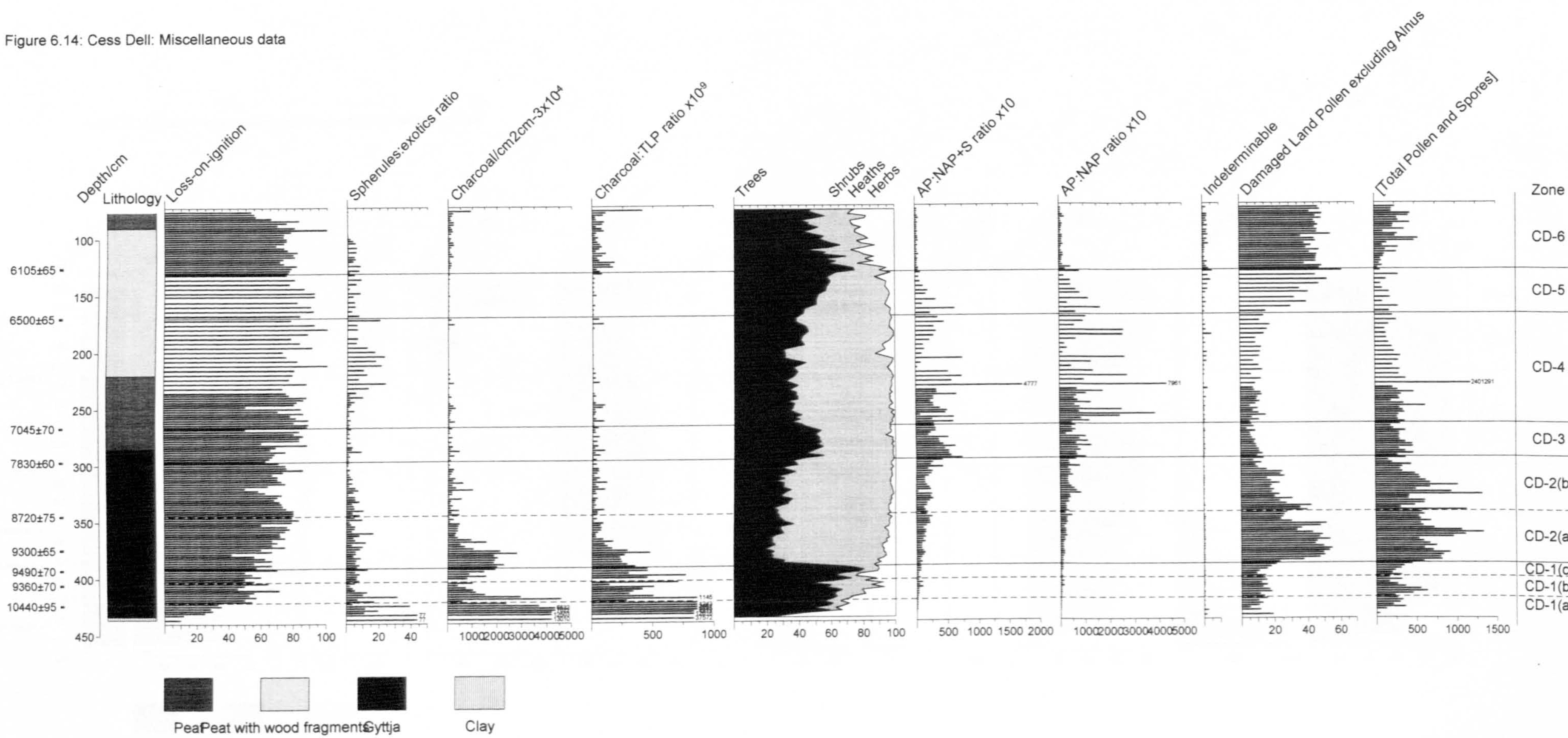
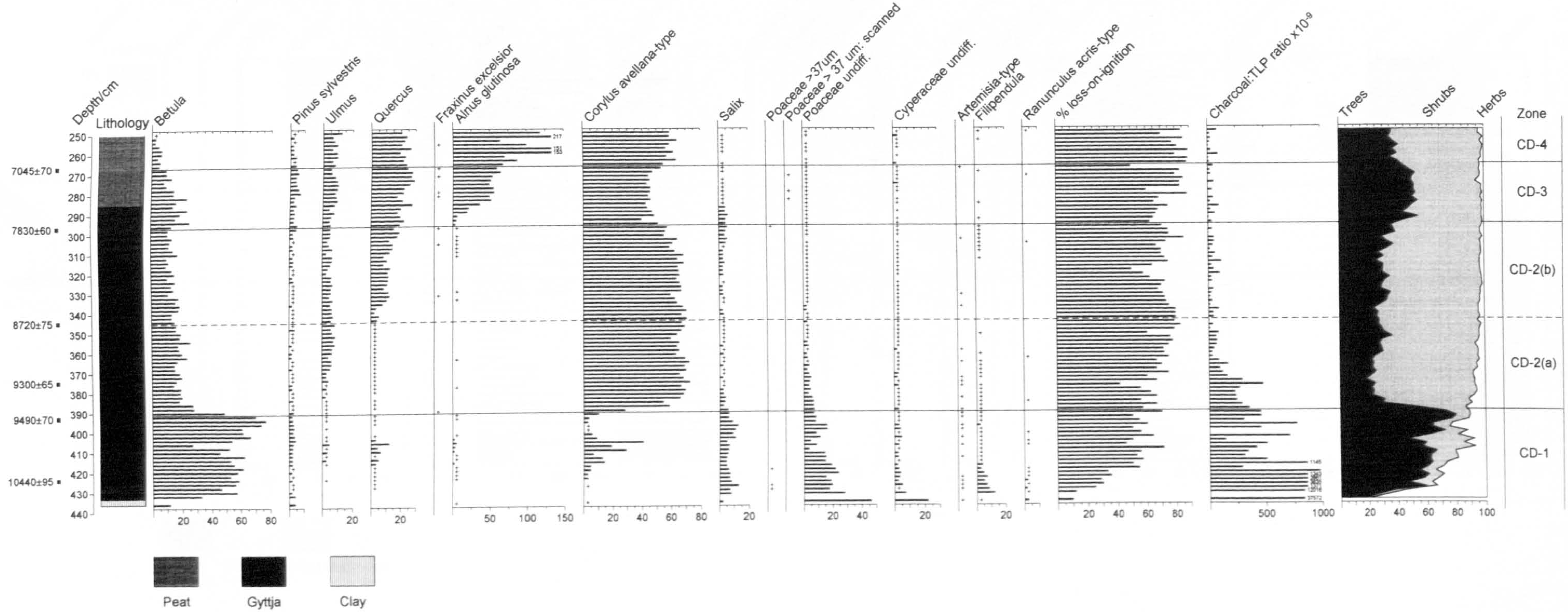


Figure 6.15: Cess Dell: summary percentage diagram for 436-250 cm



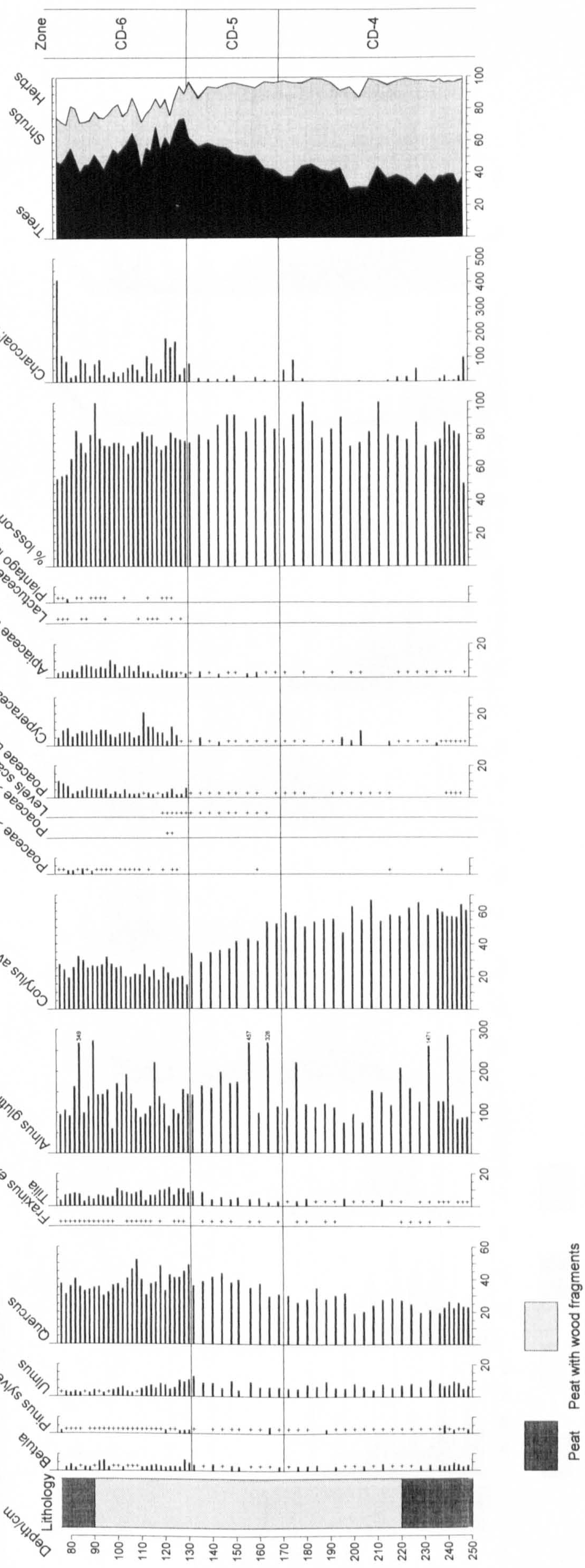


Figure 6.16: Cess Dell: summary diagram for 250-76 cm

Figure 6.17: Cess Dell: summary concentration diagram

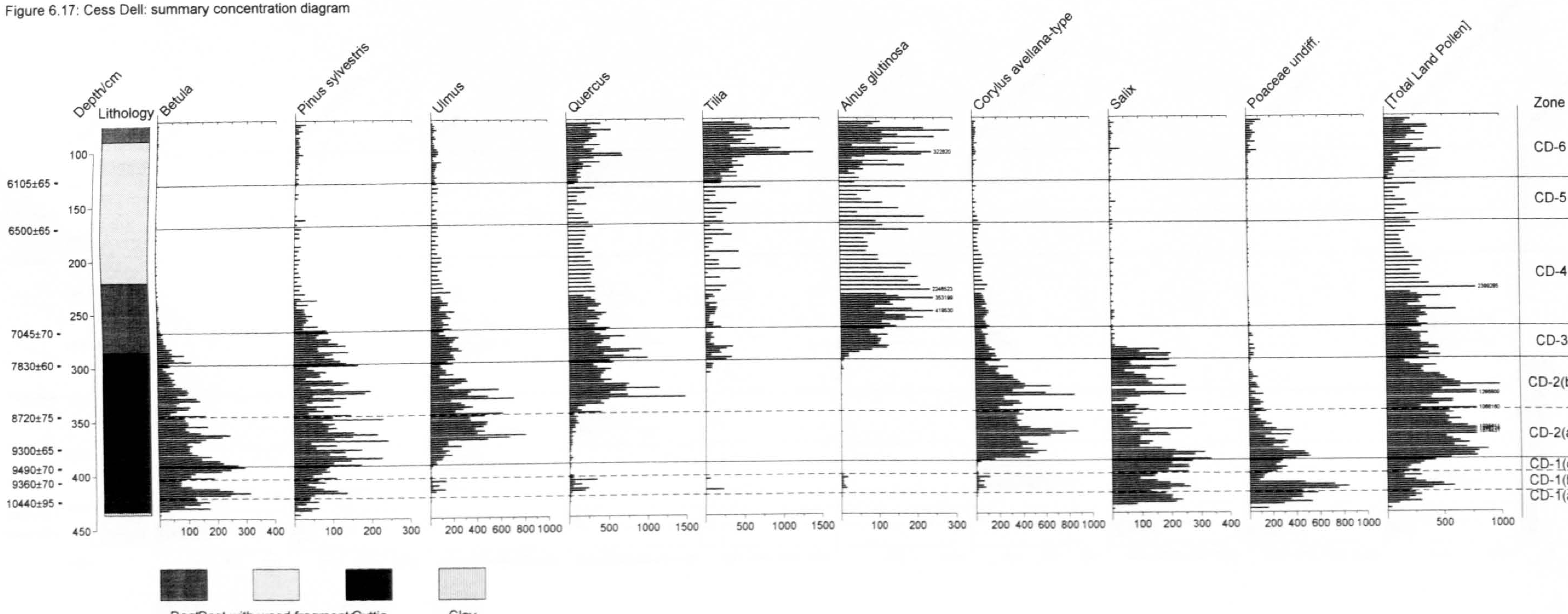
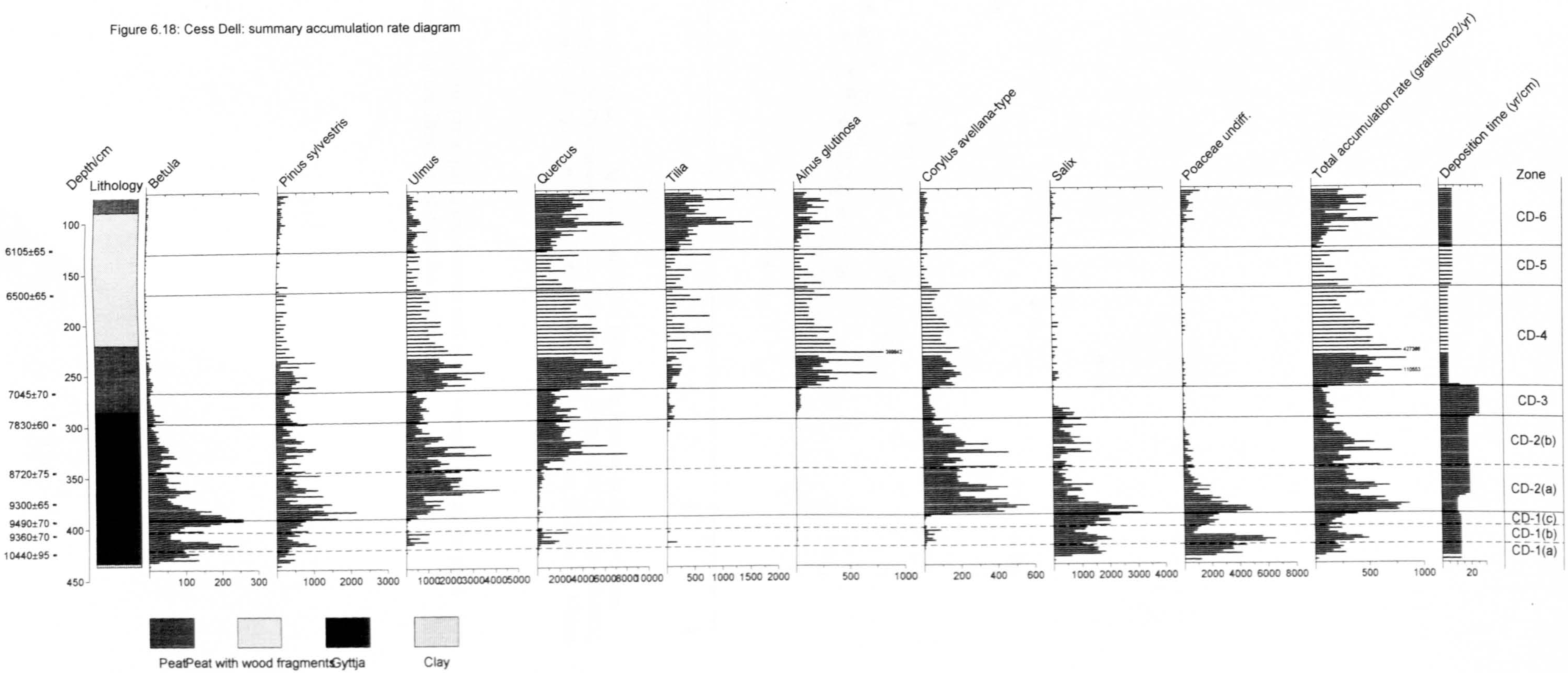
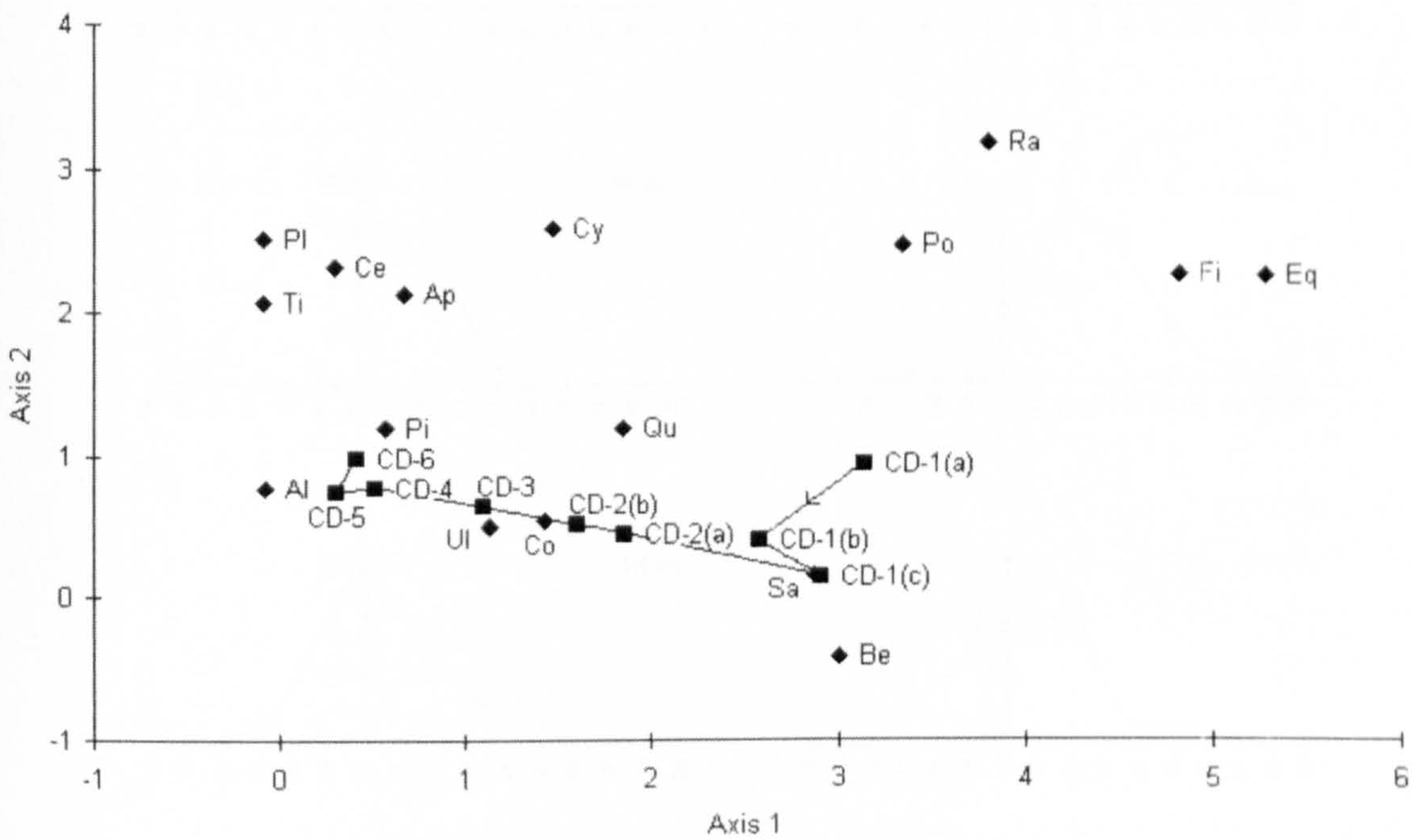


Figure 6.18: Cess Dell: summary accumulation rate diagram





Key to abbreviations used: Al, Alnus glutinosa; Ap, Apiaceae undiff.; Be, Betula; Ce, Poaceae pollen of >37 um longest axis; Co, Corylus avellana-type; Cy, Cyperaceae undiff.; Eq, Equisetum; Fi, Filipendula; Pi, Pinus sylvestris; Pl, Plantago lanceolata; Po, Poaceae undiff.; Qu, Quercus; Ra, Ranunculus acris-type; Sa, Salix; Ti, Tilia; Ul, Ulmus.

Figure 6.19: Cess Dell: DCA plot of principal taxon scores and mean sample scores for each zone and subzone for the first two axes of the ordination

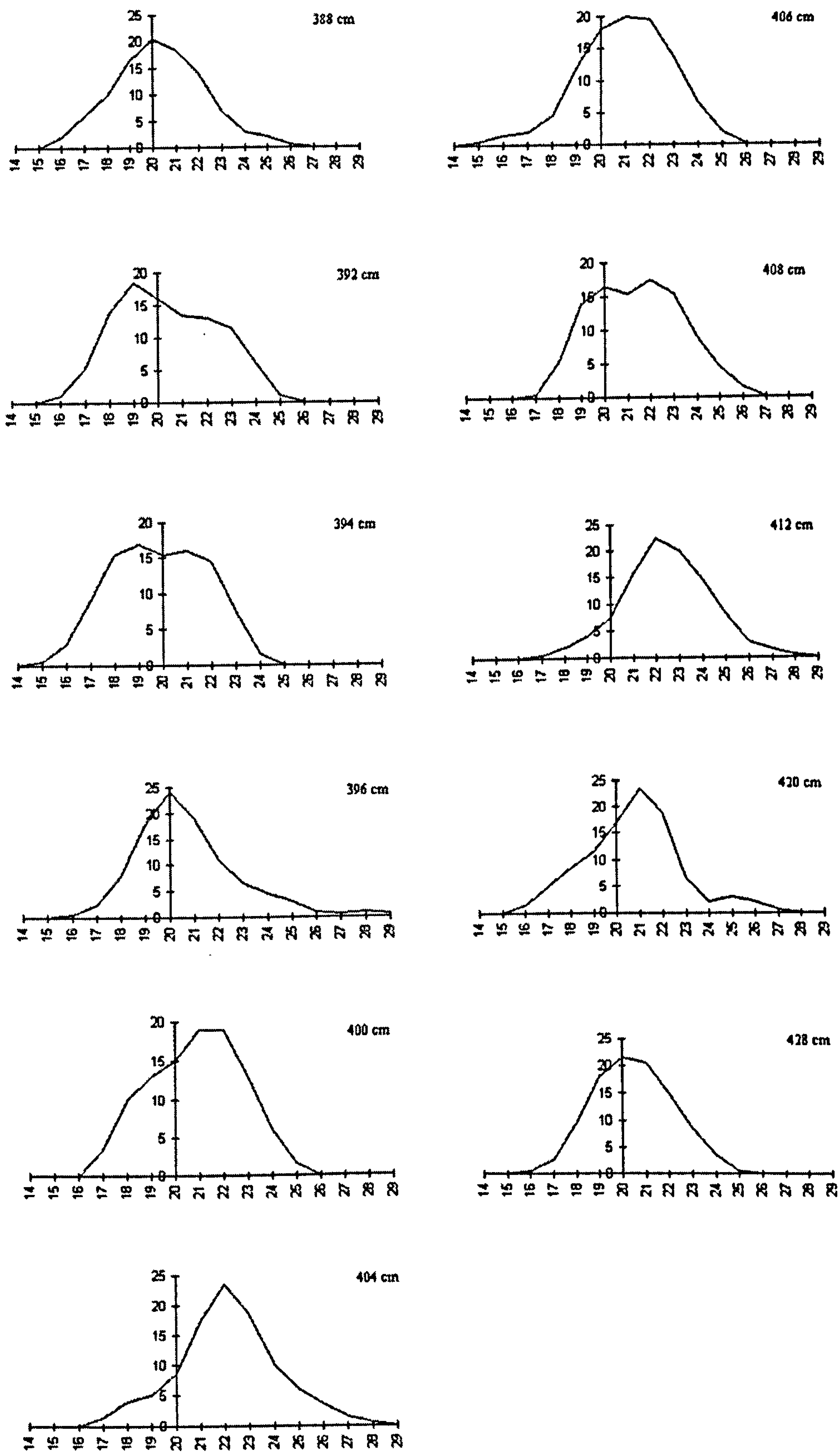


Figure 6.20: Cess Dell: smoothed Betula size-frequency graphs. Grain diameter (μm) is shown on the x-axis and smoothed percentage on the y-axis.

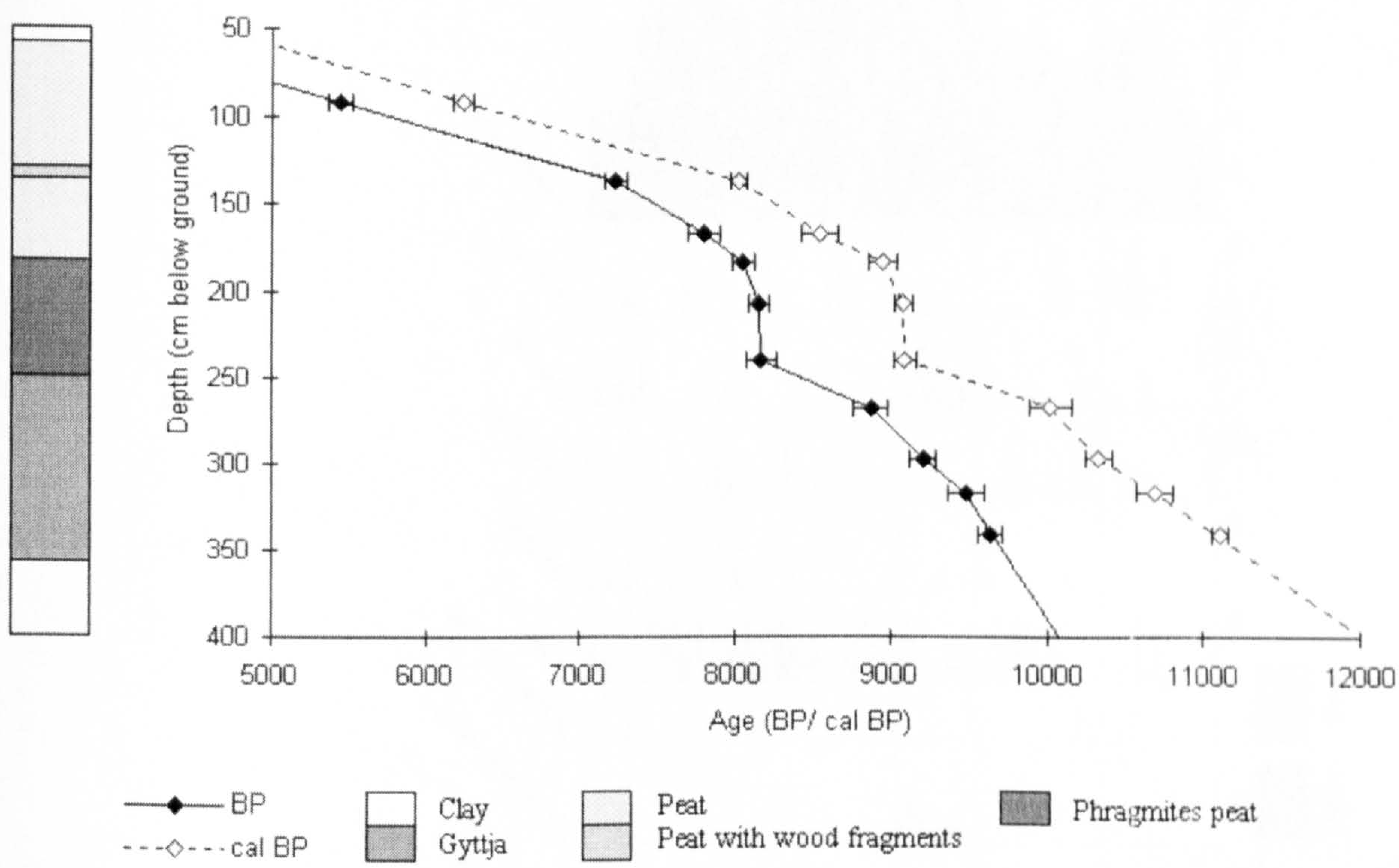


Figure 7.1: Gilderson Marr: age-depth curve of calibrated and uncalibrated BP dates

Figure 7.2: Gilderson Marr: deteriorated pollen 1: totals by type, indeterminable and miscellaneous data

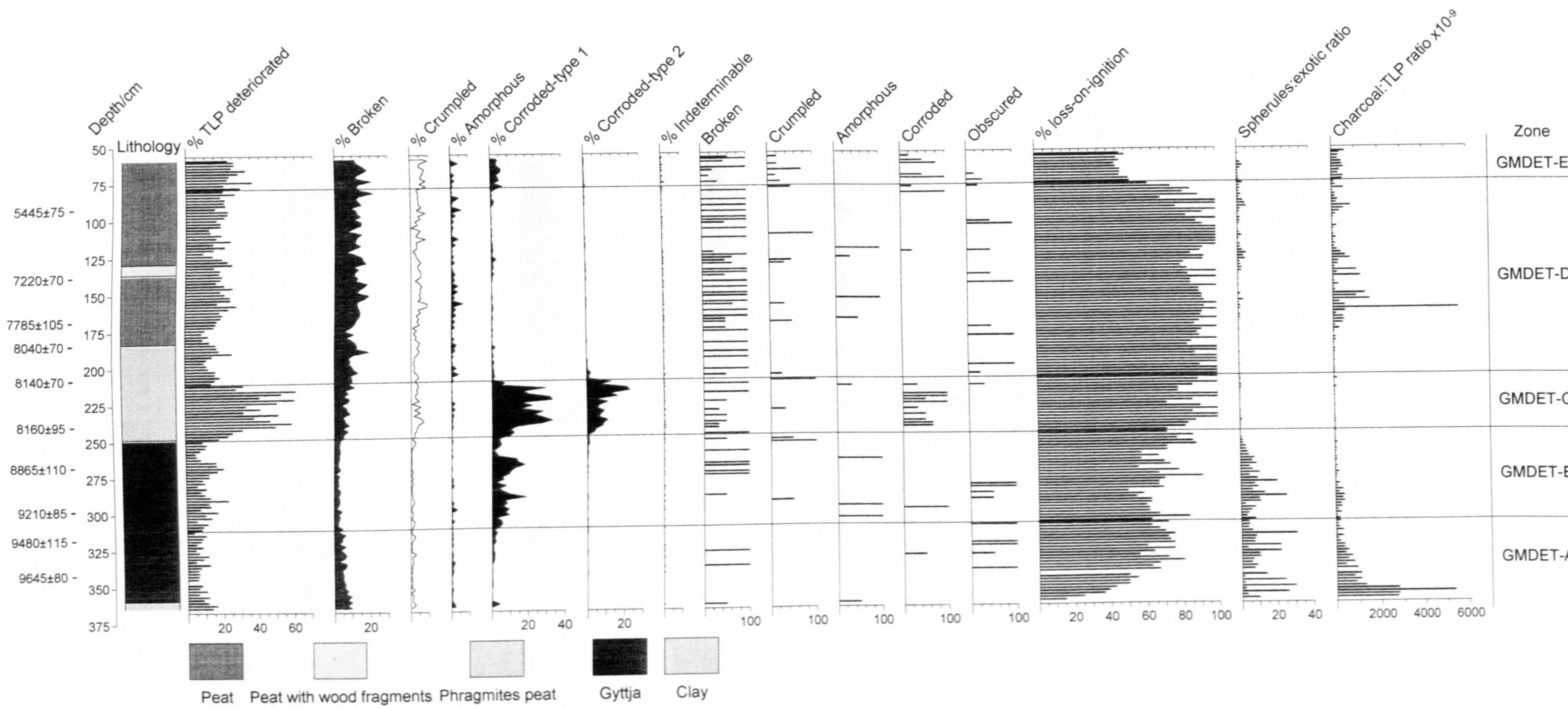


Figure 7.3: Gilderson Marr: deteriorated pollen 2: Betula

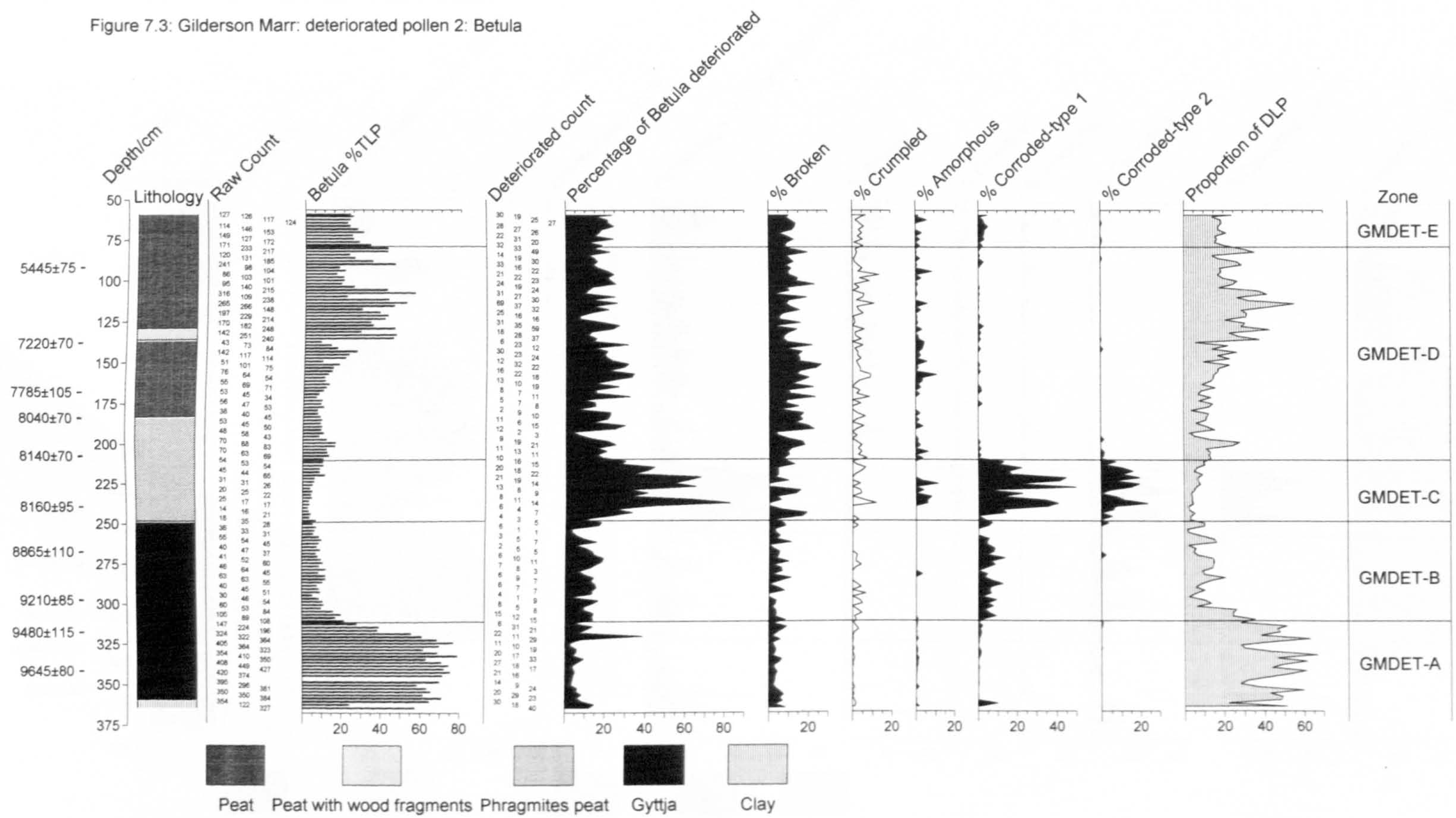


Figure 7.4: Gilderson Marr: deteriorated pollen 3: Corylus

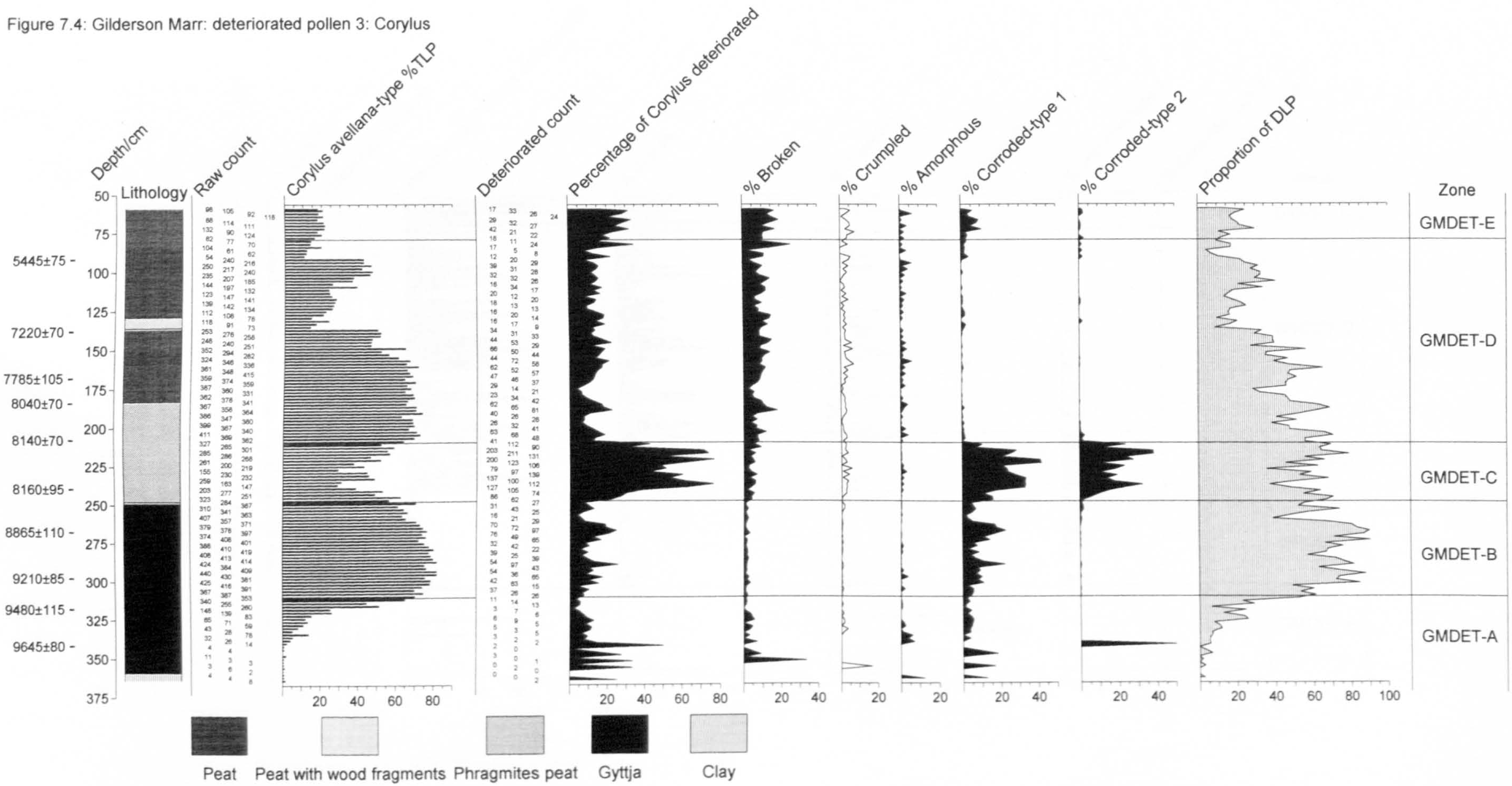


Figure 7.5: Gilderson Marr: deteriorated pollen 4: Ulmus

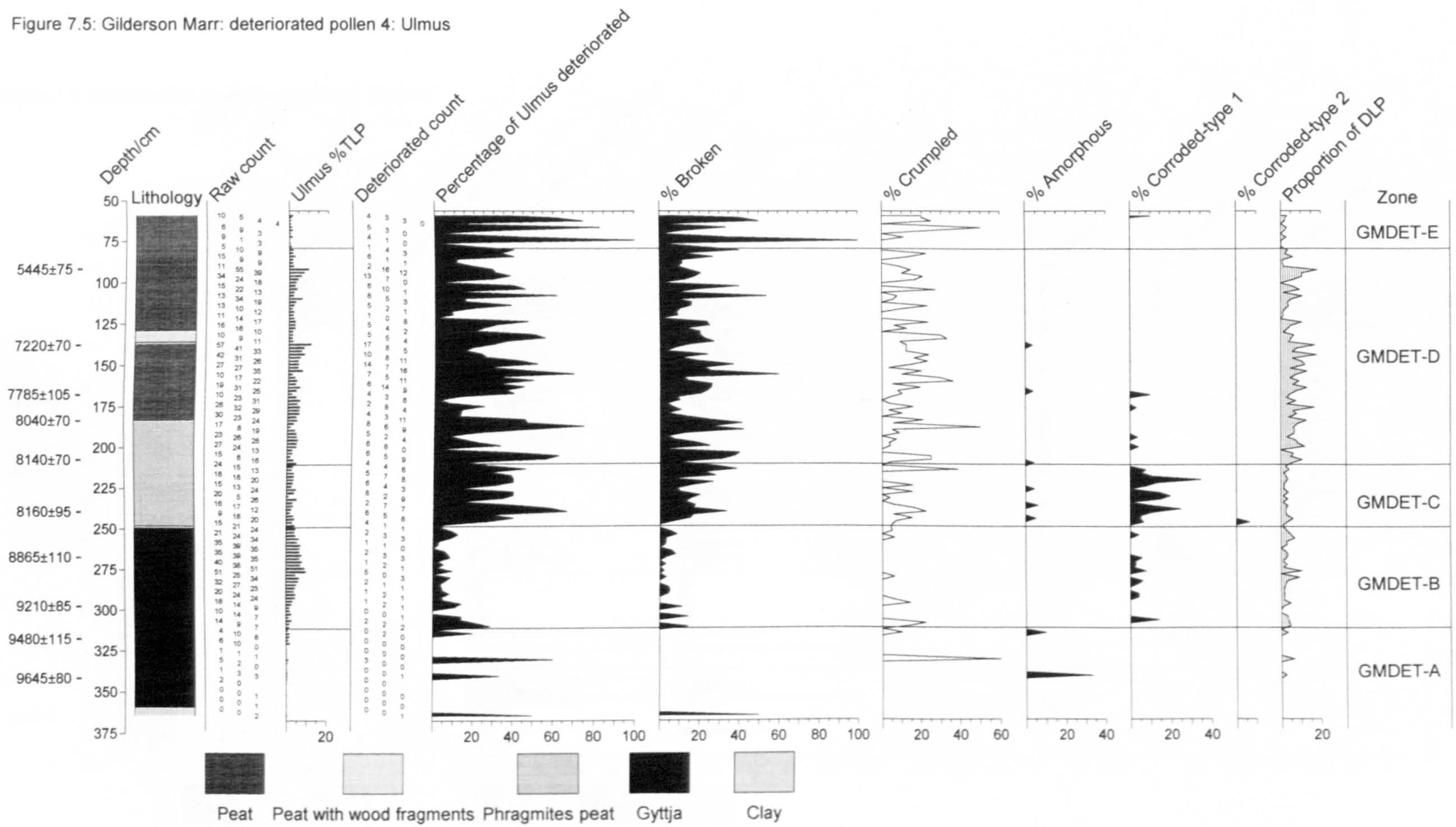


Figure 7.6: Gilderson Marr: deteriorated pollen 5: Quercus

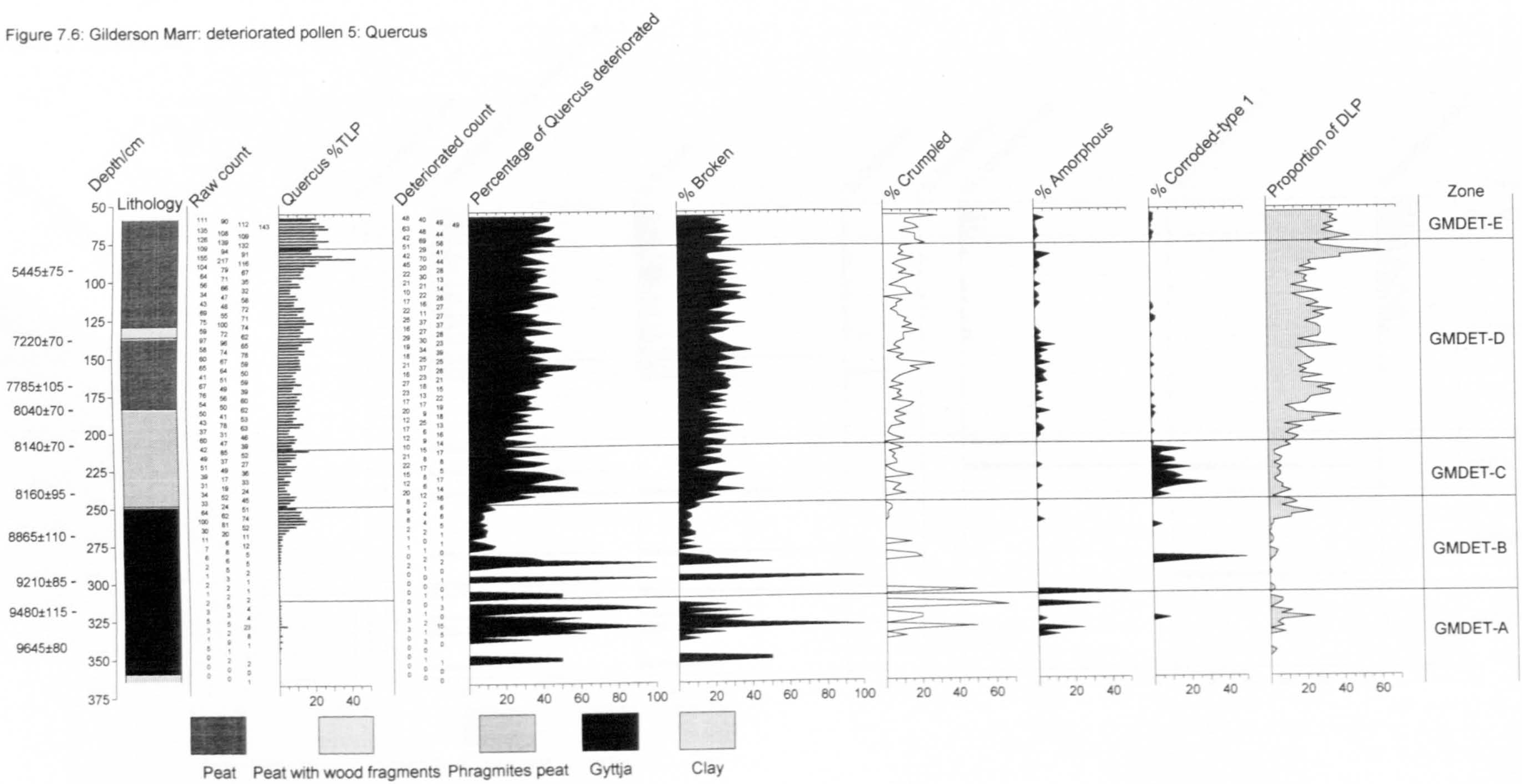


Figure 7.7: Gilderson Marr: deteriorated pollen 6: Alnus

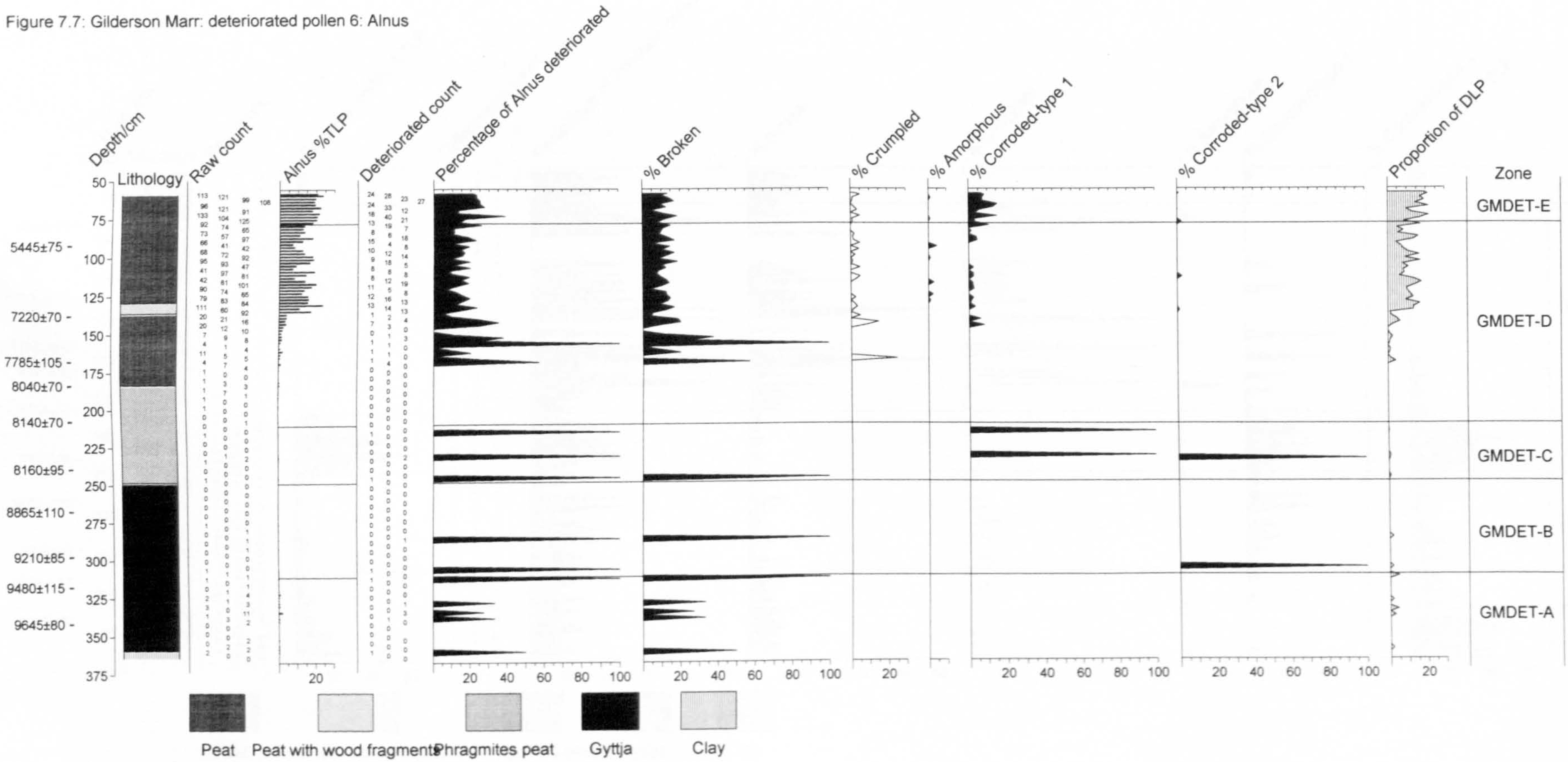
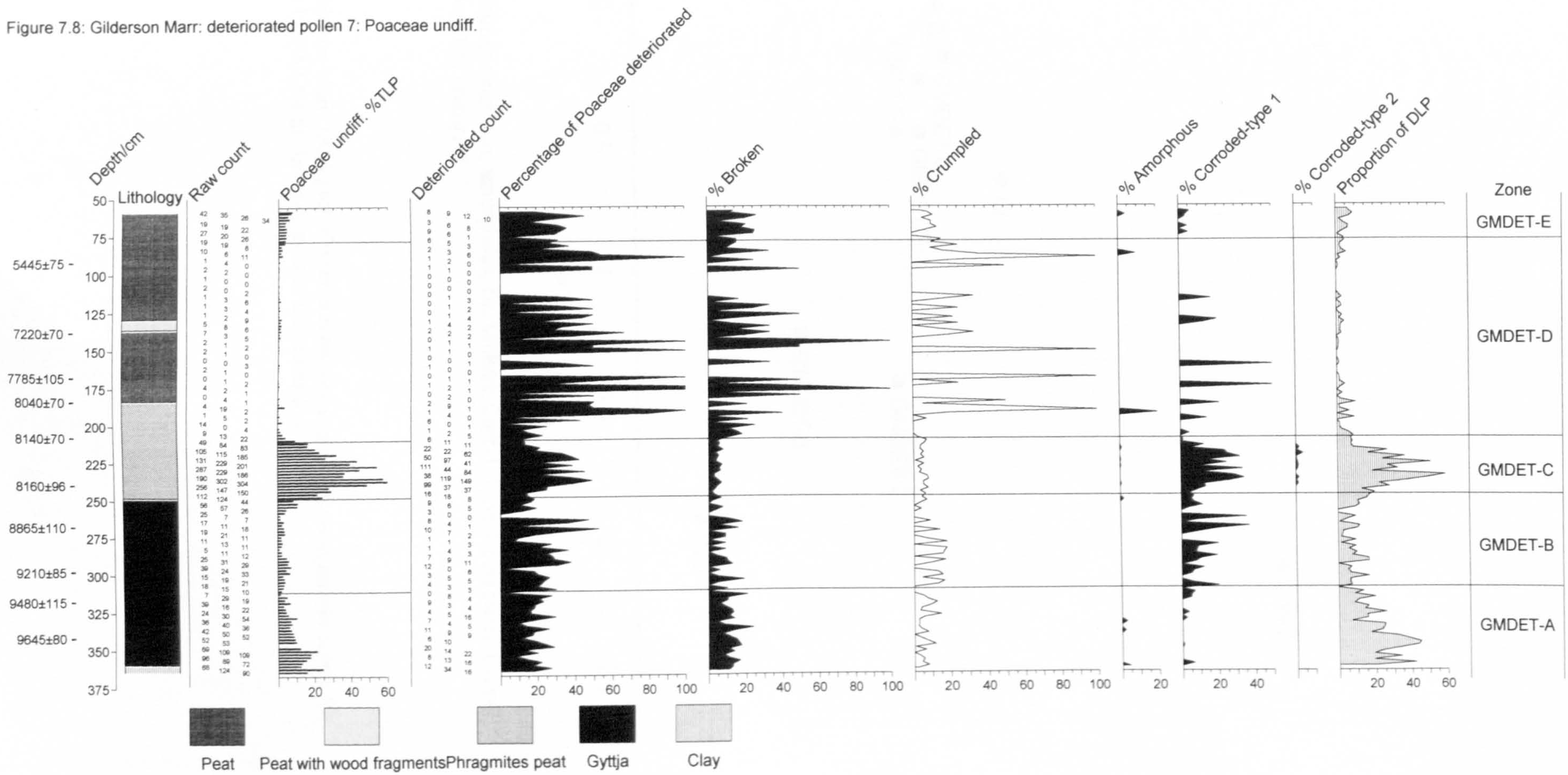
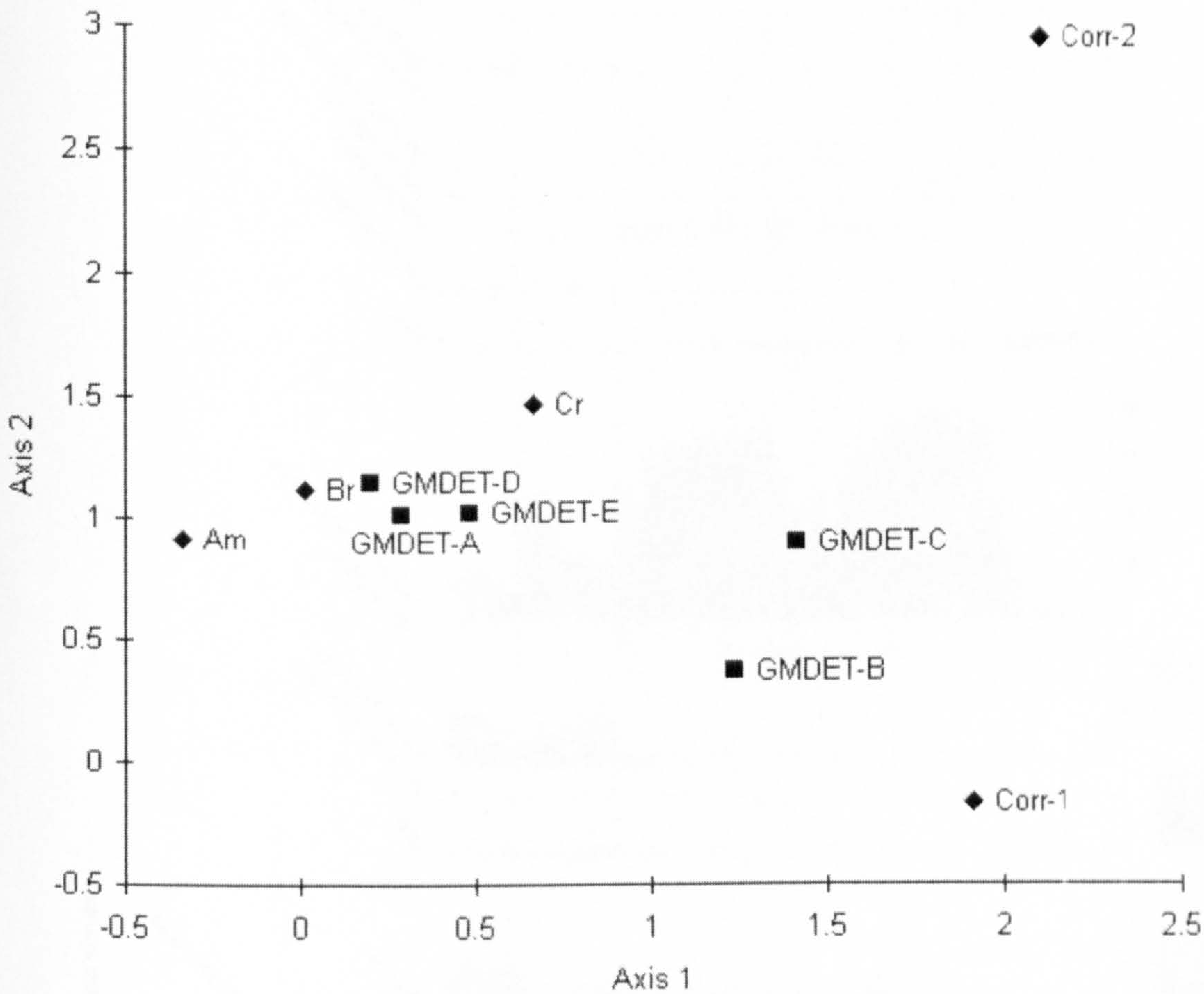


Figure 7.8: Gilderson Marr: deteriorated pollen 7: Poaceae undiff.





Key to abbreviations used: Am, amorphous; Br, broken; Corr-1, type-1 corrosion; Corr-2, type-2 corrosion; Cr, crumpled.

Figure 7.9: Gilderson Marr: DCA plot of deterioration type scores and mean sample scores for each LDPAZ for the first two axes of the ordination

Figure 7.10: Gilderson Marr: percentage diagram of trees and shrubs

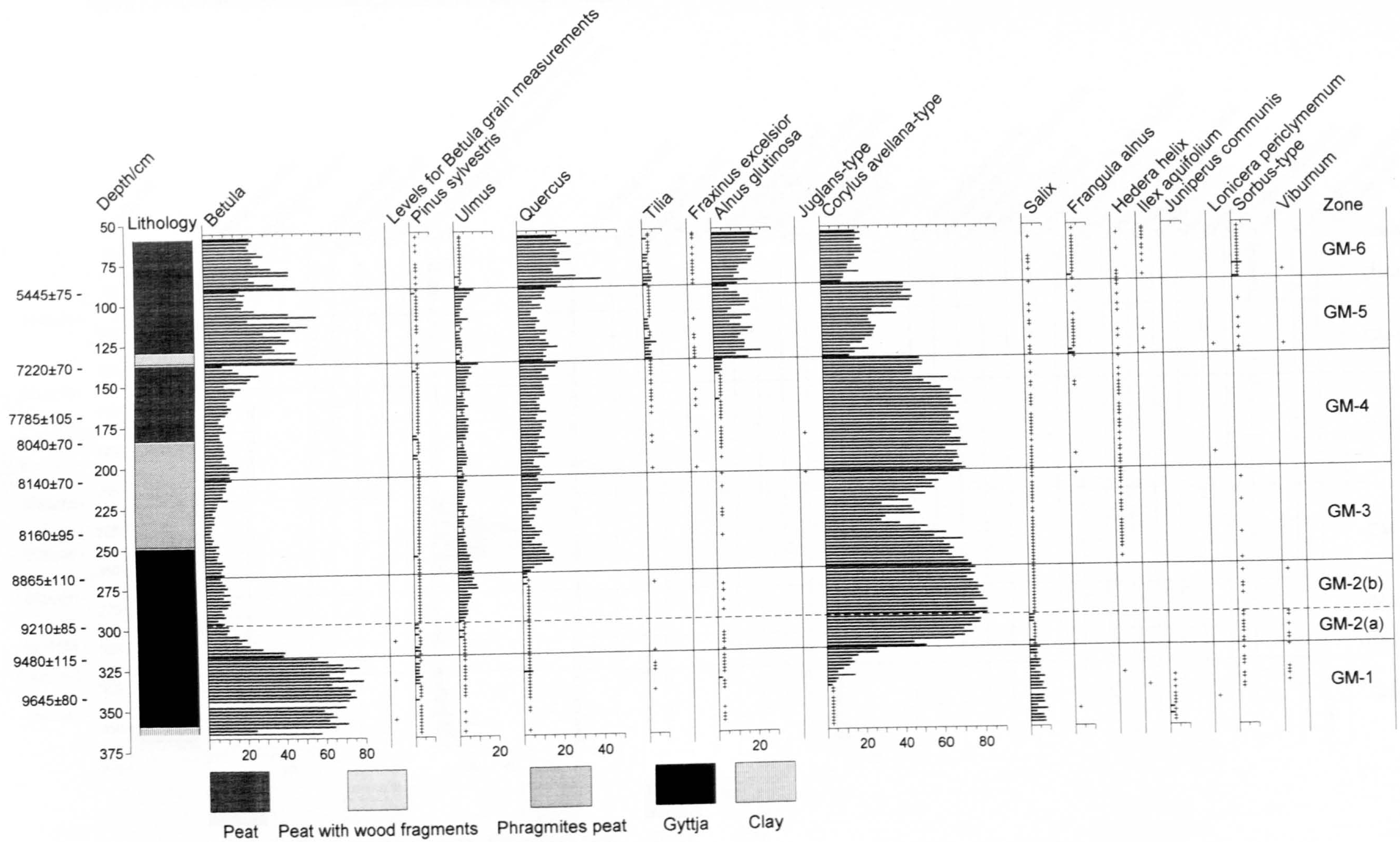


Figure 7.11: Gilderson Marr: percentage diagram of heaths and herbs(1)

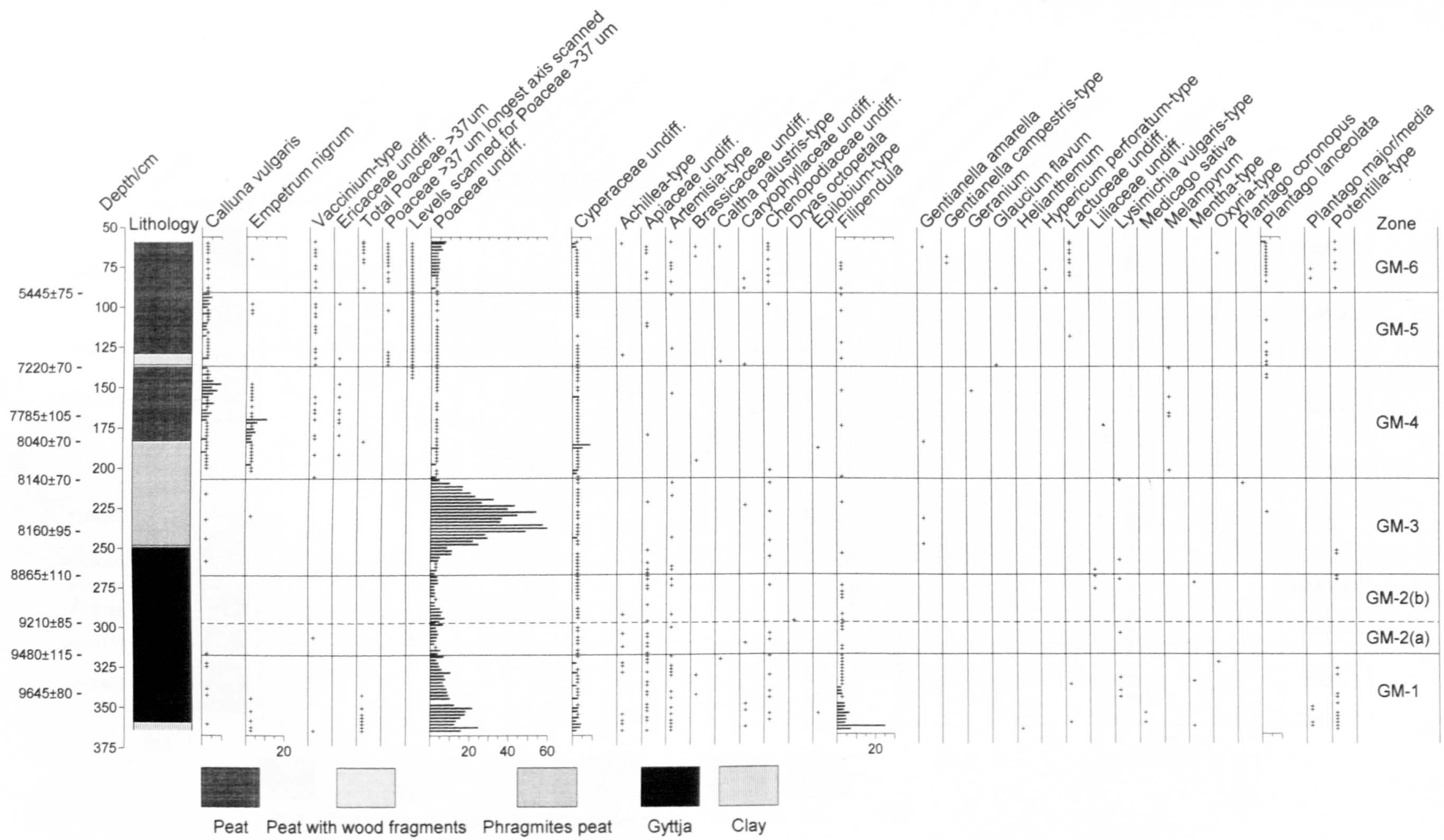


Figure 7.12: Gilderson Marr: percentage diagram of herbs(2), aquatics and spores

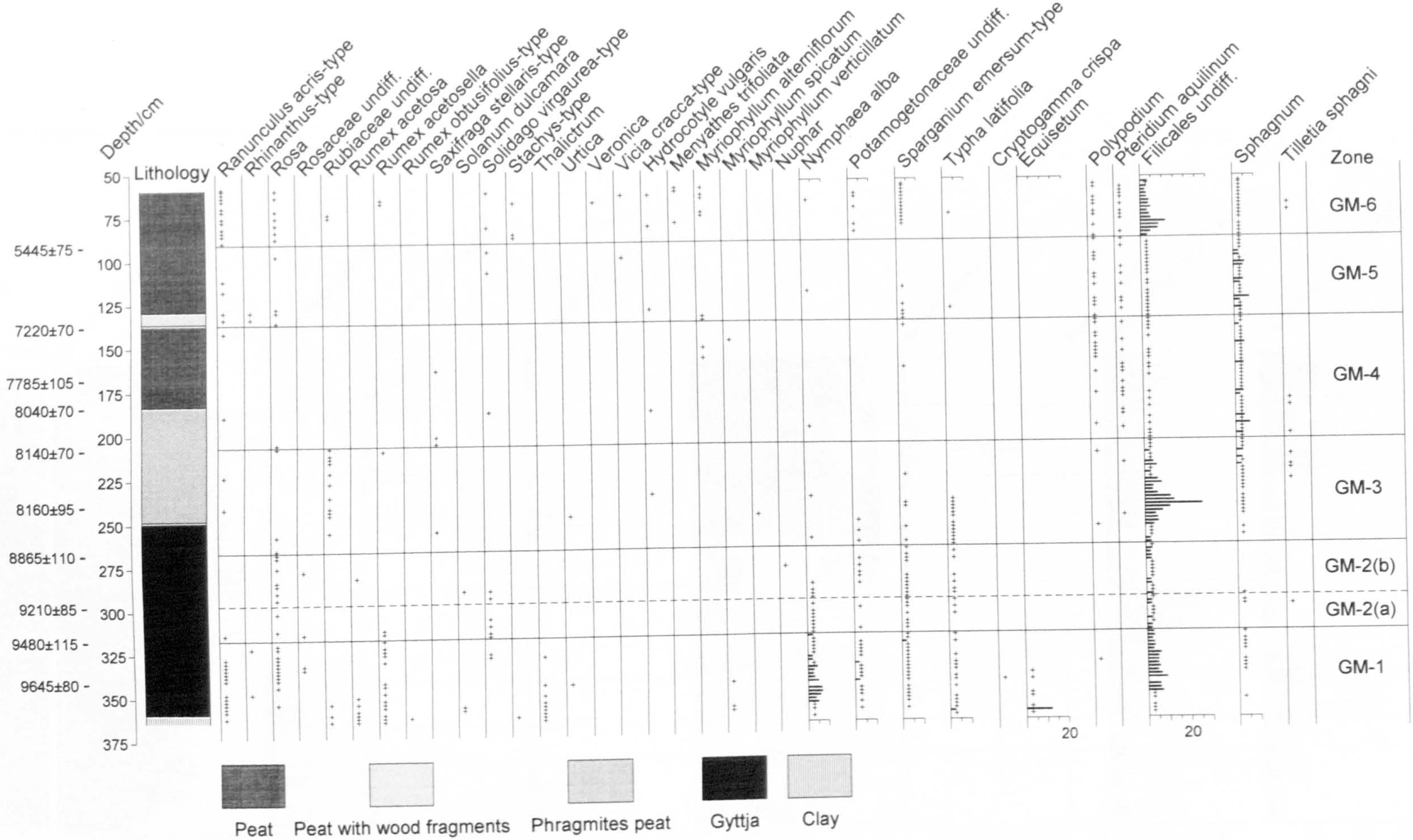


Figure 7.13: Gilderson Marr: miscellaneous data

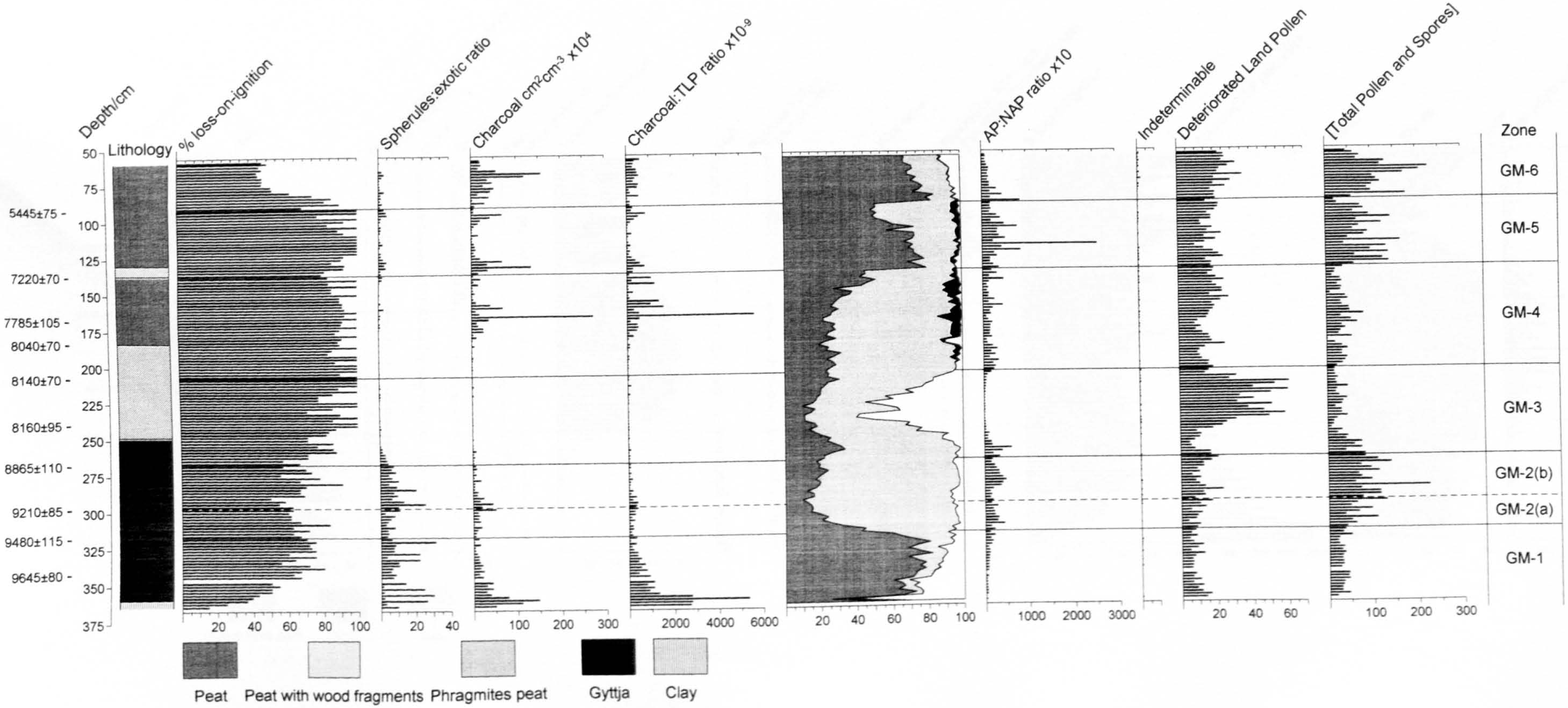


Figure 7.14: Gilderson Marr: summary percentage diagram for 364-208 cm

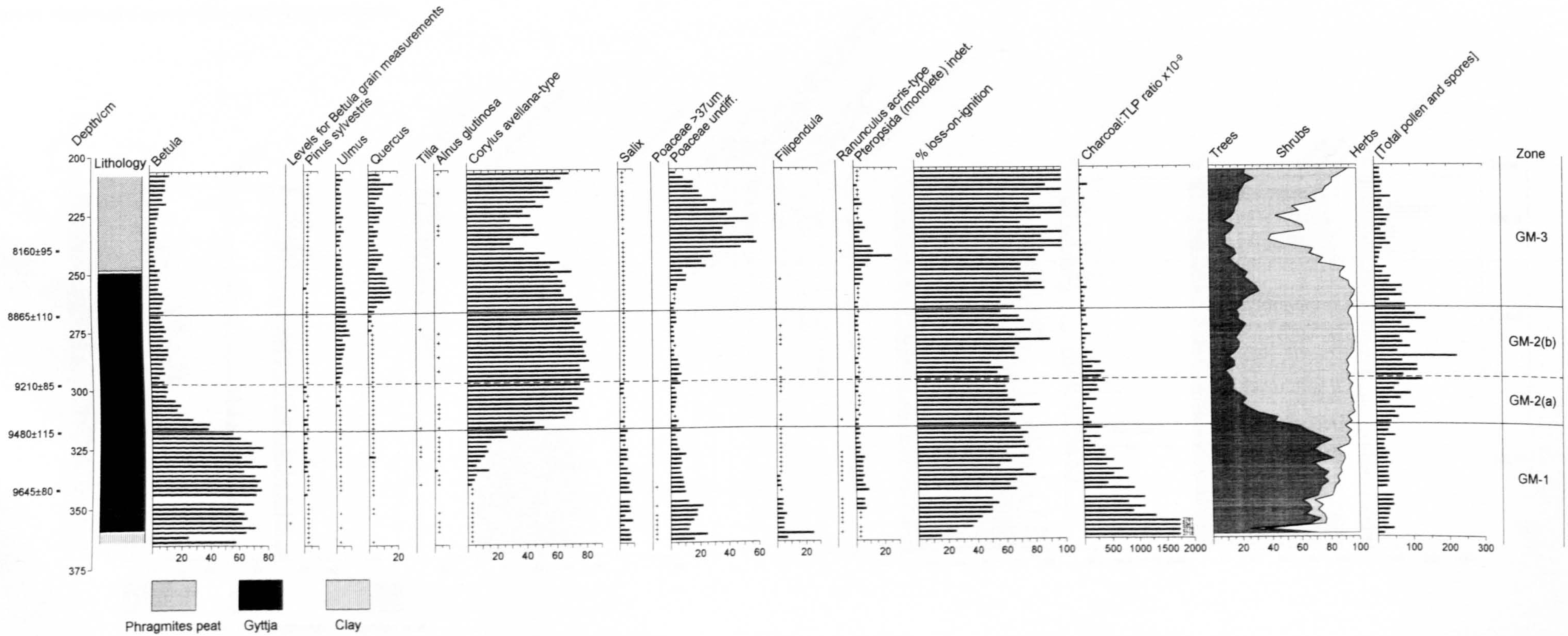


Figure 7.15: Gilderson Marr: summary percentage diagram for 206-59 cm

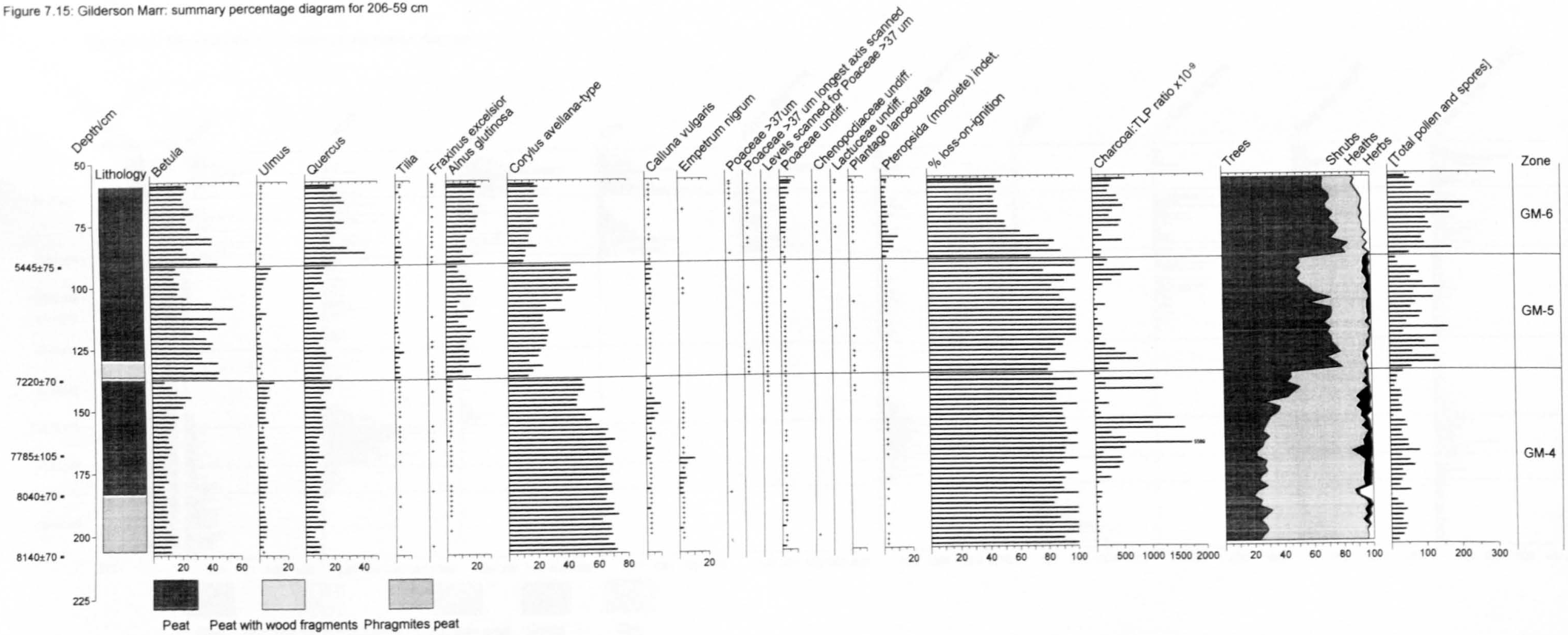
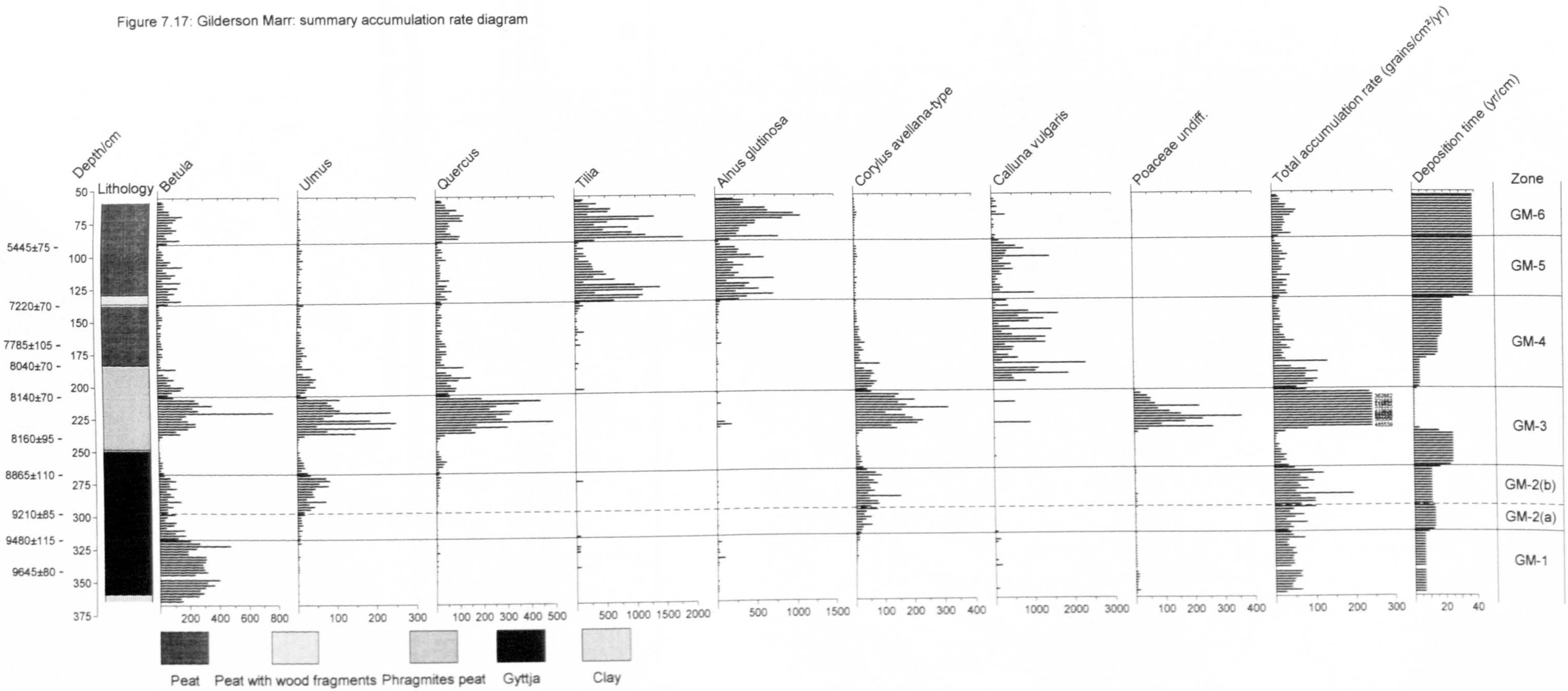
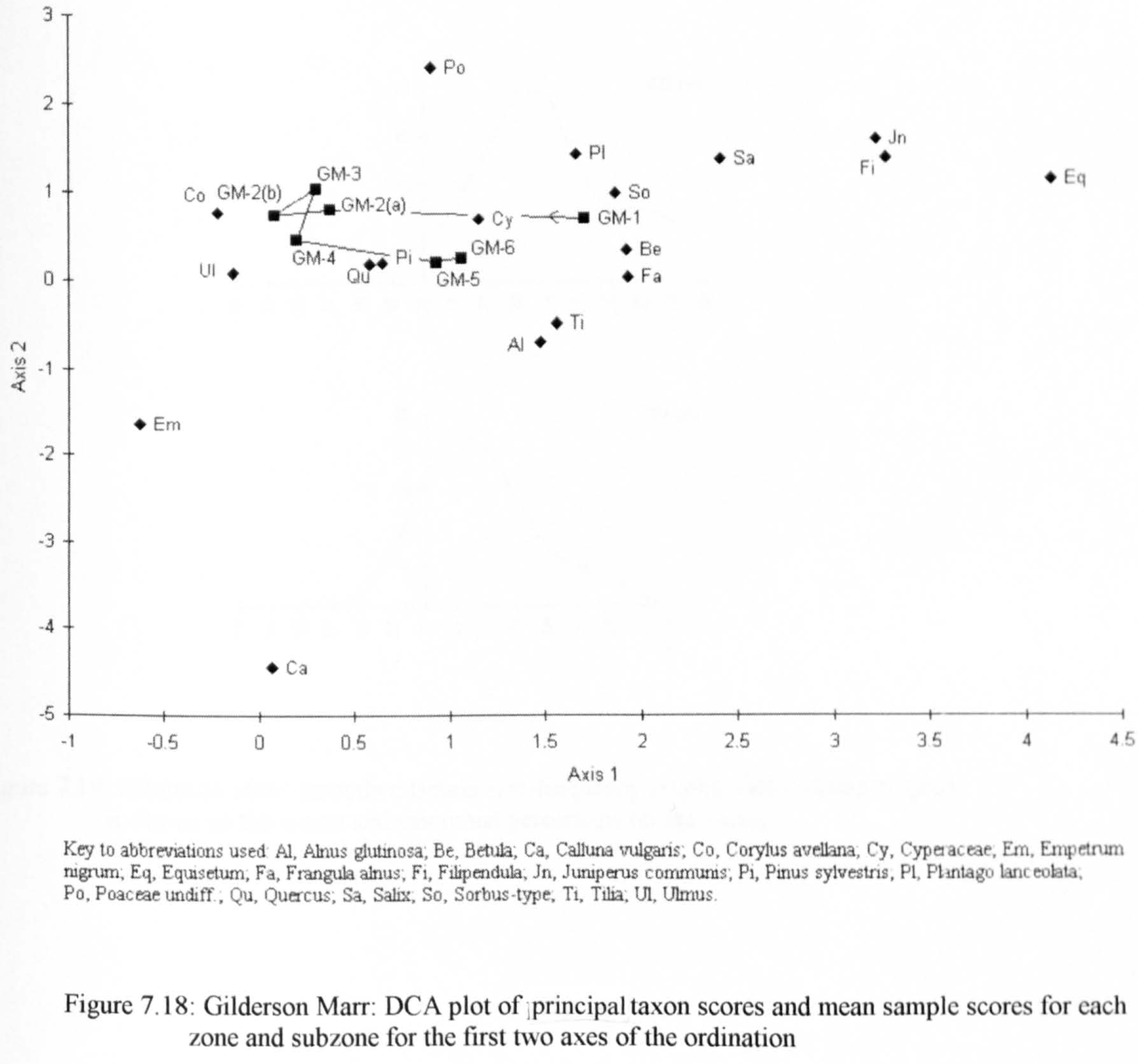


Figure 7.16: Gilderson Marr: summary concentration diagram

Figure 7.17: Gilderson Marr: summary accumulation rate diagram





Key to abbreviations used: Al, Alnus glutinosa; Be, Betula; Ca, Calluna vulgaris; Co, Corylus avellana; Cy, Cyperaceae; Em, Empetrum nigrum; Eq, Equisetum; Fa, Frangula alnus; Fi, Filipendula; Jn, Juniperus communis; Pi, Pinus sylvestris; Pl, Plantago lanceolata; Po, Poaceae undiff.; Qu, Quercus; Sa, Salix; So, Sorbus-type; Ti, Tilia; Ul, Ulmus.

Figure 7.18: Gilderson Marr: DCA plot of principal taxon scores and mean sample scores for each zone and subzone for the first two axes of the ordination

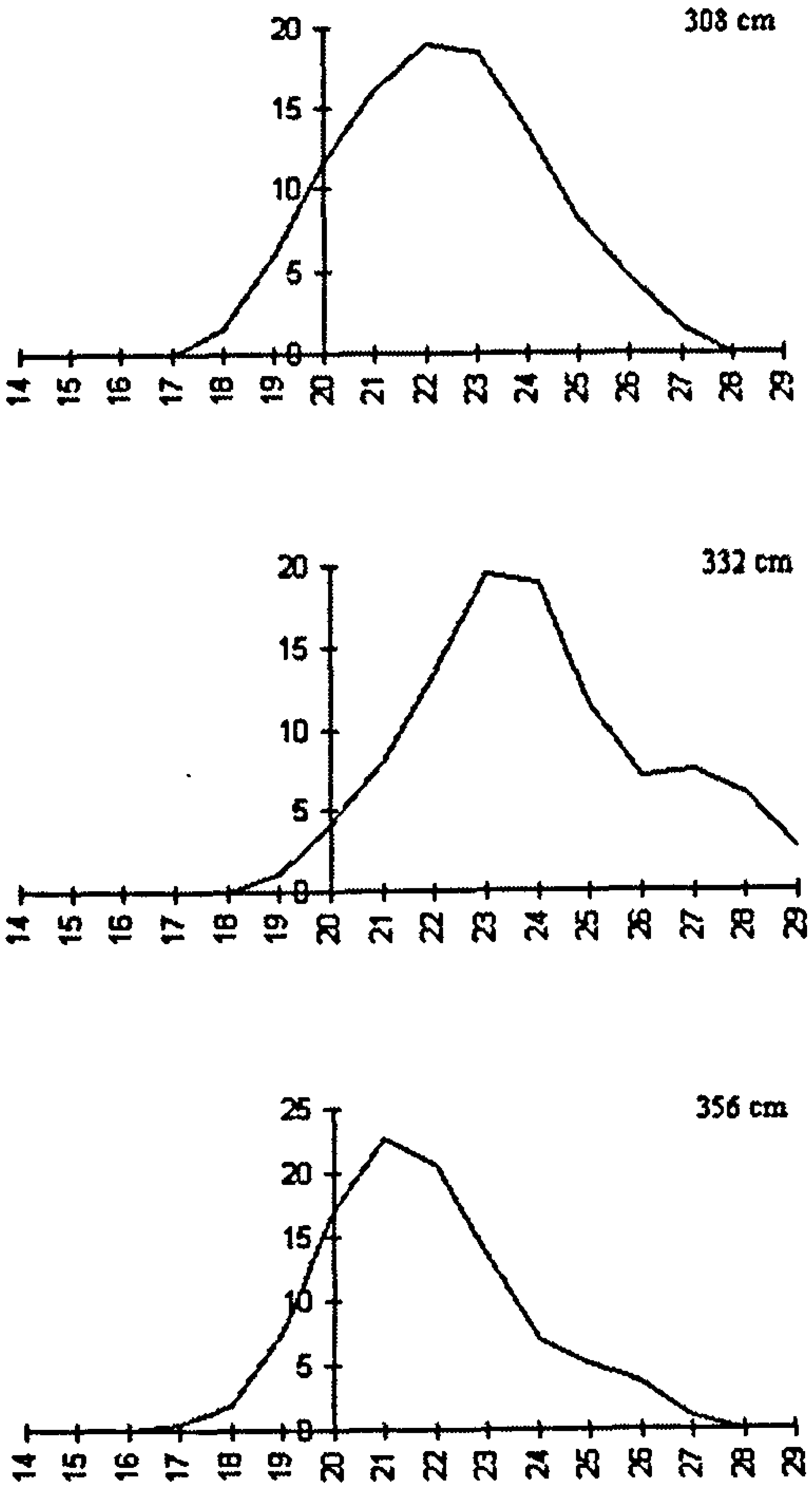


Figure 7.19: Gilderson Marr: smoothed Betula size-frequency graphs. Grain diameter (μm) is shown on the x-axis and smoothed percentage on the y-axis.

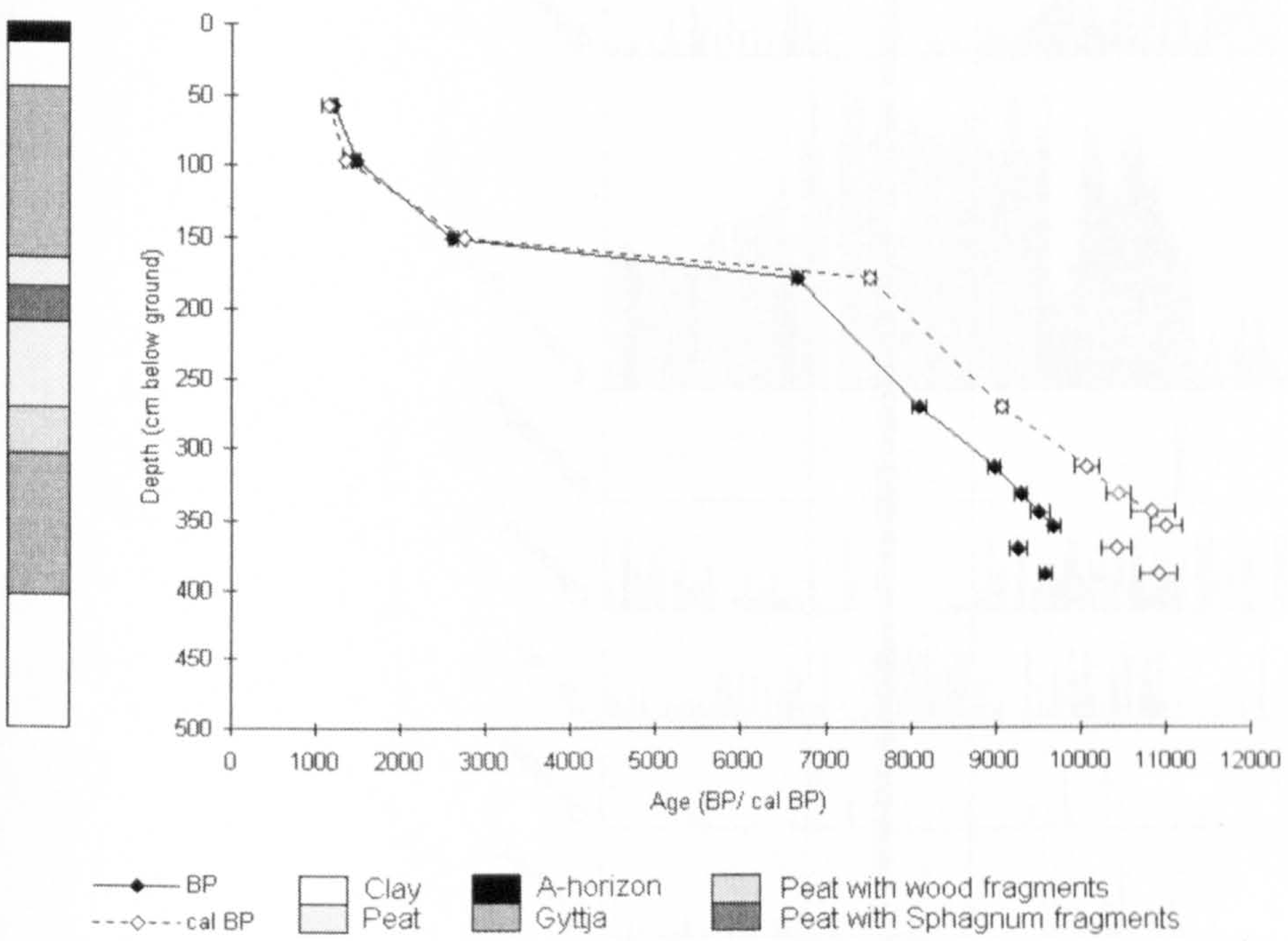


Figure 8.1: Sproatley Bog: age-depth curve of calibrated and uncalibrated BP dates

Figure 8.2: Sproatley Bog: pollen preservation 1: totals by type, indeterminable and miscellaneous data

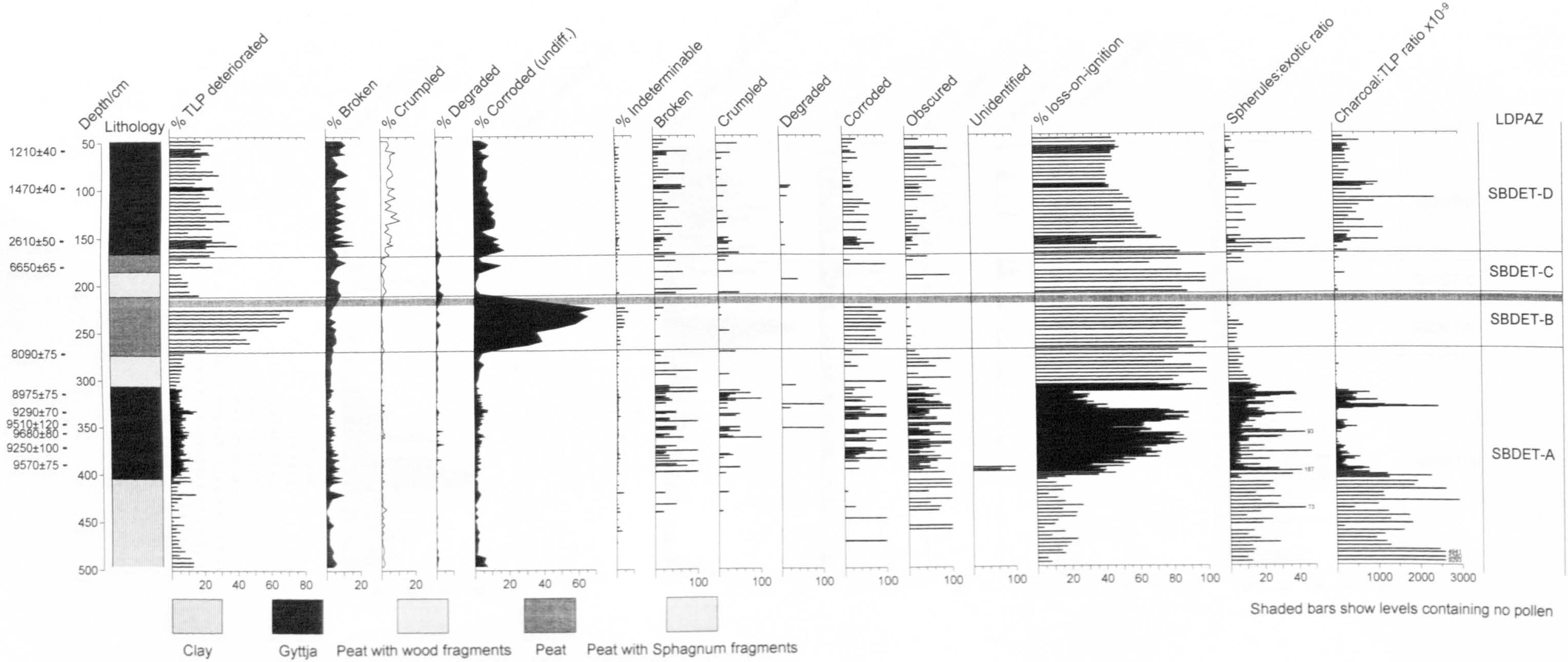


Figure 8.3: Sproatley Bog: pollen preservation 2: Betula

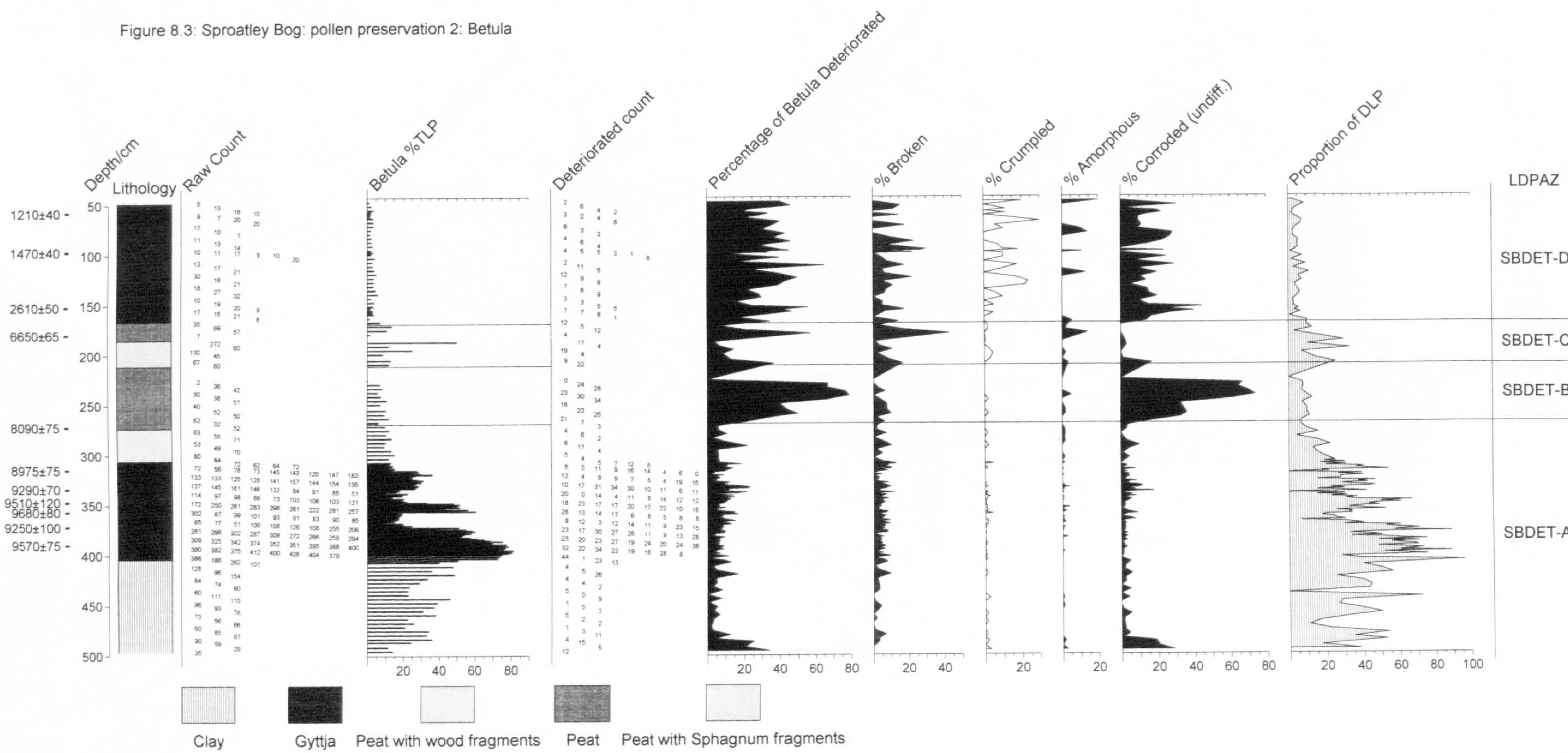


Figure 8.4: pollen preservation 3: Corylus

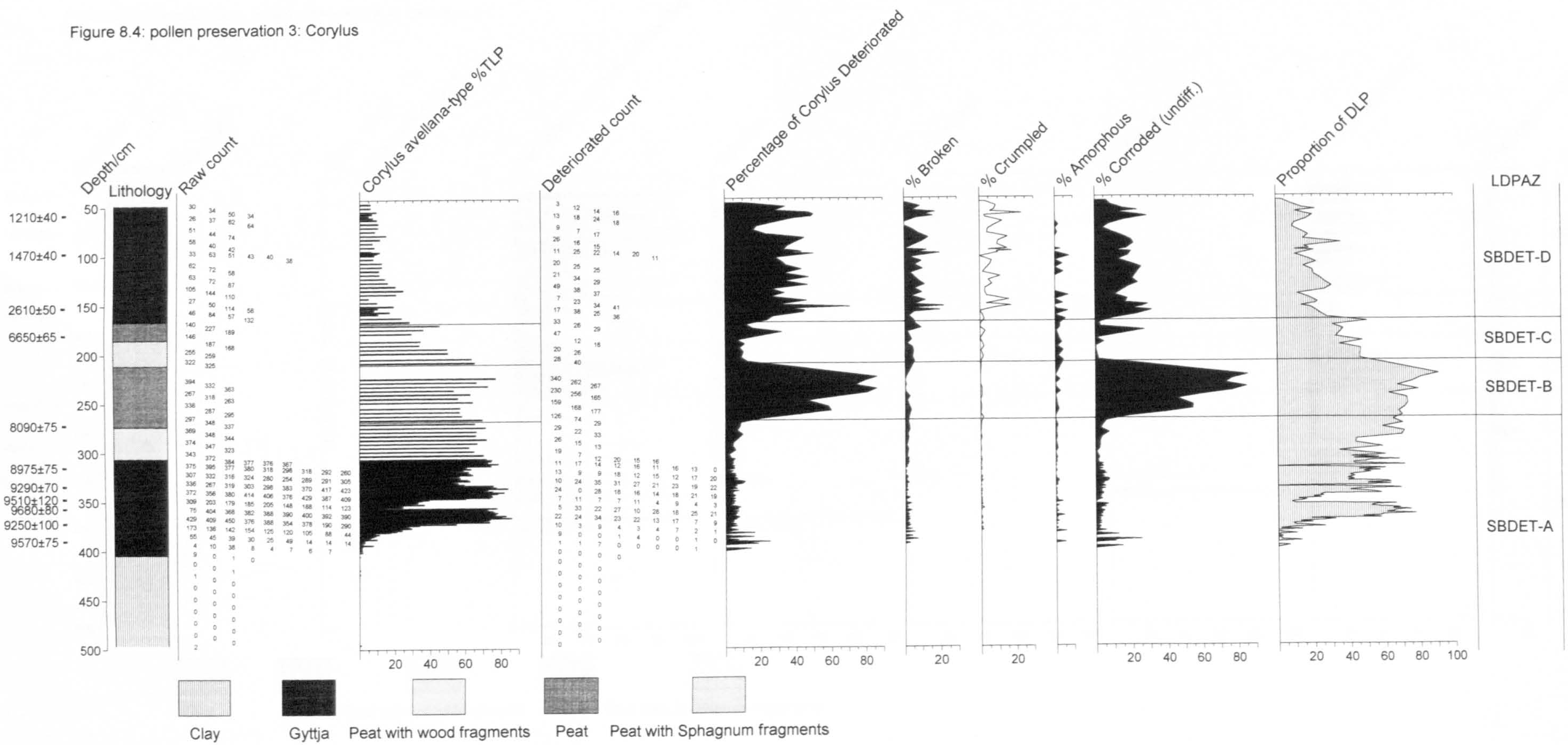


Figure 8.5: Sproatley Bog: pollen preservation 4: Ulmus

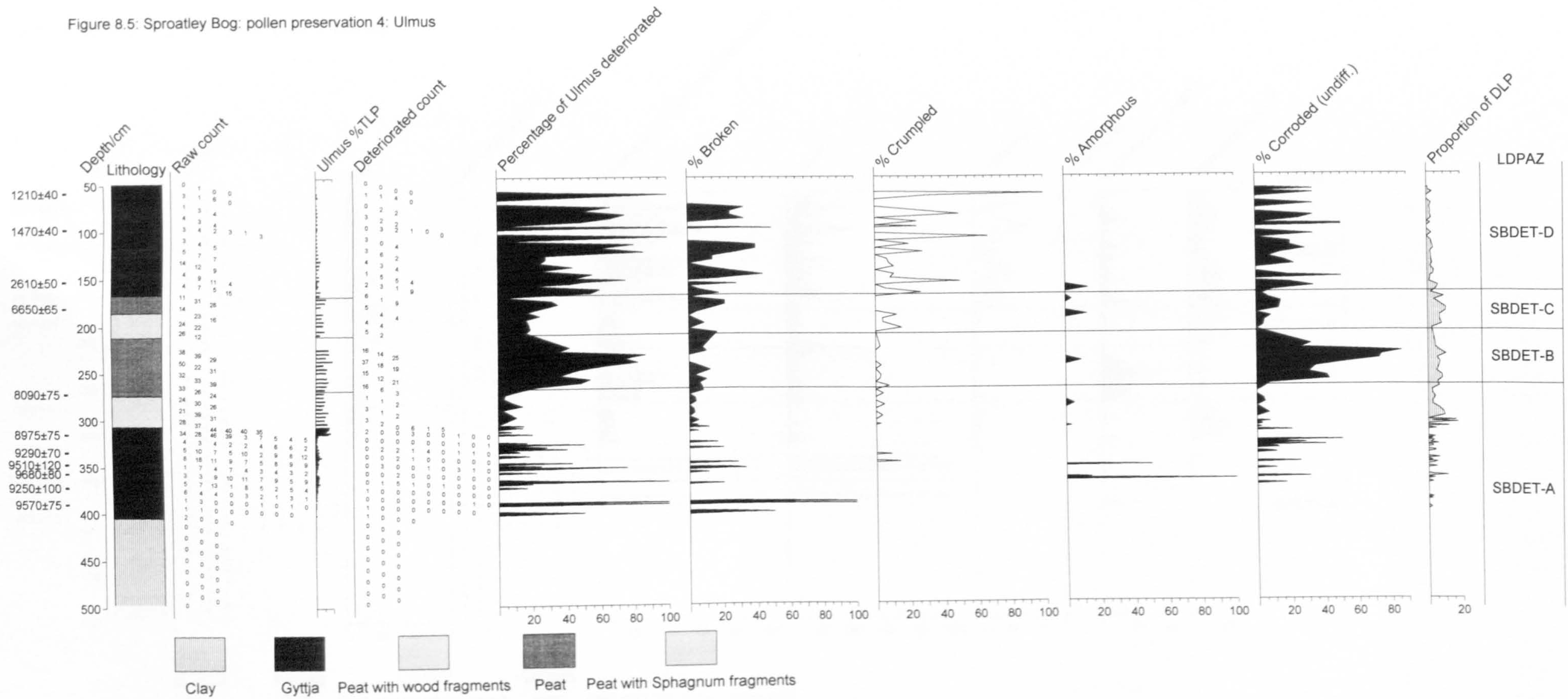
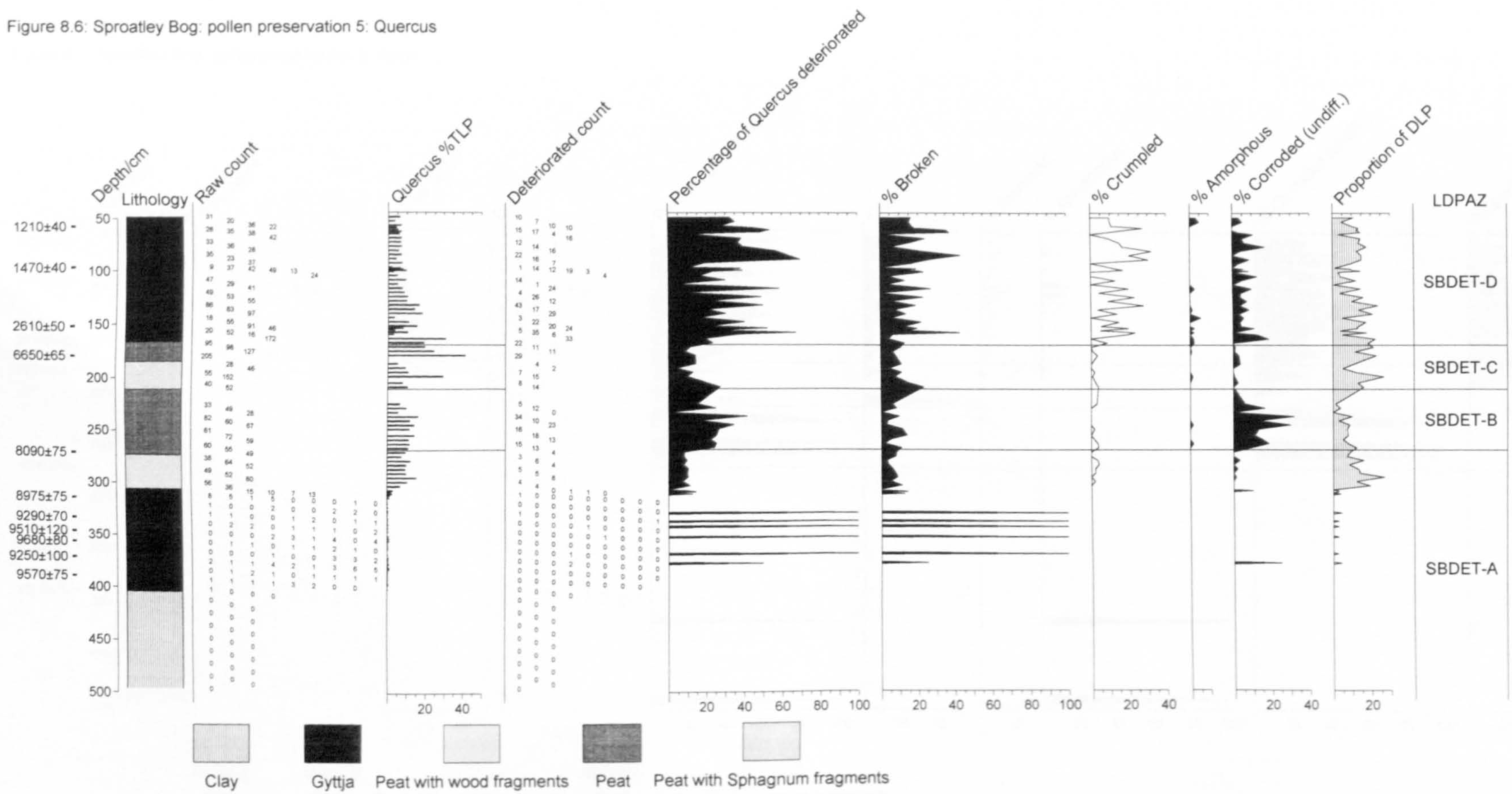


Figure 8.6: Sproatley Bog: pollen preservation 5: Quercus



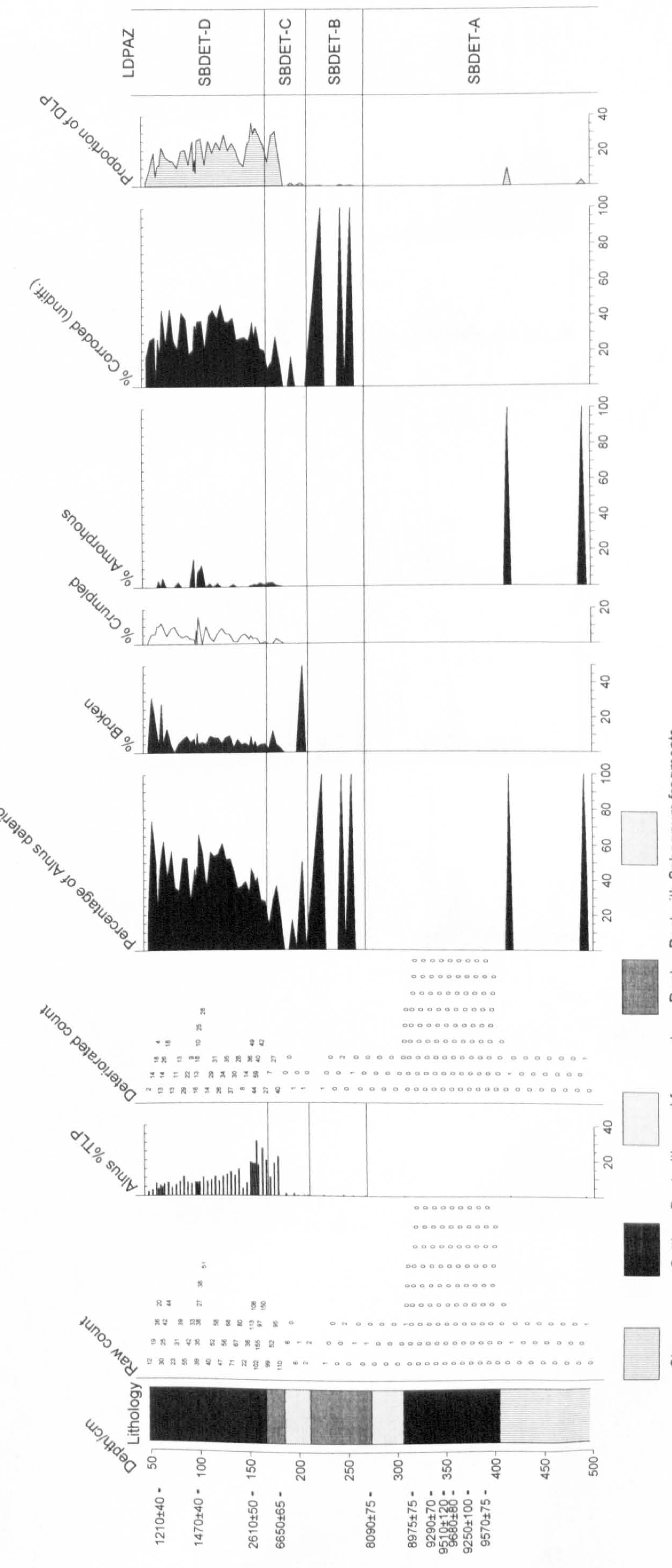
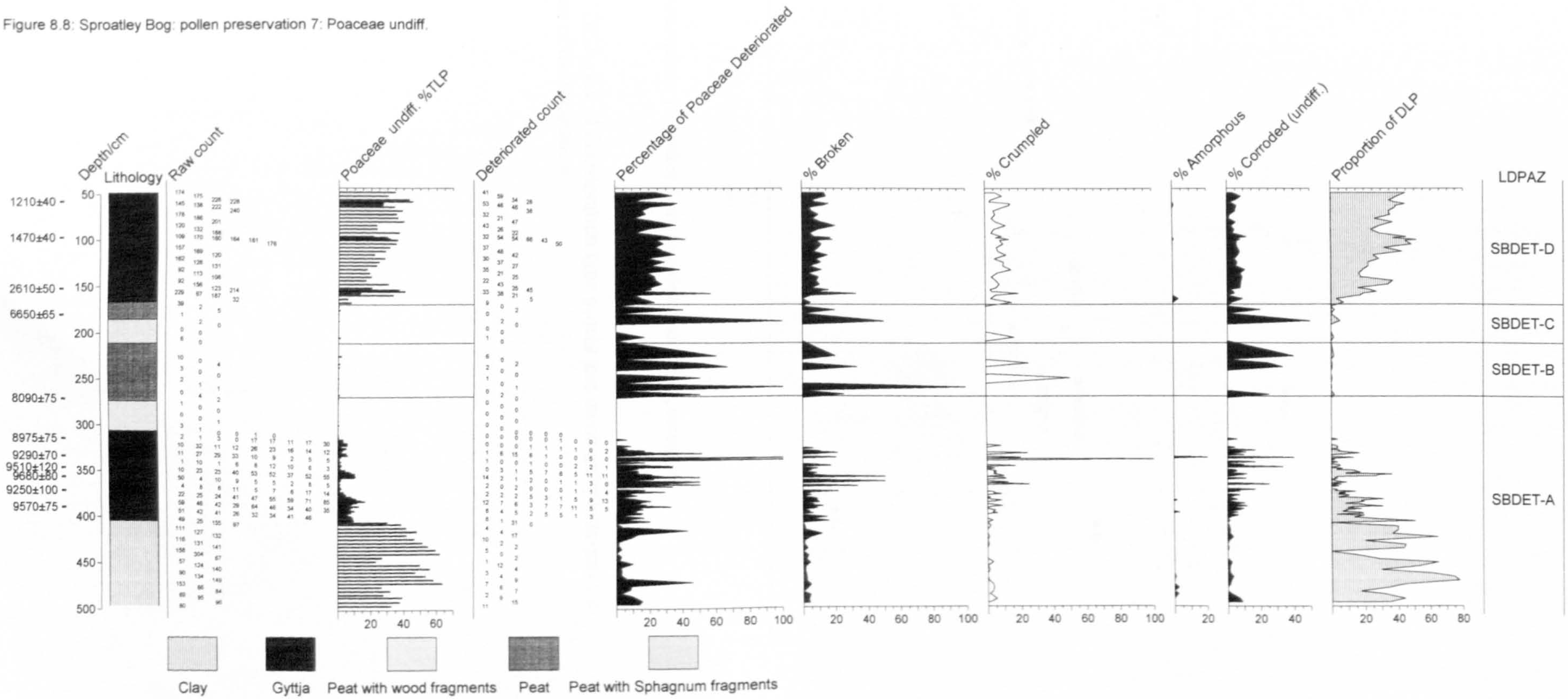
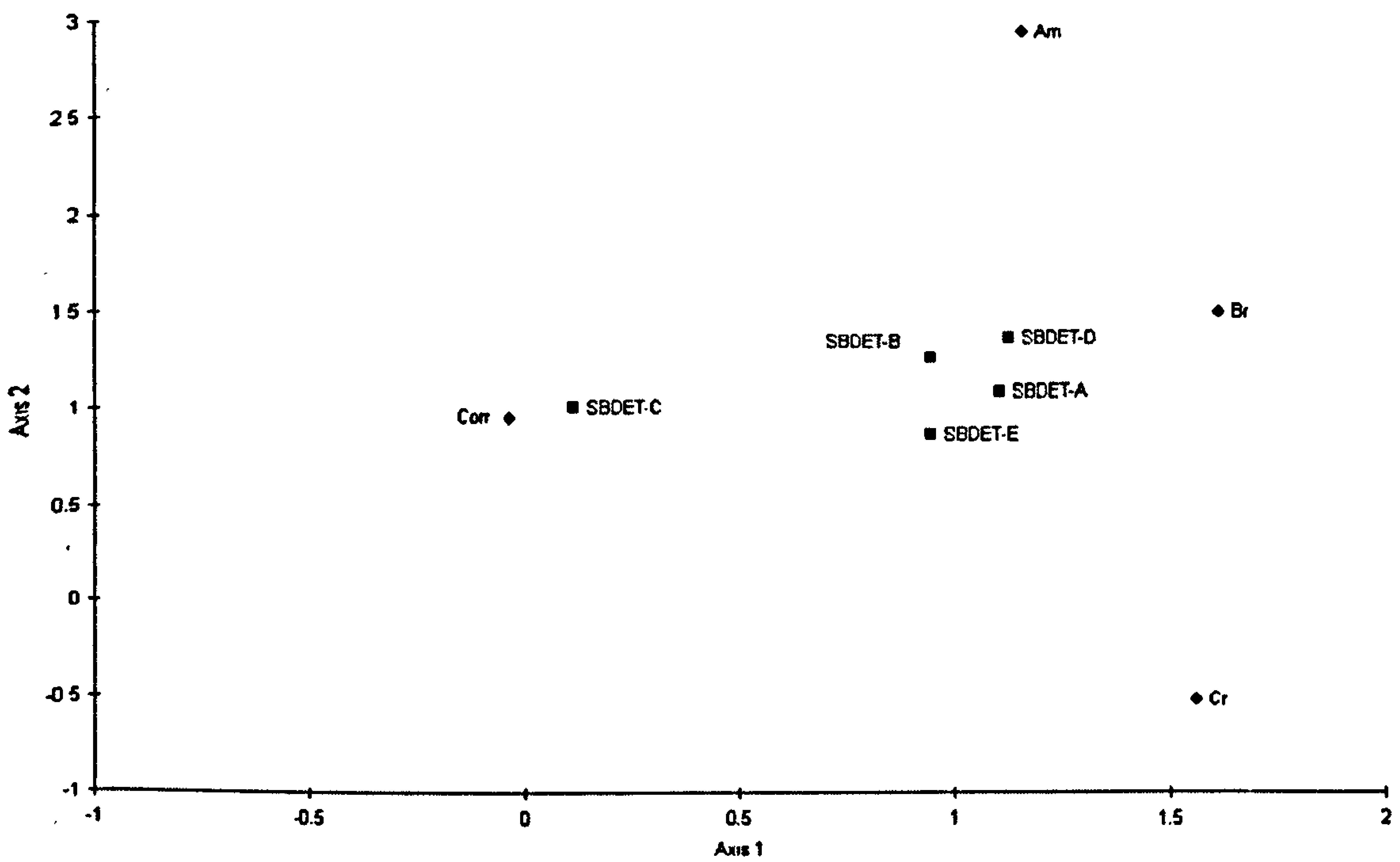


Figure 8.7: Sproatley Bog: pollen preservation 6: Alnus

Figure 8.8: Sproatley Bog: pollen preservation 7: Poaceae undiff.





Key to abbreviations used: Am, amorphous; Br, broken; Corr, corroded (undiff.); Cr, crumpled

Figure 8.9: Sproatley Bog: DCA plot of deterioration type scores and mean sample scores for the first two axes of the ordination

Figure 8.10: Sproatley Bog: percentage diagram of trees and shrubs for 496-168 cm

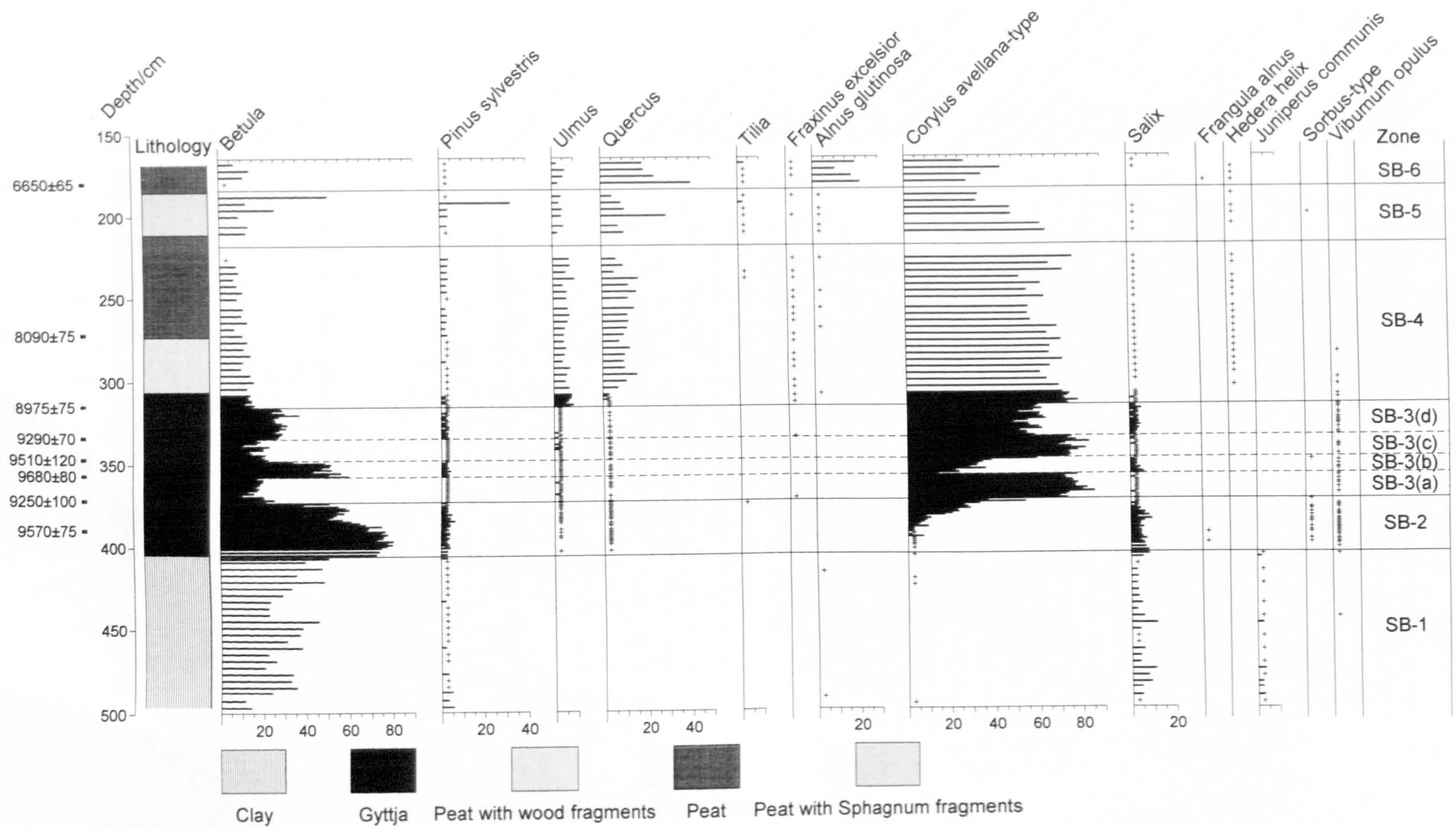


Figure 8.11: Sproatley Bog: percentage diagram of heaths and herbs(1)
for 496-168 cm

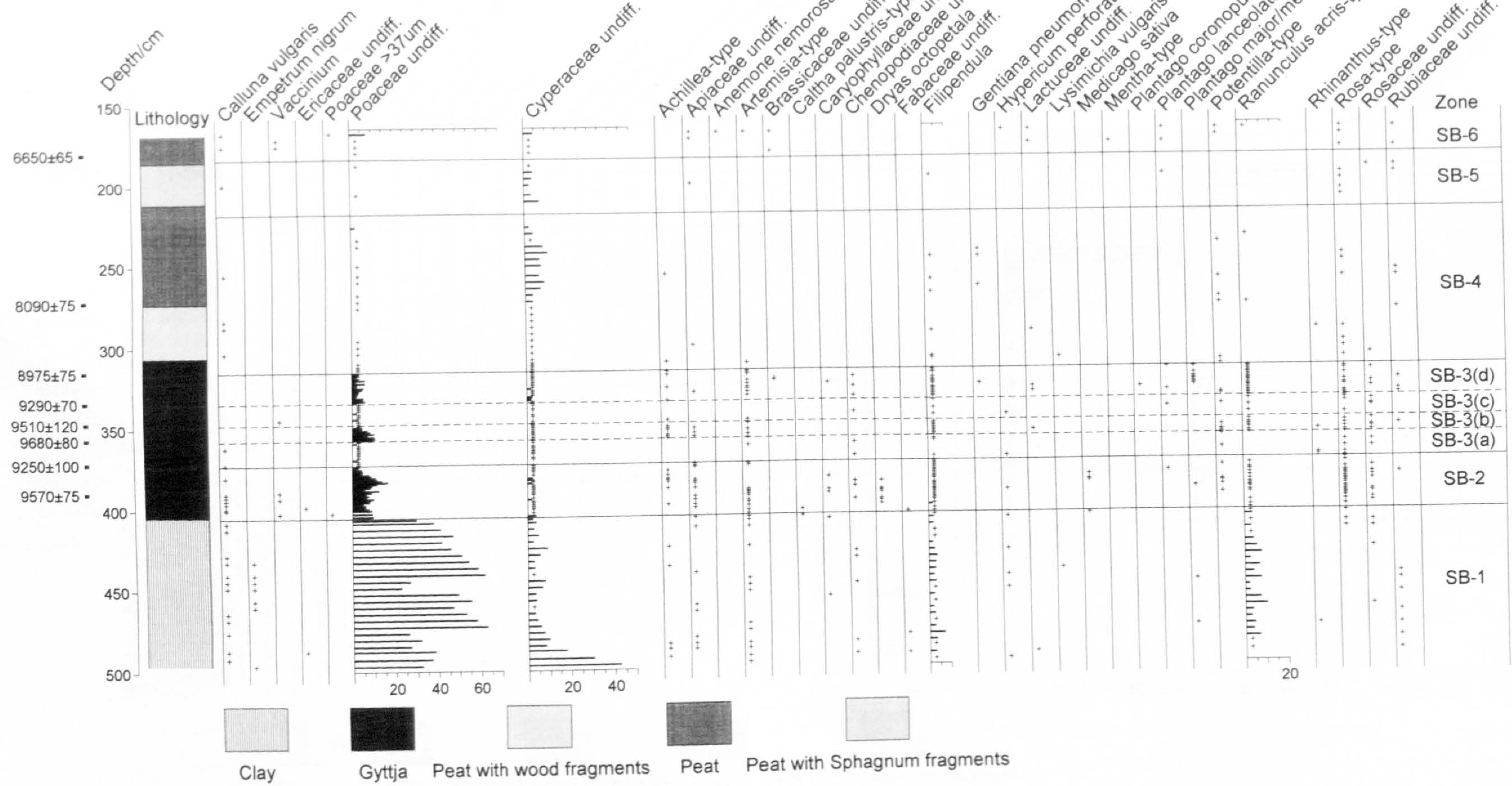


Figure 8.12: Sproatley Bog: percentage diagram of herbs(2), aquatics and spores for 496-168 cm

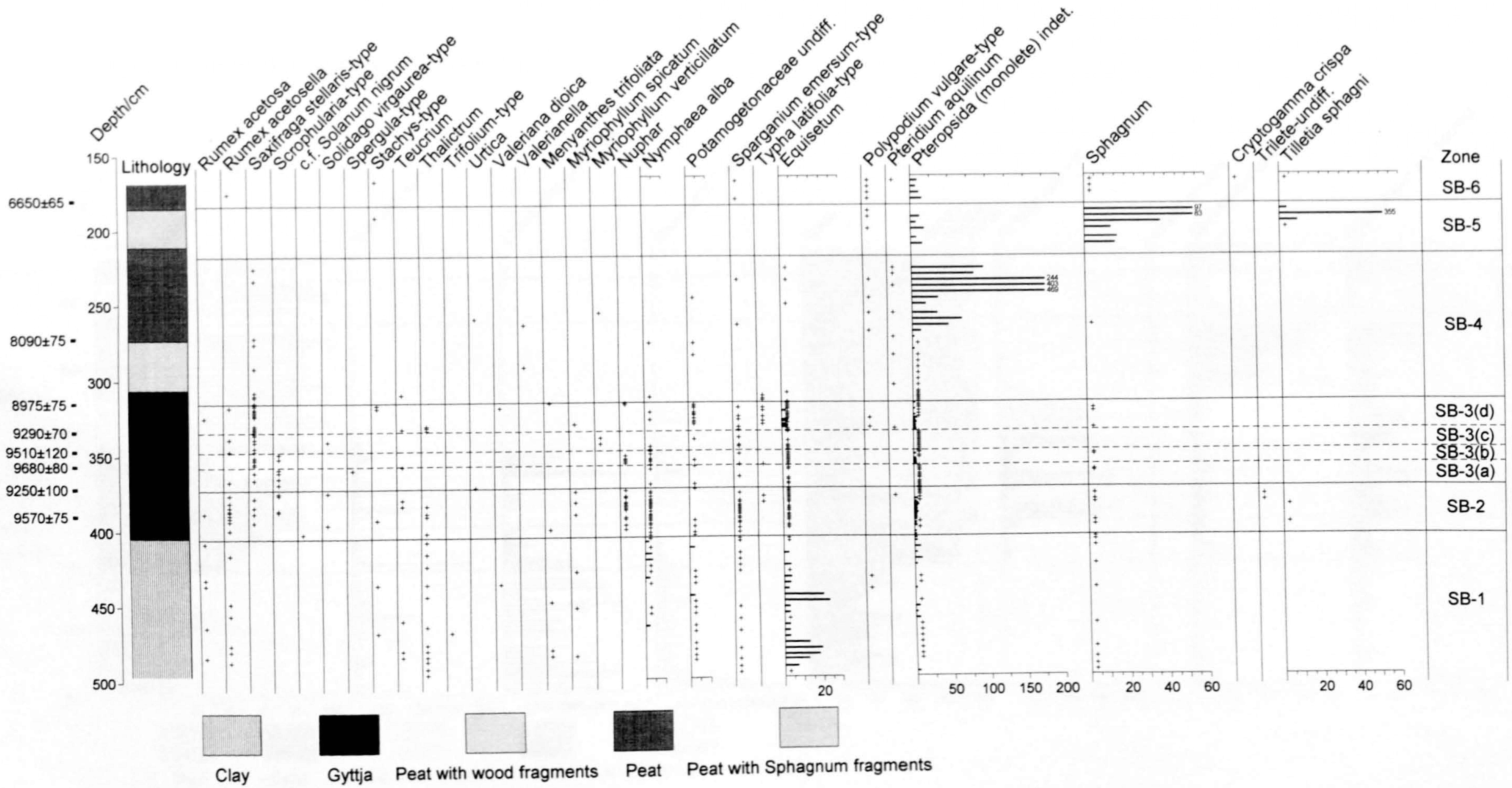


Figure 8.13: Sproatley Bog: miscellaneous data for 496-268 cm

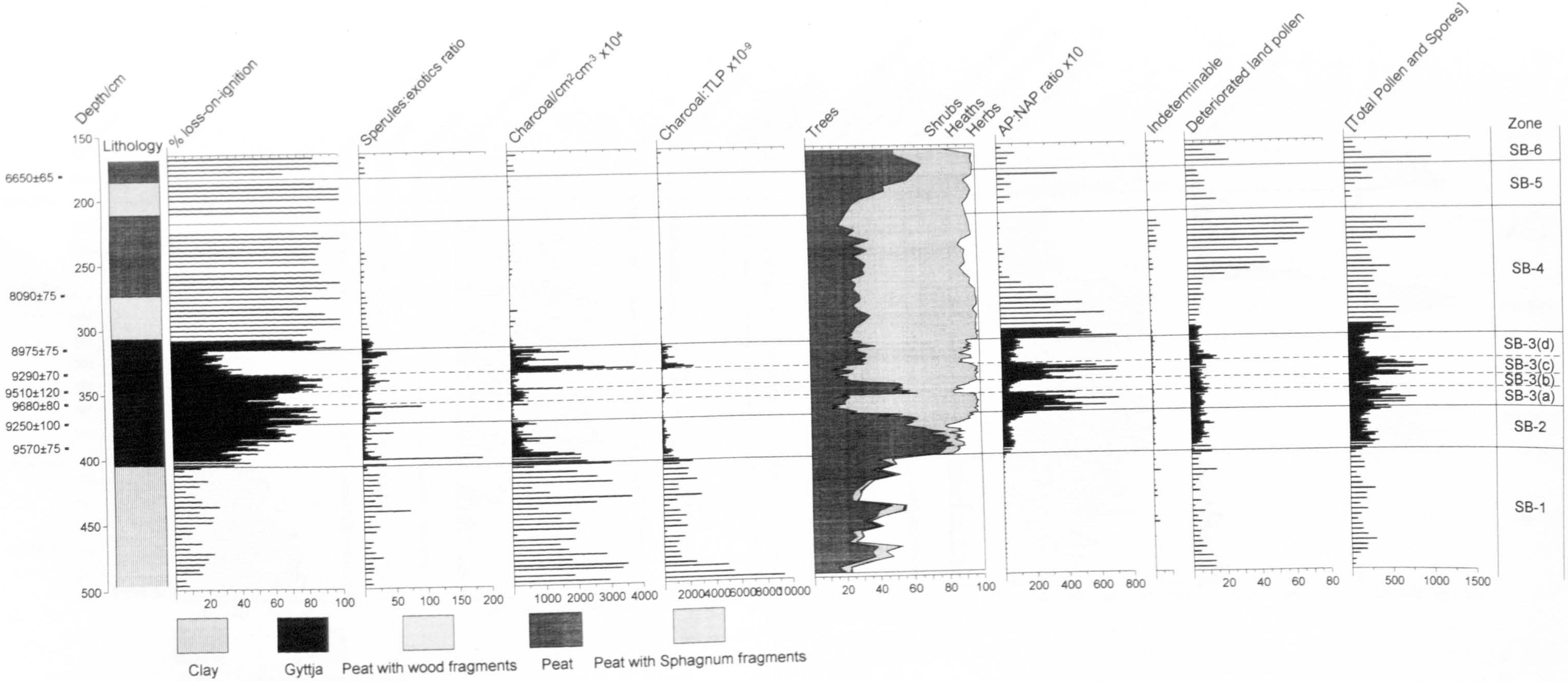


Figure 8.14: Sproatley Bog: summary percentage diagram for 400-308 cm

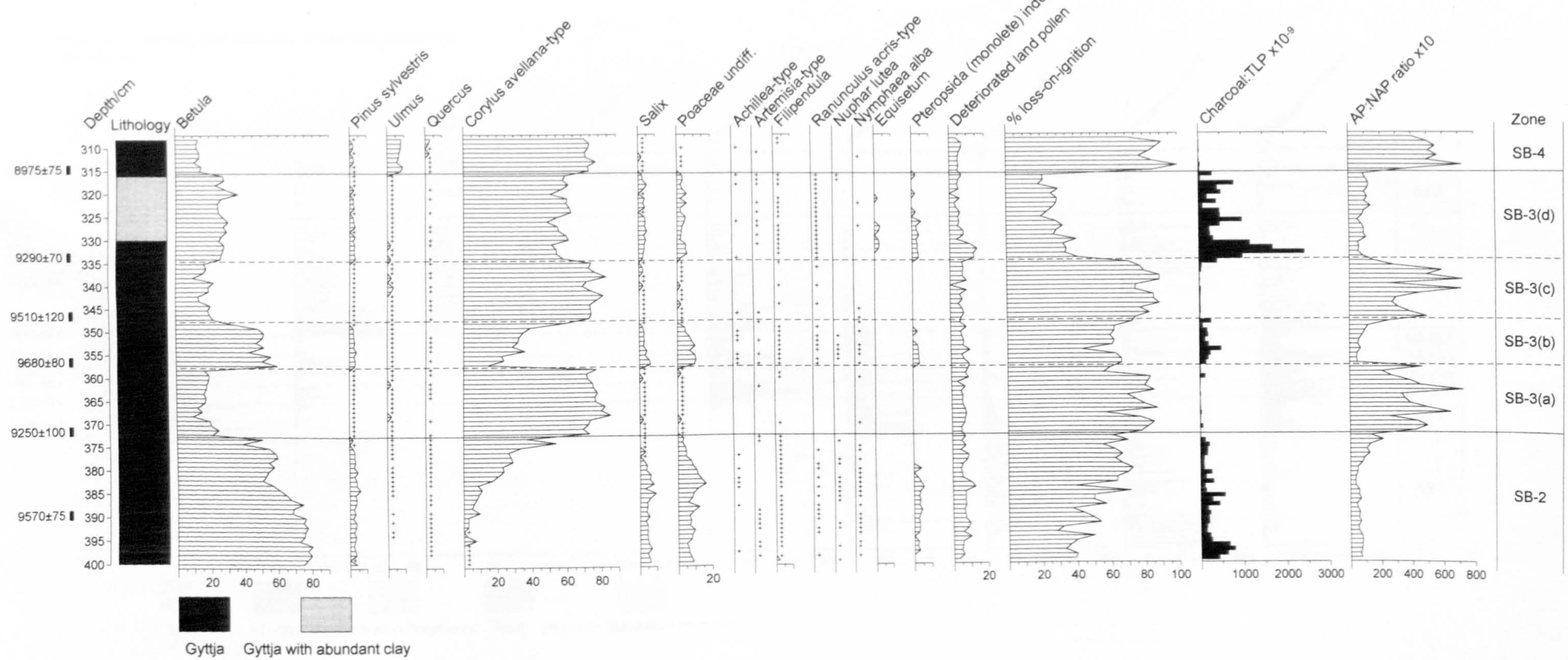


Figure 8.15: Sproatley Bog: summary concentration diagram for 496-168 cm

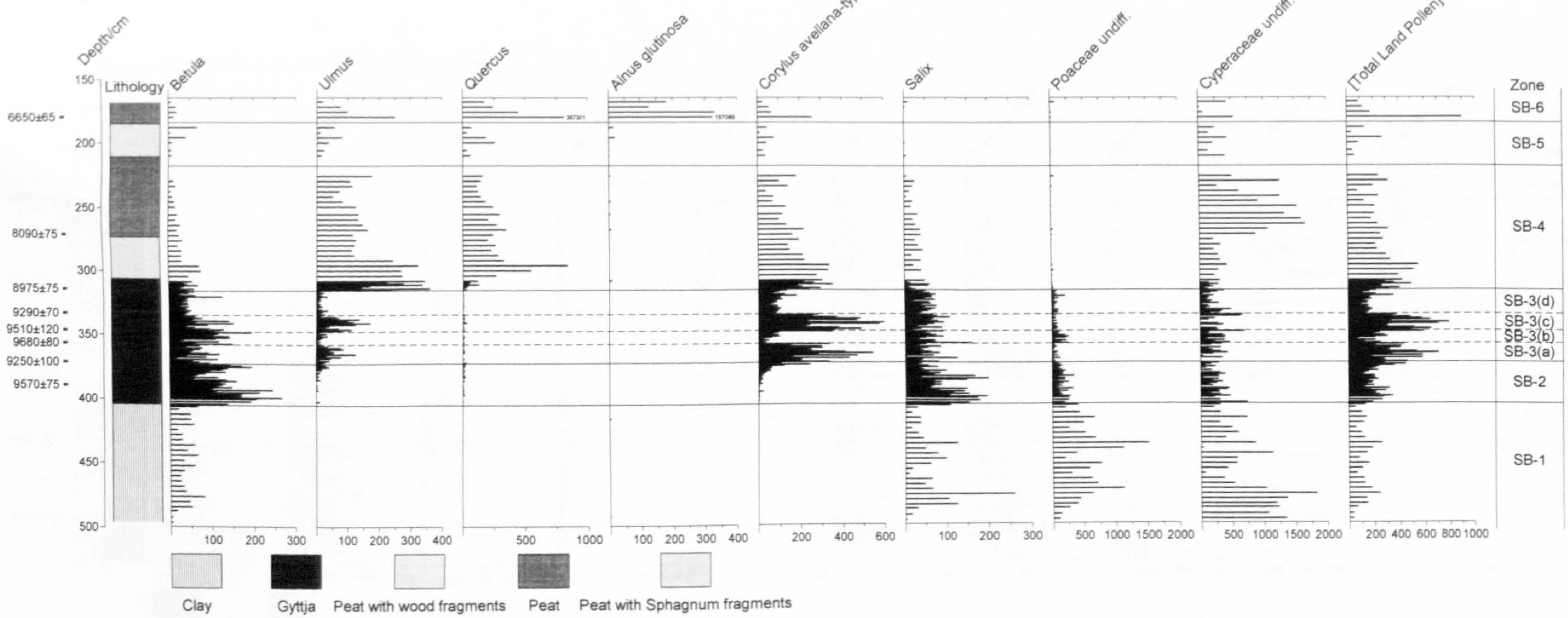


Figure 8.16: Sproatley Bog: summary concentration diagram for 400-308 cm

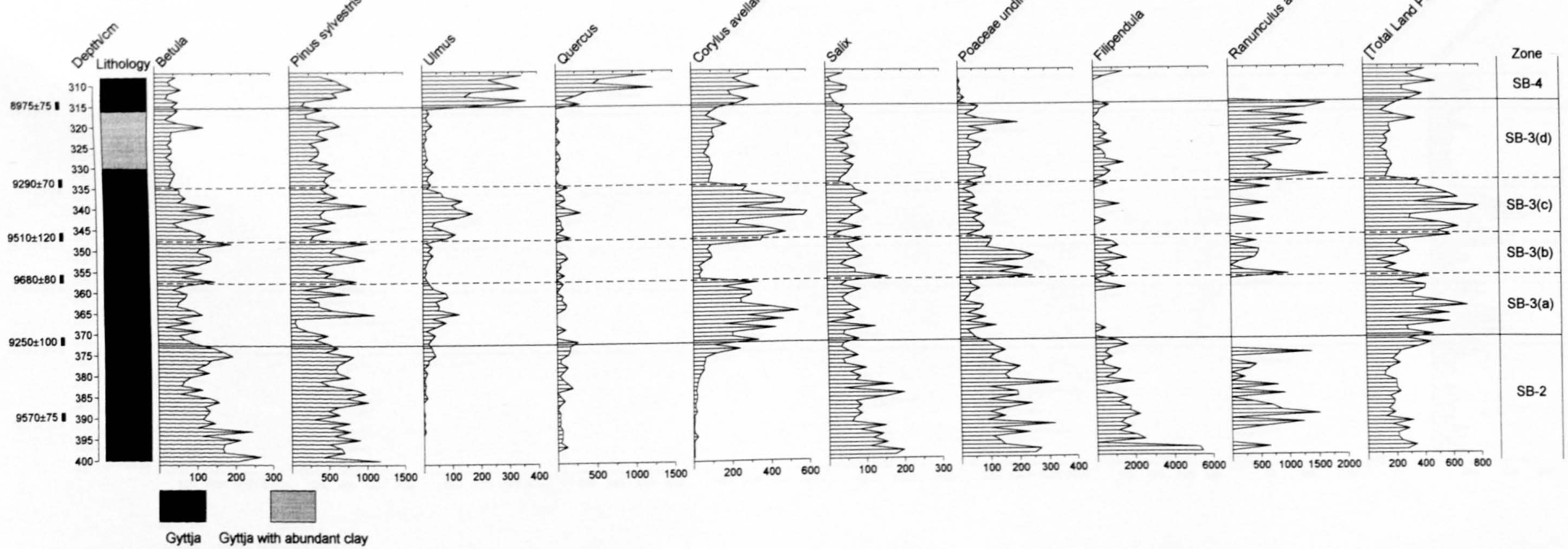


Figure 8.17: Sproatley Bog: summary accumulation rate diagram for 400-308 cm

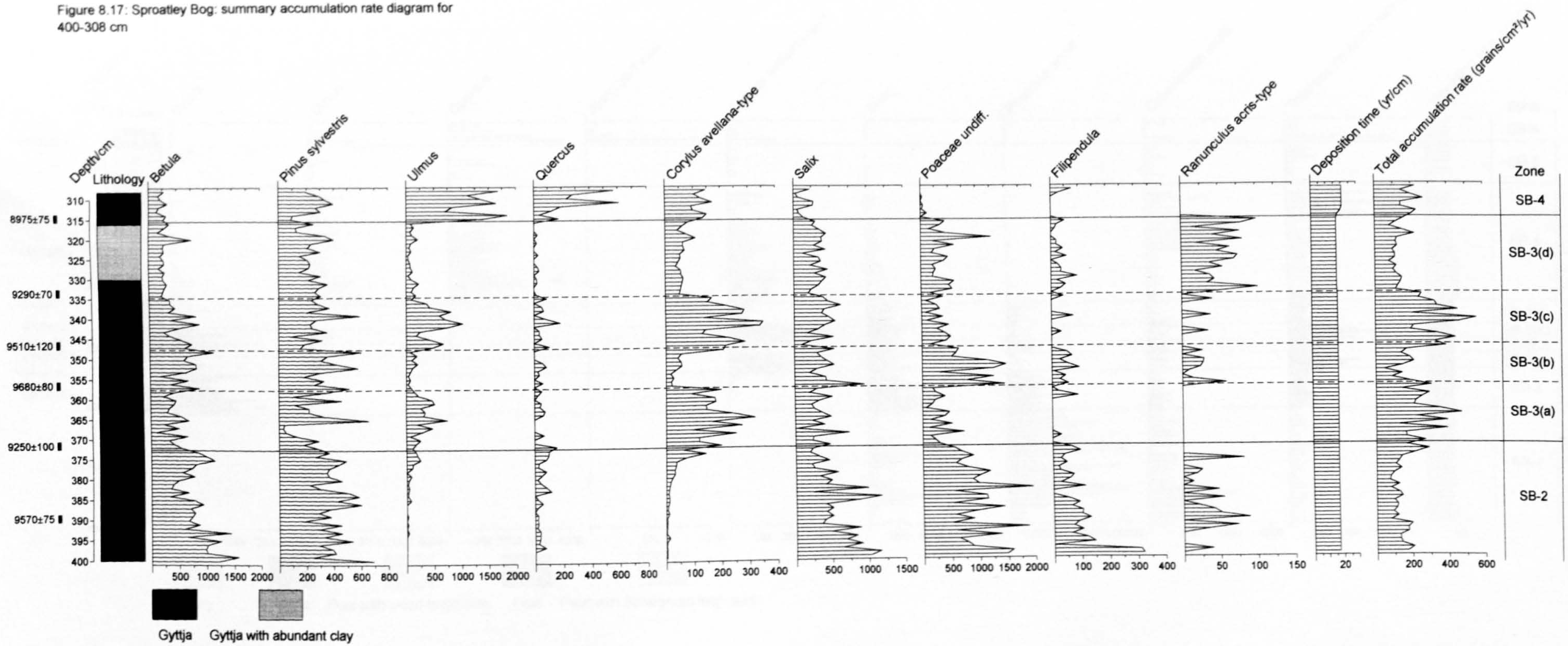


Figure 8.18: Sproatley Bog: summary accumulation rate diagram for 496-168 cm

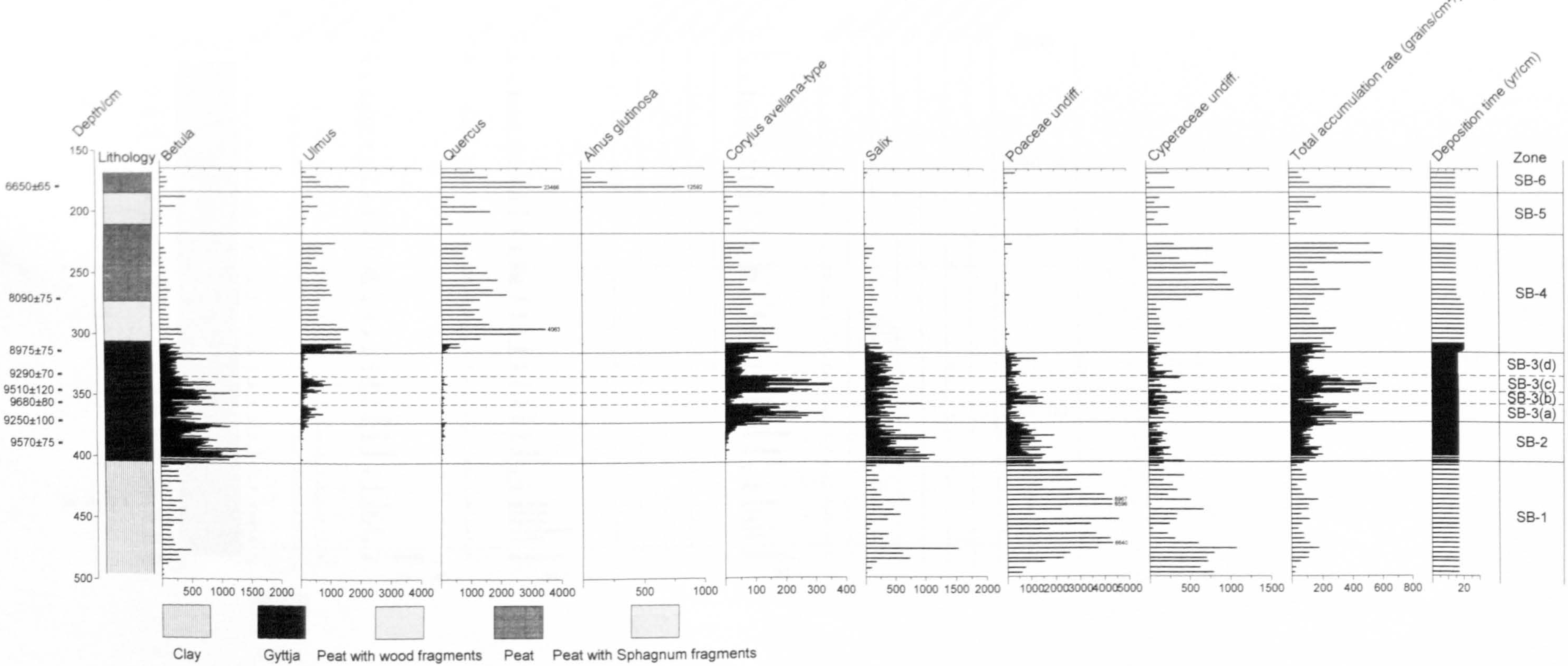


Figure 8.19: Sproatley Bog: percentage diagram of trees and shrubs for 164-48 cm

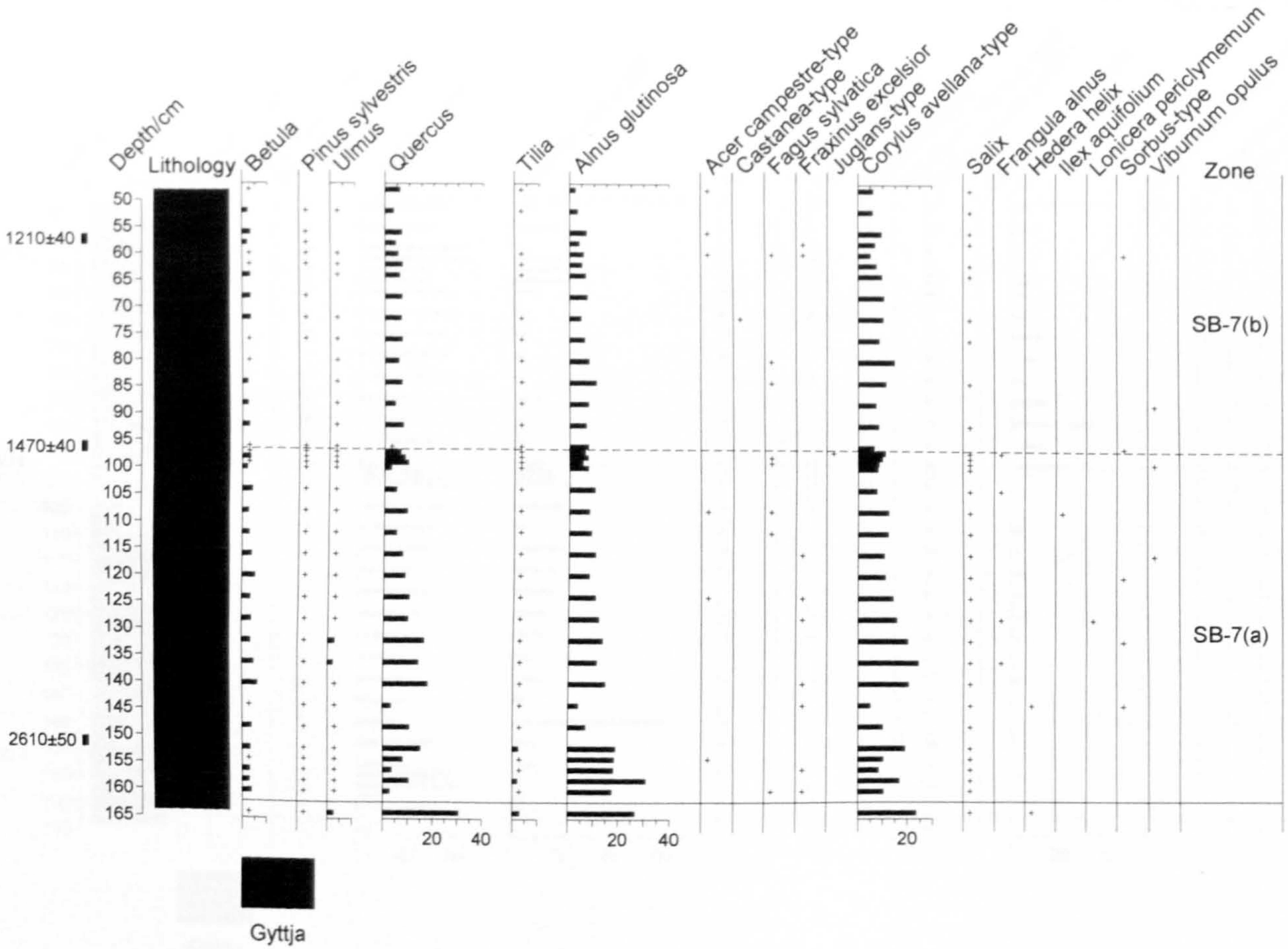


Figure 8.20: Sproatley Bog: percentage diagram of heaths and herbs (1) for 164-48 cm

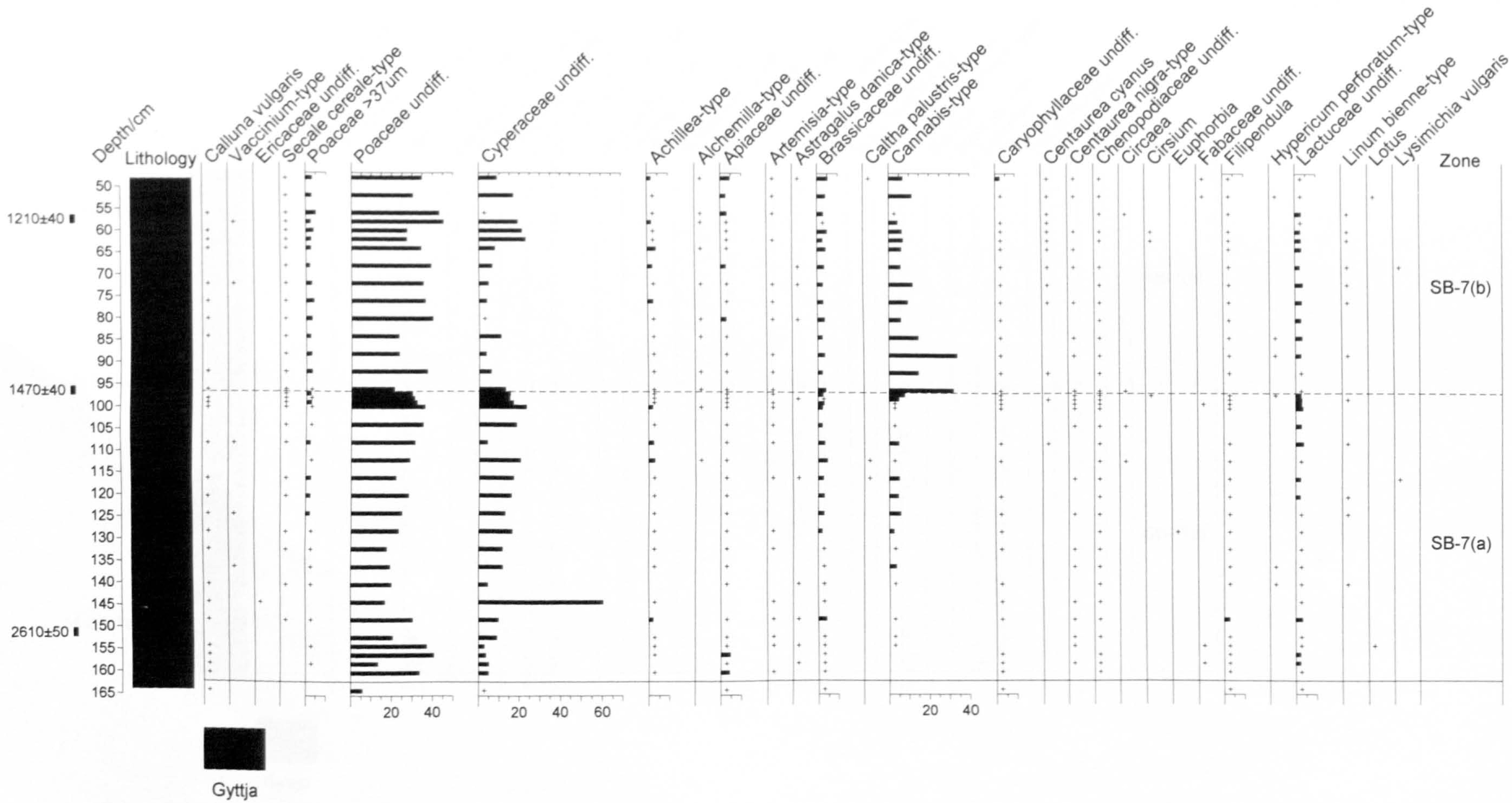


Figure 8.21: Sproatley Bog: percentage diagram of herbs (2) for 164-48 cm

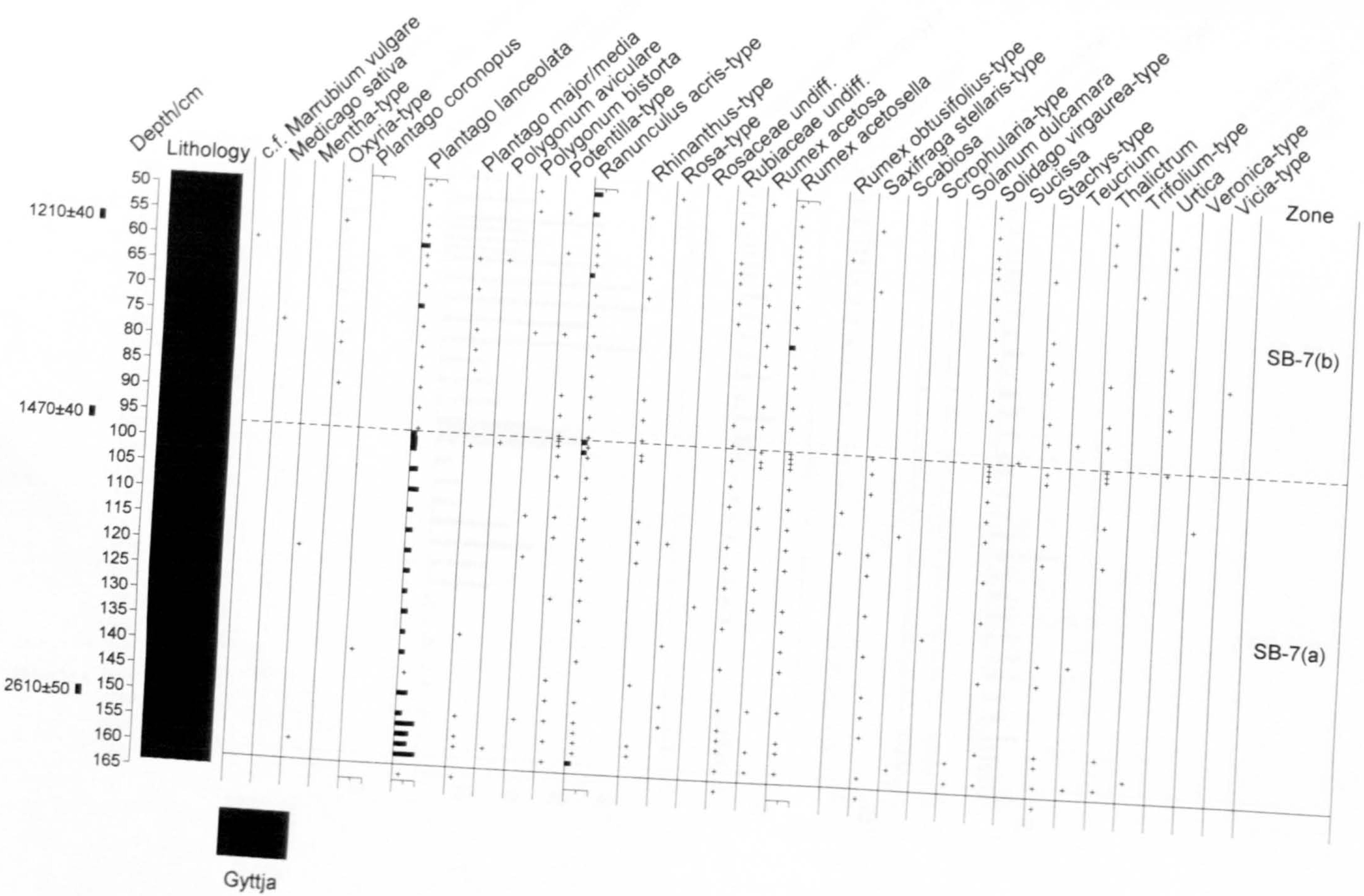


Figure 8.22: Sproatley Bog: percentage diagram of aquatics and spores for 164-48 cm

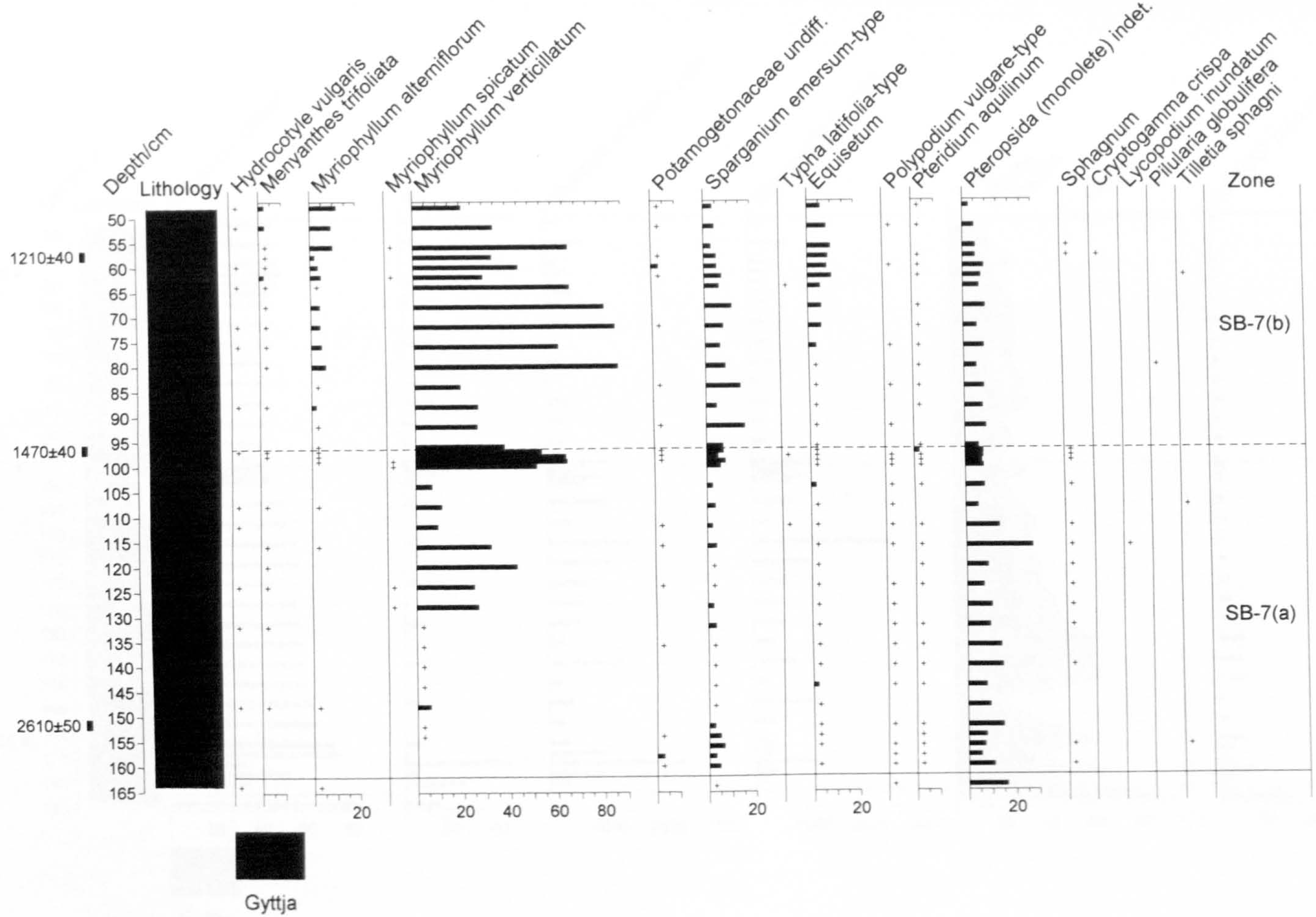


Figure 8.23: Sproatley Bog: miscellaneous data for 164-48 cm

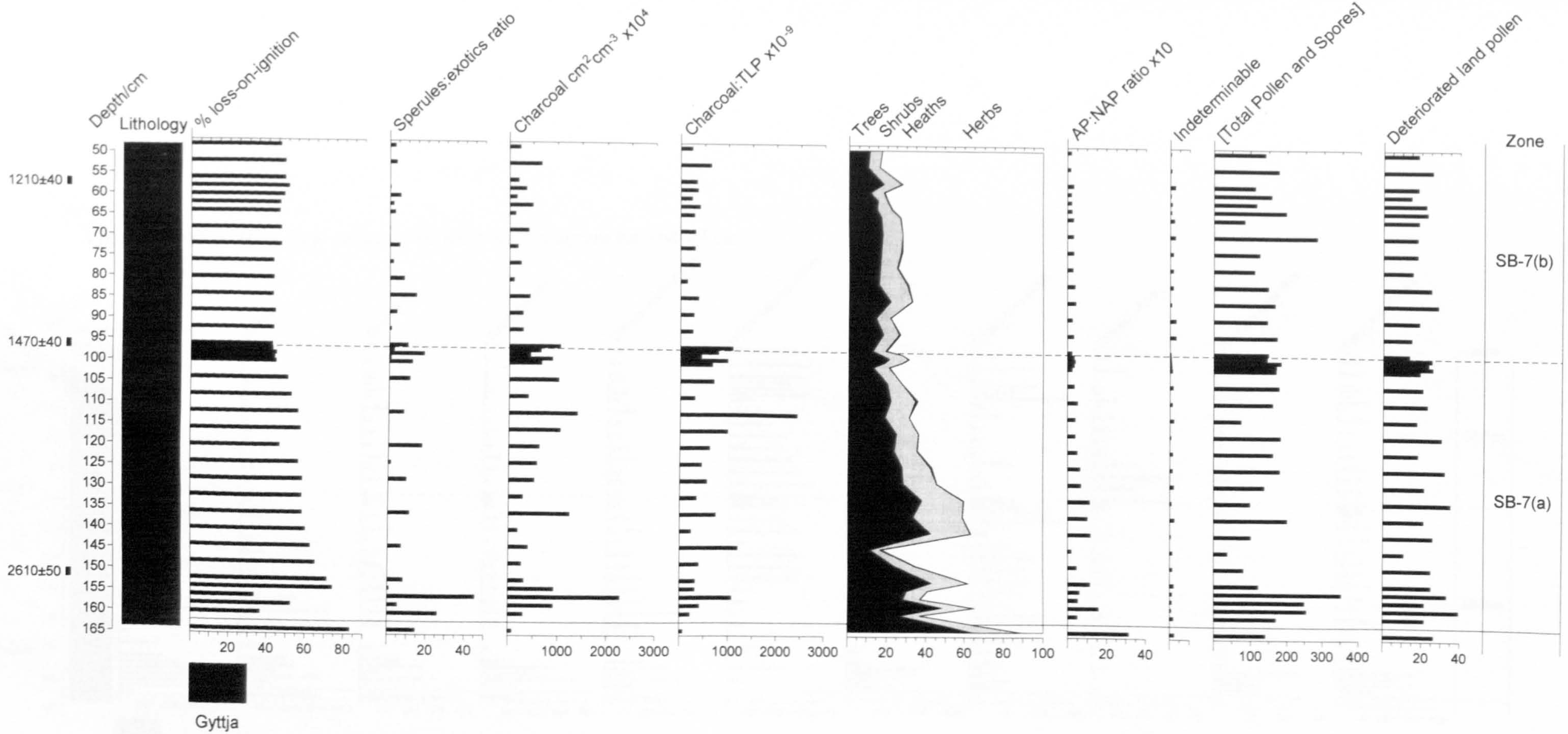


Figure 8.24: Sproatley Bog: summary concentration diagram for 164-48 cm

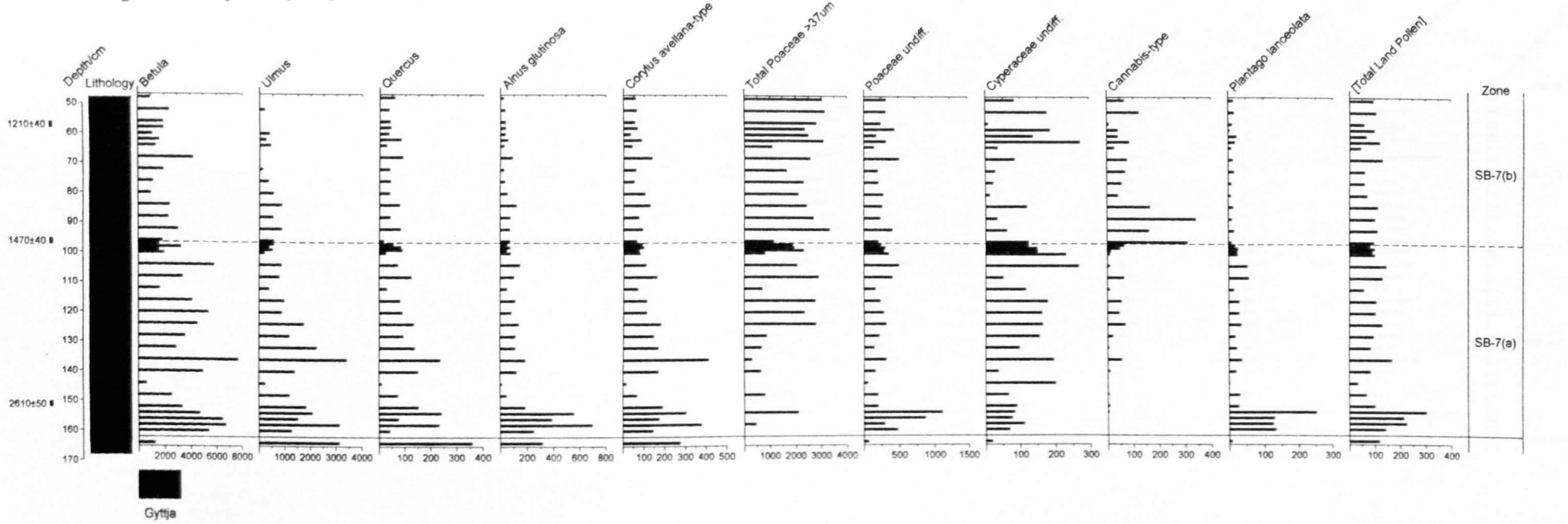


Figure 8.25: Sproatley Bog: summary accumulation rate diagram for 164-48 cm

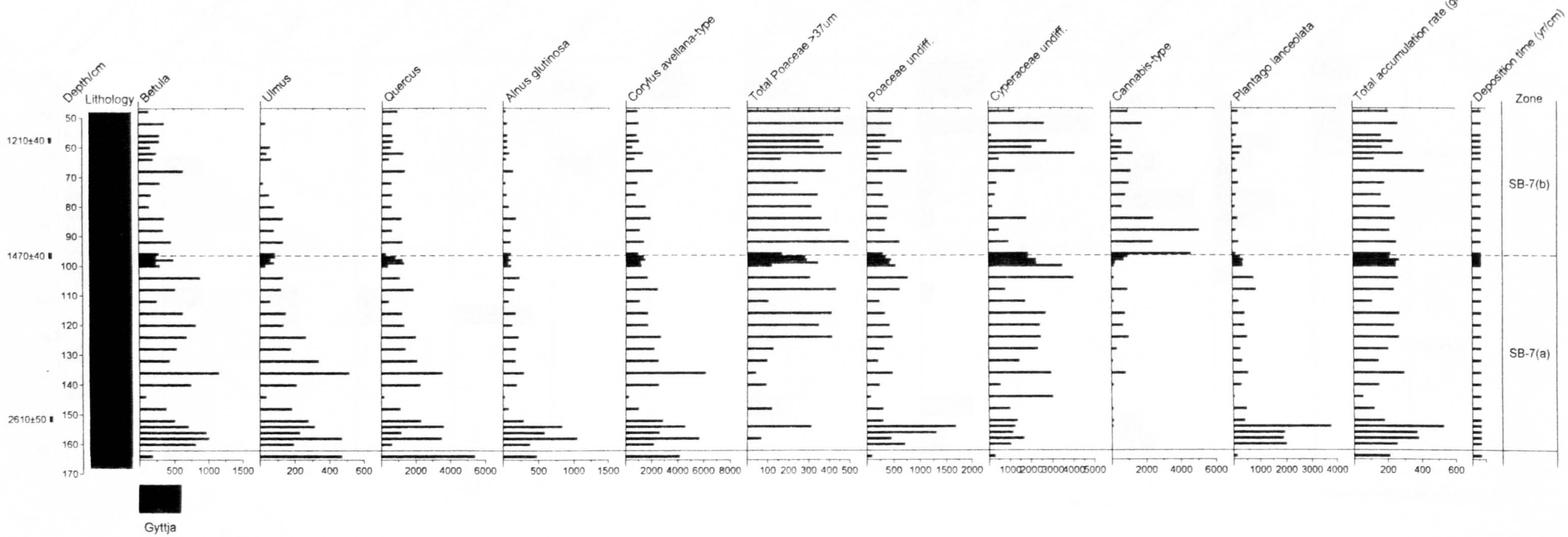


Figure 8.26: Sproatley Bog: diagram showing plant macrofossils located between 151 cm and 47 cm

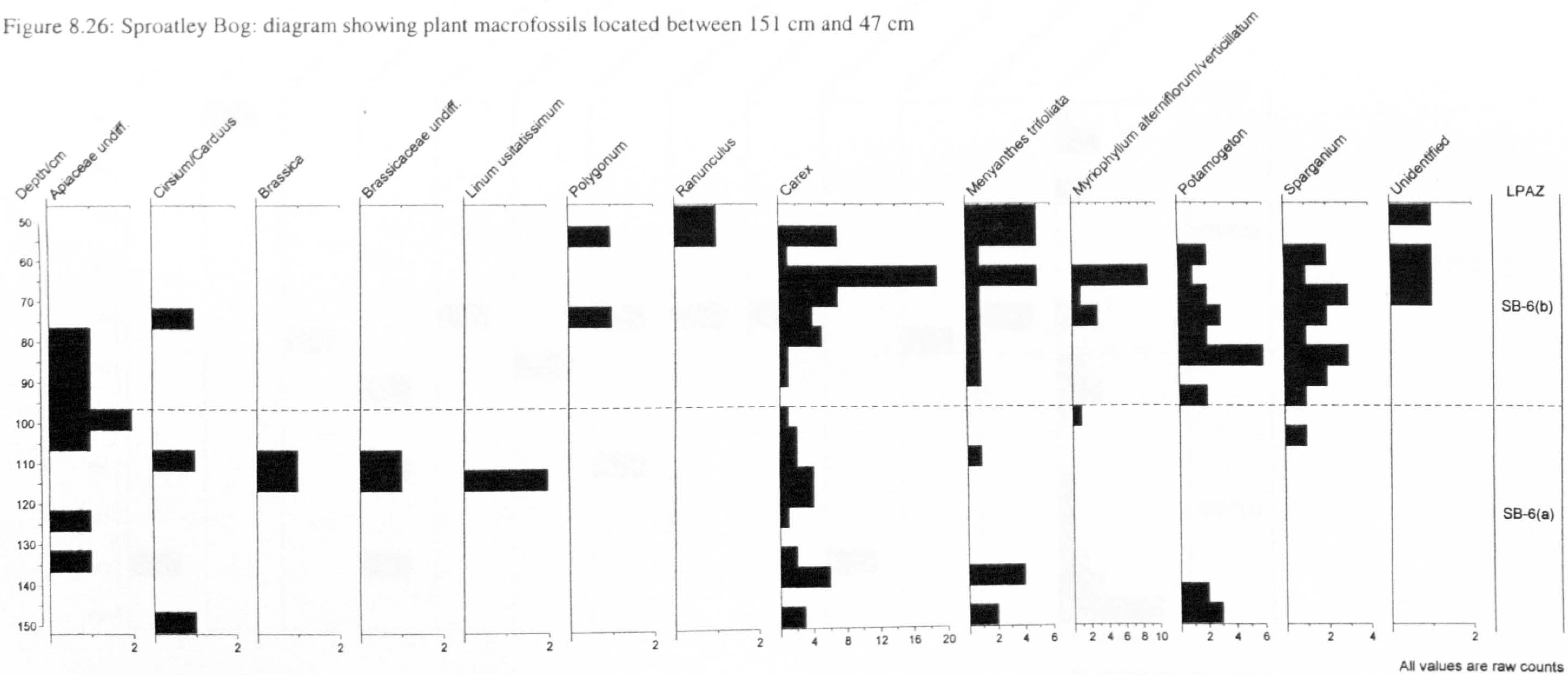
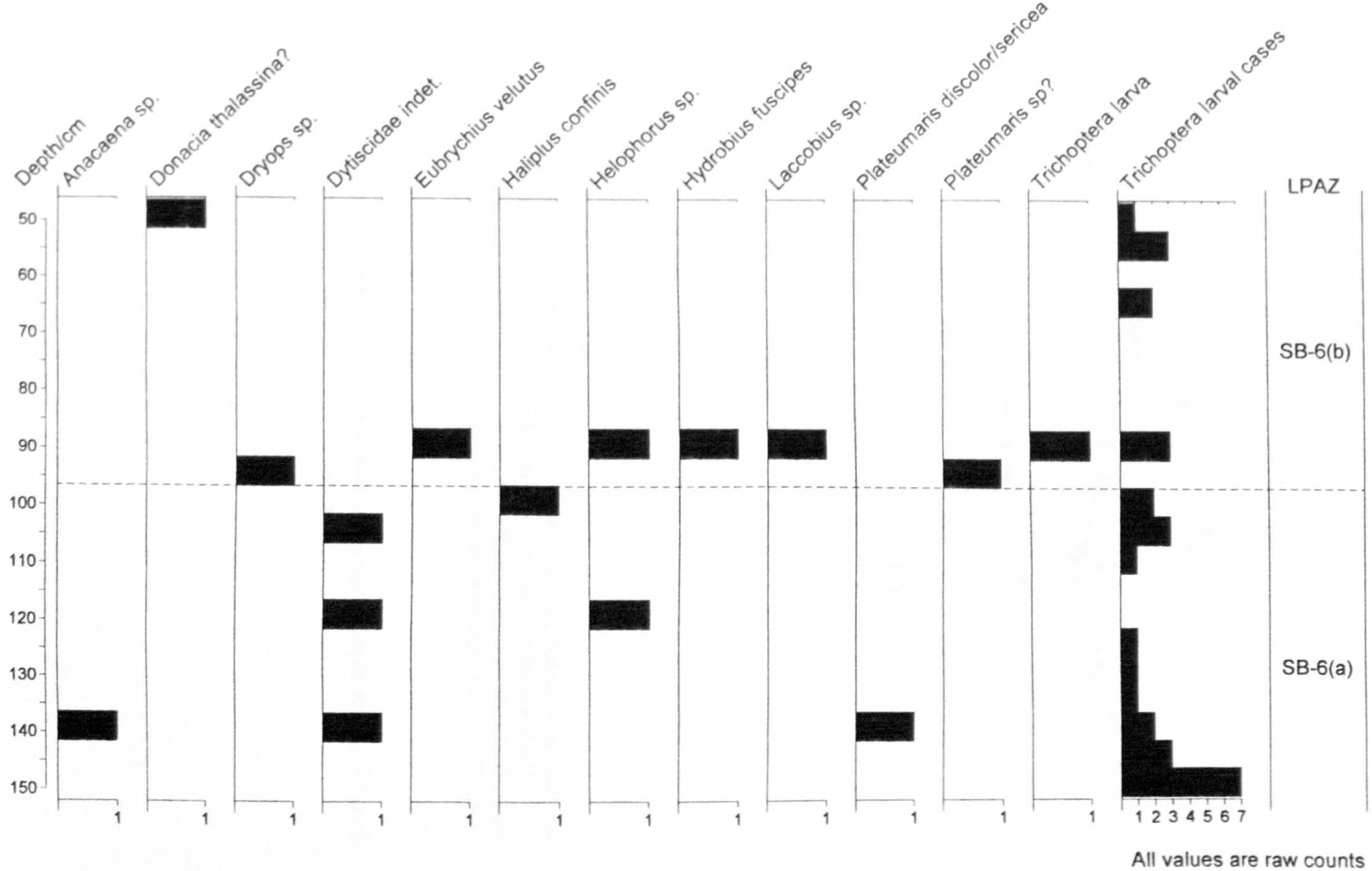
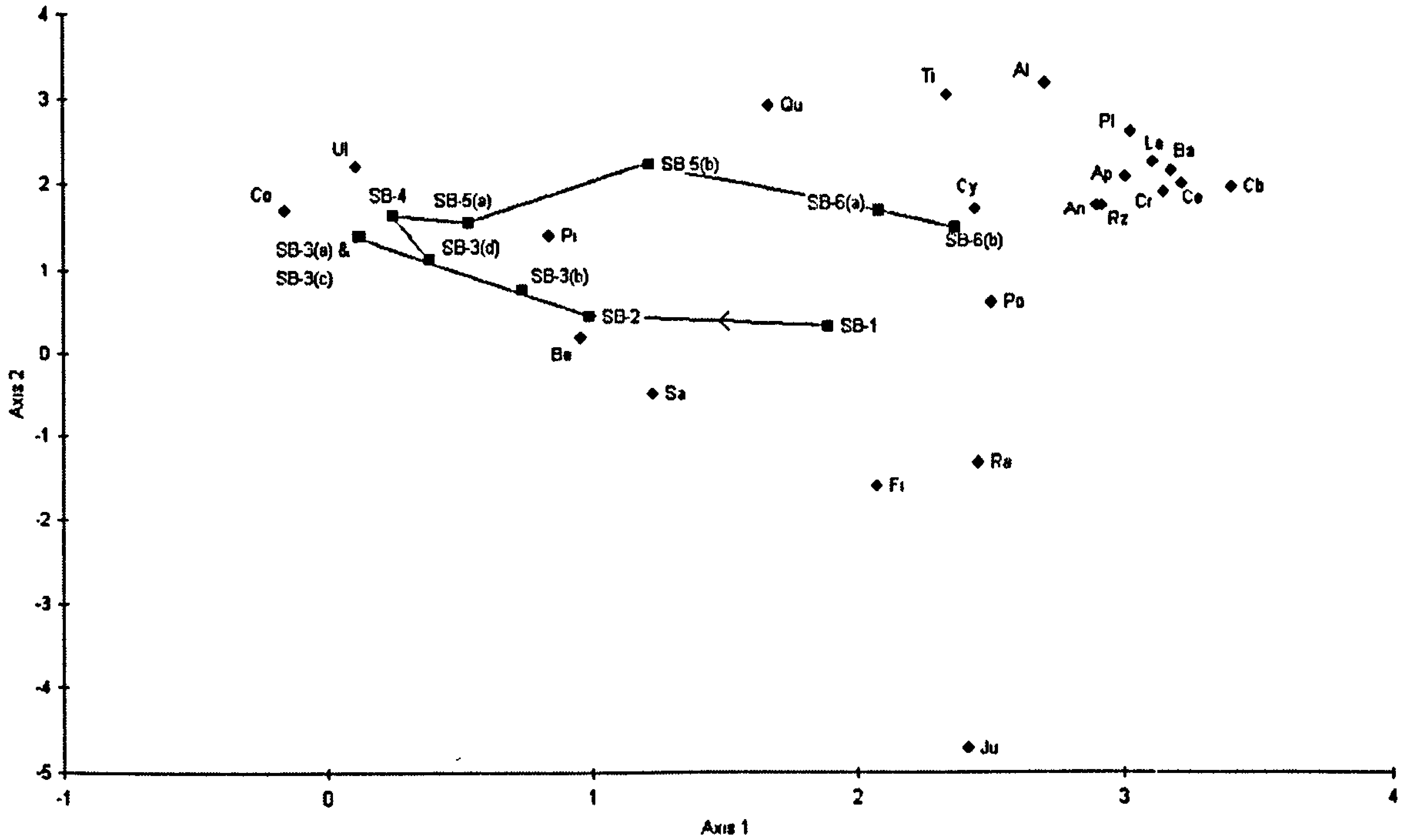


Figure 8.27: Sproatley Bog: diagram showing Coleoptera and Trichoptera remains located between 151 cm and 47 cm





Key to abbreviations used: Al, Alnus glutinosa; An, Achillea-type; Ap, Apiaceae undiff.; Ba, Brassicaceae undiff; Be, Betula; Cb, Cannabis-type; Ce, Poaceae pollen of >37 um; Co, Corylus avellana; Cr, Caryophyllaceae undiff; Cy, Cyperaceae undiff.; Fi, Filipendula; Ju, Juniperus communis; La, Lactuceae undiff.; Pi, Pinus sylvestris; Pl, Plantago lanceolata; Po, Poaceae undiff.; Qu, Quercus; Ra, Ranunculus acris-type; Rz, Rumex acetosella; Sa, Salix; Ti, Tilia; Ul, Ulmus

Figure 8.28: Sproatley Bog: DCA plot of principle taxon scores and mean sample scores for each zone and subzone for the first two axes of the ordination

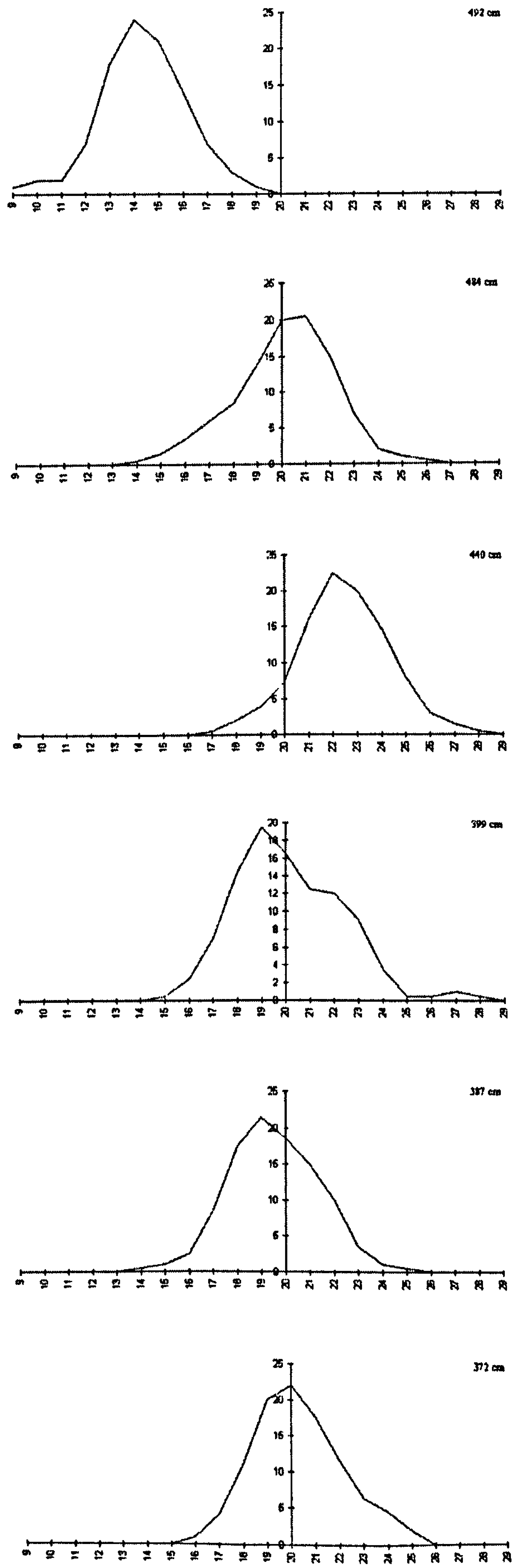


Figure 8.29: Sproatley Bog: smoothed Betula size-frequency graphs. Grain diameter (μm) is shown on the x-axis and smoothed percentage on the y-axis.

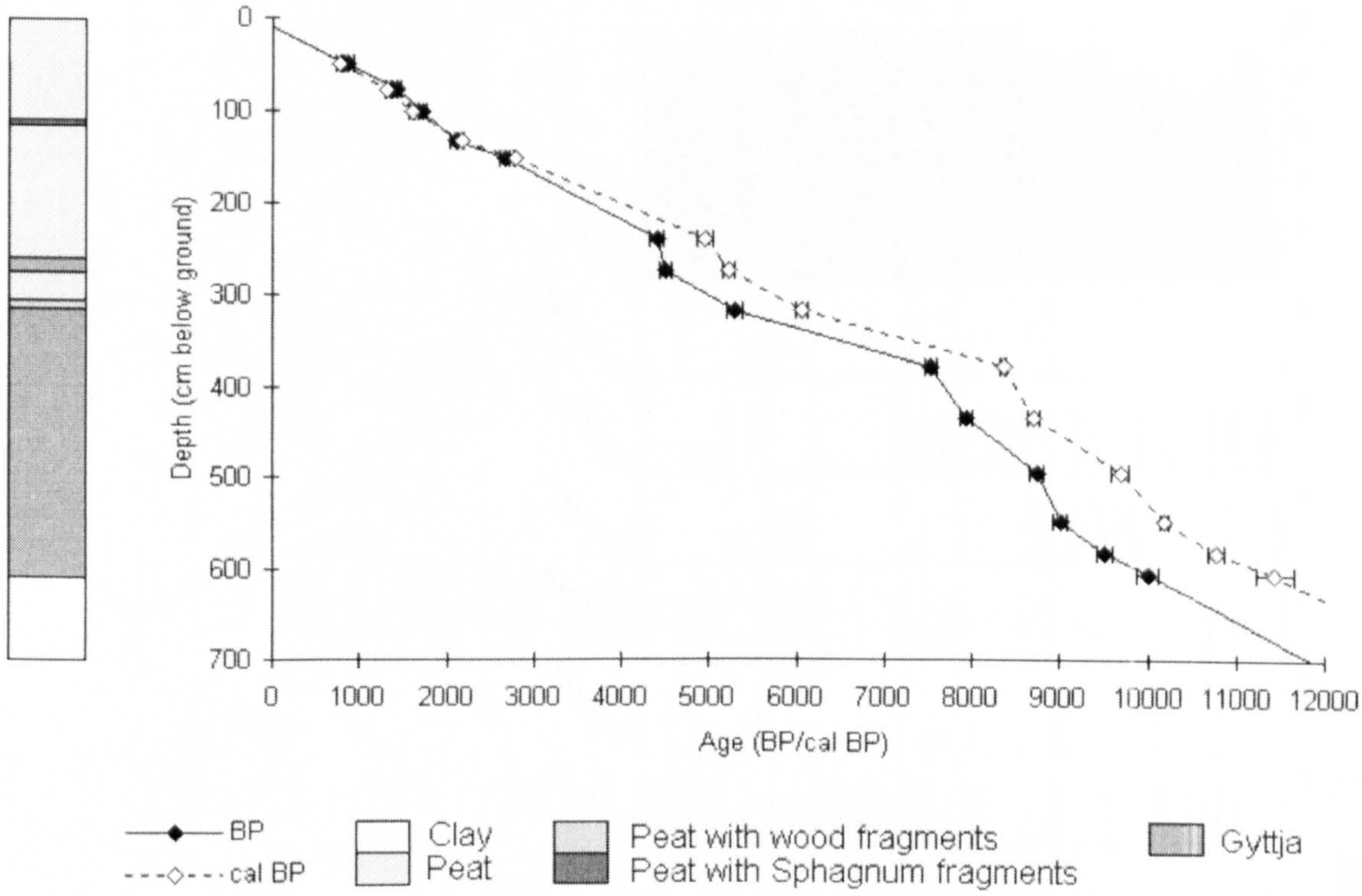


Figure 9.1: The Bog at Roos: age-depth curve of calibrated and uncalibrated BP dates

Figure 9.2: The Bog at Roos: pollen preservation 1: totals by type, indeterminable and miscellaneous data

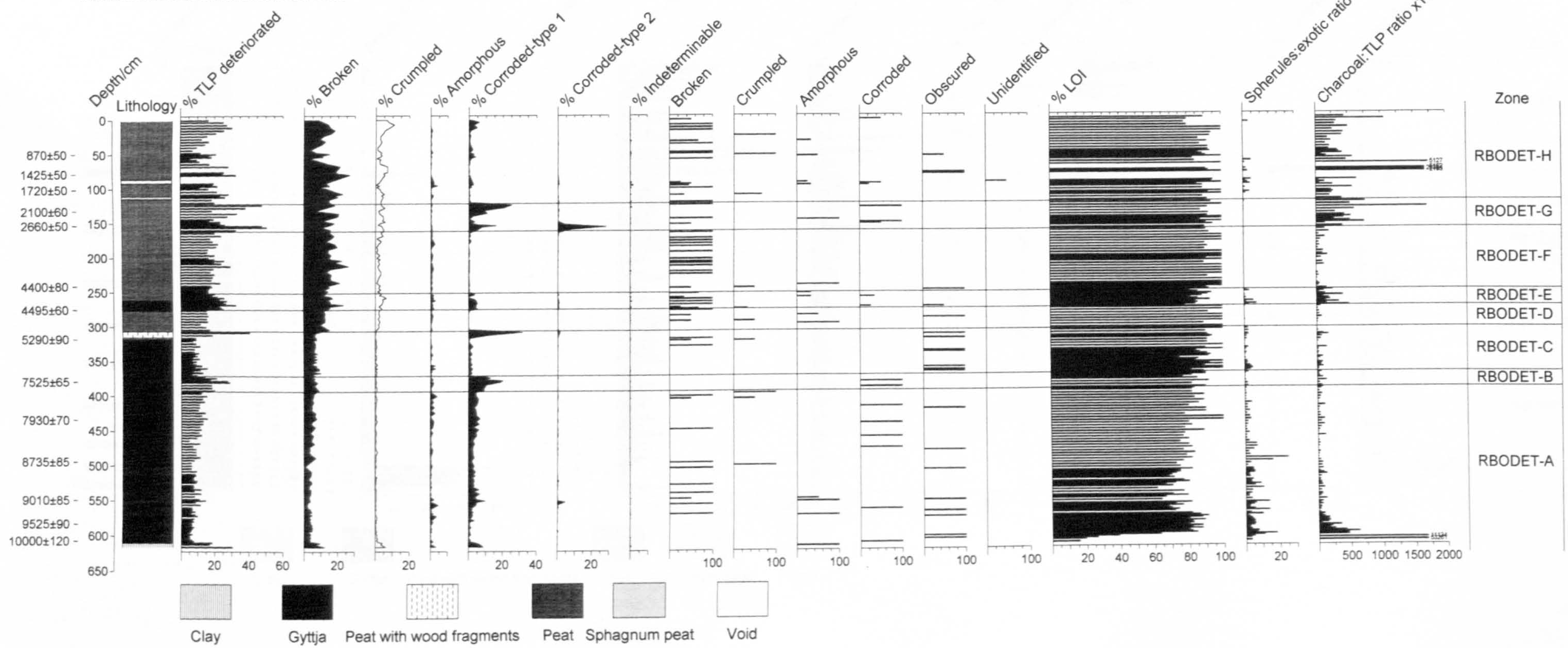


Figure 9.3: The Bog at Roos: deteriorated pollen 2: Betula

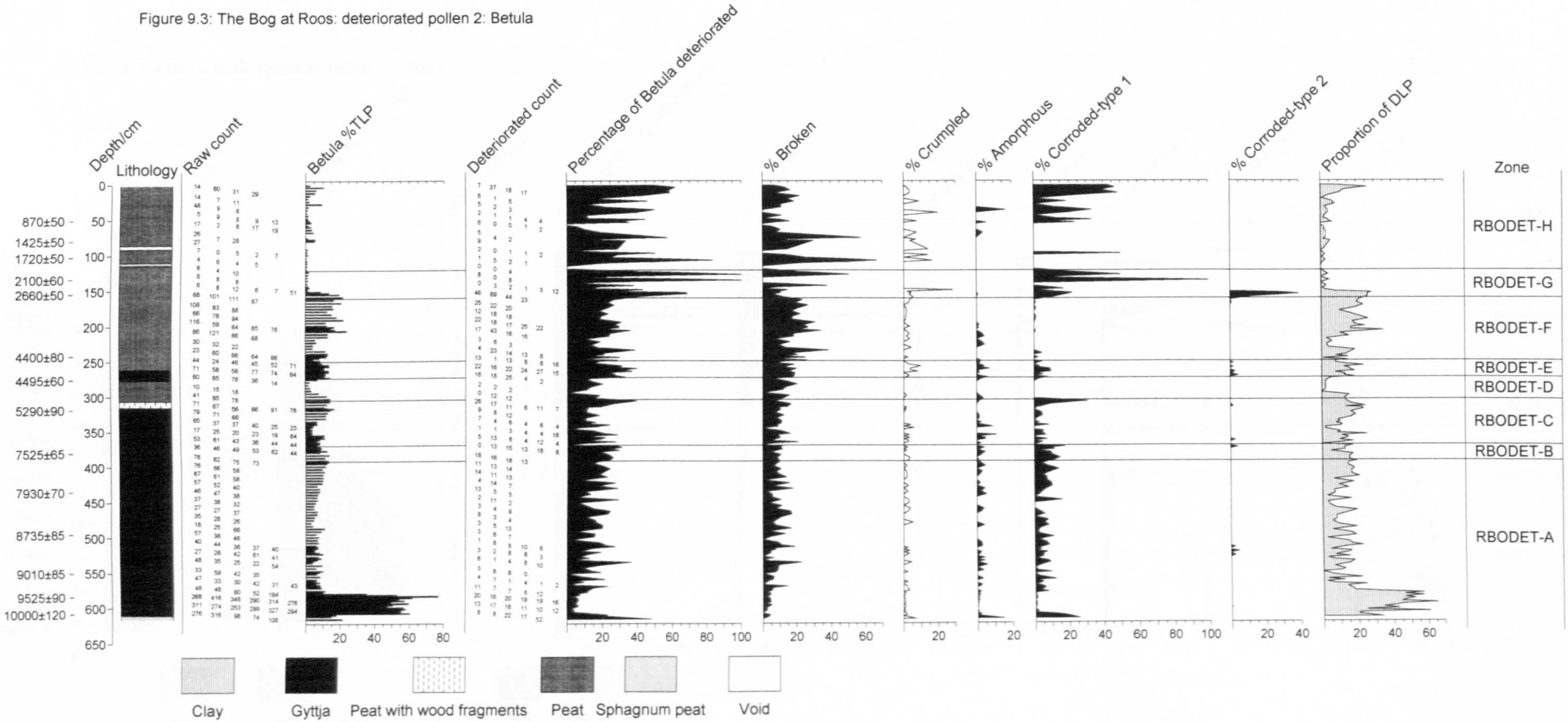


Figure 9.4: The Bog at Roos: deteriorated pollen 3: Corylus

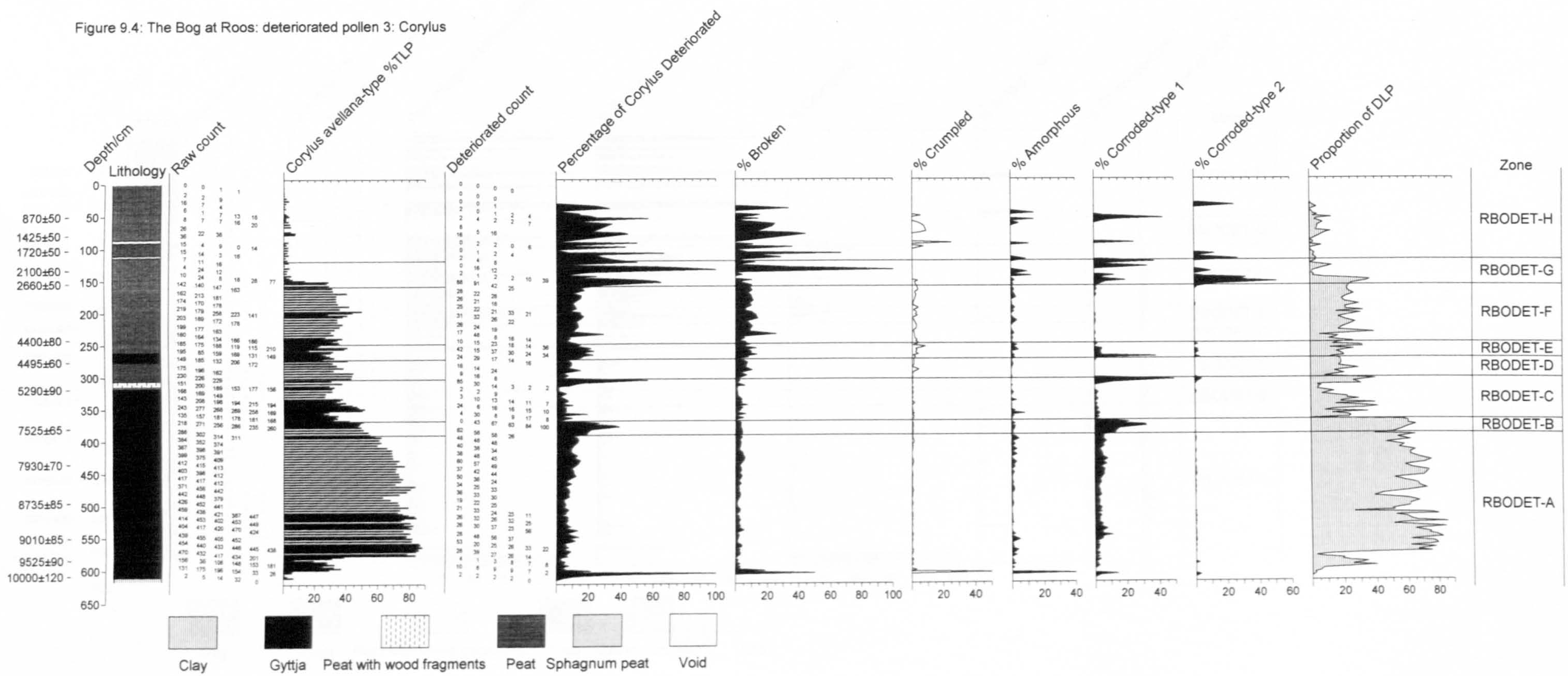


Figure 9.5: The Bog at Roos: deteriorated pollen 4: Ulmus

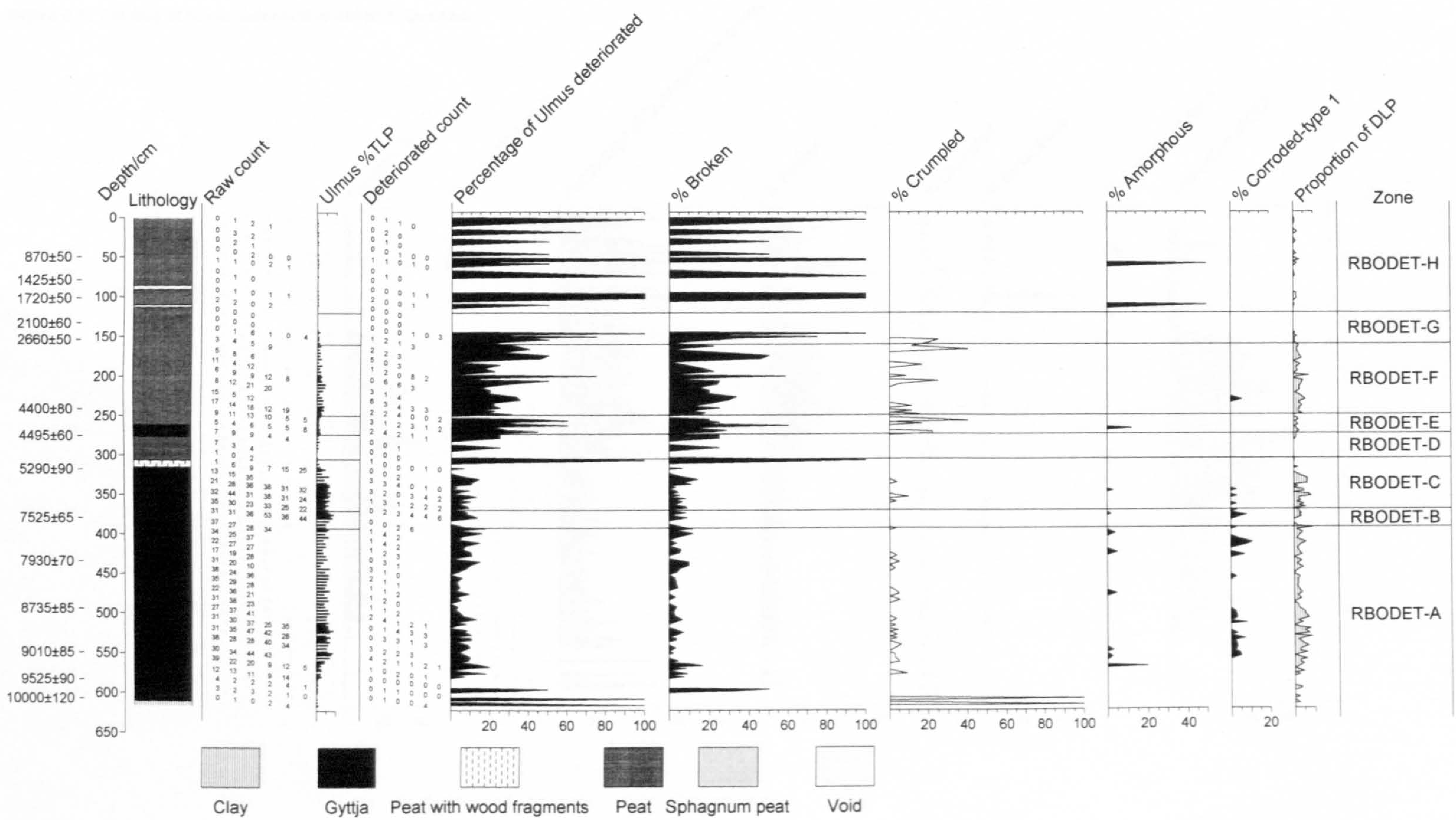


Figure 9.6: The Bog at Roos: deteriorated pollen 5: Quercus

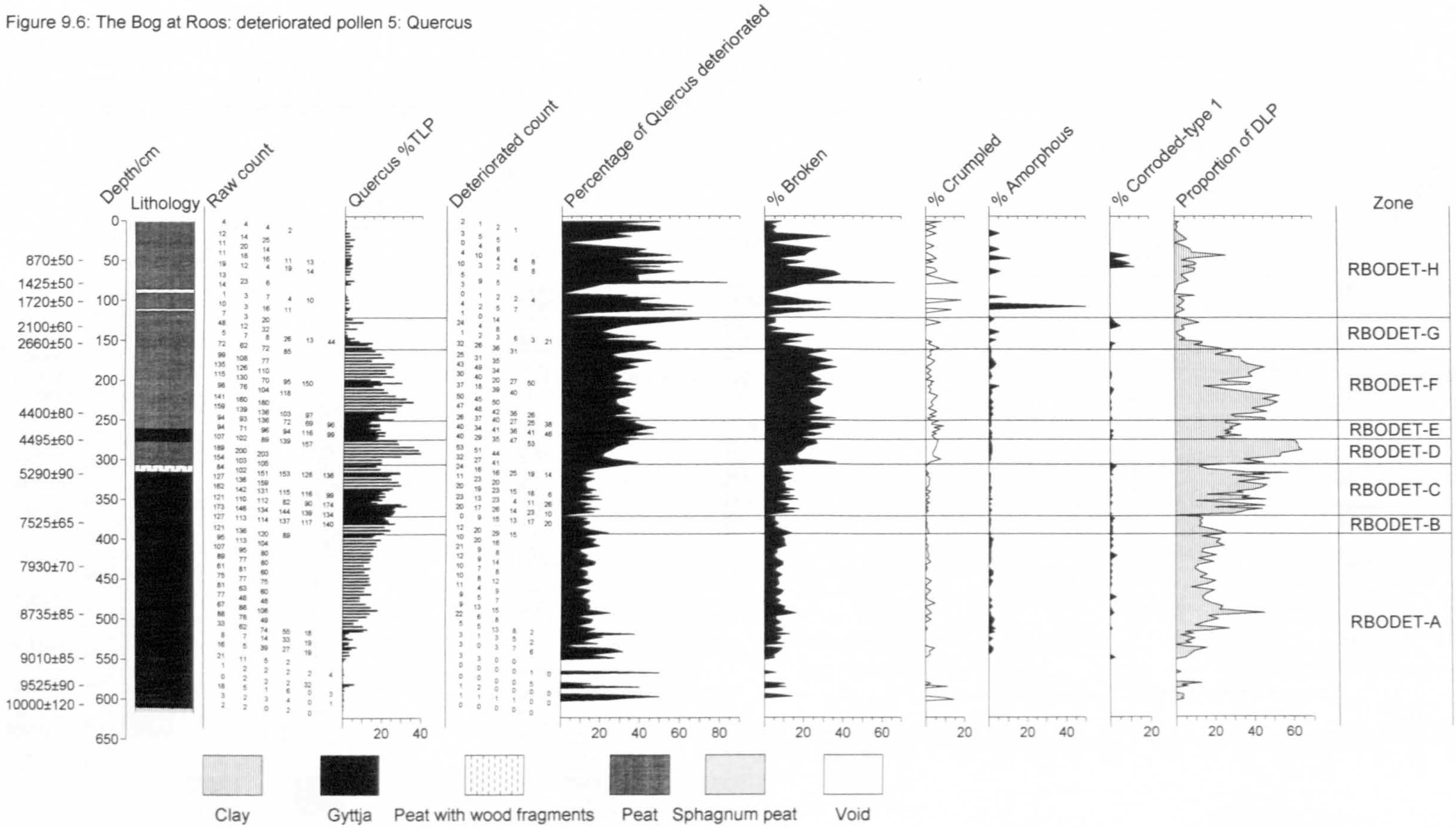


Figure 9.7: The Bog at Roos: deteriorated pollen 6: Alnus

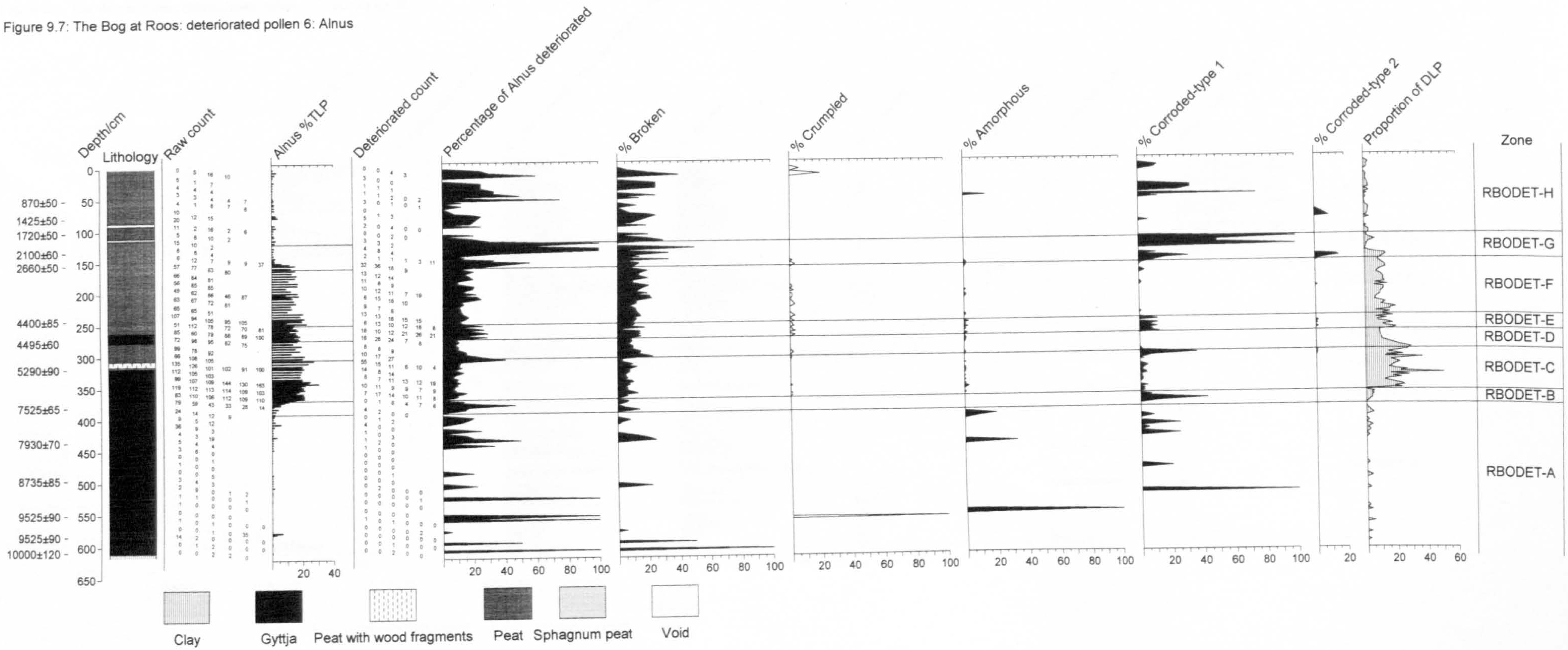


Figure 9.8: The Bog at Roos: deteriorated pollen 7: Poaceae undiff.

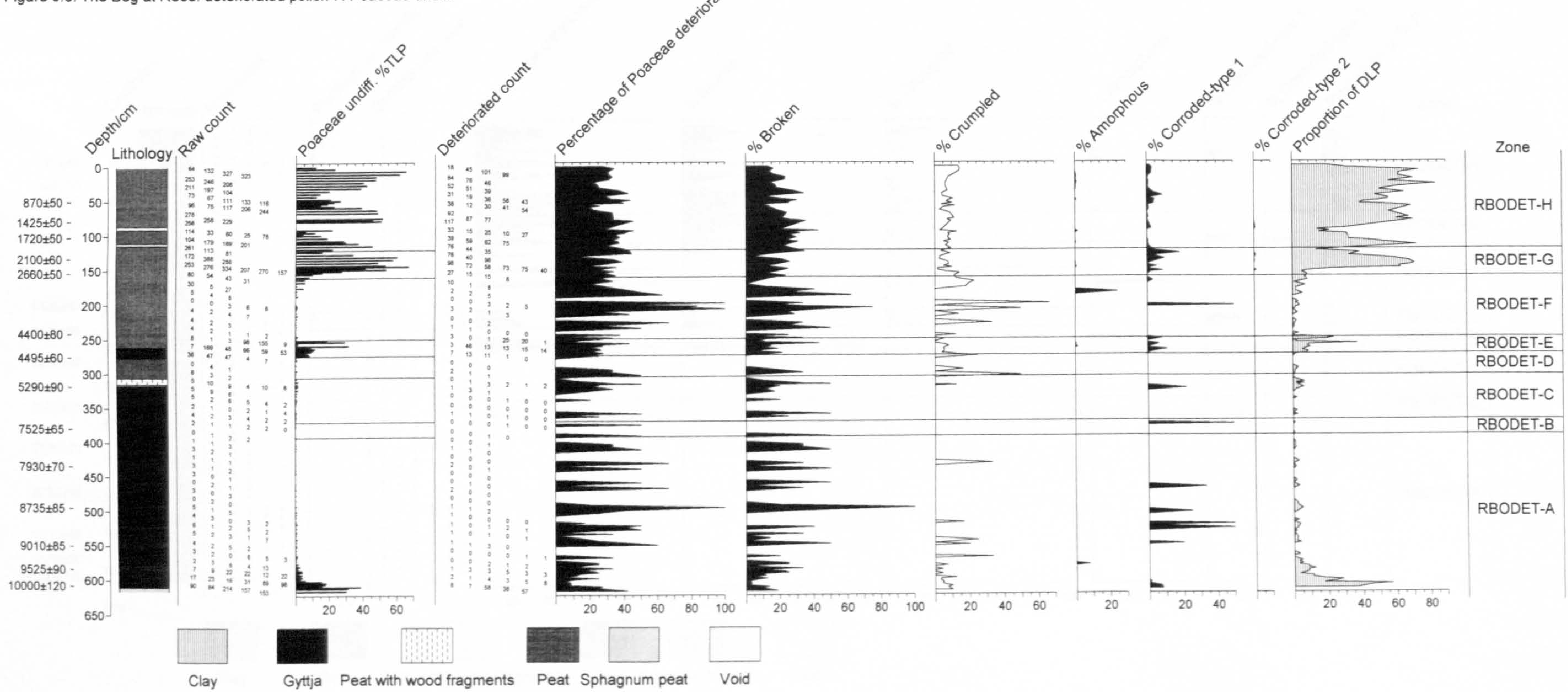
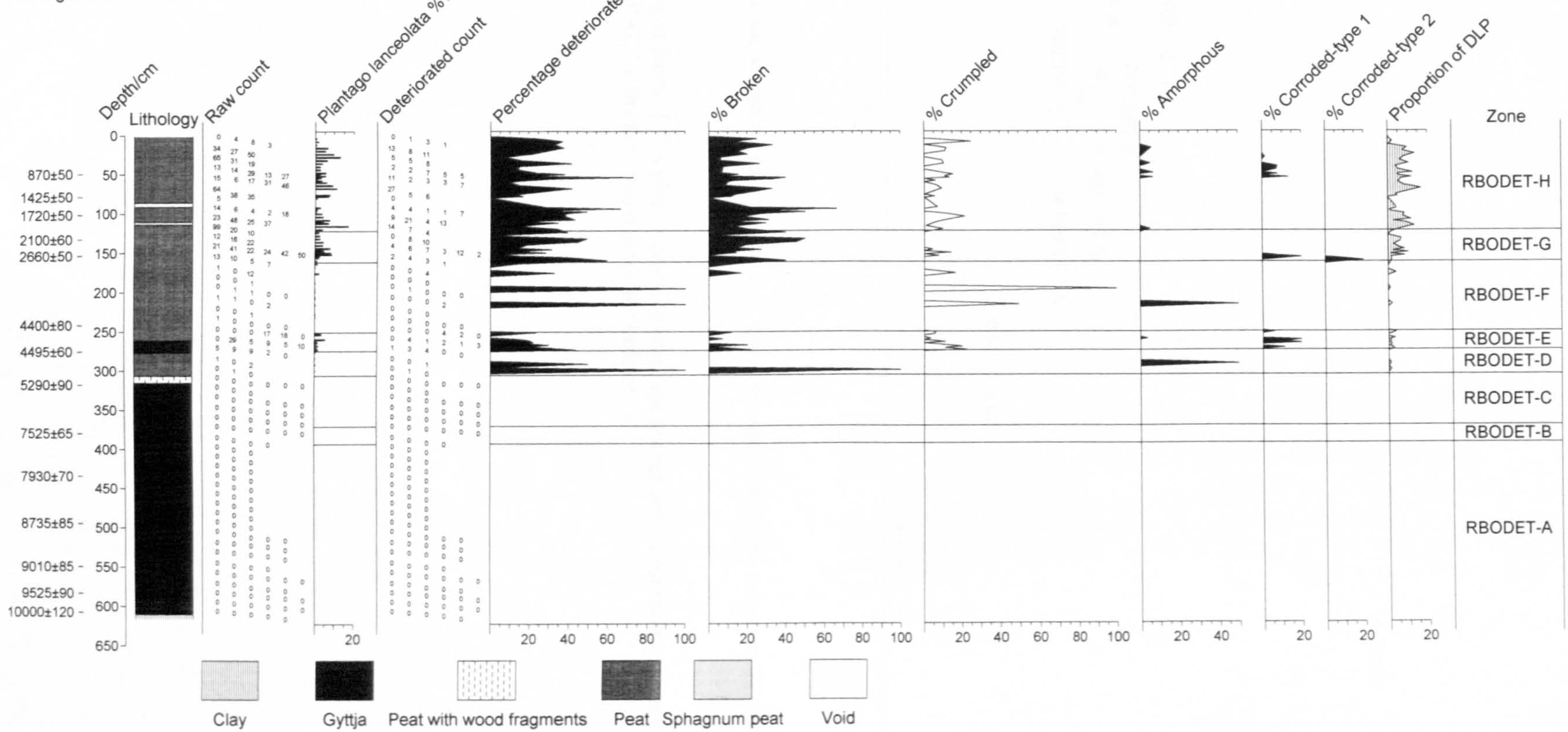
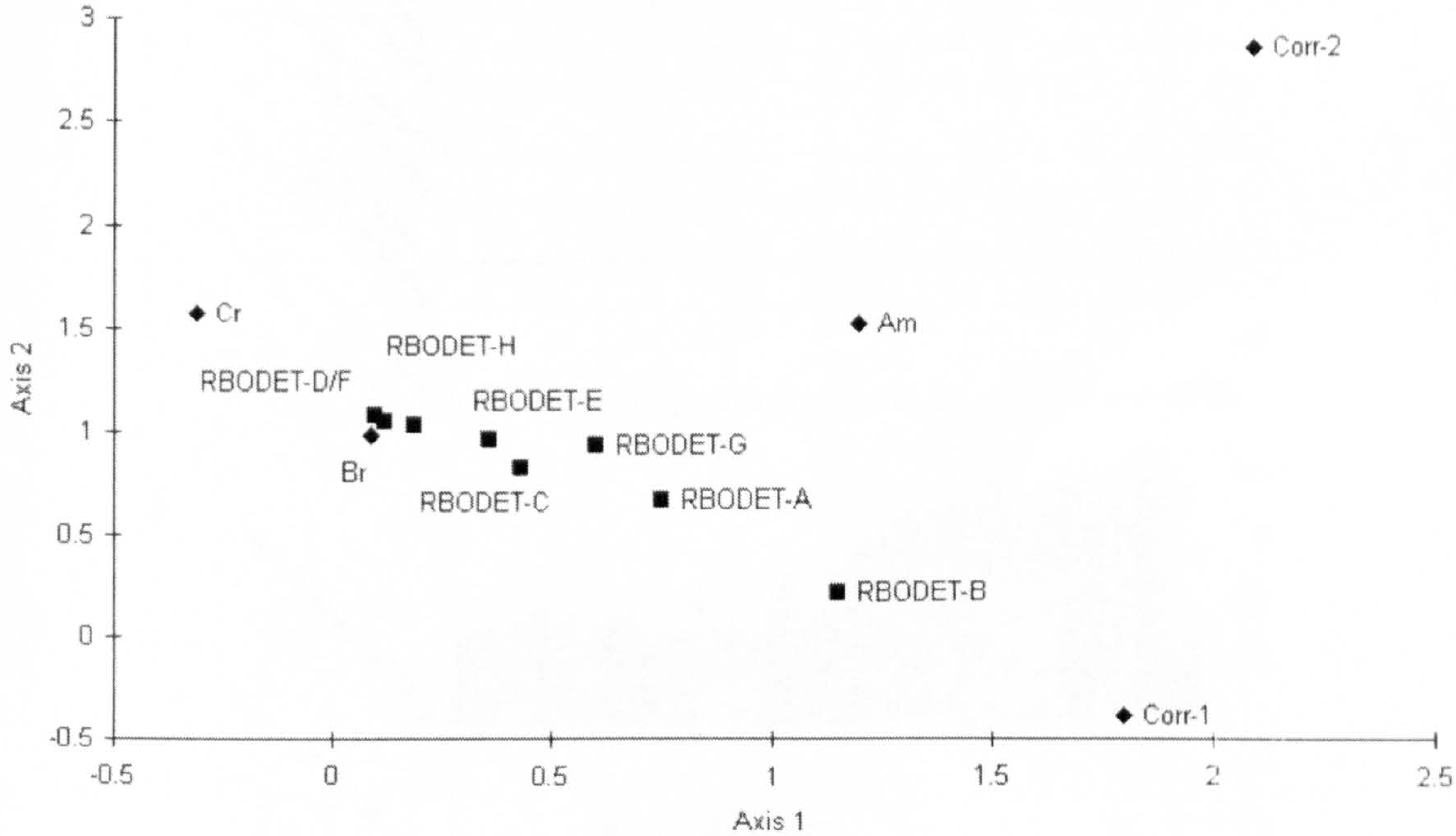


Figure 9.9: The Bog at Roos: deteriorated pollen 8:
Plantago lanceolata





Key to abbreviations used: Am, amorphous; Br, broken; Corr-1, type-1 corrosion; Corr-2, type-2 corrosion; Cr, crumpled.

Figure 9.10: The Bog at Roos: DCA plot of deterioration type scores and mean sample scores for each LDPAZ for the first two axes of the ordination

Figure 9.11: The Bog at Roos: percentage diagram of trees and shrubs for 616-154 cm

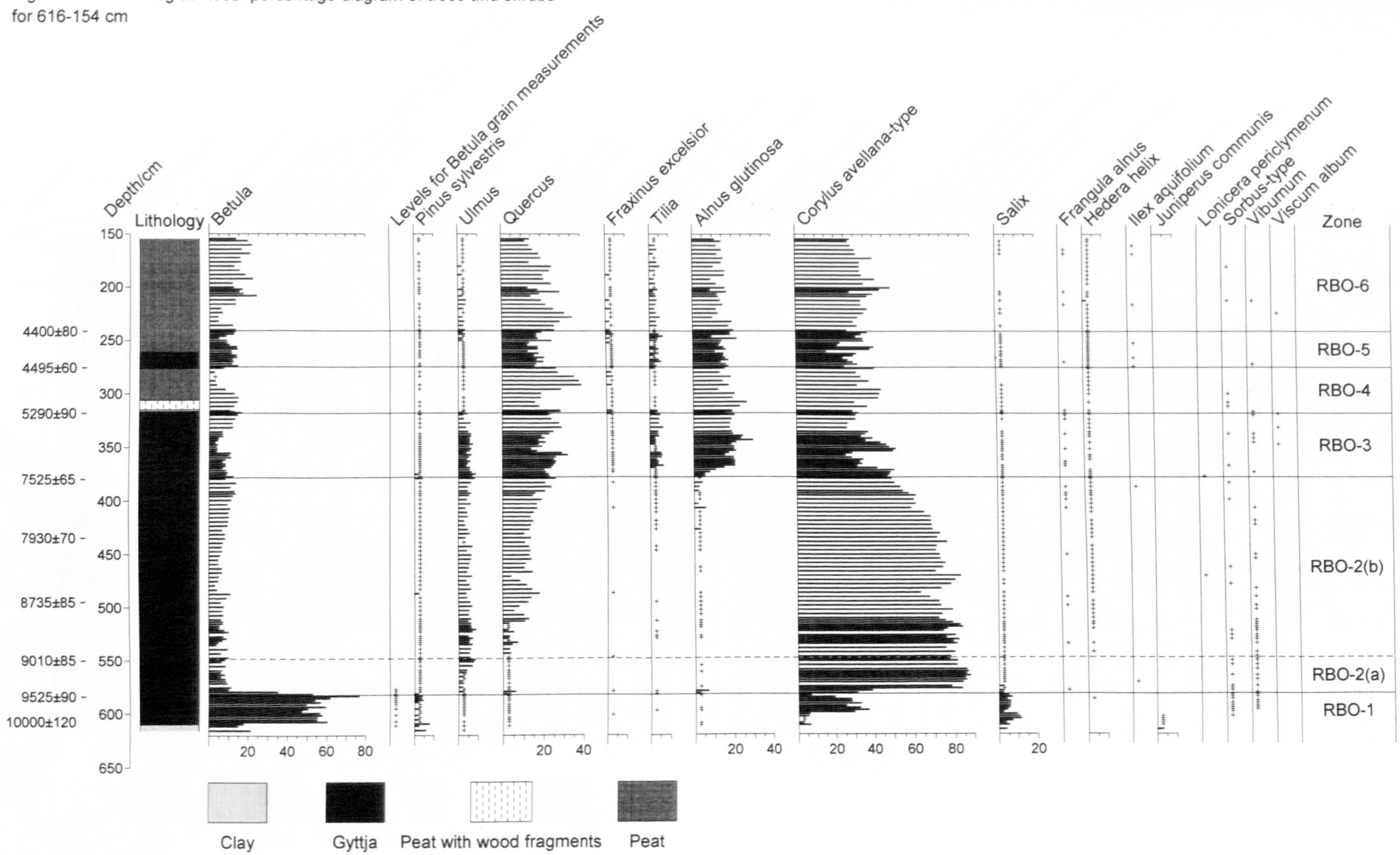


Figure 9.12: The Bog at Roos: percentage diagram of heaths and herbs
(1) for 616-154 cm

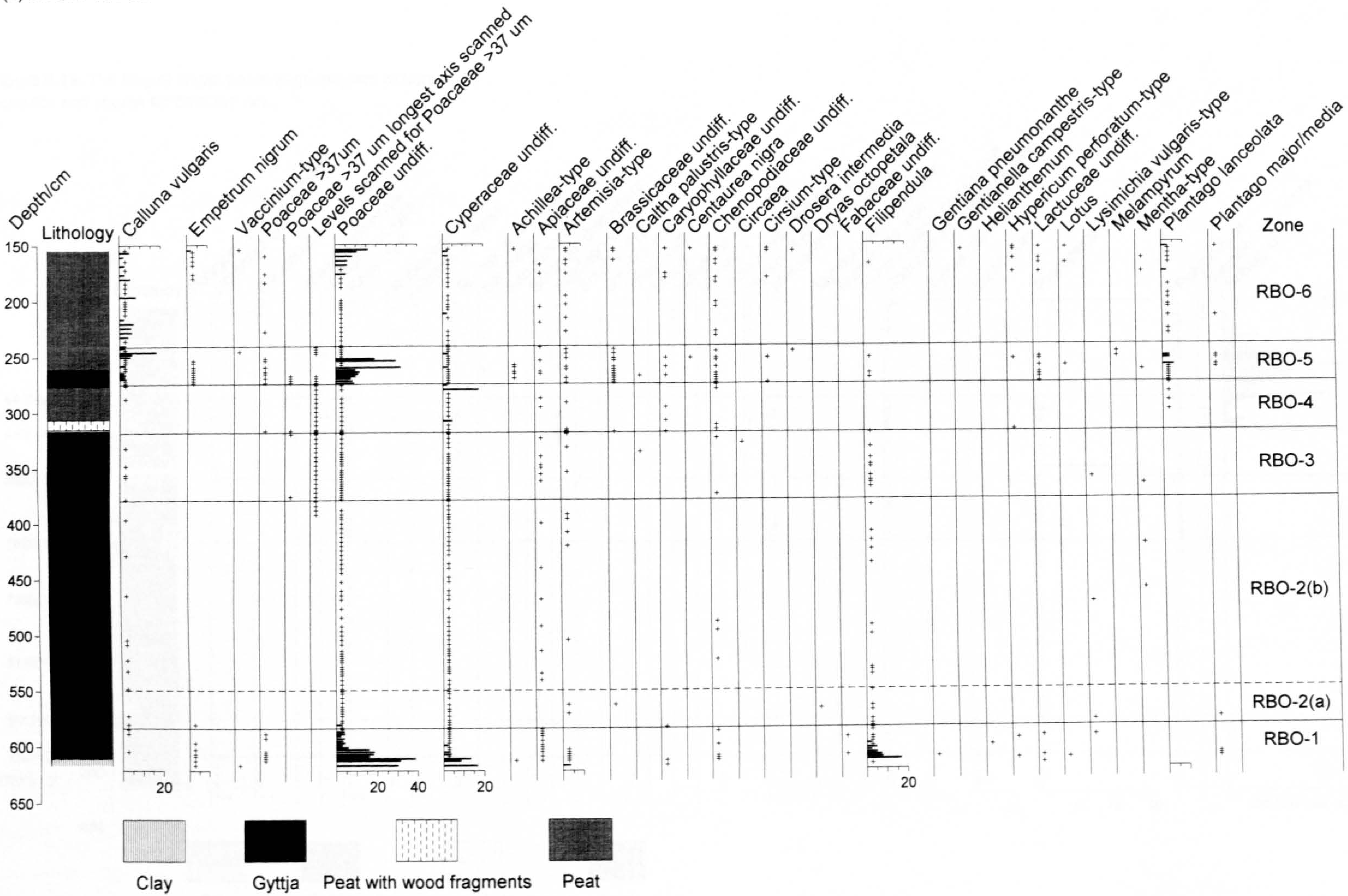


Figure 9.13: The Bog at Roos: percentage diagram of herbs (2) aquatics and spores for 616-154 cm

Figure 9.14: The Bog at Roos: miscellaneous data for 616-154 cm

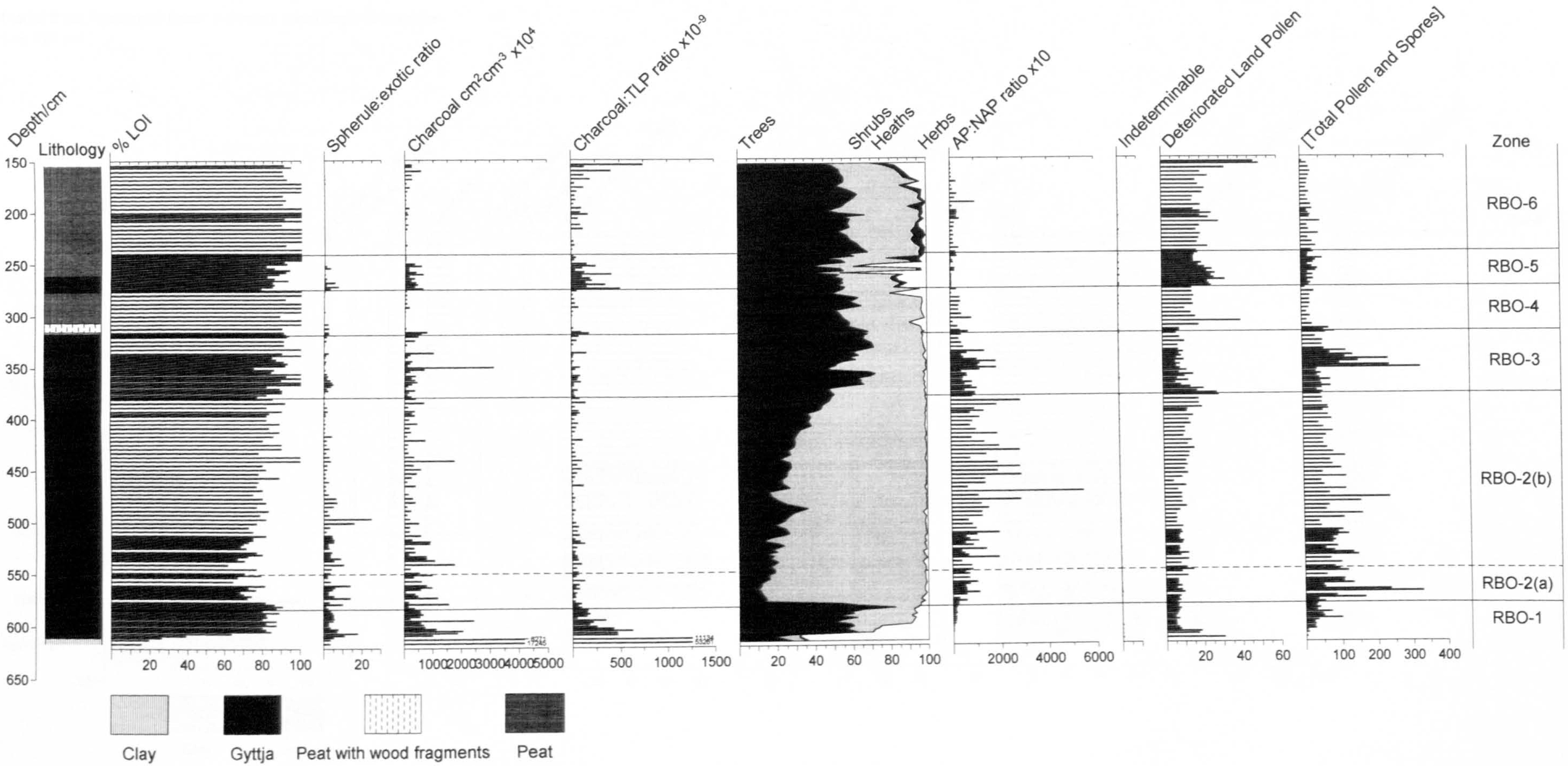


Figure 9.15: The Bog at Roos: summary percentage diagram for 616-396 cm

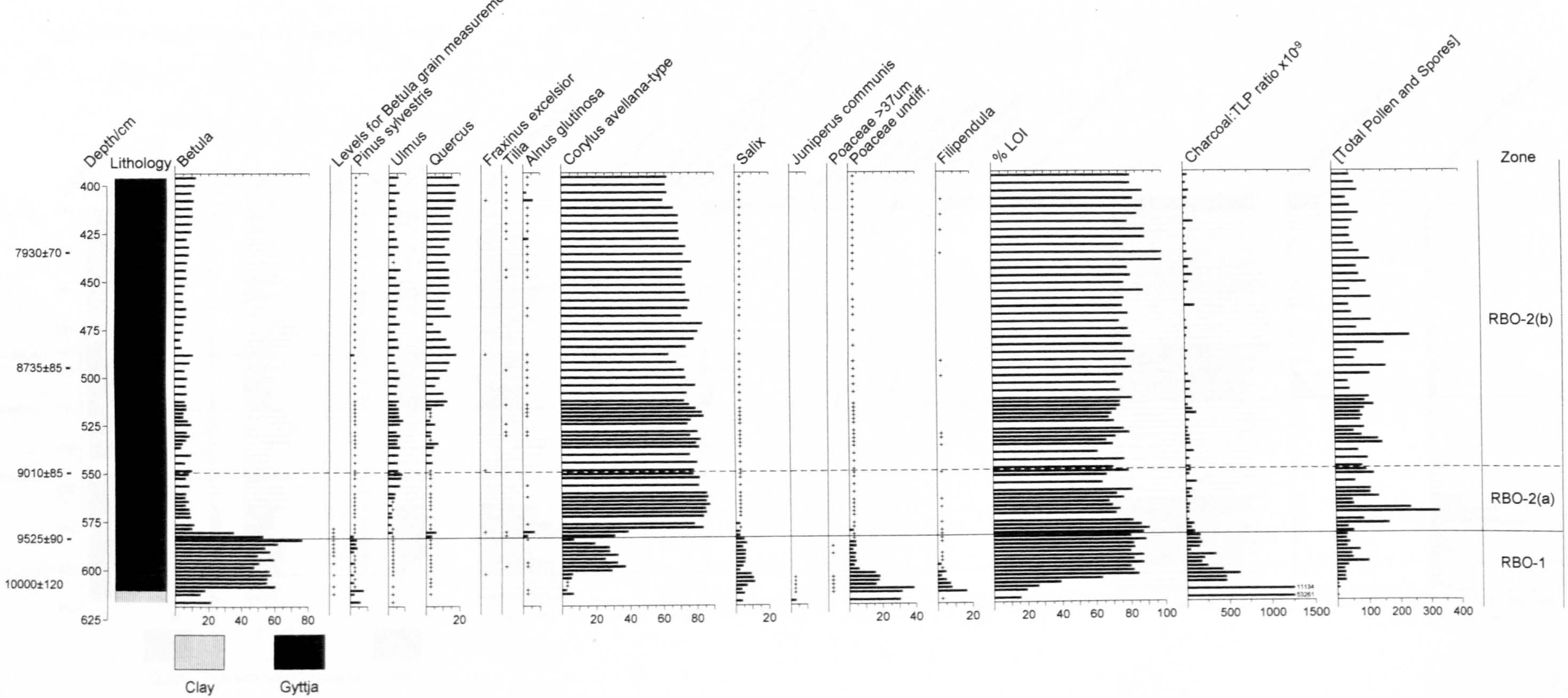


Figure 9.16: The Bog at Roos: summary diagram for 394-148 cm

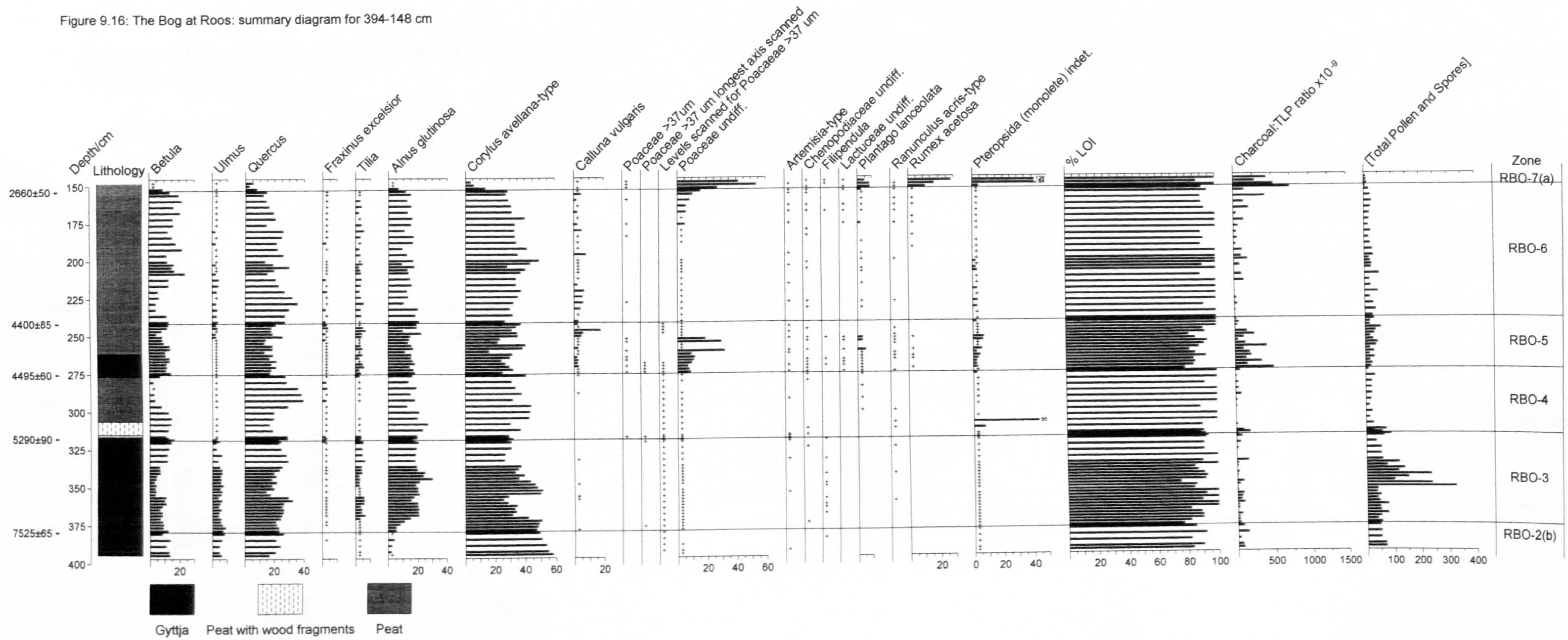


Figure 9.17: The Bog at Roos: summary concentration diagram for 616-154 cm

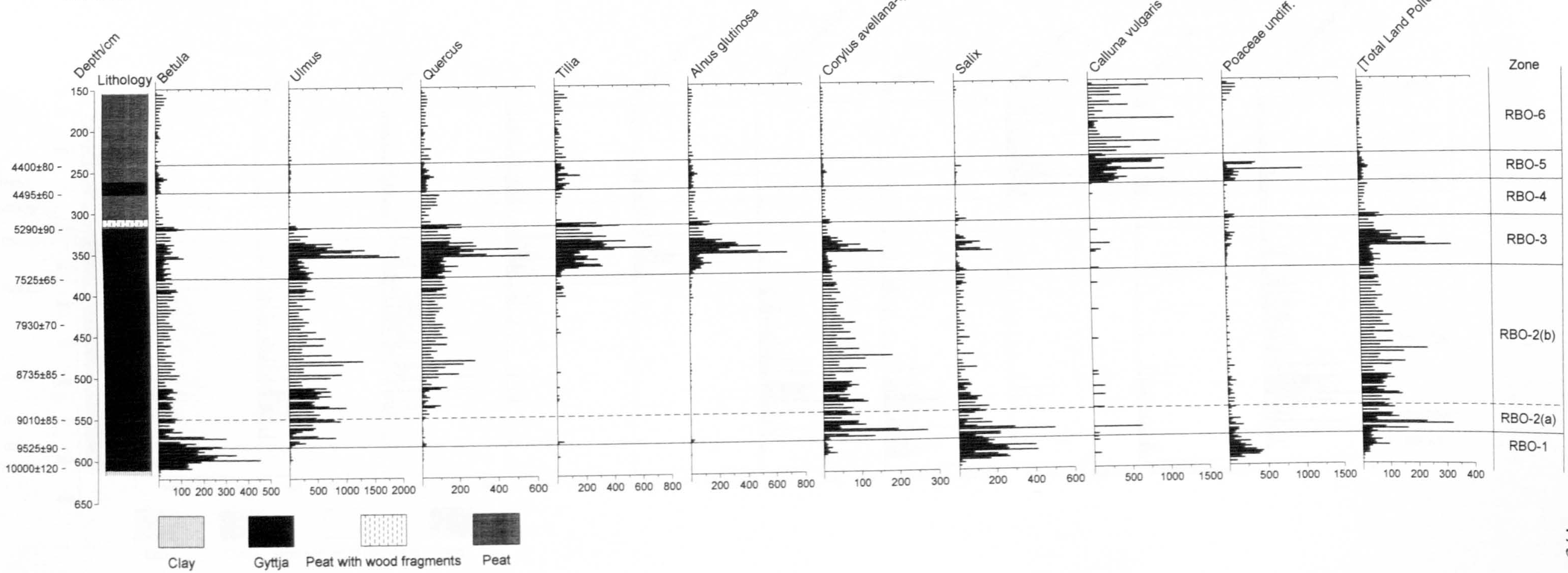


Figure 9.18: The Bog at Roos: summary accumulation rate diagram for 616-154 cm

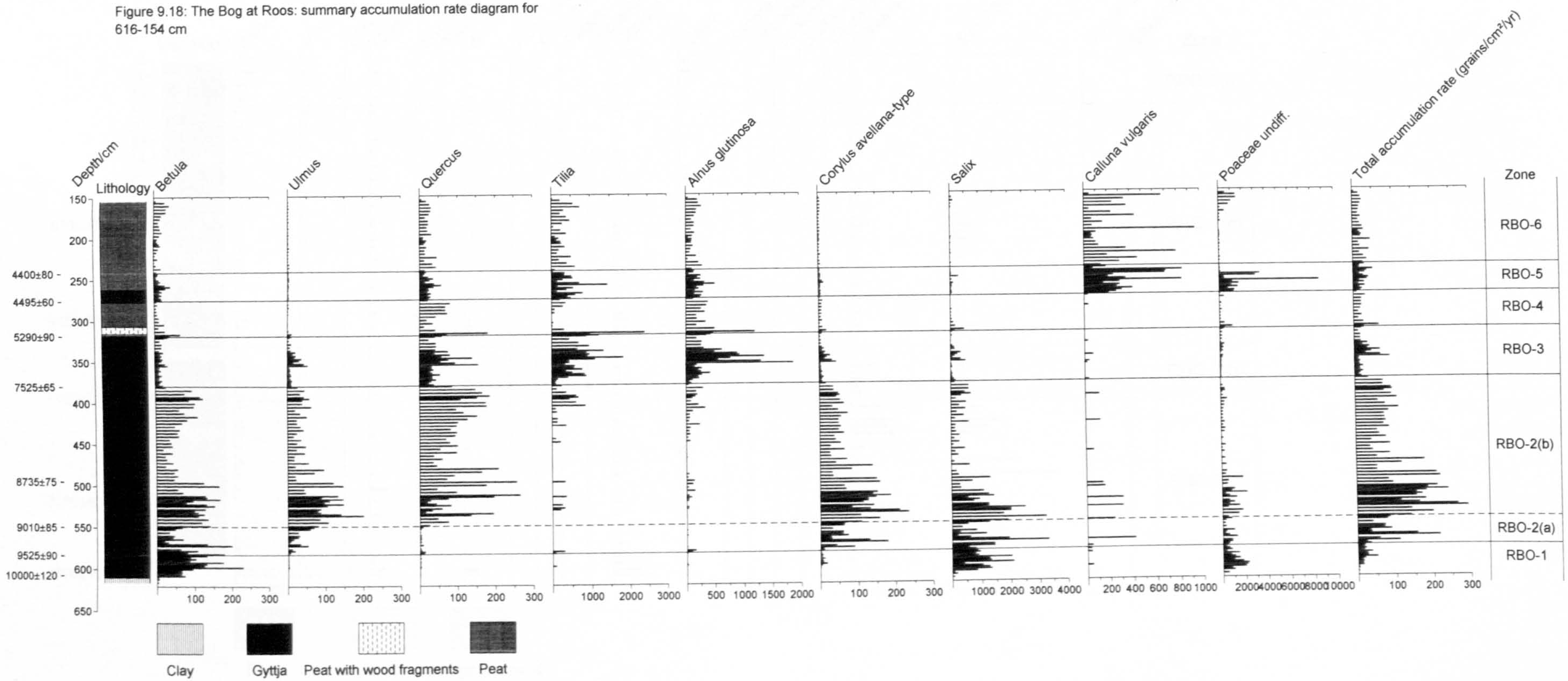


Figure 9.19: The Bog at Roos: Percentage diagram of trees, shrubs and heaths for 152-1 cm

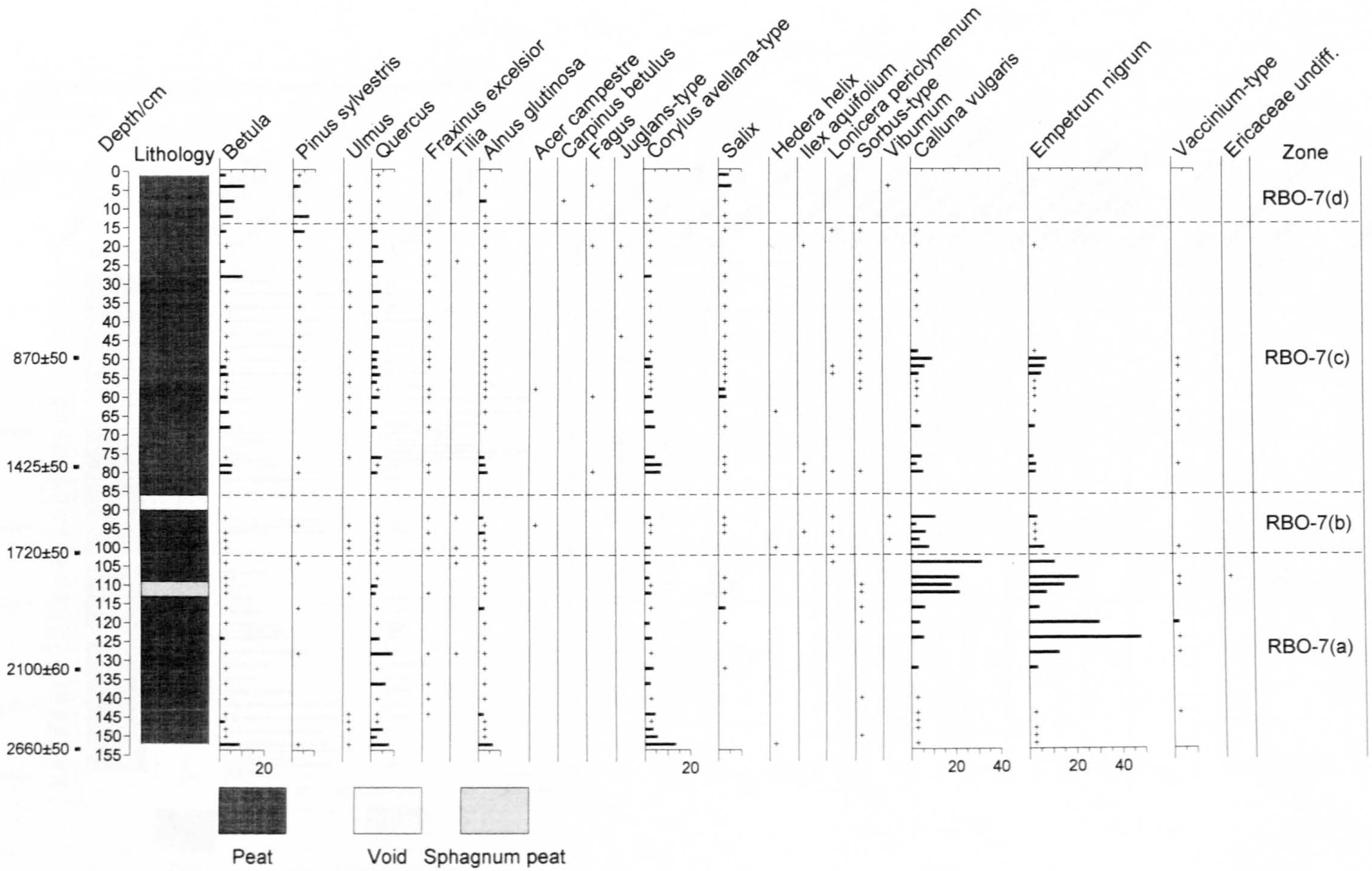
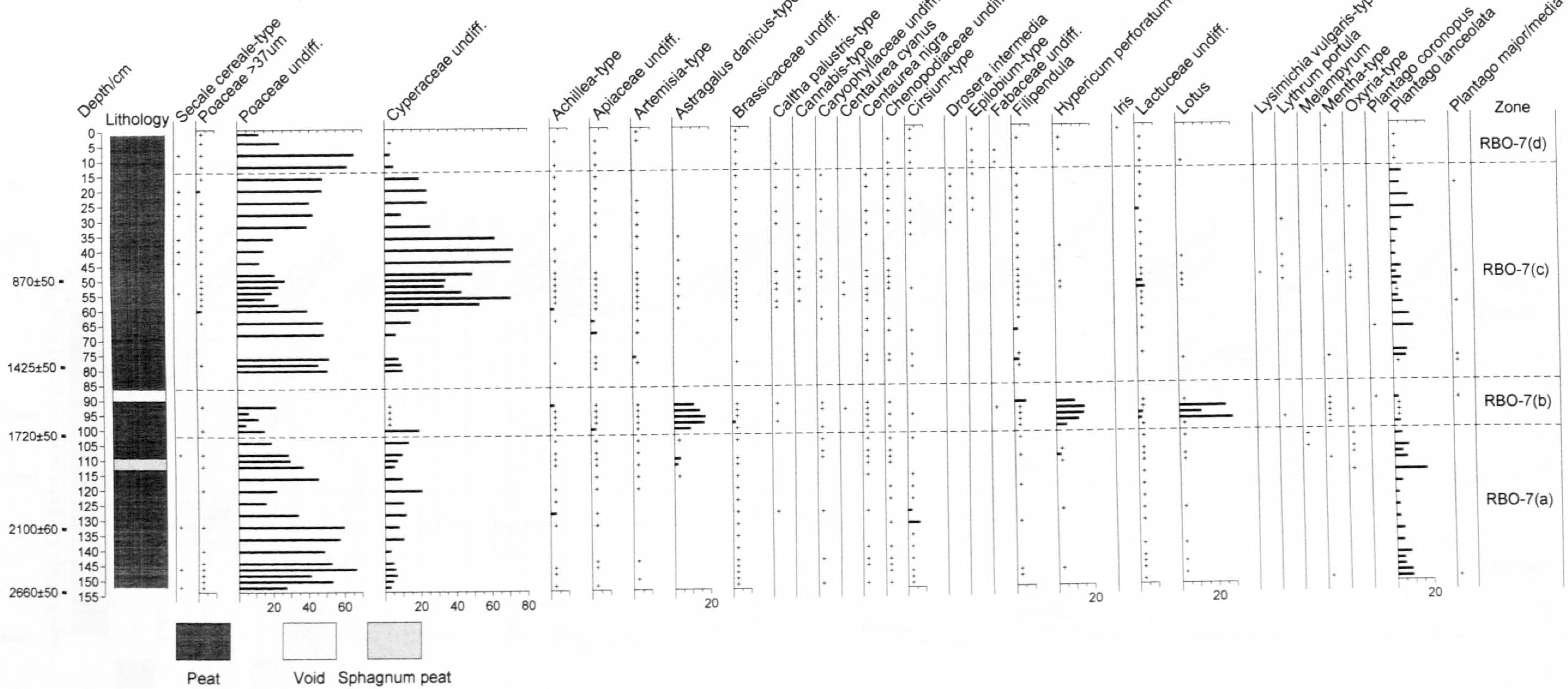


Figure 9.20: The Bog at Roos: percentage diagram of herbs (1) for 152-1 cm



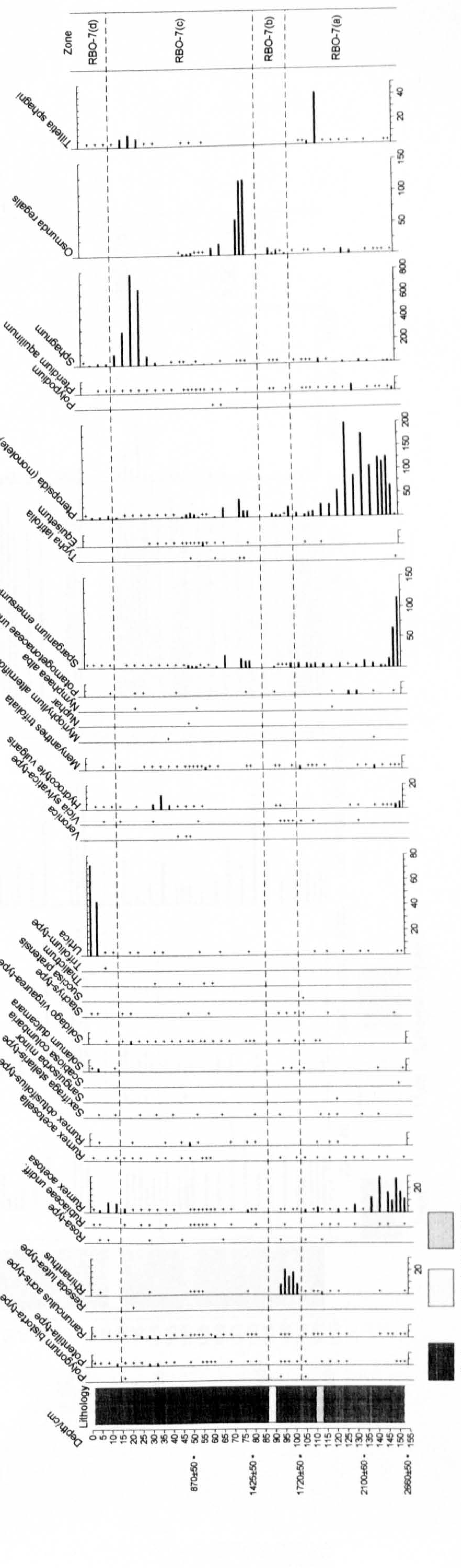


Figure 9.21: The Bog at Roos: Percentage diagram of herbs (2), aquatics and spores for 152-1 cm

Figure 9.22: The Bog at Roos: miscellaneous data for 152-1 cm

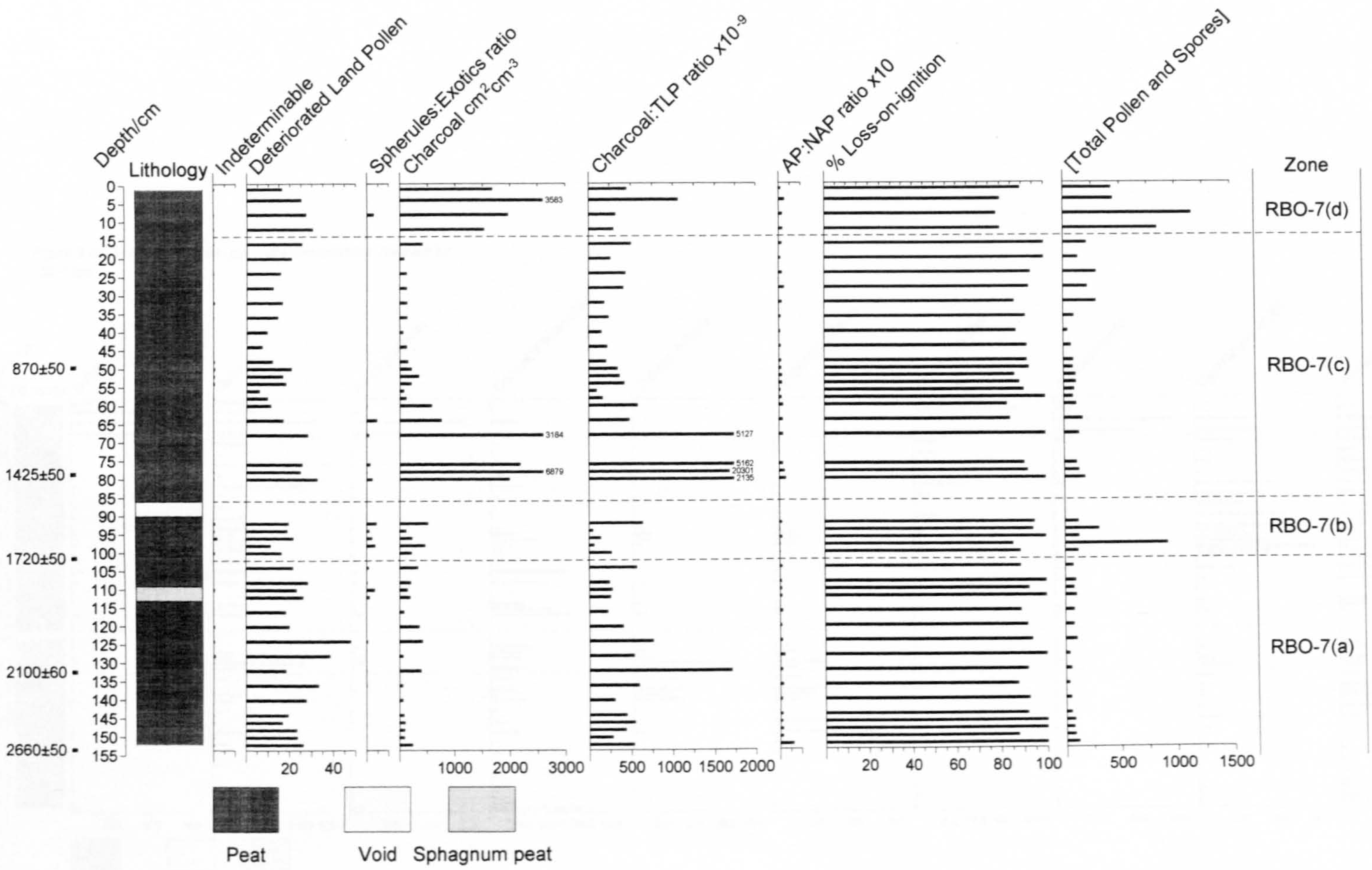


Figure 9.23: The Bog at Roos: summary concentration diagram for 152-1 cm

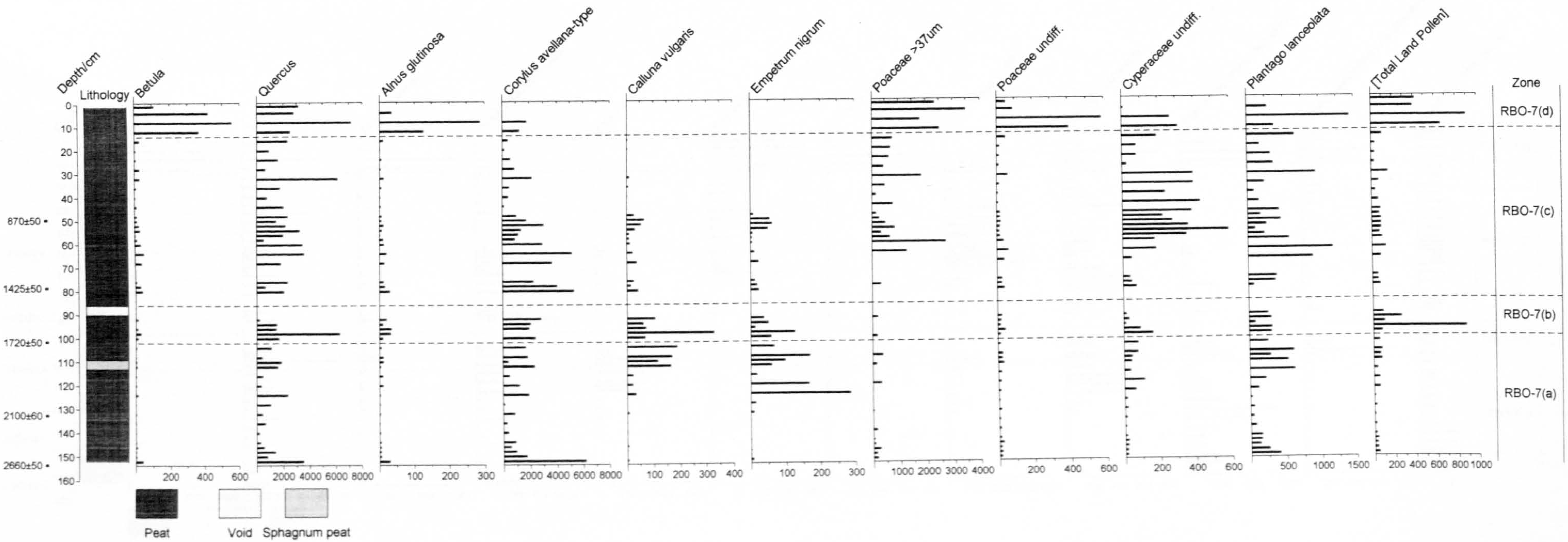
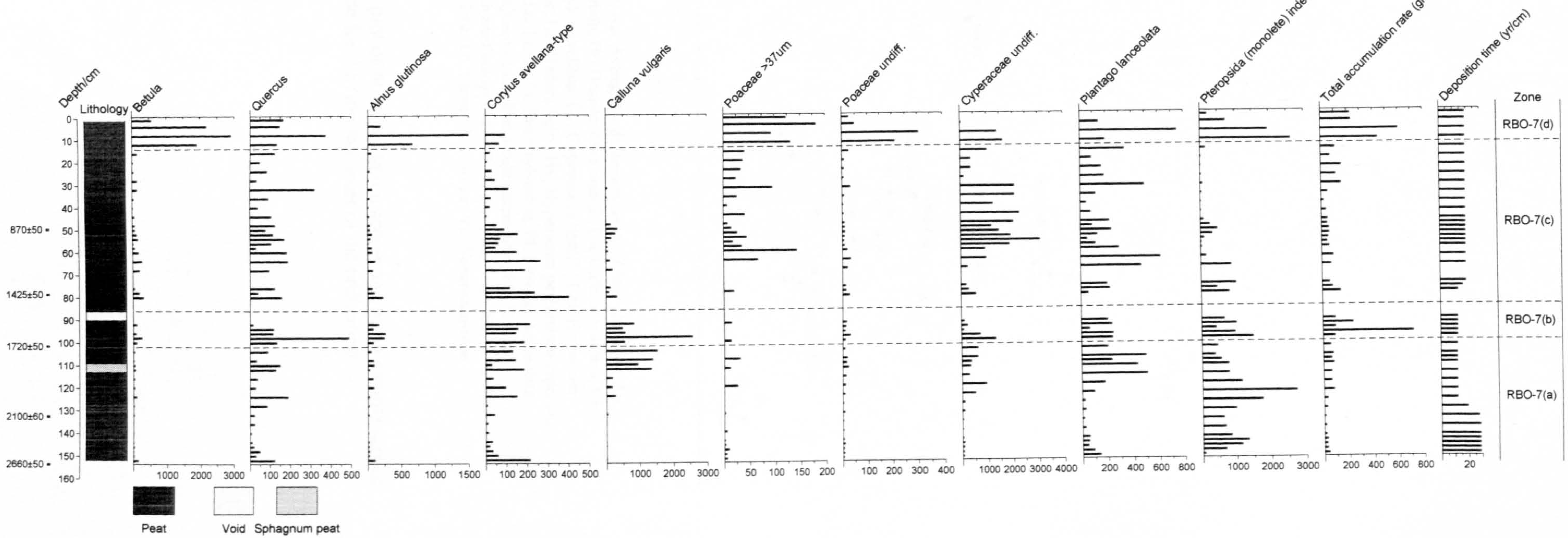
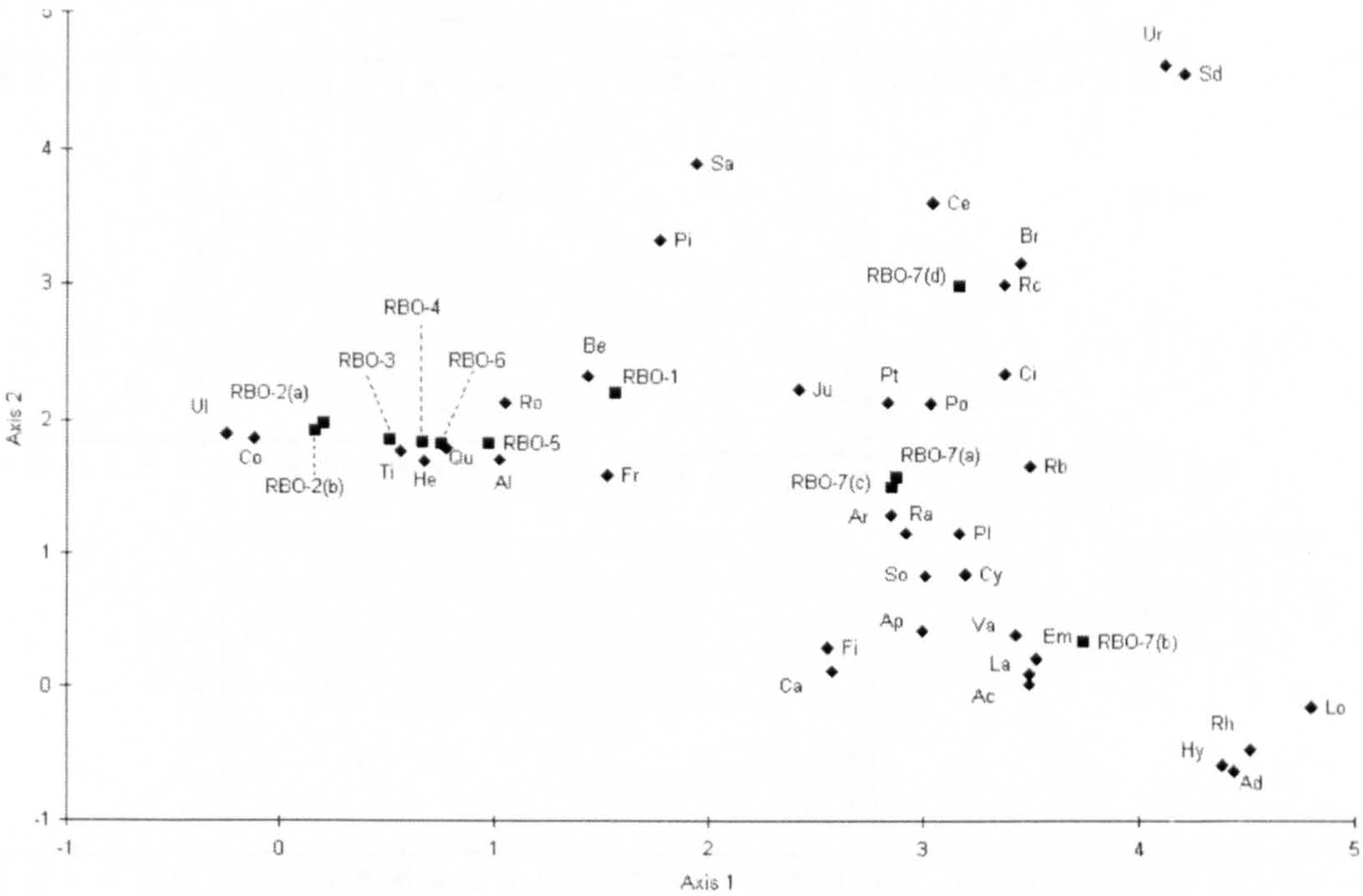


Figure 9.24: The Bog at Roos: summary accumulation rate diagram for 152-1 cm





Key to abbreviations used: Ac, Achillea-type; Ad, Astragalus danicus-type; Al, Alnus glutinosa; Ap, Apiaceae undiff.; Ar, Artemisia-type; Be, Betula; Br, Brassicaceae undiff.; Ca, Calluna vulgaris; Ce, Poaceae >37 um; Ci, Cirsium-type; Co, Corylus avellana; Cy, Cyperaceae undiff.; Em, Empetrum nigrum; Fi, Filipendula; Fr, Fraxinus excelsior; He, Hedera helix; Hy, Hypericum perforatum-type; Jn, Juniperus communis; La, Lactuceae undiff.; Lo, Lotus; Pi, Pinus sylvestris; Pl, Plantago lanceolata; Po, Poaceae undiff.; Pt, Potentilla-type; Qu, Quercus; Ra, Ranunculus acris-type; Rb, Rumex obtusifolius-type; Rc, Rumex acetosa; Rh, Rhinanthus-type; Ro, Rosa-type; Sa, Salix; Sd, Solanum dulcamara; So; Solidago virgaurea-type; Ti, Tilia; Ul, Ulmus; Ur, Urtica; Va, Vaccinium-type

Figure 9.25: The Bog at Roos: DCA plot of principal taxon scores and mean sample scores for each zone and subzone for the first two axes of the ordination

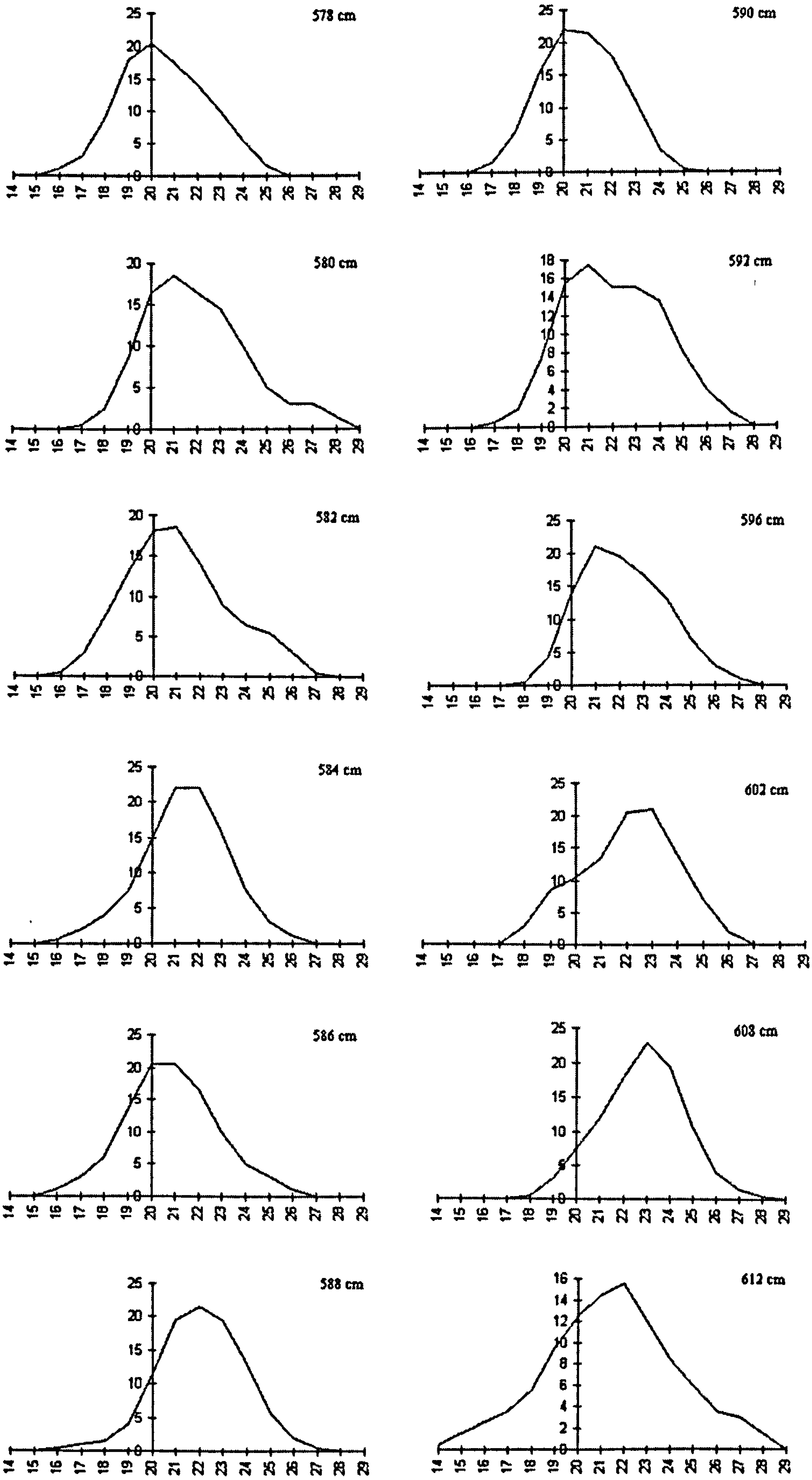
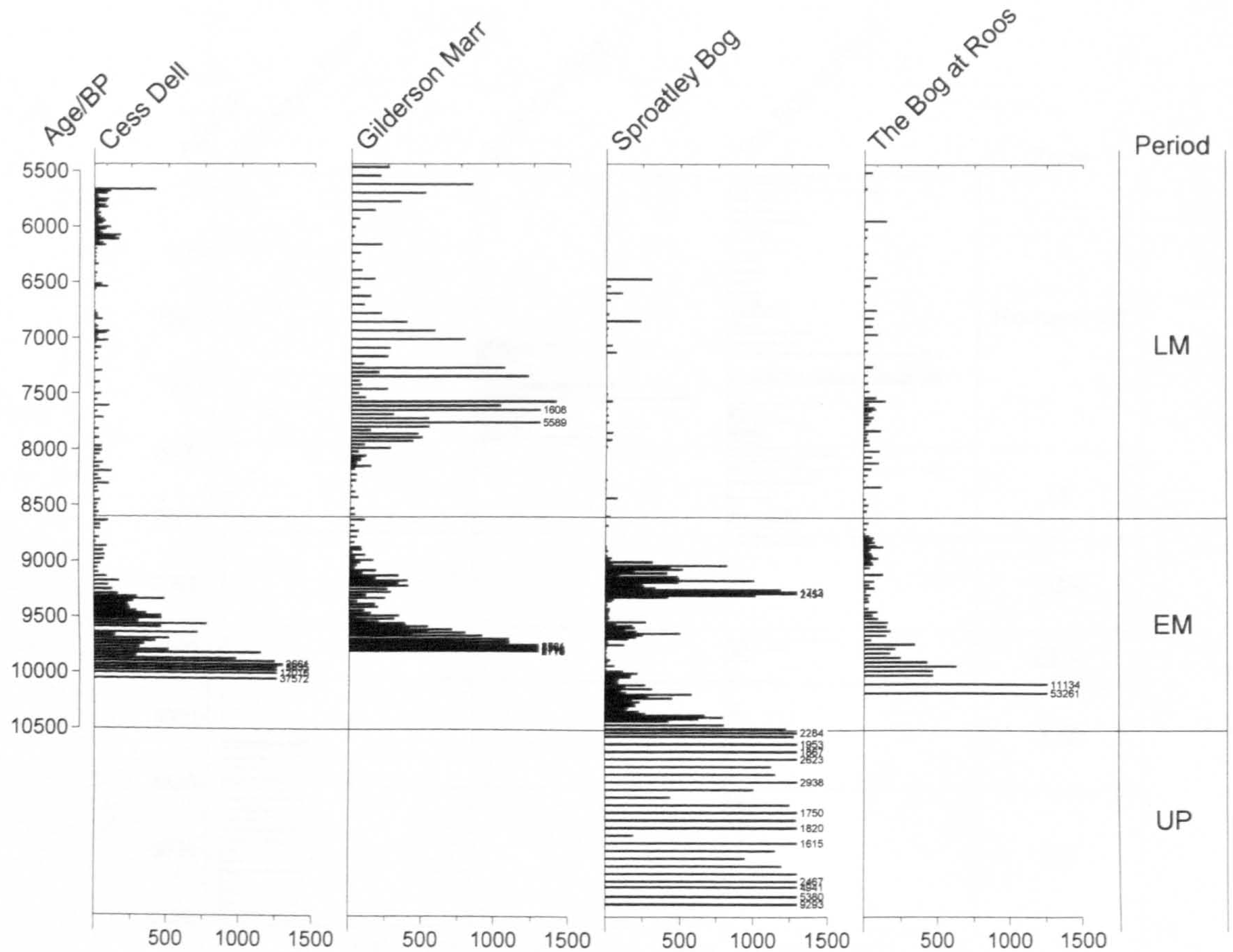


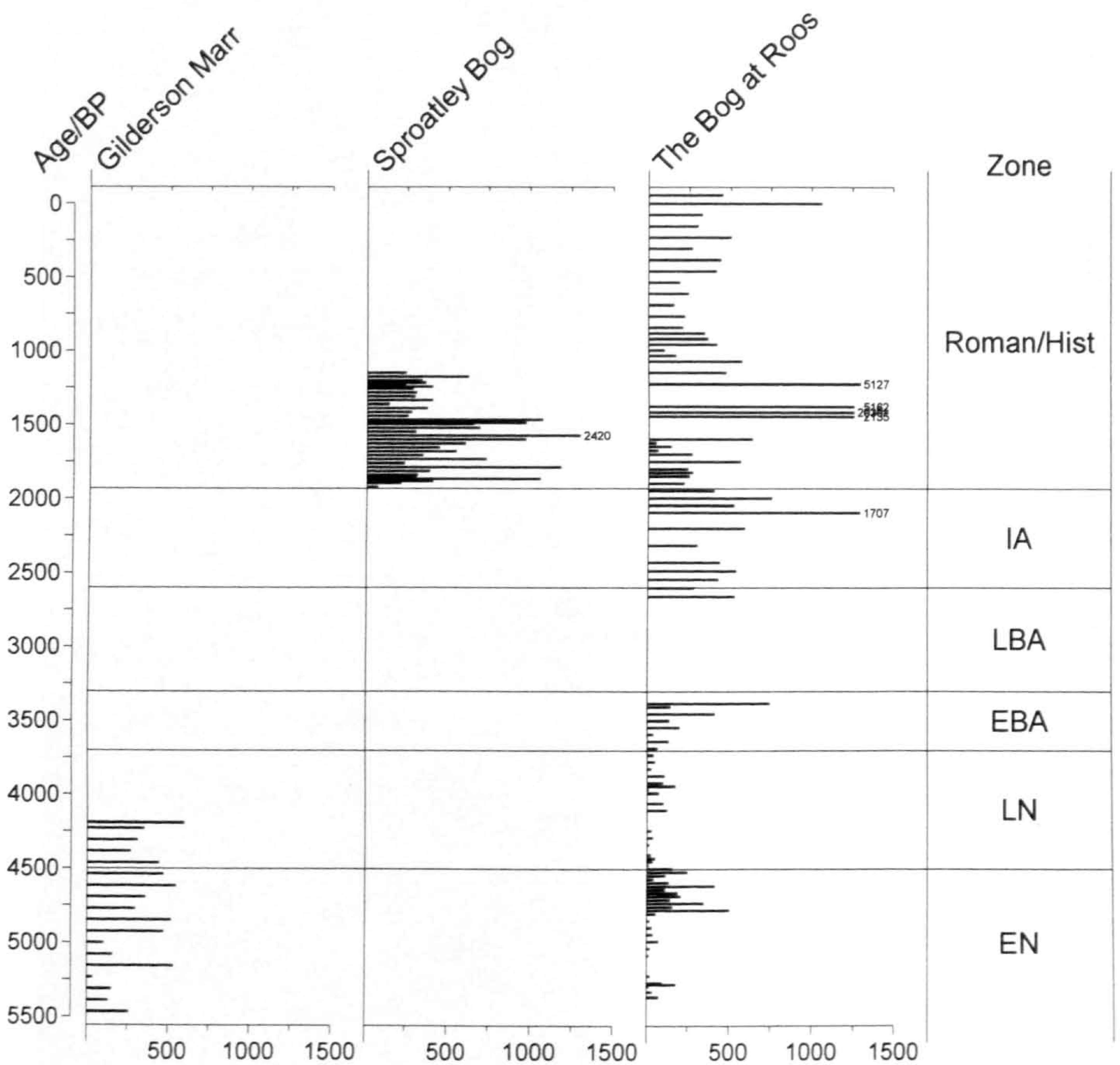
Figure 9.26: The Bog at Roos: smoothed Betula size-frequency graphs. Grain diameter (μm) is shown on the x-axis and smoothed percentage on the y-axis.

Figure 10.1: charcoal:pollen ratios for all study sites between ca 11,000 BP and 5500 BP. Also shown are the principle cultural periods.



UP=Upper Palaeolithic EM=Early Mesolithic LM=Late Mesolithic

Figure 10.2: charcoal:pollen ratios for Gilderson Marr, Sproatley Bog and The Bog at Roos between ca 5500 BP and the present day. Also shown are the principle cultural periods



EN/LN=Early/Late Neolithic EBA/LBA=Early/Late Bronze Age IA=Iron Age

Plate 3.1: Cess Dell: view of the basin showing the position from which the core was taken

Plate 3.2: Gilderson Marr: view of the basin showing the position from which the core was taken

Plate 3.3: Sproatley Bog: view of the southern part of the basin showing the position from which the core was taken

Plate 3.4: The Bog at Roos: view of the central part of the basin showing the density of on-site vegetational growth in July 1998.

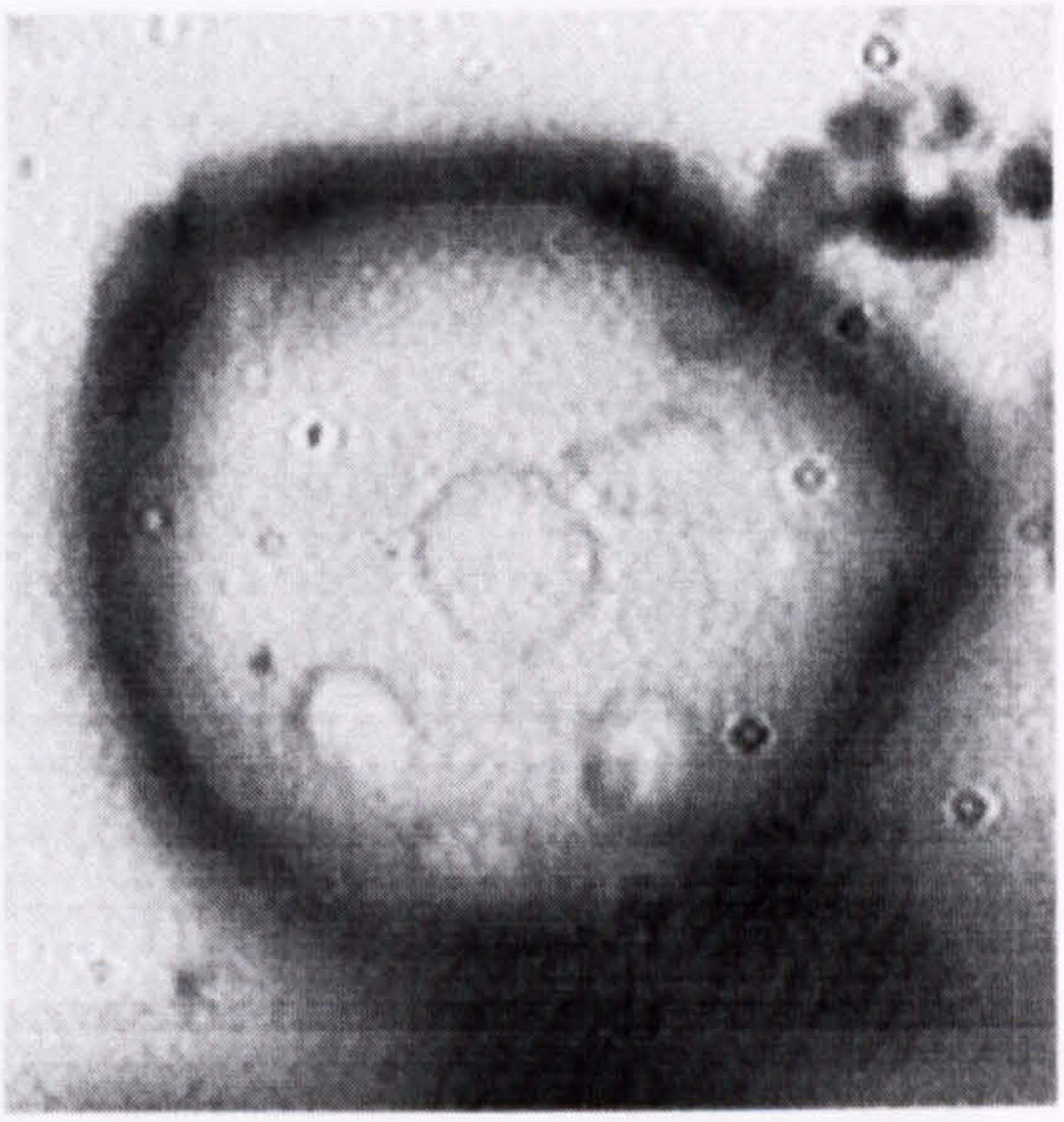


Plate 4.1: hazel pollen grain exhibiting 'type-1' corrosion

Plate 4.2: hazel pollen grain exhibiting 'type-1' corrosion. For clarity, the outlines of the perforations have been highlighted in black

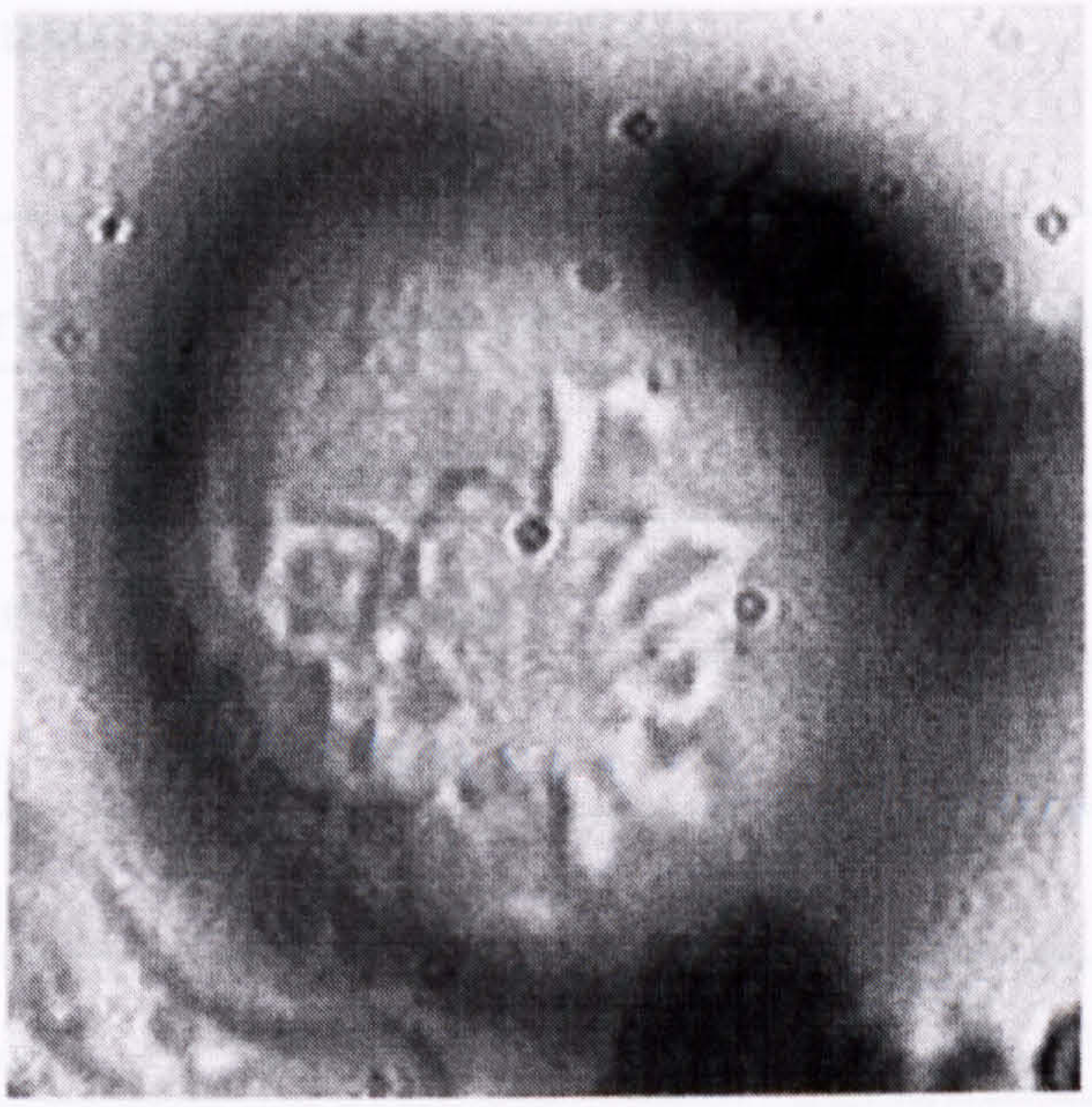


Plate 4.3: hazel pollen grain exhibiting 'type-2' corrosion

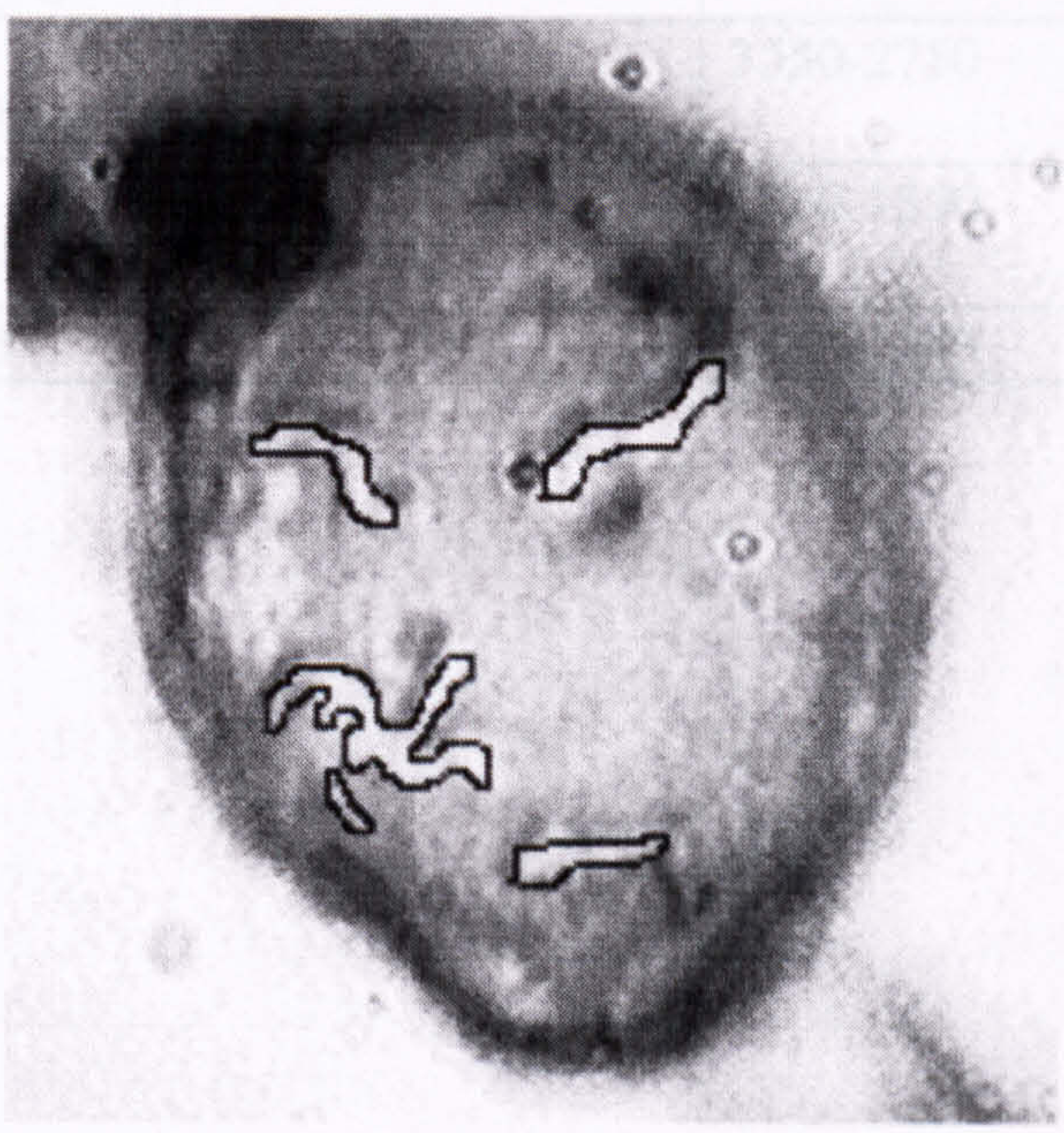


Plate 4.4: hazel pollen grain exhibiting 'type-2' corrosion. For clarity, the outlines of the perforations have been highlighted in black

Appendix 1: approximate dates of the principal cultural periods (based primarily on Spratt [1993])

Cultural period	Age range (BP)	Age range (cal BP)	Age range (cal BC)
Mesolithic	10,200-5500	11,900-6310	9950-4360
Early Mesolithic	10,200-8600	11,900-9580	9950-7625
Late Mesolithic	8600-5500	9580-6310	7625-4360
Neolithic	5500-3700	6310-4060	4360-2110
Early Neolithic	5500-4500	6310-5130	4360-3180
Late Neolithic/ earliest Bronze Age	4500-3700	5130-4060	3180-2110
Bronze Age	3700-2600	4060-2750	2110-800
Early Bronze Age	3700-3300	4060-3550	2110-1600
Late Bronze Age	3300-2600	3550-2750	1600-800
Iron Age	2600-1930	2750-1890	800 BC-70 AD
Roman Period		1890-1540	70-410 AD

Appendix 2: preparation of samples for pollen, charcoal and iron pyrite spherule analysis

1. **Exotic marker grain addition**
   Dissolve exotic tablet/s in 5 cm^3 10% v/v $HCl_{(aq)}$ in a measuring cylinder.
2. **Sample volume determination**
   Add sample until volume displaced by 1 cm^3 and stir with glass rod, centrifuge for 2 minutes at 4500 rpm and pour off supernatant.
3. **Potassium Hydroxide digestion**
   Add 5 ml 10% w/v $KOH_{(aq)}$, stir and heat in a boiling water bath for 15 minutes, stirring every 5 minutes. Centrifuge for 2 minutes at 4500 rpm and pour off supernatant. Sieve through a 100 µm mesh, centrifuge, wash with distilled water and repeat until supernatant runs clear. If the sample is clay rich, fill a large (3 cm diameter) centrifuge tube completely with sample/distilled water solution, and centrifuge as before. The clays remain in solution, whilst the palynomorphs, charcoal etc. settle out into the pellet. This avoids the potential chemical damage that may be caused by treatments such as tetra-Sodium pyrophosphate, and was observed to be extremely effective in the Late-Glacial clays analysed.
4. **Hydrofluoric acid treatment (where necessary)**
   Suspend pellet in 5 ml 10% v/v $HCl_{(aq)}$, stir, centrifuge and pour off supernatant. Add 3 ml 40% v/v $HF_{(aq)}$, stir with polypropylene rod and place in a hot water bath for 15 mins. Stir every 5 minutes. Centrifuge, pour off supernatant and resuspend pellet in 5 ml 10% v/v $HCl_{(aq)}$. Place back in water bath for 10 minutes, stirring every 5 minutes. Centrifuge and pour off supernatant. Wash with distilled water, centrifuge and discard supernatant.
5. **Acetolysis**
   Suspend pellet in 5 ml Glacial Acetic acid, centrifuge and pour off supernatant. Suspend pellet in 5 ml acetolysis mixture (9:1 ratio acetic anhydride: concentrated sulphuric acid mixture). Place in a hot water bath for 2 minutes, stirring often, centrifuge and discard supernatant. Wash with 5 ml Glacial Acetic acid, centrifuge and discard supernatant.
6. **Staining**
   Add 1 drop of stain (2 drops of Safranine in 10 ml distilled water) to sample and stir. Add 1 ml $KOH_{(aq)}$ and 5 ml distilled water, stir, centrifuge and discard supernatant. Add 5 ml distilled water and centrifuge.
7. **Mounting**
   Wash with 5 ml Ethanol, centrifuge and discard supernatant.
   Wash with 1 ml Tertiary Butyl Alcohol (TBA), centrifuge.
   Add 1 ml TBA and stir.
   Transfer to a tube containing silicon oil and leave in a drying oven overnight.
   Mount on slide ensuring to not over-compress the coverslip.

Appendix 3: pollen nomenclature

Nomenclature follows Bennett (1994) with the following exceptions. [1] denotes as in Moore *et al.* (1991).

1. **Trees**
   Acer campestre-type[1]
   Castanea-type[1]
   Juglans-type[1]
   Tilia[1]

2. **Herbs**
   Apiaceae[1]
   Cannabis-type[1]
   Poaceae >37 μm longest axis
   Oxyria-type[1]
   Plantago major/media
   Rumex obtusifolius-type[1]
   Saxifraga stellaris-type: includes both the *Saxifraga stellaris*-type of Bennett and *Chrysosplenium*
   Stachys-type: includes both the *Stachys*-type and *Scutellaria*-type of Bennett
   Urtica[1]

3. **Spores**
   Sphagnum[1]
   Tilletia sphagni[1]

Appendix 4: charcoal quantification

(i) Charcoal area per unit volume

1. Calculate the area of one eyepiece grid square in cm^2.
   e.g. In this study each square had a side of length 25 µm, giving an area of $6.25x10^{-6}$ cm^2.

2. Measure all charcoal fragments located during standard pollen counting to the nearest quarter of a grid square, rounding down rather than up. Keep a running total of area of charcoal found in terms of grid squares and also note the number of exotic grains scanned.
   e.g. 35 grid squares, 20 exotic grains.

3. Convert this area into cm^2 by multiplying the number of grid squares by the area (in cm^2) of each square.
   e.g. 35 x $6.25x10^{-6}$ = $2.19x10^{-4}$ cm^2 of charcoal.

4. Calculate the volume of sample scanned by dividing the number of exotics counted by the number added per cm^3 of sediment.
   e.g. 20/12542 = $1.59x10^{-3}$ cm^3 scanned.

5. Find the reciprocal of this value and multiply it by 3. to give the area of charcoal per cubic centimetre.
   e.g. ($1/1.59x10^{-3}$) x $2.19x10^{-4}$ = 0.997 cm^2cm^{-3}.

6. Multiply by a factor of ten for presentation purposes. In this study the data is presented as $cm^2cm^{-3}x10^4$.
   e.g. 0.997 becomes 9970 $cm^2cm^{-3}x10^4$.

(ii) Charcoal to pollen ratio

1. Divide the charcoal area per cubic centimetre by total land pollen concentration.
   e.g. 0.997/600,000 = $1.66x10^{-6}$.

2. Multiply by a factor of ten for presentation purposes. In this study, all C:P data is presented as ratio $x10^{-9}$.
   e.g. $1.66x10^{-6}$ becomes 1660.

Appendix 5: methodology for scanning for large Poaceae grains

1. Samples were prepared as for standard pollen counting and mounted onto slides under coverslips of size 50 mm x 22 mm.

2. All land pollen grains were counted at x 400 magnification across three evenly spaced transects and the average number per transect calculated.

3. The number of transects per coverslip was noted and from this the approximate number of land pollen grains per slide calculated.

4. Slides were scanned for large Poaceae grains at a magnification of x 100 until approximately 10,000 grains had been scanned. For statistical purposes it was tried to standardise this count, but where pollen concentrations were particularly low this was not always possible.

5. Any Poaceae grains with a longest axis of 37 μm or greater were measured accurately at x 1000 magnification.

Appendix 6: Radiocarbon dates

(i) Cess Dell

Publication code	Sample depth (cm)	Sediment type	$\delta^{13}C_{PDB}$ ±0.1 %	Age (^{14}C BP ± 1 SD)	Age range (Cal BP; 1 SD)	Age range (Cal BC; 1 SD)
AA-30869	422.5-424.5	Gyttja	-30.8	10,440±95	12640-12290	10690-10340
AA-30877	404.5-406.5	Gyttja	-30.7	9360±70	10650-10490	8700-8540
AA-30870	391.5-393.5	Gyttja	-31.0	9490±70	10780-10670	8830-8720
AA-30871	373.5-375.5	Gyttja	-30.7	9300±65	10580-10400	8630-8450
AA-30872	343.5-345.5	Gyttja	-30.6	8720±75	9780-9560	7830-7610
AA-30873	295.5-297.5	Gyttja	-30.2	7830±60	8670-8540	6720-6590
AA-30874	265.5-267.5	Herb peat	-29.9	7045±70	7940-7790	5990-5840
AA-30875	168.5-170.5	Woody peat	-29.4	6500±65	7400-7320	5450-5370
AA-30876	124.5-126.5	Woody peat	-30.0	6105±65	7020-6880	5070-4930

(ii) Gilderson Marr

Publication code	Sample depth (cm)	Sediment type	$\delta^{13}C_{PDB}$ ±0.1 %	Age (^{14}C BP ± 1 SD)	Age range (Cal BP; 1 SD)	Age range (Cal BC; 1 SD)
AA-32302	341-342	Gyttja	-33.7	9645±80	11170-11060	9220-9110
AA-32303	317-318	Gyttja	-32.8	9480±115	10810-10580	8860-8630
AA-32304	297-298	Gyttja	-31.3	9210±85	10420-10250	8470-8300
AA-32305	267-268	Gyttja	-31.7	8865±110	10160-9890	8210-7940
AA-32306	239-240	Herb peat	-28.7	8160±95	9160-9010	7210-7060
AA-32307	207-208	Herb peat	-28.4	8140±70	9130-9010	7180-7060
AA-32308	183-184	Herb peat	-28.3	8040±70	9030-8850	7080-6900

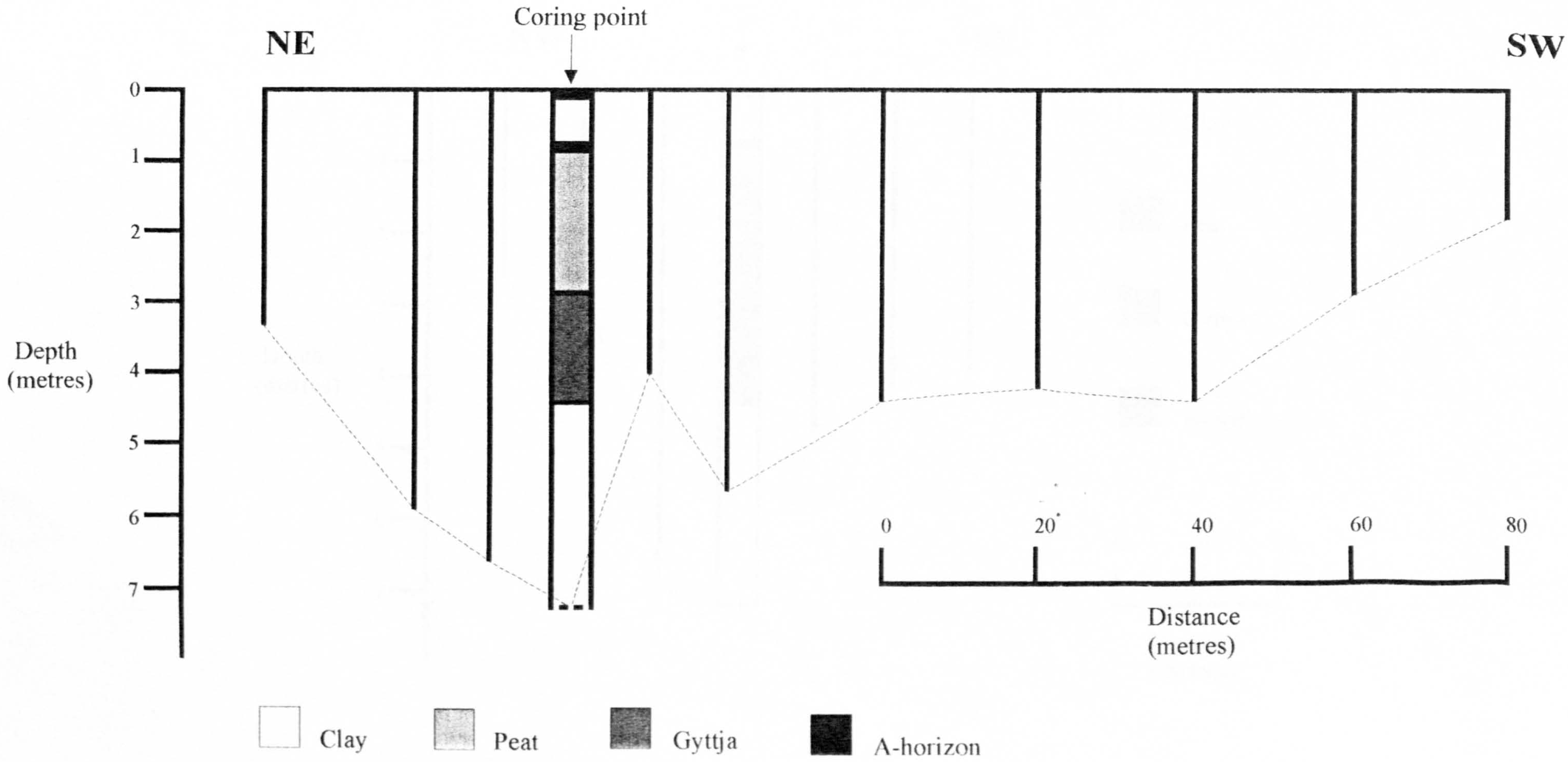
AA-32311	167-168	Herb peat	-28.9	7785±105	8650-8420	6700-6470
AA-32309	137-138	Herb peat	-29.0	7220±70	8060-7960	6110-6010
AA-32310	91-92	Herb peat	-29.2	5445±75	6310-6170	4360-4220

(iii) Sproatley Bog

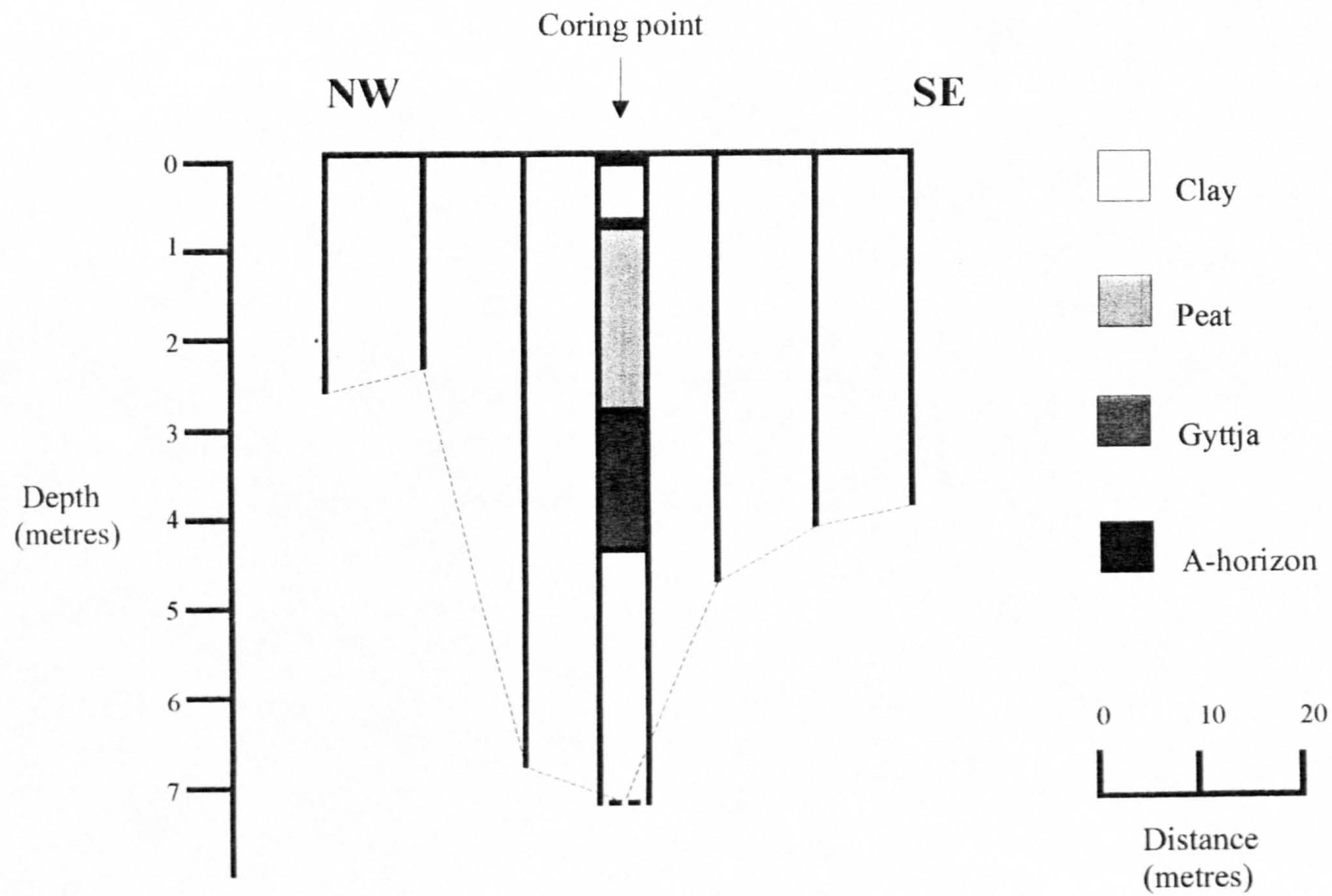
Publication code	**Sample depth (cm)**	**Sediment type**	**$\delta^{13}C_{PDB}$ ±0.1 %**	**Age (^{14}C BP ± 1 SD)**	**Age range (Cal BP; 1 SD)**	**Age range (Cal BC/AD; 1 SD)**
AA-30878	388.5-390.5	Gyttja	-31.4	9570±75	10900-10750	8950-8800
AA-30879	370.5-372.5	Gyttja	-31.6	9250±100	10500-10360	8560-8410
AA-30880	355.5-357.5	Gyttja	-31.7	9680±80	11190-11070	9240-9120
AA-30881	345.5-347.5	Gyttja	-31.6	9510±120	10880-10670	8930-8720
AA-30882	332.5-334.5	Gyttja	-30.6	9290±70	10580-10400	8630-8450
AA-30883	313.5-315.5	Gyttja	-29.1	8975±75	10220-10140	8270-8190
AA-30884	270.5-272.5	Herb peat with wood fragments	-30.2	8090±75	9130-8980	7180-7030
AA-30885	178.5-180.5	Herb peat with wood fragments	-27.9	6650±65	7580-7470	5630-5520
AA-30886	150.5-152.5	Gyttja	-28.7	2610±50	2780-2720	830-770
AA-30887	95.5-97.5	Gyttja	-29.3	1470±40	1390-1320	AD 570-630
AA-30888	56.5-58.5	Gyttja	-29.1	1210±40	1170-1070	AD 780-880

(iv) The Bog at Roos

Publication code	Sample depth (cm)	Sediment type	δ $^{13}C_{PDB}$ ±0.1 ‰	Age (^{14}C BP ± 1 SD)	Age range (Cal BP; 1 SD)	Age range (Cal BC/AD; 1 SD)
AA-32288	607-608	Gyttja	-34.0	10,000±120	11650-11240	9700-9290
AA-32289	583-584	Gyttja	-33.0	9525±90	10870-10690	8920-8740
AA-32290	549-550	Gyttja	-29.8	9010±85	10240-10150	8290-8200
AA-32291	494-495	Gyttja	-28.3	8735±85	9790-9590	7840-7640
AA-32299	434-435	Gyttja	-30.6	7930±70	8780-8640	6830-6690
AA-32292	379-380	Gyttja	-33.2	7525±65	8390-8320	6440-6370
AA-32293	317.5-318.5	Gyttja	-34.3	5290±90	6120-5990	4170-4040
AA-32294	275-276	Herb peat with some *Sphagnum*	-27.3	4495±60	5290-5160	3340-3210
AA-32295	241-242	Herb peat with some *Sphagnum*	-27.9	4400±80	5050-4860	3100-2910
AA-32296	153-154	Herb peat with some *Sphagnum*	-28.2	2660±50	2790-2750	840-790
AA-32300	132-133	Herb peat with some *Sphagnum*	-28.4	2100±60	2200-2130	180-50
AA-32297	101-102	Herb peat with some *Sphagnum*	-28.1	1720±50	1630-1560	AD 320-390
AA-32301	78-79	Herb peat with some *Sphagnum*	-28.2	1425±50	1350-1290	AD 600-660
AA-32298	49-50	Herb peat with some *Sphagnum*	-28.4	870±50	790-730	AD 1160-1220



Appendix 7a Cess Dell: depth transect along the NE-SW axis of the basin



Appendix 7b Cess Dell: depth transect along the NW-SE axis of the basin