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by

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Introduction

This report describes the results of pollen, plant macrofossil and fossil insect analysis on samples obtained from contexts associated with the remains of a Roman road at Whitland, Carmarthenshire. The samples were taken by the Dyfed Archaeological Trust from five sections exposed during the construction of a bypass around the town of Whitland.

Field work

Monoliths were taken from five locations. Whitland 1 is from a peat sequence immediately to the north of the road, while Whitland 2 (some 12 metres to the southwest) was obtained from a peat deposit that underlies the Roman road. The upper few centimetres of this sequence may be contemporaneous with an Iron Age trackway that also underlies the Roman roadway. Whitland 3 and Whitland 4 are adjacent samples from a trench at the western end of the site; column 3 underlies the Roman road, while column 4 lies beneath the Iron Age trackway 198. Finally, Whitland 5 was taken from a context at the eastern end of the excavation close to columns 1 and 2 and comprises sediment from a ditch infill adjacent to the Roman road. In addition five spot samples were taken for plant marofossil and insect analyses from ditch deposits and from deposits associated with drain structure 125.

The stratigraphy of the five contexts is as follows:

Whitland 1 (Section north of road)

0-11.5	cm	Well humified fibrous dark brown peat containing monocotyledenous remains. Fairly compacted. *Juncus* seeds abundant.
11.5-65	cm	Well humified dark brown woody peat with monocotyledenous remains. Bark, wood, roots, leaf scars and leaf fragments present. Quite compacted down to *c* 25cm but becoming more fibrous with larger pieces of wood, especially

		between 30-44cm. Increasingly compacted from 49cm. *Betula*, *Viola*, *Carex* and *Juncus* seeds. *Betula* female cone scales. Moss.
65-99	cm	Well humified more compacted fibrous woody peat. Wood, roots, bark and leaf fragments present. Monocotyledenous remains visible. *Betula*, *Alnus*, *Carex* and *Juncus* seeds. *Betula* cone scales. Bud scales.
99-123	cm	Light grey silty clay containing shaley stones. Orange brown iron pan in top cm. *Juncus* seeds present.

Whitland 2 (Under road and adjacent trackway 142 and drain structure 125 in Trench CS1)

0-4	cm	Large stone
4-6	cm	Fibrous dark brown peat. Monocotyledenous remains and wood present. *Sphagnum* moss abundant at 5cm.
6-7	cm	Band of grey clay.
7-13	cm	Greyish brown clayey peat becoming peatier with depth.
13-24	cm	Fibrous orange brown peat with monocotyledenous remains. *Sphagnum* moss and occasional bark, twigs and leaf fragments present. *Carex*, *Ranunculus*, *Potamogeton*, *Lycopus europaeus*, *Hydrocotyle*, *Betula*, *Potentilla* and *Juncus* seeds.
24-35	cm	Dark brown very fibrous peat with wood and monocotyledenous remains. *Carex*, *Viola*, *Hydrocotyle vulgaris*, *Potamogeton*, *Juncus*, *Ranunculus*, *Alnus*, *Betula*, *Lycopus europaeus* and Poaceae seeds.
35-40	cm	Orange-brown more compact peat. Fragment of *Alnus* wood *c*.37cm. *Potamogeton*, *Carex*, *Ranunculus* , *Betula* and *Juncus* seeds.
40-72	cm	Dark brown very fibrous peat with monocotyledenous and wood remains. Slightly clayey band 54.5-56.5cm *Alnus* wood fragment at 47cm. *Corylus* wood fragment at 64cm*Carex*, *Bidens cernua*, *Oxalis acetosella*, *Lychnis flos-cuculi*, *Sagina* , *Viola*, *Alnus* , *Betula*, *Callitriche*, *Cirsium*, *Rubus*, and *Juncus* seeds. *Betula* and *Alnus* cone-scales and buds and bud scales. Moss present. Charcoal.
72-78	cm	Brown peaty clay still quite fibrous.
80-100	cm	Greyish brown very silty peaty clay. Very fibrous with monocotyledenous remains. Wood, bark and leaf fragments. Stone present *c*. 88cm. *Alnus*, *Betula*, *Carex*, *Ranunculus*, *Viola*, *Sagina* and *Juncus* seeds. *Betula* female cone-scales. Charcoal.
100-110	cm	Dark brown slightly clayey woody peat. Still quite fibrous. Clay band at 105cm. Quartz present at 106cm. *Carex*, *Stellaria uliginosa*, *Betula* and *Juncus* seeds.
110-130	cm	Light grey clay with small angular stones. Plant remains present, including wood, bark and leaf fragments. Bud scales frequent. *Carex*, *Ranunculus*, *Oxalis acetosella*, *Betula* and *Juncus* seeds. Moss

Whitland 3 (Under road in Trench CS3)

0-10	cm	Light grey clay with iron staining. Contains stone fragments and large stone *c*. 1-8cm. *Juncus* seeds abundant.
10-40	cm	Light brownish-grey silty clay with plant remains. Slightly darker below 23cm, ie more organic. *Juncus* seeds abundant and *Carex*, *Hypericum*, *Ranunculus*, *Potentilla* and *Potamogeton* seeds present. Occasional *Sphagnum* leaf.
40-46	cm	Brown organic clay with monocotyledenous remains. *Juncus* seeds frequent. Charcoal.
46-50.5	cm	Brownish-grey clay. *Juncus* seeds frequent.
50.5-81 peaty	cm	Yellowish-brown organic clay with monocotyledonous remains. Flecks of material. Occasional woody root and bark. *Juncus* seeds. Charcoal.

81-105	cm	Brown organic clay with plant remains. Small stones present, becoming grittier towards base. Wood, buds and bud-scales frequent. *Stellaria uliginosa. Ranunculus, Carex,* Poaceae and *Juncus* seeds. Moss present. Charcoal
105-122	cm	Crumbly shale bedrock with clay and iron staining

Whitland 4 (Under trackway 198 in Trench CS3)

0-7	cm	Grey brown sticky clay. Plant remains visible. *Juncus* seeds frequent.Charcoal present.
7-22	cm	Dark yellowish grey gritty clay with small stones. Larger stones *c.* 18-22cm. Charcoal.
22-24	cm	Orange grey fine clay
24-25.5	cm	Dark yellowish grey gritty clay with small angular stones. *Juncus* seeds.
25.5-45	cm	Yellowish brown organic clay with plant remains. Occasional monocotyledon and woody remains. *Juncus* seeds.
45-84	cm	Light yellowish grey clay with plant remains. Flecks of peaty material. Iron staining *c.* 65.5-76.5cm Wood remains frequent 76.5-84cm. *Juncus* seeds. Charcoal.
84-86	cm	Orange-grey gritty silty clay

Whitland 5 (Northern Ditch)

0-20	cm	Light grey silty clay with orange flecks of iron. Very gritty 14-18cm. *Juncus* seeds present, particularly abundant *c.* 20cm..
20-28	cm	Brownish-grey silty clay with orange lenses of iron staining. *Juncus* , Poaceae, *Potamogeton* and *Stellaria uliginosa* seeds and macroscopic charcoal present.
28-40	cm	Very gritty grey silty clay with layers of orange iron staining.
40-59	cm	Grey silty clay with dark/light grey lenses becoming increasingly brown and organic downwards. Monocotolyedon remains and *Juncus* seeds present.
59-66	cm	Very gritty grey silty clay with quartz pebbles. Monocotyledon remains visible and Poaceae, *Ranunculus* subgenus *Batrachium, Stellaria uliginosa*, *Juncus* and *Potamogeton* seeds. *Pteridium aquilinum* leaf fragments.
66-72	cm	Grey silty clay with dark/light lenses. *Juncus* and *Ranunculus* Subgenus *Batrachium* seeds present as well as monocotyledon remains.
72-80	cm	Grey silty clay with iron staining. Small quartz pebbles. *Pteridium* leaf and moss fragments.
80-91	cm	Light grey sticky clay with darker lenses of peaty material. *Pteridium* leaf fragments, *Potentilla,Carex* and*Juncus* seeds, bud and deciduous leaf fragments. Occasional *Sphagnum* leaf.
91-101	cm	Dark brown fibrous woody peat. *Juncus* and *Carex* seeds.

Laboratory work

(a) Pollen analysis

Subsamples for pollen analysis were removed from the monoliths at 5 cm intervals. These were treated using conventional procedures (Moore *et al.*, 1991), including disaggregation in 10% KOH followed by Erdtman's acetolysis preceded, where necessary, by heating in 40% HF. The residues were mounted in safranin-stained glycerine jelly and counted on a Vickers MlSC microscope at x400 magnification, with critical identifications under oil at x1000. The state of preservation of the pollen was generally good, and a sum of 300 grains was achieved for all levels.

The results of the pollen analyses are shown in Figures 1-5 in which nomenclature follows Stace (1991) and Bennett *et al.* (1994). The pollen diagrams from the five profiles, which have been prepared using TILIA and TILIA.GRAPH (Grimm, 1991), have been divided into Local Pollen Assemblage Zones (LPAZs) on the basis of fluctuations in the curves for the principal pollen taxa. Inferred relationships between the local pollen assemblage zones in the pollen diagrams is shown in Table 1.

(b) Plant macrofossil analysis

Subsamples were extracted from the spot bulk samples taken from the ditch and drain structure deposits. Initially 250g from each sample were processed. Following preliminary examination the sample size of the two richest samples was increased by a further 250g to 500g. The samples were allowed to soak in water to which hydrogen peroxide was added, because of the minerogenic nature of the samples, prior to washing through a nest of sieves with 2 mm, 1 mm, 500μ and 250μ meshes. In addition the sievings retained on the 108 micron mesh during the pollen preparations as well as a few larger samples, removed separately from the pollen monoliths, were rapidly scanned for plant remains to supplement the stratigraphic and pollen data.. Plant macrofossils were identified using a Wild M5 stereo-microscope. Identification was by comparison with modern reference material and standard identification texts, including Berggren (1969, 1981) and Schoch *et al.* (1988). Nomenclature follows Stace (1991) and Smith (1978). The plant macrofossil results from the spot samples are presented in Table 2. The plant macrofossil results from the pollen monolith samples are incorporated in the stratigraphic descriptions.

(c) Fossil insect analysis

Five samples of organic sediment from ditches and drainage fills associated with the Roman road were analysed for insect remains. Sub-samples of 1.0 kg from each were washed onto a 0.20 mm sieve, subjected to paraffin flotation and the flots scanned. Insect remains were recovered from four of the samples, but only Context 009 from the fill of a ditch, contained a sufficiently high concentration for more detailed analysis. A further 4.0 kg of this sample was similarly processed and both flots from this sample were fully sorted. The results are given in Tables 3 and 4. The nomenclature of the Coleoptera follows Kloet & Hincks (1977). The few insects noted from Contexts 0025, 0026 and 0027 were all species also recorded from Context 009.

Radiocarbon dating

After the pollen analytical work had been completed, six biostratigraphic horizons from the two most detailed pollen diagrams, Whitland 1 and Whitland 2, were selected for radiocarbon

dating. At each level, a slice of sediment approximately 2 cm in thickness was cut from the monolith and despatched to the Radiocarbon Dating Laboratory at BETA Analytic in Miami, USA. The results of the radiocarbon assays are listed in Table 5 and the dates are also shown at the appropriate levels on the pollen diagrams (Figures 1 & 2).

Pollen data

Whitland 1

LPAZ W1-a:	*Alnus-Quercus-Corylus* (Below 77.5 cm)
Characteristics:	A biozone dominated by *Alnus*, with significant counts for *Quercus* and *Corylus avellana* type.
Vegetation:	An alder scrub, probably on wetter substrates, with hazel and oak on drier areas nearby
Chronology:	Base of paz: 4700 ± 70 BP (Beta 98684) Top of paz: c. 4065 BP (interpolated)
LPAZ W1-b:	*Corylus-Alnus-Quercus-Betula* 77.5-32.5 cm)
Characteristics:	A biozone dominated by *Corylus avellana* type with significant counts for *Quercus* , *Alnus* and *Betula*
Vegetation:	Expansion of hazel scrub, with stands of birch and oak. Alder was present but less abundant - perhaps reflecting drier conditions locally.
Chronology:	Base of paz: c. 4065 BP (interpolated) Top of paz: c. 2670 BP (interpolated)
LPAZ W1-c:	*Corylus-Alnus-Quercus-Betula* - Poaceae (32.5-12.5 cm)
Characteristics:	A biozone dominated by *Corylus avellana* type with significant counts for *Quercus* , *Alnus*, *Betula* and Poaceae.
Vegetation:	This biozone reflects a phase of woodland clearance, and the expansion of grassland habitats. Characteristic open-ground herbs include *Plantago lanceolata* (evidence of human impact?), *Potentilla*, *Anthemis* type, *Aster* type, Lactuceae and *Rumex*.
Chronology:	Base of paz: c. 2670 BP (interpolated) Top of paz: c. 1935 BP (interpolated) Radiocarbon date of 2130 ± 70 BP (Beta 98683) at 15 cm
LPAZ W1-d:	Poaceae (12.5-0 cm)
Characteristics:	A biozone dominated by Poaceae, with *Corylus avellana* type, *Betula*, *Quercus* and *Alnus*.

Vegetation: This biozone reflects an acceleration in the rate of woodland clearance, with the further expansion of grassland habitats. Characteristic open-ground herbs include similar to those in W1-c

Chronology: Base of paz: c. 1935 BP (interpolated)
Top of paz: 1030 ± 60 BP (Beta 98682)

Whitland 2

LPAZ W2-a: *Alnus-Quercus-Corylus* (Below 112.5 cm)

Characteristics: A biozone dominated by *Alnus*, with significant percentages of both *Quercus* and *Corylus avellana* type.

Vegetation: An alder scrub, probably on wetter substrates, with hazel and oak on drier areas nearby

Chronology: Base of paz: c. 4500 BP (interpolated)
Top of paz: c. 4150 BP (interpolated)

LPAZ W2-b: *Corylus-Alnus-Quercus* (112.5-67.5 cm)

Characteristics: A biozone dominated by *Corylus avellana* type with *Quercus*, *Alnus* and *Betula. Salix* is also present.

Vegetation: Expansion of hazel scrub, with stands of birch, oak and willow. Alder was present but less abundant. again perhaps reflecting drier conditions locally.

Chronology: Base of paz: c. 4150 BP (interpolated)
Top of paz: c. 2540 BP (interpolated)
Radiocarbon dates of 4080 ± 70 BP (Beta 98687) at 109 cm.and 2570 ± 70 BP (Beta 98686) at 71 cm

LPAZ W2-c: Poaceae (67.5-5 cm)

Characteristics: A biozone dominated by Poaceae, with Alnus *Corylus avellana* type, *Quercus* and Cyperaceae. *Pteridium* is also present in consistent frequencies.

Vegetation: This biozone reflects a phase of woodland clearance, with the expansion of grassland habitats. Characteristic open-ground herbs include *Plantago lanceolata* , *Plantago coronopus*, *Potentilla*, Caryophyllaceae *Aster* type, Lactuceae and *Ranunculus*. Bracken (*Pteridium*) was also common locally.

Chronology: Base of paz: c. 2540 (interpolated)
Top of paz: 1970 ± 70 BP (Beta 98685)

Whitland 3

LPAZ W3-a: *Quercus-Corylus -Alnus* (Below 62.5 cm)

Characteristics: A biozone dominated by *Quercus* and *Corylus avellana* type with significant counts for *Alnus*.

Vegetation: The pollen spectra reflect the presence of extensive stands of oak woodland, with hazel on more open sites and alder locally present on wetter substrates

LPAZ W3-b: *Corylus-Quercus-Alnus* (62.5-22.5 cm)

Characteristics: A biozone dominated by *Corylus avellana* type with significant counts for *Quercus* , *Alnus* and *Betula* . Poaceae is also present in the middle and upper levels of the zone.

Vegetation: An episode of hazel scrub, with stands of birch and oak. Alder was present locally, and birch was also a component of the nearby wood and scrubland.

LPAZ W3-c: *Corylus*-Poaceae (with *Alnus* and *Quercus*) (22.5-0 cm)

Characteristics: A biozone still dominated by *Corylus avellana* type, but Poaceae is also abundant, along with *Quercus* and *Alnus*.

Vegetation: This biozone reflects the continued presence of hazel and oak wood and scrub, but with areas of open grassland within and around the woodland stands. Characteristic open-habitat taxa include *Plantago lanceolata*, *Potentilla*, Lactuceae and *Pteridium*.

Whitland 4

LPAZ W4-a: *Quercus-Corylus -Alnus* (Below 22.5 cm)

Characteristics: A biozone dominated by *Quercus* and *Corylus avellana* type, along with *Alnus*.

Vegetation: Oak and hazel woodland, with alder on wetter sites

LPAZ W4-b: Poaceae-*Corylus* (22.5-0 cm)

Characteristics: A biozone dominated by Poaceae, with *Corylus avellana* type, *Quercus* and *Alnus*.

Vegetation: This biozone reflects a phase of woodland clearance, with the expansion of grassland habitats. Characteristic open-ground taxa include *Plantago lanceolata* , Lactuceae, *Ranunculus* and *Potentilla*. Bracken was also abundant locally, and there is evidence of local heathland (*Calluna vulgaris*).

Whitland 5

LPAZ W5-a:	*Alnus* (Below 92.5 cm)
Characteristics:	A biozone dominated by *Alnus*, with small numbers of *Quercus* and *Corylus avellana* type.
Vegetation:	An alder scrub, probably on wetter substrates, with hazel and oak on drier areas nearby
LPAZ W5-b:	Poaceae-*Corylus-Alnus* (92.5-0 cm)
Characteristics:	A biozone characterised by a rising curve for Poaceae, with *Corylus avellana* type, *Betula*, *Quercus* and *Alnus* also present.
Vegetation:	This biozone reflects a phase of woodland clearance, with the expansion of grassland habitats, but with stands of alder, hazel, oak and birch still present in the vicinity. Characteristic open-ground herbs include *Plantago lanceolata* , Plantago coronopus, *Potentilla*, Lactuceae and *Ranunculus. Pteridium* was also abundant locally.

Correlation between the Local Pollen Assemblage Zones (Table 1) suggests that at Whitland 4 and 5, the equivalent of biozones W1b, W-2b and W3-b recorded at Whitland 1, 2 and 3 respectively is missing. This accords with the lithostratigraphic evidence which points to an unconformity in the former two profiles. In Whitland 4 the fine clays in the upper part of the profile are interrupted around 24-25 cm by a more gritty horizon with small stones, the precise nature of which is unclear, but it clearly marks an interruption in the accumulation of otherwise exclusively fine-grained sediment. Either an interval of non-deposition or an erosional episode may be reflected in this distinct stratigraphic change.In Whitland 5, there is a clear break at *c.* 91 cm between the overlying grey clays and basal peats, which marks the interface between the natural peat and later ditch deposits. In terms of the vegetational sequence, therefore, these stratigraphic breaks mean that the episode of hazel wood and scrub recorded in W1-b, W2-b and W3-b is not preserved in the pollen diagrams from Whitland 4 and 5.

Plant macrofossil data

The plant macrofossil results from the pollen monoliths will be considered first followed by the evidence from the spot samples.

The results from Whitland 1 reflect the nature of the local peat and hence the local plant community. The lowest deposits are minerogenic and contain few plant remains, only the occasional *Juncus* (rush) seed. The peat deposits above are woody with fragments of bark, wood, roots and leaf fragments as well as seeds of *Alnus* (alder) and *Betula* (birch). *Betula* cone-scales

are also present. Herbaceous plants are represented by seeds of *Carex* (sedge) and *Juncus* (rush). Higher in the stratigraphy *Juncus* dominates with the occasional *Carex* seed. The evidence suggests birch-alder carr woodland with an understorey of sedges and rushes which is later replaced by a more open environment dominated by rushes and sedges.

Although the stratigraphic sequence is slightly more complicated in Whitland 2, again the occurrence of woody remains and *Betula* and *Alnus* seeds and cone-scales throughout much of the profile indicates the existence of woodland locally. Further confirmation of this is the presence of seeds of *Oxalis acetosella* (wood sorrel), a species commonly found in woods and often on humus but tending to avoid particularly wet soils. Occasional charcoal indicates indicates some burning of woodland either as a result of natural or human agencies. However, the generally wet nature of the immediate area is demonstrated by *Carex*, *Juncus* and *Bidens cernua* (nodding bur-marigold) seeds. The last species is generally found besides ponds and streams and in marshy areas. *Lychnis flos-cuculi* (ragged robin) is another plant of marshy ground and seeds of*Viola* (violet) may represent *Viola* species found in such an environment.

In the upper part of the stratigraphy there is evidence for wet conditions with the appearance of *Potamogeton* (pondweed) seeds, indicating the presence of pools of standing water. *Hydrocotyle vulgaris* (marsh pennywort) and *Lycopus europaeus* (gypsywort), which grow in fens, are also represented. Immediately below the road there is evidence for a thin layer of *Sphagnum* moss. The evidence intimates fairly open and very wet marshy ground.

The deposits from the remaining columns were essentially minerogenic in nature with a varying degree of organic material. *Juncus* seeds throughout the deposits in Whitland 3 suggest wet rushy ground in the vicinity. In the upper deposits below the road seeds of *Juncus*, *Carex*, *Ranunculus, Hypericum (St John's wort), Potentilla* (tormentil)and *Potamogeton* and the occasional *Sphagnum* leaf occur, an assemblage not dissimilar to the ground flora assemblage from the upper deposits of Whitland 2. The evidence suggests wet marshy ground, perhaps with a small stream or pools.

Plant remains were scarce from Whitland 4 and only seeds of *Juncus* were recorded, again reflecting wet/damp rushy ground. In contrast there was a greater variety of seeds from Whitland 5 taken through ditch deposits on the northern side of the road. The lowest deposits comprised a woody peat into which the ditch had been cut. Seeds present in the ditch deposits included aquatics such as *Potamogeton* and *Ranunculus* subgenus *Batrachium* (crowfoots). *Stellaria uliginosa* (bog stitchwort) and Poaceae (grass) seeds and *Pteridium aquilinum* (bracken) leaf fragments probably reflect the vegetation growing on the ditch sides or close to the ditch.

The plant macrofossil assemblages from the larger spot samples from the ditch deposits are similar to that from Whitland 5, although a greater range of species is present. Many of the taxa are indicative of the ditch environment itself. *Callitriche* (water-starwort), *Potamogeton*, *Ranunculus* subgenus *Batrachium* and *Ranunculus flammula* type (spearwort) reflect the presence of standing water. Other species such as *Juncus*, *Luzula* (wood-rush), Poaceae and the Carices may represent rushes, grasses and sedges either growing on the ditch sides or the environment close to the ditch. A number of other taxa are typical of grassland environments, including *Hypericum*, *Prunella vulgaris (selfheal),*, *Hypochaeris radicata* (cat's ear), *Rumex acetosella* (sheep's sorrel) and *Potentilla erecta*. (tormentil). A few species such as *Urtica dioica* (common nettle), *Chenopodium album* (fat-hen) and *Aphanes arvensis* (parsley-piert) could indicate cultivation in the area but their presence may equally be due to the existence of bare ground and disturbed habitats. Seeds of *Betula* and *Alnus* suggest the continued occurrence of some birch and alder woodland locally.

The remaining two spot samples were from deposits associated with drain structure 125 and contained a similar range of plant remains to that from the ditches, but comparatively few. The only species recorded not found in the other samples was *Persicaria lapathifolia* (pale persicaria), a species sometimes indicative of cultivation but also found on waste ground and especially damp ground, often beside water.

Fossil insect data

The insects from Context 009 suggest that the ditch held stagnant water. The more numerous Coleoptera included *Helophorus* cf. *brevipalpis* and *Limnebius* cf. *papposus*, beetles which readily colonize stagnant water. Larval remains of Trichoptera (caddis flies) and Chironomidae (midges) were also present. Some indication of aquatic vegetation in the ditch was given by *Plateumaris discolor* or *sericea*, which feeds on Cyperaceae (sedges) and *Prasocuris phellandrii*, which feeds on aquatic Umbelliferae such as *Oenanthe* spp. (water dropwort).

The majority of the Coleoptera had been derived from the terrestrial environments alongside the ditch. They included Carabidae (ground beetles) such as *Trechus obtusus* or *quadristriatus* and *Calathus melanocephalus* which occur in a range of habitats whereas *Pterostichus diligens* and *P. nigrita* favour damp ground. One species, *Pterostichus niger*, is generally regarded as a woodland beetle, but under the more humid conditions of Wales and Northern England, it also occurs in grassland and on arable land.

Some weedy ground was present in the vicinity of the ditch. The most numerous phytophagous beetle was *Brachypterus* sp., which feeds on *Urtica dioica* (stinging nettle). Other phytophagous beetles included *Gastrophysa viridula*, which feeds on *Rumex* spp. (dock) and the

elaterids *Cidnopus aeruginosus* and *Agriotes* sp., whose larvae feed on the roots of grassland herbs. The grass-feeding bug *Aphrodes* sp. was also present. The only indication of trees or shrubs came from a single specimen of the bug *Aphrophora* sp., which feeds on a variety of such plants.

About 25% of the terrestrial Coleoptera were scarabaeoid dung beetles from the genera *Geotrupes*, *Aphodius* and *Onthophagus*, the most numerous being *A. contaminatus*. They feed on the droppings of larger herbivores, including domestic animals on pastureland. Such a high value would suggest that domestic arrivals were concentrated in the vicinity of the site (Robinson 1991, 278-80). One of these beetles, *Onthophagus nutans*, which was represented by a single elytral fragment, is now extinct in Britain. However, there are other archaeological records of it and it survived as a member of the British insect fauna well into the 19th century (Allen and Robinson 1993, 138).

The insects gave no evidence for the proximity of human settlement. Synanthropic species were entirely absent and the beetles of decaying organic material such as *Cercyon ustulatus* and *Megasternum obscurum* would have found suitable habitats in plant debris on the edge of the ditch or in the dung.

Discussion

The three different types of palaeoecological evidence (pollen, plant macrofossils and fossil insect remains) from the various contexts associated with the Roman road, and with the underlying Iron Age trackway, combine to provide a remarkably coherent (and consistent) picture of vegetation and local environment in the period leading up to the construction of the road. Indeed, some of the pollen diagrams contain a record of vegetational history extending back into the Bronze Age and Neolithic periods, commencing shortly after the 'elm decline'. At that time, this part of South Wales was covered by a mixed oak woodland, with stands of birch and hazel on more open sites and extensive thickets of alder and willow in damper localities. Gradual clearance of the woodland resulted in the expansion first of hazel, a notably light-demanding species, presumably onto ground that had formerly been occupied by mixed woodland taxa, and subsequently by grassland plants. The evidence suggests that this increase in areas of grassland began during the early Iron Age with a further marked expansion during the later Iron Age/Romano-British period so that by the time of road construction, extensive areas of open ground existed in the vicinity. However, the pollen record does indicate that some arboreal and scrub stands were still present in the area, and that these continued into the medieval period. There are strong suggestions that the clearance of the forest was an anthropogenic phenomenon, for the decline in woody plant pollen is accompanied by an increase in all of the pollen profiles by taxa associated with agricultural activity.

Herbaceous plants found today growing in short-turf communities, and hence typically correlated in prehistoric pollen records with pastoral activity, include, *inter alia*, *Plantago lanceolata*, *Plantago coronopus*, and species of *Ranunculus*, *Potentilla*, *Anthemis*, *Aster* and Lactuceae. Interestingly, there are only isolated grains of Cerealia-type pollen, which suggests that pastoral rather than arable was the dominant form of prehistoric farming practiced in the area and that this continued through into historical times.

This reconstruction based on the palynological evidence is strongly supported by both the plant macrofossil and fossil insect records. The plant macrofossils from the peats confirm the presence of carr woodland locally throughout most of the period. The evidence from the deposits below the road indicate clearly the wet marshy conditions the builders of the trackways and the road had to contend with in this particular area. Plant remains from the ditch and drain suggest a largely grassland environment was contemporary with construction of the road. As was noted above, the Coleoptera recovered from the ditch deposit are typically associated with grassland habitats, and only a very few are characteristic of woody environments. Moreover, around one quarter of the terrestrial Coleoptera are dung beetles, which corroborates the pollen evidence which suggests that a well-established pastoral economy was operating in the area in the period prior to the construction of the Roman road. The dates suggest that this type of farming was of some antiquity, the first indications in the pollen record dating to the Bronze Age.

Unfortunately, there are few other palynological records from lowland south-west Wales with which these sequences can be compared, for Donald's (1987) evidence focuses more on the early and middle Flandrian, while Seymour's (1985) data are from sites on the Preseli uplands some distance to the north. The nearest published pollen diagram is from Llanllwch immediately to the west of Carmarthen (Thomas, 1965), and some 15 km to the east of the Whitland sites. There, a raised bog contains a vegetational record which appears to extend up into the Norman period. The evidence from Llanllwch is in close agreement pointing to a relatively low level of agricultural activity during the Neolithic but a marked intensification during the Iron Age and Romano-British periods. Interestingly, cereal pollen is relatively well-represented in that profile, by contrast with the records from the Whitland sites, suggesting significant variations in prehistoric land-use in this part of south-west Wales. There are, however, a number of similarities between the Whitland records and those obtained from the Bryn Farm profiles, some 2-3 km to the west of Whitland, and which also underlie the Roman road (Caseldine, in preparation). The upper parts of the Bryn Farm sequence also show an alder phase succeeded by a wood and scrub episode (this time dominated by birch rather than hazel) followed, in turn, by the demise of woodland and the expansion of grassland. As in the Whitland diagrams, the rise in Poaceae pollen is accompanied by an increase in 'agricultural weeds'. Again, however, there are no indications of arable activity. In

contrast to Whitland, at Bryn Farm, the onset of woodland decline dates to the Late Neolithic (*c.* 4100 ^{14}C yrs BP).

Conclusions

1. Pollen, plant macrofossil and fossil insect data provide a detailed environmental record for the period leading up to the construction of the Whitland Roman road.
2. The evidence points to the existence of a landscape of mixed woodland during the Neolithic.
3. Woodland clearance may have begun in Neolithic times, with the removal of broad-leaved trees, and ultimately of hazel and alder scrub.
4. A pastoral economy, reflected in all of the proxy records, was established in the area during Bronze Age times.
5. There is no unequivocal evidence of arable farming in any of the records.
6. The Roman road as constructed across a predominantly open grassland landscape, but stands of oak, hazel, alder and birch were also present in the vicinity.

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Table 1: Correlation of local pollen assemblage zones

Whitland 1	Whitland 2	Whitland 3	Whitland 4	Whitland 5
W1-d				
W1-c	W2-c	W3-c	W4-b	W5-b
W1-b	W2-b	W3-b		
W1-a	W2-a	W3-a	W4-a	W5-a

Table 2: Plant macrofossil data

	South Ditch	South Ditch	North Ditch	Drain 125	Drain 125
Sample	**8**	**9**	**25**	**26**	**27**
Context	**120**	**115**	**179**	**139**	**140**
Taxa					
Ranunculus sp. (Buttercup)	1	-	2	-	-
Ranunculus flammula type (Lesser spearwort)	2	93	26	1	1
Ranunculus Subgenus *Batrachium* (CD.) A. Gray (Crowfoots)	1	3	14	-	-
Urtica dioica (Common nettle)	-	1	4	-	-
Betula sp. (Birch)	-	-	5	-	-
Alnus glutinosa (L.) Gaertner (Alder)	-	4	1	-	-
Chenopodium album L. (Fat-hen)	-	-	1	-	-
Stellaria media (L.) Villars (Common chickweed)	-	2	-	-	-
Stellaria uliginosa Murray (Bog stitchwort)	-	13	39	1	-
Cerastium sp. (Mouse-ears)	1	5	6	-	-
Sagina sp. (Pearlworts)	-	5	17	-	1
Lychnis flos-cuculi L. (Ragged-robin)	-	2	-	-	-
Persicaria lapathifolia (L.) Gray (Pale persicaria)	-	-	-	-	1
Rumex acetosella L. (Sheep's sorrel)	1	5	3	-	-
Hypericum sp. (St. John's-worts)	2	47	7	2	3
Viola sp. (Violets)	-	25	3	-	-
Cardamine flexuosa type (Wavy bitter-cress)	-	8	-	-	-
Erica tetralix L. (Cross-leaved heath)		1	-	-	-
Rubus fruticosus agg. (Brambles)	-	2	-	-	-
Potentilla erecta (L.) Raeusch (Tormentil)	1	20	6	-	1
Aphanes arvensis agg. (Parsley piert)	-	-	3	-	1
Ulex sp. (Gorse) Leaf frags.	-	-	7	-	-
Epilobium hirsutum type (Great willowherb)	-	1	-	-	-
Myosotis sp. (Forget-me-nots)	-	5	10	-	-
Prunella vulgaris L.	-	2	-	-	-

(Selfheal)					
Lycopus europaeus L.	-	4	-	-	-
(Gypsywort)					
Mentha sp.	-	3	-	-	-
(Mints)					
Callitriche sp.	1	138	1043	-	5
(Water-starworts)					
Veronica sp.	-	-	6	-	-
(Speedwells)					
Cirsium spp.	-	13	-	-	-
(Thistles)					
Hypochaeris radicata L.	-	-	1	-	-
(Cat's-ear)					
Potamogeton spp.	2	130	6	5	1
(Pondweeds)					
Juncus spp.	172	1006	855	12	112
(Rushes)					
Juncus spp.	5+7frags	37	6	-	-
Capsules					
Luzula sp.	-	3	-	-	-
(Wood-rushes)					
Isolepis setacea (L.) R. Br.	-	5	1	-	-
(Bristle club-rush)					
Carex spp. - biconvex	1	142	6	2	-
(Sedges)					
Carex spp. - trigonous	-	76	3	1	1
Poaceae > 2mm	3	34	71	-	-
(Grasses)					
Poaceae <2mm	9	50	129	7	6
Poaceae	2	-	-	-	-
Glume frags.					
Tree buds	-	1	-	-	-
Pteridium aquilinum (L.) Kuhn	40	3	-	-	-
(Bracken) Leaf. frags.					
Sphagnum sp.leaves	-	5	-	-	-
Moss n.f.i.	-	+	-	-	+

Table 3: Coleopteran data

	Context 009 Minimum no. of indiv.
Trechus obtusus Er. or *quadristriatus* (Schr.)	1
Pterostichus diligens (Sturm)	3
P. niger (Schal.)	1
P. nigrita (Pk.)	1
P. cupreus (L.) or *versicolor* (Sturm)	1
Calathus fuscipes (Gz.)	2
C. melanocephalus (L.)	1
Agonum muelleri (Hbst.)	1
Amara cf. *consularis* (Duft.)	1
Haliplus sp.	1
Hydroporus sp.	1
Agabus bipustulatus (L.)	1
Hydrochus sp.	2
Helophorus sp. (*brevipalpis* size)	9
Coelostoma orbiculare (F.)	3
Cercyon ustulatus (Preys.)	2
Megasternum obscurum (Marsh.)	1
Hydrobius fuscipes (L.)	1
Anacaena globulus (Pk.)	4
Laccobius sp.	3
Enochrus sp.	1
Chaetarthria seminulum (Hbst.)	3
Limnebius cf. *papposus* Muls.	6
Silpha atrata L.	1
Olophrum fuscum (Grav.) or *piceum* (Gyl.)	1
Lesteva longoelytrata (Gz.)	3
Stenus spp.	2
Anotylus rugosus (F.)	1
Lathrobium sp.	1
Xantholinus linearis (Ol.) or *longiventris* Heer	1
Erichsonius sp.	1
Philonthus sp.	2
Tachyporus sp.	1
Aleocharinae indet.	1
Geotrupes sp.	1
Aphodius contaminatus (Hbst.)	10
A. cf. *sphacelatus* (Pz.)	4
Onthophagus nutans (F.)	1
Onthophagus sp. (not *nutans*, *ovatus* or *taurus*)	1
Phyllopertha horticola (L.)	1
Dascillus cervinus (L.)	1
Dryops sp.	1
Cidnopus aeruginosus (Ol.)	1
Agriotes sp.	1
Cantharis sp.	1
Brachypterus sp.	5
Corticariinae indet.	1
Plateumaris discolor (Pz.) or *sericea*(L.)	2

Gastrophysa viridula (Deg.)	1
Prasocuris phellandrii (L.)	1
Galerucella sp.	1
Phyllotreta vittula Redt.	1
Longitarsus sp.	1
Sitona sp.	1
Bagous sp.	1
Total	103

Table 4: Other Insects

		Context 009 Minimum no. of indiv.
Aphrophora sp.		1
Aphrodes sp.		2
Aphidoidea indet.		2
Homoptera indet.		3
Trichoptera indet.	- larva	5
Myrmica sp.	- worker	1
Lasius sp. (not *fuliginosus*)	- female	1
Lasius sp. (not *fuliginosus*)	- worker	1
Hymenoptera indet.		2
Chironomidae indet.	- larva	+
Diptera indet.		1

Table 5: Radiocarbon dates

Sample Depth	Laboratory number	Radiocarbon date (BP)
Whitland 1		
0-2 cm	Beta-98682	1030 +/- 60
14-16 cm	Beta-98683	2130 +/- 70
99-100 cm	Beta-98684	4700 +/- 70
Whitland 2		
4-6 cm	Beta-98685	1970 +/- 70
70-72 cm	Beta-98686	2570 +/- 70
108-110 cm	Beta-98687	4080 +/- 70

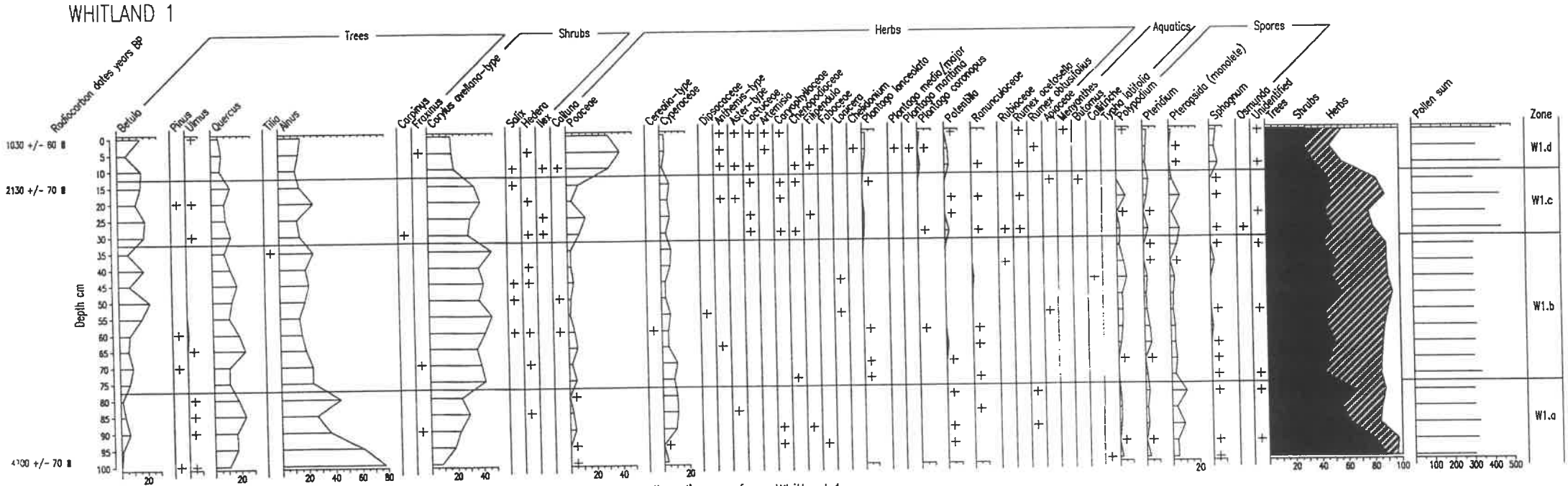

Figure 1: Percentage pollen diagram from Whitland 1

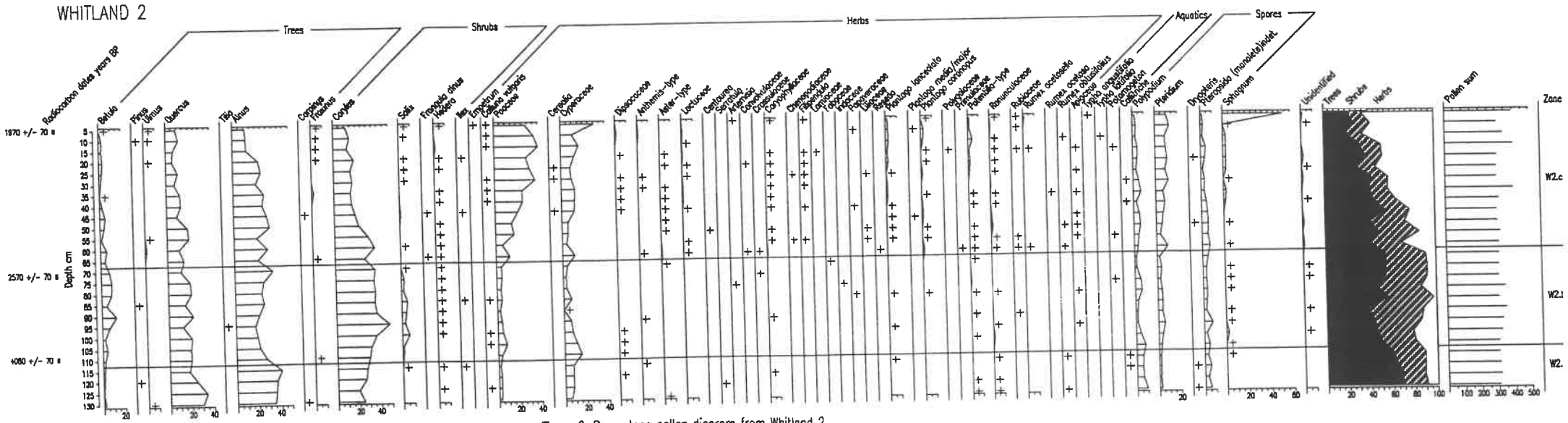

Figure 2: Percentage pollen diagram from Whitland 2

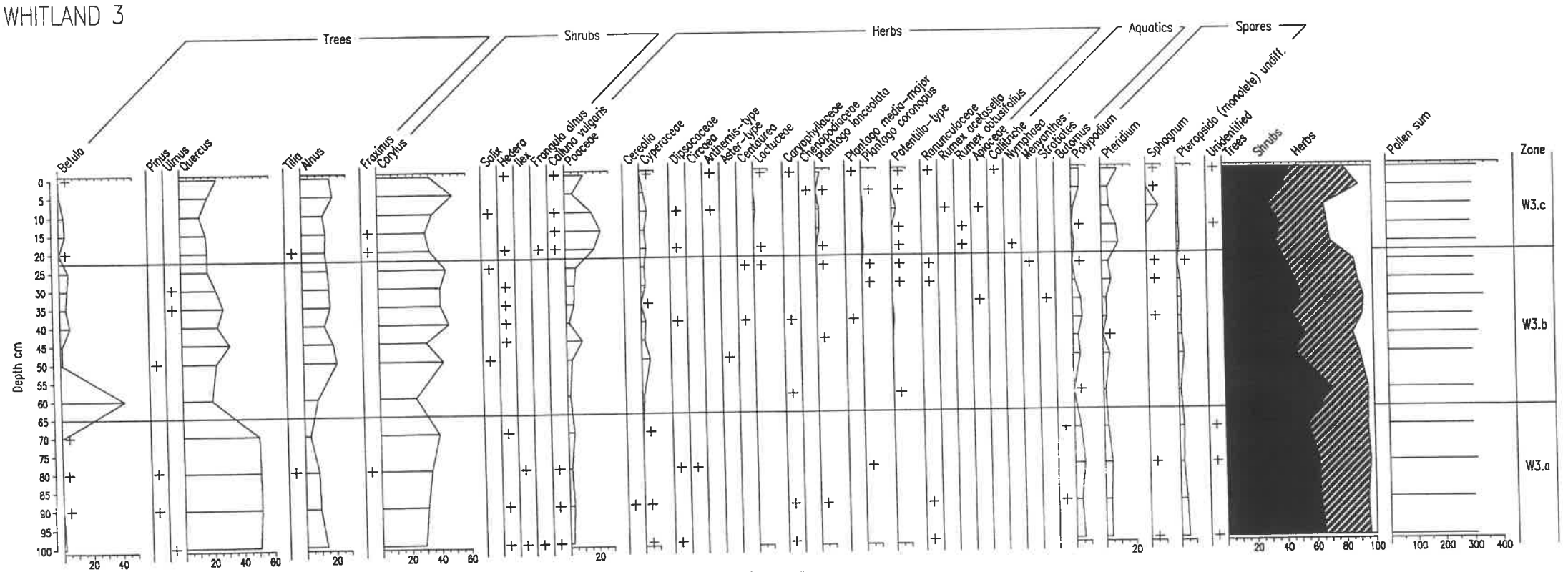

Figure 3: Percentage pollen diagram from Whitland 3

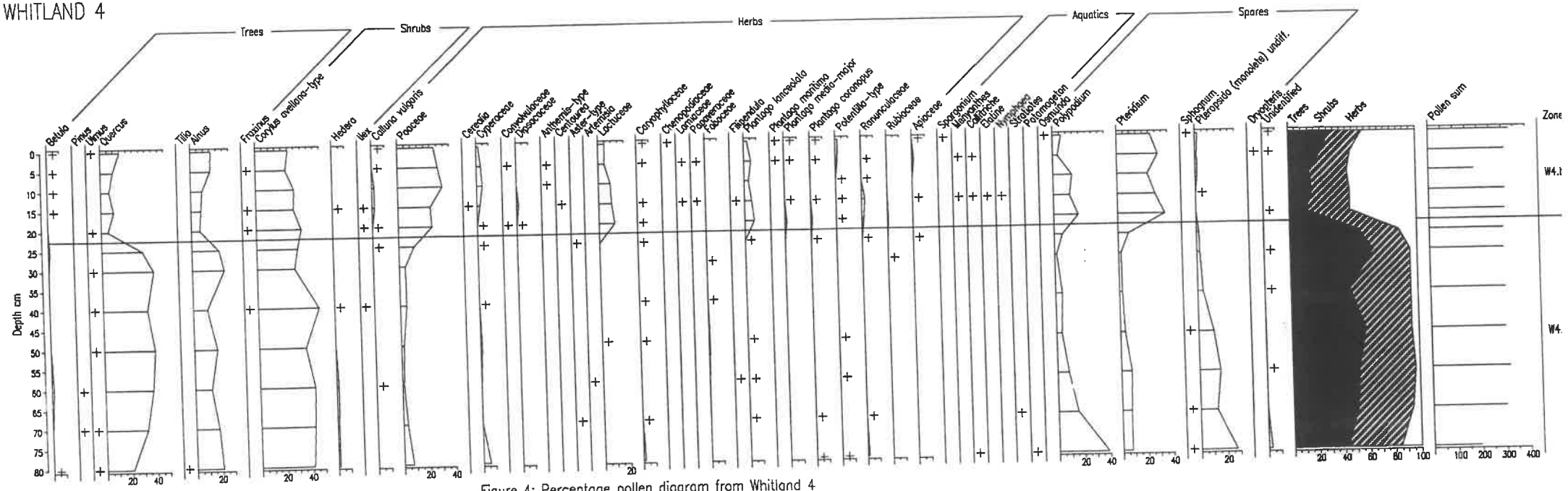

Figure 4: Percentage pollen diagram from Whitland 4

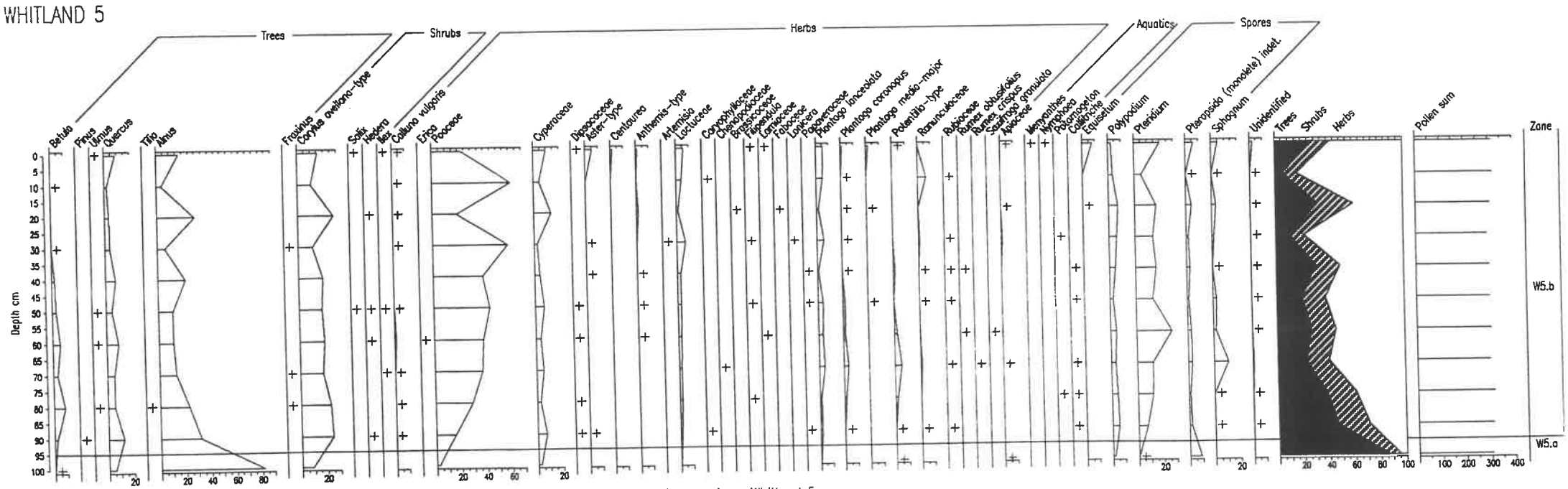

Figure 5: Percentage pollen diagram from Whitland 5