The Holocene fluvial development of the River Gipping, Stowmarket, Suffolk from Coleoptera and Plant Macrofossil Analyses

By

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With a contribution by Andrew Moss (molluscs)

1. Introduction

Extensive peat deposits were recorded within geotechnical boreholes recovered in advance of the construction of the Stowmarket relief road. Birmingham Archaeo-Environmental (BA-E) was subcontracted by Suffolk County Council Archaeological Service to undertake a palaeoenvironmental evaluation of these sediments associated with the floodplain of the River Gipping. This work recovered a sequence of organic deposits 4.5m thick and recommendations were made for the palaeoenvironmental assessment of pollen, plant macrofossil and coleoptera (beetles) from the deposits, supported by three radiocarbon dates. These assessments demonstrated the considerable palaeoenvironmental potential of the plant macrofossil and beetle records and recommended the full analyses with further radiocarbon dating (Hopla *et al.* 2008). This report describes the results of these analyses and discusses the implications for the evolution of the River Gipping and its associated landscape.

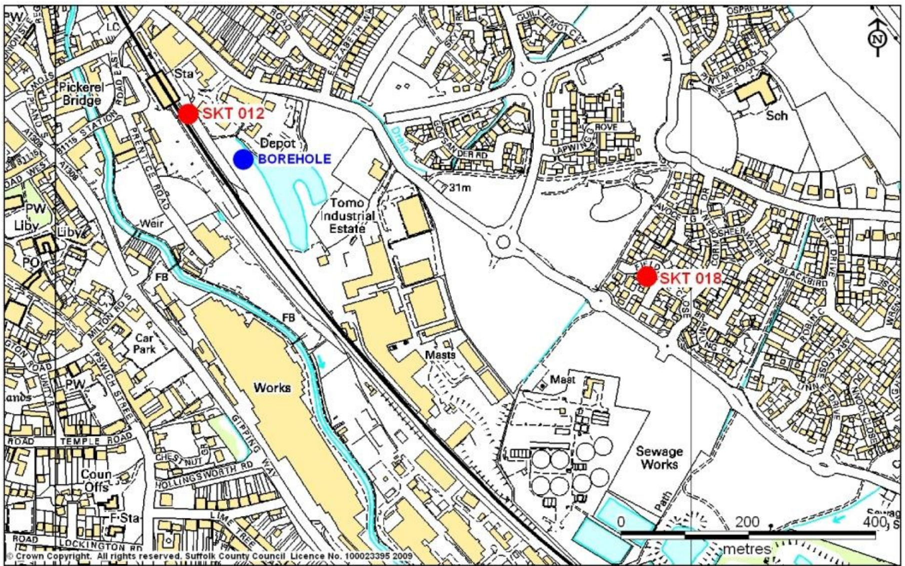

Fig. 2: B1115 Stowmarket Relief Road - Location of Archaeological Borehole (blue) and main sites (red)

Figure 1: Site location. SKT012 and SKT018 refer to archaeological sites. See section 5

2. Site Description

Due to the extensive amount of Made Ground present on the site (c. 4.00m), a cable percussive drill rig was used to recover a complete sequence, the location of which was selected on the results of previous geotechnical ground investigations. The thickest peat deposits were located immediately east of the railway line that runs through the study area (see Figure 1). Due to the known presence of contaminated land in the area, a suitable sampling strategy had to be developed in order to ensure the prevention of contamination between the Made Ground and the underlying deposits. An initial borehole was drilled to the base of the Made Ground at 4.0m depth, which was then backfilled with bentonite. This sealed the contact between the upper and lower deposits and restricted any potential vertical movements of contaminated material during the subsequent borehole extraction. Sampling commenced at 4.00m depth using 0.50m long geotechnical U100 plastic tubing and continued to a depth of 8.50m, after which rising groundwater conditions prevented further sample recovery. Each 0.50m section was sealed top and base for transport to the laboratory for subsampling.

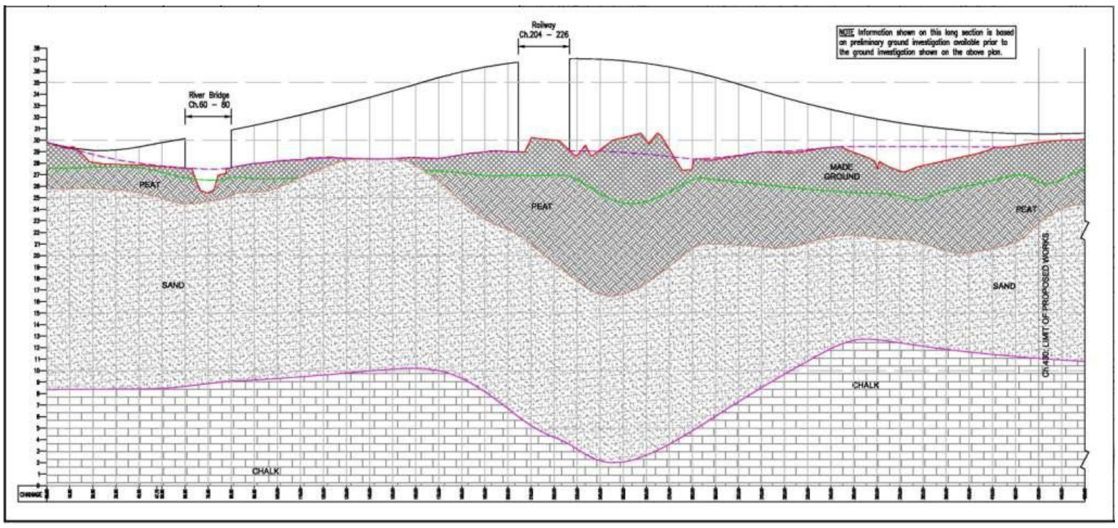

Figure 2: Stratigraphic profile across the line of the bypass.

3. Methods

3.1 Coleoptera

The nine core sections (4-4.5m, 4.5-5m, 5-5.50m, 5.5-6.0m, 6-6.5m, 6.5-7.0m, 7-7.5m, 7.50-8.0m and 8.0-8.50 m) were opened and the stratigraphy recorded in the laboratory. The samples were then bulked into 0.5m thick sections and prepared using the standard method of paraffin flotation (Coope and Osborne 1968) as outlined by Kenward *et al.* (1980). The samples were washed over a 300µm sieve; the resultant organic material was then dried for one hour and placed in a bucket. Paraffin was added to produce slurry to which cold water was added and the mixture was allowed to stand for fifteen minutes. The water/paraffin mixture was then poured off over a 300µm sieve and more cold water was added. This process was repeated twice. The insect remains were picked out using a binocular microscope and identified by comparison with specimens in the Gorham and Girling collections housed at the University of Birmingham. The taxonomy used for the Coleoptera (beetles) follows that of Lucht (1987).

Depth/m	Description	Troels Smith
0-4.0	Made ground	-
4.0-4.10	Grey organic silts	Ag. 2 Sh. 2 Dh. +
4.10-7.48	Red brown wood rich peat, wood remains increasing with depth	Sh. 2 Dl. 2 Ag. + Nig. 4 Strf.0 Elas.0 Sicc. 2
7.48-8.50m	Grey brown well humified silty peat	Sh. 2 Ag. 2 Dh. + Nig. 3 Strf.0 Elas.0 Sicc. 2
8.50m+	Grey brown saturated silty, organic sands	Gmin4 Ag + Sh + Nig. 2 Strf.0 Elas.0 Sicc. 3

Table 1: Stratigraphy of the Stowmarket sequence

3.2 Plant Macrofossils and Molluscs

The beetle flot remainders together with the paraffin residue were washed through a sieve with 300μm mesh using a mixture of detergent and water in order to remove the paraffin from the remaining organic material. The samples were then sorted in order to retrieve waterlogged plant-macrofossils. The processed samples were sorted, and material identified, under a low power binocular microscope at magnifications of x10 and x40. Identification was aided by use of a modern comparative collection and by using various seed identification manuals (Anderberg 1994; Beijerinck 1947 and Berggren 1969 & 1981 and Cappers *et al.* 2006). The nomenclature and habitat information follows Stace (1997). A large number of molluscs from the basal sample (8-8.5m) were picked out of the flot for identification and counting using a binocular microscope.

3.3 Radiocarbon dating

Three sub-samples for radiocarbon dating (4.10m, 6.26m and 8.50m) had previously been submitted during the assessment phase to SUERC, East Kilbride (Hopla *et al.* 2008). Four further bulk samples were selected for a second round of radiocarbon dating (4.82m, 5.50m, 6m and 7m). Each sample underwent acid/alkali/acid pre treatment prior to dating.

Depth/m	Lab Code	Date/BP	Material	Calibrated Date (2 sigma) *Estimated date*
4.10-4.11	SUERC-20656	1265±30	Peat (acid-alkali-acid)	670-860 cal AD
4.5	-	-	-	*220 cal. BC*
4.82-4.90	Beta-267388	2810±80	Peat (acid-alkali-acid)	1210-810 BC
5	-	-	-	*1090 BC*
5.50-5.55	Beta-267389	3070±70	Peat (acid-alkali-acid)	1490-1130 BC
6	-	-	-	*1710 cal BC*
6.26-6.27	SUERC-20657	3570±35	Peat (acid-alkali-acid)	2030-1780 BC
6.5	-	-	-	*2375 BC*
7-7.05	Beta-267391	4590±70	Peat (acid-alkali-acid)	3630-3090 BC
7.5	-	-	-	*4630 BC*
8	-	-	-	*5905BC*
8.50-8.51	SUERC-20658	8160±35	Peat (acid-alkali-acid)	7300-7060 cal BC

Table 2: Results of the radiocarbon dating of the Stowmarket sequence.

Interpolated dates are given in italics.

4. Results

3.1 Radiocarbon dating

The results of the radiocarbon dating are presented in Table 2. The dates were calibrated using Intcal04 (Reimer *et al.*, 2004). Simple linear interpolation between the dates was employed to provide estimates for the top and base of each sample (see below).

3.1 Coleoptera, plant macrofossils and molluscs

The results of the coleopteran analyses are presented in full in Appendix 1. To aid interpretation, where applicable, the taxa have been assigned ecological groups modified by Smith *et al*. (2000) after those of Kenward (1978) and Robinson (1981, 1983). All citations below contain both the primary reference source extracted from BUGSCEP (Buckland and Buckland 2006), that has drawn together the primary data sources including habitat and distribution data for Coleoptera autecology. The results of the mollusc analyses are presented in table 3 and plant macrofossils in table 4.

Species	Common Name	Number recorded	Ecology
Bithynia tentaculata	Mud Bithynia, common Bithynia or faucet snail	61	Freshwater standing or slowly running waters.
Valvata cristata	Flat valve snail	8	Stagnant/still water
Valvata piscinalis	European stream valvata	2	Running water
Planorbis crista (or *Gyraulus crista*)	Nautilus ramshorn	1	Lives on freshwater plants
Segmentina complanata	Flat ram's horn snail	1	Lives in ponds and ditches, prefers calcium-rich waters
Lymnaea peregra	Wandering pond snail	1	Colonises weedy ponds, does not travel far from water, always stays in damp places.
Carychium minimum	Short-toothed Herald Snail	2	Damp conditions
Planorbis leucostoma (Anisus leucostoma)	Button ramshorn snail	1	Freshwater

Table 3: Identification of the molluscs from sample 1 (8.5-8m)

Sample 1: 8.5-8m (7300-7060 cal. BC to c. 5900 cal. BC)

Coleoptera

This sample produced a relatively small assemblage dominated by aquatic taxa. Many of the species, such as the Hydraenidae family, are associated with open mud and shallower waters at the margins of a variety of water bodies (Hansen 1987). The

Hydrophilidae *Hydrobius fuscipes*, *Chaetarthria seminulum* and *Anacaema* sp., reflect similar habitats, the former pair are particularly associated with the well vegetated margins of standing water (Hansen 1987). The Dytiscid *Agabus bipustulatus* is indicative of well vegetated, deeper water (Nilsson and Holmen 1995). The sample also contained large numbers of the Dryopidae *Oulimnius* spp., a genus associated with well oxygenated flowing waters, such as in the splash zone at the edges of lakes and rivers with gravel substrates (Holland 1972).

Species associated with the wider, terrestrial environment are scarce, but the orthoperid, *Corylophus cassidoides*, is found with decaying grasses and flood detritus on tussocky grassland (Duff 1993). A further indictor of damp grassland is the chrysomelid, *Plateumaris discolour*, a phytophagous species found on *Carex* sp. (sedges) and *Eriophorum* sp. (cotton grasses) (Menzies and Cox 1996). Such habitats may have been present on the floodplain, but other indicators of drier grassland perhaps beyond the wetland edge include the scarabaeid *Cetonia aurata* and the Curculionidae, *Gymnetron* sp. and *Phyllobius* sp. (Jessop 1986, Koch 1992).

Plant macrofossils and molluscs

The subsample produced a very small, poorly preserved flot and the seeds of only three species were recorded: *Nymphaea alba* (white-water lily). *Alnus glutinosa* (alder) and *Pedicularis palustris* (marsh lousewort). White water-lily requires standing water to support its leaves and flowers and therefore indicates the presence of shallow standing water. The concentration of *Alnus* remains is probably too low to indicate dense local alder carr but some trees were perhaps established nearby. The mollusc assemblage (Table 3) is characterised by a range of taxa associated with freshwater environments and damp vegetation. The dominant species is *Bithynia tentaculata* (mud Bithynia), which is found in slowly running calcium-rich freshwater habitats. The second most abundant species is *Valvata cristata* (flat valve snail) and is typical of still/stagnant waters.

Sample 2: 8-7.5m (silts) (c. 5900 cal. BC to c. 4630 cal. BC)

Coleoptera

Species composition is similar to the previous sample. Aquatic taxa dominate the assemblage with relatively large numbers of the dryopid, *Oulimnius* sp., and the Hydraenidae in slightly lower concentrations. Another indicator of fluvial environments is *Hydraena testacea*, which is associated with slow moving and standing waters (Foster 2000, Hansen 1987). The presence of the chrysomelid, *Plateumaris braccata*, suggests that *Phragmites australis* (common reed) was growing nearby (Menzies and Cox 1996). This species can grow on damp soils as well as standing water (up to c. 1m deep). There is an increase in species associated with rotting organic material, a small suite of Staphylinidae, which include *Micropeplus fulvus,* and *Phylodrepa florialis*, found in drier rotting material, whilst *Anotylus rugosus* is more commonly associated with fouler rotting organics including carrion and dung (Tottenham 1954).

Macrofossils

The flot again produced poorly preserved macrofossils, but contained a wider range of plant species. The macrofossils included *Betula pendula* (silver birch) *Alnus glutinosa* (alder) and *Sambucus nigra* (elder) indicating a fen carr environment with elder and perhaps birch, although the seeds of *Betula* are readily dispersed by wind or water. The presence of *Stachys palustris* (marsh lousewort), *Lycopus europaeus* (gypsywort) and *Carex* sp. (sedge) suggest the presence of damp, open conditions.

Sample 3: 7.5 -7 (peats) (c. 4630 cal. BC to 3630-3090 cal. BC)

Coleoptera

A marked decrease in aquatic taxa, particularly the Hydraenidae and the Hydrophilidae is apparent in this sample, although the dryopid genus, *Oulimnius* sp. remains relatively abundant. Species associated with rotting organic material or sedge tussock and damp grassland are scarce, but two indicators of grassland do persist in the form of The Scarabaeid, *Cetonia aurata* and the Curculionid, *Alophus triguttatus*. These taxa are found in a range of habitats including pasture and floodplain (Koch 1992) with plant species such as *Plantago* spp., *Symphytum* spp., and *Epeaupatorium* spp.

Macrofossils

This was very similar in species composition to the previous sample. The presence of *Alnus* and *Sambucus* (elder) indicates the persistence of fen carr. *Stellaria neglecta* (greater chickweed) is also recorded; this herb is typically found in damp places.

Sample 4: 7-6.5m (3630-3090 cal. BC to 2370 cal. BC)

Coleoptera

Overall species abundance and diversity demonstrates a significant increase. Many of these species are hygrophilous taxa which suggest relatively wet environments, but fewer appear to represent fluvial contexts. The dryopid, *Oulimnius* sp, is much reduced, as are those species typical of slowing moving or standing waters. The

Taxon	Depth of core sample									Common Name	Habitat
	4.0-4.5m	4.5-5.0m	5.0-5.5m	5.5-6.0m	6.0-6.5m	6.5-7.0m	7.0-7.5m	7.5-8.0m	8.0-.50m		
Nymphaea alba L.									+	White water-lily	Still shallow water
Ceratophyllum submersum L.	+									Soft hornwort	Still water
Urtica dioica L.					+					Stinging nettle	Woods waste ground
Betula pendula Roth	+							+		Silver birch	Woods
Alnus glutinosa L	+++	+	++	++++	+++++	+++	++	+	+	Alder	By fresh water
Chenopodium album L.								+		Fat-hen	Disturbed ground
Chenopodium spp.			+							Goosefoots	
Moehringia trinervia (L) Clairv.		+								Three nerved sandwort	Woods and hedge banks
Stellaria neglecta Weihe					++	+	++			Greater chickweed	Damp, shady, streams
Cerastium cf *fontanum* baumg	+									Common mouse-ear	grassland
Lychnis flos-cuculi L.	+	+	+		++					Ragged robin	Damp Marshy places
Rumex sp.	+									Dock	Disturbed ground
Rumex crispus L.		+								Curled dock	Disturbed ground
Rubus fructicosus L.					+	+				Bramble	Woods, scrub
Potentilla erecta (L) Raeusch	+	+								Tormentil	Moors, bogs, grass
Prunus spinosa L.				+						Blackthorn	Hedges scrub woods
Crataegus monogyna Jacq.		+								Hawthorn	Hedges, scrub
Linum usitatissimum L.	+	+								Flax	Cultivar
Hydrocotyle vulgaris L.			+							Marsh pennywort	Bogs, fens and marshes sides of lakes.
Apium repens (Jacq) Lag.	+									Creeping marshwort	Open wet places
Stachys palustris L.						+	+	+		Marsh woundwort	By rivers and ponds
Lycopus europaeus. L	+	++				+		+		Gypsywort	Fens and wet fields
Pedicularis palustris L.									+	Marsh lousewort	Wet grass and bogs
Sambucus nigra L.						+	+	+		Elder	Hedges, woods
Cirsium palustre (L) Scop.		+								Marsh thistle	Marshes, damp grasslands
Anthemis cotula L.	+									Stinking chamomile	Arable, waste, rough ground
Carex appropinquata schumach		++++		+++++		+				Fibrous tussock sedge	Lakes, streams marshes and fens
Carex spp. Trigonous/*Ovate* nut	++		++	+	+	+	+	+		sedges	
Iris pseudacorus L.		+								Yellow iris	Fens, ditches, lakes

Table 4: Results of the plant macrofossil analyses.
Number of '+' indicates relative abundance *within* samples and should only be used to compare *between* samples with caution.

orthoperid, *Corylophus cassidoides* reappears, suggesting the persistence of tussocky grassland. The Staphylinidae, *Lesteva heeri*, *Lesteva punctata* and *Lathrobium brunnipes*, are associated with flood debris, particularly reed, sedge and grass litter (Koch 1989a). Other hygrophilous species indicative of similar riparian and lentic macrophyte communities include the Carabidae, *Pterostichus diligens,* and *Bembidion obliquum*. Both species are typical marsh- and wetland taxa, the latter found in reed, sedge and grass litter (Lindroth 1974). *Bembidion obliquum* is indicative of sparsely vegetated, muddy substrates (Lindroth 1974).

There is also an increase in species associated with foul, rotting organic material and dung. The Scaradbaeidae or 'dung beetle' *Geotrupes* spp. are recorded exclusively within this sample. The Geotrupidae or 'Dor beetles' are more closely associated with the dung of larger herbivores such as cows and horses (Jessop 1986). Other indicators of accumulated dung and fouler, rotting material than recorded in the previous samples are the non-aquatic Hydrophilidae, *Cercyon impressus* and *Cryptopleurum minutum,* both of which are associated with the dung of large herbivores and with organic litter and flood detritus. The latter species and the histerid, *Acritus nigricornis* (Duff 1993) are also found with carrion and can be considered indicative of particularly foul, rotting material (Duff 1993, Hansen 1987, Kenward and Hall 1995).

Macrofossils

This sample produced a larger flot with a similar range of taxa to the previous sample but with higher numbers of *Alnus* seeds. The impression is of the expansion of alder fen carr relative to the previous samples, but with more open, damp habitats persisting. *Rubus fructicosus* (blackberry) and *Carex appropinquata* (fibrous tussock sedge) both appear in this sample. Bramble is a hedgerow type species often associated with disturbed ground/waste, whilst fibrous tussock sedge is often found in lakes, streams marshes and fens. This may indicate the presence of drier areas within the local environment as older tussocks may provide such habitats beneath the tree canopy (Haslam, 2003).

Sample 5: 6.5 – 6m (2370 cal. BC to c. 1710 cal. BC)

Coleoptera

This assemblage was much smaller than the previous sample and whilst still relatively diverse, overall abundance has decreased. The fauna indicates little detectable change in the environment. Indicators of tussocky grassland and sedge/grass litter, *Corylophus cassidoides*, *L. heeri,* and *L. punctata* persist and further marsh and wetland species are recorded including the Pselaphid, *Bryaxis bulbifer*, which is also found in grass tussocks and marshland (Duff 1993, Pearce 1957). The chrysomelid, *P. braccata* and the curclionid, *Notaris* sp. may suggest stands of taller reeds and grasses including *Phragmites australis* (common reed).

There is a marked decrease in the group of species found with foul rotting material whilst taxa associated with dung have disappeared completely. A small component of the fauna perhaps hints at disturbed ground and grassland, probably beyond the floodplain edge. Many of the Curculionidae or 'weevils', are typical of grassland, meadows and pasture. This group includes *Apion* spp. more commonly found on *Rumex* spp. (docks and sorrels) (Koch 1992) and *Sitona* spp. which feeds upon *Vicia* spp. (vetches) and *Trifolium* spp. (clovers).

Macrofossils

This sample contained large numbers of *Alnus* seeds and a range of plants also typical of fen carr and damp vegetation (*Stellaria neglecta*, and *Carex* sp.) and *Lychnis flos-cuculi* (ragged robbin), a herb found in floodplain grassland. A further notable record is that of stinging nettle (*Urtica dioica*), an indicator of disturbed ground unlikely to be present in a wetland without an enriched nutrient content. *Rubus fruiticosus* (blackberry) may also indicate somewhat disturbed soils, such as woodland edge or hedgerow environments.

Sample 6: 6.0-5.5 m (c. 1710 cal. BC to 1490-1130 cal. BC)

Coleoptera

This sample produced the richest and most abundant assemblage of the entire sequence. However, the overall composition has changed very little from the previous sample, with the staphylinid group associated with tussocky grassland and a pair of Carabidae consisting of *Pterostichus nigrita*, and *Pterostichus strenuus* which are found in a variety of habitats, particularly very wet, well vegetated environments (Lindroth 1974, 1986). The most pronounced change is the re-emergence of an extensive aquatic assemblage, especially species associated with deeper, standing water, including the hydrophilid, *Cymbiodyta marginella*, and *Hydrobius fuscipes*, and the Dytiscidae, *Agabus bipustulatus*, and *Haliplus* sp. (Hansen 1987, Nilsson and Holmen 1995).

A further carabid, *Agonum thoreyi*, and the chrysomelid, *Plateumaris sericea* are associated with tall reeds and sedges including *Typha latifolia* (reedmace), *Iris pseudoacorus* (yellow flag) and in the case of *P. sericea*, the emergent macrophyte

Nuphar sp. (yellow water lily) (Lindroth 1974, 1986; Menzies and Cox 1996). A much smaller component probably reflects the dryland environment beyond the floodplain edge. Two species which may be regarded as monophagous are the eucnemid, *Melasis buprestoides*, which is particularly associated with *Fagus sylvatica* (beech) and the scoytid, *Leperisinius varius*, found on *Fraxinus excelsior* (ash) (Hyman 1992).

Macrofossils

There is a slight decrease in numbers of *Alnus* seeds in this sample, although alder carr probably remained in the near vicinity, but *Sambucus* disappears from the record suggesting this shrub was no longer part of the scrub layer. The high numbers of *C. appropinquata* may reflect the development of tussocks of sedge on the sampling site itself. *Prunus spinosa* (blackthorn) is recorded, indicating the presence of this shrub which is typical of undergrowth or woodland margin.

Sample 7: 5.5-5m (1490-1130 cal. BC to 1090 cal. BC)

Coleoptera

Species abundance and overall diversity declines, especially amongst the aquatic species and those of rotting organic material such as flood debris. Small numbers of Hydreanidae and Dytisicidae remain, as does a single indicator of rotting material in the form of a Scarabaeid of the *Aphodius* family. A range of species typical of damp, tussocky grassland are recorded, namely the Staphylinidae, *L. punctata,* and *L. heeri,* the Orthoperid, *Corylophous cassidoides*, and the carabid, *Pterostichus nigrita*. Indicators of taller reeds also decline and the Chrysomelidae recorded in previous samples are absent, with species associated with this type of vegetation restricted to *A. thoreyi.*

Macrofossils

The range of plant remains is similar to the previous sample, with evidence for the persistence of *Alnus* fen carr and damp, open environments (*Carex* sp. and *Lychnis flos-cuculi*). The aquatic *Hydrocotyle vulgaris* (Marsh pennywort) is also recorded.

Sample 8: 5-4.5m (c. 1090 cal. BC to c. 220 cal. BC)

Coleoptera

Aquatic taxa are slightly more abundant in this sample and include the larger Hydrophilidae, *C. orbiculare* and *H. fuscipes*, as well as the smaller species *C. seminulum* and *Anacaema bipustulatus.* Species of rotting material also increase, including a further pair of Hydrophilidae, *Cercyon sternalis*, and *Cercyon analis*, and the Staphylinidae, *Carpelimus bilineatus* and *Rugilus* sp. The latter species is associated with a variety of rotting material including drier hay/straw like material and reed litter (Koch 1989b).

The assemblage reflecting the wider environment also demonstrates a subtle shift. Species of damp grassland and sedge tussock have disappeared and been replaced by those typical of drier grassland such as the Scarabaeid, *Cetonia aurata,* the larvae of which are found in rotting material and the adult commonly amongst the flowers of the Apiaceae (carrot family) (Jessop 1986). The numbers of Curculionidae (*Apion* sp., *Sitona* sp., *Hypera* sp., and *Gymnetron* sp.) all increase markedly. The preference of *Apion* sp., and *Sitona* sp., for nitrophilous forbs has already been noted, whilst

Hypera spp. is found on a variety of grassland plants including *Trifolium* sp. (clovers), *Medicago* sp. (medick/burcolver), *Rumex* sp. (docks, sorrels), and *Lathyrus* sp. (sweet pea) and *Gymnetron* sp. with *Plantago* sp. (plantains), *Veronica* sp. (speedwells), and *Linaria* sp. (toadflaxes) (Bullock 1993, Hyman 1992, Koch 1992).

Macrofossils

There is evidence for a range of habitats in this sample. Lower numbers of *Alnus* seeds are recorded, possibly indicating a local decrease in fen carr whilst *C. appropinquata* is well represented, demonstrating the local persistence of tussocky sedge. Herbs typical of open fen such as *Lycopus europaeus* (gypsywort), *Potentilla erecta* (tormentil) and *Cirsium palustre* (marsh thistle) remain present and *Iris pseudocarus* (yellow iris) is also recorded. There is an indication of disturbed ground in the form of *Rumex crispus* (curled dock) and of scrub/hedge *Crataegus monogyna* (hawthorn).

Most notably, seeds of *Linum usitatissimum* (flax) are present in this sample. This plant is an introduced species and indicates that cultivation or processing of this plant was taking place on the floodplain. Flax is a shallow-rooted plant and requires ample moisture during early stages of development (Renfew 1973, 124; Percival 1918, 349) and is hence often cultivated on alluvial soils (see below).

Sample 9: 4.5-4.0m (c. 220 cal. BC to c. 670-860 cal. AD) Peats into silts (4.10m)

Coleoptera

The assemblage from the final sample again displays an increase in abundance and diversity, especially in species which are associated with drier, rotting material. This group contains sclera which could not be identified to species level but include the Rhizophagid, *Rhizophagus* sp., the Cryptophagid, *Atomaria*, and the Lathridiidae, *Enicmus minutus* and *Corticaria* sp. Whilst several species of this group are associated with drier flood debris, they may also be indicative of anthropogenic environments (Hall and Kenward 1990, 1997, Kenward and Hall 1995) in the near vicinity of the sampling site. The component of the assemblage found with foul, rotting organic material also changes somewhat with the Staphylinidae, *Oxytelus tetracarinatus* and *Platystethus arenarius*, replacing the Hydrophilidae which are found in the previous samples. The implications of this will be discussed in greater detail below.

There is an increase in aquatic and hygrophilous species, with relatively large numbers of the Hydraenidae family recorded. The Hydrophilidae, *C. Orbiculare*, *H. fuscipes*, and *C. marginella* are found in shallower water at the well vegetated margins of a variety of water bodies (Hansen 1987). The monophage *P. braccata* re-appears, indicating the proximity of *Phragmites australis*. A further species associated with emergent vegetation is *Prasocuris phellandrii*, a monophage found on *Oenanthe aquatica* (fine leaved water dropwort) (Bullock 1993). Species of damp, tussocky grassland re-emerge, such as the orthoperid, *C. cassidoides*, and the staphylinid, *L. heeri*. Taxa of drier grassland such as *Sitona* sp., and *Apion* sp. remain and two individuals of the former genus were identified to species level: *Sitona suturalis* is found with *Vicia* spp. (vetches) and *Lathyrus pratense,* and *Sitona puncticollis* with *Lotus* spp. (bird's foot trefoil), *Trifolium* spp. and *Vicia* spp. (Koch 1992).

Macrofossils

The final subsample produced the largest plant species list for the sequence. An increase in *Alnus* implies some re-expansion in fen carr whilst the re-appearance of *Betula*, albeit in low quantities, may suggest the presence of birch as local scrub/woodland. This impression of increased woodland cover may be reinforced by the record of *Moehringia trinervia* (three nerved sandwort) which grows in shady woodland environments (Thompson *et al*. 2001).

The range of taxa includes those found in the previous samples (*Lychnis flos-cuculi*, *Lycopus europaeus* and *Potentilla*) and several other species typical of wet floodplains including *Apium repens* (creeping marshwort) and the aquatic herb *Ceratophyllum submersum* (soft hornwort). The presence of *Linum usitatissimum* again implies cultivation/processing of flax, whilst cultivated soil may also be indicated by the record of *Anthemis cotula* (stinking chamomile), a weed associated with waste ground and arable habitats.

5. Discussion

5.1 Fluvial history and floodplain development

Few studies of the Holocene fluvial development of Suffolk have been carried out. Currently, the largest body of work of this type in Suffolk largely concerns earlier Quaternary material (Coope, 1974, 1992, 2006; Taylor and Coope 1985). Palaeoentomological work on the floodplain of the River Stour is restricted to Lateglacial material from Sproughton (Rose *et al*. 1980), whilst previous work on Holocene deposits in the valleys of the Waveney, Blackbourn and Lark produced only limited data-sets (Hill *et al*. 2007).

The stratigraphic profile (Figure 2) indicates that the sampling location was most likely to have been a palaeochannel of the River Gipping, which had incised into the basal gravels during the Late-glacial/early Holocene. The wet basal sands (see Table 1) which underlie the organics are likely to reflect deposition in higher energy environments during this earlier period of development. The basal radiocarbon date indicates that organic sediment accumulation and hence channel aggradation had commenced by around 8160±35 BP (7200-7060 cal. BC, SUERC-20658). This date is associated with the basal silty peat (7.48-8.5m) reflecting the flow of increasingly sluggish water. Linear interpolation between the basal radiocarbon date and that from 7-7.05m (4590±70 BP; Beta-267391, 3630-3090 cal. BC) indicates that the transition from silty peat to peat accumulation and hence the eventual infilling of the palaeochannel occurred *circa* 4630 cal. BC.

The palaeoenvironmental record reflects the evolution of the depositional regime during these earlier stages between 8.5m (8160±35 BP (7200-7060 cal. BC, SUERC-20658) to 7.5m (*circa* 4630 cal. BC). The beetle fauna from these samples are dominated by aquatic taxa with the presence of large numbers of 'riffle beetles' *Oulimnius* sp., suggesting frequent influxes of flowing water which were most probably responsible for the silt component in the basal peat. The presence of sparse remains of *Nymphea alba* in the macrofossil record is further evidence of open water, although the low concentrations of identifiable plant material somewhat restricts interpretation of these data. The molluscs from the basal sample include species found in stagnant/still water, indicative of the conditions associated with much reduced flow of water and accumulation of peat.

The nature of many British rivers changed during the early Holocene, from braided, multi-channel systems to meandering and anastomosing channels, which also facilitated the subsequent expansion of extensive floodplain wetlands (Howard and Macklin 1999). This impression is clear at Stowmarket, with species of coleoptera, indicative of open, standing water increasing in sample 2 (7.5-8m). By this point, between *circa* 5905-4630 cal. BC, there is also less insect evidence for relatively high energy fluvial environments. This presumably reflects the accumulation of peat in what was by this point an inactive palaeochannel.

However, although species associated with open water were reduced as peat accumulation progressed, the taxon *Oulimnius* sp. remains dominant in the sample from 7.5-7m, between *circa* 4630 cal. BC and c. 4590±70 BP (Beta-267391, 3630-3090 cal. BC). This might imply that although sedimentation on the sampling site had shifted from within a fluvial to semi-terrestrial environment, the location was still subject to occasional influxes of flowing water from an active channel in the close vicinity.

The accumulation of peat in a drier floodplain environment is reflected in the fauna from the Samples 3 to 5 (7-6.0m, 4590±70 BP (Beta-267391, 3630-3090 cal. BC to *circa* 1710 cal. BC), with a marked decline in hygrophilus taxa suggesting further isolation from fluvial influence. The range of beetles associated with grasses and reeds including *Phragmites australis* alongside others found with flood debris may instead reflect a seasonally flooded environment. This impression of a context increasingly marginal to fluvial influence may be reinforced by the record of *Bembidion obliquum*, a species often found at the periphery of waterbodies (Lindroth 1974) in Sample 5 (6.5-7m).

However, Sample 6 (6-5.5m) (*circa* 1710 cal. BC to 3570±30 BP (2030-1870 cal BC, SUERC-20656) reflects a further change in the depositional environment with evidence for a shift to wetter conditions. Aquatic taxa including species indicative of deep, standing water and others associated with wetland plants are recorded. The macrofossil record is dominated by *Carex approprinquata* indicating the dominance of tussocky sedge locally but no true aquatic plants are recorded. Pools and puddles may develop between the tussocks of this species in periods of raised watertables (Haslam 2003), perhaps accounting for the habitats of the beetles associated with standing water.

There is a subsequent decline in species abundance and diversity in Sample 7 (5-5.5m, 1490-1130 cal. BC to 1090 cal. BC) but the fauna would appear to indicate slightly drier conditions with tussocky grassland persisting. This is followed by evidence for wetter environments in Sample 8 (5-4.5m, c. 1090 cal. BC to c. 220 cal. BC) which appear to be maintained into Sample 9 (4.5-4m, c. 220 cal. BC to c. 670-880 cal. AD) alongside evidence for shallow open water. This final sample cuts across stratigraphic boundaries with the well humified peat overlain at a depth of 4.10m by organic-rich silts. It seems likely that the beetles indicative of aquatic habitats are largely associated with the deposition of this silt layer. Such open water environments are also reflected by presence of *Ceratophyllum submersum* in the plant macrofossil record.

There are thus notable differences between the hydrological conditions apparent in the lower samples (Samples 1 to 3; 7300-7060 cal. BC to 3630-3090 cal. BC) compared to those of the upper part of the sequence (Samples 6-9; c. 1710 cal. BC to 670-860 cal. AD). In the latter group of samples, species associated with flowing water are absent and the aquatic assemblage is dominated by species of still or standing waters, many of which are found at the margins of running water and in muddy, ephemeral pools. This would indicate that this second wetter phase during the mid-later second millennium BC is unlikely to be associated directly with reactivation of a channel close to the site, but rather with a general rise in local ground water tables.

A period of increased wetness has long been recognised during the early Bronze Age across Britain (Tooley 1982) and appears to be recorded, for example, in the Humber Estuary *c.* 1800 cal. BC (Van de Noort and Fletcher 1998), the Somerset Levels and the Severn Estuary from around *c*. 2000 cal. BC (Bell pers. comm., Haslett *et al.* 1998). A deteriorating climate, coupled with rising sea-levels at the end of the 'climatic optimum' is thought to be the catalyst for this period of change (e.g. see Macklin *et al.* 2009).

5.2 Wetland vegetation change

The coleopteran samples from Stowmarket provide evidence for changes in fluvial conditions and floodplain evolution at Stowmarket during the Holocene. The samples from 8.5-7m strongly indicate deposition in a higher energy regime in the form of the abundance of coleopteran taxa associated with flowing water and higher energy conditions, whilst those from samples 6-4.5m reflect slower moving and standing waters. Coleoptera found on emergent and aquatic vegetation are virtually absent in the lower samples but become more prevalent in the upper samples (6m+), all of which contained coleopteran taxa characteristic of standing water. A further suite of coleoptera associated with aquatic vegetation such as *Nuphar* sp., *Oenanthe aquatica* and taller reeds such as *Typha* spp. and *Phragmites australis* can also be identified in these upper samples. These herbaceous taxa are typical of standing water and silty substrates (Haslam *et al.* 1982), conditions not favoured by the elmid ('riffle' beetles) family which are abundant in Sample 1. The data therefore demonstrate the significant change in fluvial conditions from the early to the later Holocene, which has been observed in various other British catchments (see Smith and Howard 2004).

However, whilst the analyses appear to provide good evidence of the evolution of the fluvial system, there are some interpretative issues associated with reconstructing the wider floodplain environment from the palaeoentomological data. There are problems associated with extrapolating the precise extent of local *Alnus* cover on the wider floodplain from the macrofossil data, especially in the absence of pollen evidence (see Bunting *et al*. 2005), but the impression is that fen carr was a significant feature of the floodplain vegetation close to the sampling site for much of the time represented by the sequence. The pollen assessment of this sequence also indicated that *Alnus* was abundant on and around the sampling site, especially in the basal deposits (7.7-8.5m) where pollen was better preserved (see Hopla *et al.* 2008) although these data are insufficient to draw detailed conclusions.

However, the relative abundance of *Alnus* macrofossils indicates that this tree might have been present from early in the Holocene, with seeds recorded in Sample 1 from a date of 8160±35 BP (7200-7060 cal BC, SUERC-20658). The representation of *Alnus* peaks in Sample 6-6.5 (*circa* 1710-2375 cal. BC), after which a gradual decline in abundance is recorded (see below). The general decrease in wood sub-fossils in the stratigraphy probably also reflects this process, although there is macrofossil evidence that *Alnus* expanded at the close of the sequence (Sample 9, 4.5-4m, 220 cal. BC to c. 670-860 cal. AD).

The identification of *Alnus* fen carr using palaeoentomological methods is problematic for two main reasons (Girling 1985, Robinson 1993, Smith *et al*. 2000, Smith and Whitehouse 2005). Firstly, a relatively limited number of beetle taxa (14) are closely associated with *Alnus* in comparison to other trees (e.g. *Quercus* (93) (oak); Bullock (1993)). The second relates to the lack of modern entomological knowledge of *Alnus* dominated habitats. Establishing the presence of *Alnus* carr at other wetland sites (e.g. Goldcliff, Goldcliff East, the Somerset Levels and Mingies

Ditch) has also proved problematic (Girling 1985, Robinson 1993, Smith *et al*. 2000). A site which compares particularly well with Stowmarket is Goldcliff East, in the Gwent Levels where the presence of *Alnus* carr was indicated by the waterlogged plant remains and identification of sub-fossil wood. However, no evidence for this tree was found in the palaeoentomological record, which was dominated by beetle species indicating grass and sedge tussock vegetation (Tetlow 2003, 2005, 2007).

Other comparative sites are Mingies Ditch and Runnymede in the Thames Valley; where palaeoenvironmental evidence indicates *Alnus* carr dominated floodplain during the later Mesolithic (Robinson 1981, 1993a, 1993b, Allen and Robinson 1993). Further afield in the Trent Valley, pollen and beetle assemblages also demonstrate *Salix* carr at Bole Ings (Dinnin 1997, Dinnin and Brayshay 1994, and *Alnus*-*Salix* carr at Staythorpe (Davies 2001). The eighth millennium BC in general heralds the beginning of a much more stable period in the evolution of British floodplains: palaeoenvironmental study of sites in the Trent Valley at Girton, Staythorpe and Bole Ings for example, demonstrates that large palaeochannels had begun to aggrade by *c*. 7500 cal. BC (Howard and Knight 2004).

5.3 Dryland vegetation: woodland

There is little evidence in either the beetle or macrofossil record for the nature of the dryland woodland beyond the wetland edge. Recent palaeoecological study in Suffolk (e.g. Hill *et al*. 2007) indicates that the mid Holocene terrestrial vegetation consisted of dense *Tilia-Corylus-Quercus-Ulmus* (lime-hazel-oak-elm) mixed woodland. However, the precise structure of this woodland is unclear; *Pinus* and *Betula* probably remained important components of the vegetation on poorer and more unstable soils.

Such contexts probably included certain areas of floodplains such as that of the River Gipping.

The only beetle evidence for woodland is found in Sample 6 (see below) where *Melasis buprestoides*, which is particularly associated with *Fagus sylvatica* (beech) and *Leperisinius varius*, associated with *Fraxinus excelsior* (ash) (Hyman 1992), are both recorded. *Fagus sylvatica* is recorded only sporadically and in very low quantities in the Holocene pollen diagrams from Suffolk and tends to be poorly represented palynologically in any case. The significance of the palaeoentomological evidence for the status of this tree in the local environment at Stowmarket is unclear, although the expansion of *Fagus* during the later Holocene may be partly associated with woodland clearance. *Fraxinus excelsior* is also poorly represented but also generally increases following anthropogenic disturbance to closed woodland, reflecting the tendency for this tree to expand and grow rapidly in open areas such as woodland edges and clearings. Evidence for human activity and the development of vegetation possibly associated with settlement and farming activity will be discussed further below.

5.4 Anthropogenic activity: grassland and pastoral habitats

There are indications in the plant and coleoptera data for the presence of grazing animals on or near the sampling site during the Neolithic-early Bronze Age, with ‘dung’ and ‘dor’ beetles first recorded in Sample 4 (7-6.5m, 3630-3090 to 2370 cal. BC). This suggests grazing by wild and/or domesticated animals, although dung beetles are ready fliers, hence the presence of this species may not be an unequivocal indicator of *in situ* dung or of grazing animals on the site itself. The indicators of foul rotting material might suggest the accumulation of dung and other foetid deposits, but evidence for such material is present throughout the sequence and may equally reflect the partial decay of plant material becoming incorporated into the peat system.

Further perhaps somewhat equivocal evidence for anthropogenic impact is apparent in Sample 5, (6.5-6m, *c.* 2370-1710 cal. BC). Dung beetles are absent and reappear as only a single record in Sample 7 (5.5-5m). However, the insect taxa in Sample 5 include the Curculionidae or 'weevils' such as the Apionidae and *Sitona* spp. which suggest species rich grassland including *Trifolium* (clovers), *Vicia* (vetches) and *Rumex* (docks). Such pastoral habitats are also indicated by the macrofossil record, in particular *Uritca diocia* (stinging nettle) which is associated with nitrogen rich habitats. Haslam (2003: 203) has stated that: "…over four years of careful study *Urtica dioica* was never seen, in …undisturbed fen". The evidence thus indicates the expansion of grassy, pastoral environment during the early Bronze Age. It seems highly likely that the sequence thus reflects the first identifiable impact of settlement and farming on the local environment at this time. However, the precise character or extent of such activity is unclear on the basis of the current data.

The increase in *Alnus* in the macrofossil record in Sample 5 would seem to be at odds with the evidence for possible human activity in the wider environment. It is possible that the presence of 'dung' beetles in Sample 4 might reflect grazing of parts of the floodplain itself, whilst during this later period, pastoral activity moved onto the dryland fringes allowing *Alnus* to regenerate. Interpretation is hindered by taphonomic factors; it is possible that the growth of *Alnus* carr on the sampling site may have acted to physically 'screen out' the representation of the dryland fauna in a similar manner in which the dryland pollen can be excluded (e.g. see Bunting *et al.* 2005). In addition, it is not immediately clear what the precise implications of the relative concentration of plant macrofossil remains are for the spatial structure of the local palaeovegetation.

Samples 6 and 7 (5.5-4m) provided less beetle evidence for the character of the dryland vegetation, but there is an increase in Sample 8 (c. 1090 cal. BC to 220 cal. BC) of beetles reflecting grassland habitats including *Trifolium, Plantago* and *Rumex*. These plants are regarded as 'anthropogenic indicators' (Behre 1981) and the suite of associated beetles may imply increased grazing intensities and expansion of grassland locally during the late Bronze Age/early Iron Age. The plant macrofossil record also demonstrates a reduction in *Alnus* in Samples 6 to 8, perhaps reflecting anthropogenic clearance of the fen carr between 1490-1130 cal. BC to c. 220 cal. BC.

Archaeological evidence from the site of Beccles and Barsham, east Suffolk illustrates human activity adjacent to the River Waveney during later prehistory. The construction of timber post alignment structures across the floodplain during the later Iron Age is associated with evidence for the clearance of floodplain alder carr (Gearey *et al.*, forthcoming). It is possible that the later prehistoric period thus saw a general increase in the exploitation of 'marginal' environments such as floodplains in Suffolk. Whether this was related to general pressure on the land resource or other social/environmental factors is currently unclear.

5.5 *Evidence for prehistoric and later flax cultivation/processing*

Direct evidence for human activity during the later Bronze Age is also present in the form of the record of *Linum usitatissimum* in the macrofossil record (Sample 8; 1090-220 cal. BC). Stems of the cultivated plants can be processed to produce fibres suitable for weaving linen (Murphy, 1982). Whilst it seems unlikely that flax was being grown on the floodplain itself, 'retting' of this crop in pools/ponds might have been taking place locally. It can be noted that flax grows well in alluvial soils and it is possible that the crop was being cultivated on such contexts on the floodplain margins. In this case, it is possible that the plant remains represent material re-deposited on the floodplain during periods of erosion from the slopes around the site. It is also possible that some of the other plant macrofossils (e.g. *Anthemis cotula*) may have arrived on the sampling site with the flax crop (*cf.* Latalowa 1998) or with re-worked sediment.

Remains of cultivated flax are known from many sites in Europe from the Neolithic onwards (e.g. Zohary and Hopf 1988) but records for prehistoric evidence for flax retting in Britain are rare. Interestingly, early Bronze Age pit features at the site of West Row Fen, Suffolk (Martin and Murphy 1988) contained plant macrofossil remains suggesting flax retting. Whether wider significance can be attached to these relatively early records for flax in the east of England is unclear.

The final Sample 9 (4-4.5m, 220 cal. BC to c. 670-860 cal. AD) covers the period from the Iron Age into the early Medieval and contains further evidence for human impact and activity. *L. usitatissimum* is again present, reflecting continued processing/cultivation of this crop in the close vicinity. There is also evidence from

Staunch Meadow, Brandon, Suffolk and Buckenham Mere, Norfolk that flax was being processed/cultivated during the Anglo-Saxon period (Murphy 1982; Godwin 1968).

A small component of the beetle fauna in the final sample are associated with relatively dry rotting organic material and form part of the ‘house fauna’ (Kenward and Hall 1995). This group is commonly associated with unheated earthen-floored dwellings and wooden or wattle and daub structures and is also associated with relatively dry ‘hay-like’ material in the early stages of decay (Hall and Kenward 1990; Kenward and Hall 1995).

This may reflects some form of human habitation nearby, or the occasional dumping or deposition of quantities of domestic waste on the floodplain. There are two further possibilities for the source of this fauna, the first is that these species were dumped from a hayrick or similar store of hay or straw and the second is that they are from very dry, grassy flood deposits. The absence of dung beetles and other grazing indicators would suggest the former is unlikely, hence the most plausible explanation for the presence of this assemblage is perhaps domestic waste, which may also have been washed downstream and re-deposited during floods, or very dry, ‘trash-line’ debris.

5.5 The archaeological and palaeoenvironmental records

A Roman villa site (see Figure 1; SKT018) is located some 700m to the south-east of the sampling site. It seems very likely that the palaeoenvironmental evidence for human impact at the close of the sequence relates to settlement of the area during the later Holocene. Unfortunately, the temporal resolution of the upper sample (4-4.5m) covers the period from the Iron Age through to the early Medieval (220 cal. BC to c. 670-860 cal. AD) hence it is not possible to identify the precise character and chronology of environmental changes. It is clear that this later period saw significant impact on the floodplain environment.

It can be observed that the sampling site is also less than 100m south-east of Thorney Hall, the mid-late Saxon settlement which was the precursor to the post-Conquest settlement of Stowmarket (see Figure 1: SKT012). The valley fill along this stratigraphic transect is characterised by thick peats which suggest that the course of the river Gipping has not changed significantly in this reach since the early Holocene The name 'Thorney' suggests the location of the settlement on an island; the stratigraphic transect (Figure 1) demonstrates such an 'island' in the floodplain peats to the west of the sampling site. Whilst no further stratigraphic data are available, it seems likely that the Saxon settlement at Thorney was located on this feature which extended to the north of the recorded transect, effectively forming an 'island' with the river to the west and the marshy ground of the floodplain to the east. The identification of the 'house fauna' discussed above may indicate the close proximity of human habitation or possibly the dumping of domestic waste on what was marginal land beyond the settlement itself.

The deposition of the organic silts that cap the peats suggest wetter conditions after 670-860 cal. AD which were perhaps also related to the effects of local human activity. Increased catchment erosion resulting from the impact of intensified agricultural production led to accelerated rates of overbank floodplain sedimentation during the later Holocene (c. 950 cal. AD) across many British catchments (Macklin *et al*. 2009).

6. Conclusions

Table 4 summarises the results of the analyses discussed above. The beetle assemblages suggest a series of phases which correspond relatively well with changes recorded in fluvial systems in other parts of the south-east and eastern England and possibly linked to wider allogenic 'forcing' mechanisms such as sea-level and climatic change. The first stage was characterised by the infilling of a palaeochannel which was initially characterised by wet conditions with rapidly flowing water on the sampling site (c. 7180 cal. BC to 3360 cal. BC). This was followed by a period of perhaps greater tranquillity in terms of the fluvial regime, with evidence for the infilling of the channel, slower moving/standing water and the steady accumulation of peat in a floodplain/backswamp environment (c. 3360 cal. BC to 1710 cal. BC). A final phase of increased local wetness and rising watertables is then inferred (c. 1710 cal. BC to 765 cal. AD). These phases should be regarded as approximate given the thickness of the sample depths analysed.

The coleoptera demonstrate a series of changes in the local vegetation, but the evidence for a generally open environment conflicts somewhat with the plant macrofossil data which indicates *Alnus* carr woodland. This is likely to be a reflection of the taphonomic issues associated with identifying *Alnus* using sub-fossil insect remains. This illustrates the importance of a multi-proxy approach; it is unfortunate that the pollen was poorly preserved in the sampled deposit since these data would have provided further comparative information regarding changes in the wider environment (e.g. see Brayshay and Dinnin 1994). It can also be noted that the subtle evidence for hydrological changes provided by the insect analyses is generally not apparent in the stratigraphy of the sequence, demonstrating the value of such data for investigating patterns and processes of past environmental change.

Despite the interpretative problems associated with plant and insect data, the Stowmarket analyses have provided information regarding human activity in the Gipping valley. The appearance of 'dung beetles' in Sample 4 (c. 3360-2370 cal. BC) indicates the presence of grazing animals during the Neolithic/Bronze Age, although it is unclear if these were domesticated or wild. Clearer evidence for open, pastoral habitats possibly associated with human activity during the Bronze Age is recorded in Sample 5 (2370-1710 cal. BC). Direct indications of anthropogenic activity are apparent in Sample 8 (1090-220 cal. BC) with the presence of *Linum usitatissimum* (flax) in the macrofossil record and associated insect evidence for pastoral vegetation. Cultivation and/or processing of flax in the close vicinity of the sampling site can be inferred.

This is maintained into the final sample 9 (220 cal. BC to 760 cal. AD) which unfortunately includes the later prehistoric as well as early Medieval periods, both of which there is archaeological evidence for local activity. A small but distinctive assemblage of beetles known as the 'House Fauna' (Hall and Kenward 1990; Kenward and Hall 1995) was recovered from this sample. The exact source of this group is ambiguous but to suggest that it does indeed suggest human habitation or the dumping of domestic waste nearby, or material dumped into the river channel which appears to have re-activated on the sampling site during this later period. The impression of significant anthropogenic disturbance on the floodplain during this later period is clear in both insect and plant macrofossil records.

The full analyses of beetle and plant macrofossils from Stowmarket have produced a detailed record of environmental changes associated with the development of the River Gipping and its landscape during the Holocene. These data represent the first such coherent data for Suffolk, with few comparable studies currently available. Indeed, relatively few integrated studies of this kind have been carried out in England generally. The final conclusion of this report is that floodplain deposits must thus be regarded as potentially highly valuable archives for elucidating the relationship between anthropogenic and 'natural' processes of environmental change.

Approx Age	Site hydrology	Floodplain vegetation	Terrestrial vegetation
765AD	Floodplain peat, rising watertables and flooding	*Phragmites* Ruderal habitats, Flax retting Some expansion in *Alnus* fen carr?	Open landscape/pastoral habitats Patchy woodland?
220 BC	Floodplain peat, possible expansion in wetter areas	Sedge fen with wet grassland Flax retting	Increasingly open landscape? Grassland/pastoral habitats
1090 BC	Floodplain peat	*Alnus* carr, damp open environments Tussocky grassland	?
1310 BC	Floodplain peat accumulation, rising watertables and expansion in areas of standing water	*Alnus* carr but reduced extent. *Carex* and *Phragmites,* aquatic/emergent vegetation expanding	Woodland/woodland edge with *Fagus* and *Fraxinus*
1710 BC	Floodplain peat accumulation *Seasonal flooding*	*Alnus* fen carr *Phragmites* beds and wet grassland and disturbed contexts	Woodland? Grassland/meadow
2370 BC	Floodplain peat accumulation *Seasonal flooding*	*Alnus* fen carr	Woodland? but grazed/disturbed areas
3360 BC	Backswamp peat accumulation, *frequent flooding*	*Alnus* fen carr Sedge/damp grassland	Mixed woodland? Some open grassland/grazed areas
4630 BC	*Flowing water* but increasing ponding and peat accumulation	*Alnus* fen carr Tussocky grassland, *Carex* and *Phragmites*	Mixed woodland?
5900 BC **c. 7180 BC**	*Flowing water* – shallow aggrading channel	Damp tussocky grassland ?expanding *Alnus*	Mixed woodland? Some open grassland (wetland edge?)

Table 5: Summary of environmental changes in the Stowmarket sequence

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Appendix 1: Results of the coleopteran analyses

Depth	8-8.5	7.5-8	7-7.5	6.5-7	6-6.5	5.5-6	5-5.5	4.5-5	4-4.5
Carabidae									
Bembidion obliquum Sturm				1		1			
Bembidion sp.									1
Pterostichus strenuus (Panz.)						1			
Pterostichus diligens (Sturm)				1	1		1	1	
Pterostichus nigrita (Payk.)						2	1		
Pterostichus sp.					1				
Agonum thoreyi Dej.						1	1		
Paradromius linearis (Ol.)							1		1
Dytiscidae									
Haliplus sp.						1			
Hydroporus melanarius Sturm							1	1	
Hydroporus sp.			1			1	1		1
Agabus bipustulatus (L.)	1					1			2
Agabus sp.						1			
Gyrinidae									
Gyrinus sp.		1							
Hydraenidae									
Hydraena testacea Curtis		4		2					
Hydraena sp.	13	7	5	4	2		1		2
Ochthebius minimus (F.)	1	1							
Ochthebius sp.	2		1			1		3	4
Limnebius sp.	1					7	1		1
Hydrochus sp.								1	
Helophorus sp.						8	1	1	7
Hydrophilidae									
Coelostoma orbiculare (F.)						1		1	1
Cercyon ustulatus (Preys.)							1		
Cercyon impressus Sturm				1		1			
Cercyon haemorrhoidalis (F.)					1				
Cercyon tristis (Ill.)						1			1
Cercyon convexiusculus Steph.						1		1	
Cercyon sternalis Sharp				2				1	
Cercyon analis (Payk.)						1		1	1
Cercyon sp.		1			1	1	2		1
Cryptopleurum minutum (F.)				1					
Hydrobius fuscipes (L.)	1					1		1	2
Anacaena globulus (Payk.)									1
Anacaena bipustulata (Marsham)							1		2
Anacaena sp.	1	1				1	1		1
Cymbiodyta marginella (F.)		1			1	3			1
Chaetarthria seminulum (Hbst.)	1	1	1	2	4		1	2	1
Histeridae									
Acritus nigricornis (Hoff.)				1					

Liodidae									
Agathidium marginatum Sturm						1			
Clambidae									
Clambus sp.	1			1		1			
Depth	**8-8.5**	**7.5-8**	**7-7.5**	**6.5-7**	**6-6.5**	**5.5-6**	**5-5.5**	**4.5-5**	**4-4.5**
Scydmaenidae									
Scydmaenus sp.		1	1						
Orthoperidae									
Corylophus crassidoides (Marsham)	2			2	4	1	1		1
Ptilidae									
Acrotrichis sp.				2					
Staphylinidae									
Micropeplus fulvus Er.		1							
Megarthrus sp.						1			
Phyllodrepa floralis (Payk.)		1							
Omalium sp.			1						
Olophrum sp.				1	1	1			
Acidota sp.						1			
Lesteva punctata Er.				1	1		3		1
Lesteva heeri Fauvel				1	2	5	2		
Lesteva longoelytrata (Goeze)									1
Carpelimus bilineatus (Steph.)								1	1
Oxytelus sp.				1					1
Oxytelus rugosus (F.)		1		1	1				
Oxytelus tetracarinatus Block									1
Anotylus sp.						1			
Platystethus arenarius (Geoff.)									1
Platystethus sp.	1								
Bledius subterraneus Er.						1			
Stenus sp.				4	1	4	1	2	2
Paederus sp.						1			
Rugilus sp.						2		2	
Lithocharis sp.					1	1			
Lathrobium rufipenne Gyll.	1	1		1	1	1	1		
Lathrobium brunnipes (F.)				1	1	2	1		
Leptacinus sp.								1	
Gyrohypnus fracticornis (Müll.)				1					
Xantholinus sp.						1			2
Philonthus sp.						1	2		2
Quedius sp.						1			
Tachyporus sp.									2
Tachinus sp.									1
Aleocharinae indet.	1			1	3	1		1	3
Pselaphidae									
Bryaxis bulbifer (Reich.)					2			1	
Bryaxis sp.				1					

Cantharidae									
Cantharis sp.								1	
Eucnemidae									
Melasis buprestoides (L.)						1			
Dryopidae									
Dryops sp.	2								1
Oulimnius sp.	12	9	8	1					
Depth	**8-8.5**	**7.5-8**	**7-7.5**	**6.5-7**	**6-6.5**	**5.5-6**	**5-5.5**	**4.5-5**	**4-4.5**
Nitidulidae									
Meligethes sp.	1								
Rhizophagidae									
Rhizophagus sp.									1
Cryptophagidae									
Atomaria sp.								1	
Lathridiidae									
Enicmnus minutus (grp.) (L.)									1
Corticaria sp.				1					1
Anobiidae									
Grynobius planus (F.)	1		1	1		1	1		1
Anobium punctatum (Deg.)		1							
Scarabaeidae									
Geotrupes sp.		1		7					
Aphodius sp.							1	1	1
Phyllopertha horticola (L.)						1			
Cetonia aurata (L.)	1		1					1	
Chrysomelidae									
Donacia sp.	1					1			
Plateumaris discolor (Panz.)	1	1							
Plateumaris sericea (L.)						1			
Plateumaris braccata (Scop.)		1			2				1
Plateumaris sp.	2	4				2		1	1
Prasocuris phellandrii (L.)									2
Chrysomela sp.						2			
Phyllotreta sp.								3	2
Chaetocnema concinna (Marsham)									3
Chaetocnema sp.		1				2			
Bruchidae									
Bruchus sp.									1

Scolytidae									
Leperisinus varius (F.)						1		1	
Curculionidae									
Apion sp.					1			1	3
Phyllobius sp.	1							1	
Strophosoma sp.		1							
Sitona suturalis Steph.									1
Sitona puncticollis Steph.									1
Sitona sp.					1			6	2
Tanysphyrus lemnae (Payk.)				1			1		
Notaris sp.					1				1
Thryogenes sp.						1			
Alophus triguttatus (F.)			1						
Hypera sp.									1
Acalles sp.						1			
Baris sp.							1		
Depth	**8-8.5**	**7.5-8**	**7-7.5**	**6.5-7**	**6-6.5**	**5.5-6**	**5-5.5**	**4.5-5**	**4-4.5**
Curculionidae									
Ceutorhynchus sp.					1	1			1
Gymnetron sp.	1					1		1	1
Diptera indet (puparia)	1				1				3