

# Ringwood A31 (WS603): Pollen analysis

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## **1.) Introduction**

A palynological analysis has been carried out on samples taken from excavation on the A31 (WS603). This site was perceived as having potential for pollen analysis and from this, the reconstruction of palaeo-environments. A preliminary investigation was undertaken to establish if sub-fossil pollen and spores are present in this sediment profile. This proved to be the case (Langdon and Scaife 2022) and a more detailed investigation has been carried out including radiocarbon dating. This demonstrated that there is a palaeoenvironmental record which covers both the Neolithic and the medieval periods.

## **2.) Pollen method**

Standard pollen extraction techniques (Moore and Webb 1978; Moore *et al.* 1992) were used on twelve sediment sub-samples of 1.5ml volume taken from the 1.5m monolith profile. This process included treatments with sodium hydroxide for sediment deflocculation, hydrofluoric acid for removal of silica, Erdtmans acetolysis for removal of detrital plant material and sieving at 150 microns and 10 microns. A pollen sum of 200-500 (depending on preservation and numbers present) pollen grains per sample was identified and counted using Olympus and Nikon biological research microscopes. Marsh taxa and fern spores were counted outside of the basic pollen sum. A pollen diagram (figures 1a and 1b) was plotted using Tilia with percentages calculated as follows:

Sum =	% total dry land pollen (incl. <i>Alnus</i> and <i>Salix</i> )
Marsh/aquatic herbs =	% tdlp + sum of marsh/aquatics
Spores =	% tdlp + sum of spores
Misc. =	% tdlp + sum of misc. taxa.

Taxonomy, in general, follows that of Moore and Webb (1978) modified according to Bennett *et al.* (1994) for pollen types and Stace (1991). A substantial comparative collection of British and European pollen types was available to assist any identification problems. These procedures were carried out in the Palaeoecology Laboratory of the School of Geography and Environment, University of Southampton.

### 3.) *The pollen data*

Although pollen was variably preserved due to differences in lithology between the coarser sand-gravel sediment and the more satisfactory, fine grained silt with humic content, the study has provided data on the past, local vegetation and environment of this site.

The profile can be divided into two separate local pollen assemblage zones (RING: 1 and RING: 2) which are separated by sandy gravel which is devoid of pollen. That is, between 2.40m and 1.86m. The former is dated to the late prehistoric, middle Neolithic period at 4690 $\pm$ 24 BP (3528-3484 cal BC) (SUERC-107891) and the latter to the markedly more recent early medieval period at 1044 $\pm$ 24 BP (901-916cal AD) (SUERC-107891). There is, therefore, a likely hiatus between these periods which is represented by the sand-gravel facies noted.

In general tree and shrub pollen are more important in the lower levels of l.p.a.z. RING: 1 with a dominant and diverse range of herbs in the upper levels of l.p.a.z. RING: 2. The two local pollen assemblage zones, which have been recognised are described in table 1 below.

<i>l.p.a.z.</i>	<i>Palynological characteristics</i>
<p><b>RING: 2</b></p> <p>2.13m to 1.23m</p> <p>C14: 1044<math>\pm</math>24 BP (at 1.50-1.70m)</p>	<p>This upper zone is characterised by dominant and diverse herb pollen assemblages. Overall, Poaceae are dominant (50-60%). Two local pollen sub assemblage zones may also be recognised based on important phase of cereal pollen at <i>c.</i> 1.65m to <i>c.</i> 1.40m. Above this (1.40m to 1.25m), Lactucoideae become more important through differential preservation. Tree and shrub pollen is less important than in zone 1 with only low values of <i>Alnus</i> (to max 20%). <i>Quercus</i> and <i>Corylus</i> show some expansion (17% and 10% resp.) due to lower values of <i>Alnus</i> within the pollen sum. There are sporadic occurrences of <i>Betula</i>, <i>Pinus</i>, <i>Fraxinus</i>, <i>Fagus</i>, <i>Ilex</i>, <i>Salix</i> and <i>Hedera</i>. Possible (reworked <i>Picea</i>) and <i>Juniperus</i> are noted. Marsh/fen taxa show an expansion of Cyperaceae to maximum values at the top of the profile (30% sum + marsh). There is a range of other fen herb taxa.</p>
<p><b>2.84-1.86m</b></p>	<p><b><i>Probable hiatus in coarse sand/gravel</i></b></p>
<p><b>RING: 1</b></p> <p>2.70m to 2.13m</p> <p>C14: 4690<math>\pm</math>24 BP (at 2.74-2.54m)</p>	<p>This lower zone extending into the upper levels of the overlying gravel is characterised by high levels of <i>Alnus</i> (peak to 80% at 2.50m) and <i>Corylus avellana</i> type (to 20%). Other arboreal components include small numbers of <i>Betula</i>, <i>Pinus</i>, <i>Quercus</i>, <i>Tilia</i> and <i>Salix</i>. Small numbers of <i>Juniperus</i> are present in the basal sample. Herb pollen diversity is much less than in the subsequent zone. Poaceae are dominant but variable (20-40%). Cereal pollen and <i>Plantago lanceolata</i> are represented along with a small range of other taxa. Marsh/fen taxa comprise Cyperaceae (to 28%) and <i>Typha angustifolia/Sparganium</i> type (19% in basal level). Ferns are represented by a peak of <i>Dryopteris</i> type (29%) at 2.40m with low values of <i>Polypodium</i> spores.</p>

Table 1: Pollen zonation and details of Ringwood A31 (WS603).

### 4.) *The past vegetation and Environment:*

The palynological data can be considered in relation to the vegetation of the on-site depositional habitat and of the surrounding environment.

#### **4.i.) The on-site vegetation and environment**

The depositional environment was a floodplain, fen habitat. It is probable that the autochthonous pollen components are a function of the character of the fen vegetation and possibly that derived from fluvial (overbank deposition) as well as airborne transport. Initially (l.p.a.z. RING: 1), it appears that there was a phase of increased wetness which was responsible for the start of pollen preservation under anaerobic conditions. This took place during the middle Neolithic at 4690±24BP SUERC-107882) (3528-3484 Cal BC) and is shown by higher pollen levels of sedges (Cyperaceae) and bulrush and/or bur reed (*Typha/Sparganium*) in the basal sample (2.70m). Subsequently, there was rapid colonisation by alder (*Alnus glutinosa*) and willow (*Salix*). The high values of alder attest to its importance on-site, probably as floodplain carr woodland. Willow (*Salix*) with a ground flora of grasses (Poaceae), sedges (Cyperaceae) and *Typha angustifolia/Sparganium* was also present in this wetland habitat. The cause of this initial increase in wetness is conjectural but, may have been caused by local, Neolithic, woodland clearance which raised the local; water table through reduced evapotranspiration, locally higher water table and increased surface run-off. Such anthropogenic causation has been suggested for other lowland mire communities in southern England (Moore and Wilmott 1976; Scaife 1980).

In the middle of the profile (2.84m to 1.86m), pollen becomes degraded and absent in a coarser sand/gravel facies. Given the Neolithic date of l.p.a.z. RING: 1 the substantial changes in environment and medieval age in upper pollen zone RING: 2, it is probable that there was a hiatus in accretion of sediment. Either the earlier phase culminated in fluvial changes which saw the deposition of the coarser sediment or, this material marks the start of wetter conditions and sedimentation during the early medieval. Whichever, the upper sequence dated to the early medieval period, shows a very marked change in both the on-site habitat and surrounding terrestrial zone. The sand/gravel is overlain initially by alluvium and marginal river sediment. This accumulated in an open floodplain habitat contrasting with the earlier alder domination which existed in the Neolithic. Whilst alder and willow remain in the upper levels, values of the former are not of such magnitude to suggest on-site carr woodland which existed previously. It likely remained, along with willow, fringing the floodplain or on the banks of local rivers/streams. On site, there was a range of marginal and aquatic herb taxa. The former includes a proportion of the grasses (Poaceae), sedges (Cyperaceae), marsh marigold (*Caltha* type), marsh pennywort (*Hydrocotyle vulgaris*), possible hemlock water dropwort (*Oenanthe* type), water plantain (*Alisma plantago-lanceolata*), arrow grass (*Sagittaria sagittifolia*), common bulrush (*Typha latifolia*) and *Typha angustifolia/Sparganium* (bulrush and/or bur reed). Evidence of slow moving or standing water comes from the pollen of duckweed (*Lemna*), *Potamogeton* type (pond weed but also possibly *Triglochin*/freshwater arrow grass) and occasional cysts of algal *Pediastrum* in the upper level. A further hydrological change occurred in the upper levels (1.41-1.21m) which saw the deposition of alluvial clay under a probably wetter phase with growth of grass-sedge fen. The taphonomic complexity of pollen in such alluvial sediment is evident here with presence of reworked pre-Quaternary palynomorphs, fern spores (*Dryopteris* type) and dandelion types (Lactucoideae), all of which are robust microfossils which remain in rigorous conditions such as fluvial transport or colluviation.

#### **4.ii) The vegetation of the surrounds**

The analysis and radiocarbon dating of the two-pollen assemblage zones provides evidence of markedly contrasting environments. That is, the early Neolithic and much later medieval separated by a hiatus in sediment. The relatively small extent of this site implies that the pollen catchment was probably small, representing the near local vegetation and the taphonomy will also have been strongly influenced by the character of the on-site vegetation and the possibility of fluvial as well as airborne transport of pollen.

*4.ii.a.) The Neolithic. Pollen zone RING 1:* The radiocarbon date/measurement of 4690 $\pm$ 24BP (SUERC-107882) (3528-3484 Cal BC) places the base of the profile and sediment inception during the early to middle Neolithic period. Given this date, it is surprising that tree and shrub values of terrestrial taxa appear low although this may have been exacerbated by the importance of on-site and fringing alder woodland which will have filtered pollen from the surrounding zone and presented a different (still) micro-climate (Tauber 1965, 1967). This is especially so with the diminutive numbers of both elm (*Ulmus*) and lime/linden (*Tilia*). Pollen of the latter, which only occurs in small numbers in the lower levels of lower zone RING: 1, is unusual because most pollen records demonstrate its importance in central southern England from the middle Holocene to the late-prehistoric (middle Bronze Age) period (Scaife 1980, 2000; Greig 1982; Grant *et al.* 2011). Absence of elm (*Ulmus*) also indicates a post Primary/Neolithic Elm Decline age, that is after *c.* 5,500-5000BP (Smith 1970; Girling 1988; Scaife 1988). Hazel (*Corylus avellana*) may represent scrub colonisation after earlier local woodland clearance, cultivation and abandonment. Overall, there are few herbs present in zone RING1: 1 and this may also be a result of the filtering effect of the on-site carr woodland. However, towards the top of this earlier phase, there is evidence of agriculture with cereal pollen at 2.40m from arable cultivation and ribwort plantain (*Plantago lanceolata*), dandelion types (Lactucoideae), grasses (Poaceae) and possibly buttercups (*Ranunculus* type) from grassland/pasture.

Unusual and of botanical interest here, is the occurrence of *Juniperus communis* (juniper). Records of juniper pollen in the late prehistoric are extremely rare and usually where its pollen does occur, it is during the late-glacial and especially at the Devensian-Holocene transition at where it expanded as a pioneer coloniser along with birch consequent upon temperature amelioration. At this site, juniper pollen has been recorded from both the Neolithic in pollen zone 1 and from the medieval in pollen zone 2. Whilst it is possible that this pollen is reworked from earlier soil/sediment of very early Holocene age, this is considered unlikely and growth on areas of agriculturally poor, sandy soil (Dorset heath) is more probable with obvious continuity over some millenia. More robust but degraded and clearly derived fragments of *Picea* (spruce) along with pre-Quaternary palynomorphs were also noted.

*Summary:* During the Neolithic, there was a largely open mosaic environment with alder dominated valley surrounded by some scrub and dispersed woodland with areas of open agricultural ground. There is some evidence of cereal cultivation and grassland, probably pasture.

The very large time gap between the lower (Neolithic) and upper (early medieval) pollen spectra, with *c.* 1m of intervening sediment, poses the question of absence of the sediment record spanning the intervening Bronze Age to medieval period. It appears that there is a sedimentary hiatus which spans these periods in which evidence of significant environmental changes might be expected. It is possible that increasing wetness, as noted, initiated the later sediment accumulation overlying the earlier, (Neolithic).

4.ii.b.) *The early medieval period. pollen zone RING: 2:*

The very diverse herb flora demonstrates a largely open landscape of arable and pastoral agriculture and contrasts markedly with zone RING: 1. The former is evidenced by cereal pollen and associated weeds of disturbed ground (e.g. Brassicaceae spp., Polygonaceae spp., *Plantago major* type, *Artemisia*, *Solanum*). The latter, pastoral land-use is suggested by Poaceae (grasses), some of which may also be derived from the on-site habitat noted and a range of other herbs including, particularly, *Plantago lanceolata* (ribwort plantain), *Ranunculus* type (buttercups), possibly *Rumex* (docks), Scrophulariaceae spp. (figwort family) and Asteraceae types (especially dandelion types, Lactucoeidae). Note, there may be some uncertainty with these types into communities as pollen morphology often does not allow separation to a lower taxonomic level and as such, are less ecologically definable. Apart from the main cereal record which is primarily *Triticum-Hordeum* (wheat-barley) type, there is also a single but useful record of *Secale cereale* (rye). A single record of *Cannabis sativa* type (hemp or hop) is diagnostic of pollen records spanning the Saxon to medieval periods. Due to like pollen morphology, identification of the sub-fossil pollen to either taxon is not possible. The former (hop) is a native of fen carr woodland and the latter (hemp) was grown for fibre. It's pollen is diagnostic for medieval pollen records due to its widespread cultivation for cordage; by act of parliament. Thus, a mixed agricultural regime is suggested here. A phase of more intense local cereal cultivation is seen between c. 1.70m and 1.45m (Ipsz; 1). Pollen of cereals and associated segetals is less well represented in pollen spectra than are pastoral indicators and as such, it is probable that this activity was in proximity to the site. Subsequently, there are increasing values of pastoral indicators including Lactucoeidae (dandelion types) although there is a possibility that there has been differential preservation of this robust pollen form. There have also been taphonomic changes caused by a changing fluvial regime to alluvial clay.

With the exception of small numbers of *Fraxinus* (ash), *Fagus sylvatica* (beech) and *Ilex aquifolium* (holly), the other tree taxa occurring sporadically include *Betula* (birch), *Pinus* (pine), *Quercus* (oak) and *Corylus* (hazel), the latter perhaps managed woodland. These latter are all anemophilous and have the potential for long-distance dispersion and thus, pollen here is likely to have come from occasional local growth or more probably from regional and long-distance sources. It is probable that the near region was devoid of any substantial woodland with pollen of the less well-represented taxa noted above perhaps coming from remaining local copses.

A small number of plants of acid soils/habitats are noted in this upper pollen zone and include Ericaceae (heather and ling), *Potentilla* (cinquefoil) and *Sphagnum* (bog moss). These are typical of the sandy heathland areas of Dorset and Hampshire. The question and possibility of juniper growing in this habitat has been noted both for the Neolithic and medieval record. These acidophiles may and indicate soil deterioration/degradation after earlier woodland clearance and agriculture.

*Summary:* The early medieval landscape seen in the upper samples (1.65-1.25m) (P1-3) similarly suggest a largely open, dominant mixed agricultural landscape with little or no woodland present at least in the local region. This is not unexpected in the open-field agricultural system.

**5.) Summary and Conclusions:**

There remain few data pollen data in this region of southern England, perhaps with the exception of studies on the New Forest peat mires and the sediment fills of drowned valleys in

the coastal zone. Initially, this study sought to establish if sub-fossil pollen and spores were present in this sediment archive and to provide some preliminary palaeocological information for this site and local region. This study proved successful prompting radiocarbon dating and a more detailed pollen study showing the vegetation and environment of the Neolithic and the early medieval periods. Two distinct phases show markedly different palaeo-environments separated by a substantial depositional hiatus. That is, between a lower Neolithic sequence of pollen zone RING: 1 and overlying early medieval sediment of RING: 2 (figure 1).

The on-site vegetation shows initial wetness, probably causing the inception of sedimentation under grass/sedge fen. This was rapidly colonised by alder and willow in a hydrosere succession during the Neolithic. After a hiatus with deposition of fluvial gravels, the site again reverted to grass/sedge fen during the medieval period. During the Neolithic, woodland on the drier, interfluvial areas comprised oak and hazel with some lime and ash. Other sporadically occurring elements, such as birch and pine, are likely to derive from more regional and long-distance sources. Absence of elm is evidence of a post Neolithic Elm Decline age for the lowest part of the pollen profile.

During the early medieval period, as might be expected under the open field system, there was an absence of woodland at least in the local area and a markedly open agricultural environment. This is reflected in the very diverse herb pollen flora seen in pollen zone 2 within the upper sediment with pastoral and arable taxa evident.

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