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From findspot to site: a spatial examination of the Mesolithic resource in Surrey

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Surrey has a diverse range of Mesolithic occupation evidence, spanning the Early Mesolithic, Horsham period and the Later Mesolithic. This paper collates these data and then quantitatively analyses the relationships between the geographical distributions of Mesolithic material and a range of environmental characteristics. The distribution of material is also analysed using a GIS to understand where 'hotspots' (and 'coldspots') of activity may be located and takes into account variations in collecting activity and modern discovery opportunities. There is evidence that the environment may have been important in determining the spatial extent of Mesolithic hunter-gatherer behaviour, and this is assessed through comparison of the Mesolithic resource and a range of environmental variables. The record shows a prevalence of hunting-type assemblages in the south-west of the county, where the majority of microliths and points were identified, together with sites with evidence for occupation (often excavated as such, or with evidence for domestic activities such as burning). There was also evidence that records identified on higher elevations and steeper slopes appeared to represent items used, discarded or lost on hunting trips and potentially highlighted the importance of these regions as lookout or observation locations; however, there was a lack of occupation sites based near these optimal viewing locations. The majority of occupation sites were located across an east--west Greensand band and situated within 5km of the Clay-with-Flints outcrops. These were wet/dry marginal regions, probably conducive to settlement owing to the benefits these locations may have had for hunting and gathering. A lower density of records from north-west and south-east Surrey appear to indicate these areas were used primarily for the processing of material while people were moving across the landscape. The overall high proportion of findspots and scatters within the dataset may result from the nature of hunter-gatherer living, with high levels of mobility within the landscape alongside ephemeral occupation and activity sites.

Introduction

MESOLITHIC ACTIVITY IN THE SOUTH-EAST

The archaeological record in south-east England highlights a rich history of Mesolithic research, through the discovery of isolated findspots and large-scale sites. The Mesolithic (*c* 9500--4000 cal BC) (Barton 2009; Collard *et al* 2010; Woodbridge *et al* 2014) is identified by a distinct cultural change from the Upper Palaeolithic period (Barton & Roberts 2004; Woodbridge *et al* 2014). The Mesolithic is defined by hunter-gatherers using diagnostic stone tools including microliths, axes, scrapers, burins, awls and flint blades, and is thought to have been initiated by the sudden and intense climatic warming at the end of the last glaciation (Barton & Roberts 2004). This article aims to collate and examine the spatial range and scale of Surrey's Mesolithic archaeological resource. to begin to understand where hotspots of archaeological activity may be present. Archaeological data are available in numerous formats and collated across a wide range of sources, and it is important to standardise and catalogue these data correctly. Subsequent use of a geographical information system (GIS) and a range of environmental factors allows for the database of archaeological remains to be geographically analysed, providing information on the distribution of Mesolithic people in the landscape. Surrey provides evidence of occupation through the Early Mesolithic, Horsham period and to the end of the Later Mesolithic, and excellent summaries of archaeological work in the county have been published (Ellaby 1987; Cotton 2004). This work is designed to build on these and expand the information available on the location of these archaeological records and their relationship with environmental factors.

THE MESOLITHIC IN SURREY

Mesolithic activity in south-east England is much more prevalent than the Late Upper Palaeolithic, and a number of key records have been discovered (

Table 1 and fig 1). Within the modern administrative county of Surrey, Mesolithic activity is well documented, and it is thought sites may have been chosen for particular environmental or cultural reasons (Cotton 2004). Early Mesolithic sites *c* 9500--7650 cal BC (Reynier 1998; Barton & Roberts 2004; Tolan-Smith 2008) include Frensham Great Pond North (Rankine 1949a) and South (Rankine 1949b), where a number of obliquely-backed points were present, in addition to a Portland Chert blade, interpreted as evidence of a widespread exchange network. Obliquely-backed points and other period-diagnostic flints have also been discovered from Sandown Park in Esher (Burchell & Frere 1947), Buckland (Ellaby 1987) and Redhill (Evans 1861; Ellaby 1987). There are also a number of Early Mesolithic findspots (Wessex Archaeology & Jacobi 2014), possibly representing items lost during hunting forays or sites yet to be excavated. The assemblages suggest, in general, light spears and arrows were the primary hunting weapons within a *Pinus* and *Betula* woodland (Ellaby 1987).

Horsham period sites dating to *c* 8250--6890 cal BC (7000--6000 uncal BC) (Reynier 1998) are a regional variant of the Early Mesolithic, distinctive to Surrey, Sussex and other parts of the South-East, defined by the presence of class 10 microliths with distinctive basal retouching (Reynier 1998; Tolan-Smith 2008). Horsham-type evidence is observed at Kettlebury, the Lion's Mouth and Devil's Jumps Moor (Ellaby 1987). Kettlebury (Reynier 2002) has yielded one of the largest Horsham collections in the South-East and is likely to have been a retooling station (Reynier 2002) with activity radiocarbon dated to *c* 7500--6500 cal BC (Gillespie *et al* 1985; Reynier 1998). The presence of Horsham points and the decreasing size of microliths relative to the Early Mesolithic may imply a higher reliance on using bows for hunting, as the forest became denser with the expansion of *Quercus* and *Ulmus* (Ellaby 1987), possibly indicating that Mesolithic groups were not clearing areas of woodland but rather altering tool technology to overcome developments in the natural environment.

Later Mesolithic sites *c* 7650--4000 cal BC (Switsur & Jacobi 1979; Barton & Roberts 2004; Pettitt 2008; Tolan-Smith 2008; Collard *et al* 2010; Grant *et al* 2014; Woodbridge *et al* 2014) are identified through developments in microlith shapes, the loss of scrapers and saws, and sites found in or near pits (Cotton 2004), potentially the result of flint quarrying such as at Bourne Mill Spring, Farnham (Clark & Rankine 1939). Woodbridge Road, Guildford was Optically Stimulated Luminesence (OSL) dated to *c* 5750 cal BC, and indicates flintworking around a number of hearths, repeatedly visited by small groups engaging in specific tasks (Bishop 2008). Charlwood, Surrey (Ellaby 2004) is dated to *c* 4710--3900 cal BC with over 21,000 pieces of debitage and tools that were found in a pit enclosure setting. At both Charlwood and Woodbridge Road the pits appear to be contemporaneous with occupation, and were excavated around working and living areas (Bishop 2008). However, a pit at Abinger Common (Leakey 1951) may be Neolithic, with Mesolithic flints washed in when the pit was dug (Ellaby 1987).

[FIG 1]

In addition to these Early and Later Mesolithic sites, the notion of 'persistent places' (Jones 2013a) has been put forward for the North Park Farm site at Bletchingley, as evidence indicates repeated visits across the Early to Later Mesolithic. North Park Farm extends over more than 1ha, with twelve hearths, and possibly 1 million pieces of debitage and 17,000 microliths (Jones 2013a). Early Mesolithic activity was likely to be short term to replenish hunting toolkits, although some evidence exists for butchery and hide processing. The Later Mesolithic witnessed an intensification in usage, with evidence for microlith and adze production, maintenance and discard (*ibid*). Persistent places have also been observed at Sandy Meadow, Wotton (Winser 1987), Rookery Farm, Outwood (Hooper 1933), Orchard Hill, Carshalton (Ellaby 1987; Jones 2013a) and Bourne Mill stream, Farnham (Rankine 1936). The longer-term nature of occupation at these sites may also have led to greater interaction with the local environment.

[TABLE 1]

ENVIRONMENTAL CHARACTERISTICS OF SITE LOCATION

A number of environmental variables are thought to have been important in the decision-making process of Mesolithic groups (Kvamme & Jochim 1990). This highlights the need to analyse both archaeological distribution and environmental variables in unison (Warren & Asch 2000; Lock & Harris 2006). Key environmental variables include:

- Topography, in the form of elevation (Kvamme 1985; Kvamme & Jochim 1990; Brandt *et al* 1992; Kvamme 1992), has often been cited as a major determining factor in landscape positioning for hunter-gatherer groups. It governs viewpoints and access to local resources, with settlements often located on higher elevation ridge tops, rather than within valley bottoms (Kvamme & Jochim 1990), although this can be dependent on the nature and duration of the settlement.
- Hydrology is frequently identified as important in respect to the positioning of Mesolithic records (Kvamme & Jochim, 1990; Brandt *et al* 1992; Kvamme 1992) and it is understandable that Mesolithic communities would have wanted to be in close proximity to permanent or semi-permanent rivers, streams, lakes and springs. The general hydrological conditions, effectively the ability of any land parcel to collect and hold water, would also have been significant. The very wettest areas may be unsuitable for living, while wet/dry boundary zones may provide ideal conditions.
- Geology has often been used to form the basis of further maps, such as vegetation cover or varying landform proxies, frequently due to soil type being an overriding factor in site location (Farr 2008). However, within Surrey, it has been shown that the geology itself may be a major determinant of site location due to preferential conditions offered by particular geological substrates (Mellars & Reinhardt 1978). The extensive tracts of Greensand geological south-east England, including Surrey (Gallois 1965) is associated with some of the most substantial Mesolithic assemblages in the county (Rankine 1956).
- Distance to specific natural resources, such as the Clay-with-Flints and Greensand would have been important (Barton 2009). The North Downs have extensive Clay-with-Flints outcrops (Field 1998), with nodules of flint of various sizes and degrees of weathering available on the surface (Gallois 1965). Therefore, the time taken to travel to and from these natural resources may have been important in determining settlement location (Barton & Roberts 2004). Clasts of ferruginous sandstone can be found within Greensand, and these clasts were utilised as hearths within the Mesolithic period (Jones 2013a).

Surrey, in comparison with its surrounding counties, has a high density of Mesolithic archaeological records, in addition to a number of well-excavated Mesolithic sites dating across the period providing an excellent basis for further examination of the Mesolithic record. This paper is designed to examine the relationship between records of all sizes, from findspots to large persistent sites, and to understand the nature of Mesolithic occupation patterns, activity evidence and the hunter-gatherer lifestyle within the context of their environmental settings, while also understanding this distribution in relationship to the context of discovery opportunities, and representativeness of the Mesolithic record.

Methodology

DATASET COMPILATION

Complete catalogues of Mesolithic archaeology were not available from a single resource. A number of sources were consulted to create a database of Surrey Mesolithic records:

- Historic Environment Records (HERs)
- Gazetteer of Mesolithic sites in England and Wales with a gazetteer of Upper Palaeolithic sites in England and Wales (Wymer & Bonsall 1977)
- Grey literature
- Palaeolithic and Mesolithic Lithic Artefact (PaMELA) database (Wessex Archaeology & Jacobi 2014)

The HER included spatial information (OS grid reference) and non-spatial information (artefact types, age estimates and descriptions). The Gazetteer (Wymer & Bonsall 1977) was consulted as it represented an early countrywide HER, and any Gazetteer records that did not match existing HER records were tabulated as new records. Grey literature was also consulted and included in the database. The dataset compiled from the HER, grey literature and the Gazetteer (Appendix 1, see *Endnote*) contained a variety of categories that did not correlate. Data standardisation was employed to solve this issue, where data were assimilated, consulted and classified into standard dataset categories (Appendix 1, see *Endnote*). The data were complete and up to date as of April 2013.

Data from the PaMELA archive, an archive primarily derived from the observation of museum collections by Roger Jacobi (Wessex Archaeology & Jacobi 2014), had the primary function of identifying typologically dated artefacts (Appendix 2, see *Endnote*). This typological classification was subsequently placed into a Mesolithic temporal framework (Appendix 2). The PaMELA and HER databases were not combined due to a lack of correlation. Only 48 records correlated on a basis of their grid references and only a further 64 could be tentatively correlated based on their record details. This may have been caused by independent records in the two databases, different names or different grid references. However, the datasets were similar with band collection statistics yielding a correlation co-efficient of 0.78, a moderate/strong positive correlation. As records may be duplicated between datasets, the datasets were not combined with the HER database used for information on artefacts and record type/location, and the PaMELA dataset utilised for analysis of temporal data.

It is acknowledged that some of the dataset may now be out of date, owing to the non-upkeep of datasets (particularly the PaMELA and Wymer data), although these sources are used alongside the up-to-date (as of 2013) HER and grey literature records. It is also important to note that there are significant records held by private collectors, which are currently unpublished, leading to potential bias in the results. However, the spread of HER material across Surrey indicates good countywide coverage, suggesting collections held privately would not be of a scale that would dramatically alter the conclusions drawn from interrogation of this large Mesolithic dataset.

GIS AS A TOOL FOR SPATIAL ANALYSIS

The use of a GIS has been commonly used to be able to display and interrogate large archaeological datasets (Worboys & Duckham 2004) as it is difficult to thoroughly analyse datasets that have an intrinsically spatial component such as the HER and PaMELA datasets. Spatial positioning can be analysed quantitatively using kernel density plots to create 'hotspot maps'. Kernel density plots were used for analysing distributions of point events (Xie & Yan 2008) and were created by transforming the intensity of individual events (points) into an estimate of density as a continuous surface (Porta *et al* 2009). Density was estimated at a pre-set number of evenly spaced locations across the county (Xie & Yan 2008), resulting in a magnitude per unit area output where any location with nearby points was weighted higher than those with only distant points (Porta *et al* 2009).

A standard density plot examines spatial relationships between all the records in the database, but does not consider density of finds, which could range from individual flints to records with thousands of pieces. To examine whether this impacted the distribution, kernel density plots with a population weighting were utilised. The population weighting was based on incremental addition, whereby larger records were allocated a larger number. This was defined from the amount of material at each record and must be created carefully as large or small values can give unintuitive results. Therefore, a population density was derived (table 2) that allowed larger records to have greater importance, but with a mean around 1. Other weightings were trialled; however, with means much further from 1 they did not provide satisfactory results for examining the spread of activity, with weightings where the mean is significantly larger than 1 leading to numerous small hotspot regions and means lower than 1 resulting in a swathe of homogeneous density.
[TABLE 2]

CHI-SQUARED ANALYSIS

To understand whether a significant relationship existed between the Mesolithic record dataset and a range of environmental variables, the Chi-Squared (χ^2) goodness-of-fit test was used. Chi-Squared analysis is used to identify how likely it is that any observed distribution is due to chance. The null hypothesis for the Chi-Squared test states that the observed distribution is the same as the expected distribution for each variable.

Elevation
Topography was based on the Landform Profile Digital Terrain Model (DTM), a 10m set of gridded height values interpolated from Ordnance Survey contour data with an accuracy of ± 2.5m. The DTM was then categorised into height bands at 50m intervals.

Geology
British Geological Survey 1:50,000 superficial and bedrock geological maps were classified according to geological groups (

Fig 2). The exception was the Langley Silt Member, included within the London Clay based on consultation with previous county geological maps (Branch & Green 2004; Farr 2008).
[FIG 2]

Slope
Slope angles were derived from the DTM and identified the maximum change in elevation between a location and its surroundings leading to the steepest downhill descent for each cell.

Aspect
Aspect identified which compass direction each cell was facing, derived from the digital elevation raster and slope dataset. This was ordered into nine categories including the eight compass points and areas with no downslope direction (ie flat regions).

Total Wetness Index
The total wetness index (TWI) characterised the landscape in terms of cell-by-cell flow, and provided a scale from dry to wet, a scale based on the TOPMODEL system (Beven & Kirkby 1979). This method is calculated irrespective of local geological conditions, which must be taken into account during interpretation. TauDEM processing was chosen as it allowed for a D-infinity method as opposed to a standard 8-direction method (Tarboton 1997; 2004). Areas with a slope angle of 0 led to unclassified cells (no data) within the output. Flat areas would have a high likelihood of ponding water and were classified as having a very wet moisture index. Data aggregation (from 10 x 10m to 50 x 50m) allowed for general wetness trends to be observed. Aggregation is important as surface wetness is a highly continuous variable and sharp changes occur infrequently, therefore giving a more realistic scenario. The data were classified into 4 categories: dry, dry/wet, wet and very wet.

Distance to Strahler Order 3 and Greater Rivers
The stream network was derived from the DTM using the TauDEM package (Tarboton *et al* 1991; Tarboton 2004). Limitations of TauDEM mean both the start- and endpoints of streams may not be sourced correctly (Steinke *et al* 2013) so results were cross-compared to OS mapping, with errors or gaps corrected and any humanly-made watercourses deleted. During the Late Glacial and Mesolithic landscapes other channels and waterways would have existed, and modern rivers will have been altered by both natural and anthropogenic channelisation (Vanacker *et al* 2001). The stream network was reclassified to include only rivers with a Strahler order of 3 or greater -- a method frequently used in archaeological modelling as these streams may have offered a more permanent source of water over time (Kvamme & Jochim 1990; Warren & Asch 2000). This network was then classified into distance bands, allowing for limited lateral movement within river networks over time.

Distance to Lower and Upper Greensand and Clay-with-Flints
Distance to Clay-with-Flints and distance to Greensand variables were both calculated by extending the geological units to 50km outside the county border, to ensure correct data were gathered near the county border. The two units were selected using a Structured Query Language (SQL) expression to isolate them from the other eleven geological categories (Analysis Tools--Extract--Select). The shortest distance from the input geology to every pixel within the county was then calculated (Spatial Analyst--Distance--Euclidean Distance) and categorised into distance bands.

Land cover

Land cover type was derived from the Land Cover Map (LCM 2007), which designates a land cover type for the UK based on satellite imagery and digital mapping, with categories based on the broad habitats as defined in the UK Biodiversity Action Plan (Morton *et al* 2011). The initial Great Britain land cover map had twenty different classes, of which twelve were present within Surrey. Some classes have been amalgamated when categories were based on ecological factors unrelated to the identification of archaeological material. Examination of records in relation to land cover type assists with looking at potential bias in collection and fieldwork activity, as it allows for researchers to understand whether records are predominantly found on particular land cover types, or are evenly spread across the varying types, suggesting no bias in collection or visibility of records.

Results

THE HER DATASET

The Surrey HER provided 519 Mesolithic records and grey literature added another fourteen records to this total. Records were collated at Surrey County Council by the authors and the dataset was deemed complete as of April 2013. Records from the Gazetteer of Mesolithic sites in England and Wales (Wymer & Bonsall 1977) were amalgamated with the HER, based on names, locations and details with a strong correlation between the datasets. The Gazetteer, completed in 1977, contained 322 Surrey Mesolithic records, of which only 58 did not match between the Gazetteer and the HER database (*ibid*). These records, including the number of artefacts at each record, were plotted within a GIS to examine distribution across the county (fig 3). The spatial accuracy of the dataset, ranging from 1 to 1000m^2, was compatible with other large-scale archaeological datasets generated through a combination of professional and non-professional activity, including the Southern Rivers Palaeolithic Project (Wessex Archaeology 1993; 1994) and the Lower Palaeolithic Occupation of Britain Dataset (Wymer 1999).

Visual examination highlighted a broad east--west cluster, with some grouping of records towards the north. A standard and a weighted kernel density estimate quantitatively examined countywide patterning, creating ‘hotspot’ maps (Fig 4). Density results corroborated this east--west band of activity, with some outcrops to the north. There was no significant variance between the non-weighted model and weighted model, suggesting the distribution of single and unspecified records did not exert an over-influence on the dataset. A crosscheck with surrounding counties HER data (4079 total Mesolithic points) did not modify the dominant large west--east band of dense archaeology that continued into Hampshire and north-east into London, with the lower densities observed in the south-east of the county also present in the adjoining areas of Kent and West Sussex.

[FIG 3]

[FIG 4]

The examination of the record type (table 3) shows a high number of findspot and lithic scatter records. It is likely that Mesolithic people would have reused paths and routes through the landscape, dropping and leaving these records as they travel, although it is recognised that this palimpsest of activity does not necessarily create a cohesive network of routes and paths, which would need confirmation through the analysis of a much broader spatial region. It is also likely that people would have utilised multiple landscape mobility strategies, while the nature of hunter-gatherer archaeology (eg range of material culture, ephemeral nature of occupation sites) would also result in a findspot and lithic scatter focused record. The exact breakdown between findspots and lithic scatters is defined within the data, but discussed here as a group, as a breakdown into type may be inaccurate due to poor documentation, and a potential for larger scatters to be underrepresented as findspots.

[TABLE 3]

Density plots (

) of the different types of lithic material allowed for the characterisation of activity across the county and the examination of patterning between the different tool types (Table 4). The density plots did not differ significantly between the four different lithic categories. The main west--east band of material ran across all four categories, and this correlation (Table 5) indicated that the biggest difference was between the location of axes, maceheads, picks and sharpening flakes, and the other categories, suggesting the distribution of these tools may be different to the other three categories of material.

[TABLE 4]

[TABLE 5]

ENVIRONMENTAL VARIABLES AND THE ARCHAEOLOGICAL RECORD

Analysis of environmental variables against the Mesolithic records using the Chi-Squared test provided valuable information on where people may have been most active and some of the reasons why these areas may have been favoured. The test looks at the expected distribution of material based on the size of each category. If the observed distribution of archaeology is statistically different to the expected difference then these areas may have offered preferential living, hunting or travelling conditions for Mesolithic groups, or offer increased identification potential. The results summaries are presented here (Table 6) and full results can be found within Appendix 3 (see *Endnote*).

[TABLE 6]

Elevation: The distribution of Mesolithic records was not spread equally across the county in relation to their elevation. The majority of records (83%) were found below 150m, although there were fewer records than expected on lower topographies (0--100m) and more records than expected on many of the higher topographies (100--200m, 251--300m).

Geology: The Mesolithic records did not appear to be evenly distributed in relation to their geology, meaning that locations were potentially related to geological type (Mellars & Reinhardt 1978), which corroborated observations made from the distribution map. There appeared to be a concentration of records on and around the Lower Greensand, and this was confirmed to be a significant observation, with over 2.5 times more records on the Lower Greensand than expected if the distribution was random. Significant positive differences also occurred on the Thanet Sands, Lambeth Group and the Clay-with-Flints outcrops, with a lower than expected number of records across the alluvium and peat.

Aspect: The aspect of the records did not seem to be a dominant factor in determining Mesolithic locations in Surrey as there was no significant difference between expected and observed distributions. The south-east-, south- and south-west-facing slopes all had more records than expected; however, this was not statistically significant within the whole dataset.

Slope: A significant difference existed between expected and observed distribution of Mesolithic records compared to their slope angle. From the results of analysing the Surrey dataset, the majority of records (86%) were found where the slope angle was less than 6.7º. There were lower than expected numbers of records on the very low slopes (0--4.1º) and more records than expected on steeper ground (>*c* 24º).

Total Wetness Index: In Surrey, more records than expected were situated on the wet/dry regions (55%), and dry regions also had slightly more records than expected. Both the wet and very wet categories produced fewer records than were expected.

Distance to Strahler 3+ Rivers: The Chi-Squared test results showed that the relationship between Mesolithic records and the distance to major watercourses was not statistically significant for Surrey and there appeared to be no relationship between the two. However, the results do show that there are fewer records as the distance to the watercourses increases and emphasises that accessibility to water would have been important during the Mesolithic.

Distance to Greensand: The results showed that within Surrey, 62% of the Mesolithic records were found within 1000m of the Greensand. There were many more records on the Greensand than expected, which suggested a strong relationship between the Mesolithic records and the Greensand geologies. All distances over 1000m from the Greensand had fewer Mesolithic records than would be expected by chance.

Distance to Clay-with-Flints: The results of the Chi-Squared test showed that there were significantly more records than would be expected in locations up to 5000m from the Clay-with-Flints geology, which accounted for over half of the entire dataset. There were also a greater number of records within 1000m of the Clay-with-Flints than expected as well, suggesting that this was an important source of raw material. All distances further than 5000m from the Clay-with-Flints show fewer records than expected.

Land cover: Owing to the fragmented nature of land cover types in Surrey it was difficult to discern any pattern from the map of land cover type and therefore the Chi-Squared test is particularly useful. The results showed there were fewer records than expected on grasslands and freshwater with more records than expected across woodland, built-up areas, dwarf-shrub heath, inland rock, and arable and horticultural land. It is important to look at the land cover in relation to the 'hotspots' of activity, as well as across the variables that strongly associate with Mesolithic activity to understand whether the records in these regions are identified on particular land cover types. This relationship, along with the spatial distribution of records from other archaeological periods, are examined further in the discussion to scrutinise the issue of bias within the Mesolithic record.

THE PAMELA DATASET

The PaMELA database provided 408 unique Mesolithic records, and two records with both Late Upper Palaeolithic and Mesolithic archaeology. Another 111 records provided no location information. The archive showed that archaeological remains existed from the Early Mesolithic through the Horsham period to the Later Mesolithic (fig 6), with the Early Mesolithic having most records (

Table 7).
[TABLE 7]
[FIG 6]

The highest density of Mesolithic records was in the Early Mesolithic, where records were spread on a similar east--west patterning as observed in the HER data. The Horsham period had a majority of records confined to the south of the county, a pattern that continued into the Later Mesolithic, where only three records were identified in the north. These are patterns that were also previously observed (Ellaby 1987; Cotton 2004) and may be related to different activities undertaken in these regions during the different phases of the Mesolithic. It may also be a reflection of the types of diagnostic artefacts used to identify these different periods, especially if the actual range of artefacts used during the Horsham period and Later Mesolithic were not identified in the typological dating system. The HER records indicate a diverse range of tool types in the north of Surrey, although there is a lack of microliths, and these later periods are defined on their microlith assemblages. Therefore, this northern region may have been used during the later periods, but for activities other than those using microliths and therefore not identified in this typological classification. The undefined Mesolithic records (fig 6) were scattered broadly across the county and did not assist with furthering knowledge on the range and density of Mesolithic activity through time.

Discussion

Mesolithic material is distributed widely across Surrey, but in significantly varying quantities. In addition to domestic settlements and flint activity sites, there are a number of Mesolithic scatters and findspots, potentially representing items lost or discarded during hunting trips or at activity sites. It is possible that taphonomic processes may have affected the location of these findspots and scatters, although it is thought this is unlikely to be significant enough to cause major shifts within the record. Sites that only span one phase of the Mesolithic are relatively rare (Cotton 2004) and when sites are identified, the acidic nature of the soils often means that no bone or antler remains are preserved. Hotspot mapping from both datasets highlight a distinct difference in the distribution of archaeological material across the county. There is a clear distinction between a dense band of archaeology running across the county from the south-west to the east, compared with a very low density of archaeology present in both north-west and south-east Surrey. This does not appear to be a function of modern land cover, with these hotspots broadly encompassing all the land cover types equally, suggesting modern finds have been identified regardless of land cover types. However, dwarf-shrub heath is underrepresented at the lowest hotspot scale, while freshwater is underrepresented in the mid and high hotspot zones, potentially leading to under-representation in these two categories. This hotspot pattern is also identified from the PaMELA database where these same ‘hot’ and ‘cold’ spots of activity remain throughout the Early Mesolithic, the Horsham period and the Later Mesolithic. The environmental analysis results indicate that across Surrey, sites are broadly situated on freely-draining or fast-draining sands, gravels and slope ridges, often within a relatively close distance to a water source or other natural resource, corroborating the findings of past research (Ellaby 1987). Again, the statistics suggest that modern land cover is unlikely to significantly affect discovery opportunities based on these environmental characteristics, with relatively equal representation from the majority of land cover types. Caution is needed in regions that have high levels of dwarf-shrub heath or freshwater cover as finds may be underrepresented from these areas. However, as these regions total only 3.74% of total land cover in Surrey, this is not thought to affect the major trends seen within the dataset. The wide-ranging nature of activity across the county is not surprising, as research also highlights the evidence for long-distance movement of people and material exchange between groups, with the find of a Portland Chert blade in Farnham pit-dwellings, interpreted as evidence for a wide spatial exchange system (Rankine 1952).

DENSE HOTSPOTS OF ARCHAEOLOGY

The Lower Greensand running east--west across Surrey, and in particular the south-west corner of Surrey, is evidently an area of particularly dense Mesolithic activity and long known as the location of many major Early Mesolithic occupation sites (Rankine 1956). This was evidenced within Surrey with 62% of the dataset within 1000m of the Greensand. It is possible that the high density of records relates to a south-west Surrey collection or study bias, especially with the nature of the Greensand being exposed at the surface in many areas. It is also possible that regions of extensive head deposits and chalk outcrops, containing large amounts of unworked raw material, may be masking prehistoric lithic signatures. This may be true for chalk deposits, where there were fewer records found than were to be expected based on the Chi-Squared test results, suggesting possible bias in the record patterning. However, more records were found on head geologies than may be expected, therefore not appearing to bias finds in these regions. Collection bias due to geological type (both positive and negative) is not thought to fully account for the observed discrepancies. The south-west collection bias is not reflected in other time periods, where many other regions of Surrey, such as the south-east and north-west, have significant archaeological remains dating to other periods (fig 7). The Chalk outcrops also provide evidence for records dating to periods other than the Mesolithic, suggesting collection bias is not causing these anomalies, but the observed pattern is reflecting Mesolithic activity patterns.
[FIG 7]

The Greensand Mesolithic records include findspots, lithic scatters, lithic working sites and occupation sites and indicate a diverse assemblage, with microliths, tranchet axes, burins, flakes, blades, cores and debitage suggesting a sustained presence around these sites, possibly as settlements, tool and weapon production sites. Many of the Horsham period records are frequently small surface finds, representing stops to repair or enhance hunting kits (Harding 2000) and a remote hunting party may explain the single small Horsham assemblage in Surrey north of the Chalk escarpment, at Fox Hill. Later Mesolithic groups were clearly active in south and south-western Surrey, with 24 Later Mesolithic records found within 10km of the Thursley, Hankley and Frensham Commons Sites of Special Scientific Interest (SSSI) region, representing *c* 40% of Surrey’s identified Later Mesolithic record. During this time there appears to be a trend towards larger numbers of smaller records, often resulting in clustering of multiple records across relatively large areas, where they are often associated with hearths and pits (Gardiner 1988; Hey 2010). All these records include the presence of microliths, suggesting that hunting would have played an important role. There is also a strong likelihood that more permanent base camps would also have been present, based on records with axes, fabricators and picks within these assemblages (Butler 2005).

The environmental characteristics of the Greensand region would have provided a rich diversity of vegetation and habitats, leading to a broader range and diversity of animal species than was present in other areas having a lower diversity of vegetation (Ellaby, 1987). This would have meant the Greensand subsequently offered preferential living and hunting conditions (Rankine 1949b). The hydrological location of Mesolithic records has often been argued to be of high importance (Kvamme

& Jochim 1990; Brandt *et al* 1992; Kvamme 1992) due to the excellent opportunities for hunting and gathering of foodstuffs, and fuel acquisition. The Greensand region also has a number of lakes and wetlands (Carpenter & Woodcock 1981; Farr 2008; Simmonds 2016), and is dominated by ground that is on a wet/dry interface. There was, however, no significant link between the location of major rivers and archaeological records. It may also be that some of the streams or rivers have changed course or dried up and have been infilled, skewing the present picture, although the bands used are thought to have covered the potential for channel shifting. Unfortunately, the (relatively) low number of sites within Surrey does not allow for a statistical comparison between occupation sites and watercourse distance, where a stronger trend may have been expected. However, a relationship did exist with the total wetness index. Locations on and across the wet/dry boundary may have provided ideal conditions for Mesolithic activities, as the wettest areas may have been highly unsuitable due to either continual waterlogging or a sustained high risk of flooding (Farr 2008). That 55% of records were situated on these wet/dry boundary regions is a significant finding as it highlights the prominence of these areas within the Mesolithic landscape. The wet and very wet regions are likely to have been visited on fewer occasions or for shorter periods owing to the difficulties of traversing and hunting in this environment. It may also be that these areas were less appealing to modern archaeological investigations. During the Early Mesolithic, small lakes within the wet/dry interface, such as Elstead Bog (Farr 2008) and Elstead Bog B (Simmonds 2016), may have been highly advantageous to hunting and settlement. Animals may have used these lakes as a water source, and the nature of the vegetation cover, thought to be open woodland, or a woodland matrix with clearings, would have allowed for hunting with points used for spears and arrows (Ellaby 1987), explaining the density of microliths in these records. The location of archaeological records near to wetland/dryland interface zones has also been identified elsewhere, such as around the Early Mesolithic site of Oakhanger in Hampshire (Rankine *et al* 1960) and at Star Carr (Mellars & Dark 1998). During the Horsham period, the palaeoenvironmental records suggest thermophilous woodland expansion with a dense understorey that may have led to difficulties chasing and hunting animals with spears (Fig 8). The density of Horsham points and smaller microliths may indicate that the bow and arrow would provide greater accuracy within these difficult to traverse environments (Churchill 1993), although at greater distances visibility through this woodland may still have posed difficulties. Mixed woodland, comprising both open and closed woodland, would have allowed for Later Mesolithic groups to exploit both closed shelter habitats, ideal for permanent base camps, and more open habitats for hunting.

In addition to a range of lakes and vegetation types, large sand dunes within the Greensand, such as those present across Frensham, Hankley, Thursley and Ockley bogs, may have provided excellent viewpoints, and may have been ideal areas for Mesolithic people to use as a lookout. This may have attracted people for short, temporary visits during the Horsham period, as records larger than small flint scatters are rare (Harding 2000). However, the Thursley, Hankley & Frensham Commons SSSI region has a particularly dense concentration of Horsham tool types, with ten records occurring in and around this area, potentially related to the large sand dunes utilised to view the landscape. Kettlebury, dated to *c* 7550--6550 cal BC, is one of the largest Horsham collections in the South-East (Gillespie *et al* 1985; Reynier 1998; 2002) and is thought to be a retooling station because of two distinct flint knapping clusters and a waste dump area (Barton 1992). A greater array of flint tools at the Horsham occupation site at Rock Common in West Sussex reinforces this retooling view (Harding 2000). The identification of eight Horsham points at Saltwood Tunnel in Kent, situated in an area overlooking potential animal paths (Garwood 2011), also shows the significance of viewpoints to groups during this period. The data from Surrey did not, however, corroborate the hypothesis that Mesolithic records are commonly situated on ridge tops (Kvamme & Jochim 1990) as the majority of records were found on low-lying ground or the lower slopes where mobility would not have been significantly impeded (*ibid*; Kvamme, 1992). There was some evidence to support the hypothesis that Mesolithic records were found on south-facing slopes, owing to their higher solar insolation. These southern aspects did have more records than might have been expected; however, only six out of the sixteen Mesolithic sites can be found across the three south-facing aspects. This number would be expected to be higher if people were actively choosing these south-facing slopes. The broad range of aspects where records were found may not be surprising if they reflect casual losses during short-term activities. Records identified at higher elevations comprise primarily lithic scatters and findspots, with a dominance of axes, microliths and associated debris. This may indicate that higher regions were used for shorter periods of time as lookout or observation points while hunting or, in the case of the higher land around the Clay-with-Flints, as part of raw material acquisition trips. Additionally, the strong positive relationship between Mesolithic records and the Greensand geology may have been related to the ferruginous sandstone clasts present within the Greensand that could have been used for hearth construction (Jones 2013a).

There is also a wide array of activity in north-eastern Surrey, with activity spanning the entire Mesolithic, albeit with a specific focus during the Early Mesolithic. This is likely to be due to the presence of the Clay-with-Flints on the North Downs (Field 1998), which would have been an important natural source of material in this region owing to the abundance of flint (Barton & Roberts 2004; Barton 2009). Flint would have been available at other locations in Surrey (Gallois 1965); however, the flint density across the North Downs would have made this a particularly important source as indicated by the strong relationship between the distance to the Clay-with-Flints and the Mesolithic records. There is the possibility that this relationship could be explained by the locality of the Greensand, with these records actually being related to the distance to the Greensand, although the high number of records found on and within 1000m of the Clay-with-Flints suggests this is not the case. Unlike the Greensand to the south and west, the record types here are more constrained, with the region dominated by lithic scatters and findspots, with occupation sites situated to the south on the Greensand. This may suggest the Clay-with-Flints functioned as an area for hunting and raw material gathering. The high number of finds on the Thanet Sands and the Lambeth Group may also indicate that these were locations for significant raw material acquisition.

Within the regions having a high density of Mesolithic records, there is evidence for sites that show the repeated use of a single place across the entire Mesolithic, termed 'persistent places', often with an intensity of activity during the Later Mesolithic (Jones 2013a). At North Park Farm, Early Mesolithic activity was represented by short-term visits replenishing hunting toolkits, with some small-scale butchery and hide processing. The production, maintenance and discard of microliths indicate a greater use of the site during the Later Mesolithic. The reason behind this later intensity of use is not clear, but it is a pattern that broadly runs counter to the rest of Surrey, and may be due to the location of the site -- between the headwater regions of two river systems -- acting as an excellent area in which to focus and expand activities. Other persistent places include Sandy Meadow (Winser 1987), Rookery Farm (Hooper, 1933), Bourne Mill stream (Rankine 1936) and Orchard Hill (Ellaby 1987; Jones 2013a). These persistent places appear to be situated near to (or on) Clay-with-Flints or Lower Greensand geologies, low slope angles (<10%) and dry/wet or wet ground. These patterns are not dissimilar to the broader Mesolithic dataset, and emphasise that the distance to local resources and the potential for hunting and gathering in the vicinity of the settlement appear to be very important choices when determining settlement location. These sites may be representative of a mobile settlement pattern, perhaps focused on family units, rather than individual male or female task groups. This would allow the entire family to live within and exploit the local environment in a similar manner as that suggested for the sites at the Beam Washlands in Essex (Champness *et al* 2015).
[FIG 8a and b]

AREAS WITH LOWER LEVELS OF MESOLITHIC ARCHAEOLOGY

Within the north-west and south-east regions, there are significantly fewer records than both the south-west and central band, and the north-eastern regions. In the north-west and south-east, a distinct lack of microliths and points may indicate that these lithics and associated tools may have been made elsewhere and transported between these zones. There may also have been a lower level of activity in this region, possibly representative of a passing through signature (fig 8). This suggested lack of both hunting and settlement may be related to the local vegetation cover, as in the north-west of the county, the record from Langshot Bog indicates a period of woodland expansion during the Early Mesolithic (Simmonds 2016). A lack of herbaceous taxa indicates that this woodland was dense and there is no evidence for local fires, perhaps leading to less frequent visits as the vegetation made it harder to traverse or hunt in the landscape. This low level of activity continues throughout the Later Mesolithic, even once the environment had changed from a dense *Pinus* and *Betula* woodland to more open and predominantly deciduous woodland. The lack of archaeological evidence may also be attributable to poor discovery opportunities, especially on the expanses of alluvium and peat in this region as these are areas that Mesolithic people may have been expected to visit because of their potential hunting and gathering opportunities. This lack of records on these substrates may be due to the deposition of some of these deposits later in the Holocene deeply burying the Mesolithic material. However, this is not thought to have led to much under-representation, as not only do these regions cover a relatively small area, but some evidence for Mesolithic activity has been uncovered there, in addition to pre-Mesolithic activity, including at Church Lammas (Jones 2013b) and Wey Manor Farm, Addlestone (Jones & Cooper 2013), and immediately post-Mesolithic such as the Neolithic burials at Staines Road Farm in Shepperton (Mays & Steele 1989).

It is likely that across north-west and south-east Surrey there was a small Early Mesolithic presence, related to visits where people were moving across the landscape on hunting trips or resource gathering, as indicated by small discard type finds. The landscape may not have been used as suitable for settlement owing to a lower density of raw material availability than elsewhere in the county and the presence of a denser and harder to traverse woodland and vast regions of very wet conditions. All these factors may have made the area less conducive to settlement and therefore these regions would have been a less attractive part of the landscape than south-west and north-east Surrey.

Conclusions

The results of the data collation exercise, the spatial mapping and the predictive modelling demonstrated the diversity, range and scale of Mesolithic archaeology across Surrey. The HER provided a large corpus of Mesolithic records, and the PaMELA database provided a secondary database to the HER, with a time-scale element based on the identification of typological lithic artefacts, showing that records covered the Early, Horsham and Later Mesolithic periods. This highlighted a large expansion of records in the Early Mesolithic, with a decline in both the number and extent of records in the Horsham and Later Mesolithic periods, where the records are restricted primarily to locations south of the North Downs, although this may be an artefact of the typological classification. The HER records were clustered in the landscape, particularly across the south along an east--west Greensand band, and in the north-east, particularly around the Clay-with-Flints. There appeared to be a prevalence of hunting-type assemblages in the south-west of the county, where the majority of microliths and points were identified. The majority of occupation sites (sites excavated as such or with evidence for domestic activities, eg burning) were located in the south-west, and across the east--west Greensand band. A lack of patterning in records observed across the north-west and south-east would suggest a broad range of activities undertaken while people were moving across the landscape. This may suggest the use of pathways through the landscape and the nature of movement, where dominant movement may be concentrated around regularly used routes of both animals and humans. The high proportion of findspots and scatters is likely to be due to the nature of the hunter-gatherer lifestyle, with high levels of landscape mobility alongside ephemeral occupation and activity sites.

The Chi-Squared test allowed for an examination of the distribution of HER records and environmental variables. These tests emphasised significant differences between expected and observed distributions of records for a number of variables, strongly suggesting that the environment may have been important in determining the spatial nature of Mesolithic hunter-gatherer behaviour. These relationships indicated that records identified on higher elevation and steeper slopes appeared to represent items used, discarded or lost on hunting trips and possibly indicating their importance as lookout or observation locations. However, the data did not corroborate the hypothesis that Mesolithic sites were common on ridge tops (Kvamme & Jochim 1990). Geology was a key significant variable, with records identified more frequently than expected across the Greensand and Clay-with-Flints. This is thought to relate to the use of these areas as significant raw material acquisition and settlement locations. Interestingly, there appeared to be no strong relationship between south-facing slopes and Mesolithic sites, contrary to published opinion (*ibid*; Brandt *et al* 1992). An important relationship between archaeological records and wet/dry regions was identified, suggesting these were highly active zones during the Mesolithic period and indicating the potential importance of these wet/dry locations for hunting, gathering and settlement. Importantly, the correlations between the records found, modern land cover variability and other variables did not indicate any significant bias in record collection, suggesting the results observed are real Mesolithic choices, rather than a reflection of collection activity. This work has shown the importance of considering archaeological record distribution in conjunction with environmental record characteristics, as a landscape-scale look at this data highlights trends and patterns indicating places where people may have been more or less active across Surrey during the Mesolithic period.

Endnote

The appendices listed below are available on the Archaeology Data Service website: https://doi.org/10.5284/1000221

Select *Surrey Archaeological Collections* volume 102 and the files are listed as supplementary material under the title of the article.

Appendix 1 Dataset compiled from the Surrey HER, grey literature and the Gazetteer
Appendix 2 Data from the PaMELA archive
Appendix 3 Chi-Squared results

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Figure captions

Fig 1 Selected Mesolithic sites within modern Surrey and the South-East.

Fig 2 The geology of Surrey. Geological Map Data (© Crown copyright 2019. OS 100014198)

Fig 3 Quantity and distribution of Mesolithic records in the database.

Fig 4 Basic and population weighted kernel density estimates for Mesolithic records.

Fig 5 Density and distributions of the four different Mesolithic lithic categories.

Fig 6 Distribution of records (PaMELA archive) through the Mesolithic time periods. © Crown Copyright and Database Right 2018. Ordnance Survey (Digimap Licence).

Fig 7 All Mesolithic *vs* Neolithic to pre-Industrial Revolution monuments and findspots. Courtesy of Robert Briggs, Surrey Historic Environment Record, Surrey County Council.

Fig 8 Mesolithic archaeological synthesis beside climatic and vegetation history. OB -- Ockley Bog; TB -- Thursley Bog; LB -- Langshot Bog; EBA -- Elstead Bog (Farr 2008); 1 -- Bagshot (Groves 2008); 2 -- Moor Farm (Keith-Lucas 2000); 3 -- Nutfield Marsh (Farr 2008); 4 -- Runnymede Bridge (Scaife 2000); 5 -- Bramcote Green (Branch & Lowe 1994); 6 -- Farm Bog (Jennings & Smythe 2000).

Table 1 Selected key sites dating to the Mesolithic in south-east England

Period	Site(s) and references	Typical finds
Early Mesolithic	Buckland (Ellaby 1987) Ditton (Champion 2007) Frensham Great Pond North (Rankine 1949a) and South (Rankine 1949b) Iping Common Sussex (Keef *et al* 1965) Moor Farm, Bray (Ames 1991--93) Oakhanger Site V & VII (Rankine 1953; Rankine *et al* 1960) Redhill (Evans 1861; Ellaby 1987) Sandown Park, Esher (Burchell & Frere 1947) Scatter C West, Three Ways Wharf (Lewis & Rackham 2011) Thatcham Reedbeds, Berkshire (Churchill 1962; Wymer 1962; Healy *et al* 1992; Carter, 2001; Barton & Roberts 2004) Vauxhall (Symonds 2014) West Heath, Hampstead (Girling & Greig 1977)	Microliths (obliquely blunted), scrapers, saws, adzes and awls
Horsham period	Fairbourne Court, Harrietsham (Jacobi 1982) Kettlebury sites and the Lion's Mouth (Ellaby 1987; Reynier 2002) Longmoor Enclosure I, Hampshire (Huxtable & Jacobi 1982) Oakhanger Site V & VII (Rankine 1953; Rankine *et al* 1960) Rock Common, West Sussex (Harding 2000) Saltwood Tunnel, Kent (Garwood 2011)	Horsham points (other flintwork similar to Early Mesolithic)
Later Mesolithic	Abinger Common (Leakey 1951) Addington (Dimbleby 1963) Beechbrook Wood (Cramp 2006; Garwood 2011) Blick Mead (Jacques & Phillips 2014) Bourne Spring (Clark & Rankine 1939) Broom Hill, Lower Test Valley & Eton, Windsor (Hey 2010) Confluence of Thames & Effra in Vauxhall (Cohen 2011) Farlington Marshes, Langstone (Allen and Gardiner 2000) Gravelly Guy, North Stoke & Goring (Hey 2010) Hunt's House, Guys Hospital (Taylor-Wilson 2002) Hermitage Rocks, High Hurstwood (Jacobi & Tebbutt 1981) High Rocks (Money 1960) Jennings Yard site in Windsor (Roberts 1993) Lock Crescent, Kidlington (Booth 1997) Low Farm, Fulmer (Farley 1978) Lower Halstow and Perry Wood (Jacobi 1982) Oakhanger III, VIII & XX (Milner & Mithen 2009) Park Farm, Binfield (Roberts 1993) Rainbow Bar (Sommerville & Tetlow 2011) Sandway Road (Harding 2006; Garwood 2011) Stonewall and Swanscombe (Jacobi 1982) Streat Lane, Sussex (Butler 2007) Tilgate Wood (Clark 1934; Rankine 1960)	Scalene triangles, microburins, burins, gravers, awls, rods, adzes

	Wawcott III & Wawcott XXIII (Froom 1976) Woodbridge Road, Guildford and Charlwood (Bishop 2008)	
‘Persistent Places’	North Park Farm (Jones 2013a) Orchard Hill (Ellaby 1987; Jones 2013a) Rookery Farm (Hooper 1933) Sandy Meadow (Winser 1987)	Repeated visits -- variety of tools

Table 2 The population weighting classification used in this study

Amount of material	Population weighting	Amount of material	Population weighting
One piece	1	Hundreds	4
Single figure	2	Thousands	5
Tens	3	Unspecified	1
Mean	*1.69*		

Table 3 Breakdown of HER record type. (Findspots = single artefacts, small lithic scatters <20 lithics, large lithic scatters >20 lithics. Undefined scatters = no information. Lithic working sites = debitage and stratified remains, eg chipping floors. Occupation sites = excavated and identified as such, or offer evidence for domestic activities. Unspecified records = no information)

Record type	No of records
Findspot	143
Small lithic scatter	93
Large lithic scatter	53
Undefined lithic scatter	202
Lithic working site	22
Occupation site	16
Unspecified	4
Total	533

Table 4 Breakdown of record-specific details. Some Mesolithic records have material in more than one category and therefore the column total exceeds the total number of records.

Record specific details	No of records
Evidence for burning (Burn)	15
Axes, maceheads and sharpening flakes (A, M+SF)	184
Scrapers, gravers and other pieces (S, G+OP)	124
Cores and manufacturing debris (C+MD)	263
Microliths and points (M+P)	144

Table 5 Band correlation statistics for the four lithic groups.

Material	*A, M+SF*	*S, G+OP*	*C+MD*	*M+P*
A, M+SF	1	0.75	0.81	0.77
S, G+OP	0.75	1	0.91	0.92
C+MD	0.81	0.91	1	0.94
M+P	0.77	0.92	0.94	1

Table 6 Results of the Chi-Squared test on the range of environmental variables.

Environmental variable	Critical value of Chi-Squared	Degrees of freedom	Chi-Squared Statistic	α	Significant difference between expected and observed distribution? (Statistic > Critical value)
Elevation	12.59	5	73.742	0.05	Yes
Geology	19.68	11	495.964	0.05	Yes
Aspect	15.51	8	10.064	0.05	No
Slope	14.07	7	24.739	0.05	Yes
Total Wetness Index	7.81	3	13.792	0.05	Yes
Strahler Order 3 Rivers	19.68	11	9.686	0.05	No
Greensand	11.07	3	216.447	0.05	Yes
Clay-with-Flints	11.07	3	78.712	0.05	Yes
Land Cover	12.59	11	27.013	0.05	Yes

Table 7 PaMELA breakdown of archaeological records in Surrey. Multi-period records are represented multiple times and therefore the total records are greater than in the PaMELA database.

Period	Age range (cal BC)	No of records
Early Mesolithic	*c* 9500--7650	346
Horsham Period (or Early Mesolithic Stage 3)	*c* 8250--6890	44
Later Mesolithic	*c* 7650--4000	66
Mesolithic (no defined period)	*c* 9500--4000	103