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THE CHANGING ENVIRONMENT OF THE MESOLITHIC AND OCCUPATION AT BOULDNOR CLIFF

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Introduction

The coastline is dynamic and forever changing. Only 400 generations ago or around 10,000 years, water levels were in the order of 30-40m lower than those we see today and many kilometres further offshore. This exposed a vast landmass that offered opportunities for exploitation by Mesolithic people. The coastal lowlands that existed then would have contained areas rich in resources that were available for exploitation. But the coast did not remain static. During the Mesolithic and into the Neolithic, sea levels rose and as they did so the coastline migrated across an established landscape that had been dry for over 100,000 years. Some areas were eroded while other more sheltered sites were protected. Those that were saved from erosion and subsequently preserved were invariably covered by marine sediments. Where they survived in an undisturbed state, they have the ability to tell the story of changing environments and of the people who lived on them.

Studies of the Mesolithic in North West Europe and particularly the Baltic have highlighted that the coastline was an attractive place to live, but it was not the only place. The large areas of land with established lacustrine and fluvial systems that are now submerged would also have offered very suitable sites for occupation. However, the people that lived on this landscape would have been forced relentlessly back as the sea encroached. The full story of human dispersal and adaptation in the north-west of Europe remains to be told as the arena where much of it unfolded is now under the waters of the continental shelf.

An example of a submerged landscape that is providing prolific evidence of human activity is Bouldnor Cliff in the Western Solent. It dates back over 8000 years and lies 11m below British Ordnance datum. The occupation of the area initially occurred in a basin that supported a fresh water wetland and possibly lakes. These conditions continued until sea level rise covered the land (Figure 1). It has been the source of stratified lithic assemblages, but more significantly, over 20 pieces of worked work have been recovered from a single feature which appears to sit on an area of small scale industrial activity. This may have been a boat building site where a dug out canoe or log boat was made (Momber *et al*., 2011). The submerged loci is rich in well-preserved organic material and is unique in the UK. It has the ability to add extensive detail to the current Mesolithic archaeological record that is dominated by terrestrial discoveries. This paper will look at the value of the cultural resource within Bouldnor Cliff and consider it as an example of what could remain where similar conditions exist on the European Continental Shelf.

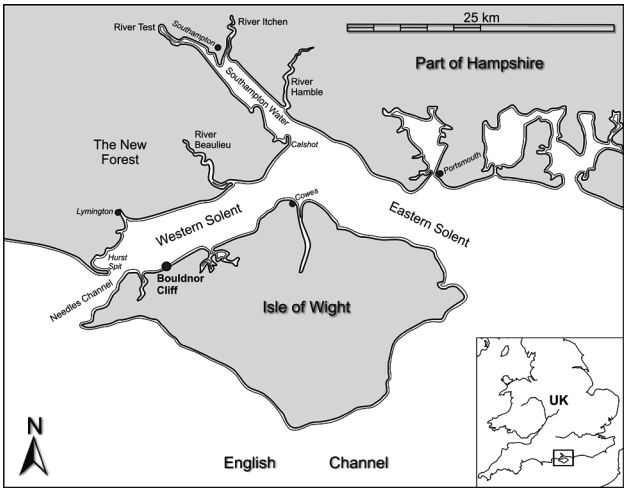

Figure 1. Location map of Bouldnor Cliff.

Considering the Mesolithic archaeological record

Studies of Mesolithic cultures across Europe over the last century created frameworks that have been used to define lithic technologies and characterise cultural differences. This led to the creation of a comprehensive typology (Clark 1932, 1936). Flint tools have been the focus for studies because these artefacts dominate the archaeological record. By comparison, our knowledge of the structures and objects that prehistoric people crafted with their flint tools is less well understood. As a result, recreating the peoples' lives from the archaeological material that survives has proven difficult. This has created an inevitable bias in the record that has generally resulted in a more functional approach to interpretations. Constraints in our understanding have also been skewed towards artefacts recovered from dry land sites. This is unfortunate as a great deal of human activity would have been on the lands that are now submerged as the *c.* 5000 years Mesolithic epoch that followed the last glacial period coincided with a sea level rise of 30-40m.

The rising water inundated some of the most resource rich lands on the north-west European Continental Shelf and

disrupted subsistence patterns by removing physical links between land masses. The changes meant this would have been an area that was continually transformed and as such, this is a key area for study when looking to understand human adaptations to the changing climate.

Transitions within Mesolithic cultures

The period of dramatic climate and environmental change that occurred during the Mesolithic had a major impact on people who lived through it which caused them to adapt and change their survival strategies. This is reflected in the transition from the Early Mesolithic to the Late Mesolithic where the occupants of Britain were ultimately separated from their mainland Europe counterparts.

The Early Mesolithic is represented by the Maglemosian or "big bog" culture which appeared in northern Europe as the Younger Dryas came to a close around 9500 cal BC (Clark 1936; Day and Mellors 1994). Their characteristic flint technology which remained prevalent for around 3000 years is characterised by a dominance of microliths in the form of obliquely blunted points. The Maglemosian exploited wild flora and fauna including red deer, elk and reindeer (Bang-Anderson 2003; Carter 2009; David 2009). Their drivers for movement were seasonal, which invariably required large territories. Typologically comparable lithics have been recorded thousands of kilometres apart from Poland in the East to Britain in the west (Barton 1992; Chatterton 2003; Clark 1936; Gooder 2007; Rankine 1952). Their wide range demonstrates that they would have been active in areas now covered by the sea.

Mesolithic burials are another indicator of cultural differences. While they are relatively extensive across mainland Europe throughout the period, evidence for burial practice in the UK is not continuous. In England and Wales human bones have been found in twelve different caves (Conneller 2009). This is a practice that is largely restricted to the Early Mesolithic when cultural links across Europe appear to be more cohesive. By comparison, disarticulated skeletal remains continue to be common on the continent. With almost 40% of Scandinavian Mesolithic sites, where faunal remains survived, containing individual human bones (Meiklejohn *et al.,* 2009).

Dwelling sites from the Early Mesolithic are few but invariably large with a significant amount of material. One of the most extensively studied sites in the UK is Star Carr which is interpreted as a ceremonial site with evidence of structures and shelters (Clark 1954; Conneller 2003). DNA/stable isotope analysis from dog bones at the site indicated that the occupants included a large component of marine food in their diet. This suggests they spent a large proportion of their time exploiting coastal resources and as the coastline would have been hundreds of kilometres away they must have travelled a great distance to reach Starr Carr.

The interpretation of archaeological data over the last 100 years has been largely dependant on robust evidence from land sites where flint and bone tools dominate. However, as more worked organic material is recovered from anaerobic sites such as those from the Baltic; a more complex society is being revealed. These crafted artefacts enable a broader insight into the Mesolithic lifestyle as they provide material with greater potential to address cognitive affiliations between the people and their physical environment whereby assessing their sense of place (Chatterton 2009; Jordan 2009; McFadyen 2009; Peeters 2009; Warren 2007). The application of theoretical approaches to reconstruct lifestyles is undoubtedly enhancing the Mesolithic profile by helping us to interpret their sence of place. However, a broader spectrum of everyday items is essential if we are to continue to qualify the aspirations of Mesolithic hunter gatherers.

Preservation and survival

A key factor that controls the extent of the archaeological resource is preservation. Organic material can survive when it remains in secure anaerobic conditions similar to that found in caves or saturated environments, but it will not survive for long when it is open to the elements.

The warming that followed the last glaciation and coincided with the end of the Upper Palaeolithic saw humans move out into the open. Accordingly, dependence on caves and natural features for shelter lessened as the climate ameliorated. This, in turn meant relatively less human activity was taking place in these environmentally stable shelters and more was taking place outdoors. The widespread evidence of postholes for structures vividly demonstrates how people adapted to the changes during this time (Bang-Anderson 2003; Casati and Sorensen 2009; Crombé *et al.,* 2003; Waddington 2007). The down side for archaeological study is that organic objects or constructions are lost relatively quickly and more completely when exposed to weathering in the open. Consequently, what remains will represent only a small fraction of the material that once existed. The lacuna this presents is not uncommon to archaeology but it is made more acute when considering the Mesolithic of Northwest Europe due to the vast ranges of the occupied lowlands having been removed from investigation by sea level rise whereby leaving even less of a sample to work with (Bailey 2004; Flemming 2004; Lambeck and Chapell 2001; Shennan *et al.,* 2000).

Prior to inundation, the lands which are now below Europe's shallow seas contained important wetland and lacustrine environments that are likely to have been attractive to hunter-gatherer communities (Coles 1998; Gaffney *et al.,* 2007; Reid 1913). Therefore, if we wish to discover stable Mesolithic archaeological remains in anaerobic conditions, they are most likely to remain in those secure deposits underwater.

Cultural changes, sea level rise and separation

In Britain, the end of the initial Early Mesolithic is marked by the introduction of a wider, more sophisticated range of flint tools which arrived around 7800 cal BC. This classification of the Later Mesolithic in Britain is signified by the introduction of a diverse range of microliths. Sites

rich in these tool types include Howick, Northumberland *c.* 7800 - *c.* 7600 cal BC (Waddington 2007) and at a similar time at Silvercrest, Elgin *c.* 7520-7340 cal BC (Suddaby 2007), also for a protracted period at Broom Hill, Hampshire *c.* 7600-6450 cal BC (O'Malley and Jacobi 1978). The introduction of these tools indicates the new influx of technology would have been transmitted from east to west across what were still dry lowland plains.

Most of these sites hosted large shelters or long term dwellings. The arrangement and size of post holes for timber structures vary both in age and size with a significant grouping dating between *c.* 7500 and 8000 cal BC. These are robust constructions of around six meters across. One of the most important to date is that discovered at Howick. It was a multi phase sub-circular Mesolithic hut measuring *c.* 6m across. With occupation apparently spanning 150-200 years from *c.* 7800 cal BC and containing over 13,000 lithics, it provides strong evidence for sedentism (Waddington 2007, 106). Similar arguments can be made for East Barnes, 60km to the north, which contained another substantial structure dated to *c.* 8000 BC. This gave shelter to an internal living space that measured 5.8m by 5m and around 30,000 lithics have been recovered from the site (Gooder 2007). Further north again in Elgin, two hut circles have been identified with around 900 lithics (Suddaby 2007).

The large structures found on the British mainland during the early Late Mesolithic are not dissimilar to contemporary sites in continental Europe. On the continent, evidence of structures continued to be prolific during the Later Mesolithic (Grøn 2003; Jenson 2009; Skarrup and Grøn 2004), while in the British Isles as a whole, notwithstanding occasional exceptions towards the end of the Mesolithic epoch, large shelters recede from the archaeological record. This coincides with a reduction in the size of occupation sites where the large artefact rich sites of the Early Mesolithic and early Later Mesolithic were now generally replaced by more diffuse and smaller flint scatters.

As the time passed and the changing environment began to restrict movement, the range and magnitude archaeological assemblages around the UK suggest an element of regionalisation. Richards and Schulting (2003, 123) have used stable isotope analysis data to support an argument for sedentism at some sites which had a reliance on marine foods. Other Later Mesolithic sites exploiting coastal resources are known in England at Portland (Mannimo and Thomas 2009; Palmer 1977) and Westerward Ho! (Churchill and Wymer 1965). At Wooton Quarr, Isle of Wight (Loader *et al*., 1997; Tomalin *et al.,* forthcoming) and Langstone harbour (Allen and Gardiner 2000), a multitude of worked flint tools have come to light during studies. However, coastal sites in England are relatively few and far between. The record of British Later Mesolithic coastal exploitation contrasts markedly with European practices. In Northwest Europe there is increased coastal sedentism and social development where Later Mesolithic cultures appear to be drawn to the coast resulting in social and technological advancement (Åstveit 2009; Fischer 2004; Grøn 2003; Skaarup and Grøn 2004). This is particularly true of the Ertebølle culture of the Baltic whose hunter gathering and fishing lifestyle continued for around a thousand years after the arrival of farming (Lübke 2009; Pedersen 1997).

The Late Mesolithic in the continental northern European archaeological record occurred during the mid 7th millennium BC. It is defined by the introduction of trapeze type microliths (Terberger 2003). This differs from that seen in Britain, marking a divergence of cultures that continues until the end of the epoch. In Denmark the change is signified by the introduction of finely crafted Kongemose tools at *c.* 6400 cal BC. Investigations of submerged sites off the Storbaelt and Fuen in the Danish Archipelago over the last few decades have produced thousands of Knogemose lithics, many associated with old coastal sites (Fischer 1997; Pedersen 1997; Skaarup and Grøn 2004). The exploitation of coastal resources is notable as this was a time when coastlines were extending rapidly, forcing sea into the Baltic and across the lower European plains. Within a thousand years the sea level in Denmark was only a couple of metres lower than today and the Kongemose had been superseded by the coastal Ertebølle culture.

The new ecological regimes and sea level rise would have been strong drivers for change. The model in the Baltic, where Later Mesolithic communities were attracted to the coastline, is a tangible consequence of marine ingress. Where conditions are favourable, the productivity of the coastal zone could be three times greater than that inland (Rowley-Conwy 1983; Westley and Dix 2006).

Britain had become an island by *c.* 5500-6000 cal BC when the physical link with Europe was severed. Although travel by sea was demonstrably possible, as indicated by occupation on Ireland and islands around the UK, it invariably became more difficult and risky as the seas grew (Lambeck and Chappell 2001; Shennan *et al.,* 2000). The archaeological record does not show a strong affinity with the coastline in Britain although it is true that the vast majority of coastlines during the thousands of years of that spanned the Mesolithic period would now be underwater.

Isolation and divergence

As the Mesolithic period progressed idiosyncratic traits emerge, particularly where locations are more isolated. In Britain, the disappearance of large sites with many thousands of worked flints in favour of smaller, more numerous assemblages with more discrete and less permanent dwelling places, suggests that the strong parity that initially existed with continental European peoples waned during the Later Mesolithic. The cause is speculative but the fulcrum between the divergent living practices lies in the area that is now below the North Sea. The discovery of more material from the lands that were dry around the time this transition took place could be particularly informative.

The possibility of finding material that has been drowned by the turbulent waters around the fringes of the Atlantic Ocean has long been doubted. However, the feasibility of such finds has recently been enhanced with the identification of early Holocene landscapes remaining in

large areas of the North Sea (Gaffney *et al.,* 2007). These contain geomorphological features interpreted as lakes, rivers, hills and marshes. The landscape is protected under sand and silt deposits offering significant potential for preservation of the material needed to address the gaps in our knowledge.

The challenge now is to locate archaeological sites and quantify the magnitude of the resource to gain an evaluation of the potential within such deposits. Fortunately, the submerged landscapes within the Solent present an opportunity to assess stratified terrestrial deposits that are over 8000 years old.

Bouldnor Cliff; a submerged Mesolithic landscape

Investigations of the 11m deep submerged forests off the north shores of the Isle of Wight at Bouldnor Cliff have been ongoing intermittently since the 1980s (Figure 1). It was not until 1999, however, that the first archaeological discovery was made by the Hampshire and Wight Trust for Maritime Archaeology (HWTMA), prompting annual inspections and a series of fieldwork projects primarily supported by English Heritage in 2003 and the Leverhulme Trust in 2007.

The fieldwork has tested the archaeological potential of an 8000-8200 year old peat terrace that runs parallel with the coast for over one kilometre. The peat protrudes from beneath protective sediments that were deposited above it as sea level rose. Samples have been collected from the submerged landform and small evaluation trenches excavated. The studies have built a picture of the palaeoenvironment, palaeolandscape, process of inundation and subsequent erosion (Momber 2000, 2004, 2006; Momber *et al.,* 2009; Tomalin 2000a, 2000b).

Site formation and excavation at Bouldnor Cliff

The submerged landscape at Bouldnor Cliff was inundated by the sea around *c*. 6000 cal BC. It was a low lying basin through which ran a river from north to south. This was followed by the deposition of brackish, estuarine sediments which entered the River Yar system from the south (Momber *et al.,* 2011; Scaife 2000; Scaife in Momber *et al.,* 2011). By *c*. 2000 cal BC rising sea-level saw the protective barriers that fringed the old flood plain being overtopped from the east and west. It was at this time that the Solent formed and what was once a sedimentary sink in the estuary became open to erosion. The formation of the Solent introduced processes that dramatically remodelled the earlier landforms by introducing erosive forces across the sediment covered palaeo-landscape (Momber in Momber *et al.,* 2011, 123-135).

In 2007, the Leverhulme Trust, through the University of York and the HWTMA, supported an evaluation trench into an area of the submerged deposit at the Bouldnor Cliff V (BC-V; Figure 2) loci that was suspected to be rich in archaeology. The evidence recovered included charcoal, burnt flint, roasted hazelnuts, prepared string and some interesting pieces of worked wood (see below). Archaeological features included a reused pit full of burnt flint, widespread evidence of burning, the foot of a wooden post in the seabed and integrated worked timbers. Despite only a small fraction of BC-V having been explored, the remains pointed to a significant site of wood-working activity. The finds identified during the initial survey were plotted over an area of 60 square metres although time only allowed for two square metres

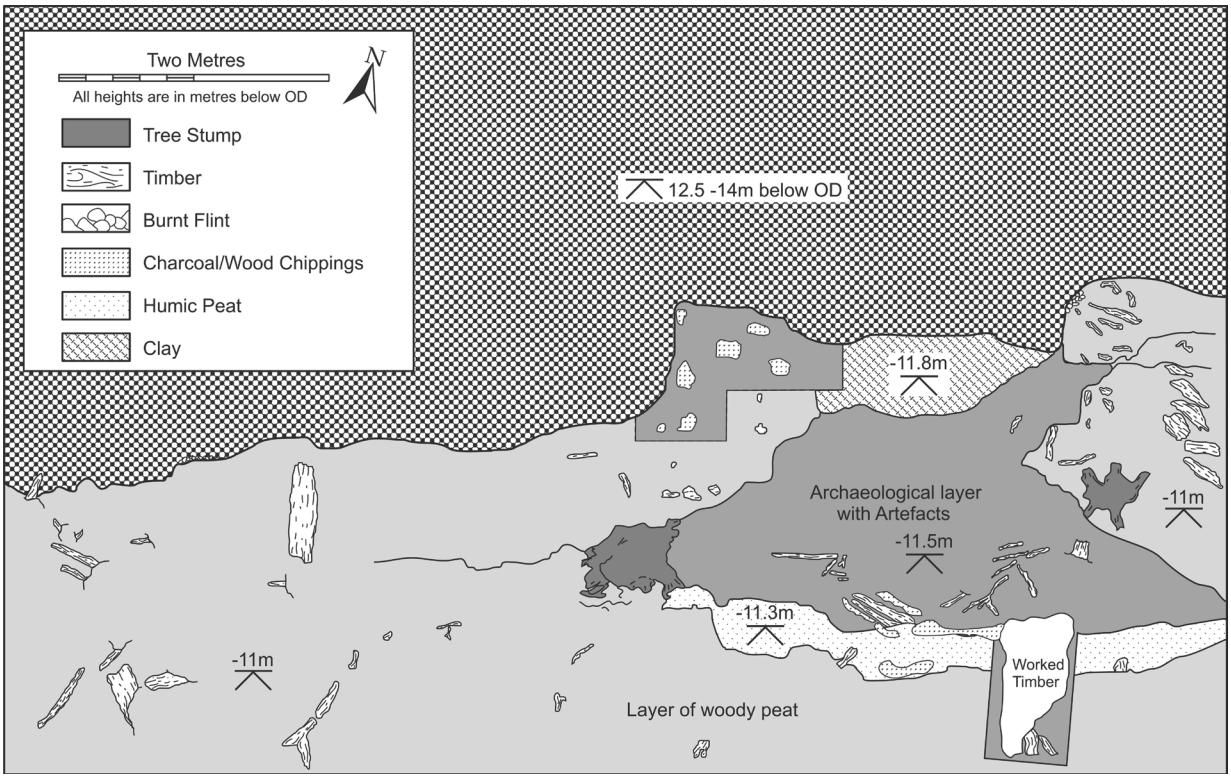

Figure 2. Site plan of BC-V; area surveyed and excavated in 2007.

to be investigated in detail.

The preservation of the discoveries and the extent of the archaeological material suggested a site of great significance. However, the extensive environmental degradation caused by exposure to the water column and the limited number of easily identifiable finds, coupled with the absence of comparable data from the Mesolithic, continued to make definitive interpretation problematic.

In June 2009 an inspection dive revealed further changes. Natural erosion and trawler damage was seen to have flattened and "trimmed" the seabed around the area of investigation. The loss of seabed exposed a piece of worked timber from the dated horizon beneath a covering of clay and peat. It had been recently uncovered and still retained clearly visible tool marks. A 20cm long section of the exposed piece of timber was recovered (Figure 3).

Figure 3. Sharp cut on an example of worked timber eroding from BC-V at Bouldnor Cliff.

In response to the discovery, further work supported by the Leverhulme Trust through the Department of Archaeology, University of York, uncovered and recorded the threatened timbers. In June 2009 the sondage cut in 2007 was extended to include the area around the newly exposed timber. Removal of the covering sediment revealed a wide array of interconnected pieces of what appeared to be trimmed oak measuring between eight centimetres and 14cm wide. The complex interplay of worked wood suggests that a substantial Mesolithic structure had once stood in this location (Figure 4, Figure 5).

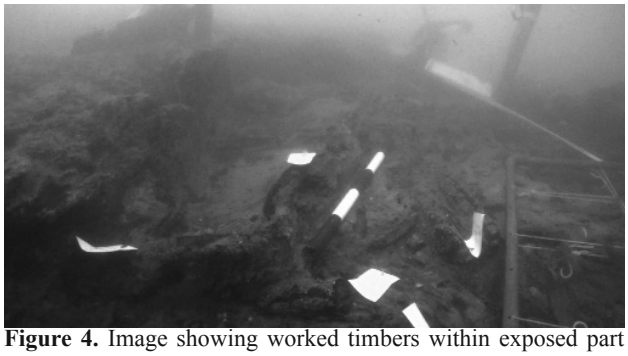

Figure 4. Image showing worked timbers within exposed part of site.

Over 20 pieces of wood or parts of the structure and dozens of chipped and burnt fragments have been identified at BC-V to date. Most pieces of worked timber have been found eroded from the edge of the peat shelf while one piece has been found two metres to the north in deeper water. This timber post had been worked and forced into the ground and was steadily degrading as the seabed dropped (Figure 6). It is therefore clear that the site had extended further north into the old "Solent valley" and much has now been lost.

Analysis of timbers by Dr Maisie Taylor has revealed sophisticated wood-working. One piece in particular, which provided a secure radiocarbon date of 6370-6060 cal BC (BETA-249735), has been tangentially split from a large oak tree approximately two metres in diameter. The timber would have been large, possibly in the order of ten metres long. The method employed to make such a flat plank-like piece would require wedges hammered into the sides of the trunk at points where the grain runs parallel, or close to parallel, along its width. This would eventually split the plank from the trunk (Evans and Hodder 2006). Later prehistoric evidence indicates that this technique has been used to produce log-boats, as once the plank has been removed, the rest of the trunk can be hollowed out to produce a larger than usual craft with steeper sides and a flatter base. Examples come from the Bronze Age Appleby boat of *c.* 1100 BC or the Brigg Boat *c.* 834 BC (McGrail 1978). These boat were generally made from oak; the material of choice for the many log boats discovered in Britain and northwest Europe (McGrail 1978, 117; Mowat 1996; Okorokov 1995).

Comparison with other archaeological evidence shows this technique of wood-working also being used in the construction of monumental structures. For example, similar prehistoric timbers have been found in burial chambers, although not for another 2000 years. The earliest evidence comes from the Neolithic site of Haddenham Long Barrow *c.* 4000 BC where large timers of this type were used to construct a chamber to house burials (Evans and Hodder 2006).

Deepening the trench and extending understanding

In 2010 and 2011 support from the European Regional Development Fund through the INTERREG IVA 2 Mers Seas Zeeën Cross-border Cooperation Programme and Associated British Ports enabled the trench begun in 2007 to be extended further back into the bank. The objective was to determine the extent of the worked timbers associated with the discoveries in 2007 and see if we could find additional timbers that would help with the interpretation of the assemblage. Further inter-related pieces of worked oak were uncovered and of note were two long curved pieces that flanked the line of the tangentially split piece. These were 0.95m and one metre long respectively and they both had been worked with longitudinal groves. Another piece of timber recovered was in line with the tangentially split piece (Figure 7). This would have been part of a larger timber that had suffered damage around the time of deposition. There is evidence of burning and degradation around the edges of the timber pieces while some cut marks remain well defined

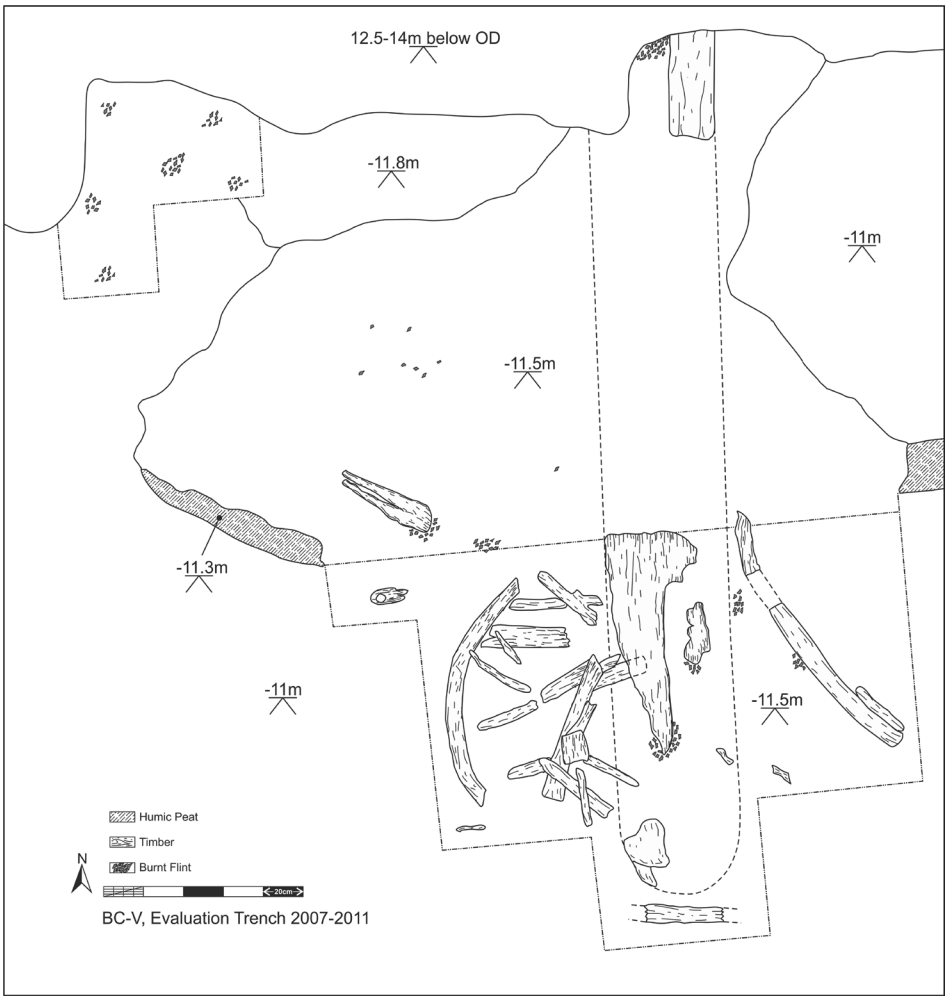

Figure 5. Plan of associated pieces of timber identified in the evaluation trench.

Figure 6. Bottom 18cm of timber that had been split from an oak tree, trimmed and forced into the ground. The function is not known as any associated material above and around it has been lost to erosion.

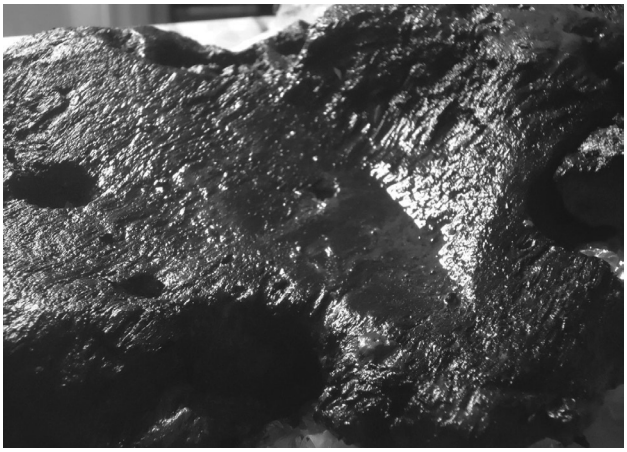

Figure 7. Worked timber with groves and cut marks comparable with those found at the end of a log boat.

and clear. The contrasting levels of erosion are not the results of universal decay that you would expect as a result of 8000 years of burial within a homogenous deposit, but rather they are the result of localised variations which would have existed at the time of deposition. This effect was also compounded by the burning which is evident on the tapered ends of some timbers and indicated by the numerous burnt flints. More recent damage does exist in the form of piddock burrows which had penetrated the timber from above to make vertical holes up to three centimetres in diameter and where the timbers have been eroded from their 8000 year old protective matrix of silty peat.

Conclusion

The rich archaeological material from the settlement on the edge of the basin contrasts with the scarcity of Mesolithic occupation sites in the wider region, suggesting that the lowland basin below Bouldnor Cliff was a focal point offering attractive settlement opportunities. The work is still in its evaluation stage, yet it has already uncovered artefacts the like of which are rarely seen in British Mesolithic sites. Furthermore, the landscape around a wetland or lacustrine environment that once existed in the Western Solent, would have been rich in resources and the concentration of Mesolithic material at Bouldnor Cliff may suggest an element of sedentism. Although, still in early stages of investigation, the work at Bouldnor Cliff has already demonstrated the preservation potential for landscapes beneath sediments within infilled palaeo-landscapes and it has shown that such environments can support a rich and varied range of well preserved archaeological material.

Bouldnor Cliff is currently unique but represents an example of what may remain buried at many similar locations offshore.

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THE CHANGING ENVIRONMENT OF THE MESOLITHIC AND OCCUPATION AT BOULDNOR CLIFF

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Key-words:
Mesolithic, Bouldnor Cliff, geomorphology, sea-level change, prehistoric submerged landscape

Abstract:
This paper reviews evidence of Mesolithic cultural changes that have been gleaned from the northwest European archaeological record. This is used to provide a context when assessing the potential for cultural development in land areas that are now inundated. Work by the Maritime Archaeology Trust over the past 13 years has been unravelling the processes that buried and preserved a subsequently submerged archaeological landscape.
A site that has attracted particular attention is Bouldnor Cliff, at a water depth of 11m off the Isle of Wight. It was discovered owing to its exposure by [underwater] erosion. Worked wood, hearths, flint tools, food remains, twisted plant fibres and an enigmatic assemblage of intercalated timbers dating at around 8100 years before present represent some of the discoveries. They demonstrate technological abilities that are 2000 years ahead of anything found in mainland Britain. The investigations are presented as a case study that has revealed significant artefacts demonstrating the potential to open a window on this little understood phase of North European human occupation.
The investigations conducted on site during 2010 to 2013 have been supported by Interreg IVa projects funded by the EU (European Regional Development Fund) through the Joint Technical Services and with support from the ERC funded DISPERSE Project

CHANGEMENTS ENVIRONNEMENTAUX ET LES OCCUPATIONS MÉSOLITHIQUES À BOULDNOR CLIFF

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Mots-clefs :
Mésolithique, Bouldnor Cliff, géomorphologie, variation du niveau marin, paysage préhistorique submergé

Résumé :
Cet article reconsidère les témoignages de changements culturels au Mésolithique qui rejaillissent au travers des sources archéologiques de l'Europe du Nord-Ouest. Il est habituel de fournir un contexte pour évaluer le potentiel de développement culturel dans les terres actuellement inondées. Un travail mené par le Hampshire and Wight Trust for Maritime Archaeology depuis 13 ans a porté sur les processus qui ont amené à l'enfouissement et à la protection d'un paysage archéologique aujourd'hui submergé.
Le site de Bouldnor Cliff, à une profondeur de 11m et localisé au large de l'Île de Wight, a particulièrement attiré notre attention. Il a été découvert lors d'une phase d'érosion. Des bois travaillés, des foyers, des outils en silex, des restes alimentaires, des fibres végétales torsadées et un assemblage énigmatique de poutres imbriquées datant d'environ 8100 BP ne représentent qu'une partie du mobilier récupéré à ce jour. Ils témoignent d'un niveau technologique qui possède 2000 ans d'avance sur la Grande-Bretagne continentale. Les investigations menées à Bouldnor Cliff sont présentées comme une étude de cas qui a révélé des artefacts significatifs démontrant un potentiel qui permet d'accéder à une meilleure compréhension de cette phase de l'occupation humaine de l'Europe du Nord.
Les recherches menées sur le site en 2010 et 2011 font partie du projet européen « Atlas des 2 mers » (Interreg IVa) financés par l'Union européenne (fonds FEDER ; Fonds Européen de Développement Régional) à travers son Service Technique Conjoint (STC).