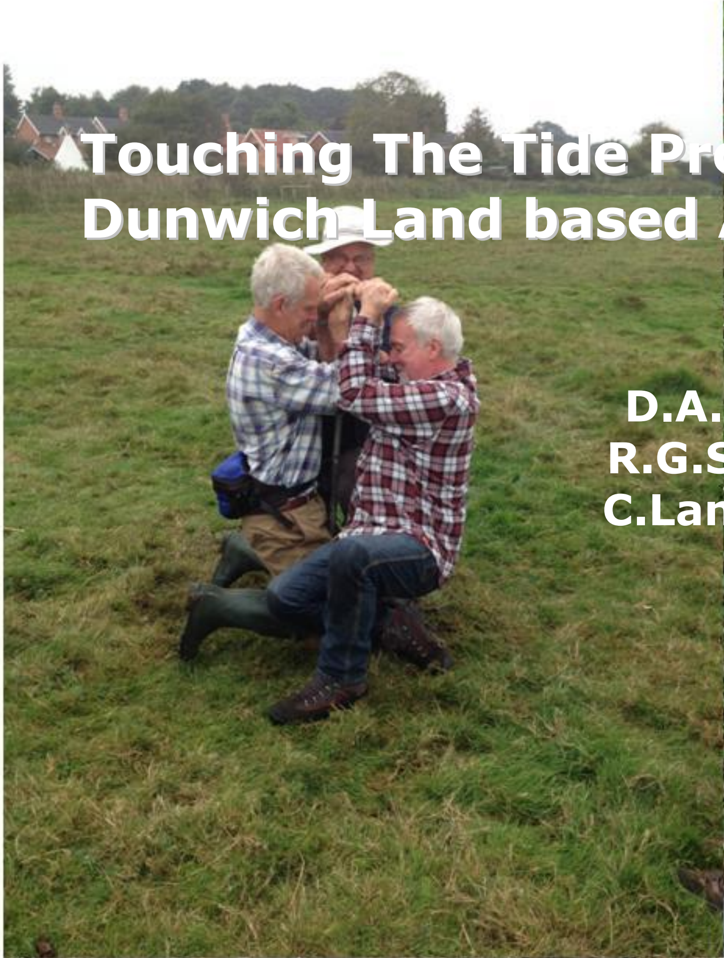
Touching The Tide Project
Dunwich Land based Archaeological report

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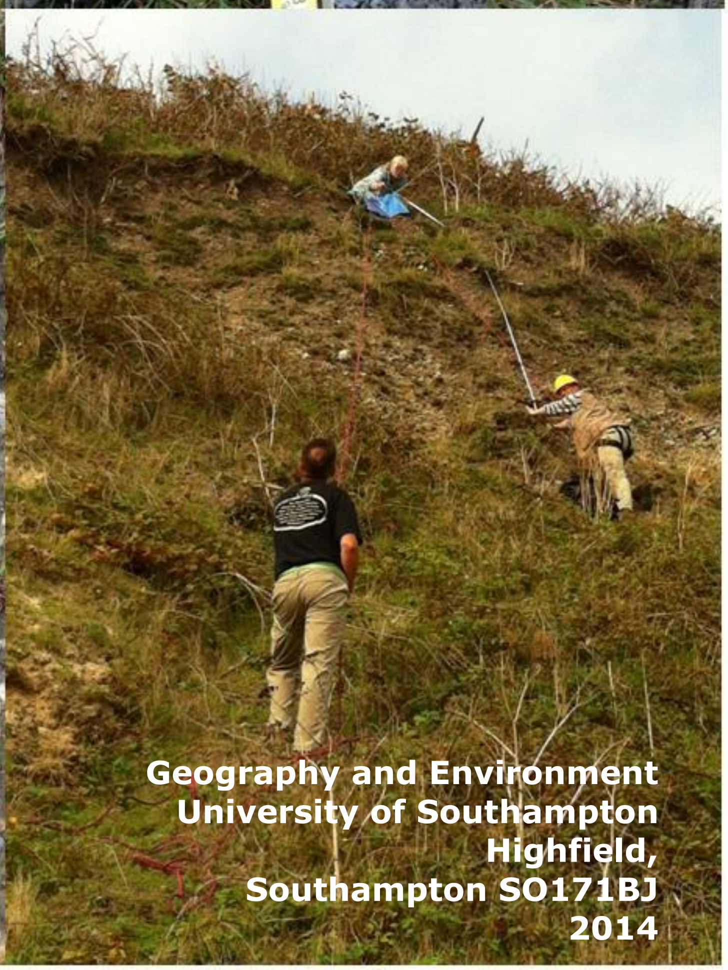

Geography and Environment
University of Southampton
Highfield,
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Touching The Tide

Dunwich Land based Archaeological Survey: 2014-15

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Contents

Introduction

Dunwich is a ….

Project Aims

The main aims of the project were:

1. To establish a minimum date for the construction of the town based on dating of sediments at the base of road and defensive ditch deposits exposed in the cliff.

2. To establish an environmental history of the harbour and in particular to determine the sequence and timescales over which it changed from an open estuary to a freshwater marsh and to identify flood event deposits.

Site Overview

Cliff Exposures

The eroding cliffs at Dunwich provided an opportunity to access sections cut through the archaeological horizons within the western extent of the Pales Dyke. This work is vital since these remains are potentially at risk from destruction from cliff retreat (Sear et al., 2012). The land within the Pales Dyke is only 30m wide at the widest point and is likely to be lost within the next 50-100 years. However, it is this exposure in the cliff face that provides an opportunity to access the archaeology without the need for destructive trench digging.

Objectives

1. To obtain dateable material from the lowest horizon within the Pales dyke defensive ditch and roads. This material to be either organic (bone, plant material or charcoal) for radiocarbon dating or in the absence of dateable organic material, to collect sediment samples from below and within the lowest disturbed sediments for optical luminescence dating.
2. If pottery fragments are evident and accessible without disturbance, then a sample of these will also be recovered.
3. In ALL cases we are only interested in recovering a minimum 2 samples from the lowest (oldest) layers of the exposed roads and Pales Dyke exposures.
4. To obtain dates for each sample and report to Greyfriars Trust and Dunwich Museum.

Methods

A stipulation of the permission to undertake the Cliff Face sampling given by the Greyfriars and Dunwich Town Trust, was that minimal disturbance was made to the cliff face. These required a method to access and sample the lowest horizons of each site without full cleaning of the section. In effect sampling only around the are (lowest horizon) necessary. Access to the sediment layers exposed in the cliff were undertaken by climbing up stable vegetated talus (St James Street/Pales Dyke), or by abseiling (Scott's Lane) using a fixed top rope set >10m back from the cliff edge. The cliff edge was protected from the rope by using tarpaulin and wooden boards to distribute the load over the ground adjacent to the cliff edge. On arrival at the base of the section the surveyor identified the lowest of the sections above the undisturbed cliff sediment. In all cases we used naturally exposed sections, but where necessary we carefully cleaned a small section to reveal this lowest horizon. This minimized disturbance to the cliff face whilst ensuring access to any dateable material exposed at that point. For Radiocarbon and pottery dating we photographed and recovered the exposed fragments/soil, minimizing disturbance to the cliff face.

The sample sites were selected using the digital mapping developed by Sear et al., (2012), and locating the positions where major roads and the town defensive ditch – the Pales Dyke, intersected the 2012 Air photo cliff line (Figure 1).

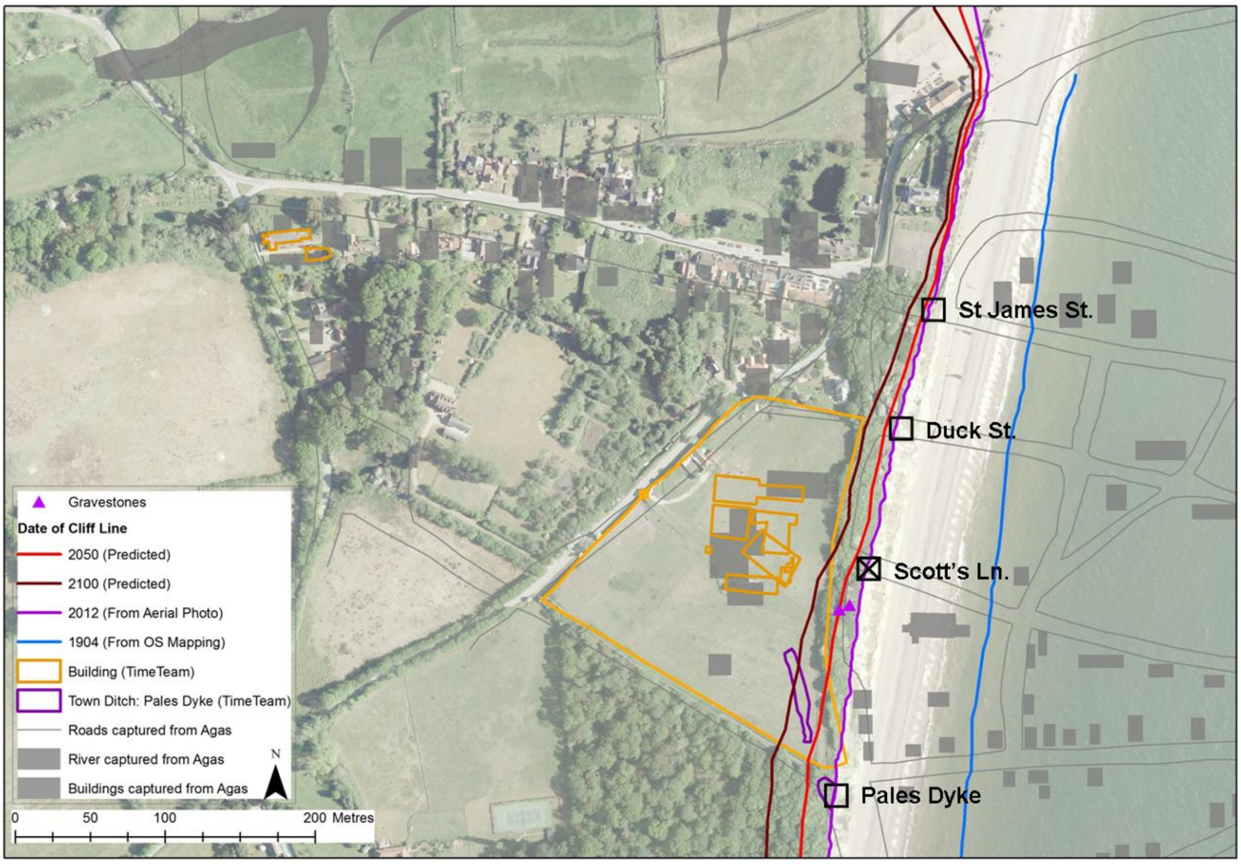


Figure 1: Cliff sites identified for sampling. Note the predicted position of the 2050 – 2100 coastline shows the imminent loss of these sites. Scott's Lane site was not sampled for safety reasons. Samples were taken from the base of St James Street, Duck Street and the Pales Dyke. Base map from Sear et al., (2012).

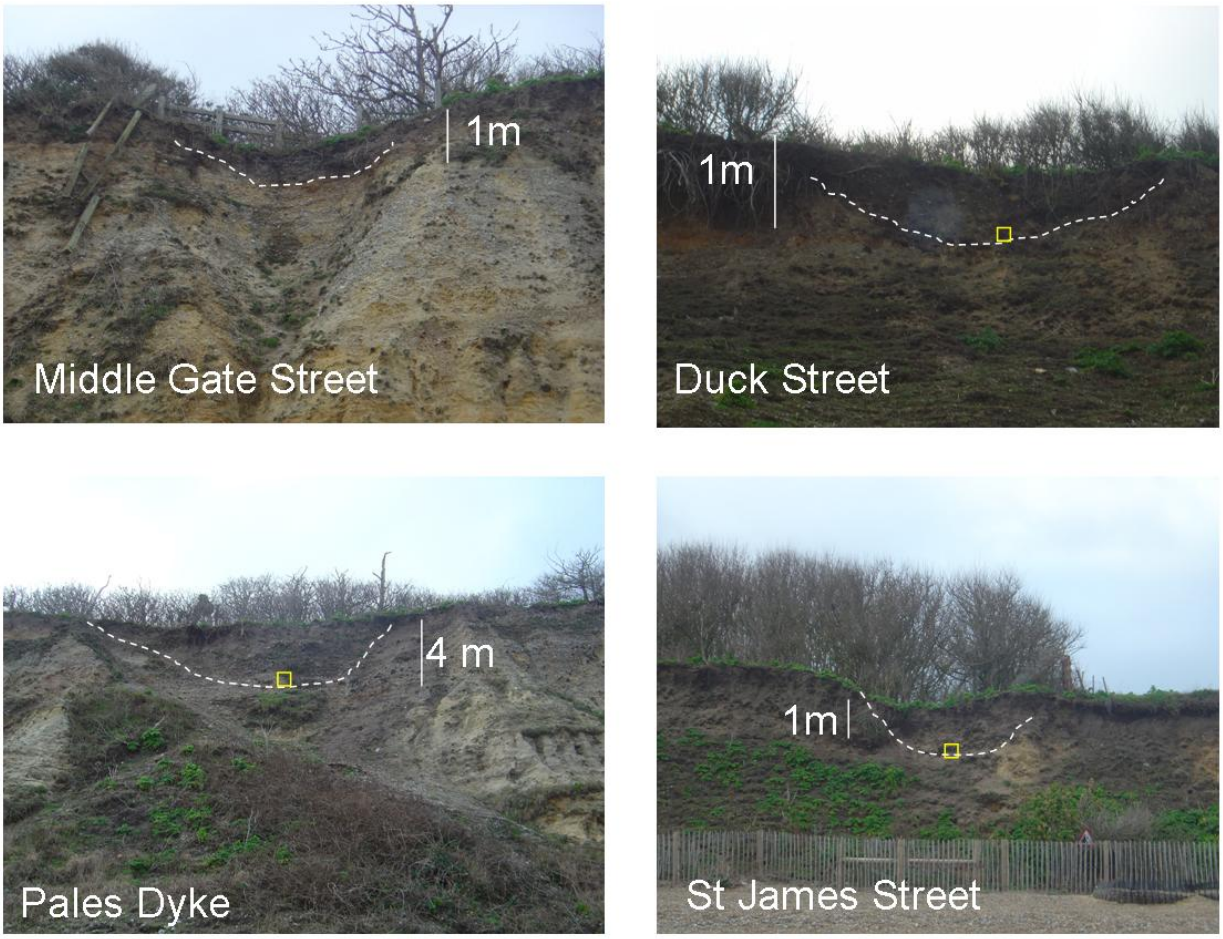


Figure 2: Cliff exposures identified as sampling sites. The lowest horizon above the natural geology of the cliff was sampled (Yellow square). Middle Gate Street was not sampled for safety reasons assessed on the day of survey.

Geochronology

Three dating methods were considered; 1) dating of any archaeological material found within the sections (e.g. pottery/bone); 2) AMS Radiocarbon dating of charcoal, organic rich sediments and / or plant/bone material; and 3) Optical luminescence dating, which works on the principal that exposure to sunlight 'zeroes' the natural radiation stored over time within the crystal lattice of quartz. Hence the amount of stored radiation (released as luminescence) is a function of time since last exposure to sunlight (see http://crustal.usgs.gov/laboratories/luminescence_dating/what_is_tl.html). It can be used on sediments that are from 300 to 100,000 years BP, and has a 5% accuracy (±50 years on a 1000 year old sample).

Clearly, there is the risk that the ditch and road fills were periodically cleaned out or deepened later in its lifetime. Thus any age is likely to be a minimum date. The purpose of securing dates from a range of sites is to try and maximize the probability of securing a date which reflects the earliest date of construction for the town. In the event, 3 sections were sampled, and two were amenable for AMS bulk radiocarbon dating. One sample from St James Street, contained coal fragments and was therefore unable to be dated. It proved impossible to obtain samples for OSL, due to the presence of pebbles in the layers in or around the location of the dateable layers which prevented recovery of a suitable sample.

In the core samples taken in the floodplain (See section X below). Two samples were picked for AMS radiocarbon dating, located at 64cm and 84cm below ground surface in core Dun4. All samples were sent to beta Analytical for dating. Table X reports the full dates, and Appendix 1 provides the full Beta reports.

Sample	Material	Conventional Radiocarbon age	Calibrated Radiocarbon age
Pales Dyke TTTDunwichS2 Beta – 397875	Organic sediment (bulk)	2270 ± 30 BP	Cal BC 375 (Cal BP 2325)
Duck Street TTTDunwichS3 Beta - 397876	Organic sediment (bulk)	1310 ± 30 BP	Cal AD 675 (Cal BP 1275)
Core DUN64 Beta-407117	Organic material (bulk)	1620 +/- 30 BP	Cal AD 420 (Cal BP 1530)
Core DUN84 Beta-407118	Plant material (Cannabis Seed)	980 +/- 30 BP	Cal AD 1025 (Cal BP 925)

Table x: Radiocarbon dates for the cliff sections (TTTDunwichS2;S3) and for the core samples (DUN64;DUN84) collected from the floodplain. Dates are calibrated using Reimer PJ et al. (2013). IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887.

All dates reported are earlier than expected, dating from the middle Iron Age through to late Saxon-early medieval.

Results

The site was visited on September 5th-7th 2014. A visual survey was made of the cliff top and the location of sections identified and photographed. A GPS (Garmin eTrex 10, horizontal accuracy +/- 2m) survey of the cliff top was then used to find the centre point of each section and checked against a) the GIS mapping, b) the field evidence (relationship to walls, earthworks), and c) stratigraphic evidence in the cliff exposure. Two sites, Middle Gate and Scotts Lane (Fig 1), were considered too dangerous to sample at the time due to evidence of loose and recently eroded sediments that reflected locally active cliff erosion. The remaining sites – Pales Dyke, St James Street and Duck Street were accessed and sections identified for sampling.

At each site the position of the transition from undisturbed geology to disturbed soil and fill were identified visually, and a small 0.3m wide x 0.5m high section cleared for detailed stratigraphic recoding and sampling for dateable materials. The transition was readily identifiable in the form of yellow marine sand exposed in layers along the cliff (Duck Street, St James Street), and a continuous, orange stained layer of sand and marine pebbles (Pale Dyke). The underlying geology is undivided drift, mainly fine-grained buff to brown, locally shelly, micaceous sands, with local rounded flint gravels (BGS 191).

Pales Dyke

The town of Dunwich was enclosed to the west, south and most probably north by a defensive ditch called the Palles Dyke (Comfort 1994). A defensive ditch and palisade is said to have been present during the regional insurrection led by Sir Hugh Bigod, that threatened Dunwich in 1173AD. This puts the earliest date for the ditch in the 12th Century. West (1973) reports "the presence of three pieces of Romano-British pottery from the infilling of the ditch are indications of some sort of occupation during that period but allow nothing more", thus suggesting a possible early origin for the ditch.

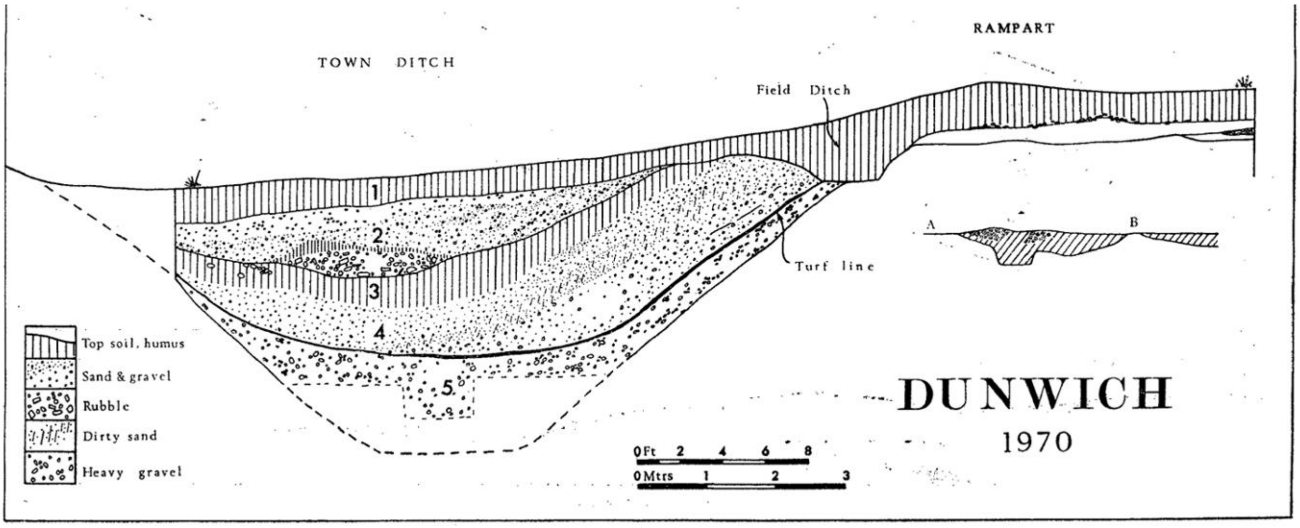
Excavations through the ditch and eastern (inner) rampart were conducted by West in 1970 (West 1973) and by the Time Team in 2011 (Wessex Archaeology 2012). Additional associated excavations of the Temple Mound in 1936 (Spencer 1936) showed that this structure post-dated the ditch and rampart. Similarly Norris (1939) and West (1973) demonstrate that the ditch predates the construction of Greyfriars Friary (c. 1290AD) which accords with documentary accounts (Parker 1976; Comfort 1994).

The West (1970) excavations were conducted at a location similar to that of the current cliff section survey. The section was outside the south and eastern perimeter of Greyfriars Friary. In contrast, the Time Team section was within the eastern perimeter of Greyfriars. Figure Xa shows the stratigraphy of West (1973) section, and Figure Xb the Stratigraphy of the Time Team section (Wessex Archaeology, 2012).

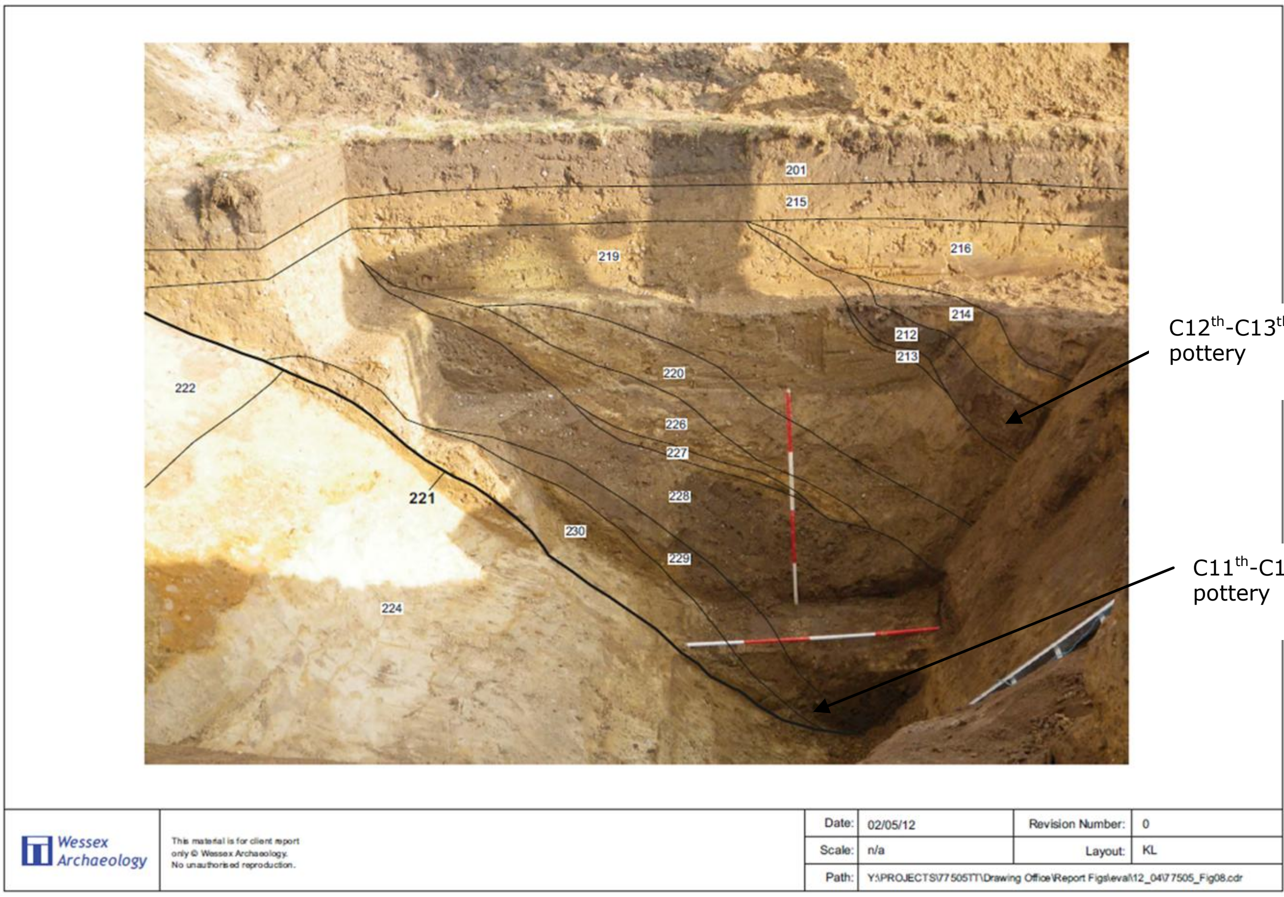
Spencer records the ditch as 10ft (3.05m) deep and 40ft(12.19m)wide. West (1973) records a ditch 15ft (4.57m) deep and 40ft (12.19m) wide, explaining that the lower turf layer in his trench (see boundary between 4 and 5 in Fig Xa) represented the bottom of Spencer's trench. Wessex Archaeology (2012) record broadly similar dimensions as West, at 10m (32ft) wide and 3.7m (12ft) deep.

Stratigraphy is different although broadly similar trends can be seen. The base of the ditch is cut into a Mid orange sand. 5% stone/gravel, subrounded–rounded, <1-2cm gravels (Wessex Archaeology, 2012). Above this is the start of the fill (229-228 in Fig Xb and layer 5 in Figxa), a layer of Dark brown sandy silt loam. <1% stone, sub-rounded – rounded, <1-2cm, Fairly homogeneous; moderately compact; slightly humic. Wessex Archaeology suggest that this is water-worked inwash containing topsoil which accounts for the humic nature of the sediments. Above this layer are a series of complex infill, including materials associated with the lowering of the eastern rampart, rubble from 19th Century activity in Greyfriars, and humic topsoil. Detailed stratigraphy can be found in Wessex Archaeology (2012) and West (1973).

No dates were produced by the 1970 excavation of West. Time Team provided a tentative estimate based on one small pot sherd which was dated to the 11th - 12th Century, suggesting an early medieval or late Saxon origin.



a)



b)

Figure Xa Section through the Pales Dyke based on the excavations by West (1973). Note the 5ft depth of dark silts sand with gravels overlain by a turf layer. Xb Section through Pales Dyke within the Greyfriars eastern perimeter wall. Gravelly humic silty sand layers 229-228 likely correspond to the layer 5 in West's section. Figures reproduced from West (1973) and Wessex Archaeology (2012).

Duck Street

The site of Duck street was located visually and by GPS. It consisted of a deeper layer of topsoil relative to adjacent sections exposed in the cliff.

St James Street

St James Street is clearly visible in the cliff section as a shallow depression aligned with the existing path that occupies the old street. A clear transition between the base geology (in this case a yellow sand) and humic brown sandy silt.

Summary

Further Research

The Stratigraphy and Pollen analysis of the Dunwich Marshes: Core 4

Introduction

Stratigraphical survey of the Dunwich Estuary (Sear, 2015) revealed a number of interesting sediment profiles which have potential for establishing the changing historic environment of Dunwich and estuary, That is, especially pertaining to the local vegetation and land use of the near region and of the history of estuarine development. Multidisciplinary studies are being used comprising detailed description and analysis of the sediments, pollen and diatom analysis and radiocarbon dating, the latter to provide an absolute chronology of marine and brackish water incursions. Subsequently, these palaeodata will be compared and integrated within the historical documentation available for the port of Dunwich. This report presents the first stage of this analysis dealing with the stratigraphy, pollen analysis and vegetation dynamics of the site.

Core Transects and site

Two core transects were collected over the period 2010-2015. Detailed analysis of Transect Dun2015 and specifically Cores Dun4 and Dun6 were performed under contract for the Touching-the-Tide HLF project. Figure X shows the locations of the cores collected as part of an undergraduate dissertation project supervised by Professor David Sear (Wright 2011); only stratigraphic analysis are reproduced for this transect. The mapping shows the location of the core site Dun4, to be positioned in an area of former estuary, most likely salt marsh or grazing marsh. It is likely the site was inundated by salt water at very high tides and from fluvial runoff during rain driven flooding. The location relative to historic Dunwich, shows that the core site was formerly protected by Cock and Hen hills (upwards of 40ft high) and the lower lying ground asociatd with the northwest of the town. This area was stripped of soil and vegetation during the storm of 1740 (Gardner 1754). It is conceivable that some of this material was redeposited over the area of the core site. The position of Core 4 is located west and slightly north of the former enclosure of the Maison Dieu hospital, and north of the main St James Street. It is possible that the area was formerly used to gain access to the Hospital during high tide, when the core site would have been intertidal mudflats.

The site of the 2015 transect and cores Dun4 and Dun 6 are shown in Figure xx. The 1754 sketch reported in Gardner (1754), shows the area around the core site to be freshwater reed bed with adjacent grazing marsh and some (brackish?) pools. In the 1880 photograph, the site is landward of the scene, but the image shows extensive shingle and sand associated with the gravel barrier, and grazing marsh behind. The 1945 Air photo shows the site to be grazing marsh much as it is today. Further details of the 2015 Core transect are given in Appendix 2.

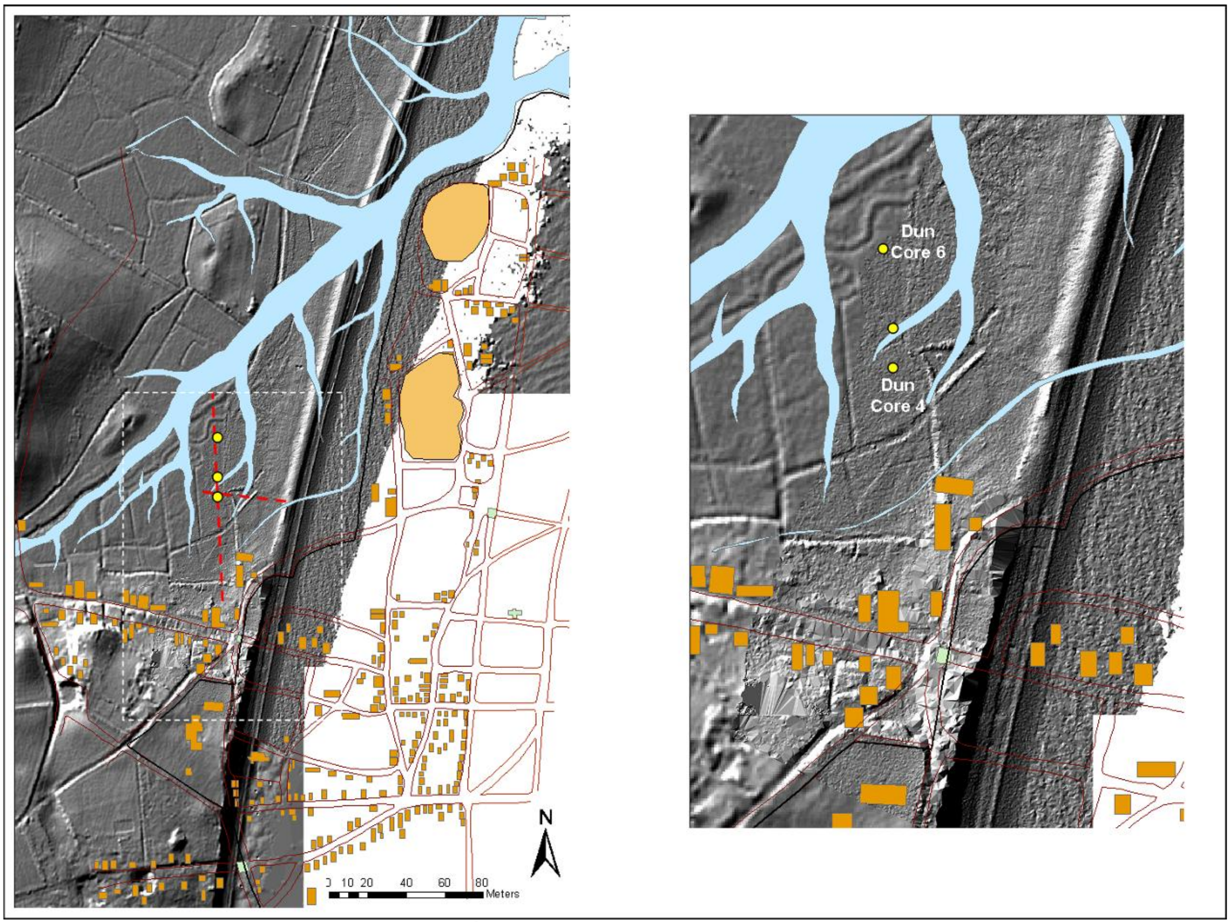
The stratigraphy

The basic stratigraphy of the Dunwich river estuary is typical of other coastal sediment stacks. At Minsmere, woody peat indicative of freshwater floodplain woodland gives way to blue-grey estuary muds created by a marine transgression around c.3200BP (1250BC), which lasted until c.400BP (1550AD) when freshwater peats again appear, often associated with evidence of higher energy incursions, notable siltyclay and sandy-silt banks (Lloyd et al., 2011). In the Blyth estuary, Brew et al (1992) report the same transgression occurring around c.4300BP, noting that the precise date depends on the development of barriers at the estuary mouth and the availability of clastic material. Thereafter, freshwater peat dominated often associated with Phragmites (common Reed) and where grazed and drained, the top sediments are of partly oxidised peat. Figure Xb shows a transect across the Dunwich river valley, collected by Wright (2011). This clearly shows the estuary mud following an earlier valley form, dipping to a low point near core A1C3, east of the location of the current Dunwich river near A1C4.

The core transect collected in 2015, runs north from the bottom of the gardens located on the north side of St James street, to just south of the Dunwich river. Figure Xb shows the 2m LiDAR elevations dipping rapidly off the sandy-gravel ridge onto the marches. The top of the estuary blue-grey clay dips towards the Dunwich river with evidence of a shallow channel around Core Dun5. This corresponds with a channel shown on the 1587 Agas map (Figure xa) and visible on air photos (Figure xb). Core Dun4 sites on the southern margin of this shallow channel, at a point where the underlying peat surface rises. The estuary blue-grey clay, though not shown in the Figure, pinches out at around 100m north along the transect.

Two cores have been examined in detail (cores 4 and 6) for both stratigraphy and sub-fossil pollen and spores. Core 6 proved to have little pollen and although the stratigraphy has been described this is not discussed here. Core 4 proved to be of greater interest in having a basal organic unit. The profile also produced sufficient pollen and spores to allow construction of a pollen diagram (section 3 below). The stratigraphy of core 4 is described in table 1 below.

a



b

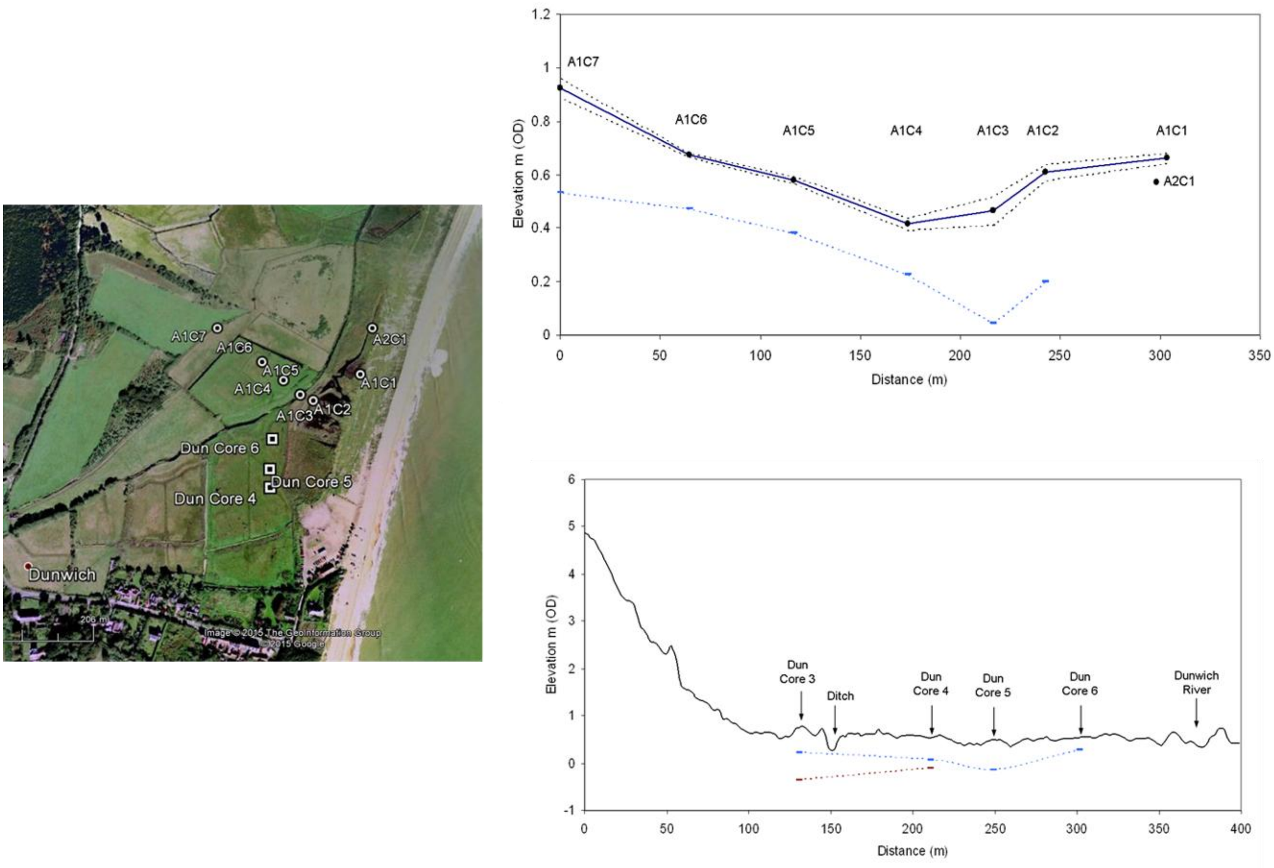


Figure x: Location of core transects in relation a) in relation to local LiDAR elevation and landscape features from the old town of Dunwich and the current position of the gravel barrier and sea and, b) to a contemporary air photograph of the landscape, and EA LiDAR based elevations. Transect of cores A1C1 – A1C7 cut across the Dunwich river floodplain. Transect Dun4-Dun6 cut north from the margins of the Maison Dieu hospital land towards the Dunwich river.

Depth metres	**Munsell colour**	**Description**
0.0-0.02	10YR 2/1	Upper rooted humic layer of present marsh community. Matted roots within detrital peat matrix
0.07-0.02	10YR 2/2	Granular/blocky peat. Dark, detrital.
0.17-0.07	10YR 2/2-10YR2/1	Dark detrital peat.
0.20-0.17	10YR 2/2	Sandy silt. Coarse humic. Broadly laminated. Medium to dark brown.
0.21-0.20	Transition	Transition
0.255-0.21	10YR 4/2	Grey/brown, coarsely laminated silt.
0.31-0.255	10YR 2/2	Peat. Fibrous, coarse with occasional sand and small gravel. Some roots.
0.32-0.31		Transition
*c.*0.61.5-0.32	10YR 4/2 to 3/2 with 10YR 5/1	As below but generally paler grey/brown. Coarsely laminated. Pale grey and grey brown laminae. Silt
0.60		Peaty inclusions. Dark.
0.63-0.61.5		Transition
0.86-0.615	10YR 2/1 to 10YR 2/2	Dark brown/black detrital peat. Fibrous.
0.86		Base of profile

Table 1: Sediment stratigraphy of Dunwich Core 4.

Pollen analysis of core 4

Pollen cores 4 and 6 were obtained using a large Dutch Gouge corer and have been analysed. The latter, core 6, proved unsatisfactory with only small numbers of pollen found. These traces comprised largely very occasional Chenopodiaceae (goosefoot, orache and samphire) from salt marsh (halophytic) communities, coniferous pollen and re-worked pre-Quaternary palynomorphs. There was insufficient pollen to enable even small assessment style pollen counts. This paucity of pollen is attributed to rapid deposition. Core 4 proved more satisfactory with a basal humic unit overlain by sediment of brackish and marine origin signifying a marine transgressive event.

<u>Pollen method</u>

Samples of 1.5ml volume were processed using standard techniques for the extraction of the sub-fossil pollen and spores (Moore and Webb 1978; Moore *et al.* 1992). The sub-fossil pollen and spores were identified and counted using

Nikon and Olympus biological research microscope. Pollen counts of up to 400 grains of dry land taxa per level was counted (the sum). All spores and pollen of marsh taxa (largely Cyperaceae), fern spores and miscellaneous were also counted for each of the samples analysed. A pollen diagram has been plotted using Tilia and Tilia Graph (figure 1a and 1b). Percentages have been calculated in as follows:

Sum =	% total dry land pollen.
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 (1992) for plant descriptions. These procedures were carried out in the Palaeoecology Laboratory of the Department of Geography, University of Southampton.

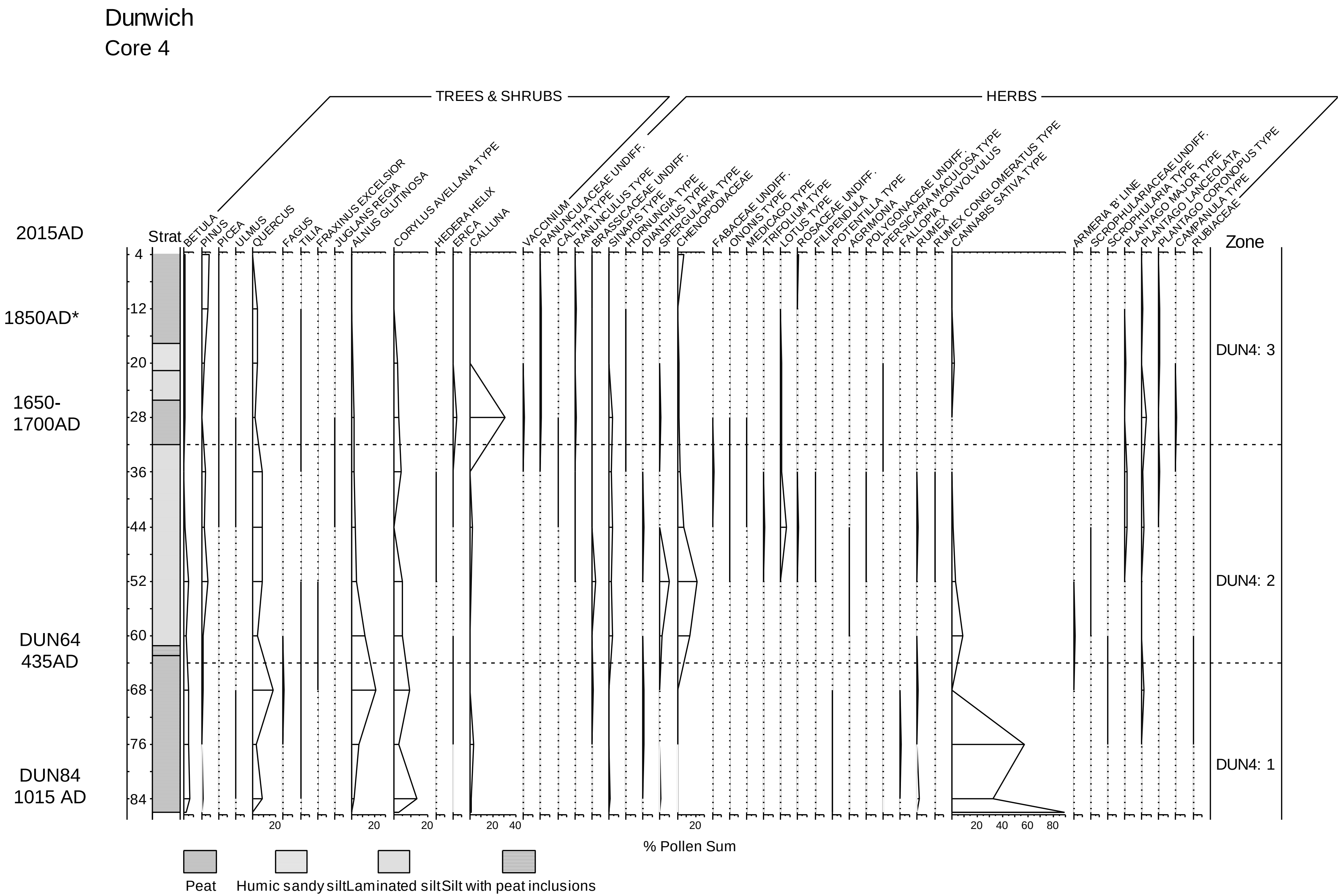
The pollen data

Pollen preservation was found to be variable as might be expected from the contrasting humic sediment at the base of the profile and the more minerogenic, overlying silt and clay of salt marsh and mud flat origin. However, the pollen spectra obtained show interesting and significant changes throughout the *c.*0.9m of sediment. These changes have been described as local pollen assemblage zone DUN4: 1-3 from the base of the profile at 0.90m upward. These are defined and described in table 1 below and shown graphically in Figure XX.

Local Pollen Assemblage Zone	***Palynological characteristics***
l.p.a..z DUN4: 3 4cm to 32cm Poaceae-Lactucoideae	DUN4: 3 is delimited by increasing values of Poaceae and Lactucoideae, the latter peaks to 40% at 12cm. Arboreal and shrubs comprise *Betula* (to 10%), *Quercus* (6%), *Tilia* (1-2%), *Alnus* (1-2%) and *Corylus avellana* type (declining 3-1%). *Pinus* increases (10% at top of profile) and *Picea* is present. Dwarf shrubs include *Calluna* (peak to 40%) and *Erica* (3%) These peak at 28cm and subsequently decline. Herbs are dominant and include Chenopodiaceae (3% at 4cm), *Cereal* type, *Cannabis sativa* (<3%), *Cirsium* and *Bidens* type. Other herbs sporadically present at <2% include *Lotus* type, *Persicaria maculosa* type and *Anthemis* type. Marsh taxa are important and dominated by Cyperaceae (to 39%) with small numbers of *Typha/Sparganium* type and *Potamogeton* type. Fern spores decline markedly in comparison to the previous zones with a reduction of *Pteridium aquilinum.* Pre-

	Quaternary palynomorphs are present at reduced levels.
l.p.a.z. DUN4: 2 32-64cm Chenopodiaceae-Poaceae	This zone is delimited by increasing values of Chenopodiaceae (to 20% at 52cm). There is a corresponding increase of *Spergularia* (to 9%). Herbs are dominant with Poaceae (peak to 58%) most important. Other herbs include *Cereal* type, *Ranunculus* type, Lactucoideae, *Bidens* type. *Medicago* and *Lotus* type (small peak at 44cm). *Cannabis sativa* type remains present but at considerably lower levels than in DUN4: 1. Tree pollen values remain at low levels. *Quercus* which remains (*c.* 10%). *Alnus* (10% to <5%) declines whilst *Corylus avellana* also reduces throughout the zone. Other trees and shrubs include *Betula* (to 6%) and *Pinus* (8%) and occasional *Picea* (top of zone), *Ulmus* and *Juglans regia*. Marsh taxa comprise Cyperaceae with increasing values (peak to 40% at top of zone), *Caltha* type, and *Potamogeton* type (peak to *c.*20%) at 60cm. Ferns comprise *Dryopteris* type declining throughout whilst *Pteridium aquilinum* and *Polypodium vulgare* are also present in small numbers. Pre-Quaternary pollen palynomorphs peak to high values (50% Sum + Misc.)at 52cm.
l.p.a.z. DUN4: 1 64 -86cm *Cannabis sativa*	This basal zone is characterised by extremely high values of *Cannabis sativa* (hemp) pollen (to 90% at 86cm and 60% at 76cm). Values subsequently decline markedly at the end of the zone and no *Cannabis sativa* is present at 68cm. Tree and shrub pollen includes *Betula* (<5%), *Quercus* (<10%) and *Corylus avellana* type (to 15% at 84cm). Dwarf shrubs include *Calluna* (to 5%). Poaceae are present at values of *c*. 20% at 84cm increasing to *c.* 30% by the end of the zone. Other herb pollen taxa include occasional Brassicaceae, Chenopodiaceae (top of zone), *Potentilla* type, *Rumex Cirsium* and Lactucoideae. Cyperaceae (sedge) is present to a maximum of 20% at 84cm with occasional *Typha latifolia* and *Typha angustifolia/Sparganium* type. Ferns comprise significant *Dryopteris* (to 40%) with some *Pteridium aquilinum* (6%) and *Osmunda regalis* (occasional at top of zone)

Table 2: Pollen zonation of Dunwich Core 4.



Dunwich
Core 4
TREES & SHRUBS
HERBS
Strat
BETULA
PINUS
PICEA
ULMUS
QUERCUS
FAGUS
TILIA
FRAXINUS EXCELSIOR
JUGLANS REGIA
ALNUS GLUTINOSA
CORYLUS AVELLANA TYPE
HEDERA HELIX
ERICA
CALLUNA
VACCINIUM
RANUNCULACEAE UNDIFF.
CALTHA TYPE
RANUNCULUS TYPE
BRASSICACEAE UNDIFF.
SINAPIS TYPE
HORNUNGIA TYPE
DIANTHUS TYPE
SPERGULARIA TYPE
CHENOPODIACEAE
FABACEAE UNDIFF.
ONONIS TYPE
MEDICAGO TYPE
TRIFOLIUM TYPE
LOTUS TYPE
ROSACEAE UNDIFF.
FILIPENDULA
POTENTILLA TYPE
AGRIMONIA
POLYGONACEAE UNDIFF.
PERSICARIA MACULOSA TYPE
FALLOPIA CONVOLVULUS
RUMEX
RUMEX CONGLOMERATUS TYPE
CANNABIS SATIVA TYPE
ARMERIA 'B' LINE
SCROPHULARIACEAE UNDIFF.
SCROPHULARIA TYPE
PLANTAGO MAJOR TYPE
PLANTAGO LANCEOLATA
PLANTAGO CORONOPUS TYPE
CAMPANULA TYPE
RUBIACEAE
Zone
2015AD
1850AD*
1650-
1700AD
DUN64
435AD
DUN84
1015 AD
4
12
20
28
36
44
52
60
68
76
84
DUN4: 3
DUN4: 2
DUN4: 1
20
20
20
20
40
20
20
40
60
80
% Pollen Sum
Peat
Humic sandy silt
Laminated silt
Silt with peat inclusions

Dunwich Cont.

Core 4

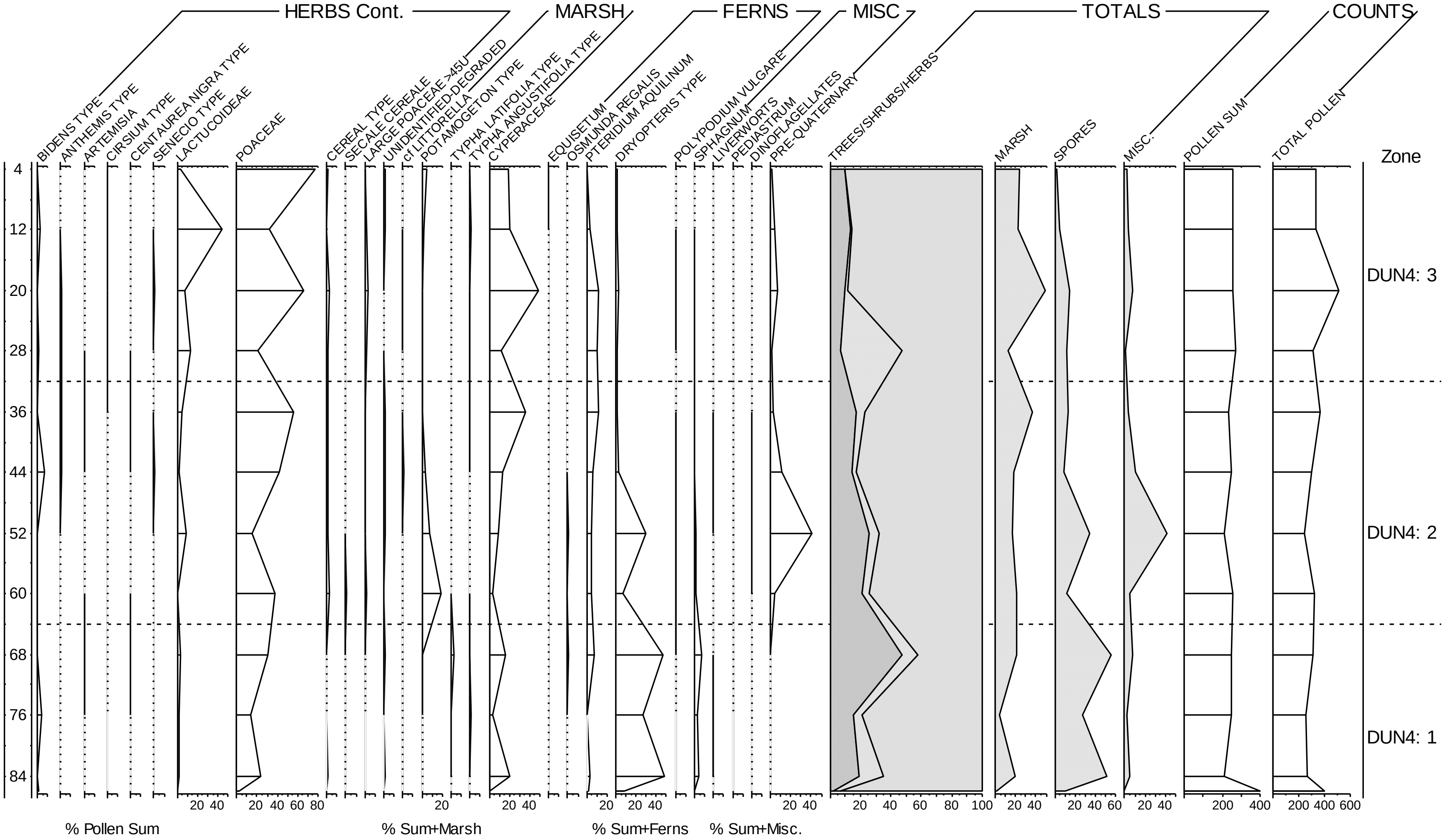


Figure x: Pollen diagram for the Dun-Core 4 showing vegetation changes associated with environmental transitions from terrestrial cannabis rich peat, through saltmarsh and tidal mudflats into reed swamp and grazing pasture at the top of the core. The chronology of the core profile is provided by 2 Radiocarbon dates, DUN84 and DUN 64, and the rise of Pine and Spruce pollen towards the top of the core that provide a chronomarker of c.1650-1700AD.The top of the core at 0cm is live vegetation and dates to the current century. The date at 1850AD is based on an SCP profile from Rollo (2012) constructed from a core located close to Dun6.

The vegetation and environment

Given the historic date/age of the sediment profile, that is spanning perhaps the last millennium (1025AD (95%1015-1150AD)), it is not surprising that the overall character of the vegetation landscape was one of openness with open agricultural habitats in evidence. There is, however, a background of woodland and tree growth also represented in this otherwise agrarian landscape.

The pollen data can be viewed in terms of the on-site vegetation and other wetland vegetation which was fluvially transported to the site and pollen representing the surrounding area of the site and in some cases from more regional sources. These aspects are discussed.

The on-site (autochthonous) elements: The changing sediment character and overall stratigraphy reflect the environment of deposition and thus, the character of the vegetation and vegetation communities which colonised the site. As a result of the stratigraphical variations, the taphonomy is complex.

The site of Core 4 proved interesting having a basal, peat/organic unit (c. 0.60cm to the base at 0.8m. Such basal units tend to be of late middle to late Bronze Age date throughout southern and Eastern England and developed in response to rising sea level and subsequent transgression. Here, however, the organic unit is of historic date (385-1150AD 95% extremes) and appears to have been a pond which was subsequently inundated sometime after c.1100BP. As described below, this wet depression was also interesting proving to have been a hemp (*Cannabis sativa* L.) processing site. This was substantiated by the presence of *Cannabis* achenes in these level (see below). Pollen (l.p.a.z. DUN4: 1) indicates that this depression or pond supported a grass-sedge fen. There is surprisingly little evidence of freshwater aquatic macrophytes and this may be due to polluted water through hemp processing. Occasional cysts of freshwater *Pediastrum* were however, recorded in this basal pollen zone.

At 0.64m (Date unknown but after c.1100AD) there was a significant change of environment with change to minerogenic sediment with a horizon of reworked, transitional peat and sediment. The peat containing elements of pollen from l.p.a.z. 1 (mainly *Cannabis sativa*). This was clearly a brackish or marine transgressive event which resulted in the formation of salt marsh and mud flat on and nearby the site. L.p.a.z DUN4: 2 contains much palynological evidence for such habitats with strong representation of halophytes which include especially, Chenopodiaceae (goosefoot, orache and samphire), *Spergula* (spurrey), *Armeria* (thrift and/or sea lavender) and *Potamogeton* type. The latter taxon include both pond weed and sea arrow grass and it is the latter which was probably part of the halophytic/salt marsh habitat. With this transgression, the change to mineral sediment also demonstrates the erosion and transport of earlier sediment containing geological palynomorphs. High values of these at *c.* 0.52m indicate that the site was mud flat at this time. During this zone/phase, deposition was stable with the accretion of blue-grey sediment of typical salt marsh origin.

Towards the top of l.p.a.z. 2, there is evidence of declining importance of salt marsh and a recursion to a more freshwater habitat. From c. 0.44m, sedge pollen (Cyperaceae) start to become important replacing the Chenopodiaceae and Potamogeton/Triglochin pollen which otherwise characterise this zone. Increases of Lactucoideae (dandelion types from the dry-land zone) and the on-site sedges characterise l.p.a.z. 3 which shows a change to a more freshwater fen with sedges and other reed swamp elements (bulrush) or a flood plain habitat. Stratigraphically, this was also a phase of less stability with alternating peat, humic silt and sand lenses. The latter may be associated with flood events.

The dry-land, terrestrial zone: The most interesting and important aspect of this profile is the dominance of hemp (*Cannabis sativa*) pollen in the basal organic sediment of l.p.a.z. 1. Such high pollen values are rare and only occur where cultivation and processing has taken place or from specific circumstances where pollen analysis has been carried out on rope/cordage or from ships caulking (Scaife ***). Here, it appears that this site from which this core was obtained was used for retting to obtain fibre for rope making. This is not unprecedented in East Anglia being discussed by Godwin (1967a, 1967b) and subsequently by Bradshaw *et al*. 1982. Traditionally, hemp crop was left in ponds and wet ditches for some weeks or months adjacent to places of cultivation to separate the bast fibres. This was clearly the case at this site. This would have been especially important for rope production in Dunwich and most probably for maritime use. Palynologically, the pollen is indeterminable from hop pollen (*Humulus lupulus*) in sub-fossil state; the morphology is similar due to close botanical relationship. Here, achenes (seeds) of hemp were also found and radiocarbon dated (results awaited). Hemp was an especially important crop to the extent that edicts especially by Henry VIII to ensure fibre for rope making to support the English fleets. Thus, it is clear that fields adjacent to this sample site were used for cultivation at this time (1025BP) and the adjacent wetland used for retting of fibre. This was the non-toxic variety!

The substantial numbers of pollen mask the background and more regional vegetation components. However, during this phase and in the overlying zones/levels, the pollen data show a typical late historic environment. That is, mixed arable and pasture and some retained woodland. Oak and hazel were the principal woodland components and this probably represents remaining managed, coppice with standards, woodland also of use for shipbuilding and other more domestic uses (building timbers, hurdles and wattle). Small pollen numbers of ash (*Fraxinus*), lime (*Tilia*) and beech (*Fagus*) are from occasional local growth. These taxa are markedly under represented in pollen spectra (Andersen 1970, 1973). There is a single record of walnut (*Juglans regia*) which attest to a post Roman date.

Agriculture: Apart from the hemp cultivation discussed, the herb pollen spectra show predominantly pasture with some cereal elements. The latter are, however, less well-represented in pollen assemblages unless in very close proximity to sampling. Grass pollen is dominant throughout and although a proportion will have derived from the on-site vegetation, along with ribwort plantain (*Plantago lanceolata*) and other herb this suggests stronger pastoral land use in the nearby region.

Pine pollen is present throughout the profile. In l.p.a.z. DUN4: 2, this may be attributed to the typical over representation in fluvial, especially marine sediment due to the buoyancy of the saccate pollen. However, the expansion in l.p.a.z. DUN4: 3 there is an increase of pine and also the presence of spruce. The latter is non-native and along with pine these represent plantation. The pine rise from c. 1650-1700 is seen in many pollen diagrams of the recent historic period (Long *et al.* 1999) and is attributed initially to planting of exotic conifers in parks and gardens after popularity resulting from John Evelyn's treatise *Sylva.* Subsequently, pine also increases in importance from forestry plantation. The pollen is anemophilous and is of regional rather than local origin.

Summary

Marsh sediments contain a record spanning the full history of Dunwich. Our research has demonstrated that these sediments can be used to reconstruct regional and local changes in land cover, and from these infer periods of environmental change and potentially industry within the immediate vicinity. Moreover, the presence of distinct higher energy sediment layers of silt and sands offer the possibility that the sediments also record periods or discrete events resulting from coastal storms. The analysis of core Dun4, is nationally of interest as it contains strong evidence of only the third UK example of a retting pit for the production of hemp fibres used in rope and sail making. The association with a major international port makes this highly likely. The period of retting appears to continue from early Saxon to early medieval, before a major marine transgression, perhaps associated with storm action around the 13th-14th century, resulted in a change to salt marsh and mudflat environments at the site. This phase of estuarine habitat continued until c.1600, when freshwater marsh again occupied the site. This phase was interrupted by a period of episodic higher energy deposition (silt-clay laminations, culminating in a major event recorded as a sandy-silt layer. This layer is also seen in the Core sample recovered by Rollo (2012) some 20m north of Dun4. Preliminary evaluation strongly points towards the storm event of 1740, which Gardner (1754), records as washing across the adjacent land seaward of the core, stripping the soil and vegetation, and depositing it landward. The presence of calluna and other heath pollen may represent this stripped soil and vegetation. The environment at the core site stabilised, and returns to freshwater peat representative of the current reed beds and grazing marsh. This accords with Gardner's (1754) sketch, which shows the site to be dominated by reed beds and small pools of open (fresh-brackish?) water.

Further Research

Having established a chronology and environmental context for the sediment profile at DUN-4, additional analysis is warranted. During summer 2015, an undergraduate dissertation student will undertake sand grain analysis through the profile to identify periods of increased sand deposition that may correlate with individual storms or periods of increased storm activity. Additional diatom analysis may be undertaken to confirm the rate of change from terrestrial to marine and back to terrestrial habitat. This will permit correlation with the historical documented change in the harbour at Dunwich. Additional samples will be picked for Radiocarbon dating at 62cm to establish an age for the marine transgression, at 32cm to establish the date of the return to freshwater marsh conditions, and at 17cm to establish a minimum age for the flood event/period recorded in the organic sandy silt sediments. If resources permit, we will also check for Spheroidal Carbonaceous Particles (SCP's) – the product of high temperature combustion, to provide dates post 1850AD (Rose and Appleby, 2005). Rollo (2012) and Wright (2011) both identified SCP's within the top 15 cm of cores recovered from close to the present Core.

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Appendix 1.0: Beta Analytical Radiocarbon Dating Reports

Appendix 2.0: Transect 2015 Core stratigraphy and location.

Town ditch

7.3.4 Trench 2 was situated across a section of the town's defensive ditch (**221**),known to pre-date the construction of the eastern precinct wall. Only a halfwidth slot was excavated, but at over 5m wide and 3.7m deep the ditch dimensions are comparable with those from the previous excavation by West (1973). Although nothing as distinctive as a buried turfline was identified in the ditch section, humic deposits (**228** and **229**) did overlie the primary deposit. Higher up in the sequence, humic deposit **212** lay at a similar depth to a topsoil/humic layer encountered by West pre-dating a layer of building rubble which he interpreted as 19th century 'tidying-up' of the Greyfriars site. In contrast, no building rubble was located in the section dug during the current evaluation and the only later material was obtained from the modern topsoil.

7.3.5 The presence of an internal bank on the eastern side of the ditch was confirmed. In common with earlier findings (West 1973), it was substantially reduced but, in contrast to West's section, there was no clear evidence that the bank had been deliberately levelled. This different may be due to the fact that the section of ditch excavated by West lay just outside the south-east corner of the precinct wall, while the current section lay within the area of the precinct.

7.3.6 Pottery from the ditch indicates activity from the late 11th to the late 12th/13th century, pre-dating the establishment of the friary.

Trench 2 (Figures 7 and 8)

4.3.18 Trench 2 was situated across the town defences located by geophysical survey (**Figure 4**). These were thought to consist of a large ditch and external bank to the east; geophysical survey also suggested the possibility of damaged structures located just to the west of the ditch.

4.3.19 In the eastern part of the trench (**Figure 7, Plate 6**), removal of the topsoil (**201**) exposed a clay-rich layer (**202**) thought to be a post-medieval made ground deposit. Cut through **202** was a small pit (**206**), clearly of modern origin. The upper fill (**207**) contained large amounts of brick and tile. Beneath this was **223**, derived from the collapse of the edge, which overlay **208**,composed of topsoil-derived material, and **209**, which contained large amounts of re-deposited natural sand.

4.3.20 The exposed edge of pit **206** revealed a fine pale grey sand (**205**) beneath **202**. An equivalent deposit (**222**) was located elsewhere in the trench where it was concluded to be a buried soil.

4.3.21 Initial stripping of the western arm of the trench exposed the top of the internal bank (**203**) but could not clearly define the edges of the ditch. After hand excavation of a number of test sondages the level of the trench was reduced, revealing the eastern edge of ditch **221** (**Figure 7, Plates 7 and 8**). Due to time and safety restrictions only half of the full width of the ditch was excavated, but it appeared to be around 10m wide and 3.7m deep with a steep-sided profile (**Figure 8, Plate 9**). After a primary sandy deposit (**230**), the ditch then appears to have received two water-lain secondary deposits (**229** and **228**) whose dark colour suggests the presence of significant amounts of topsoil-derived material. Small quantities of domestic debris were recovered from the lower of these (**229**) and included 12th to 14th century pottery as well as a probably residual late 11th century sherd.Information from the environmental samples obtained from this deposit is suggestive of arable farming, with general food waste typical of medieval settlement. After two further sandy deposits (**227** and **226**) was another darker, more silty deposit (**220**). This alternating sequence continues with two more sandy deposits (**219** and **213**) and then another very dark deposit (**212**) which also contained 12th to 14th century pottery. Finally, two sandy deposits (**214** and **216**) complete the depositional sequence. This alternating sequence is likely to reflect different activities in the vicinity of the ditch as well as changes in the surrounding environment. The ditch was overlain and sealed by **215**, a tertiary deposit.

4.3.22 The bank (**203**) to the east was internal to ditch **221** and around 7m wide. It survived to a height of over 0.5m, and is likely to have been reduced by ploughing (**Figure 7, Plate 8**). The remaining bank material was composed of pale grey sand and probably constructed from excavated topsoil and subsoil. The absence of re-deposited natural within the bank is curious as the excavation of the ditch would have produced a large amount of sand;however, this may have formed the higher part of the bank and may have been eroded back into the ditch to form the paler, sandier deposits such as **216** and **226**.

The ditch cut through layer **222** (which is thought to be equivalent to **205**,exposed in the side of modern pit **206**). Given the likely medieval date of the defensive ditch, this pale grey sand is likely to have been a buried medieval soil horizon (**Figure 7, Plates 7 and 8; Figure 8, Plate 9**). This directly overlay the natural sand (**224**).

Phase i (Fig. 15, Layer 5). The primary fill in the ditch—a dark grey sand with a high proportion of gravel. This is sealed by a turf-line after some 5 ft. of deposit had built up on the floor of the ditch.
Phase 2 (Fig. 15, Layer 4). A thick layer of dirty sand and gravel, much thicker on the rampart side of the ditch. This represents a deliberate levelling of the rampart and is in turn covered with a thick layer of humus, 18-24 ins. thick (Layer 3).
Phase 3 (Fig. 15, Layer 2). This phase of the filling consists of a layer of rubble with mortared flints, bricks, tiles and fragments of shaped limestone, mixed with early 19th century potsherds. This infilling, which thickens towards the monastic wall probably represents the 'tidying-up' of the Grey Friars site in the early 19th century. Above this, a further deposit of gravel, again thickening towards the monastic wall represents the final flattening of the rampart, probably associated with the field-ditch cut along the face of the rampart and with the ploughing of the inner area of the town which is known to have taken place within living memory. The field-ditch unfortunately cut away the face of the rampart destroying any traces of the wooden revettment. A revaluation of the 1935 section ***4*** of Temple Hill shows two vertical black marks in the outer face of the rampart, which contained 'carbonaceous matter'. It is possible that these represent traces of a wooden revettment of some kind, either of the mound, or of the rampart.
Site A.