Mesolithic Research and Conservation Framework 2013

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Edward Blinkhorn
and Nicky Milner

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Summary Statement

In 1999 the first Palaeolithic and Mesolithic Framework document was produced. Due to significant advances in Palaeolithic research, a new Research and Conservation Framework document was published in 2008 for the Palaeolithic alone, in which it was noted that Mesolithic archaeology had developed a distinct agenda and set of requirements. Since 1999, Mesolithic archaeology has indeed changed significantly: many important discoveries have been made and there has been increased interest in the period among both archaeologists and the public. A new Mesolithic Framework was necessary in order to improve understanding of the period and guide future work. Accordingly this document outlines the current challenges facing the study of the Mesolithic, as well as the opportunities, and sets out a series of research themes and strategies to address these over-arching aims.

Introduction

Background and aims of the Framework

Since the previous Palaeolithic and Mesolithic Framework document (Prehistoric Society 1999) was produced numerous significant discoveries have been made and fresh perspectives have been developed for the British Mesolithic. These include the discovery of a number of settlement sites with houses; the recognition of the potential of intertidal and offshore deposits following the mapping of submerged landscapes under the North Sea and elsewhere; renewed excavations at the flagship site of Star Carr which have highlighted alarming problems with drying out of the peat; and more detailed studies of the Mesolithic environment and landscape change including the creation and settlement of the British archipelago.

However, the Mesolithic is arguably still the most neglected period in British prehistory and as a consequence of its low profile and the need to assimilate new information and discoveries a project was commissioned by English Heritage to develop a new Mesolithic Research and Conservation Framework for England. This supersedes the 1999 joint framework for the Palaeolithic and Mesolithic and sits alongside the current Palaeolithic Framework, which acknowledged that Mesolithic archaeology had developed its own distinct agenda and requirements (Pettitt *et al* 2008, 3–4).

The aims of this Research and Conservation Framework are to: (1) improve the understanding of the Mesolithic of England; and (2) set out key issues and priorities for future work. In addition, it will aid English Heritage in its broader objectives of identifying and protecting our most important heritage, and helping people appreciate and enjoy England's national story (English Heritage 2011), as well as contributing to the Pleistocene and Early Holocene activity of the National Heritage Protection Plan (English Heritage 2012).

This framework has been produced by undertaking broad-ranging consultation across the sector using a dedicated website to disseminate information, an on-line discussion forum to generate interactive debate, email correspondence, and a meeting of interested experts from across

the sector. The framework process has been composed of three parts, as set out by Olivier (1996) in *Frameworks for our Past*. The first part was a resource assessment: a statement of the current state of knowledge and a description of the archaeological resource; this will be archived with the Archaeology Data Service (Blinkhorn and Milner 2012a). The second part was a research agenda: a list of the gaps in that knowledge, of work which could be done, and of the potential for the resource to answer questions (Blinkhorn and Milner 2012b). This was discussed at the expert meeting and formed the basis for the final part of the process, the production of this Research and Conservation Framework, which sets out key issues and priorities for future work as well as methods and approaches for achieving these.

In terms of geographical scope, the document aims to improve the understanding of the Mesolithic of England. It should be noted that for over half the period Britain was physically joined to Europe and consequently the maritime resource has been included. This framework partners the Palaeolithic and Mesolithic Research Framework for the Archaeology of Wales (Walker 2011), the Scottish Archaeological Research Framework for the Palaeolithic and Mesolithic (ScARF 2012), and the Maritime Research Agenda (Ransley *et al* 2013).

What is the Mesolithic and what are the challenges of studying it?

The Mesolithic is generally defined as corresponding to the beginning of the Preboreal period (which follows the Younger Dryas – the last cold snap of the Ice Age) at about 9600 cal BC, and finishes at about 4000 cal BC in Britain with the introduction of farming. However, the term 'Mesolithic' is a modern construct, coined in 1866, and the boundaries of the period are rather fuzzy (Milner and Woodman 2005a). The 'transition' from Upper Palaeolithic to Mesolithic is poorly understood: the long blade sites of the Terminal Palaeolithic are poorly dated and the degree of continuity with the Early Mesolithic is not clear (Barton and Roberts 2004).

There are hints of temporal succession in the Early Mesolithic assemblage types of the Preboreal (Reynier 2005) and some indications of Middle Mesolithic developments around the beginning of the Boreal, but the chronologies require more work. In addition, the nature and timing of the Mesolithic–Neolithic transition is much debated (Milner 2010). Although the general consensus is that at some point around 4000 cal BC changes associated with the Neolithic occur (see eg Whittle *et al* 2011), rod microlith sites have been identified as particularly late vestiges of Mesolithic behaviour, possibly extending into the 4th millennium cal BC (eg Spikins 2002, 43; Chatterton 2005; French *et al* 2007, 283). Overall, the lack of chronological refinement for the whole of the Mesolithic has been thrown into sharper relief by the precision now achieved for the Early Neolithic through Bayesian modelling (Whittle *et al* 2011).

Despite the difficulties of defining a specific beginning and end point to the period, we can say that the Mesolithic spans roughly five and a half thousand years: a significant chunk of time which covers about half of the Holocene, the geological epoch we are currently living in. One of the reasons this period has been overlooked may be because it lacks

Excavating horse bone at the long blade site on Flixton Island, 2013 (© POSTGLACIAL project)

the impressive monuments and artefacts associated with later periods. Developments in lithic artefact styles and technology enable a broad Early/Late assignment to stone tools, the change occurring across the late 9th and 8th millennia cal BC, and a 'Middle' facies has been posited for southern and central England. Scarcity of substantial remains and associated radiocarbon dates has hindered refinement of Mesolithic chronology to a more familiar, human scale. Consequently, these five and a half thousand years tend to be conflated and the Mesolithic is often seen as a 'timeless' period, lacking history and change until the arrival of the Neolithic.

However, this neglect in the past arguably makes the Mesolithic one of the most exciting periods to study because there are so many questions to answer; recent work has demonstrated that important discoveries can overturn our understanding of hunter-gatherers after the Ice Age and contribute significantly to the national story. Recent research has also shown that a historical perspective is both vital and possible. Several cultural and environmental events occurred during the Mesolithic, including rapid climate change at the beginning of the period, significant changes in lithic technology and, in the 7th millennium cal BC, a cold event, a tsunami and eventually the breaching of the landscape which

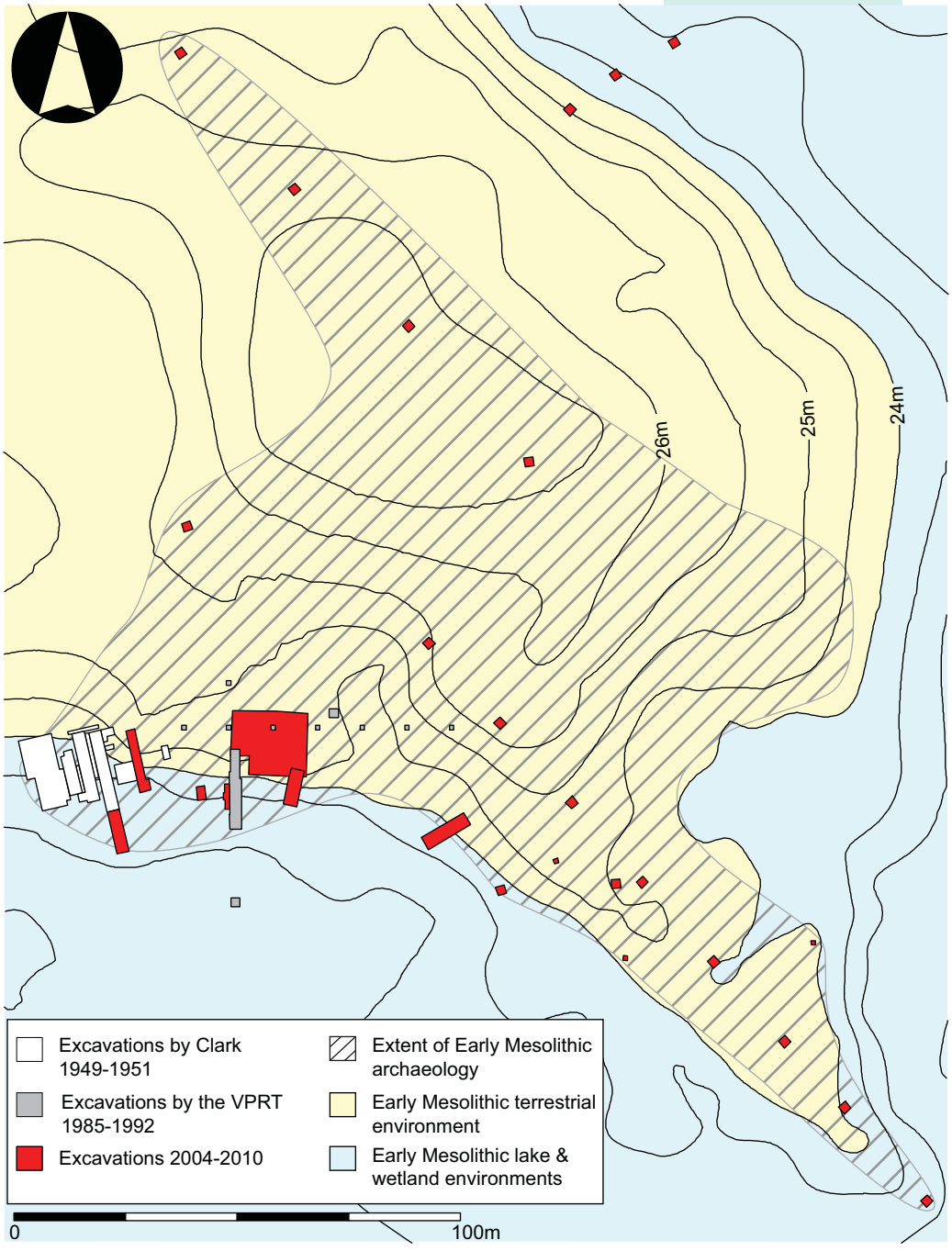
Cliff face section at Low Hauxley showing probable tsunami deposit and underlying sediments (© Clive Waddington, Archaeological Research Services Ltd)

joined Britain to the rest of Europe. Many of these events speak to current concerns about climate change, the environment, and Britain's place in the world.

There are a number of challenges that those dealing with the Mesolithic have to face (Spikins 2010). Mesolithic sites can be hard to find: the archaeology can be ephemeral and prospecting for sites can be difficult. There are some entrenched views on what Mesolithic sites and material should look like, which can limit exploration and consequently lead to a self-fulfilling prophecy. For instance, because the human bone record is so sparse for the Mesolithic, such remains are not expected to be found. It is only through recent radiocarbon dating programmes that more have been identified as Mesolithic (Meiklejohn *et al* 2011). Similarly, recent excavations at Star Carr have shown that the site is much larger than the original excavator had envisaged, which had been based on a belief that sites of this period are small (Conneller *et al* 2012).

Conversely, the difficulties of prospection for small sites (and intra-site archaeology) mean that the enormous potential of studying single-period events is mostly untapped. Such small sites can preserve archaeological signatures for short-term events, archaeological snapshots, and offer 'clean' assemblages, unaffected by the palimpsests often seen on larger scales. Their significance is inversely proportional to their size, offering huge potential to inform our understanding of the bigger picture at certain points in time (see text box overleaf).

The full extent of early Mesolithic activity at Star Carr (© POSTGLACIAL project)



Asfordby, Leicestershire

Lynden Cooper, University of Leicester Archaeological Services

Archaeological evaluation ahead of a proposed housing development revealed a discrete scatter of lithics and calcined bone preserved within an early Holocene palaeosol. Joint funding from Jelsons Ltd and English Heritage has allowed a programme of post-excavation analysis. The site was located on a south-facing Devensian gravel terrace on the right bank of the River Wreake. The site comprised a 5m wide sub-circular scatter of worked flint with a central cluster of burnt and calcined flint, the indications of a former hearth. Some 8000 flints were recovered by hand excavation, while a wet-sieving programme produced copious micro-debitage. The principal activities at the site comprised the production of bladelets, blanks for making microliths. Re-tooling of projectiles can be inferred from a cluster of impact-damaged and broken microliths and evidence for microlith manufacture in the form of numerous microburins. However, some microliths showed use-wear traces relating to other activities such as butchery.

The assemblage has the distinctive technological and typological profile of a Honey Hill assemblage type. The microliths are dominated by obliquely truncated points, backed points

and points with inverse basal retouch, the latter a defining trait of such assemblages. The microliths show a near-ubiquitous feature in the form of sinistral lateralisation, ie they were nearly all retouched on their left-hand side. Bladelet production was methodical and comprised reduction from single-platform and opposed-platform cores, prepared by abrasion of the core front. Ventral stigmata on the bladelets demonstrated that the cores were reduced with a soft stone percussor. However, there was some evidence for a less-skilled knapper on site, possibly a child.

Excavations in progress at Asfordby (© University of Leicester Archaeological Services)

The Honey Hill assemblage type appears to be a Midlands phenomenon but showing some linkage with Horsham sites of southern England, and more distant links with Middle Mesolithic sites of northern France. A radiocarbon dating programme undertaken by Alex Bayliss suggests that the principal occupation at the site occurred c 8100 cal BC, around the beginning of the Boreal pollen zone, a period when climate warming caused a rapid replacement of the pine/birch forest with a mixed deciduous woodland. Proxy environmental indicators such as oak charcoal and pig bones support the position within the Boreal. It is proposed that Honey Hill-type sites and the related Horsham sites be termed Middle Mesolithic, reflecting similar developments in north-west Europe. Interestingly the site is broadly contemporary with the site of Howick in Northumberland which has lithic techno-typological characteristics of the Late Mesolithic (geometric microliths and narrow blade technology). It seems plausible that there are co-eval developments in the settlement history of England, with different Mesolithic traditions (people?) infilling the north-west peninsula of Europe just prior to the creation of the British archipelago.

Lithics from Asfordby (© University of Leicester Archaeological Services)

A youth group excavating at the site of Low Hauxley which had been eroding into the sea (© Clive Waddington, Archaeological Research Services Ltd)

There can also be negative expectations that Mesolithic sites will be disturbed and therefore of little value, or that structural remains such as hearths, pits, and postholes are unlikely to be found: these perceptions can mean that important archaeology is missed or incorrectly assigned to other periods (Spikins 2010).

There are also a number of threats to the resource which in recent years have come to the fore. Growing pressure on previously uncultivated land, which on the one hand presents a new opportunity to identify unrecorded Mesolithic scatters, also results in potential further damage to buried sites which have long been protected by grassland. The severe drying out of peat, at upland sites due to climate change (*ibid*), and on lowland sites due to changing water tables often related to drainage (Boreham *et al* 2011; Milner *et al* 2011), is also having a significant damaging effect on the Mesolithic resource.

A number of coastal Mesolithic sites are also under threat from sea-level rise, or are currently eroding into the sea (Milner 2012), such as at Low Hauxley, Northumberland (Waddington 2011; Eadie and Waddington 2013). Rapid assessments of England's coastal zones, undertaken to inform asset management in areas affected by coastal erosion and defence, have added significant evidence for nearshore and intertidal peats and forest beds. Many of these organic deposits have dates showing that they formed during the Mesolithic period (eg Eadie 2013, chapter 6). These provide evidence of past environments and relative sea levels. A national database is managed by English Heritage and new discoveries can be added on-line at http://www.english-heritage.org.uk/professional/research/heritage-science/environmental-archaeology/Environmental-Studies-Resources/intertidal-peat-database/.

In terms of management and protection, most Mesolithic sites found on the Schedule of Monuments are there because of archaeology of another period, since designation requires there to be evidence of buildings, structures or works. Significantly, Star Carr was scheduled in 2011 (see http://www.english-heritage.org.uk/caring/heritage-centenary/landmark-listings/star-carr) because of the discovery of a 'house', offering the possibility that the Mesolithic will be afforded increased statutory protection elsewhere when such features are recognised. The case at Star Carr has helped inform the rationale for designation in that it was scheduled both in order to encourage a dialogue with stakeholders over best management practices, including further excavation, and to support funding applications by official recognition of the importance of the site. A further step forward is that English Heritage has now published a 'scheduling selection guide for sites of early human activity' which outlines degrees of significance of various forms of evidence (see http://www.english-heritage.org.uk/publications/dssg-sites-early-human-activity/).

A further challenge is the presentation of the period to the public. The 2008 Palaeolithic Framework identified rising sympathies with creationism as a cause for concern, to which can be added the low level of understanding of deep time and chronology amongst the public at large, and the persisting 'caveman' stereotype. In a recent questionnaire to members of the public in Scarborough over a period of three years, only 9% knew about the Mesolithic despite living a few miles away from the site of Star Carr (Milner *et al* forthcoming); although the sample size was relatively small (a total of 173 people over three years), the results were consistent each year. This lack of knowledge is hardly surprising given the relative paucity of information in the public domain: the Mesolithic is not taught in schools, it has a minimal presence in most museums and there are very few popular books on the subject. In addition, some representations of the period tend not to be the type of depictions that Mesolithic archaeologists would make: eg the film *10,000 BC* bore no relation to the existing data for the period. However, other examples such as the graphic novel *MeZolith* (Haggarty and Brockbank 2010), and books like *The Gathering Night* (Elphinstone 2009), *Wolf Brother* (Paver 2004) and subsequent books in the *Chronicles of Ancient Darkness* highlight what can be achieved. In sum, there is a continuing need to disseminate our understanding of the Mesolithic widely, clearly, and in non-specialist language in order to explain the story of how the repopulation of Britain took place in a changing world.

Achievements since 1999

Since 1999, the shape of Mesolithic archaeology has changed significantly:

- there have been a number of projects (research, community-based and developer-led) which have resulted in important discoveries (see below);
- there has been a significant increase in academic interest, including a surge in edited volumes which set new agendas, expanding the breadth of subjects of interest to include social and interpretative questions (eg Bailey and Spikins 2008; Bevan and Moore 2003; Conneller 2000a; Conneller and Warren 2006; Milner and Woodman 2005b; Waddington and Pedersen 2007; Young 2000);

- a range of new scientific techniques have been applied such as Bayesian modelling of radiocarbon dates (Waddington 2007), modelling of the submerged landscape (Gaffney *et al* 2007), and stable isotope analyses (Schulting and Richards 2002);
- a range of different funding bodies have provided significant support: English Heritage, Heritage Lottery Fund, European Research Council, British Academy, Natural Environment Research Council and the now discontinued Aggregates Levy Sustainability Fund;
- and there has been a rise in public engagement, in particular through popular TV programmes.

Such achievements are described within the Mesolithic Resource Assessment Document (Blinkhorn and Milner 2012a); some of the major successes are highlighted here.

Numerous sizeable research projects in England have taken place or been published within this period: eg Howick (Waddington 2007), the Severn Estuary (Bell 2007), Three Ways Wharf, Uxbridge (Lewis and Rackham 2011), 'Doggerland' (Gaffney *et al* 2007, 2009), Star Carr (Conneller *et al* 2012; Milner *et al* 2013), Bouldnor Cliff (Momber *et al* 2011) and most recently at Low Hauxley (Waddington, pers comm) and a project on high-resolution analysis of late-date 'rod' microlith sites (Jim Innes and Peter Rowley-Conwy, pers comm). Significant lithic assemblages have continued to be identified across the country from diverse projects such as infrastructure work, eg Channel Tunnel Rail Link (Foreman 2009; Booth *et al* 2011) and the Steppingley to Aylesbury Pipeline (Moore 2010), and aggregates sourcing, eg Tubney Wood, Oxfordshire (Bradley and Hey 1993; Norton 2008). Similar large-scale work at the Stainton West site on the Carlisle Northern Development Route in Cumbria has recovered vast amounts of Later Mesolithic lithics utilising industrial-scale sieving strategies (see text box opposite).

Most prominent amongst new discoveries are the substantial structures that have been found. Howick, Northumberland, which featured prominently in the media as the 'oldest house in Britain' (Richards 2011) was the first to be identified, amongst a number of new Mesolithic structures which are of remarkably similar form and dimensions. The Howick structure featured a sunken floor with a ring of substantial post-sockets and an internal sequence of hearth pits. More recently at Star Carr a smaller structure was found, with a shallow scooped floor surrounded by postholes, but which dates to about 1000 years earlier (Conneller *et al* 2012). The excavations at Star Carr have also revealed that the worked wooden platform first identified in the 1980s (Mellars and Dark 1998) extends over 30m of lake shore – a major structural undertaking. The evidence from both Howick and Star Carr has suggested the possibility that hunter-gatherers invested significant time and resources into building structures and that they may not have been as mobile at certain times and at certain places as was previously thought.

Furthermore, some sites in Britain, such as Stonehenge, Wiltshire (Allen and Gardiner 2002), and Warren Fields, Aberdeenshire (Hilary *et al* 2009), have evidence for large posts or post-rows (usually attributed to the Neolithic) dated to the Mesolithic. Against a background of more frequent recognition of Mesolithic features, this sort of evidence is demonstrating the possible ritual use of the landscape in the Mesolithic and lends further support to the idea that people invested time and energy at certain places in the landscape (Gaffney *et al* 2013).

Stainton West, Cumbria

Fraser Brown, Oxford Archaeology

The excavation of Stainton West in advance of the construction of the Carlisle Northern Development Route, a new bypass built around the west side of Carlisle, revealed a multi-period site perched upon an early Holocene terrace of the River Eden. The fieldwork was undertaken by Oxford Archaeology North in 2009, and a programme of post-excavation analysis has also been undertaken, involving specialists from a wide range of fields and different organisations.

The excavated site covered 0.6ha, within the footprint of the road, but seems to extend outside this, towards both the north and the south. It comprised a series of palaeochannels, with a dense *in situ* scatter of struck lithic material (c 300,000 pieces) occurring on an island between two of these. Finds of worked wood and stone within the channels, associated with well-preserved palaeoenvironmental assemblages, indicate various phases of human activity. The earliest of these, dating to the 6th millennium cal BC, probably represents the opportunistic reuse of beaver-made structures by people.

The lithic scatter, on drier land between the channels, was associated with hearths, cooking pits, hollows and stakehole structures, suggesting that a semi-permanent camp or settlement once occupied this area. Scientific dating suggests this site was most likely in use from c 4800 to 4300 cal BC, or slightly thereafter, and, as such, it seems to fall between the phases of activity identified in the channels. Overwhelmingly, the lithic material is characteristic of a narrow-blade, geometric microlithic technology and thus is, in general, consistent with the late Mesolithic date, although other types, such as leaf-shaped points and polished stone pieces, which are usually considered to be later, were also recovered. One possible conclusion is that the site is transitional, encompassing the Mesolithic–Neolithic continuum. The raw materials represented had been sourced from an exceedingly large catchment area, including beach pebble flint from western Cumbria, good-quality flint probably of eastern Yorkshire origin, Lake District tuff, Arran pitchstone, quartz, ochre and a variety of cherts, including those that can be sourced locally and materials that most probably derived from both the Pennines and from the southern Scottish uplands.

A range of innovative techniques were successfully employed during the course of the Stainton West investigation and the results, including the raw data, will ultimately be made available on-line, in an indexed digital format. In order to retrieve the huge, *in situ* lithic assemblage, in a way that preserved its spatial integrity, a wet sieving methodology was imported from the Netherlands. The site was divided into 886 1m² grid squares, and the sediment from these was whole-earth sampled by context. Approximately 270,000 litres of clay-rich sediment was then wet sieved on site to 2mm, employing water pumped from the palaeochannel excavations. This was a very gentle process that has successfully preserved the microglosses on the lithic fabric, enabling their study.

The scale of the sampling programme at Stainton West (© Oxford Archaeology North)

The value of human remains and the potential of ancient DNA studies

Rick Schulting, University of Oxford, and Oliver Craig, University of York

Human remains dating to the Mesolithic are rare in Britain (Meiklejohn *et al* 2011). This is unfortunate, as they provide a direct window into many different aspects of a long-vanished lifeway, pre-dating the arrival of farming. While the ideal case is an intentional burial, with its unrivalled combination of biological and cultural information, these are currently unknown for the period in Britain, with the possible exception of poorly documented early accounts, such as that of Aveline's Hole, Somerset (Schulting 2005). This in itself might be telling us something important about how human remains were treated after death in the Mesolithic. Scattered and partial fragments of human bone, however, have been recovered from a variety of contexts, primarily caves, but also shell middens, rivers, and open-air sites. With the application of modern scientific approaches, these can provide a surprising amount of information, including insights into past diets and population relationships, which in turn have implications for the subsistence economy, territoriality and population density (Schulting 2010). It is clear that additional Mesolithic human remains do exist in museum collections, and the increasing use of AMS (Accelerator Mass Spectrometry) ^{14}C dating, together with archival research, has resulted in a number of 'new' finds being identified in recent years. One of the best examples of this is the partial skeleton of 'Tilbury Man' found during the construction of the Tilbury Docks in 1883, now dated to the Late Mesolithic, c 6000 cal BC (Schulting in press). New excavations in targeted locations have also yielded human remains subsequently directly dated to the Mesolithic, most recently at Foxhole in South Wales (Schulting *et al* in press). This material presents new opportunities for research simply not available from any other source.

The field of ancient DNA (aDNA) research is one example of a new opportunity. This has advanced rapidly over the last few years and a major advance has been the application of next-generation sequencing (NGS) technologies that are particularly well suited to analysing the short fragments of aDNA found in ancient biological material. The renaissance of research on aDNA driven by NGS is demonstrable through a series of recent successes in the analysis of prehistoric human bone, most notably the sequencing of Neanderthal remains and the identification of a new hominin species from c 40,000-year-old remains found in Southern Siberia. From later prehistoric contexts, ancient mitochondrial DNA has been sequenced from the bones of Mesolithic foragers and Early Neolithic farmers (8000–3000 cal BC) from a range of sites across Europe, whilst nuclear DNA has been recovered from Early Neolithic human bone from Central Europe. These landmark studies have provided new insights into the demographic changes associated with the shift to food production, showing in some cases large-scale replacement of Mesolithic hunter-gatherers with 'incoming' farming populations. As more later prehistoric bones are sequenced, more regional-specific and subtle inferences are beginning to emerge regarding the demographic history of Europe during this key period. Unfortunately, no prehistoric British human sequences have ever been published. Research in this area is a priority in order to achieve a better understanding of the scale of migration at the start of the Neolithic period in Britain and the relationship between Britain and Europe during the Mesolithic period.

A partially reconstructed cranium from Aveline's Hole, Somerset (© Rick Schulting)

We are also beginning to understand submerged landscapes due to the pioneering work of the North Sea Palaeolandscapes Project which has firmly placed modern technology at the heart of submarine archaeology (Gaffney *et al* 2007). A total of 23,000km^2 of 3D seismic survey data was acquired and reprocessed to reconstruct Mesolithic land surfaces. This project has illustrated the significance of marine geophysical survey in identifying areas of enhanced archaeological potential. A similar project off the west coast in the Bristol Channel and Liverpool Bay areas identified former freshwater bodies that may have attracted human activity and areas with the potential for organic preservation (Fitch and Gaffney 2011). In addition, at Bouldnor Cliff in the Solent, the value of submarine exploration saw impressive returns when the Hampshire and Wight Trust for Marine Archaeology excavated twisted plant fibres, hearths, pits, burnt flint, timbers and lithics (Momber *et al* 2011).

Human skeletal evidence remains slight in England and new discoveries are rarely made; however, a human femur excavated from a palaeochannel at Staythorpe, Nottinghamshire (Davies *et al* 2001) was radiocarbon dated to the Mesolithic (the 6th millennium cal BC). Further discoveries have been made through radiocarbon dating of previously excavated bone, such as two human skulls from Greylake, Somerset (Brunning and Firth 2012). Much of this dating work has been carried out by Rick Schulting as part of a wider study to determine diet through stable isotope analyses and dental microwear, which is very important in its own right (see text box opposite).

'String' made from twisted plant fibres from Bouldnor Cliff, dated to 6370–6060 cal BC (width across loop c 40mm) (© Hampshire and Wight Trust for Maritime Archaeology)

Possible Mesolithic rock art has been suggested by members of the University of Bristol Spelæological Society, comprising two incised rows of crosses sealed by a stalagmite at Aveline's Hole (Mullan and Wilson 2004) and similar motifs at Long Hole, Somerset (Mullan and Wilson 2005; Mullan and Wilson 2006); there is also a figurative example at Goatscrag in Northumberland (Waddington 1999). More prolific and stratified items such as portable art objects and decorated woodwork are found across Europe so it is not unreasonable to anticipate similar discoveries in Britain, especially from marine or wetland contexts.

One of the most significant scientific achievements has been the enhancement of dating precision through the use of Bayesian statistics, as carried out on the sequence of hearths from the structure at Howick (Waddington 2007). This dating programme has demonstrated the level of refinement that is possible on sites with stratigraphy. Furthermore, the association of geometric narrow-blade lithics with these early dates has allowed Waddington to suggest a north-eastern point of entry to Britain for this lithic technology (*ibid*, 223; Waddington and Passmore 2012), a conclusion supported by a recent assessment of the northern

British evidence (Ritchie 2010). A similar programme of radiocarbon dating and Bayesian modelling is currently being carried out by Alex Bayliss for Star Carr and by Ian Bailiff and Clive Waddington for Low Hauxley. This technique is beginning to provide the historical perspective that has been so lacking for the Mesolithic. Other dating techniques, such as thermoluminescence (TL) and optically stimulated luminescence (OSL), have also been used on a number of sites. Although they tend to have broad error ranges, these lesser-used techniques have helped to clarify chronologies on sites where radiocarbon dating was unsuitable, such as at Heathrow Terminal 5 where TL dating suggested a late 8th- to 7th-millennium cal BC origin for burnt flint-filled pits (Lewis *et al* 2010).

Interrogating source material has become much easier with the advent of OASIS (http://www.oasis.ac.uk/index.cfm) and the Archaeology Data Service's (ADS) 'Grey Literature Library' providing on-line access to unpublished commercial fieldwork reports. The Archaeological Investigations Project's (AIP) database facilitates the identification of grey literature, as does the on-line portal for Historic Environment Records (HERs) 'Heritage Gateway'. This is complemented by the *Colonisation of Britain by Modern Humans* project run by Wessex Archaeology, also known as PaMela (http://www.wessexarch.co.uk/48666/colonisation-britain-project), which digitised Roger Jacobi's archive, and Blinkhorn's (2012) work which compiled evidence from PPG16-era archaeology. Additionally, John Wymer's gazetteer (1977) has been digitised and made available on the ADS (Whyte 2008). As of May 2013, the Portable Antiquities Scheme database (http://finds.org.uk/database/search/results/broadperiod/MESOLITHIC/) contains almost 6000 items identified as being of Mesolithic date (see also Bond 2010). However, the system of identification and verification requires tightening to lend more credibility to the lithics in the database.

The consistent popularity of *Time Team* since the 1999 Framework was published has served to maintain archaeology in the public consciousness but the incorporation of the Mesolithic into its schedule has been scant in comparison to other periods: of the 256 episodes listed on the Channel 4 website only five give any coverage to the Mesolithic. However, these have included a number of special programmes on Doggerland (2007) and the Mesolithic tsunami (2013), with another being filmed during excavation at Low Hauxley in 2013. In 2003, the BBC featured Howick in a *Meet the Ancestors* episode on 'Britain's oldest house' and on the first series of *Coast*. Ray Mears chose the Mesolithic for a five-part series with Gordon Hillman entitled *Wild Food* (Mears and Hillman 2007), in which they explored Mesolithic Britain from a dietary perspective and included contributions from academics specialising in the Mesolithic period. The BBC series *A History of Ancient Britain* included items on Goldcliff, Star Carr and Bouldnor Cliff alongside more extensive discussion of the Mesolithic, and the first episode of *Britain BC* had an item on Star Carr with special reference to the canine faunal remains. More recently, the BBC's *Digging for Britain* programme also investigated Star Carr, highlighting the recent research into the site's deterioration.

Although museum exhibitions on the Mesolithic are rare in this country, in recent years attempts have been made to rectify this. Notably, Clive Waddington has carried out two reconstructions of the Howick

The site of Howick and a reconstruction of the Mesolithic house (© Clive Waddington, Archaeological Research Services Ltd)

structure, one on the site itself and one on the Maelmin Heritage Trail near Wooler, Northumberland. In addition, the Yorkshire Museum in York installed a major, year-long exhibition on Star Carr in 2013 and the Great North Museum, Newcastle upon Tyne, is producing a display on the site at Low Hauxley.

Other initiatives to get the public involved in discovering the Mesolithic include the North East Yorkshire Mesolithic Project (Waughman 2012), which has used volunteers to monitor erosion scars in order to identify areas of Mesolithic potential in the North York Moors National Park; work at North Park Farm, Surrey, where excavations of Mesolithic archaeology by the Surrey County Archaeological Unit, Archaeoscape and volunteers (Guinness 2012) inspired Surrey County Council to organise a 'Stone Age Summer' (2006). Current projects at Blick Mead near Vespasian's Camp (Wiltshire), Flixton Island (North Yorkshire), and Low Hauxley (Northumberland) all include outreach elements such as the participation of school children and volunteers in the excavations. Meanwhile Emily Hellewell has developed a number of activities for children which have been made into a freely available resource pack, *Life in the Mesolithic* (Hellewell 2012). This has been disseminated to Young Archaeologists' Club volunteers in order to engage 8–16 year olds with the period.

Primary Research Themes

Introduction

Three primary research themes have been identified for future investigation, broken down into specific questions, many of which have drawn upon other regional, national or thematic frameworks across the country. They have changed from those in the 1999 framework in order to reflect the focus in this framework document on purely Mesolithic research and the advances made in the last fourteen years. The themes are:

1. Living in a changing world
2. Mesolithic lifeways
3. Investigating change and diversity

Theme 1: Living in a changing world

The Mesolithic is notable for a number of recognised climatic and natural environmental phenomena including rapid climate change at the start of the Holocene, the Preboreal oscillation (Hoek and Bos 2007), the 8.2 kiloyear event (Alley and Ágústsdóttir 2005; Edwards *et al* 2006), a tsunami caused by the Storegga slide (Weninger *et al* 2008), and the creation of the British Isles as an archipelago of islands as a result of rising sea levels, the breaching of the strait of Dover (Gupta *et al* 2007) and the final submersion of Doggerland (Gaffney *et al* 2007). At the same time there is widespread evidence for anthropogenic change in a landscape enriched by successions of flora and fauna adapting to local conditions. The following questions aim to address the relationship and interaction between human populations and the environment.

T1.1: What was the effect of the climate and environment on past communities, including both long-term processes and brief events such as the Storegga tsunami?

T1.2: What was the impact of a human presence upon the environment, vegetation, and animal population, and how does this compare to the wider European evidence?

T1.3: To what extent did environmental change impact upon Mesolithic technology and 'tool kits'?

T1.4: How can our understanding of Holocene environmental change inform perspectives on climate change in the present day?

Theme 2: Mesolithic lifeways

Social narratives of the period have become more prevalent in recent years, highlighting Mesolithic people as primary agents of change. These perspectives have not sidelined traditional approaches. Rather, new theoretical perspectives have added a social dimension to understanding various aspects of Mesolithic archaeology, such as technology (Conneller 2000b; Warren 2006; Elliott and Milner 2010; Finlay 2003), death (Conneller 2006), settlement and mobility (Spikins 2000; Milner 1999; McFadyen 2006), ritual (Bevan 2003; Chatterton 2006; Conneller 2004), and diet (Milner 2005; 2009). The following questions aim to address aspects of the human experience during the Mesolithic and work out how to build narratives based around the material evidence.

Technology and art

T2.1: What can Mesolithic technology (eg stone, antler, bone and wood working), its production, use and deposition, tell us about Mesolithic lifeways?

T2.2: To what extent can we understand the sourcing of raw materials and the movement of materials and people at different spatial scales?

T2.3: How can we better understand spatial and temporal variation in lithic technology, use and deposition?

T2.4: Can instances of Mesolithic cave and portable art be identified and dated, and placed within a broader understanding of social and geographical context?

Small, shallow pit at Lismore Fields, Buxton, Derbyshire, where Mesolithic charcoal dating to the later part of the 7th millennium cal BC was sealed by burnt and unburnt stones (photograph by Pat Losco-Bradley)

Settlement and mobility

T2.5: To what extent can the composition, size and geographical characteristics of lithic scatters be used to define different types of site in the Mesolithic?

T2.6: What is the range and nature of structural remains? How were structures built, how were they used, and did these features change through space and time?

T2.7: How were caves and rock shelters utilised in this period and what were their relationship to open-air sites?

T2.8: How did mobility strategies develop from the Lateglacial to the end of the Mesolithic?

T2.9: Can patterns of territoriality be distinguished?

T2.10: How were coastal, island and marine environments incorporated into networks of interaction?

People

T2.11: What did people eat and how varied were their diets?

T2.12: What was the health of people at this time?

T2.13: How did the living treat the dead?

T2.14: What was the genetic relationship between Mesolithic human populations, their predecessors and successors?

T2.15: Is it possible to understand social organisation in the Mesolithic better? For instance, group sizes and population density?

Theme 3: Investigating change and diversity

Despite spanning the first half of the Holocene, the Mesolithic has often been discussed as a uniform concept, consequently removing a sense of change and history across almost six millennia. Additionally, interpretations of the few sites with good preservation have been extrapolated to other sites which are temporally distant and geographically diverse. Three main sub-periods are brought into focus: transition from the Terminal Palaeolithic to the Early Mesolithic; change during the Mesolithic; and transition from the Later Mesolithic to the Early Neolithic.

Understanding the transition from Lateglacial to early Postglacial hunter-gatherer societies

T3.1: Did people occupy Britain during the Younger Dryas, the last cold snap of the Lateglacial?

T3.2: How can we refine the chronology for long blade sites and for Early Mesolithic sites, and the relationship between the two?

T3.3: How did human occupation relate to climate and environmental change at the beginning of the Holocene?

T3.4: What were the origins of the people who occupied Britain at the start of the Holocene?

Nine microliths found in close proximity where peat had eroded on moorland above Arnfield Clough, Tintwistle, in the southern Pennines. Their similar raw material suggests that they were knapped from a single nodule. Here they are arranged as they might have been hafted, replicating one interpretation of a similar group excavated at Seamer Carr, Yorkshire, which has been radiocarbon dated to c 8500 years old (photograph by Daryl Garton)

Identifying change through the Mesolithic at national and regional scales

T3.5: Can we refine further the chronology of Mesolithic lithic industries? For instance, is it possible to refine the spatial and temporal limits of distinctive lithic assemblage types (eg Star Carr, Deepcar, Horsham) and what may these distribution patterns imply? What do the changes in tool form, especially microliths, indicate?

T3.6: How did bone, antler and wood-working technology change through time and across space?

T3.7: What changes were there in animal exploitation through the Mesolithic? What were the key arrival and extinction events?

T3.8: How did subsistence practices and diet change through time and space?

T3.9: How variable was site use and landscape use through this period?

T3.10: When and how did Britain become separated from continental Europe and what impact did this have on human groups?

T3.11: Can radiocarbon dates be used as a proxy for population fluctuation during the Mesolithic?

T3.12: Were there significant social changes taking place within this period?

Understanding the transition from the Later Mesolithic to the Early Neolithic

T3.13: Can we further refine the dating of final Mesolithic sites and how do these relate to the Early Neolithic?

T3.14: How can we investigate the character of final Mesolithic archaeology?

T3.15: Why does there appear to be a paucity of dated 5th-millennium Mesolithic sites?

T3.16: When do domesticates appear in the archaeological record and what evidence is there for overlap with Mesolithic populations?

T3.17: What happened to the final Mesolithic hunter-gatherer groups when farming peoples brought domesticates to the British Isles?

Strategic Themes

Introduction

The questions listed in the Primary Research Themes can be addressed through a number of strategies for future Mesolithic research and conservation. This section sets out practical ways of advancing Mesolithic research, ensuring conservation of the resource and providing wider access to the period.

Strategy 1: Improving public engagement and education

Allowing both the wider archaeological sector and the public to engage with the Mesolithic will aid in the progression of Mesolithic research as set out in all three primary research themes, as well as improving conservation and management of the resource. In addition, it is important to establish the period as a key part of Britain's history alongside other better-known periods, by demonstrating the exciting potential of the resource and the importance of new discoveries.

The Mesolithic has been conspicuous by its relatively low profile amongst the public and even within archaeological circles. This low profile means that innovative methods of communication need to be sought so that the Mesolithic can compete both with the older and more 'exotic' Palaeolithic, and later periods replete with monumental archaeology and more familiar styles of living. However, since 1999 there has been a sizeable shift in attitudes to public engagement and a sense of duty to communicate archaeological findings of projects more widely. In fact, impact beyond academic circles is now positively encouraged.

S1.1: National media coverage should be increased to demonstrate the high relevance (to current social, political and environmental concerns) of earlier human adaptations to changes in climate and relative sea level during the Mesolithic.

S1.2: Museums should be encouraged to establish a greater presence for the Mesolithic: currently the visibility of the period from displays is generally minimal, particularly when compared to other countries in Europe, such as Denmark, where the presentation of the Mesolithic is much more prominent.

S1.3: Innovative means of presentation should be explored to present Early Holocene archaeology to the public, particularly digital technologies which can be made accessible over the internet. Resources should be developed on the identification of materials, particularly lithics, and opportunities could be provided for handling. Innovative means of presentation should be tested, such as rotating images using multi-image photogrammetry (structure-from-motion) which could be mounted on websites, or 3D printing of key diagnostic pieces.

S1.4: Engagement with local communities is essential to engender a spirit of shared ownership in decision-making about how land is managed and the means by which archaeology is accessed and preserved. Working with local societies and raising awareness among relevant people about at-risk zones, such as eroding coastlines, could help with monitoring and research.

S1.5: Workshops could be set up to train interested parties in Mesolithic archaeology and how to identify materials from this period.

S1.6: Archaeologists should actively engage schools in diverse ways (such as visits by archaeologists or production of resource packs) to expose primary and secondary education professionals and pupils to an otherwise remote period. We should also aim to establish the Mesolithic as a component period of prehistory within the National Curriculum.

S.1.7: We should assess the extent to which undergraduates have an understanding of the Mesolithic and increase the opportunities for training on Mesolithic sites: it is critical that future generations of archaeologists are made fully aware of Mesolithic issues, as part of developing and applying appropriate research methodologies in prehistory.

S.1.8: PhD research undertaken since the last framework has provided a significant and important output for the Mesolithic but opportunities for postgraduate research have now fallen significantly due to changes in AHRC funding routes. New ways of funding should be sought, for instance, through the new AHRC collaborative doctoral partnerships which could provide an opportunity for potential Mesolithic researchers to work with organisations such as English Heritage or the British Museum.

Engaging people with Star Carr

Nicky Milner, University of York

While Star Carr is famous within the global archaeological community, research in the local area over a three-year period (2009–2011) has demonstrated that less than 9% of the public had heard of the Mesolithic and less than 8% had heard of Star Carr. Consequently, the University of York POSTGLACIAL project has been aiming to improve public knowledge and engagement with the site. This has included setting up a free 'Friends' group with opportunities to volunteer on excavations at the nearby site of Flixton Island, primary school visits to the excavation which included digging and sieving, holding a 'Star Carr Festival' in Scarborough in collaboration with Scarborough Museums Trust, Young Archaeologists' Club and York Archaeological Trust, talks to more than 30 local societies over the past four years, engagement with local artists including an exhibition in York City Art Gallery, publication of a booklet, news coverage, involvement in television documentaries, an on-line ADS database (http://dx.doi.org/10.5284/1019856) of all the artefacts now housed in museums from Clark's excavations, and a website which provides information and news updates (www.starcarr.com).

Most recently, collaboration with The Yorkshire Museum resulted in a year-long exhibition on Star Carr from May 2013. This included exhibits of artefacts, a digital fly-through of the Mesolithic landscape (http://vimeo.com/66913559), a 40-minute Mesolithic 'soundscape' with a storyline, and the publication by the Council of British Archaeology of a book *Star Carr: Life in Britain after the Ice Age* aimed at a non-specialist audience (Milner *et al* 2013).

The feedback from all of these activities has been overwhelmingly positive and the engagement has grown, as evidenced through larger numbers at talks, open days, volunteers on site, the number of 'Friends', and numbers attending the exhibitions. This example, as well as other projects which have also engaged the public such as Howick and Low Hauxley, demonstrates the huge potential for expanding public interest in the Mesolithic period.

Reconstruction of Star Carr, North Yorkshire, for the recent book (Milner *et al* 2013; image © Dominic Andrews)

Strategy 2: Enhancing approaches to fieldwork and survey

All three of the research themes are dependent on obtaining good-quality data. The important discoveries which have been made since 1999 have overturned the ways in which the Mesolithic is interpreted and this momentum needs to continue, in particular focusing on sites which can provide data on the palaeoenvironment (T1.1–T1.4, T3.7, T3.8, T3.16), structures and site sizes (T2.5–T2.7), human remains (T2.11–T2.12), rare organic artefacts made of plants, bone and antler (T2.1, T3.6) and providing opportunities for dating (T3.1–T3.17). It is also important that we focus resources on sites at risk, such as wetland sites where peat is drying out, dry land sites which are being ploughed away or coastal sites which are eroding into the sea: these may not survive for future generations to research.

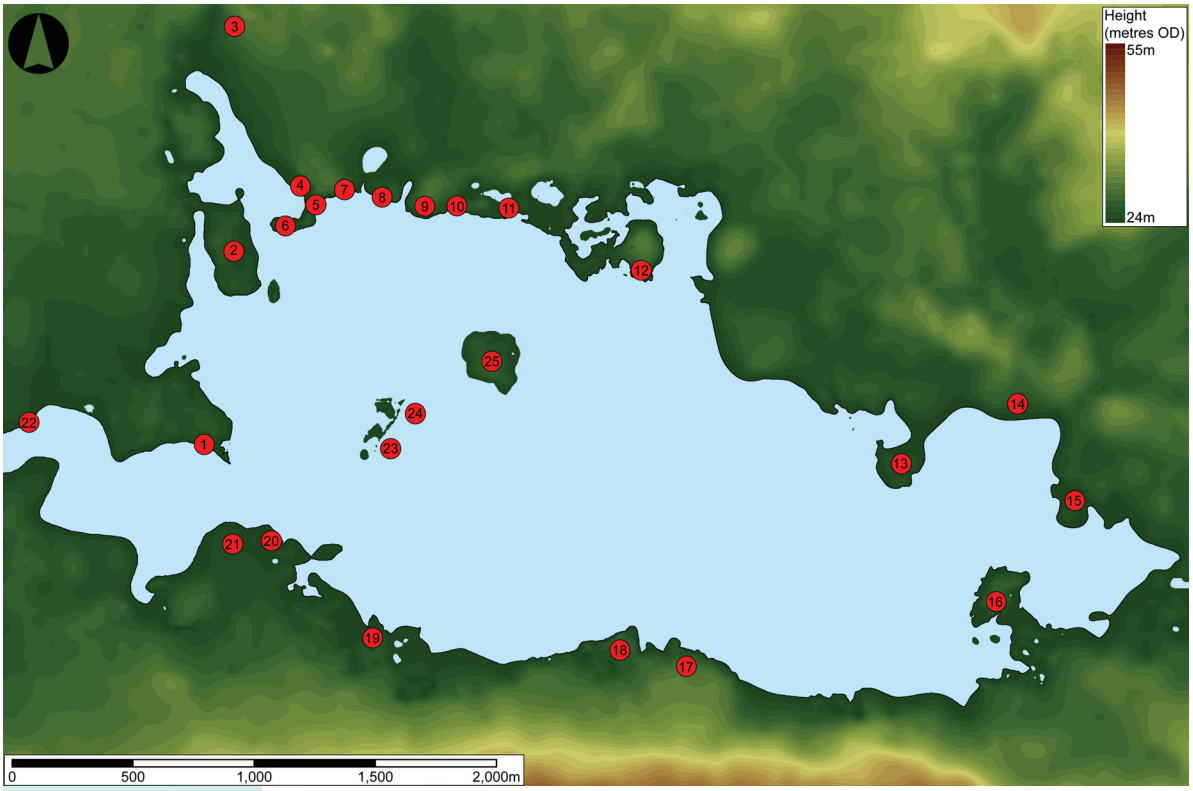
Mesolithic archaeology is notoriously difficult to find because the remains tend to be ephemeral and consequently further research is needed to develop robust strategies for prospection. Some sites such as lithic scatters, particularly in plough soil, have been viewed as of little value but this is not the case and strategies to address these will enable important research questions to be answered (T2.1–T2.3, T2.5, T2.8–T2.10, T3.5, T3.9, T3.10, T3.14, T3.15, T3.17). Intelligent approaches to fieldwork are essential if the production of inappropriate datasets is to be avoided and sites are not to be overlooked. This is especially relevant to the commercial sector where the high frequency of field interventions and the large number of multi-period sites and landscapes can lead to methodologies not best tailored to Mesolithic archaeology. Injudicious schemes of evaluation-trenching, strip-map-record or ploughzone investigations can miss or remove Mesolithic archaeology and low sampling intervals do not account for relatively intact yet discrete scatters of material.

Building on developments in Quaternary studies, and using a combination of remote sensing technologies and more intrusive fieldwork, investigation of geomorphological contexts may help explain patterns of survival and allow the development of models of favoured settlement locations in the Mesolithic, akin to those of Fischer (1995) in Denmark. The approach is applicable to terrestrial, coastal and marine contexts, and such models would be of great importance for the archaeological assessment of areas affected by development, and also in drowned and buried landscapes.

Prospection methods

S2.1: The extent and ways in which geophysical survey and aerial remote sensing techniques can be used to understand the presence and nature of Mesolithic archaeology need to be explored further.

Coring to determine the depth of the Mesolithic landsurface in the Vale of Pickering (© POSTGLACIAL project)



Map of the palaeolandscape of Lake Flixton obtained by coring through the peat. Late Palaeolithic and Early Mesolithic sites found by test-pitting indicated by red dots (Milner *et al* 2013) (© POSTGLACIAL project)

S2.2: Broader use of fieldwalking, test-pitting and other low-impact techniques is needed, especially within a developer-led context.

S2.3: Prospection methods should be conducted at a sampling density appropriate to the scale of the archaeology that is anticipated. Due to the sometimes small and discrete nature of Mesolithic lithic scatters, many will not be found using conventional methods: however, understanding small scatters is of considerable value in researching single-scale events as well as in investigating the composition of palimpsest assemblages.

S2.4: Novel methodologies to evaluate the locations of Mesolithic activity should be sought and successes in the field appropriately communicated across all sectors. For instance, these might be grounded in geoarchaeological modelling, or the application of borehole, coring and sieving strategies.

S2.5: Investigation of palaeolandscapes is achievable although how different techniques perform in different environments with varying landscape histories should be evaluated.

S2.6: Predictive/deposit modelling should be explored further to help understand the contexts in which Mesolithic archaeology is found.

S2.7: Landscape surveys like those undertaken in the Vale of Pickering and the Severn Estuary should be carried out in other regions in order to understand the landscape context of Mesolithic activity.

Erosion of *in situ* Mesolithic remains at Low Hauxley, Northumberland

Clive Waddington, Archaeological Research Services Ltd

At the north end of Druridge Bay, near Low Hauxley, a Mesolithic site comprising an extensive flint scatter, small scoops and pits, occupation areas and pockets of shellfish remains in a Late Mesolithic soil is eroding from the cliff face due to direct wave action. The site is located on what was originally a slight knoll standing at a higher elevation than the surrounding ground. This intact Later Mesolithic land surface has developed on a thick storm surge deposit thought to have been deposited as part of the Storegga Slide event. At the end of the 3rd millennium cal BC a Beaker period cist cemetery, covered by a large stone cairn, was constructed over the Mesolithic site, sealing the underlying Mesolithic soil horizons and protecting them from erosion. Since the Late Bronze Age, additional protection was afforded when calcareous dune sand accumulated over the site and a further palaeosol developed in the Iron Age before being covered over by ongoing dune sand accumulation since Roman times to a depth varying between 2.5m and 5m. The non-acidic conditions mean that bone and marine shell have been preserved.

Around 100m south of the cliff-face site, an eroding inter-tidal peat has recently been discovered with human and animal footprints, including those of adults and children and the tracks of red deer, wild pig and wild cattle imprinted on the surface. The base of the peat has been radiocarbon dated to the later 6th millennium cal BC when woodland including alder, hazel and oak grew on this land surface. The cliff-face site is also thought to be Late Mesolithic in date, although there could be earlier phases of Mesolithic occupation present. A community-based research project, 'Rescued from the Sea', has been established by Archaeological Research Services Ltd and the Northumberland Wildlife Trust to investigate the site and record the remains before coastal erosion removes the site for good.

Recording footprints in the intertidal peat at Low Hauxley, Northumberland, after a winter storm (© Clive Waddington, Archaeological Research Services Ltd)

Lithic scatters

S2.8: Techniques to assess ploughsoil lithic scatters need revisiting to assess their appropriateness in determining the location and character of Mesolithic archaeology.

S2.9: The relationship between surface scatters and the presence of *in situ* archaeology remains unsatisfactorily addressed, hampering the potential of ploughsoil lithic analysis. Finer-grained understanding of the extent and character of different lithic scatter sites might highlight the value of these.

S2.10: Better methods need to be found for identifying very high-integrity sites dominated by lithic artefacts such as those recovered at March Hill (Spikins 2002), and known high-integrity sites need protection from repeated, destructive collection.

Excavation

S2.11: Sites with organic preservation should be targeted in order to move beyond reliance on the small number of sites, such as Star Carr and Thatcham, Berkshire, which dominate interpretations of the period.

S2.12: Similarly, features containing palaeoenvironmental information should be targeted to complement archaeological information, especially where the two datasets can be demonstrated to be contemporary or relevant for investigating landscape use and development through the Early Holocene.

S2.13: Coastal, estuarine and marine contexts also require the development of novel methodologies both to evaluate the archaeological resource and to mitigate for its destruction through development or erosion. Areas of poor data need to be targeted and archives need to be accessed through working in partnership with developers (eg wind farms) (see also the recently published maritime research agenda, Ransley *et al* 2013).

Strategy 3: Scientific methods

There is enormous potential for a range of scientific techniques, both established and new, to be applied to Mesolithic datasets. There is also the potential for re-examining curated material currently held in archives in addition to any newly excavated samples.

Mesolithic archaeology has a history of applying scientific techniques, particularly those connected with the palaeoenvironment and economy, since Grahame Clark's seminal study of Star Carr (Clark 1954). The need to understand the palaeoenvironment and palaeoclimate has not gone away, and further high-resolution techniques have been developed which are critical for answering questions related to Research Theme 1 'Living in a changing world' (T1.1–T.1.4) and issues of environmental change through time (T3.1, T3.3, T3.9).

Grahame Clark carried out some very early radiocarbon dating on material from Star Carr, but approaches to dating have since gone through several revolutions, the latest being the application of Bayesian modelling which has been most notably applied to Howick, and is currently being applied to recent dates at Star Carr and Low Hauxley. There is a critical need for many more good-quality dates on Mesolithic samples in order to answer all of the questions set out in Research Theme 3 'Investigating change and diversity' (T3.1–T3.17).

Biomolecular approaches have also revolutionised the ways in which we can address archaeological questions and many techniques have significant value for Mesolithic studies, particularly in addressing issues concerning people and animals (T2.11–T2.15). For instance, stable isotope studies have been used to interpret the relative contribution of animal and marine resources to the diet patterns of humans and animals (eg Schulting 2010; Schulting and Richards 2002). In addition, some forensic approaches can also be applied to stone and organic tools which can further enhance our understanding of technology and use (T2.1, T2.3, T3.6). Geochemical approaches and studies of raw materials would help us better understand the movement of stone, in turn helping to answer questions of settlement and mobility (T2.2–T2.4, T2.8–T2.10, T3.9, T3.14).

Dating

S3.1: The desirability of AMS dates, and where possible the application of Bayesian modelling, should be emphasised. Where this is not possible (eg due to a lack of stratigraphy), direct dating of secure, short-lived materials, such as human or animal bone or hazelnuts, is essential in order to expand the database of Mesolithic dates and to provide a better chronological framework for the period.

S3.2: Dating linked to lithic assemblage types is essential to underpin the development of typochronologies that can then be applied to lithic assemblages where no directly datable material survives. This should be accompanied by precision in typological description and appropriate illustration to engender confidence in lithics assessments (see Saville 2009).

S3.3: Dates should be calibrated and expressed preferably in BC terms. Bayesian modelling depends on calibration, and use of cal BC for the entire Holocene will help overcome disjunctures across the Mesolithic–Neolithic transition.

S3.4: Other dating techniques, such as TL (Thermoluminescence) and OSL (Optically Stimulated Luminescence), should also be considered with appropriate specialist advice.

S3.5: Tephrochronology is relevant to some sites and can provide an important chronostratigraphic underpinning of environmental sequences. The recent recognition of cryptotephra deposits provides an expanded series of volcanic ash isochrons for potential synchronisation of environmental and archaeological records in the Lateglacial and Early Holocene.

S3.6: Dendrochronology is a technique becoming increasingly relevant to the Mesolithic and is particularly important when dating submerged forests (eg see Bell 2007).

S3.7: A national on-line database would be a desirable development which would include both archaeological sites and palaeoenvironmental data. It is important that dates are shared and communicated if patterns of change and continuity are to be discerned across the country.

Biomolecular techniques

S3.8: There is great potential for aDNA studies in order to understand population history and movement of people better. Major advances have recently been made and with a developing dataset it should be possible to carry out ground-breaking research, as in other parts of Europe. aDNA analysis on animal remains should also be extended in order to understand animal demography, arrivals and extinctions.

S3.9: A better understanding of human and animal mobility can also be achieved through strontium and oxygen isotope analysis, which has been used to great effect in later prehistory.

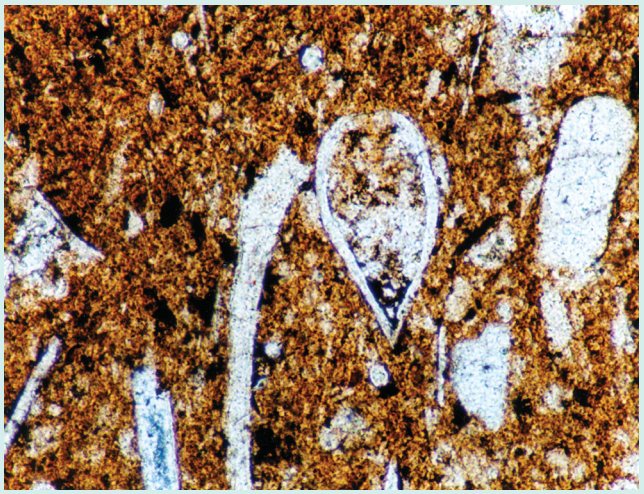
S3.10: Carbon and nitrogen stable isotope analysis has provided insights into human diet, including proportions of marine and terrestrial dietary components, and temporal and regional patterning. This should be continued as more human skeletal material is discovered.

S3.11: ZooMS (Zooarchaeology by Mass Spectrometry) is a technique which uses subtle differences in collagen sequences to identify tiny bone fragments to a high taxonomic resolution (genus or species level). This is being trialled for a number of Mesolithic sites.

S3.12: Forensic approaches to tool use, such as use-wear analysis and residue analysis, are being used more widely, particularly in other parts of Europe, to help discern the cultural biographies of stone and organic tools. Further applications in Britain are needed in order to understand how tools were used.

Stone raw materials

S3.13: The establishment of national/regional lithics raw material reference collections should be undertaken in collaboration with geologists, geomorphologists and Quaternary scientists. The comparison of archaeological material with geological examples, and access to the most recent geological research, would be of great benefit in facilitating progress in an area that has been persistently slow to develop. Typochronologies with supporting dates should also be analysed with a focus on raw material selection.



Chert was used as a raw material in the Mesolithic throughout Derbyshire and the southern Pennines. It occurs in tabular bands and nodules in the Carboniferous Limestone, some being distinctly fossiliferous. The core is from Blake Acre, Bradwell, Derbyshire, and the thin-section is of fossiliferous chert also from Bradwell (photographs of core and cliff face by Daryl Garton; thin-section image by Ian Brooks)

S3.14: Further investigation is needed into the potential of geochemical approaches to establish the location of lithic sources, and how trace element analysis can develop ideas of settlement and mobility.

Climate and environment

S3.15: Well-dated palaeoenvironmental studies should continue to be undertaken to develop understanding of the temporal and spatial scales of human interaction with the environment. These should include palaeoenvironmental dating work to synchronise our chronological, environmental and archaeological records – targeted high-resolution work at coincident palaeoenvironmental and archaeological sites is key.

S3.16: There is a need to refine understanding of the burning episodes which occur in the Mesolithic and are attributed to human agency, with the consequent need to understand patterns of wildfire occurrence and their relationship to climatic episodes favourable for burning.

S3.17: A better understanding of the exploitation and use of plant resources in the Mesolithic is required, the data for England being very limited. An extension to this is investigating whether evidence exists for the management of woodland (eg for coppicing or nut production).

S3.18: The archaeological and palaeoenvironmental potential of Lateglacial and Postglacial landscape features such as kettle-holes, palaeochannels and areas of waterlogged deposits should be recognised and targeted. Palaeochannels are highlighted here for their potential to bear archaeological evidence of fishing, such as fish-traps and dugout canoes, that can be dated to the Mesolithic with certainty. As such they should not be discounted in schemes of investigation.

Potential for palaeoenvironmental data

Martin Bell, University of Reading

Wetland-edge contexts offer particular opportunities for putting known Mesolithic flint scatters on dry land into a wider palaeoenvironmental and economic context. They can also provide more secure dating. The Kennet valley has several examples. Excavations by John Wymer at Thatcham, Berkshire, were mainly on a bluff at the floodplain edge with some evidence from adjoining peat. More recently, coring on the floodplain by Cathie Barnett (formerly Chisham) has shown that activity extends to the floodplain with a good pollen and palaeobotanical record and distinct episodes of burning within the first millennium (9000–7500 cal BC) of the Mesolithic (Barnett 2009). In parts of the Kennet valley the development of climax woodland seems to have been delayed and the question remains to what extent it was retarded by human agency and/or natural factors such as grazing pressure, or the activity of beavers. Another Kennet valley site is Ufton Bridge, where a restricted flint scatter on a gravel rise has been shown by coring to extend below surrounding Holocene wetland sediments. Both here and on a number of other Kennet valley sites, early Mesolithic activity is associated with a dark black palaeosol horizon overlain by peat, tufa and alluvium. Similar wetland-edge Mesolithic sites are currently (2013) under investigation in the Somerset Levels at Chedzoy, Greylake and Shapwick, where flint scatters on dry, sandy Burtle sediments immediately adjacent to wetlands have long been known.

Intertidal wetland edges offer comparable palaeoenvironmental potential and are often easily accessible because later Holocene sediments have been removed. Submerged forests have particular potential in this context both in terms of palaeoecology, advancing our understanding of the wildwood, and in terms of the chronological precision they can provide for associated sites and environmental sequences. For instance, a submerged forest at Stolford, Somerset, has been shown to span the Mesolithic–Neolithic transition, a period which more widely has evidence for complex environmental changes, the nature and chronology of which need clarification by investigation of sites of this type and date.

Submerged forest at Stolford, Somerset, which has been dendrochronologically dated to the Mesolithic–Neolithic transition (© Martin Bell)

Excavations at Westward Ho!, Devon (© N Balaam, English Heritage)

S3.19: Submerged forests are also important, as their archaeological potential extends from submarine, through intertidal and reclaimed wetland areas. Many of those in western Britain relate to the final millennia of the Mesolithic and represent tracts of Mesolithic landscape with known Mesolithic sites, eg Westward Ho!, Devon. Elsewhere in north-west and north-east England peats have recently been dated from the Windermere Interstadial through to the Late Mesolithic and these represent a very important and, as yet, barely tapped resource.

Strategy 4: Curation and conservation

There is a huge amount of data that has previously been obtained but which needs further collation, investigation, publication and archiving. This includes analysis of artefacts and ecofacts stored in museums (and sometimes private collections) and unpublished data and reports from research, commercial and amateur excavations. Through further examination of these data it may be possible to contribute answers to the questions posed for all three of the Research Themes. For instance, Rick Schulting has shown the potential for making new discoveries which can address questions around people and lifeways (T2.11–T2.15) through dating human bone material in museum collections, and there is often potential for lithics specialists to revisit collections, thus contributing to a better understanding of technology (T2.1–T2.3). Progress in these areas will be achieved through better communication across the sector.

Data

S4.1: A quality audit on radiocarbon dates from across the country encompassing the full temporal range from the Lateglacial to the last vestiges of the Mesolithic should be carried out, as has previously been undertaken in the South-West under the Ancient Human Occupation of Britain banner for the Lateglacial (see Jacobi and Higham 2009). As part of this programme, the identification of samples suitable for re-dating could be undertaken.

S4.2: Complementing the quality audit, identification of suitable samples for radiocarbon dating in museum collections which could either enhance the value of assemblages or provide temporal clarity on specific classes of evidence (eg worked faunal remains, human bone) would open up new opportunities to investigate and refine understanding of the Mesolithic. If successful, opportunities to perform further scientific testing may be identified.

S4.3: More widespread on-line information about museum and known private collections would facilitate access by researchers.

S4.4: Updating Wymer's gazetteer (1977) would reconnect Mesolithic research to museum collections and review the state and location of many key sites and assemblages. Substantial additions from rescue/developer-led and academic archaeology are anticipated.

S4.5: For the Mesolithic to be represented properly in national and local records, standardised quality audits and enhancements need to be undertaken, especially in Historic Environment Records (HERs). This would serve the purpose both of making the HERs a viable research tool and of enabling Mesolithic archaeology to be catered for adequately in the planning process. Standards could be agreed which embed refined dating assignations into these records and draw upon palaeoenvironmental and geomorphological evidence with which to inform schemes of fieldwork and resource management.

S4.6: Reassessment of known mixed Mesolithic–Neolithic assemblages may isolate temporal components allowing reinterpretation.

S4.7: Comprehensive surveys of the data available for all aspects of the environment and biotope through the Lateglacial and Early Holocene would clarify the state of knowledge and identify lacunae in the national dataset.

Analysis and publication

S4.8: Work on known collections held privately or by museums should be championed; many of these might form suitable projects for university students or 'indoor' components of community archaeological projects.

S4.9: An audit of the regional research frameworks is required to identify significant sites which require analysis and publication, including assemblages from old academic and rescue projects known or likely to include significant Mesolithic components. For example, excavations at Eskmeals, Cumbria, and the work of the Vale of Pickering Research Trust have produced important information and their publication should be a priority.

S4.10: Synthesis of unpublished material from various urban and rural investigations could be achieved without the necessity to publish individual collections or projects. This might elevate the perception of frequent 'residual' or 'background' Mesolithic archaeology, highlight the problems with site-based synthesis, and encourage the continued detailed recording of Mesolithic archaeology by demonstrating value through publication.

S4.11: Reports submitted to OASIS for inclusion in Historic Environment Records and the Archaeology Data Service should take care to include Mesolithic information even where its recovery was incidental to the original aims of the investigation.

S4.12: Guidelines for long-term storage and curation (and, on exceptional occasions, disposal) of lithic artefact collections would ensure their continued relevance and research value.

Communications

S4.13: The potential impact of changes in land-use and development on Mesolithic archaeology, as part of the planning process or otherwise, needs to be recognised at an early stage. There is a need to realise that Mesolithic deposits are important and are more prevalent than is sometimes imagined.

S4.14: Stronger connections between the university, museum and commercial sectors are necessary to promote sharing of both interpretative and methodological findings and developments. Further to this, effective cross-sector relationships may prove to be fruitful in establishing efficient schemes by which one party can fill the other's skills gap as necessary.

S4.15: Closer connections between Mesolithic specialists and local planning archaeologists are needed in order to strengthen the academic justification for undertaking research into the Mesolithic, and communicate this justification to developers.

S4.16: Opportunities potentially exist to engage with groups already researching or managing resources pertinent to Postglacial climate, palaeoenvironment and geomorphology. These may exist within agencies such as Natural England, charities like the RSPB or the private sector. The success of the North Sea Palaeolandscapes Project is testament to the benefits of engaging with Quaternary science and industry in gaining access to established datasets.

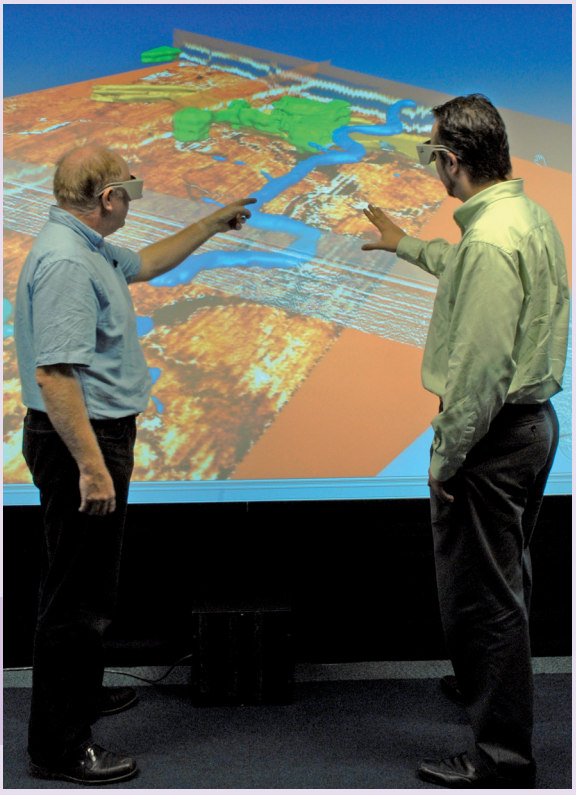
S4.17: There is great potential for further collaborations between academics in a range of University departments (including but not confined to geology, geography, ecology, biology and oceanography) to investigate changes in sea level, climate, vegetation and landforms during the Early Holocene/Mesolithic periods.

Mapping Doggerland

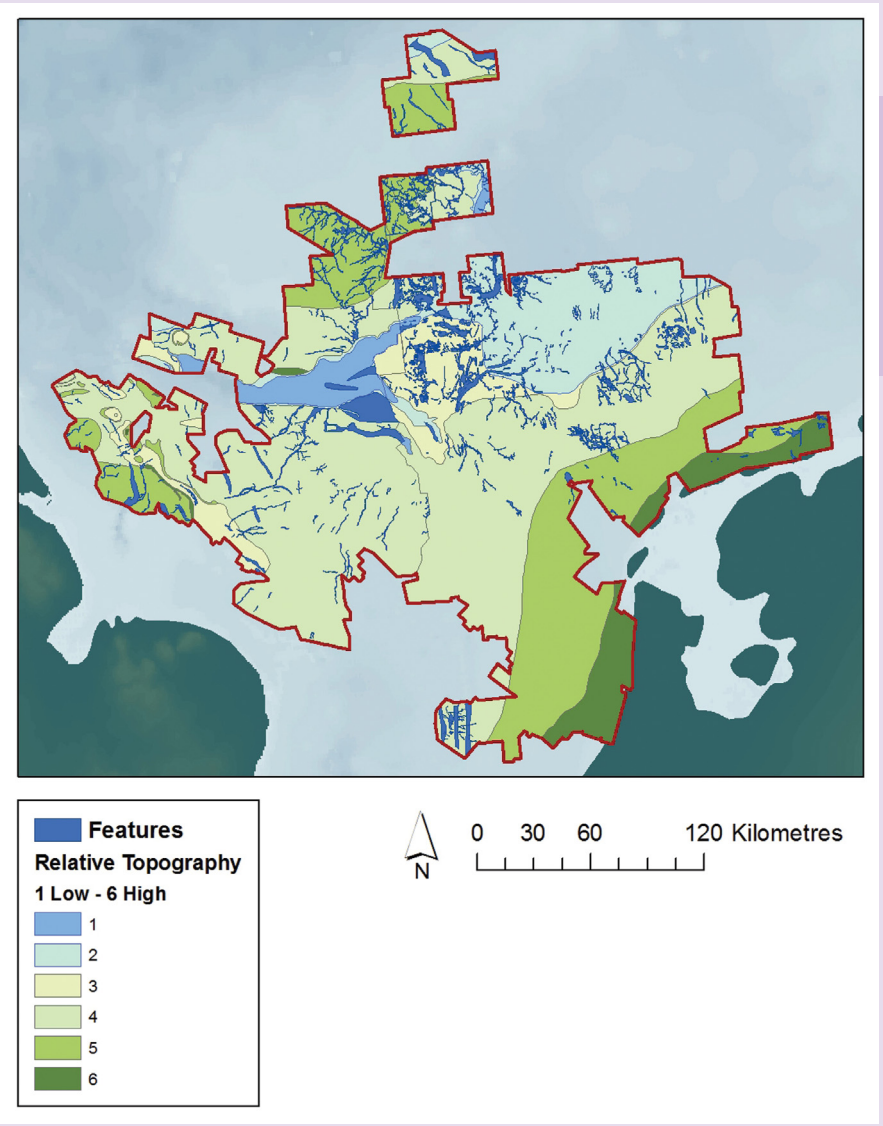
Vince Gaffney and Simon Fitch, University of Birmingham

Global warming at the end of the last Ice Age led to the inundation of vast landscapes that had once been home to thousands of people. Amongst the most significant of these is Doggerland, occupying much of the North Sea basin between continental Europe and Britain. At the opening of the Holocene, Doggerland was still a large 'country' of hills, plains and river valleys, with an extensive coastline. Over a period of more than 4000 years this landscape was progressively lost to rising sea levels, so that by around 5500 cal BC Britain had become an island and the geography of north-west Europe approximated its present configuration. It was perhaps not until the publication of Bryony Coles' *Doggerland: a Speculative Survey* in 1998 that the importance of this submerged landscape was brought home to the current generation of researchers; indeed it was Coles who gave Doggerland its name (after the well-known submarine banks). Before Coles' seminal paper, archaeologists had tended to envisage Doggerland simply as a land-bridge but Coles rightly asserted that the area should more correctly be seen as an inhabited landscape in its own right, and indeed one that is likely to have played a central role in the early prehistory of north-west Europe. Although it was recognised that these landscapes had the capacity to retain and preserve archaeological evidence that might be rare or absent within contemporary terrestrial contexts, the relevant deposits are often masked by tens of metres of water or sediment and they provide archaeologists and heritage managers with a unique set of technical and methodological challenges.

Over the last decade researchers at the University of Birmingham have pioneered the development of techniques which use seismic reflection data, gathered in particular for oil exploration at an overall cost of hundreds of millions of dollars, to map submerged Holocene (and Late Pleistocene) landscapes, with notable success (Gaffney *et al* 2007; 2009). The North Sea Palaeolandscapes Project (NSPP), funded through English Heritage, the Marine Aggregates Sustainability Fund and NOAA (National Geophysical Data Centre), achieved approximately 60% mapping coverage (c 45,000km^2) of the area likely to have formed the landmass of Early Holocene Doggerland in the southern North Sea, using data provided by PGS (Petroleum Geo-Services – http://www.pgs.com/) from their 'Southern North Sea Mega Merge', along with additional information provided through the Geological Survey of the Netherlands (http://www.en.geologicalsurvey.nl/). The Humber Regional Environmental Characterisation project



Group stereo viewing of seismic data at the VISTA laboratory (© NSPP)



Topographic map of Early Holocene Doggerland: about 60% of the area has been mapped to date (© Henry Buglass, VISTA University of Birmingham)

(Humber REC), a collaboration between the Birmingham team and the British Geological Survey (Tappin *et al* 2011), included 'ground truthing' of interpretations of the seismic datasets, through the targeted recovery and palaeoenvironmental analysis of sediment cores from features previously identified as palaeochannels (Gaffney *et al* 2007). Together these data provide our best guide to the outline of Mesolithic Doggerland and its environment and the same methodologies have been applied to other, similar areas around the British Isles. The results of this work are now being used as the basis for further palaeoenvironmental and behavioural modelling to guide future exploration of these enigmatic and globally important landscapes (Ch'ng and Gaffney forthcoming).

Conclusion

Mesolithic archaeology is an exciting area of study with the potential for many more important discoveries to be made in the future. The three themes of 'Living in a changing world', 'Mesolithic lifeways', and 'Investigating change and diversity' provide a range of questions which commercial archaeologists, academics, students, planners and the public can use to advance Mesolithic research. The ways in which we might do this are set out as strategies which are aimed at ensuring the conservation of the resource and providing wider access to the period.

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