MESOLITHIC TO NEOLITHIC AND MEDIEVAL COASTAL ENVIRONMENTAL CHANGE: INTERTIDAL SURVEY AT WOOLASTON, GLOUCESTERSHIRE

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At Woolaston on the western shores of the middle Severn Estuary c. 7 km upstream of Chepstow intertidal Holocene sediment exposures have been surveyed and the stratigraphic sequence established by coring and limited excavation. There are two main peats each with a submerged forest. An existing dendrochronological sequence for the Upper Submerged Forest has been extended and the preliminary results of pollen analysis from the peat sequence are summarised. A few flint flakes were found but were not stratified in the mid-Holocene sequence. There is evidence for late Mesolithic / early Neolithic burning episodes which may relate to human activity. Evidence is reported for Medieval activity and the extensive modification of drainage in this period is suggested.

INTRODUCTION

Investigations at Woolaston were carried out as part of the wider project on Mesolithic to Neolithic Coastal Environmental Change (NERC Grant NER/A/S/2000/00490). Previous interim reports on aspects of this project at Goldcliff East and Redwick have appeared in previous volumes of *Archaeology in the Severn Estuary* (Bell *et al* 2001, 2002, 2003). The final report on that part of the project is in preparation (Bell forthcoming). Woolaston was selected for the final piece of fieldwork in this project because there was a submerged forest, which had existing dendrochronological dates showing it was of the Mesolithic - Neolithic transition. The peat sequence containing trees was at the very edge of the wetland, adjoining the bedrock rise of Guscar Rocks, making it a plausible site of prehistoric activity. The site at the wetland edge was an ideal target for the research of Alex Brown on wetland edge sites as evidence for the relationship between wetland and dry ground prehistoric activities (Brown 2005).

PREVIOUS RESEARCH (AB)

Previous research at Woolaston (Figure 1) has consisted of investigation of numerous archaeological contexts within both the intertidal zone and adjacent dryland, the majority of which are Romano-British and medieval in date. Archaeological investigations in the late 1980s focused on the characterisation of iron-making at the Chesters Roman villa (Fulford and Allen 1991), located *c.* 1 km to the north-east. Under the wider umbrella of that project, limited research was also undertaken at a number of other sites, including a post-medieval mill (Fulford 1992), and the remains of a medieval quay. Located within the intertidal zone on the northern banks of Grange Pill, the quay consists of two stone and timber structures extending over 35-40 m alongside the pill, dendrochronology showing that the upper quay was constructed in the mid 12th century and the lower quay in early 13th century. The lower quay was lost during the 15th century, whilst the upper quay was extended landward, remaining in use until probably the 16th or 17th century (Allen 1996; Fulford *et al* 1992). While the quay was being sampled for dendrochronology, the opportunity was taken to take a small number of samples from the submerged forest on the opposite side of the Pill, which yielded a 227 year oak sequence from 4096-3869 BC. This formed part of research aimed at producing the first prehistoric oak tree-ring chronology from England (Hillam *et al* 1990). The mill and quay are part of a larger medieval landscape focused on Woolaston

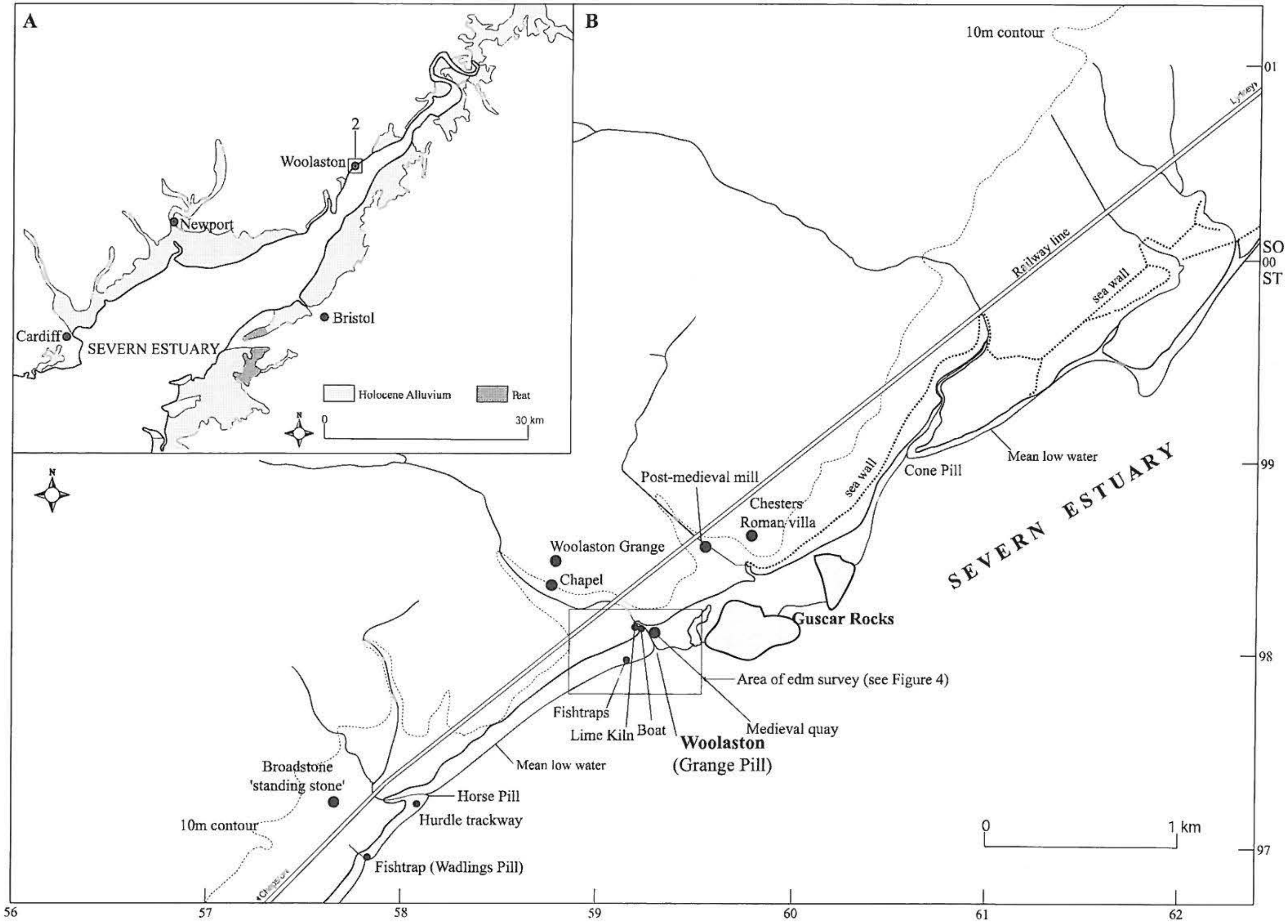

Figure 1 (opposite). The location of Woolaston (A) in the Severn Estuary Levels, (B) in relation to sites and topographic features in its immediate area. (A) drawing by M. Mathews, modified by A. Brown

Grange, located 0.5 km inland. The Grange included a chapel that formed the centre of the estates of Tintern Abbey at Woolaston (Fulford *et al* 1992: 101). Prior to the current project, a survey of the intertidal zone between Stroat and Woolaston by Elizabeth Townley (1998) identified a series of wooden structures, including several undated fishtraps 100 m to the south of Grange Pill, and two short lengths of what were interpreted as trackways, 1.5 km to the north and south of Woolaston at Horse and Cone Pill. In neither case are dates available for these structures.

INTERTIDAL SURVEY (MB and AB)

The area selected for survey focused on the mouth of Grange Pill and the area 200 m to its west where Holocene sediments of the Wentlooge Formation were exposed at the mouth of the valley drained by the Pill. A brief preliminary examination of the area took place on 3.3.03 followed by EDM survey and sampling on 9.9.03. Further survey, sampling and dendrochronological work took place on 20-22.2.04. Thus survey at Woolaston was rapid, conducted over 6 low tides by a small team of between 3 and 12 people. On each occasion when work took place, most of the intertidal zone was muddy, particularly in the area of the Upper Submerged Forest and accordingly cleaning, excavation and coring were necessary in order to establish stratigraphic relationships. EDM survey by Drs S. Buckley and S. Timpany had the objective of locating the main peat exposures, the submerged forests, trees, cores and sample locations in relation to the main topographic features of the survey area (Figures 2-3). This was complemented by a coring exercise by Alex Brown to establish the stratigraphic sequence. East of Grange Pill exposures of Trias bedrock (Mercia Mudstone) are visible near low water. These form the west edge of the Guscar Rocks bedrock rise. Peat and submerged forest trees are exposed on the west face of the pill and west of this the peat and submerged forest can been seen in plan on the foreshore. Two main peats are visible, the Lower Peat and the Upper Peat. The Lower Peat achieves a maximum depth of *c.* 1.80 m, comprising a thick basal wood peat overlain by a reed peat, sealed by estuarine sediments. The Lower Peat is heavily eroded along the lower foreshore, containing mostly small alder trees, and is exposed between -1.5 and -2.7 m OD near low water from Grange Pill for 80 m to the west. The jaw bone of a roe deer was found stratified in this peat at -2.51 m OD. Immediately west of the Pill a section (Trench 3) was recorded (Figure 4) showing the surface of the underlying sandy clay head dipping at *c.* 10° to the west. Above this is a thin gleyed Old Land Surface (OLS) on which the wood peat has developed; the section shows an alder tree growing on the Old Land Surface. At right angles to this the trench cut for environmental monolith WP1 showed a thin Old Land Surface overlain by 0.7 m of wood peat interrupted by three thin clay lenses.

The Upper Peat is substantially thinner than the Lower Peat, achieving a maximum depth of *c.* 0.5 m (Figure 8). The surface of the Upper Peat is tilted as a consequence of autocompaction, dipping at *c.* 10° to the east, outcropping between -0.9 and +2.1 m OD. Substantial oak trees are contained within this peat which has been the subject of dendrochronological investigation. A trench was cut to investigate the stratigraphic context of Trees 4 and 5. At the base of this section the Lower Peat, which was 0.5+ m thick, is overlain by 0.3 m of silty clay and then by the 0.4 m thick Upper Peat within which the trunks of Trees 4 and 5 were stratified. The Upper Peat was overlain by a thin estuarine clay immediately above the top of the trees. To the south east the Lower Peat is divided by minerogenic bands, so that in places there are outcrops of three small step features marking the eroded edges of distinct peat layers.

Thirty metres south of a disused sluice Grange Pill exposes a section through the peat sequence (Figure 5). At the base of the sequence just above the water of the pill is head with a probable Old Land Surface. This is buried by 0.3 m of the Lower Peat and then 0.5 m of silty clay. Above this is the Upper Peat within which the substantial oak tree 10, of diameter 0.74 cm, is partly stratified; there is silty clay above.

The edge of the Lower Peat 120 m west of the mouth of Grange Pill turns north-westward towards the seawall. This marks the eastern margin of a silt-filled palaeochannel 50 m wide (Figure 2). The western side of this channel is

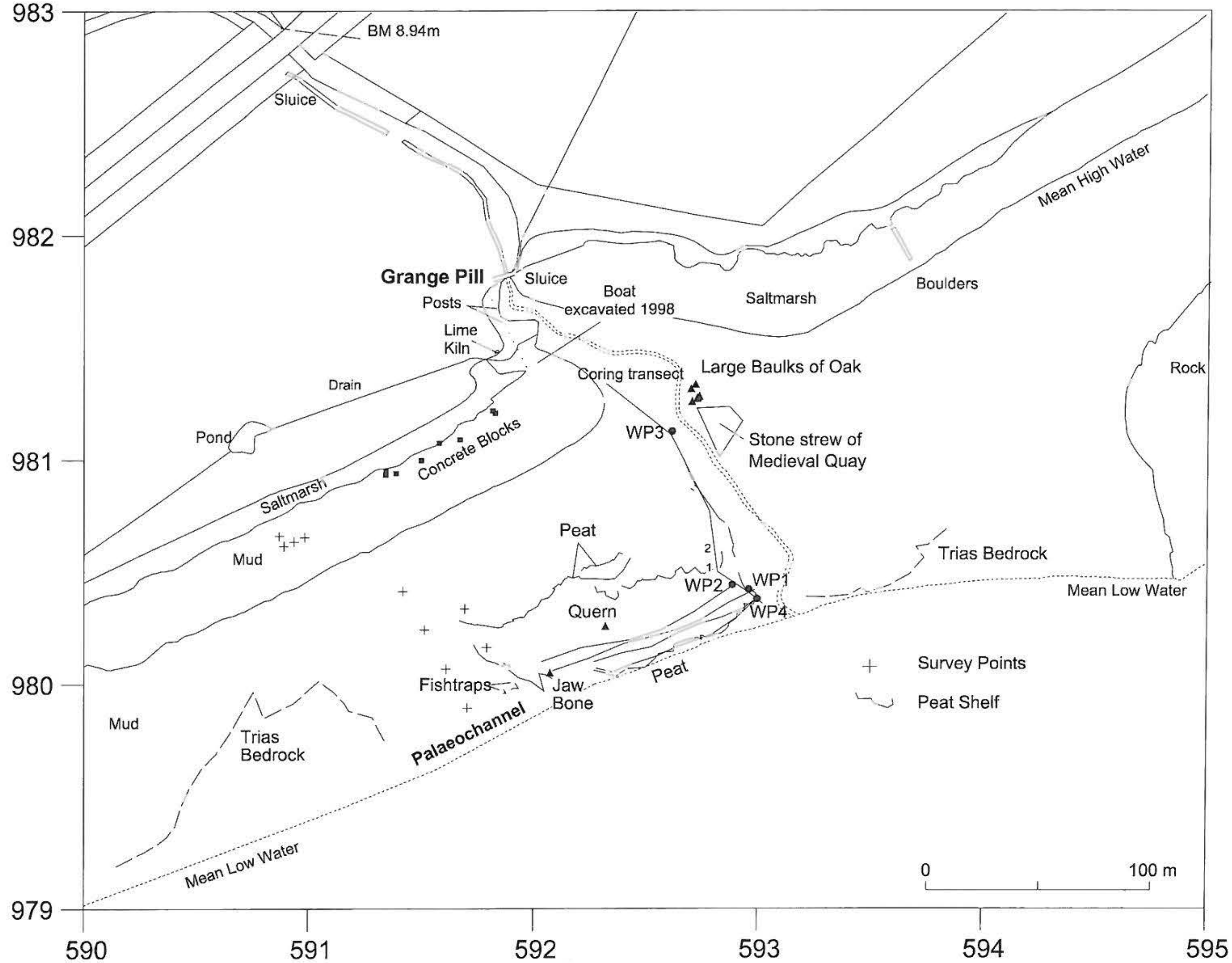

Figure 2. Woolaston intertidal area showing the outcrops of peat, the palaeochannel, archaeological features, coring transect and pollen sequences (WP1-4) (survey by S. Buckley and S. Timpany).

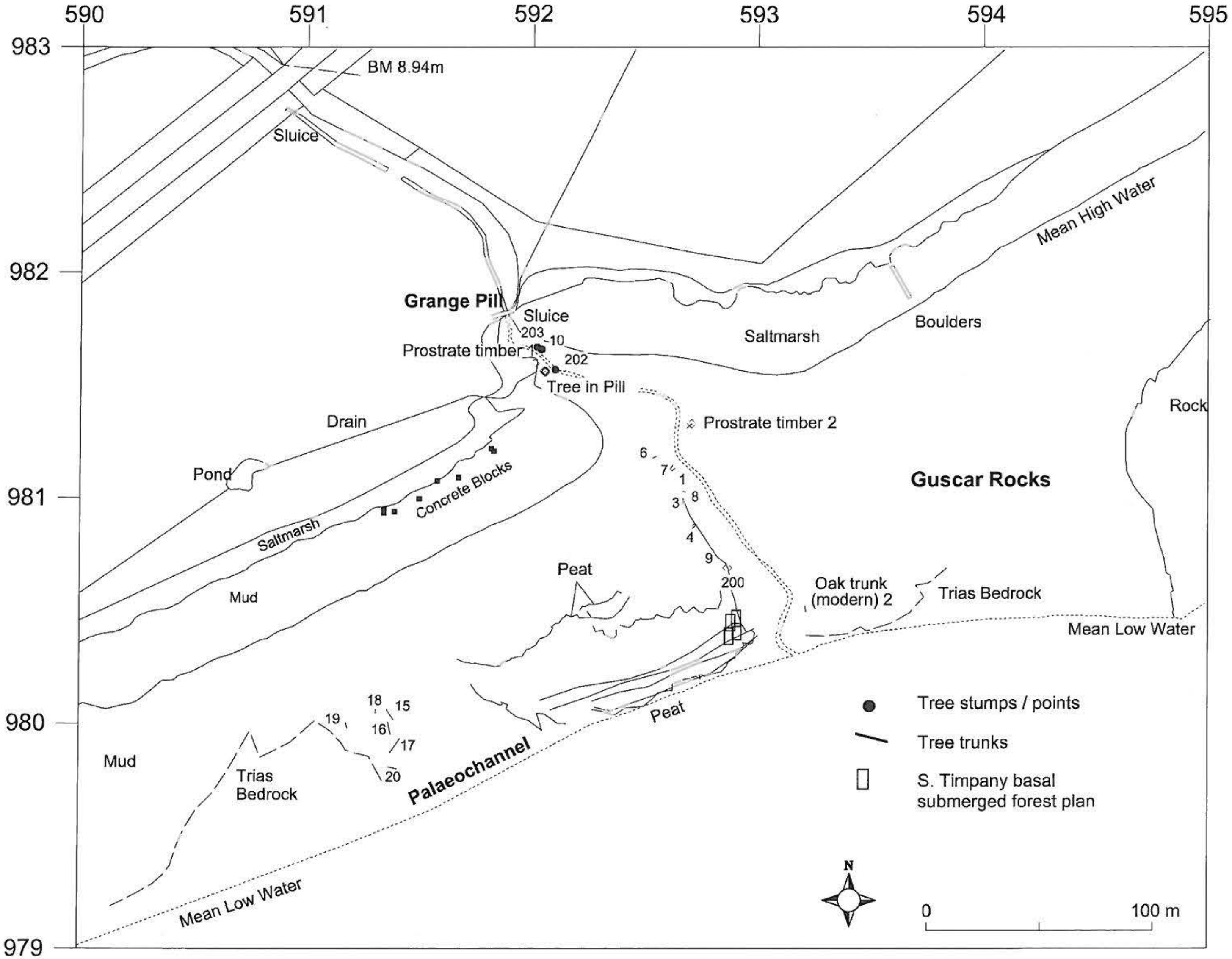

Figure 3. Woolaston intertidal area showing the main topographic features in relation to the trees sampled for dendrochronology (survey by S. Buckley and S. Timpany).

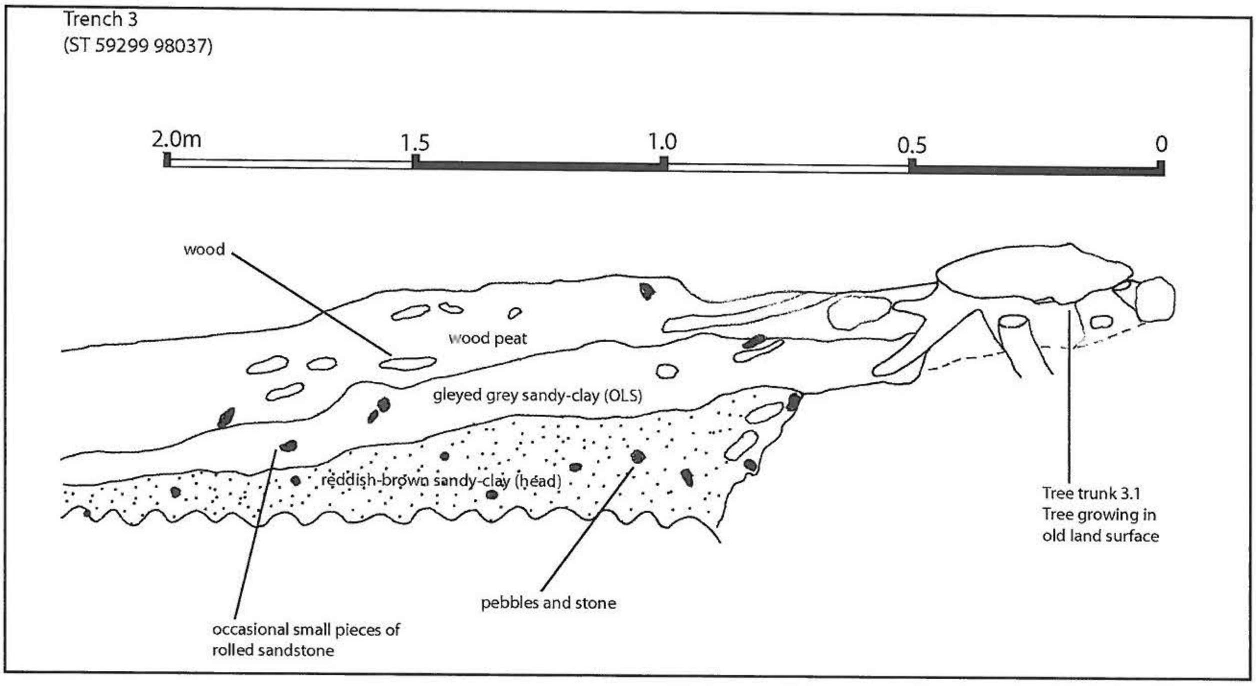

Figure 4. Woolaston, Trench 3 section at base of Holocene sequence showing the Lower Peat.

marked by an exposure of Trias bedrock. Within the fill of the channel are the trunks of six large oak trees and other smaller pieces of wood. These contrast with the long straight trunks of trees encountered elsewhere in the prehistoric submerged forests of the Severn Estuary. Those in the Woolaston channel branch low on the trunk and appear therefore to have grown in an open, or park-like, landscape. Parts of the east side of the channel were fairly clear of mud and here there was evidence of wood structures including a V-shaped woven basket about 3 m by 2.5 m (Figure 6). Nearby were other less well-defined wattlework structures, hurdle fragments and lengths of vertical roundwood. These are clearly the structures identified by Townley (1998, 83), which she describes as fishing structures 'located at the end of the submerged forest 100 m south of Grange Pill'. Here she recorded three tapering baskets and other wood structures and her drawing of Site G (Townley 1998, Fig 2b) is clearly the basket shown here in Figure 6. Midway between the fishing structures and the present pill a quern, or millstone, lay unstratified on the surface of the lower peat (Figure 7). It is about 0.4 m in diameter with a central hole, and a small segment missing on one side, but it has not been removed or examined in detail.

The survey revealed less evidence of prehistoric activity than had been expected from intertidal surveys west of the Second Severn Crossing (Neumann 2000). Line walking of the intertidal zone along a 1 km stretch southwest from Grange Pill produced little evidence. The only finds made in this area were the previously mentioned stratified deer jaw. The other finds - the wooden fishing structures and the quern/millstone - are all likely to be medieval or later. A careful examination was made of the small exposed areas of Old Land Surface developed on head and below the Lower Peat without finding any artefacts: the areas examined were in Trench 3, WP1 and the section of Grange Pill (Figures 4-5). East of Grange Pill at the head of the intertidal zone is a low cliff. Adjacent to the pill this exposes a section of saltmarsh sediments which to the east are seen to lap onto an eroded surface of Trias. A little further east, beyond the saltmarsh edge, a soil has developed on the Trias and is buried by colluvium which, in places, is obscured by recently dumped material. A flint flake was found in this soil at ST 59298 98201 and five other flakes in less securely stratified, slumped material nearby. All were derived from a yellowish-brown flint, similar to battered, water-worn and frost fractured gravels and cobbles to be found along the current

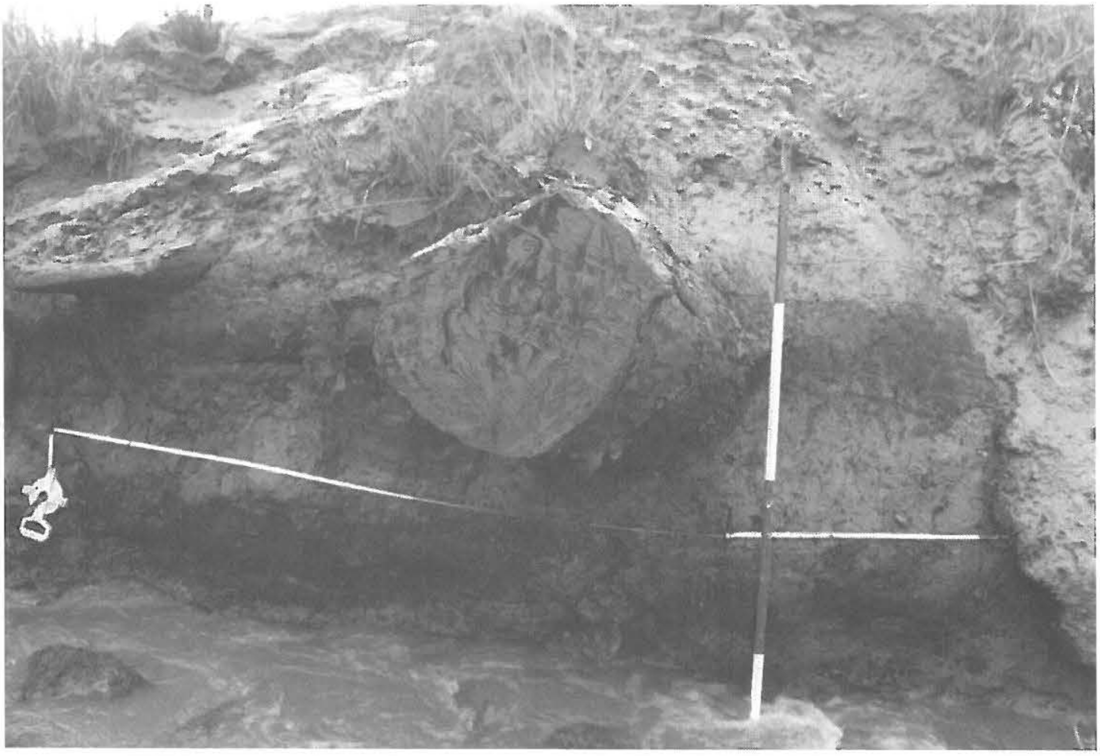

Figure 5. Woolaston section exposed by erosion in Grange Pill showing Tree 10 after it had been sampled for dendrochronological. This tree is partly stratified in the Upper Peat, the Lower Peat is visible below the tape, head and Old Land Surface are visible just above the water, scale 2m.

Figure 6. Woven basketry fish trap in the palaeochannel at Woolaston, scale 2m.

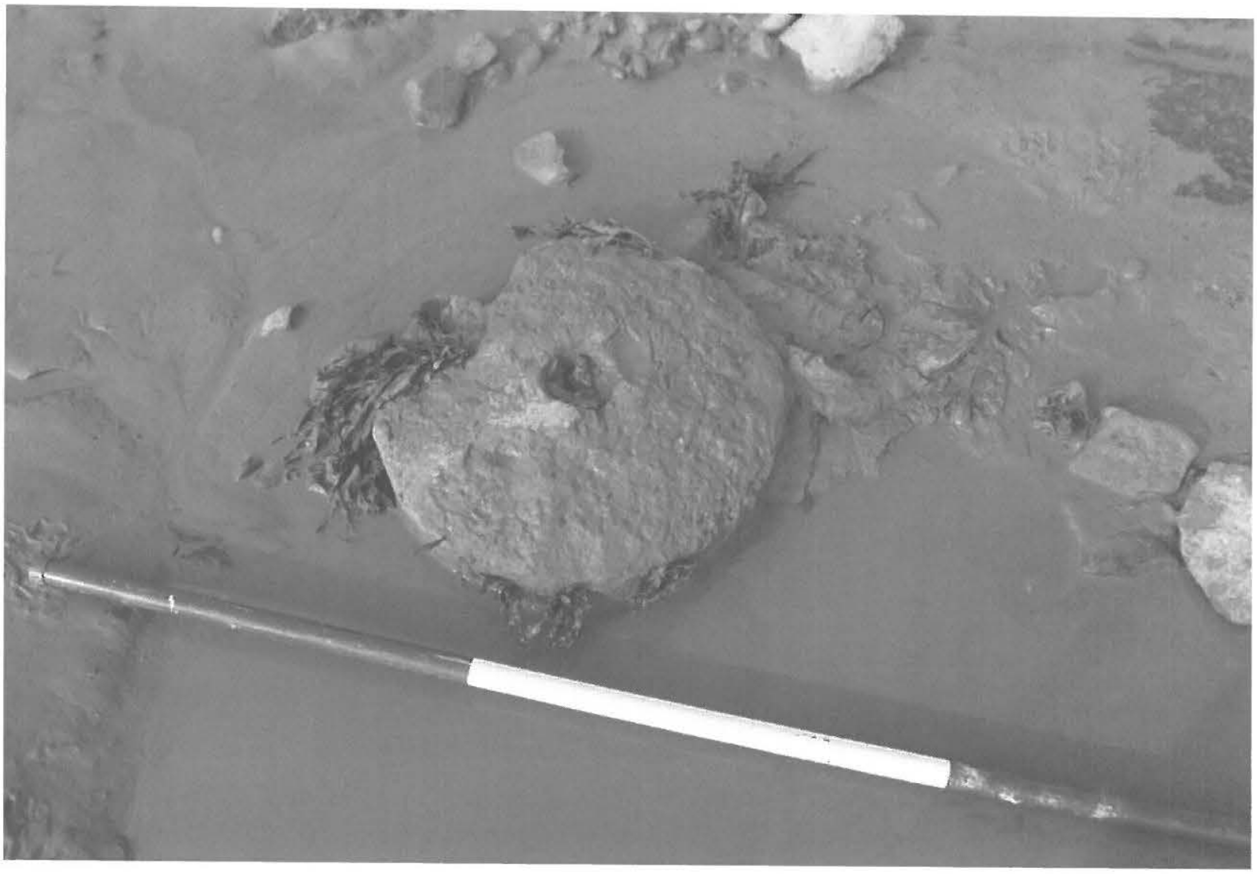

Figure 7. A quern or millstone found unstratified resting on the Lower Peat at Woolaston, scale 0.5m divisions.

intertidal zone. There is an arable field between here and the railway line north east of the Pill but at the time of our work it was under crop and could not be walked. A single edge-retouched flake was recovered from the edge of this field at ST 5946 9843. A rapid inspection of the Guscar Rocks intertidal exposure failed to find any remnants of former land surfaces developed on the bedrock, although this examination was far from comprehensive and carried out under muddy conditions. Inspection of the saltmarsh section face along a 1.5 km stretch northwest from Grange Pill produced only one find: a single unstratified flint flake was retrieved close to the saltmarsh edge towards the southern end of a line of concrete culvert blocks 100 m west of the Pill (Figure 2). All the fields northwest of Grange Pill were under pasture and, therefore, unsuitable for fieldwalking. Present evidence suggests that in the area examined by our survey west of the palaeochannel identified and on the Guscar Rocks any Holocene sediments have been eroded away and with it conceivably any archaeological evidence. None of the flint flakes found in the present survey are diagnostic as to date.

Some earlier finds add to the small amount of evidence for prehistoric activity from our survey. An early Mesolithic broad blade core was found 'within a few metres of the Severn Estuary at Woolaston' in 1988 (Walters 1992, 11). Several significant Mesolithic sites are located within *c.* 10 km of Woolaston at Tidenham, Nedge Cop, The Bearse and Oldcroft (Walters 1992, fig. 8). Finds of isolated Neolithic axes have been made to the north of Woolaston, and the Broadstone standing stone, of probable late Neolithic / early Bronze Age date, lies just 1.8 km to the southwest, at the margin of the estuary wetland (Figure 1).

STRATIGRAPHIC SEQUENCE (AB)

The sedimentary sequence at Woolaston consists of heavily eroded remnants of Holocene peat and alluvial sediments of the Wentlooge Formation, largely surviving infilling a former broadly northwest-southeast running palaeovalley incised during the Devensian or earlier. An auger survey was carried out during the course of 2003-04, in order to establish the nature of the sediments prior to palaeoenvironmental sampling (Figure 8). In total, thirteen cores were sunk using a manual gouge auger, augmented by three areas where eroded faces were cleaned and recorded, the first within Grange Pill *c.* 10 m south of the sluice gate where tree 10 was exposed, and two at low water mark immediately south of Grange Pill. In addition pits were excavated at WP2 and at Trees 4 and 5 to establish the stratigraphy.

The bedrock of Triassic mudstones and sandstones forms a platform of uneven relief that dips steeply to the south-west. The Holocene sediments achieve their greatest thickness at the edges of Grange Pill against the margins of the Guscar Rocks, which would have formed a low-lying bedrock promontory in prehistory between the channels of Grange Pill and Cone Pill. A survey of 1.5 km of intertidal zone southwest from Grange Pill demonstrate that the Holocene peats/silts thin substantially as the bedrock gradually rises in elevation, but, significantly, that the Holocene sediments are completely eroded away beyond *c.* 140 m south-west from Grange Pill.

The base of the sequence, exposed at low water mark, is represented by a compacted reddish-brown sandy clay with occasional pebbles, considered to represent head, rising between cores 1-13 from *c.* -3.2 m to +0.3 m OD. Overlying the head is a sequence of highly complex, laterally variable deposits ranging from sands through sandy silts, sandy clays, gravely sands, silty sands with gravels and clayey silts that either represent fluvial sediments of Devensian or earlier date deposited within the incised palaeovalley, or head deposits. The sequence exposed at low-tide within Trench 3 (Figure 4) includes a relatively short sequence of reddish-brown sandy clay head, overlain by a gleyed grey sandy clay, considered to represent a Holocene buried soil. This is visible in sections exposed by Grange Pill, *c.* 150 m north-west of Trench 3, as a grey sandy clayey-silt with occasional pebbles overlying head (Figure 5).

The basal minerogenic sediments are overlain by a compact dark reddish-brown wood peat (Figure 4), which forms the Lower Peat at Woolaston, ranging between 0.10 and 1.8 m thick, and dated at its base in sequence WP1/core 03 to 6819±33 BP (OxA-13699: 5775-5635 Cal BC). The top of this peat, where preserved (cores 5-13), includes a thin reed peat, 20 cm thick in core 5/sequence WP2. The edge of the peat bed can be traced along the lower foreshore (cores 1-4) as a series of low clifflets, with erosion occurring principally along a series of clay layers within the peat. The remains of trees are abundant, both within the matrix of the peat, and littering the surface as stumps and timbers. The base of the lower peat is diachronous, forming progressively later as it encroached up the dryland edge. The top of the basal peat is likely to be roughly synchronous in date. It may originally have formed a roughly level surface, but has suffered severe autocompaction with the result that it dips steeply away to the south, an effect described elsewhere by Allen (1999, 2000).

The Lower Peat at the base of the sequence was inundated on three separate occasions: the first two are relatively minor events, represented by two indistinct estuarine clay bands in cores 3 and 4, most probably reflecting periods of short-term marine inundation, eg, storm surges. The third inundation, dating to *c.* 4500 Cal BC, halted peat growth. The upper portion of the estuarine sediments that seal the basal peat are strongly laminated, comprising a series of dark-grey clay and structureless organic bands. The organic bands reflect short phases of organic deposition, typically poorly developed reed peats, separated by the deposition of clays, most probably deposited during short-term episodic high tides or storm surges. One of the organic bands has been dated to 5420±40 BP (OxA-14003: 4335-4245 Cal BC).

Estuarine deposition is followed by a return to peat formation, dated in sequence WP3/core 13 to just prior to 5256±35 BP (OxA-13878: 4230-3970 Cal BC). The Upper Peat is substantially thinner (maximum 0.5 m) than the Lower Peat, but is littered with prostrate timbers and stumps of *Quercus* that forms the Upper Peat Forest. The radiocarbon date from the top of the peat of 4910±40 BP (OxA-13879: 3770-3640 Cal

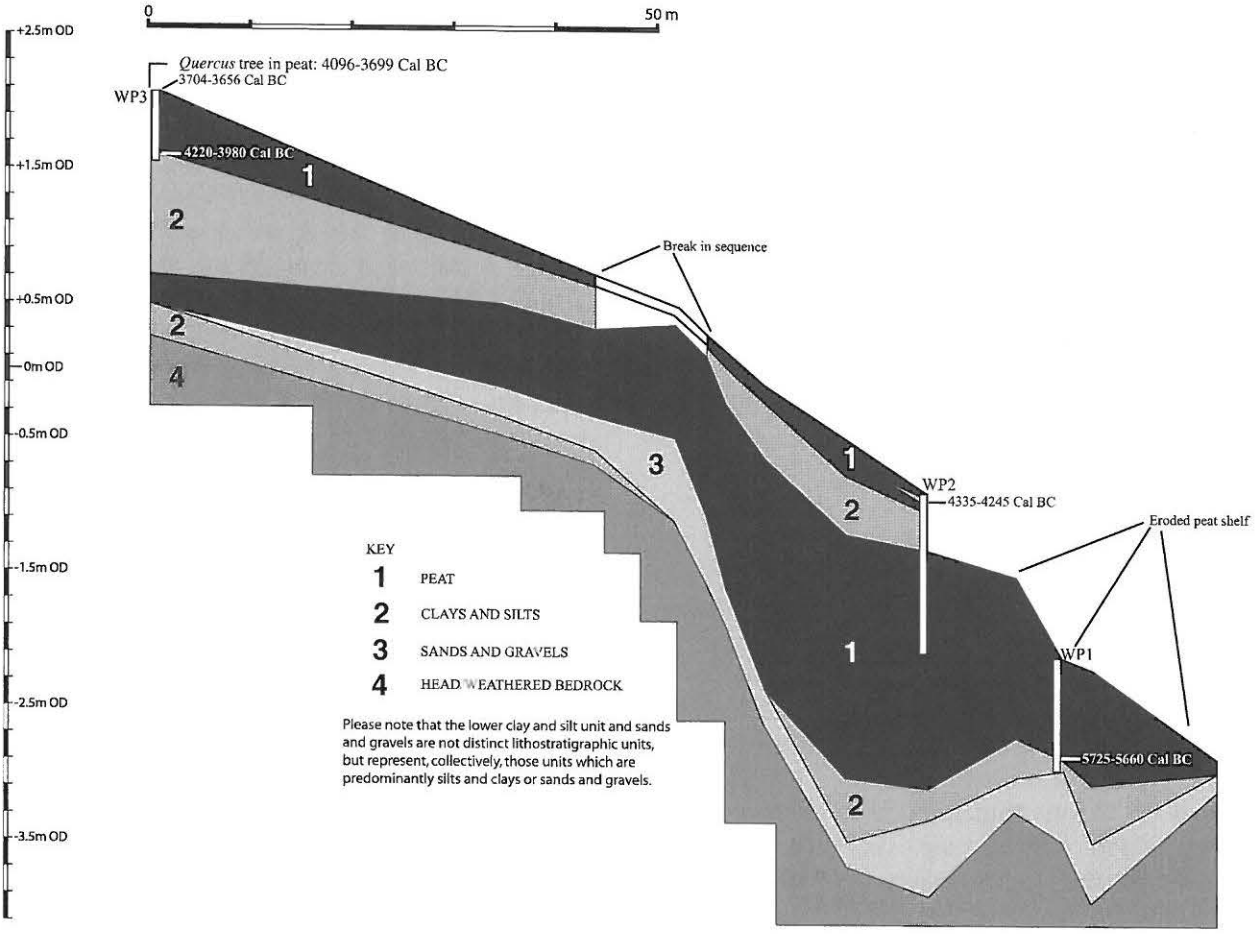

Figure 8. Woolaston coring transect (for location see Figure 2) showing the location of the main palaeoenvironmental sequences sampled and the calibrated dates of the main stratigraphic units.

BC) accords well with the dendrochronological date produced on Tree 8 directly adjacent to sequence WP3. The surface of the Upper Peat is severely eroded and oxidised along the lower foreshore, but is also covered by more recent deposits of mud along the upper foreshore. The exposures are seldom clear and continuous but it seems likely to have been truncated. The Upper Peat is sealed landward by clayey silts of the upper Wentlooge Formation, and then by stepped saltmarsh deposits of the Rumney, Awre and Northwick Formations (Allen 1987; Allen and Rae 1987).

PALAEOENVIRONMENTAL ANALYSES / SAMPLING (AB and ST)

The entire Holocene sequence was subjected to palaeoenvironmental analysis. Sampling for pollen, charcoal and plant macrofossil analysis took place where the sequence was thickest towards the margins of Grange Pill. Each of the sampled monolith sequences represents successive stages in the Holocene sedimentary sequence, with limited overlap between them (Figure 8). A composite selected taxa pollen and charcoal diagram including all three diagrams in stratigraphic order is presented in Figure 9, illustrating the principal vegetation environments and related sedimentary deposits of the Holocene sequence. Complete details of the palaeoenvironmental analyses and methods applied at Woolaston can be found in full in Brown (2005) with additional information on the composition of the Lower Peat Forest in Timpany (2005, 351-367). A more detailed report on the palaeoenvironmental sequences from the middle Severn Estuary is in preparation (Brown, in prep).

Prior to 5775-5635 Cal BC, the margins

of the palaeovalley were dry ground, dominated by *Quercus-Ulmus-Tilia* woodland in which *Tilia* was an important, if not dominant component. Where conditions had become sufficiently waterlogged as a consequence of rising sea-levels, peat formed on the old land surface, dated to 6819±33 BP (OxA-13699: 5775-5635 Cal BC) and the *Quercus-Ulmus-Tilia* woodland was succeeded by an *Alnus glutinosa* carr-woodland that remained the dominant vegetation type for the remainder of the Lower Peat. There were two minor inundation events during the *Alnus* carr-woodland phase, each represented by a discontinuous band of estuarine silt in the peat, and accompanied by pollen of plant taxa indicative of saltmarsh (sequence WP1, 26-28 and 43-46 cm). Drier niches within the carr-woodland are also suggested by increases in spores of *Dryopteris filix-mas*, particularly within zones WP1-2 and 3, perhaps growing on the stools of old trees and sedge tussocks.

Wood identifications by Scott Timpany (2005) of the Lower Peat Forest reveals woodland dominated by *Alnus*, with *Salix* and *Corylus* present (Figure 10), supporting the evidence from the pollen and plant macrofossils. Identified *Corylus* remains show this taxon was growing in the carr-woodland. Interestingly, *Corylus* is only mentioned in modern *Alnus* carr-woodlands by Rodwell (1991) as being part of the drier W6 *Alnus-Urtica* carr-woodland. However, *Corylus* has been recorded within the wet *Alnus* carr-woodland phase at Sites J and K at Goldcliff East (Timpany 2005), suggesting that although *Corylus* was able to survive on the wetland it was unable to thrive. At Goldcliff East it has been hypothesised that *Corylus* may have spread onto the wetland as a result of the movement and burial of its nuts by small mammals and birds (Timpany 2005). This distribution mechanism may have occurred at Woolaston and may help to explain the small numbers of *Corylus* wood remains.

Recording of the tree remains show *Alnus glutinosa*, *Corylus avellana*-type and *Salix* grew in close proximity to each other, with the larger remains all *A. glutinosa*. OD height information together with the pollen and plant macrofossil evidence shows the succession to *Alnus* carr-woodland followed a pattern similar to modern day communities (Walker 1970; Rodwell, 1991). *Alnus* was the principle invader into a swamp dominated by *Carex* sp., accompanied by smaller numbers of *Salix* sp. and *Corylus*. The environmental evidence shows *Alnus* was the most successful colonizer of the wetland among the arboreal species and formed the main canopy layer, with the other arboreal species present amongst the understorey and the *Carex* dominated swamp forming the field layer.

The period from the top of the basal peat until 4230-3970 Cal BC is characterised by a transition from *Alnus* carr-woodland to reedswamp and then saltmarsh, corresponding to the transition from wood peat to reed peat and then estuarine clayey-silts. This represents the period of maximum environmental dynamism, with significant fluctuations in the pollen of both Cyperaceae and Poaceae (zones WP2-3 to 6, sequence WP2), probably reflecting fluctuating ground water levels within the wetland. However, there are marked increases in micro- and macro-charcoal during the phase of reedswamp coinciding with the increases in pollen of Poaceae (most-probably reflecting *Phragmites australis*). Several of the fragments of macro-charcoal are clearly identifiable as charred reed stems, strongly implying *in situ* burning of reedswamp. In one case, significant quantities of macro-charcoal, including several fragments of charred reed stems, are associated with fragments of charred wood, representing a phase of reed burning during which trees still extant within the reedswamp were also charred.

The repeated nature of the burning, covering several hundred years, is most apparent during the deposition of a series of strongly laminated clayey silt/organic bands (*c.* 3-15 cm, sequence WP2), argued to represent short-term episodic high-tides or storm surges, followed by equally short-term phases of peat development. Charred reed stems from one of the organic bands produced a radiocarbon date of 5420±40 BP (OxA-14003: 4350-4220 Cal BC). The recurring nature of the burning in sequence WP2, consistently associated with increases in Poaceae pollen, and covering several hundred years, could be taken as strong supporting proof of an anthropogenic origin. However, none of the charcoal spikes is associated with direct evidence for human activity. This makes it impossible

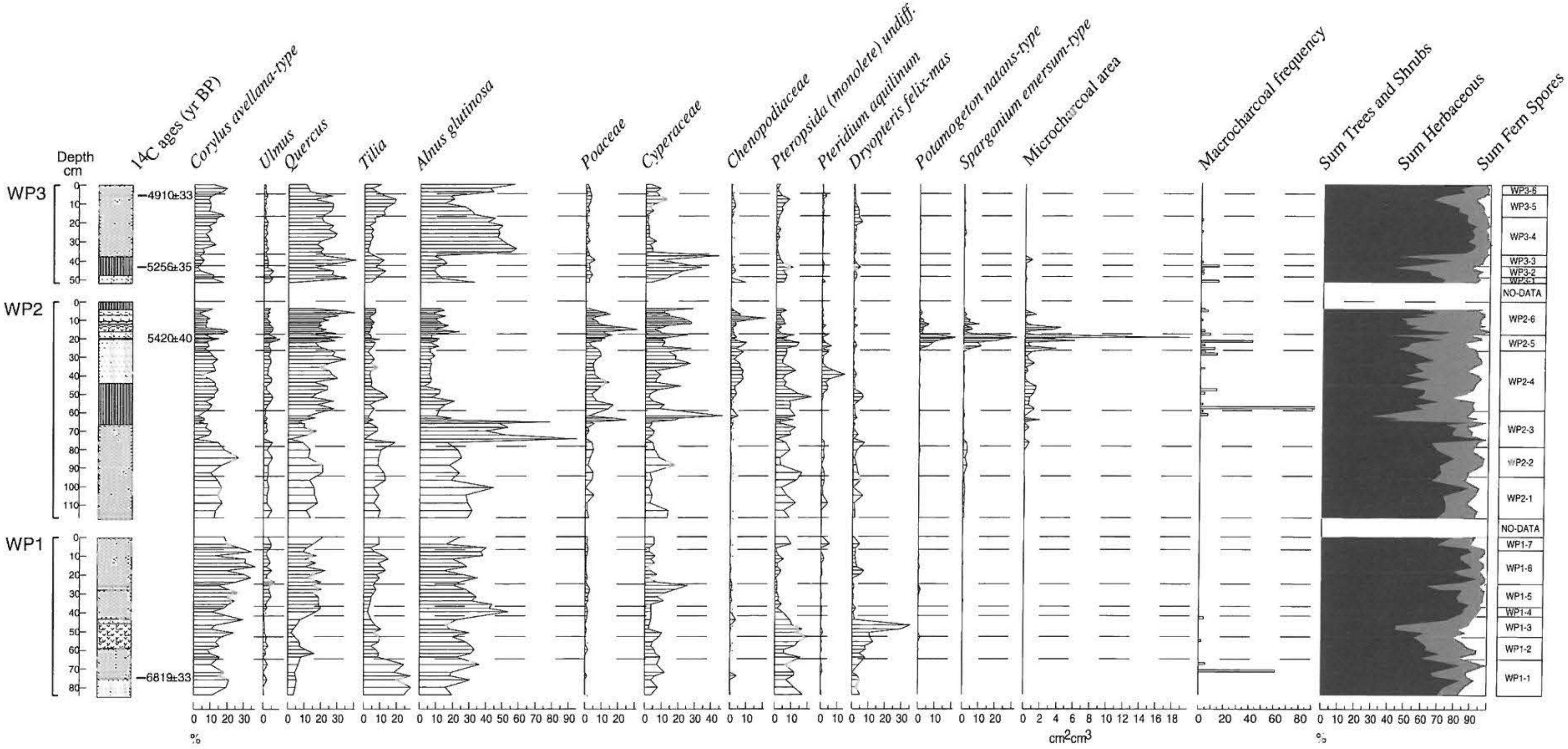

Figure 9. Woolaston composite pollen and charcoal frequency diagram for palaeoenvironmental sequences WP1 -3. For the relationship between these sequences see Figure 8.

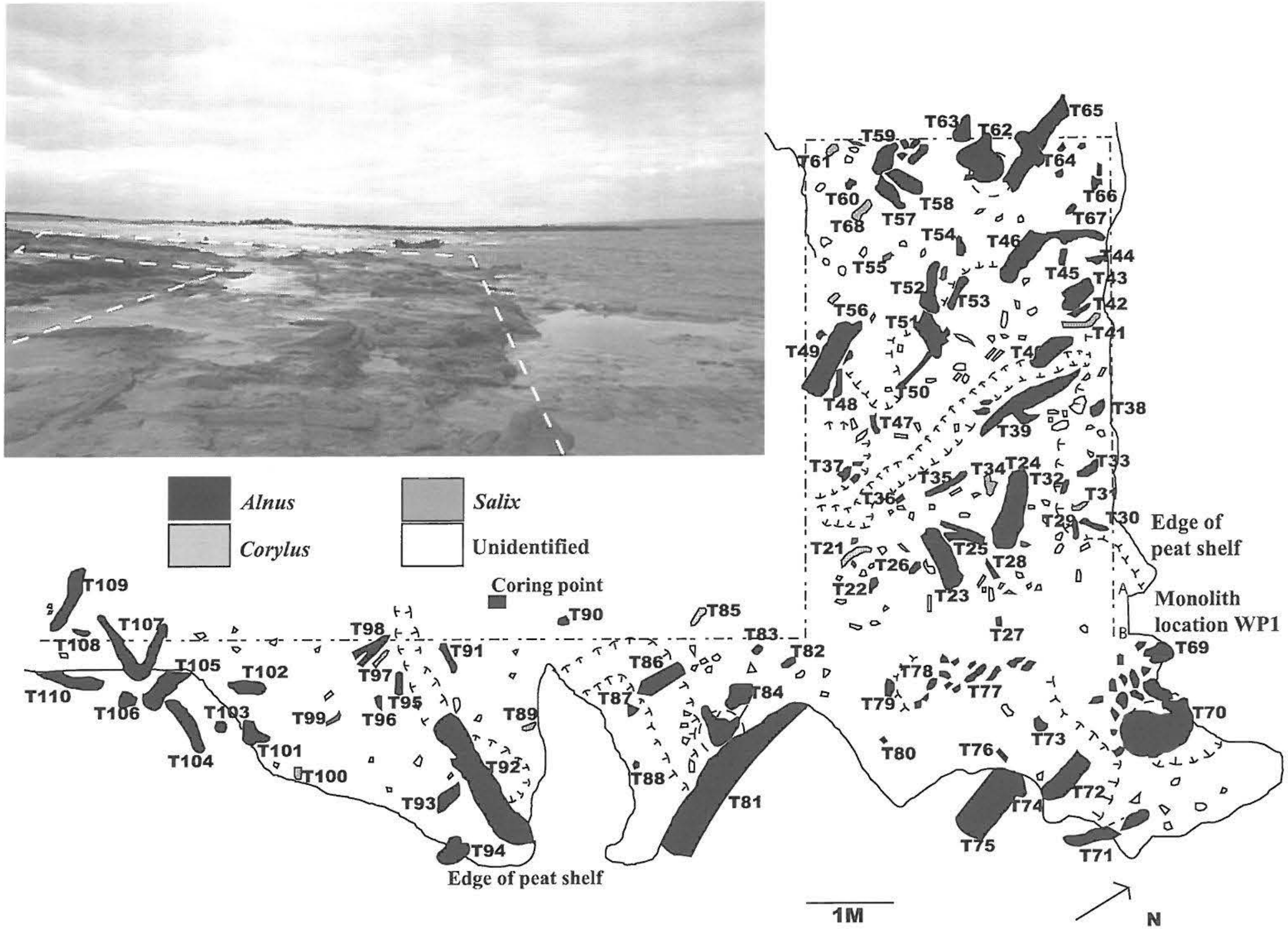

Figure 10. Plan showing the tree composition of the Lower Submerged Forest immediately west of Grange Pil, Woolaston. Plan and identifications by Scott Timpany.

to be certain of an anthropogenic origin. Even in situations where charcoal is associated with artefactual evidence for human activity, due consideration must be given to the role of natural agencies, eg. lightning strikes and wild fires (Brown 1997).

The phase of reedswamp and saltmarsh is followed by a return to peat formation and the re-establishment of an *Alnus* carr-woodland (zone WP3-3), the latter dated just prior to 5256±35 BP (OxA-13878: 4230-3970 Cal BC). Sequence WP3 includes two declines in *Ulmus* pollen (*c.* 46 and 20-19 cm). Both declines fall within the combined date range produced by Parker *et al* (2002) on 138 dated *Ulmus* declines from the British Isles. The second decline, in particular, is characterised by a two-thirds reduction in *Ulmus* pollen values, and, significantly, occurs concurrent with evidence for an opening up of the woodland flora. There is also a small increase in macro- and micro-charcoal, perhaps suggesting the possibility of some vegetation disturbance in the vicinity at the time of the decline. On the basis of an average accumulation rate of the compacted peat of 10 years per 1.1 cm (Brown 2005, 290), both declines are comparatively rapid events, similar to that demonstrated by Peglar (1993) at Diss Mere, and comparable to the rates recorded during the modern *Ulmus* decline (Perry and Moore 1987).

Quercus stumps and timbers litter the outcrop of this Upper Peat along the higher foreshore, representing a later stage of submerged forest to that of the *Alnus* carr-woodland on the lower foreshore. The dendrochronological dates (4096-3699 BC) of this *Quercus* woodland measured in the Upper Peat, compare favourably with the radiocarbon dates from the top and bottom of the peat from sequence WP3 (4230-3640 Cal BC), suggesting *Quercus* trees were able to rapidly invade the wetland from areas of nearby dry ground, following the commencement of peat formation. Many of the trees represent long-lived components of the wetland-edge flora, the last of the trees died *c.* 3699 BC. The most likely scenario for this is as the result of a marine transgressive phase. The dry ground remained dominated by *Quercus* and *Tilia* throughout.

DISCUSSION AND CONCLUSIONS (AB and MB)

Stratigraphic survey at Woolaston has produced a detailed profile of the sedimentary sequence, demonstrating that the Holocene sediments largely survive infilling a northwest-southeast running palaeovalley. At the base of the sequence bedrock is overlain by head deposits on which a soil developed. This is sealed by a sequence of peats and estuarine sediments of the middle Wentlooge Formation (Allen and Rae 1987), deposited over *c.* 2000 years from 5775-3640 Cal BC. There are two main peat beds: a Lower Peat which covers the basal old land surface, and an Upper Peat separated from the Lower Peat by estuarine sediments. Both Lower and Upper Peat beds contain abundant stumps and timbers, the Lower Peat Forest dominated by alder, the Upper Peat Forest by oak. The Upper Peat is sealed by a thin deposit of estuarine clayey silts, most probably of the upper Wentlooge Formation. The upper Wentlooge sediments appear to have been severely truncated and are overlain by much later sediments of the Rumney Formation (Allen 1987), similar to that reported at Peterstone on the Gwent Levels (Bell and Brown, this volume).

Survey at Woolaston has produced a wetland edge palaeoenvironmental sequence for comparison with that investigated in detail on the edge of the former island at Goldcliff East and those at the wetland edge at Llandevenny, Oldbury, Hill Flats and the earlier study at Vurlong Reen (Walker *et al* 1998). At Woolaston the woodland on the dryland Trias deposits was predominantly oak and lime. The survey has established the stratigraphic context of the submerged forest and the tree-ring sequence originally studied by Hillam *et al* (1990) has been extended. The elm decline is seen to occur in two stages, the earlier is marked by a pronounced charcoal peak, the later by a slight charcoal peak. There are hints of possible human activity from the recurrent burning of reedswamp evident in sequence WP2 (Figure 9). Evidence for the burning of reedswamp is widespread throughout the Severn Estuary from later Mesolithic contexts (Brown forthcoming; Dark forthcoming). At Woolaston, burning occurs both *in situ* and within the vicinity of Woolaston over a period of several hundred years between *c.* 4700 to 4230-3970 Cal

BC. Burning is also apparent from the base of the Lower Peat, dated to between 5775-5635 Cal BC, associated with a small-scale clearance on the dry ground.

Our survey has, however, only produced very slight artifactual evidence for prehistoric activity, a few flakes, none of them in stratigraphic contexts contemporary with the peat sequence and none typologically diagnostic of the Mesolithic or Neolithic, although we have noted the earlier find of a Mesolithic flint core from the area. It should be noted, however, that only very small areas of Old Land Surface have been examined, and the Holocene sediments were largely obscured by mud at the time of the survey. The former Holocene surface, and any sites which lay on it, has been eroded from the extensive rock exposure of Guscar Rocks. In these circumstances we cannot exclude the possibility of nearby sites which have not been discovered because they are buried or eroded away. At face value, however, the evidence suggests a low level of transient activity in the later Mesolithic and Neolithic. This is in contrast to Goldcliff East, Llandevenny and Oldbury where macro- and micro-charcoal evidence for burning episodes is associated with abundant artefactual evidence for contemporary human activity. The absence of artefactual evidence at Woolaston weakens any argument that people were responsible for the fire. We should certainly not exclude the possibility of naturally induced fires as a result of lightning strikes. However, the repeated nature of burning seen at Woolaston, occurring during the phase of maximum environmental perturbation makes an anthropogenic origin more likely. If so, it is interesting to see it occurring, not just in direct association with foci of settlement, but also away from identified artefact scatters, both here at Woolaston and also at Redwick (Bell *et al* 2003). There does seem to be growing evidence that burning formed part of a pattern of deliberate management of the landscape, either geared towards increasing the biomass productivity of the fringing reedswamp and woodland edge to encouraging increased graze by herbivores upon which humans could predate, at other times to thin out the reeds to facilitate fowling, or to promote the growth of edible wild plants along the woodland edge. Burning is likely, therefore, to have made a significant contribution to ensure the geographical predictability of resources.

Unexpected among the outcomes of this survey was evidence of medieval activity. It is clear that the palaeochannel containing wood fishing structures is a previous course of the drainage now represented by Grange Pill. That drainage arises about 3 km inland in springs at the head of three streams known as Black Brook, Piccadilly Brook and Pope's Well. There has been considerable human modification of the seaward part of this drainage. Townley (1998, Figure 3) illustrates complex earthworks on the valley floor west of Woolaston Grange which she interprets as fish ponds associated with the grange. Her survey shows channels on both the west and east sides of the channel floor. A little further upstream north-west of the Grange there is cartographic evidence for a mill (Fulford 1992, 127) which is also likely to be related to significant modifications of drainage. Townley notes that the Pill appears to have been straightened south of the Grange and just above high tide level.

Our survey suggests that Grange Pill itself is likely to be an artificial cut replacing the palaeochannel identified to its west. The present channel cuts through mid-Holocene peats showing that its course was at that time elsewhere. Minerogenic bands in the Upper Peat thicken to the west showing that at that time its course lay in that direction. At the mouth of the Pill, near low water, there is a cut through Trias on the east side of the Pill. Trias is also exposed on the west side of the pill at ST 5930898035. The most likely date for an artificial cut is the mid-twelfth to thirteenth century, at the time of construction of the substantial stone and wood structure identified as a quay which lies on its edge (Fulford *et al* 1992). This structure is formed of two distinct parts on different alignments and at different levels: a lower section to the south, and an upper section, with very substantial squared oak timbers, to the north. The discovery of a quern or millstone just 90 m south-south-east of the structure (Figures 2 and 7) suggests the possibility that part at least could have been a mill. Substantial squared oak beams often form the foundations of mills. This suggestion is not inconsistent with the fact that the main timbers are at right angles to the Pill and not along its axis, the method of construction, whilst very substantial, differs from the waterfronts at

Bristol and elsewhere at this period (Fulford *et al* 1992, 118). The plans (Fulford *et al* 1992, Figures 4 and 5) show evidence for stone faced channels within the structure. Massive horizontal timbers have mortices for closely spaced verticals, which could have formed part of a timber framed building, and stone roof tiles were found. On the pill edge beside the lower part of the structure is a platform cut in the Trias which could be a pit for a waterwheel. Upstream no evidence is known of a millpond, but the likely site of one is in an area affected by significant coastal retreat. Speculating further it may also be that diversion of the Pill coincided with the creation of a seawall across the mouth of the Woolaston valley and then, or later, the making of fishponds in the land claimed valley floor inland. It is notable that substantial modification of drainage is also recorded in Ley Pill 0.5 km to the north-east in association with the site of a Post-medieval mill which might have earlier origins (Fulford 1992). Whatever the interpretation of the Grange Pill stone and wood structure, it seems that the monastic grange of Tintern Abbey at Woolaston was responsible for large-scale drainage and landscape modification and landuse intensification as seen in relation to monastic communities in the Somerset Levels and elsewhere.

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