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A palaeoenvironmental assessment of sediments recovered from Needham Market, Suffolk.

By

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Summary

In March 2012 BAE were commissioned to undertake environmental sampling at Needham Market, Suffolk in advance of development. The site lies on the former floodplain of the River Gipping. BAE have previously undertaken investigations of the River Gipping to the north at Stowmarket (in advance of the relief road) which recovered sediments infilling a former channel dating from the Mesolithic to the Medieval period (Hopla et al., 2008). Samples for multi-proxy analysis were recovered at Needham from a trial trench located in the centre of the site. Three radiocarbon dates from the sequence indicate that organic sediment accumulation began during the Bronze Age and ended during the Medieval period when inorganic alluvial deposits were deposited across the site by fluvial processes. The assessments demonstrate variable preservation of palaeoenvironmental proxies, with plant macrofossils and insect remains poorly preserved. Pollen preservation varies somewhat, but counts were sufficient to enable limited interpretation, which suggests the landscape at Needham Market was open grassland from the Bronze Age onwards, with evidence for possible arable agriculture during the Romano-British period. No further analytical work is recommended on these samples.

KEYWORDS: Peat, River Gipping, Pollen, Plant macrofossils, Beetles,

1. INTRODUCTION

In March 2012 BAE were commissioned by Suffolk County Council Archaeology Service to recover environmental samples from a peat deposit recorded during trial trenching at Needham Market, Suffolk. The samples were recovered from a test pit in the centre of the site using monolith tins and bulk sample bags. The site is in close proximity to Anglo-Saxon activity to the south. In light of other sites investigated in the Gipping valley (e. g. Hopla *et al.,* 2010) the site has considerable potential to yield valuable palaeoenvironmental remains which might assist in understanding the archaeological record within its landscape context.

2. METHODS

2.1 Fieldwork

The location of the test pit was surveyed by staff at SCCAS and was located where the watertable was at its lowest in order to facilitate sample recovery. The samples were recovered using 25cm monolith tins and bulk sample bags. The section was hand drawn and photographed (Plates 1 and 2) and the stratigraphy of the deposits was logged in the field using the Troels Smith (1955) method (Table 1).

2.2 Pollen

A total of 8 sub-samples were taken at 8cm intervals for pollen assessment. Pollen preparation followed standard techniques including potassium hydroxide (KOH) digestion, hydrofluoric acid (HF) treatment and acetylation (Moore *et al.,* 1991). A count of at least 125 total land pollen grains (TLP) excluding aquatics and spores were attempted for each sample.

2.3 Insect Remains and Plant Macrofossils

Two bulk (8L) samples were processed using the standard methods of paraffin flotation for insect remains and washover technique for extraction of plant macrofossils (Kenward *et al.,* 1980: 11). The washovers exhibited waterlogged preservation of organic remains and were kept wet and examined for plant and invertebrate remains (see Kenward *et al*., 1986). Low-power microscopy (x7 to x45) was employed and the washovers were separated into two fractions (0.3 to 4 mm and

greater than 4 mm) to facilitate recording. One of the sample residues was primarily organic and was examined wet, whilst the other was inorganic and this was dried prior to recording.

All of the components of the processed sample fractions were recorded using a five-point semi-quantitative scale; fractions were generally scanned until no new remains were observed and a sense of the abundance of each taxon or component (relative to the processed fraction as a whole) was achieved. The abundance scale employed was: 1 – few/rare, up to 3 individuals/items or a trace level component of the whole; 2 – some/present, 4 to 20 items or a minor component; 3 – many/common, 21 to 50 or a significant component; 4 – very many/numerous, 51 to 200 or a major component; and 5 – abundant/super-abundant, over 200 items/individuals or a dominant component of the whole.

Plant macrofossil remains were identified as closely as possible by comparison with reference material (where available) and the use of published works (e.g. Cappers *et al*., 2006). Nomenclature for plant taxa follows Stace (1997). Non-molluscan invertebrate macrofossils were identified with reference to published works and within the constraints of the assessment (utilising Harde, 1984 and Lindroth, 1974, for example, to identify beetles to a basic level).

2.4 Radiocarbon dating

Three bulk (top, middle and base of the organic deposits) sediment samples were submitted to Beta Analytic Inc., Florida, for AMS dating. The samples underwent acid/alkali/acid pre-treatment prior, during which process it was determined that the sample from the top of the sequence was contaminated by petrochemicals and was therefore unsuitable for radiocarbon dating.

3. RESULTS

3.1 Stratigraphy

The trial trench was located in the centre of the site (Fig 1). The basal sands and gravels were reached at 14.66m AOD. These were overlain by a very dry well

humified peat (Unit 6) 0.34m thick which then transitioned sharply into a 0.16m thick deposit of blue grey silt clay (Unit 5) which contained *Phragmites* (reed) remains throughout. This transitioned sharply into another dry well humified silty peat (Unit 4), which was overlain by a 0.10m thick layer of grey, fluvial clay (alluvium; Unit 3). This alluvium was some 0.40m thick and became more oxidised towards the top of the profile (Unit 2). This was finally sealed by a thick (0.80m) layer of re-deposited orange yellow sand (Unit 1).

Monolith tins were taken from the lower peat and grey silt units along with bulk samples in 0.10m spits. Bulk AMS dating samples were also recovered from the top and bottom of the peat sequence (Table 2).

3.2. Radiocarbon dating

The results of the radiocarbon dating are summarised in Table 3 with all calibrations calculated using Intcal04 (Reimer *et al*., 2004). The basal sample (wood; 1.98-1.99m) was dated to 3520+/-30BP (Cal BC 1930 to 1750, Cal BP 3880 to 3700, Beta 321009). The sample (peat) from 1.66m produced a date of 1860+/-30 BP (Cal AD 80 to 240, Cal BP 1870 to 1720, Beta-321008). The top sample from 1.30-1.32m was dated to 730+/-30 BP (Cal AD 1260 to 1290, Cal BP 690 to 660, Beta-321007). This indicates that peat accumulation began during the early Bronze Age and continued up into the middle of the Medieval period. The generally slow sediment accumulation rates (see below) probably demonstrate marginal conditions for peat formation at the sampling site, which is probably also indicated by the results of the plant macrofossil assessments.

3.3 Pollen

Concentration and preservation was excellent in the upper three samples (1.34m, 1.46m and 1.54m). Lower concentrations were apparent in sample 1.62m as well as a decrease in the preservation to medium. Corrosion was particularly evident on some of the grains as well as crumpling. The sample from 1.70m yielded extremely low concentrations and an assessment count was not possible and this sample has therefore been omitted from the pollen diagram. Concentrations increased again in the lower three samples (1.78m, 1.86m and 1.98m) however, preservation remained

medium-low with high levels of corrosion, degradation and splitting evident on many of the grains. All percentage figures are of Total Land Pollen (TLP) unless otherwise specified.

The base of the sequence is dated to 3520+/-30BP (Cal BC 1930 to 1750, Cal BP 3880 to 3700, Beta 321009) demonstrating that organic accumulation began during the early Bronze Age. The basal sample of the diagram is dominated by trees and shrubs up to 60%. This largely consists of *Alnus glutinosa* (alder) with *Corylus avellana*-type (most probably hazel) present up to 10% along with *Pinus sylvestris* (Scots pine), *Quercus* (oak) and single grains of *Betula* (birch), *Ulmus* (elm), *Tilia* (lime) and *Hedera helix* (Ivy). Herbaceous pollen is dominated by Poaceae (wild grasses) and Cyperaceae (sedges) up to 35% along with occasional grains of Caryophyllaceae (pink family), Chenopodiaceae (goosefoot family), Lactuceae (dandelions), *Plantago lanceolata* (ribwort plantain) and *Rumex* (docks).

The pollen record reflects a floodplain environment, which would have initially at least, been dominated by alder fen carr with sedges and small areas of grasses, most likely *Phragmites* (reed) also on the floodplain. The dryland vegetation appears to have been more open, but there is some evidence for woodland including at best limited areas of *Corylus* and *Quercus*. The record of *P. lanceolata* and Lactuceae indicates some open, grassy areas in the wider landscape, which might have been created and/or maintained by human activity. It is also likely that the Poaceae curve includes pollen from dryland grasses reflecting a largely open environment.

Herbaceous pollen (c. 80%) dominates the rest of the sequence from 1.87m to the top of the diagram. Cyperaceae increases to values between 40-60% throughout with a rise in Pocaeae (30-40%) also recorded. Other herbs include Lactuceae and *Plantgao lanceolata* <10%, Rubiaceae (bedstraw family), *Rumex* (docks and Rosaceae (rose family) <5%, with occasional grains of *Artemesia* (mugwort), Caryopyllaceae (pink family), Chenopodiaceae (goosefoot family), *Cirsuim* (thistles) and *Filipendula* (meadowsweet). *Alnus glutinosa* declines rapidly in association with the increase in Cyperaceae and is recorded at values less than 10% by 1.87m, which continue to fall throughout the diagram. Traces of other trees/shrubs *Betula, Ulmus* and *Tilia* have also disappeared by the middle of the sequence, for which a date of 1860+/-30 BP (Cal AD 80 to 240, Cal BP 1870 to 1720, Beta-321008) is available at 1.66m. Increases in *Plantago lanceolata*, Lactuceae and *Pteridium* (bracken) are also

recorded around this point, with the beginning of a *Hordeum*-type (barley, but can include wild grasses) curve.

The pollen diagram thus reflects a largely open local floodplain dominated by *Phragmites* (reeds) and other wetland grasses. The low values of trees and percentages of Poaceae and suite of other herbs implies that the drier soils around the sampling site remained largely open throughout the Bronze Age into the Romano-British period, with indications of pastoral and perhaps also arable farming. A slight increase in arboreal pollen is apparent towards the top of the sequence with *Quercus* reaching values up to 10% and *Ulmus* and *Salix* re-appear at trace values, suggesting some recovery in woodland. The record terminates before 730+/-30 BP (Cal AD 1260 to 1290, Cal BP 690 to 660, Beta-321007).

3.3 Plant macrofossils and beetles

The results of the assessments of the bulk samples are presented below in stratigraphic sequence uppermost first. A brief summary of the processing method and an estimate of the remaining volume of unprocessed sediment follow after the sample numbers in round brackets.

Context 1.30-1.40 metres depth

Sample 1/T (1 kg/~1 litre sieved to 300 microns with washover; ~1.5 litres of unprocessed sediment remains)

Moist, dark brown to dark grey-brown (with a slight purplish cast), somewhat indurated and slightly brittle to crumbly, slightly sandy amorphous organic sediment, with occasional rounded quartz pebbles (to 22 mm).

The small washover (100 ml) was mostly small (1 to 2 mm) lumps of undisaggregated organic sediment 'crumb', with some indeterminate fine plant detritus. Some 'seeds' were present including sedge (*Carex*) nutlets and possible nightshade family (cf. Solanaceae) seeds and there were occasional fragments of insect cuticle. The insect remains were largely indeterminate, with a few non-diagnostic beetle body parts, such as abdominal sclerites, represented.

The modest residue (200 ml) was almost entirely composed of further undisaggregated (somewhat indurated) organic sediment 'crumb', with a little fine sand and a single rounded quartz pebble (to 22 mm).

Context 1.89-1.99 metres depth

Sample 2/T (1 kg/~1 litre sieved to 300 microns with washover; ~2.5 litres of unprocessed sediment remains)

Wet to waterlogged, dark brown to dark grey-brown, brittle to crumbly (working somewhat soft), slightly humic, slightly sandy silt, with stones (2 to 20 mm) present (mostly angular flint). The sample gave a slight sulphide smell when lumps of sediment were broken.

The very small washover (20 ml) was mostly small (1 to 2 mm) lumps of undisaggregated sediment 'crumb' and indeterminate plant detritus, with a little sand and a few decayed 'woody' fragment (to 20 mm; wood or woody root). Occasional 'seeds' were present including sedge (*Carex*) nutlets and common nettle (*Urtica dioica* L.) achenes. There were also occasional fragments of insect cuticle but most of these could not be identified further; there were a few non-diagnostic beetle body parts, including leg sclerites, and a single head fragment of a rove beetle (Staphylinidae).

The small residue (dry weight 116.6 g) was mostly fine sand, with small angular flints (to 10 mm) and a few larger angular flints (to 34 mm) present. None of the flint appeared to have been worked.

4. DISCUSSION

The basal deposits at Needham Market are coarse sands and gravels, which were probably deposited by fluvio-glacial processes during the Late Glacial period (c. 13, 000 years before present or earlier). These are overlain by a dry well humified peat which indicates paludification of these gravels and the subsequent growth of peat, probably associated with rises in the local watertable during the Bronze Age. The sequence might alternatively reflect the infilling of a palaeochannel which was previously taking flow but became cut off from the river system through channel avulsion. There is palaeoenvironmental evidence from elsewhere in Suffolk for increasingly wet conditions in river valleys during the earlier Bronze Age (e.g. Stowmarket also on the River Gipping; Gearey *et al*. 2010). This may well be related to similar evidence from other areas of England for a rise in sea level and possible climatic deterioration during the earlier Bronze Age (e.g. Macklin *et al*. 2009).

The pollen data indicates that peat formation was initially within an alder carr environment, but this did not persist and the subsequent floodplain environment was apparently dominated by open sedge fen, with macrofossil remains of this plant apparent in the bulk samples. Whilst the palynological record is thus probably dominated by this local wetland vegetation, there is also an indication of the vegetation growing on the drier soils beyond the wetland edge. Some patchy deciduous woodland seems to have been present, but the environment otherwise appears to have been largely open grassland, with a range of herbacaeous taxa typical of meadow, pastoral habitats. This implies the presence of human communities in the area, who had presumably cleared the woodland for farming and settlement during the earlier Bronze Age. Palynological data from other sites in Suffolk also hint at the presence of open, meadow like environments in river valleys during the Bronze Age (e. g. Krawiec *et al*. 2009).

The pollen record demonstrates little detectable change in the vegetation present on both the wetland and dryland areas throughout the lower part of the record. The sharp stratigraphic transition to a minerogenic deposit (Unit 5 silt clay) indicates a change in the depositional regime, perhaps a period of flooding which deposited silty-clay over the floodplain, or alternatively reactivation of the abandoned channel. The presence of sub-fossil remains of *Phragmites* (reeds) throughout Unit 5 suggests a relatively sluggish flow of water. Evidence for standing water on the sampling site is also apparent in the increase in *Sparganium* (pond weeds) in the pollen record.

The change from organic to inorganic deposition is dated to Cal AD 80 to 240, Cal BP 1870 to 1720 (Beta-321008) implying this event occurred during the Romano-British period. There is palynological evidence for increased human activity at this point in the form of rises in *P. lanceolata* and Lactuceae and the beginning of a *Hordeum*-type curve. The latter pollen type includes wild grasses *Glyceria* sp. (sweet vernal grass) as well as *Hordeum vulgare* (barley) but might reflect arable cultivation close to the sampling site. It is unclear whether this evidence for possible intensification in local farming activity can be associated with the stratigraphic evidence (Unit 5) for possible raised water tables/flooding at the sampling site: agricultural intensification may lead to soil instability and increased sediment input into watercourses.

Sediment accumulation also appears to have been relatively slow up until this point, with the radiocarbon dates from the base and middle of the sequence equating to an

accumulation rate of c. 62 years cm^{-1} between 1.98 to 1.66m. Accumulation rates for the upper part of the sequence (1.66 to 1.30m) increase to c. 30 years cm^{-1}, perhaps as a result of slightly wetter conditions on the floodplain more suitable for peat accumulation. This may also be evidenced by the improved pollen preservation towards the top of the sequence.

The silty peat (Unit 4) overlying Unit 3 suggests a reversion to sediment accumulation in a semi-terrestrial environment, again apparently dominated by sedge fen. The pollen record seems to indicate some recovery in oak woodland on the drier soils beyond the floodplain towards the top of the sequence, but the sampling intervals are too broad to permit detailed interpretation. The pollen record terminates prior to Cal AD 1260 to 1290, Cal BP 690 to 660 (Beta-321007) with a final transition from organic to minerogenic alluvial units (Units 2 and 3). These deposits suggest a final phase of overbank sedimentation during the Medieval period. The overlying re-deposited sands and gravels have clearly been imported from elsewhere, possibly the recent development of the business park adjacent to the site.

5. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER ANALYSIS

The assessments have shown variable preservation of palaeoenvironmental material in the deposits at Needham Market. Sufficient pollen was present to permit some tentative interpretation and radiocarbon dating has demonstrated that the deposits began to accumulate during the Bronze Age within a floodplain environment, with organic sedimentation ending during the Medieval period when inorganic, alluvial clays and silts were deposited across the site.

The bulk samples produced little interpretable data. Although the upper of the two submitted sediment samples was clearly primarily composed of organic material and some organic content was also present in the lower sample, identifiable plant and invertebrate remains were very few. Both deposits contained remains of sedges most species of which grow in wet/waterlogged ground typical of floodplains and confirmed by the pollen record. Beyond this the macrofossil remains were of no interpretative value.

The palynological data is of some note as it indicates that the landscape around the site may already have been relatively open and cleared of its woodland cover by the Bronze Age. The presence of 'anthropogenic indicator' such as ribwort plantain and dandelions suggest open, meadow like habitats created and maintained by human activity. The environment appears to have remained relatively open and probably farmed/settled for much of the time through later prehistory into the Romano-British period, when there is some indication for a possible intensification in agriculture and perhaps the local cultivation of barley. This is closely associated with evidence for increasing wetness/flooding on the sampling site, which resulted in the deposition of a layer of silty clay.

There is some evidence that the generally poor preservation of the palaeoenvironmental record might be attributed to recent processes rather than conditions during sediment accumulation in the past. Observations made in the field noted that the sampled deposits were dry (the present day water table being perched above them by an alluvial clay – the moist to wet/waterlogged condition of the samples as presumably occurring during sampling) which would account for the highly humified condition of their organic content; i.e. the permanently waterlogged anoxic conditions which can result in good preservation of uncharred organic remains have not prevailed, with drainage and subsequent desiccation affecting the micro and macrofossil content of the sediments. To this end, not further palaeoenvironmental analyses are recommended at this time.

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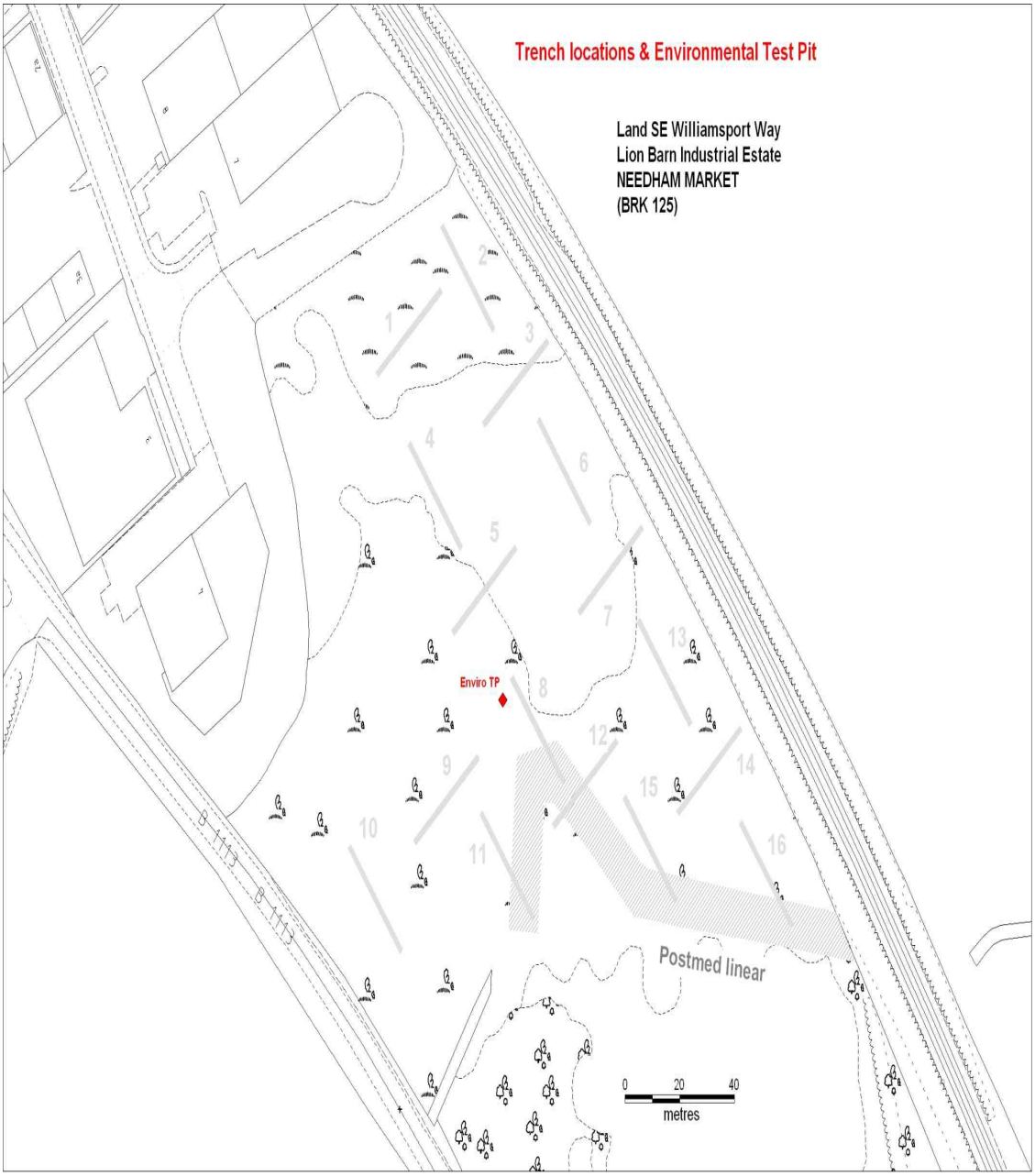

Figure.1. Trench Locations

Plate 1: Section before sampling

Plate 2: Tins in situ

Table 1.Stratigraphic sequence

0-0.80m		**Da**	**St**	**El**	**Dr**	**UB**
	1	0	0	1	0	
	Gmaj 2 gmin2					
	Redeposited yellow orange sand (Unit 1)					
0.80-1.20m	**Da**	**St**	**El**	**Dr**	**UB**	
	2	0	0	1	3	
	As3 Ag1					
	Oxidised orange alluvial clay (Unit 2)					
1.20-1.30m	**Da**	**St**	**El**	**Dr**	**UB**	
	2	0	0	1	2	
	As3 Ag1					
	Grey unoxidised alluvial clay (Unit 3)					
1.30-1.50m	**Da**	**St**	**El**	**Dr**	**UB**	
	3	0	0	1	4	
	Dh3 Ag1					
	Dry well humified peat (Unit 4)					
1.50-1.66m	**Da**	**St**	**El**	**Dr**	**UB**	
	2	0	0	1	4	
	As1 Ag3					
	Grey silt with occasional reed remains (Unit 5)					
1.66-1.99m	**Da**	**St**	**El**	**Dr**	**UB**	
	3	0	0	1	4	
	Dh3 Ag1					
	Dry well humified peat (Unit 6)					
1.99m		Grey flinty sands and gravels				

Table 2. Samples register from Needham Market

Sample number	Type	Sample depth (not od)
1	Monolith tin 25cm	1.50m-1.75m
2	Monolith tin 25cm	1.74-1.99m
3	Bulk	1.30-1.40m
4	Bulk	1.40m-1.50m
5	Bulk	1.50-1.66m
6	Bulk	1.66-.176m
7	Bulk	1.89-1.99m
	AMS	1.30-1.34m
	AMS	1.66m
	AMS	1.98-1.99m

Table 3. Radiocarbon Dating from Needham Market (Beta Analytic Ltd)

Lab no	Material	13C/12C	Radiocarbon Age	Calibrated Age
321007 1.30-1.32m	Peat: Acid/alkali/acid	-28.5 o/oo	730+/-30 BP	Cal AD 1260 to 1290 (Cal BP 690 to 660)
321008 1.66m	Peat: Acid/alkali/acid	-28.8 o/oo	1860+/-30 BP	Cal AD 80 to 240 (Cal BP 1870 to 1720)
321009 1.98-1.99m	Wood: acid/alkali/acid	-29.2 o/oo	3520+/-30BP	Cal BC 1930 to 1750 (Cal BP 3880 to 3700)

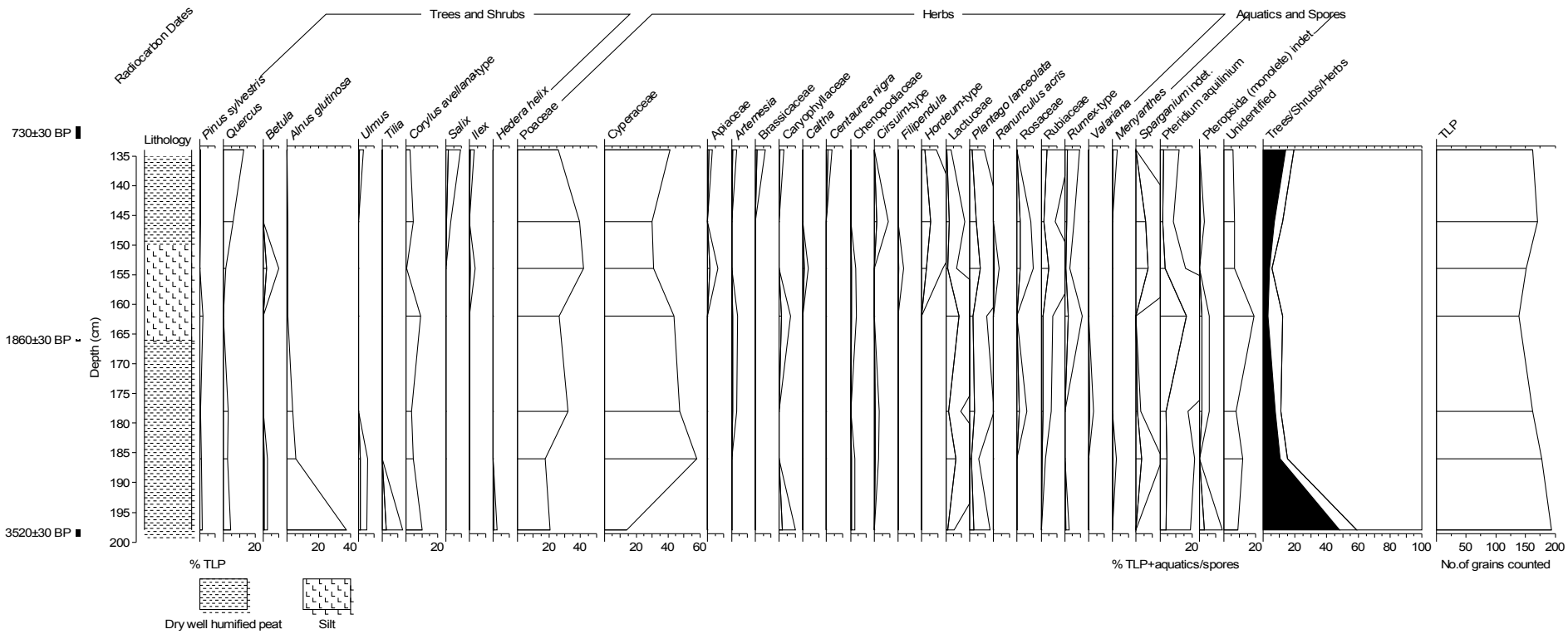

Figure 2: Needham Market Percentage Pollen diagram (shading = exaggeration x 5)