Antlerworking practices in Mesolithic Britain

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Abstract

B.J.E. "Antlerworking Practices in Mesolithic Britain" – PhD thesis

This thesis aims to characterise the use of antler in the British Mesolithic, and to place this within the broader context of human and deer relations during the period. It uses traceological analysis to study worked antler from Mesolithic Britain, building up a picture of the ways in which the *chaîne opératoire* for the treatment of antler artefacts varied across time and space during the period. This marks the first large-scale application of this method to material from the British archaeological record, resulting in the analysis of 516 pieces of worked antler. In doing so, it extends the current understanding of technological variation within the British Mesolithic further than the previous comparisons between Early Mesolithic sites in North Yorkshire and Final Mesolithic sites in Western Scotland, by including material from 39 sites across England, Scotland and Wales. New artefact types are defined and previously undocumented patterns of re-use and repair of antler materials are identified within specific archaeological contexts.

Additionally, this thesis considers variations and consistencies within the treatment of antler as a material, in relation to the dynamic and changing relationship between people and deer during the period. This relationship has become the focus of academic discussion in recent years, following shifts in theoretical thinking within Mesolithic Studies. Several authors have used the treatment of deer remains to argue for variations in the perception of animals within the British Mesolithic, although these have been restricted to a limited number of archaeological sites. This thesis considers the analysis of antler technology within the context of a wider pattern of human/deer encounters and interactions, and draws out subtle differences in the relationships between people, red deer, roe deer and elk during the period.

Pages: 423 (xxiii preliminary + 398), Figures: 236, Tables: 163, Appendices: 5 (4 printed + 1 digital USB hard drive) and a bibliography.

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List of Accompanying Material

This thesis is accompanied by a USB flash drive which contains Appendix 5: Digital photographic archive of British Mesolithic antlerworking.

Acknowledgements

This thesis would not have been possible without the support and guidance of a number of people. My supervisor Nicky Milner has been a fantastic source of advice and support during the course of this research project, as she has been throughout my entire time in York. I would also like to thank the other members of my Thesis Advisory Panel - Geoff Bailey and Steve Ashby – for their enthusiasm and knowledgeable insights, and for creating a positive and supportive atmosphere within the TAP meetings themselves.

The analysis undertaken as part of this thesis is indebted to the generosity and enthusiasm of Éva David. I was incredibly privileged to spend two weeks with Éva at CNRS Nanterre, Paris in October 2010, when she took time out from her research and teaching to train me in the analytical techniques of traceology and educate me on the history of osseous technology research in France. The travel expenses for these two weeks were covered by the Prehistoric Societies' John and Bryony Coles Award, to whom I also owe gratitude.

This project has dealt with artefacts held in museums from across England, Scotland and Wales, and so has been reliant on the help of a host of museum curators and administrative staff who have facilitated access to this material. At the Glasgow Museums Resource Centre and Kelvingrove Museum, Jane Flint kindly helped me to access Mesolithic antler material. Andrew Parkin took the time to help me work with the material at the Great North Museum, whilst Sally-Ann Coupar enabled me to study the finds held within the collections of the Hunterian Museum, Glasgow. At the Kingston upon Hull Museum, Paula Gentil went out of her way to help me access the antler artefacts held within their collections. Jon Cotton at the Museum of London not only granted me to access their material, but also provided many insightful and stimulating discussions, based on his thirty years experience of working with the collections. Similarly, Alan Saville at the National Museum of Scotland not only helped with access, but also proved to be a wealth of information regarding the context in which these materials had been recovered. Richard Sabin at the Natural History Museum proved very helpful in my study of the material held within their sizable collections. Jillian Greenaway of the Reading Museum was very accommodating in allowing me to analyse their Mesolithic antler, as was David Devreux of the Stewartry Museum. Finally, Thomas Cadbury of the Royal Albert Memorial Museum was extremely helpful not only in assisting me in accessing their collections, but also in providing extensive archival information on the history of research at the sites from which their material originated from. Given the current economic climate and the challenging conditions faced by all of those working in the museums sector today, the levels to which these curators were able to assist and co-operate with my requests was genuinely overwhelming and very much appreciated. The Departmental Research Fund awarded me the money to facilitate this research, and so to them I also owe thanks. Pat Hadley also needs special thanks for the loan of a digital camera during the period of data collection.

Another group of people to whom thanks are due are the friends and colleagues who have provided stimulating and inspiring discussions of many of the themes within this thesis. These conversations have largely occurred over food and drink during long evenings in the pub, and have been combined with many of the kind words of encouragement that are needed to pull together a project of this scope. Mark Edmonds, Barry Taylor, Amy Gray-Jones, Rose Ferraby, Chantal Conneller, Nick Overton, Harry Robson, Emily Hellewell, and Andy Needham have all helped in this respect. Special thanks are due to Ed Blinkhorn, the value of whose good company and critical insights over the past three years have only been matched by the inspirational nature of his own research.

Finally, my family, friends and loved ones have been a constant source of emotional support during my PhD, and are due huge debt of thanks. In particular, Pete and Jo Elliott, Lewis Pollock, Chris Maclay, Katie Bishop, Triona Fitton and Holly Clarkson have all provided wise and guiding words in times of crisis over the past three years. Holly in particular. She's the best.

Author's Declaration

None of the research presented in this thesis has been published previously, by this author or any other. This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration. The bibliography was constructed using Zotero 3.0.8 bibliographic software, using the "Journal of the Royal Anthropological Institute" style for in-text citations and bibliographic formatting.

Chapter 1: Introduction

1.1 Aim

The recovery of Mesolithic objects made from deer antler has been documented within Britain for over 130 years (Turner 1889). To date, these artefacts have been recognised from findspots across England, Scotland and Wales and whilst this body of material has attracted academic attention and discussion at various points since its initial discovery, a comprehensive review of antlerworking practices within Britain has never been undertaken. In more recent years, the study of objects manufactured from antler has been intensified through an increased interest in the broader relationship between people and deer in the Mesolithic – with the use of antler being recognised as an active element in the formation and negotiation of this relationship (Bevan 2003; Chatterton 2003; Conneller 2003, 2004, 2011; Schadla-Hall & Conneller 2003; Warren 2006). This renewed focus on the use of antler further increases the need for national-scale research into antler technology within the British Mesolithic.

It is in recognition of this gap in our understanding of British antlerworking on a national scale, and in appreciation of the wider significance of antlerworking practices within the human/deer relations that this thesis has come about. The aim of this thesis is therefore:

To characterise the use of antler in the British Mesolithic, and to place this within the broader context of human and deer relations during the period.

1.2 Objectives and methods

In order to achieve the aims outlined above, six key objectives need to be met:

1. **Assess the current state of knowledge regarding the use of antler in the British Mesolithic.** This will be achieved through a detailed and critical review of the published literature on this topic which will seek to identify the persistent and pertinent questions within the history of research into Mesolithic antlerworking, as well as the issues which more recent shifts in theoretical thinking have raised for the study of antler materials.
2. **Outline a methodology for the recording and analysis of antler material from Britain**. This will be achieved through the application of traceological analysis – a methodology developed in France by osseous technology analysts to identify the specific working techniques used to manufacture bone and antler artefacts in stone-age contexts. In order to meet the objective, the author arranged training under the tuition of Dr. Éva David (CNRS Nanterre, Paris X).
3. **Assess the location and accessibility of British Mesolithic antler material.** Although non-destructive, traceological analysis requires the first-hand analysis of antler artefacts and manufacturing waste products. In the light of more recent advances in AMS dating techniques, this will require a critical review of the British material to establish the robustness of its Mesolithic affinities. Once this has been carried out, the Mesolithic material will be located through a synthetic review of gazetteers and publications which give details of artefact holdings, supplemented by correspondence with individual institutions and curators.
4. **Present the results of the traceological analysis of antler from British Mesolithic contexts**. This will be achieved through the use of annotated drawings of analysed

artefacts to illustrate the *chaîne opératoire* of working actions and taphonomic events observed on individual pieces. The metric data recorded from each piece, alongside the working marks, taphonomic processes and conservation techniques will be presented in a standardised table within an appendix.

5. **Characterise the relationship between people and deer during the British Mesolithic.** It is important to develop some form of understanding of the relationship between people and deer, into which antlerworking can be contextualised. In the absence of an extensive faunal record, this will be achieved by focusing on the characteristics of deer behaviour, and considering the ways in which people may have encountered different species of deer during the Mesolithic period. Variations within this relationship will be explored through the discussion of the differences between the three species of deer known to inhabit Britain during the Mesolithic, and the ways in which deer behaviour can vary in different Mesolithic environments. This approach to characterising human/animal relationships (Conneller 2011) also affords the actions of animals themselves a considerable amount of agency – in line with more recent anthropological literature on this subject (Ingold 2000; Viveros de Castro 1998).
6. **Discuss the results of the analysis of the worked antler from Britain to produce a characterisation of Mesolithic antlerworking practices and place these practices into the broader context of human and deer interaction in the period**. This will be achieved through the discussion of the data presented previously, linking findings from different sites across Britain to highlight trends and variation within antlerworking practices. The data will also be discussed in relation to the human/deer interactions during the period.

1.3 Summary and chapter outlines

This introductory chapter can now be summarised in relation to the structure of the thesis itself. The objectives will be met sequentially, with chapters designed to meet individual objectives and building towards a conclusion which fulfills the aim of the thesis:

- Chapter 2 will address Objective 1, and provide a literature review of academic discourses concerned with antler technology in the British Mesolithic. This will outline the history of research for the various types of artefact traditionally associated with the Mesolithic, and summarise the current level of understanding. Finally, the more recent theoretical developments on the role of antlerworking within broader human/deer relationships will be critically reviewed, and their implications for considering antlerworking as part of this relationship considered.
- Chapter 3 will outline the methods used to generate new data in this thesis, and thus address Objective 2. This will consist of a brief historical review of the development of traceological analysis, before moving on to outline the methodology used to identify and record stone-age working techniques on archaeological worked osseous materials. A full definition of each individual working technique will also be provided, with reference to their defining features and provision of archaeological examples.
- Chapter 4 will address Objective 3. This will feature a systematic review of each of the typological groups of artefact that have been traditionally associated with the Mesolithic in Britain, and critically examine the evidence for these affinities. Following the evaluation of this review, material which can be confidently attributed to the

Mesolithic will be located and its accessibility assessed through correspondence with collections managers and curatorial staff at the holding institutions.

- Chapter 5 will present the results of the traceological analysis of the antler material from Mesolithic Britain, and thus address Objective 4. This will be presented systematically, dealing with the context of recovery for each findspot, before presenting the results of analysis by artefact type at the findspot itself. These will be presented through annotated drawings, selective photographs and sequences of working actions. The raw data and digital photographs generated by the analysis will be presented within two appendices. Where a broader *chaîne opératoire* can be demonstrated through artefacts and *debitage* at a specific findspot, this will also be reviewed and discussed. The results will be presented in an arbitrary order, working from the most northerly latitudes to the most southerly in Britain.
- Chapter 6 will address Objective 5. After providing a brief introduction to the physical and biological characteristics of antler as a material, it will move on to give an ecological and behavioural overview of the three species of deer living in Britain during the Mesolithic period – *Cervus elaphus* (Red deer), *Capreolus capreolus* (Roe deer) and *Alces alces* (Elk). Once these have been outlined, deer behaviour will be considered in relation to the different types of Mesolithic environment which are documented within the palaeoenvironmental record. This will characterise the variations within the ways in which Mesolithic people may have encountered deer, and lead to the characterisation of people/deer relations that incorporates the actions of the animals themselves.
- Chapter 7 will draw together the results presented within Chapter 5 and the characterisation of human/deer relations outlined in Chapter 6 to discuss Mesolithic antlerworking within Britain (Objective 6). This will deal systematically with each artefact type, discussing their spatial and chronological distribution, their respective *chaîne opératoire* and any variations which can be observed within this sequence. This will be followed by a discussion of the specific ways in which people utilise the antler of different species of deer, with reference to the characterisations of human/deer relations developed in Chapter 3.
- Finally, Chapter 8 will draw together the major conclusions of the proceeding seven chapters. The initial aim of the thesis will be revisited and the extent to which the thesis has fulfilled the aim assessed. The contribution of this project to the academic understanding of the British Mesolithic will be evaluated and key questions for future research identified.

1.4 Use of radiocarbon dates

All of the radiocarbon dates provided within this thesis have been calibrated using the OxCal 4.1.17 program (Bronk Ramsey 2009). The date ranges produced are to a 95% level of certainty, and are denoted by the use of “cal. BC”. However, lab codes, uncalibrated BP dates and error margins are also provided to allow the recalibration of these dates in line with future developments of the OxCal software.

Chapter 2: Literature review

2.1 Introduction

This chapter will aim to assess the current state of knowledge concerning the use of antler in the British Mesolithic through a critical review of the academic literature. In doing so, this will fulfill Objective 1 of this thesis. The chapter will be structured to first deal with research focused specifically on each of the three types of antler artefact which are commonly associated with the period (Figure 1); mattocks, barbed points and bevel-ended tools (Barton & Roberts 2004; Clark 1932; Mithen & Milner 2009; C Smith 1989, 1992; Tolan-Smith 2008). The literature on each type of artefact will be reviewed, taking a historical approach to plot the development of academic thinking regarding the classification, function, methods of manufacture and chronological affinities of each.

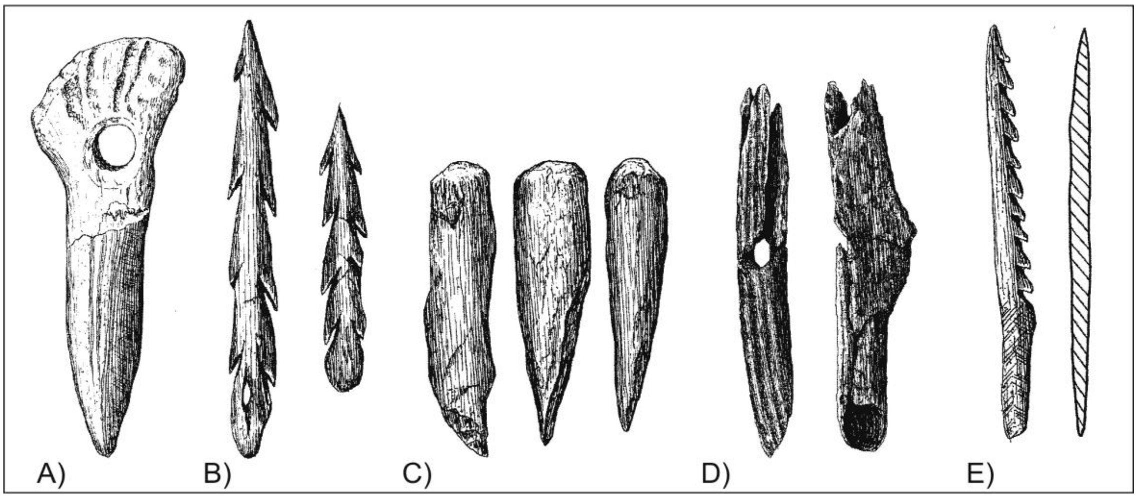


Figure 1: Mattocks, barbed points and bevel-ended tools: the three types of antler artefacts commonly associated with the British Mesolithic (Mithen & Milner 2009, 60). A) Elk antler mattock B) Biserial barbed point C) Bevel-ended tools D) Red deer antler mattock E) Uniserial barbed point

Following this, a review of the more general discussions concerning the use of antler as a material will be undertaken. This will encompass the limited number of general studies concerned with osseous technology in the British Mesolithic, and also the more recent trends in addressing the materiality of antlerworking during the period. This review in itself highlights the link between the use of antler and the hunting of deer, and so will be followed by a brief review of literature concerned with deer hunting in the British Mesolithic. The findings of this review will then be summarised and used to identify key areas for further research into the use of antler during the British Mesolithic. The findings of this review will then be summarised and used to identify key areas for further research into the use of antler during the British Mesolithic.

2.2 Antler "mattocks"

Artefacts which can be classified as antler mattocks have been recognised within Britain from as early as the mid 19th century. During the drainage of large Scottish estates along the Firth of Forth, a collection of three objects initially termed "implements of stags' horn" (Turner 1889, 789) were discovered in association with whale skeletons. These consisted of a length of antler with a sloping break at one end to create an angle similar to that of an axe blade. They were perforated, with one specimen noted as featuring an intact wooden haft within the perforation (Turner 1889). The original interpretation of these objects as tools for whale butchery was heavily influenced by the context of these earliest discoveries (Saville 2004; Woodman 1989). The deposits from which these finds were made were dated to the post-glacial period by the excavators, and as such the finds were initially attributed to the Neolithic period. This can be regarded as symptomatic of general academic attitudes towards the Mesolithic during the latter 19th century, a time when the period between the Upper Palaeolithic and Neolithic was regarded as something of a cultural "hiatus" (Munro 1908) and not meriting of targeted research.

However, later work by Bishop (1914) at the shell midden site of Cnoc Sligeach, Oronsay demonstrated the Mesolithic date of sites from which broken mattocks were recovered. As such, this represents a significant landmark in the study of antler tools in the British Mesolithic, and so is worth reviewing in further detail. Bishop was attracted to the small Inner Hebridean island of Oronsay (Figure 2) by the publication of finds made by the ornithologists Grieve and Galloway during the 1880s. Their excavations at Caisteal nan Gillean, Cnoc Sligeach and Croch Riach (Anderson 1898) had aimed to recover Great Auk remains, to document the presence of the extinct species within Western Scotland. However, during the course of Grieve and Galloway's investigations, a large assemblage of material culture was also recovered, with bone and antler being particularly well preserved by the calcareous shell midden conditions. Following the deaths of Grieve and Galloway, their collection of material passed into the possession of the Society of Antiquaries of Scotland, and was published by Anderson (1898).

It should be noted here that successive authors have used different spellings, and in some cases even different names to refer to the shell midden sites of Oronsay (Mellars 1981). For the sake of consistency, the spellings used by Mellars (1987a) will be adopted here, with the exception of "Croch Riach" which may refer to a site which was not investigated further during Mellars' (1987b) later research on Oronsay.

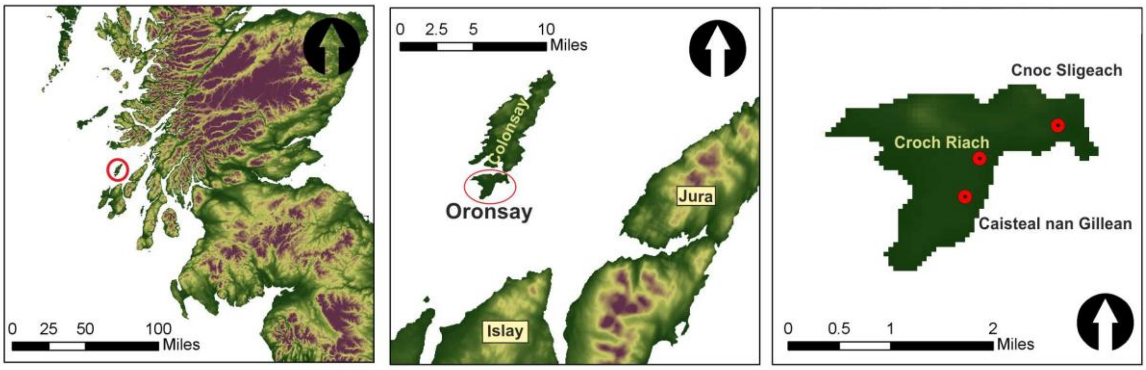


Figure 2: Location of Oronsay, and the shell middens excavated by Galloway and Grieve

Bishop's excavations at one of the sites identified by Grieve – Cnoc Sligeach – aimed to establish the contemporary sea level for human activity at the midden (Bishop 1914, 55). Through excavation of geological sediments in the surrounding areas, it was shown that the midden was situated on top of a raised beach deposit. Bishop also records evidence of mixing of the cultural material with the adjacent marine pebbles of the beach at the base of the midden, which he interprets as indication of a tide line in direct contact with the midden during the period in which occupational activities took place. This “30ft line” for a relic sea level is linked to other cave sites at Oban, where archaeological material had been recovered from a similar height above sea level in association with raised beach deposits (Bishop 1914, 54). By linking the archaeological assemblage found at Cnoc Sligeach with those of MacArthur’s Cave and Druimvargie, Bishop defined a group of similar assemblages in Western Scotland which became known as the “Obanian” culture (Breuil 1922).

Typologically, Bishop links what he describes as “shoe-horn implements”, but which have subsequently been recognised as fragments of mattocks (Clark 1956), alongside other type fossils to the assemblages recovered from the French cave site of Mas d’Azil (Bishop 1914, 53). He notes that at this location, a similar assemblage was found to be stratified between a classic Magdalenian and Early Neolithic assemblage. As such, this occupation falls within a period of time regarded by Bishop’s contemporaries as a “cultural hiatus”. He also cites similar “Azillian” assemblages from the sites of Montfort, Armège and Tourasse, Haute-Garonne (Bishop 1914, 52) as further examples of cultural activity taking place within the so-called “hiatus”. Bishop’s work, combined with a growing appreciation for Danish sites where these artefacts occurred frequently within Mesolithic contexts (Burkitt 1926) in early 20th century Britain led to the ascription of the antler mattock tools to the Mesolithic period. This was further confirmed by Clark’s (1954, 158) discovery of a series of elk antler mattock heads during excavations at Star Carr, North Yorkshire.

The recovery of these perforated antler tools continued throughout the 20th century. Due to the unusual preservation conditions required for the artefact’s survival they tended to be identified through chance finds in association with unsecure river sediments (Lawrence 1929; Middleton & B Edwards 1993; Wymer & Bonsall 1977), rather than from excavated sites with demonstrable stratigraphy. It was not until Smith’s (1989) key work on these artefacts that a typology and chronology for the British mattocks was proposed. Through the construction of a gazetteer of find sites, Smith is able to identify and locate 83 “mattocks” from across Britain. These are defined as featuring a “round, oval or sub-rectangular perforation for inserting a haft,”, and the “presence of a working edge made by an oblique truncation of the antler,” to create a facet at around 50° to the main axis of the artefact (Smith 1989, 272). This definition of a mattock is used to unite a large range of artefacts which had previously been termed as “axes, adzes, perforated picks, hoes and mattocks” (Smith 1989, 272).

Smith notes that despite the presence of four cervid species in Britain during the late glacial/early Holocene (reindeer, red deer, elk and roe deer) only elk and red deer antler is known to have been used in the manufacture of these heavy tools. 77 of the mattocks from Britain were made from red deer antler, with the six elk specimens from Star Carr providing the only exceptions to this pattern.

Smith divides the British antler mattocks into five typological groups, based on variations in the part of the antler being used, the location of the perforation and the angle of the working edge. Types A-D are shown in Figure 3, whilst type E consists of the elk antler mattocks from Star Carr. In terms of chronological distribution of the British mattocks, Smith states that they are Mesolithic in date, with red deer antler replacing elk as the material of choice around 8000 bc. This is explained by a lack of raw materials, brought about by the extinction of Elk in Britain during the Early Mesolithic. He argues that the elk antler artefacts were replaced by types A and B of red deer, which in turn were succeeded by types C and D at around 4500 bc (Smith 1989, 279). Smith notes that, whilst types B, C and D are recognised in European Mesolithic contexts, type A appears to be a purely British phenomenon.

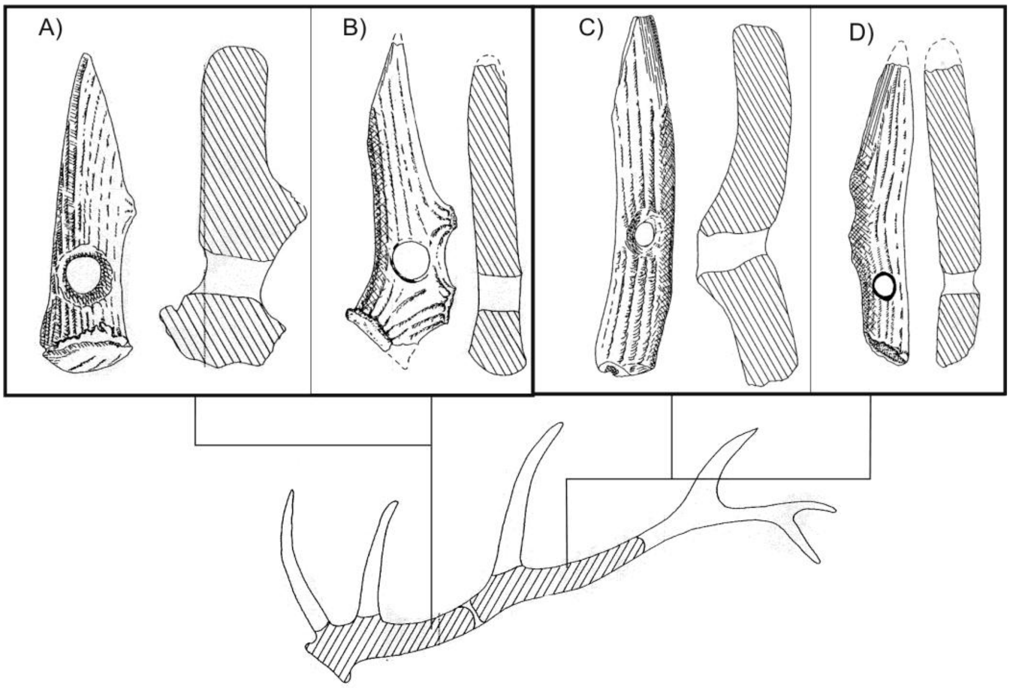


Figure 3: Smith's (1989, 276) typology for red deer antler mattocks. Types A and B use the base of the antler, whilst types C and D use the beam.

Following the development of this broad chronology, an AMS radiocarbon dating project was undertaken on bone and antler artefacts from the British Upper Palaeolithic and Mesolithic (Bonsall & C Smith 1989, 1992; Bonsall et al. 1995; Tolan-Smith & Bonsall 1999). The primary aim of this research was to obtain more direct dates for plotting human occupation at the sites where these materials had been recovered. However, this dating program also contributed to the refinement of Smith's mattock chronology. Following the dating of a sample of the mattocks from Britain, it was found that Types A and B date mainly to the Bronze Age, with a single Type B mattock producing an Early Mesolithic date. However, types C and D were found to date exclusively to the Mesolithic period, and did not appear to extend into the Neolithic or Bronze Age (Tolan-Smith & Bonsall 1999, 254). This has led to a distinction between the more widely distributed "base mattocks" (types A and B) and the specifically Mesolithic "beam mattocks" (types C and D).

Smith's use of the term "mattock" to define this group of artefacts is also interesting, as it has some implications for interpreting the function of these objects. The term was originally proposed by Clark (1954) in relation to the elk antler artefacts from Star Carr. He notes that, although the angle of the working edge runs at 90^o to that of the haft, they should be termed mattocks and not adzes. He states that the acute angle of the haft would make them unsuitable for woodworking, and as such they would have been used in digging activities (Clark 1954, 158).

Smith notes the occurrence of what he refers to as "chatter marks" on the working faces of many of the artefacts included in his study. These markings, combined with the sediments which Smith observes adhering to the working faces of the tools leads him to conclude that they have been used as digging implements – hence the term “mattock”. This contradicts Clark and Piggot’s suggestion that the appearance of “heavy antler tools” in southern Scandinavia is linked to the first woodland clearance events, and that “mattocks” were used to fell trees (Clark & Piggott 1965, 145).

In contrast to this, Woodman (1989, 19) highlights the specimens from Oronsay which have been recovered in association with seal bones. He refers back to the older suggestion (Turner 1889) that mattocks were being used to butcher marine mammals such as seals and whales at coastal sites. More recent experimental work carried out in Britain (Bell 2007a) and Denmark (Jensen 1991) has demonstrated that antler mattocks can be used in a range of carpentry tasks including felling trees, splitting timbers and removing large portions of bark (Jensen 1991). As such, it appears that antler mattocks have the potential to have been used for a range of activities during the British Mesolithic (Saville 2004, 200).

2.3 Antler barbed points

2.3.1 Biserial barbed points

As with the antler mattocks, some of the earliest discoveries of Mesolithic barbed points originate from Scotland in the late 19th century. During the excavation of a cave site in Oban – MacArthur’s Cave – a series of seven antler projectile points were recovered (Anderson 1895). These distinctive artefacts featured barbs along both sides (Figure 4), and as such can be classified as biserial barbed points. Comparisons were quickly drawn between the MacArthur’s Cave finds and fragments of similar objects from the shell midden site of Caisteal nan Gillean and the cave sites of Kent’s Cavern and Victoria Cave in England - which were previously believed to date to the Neolithic and Upper Palaeolithic respectively (Anderson 1895).

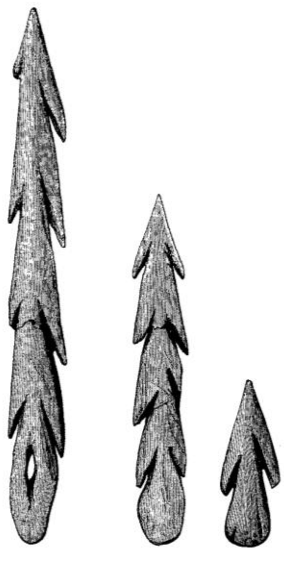


Figure 4: Biserial barbed points from MacArthur's Cave (Anderson 1895, 13–14)

Further to this, parallels were also rapidly drawn with the form of biserial barbed points and harpoons recovered from the French cave site of Mas d’Azil (Bishop 1914; Breuil 1922; Munro 1908). This led to a growing appreciation of a material culture within western Scotland which post-dated the glacial period but pre-dated the Neolithic, in which biserial barbed points were considered a type fossil (Munro 1908). The Mesolithic affinities of the biserial barbed points in western Scotland were finally affirmed through the work of Bishop (1914) at Cnoc Sligeach, which resulted in the recovery of five more fragments of antler barbed points.

Further research into the chronological distribution of the biserial barbed points from Britain was subsequently hampered by difficulties in dating the deposits from which the artefacts were recovered from. However, the development of AMS radiocarbon dating techniques in the 1980s allowed the direct dating of many of the unstratified finds from Scotland (Bonsall & C Smith 1989, 1992; Bonsall et al. 1995; Tolan-Smith & Bonsall 1999). This has demonstrated that the use of biserial barbed points in Britain appears to be confined to two periods of time; the 11th millennium cal. BC (Final Palaeolithic) and the 6th- 5th millennia cal. BC (Late Mesolithic). Biserial barbed points from the two periods have been shown to be typologically distinct, with Palaeolithic specimens featuring a diagnostic, "shovel-shaped" tang (Tolan-Smith & Bonsall 1999, 253).

2.3.2 Uniserial barbed points

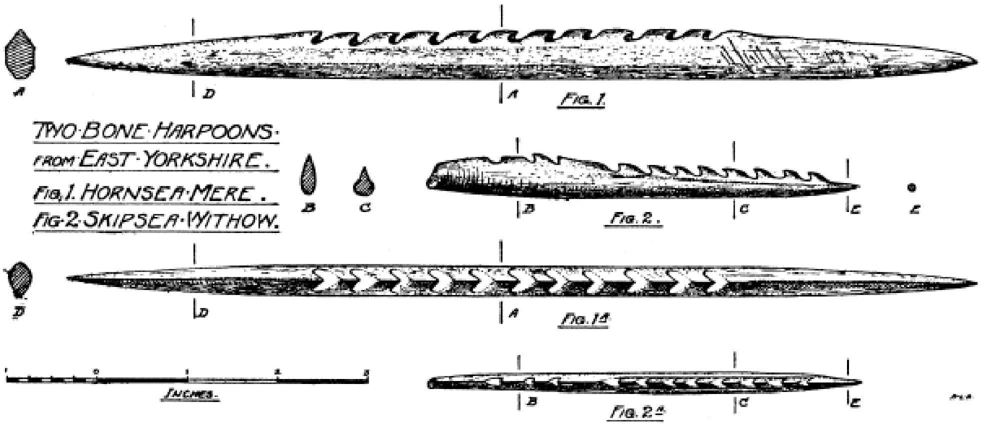


Figure 5: Two uniserial barbed points from the Holderness area (Armstrong 1922, 130)

Whilst the late 19th and early 20th century saw the development of the links between antler biserial barbed points and the Mesolithic period in Scotland, a similar link was also being made between the occurrence of bone and antler projectile points featuring barbs along only one edge at a number of sites in England in the early 20th century. A pair of uniserial points (Figure 5) from Holderness, East Yorkshire were recovered in 1902 and 1905 (Armstrong 1922) were quickly compared with similar artefacts recovered from Denmark and Estonia, from sites which had recently been linked as part of the newly defined Maglemosian culture (Sarauw et al. 1903) of the Early Holocene.

These initial discoveries from Holderness were followed by further finds of uniserial barbed points across Eastern Britain (Clark 1932; H Godwin & M Godwin 1933). Most notably, the recovery of an intact uniserial barbed point during dredging activity 25 miles from the port of Crowther, attracted specific academic attention as it demonstrated the presence of a once-inhabited and now flooded landsurface below the North Sea. Demonstrating a chronological link between these artefacts and their European counterparts became a focus for research, and the newly developing technique of pollen dating was applied a number of these finds in order to investigate this question further. Although not discussing the character of the points or technology behind their manufacture in any detail, Godwin and Godwin (1933) attempt to reconstruct the environmental conditions into which the British points were deposited and compared these to pollen samples collected at European uniserial barbed point sites. They interpret the results of this analysis as being indicative of identical environments, and thus corresponding to the same point in the early Holocene colonisation of Europe by tree species (H Godwin & M Godwin 1933). Whilst the validity of pollen dating has since been questioned, this work further strengthened the link between the uniserial barbed points from Britain and Europe in the Early Holocene.

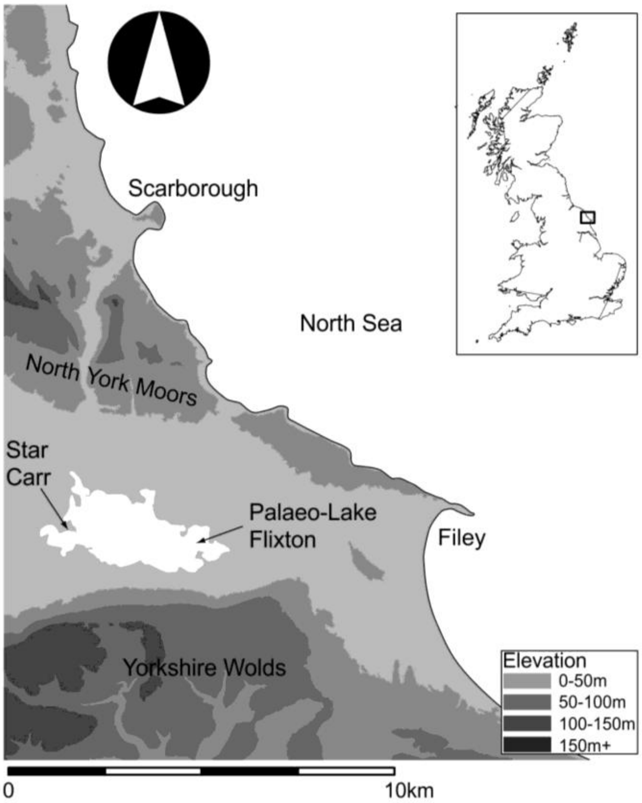


Figure 6: Location of Star Carr (Conneller et al. Forthcoming)

This link between uniserial barbed points and the Maglemosian as a continental entity was cemented within the mindset of British prehistorians by the discovery and excavation of Star Carr (Clark 1954). Star Carr is an early Mesolithic site in East Yorkshire. Located five miles south of modern day Scarborough, the site was situated on the shore of Lake Flixton in the Mesolithic period (Figure 6), an ancient glacial lake which has subsequently become infilled with peat. Discovered by John Moore in 1948, Star Carr was originally termed “Site 4” by Moore, who carried out the initial excavations by cutting back the bank of the nearby Hertford River. The site soon attracted the attention of Grahame Clark, who was interested in the association between a Mesolithic flint assemblage and the well preserved organic material being recovered by Moore. Clark carried out three seasons of excavations at Star Carr between 1949 and 1951 and published his monograph on the site in 1954.

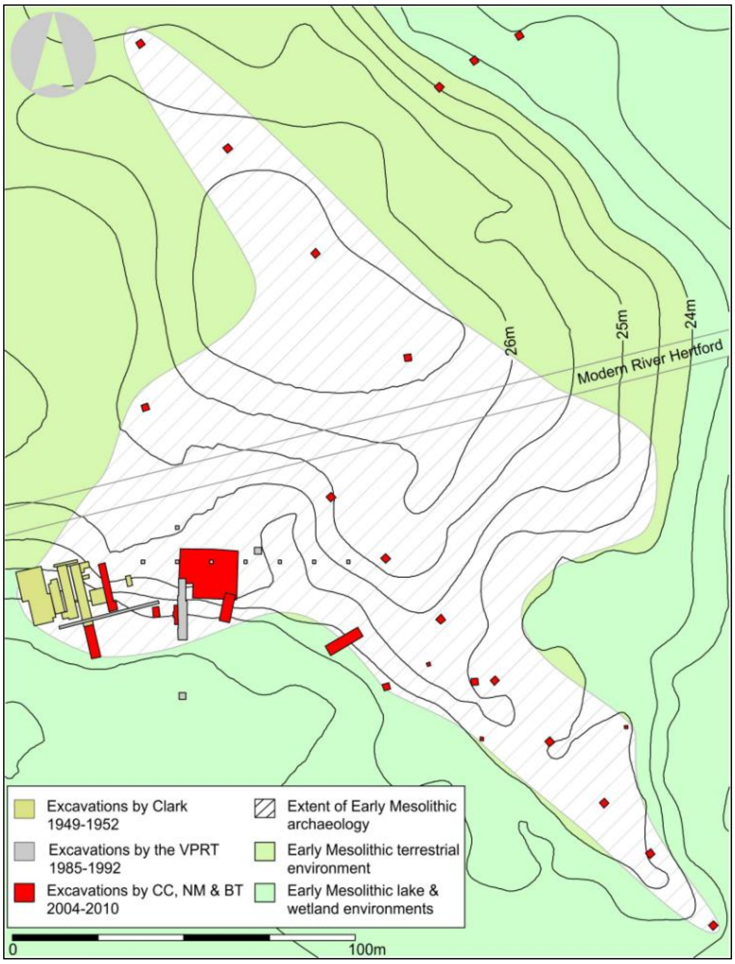


Figure 7: Plan of all excavations at Star Carr, in relation to the surface scatter of Early Mesolithic material and the contemporary wetland/dryland interface (Conneller et al. Forthcoming)

The extraordinary archaeological assemblage recovered by Clark included a "brushwood platform", large quantities of animal bone, 102 red deer antlers (88 of which had splinters removed for tool manufacture) 191 barbed points, 33 shale beads, deposits of ochre, 3 pieces of amber and an intensive flint industry, notable for having the only burin-heavy lithic signature in Britain. Some of the most spectacular finds from the site included 21 sets of worked red deer frontlets; the frontal bone of a male red deer skull with the antlers still attached. These had been worked through reduction of the antlers, smoothing of the interior of the skull and multiple perforations of the frontal bone itself. Clark interpreted these frontlets as headdresses, for use as either a hunting aid or in ritual, shamanic dances (Clark 1954, 169–170).

Clark's initial interpretation was of a residential winter base camp, occupied by four or five families. This has been revised and reinterpreted numerous times (Andresen et al. 1981; Bevan 2003; Carter 1997, 1998; Caulfield 1978; Chatterton 2003; Clark 1972; Conneller 2003, 2004; Jacobi 1978; Legge & P. A Rowley-Conwy 1988; Noe-Nygaard 1975; Pitts 1979; J Pollard 2000; Price 1982; Schadla-Hall & Conneller 2003; Warren 2006). Many of these new interpretations have focussed on the faunal assemblage and what this can tells us about the seasonal nature of site occupation (Andresen et al. 1981; Carter 1997, 1998; Caulfield 1978; Clark 1972; Legge & P. A Rowley-Conwy 1988; Noe-Nygaard 1975), as well as questioning Clark's idea of a "residential base-camp" (Andresen et al. 1981; Caulfield 1978; Jacobi 1978; Pitts 1979). The environmental context into which cultural material was deposited has also been a focus of debate at Star Carr, with various authors arguing that the archaeological assemblage represents *in situ* activities (Clark 1954; Mellars & Dark 1998; Mellars 2009; Pitts 1979; Price 1982), a “toss-zone” for waste from occupation on the adjacent dryland (Andresen et al. 1981; Legge & P. A Rowley-Conwy 1988; J Pollard 2000) or ritualised deposition into open water conditions (Bevan 2003; Chatterton 2003; Milner 2007).

Subsequent investigations at the site during the 1980s (Mellars & Dark 1998) and early 21st century (Conneller et al. Forthcoming; Milner et al. 2011) has revealed that the area excavated by Clark may constitute as little as 5% of the site’s entirety (Milner 2007), with occupation spanning 19,500 m^2 along the lake-edge and onto the surrounding dryland areas (Figure 7). A timber platform, created through the deposition of parallel, split and worked tree trunks has been observed at the lake-edge itself (Conneller et al. Forthcoming; Mellars & Dark 1998), and is believed to be a minimum of 30m in length. On the dryland areas, structural evidence indicates the presence of a hut structure surrounded by a series of post-holes (Conneller et al. 2010). Further to the excavations at Star Carr itself, an extensive survey of the peat deposits within the Vale of Pickering has also resulted in the mapping of the Lake Flixton shoreline (Figure 8) and the identification and excavation of 12 more Early Mesolithic sites (Lane & Schadla-Hall Forthcoming) within the landscape.

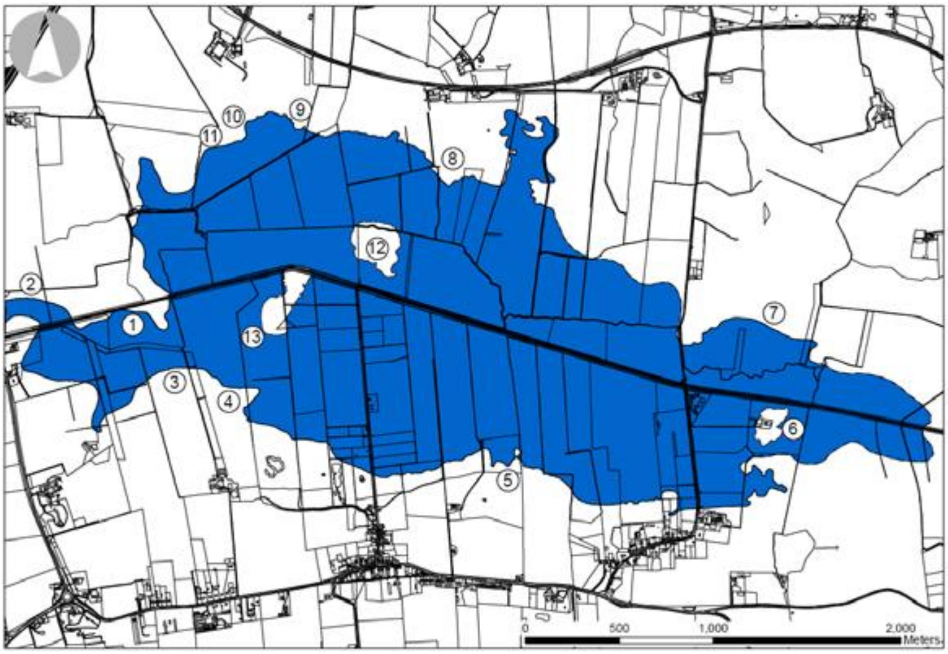


Figure 8: Reconstructed map of Lake Flixton showing the location of Star Carr and other Early Mesolithic sites along the lake edge: 1. Star Carr, 2. Flixton 9, 3. VP-D, 4. VP-E, 5. Flixton School, 6. Barry’s Island, 7. Lingholme Farm, 8. Cayton Carr, 9. Seamer Carr C, 10. Seamer Carr K, 11. Seamer Carr D, 12. No Name Hill, 13. Flixton Island. (Taylor 2007, 12)

The remarkable character of the Star Carr assemblage allowed Clark to go further than simply discussing the typological nature and cultural affinities of the uniserial barbed points recovered from the site. The preservation of worked red deer antlers and flint tools within the peat deposits at Star Carr facilitated a detailed review of the entire uniserial barbed point manufacturing process. This began with the removal of the crown and tines from a red deer antler. Flint burins were then used to score two shallow, parallel grooves along the length of the antler beam. These grooves were deepened so that they penetrated the thickness of the antler's hard outer material and exposed the spongy core within. Having defined a rectangular strip of antler (a "splinter") with these grooves, Clark notes that a range of methods could be employed to remove the isolated portion of material. The majority of the antlers with removed splinters display breaks at the ends which suggest that the splinters were forcibly bent out of the beam, requiring considerable strength from the worker. However, Clark also notes evidence for the use of transverse cutting of the antler to define the ends of the splinters in a minority of cases. Unpublished experiments are also cited which claim to have used a piece of wood with string attached to remove splinters, by passing the string beneath the isolated portion and working it up the length of the beam to detach the adhering spongy material.

Once prised from the parent beam, Clark states that the adhering spongy material was removed from the outer tissue. Following this, the point was shaped through "a good deal of cutting or scraping or smoothing" using flint tools (Clark 1954, 124). The dorsal aspect (the unbarbed edge of the point) was smoothed and rounded, although in many instances the grooved nature of this edge could still be observed despite subsequent modification. The ventral aspect (onto which barbs were made) was "beveled", with tapering from both the internal (spongy) and external (hard) sides of the splinter (Clark 1954, 124–125). In some instances, the position of barbs was marked out by the scoring of fine lines of the ventral aspect. The majority of the barbs were created by cutting oblique notches into the profile of the splinter (Clark 1954, 125). The tang of the point was defined, and then had scoring marks added through coarse grinding and then scraping respectively. The surface of the tangs were scored with a variety of different patterns, classified as transverse lines, oblique lines, criss-cross lines and chevrons. Clark (1954, 124) interpreted these markings as roughage for the tang, allowing more grip when bound and hafted.

Clark's discussion of antlerworking at Star Carr marks another key milestone for the development of our understanding of the use of antler in the British Mesolithic. Previous research into antler artefacts had, up to this point, focused exclusively on the typological characterisation and cultural affinities of objects. Clark's report, facilitated by the unprecedented assemblage of finished tools and manufacturing *debitage* from Star Carr, heralded a shift towards an appreciation of antler technology, and the technical choices and actions behind the production finished antler artefacts.

Clark also notes the use of red deer antler at Star Carr, and contrasted this to the exclusive use of reindeer antler at Late Palaeolithic Magdalenian sites and the use of red deer and elk metapodial and rib bones at the classic Maglemosian sites. This led him to the conclusion that Star Carr was representative of a cultural group which post-dated the Magdalenian, but predated the Maglemosian seen elsewhere on the continent. He termed this culture the "Proto-Maglemosian".

The more recent investigations at the site have recovered evidence of antlerworking away from Clark's original excavations, indicating that within a larger site, this activity was widely distributed (Elliott & Milner 2010; P Rowley-Conwy 1998). However, recent work has noted a dramatic deterioration in preservation conditions at the site (Milner et al. 2011), and as such the contribution of these finds to our understanding of antlerworking at Star Carr has been limited (in comparison to more general interpretations of the character and nature of occupation), Clark's (1954) original report still proves the most comprehensive account of antlerworking at Star Carr to date.

The identification of the "groove-and-splinter" technique as the method used to produce barbed points at Star Carr also allowed Clark (1956) to make further distinctions between this assemblage and the biserial barbed point sites of Scotland. In a paper comparing the "Obanian" sites of Argyll to other British Mesolithic assemblages, he notes that earlier-dating examples of biserial points within the Obanian appear to be made from antler, whilst the other points are made from bone. This is linked to his previous work at Star Carr which suggested that antler was preferred for barbed points during the proto-Maglemosian and bone was more widely used in the subsequent mature Maglemosian cultures (1956, 92). He highlights geographical patterning in the choice of raw material, identifying the antler barbed points from areas outside of the Obanian territory (Cumstoun, Shewalton, Victoria Cave and Whitburn) as being manufactured from antler (Clark 1956, 92). Clark also comments on the complete lack of evidence for use of the groove-and-splinter technique at the Scottish sites, further distancing the production of biserial barbed points in the Obanian to the uniserial barbed points from Star Carr. Clark concludes that the antlerworking methods utilised in the Obanian show a clear discontinuity with those practiced at Star Carr, and thus does not draw a cultural affiliation between the two groups.

The depth of understanding afforded by the extensive Star Carr assemblage was swiftly consolidated by further unsierial barbed point finds in the Holderness area. These were compiled, alongside the earlier finds from Britain, in a paper published shortly after the Star Carr monograph (Clark & H Godwin 1956). The points from Brandesburton were made exclusively from bone, with Clark and Godwin (1956, 9) suggesting that these may have been carved from a split elk metacarpal bone based on their form and size. They note a certain degree of variation in the style of the barbs themselves, and their methods of manufacture. Some points feature barbs which have been incised by sawing two criss-cross cuts into the bone, one from either side. Other points have barbs that appear to have been defined by sawing a single notch into the profile of the point. The point recovered from the Hornsea foreshore in 1932 is made from antler, and said to have strong parallels in terms of both material and style to a point recovered from the Leman and Owther bank off the coast of Norfolk in 1931. Clark and Godwin consider these finds to represent the continuation of Maglemosian points in Britain after the occupation of Star Carr, and suggest that they may be chronologically ordered. They propose that the points made from antler, but used the "criss-cross" method to incise barbs in a manner not used at Star Carr succeeded immediately after the Star Carr-type barbed points. These in turn were succeeded by the bone points with barbs defined by single cuts (*ibid.* 13). The development of this typo-chronology was important for finds recovered with minimal contextual data. Many of the surface finds were lacking stratigraphic or contemporary environmental data and considered too rare and valuable to be subjected to destructive radiocarbon dating. Thus a typological method for establishing dates of artefacts and occupations was vital.

This typology was developed by Wymer *et al.* (1975) following further discoveries of uniserial barbed bone and antler points at Sprougton, Suffolk which were dated to the Terminal Palaeolithic/Early Mesolithic on stratigraphic grounds. The early occurrence of a bone point leads to the dismissal of antler/bone choices of material being chronologically determined.

They also proposed that criss-crossing was confined to the Late Glacial (Pollen zones III – IV) whilst the distinction between criss-cross and single cut barbs was not as straightforward as originally thought. Despite this, the need for a method of dating these isolated finds was so strong that the typology itself was not totally abandoned until the advent of AMS radiocarbon dating (Bonsall and Smith 1989).

Clark's (1954) assertion that the entire barbed point manufacturing process was carried out at Star Carr has been subsequently contested by Jacobi (1978). Jacobi argues that the Star Carr assemblage lacks the small triangular "lozenges" of antler that would have been produced in the definition of individual barbs, or any great quantity of half-finished barbed points (Jacobi 1978, 318). As such, he argues that Star Carr may have been the scene of the "groove-and-splinter" process, but that once removed, antler blanks were taken from the site and finished at other sites within the landscape (Jacobi 1978, 319). This argument is significant as it is the first consideration of antler artefact production being carried out across more than one site, and introduces a spatial element to the organisation of barbed point manufacturing in the British Mesolithic.

A more recent review of the evidence for barbed point manufacturing at Star Carr (Elliott & Milner 2010) has contested Jacobi's suggestion that the lack of finishing evidence at the site indicates that points were completed elsewhere. This has employed experimental studies into the production of the "lozenges" when defining the barbs of antler points, and found that in the majority of cases artefacts could be finished without producing such pieces of *debitage.* The experience gained in these experiments also enabled the authors to identify further unfinished barbed points within the assemblage recovered by Clark. Additionally, an examination of material recovered during the 2006-2008 excavations and the analysis of previously unstudied material within the Tot Lord Collection (Dark et al. 2006) expanded the number of unworked, removed splinters from the site. As such, the authors concluded that there was no further evidence to support the theory that removed splinters were taken from Star Carr and barbed point manufacture completed at another point in the landscape (Elliott & Milner 2010).

Direct dating of isolated and unstratified uniserial barbed point finds from Britain (Bonsall & C Smith 1989, 1992; Bonsall et al. 1995; Tolan-Smith & Bonsall 1999) has significantly undermined their links to the Maglemosian cultural group. Their chronological range has been shown to span the 14^{th}-7^{th} millennia cal. BC, thus crossing from the Late Upper Palaeolithic into the Early Mesolithic (Tolan-Smith & Bonsall 1999). This dating has also contradicted the typo-chronological distinction between the use of criss-cross and single cut barbs (Tolan-Smith & Bonsall 1999, 256).

In regards to the function of uniserial barbed points, Jacobi (1978) provides one of the most detailed discussions. He notes that similar artefacts are known to have been used for spear fishing at Mesolithic sites in Europe, although he concedes that there is a general lack of evidence for fishing in the faunal and artefactual record at Star Carr (Jacobi 1978, 319). Instead, Jacobi argues that barbed points may have been used "in the hunting of large land mammals," (Jacobi 1978, 318). An elk skeleton found in association with the barbed points at High Furlong (Hallam et al. 1973) is cited as evidence for the use of barbed points in the hunting of deer during the British Mesolithic. He suggests that the form of the points, with their smooth profiles and unhooked barbs, would provide little anchorage within the hunted animal and so may have been used for the "final dispatch" of an injured animal at short range (Jacobi 1978, 320).

Recently, the range in sizes of the Star Carr barbed points have been considered in relation to the sizes of different animal remains that have been recovered from the site (Elliott 2009). This has concluded that the Star Carr barbed points may have been used to hunt large ungulates, fur-bearing species and water fowl – and that certain sizes of point would have been more suitable for certain kinds of prey. Additionally, it has been suggested that the variety in forms of uniserial barbed points at Star Carr suggests that they were used in a range of ways, and that they could have been hafted as arrow tips, javelins or thrusting spears (Elliott 2009, 34–37).

2.4 Antler bevel-ended tools

As with the biserial barbed points, antler bevel-ended tools (Figure 9) were first recognised in Britain at a series of shell midden sites on the western seaboard of Scotland (Anderson 1895, 1898). Their earliest discovery occurred during the excavations of Grieve and Galloway during the 1880s (Anderson 1898). Grieve interpreted the numerous pieces of bone, antler and stone from the shell midden sites as "limpet hammers", used to remove limpets from rocks (Clark 1956, 93).

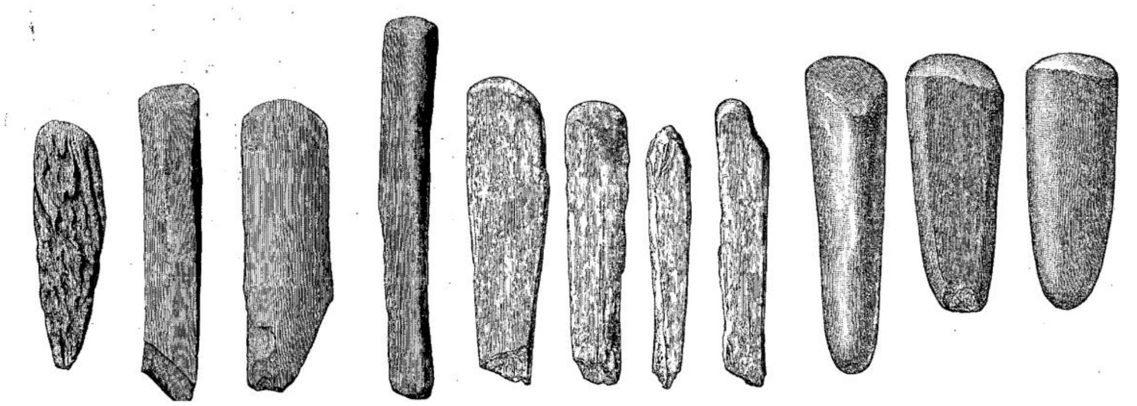


Figure 9: Bevel-ended tools of antler, bone and stone from MacArthurs Cave, Druimvargie Cave and Caisteal nan Gillean (Anderson 1895, 1898)

When discussing the MacArthur's Cave finds, Anderson originally terms these artefact "rubbers or smoothers, formed from splinters of bone or deer horn" (Anderson 1895, 216) and notes the similarity between the rounded, used ends of the osseous tools and the rounded end of worked pebbles also found at the site. Anderson states that the tools are made from fragments of deer leg bones and antlers, which had been broken up at the site for the extraction of marrow. The range in lengths of the tools is also commented on, and he speculates that the larger examples highlight the fact that smaller specimens may have been hafted for use. Although conceding that the interpretation of the function of these objects is difficult, he does observe similarities between the high polish on the artefacts and that of hideworking tools from occupational sites at Orkney. Anderson concludes that the artefacts were most likely tools for the "dressing and working of skins" (Anderson 1895, 222).

Bishop's excavations at the Cnoc Sligeach shell midden, Oronsay recovered further bone, antler and stone bevel-ended tools. Bishop revisited Anderson's original interpretation of the function of the objects, postulating that they had been used to scoop limpets from their shells (hence the term "limpet-scoops"). This was based on an experiment using a piece of cement to carry out a scooping action on modern limpet shells. This produced a similar wear pattern to that observed on the working edges of the bevel-ended tools (Bishop 1914, 95). There are fairly obvious limitations to the use of cement as a proxy for wear patterns on stone, bone and antler as different materials have different physical properties which may alter the wear pattern.

Breuil's (1922) assessment of the cultural affinities of the Obanian shell middens in to relation to the Azillian sites of France also featured a re-interpretation of the function of the bevel-ended tools. He draws parallels between the objects from Scotland and "flint flakers" observed in Azillian assemblages. This is based on the small flake scars which can be observed at the ends of some of the tools. Although not explicit about the precise use of the Scottish bevel-ended tools, the use of the term "flint flakers" to describe them heavily implies their function as soft hammers in knapping activities. However, this interpretation is undermined by the relatively low quantities of worked flint recovered from the Obanian shell midden sites (Movius 1942). At many of the shell middens on Oronsay, the numbers of bevel-ended tools far outweigh those of worked flints (Anderson 1898).

As an alternative to flint flakers, Movius (1942) suggests that they may have been used for a range of activities, including the working of animal hides, removing limpets from rocks through percussion and as woodworking tools. Clark takes issue with the latter of these suggestions, stating that the rounded form of the worked edge of the bevel-ended tools appears in no way to have been created by, or useful in, carpentry tasks (Clark 1956, 94). Lacaille also favours a multi-purpose interpretation for the function of the bevel-ended tools, citing Grieve's original theory of "limpet hammers" alongside their use in rubbing animal hides (Lacaille 1954, 204).

Foxon (1991) takes a more methodically reasoned approach to the potential uses of bevel-ended tools in his study of osseous technology and utilisation at the shell midden site of Risga, Argyllshire. He notes that the worn surfaces of the bevel ended tools from Risga are flattened and smoothed, and as such their use must relate to abrasive, rubbing activities. However, he also notes that in a small minority of cases, flaking damage appears to have been sustained on the used edges, implying a percussive force of some kind. He interprets this variation as the product of multiple uses in hideworking and flint knapping tasks and views the artefacts as "general purpose tools made use of at times because they were to hand" (Foxon 1991, 115).

The function of bevel-ended tools has also become embroidered into debates over the role of shell middens within wider settlement patterns along the seaboard of Western Scotland. Finlayson (1995) argues that, as hideworking tools, the presence of large quantities of bevel-ended tools at the Oronsay shell midden sites suggests a level of social complexity which would have allowed a community of people not directly engaged in subsistence activities to be supported by a wider society which valued the products of these hideworking activities (Finlayson 1995). In contrast to this, Bonsall (1996) argues that the use of bevel-ended tools as limpet scoops indicates that Mesolithic shell middens formed a specific coastal settlement adaptation – that they were centres for the repeated processing of large quantities of shellfish during short term visits. Whilst both of these arguments also draw on a range of other sources of evidence, neither fully acknowledges the apparent confusion over the precise function of the tools, nor the possibility that they may have served multiple uses.

In response to this debate, Griffitts and Bonsall (2001) carried out a more systematic experimental investigation into the possible uses of bevel-ended tools. They produced a small set of antler bevel-ended tools using the groove-and-splinter method, and a larger collection through the use of a metal band saw. They note that attempts to longitudinally split the antler were unsuccessful and that therefore the groove-and-splinter technique must have been employed to create antler bevel-ended tools at Scottish sites (Griffitts & Bonsall 2001, 209) – contra Clark (1956). They also note that the length of the bevel-ended tool can be adapted considerably by inserting into a handle of either wood, antler or kemp stem. They cite the tapering form and thin nature of the tools as evidence for their suitability in hafting (*ibid.*).

In relation to use, Griffitts and Bonsall carry out a series of experiments with the modern tools that they produced. These consisted of removing limpets from rocks via percussive actions and gouging limpet flesh from the shells of removed limpets. In the case of removing limpets from rocks, this was first achieved with live limpets and once the functional viability of the tools for this task was established empty shells were held against rocks and struck at the required angle (Griffitts & Bonsall 2001, 209). When gouging limpets from their shells, three variations were practiced. These consisted of gouging dry, empty shells; gouging wet empty shells; and gouging empty shells filled with canned fish meat. They recorded both the macroscopic and microscopic traces of wear associated with these different activities and compared them to archaeological specimens from a variety of shell midden sites in Scotland (Griffitts & Bonsall 2001, 214) from various periods (including the Mesolithic). They conclude that the majority of archaeological specimens most closely match with the macroscopic and microscopic patterns produced when gouging empty shells filled with fish meat (Griffitts & Bonsall 2001, 215). This effect was achieved by filling empty limpet shells with loose fish meat, and then removing the fish meat using an experimental tool.

Despite the confidence with which Griffitts and Bonsall conclude that bevel-ended tools are used for scooping out limpet flesh from their shells, the methodology employed featured a number of flaws. The manufacturing techniques used to produce the tools in the first instance are not supported by the archaeological record for the shell midden sites, which lack any evidence for the groove-and-splinter technique (Clark 1956). Further to this, the experiments use antler specimens exclusively and do not address the use patterns produced when other materials are employed. The same experimentally manufactured tools are used in both sets of usewear experiments, and so the patterns of microscopic and macroscopic wear identified are actually a palimpsest of multiple uses. As such, the link between the "limpet gouging" marks on experimentally generated artefacts and the archaeological specimens is actually indicative of the use of bevel-ended tools for multiple functions at Mesolithic sites. Also, although stating that the macroscopic wear generated in gouging limpets is similar to that seen on archaeological examples, they fail to provide photographic evidence to support this. Finally, although Griffitts and Bonsall claim to have shown that bevel-ended tools were used for gouging limpets from their shells, they fail to examine the wear patterns produced in flint knapping or hideworking – two of the alternative hypotheses for the function of these objects.

In response to some of the limitations of Griffitts and Bonsall's study, Birch (2009) provides a more extensive series of experiments into the use of bevel-ended tools of various materials. This involved the experimental production of 28 bone and antler bevel-ended tools. Bone specimens were produced using both fresh and seasoned bone. Different techniques were used to fragment the bone, and all proved successful in producing pieces suitable for use. In the case of the antler tools, the groove-and-splinter technique was employed to produce a rectangular "blank". Direct and indirect percussion was used to prepare the bone tools working edges. In the case of the antler tools some had a working end prepared through rounding of the corners by grinding on a coarse stone. In other cases no preparation was undertaken (Table 1). Some of the prepared tools were then hafted in a number of ways, including insertion into a hazel wood handle, a portion of antler beam or a bone metapodia. Other tools were used unhafted.

Tool number	Material	Reduction method	Bevel Preform Method	Hafted/Unhafted	Tool use
1	Bone	Direct percussion	Direct percussion	Not hafted	Scraping wet limpet shell
2	Bone	Direct percussion	Indirect percussion	Hazel handle	Breaking down nettle stems into fibres
3	Bone	Wedge-splinter	Direct percussion	Bone metapodia haft	Scraping wet limpet shell
AT3	Antler	Groove-and-splinter with a flint burin	Corners rounded by grinding	Antler beam Handle	Removing pine bark from tree trunk
4	Bone	Direct percussion	Direct percussion	Antler beam handle	Detaching limpets from rocks
6	Bone	Wedge-splinter	Indirect percussion	Hazel handle	Scraping a fresh wild boar hide
6	Bone	Wedge-splinter	Indirect percussion	Hazel handle	Scraping a dry red deer hide
7	Bone	Direct percussion	Indirect percussion	Not hafted	Grinding down sorrel leaves
AT7	Antler	Groove-and - splinter with a flint burin	None	Hazel handle	Scraping wet limpet shell
AT8	Antler	Groove-and-splinter with a flint burin	None	Antler beam handle	Removing limpets from rocks
AT9	Antler	Groove-and-splinter with a flint burin	None	Hazel handle	Extracting limpet meat from shell
AT11	Antler	Groove-	Corners	Antler beam	Scraping a dry red

		and-splinter with a flint burin	rounded by grinding	handle	deer hide
15	Bone	Grooving technique	Indirect percussion	Not hafted	Scraping a wet limpet shell
17	Bone	Grooving technique	Direct percussion	Not hafted	Extracting limpet meat from shell
20	Bone	Direct percussion	Direct percussion	Not hafted	Removing birch bark residues

Table 1: Methods of manufacture, hafting and use for the bevel-ended tools experimentally produced and utilised by Birch (2009)

A diverse series of experiments were then undertaken using these tools, including various forms of plant processing, scraping of both seasoned and fresh animal hides and limpet removal and processing (Table 1). The suitability of each tool for different task was assessed, and the working marks produced by the different actions described. Birch concludes that bone bevel-ended tools were ill-suited to removing limpets from rocks, and the extraction of limpet meat from shells produced a different shaped working edge to those observed in archaeological examples. Antler tools proved more effective for removing limpets from rocks, but again the extraction of limpet flesh produced a working edge which did not correspond to archaeological examples. In contrast to this, Birch notes that a simple sandstone pebble proved highly effective for removing limpets, and so argues that stone bevel-ended tools were most likely to have been used in this task. In regards to plant processing tasks, both bone and antler tools proved effective in removing bark and breaking down nettle stems. However, the weak wear traces produced in these actions suggest that, if used in these activities, bevel-ended tools would have had a considerable use life which extended over many hours of work. Birch concludes that further investigation is needed to ascertain the lengths of time required to produce similar working traces to those observed on archaeological specimens – but that it is possible that some tools were used for plant processing. The bevel-ended tools used in hide-processing activities produced both a wear pattern and bevel-shape which was closest to that seen in archaeological specimens – particularly when softening skins during the curing process. However, Birch notes that tool length had a significant effect on a tool's ability to perform hideworking tasks, and that any tool under 40mm in length would require hafting in order to be used for these activities.

Birch's experimental study is published alongside use-wear and scanning electron microscope analysis for the detection of residual material (Hardy 2009a) on a sample of bevel-ended tools recovered from Mesolithic shell midden sites. Use-wear analysis was confined exclusively to the sites excavated by the Scotland's First Settlers project (Hardy & Wickham-Jones 2003, 2009), and included a total of 44 tools from Sand and Loch Sguirr. The scanning electron microscope analysis was applied to 37 archaeological specimens from shell midden sites across Scotland (Table 2).

Site	Bevel-ended tools analysed
Morton, Fife	1
Druimvargie, Argyll	2
Caisteal nan Gillean I, Oronsay	5
MacArthur's Cave, Argyll	5
Sand	10
Loch a Sguirr	1
An Corran, Skye	13

Table 2: Bevel-ended tools analysed for residual material (Hardy 2009b)

This used a sample of Birch's experimentally utilised tools as reference material and looked to compare the use-wear marks identifiable with a hand-held magnifier (x10 magnification). This examination found that 64% of the archaeological specimens featured longitudinal striations on the beveled surface (Table 3). Four of Birch's tools were examined in a similar manner (AT9, AT11, AT8 and AT3), with only AT11 – a tools used to work deer hides - displaying similar striations. This leads Hardy (2009b) to conclude that the majority of bevel-ended tools were used in hideworking activities.

Use-wear traces observed	Number of archaeological specimens
Longitudinal scratch marks	28
Other types of use-wear (polish etc)	7
Not visible, eroded etc	9

Table 3: Wear traces observed under x10 magification on the bevel-ended tools from Sand and Sguirr (Hardy 2009b)

There are a number of flaws with this conclusion. Firstly, it ignores the other forms of "use-wear" that Hardy observes on archaeological specimens, and there is no data to show whether the "other" types of use-wear can be linked to experimental specimens used for different tasks. Secondly, as not all of the experimental tools were examined it remains possible that other replicated activities may also produce these longitudinal striations. Given that Birch notes the importance of material choices in determining the suitability of tools for certain activities, the exclusive examination of antler specimens also appears to undermine Hardy's conclusion. As all of the bevel-ended tools recovered from Sand are made from bone and not antler (Hardy 2009b), the choice of reference specimens seems inappropriate. Finally, despite Birch's discussion of the different methods used to manufacture the tools, Hardy assumes that all striations on the bevel-end are the result of "use-wear". There is no discussion of the possibility that these markings could have been made during the manufacture of the tools themselves (Foxon 1991) and were not therefore solely the product of use.

Hardy (2009a) also identifies a number of residual substances on the beveled ends of the tools through the use of a scanning electron microscope. These mineral deposits were distinguished from the ores and substances expected to be found within a midden depositional environment, and as such were assumed to have been deposited on the tool's surface during its use. This results in mineral deposits being identified on 19 of the 37 archaeological specimens examined. Hardy notes that the minerals identified are known for their use in more recent times as pigments and dyes, and thus concludes that bevel-ended tools were also used to produce pigments and colouring agents at sites across Scotland. However, she states that the use-wear analysis of the tools from Sand suggest that hideworking was the main activity carried out at this site.

The application of AMS radiocarbon dating to bevel-ended tools from Scotland has produced some unexpected results, which have caused their Mesolithic affinities to be questioned by several authors. Saville (2004, 202) notes that, whilst the majority of directly dated specimens have produced Mesolithic dates, the sites of An Corran, Skye and Balephuil Bay, Tiree have also produced dates which indicate that the chronological range of bevel-ended tools extends throughout later prehistory and into the Iron Age.

2.5 The use of antler as a material in the British Mesolithic

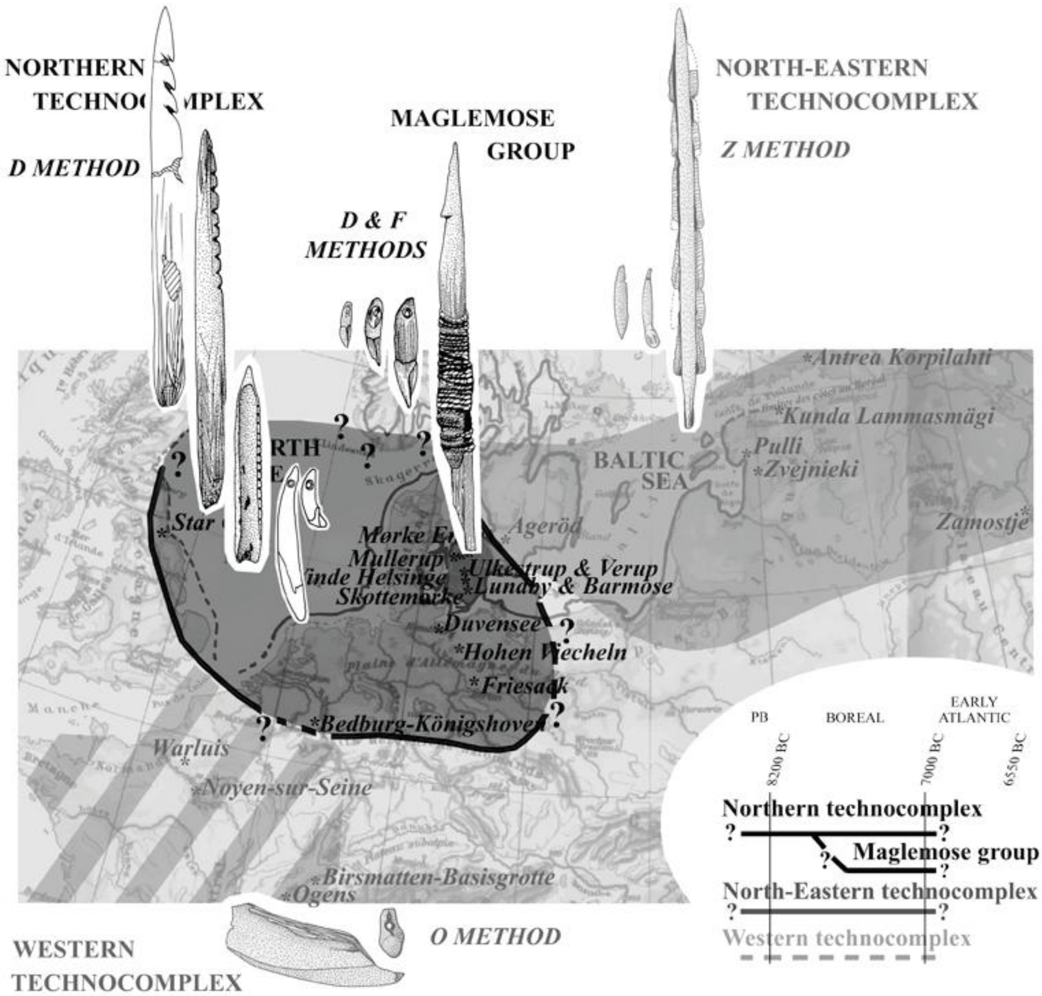


Figure 10: Various osseous technocomplexes of the Maglemosian (David 2007, 43)

Whilst the research reviewed above has tended to focus on specific types of antler artefact in isolation, other studies have sought to address the use of antler more generally in the British Mesolithic. David's work has explicitly examined the use of antler more generally alongside that of bone, in a characterisation of osseous technologies from across Early Mesolithic Europe (E David 1999, 2006, 2007, 2009). Although only dealing with material from Star Carr in Britain, David has characterised the way in which antler and bone was managed as a resource during the British Early Mesolithic as part of this research. This is achieved by taking a *chaîne opératoire* approach to the Star Carr osseous assemblage and identifying the technical decisions made by the inhabitants of the site in regards to their choices of materials and the techniques employed in the manufacture of bone and antler tools. She considers the use of the groove-and-splinter technique for the production of barbed points alongside the methods used to split elk metapodial bones for the production of bodkins and the use of elk antler to manufacture mattocks. This *chaîne opératoire* is then compared to that of other Maglemosian sites from elsewhere in Europe. David is able to define distinct, geographically discrete traditions in osseous technology, based on these shared technical sequences and interprets this as evidence for a diverse set of technocomplexes, producing typologically similar bone and antler tools across Europe (Figure 10). Within these groups, Star Carr falls into the “Northern Technocomplex” – a group which appears to be focused around the North Sea area (and presumably the now-submerged Doggerland).

British Mesolithic studies in the 21st century have been characterised by a more reflexive and critical examination of previous narratives, in conjunction with a more socially orientated research framework. Within these broad theoretical themes, various authors have discussed the materiality of antler during the Mesolithic, and the ways in which antlerworking activities helped structure human engagement within a landscape context.

Bevan (2003) speculates on a range of ways in which people and red deer may have interacted at Star Carr, drawing on a wealth of historical and ethnographic sources. She discusses antlerworking, the red deer frontlets, the role of red deer in Mesolithic rituals and possible hunting methods for red deer at Star Carr; exploring the social aspects of these themes. Although some of this discussion relates to Star Carr exclusively, arguments concerning the social perception of antler as a material have wider implications for the interpretation of antler artefacts at other sites in Britain.

Bevan describes antler as an “instrument of transformation,” (2003, 36), in regards to the annual cycles of growth and shedding, and their prominence during the rutting season. These cycles are suggested to have led to antlers becoming metaphors for life, death and rebirth. Bevan also suggests that the importing of antler from other kill sites may have involved the curation of antlers over long periods of time, and transport over large distances. It is noted that a range of techniques were used for the working of different forms of antler at Star Carr and yet red deer antler is the only material used to manufacture barbed points. It is argued that this shows a clear selection of a particular species, and may represent the desire to incorporate some of the animal’s “essence” into the finished artefact (Bevan 2003, 36). In doing this, Bevan argues that antler as a material has certain properties which could potentially empower it as a key metaphor in Mesolithic cosmologies. This argument is not specific to Star Carr, and has a profound effect on the way in which antler technology and the treatment of antlers may have been perceived at sites across Britain.

In the same volume, Chatterton (2003) discusses life at Star Carr and draws some more interesting conclusions which relate more closely to the archaeological evidence from the site. He distinguishes antlerworking from the everyday “occupational” activities, noting that the areas excavated by Clark do not represent a full suite of *in-situ* occupational activities, but that the ample evidence for the “groove-and-splinter” technique would confirm that this was the location of this specific activity (Chatterton 2003, 72). In this way, Chatterton distinguishes antlerworking from the everyday activities of Mesolithic life, affording it an elevated status. He also notes that subsequent excavations at Star Carr (Mellars & Dark 1998) have failed to produce any more of the evidence for barbed point finishing at the site which was expected by Jacobi (1978), despite the use of high resolution recovery techniques (Chatterton 2003, 72). He does note, however, that the points themselves had been hafted and used, based on the presence of scoring marks and resin on some of the tangs. This leads Chatterton to question the context of deposition of the barbed points; why was there a mixture of broken and unbroken points? Why were the points returned to the site of their splinter extraction for deposition? He notes that no previous interpretations of Star Carr have successfully addressed these questions, and that a functional explanation may be difficult in this instance.

When discussing the Star Carr assemblage, Chatterton notes the occurrence of deer materials alongside other unusual artefacts such as shale beads and amber and comments that this represents a significant “ritual” element to the material deposited at the site (Chatterton 2003, 73). He also comments on the act of placing objects into water, stating that this is a ritual practice which is continued throughout the Mesolithic, but also through British Prehistory more generally (Chatterton 2003, 76). He draws a link between the deposition of barbed points into the lake at Star Carr and the deposition of tranchet axes in Sweden at the Mesolithic-Neolithic transition. He states that in both these cases, the choices of material are significant, echoing Bevan’s (2003) observation that red deer antler was actively selected for barbed point manufacture. He also states that antler barbed points are the “dominant symbol” of the Mesolithic, in contrast to stone axes in the Neolithic (Chatterton 2003, 76). By placing this emphasis on materiality in acts of deposition, Chatterton highlights the significance of red deer, and specifically antler, in ritual aspects of Mesolithic life.

Chatterton uses ethnography to address the meaning of these practices. He refers to the Cree in North America and the Saami of Scandinavia, demonstrating the ways in which hunter-gatherers exert control within their relationship with the animals they hunt, through the structured deposition and treatment of their remains. Chatterton notes the ritualised aspects of mundane economic tasks, which lead to unusual assemblages over time. The Saami in particular have a strict set of rules which govern the ways in which antler and bones from reindeer should be handled, worked and deposited, with certain elements being either used to make tools or placed in water. Failure to comply with these rules can result in the animal spirits becoming offended, which in turn is perceived to effect hunting success. Chatterton (2003, 77) argues that the ritualised treatment of animal remains is a part of the broader hunting cycles in hunter-gatherer group in the Mesolithic, and at Star Carr this can be seen through the structured deposition of red deer remains and materials.

Embedded within discussions of lithic technology in the Early Mesolithic Vale of Pickering, North Yorkshire (Schadla-Hall & Conneller 2003), antlerworking is approached from a radically different angle to the technical studies of previous authors (Clark & Thompson 1953; Clark 1954, 1956; E David 2003, 2006, 2007; C Smith 1989). Schadla-Hall and Conneller (2003) note that Star Carr represents a unique concentration of antler barbed points, in comparison to the other sites within the Vale of Pickering. The possibility of preservation bias is eliminated through the excavation of a series of other waterlogged sites around the edges of Lake Flixton, which have yielded much smaller and “scrappier” organic assemblages (Schadla-Hall & Conneller 2003, 89–91). Links are drawn between the life-histories of the various antler objects deposited at Star Carr, with it being noted that antler removed from the frontlets may have been used for barbed points (Schadla-Hall & Conneller 2003, 102). They suggest that the activities carried out at Star Carr, with the butchery of deer bodies, the consumption of deer meat and the working of deer hides, would have resulted in Star Carr being seen as a place where the boundaries between human and deer identities were explored and blurred. The following of certain rules relating to the deposition of red deer materials at Star Carr would also have acted a means to mediate relations between people and deer. When considered within its landscape setting, Conneller and Schadla-Hall (2003, 103) consider this to be one of the defining features of Star Carr as a place.

Conneller's (2003) discussion of Early Mesolithic life at Star Carr also refers to the way in which antlerworking contributed towards the construction of a social relationship between people and red deer. Again, Conneller (2003, 83) highlights the manufacture and deposition of barbed points as a practice linked specifically to Star Carr. She notes that the activities involved in barbed point manufacture link Star Carr to a network of other places and actions being carried out within the landscape. Using a *chaîne opératoire* approach, Conneller (*ibid.* 84) examines the other processes involved in manufacturing a barbed point, from the killing of deer, the collection of antler, the selection of wood for hafting, and the actions of making and binding the point and haft themselves. This is considered to play a role in intertwining a network of materials, actions and places, and contribute to the social construction of the landscape around Star Carr.

Conneller (2003) compares the frontlets with the similar finds from sites in Germany. Clark's (1954) original parallels are discarded, with Conneller (2003, 83) stating that the Star Carr frontlets do differ from the German examples in the way in which they have been lightened through the removal of material. She suggests that frontlets may have been used to "take on aspects of animal identities," (Conneller 2003, 84), and that this practice itself suggests a more mutualistic relationship between people and red deer than has previously been envisioned.

Conneller develops this discussion on the relationship between people and red deer at Star Carr in later publications (Conneller 2004). She reviews Clark's original interpretation of the frontlets as either/or a hunting aid or mask for ritual dance, and comments that both of these interpretations involve the use of frontlets as a disguise, to hide the human body and create the visual impression of a red deer (Conneller 2004, 42). She notes that this interpretation is restricted by a number of Western dichotomies which may have not existed during the Mesolithic, such as culture/nature, human bodies/animal bodies, objects/bodies. These lead Clark to believe that the frontlets would not have been capable of having a physical effect on the wearers' body. As an alternative approach, Conneller (*ibid.*) suggests that the frontlets may have been used to "reveal, rather than conceal, bodies". She notes the occurrence of corporeal transformations of the body in perspectivist societies, which has been documented through ethnographic work in South and North America (Viveros de Castro 1998). These ethnographies also note the occurrence of "animal affects" in the construction of animal identities. These are specific ways of behaving which are associated with a particular species. Within perspectivist societies, it is deemed possible to harness these behaviours or attributes by transforming the human body into something which incorporates both human and the desired animals' form (Conneller 2004, 43). It is noted that the concepts of "animal effects" may have important implications for the interpretation of artefacts derived from animal materials, as the retention of "animal affects" may have a dramatic effect on the agency of the object itself. Conneller suggest that the "animalness" of the red deer frontlets and antler barbed points was emphasised by their intertwining life histories – both originated from red deer, and the removal of antler in the lightening of the frontlets may have provided raw material for the manufacture of further barbed points (*ibid.* 45-46). Their similar treatment at deposition, both being deposited at Star Carr, could be seen as recognition of their retained red deer "affects" and original species.

Warren's (2006) exploration of Mesolithic technology also includes a stimulating discussion of objects manufactured from antler. In a similar vein to Conneller (2004), he takes a *chaîne opératoire* approach to the bevel ended tools found at coastal sites in Scotland. He states that red deer bones and antlers were brought in to midden sites, following hunting and butchery elsewhere, for bevel tool manufacturing (Grigson & Mellars 1987). He also notes that procuring shed antler may have been a difficult task, being distributed sparsely in forested environments where other animals would regard them as a food source (Warren 2006, 18). The manufacture of the bevel-ended tools would also have involved the use of other tools, such as hammers, wedges, chisels and scrapers, which would have their own histories and raw materials. Through this discussion, Warren shows how even the simplest forms of bone or antler tools have a range of associations with different activities and places, which contributed towards the social construction of Mesolithic landscapes (*ibid.*).

Warren takes a similar approach to deer materials from Star Carr. He also acknowledges "an intimate knowledge of the properties of raw materials," (Warren 2006, 23) which is shown with the selection of antler for barbed points. The mechanical properties of antler mean that it is more resistant to impact than bone. Jacobi's (1978) argument that barbed points were finished elsewhere is again repeated by Warren, and he notes that this extends the actions involved in making and using barbed points out across the landscape. He also notes the choice made to return the barbed points to Star Carr after their use, and deposit them alongside other antler objects (Warren 2006, 23). It is argued that, through these actions, Star Carr was a site where relations between people and deer were negotiated, through the structured treatment of red deer materials and remains. Through the adherence of these rules, deer fertility and hunting luck was assured (*ibid.* 24). Warren makes explicit the link between antler technology and human/animal relations with the statement:

"Technology, far from being a rational abstraction, can be seen to be intimately associated with the social reproduction of worldviews. Ideas about the relationships between people and red deer were brought into being and reproduced through technical choices involving the manufacture, use and discard of barbed points,"

(Warren 2006, 24)

This is then applied to technological choices made at the Early Mesolithic site of Thatcham, Berkshire (Wymer 1962). Warren notes the upturned red deer skullcap found propped up above the Mesolithic land surface, with an antler beam and flint-knapping debris found in close association. He argues that by using the red deer materials as both a hammer and anvil in flint knapping, it may have been possible to infuse the created stone tools with some of the essence or associations of red deer (Warren 2006, 24).

Most recently, Conneller (2011) has extended her previous considerations of the materiality of antlerworking at Star Carr to explore the articulation of specific deer genders and identities. She notes that *chaîne opératoire* approaches to Mesolithic bone and antler technology often begin with the procurement of material, but do not recognise the earlier phases of the originating animals growth, life history and death (Conneller 2011, 51). This, she argues, neglects the aspects of animal behaviour or perceived identity which may confer meaning on the material itself – and therefore influence the way in which humans choose to engage with that material. She also highlights the need to understand "animalhood" alongside personhood within the archaeological record, and that that studying the use of animal materials in past societies is a potential avenue through which these enquires can be pursued (Conneller 2011, 53).

In the case of Star Carr, Conneller argues that the relatively high frequency of red deer post-cranial remains within the site's faunal record and the identification of healed lesions on several red deer scapula indicate that people were frequently encountering red deer in the wooded landscape around the edges of Lake Flixton. Yet the dispersed nature of modern red deer populations living within forested environments implies that individual animals may have been difficult to locate and monitor, and as such these encounters required effort and skill in understanding deer tracks and movements (Conneller 2011, 59).

Conneller also uses the faunal analysis of Legge and Rowley-Conwy (1988) to argue that the inhabitants of Star Carr were able to recognise deer of specific ages, and interact with them in different ways. The dominance of immature animals of both sexes within the post-cranial red deer faunal remains suggests that these animals were most frequently hunted and killed (Conneller 2011, 60). In contrast to these "young, naïve animals of either sex" (*ibid.*), the antler being brought to the site appears to originate exclusively from animals over the age of three years and exclusively originates from male red deer. Whilst the presence of unshed antlers suggest that some of these may have come from animals which had been hunted and killed, the relatively low occurrence of mature male red deer post-cranial remains within the Star Carr faunal assemblage indicates that these animals were less frequently being butchered and presumably consumed at the site. As such, there appears to be a distinction between the relationship people shared with prime age male red deer to that of younger animals of both sexes (*ibid.*).

Conneller goes on to argue that these distinct red deer identities were further articulated through the working of bone and antler from the animals – utilizing the concept of "animal affects" in a similar manner to her previous work (2004). The use of antler from red deer stags that were old enough to participate in the rut for the production of barbed points is interpreted as a decision made to incorporate the violent, spearing actions of antlers in rutting contests with the stabbing actions of barbed points when used as hunting projectile points. In contrast to this, she notes that the animals whose remains were selected for the production of antler frontlets were notably smaller than those used to produce barbed points. Additionally, the way in which the antlers of the frontlets are reduced – creating a single, slender "spike" – mimics the form of yearling stags and as such relates to the younger animals which appear to have been consumed at the site. Thus, Conneller is able to illustrate the complex nature of animalhood at Star Carr, and interpret the use of antler within the wider context of human/red deer relations.

The emphasis of the human/deer relations in more recent studies of Mesolithic antlerworking strongly advocate the contextualisation of antler technology within the bigger picture of the way that people encountered and perceived deer during the period. Conneller's work in particular highlights the potential for research into the use of antler for exploring concepts of animal identities and materiality within past societies. In considering the ways in which humans may have encountered animals during life, Conneller is able to situate her discussions of the treatment of antler within the wider context of human/red deer interactions – and thus is able to sketch a characterisation of the ways in which Mesolithic people may have perceived a particular species of red deer which draws on human action (through technological choices, hunting actions and the deposition of deer remains) and the actions of the animals themselves (through an awareness of deer biology and behaviour within specific environmental contexts.)

2.6 Acquiring antler and hunting deer in the British Mesolithic

Although "deer hunting" has long been acknowledged by archaeologists as an important aspect of Mesolithic life (Finlay 2000), the exact nature of these interactions between people and deer has been reviewed a number of times. These discussions are important as they provide a snapshot of a very specific set of circumstances under which people encountered deer during the Mesolithic.

Early discussions of deer hunting methods tend to focus on the types of technology employed; Clark (1952) notes that the bow and arrow became widespread across Europe during the Mesolithic, and that this is evidenced by the appearance of microliths throughout the continent. He also comments that nooses and snares could also be employed to catch big game – particularly elk (*ibid.* 35). The use of snares has important implications for the ways in which people encounter deer, as these methods rely more on predicting the movements of animals, and understanding their behavioural habits. It also allows an animal to be killed without being encountered whilst alive.

A more detailed discussion of possible deer hunting methods is first provided in Clark's (1972) settlement model for Northern England. Here it is noted that people would have encountered deer in different ways at different times of the year, with dispersed upland groups being hunted by small groups of people during the summer, and aggregated groups of males being specifically targeted in lowland areas during the winter. This distinction is important, as it implies that the nature of hunting encounters would have varied throughout the year – with certain sexes being hunted and killed more frequently during specific seasons and within specific landscapes.

Jarman's (1972) study of the ecological relationship between people and red deer in the European Mesolithic (with specific reference to Britain and the faunal material from Star Carr), offers an alternative to Clark's account of hunting encounters. When addressing subsistence strategies, he comments that "very few species provided the bulk of animal protein and were apparently staple foods of diverse "cultural" groups for several millennia, and that red deer was commonly the most important of these species," (Jarman 1972, 125). This results from the statistical analysis of 165 European Mesolithic faunal assemblages, which shows that red deer and pig are in the dominant species in the vast majority of cases, and that the mean number of individuals represented at each site is almost double that for red deer than pig (*ibid* 126). He also notes that the significance of elk is restricted to certain geographical regions and to certain periods of time, and suggests that this may represent the poor ability of elk populations to cope with human predation. He notes that, in England, the exploitation of elk is negligible at sites post-dating Star Carr (*ibid* 126). He also states that roe deer are common in assemblages across Europe, but rarely occur in high enough quantities to suggest the targeted exploitation of the species. As such, Jarman argues that red deer were encountered more frequently than other species of mammal in hunting contexts.

In relation to the importance of red deer in Britain, Jarman states that continuous occupation of the British Isles by the same genetic populations from the end of the ice age means that the same groups of people would have hunted the same deer populations and their offspring for a period of up to 5,000 years. The continued importance of red deer for such a long period of time would have led to people effectively becoming dependant on the survival of these red deer. He notes the sensitivity and balance required to maintain predator/prey relations for such a prolonged period of time, and the fact that mechanisms must have existed to prevent the over hunting of red deer in order for this relationship to continue. He states that in such seemingly balanced and stable ecological relationship, it is not simply a case of the most effective predator or prey outlasting its counterparts (*ibid.* 131).

In the case of Star Carr, Jarman notes that an unusually high percentage (70%) of the animals killed were male. He examines red deer population dynamics and finds that whilst males are marginally more common than females at birth, differential mortality rates normally lead to a 1:2 ratio in adult herds between males and females. The ratio of 7:3 found at Star Carr, therefore, does not represent the base population levels. To explain this, Jarman outlines four hypothesis; a)that adult males are inherently more vulnerable to hunting than adult females, b) that the hunting methods used by people in the British Mesolithic resulted in the unconscious selection of males eg through coincidences in the occurrence of hunting seasons, hunting grounds, or the techniques themselves, c) that males were consciously selected by hunters or d) that some form of herding or husbandry was being carried out during the British Mesolithic (*ibid.* 132).

Jarman acknowledges that the concept of herding and husbandry is rarely discussed in the context of the Mesolithic, being more traditionally associated with the advent of agriculture and domestication during the Neolithic. However, he points to a number of historical instances where deer have become “semi-domesticated” and responsive to human behaviour. He states that the management of wild deer herds in deer parks is a practice dating back to the Norman Conquest, and has been used to improve the size of stags and the quality of their antlers. He also notes red deer respond well to winter feeding, and can be tamed with relative ease – making reference to 14^{th} and 18^{th} century accounts of carriages drawn by deer in England (*ibid.* 132).

He proceeds to work through these hypotheses in relation to the Star Carr sex profiles, and argues for the elimination of all of them other than intentional selection or herding/husbandry. Moving on to discuss these in more detail, Jarman notes that the distinction between these two practices is not clearly defined. It is difficult to be selective about the animals being hunted and yet maintain a breeding population for the amount of time that people exploited deer in the British Mesolithic without having some knowledge of red deer population dynamics. From an economic perspective, Jarman notes that young animals and males are the logical choice of prey in terms of herd-management. Young animals will have received the least investment in terms of fodder and time from the herder, and thus are “more easily replaced” (Jarman 1972, 133). Non-dominant males can also be culled without having a significant effect on the long-term future of the breeding herd, as the majority of females are impregnated by a single dominant male during the rut (*ibid* 133). He states that this appears to have been the case for Star Carr, with the deliberate selection of males preserving the long-term future of the red deer population.

Mellars (1976) discussion of intentional burning in the Mesolithic also has some important implications for the way in which people would have encountered deer in a hunting context. He notes the ethnographic records from Northern America which show the use of fire to manage forest environments by a range of hunter-gatherer groups. He outlines the biological impact of controlled burnings of areas of forest which would increase the population densities of deer species living in these pre-determined areas. Studies of forest fires in North America show the increase in low-level grazing and the diminishment of cover attracts more deer, which are better nourished and therefore provide a higher yield in terms of biomass. Mellars (1976) also discusses the optimum size for controlled forest burning, concluding that different species such as elk and roe deer will respond differently to variations in burn size, and that maximum red deer biomass return would be achieved through a patchwork of small burns staggered over several years to create variations in recovery successions for the vegetation in the burn areas

As noted above, Mellars focuses his model of the ecological impacts of controlled vegetative burning on the responses of deer. He argues that the regrowth of low-level browse would attract deer to these areas, making their movements more predictable and therefore increasing the regularity of people encountering deer. The added nutritional value of the fresh browse, Mellars argues, would also increase the biomass of the animals, so not only would the people be encountering deer more regularly at these locations, but also the deer themselves would be larger animals than might be found at other points in the landscape. He states that the variations in species populations, based on the size and character of the burns, would allow people to intentionally attract certain species to certain locations. Further to this, the attraction of large populations of deer into small areas would allow hunters to become selective about the age and sex of the individuals that were going to be killed.

Mellars acknowledges that these changes in the nature of encounters between people and deer have implications for the perception of the animals themselves (Mellars 1976, 38–40). He notes that burning may have acted as a stimulus for concepts of ownership in hunter-gatherer societies, as burning requires fore-planning and effort could have meant that the deer attracted to certain areas were considered the property of those who instigated the burn. Concepts of control over animals may also have developed, as burning allows the distribution of deer populations to be manipulated at a landscape level. This may have been furthered by the use of drive hunting in the burnt areas, with the concentrated populations of animals being forced along set routes before the kill (*ibid.* 40).

Clark’s (1972) broad model is further explored by Jacobi (1978), who adds further insights into the specific nature of people/deer encounters during hunting. He notes that the winter aggregations of red deer could have been maneuvered and cajoled into the natural traps which would have formed with the boggy or icy terrain at the edges of Lake Flixton, where barbed points could have been used at close range to finish the kill. Alternatively, barbed points may have been arranged in traps at locations into which deer could be driven (Jacobi 1978, 320–21). This possibility is explored through comparisons with a piece of rock-art from

Northern Spain (Figure 11) depicting a red deer herd being driven onto a group of concealed archers. Jacobi uses this to suggest that drive hunting may have been a group activity and thus has important social implications for the way in which people worked with one another (*ibid.* 327).

Figure 11: Spanish rock art depicting a red deer drive (In Jacobi 1978, 327)

In upland areas, Jacobi comments on the clustering of small Mesolithic hunting camps around areas with good views of the surrounding upland areas. This is linked to the summer burning of large areas of moorland in northern England, in order to concentrate deer populations in certain areas (Jacobi et al. 1976). It is suggested that settlement during the summer may have been focused at locations where deer could be monitored (Jacobi 1978, 325). Again, Jacobi's discussion has some implications on the nature of human and deer encounters. His model of group hunting suggests that encountering deer whilst hunting was a communal (rather than individual) experience for both people and red deer. The idea of vantage points with favourable views of animal movements also brings forward the idea that people could encounter deer that were not in their immediate vicinity, and that spotting groups of deer was the first stage in a prolonged series of hunting encounters which resulted in the violent death of the animal at close quarters through the use of barbed points.

Andresen *et al.* (1981) suggest a slight alternative to Jacobi (1978), in the form of drives geared to the exploitation of single animals. They note the local topography, and suggest that the gravel peninsula on which Star Car is located would be ideal for driving deer into in order to immobilise them (Andresen et al. 1981, 43). They distinguish their argument form that of Jacobi (1978) by stating that driving can be used to hunt individual animals rather than large herds. Again, this implies a distinction in the nature of human/deer encounters, with groups of people interacting with individual animals.

Myers' (1987, 1989) discussions of changing lithic-based hunting technologies within the Mesolithic uses flint tool assemblages to characterise the ways in which people hunted and encountered deer during the period. He notes that, in the absence of faunal remains, it is necessary to study the lithic record in order to accurately address the issue of subsistence strategy in the Mesolithic (Myers 1989, 79). Some of the general changes in toolkits between the Early and Late Mesolithic are highlighted, the early period being characterised by the occurrence of uniserial bone and antler barbed points, and large microliths which would have been hafted to give a flint tip and single barb – based on preserved examples from Sweden. Flint was knapped to produce long, elongated blades which could then be worked into different types of tool (Myers 1987, 83-84). In contrast, the Late Mesolithic sees the disappearance of osseous barbed points, and the replacement of larger microliths with a more varied range of much smaller forms. These are believed to have been hafted in a way which includes multiple flint barbs along the length of the arrowshaft. Flint knapping techniques also change towards the production of much less regular and squat blades/flakes (*ibid.* 83-84).

These changes are linked to a shift in hunting strategy within the ecological context of Mesolithic Britain, with specific reference to the hunting of deer (*ibid.* 88). He states that elk become extinct before the transition from Early to Late assemblages, but that auroch, red deer, roe deer and pig would have been the chief prey during the period. It is then argued that the shift from early to late assemblages coincides with environmental changes during the 7th millennium uncalibrated BC. Myers notes a decrease in lowland temperatures during this period and the replacement of birch and pine woodland with mixed deciduous forests, accompanied by dense understory vegetation (*ibid.* 90). It is argued that deer migratory habits would have been disrupted by these changes, making it more difficult to predict their movements. Despite the earlier emphasis of a balanced hunting economy, only the movements of deer species (both red and roe) are included in this discussion (*ibid.* 89).

Myers draws on the theories of risk management in hunter-gatherer subsistence patterns to argue that all of these changes in lithic technology are designed to reduce the risk involved in hunting. He states that the use of microlithic barbs, as opposed to osseous points, means that arrows would have been more easily maintained and repaired. The increased variability of microlith forms represents a specialisation in arrow design, making the weapons more accurate and effective at killing different prey (*ibid.* 86-87). Changes in knapping technique are said to represent a reduction in the time available for hunting preparation, with less care being taken over the production of blanks (*ibid.* 88). Myers (1989) discussion of risk management appears to suggest that encounters between people and deer became progressively less predictable or controllable during the Mesolithic. He argues that the shift from broad blade to narrow blade flint toolkits at the Early/Late Mesolithic transition reflects a lack of certainty, caused by an increase in the unpredictability of deer behavior.

Bevan also examines the possible ways in which red deer were hunted at Star Carr (Bevan 2003, 38), and notes that the Saami utilise pitfall traps and corralling into fences and stone walls to drive hunt reindeer. She also states that reindeer are particularly vulnerable in water, and that animals may have been driven into the lake at Star Carr to be killed from boats in the water. If killed in the lake, this is argued to have attached additional significance to the practice of depositing red deer remains back into the lake after carcass processing. The use of barbed points as spearheads in this activity is also said to be potentially significant, as the material from the species is used to kill an animal of the same species – Bevan suggests that this may have been perceived as the animal “killing itself” (Bevan 2003, 38).

Another potential method of hunting deer at Star Carr is suggested to be through decoys. The Saami are said to use tame females to lure males into close proximity to hunters. Hunting of this type is said to explain the heavy bias towards males in the Star Carr assemblage (although this has been reviewed by Legge and Rowley-Conwy (1988)). The presence of birchbark rolls at Star Carr is also highlighted as a potential material for the manufacture of birch whistles, which are said to have been used by the Cree of North America to lure deer closer to hunters (Bevan 2003, 38). The use of the frontlets as disguises or decoys is also considered. Bevan comments on the changes in stag behaviour during the rut, with the competitive displays of roaring and fighting. This would not only make stags easier to locate during this season, but also would make them vulnerable to decoy hunting using frontlets, as they may have been attracted towards a challenging stag (*ibi.d*). The hunting of particularly dominant or fertile males during the rut is suggested to have had implications for the perception of the act of hunting, which may have played a role as a rite of passage for young men to enter manhood and sexual maturity themselves (*ibid.* 39).

Finlay (2000) notes the intense discussion of deer hunting within narratives of the British Mesolithic, and provides a critique of its implications for Mesolithic Studies more generally. She comments on the prevalence of deer within Mesolithic studies and the use of “red deer and the hunt as dominant motifs for the Mesolithic,” (Finlay 2000, 68). She notes the associated relationship between red deer hunting and bow and arrow technology, quoting Rozoy’s reference to the Mesolithic of Europe as “the age of bowmen and red deer,” (Rozoy 1989). Finlay traces the significance of red deer back to the excavation of Star Carr, and the role that Clark (1972) assigned to red deer hunting in settlement patterns. She also notes that, despite the substantial arguments against Clark’s model, it retains a surprising level of credibility and influence, citing Mellars (1998) use to interpret occupations at Pointed Stone. Finlay also comments on the intimacy of the relationship between people and red deer, which is suggested to be close to husbandry by Jarman (1972), and notes that this type of special relationship is not talked about in reference to other species during the period (Finaly 2000, 69). The role of red deer in cosmology is also commented on, with attention being drawn again to Star Carr and the importance that the frontlets have played in crossing red deer from the economic sphere into the cosmological sphere of Mesolithic life. Finlay notes Clark’s (1954) discussion of fertility and sexuality in relation to the frontlets, and that these symbolic properties are only considered within the context of masculine attributes (Finlay 2000, 69). This divergence of deer into other strands of discussion is also noted for the more traditional economic research themes in the British Mesolithic, with red deer developing from a source of calories, to a vital raw material resource providing antler, bone and hide for a range of basic economic activities. Finally, Finlay notes that the prominence of red deer hunting in the British Mesolithic has a huge influence on the ways in which gender is perceived and discussed in the period. Red deer hunting is an activity implicitly associated with males and masculinity – for both the predator and prey. This is linked to other depictions of deer hunting from both the Classical and Medieval worlds, to show a strong connection between deer hunting prowess and masculinity in our own worldview (Finlay 2000, 70).

The above discussions describe a range of different contexts in which people may have encountered deer during the Mesolithic. It can be noted that these exclusively on hunting. The work of Finlay (2000) has highlighted the implicit gender stereotypes implied by many of these discourses, and the problems this can pose for Mesolithic research. There is a startling lack of discussion surrounding the types of encounter which *do not* occur during hunting, such as chance encounters and the observation of deer tracks or calls. Although less obviously archaeologically visible, these types of encounter would have undoubtedly occurred during the Mesolithic, and have very different gender connotations.

2.7 Summary and conclusions

This review demonstrates that the use of antler by people in the British Mesolithic is a topic which has been discussed by scholars since the very inception of the Mesolithic Studies itself. Although the work of Bishop (1914) proved a significant milestone in establishing the Mesolithic affinities of the antler artefacts associated with shell midden and cave sites of the "Obanian" culture, an awareness of the importance of antler within the Obanian economy for the fabrication of bevel-ended tools, mattocks and biserial barbed points had already been developed by the work of previous authors (Anderson 1895, 1898; Munro 1908) prior to the confirmation of its Mesolithic status. At a similar time, unsierial antler barbed points were also being linked with the Maglemosian culture of Central Europe, a link which had been made since the very start of the 20th century (Armstrong 1923). As such, it can be seen that an awareness of the use of antler in the production of Mesolithic material culture is apparent in the very earliest literature concerning the British Mesolithic.

However, despite the lengthy history of research into the use of antler our collective understanding has been dominated by a very limited number of archaeological sites. In Scotland, the earliest discovered shell-midden assemblages have provided the fuel for the majority of research into the use of antler – with the Oronsay shell middens being seen as the focus of interest throughout the development of Mesolithic Studies (Bonsall 1996; Clark 1956; Finlayson 1995; Griffitts & Bonsall 2001; Hardy 2009a; Warren 2006). Within southern Britain, research into the use of antler has been similarly dominated by the Star Carr assemblage (Bevan 2003; Chatterton 2003; Clark 1954, 1956; Conneller 2004, 2011; E David 2006, 2007; Elliott & Milner 2010; Elliott 2009; Warren 2006). This has created a biased and unbalanced understanding of antler technology in the British Mesolithic, with little appreciation for the spatial or chronological variation further than the Early Mesolithic/Late Mesolithic and East Yorkshire/Western Scotland, distinctions that were originally drawn by Clark (1956). It should be stressed that these sites date to the very earliest and very latest phases of the Mesolithic period and are separated by approximately 5500 years. Yet this reductionist comparison has yet to be developed in over 50 years of subsequent research into the period. Gazeteers of Mesolithic finds (C Smith 1989; Wymer & Bonsall 1977) demonstrate that evidence for the use of antler in the Britain is distributed across England, Scotland and Wales – yet with the exception of Smith (1989) and Wymer et al. (1975), little research has been carried out on the spatial variation in the use of antler.

The application of AMS ^{14}C dating has helped to refine many of the previous theories regarding the chronological distribution of antler artefacts within the British Mesolithic on a broad scale – ruling out some of the previously held views on the exclusively Mesolithic affinities of base mattocks and uniserial barbed points (Tolan-Smith & Bonsall 1999). This has highlighted some of the problems created by focusing on the material from a limited number of sites, but also the potential for artefacts from insecure or poorly archived contexts to contribute towards our understanding of Mesolithic antler technologies within Britain. Despite the lack of secure stratigraphic information for the majority of antler finds from Britain, it is now possible to discuss their contribution to our understanding of Mesolithic antler technology as their typological affinities have been confirmed within a British context.

During the 21st century, theoretical developments within British Mesolithic studies have placed an increased focus on the use of antler. The potential for exploring the relationship between people and animals through the treatment of animal materials has been stressed by several authors (Bevan 2003; Chatterton 2003; Conneller 2003, 2004, 2011; Schadla-Hall & Conneller 2003; Warren 2006). When the source of the material is considered, antler has been used as an avenue for exploring the relationship between people and red deer specifically. This has been facilitated by the recognisable nature of antler as a material; as discussing the interactions between people and animals through the study of bone tools can often be hampered by the fact that bone artefacts can often be impossible to attribute to a specific species of animal.

In addition to this, taking a *chaîne opératoire* approach to the sourcing, production, use and deposition of antler objects has been shown to be a useful way of entwining discussions of technology within discourses concerning the negotiation and articulation of hunter-gatherer landscapes (Conneller 2011; Schadla-Hall & Conneller 2003; Warren 2006). These two themes have been elegantly married by Conneller in her discussion of the ways in which Mesolithic people encountered deer in the woodlands around Lake Flixton, and the relationship between these interactions and the use of antler at Star Carr in the articulation in distinct deer identities based on the recognition of age and gender differences.

Yet these discussions remain limited in their focus; all of these papers deal with the Vale of Pickering landscape, based on analysis of the Star Carr assemblage. Warren (2006) provides the sole exception to this with his discussion of bevel-ended tools at Oronsay and the seascapes of the Inner Hebrides. Whilst innovative in their approach, there still remains a large geographical and chronological gap in our knowledge of these issues across Britain. Is the use of antler at Star Carr typical of other sites across Britain? Can we see variations in the use of antler at other sites which might suggest a different type of relationship to that described by Conneller? What can differences in the treatment of antler from species other than red deer tell us about the nature of different people/animal relationships? All of these questions remain unanswered whilst research continues to focus exclusively on a limited number of the sites available for study.

Methodologically, the success of David in characterising the specific techniques used to work antler and bone at Mesolithic sites across Europe marks an exciting development for the study of antler in the British Mesolithic more generally. The ability to discuss the *chaîne opératoire* of antler tool manufacture directly offers the potential to further explore the issues raised by the recent theoretical shifts in people/animal and technology/landscape discourses. However, the limits of her analysis within Britain to a single assemblage – Star Carr – further exacerbates the problem discussed above.

In summary it can be seen that, whilst the study of antlerworking in the British Mesolithic can be traced back to the very origins of the Mesolithic Studies, developments in our understanding of this practice have been inhibited by a focus on an extremely limited range of sites. This may be explained partly by the scarcity of antler finds from securely dated stratigraphic contexts in Britain. However, since the advent of AMS ^{14}C dating and the refinement of the Mesolithic affinities of certain artefact types, it is now possible to ascribe finds from all over Britain to the Mesolithic based on a more nuanced understanding of typology and chronological distribution (Tolan-Smith & Bonsall 1999). Theoretical developments since the advent of the 21st century have advocated the use of a *chaîne opératoire* approach to the use of antler in the British Mesolithic, to allow the integration of technological discussions of antlerworking with debates surrounding the relationship between people and deer and the structuring of Mesolithic landscapes. This has occurred alongside methodological developments in the study of prehistoric osseous technologies, which allow specific technical actions to be identified within the archaeological record and synthesised into a *chaîne opératoire* of artefact production (E David 2003).

This creates a huge potential for further study of the worked Mesolithic antler material from Britain, and an opportunity to characterise the *chaîne opératoire* of antler artefact production throughout the British Mesolithic. Further to a solely technological study, this characterisation also offers the potential to provide insights into the relationship between people and deer throughout the period when considered alongside the ways in which people may have encountered these animals.

Chapter 3: Methodology

3.1 Introduction

This chapter will fulfill Objective 2 of the thesis by aiming to outline the methods employed in the traceological analysis of prehistoric worked bone and antler material. The first objective needed to fulfill the chapter aim is to provide a broader context for the development of the approach, and give some historical background to the study of prehistoric osseous industries. This will be achieved by briefly outlining the historical development of the method, and the ways in which it differs from previous studies of bone and antlerworking. The second objective of this chapter will be to outline the traceological methodology used to identify and record working marks on antler and bone material. Training in the method was undertaken under the personal tuition from Éva David at CNRS Nanterre in October 2010. The objective will be achieved through an account of the process of analysis, recording and interpretation, as well as a summary of the potential research outputs offered by the approach. The final objective of this chapter is to describe in detail the 20 osseous working techniques documented in the Mesolithic archaeological record (E David 1999), which can be used to characterise antlerworking in Britain. This will be achieved through a systematic review of the techniques identified in David's work, and utilisation of archaeological reference material to illustrate the ways in which these working techniques can be identified.

3.2 Background

The methods of analysis used in this study were first devised and utilised by David in her doctoral thesis (E David 1999). This drew on pre-existing methods for the quantification and analysis of Neolithic and Bronze Age assemblages (Billamboz 1977), which classify and record bone and antler *debitage* alongside finished artefacts in order to characterise osseous industries at sites in France and Switzerland. Through the analysis of the relative abundance of specific artefact and *debitage* pieces within these assemblages, interpretations are drawn as to the stages of artefact manufacture being carried out at specific sites. In considering the *debitage* alongside the artefacts, this form of analysis allows the integrated discussion of manufacturing processes and artefact typologies. This approach also allows the spatial structuring of osseous industries to be discussed, and the ways in which this structure can vary through time. An emphasis is placed on the understanding of the site-level taphamonic factors and preservation biases which affect specific archaeological assemblages (E David 2007), so that the absence of *debitage* types is not erroneously attributed to anthropogenic action.

David takes these principals of studying both artefacts and *debitage,* and applies them to 15 of the classic Maglemosian sites of Northern Europe in her doctoral thesis (E David 1999). Of the sites analysed, Star Carr is the only assemblage from the British Isles. Through the systematic study of working marks and validation of their identification through a programme of experiments carried out at the Sagnlandet Lejre Experimental Archaeology Centre, David is able to go further than simply quantifying the osseous assemblages, and discusses the specific working techniques used in the manufacture of bone and antler artefacts. This resulted in an increase in the number of known osseous working techniques from 13 to 20 (David 2007, 38) and a comprehensive definition of each of these techniques and their associated working marks. Through the study of the occurrence of these techniques, David is able to characterise Maglemosian sites in much more detail than has previously been attained, picking out subtle variations in the technical choices made by Mesolithic people in different areas of Europe (E

David 2003), within assemblages which were previously believed to be relatively homogenous. This has allowed the identification of discrete "techno-complexes" within the European Maglemosian, through the definition of a set of geographically-specific methods for the production the bone and antler artefacts that are characteristic of Magemosian material culture. Application of the traceological method to worked osseous material has also illuminated variation in technologies on an intra-site level. For instance, the analysis of worked beads from funerary and occupational contexts at Zvejnieki, Northern Latvia has shown variations in the techniques used to produce typologically identical artefacts in different stratigraphic contexts (E David 2006). This fascinating example of technological variation also emphasises the role that the social context can play in the technical choices made by past peoples.

3.3 Process of analysis

The following section will outline the method used in this thesis to study the worked Mesolithic antler material from Britain. Training was undertaken at CNRS Nanterre, Paris under the supervision of Éva David in October 2010 – made possible by the generous co-operation of Èva David and Jacques Pelegrin (Director of CNRS Nanterre)

David's method of analysis comprises of four major stages of recording for each piece of osseous material recovered from an archaeological site. The first stage consists of a hand survey to record the maximum length, width, thickness and weight of the piece – as well as any anatomical measurements that are possible to record. The most commonly intact biometric measurement in worked antler is the circumference at the burr (von den Driesch 1976, 35), although other details such as the length, width, thickness of the beam and tines can also be recorded. This is usually carried out using a set of digital metal calipers, although in cases where material is too fragile, plastic calipers are used. A hand tape is used to take longer measurements beyond the range of calipers. In the case of antler artefacts, typological features such as the length, width and thickness of working faces, angle of working edges, diameter of perforations and numbers of barbs are also recorded during this phase.

Secondly, a technical description of the piece is carried out, using the methodology outlined by Voruz (1984). This method of shorthand description allows the character and occurrence of working marks, their location and relationship to other markings and surfaces to be recorded quickly and consistently. It is also used to characterise the shape, form and condition of working edges. When necessary, this stage can be aided by the use of a low powered light microscope, to address specific questions such as the relationship between overlapping working marks.

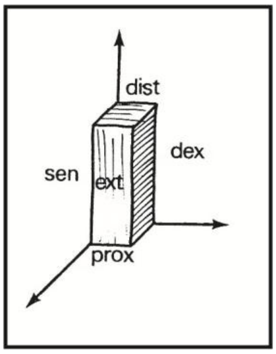


Figure 12: Voruz's orientation of osseous materials (1984, 287). "ext" denotes the exterior surface of the osseous material, "sen" and "dex" are Latin translations of "left" and "right" and "prox" and "dist" are abbreviations of the osteological terms "proximal" and "distal".

This method of recording relies heavily on the consistent orientation of artefacts and *debitage* pieces. However, previous discussions of British Mesolithic antler artefacts have been inhibited by an element of ambiguity surrounding the terminology and orientation used in their description. Clark's discussion of the barbed points from Star Carr (1954) utilises terms such as "dorsal" and "ventral" to refer to specific edges of the artefacts being described, yet he fails to provide any illustration to indicate which edges these terms correspond to. He also uses multiple terms to refer to the same aspect of the artefacts – with the same side being termed the "barbed" and "ventral" at different times (Clark 1954, 128). This ambiguity is highlighted by subsequent discussions of uniserial barbed points in Britain (Clark & H Godwin 1956; Hallam et al. 1973; Lacaille 1961; Wymer et al. 1975), where the description of working methods and the character of barbs is often confusing and unclear. Particular difficulty is encountered when trying to describe biserial barbed points, as the terms "ventral" and "dorsal" seem to have no relevance to artefacts which are barbed along both sides. This is typified by Mellars' (1970, 337–338) description of the Whitburn biserial point, which refers to differences between the barbs on the "left" and "right" sides of the artefact, without being able to specify from which aspect this distinction is made. To avoid this type of confusion and for the sake of terminological consistency with the other types of worked antler material included in this thesis, Voruz's (1984) principals (Figure 12) are applied to barbed points here. In the case of more fragmentary *debitage*, bevel-ended tools and barbed points (when it is impossible to establish the anatomical orientation of the parent material), distal and proximal ends are defined arbitrarily for the sake of clarity and consistency. Wider ends are termed proximal and narrower ends termed distal. Once distal and proximal have been established, SEN and DEX sides are assigned from the exterior view in accordance with Voruz (1984). The three main artefact types encountered in this thesis are barbed points, mattocks and bevel-ended tools. Their orientations are shown in Figure 13.

Thirdly, the pieces are photographed to give an impression of the overall character, and to illustrate working marks where present through the manipulation of the source of raking light. Digital photographs were taken using Canon EOS 350D Digital camera. Each pieced was photographed from multiple aspects to give a general impression of size and form, and specific areas of working or taphonomic significance were also focused on to document their occurrence and character. These photographs are archived in Appendix 5.

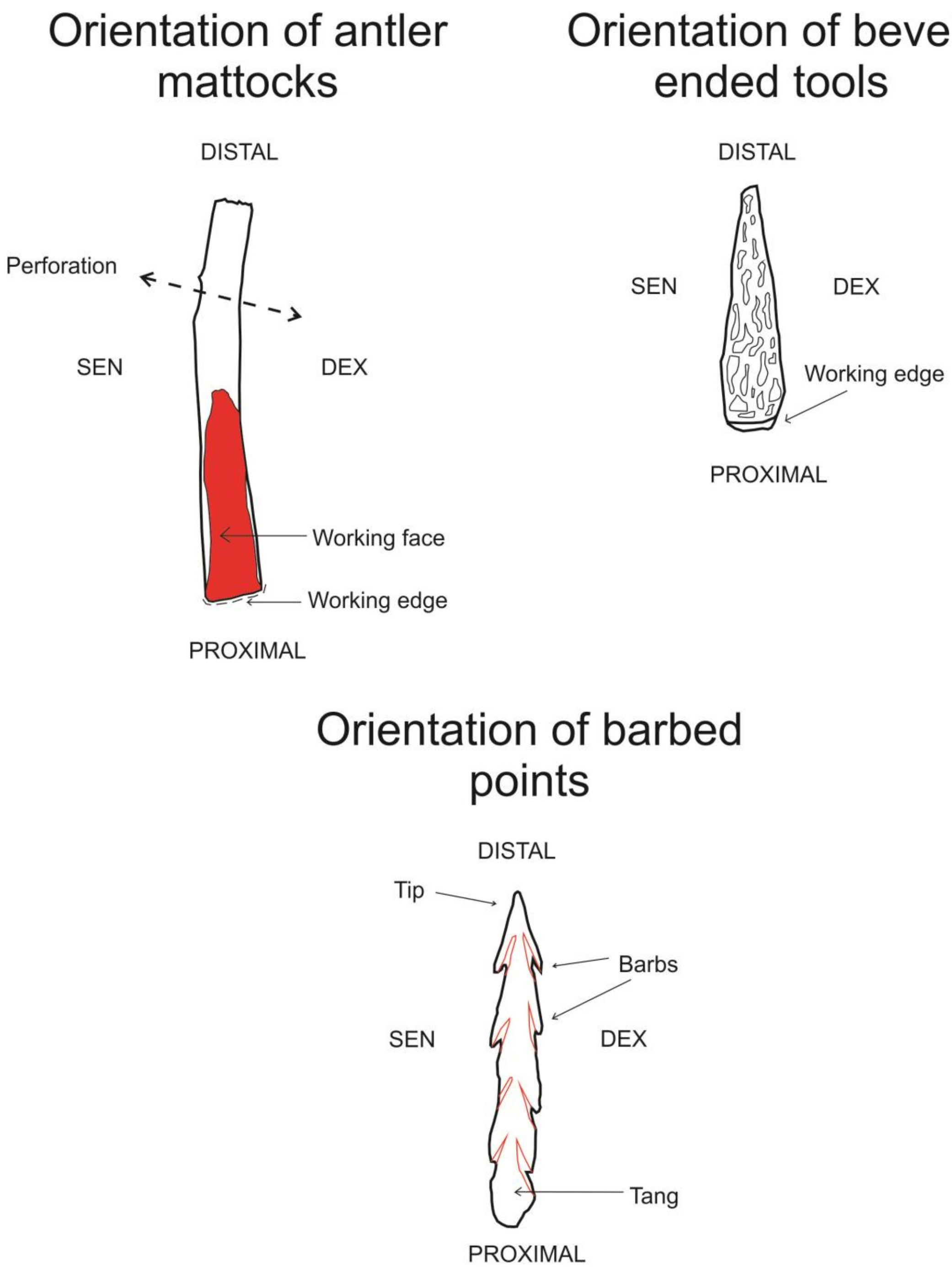


Figure 13: Schematic orientation of the three main types of artefact analysed in this thesis, as viewed from the external aspect. The labels denote the names of specific areas of the artefacts, and the determination of other aspects under Voruz's (1984) system

The fourth stage in the recording is the production of annotated, technical sketches of the worked osseous material. The layout of these drawings follows that of David (1999) and is shown in Appendix 1. These differ from a full, archaeological illustration of the material, in that they are intended to function as a method of recording the occurrence and location of working marks and use-wear patterns only. Following this, in instances where no further insight into the manufacture and use of the artefact could be gained through further illustration, these aspects were not drawn. In practice, this led to the majority of artefacts being drawn from at least three angles. All sketches are drawn to scale, and polish is denoted through dots. Areas of thicker polish are represented by a higher intensity of dots. The drawings are also annotated to show the anthropogenic actions responsible for the production of the working marks present. The symbols used to denote of these actions are shown in Figure 14.

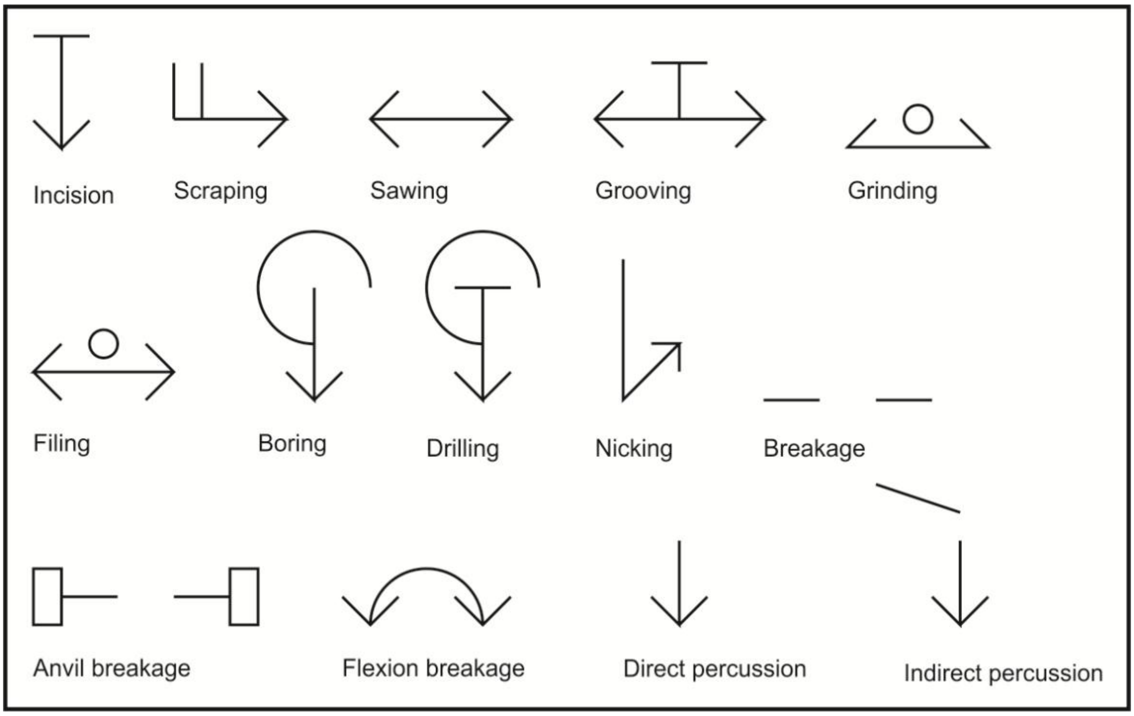


Figure 14: Symbols of working actions

This element of the methodology is modified slightly from that used by David. In this study, only finished artefacts were drawn and annotated in the style outlined by David (1999, 468–72). This decision was taken based on the advances in digital photography technology that have occurred since David's original development of the methodology, which allow high quality images to be taken and disseminated with relative ease and which can illustrate the markings present on osseous material without the need to produce drawings.

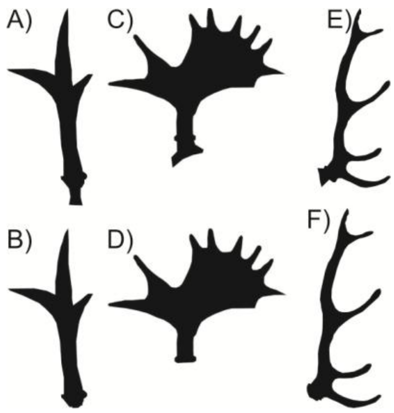
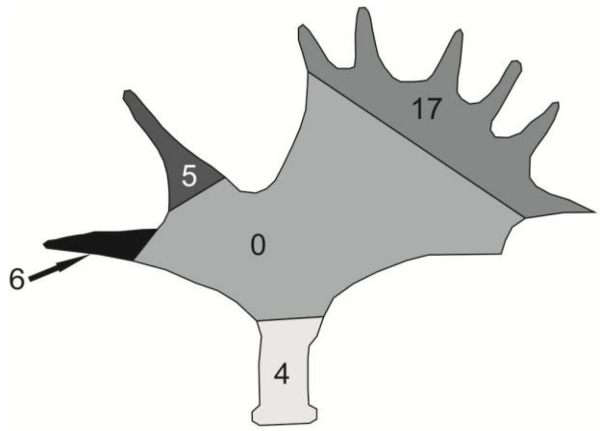


Figure 15: David's (1999) Schematic drawings of antler for the recording of debitage. A)Unshed roe deer B)Shed roe deer C)Unshed elk D)Shed elk E)Unshed red deer F)Shed red deer

From this recording process, several assertions can be made regarding the individual pieces of material studied. Firstly, the biological properties of the piece can be described. Through comparisons with reference material (both modern and archaeological), the species and element of origin can be determined. These are then recorded by shading on schematic diagrams designed by David (Figure 15). This anatomical determination is based on the morphological form of the piece, the character of any intact compactor tissue and the consistency of spongy material. In the case of *debitage*, this is an important stage in the process as it allows the *debitage* assemblage for a particular site or stratigraphic context to be characterised. This data can be tabulated or represented in diagrams using schematic drawings (Figure 16). By recording the quantities of specific elements of antler present at a site, it is possible to discuss antlerworking practices in the absence of the finished artefacts. However, this type of analysis and discussion requires a high level of confidence in the stratigraphic security of the assemblage, and the taphonomic processes at work to successfully link the relative frequencies of antler elements to anthropogenic actions.



Element	Quantity
Basal portion	4
Palmate portion	0
Brow tine	6
Bez tine	5
Crown tines	17

Figure 16: Example of a pictorial and tabular representation of an elk antler *debitage* assemblage for a hypothetical site.

Events and processes which occur in the course of the biological history of the material are also possible to identify, based on an understanding of deer behaviour. For instance, the occurrence of polish and scratch marks on tine tips can be linked to the fraying of antlers, when deer rub themselves against the ground or trees, and need not be directly linked to anthropological action. In a similar vein, rutting contests can also result in impact damage being sustained at the tips of tines. Recent studies (Jin & Shipman 2010) have identified the specific areas of antlers where these fraying polishes and scratches develop. This allows these markings to be identified and discounted, but requires a confident attribution of the anatomical element to be accurate.

Secondly, the taphonomic processes to which the piece has been subjected can also be identified. Through an examination of the character of the material, the condition of the anatomical surfaces, instances of discolouration and the nature and orientation of striations and incisions, it can be possible to broadly identify events such as gnawing (by rodents, ungulates or mollusks), demineralisation, exposure to weather or the action of water. This can also be greatly aided by the study of contextual information from the excavation archive, and David's thesis contains extensive discussions of the stratigraphic security of osseous material-yielding deposits at archaeological sites. However, when working with material from Britain this data is often unavailable due to the context in which the artefacts have been recovered (Chapter 4). This sometimes necessitates a level of archival research to establish as much information about the context of recovery as possible, as even the most general information (e.g. “recovered from the banks of a river”) can help inform the identification of specific taphonomic processes (in this instance, water action).

Thirdly, once the biological and taphonomic processes have been identified and accounted for, the anthropogenic processes can be analysed. The type of artefact can be ascertained and the markings associated with specific working actions can be discussed. The form of these working marks can be related to specific techniques and action, based on comparisons to the archaeological and experimentally produced reference material compiled by David (2008). A detailed description of the various working marks that traceology is able to identify is provided in Section 4.4. The relationship between these markings can also be studied to gain an understanding of the sequence in which they were carried out. In a similar way to the principals of stratigraphy that are used to establish sequential relationships between depositional events on a site level, working marks which overlie or “cut” other episodes of working or taphonomic processes can be said to occur later than the original actions. In this way a sequence of actions, or *chaîne opératoire,* can be built up for individual pieces within the assemblage. It is vital to note, when considering sequential actions within a *chaîne opératoire* that later actions and processes may often obscure the working marks left by earlier actions. This can lead to accounts of manufacturing processes which are biased towards the working techniques associated with the “finishing” stages of an artefact. It is also possible for non-anthropogenic processes to obscure working marks and thus undermine the value of the material in the study of Mesolithic antlerworking. However, these processes are of interest in themselves, as they can give further insight into depositional and site formation process, as well as the general preservation conditions present at a site.

In David’s work, the focus on stratigraphically secure assemblages enabled some of these difficulties to be circumvented, as she is able to use associated *debitage* and artefacts abandoned during manufacture to construct normative *chaîne opératoires* for artefact types at specific sites. However, when analysing material from unstratified or insecure contexts, it is important to remember the limits of the analytical method for inferring the earlier stages of manufacturing processes from finished artefacts.

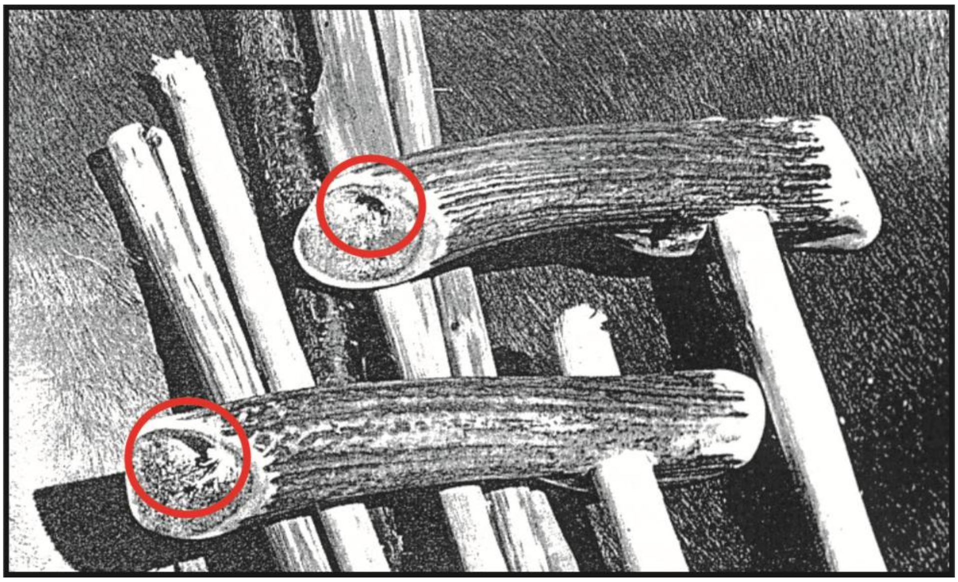


Figure 17: Experimentally manufactured antler axes after use in working green wood. Note the early signs of damage to the working faces (Jensen 1991, 18)

Experimental studies into the potential use and functional features of Mesolithic antler tools have also allowed the broad identification of wear patterns associated with use on antler artefacts. Whilst micro-wear analyses of antler tools are still in the process of being developed, the work of Jensen (1991) has shown how mattocks (C Smith 1989) develop a thick polish across the working face when used in carpentry tasks, and how prolonged usage results in damage to the exposed spongy material towards the working edge (Figure 17). Away from the working edge, Jensen also notes the development of polishes at the points of hafting – both within perforations and across areas of binding (Jensen 1991, 20). These can also be identified on archaeological material to give a broad indication of whether an artefact has been used before deposition.

The sequence of biological behaviour, anthropogenic actions and taphonomic processes for each area of the individual pieces of antler material are recorded in an Excel spreadsheet. These sequences can be synthesised in a short report, with photographs and drawings used to support the conclusions of the analytical process. It is also sometimes possible to synthesise a full or partial *chaîne opératoire* for the artefact or *debitage* piece. These can be represented in multi-stage sequential diagrams using David's schematic drawings of raw materials (Figure 15). An example of this is provided in Figure 18, which shows the way in which a piece of red deer antler *debitage* can be represented. However, where sequential relationships cannot be established or inferred from the markings identified on the individual piece, it is not possible to produce a *chaîne opératoire*.

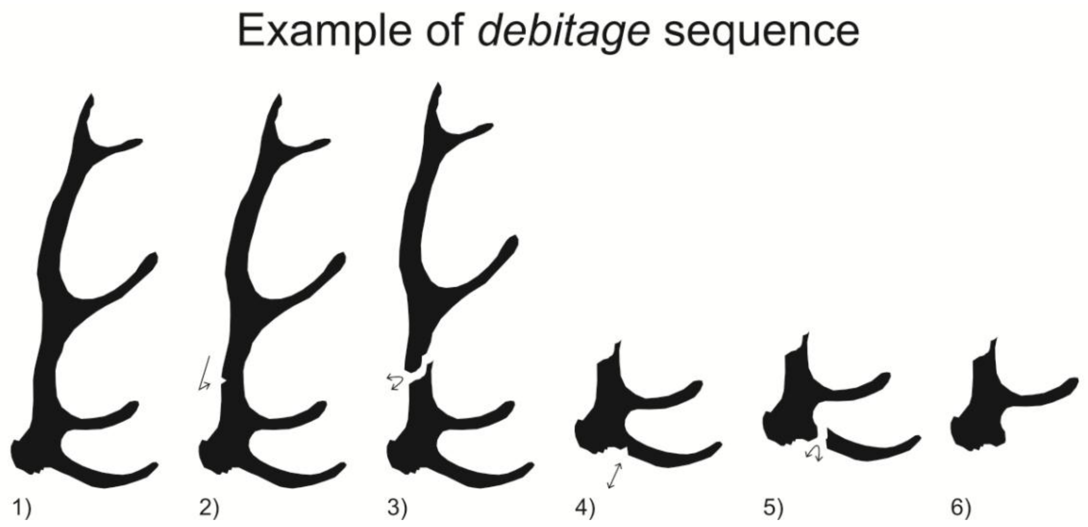


Figure 18: Example of a *chaîne opératoire* diagram for a piece of red deer antler *debitage*

However, it is important to note that the interpretation of the *chaîne opératoire* will differ slightly within this thesis. The work of David and her predecessors (see Section 3.2) utilises the concept of *chaîne opératoire* to characterise technological practices, and extends this to identify and define prehistoric cultural groups (E David 2006, 2009). This thesis is less concerned with the contribution of antlerworking towards the identification of cultural groups in the British Mesolithic for two main reasons.

Firstly, in contrast to other areas of Northern Europe, cultural typologies for the British Mesolithic remain largely under-developed. The original work of Clark (1932, 1956) and later contribution of Reynier (2005) towards the characterisation of lithic technology into cultural groups has been contradicted by a shift towards more functional interpretations of lithic assemblage compositions (e.g. Bonsall 1996; Jacobi 1978; Radley & Mellars 1964), and these in turn have more recently been critiqued from a social perspective (e.g. Conneller 2005; Schadla-Hall & Conneller 2003; Spikins 2000). This tradition of alternative theoretical perspectives is characteristic of British Prehistoric studies more generally, and the differing priorities of the Mesolithic research community has led to somewhat underdeveloped narrative of the Mesolithic from a culturally historic perspective. As such, it becomes difficult to assess the contribution of antler technology for the characterisation of distinct cultural groups in the British Mesolithic, as we lack the models and frameworks of understanding into which antler technology can be integrated, when compared to the more extensively characterised and typologised groups of northwest Europe. Additionally, the limited models that are available for cultural groupings and variation within the British Mesolithic are based almost exclusively on lithic assemblages. Given the scarcity of Mesolithic sites with *in situ* evidence for antler and flint technology (Chapter 4) within Britain, it becomes very difficult to link any variation or consistency in antler technology to spatially and chronologically specific groupings of material culture which would be described as some authors as a "culture".

Secondly, there is also a specific research agenda which has emerged from British Mesolithic Studies which allows an alternative, and arguably more relevant, approach to the interpretation of antlerworking *chaîne opératoires.* This, as has been argued within Chapter 2, relates to the relationship between people and deer during the Mesolithic. This theme has been approached from a range of different perspectives since the very inception of Mesolithic Studies, and is argued to be one of central motifs of the British Mesolithic itself (Finlay 2000). The work of Warren (2006) and Conneller (2004, 2011) has advocated an emphasis on the sourcing of raw materials within the *chaîne opératoire* of osseous artefacts as a way of exploring the role of antler technology within the wider context of the relationship between people and deer.

As such, when the *chaîne opératoire* of antlerworking practices within the British Mesolithic are discussed within this thesis, interpretation will focus on two specific aspects. Firstly, a more traditional, technological discussion will aim to characterise the antlerworking practices across Britain – something which has yet to be achieved on a national level for the British Isles. Secondly, by considering the relationship between people and deer as being intimately linked to the sourcing and understanding of antler as a raw material in the Mesolithic, the technological decisions apparent within the *chaîne opératoire* of antler artefact manufacture will be interpreted in relation to the different ways in which people may have encountered deer during the period (Chapters 6 and 7). This is viewed as a key part of the *chaîne opératoire* itself, and thus represents a significant departure to the approach of previous traceological studies. The contribution of antlerworking practices towards the characterisation of cultural groups within the British Mesolithic will not be dealt with in this thesis, in the absence of a comprehensive framework or a consistently directly demonstrable link between the culturally diagnostic lithic assemblages and evidence for antlerworking practices.

3.4 Mesolithic working techniques

The material studied by David has been compiled to form an extensive reference collection of the 20 Mesolithic working techniques, which can be used to aid the analysis of previously unstudied assemblages (E David 2008). The following section will list the working techniques identified and defined by David (1999). Samples of archaeological reference material from Mesolithic sites will be used to illustrate the different working marks created by these techniques, and demonstrate how they can be recognised within previously unstudied assemblages.

3.4.1 Incision

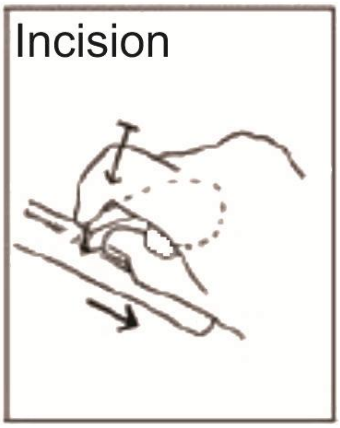


Figure 19: Incision (David 2007, 38)

Incision involves the application of downward force, through a pointed tool, onto a piece of osseous material. The downward force is maintained whilst the tool itself is moved across the surface of the material in a single direction (Figure 19). This produces a linear, shallow mark on the surface of the osseous material. At the termination of the mark, a gradual removal of pressure can sometimes lead to “tailing off” of the mark’s depth.

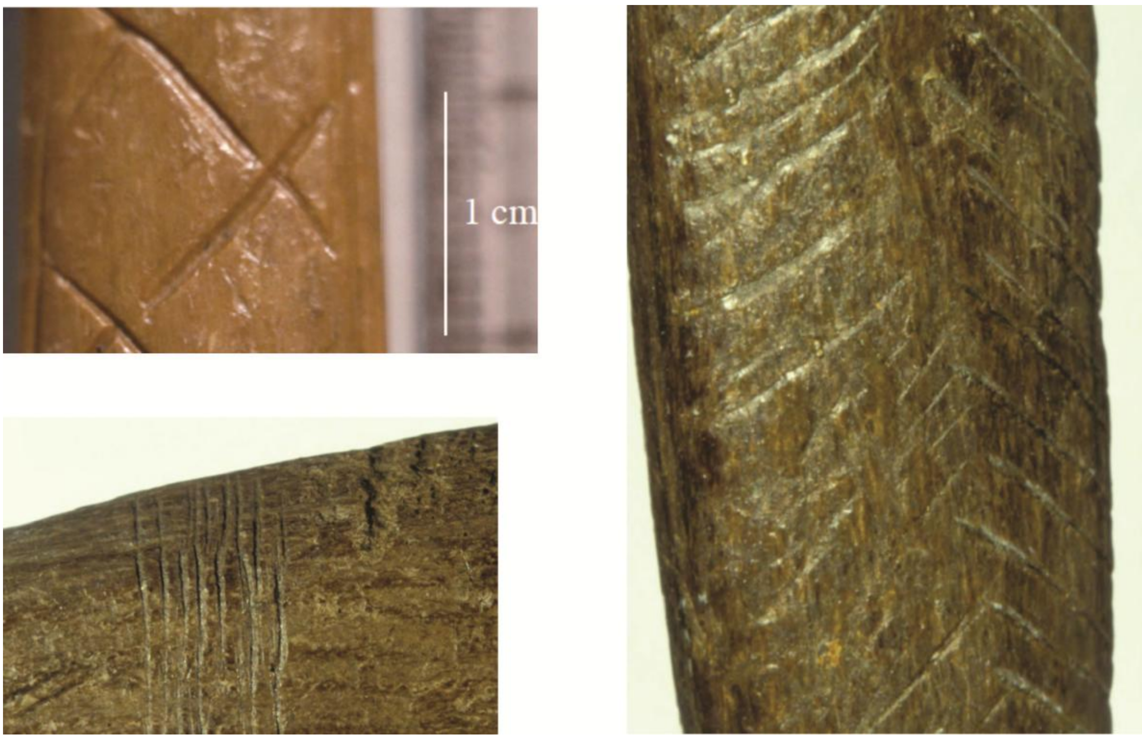


Figure 20: Archaeological examples of incision (E David 2008)

3.4.2 Scraping

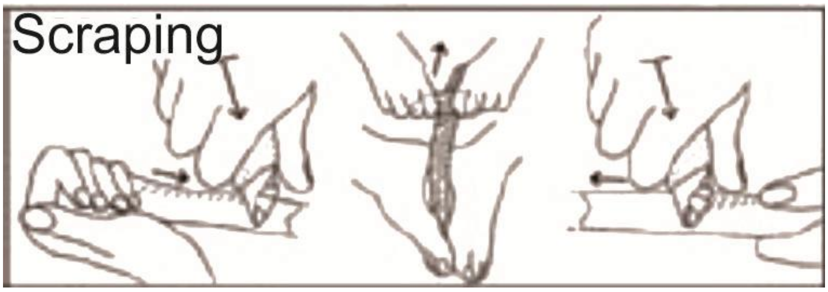


Figure 21: Scraping (David 2007, 38)

Scraping requires a tool with a sharp edge (rather than a point) through which pressure is applied onto a piece of osseous material. Pressure is maintained as the tool edge is moved across the surface of the material (Figure 21). This creates a facet on the subject material which is marked by linear, unidirectional striations. The width of the tool edge used dictates the width of this plane, and scraping with more angular tools can produce deeper, narrower scraping marks (C of Figure 22). The point at which pressure is removed from the tool is also demarcated by an abrupt transverse termination of the scraping facet which can result in a "shelving" effect (B of Figure 22). Repeated scraping can also produce a polish on osseous material (A of Figure 22).

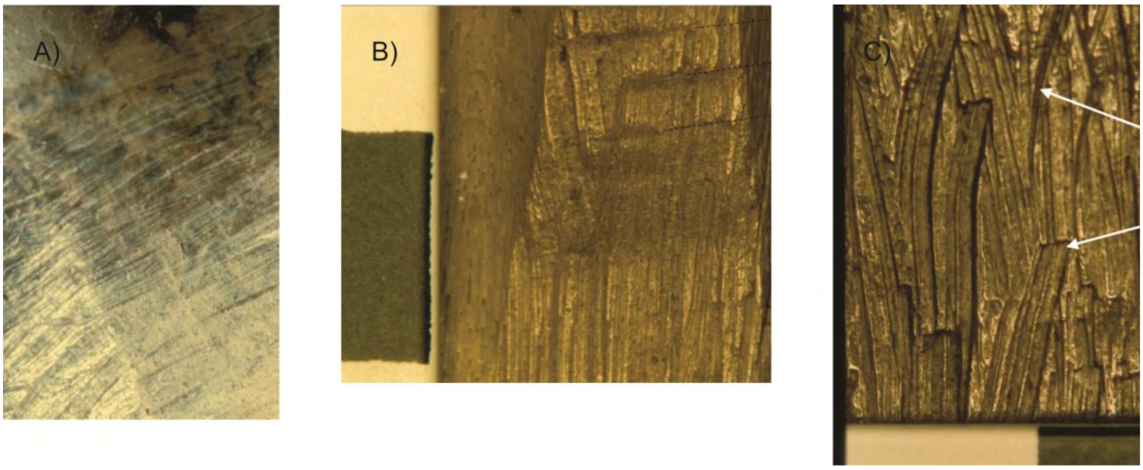


Figure 22: Archaeological scraping marks (E David 2008). A) Showing polish and unidirectional striations created by scraping, B) Showing unidirectional striations and termination marks of scraping, creating a "shelving" effect, C) Deeper scraping marks created through scraping with a narrower tool.

3.4.3 Sawing

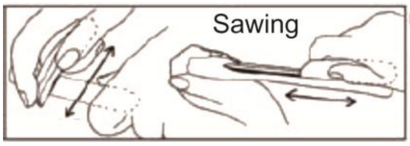


Figure 23: Sawing (David 2007, 38)

Sawing involves the movement of a sharp tool edge across the surface of a piece of osseous material (Figure 23). The movement does not require large amounts of downward pressure, but repeated motion in alternating directions along a single working axis. This can produce deep marks on osseous material, with characteristic fine striations on their internal aspects (B of Figure 24). Misplaced or failed sawing actions can create a series of shallower longitudinal markings in association with the main sawing mark, lying along the same general orientation (A of Figure 24). Occasionally, the undulating surface of osseous materials can result in a single sawing action making contact with two points of the subject materials surface (D of Figure 24). The termination of sawing marks also usually feature further, shallow striations running along the same axis as the main mark (F of Figure 24), where the tool has lightly caught the material on departure from the main mark. Sawing can also produce planes on the osseous material, which, when they intersect can be scrutinised to determine the chronological sequence in which they were made (B of Figure 24). Sawing can also be used in conjunction with grooving, to create a continuous linear working mark with a varying profile (E of Figure 24). Sawing can also be used to facilitate a prepared break (Figure 45).

Figure 24: Archaeological sawing marks (E David 2008). A)Associated striations caused by misplaced sawing actions, B)Intersecting sawing marks C)Sawing marks on opposing sides of a tooth D)Separate marks created by a single sawing action E)Deeper sawing continuing into shallower grooving F)Internal striation of sawing marks

3.4.4 Grooving

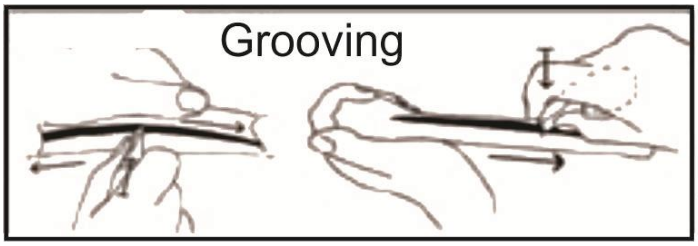


Figure 25: Grooving (David 2007, 38)

The grooving technique is similar to both incision and sawing, and yet subtly distinct in its own right. Downward pressure is applied through the point of a tool onto the surface of the osseous subject, and then moved in opposing directions along a single axis repeatedly (Figure 25). It differs to sawing in that a downward pressure is continuously maintained, and in the use of a pointed tool rather than a working edge. It differs to incision in that the action is repeated along the same axis, creating a deeper impression on the subject material. Subtler changes in the angle of the tool during grooving cause distinctive striations to develop on the internal edges of the working channel (A of Figure 26). The profile of the channel created by grooving varies with the type of tool used, with more pointed tools creating “V” shaped channels and square-ended tools creating flat-bottomed channels.

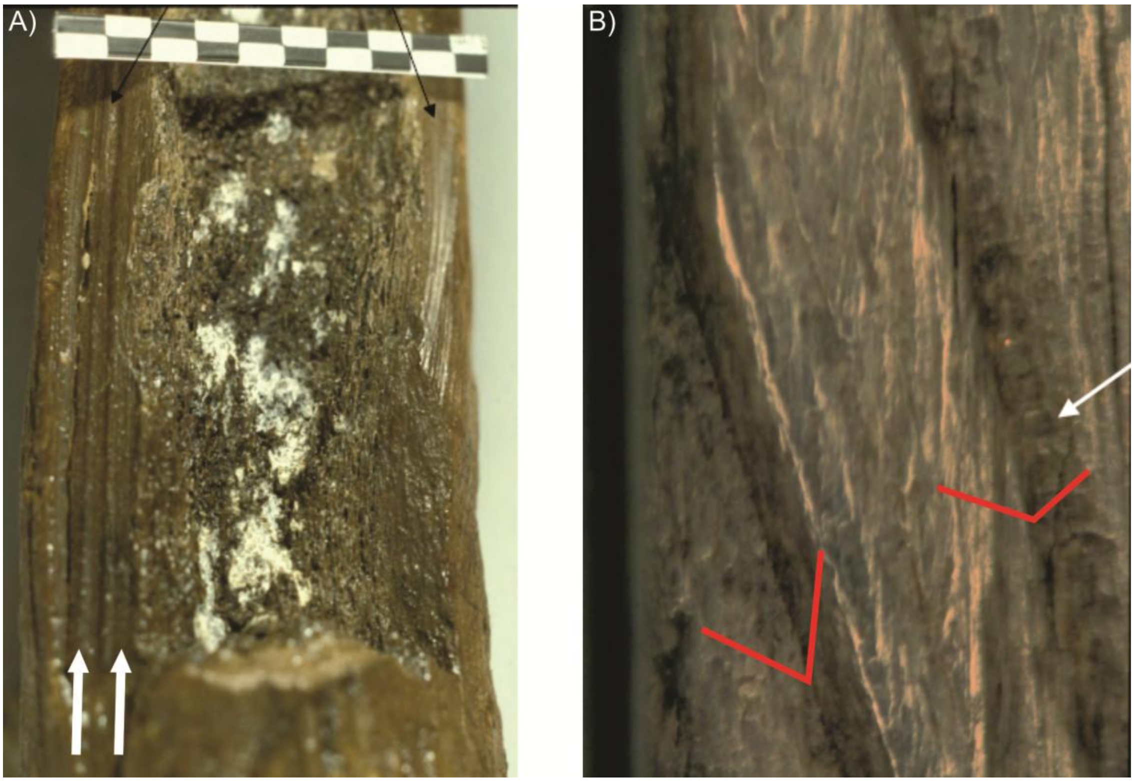


Figure 26: Archaeological grooving marks (E David 2008) A)Striations along the inner aspects of grooving marks, B)“V” shaped profile of grooving mark

3.4.5 Grinding

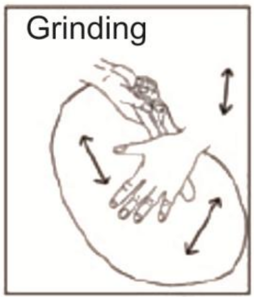


Figure 27: Grinding (David 2007, 38)

Grinding requires a large surface area of coarse material – most usually stone. It involves the application of downward pressure, through a piece of osseous material, onto the coarse surface and then repeated lateral or circular movements. This produces a smoothing effect on the osseous material through abrasion with the coarse surface, often obscuring any previous working marks which may have been present. Grinding under higher levels of pressure can produce smoothing on a single plane or facet. When viewed under low-powered light microscopes, grinding can be identified through the presence of short, multi-directional striations on the surface of the osseous material (Figure 28). Grinding also produces a polish on osseous material.

Figure 28: Archaeological grinding marks (E David 2008)

3.4.6 Filing

Figure 29: Filing (David 2007, 38)

Filing involves the use of a narrow, sharp tool which is placed against the osseous material and repeatedly moved backwards and forwards at a high tempo (Figure 29). This movement produces a smooth surface on the subject material and also a localised polish. These areas of polish are often visible in alternating stripes. The use of a more dexterous tool (in relation to grinding) allows filling to be achieved on a smaller scale and in more inaccessible areas of osseous artefacts.

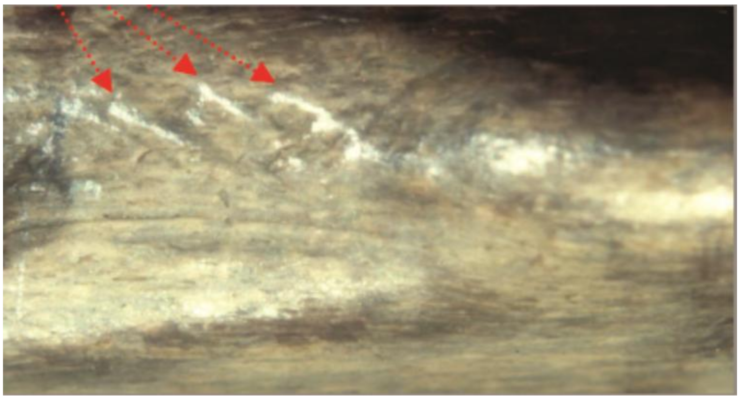


Figure 30: Archaeological filing marks (E David 2008)

3.4.7 Boring

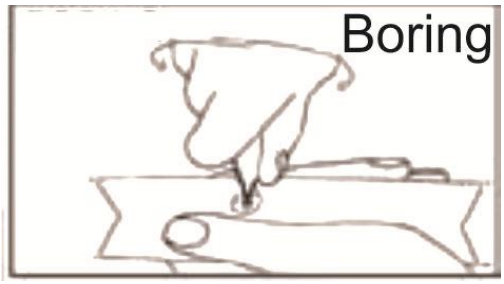


Figure 31: Boring (David 2007, 38)

The technique of boring involves the application of constant downward pressure through a tool onto a piece of osseous material and circular rotation of that tool upon an internal axis (Figure 31). The downward pressure is maintained as the tool works further into the osseous material, creating a perforation. The sides of this perforation are often marked with fine, circular striations (Figure 32). Perforations created through boring often display lipped edges, where broader pars of the boring tool have widened the perforation as it has been inserted further into the material. The widest and narrowest points on the boring tool is therefore recorded in the profile of the perforation (Figure 32)

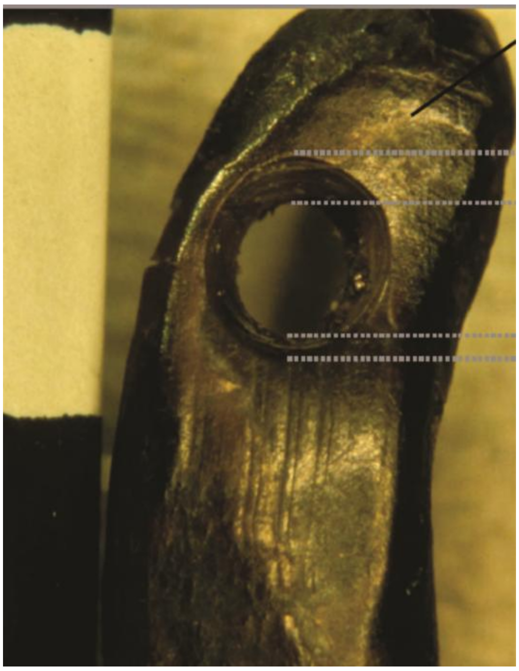


Figure 32: Archaeological boring marks (E David 2008) Dotted lines indicate the maximum and minimum widths of the tool used in boring

3.4.8 Bow perforation

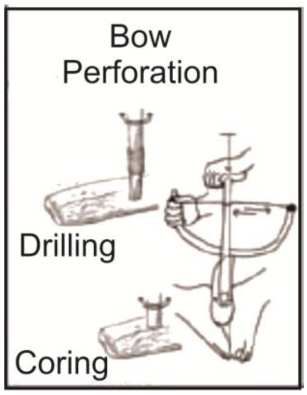


Figure 33: Two types of bow perforation (David 2007, 38)

The bow perforation technique requires the availability of bow-drill technology in order to be accomplished successfully. A cylindrical drill shaft is attached to a piece of string or cord which is then wrapped around the circumference of the shaft. The ends of this cord are then strung to a bow frame. Pressure is applied to one end of the drill shaft and the other end is placed against the osseous material. The bow is moved laterally, causing the shaft to rotate, whilst the pressure is maintained – slowly driving the shaft deeper into the subject material and in the process creating a perforation (Figure 33). A drill "bit" can be fastened to the end of the shaft, facilitating the perforation with increased cutting ability. The attachment of a bit is termed "drilling" whilst simple use of the drill shaft to create a perforation is termed "coring". The sides of the perforation are straight edged and display small internal striations caused by the circular action of the shaft as it moves through the material (A and B in Figure 34). A full perforation can often be achieved through application of bow drilling from opposite sides of the material. When this occurs, it is possible to establish a chronological relationship between the two actions by studying the ways in which the drilling marks relate to one another. A in Figure 34 shows a piece of bone that has been drilled from the left side of the image first, and then drilled from the right side to complete two perforations. The abrasion caused by the drill moving through the material can also result in the development of a polish on the edges of the perforation (see B and C in Figure 34).

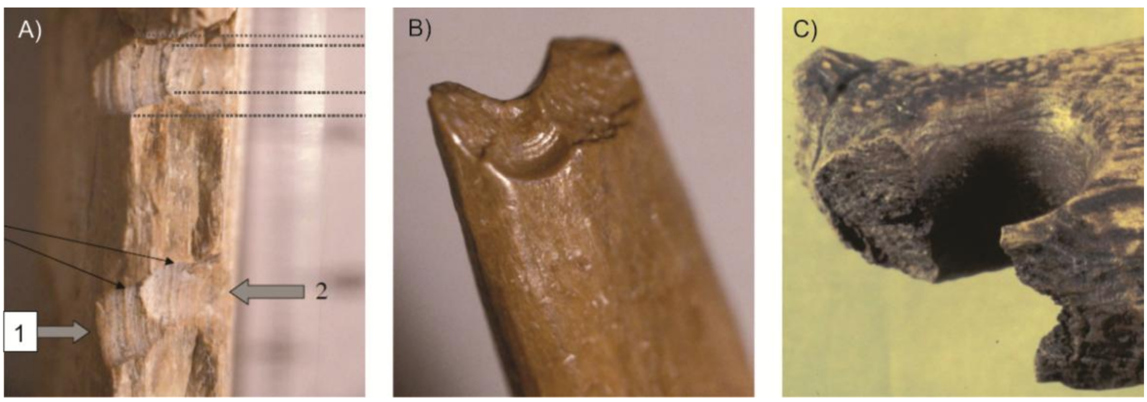


Figure 34: Archaeological bow perforation marks (E David 2008). A)Sectioned bow perforations, showing the sequential relationship between perforation from the left and right side of the object B)Straight edges, polish and striations produced by bow perforation C)Polish produced by bow perforation

3.4.9 Nicking

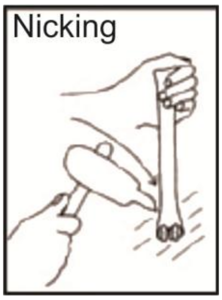


Figure 35: Nicking (David 2007, 38)

The nicking technique involves the use of a hafted tool with a sharp working edge, such as a flint axe or hafted core. The osseous material is struck repeatedly at an acute angle with this the tool's working edge (Figure 35), removing small pieces of material with each impact and leaving the impression of the working edge itself. These impressions are usually characterised by an abrupt, transverse termination, at the point where the tool's working edge stops travelling into the osseous material (Figure 36). This method can be applied around the circumference of a bone or antler to as part of the prepared breakage technique (Figure 45).

Figure 36: Archaeological nicking marks (E David 2008)

3.4.10 Dotted perforation

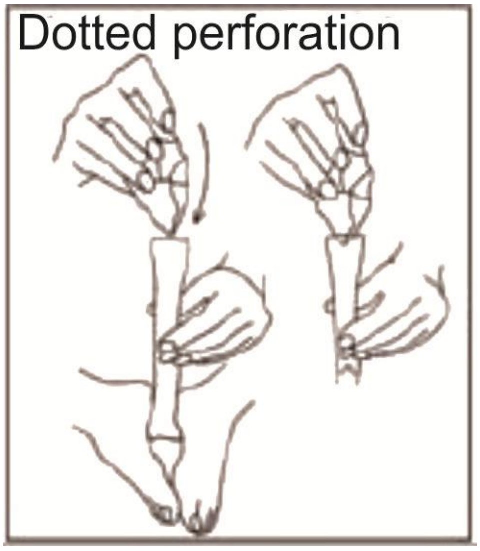


Figure 37: Dotted perforation (David 2007, 38)

As with nicking, the dotted perforation technique also requires a sharp-edged tool with which to strike osseous material. A selected area of material is repeatedly struck directly with an unhafted tool (Figure 37), creating multiple, randomly orientated impact impressions (A and B in Figure 38). This technique has been shown through experiments to be the method by which large ungulate metapodial bones are perforated (see C in Figure 38) at Maglemosian sites, through application of the dotted perforation technique to exposed areas of spongy bone tissue (E David 2008). This strong association between dotted perforation and metapodial bone perforations makes it unlikely to feature majorly in this thesis, which is exclusively concerned with antler.

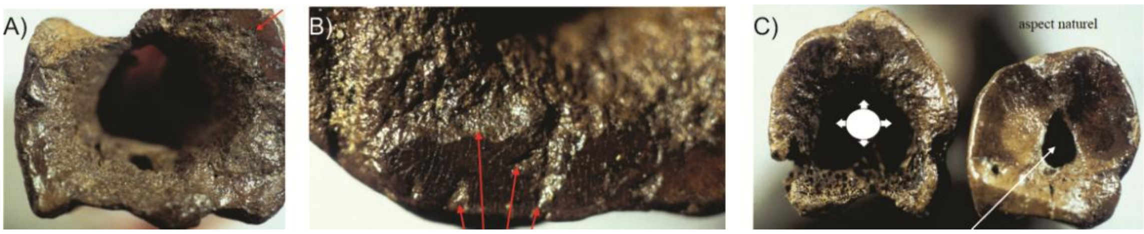


Figure 38: Archaeological dotted perforations (E David 2008). A)Multiple impact marks created around the circumference of a metapodial bone through dotted perforation, B)Varying depths of impact damage created through dotted perforation, C)Comparison of a perforated (left) and un-perforated (right) terminations of metapodial bones.

3.4.11 Breakage

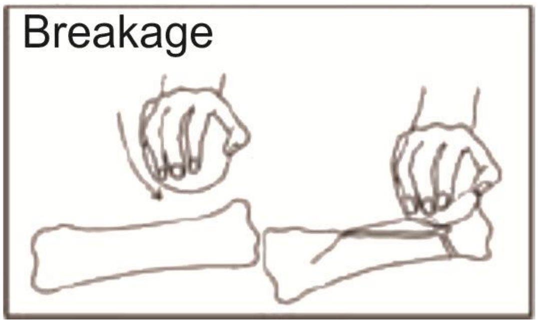


Figure 39: Breakage (David 2007, 38)

The breakage technique (Figure 39) can be used to divide pieces of bone or antler, and has a rich history within the archaeological record. It involves the simple application of a percussive force through a hammer tool, onto a piece of osseous material. This results in the removal of an impact flake from the struck surface which leaves a negative impression on the remaining osseous material. An uneven edged fracture also forms across the diameter of the bone or antler as a result of successful breakage (Figure 40).

Figure 40: Archaeological breakage (E David 2008)

3.4.12 Anvil breakage

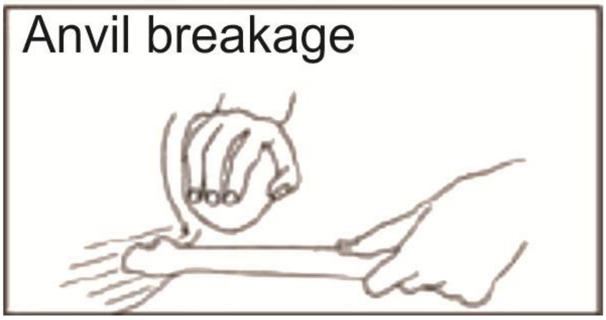


Figure 41: Anvil breakage (David 2007, 38)

Anvil breakage is very similar to the breakage technique described above, the slight variation being that a hard surface is utilised to as a brace for the percussive impact – allowing greater force to be exerted onto the subject. Part of the osseous material is placed on the hard anvil surface, and then struck directly with a hammer tool to facilitate a break at the point where the bone or antler extends over the anvil (Figure 41). The reverberation of force from the impact and then anvil surface creates a notably warped and jagged fracture edge – symptomatic of a material that has been broken from two sides simultaneously (Figure 42).

Figure 42: Archaeological anvil breakage (E David 2008)

3.4.13 Flexion breakage

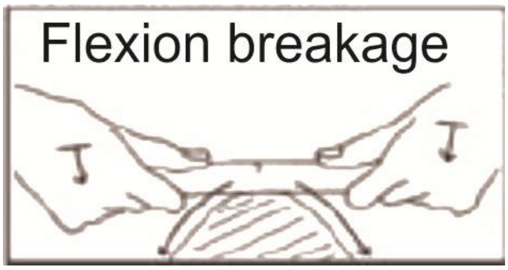


Figure 43: Flexion breakage (David 2007, 38)

Flexion breakage differs to both breakage and anvil breakage in that it does not require the use of a percussive force. The centre of a piece of osseous material is simply set against an anvil, and pressure applied to either end to create a fracture in the centre (Figure 43). The characteristic profile of the fracture edges produced in through flexion breakage is termed "dental marks" due to the way in which their undulating, angular lines can resemble teeth (Figure 44).

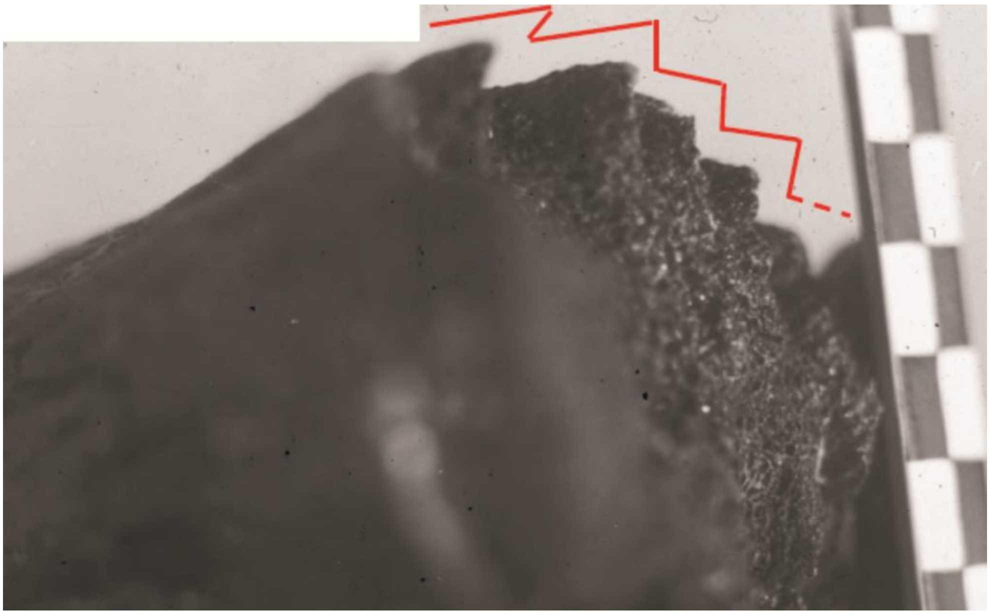


Figure 44: Archaeological flexion breakage (E David 2008)

3.4.14 Prepared breakage

Figure 45: Prepared breakage (David 2007, 38)

The prepared breakage technique utilises the same principal of an anvil break, in that the subject material is placed extending over the edge of a hard surface. However, prepared breakage requires prior preparation of the osseous material in the area which is intended to be broken. This often involves the application of the sawing, nicking or incision techniques (Figure 46) to part or the entirety of the material's circumference. A downward force is then applied to the material placed over the anvil, and the prepared area is struck directly with a hammer tool (Figure 45). This produces a much more controlled and level-edged break (see A in Figure 44) than is created when using breakage or anvil breakage, and is identified through this level profile and/or the associated preparatory working marks (see B in Figure 46).

Figure 46: Archaeological prepared breakage (E David 2008). A)Level break surface produced by prepared breakage B)Sawing marks associated with a prepared break.

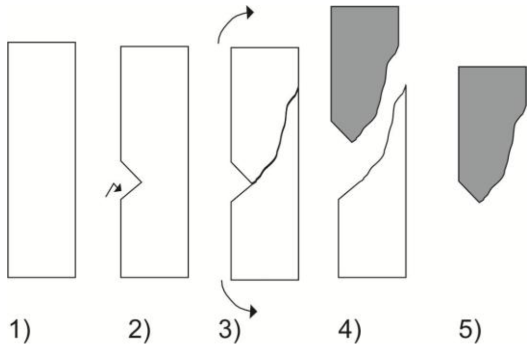


Figure 47: Working edge production break (E David 2004)

One particular variation of prepared break is of special relevance to this thesis. This has been verified through extensive experimental work, and is required in order to produce the working edges for the tools termed “mattocks” in the British Mesolithic (C Smith 1989). This involves utilizing the mechanical properties of antler itself to produce a beveled working edge, or *biseaux* (E David 2004). Preparatory working is carried out on one side of the antler beam – through nicking, sawing or incision. The beam is then turned over and placed against an anvil, and a flexion break executed. This causes the beam to split longitudinally, creating an obliquely-faced break (Figure 47). The convex-ended piece of antler produced in this break can then be worked further to create a working edge and face. Characteristic *debitage* is produced from this action, in the form of obliquely broken pieces of antler beam displaying areas of working in association with the breaks themselves. The angle of the preparatory working and point of flexion are crucial in the success of this technique and experimentation has shown that a level of skill is needed to complete this action. A mistake can easily result in the wrong type of break and the material being wasted. The levels of risk involved in this technique have therefore led to the assumption that, in absence of evidence to the contrary, the execution of a working-edge producing break will be one of the first working actions to be attempted in a *chaîne opératoire* of tool manufacture.

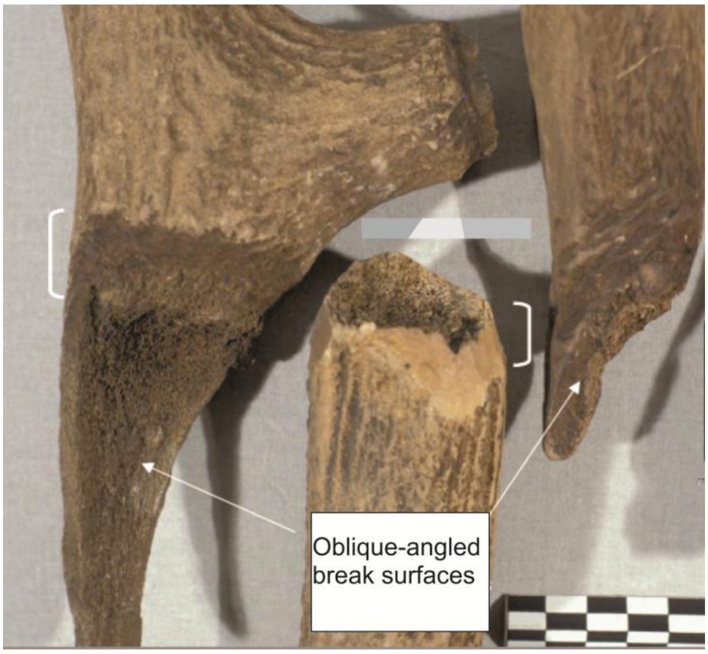


Figure 48: Archaeological working edge production breaks (E David 2008)

3.4.15 Counterblow retouch

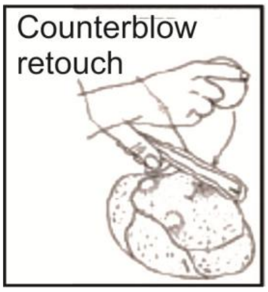


Figure 49: Counterblow retouch (David 2007, 38)

The counterblow retouch technique is a working technique specifically adapted for producing controlled lengths of long bone material for further working. It involves the setting of a split long bone against an anvil, and then the striking of a hammer tool *across* the face of the split bone, to remove small flakes of medullary bone and thus reduce the piece (Figure 49). This produces a series of overlapping impact negatives which may feature bulbs of percussion and radial impact ripples (Figure 50). Because the impacts are directed across the face of the material, the profile remains largely unaffected by these markings. As a method specifically adapted to the working of bone, this working technique is highly unlikely to feature heavily in this thesis as it is focusing exclusively on antler technology.

Figure 50: Archaeological counter-blow retouch (E David 2008)

3.4.16 Flake breakage

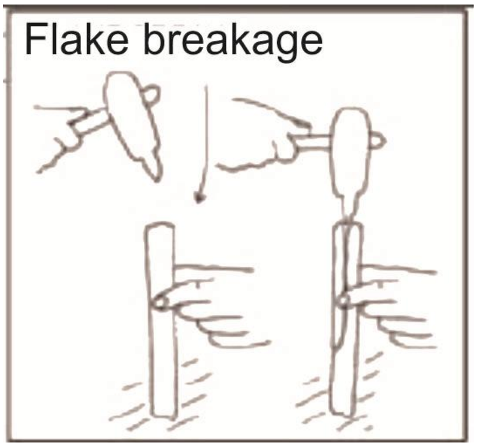


Figure 51: Flake breakage (David 2007, 38)

Flake breakage is another working technique which utilises direct percussion to divide osseous material. A hafted tool with a sharp working edge is used as a percussive instrument, to strike the subject material and remove elongated flakes (Figure 51). This technique is particularly useful for modifying long bones, as the mechanical properties of the material make it vulnerable to longitudinal stresses (Currey 2006). Flake breakage marks are characterised by longitudinal splitting of bone or antler, with multiple, uneven fracture planes and occasional undulations in the profile (Figure 52).

Figure 52: Archaeological flake breakage (E David 2008)

3.4.17 Wedge-splinter

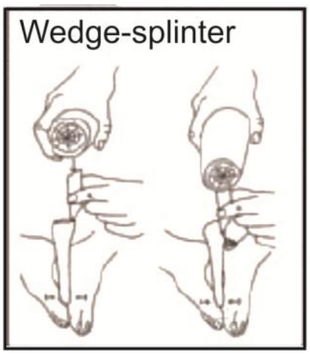


Figure 53: Wedge-splinter (David 2007, 38)

The wedge-splinter technique is a form of indirect percussion and requires the use of a soft hammer tool and an intermediate wedge to transfer force from the hammer to the subject material (Figure 53). The tip of the wedge acts as the focus for this force and thus allows greater control over its application onto the subject material than with direct percussion techniques. The wedge is set against the distal or proximal end of the osseous material, and then struck with a soft hammer. This results in the removal of small flakes of osseous material from the exterior edges of the piece being worked, creating visible negatives of the removed flakes on the proximal and distal ends of the material (A in Figure 54) and altering the profile of the bone when viewed in section (B in Figure 54).

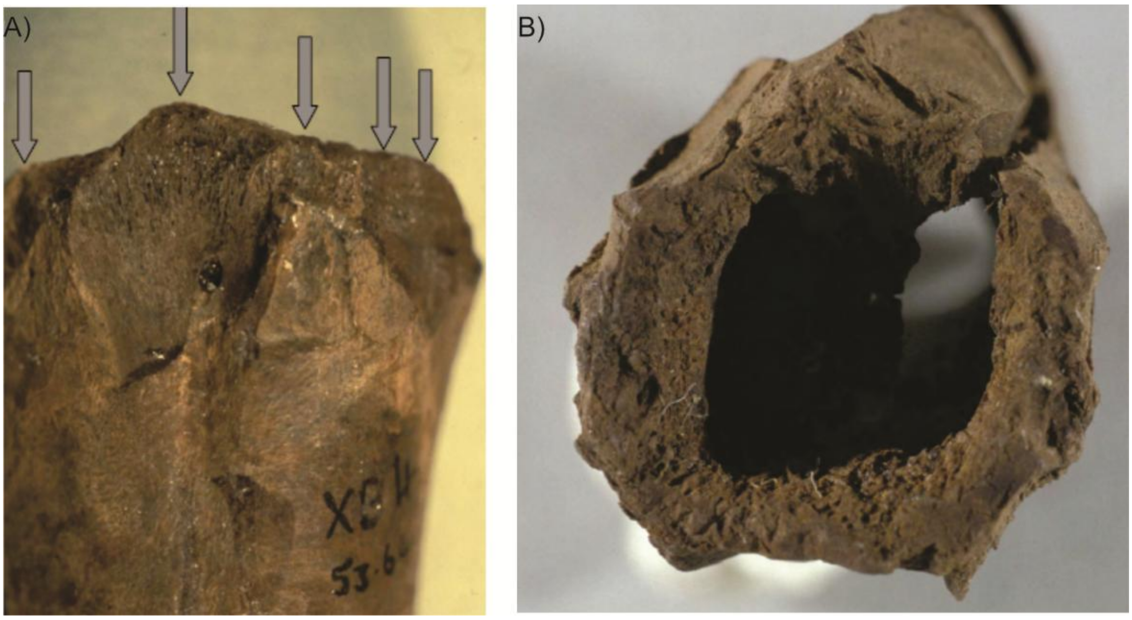


Figure 54: Archaeological wedge-splinter (E David 2008). A)Scars created in the downward application of wedge-splintering, B)Profile of long bone that has had wedge-splintering applied to its circumference

3.4.18 Shaft-wedge-splinter

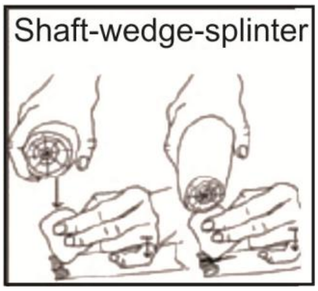


Figure 55: Shaft-wedge-splinter (David 2007, 38)

The shaft-wedge-splinter technique employs many of the same principals as the wedge-splinter method, although it is applied in a slightly different way to the subject material. Again, a soft hammer and wedge is used to exert force upon a piece of osseous material through indirect percussion. In this instance though, the wedge is set against the shaft of the long bone. With each impact, the wedge is moved incrementally down the shaft to open a longitudinal split (Figure 55). This method relies on the hollow structure of long bones which is provided by the medullary cavity. The insertion of the wedge into the material leaves a negative on the profile of the piece, and when this has been systematically repeated this creates a characteristic widely-spaced undulating pattern (A in Figure 56). The negatives themselves often display a bulb at the point of impact, with radial ripple marks within moving away from this point (C in Figure 56). The removed flakes of bone produced by the shaft-wedge-splinter technique can also be identified within the archaeological record, and are characterised by similar bulbs of percussion and radial ripple markings (B in Figure 56).

Figure 56: Archaeological shaft-wedge-splintering (E David 2008). A)Multiple scars created on a split long bone through the application of shaft-wedge-splintering B)Flakes of bone removed through shaft-wedge-splintering C)Bulb of impact and radial ripple marks of a shaft-wedge-splinter scar.

3.4.19 Wedge-splitter

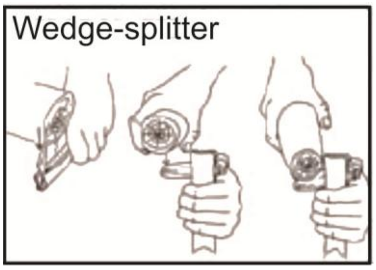


Figure 57: Wedge-splitter (David 2007, 38)

The wedge-splitter technique is the final working method which utilises indirect percussion. It involves the insertion of a wedge through the longitudinal edge of a long bone, so that it protrudes on both sides. This is achieved through repeated application of percussive force on the wedge with a soft hammer, to drive it through the compact layers of tissue on both sides of the bone. Once the wedge is in place, further percussion is applied from an angle 90^{o} to that of the original episode. This slowly drives the wedge along the length of the bone, splitting it into two fragments (Figure 57). Successive impacts can create closely-spaced undulations in the profile of the split material (A in Figure 58) whilst the forcible insertion of the wedge can also cause damage to the spongy core (B in Figure 58) of the osseous material, when present.

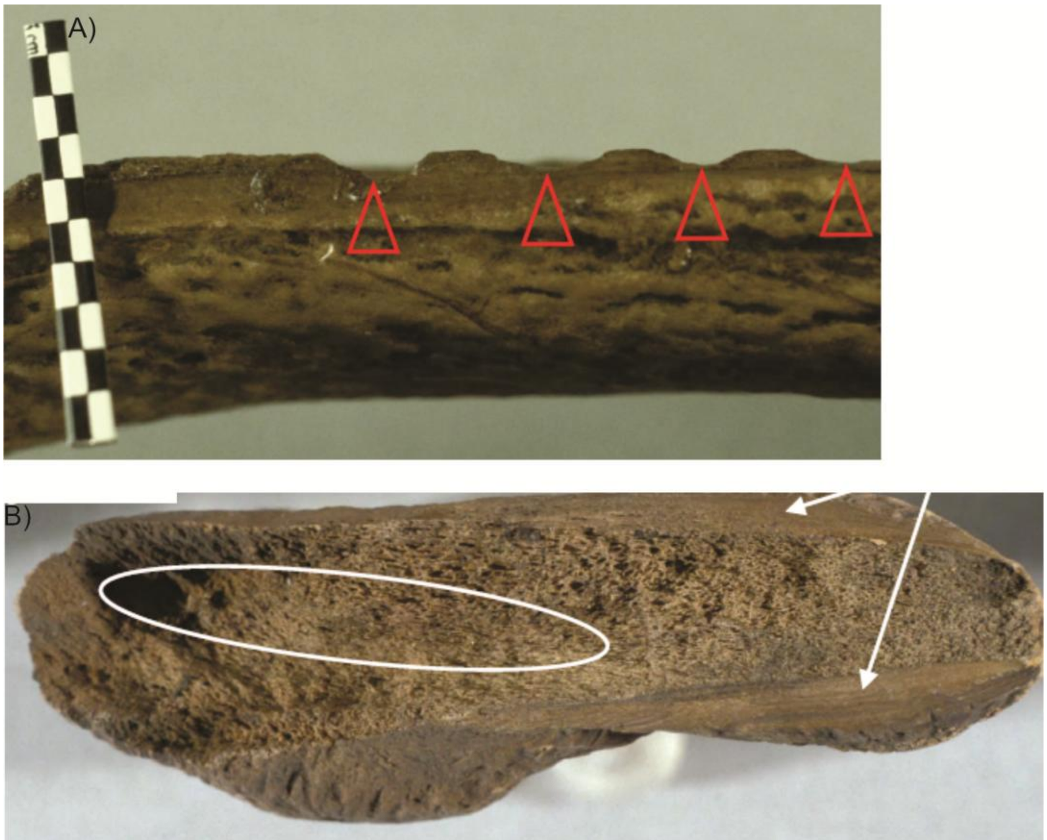


Figure 58: Archaeological wedge-splitting (E David 2008). A)Regular negatives created by the insertion of a wedge in wedge-splitting, B)Damage to cortical tissue cause by the insertion of a wedge in wedge-splitting.

3.5 Summary

To summarise, the traceological methodology has its roots in a longer tradition of studying osseous artefacts and *debitage* assemblages within European prehistoric research. However, the work of David is notable for its explicit focus on the identification of working techniques and a consideration of sequences of actions (or *chaîne opératoire*) in prehistoric osseous technologies. Through visual scrutiny, technical description, drawing, photography and experimental replication, David has been able to define a list of 20 discrete working techniques which are documented within the archaeological record of Mesolithic Europe. Whilst David's work has focused on the application of traceological analysis to archaeological material from the classic Maglemosian assemblages of Northern Europe, there is potential to apply these methods to the worked antler material from Britain as a means of furthering our understanding of the treatment of antler in the British Mesolithic. Through the identification of working techniques, it is possible to begin to characterise the antler technology of Mesolithic Britain at a site, regional and national level. This characterisation can be furthered, where possible, through the reconstruction of *chaîne opératoires* to examine the processes by which artefacts were manufactured. At sites with a degree of stratigraphic integrity, *debitage* assemblages can also be characterised to allow discussions of the way in which stages in the artefact manufacturing process are structured spatially and temporally. As such, traceological analysis is a fitting and appropriate method for the study of antlerworking in the British Mesolithic.

However, the interpretation of the wider significance of antlerworking *chaîne opératoires* within the British Mesolithic will differ to the approach taken by previous traceological studies. Whilst the technological choices within Mesolithic antlerworking practices will still be discussed, this thesis will focus more on the conditions under which the raw material was sourced – the relationship between people and deer during the period. This will be at the expense of the more traditional approach of using osseous tool-making processes to characterise distinct prehistoric cultural groups (E David 2006, 2009).

Chapter 4: Sample

4.1 Introduction

This chapter will fulfill Objective 3 of the thesis by aiming to assess the location and accessibility of British Mesolithic antler material. The chapter aim will be achieved through the fulfillment of three objectives. Firstly, the known quantities and holdings of Mesolithic worked antler in Britain will be established through a review of Mesolithic gazetteers, dating literature and published museums holdings (Appendix 2). The second objective of this chapter will be to carry out a critique of the Mesolithic affinities of this material, in the light of the refinement of typological distinctions established by the AMS dating programme of Bonsall and Smith (Bonsall & C Smith 1989, 1992; Bonsall et al. 1995, 1995; Tolan-Smith & Bonsall 1999). This will eliminate some of the material previously believed to be Mesolithic, but which is now thought to date to later or earlier periods of prehistory. The third objective will be to evaluate the accessibility of the located material. This will be met through a report on the correspondence with museum curators, which sought to gain permission for the application of traceological analysis to the material under their stewardship. The result of this chapter will be the compilation of a list of material which has been accessed and analysed as part of this thesis (Appendix 3).

4.2 Review of worked Mesolithic antler material from Britain

In order to assess the quantities worked antler material recovered from Britain to date, a comprehensive review of the published excavations and museums holdings was undertaken. The point of departure for this review is the *Gazetteer of Mesolithic sites in England and Wales* (Wymer & Bonsall 1977), which lists the known holdings of Mesolithic material culture within England and Wales in 1977 for local, regional and national museums and collections. This gives details of 464 Mesolithic antler artefacts, recovered from 67 "sites" and includes chance surface-finds, residual material recovered in the excavation of later or earlier-dated sites, finds made during construction work and fully excavated Mesolithic archaeological sites. A historical summary of the Mesolithic material from Scotland is provided by Lacaille (1954), who gives details of a further 12 sites from which Mesolithic antler artefacts and *debitage* have been recovered. Given the absence of deer species in Ireland during the Mesolithic, the total lack of antler working evidence is not surprising (Tolan-Smith 2008).

A more focused national review of a specific aspect of British antler technology is provided by Smith (1989) in his study of antler mattocks from Britain. He lists a total of 99 artefacts from across England, Scotland and Wales that he terms as "mattocks" and ascribes to the Mesolithic (Smith 1989, 72). The majority of these are included in previous reviews of Mesolithic material culture in Britain (Wymer & Bonsall 1977), but there are some additions – notably from the sites on Oronsay, Western Scotland (Mellars 1987a) and Splash Point, Rhyll (C Smith 1989).

Further artefacts of relevance to this thesis have been located through the work of Bonsall and Smith (Bonsall & C Smith 1989, 1992; Bonsall et al. 1995; Tolan-Smith & Bonsall 1999). This gives details of 46 red deer antler artefacts, previously ascribed to the Palaeolithic and Mesolithic, which have been ^{14}C AMS dated. The focus of this project on "any organic materials modified by man" (Tolan-Smith & Bonsall 1999, 249) means that the dated material includes both finished artefacts and *debitage*, making it particularly useful in relation to Smith's (1989) study, which focuses exclusively on artefacts. Some of the material dated is included in Wymer and Bonsall (1977), whilst others represent more recently recovered material.

Finally, recent national reviews of Mesolithic material culture from England (Barton & Roberts 2004), Scotland (Saville 2004), Wales (A David & E Walker 2004) and Britain generally (Mithen & Milner 2009; Tolan-Smith 2008) were consulted. Although these do not specifically focus on worked antler, the high prominence afforded to sites with organic preservation within general narratives of the Mesolithic (Clarke 1976) often results in sites which have faunal and osseous technological assemblages being regularly commented upon. This ensured that more recent excavations, such as those in the Severn Estuary (Bell 2007b) and undertaken as part of the Scotland's First Settlers project (Hardy & Wickham-Jones 2003) were included within the review. Additionally, the high prominence afforded to antler artefacts within these discourses often results in photographic representations of artefacts, which include holdings information within their captions for copyright purposes. Completion of this literature-based survey (Appendix 1) yielded a total of over 1330 artefacts, from 103 "sites" across England, Scotland and Wales (Figure 59).

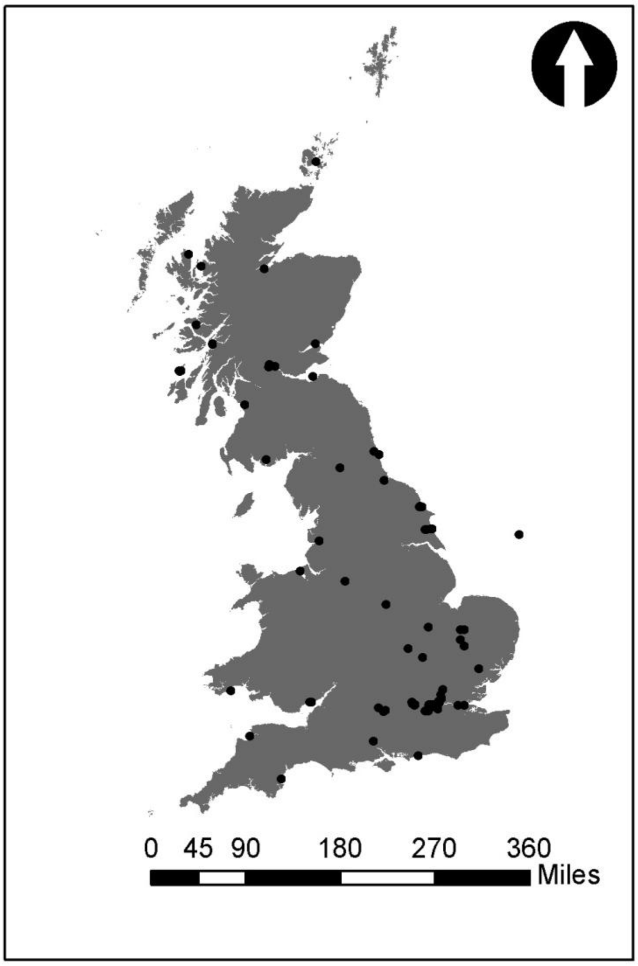


Figure 59: Distribution of British Mesolithic antler findspots

4.3 Refining Mesolithic affinities for antler artefacts and *debitage*

4.3.1 The problems created by unstratified finds

The list of material compiled in Appendix 2 was created through a simple literature review, identifying and recording the occurrence of material described as "Mesolithic" by previous authors. However, the ascriptions within some of the older references have been contradicted by some of the more recent research into these artefacts. These will be summarised here, and the appropriate material removed from the corpus of material that this thesis aims to examine.

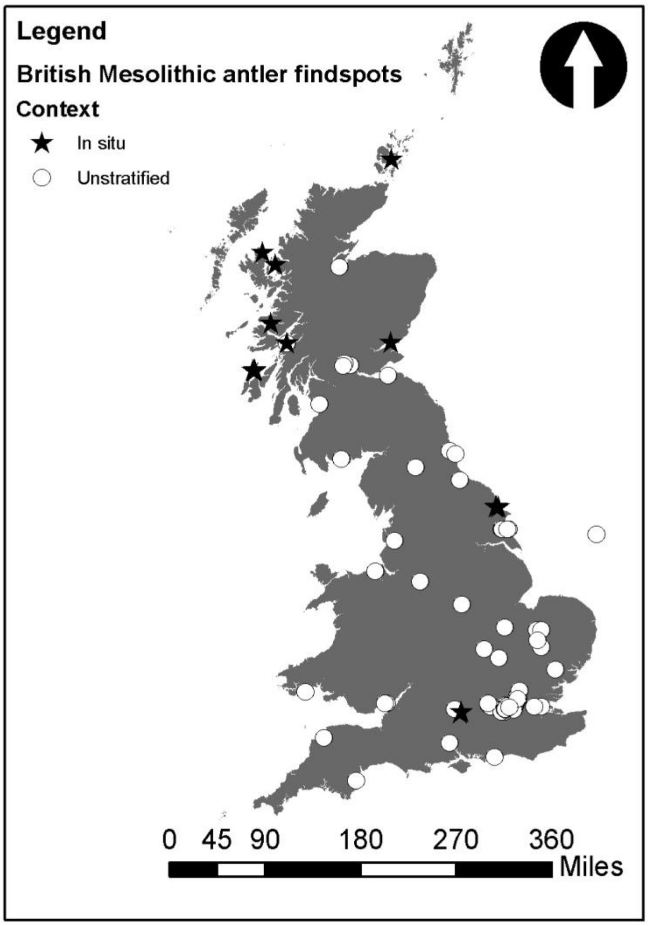


Figure 60: Distribution of Mesolithic antler material recovered from unstratified contexts and *in situ* deposits

The vast majority of antler material from Britain ascribed to the Mesolithic lacks data regarding the original context of deposition (Figure 60). This thesis has taken a critical approach to this corpus of data, only assuming a Mesolithic date for unstratified finds when there are reasonable grounds to suspect that this is the case. The evidence for these assumptions is largely provided by dated typological links (Sections 5.3.2 - 5.3.8) – there is very little potential for ascribing Mesolithic affinities to unstratified antler *debitage,* unworked material and typologically miscellaneous artefacts, without a direct ^{14}C date. This has had a skewing effect on the material included in this thesis, as *debitage* assemblages can only be studied in the minority of cases where antlerworking evidence has been excavated from *in situ* deposits. However, less systematic ^{14}C dating programs have occasionally allowed the identification of typologically indistinct pieces of unstratified Mesolithic antlerworking, such as the Romsey

Horn (R Smith 1934). A full discussion of the implications of these dates in understanding variations in antler technology *within* the Mesolithic will be given in Chapter 7. This chapter will focus on the use of these dates in eliminating earlier or later specimens from the corpus of material studied in this thesis.

4.3.2 Uniserial barbed points

Previous discussions have assumed that British uniserial barbed points are exclusively Mesolithic in date (Wymer & Bonsall 1977). This was later challenged in the light of associated ^{14}C dates (Hallam et al. 1973) and stratigraphic grounds (Wymer et al. 1975), which implied that uniserial barbed points had also been recovered from Upper Palaeolithic contexts. This argument has been confirmed through the ^{14}C AMS dating of multiple uniserial barbed points, which show that they appear over a large chronological range in Britain and span the Upper Palaeolithic and Early Mesolithic (Tolan-Smith & Bonsall 1999). Whilst this distinction has not been able to find any typological differences between uniserial barbed points which may help to determine Upper Palaeolithic or Mesolithic affinities, it does allow the artefacts which have been previously suspected to be of Palaeolithic date to be removed from the corpus of material that this thesis aims to examine.

Site	Dating sample lab number	^{14}C Age BP	^{14}C calibrated Age range (BC)	Reference
Poulton-le-Fylde (Lancashire)	OxA-150	12400±300	13916-11703	(Hallam et al. 1973)
Leman and Ower Banks (North Sea)	OxA-1950	11740±150	11941-11346	(Tolan-Smith & Bonsall 1999)
Porth-y-Waen (Shropshire)	OxA-1946	11390±120	11558-11012	(Tolan-Smith & Bonsall 1999)
Sproughton 1 (Suffolk)	OxA-517	10910±150	11166-10626	(Tolan-Smith & Bonsall 1999)
Sproughton 2 (Suffolk)	OxA-518	10700±160	11011-10166	(Tolan-Smith & Bonsall 1999)
Waltham Abbey (Essex)	OxA-1427	9790±100	9656-8837	(Tolan-Smith & Bonsall 1999)
Earl's Barton (Northamptonshire)	OxA-500	9240±160	9128-7994	(Tolan-Smith & Bonsall 1999)
Wandsworth (London)	OxA-3736	9050±85	8533-7964	(Tolan-Smith & Bonsall 1999)

Table 4: ^{14}C AMS dated uniserial barbed points from Britain

4.3.3 Biserial barbed points

The application of ^{14}C AMS dating to biserial barbed points has also confirmed their broad chronological range. The direct dating of five biserial barbed points (Table 5), and the indirect dating of deposits associated with biserial points from a further five sites in Britain has shown these artefacts to be distributed across both the Upper Palaeolithic and Mesolithic (Table 6). However, a distinction does exist between the two periods. The finds from Victoria Cave, Aveline's Hole and Kent's Cavern where believed to date to the Upper Palaeolithic prior to the application of ^{14}C AMS methods due to their typological character, which is "reminiscent of the biserial points with angular projecting barbs and spade-shaped base from the Final Palaeolithic of the North European Plain," (Tolan-Smith & Bonsall 1999, 254). Based on this distinction, it is possible to discount the artefacts which have been directly dated to the Upper

Palaeolithic and any more angular barbed, spade-based specimens that are undated. Undated artefacts of the "Obanian" style can still be considered as Mesolithic and remain relevant to this thesis. These include the finds from MacArthur's Cave, Druimvargie Cave, Thrumpton and Whitburn.

Site	Dating sample lab code	^{14}C Age BP	^{14}C calibrated Age range (BC)	Reference
Victoria Cave (Yorkshire)	OxA-2607	10810±100	10986-10607	(Tolan-Smith & Bonsall 1999)
MacArthur's Cave	OxA-1949	6700±80	5728-5488	(Tolan-Smith & Bonsall 1999)
Cumstoun	OxA-3735	6665±70	5706-5483	(Tolan-Smith & Bonsall 1999)
Carriden	OxA-7852	6030±55	5198-4786	(Saville 2001)
Shewalton	OxA-1947	5840±80	4933-4529	(Tolan-Smith & Bonsall 1999)

Table 5: Direct ^{14}C AMS dates from biserial points

Site	Dated material	Dating sample lab code	^{14}C Age BP	^{14}C calibrated age range (BC)
Aveline's Hole	Cut marked bovine bone	OxA-1121	12380±130	13098-12047
Kent's Cavern	Bone piercer from same sand deposit	OxA-1789	12320±130	13044-11964
Caisteal nan Gillean	Charcoal from midden deposits	Q-3008 Q-3007 Q-3009 Q-3010 Q-3011	6190±80 6120±80 6035±70 5485±50 5450±50	5321-4938 5293-4843 5207-4773 4449-4246 4446-4080
Risga	Antler artefacts from midden deposits	OxA-2023 OxA-3737	6000±90 5875±155	5207-4706 5207-4375
Cnoc Sligeach	Marine shell associated with barbed point	Birm-465	5605±65	4584-4335

Table 6: Indirect ^{14}C dating of biserial points (Tolan-Smith & Bonsall 1999)

4.3.4 Antler maceheads

20 of the 464 antler artefacts listed by Wymer and Bonsall (1977) are described as "antler hammers" or "maceheads". These can be broadly defined as the perforated, basal portion of a shed antler that has had the beam and brow tine removed. The tool is then hafted and the shed burr used as a percussive instrument (Figure 61). The Antler Macehead Dating Project (Loveday et al. 2007) has shown that these artefacts date to the Early Neolithic (Latter half of the 4th millennium cal. BC) through ^{14}C AMS dating. The dated specimens include artefacts from Windmill Hill, Teddington and Mortlake that had been previous identified as Mesolithic (Wymer & Bonsall 1977). The total absence of these types of artefacts from the excavation of Mesolithic contexts in Britain and the results of the Antler Macehead Dating Project leave no evidence that these artefacts have any Mesolithic affinities in Britain and as such have not been included in this study.

Site	Dating sample lab code	^{14}C Age BP	^{14}C calibrated age range (BC)
Attenborough	OxA-13208	4463±37	3342-3018
Duggleby Howe	OxA-13327	4597±35	3512-3121
Windmill Lane	OxA-13207	4611±37	3518-3136
Windmill Lane	OxA-13440	4684±37	3628-3368
Teddington	OxA-14192	4481±33	3342-3030
Mortlake	OxA-14193	4337±33	3079-2893
Burwell Fen	GrA-27417	3920±60	2571-2903
Northton	BM-705	4411±79	3339-2903

Table 7: ^{14}C AMS dates from British antler maceheads/hammers (Loveday et al. 2007, 387)

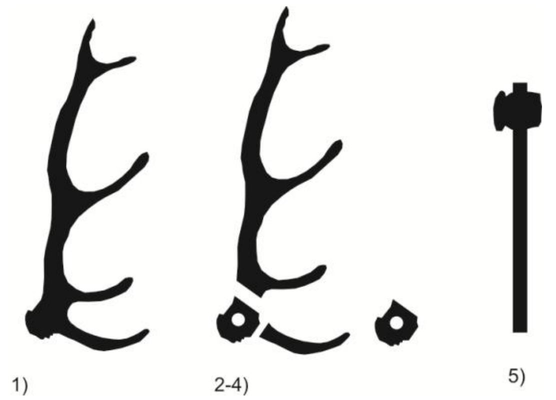


Figure 61: ***Chaîne opératoire*** **of red deer antler maceheads and hammers**

4.3.5 Base mattocks

Another type of artefact that has had its Mesolithic affinities questioned is the base mattock. These consist of the basal portion of a red deer antler which has had the tines removed, and a beveled working edge created through the prepared breakage of the beam. A perforation is then created at the basal junction and the tool is hafted (Figure 62). Base mattocks are defined by Smith (1989, 275–276) as types A and B. Of the 77 mattocks which Smith (1989, 274–275) is able to typologically classify, 37 are base mattocks.

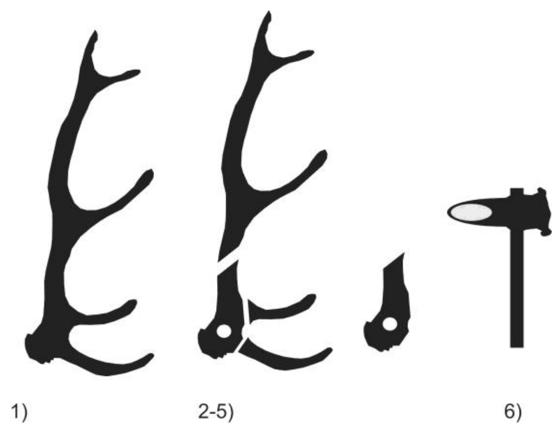


Figure 62: ***Chaîne opératoire*** **of base mattocks**

^{14}C AMS dating of 11 base mattocks from a range of contexts across Britain has again illuminated a much broader chronological range than was previously anticipated. Only one of the dated sample was found to have direct affinities with the Mesolithic, the remaining ten producing Bronze Age dates (Table 8). Tolan-Smith and Bonsall (1999, 254–255) interpret these results as two non-overlapping phases of base mattock production in Britain – one occurring in the Early Mesolithic and a later re-adoption in the Bronze Age. This creates a problem for material which has not been recovered from securely dated Mesolithic contexts. In the absence of stratigraphic data that could suggest an artefact was deposited during the Mesolithic, the dated sample would appear to indicate that the majority of base mattocks can be assumed to be Neolithic or Bronze Age whilst a small and typologically indistinct minority dates to the Mesolithic. There would appear to be no way of distinguishing between earlier and later artefacts.

Site	Dating sample lab number	^{14}C Age BP	^{14}C calibrated Age range (BC)
Kew Bridge	OxA-1160	8820±100	8165-7793
Finsbury Circus	OxA-2024	4140±70	2893-2497
Willington Quay	OxA-1157	3880±80	2547-2136
County Hall	OxA-2020	3850±70	2471-2026
County Hall	OxA-2021	3800±80	1964-1608
Southery Fen	OxA-3745	3460±70	1924-1531
Peterborough	OxA-3742	3430±75	1767-1416
Kew	OxA-2022	3300±80	1767-1416
Brentford	OxA-3744	3245±75	1733-1389
Putney	OxA-3743	3155±70	1608-1264
Feltwell	OxA-3741	3000±75	1416-1020

Table 8: AMS ^{14}C dating of antler base mattocks (Tolan-Smith & Bonsall 1999, 252)

The single artefact from Kew Bridge that has been directly dated to the Mesolithic is notable for its large size and burr circumference (Lacaille 1961, 133), and this can be seen as symptomatic of the general large sizes of red deer during the Early Mesolithic (Howard 2007; Lacaille 1961). As such, the greater biological size of the Kew Bridge specimen marks it out from the later base mattocks, and greater biometric measurement values may be an indicator of earlier artefacts.

The technical choices involved in the manufacture of base mattocks allow the measurement of the burr circumference, which is maintained in the form of the finished artefact. This can be measured and compared against other specimens to give an impression of the relative size of the stag from which the antler originally derived. Nine other base mattocks from the Museum of London were also had the circumference of the burr measured, to provide a sample against which the Kew Bridge specimen could be compared (Table 9). These nine mattocks produced a mean burr circumference of 180mm, whilst the Kew Bridge specimen's value of 301mm far exceeds this.

Findspot	Accession number	Burr circumference (mm)
Kew Bridge	49.107/897	301
Bankside	38.187	209
Thames foreshore	84.405	190
Thames foreshore	NN20977	187
Brentford	0.1157/a	183
New Scotland Yard	49.85	182
Unknown	49.107/901	140
Windsor	81.167/2	124
Putney	81.167/3	195
Brentford Eyot	A28142	213

Table 9: Burr circumferences of base mattocks at the Museum of London

However, whilst this data clearly shows the Kew Bridge specimen to be of exceptional proportions in relation to the later artefacts, it has limited utility in identifying further base mattocks which may be of a Mesolithic date elsewhere in Britain. With such little biometric data available, the sample size for calculating mean burr values for early and late Mesolithic deer is too small to be able to establish reliable absolute values to which a date can be attributed. In light of this, and the small proportion of dated base mattocks that fall into the Mesolithic period, the decision was made to assume that all base mattocks (with the exception of the directly dated Kew Bridge specimen) were likely to be of a later date and thus irrelevant to this thesis.

4.3.6 Beam mattocks

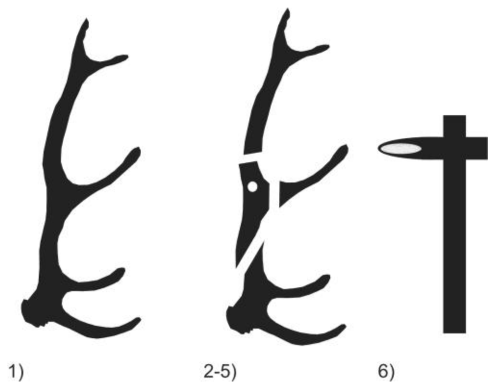


Figure 63: *Chaîne opératoire* of beam mattocks

In contrast to the base mattocks discussed above, the ^{14}C AMS dating of beam mattocks (types C and D in Smith's (1989, 278) typology) has positively confirmed their status as a Mesolithic artefact. These consist of a portion of an antler beam – most usually from around the trez tine junction. The tines and crown are removed and a beveled working edge created. A perforation is executed, allowing the mattock to be hafted (Figure 63). Smith (1989, 274–275) is able to identify 35 beam mattocks from across Britain, with a more recent find from Hutton (Middleton & B Edwards 1993), Uskmouth (Aldhouse-Green et al. 1992) and Goldcliff (Bell 2007b) bringing the total to 38. The AMS dating of six of these has produced exclusively Mesolithic dates. A small number of these artefacts have been recovered from *in situ* late Mesolithic archaeological deposits at the shell midden sites of Risga (T Pollard et al. 1996) and Oronsay (Bishop 1914; Mellars 1987a), and there is no record of beam mattocks being recovered from secure Neolithic or Bronze Age contexts. As such, the beam mattocks can be assumed to date exclusively to the Mesolithic.

Site	Dating sample lab number	^{14}C Age BP	^{14}C calibrated Age range (BC)
Alton Longville	OxA-4606	8005±80	7136-6657
Splash Point	OxA-1009	6560±80	5636-5366
Hutton	OxA-4800	6520±60	5616-5363
Uskmouth	OxA-4547	6180±80	5319-4933
Meiklewood	OxA-1159	5920±80	5001-4591
Staines	OxA-1158	5350±100	4358-4706

Table 10: ^{14}C AMS dating of antler beam mattocks (Tolan-Smith & Bonsall 1999, 252)

Given that this distinction between beam mattocks and base mattocks appears to be important in establishing the relevance of material to this thesis, the work of Smith in typologically defining 77 of the mattocks from Britain is useful for assessing the location of material that may need to be accessed. However, for the artefacts listed in older publications but *not* included in Smith's study, there remain some issues for distinguishing between base and beam mattocks. Wymer and Bonsall (1977) refer to the group of perforated antler tools featuring a working edge as "mattocks", "hoes", "picks", "axes" and "adzes" at different points in their gazetteer (C Smith 1989). It is also worth noting the damage to the spongy material on the working faces of these tools, which is caused during use (Jensen 1991). This can create a hollowing effect at the working face, and has led to some of these artefacts being termed "sleeves". With this in mind, it was assumed that all artefacts referred to in the literature as "mattocks", "hoes", "picks", "axes", "sleeves" or "adzes", but not ascribed to a typological group by Smith (1989) were of potential relevance to this thesis. On initial inspection, however, a large number of these could be quickly identified as "base mattocks" and therefore unlikely to be of further use in this study for the reasons outlined above.

4.3.7 Bevel-ended tools

Bevel-ended tools have been recovered from Mesolithic sites across Britain, and are manufactured using a range of materials. Antler is most famously documented for the production of bevel-ended tools at the shell midden sites from Scotland (Lacaille 1954), where bevel-ended tools have been recovered from *in situ* Mesolithic deposits at sites such as Risga, Cnoc Coig, Priory Midden, Sand, An Corran, Cnoc Sligeach and Morton. The antler bevel-ended tools consist of an antler that has been split longitudinally, and often broken transversely to produce small rectangular or triangular pieces of material (Clark 1956). In order for this splitting to be achieved, the tines and burr must first be removed (Figure 64).

AMS dating of both bone and antler bevel-ended tools from Scottish shell midden sites have shown that they persist throughout Scottish Prehistory, with dates which range from the Early Mesolithic through to the Iron Age (Table 11). As such, bevel-ended tools require some form of corroborative evidence if they are to be interpreted as Mesolithic. Their Mesolithic affinities may be demonstrated on stratigraphic grounds (where this data is available), through direct AMS dating or by their association with other forms of diagnostic Mesolithic material culture. Isolated, unstratified bevel-ended tools cannot be assumed to be of a Mesolithic date.

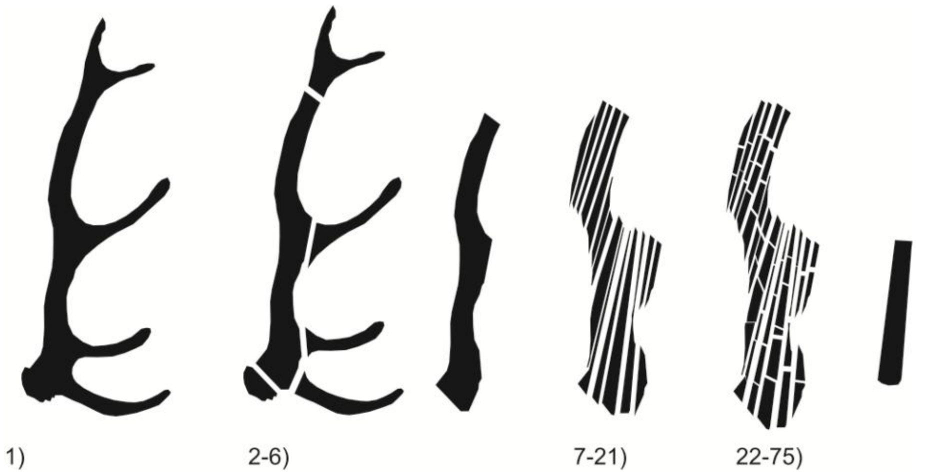


Figure 64: ***Chaîne opératoire*** **for the production of bevel-ended tools**

Site	**Dating sample lab number**	**^{14}C Age BP**	**^{14}C calibrated Age range (BC)**	**Material**
Sand	OxA-10152	8470±90	7705-7309	Bone
Druimvargie	OxA-4608	8340±80	7571-7177	Bone
Druimvargie	OxA-4609	7890±80	7043-6599	Bone
Sand	OxA-10384	7855±60	7029-6572	Bone
Sand	OxA-10175	7825±55	6999-6500	Bone
Sand	OxA-9281	7715±55	6643-6462	Bone
An Corran	OxA-4994	7590±90	6607-6247	Bone
Sand	OxA-9282	7545±50	6477-6256	Bone
Raschoille Cave	OxA-8398	7480±75	6470-6215	Bone
Raschoille Cave	OxA-8535	7265±80	6352-5990	Bone
Loch A Squir	OxA-9255	7245±55	6223-6020	Bone
Sand	OxA-10176	6605±50	5622-5482	Bone
Sand	OxA-10177	6485±55	5538-5326	Bone
An Corran	AA-29316	6215±60	5312-5018	Bone
Risga	OxA-3737	5875±65	4906-4554	Antler
Morton B	OxA-4612	5790±80	4827-4460	Bone
Ulva Cave	OxA-3738	5750±70	4778-4453	Antler
Morton B	OxA-4611	5475±60	4457-4174	Bone
An Corran	AA-29315	5190±55	4229-3897	Bone
Morton B	OxA-4610	5180±70	4230-3799	Bone
Carding Mill Bay I	OxA-3739	4765±65	3656-3372	Bone
An Corran	AA-29311	4175±60	2896-2581	Bone
An Corran	AA-29314	3975±50	2621-2301	Bone
An Corran	AA-29313	3660±65	2274-1881	Bone
Balephuil Bay	OxA-7887	3010±50	1410-1114	Bone

Table 11: ^{14}C AMS dates from bevel-ended tools (Saville 2004; Tolan-Smith & Bonsall 1999)

4.3.8 Perforated antler tines

Figure 65: *Chaîne opératoire* for the production of tine mattock tools

There are five locations in England and Scotland from which perforated antler tine tools (Figure 65) have been recovered. All of these artefacts have originated from chance finds in areas of eroded river banks, and have previously been assumed to date to the Mesolithic. However, the ^{14}C AMS dating of a tine mattock (Bonsall & C Smith 1992), believed to have originated from the Mesolithic Cnoc Sligeach, Oronsay, produced a Bronze Age date (Table 12). Through archival research it was established that the mattock had actually been recovered from the excavation of a Bronze Age Cist burial at Crantit Farm, Orkney (MacKie 1995). With no direct Mesolithic date for tine mattocks in Britain, and in the absence of any finds recovered from secure and dated Mesolithic stratigraphic contexts, there is therefore no positive evidence for the ascription of this artefact type to the Mesolithic. As such, they have not been included in the analysis of this thesis.

Site	Dating sample lab number	^{14}C Age BP	^{14}C calibrated Age range (BC)
Crantit Farm	OxA-4607	3,385±55	1,876-1,526

Table 12: ^{14}C AMS date from the antler tine mattock of Crantit Farm, Orkney (Bonsall & C Smith 1992)

4.4 Access to material

Based on the implication of the discussion above, the instances of worked antler from Mesolithic Britain that this thesis will attempt to examine can now be synthesised. These are given in Appendix 3. The current location of the material within this list was ascertained via the holdings information given in Wymer and Bonsall (1977) and Smith (1989), and the diligent referencing of photographs in more recent reviews of the British Mesolithic (A David & E Walker 2004; Saville 2004), it is possible to establish the current location of a substantial proportion of this corpus of material. Subsequent correspondence with curators enabled research visits to be arranged with the appropriate institutions, to allow the traceological analysis of the material (Table 13). The analysis itself is both non-invasive and non-destructive, but does require considerable time and handling of the material (see Chapter 4). This posed some problems in institutions where research access and space was limited, and with material that was deemed too fragile to be handled or inaccessible due to its current role in public displays – although the majority of these were overcome after some negotiation with curatorial staff.

Institution	Curator contacted	Material from…
British Museum	Nicholas Ashton and Marianne Eve	Sites along the River Thames, Romsey
Glasgow Museums Resource Centre	Jane Flint	Risga
Great North Museum	Andrew Parkin	Whitburn
Hunterian Museum	Sally-Anne Coupar	Risga and Oronsay
Kelvingrove Museum	Jane Flint	Risga
Kingston upon Hull Museum	Paula Gentil	Brandesburton
Museum of London	Jon Cotton	Sites along the River Thames
National Museum of Scotland	Alan Saville	Oronsay, MacArthur's Cave, Druimvargie Cave, Sand, An Corran
Natural History Museum	Richard Sabin	Seamer Carr, Thatcham
Reading Museum	Jillian Greenaway	Thatcham
Royal Albert Memorial Museum	Thomas Cadbury	Westward Ho!
Stewartry Museum	David Devereux	Cumstoun
Torquay Museum	Barry Chadler	Torre Abbey Sands

Table 13: Curators contacted, museums visited and material accessed as part of this thesis

This resulted in the analysis of 47 "mattocks" (or fragments thereof), 26 barbed points (or fragments thereof), 95 bevel-ended tools, 1 awl, 344 pieces of worked antler *debitage,* and 3 miscellaneous pieces of Mesolithic antler, and the accessing of potentially relevant material from a total of 38 separate findspot locations.

Unfortunately, there remained some artefacts which could not be accessed. This was largely found to be the case with smaller museum collections which had been either merged with larger regional institutions or been poorly curated, and had resulted in the loss or mislabeling of the artefacts in question. Unsuccessful enquires were launched at the Buckinghamshire County Museum, Eton College Museum, Bury St. Edmunds Museum, Bowes Museum, Colchester Museum, Stratford Museum, Sunderland Museum, Enfield Museum, Rotherham Museum, Warrington Museum, Manchester Museum, King's Lynn Museum, Tenby Museum, Middenhall Museum and Kingston Museum. This can partly be ascribed to the substantial amount of time that some of the material has spent within museum collections, and the associated increased risks of human error in curation and cataloguing that can prevent the identification and location of the material in question. Additionally, the vague nature of some of the descriptions given by Wymer and Bonsall (1977) may have inhibited efficient searching of internal accessions catalogues, and could have contributed towards the inability to locate these artefacts. Several of the smaller museums and private collections listed by Wymer and Bonsall (1977) are now no longer in existence, and so the material could not be located. This was the case for the A. Marshall Collection, the Passmore Edwards Museum, Bexley Public Library Collection, Dundee Naturalists Society and the North Tees Power Station Collection. The fascinating mattock specimen from Hammersmith which has been photographed the wooden handle still in place was sadly destroyed during the Second World War (Lacaille 1961).

Access could not be gained to the Thrumpton biserial point, as it is on display in the Nottingham Castle Museum and Art Gallery. A similar situation was also encountered with the uniserial barbed points from Brandesburton, which is also on display at the Kingston-upon-Hull Museum. The Newbury Museum is currently undergoing a long-term renovation project and so was unable to provide access to their material.

Difficulties were also encountered when attempting to study material held within University collections. Permission was also sought to study the worked antler from the 1970-1979 excavations at Cnoc Coig, Cnoc Sligeach, Priory Midden and Caisteal Nan Gillean I and II (Mellars 1987a), which is housed within Cambridge University. Unfortunately, this request was not granted and so access could not be gained. The worked antler material from the No Name Hill excavations could not be located. Despite references to analysis undertaken on this faunal assemblage at Durham University, correspondence with the original excavators and zooarchaeologists involved in this analysis did not result in the successful locating of the material.

Finally, the mattocks from Alton Longville and Hutton and the uniserial barbed points from Earl's Barton and Waltham Abbey, which have been ^{14}C AMS dated to the Mesolithic (Tolan-Smith & Bonsall 1999) could not be located, despite contact with the authors of the original dating project, local museums and Historic Environment Records offices in the regions of their recovery. In total, potentially relevant material from 35 locations could not be accessed.

Further to the material which could not be accessed, the decision was also made not to analyse the worked antler material from Star Carr in this thesis. David's original study of European Maglemosian sites included extensive work with the Star Carr assemblage, and analysis of the material held at the British Museum, Natural History Museum and Cambridge Museum of Archaeology and Ethnography (E David 1999, 5). Given that the methods being applied in this study are directly linked to those employed by David, it was felt that further work on the Star Carr assemblage would simply replicate previous results and contribute further to an understanding of antlerworking in the British Mesolithic. The results of David's analysis are summarised in Chapter 2.

4.5 Summary

This chapter has outlined the way in which worked antler material from the British Mesolithic has been located and accessed for the application of traceological analysis. Gazetteers and national reviews of archaeological material in the 20th century were utilised to compile listings of worked Mesolithic antler from across Britain, resulting in the identification of over 1330 pieces of material from 103 sites across England, Scotland and Wales (see Appendix 1).

These listings were then critically reviewed in the light of insights gained through the application of ^{14}C dating to worked antler, to eliminate material which may date to earlier or later periods of British Prehistory. This resulted in the dismissal of tine mattocks and antler hammers from the corpus of material deemed relevant to this study, due to the total lack of stratigraphic or ^{14}C evidence linking their occurrence to the Mesolithic in Britain. Directly dated antler *debitage* and typologically miscellaneous artefacts were considered relevant, as was any antler material recovered from securely dated Mesolithic contexts. However, similar finds from unstratified contexts were classified as irrelevant due to the strong possibility that they could date to earlier or later phases of British Prehistory. The uniserial and biserial barbed points that have been dated to the Upper Palaeolithic were also dismissed. The distribution of base mattock dates across the Early Mesolithic and Bronze Age prompted a brief evaluation of the potential for biometric data in distinguishing between artifacts from the two periods. However, the small sample sizes available for calculating mean antler dimensions for Early Mesolithic red deer severely undermined this approach, and it was concluded that base mattocks must also be assumed to most likely be of a later date. Antler bevel-ended tools and beam mattocks can be firmly dated to the Mesolithic on both stratigraphic grounds and through the sample of ^{14}C AMS dated material, and so are considered to be relevant for this thesis. The reviewed listings of Mesolithic antler material are given in Appendix 3.

Access to this material was then sought through enquiries with a number of national and regional museums. Although not universally successful, these enquires resulted in the analysis 47 "mattocks" (or fragments thereof), 26 barbed points (or fragments thereof), 95 bevel-ended tools, 1 awl, 344 pieces of worked antler *debitage,* and 3 miscellaneous pieces of Mesolithic antler. The results of this analysis are presented in the following chapter.

Chapter 5: Results

5.1 Introduction

The aim of this chapter is to present the results of the traceological analysis of Mesolithic worked antler material from Britain, thus fulfilling Objective 5 of the thesis. These results will be presented on a site-to-site basis, working from the most northern sites to the most southern. The results will include a brief description of the context of recovery for the antler material, followed by a report on the results of the traceological analysis carried out as part of this thesis. Where new ^{14}C AMS dates are presented, the lab code, uncalibrated and calibrated data will be provided. In the case of dates which have been previously presented in Chapter 5, only the calibrated range and sample lab code will be given.

5.2 An Corran, Skye

5.2.1 Context of recovery

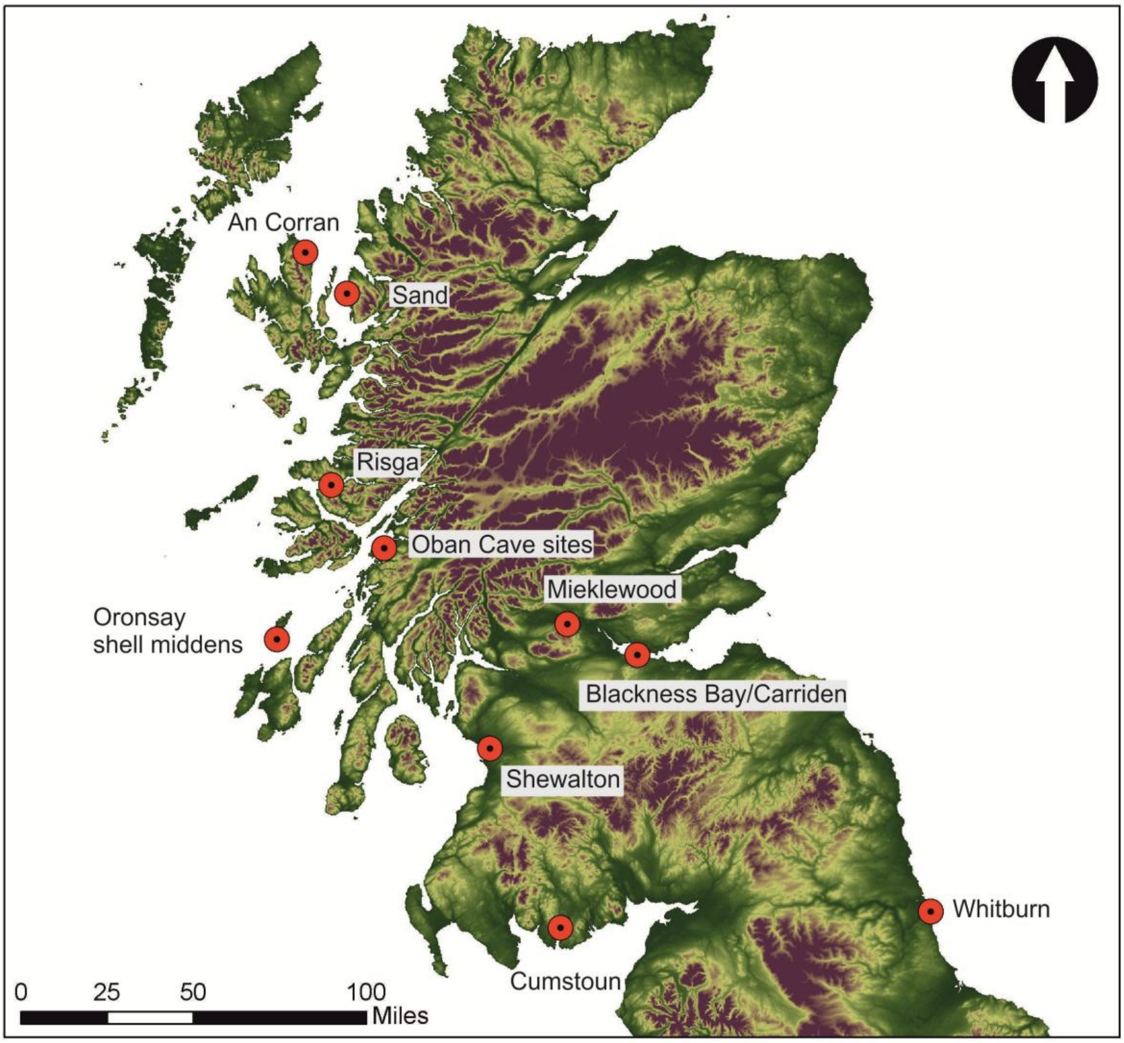


Figure 66: Location of sites in Northern Britain

The Mesolithic site of An Corran is located on the Isle of Skye, Scotland (Figure 66). The site is situated within a rock shelter, at the foot of a series of cliffs to the south of the Bay of An Corran and was excavated between 1993 and 1994 (Saville & Miket 1994). The excavations recorded a sequence of 41 deposits, the lower 10 (Figure 67) being ascribed to the Mesolithic based on the presence of microlithic technology and ^{14}C dating. These lower contexts consisted largely of humified shell deposits, containing worked flint, animal bone, charcoal and ash. Of particular interest are deposits C37 and C36, which have been interpreted as discrete shell middens.

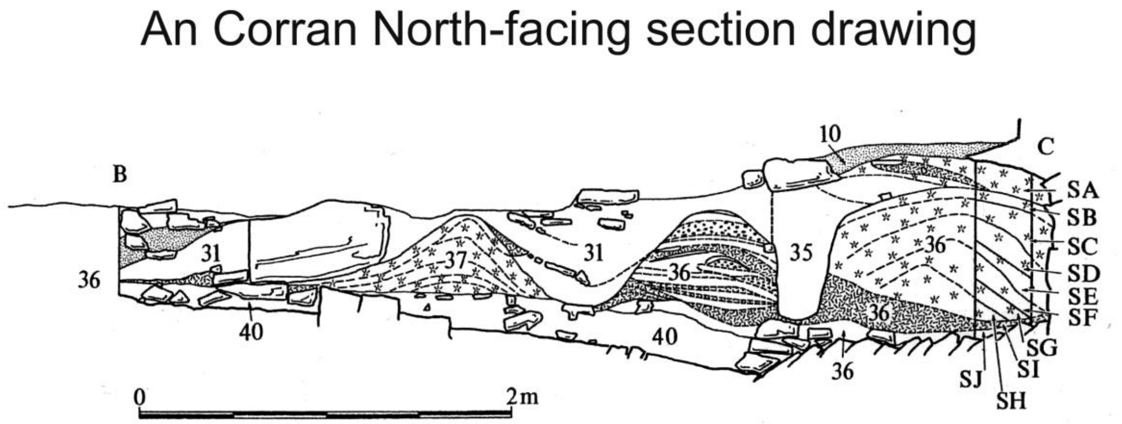


Figure 67: North-facing section at An Corran

5.2.2 Antler barbed point from An Corran

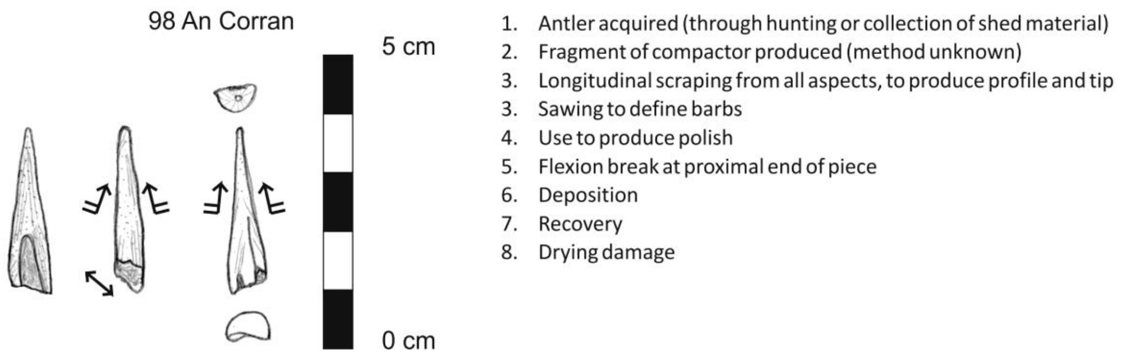


Figure 68: Piece 98 - barbed point tip from An Corran and sequence of working actions

A single fragment of a worked antler artefact has been recovered from An Corran. Piece 98 (Figure 68) is the extreme tip of a barbed point made from antler. This was recovered from C31, the humified layer overlying the discrete midden deposits of C37 and C36 (Figure 67). Based on the analysis of the piece, a sequence of working actions can be suggested (Figure 68).

5.2.3 Antler *debitage* from An Corran

Context C36 contained a total of 22 antler fragments. These pieces vary considerably in terms of their potential for traceological analysis, some representing considerable portions of anatomically diagnostic antler, whilst others offering no further insight into the use of antler at the site due to their small size and fragmentary nature.

The analysis of a small sample of the pieces under 5g (Figure 69) in weight revealed that these pieces offered no further insight into the use of antler at An Corran, as working surfaces were not visible and only one piece could be identified to a specific part of an antler – a tine tip. It was concluded that the analysis of fragments below the weight of 5g would yield little insight into antlerworking practices at An Corran, further than can be offered by recording the presence and frequency of these pieces.

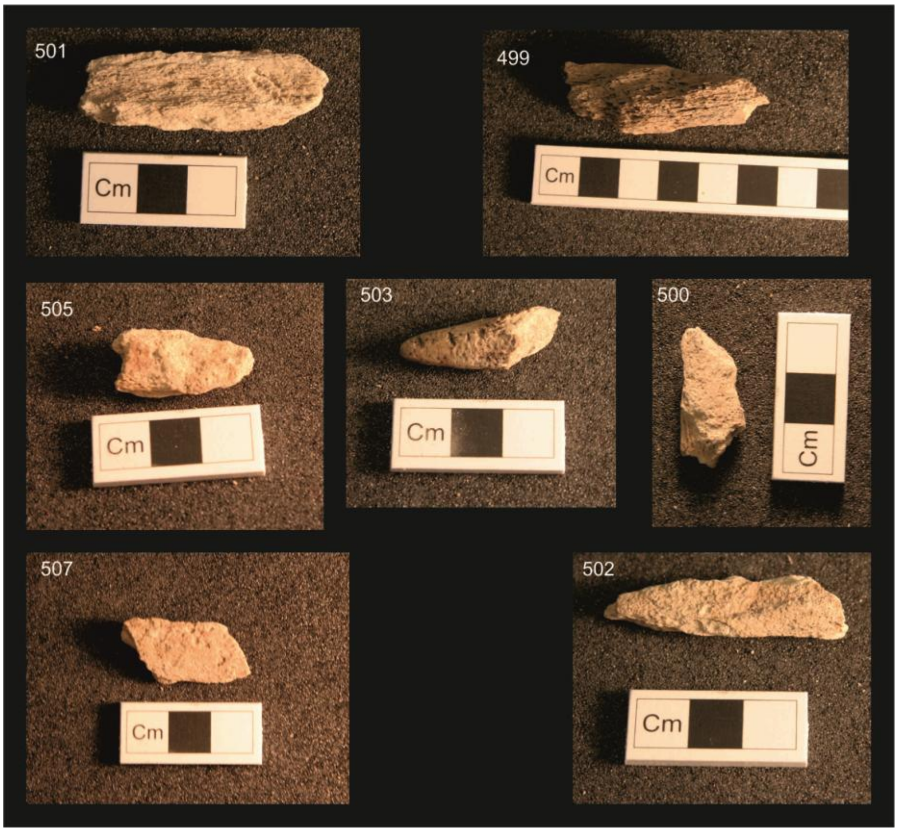


Figure 69: Sample of antler *debitage* weighing under 5g from An Corran

The analysis of six *debitage* pieces over the weight of 5g proved more successful. Prepared breakage appears to have been used to separate tines from beams, which has been facilitated by nicking around the circumference of the tines. This is shown on both removed tines, and also on the single portion of beam present in the An Corran assemblage (Figure 70). In the case of the smaller tine tips, simple breakage technique has been employed to remove them. Longitudinal fracture planes along the sides of fragments of compactor also indicated that flake breakage had been employed to further fragment portions of red deer antler. Flake breakage is also apparent in the flake scars observed at the proximal ends of some removed tines, indicating that flake breakage had been applied to the adjacent antler prior to the detachment of the tine. In the case of Piece 504, this flake scar is observed on a tine tip. This must have meant that the tine was first removed from the beam, in order for flake breakage to be applied longitudinally along the length of the tine, creating the flake breakage scar observed.

Figure 70: 508, An Corran

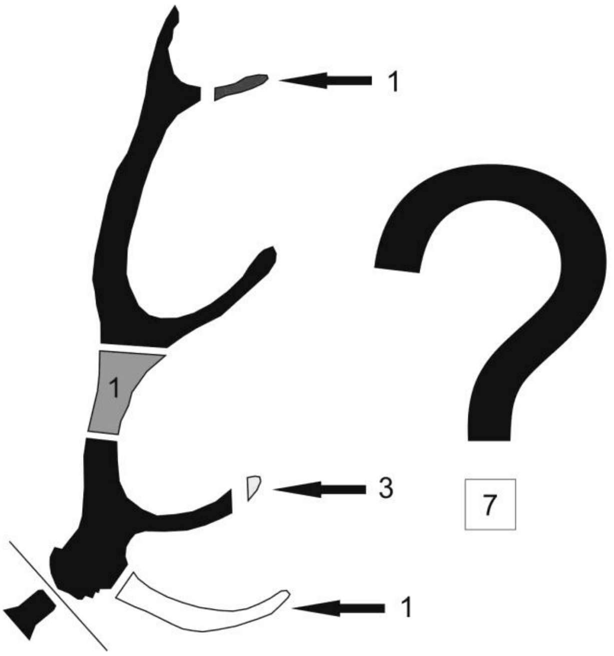
5.2.4 Summary and discussion of antlerworking at An Corran

The traceological analysis of the An Corran antler material illustrates a number of trends in the treatment of antler at the site. The occurrence of the broken barbed point tip indicates the deposition of these artefacts at the site. The type of break which resulted in the creation of piece 98 – a flexion break beneath a barb and close to the tip – is consistent with breakage in use (Elliott 2009). This raises the possibility that the barbed point was used at the site, or in the immediate vicinity. The recovery and subsequent discard of broken barbed point tips may occur during the butchery of animals that have been caught using these tools. However, the single instance of this type of artefact, and its occurrence within a single context (C31) of a multi-phase site suggest that the breakage, recovery and deposition of barbed points was not a repeated or persistent practice at An Corran. The stratigraphic distinction between C31 and C36, from which the *debitage* discussed below was recovered from also means that there is no stratigraphic link between the fragmentation of red deer antler and the occurrence of the barbed point – there is therefore no direct evidence for a full barbed point *chaîne opératoire* at An Corran.

The *debitage* assemblage highlights a different treatment of antler at the site. The debitage is exclusively red deer, suggesting that elk and roe deer antler were not worked. The quantities of data discussed here are generally low, and the lack of multiple instances of anatomical elements such as burrs, basal portions or large sections of beam suggest that no more than one antler was worked at the site. The confinement of the vast majority of this material to a single context (C36) further supports the interpretation of this assemblage as a single antlerworking event. The absence of basal portions with the burr intact also prevents the shed/unshed nature of the antler from being ascertained, and as such the working of red deer antler cannot be directly linked to the processing of hunted of red deer carcasses – collection of shed antler remains a possible source of this material.

The economy of the *debitage* (Figure 71) indicates that relatively high proportions of tines and tine tips appear to have been deposited at the site, in comparison to sections of beam or basal portions. The working techniques documented within the debitage assemblage are also interesting. In the cases of pieces 487, 498 and 504 tines appear to have been worked longitudinally using the flake breakage technique to produce rectangular splinters of compactor material (similar to piece 254), before the tines or tine tips are deposited at the site. Pieces 498 and 508 directly demonstrate the removal of tines prior to the application of flake breakage, whilst the angle of the flake breakage markings on piece 497 heavily imply that the tine was removed before flake breakage was carried out.

Yet despite high recovery rates which resulted in the recovery of antler fragments weighing as little as 1 gram, there appears to be much less antler splinters recovered from the site than would be expected if an entire red deer antler had been broken up in this way. This may suggest that; a) the fragmentation of this material, via the flake breakage method, was carried out at another location and then the tines were brought to An Corran and deposited, or b) fragmentation of the beam and tines was carried out at An Corran and the products subsequently taken elsewhere for use and deposition, whilst the tine tips were deposited at the site itself. Given the lack of evidence for the utilisation of tines or tine tips in themselves at An Corran, the latter interpretation is favoured here.



Element	Quantity
Brow tine	1
Tine tip	3
Mid-beam	1
Crown tine	1
Unknown	7

Figure 71: Economy of *debitage* from An Corran

5.3 Sand, Applecross

5.3.1 Context of recovery

Discovered and excavated as part of the *Scotland's First Settlers* project (Hardy & Wickham-Jones 2003), the shell midden site of Sand is located within a rock shelter in the parish of Applecross (Figure 66). Test pits were dug in 1999 to establish the extent of the midden deposits, followed by full excavation of the midden in 2000. This resulted in the excavation of c.16% of the midden deposits at the site, and allowed the stratigraphy of the midden to be established (Hardy 2009c). The shell-rich layer was assigned as “Context 13” (C13), which overlay a organic-rich, silty deposit which did not contain shells (C22).Evidence of later occupations in a range of prehistoric periods was found in the deposits overlying the Mesolithic midden layers, and the relationship between the deposits implied that the site had been subjected to considerable geological and anthropogenic disturbances since the Mesolithic period.

The excavators argue that the Sand shell midden built up quickly and continuously over a relatively short period of time (Hardy 2009c). This is based on the lack of evidence for vegetation growth within the midden deposits themselves, and the general congruence of the three Mesolithic dates from C13 (Table 14). The site produced evidence for occupation in a range of periods, with modern, Bronze Age and Neolithic material being recovered from a variety of contexts. However, ^{14}C dating of worked bone material (Table 14) from C13 have firmly established the Mesolithic age of this specific strata at the site. The slightly later dating of the underlying C22 is believed to be the product of slipping, as the midden itself was situated on a steep slope (Hardy 2009c).

Dated material	Context	Lab code	^{14}C age (bp)	Calibrated age range (BC)
Bone bevel ended tool	13	OxA-10384	7855±60	7029-6572
Bone bevel ended tool	13	OxA-10175	7825±55	6999-6500
Charcoal	13	OxA-9343	7765±50	6680-6478
Bone bevel ended tool	13	OxA-9281	7715±55	6643-6462
Bone bevel ended tool	13	OxA-9282	7545±50	6477-6256
Antler	13	OxA-9280	7520±50	6461-6253
Bone bevel ended tool	22	OxA-10176	6605±50	5622-5482
Bone bevel ended tool	22	OxA-10177	6485±55	5538-5326
Bone bevel ended tool	22	AA-50698	3615±65	2194-1773
Bone bevel ended tool	13	OxA-12096	7744±37	6643-6484

Table 14: ^{14}C dates from Sand (Ashmore & Wickham-Jones 2009)

A total of 83 fragments of antler were recovered from the Sand. Five of these fragments originated from topsoil and slopewash, whilst a further fragment had no secure provenance. 34 antler fragments were recovered from C13, whilst a further 43 originated from the C22. Following analysis by Parks at the University of York (Parks & Barrett 2009), the antler was stored at the National Museum of Scotland. Permission to study this material was granted and access arranged, but subsequent problems in locating the material meant that only a small selection of antler was available for analysis. Whilst this inhibited the potential for analysis and interpretation of the Sand assemblage, Parks' original work did include some rudimentary elemental identification of the antler material (R Parks *Pers. Comms.*). This data will be integrated with the traceological analysis of accessible material to inform a discussion of antlerworking at Sand.

5.3.2 Antler *debitage* from Sand

Piece 1884 was recovered from Context 13, within the shell midden itself. It consists of the crown of a right-sided red deer antler. The piece itself has broken into three fragments (A of Figure 72), either during recovery or in curation. It has been subjected to extensive gnawing, with deep striations at the tine tips indicating the actions of rodents, and crushing damage at the proximal termination of the piece suggesting chewing by large mammals. Nicking, followed by the execution of a prepared break was used to remove the crown from the upper beam. The nicking marks overlie the crushing damage at the proximal end of the piece, and the prepared break itself cuts through the crushing marks (B in Figure 72). This implies that the antler had been chewed by ungulates before being worked. However, the gnawing marks apparent at the distal tips of the crown tines may still have occurred after the piece was worked and deposited. There are also two circular drilled holes in the spongy material exposed at the proximal end of the piece, produced in the process of sampling for ^{14}C dating.

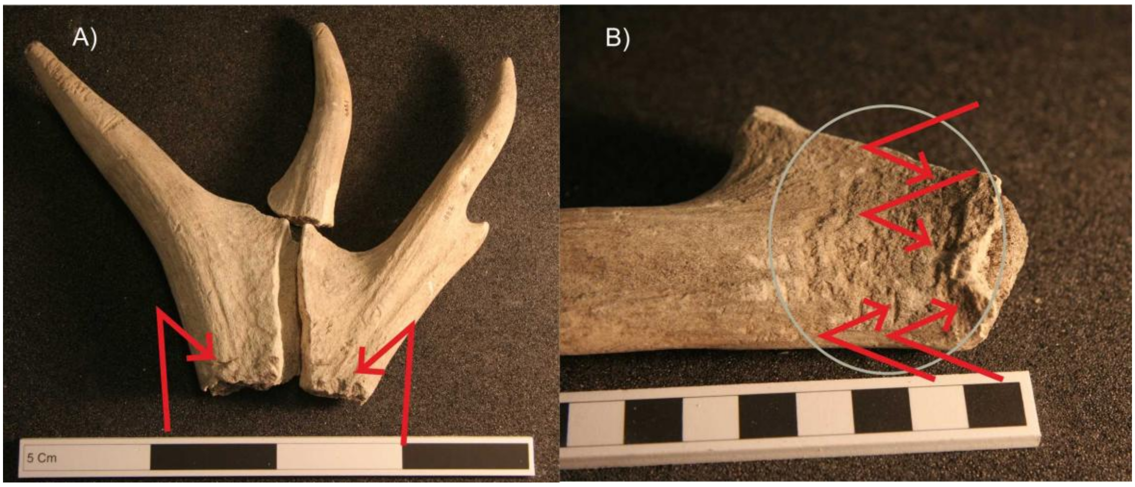


Figure 72: Antler *debitage* piece 1884, Sand. A) Modern fragmentation of the piece and areas of nicking, B) Area of chewing marks (encircled), overlaid by nicking marks at proximal break

The working sequence for piece 1884 can be summarised as follows:

1. Antler becomes available for other mammals to chew (either deer dies with antlers attached, or antler is shed)
2. Chewing by large mammals
3. Antler acquired (through butchery of previously deceased red deer or collection of shed material)
4. Nicking at base of crown
5. Prepared breakage of crown from upper beam
6. Deposition
7. Possible further gnawing by animals
8. Recovery
9. Modern damage – breaks into three pieces
10. Sampled for dating

Pieces 3172, 14 and 16 are removed red deer tine tips. Gnawing marks are apparent across the surface of all three pieces. The character of the proximal breaks varies to a certain extent, but the dental marks observable of piece 3172 suggest flexion breakage. Damage to the extreme distal tips of the three pieces is consistent with the damage sustained to antlers in fraying.

5.3.3 Park's analysis of the Sand antler

The remaining 43 finds (79 fragments) of antler from Sand have been analysed by Parks (R Parks *Pers. Comms.*). Much of this data is summarised in the Sand zooarchaeological report

(Parks & Barrett 2009), but access has very kindly been granted by the original author to the raw data generated by Park's analysis of the assemblage (Table 15).

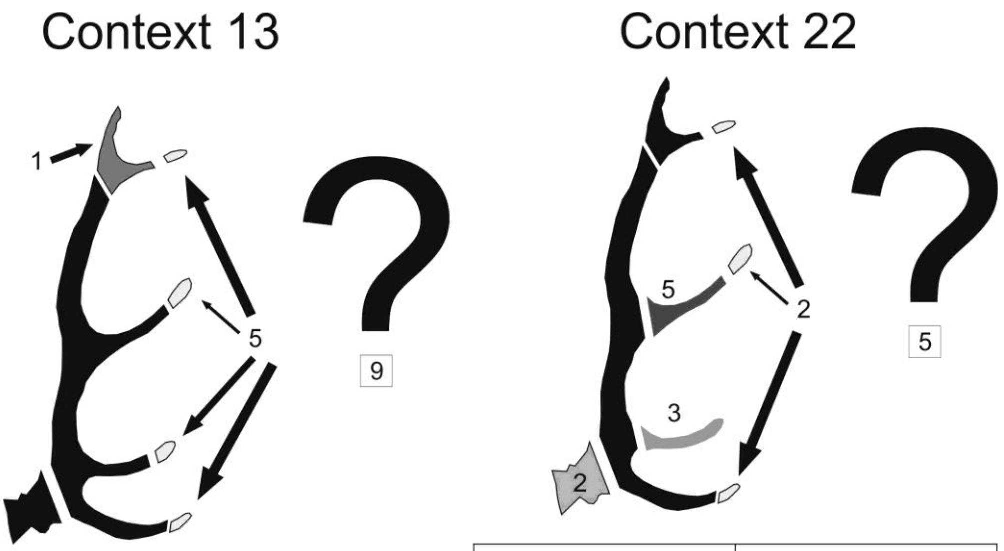
Bone number	Context	Quantity of fragments	Notes	Weight
3827	tr9	3		217.5
1884	013	1	antler tine frag, fresh breakage, part was in SW part of square	128.8
1811	022	1	not shed! Base of antler massive, basal circumference 177mm	119.5
5853	013/023disturbed	15		93.49
3826	tr9	1		84.5
3246	025	2	looks like one large antler frag, prob red deer v. degraded further fragmented by root damage, were lots of little bits of antler too, recorded as unid uim so as not to distort NISP	68
2473	013	1		62
2469	022	19		38
437	022	1	pedicle & very base of antler	35
449	022?	1		34.9
3600	007/008	1		34.5
5863	013/023disturbed	1		28.6
398	TP9	1		18
2514	013	1		13.5
1802	022	1	antler tine frag	13
1852	013	1		12
3172	013	1		12
3559	013/023/024disturbed	2	2xtips of tine, prob red deer as very little roe	11.5
2519	022	1		10
450	022?	1	antler tine	7
1806	022	1	antler tine frag	7
528	022	1	antler tine	6.5
545	022	1		6
1804	022	2		6
14	013/023	1	tip of antler tine	5.5
565	022	5	antler tine frags	5.5
1803	022	1	antler tine frag	5
13875	013	3		3.5
24	001/2	1	tip of antler tine	3.5
471	022	1	antler tine	3.5
575	013	1		3.5
1807	022	1	antler tine frag	3.5
13878	013	3		3.42
555	001	1	fresh break during analysis, was one tine frag	3
1805	022	1	antler tine frag	3
3408	001/2	1		2.5
16	013	1	tip of tine	2

2	022	1	tip of tine	1.5
1815	013 disturbed	1		1.5
3361	001/2	1		1
310	001/2	1		1
401	022	1		1
1848	013	1	tip of antler tine	0.5

Table 15: Antler identified in the Sand assemblage by Parks

5.3.4 Summary and discussion of antlerworking at Sand

From this data, the economies of *debitage* can be constructed (Figure 73). Of the material that has been identified, there appears to be a relatively high occurrence of tine tips within the assemblage and an absence of beam portions from both C13 and C22 – similar to the patterns observed at An Corran (Figure 71). The presence of two unshed antler base portions positively confirms the use of antler at Sand from animals killed in hunting activities, although this is confined to Context 22.



Element	Quantity
Crown	1
Tine tip	5
Unknown	9

Element	Quantity
Unshed basal portion	2
Tine tip	2
Tine	3
Tine fragment	5
Unknown	5

Figure 73: Economy of *debitage* from Sand

However, it is important to note that although some elemental identifications have been made for this material, the majority of the antler fragments from Sand have not been ascribed to a specific element of antler. It is therefore important to stress that the absence of elements recorded in this data may not necessarily equate to their absence within the assemblage. As such, the apparent high frequency of tine tips and low proportion of beam fragments need to be treated with caution.

5.4 Risga, Loch Sunart

5.4.1 Context of recovery

The midden site of Risga is located on the small island of Risga, situated within Loch Sunart (Figure 66) and was excavated by Mann in 1920, and MacKewan in 1921-22. The only publication from these excavations came in the form of a newspaper article in the *Glasgow Herald* (Mann 1920), which is reproduced by Pollard *et al.* (1996, 178–180). He states that red deer remains were recovered from Risga, and that antler was "made into tools like shoe horns," and "finger-like implements" (Pollard et al. 1996, 179).

Foxon's (1991) study of the use of osseous materials in prehistoric Scotland includes an analysis of the Risga bone and antler assemblage. In relation to the use of red deer antler, he notes that the quantities of tines within the assemblage indicate that approximately five antlers were worked at the site. He states that antler beams were broken up using a "fracture" method, although fails to provide a detailed description of how this method could be applied to antler, or any experimental material to support this interpretation (Foxon 1991, 99). He also identifies 13 barbed points within the assemblage, which he argues are made exclusively from antler and which indicate an understanding of the structural properties of the material which make it resistant to impact damage (Foxon 1991, 103). In relation to the manufacture of antler bevel-ended tools, Foxon argues that the Risga specimens show signs of having their working edges shaped prior to use, and then smoothen and flattened during use. He also notes that some specimens have flake damage to their working edges, which he interprets as evidence for use in a percussive action. This leads him to conclude that the bevel-ended tools at Risga can be divided into three groups; "punches, rubbers and piercers" (Foxon 1991, 115).

Yet Foxon's analysis, discussions and conclusions are undermined by inconsistencies in the language used to describe specific working marks, and a lack of illustration. Terms such as "trimming", ""striated" and "second level shaping" are not adequately explained and make his conclusions difficult to verify (Foxon 1991, 111). Additionally, the drawings he does include do not provide the detail necessary to verify his conclusions – the barbed points, for instance, are not drawn in a way which adequately demonstrates the reasons for their identification as antler.

More recently, Risga has been revisited by Pollard *et al.* (1996) – who provides a detailed account of the previous excavations. Through reference to unpublished correspondence between the original excavators, Pollard *et al.* ascertain the existence of a "soot layer" underlying a deposit of dark organic soil, rich in shells. Both the soot layer and the shell midden deposits contained Obanian material culture, in the form of bevel-ended tools (Pollard et al. 1996, 171–172). Pollard *et al.*'s excavations at the site focused on areas away from the midden, which following a trial excavation was found to consist of MacKewan's disturbed spoil material (Pollard et al. 1996, 172–174). However, the authors do acknowledge that undisturbed midden deposits may remain *in situ* at the site.

Mann and MacKewan's material is held at the Glasgow Museums Research Centre (GMRC), Kelvingrove Museum and Hunterian Museums. Whilst contextual information for individual finds is lacking, the general character of the antler assemblage is consistent with other Mesolithic "Obanian" sites in the area, and there is nothing within the worked and unworked antler to suggest that this material originates from a period of later occupation. The Mesolithic date of the material is further supported by the AMS dating of an antler mattock from Risga to 5250-4650 cal. BC (OxA-2023) (Tolan-Smith & Bonsall 1999).

5.4.2 Antler mattocks from Risga

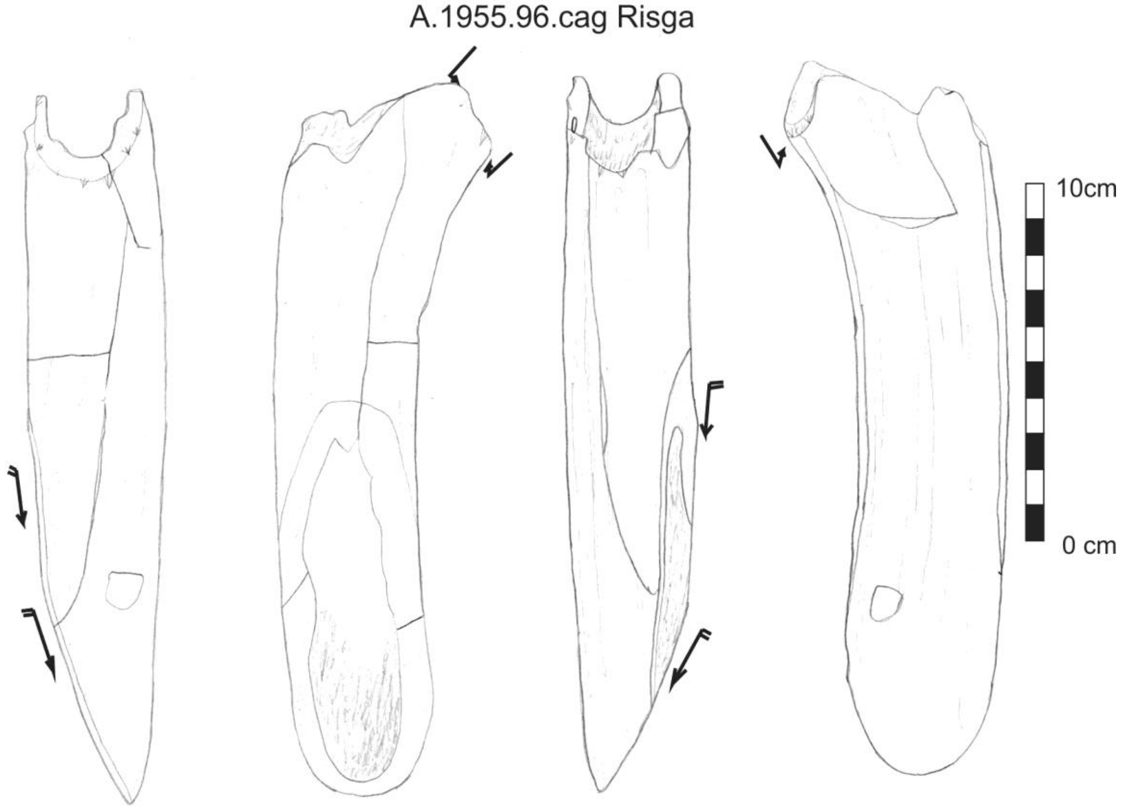


Figure 74: A.1955.96.cag, Risga

Although no complete specimens have been recovered from Risga, nine broken fragments of mattock tools were located within the collections of the Glasgow Museums Resource Centre and Hunterian Museum. The most complete is piece A.1955.96.cag (Figure 74). This can be classified as a beam mattock under Smith's typology (1989), and has been broken at the point of hafting. The exterior anatomical surface of the piece has been smoothed though weathering and some traces of fine cracking are apparent. However, the general morphology of the piece indicates that it is made from a portion of red deer antler beam, taken from below the trez tine. The beveled working edge of the piece features series of longitudinal striations running on two separate axes, overlain by a thin polish. Damage to the spongy core material of the working face can also be observed. This has been interpreted as the product of two phases of scraping, in slightly differing directions, followed by use of the tool. At the distal end of the tool a jagged broken edge can be observed, cutting through both the beam and the trez stump. Signs of a perforation are also apparent at the broken trez stump. This has been created through the removal of the trez tine and the subsequent execution of a perforation at the stump of the trez tine, through use of the boring technique. Nicking marks are apparent around the trez tine stump, and the level break surface suggests the execution of a prepared break. The *chaîne opératoire* of A.1955.66.cag is shown in Figure 75.

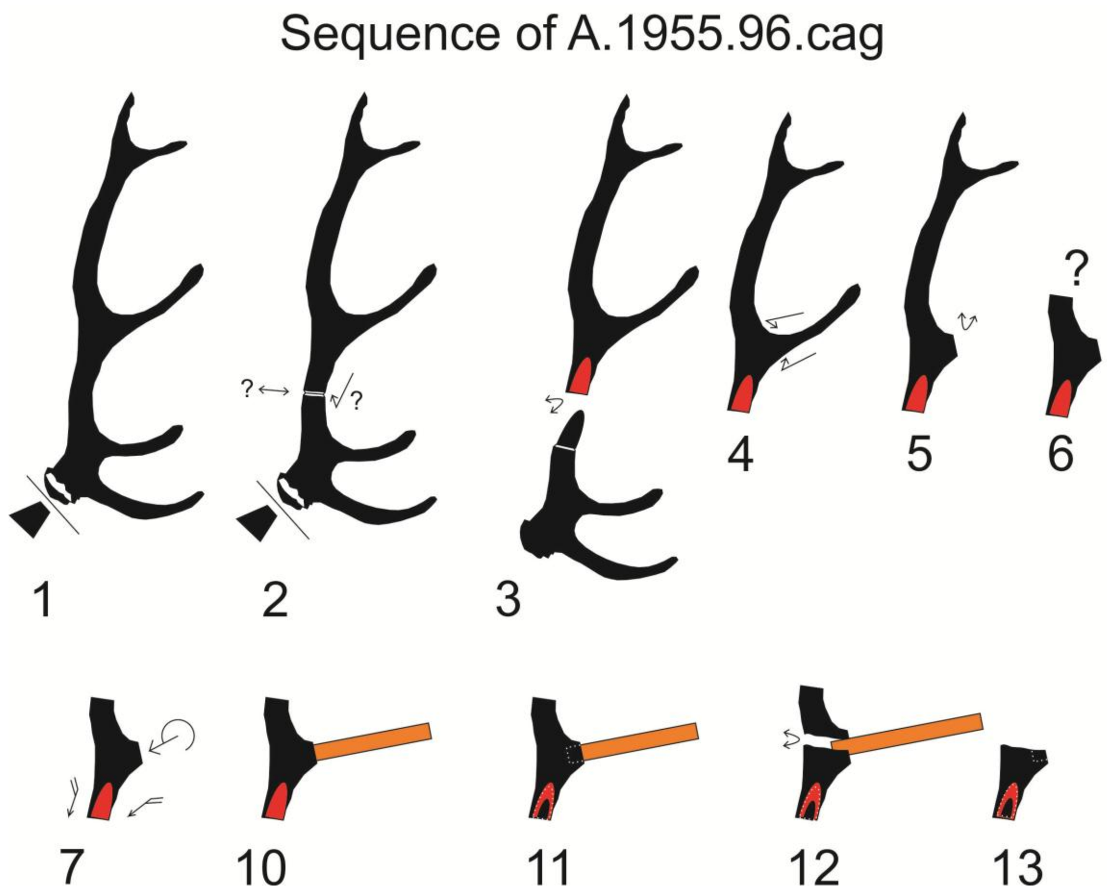


Figure 75: ***Chaîne opératoire*** **of A.1955.96.cag**

The remaining eight pieces consist of fragments of mattock working faces and edges, and a fragment of a perforation (Figure 76). These pieces indicate the presence of multiple mattocks during the occupation of the site, and that the working edges of the mattocks were consistently shaped through scraping prior to use. In the case of B.1951.1970.G, drilling appears to have been used to create a perforation.

There is interesting variation in the fragmentation techniques responsible for the breaking of the mattock fragments. The character of the break surfaces of two fragments indicates that they have been created through flexion. This can be interpreted as flexion pressure created in the use of the object, and the angle of the break surfaces indicates that this pressure was applied laterally across the working face. In contrast to this, six of the fragments feature longitudinal fracture planes, running parallel along the SEN and DEX edges. These suggest the use of flake breakage to split the mattocks longitudinally.

Further to this, one piece of fragmented mattock working edge also features a notably beveled end (B.1951.1970.A). The beveling of this end can be seen to overlie the polish of the original mattock working edge, and thus has been created after the use of the mattock itself. In this instance it appears that an antler mattock has been manufactured, used, intentionally broken up through flake breakage and then the fragments re-used as a bevel-ended tool.

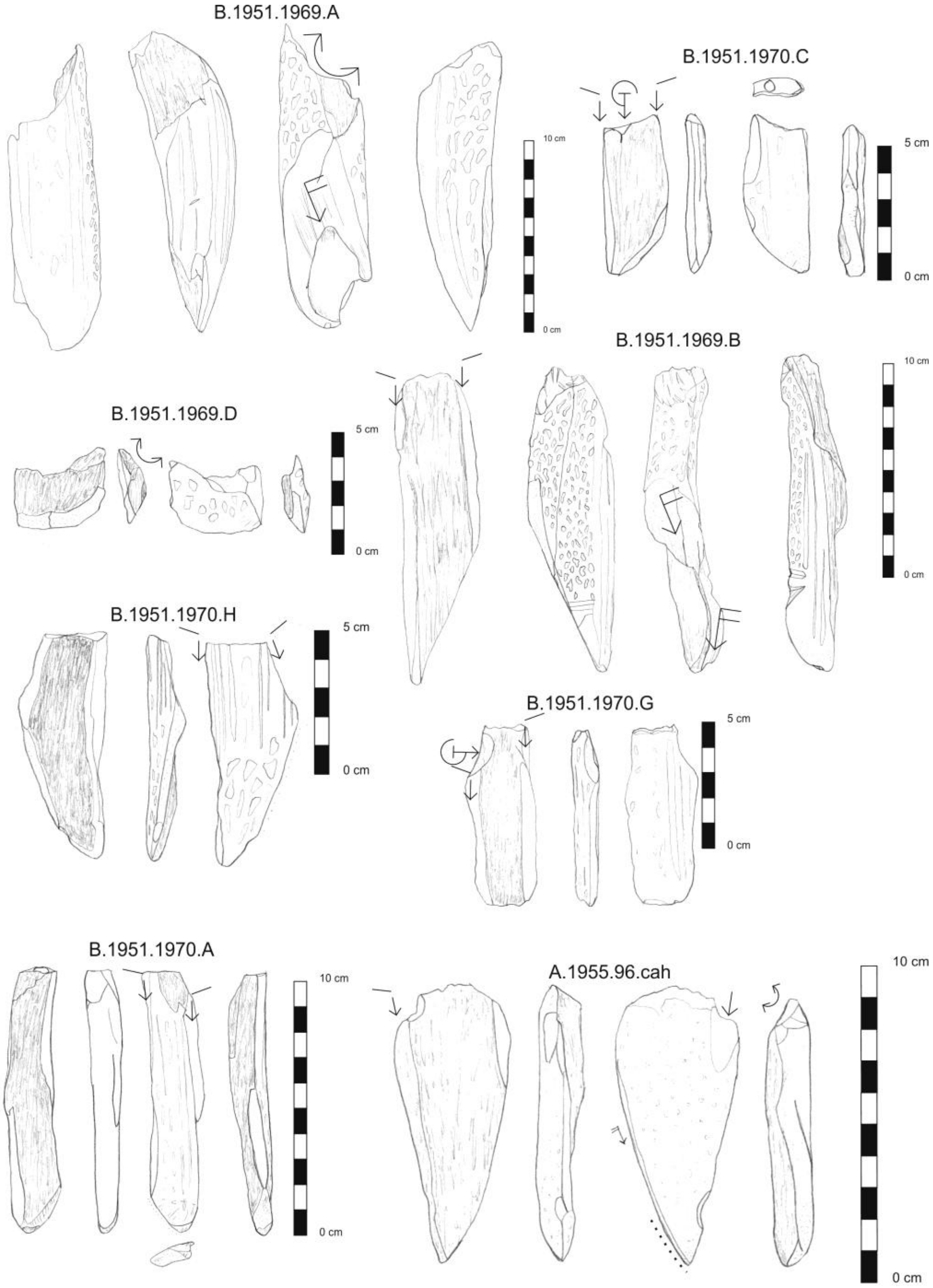


Figure 76: Fragments of antler mattocks from Risga

5.4.3 Bevel-ended tools from Risga

17 antler bevel ended tools were located within the Glasgow Museums Resource Centre (Figure 77), whilst a further six were accessed at the Hunterian Museum, Glasgow (Figure 78). The fractured SEN and DEX edges of these are consistent with the flake breakage method. The working edge of the tools then appears to have been shaped through an abrasive activity, producing a smooth and rounded working surface. It is unclear whether this is action is carried out *prior* to use, and is created through the grinding technique before being accentuated by use itself, or if the beveled effect is created solely through use.

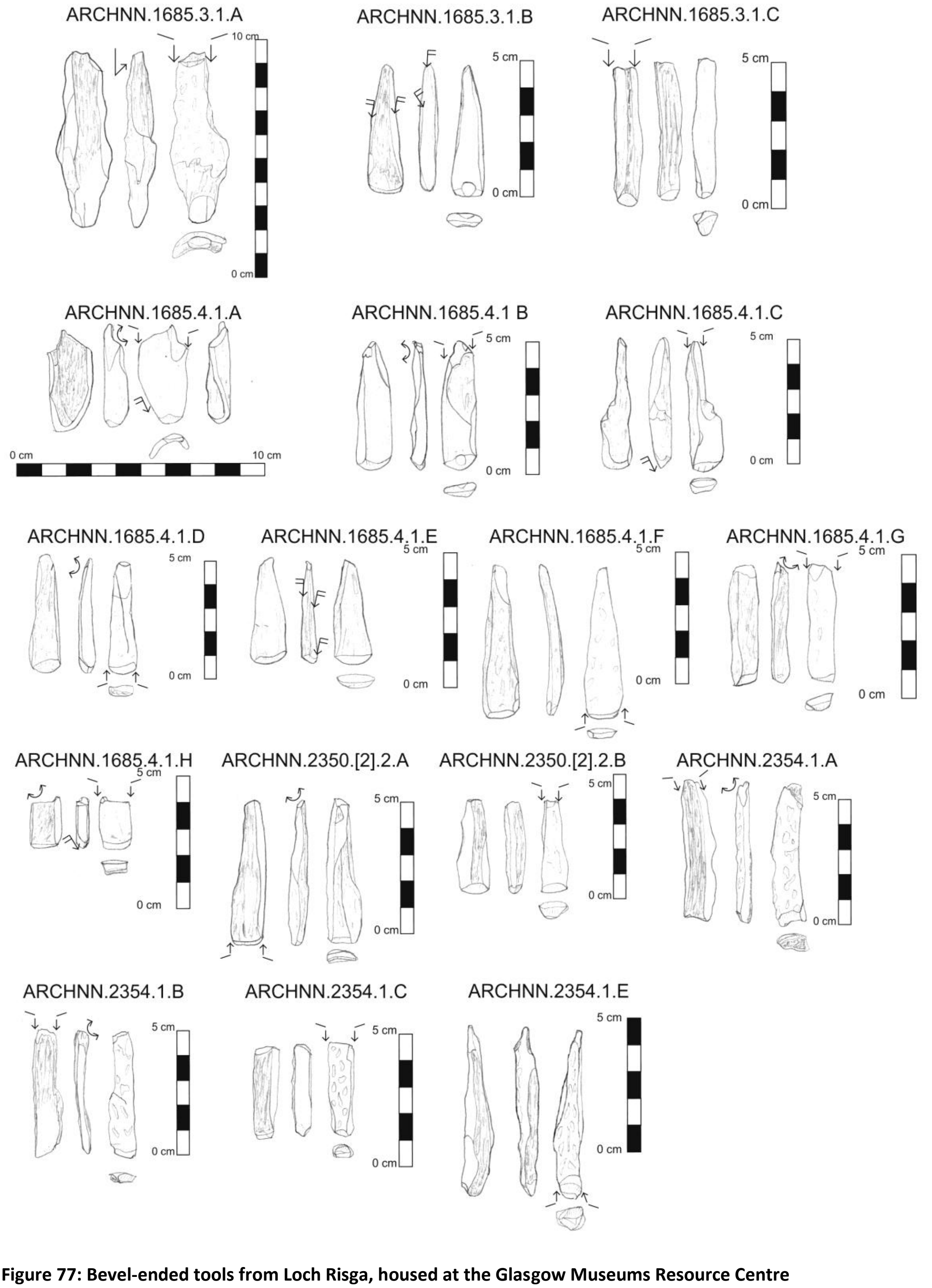


Figure 77: Bevel-ended tools from Loch Risga, housed at the Glasgow Museums Resource Centre

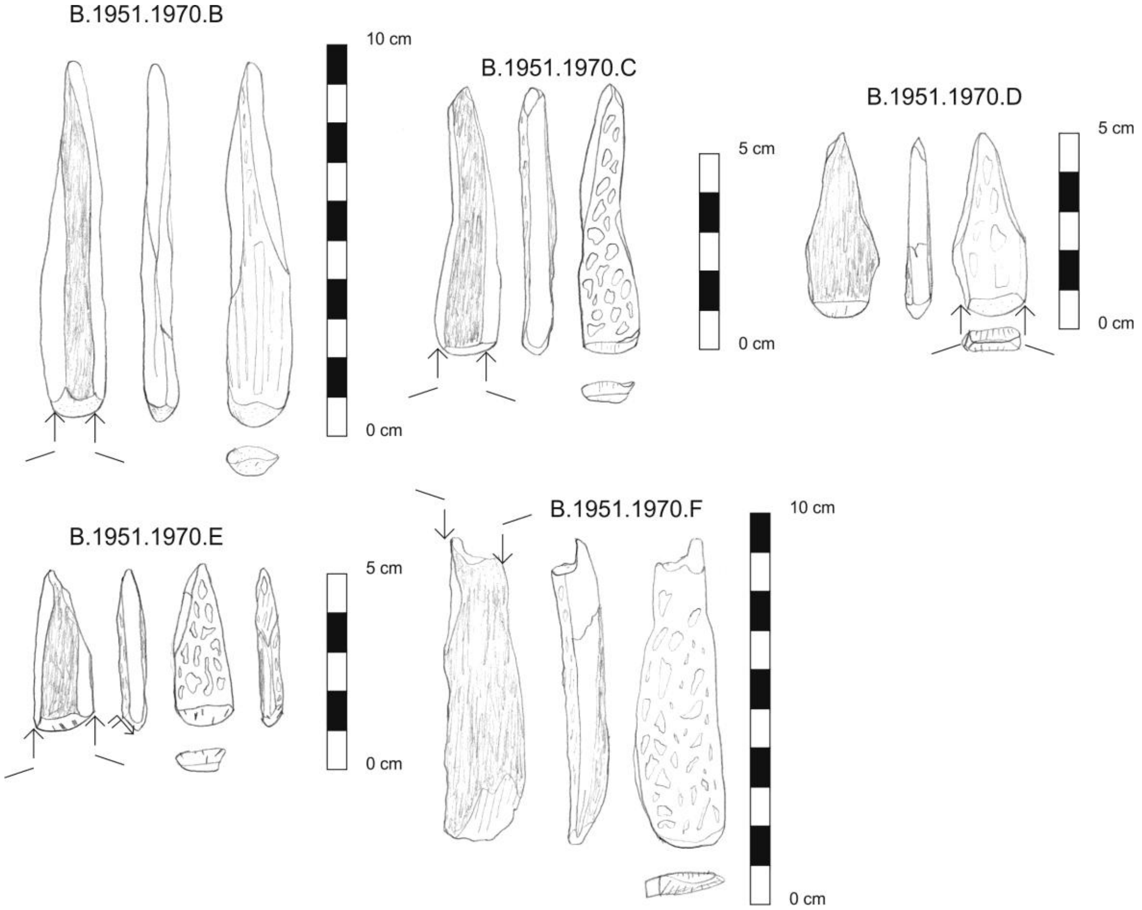


Figure 78: Bevel-ended tools from Risga, held at the Hunterian Museum, Glasgow

Four of the bevel-ended tools from Risga show signs of scraping on the working edge (Figure 77 and Figure 78), in the form of unidirectional striations running longitudinally across the face. These markings have been partially obscured by the process which has smoothed the working face. It is important to highlight the fact that subsequent abrasive usewear may destroy or obscure any pre-existing working marks. As such, it is difficult to ascertain whether the remaining thirteen bevel-ended tools were shaped using scraping *prior* to use that grinding was used to shape the working edge, or that the working edge was created solely through use.

At the distal end of the artefacts, there is some variation in the methods used to define the extremities of the tool. 12 of the tools show signs of a flexion break at their distal end, one shows signs of nicking followed by the execution of a prepared break, seven display intersecting SEN and DEX edges and have a “tear-drop” shape when viewed from the exterior or interior face and a further two have unidentifiable breaks at the distal end.

Scraping marks are apparent, in association with distinct facets, along the SEN and DEX edges of some of the bevel-ended tools. Further to this, a number also feature polish episodes along the SEN and DEX edges (A and C in Figure 79). These working marks are interpreted as evidence of intentional shaping of the tools in preparation for hafting, and polished developing in areas where the haft came into contact with the tool itself. Some of the Risga bevel-ended tools have also been exposed to varying levels of weathering before being recovered from the site (B in Figure 79). This has the potential to obscure the polish associated with hafting, and as such an absence of polish cannot necessarily be interpreted as an absence of hafting in use.

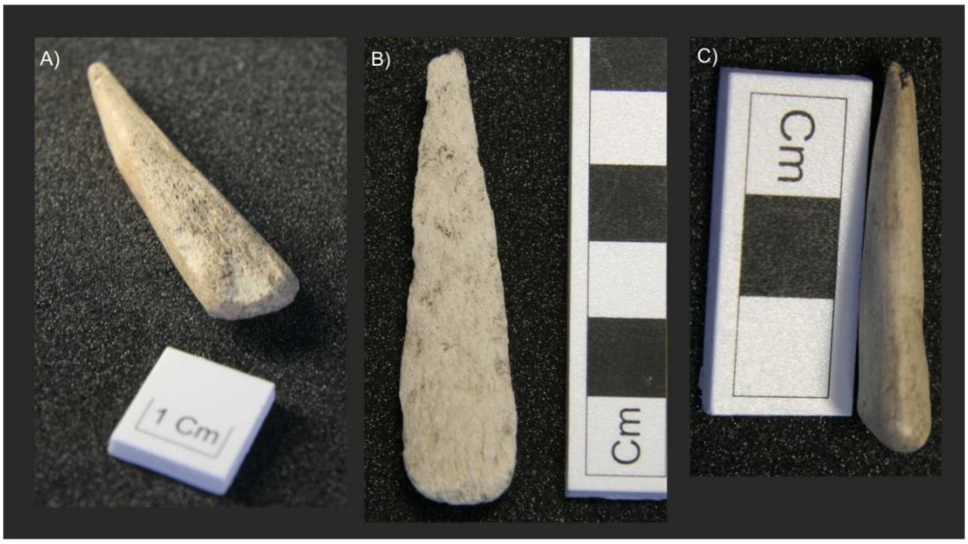


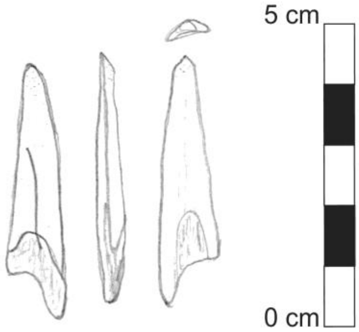
Figure 79: Bevel-ended tools from Loch Sunart. A) ARCHNN.1685.4.1.E with polish on DEX, B) ARCHNN.1685.4.1.F with heavily weathered surfaces, C) ARCHNN.1685.4.1.B with polish on DEX

Analysis of the shape and working marks visible on ARCHNN.1685.4.1.A suggest that this piece once formed part of the working edge of a mattock. The SEN edge has the characteristic convex profile of a mattock working edge (Figure 80), whilst the smooth surface and thick polish across this edge also indicates that this edge has been artificially created and then used. The DEX edge displays a multi-faceted fracture plane which is consistent with the flake breakage method. The pattern of antler mattocks which have been fragmented through flake breakage and re-used as bevel-ended tools is also documented in B.1951. 1970.A (Figure 76).

Figure 80: ARCHNN.1685.4.1.A - working edge of former mattock, and beveled end of more recent use

5.4.4 Barbed points from Risga

A.1955.96.cak



1. Antler acquired (through hunting or the collection of shed material)
2. Splitting of antler to produce "blank" (method unknown)
3. Abrasion of the spongy material and anatomical surfaces to thin the blank
4. Abrasion of the sides of the point to give it shape
5. Creation of barbs (method unknown)
6. Use
7. Flexion break at first barb
8. Deposition
9. Weathering

Figure 81: Barbed point A.1955.96.cak and working sequence

Piece A.1955.cak is the tip of a barbed point. No barbs are visible, and so it is impossible to tell if this point is uniserial or biserial. A thick polish is apparent at the tip. At the proximal end of the piece, a stepped break surface suggests a flexion break. The piece is heavily weathered and this obscures working marks which might indicate the methods used to shape the tip, but the general rounded nature and considerable work required to remove the internal spongy tissue would suggest that grinding was involved. The persistence of polish at the tip suggests that the point was used before being broken and deposited. The sequence of A.1955.96.cak is shown in Figure 81.

5.4.5 Antler *debitage* from Risga

The *debitage* assemblage from Risga consists of 158 pieces antler (Table 16). With the exception of a single fragment of roe deer antler, the assemblage is exclusively red deer. The material contains evidence of various working techniques including longitudinal splitting through flake breakage, nicking, sawing, prepared breaks, flexion breaks and percussion breaks. There are indications of a range of taphonomic processes, including chewing by ungulates, gnawing by rodents, gnawing by canids, weathering and damage by metal tools (presumably in recovery). There is also considerable evidence of events which have occurred since the material was recovered from the site in the form of cracking caused by rapid drying, flaking caused by rapid drying, impact damage during handling and storage, gluing and the application of reconstructive conservation putty.

Element	Basal segment	Intact tine	Tine tip	Fragment of tine	Fragment of antler from junctions	Fragment of spongy material	Fragment of compactor material
Frequency	2	4	51	20	8	6	67

Table 16: Antler elements within the Risga assemblage

The antler *debitage* assemblage contains a high proportion of compactor fragments (Table 16). Whilst ten of these fragments could not be analysed due to their small size, the remaining 57 all show signs of being produced through the flake breakage method. In this way, they are consistent with the methods of production for the bevel-ended tools from Risga.

The basal segments of antler within the *debitage* assemblage give some key insights into the antlerworking practices carried out on Risga. A.1955.96.cam consists of a shed, right-sided piece of antler from a red deer (Figure 82). The brow tine has been removed and the beam broken short of the bez junction. Nicking marks can be observed around the brow stump, indicating that nicking was first carried out, and then a prepared break was executed to remove the brow tine. At the distal break, nicking marks can be observed on the exterior edge (B in Figure 82). The break itself displays a sloping surface, concave in profile. This could be interpreted as the *debitage* negative produced in the creation of a convex mattock working edge.

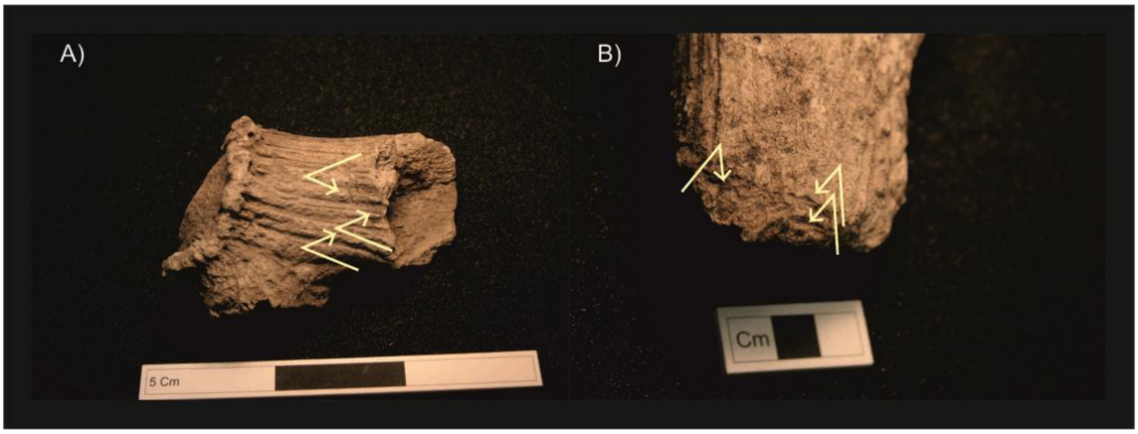


Figure 82: Nicking marks on A.1955.cam. A) Interior aspect B) Exterior aspect

Additionally, there are nicking marks on the interior aspect of the distal break (A in Figure 82), which give further insight into the working of this piece. These may represent an earlier attempt to carry out the preparation for a mattock working edge break. This appears to have been abandoned, either because the worker changed their mind as to the suitable location of the break, or because it was attempted and failed (Figure 83).

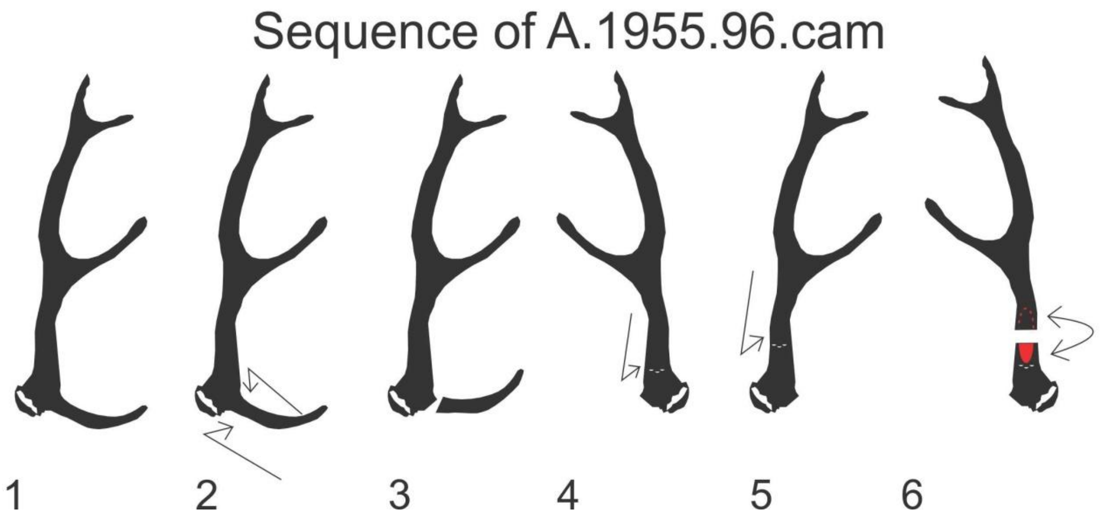
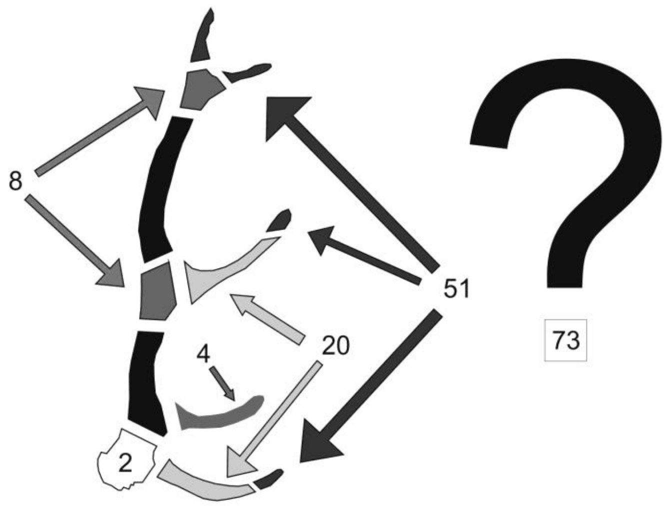


Figure 83: Sequence of A.1955.96.cam

Four complete red deer tines and 51 tine tips are present within the Risga assemblage. The tines have been removed through a variety of means. Twelve tine tips display the level break surfaces and associated nicking marks of prepared breakage. Nine of the tines appear to have been removed through flexion breaks, and a further seven show signs of flake breakage. A further two show signs of breakage.

5.4.4 Summary and discussion of antlerworking at Risga

The antlerworking assemblage from Risga shows some interesting patterns which require further discussion before an interpretation of the antlerworking activities carried out at the site can be made. The economy of *debitage* for the site is shown in Figure 84. This is broadly similar to that of Sand (Figure 73), with basal portions, tines, large quantities of undeterminable antler fragments and a lack of beam portions. As with Sand, the absence of beam portions may be attributed to the fragmentation of this element. The analysis of the *debitage* indicates that this fragmentation was achieved using the flake breakage method. However, the presence of bevel-ended tools within the assemblage suggests that the fragmentation of the beam was intended to produce splinters for the manufacture of bevel-ended tools which were subsequently used and deposited at the site. The presence of mattock fragments and the character of the prepared break apparent on piece A.1955.96.cam also suggest that mattock manufacture was carried out at Risga, and this could also account for the lack of beam portions within the *debitage* assemblage.



Element	Frequency
Shed basal portion	2
Intact tine	4
Tine tip	51
Tine portion	20
Junction	8
Unknown	73

Figure 84: Economy of *debitage* for Loch Sunart

However, when interpreting this economy of debitage, the context of deposition needs to be considered carefully. The lack of excavation archive or section means there is uncertainty around the length of time over which the antlerworking assemblage was deposited. As such, it cannot be assumed that the patterns of deposition summarised in Figure 84 are the product of a single *chaîne opértoire*; it may be the accumulation of multiple different Mesolithic antlerworking practices.

5.5 MacArthur's Cave, Oban

5.5.1 Context of recovery

Figure 85: Location of the Oban Cave sites referred to in the text: MacArthur's Cave and Druimvargie Cave

Excavated in 1894, MacArthur's Cave is one of two cave sites (Figure 85) in Oban (Figure 66) which have produced evidence of Mesolithic antlerworking. The site was discovered during quarrying activities at a bend in a cliff which abuts a series of extent beach deposits (Anderson 1895). Quarrying activities removed the roof of the cave, revealing an area approximately 25 ft x 16 ft. The excavation of a trench at the rear of the cave established a broad stratigraphic sequence for the deposits within the cave which consisted of:

Talus and rockfall (created in the destruction of the cave roof)
Layer of black earth
The "Upper shell bed". Deposit of shells varying in depth from 27 inches to 3 feet and containing evidence of *in-situ* hearths.
Fine, clean gravel, 22 inches deep. Contained a thin lens of shells, interpreted as a brief period of midden accumulation and termed the "lower shell bed".
Loose rock fragments of varying sizes

(Anderson 1895, 214–215)

Evidence for human occupation was recorded in the "black earth layer", the "upper shell-bed" and the "lower shell-bed". The black layer was characterised by the deposition of human remains and bones of large ungulates, alongside the small mammal fauna that might be expected to inhabit a cave environment (Anderson 1895, 217). Dating of the human bone within the black layer has produced Iron Age dates (Saville & Hallén 1994), and this combined with the absence of Mesolithic material culture suggests that this layer was deposited at a later date in prehistory. The "upper shell-bed" is interpreted as cultural accumulation of refuse containing limpet, razor, scallop, mussel, oyster and periwinkle shells and large quantities of splintered animal bone. Artefacts manufactured from bone also occur frequently within this layer. The splintered bones are noted to display signs of gnawing by dogs, although are believed to have been split through anthropogenic actions for the production of bone tools. The composition of the smaller deposit termed the "lower shell-bed" is described as being identical to that of the upper shell-bed, although with a notable deterioration in organic preservation conditions which Anderson ascribed to the fact that these deposits were more frequently waterlogged (Anderson 1895, 217).

Anderson also describes the artefacts recovered from the shell-bed deposits at MacArthur's Cave. These include a small quantity of worked lithics consisting of three hammerstones and twenty unretouched flint flakes. The majority of the artefacts from the midden were manufactured from bone and antler. The quantities of these artefact types are shown in Table 17. Of these artefact types, only bevel-ended tools and barbed points included were manufactured from red deer bone and antler, the pins and awls being made exclusively of bone. Anderson describes each barbed point individually, noting that all are made from "deer-horn". The precise quantities of *antler* bevel-ended tools are not specified by Anderson.

Artefact type	Quantity
Pins	3
Awls or borers	3
Bevel-ended tools	140
Barbed points	7

Table 17: Quantities of bone and antler artefacts from MacArthur's Cave (Anderson 1895, 218–222)

5.5.2 Biserial points from MacArthur's Cave

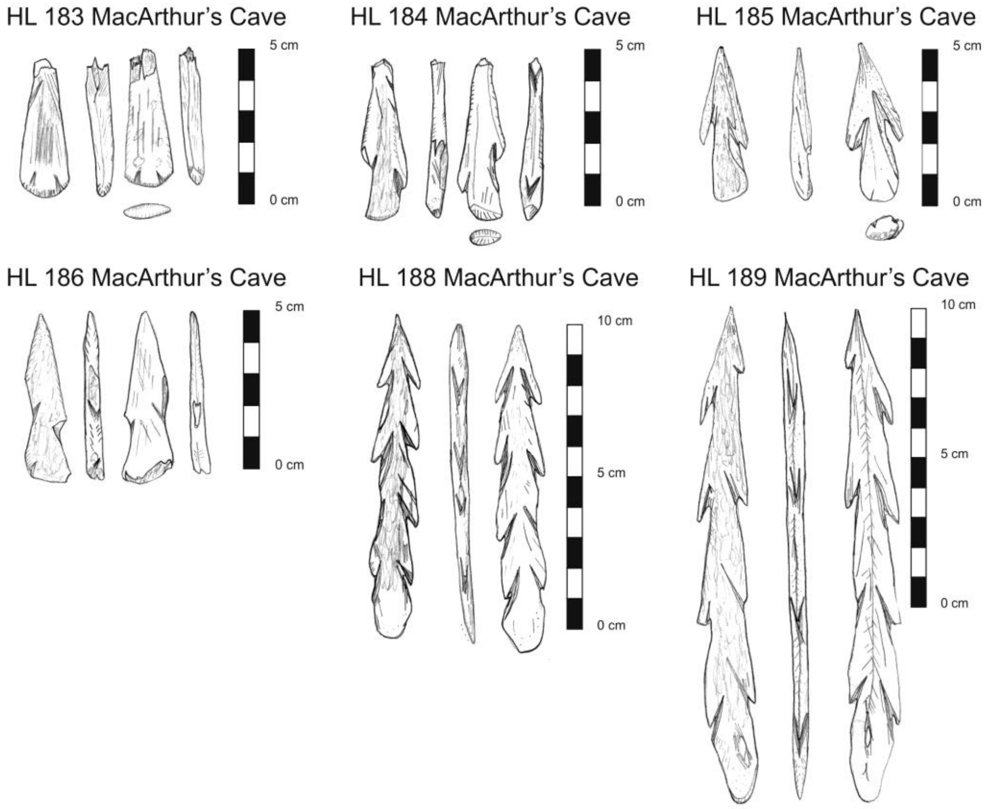


Figure 86: Biserial barbed points from MacArthur's Cave

Six of the seven biserial barbed points referred to by Anderson (1895, 223–224) were located within the collections of the National Museum of Scotland (Figure 86). Two of these specimens are complete (HL 188 and HL 189), whilst the other four are distal tip portions. Typologically, the points are similar, although the perforation on the tang of HL 189 technically defines it as a "harpoon" rather than a barbed point. As the other four artefacts consist of the distal portions, it is impossible to establish whether they should also be defined as harpoons.

The points display oblique, longitudinal striations along their length which diverge from the central line of the points. This suggests that scraping has been used along the length of the points to taper the SEN and DEX edges of the original antler blank. This working has destroyed the original edges of the blank antler splinter, and thus the method of producing splinters is obscured. The barbs have been created through sawing of the internal and external aspects of the antler blank, and the intervening antler has been reduced further to accentuate the curvature of the barbs. The intersection of sawing planes on HL 189 indicate that the initial sawing action was undertaken on the external aspect, whilst the failed sawing action on the internal aspect of HL 188 suggests that initial attempts were made from both aspects. At the distal tips of the points, longitudinal striations are observed along all aspects, indicating that longitudinal scraping has been applied from multiple angles to bring the tip to a point. In the case of HL 188 and HL 189, where the tang of the point is intact, this appears to have been thinned through grinding as no striations are visible. Thin polishes on these tangs suggest that they have been hafted. The one instance of a perforation on HL 189 has been created through the application of grooving to both the external and internal aspects of the tang.

Of further interest are the proximal ends of pieces HL 183, HL 184 and HL 185. These show signs of grinding from both the internal and external aspects – creating the same effect as that observed on the bevel-ended tools of other shell midden sites. The un-beveled proximal end of HL 185 indicates that a flexion break has occurred, whilst the flexion breaks at the tip of HL 183 and HL 184 suggest that these artefacts have been broken through use as projectiles, and then reused as bevel-ended tools.

5.5.3 Bevel ended tools from MacArthur's Cave

Two antler bevel-ended tools were located within the National Museum of Scotland collections and analysed (Figure 87). Roughly rectangular splinters of antler were created using the flake breakage method to define the SEN and DEX edges. In the case of HL 52, this was followed by an episode of light, longitudinal scraping which created a slight polish and produced faint striations, but which did not obscure the character of the original flake breakage surfaces.

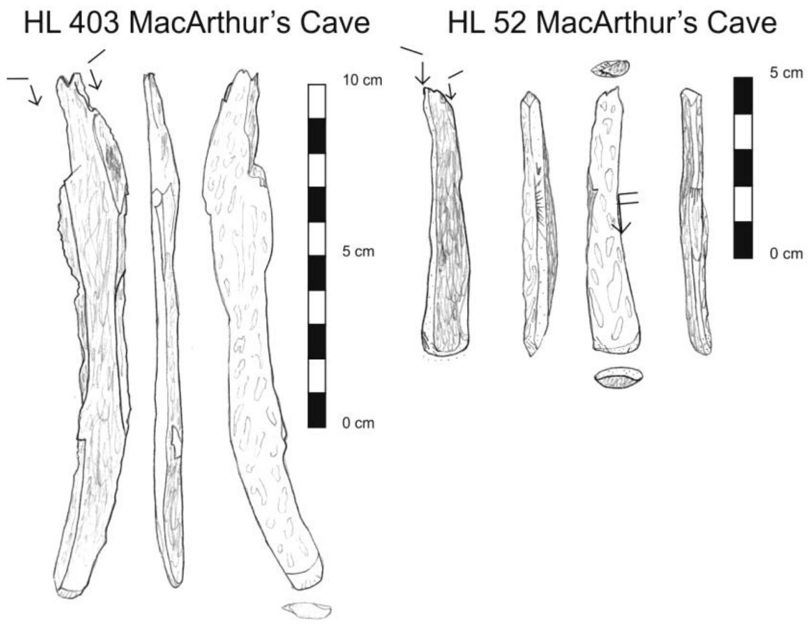


Figure 87: Bevel-ended tools from MacArthur's Cave

5.5.4 Antler *debitage* from MacArthur's Cave

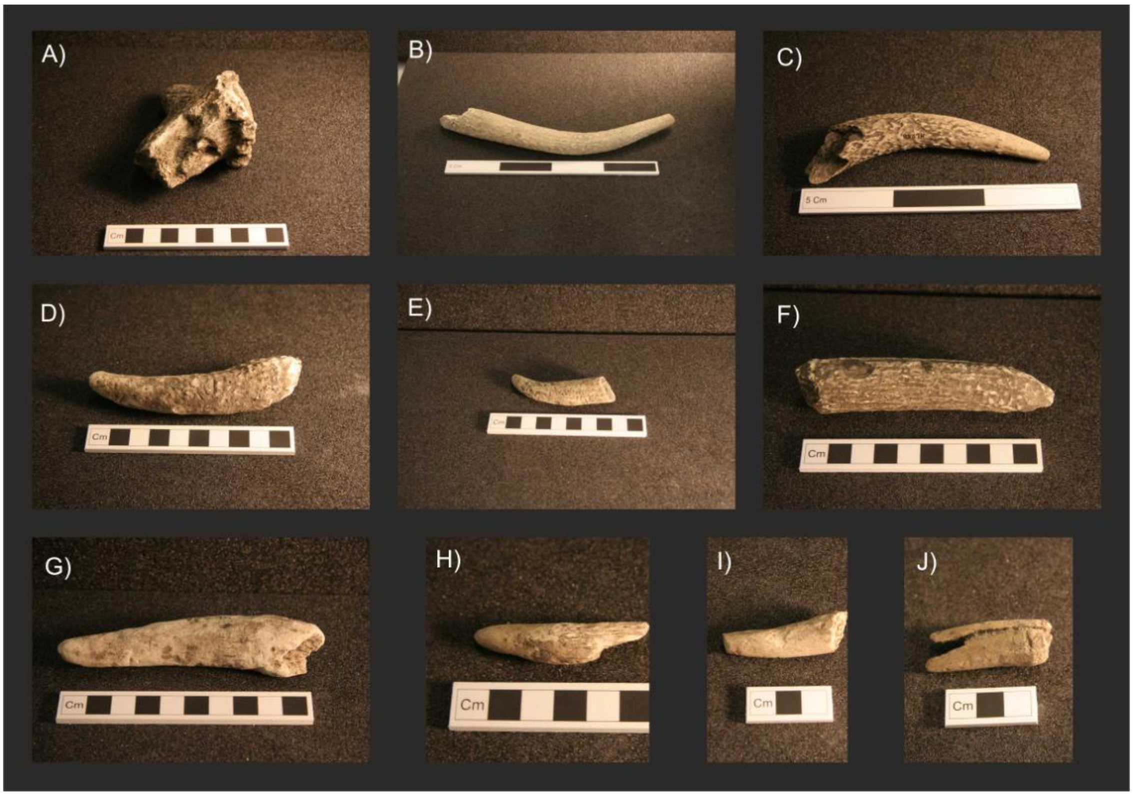
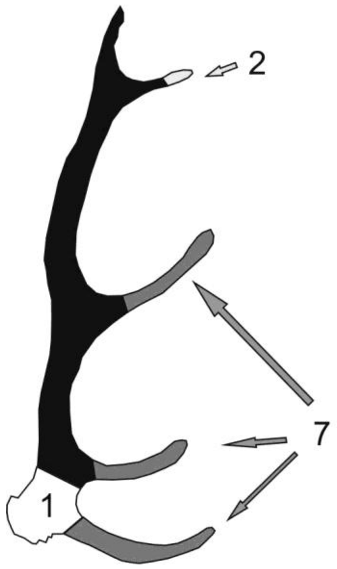


Figure 88: Antler *debitage* from MacArthur's Cave, Oban. A) HL 293, B) HL 287, C) HL 288, D) HL 290, E) HL 292, F) HL 289, G) HL426, H) HL 399 1 of 3 I) HL 399 2 of 3 J) HL 399 3 of 3

Ten pieces of worked antler *debitage* were located at the National Museum of Scotland and analysed (Figure 88). These were exclusively red deer, and included a shed basal portion from a right sided antler (HL 293 - Figure 88 A). This piece had been worked using the flake breakage technique, with material removed from the adjacent beam, before sawing was carried out and a prepared break executed to remove the basal portion. The remaining pieces were from red deer tines, and showed signs of flexion breakage and prepared breaks. Metal tool marks were also observed on some pieces (HL 290, HL 426, HL 399), and are assumed to have been created during the recovery of the artefacts from the cave. Drying damage is also noted to have affected the material since its excavation.

5.5.5 Discussion and summary of antlerworking at MacArthur's Cave

The lack of a detailed finds catalogue from the excavation of MacArthur's Cave severely inhibits the interpretation of antlerworking at the site. Absence of evidence cannot be assumed to equate to evidence of absence, even given the good preservation conditions afforded by the MacArthur's Cave shell deposits. However, a number of interesting interpretations can be made. An economy of *debitage* can be constructed from the *debitage* material analysed (Figure 88).



Element	Quantity
Basal portion	1
Tine	7
Tine tip	2

Figure 89: Economy of debitage from MacArthur's Cave

Both unperforated biserial barbed points and perforated harpoons were deposited at the site, suggesting variations in the hafting technologies associated with these tools and also possible variations in function. The re-use of the broken tips of biserial points suggests an intensive exploitation of antler as a material at MacArthur's Cave. This is supported by the presence of piece HL 293 – a basal segment of shed antler which indicates that flake breakage was used to extensively remove splinters of material from an antler before being deposited at the site. Whilst the economy of debitage needs to be treated with caution, given the fact that the material accessed may in effect be a sample of the assemblage recovered from MacArthur's Cave, it does also appear to support the suggestion that only the elements from which antler splinters could not be produced were deposited at the site.

5.6 Druimvargie Cave, Oban

5.6.1 Context of recovery

Archaeological material from the Druimvargie Cave (Figure 85) was excavated in 1897 by J Munro and D M'Issac, following its discovery during quarrying work (Anderson 1898, 298). The site is located within a weather-worn rock shelter situated on the underside of a ridge. The shelter was totally covered by a talus deposit which protruded over the edge of the ridge, and extended down the land-facing side. In removing this talus, the sealed rock-shelter was discovered. Following this, shell midden deposits were observed towards the rear of exposed area (Anderson 1898, 299). Once the remaining talus was removed from the front of the shelter, the midden deposits were observed to extend across the entire floor, and were at least 4 feet in thickness (*ibid.*). The shell midden deposits themselves consisted of an upper layer of dark, ash-rich shell deposits and a lower layer of lighter shell deposits in which the ash had been replaced by reddish earthy clay and stony breccia.

A range of artefacts were recovered from the Druimvargie cave, including two uniserial barbed points made from bone, two bone "borers" and "a number of those round-nosed chisel-shaped implements" (Anderson 1898, 299) which were later identified as bevel-ended tools (Bishop 1914). The vast majority of these bevel-ended tools were made from fragmented red deer long bone, although a small minority had been manufactured from red deer antler. Anderson's original article makes reference to a perforated fragment of antler *debitage* from a junction region (Anderson 1898, 302), although this could not be located within the National Museum of Scotland's collections. Faunal remains also recovered from the Druimvargie Cave include the bones of red deer, wild boar and otter.

AMS dating (Bonsall et al. 1995) of two of the Druimvargie bone bevel-ended tools (OxA-4608 and OxA-4609) has produced dates of 7571-7177 cal. BC and 7043-6599 cal. BC respectively. These indicate that the cave was occupied during the Mesolithic. However, these dates need to be treated with caution as further information regarding the duration of occupation at Druimvargie is unavailable. The layer from which these bevel-ended tools originated is not determined in their publication, and so whilst these dates have been treated as general indicator of the date of occupation at the site, they cannot be related directly to the apparent stratigraphic sequence described by Anderson (1898, 299).

5.6.2 Bevel-ended tools from Druimvargie Cave

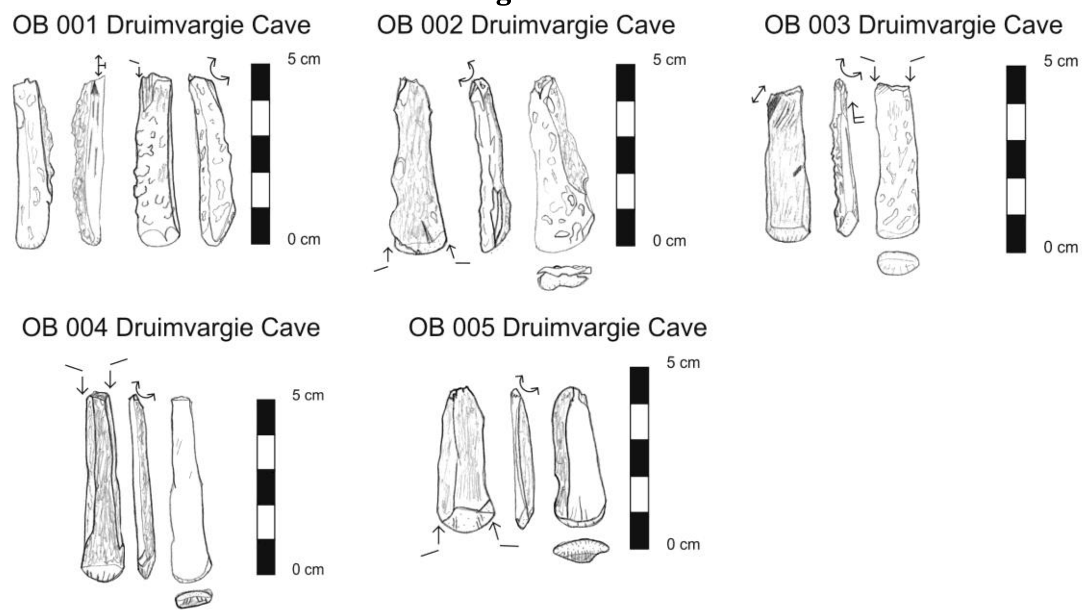


Figure 90: Bevel-ended tools from Druimvargie Cave

Five antler bevel-ended tools were located within the National Museum of Scotland's collections and analysed (Figure 90). Flake breakage is used to define the SEN and DEX sides of the artefacts, although in the case of the OB 001, grooving appears to have been used on the DEX side to produce a level surface with characteristic longitudinal striations (A in Figure 91). OB 003 shows signs of modification at the DIST end, with scraping being applied to the internal surface to remove further spongy material. This is interpreted as modification for the insertion into a haft. Flexion breaks define the distal ends of the pieces, and in OB 003 this has been facilitated by an episode of sawing.

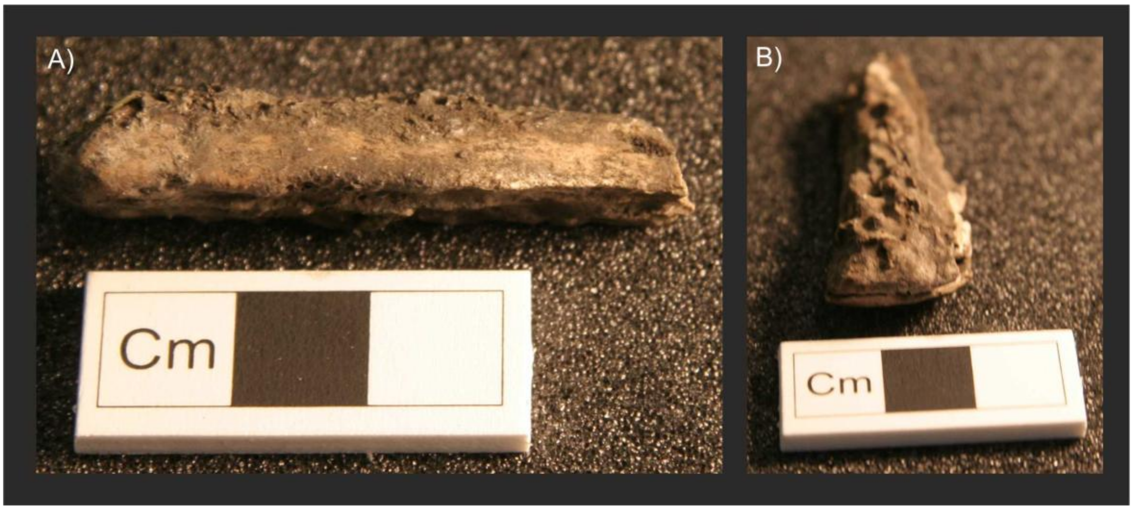


Figure 91: Bevel-ended tools from Druimvargie. A) Grooving on SEN edge of OB 001 B) Roe deer antler used for OB 002

The bevel-ended tools from Druimvargie demonstrate the use of both roe deer and red deer antler. The small and raised character of the pearls observed on the EXT surface of OB 002 (B in Figure 91) indicate that roe deer antler was used to manufacture bevel-ended tools at the site

5.6.3 Summary and discussion of antlerworking at Druimvargie Cave

The small number of antler bevel-ended tools that could be located within the collections of the National Museum of Scotland highlights some of the problems with studying assemblages from poorly recorded excavations. As no comprehensive catalogue for the artefacts recovered from Druimvargie is provided by Anderson (1898), it is impossible to ascertain whether the artefacts analysed represent the sum total of the material recovered, or only a small sample that has been acquired by the National Museum of Scotland. In a similar vein, no antler *debitage* from the site could be located within the museum catalogue. This makes the interpretation of an apparent absence of *debitage* difficult to interpret – is this the product of decisions in the post-excavation curation of the material, or does it reflect a genuine lack of evidence for on-site antlerworking at Druimvargie? In the absence of a more detailed excavation archive there is no way to address these questions.

5.7 Meiklewood, Stirling

5.7.1 Context of recovery

The Meiklewood mattock (Figure 66) was recovered in the late 19th century (Turner 1889). Turner describes the discovery of the artefact:

"In 1877, the skull and other bones of a Balaeonoptera were exposed in the course of drainage operations on the estate of Meiklewood, a few miles west of Stirling. Resting upon the front of the skull, lying vertically in the blue silt, was an implement made of the horn of a red deer,"

(Turner 1889, 791)

He notes that on discovery, a small piece of wood was intact within the perforation, although this rapidly shrunk following the artefact's recovery and has subsequently been lost. He compares the Meiklewood find with two other similar sites (Airthrey and Blair-Drummond) in the Carse of Sterling, and suggests that the presence of shellfish within these beach deposits indicate that they are of a post-glacial date. Tuner hypothesises that the whales were the victims of stranding, at a time when higher sea levels allowed whales to swim further up the Firth of Forth than in the present day. After being acquired by the National Museum of Scotland, the Meiklewood mattock has since been ^{14}C dated to 5001-4591 cal. BC (OxA-1159).

5.7.2 Antler mattock from Meiklewood

The Meiklewood mattock (Figure 93) is made from the beam of a right-sided red deer antler, at the trez tine junction. The working face features numerous obliquely orientated striations and a series of longitudinal striations along the DEX side. These are interpreted as two phases of scraping to shape the working face. A thick polish and damage to the spongy material of the working face indicate that the artefact has been utilised. The reverse of the working face also features oblique striations at the proximal extremity of the piece, indicating further scraping was carried out to shape this part of the tool. The trez tine stump shows signs of nicking around the circumference, and features a level break edge indicative of removal via a phase of nicking and then the execution of a prepared break. Spongy material has been removed at the trez stump, and the sharply defined internal edges and polish indicate that this has been achieved through drilling. On the reverse DEX side, a circular perforation overlies nicking marks, indicating a phase of nicking followed by drilling to create a complete perforation through the trez tine stump. This region is also covered by a thin polish which extends onto the surrounding beam, and may be the result of binding in hafting. At the distal end, there are signs of nicking around the circumference of the beam and level break surface indicates that this has been subject to a prepared break. In association with the DIST break, two large metal tool marks are apparent on the INT aspect of the mattock. These are assumed to have been created in the recovery of the artefact. The *chaîne opératoire* of the HLA 3 is shown in Figure 92.

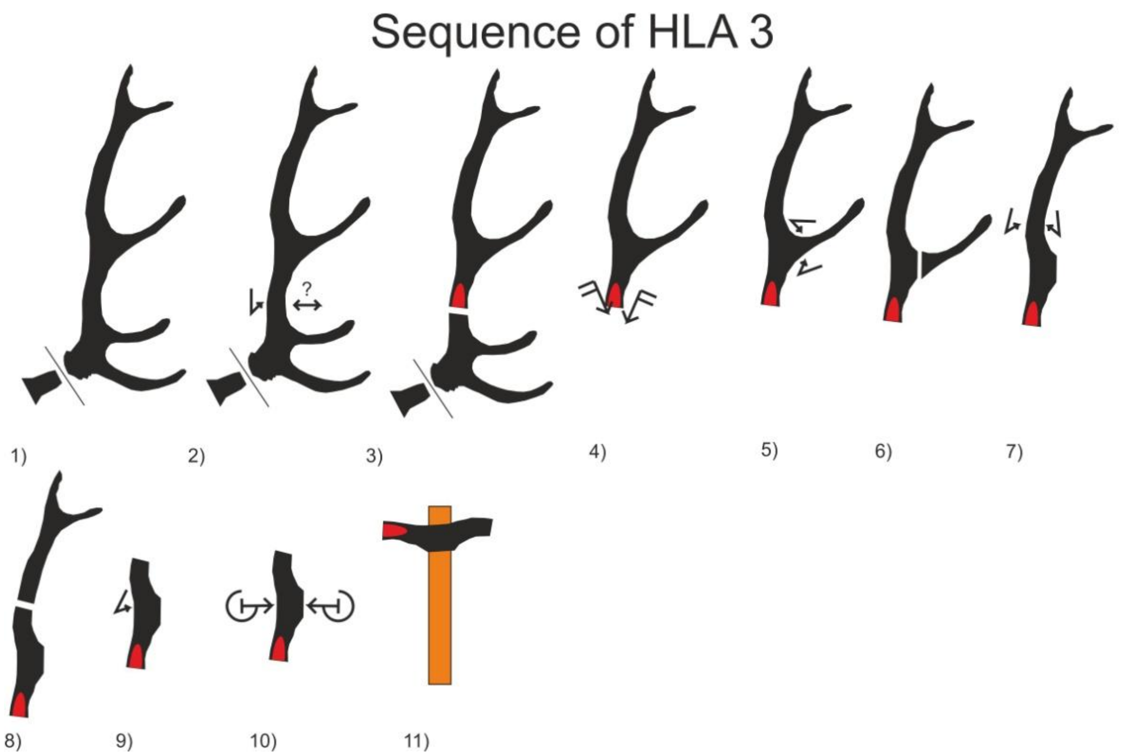


Figure 92: Sequence of HLA 3, Meiklewood

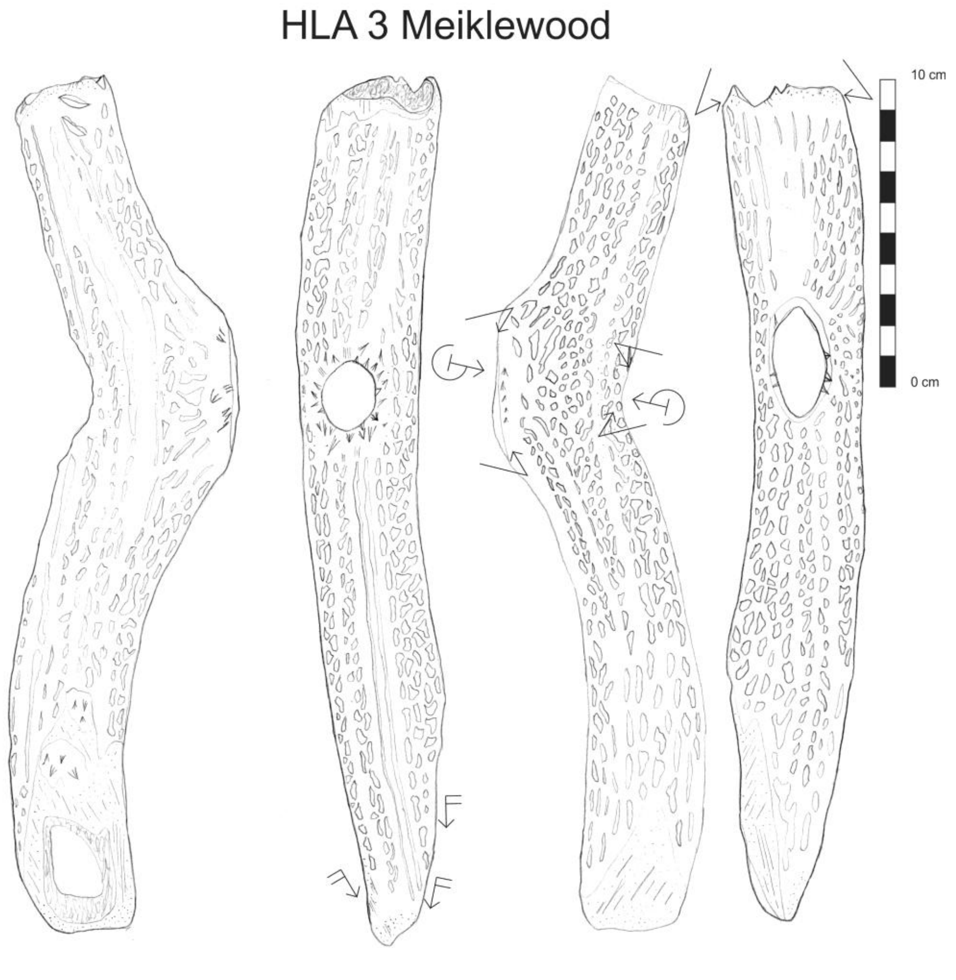


Figure 93: Antler mattock HLA3 from Meiklewood

5.8 Cnoc Sligeach, Oronsay

5.7.1 Context of recovery

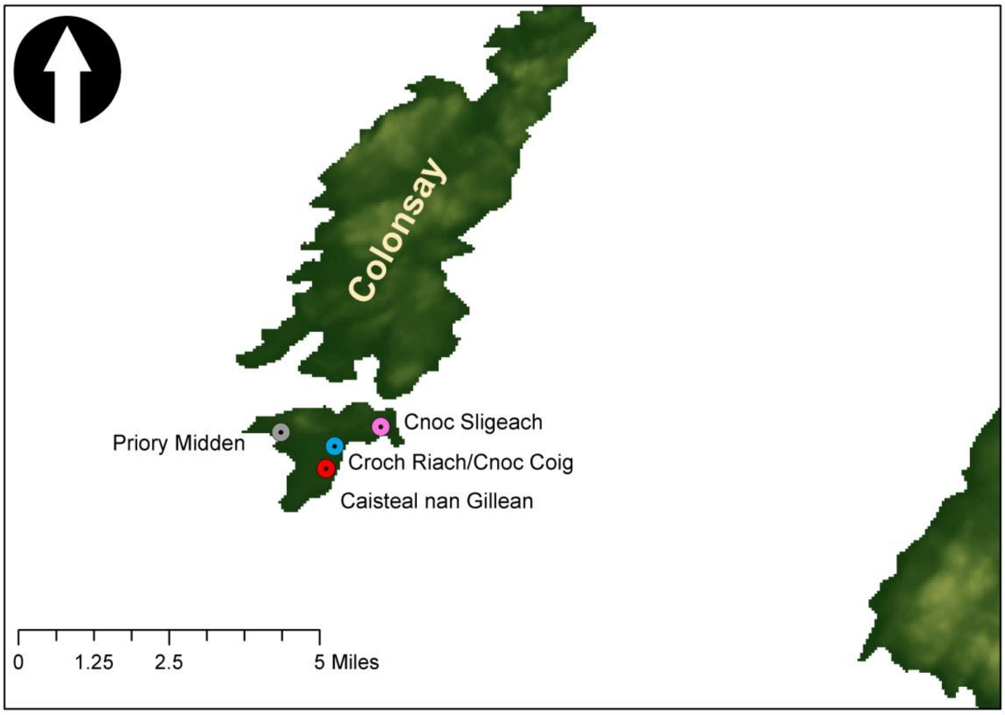


Figure 94: Location of Cnoc Sligeach and other Oronsay sites

Archaeological material excavated by Galloway and Grieve (Anderson 1898) from the shell midden site of Cnoc Sligeach on the island of Oronsay (Figure 94) is currently held at the National Museum of Scotland, Hunterian Museum, Glasgow and Kelvingrove Museum. The site itself has been the subject of three major campaigns of investigation; that of Galloway and Grieve in the 1884 (Anderson 1898), Buchannan and Bishop's excavations in 1911-1913 (Bishop 1914) and the limited work of Mellars in 1970 (Mellars 1987c). Other than Bishop's minor note that previous excavation appeared to have been carried out at the apex of the Cnoc Sligeach hill (Bishop 1914, 56), very little detail of the 1884 excavations have been recorded. However, the subsequent work of Bishop and Mellars can help to provide some general context for the material excavated by Galloway and Grieve.

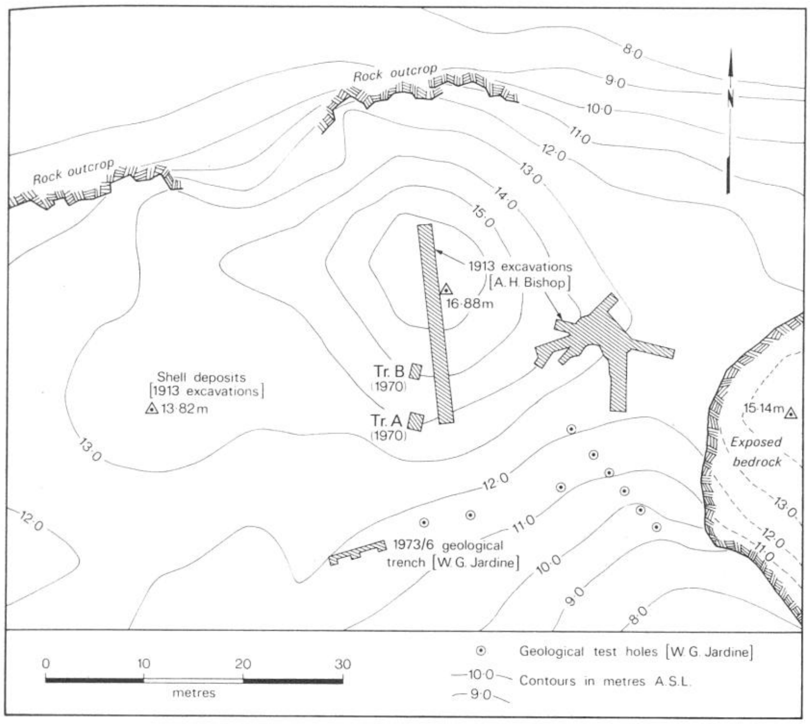


Figure 95: Contour map of Cnoc Sligeach showing the areas excavated by Bishop and Mellars (Mellars 1987, 195)

Bishop's aim in excavating at Cnoc Sligeach was to establish the sea level at the time of human occupation at the midden (Bishop 1914, 55). Work began with a survey of the Cnoc Sligeach hill, which established the existence of an "upper mound" (at the central apex of the hill) and a "lower mound" (around 5ft south-east of the upper mound). A series of linear, intersecting trenches were excavated (Figure 95), focusing on the lower mound area. A single, longer trench was also excavated through the upper mound to produce a continuous section (Bishop 1914, 57). This demonstrated the general depositional sequence of the midden:

Turf
Thin layer of shells
Pure white sand
Grey sand
Mixed shells and sand, with localised dark banding. Contained post holes and baked clay hearths
Clean shells
Red sand
Grey sterile sand
Bedrock

This sequence is interpreted as being the product of a human occupation which took place directly on the beach deposits. Bishop notes that the occurrence of rabbit burrowing within the deposits overlying and underlying the shell layer, and that this disturbance may create the multilayered effect noted within the shells (Bishop 1914, 85). The conclusions drawn from these excavations were that the lower mound deposits were the product of refuse deposition from the upper mound area, which accumulated against the surface of an underlying sand dune. The presence of a storm beach deposit at the foot of this underlying sand dune, with material culture and shells intermingled within its matrix, was interpreted as evidence that the contemporary sea level was higher than that of the present day, and that material culture deposited into the sea was washed back onto this beach.

Mellars' (1987c) excavations aimed to confirm the stratigraphic sequence described by Bishop, and to recover samples from this sequence for palaeoeconomic analysis and dating. This confirmed Bishop's findings, although efforts to date the midden deposits were less successful. A single ^{14}C date was obtained from a bulk charcoal in the upper midden layers (Table 18). Whilst this is noted by Mellars to be generally concurrent with the later occupation phases at the other middens around Oronsay, the isolated nature of this date and the method through which the organic material was acquired severely limit its utility in establishing a chronology for human occupation at Cnoc Sligeach.

Sample lab code	Deposit	^{14}C Age (BP)	Calibrated date (cal. BC)
BM-670	Upper Midden	5426±159	4668-3945

Table 18: ^{14}C date from Cnoc Sligeach, Oronsay (Mellars 1987, 211)

Bishop provides an extended discussion of the artefacts recovered from Cnoc Sligeach, and makes some interesting comparisons to the material excavated from similar sites along the Obanian coast. Although precise quantities are not given, Bishop describes a lithic assemblage which included primary flakes and cores, but lacking in retouched tools. He also discusses the occurrence of a series of pebbles and hammer stones which display signs of use – which is linked to the working of flint nodules and the fragmentation of shell fish observed within the deposits.

Bishop notes large quantities of stone, bone and antler bevel-ended tools within the assemblage and suggests that they have been bevelled in use by removing limpets from their shells. This is verified through experimentation with a concrete replica, which when repeatedly used to remove limpets from their shells created a similar bevelling effect. He hypothesises that the stone tools were manufactured by selecting a suitably sized pebble, and then removing a single flake from the two angles to create a pointed working edge. The tools were then used, which rounded the pointed edge and created the rounding observed on the tools today. Once a working edge had been completely rounded, the tool became ineffective and thus was discarded.

A collection of seven fragments of barbed points were also recovered by Bishop. Of these, only one is identified as being made from antler, the rest from bone. Bishop notes that these resemble the form of biserial barbed points recovered from MacArthur's Cave. One specimen even displays the same bevelling at the proximal break that is observed on specimens from MacArthur's Cave (HL 183-185). However there are two exceptions which mark the barbed points at Cnoc Sligeach as distinct from those of MacArthur's Cave. The first of these is a point where the barbs are particularly slender and well defined, and stand apart from the stem. The second is a distal portion of a biserial barbed point which features a set of four parallel striations running at 90° to the axis of the point – which is interpreted as decorative.

Other antler artefacts include a collection of tools which Bishop terms "shoe-horns-like implements". These consist of fragments of red deer antler which have been "worn on the inner edge", possibly through grinding against a stone. He states that several of these were recovered from the site, and tentatively suggests that they may have been used in the preparation of skins (Bishop 1914, 98).

5.8.2 Antler mattock fragments from Cnoc Sligeach

Two fragments of mattock working faces, excavated by Bishop and Buchanan were located at the Hunterian Museum, Glasgow. It should be noted that the Hunterian Museum accessions catalogue listed a total of four mattock fragments, but only two could be located within the collections.

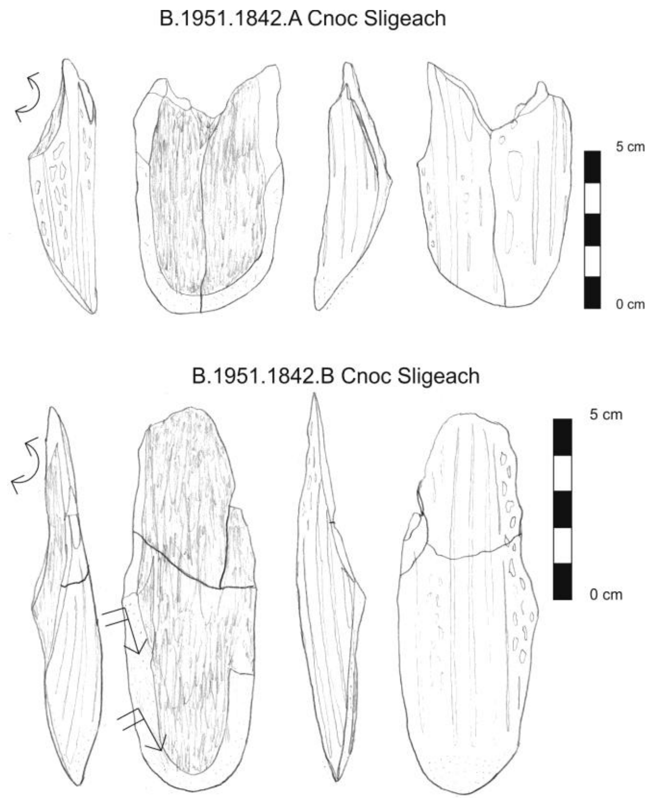


Figure 96: Fragments of mattocks, Cnoc Sligeach

The working face and edge of the mattock are intact on both of these pieces. They can be assumed to have been created initially by a prepared break of an antler beam. Striations running along the length of the working face of B.1951.1842.B indicate that the working face was shaped through scraping. The working faces and working edges of both pieces are covered in a thick polish, which alongside the hollowing of the spongy material on the working face is suggestive of considerable use. This polish also extends onto the external aspect of the working edge. At the distal end of each piece, the profile of the break suggests that it has been created through flexion, with force being exerted across the INT-EXT axis. Various cracks are also visible on the pieces and are interpreted as being created after recovery as the artefacts dried.

5.8.3 Bevel-ended tools from Cnoc Sligeach

A total of sixteen antler bevel-ended tools from Cnoc Sligeach were located and analysed (Figure 97). 14 of these were located within the National Museum of Scotland collections. The accession catalogue within the museum states that these artefacts were recovered during the excavations of Galloway and Grieve (Accession numbers HP 527-544, Figure 97). A further two antler barbed points (B.1951.1845.A and B.1951.1845.B, Figure 97) were located within the collections of the Hunterian Museum, Glasgow. These artefacts were recovered during the work of Bishop and Buchanan. It should be noted that the Hunterian Museum accessions catalogue listed a total of 19 antler bevel-ended tools, but only two could be located and accessed. With this in mind, the artefacts recovered during Bishop's excavations should be treated as a small sample of a larger assemblage.

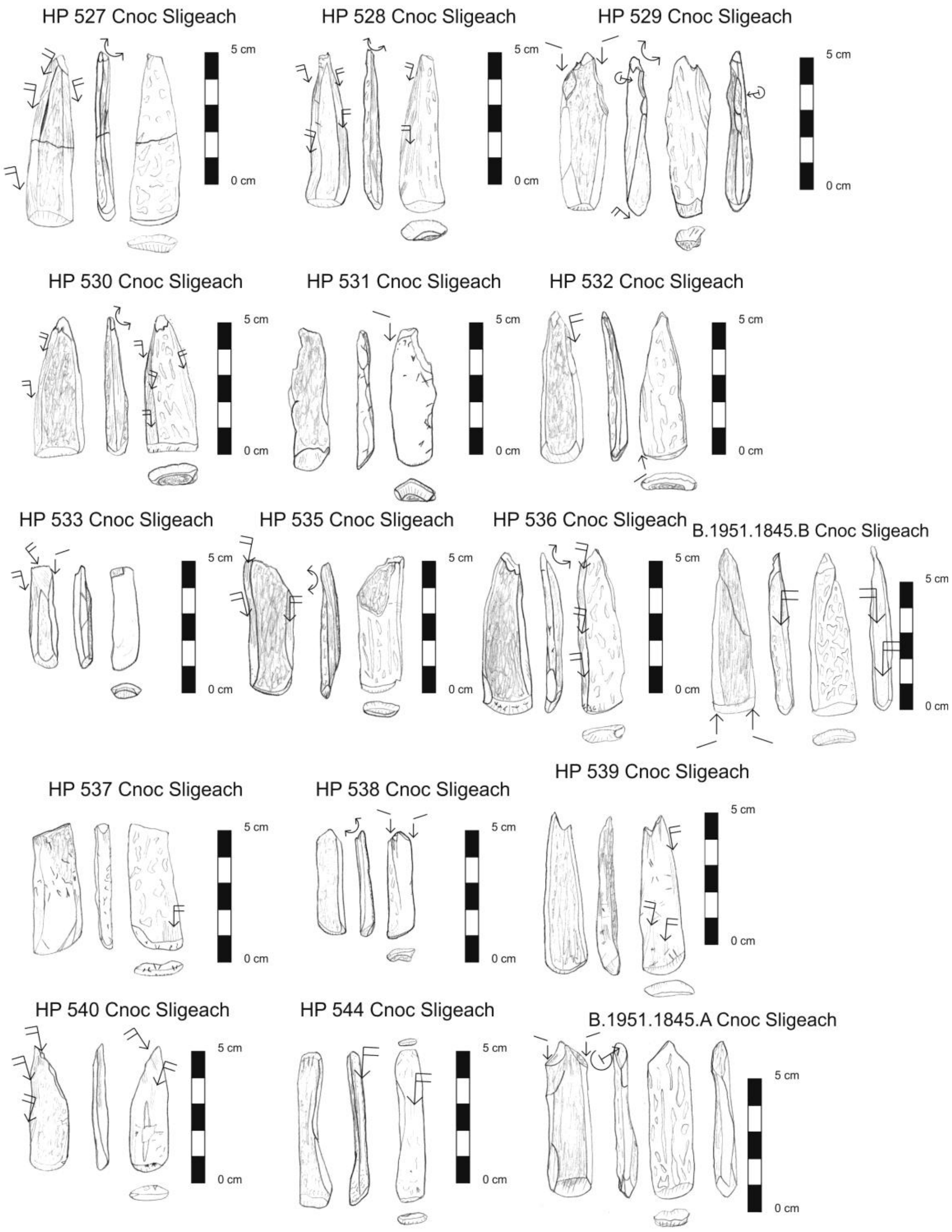


Figure 97: Bevel-ended tools from Cnoc Sligeach

Of the fourteen recovered by Galloway and Grieve, one of the tools has working edges at both the PROX and DIST ends (HP 544), whilst the remaining thirteen have a single working edge.

Eleven of the fourteen Galloway and Grieve artefacts show signs of longitudinal scraping to modify the form of the tool. This is focused on the SEN and DEX edges, but occasionally extends onto the external surface. In some cases, the areas subjected to scraping are also overlain by a thin polish. This is interpreted as the polish created by hafting and use. These scraping actions often obscure the original fracture surface, creating problems in determining the precise method by which antler has been broken up. However, the instances of unscraped SEN and DEX edges indicate that this is through the flake breakage method. The pattern of SEN and DEX scraping is also represented in the Bishop artefacts, with B.1951.1845.B showing signs of modification along both sides.

Additionally, HP 299 and B.1951.1845.A also feature fragments of perforations at the DIST end of the pieces (C of Figure 98). These perforations are incomplete, but display internal polish. In the case of HP299, two fragments of perforations appear to align across the piece (B of Figure 98), indicating that the perforation penetrated the antler from both sides. Their steep profile of these perforations suggests the use of the drilling method. In both instances, the perforation has been broken to create the form of the bevel-ended tool before being utilised, and this can be seen in the way that the working edge respects the current width of the SEN and DEX edges. In the case of HP299, the working edge itself displays longitudinal striations (A of Figure 98) underlying the usual polish associated with use, suggesting that the working edge was shaped through scraping prior to use. The character of the SEN and DEX edges indicate that these edges were created through flake breakage. The sequence of HP 299 and B.1951.1845.A therefore runs as follows:

1. Red deer antler acquired (through hunting or the collection of shed material)
2. Perforation created through drilling
3. Hafting
4. Flake breakage of SEN and DEX
5. Scraping at working edge
6. Use
7. Deposition
8. Recovery

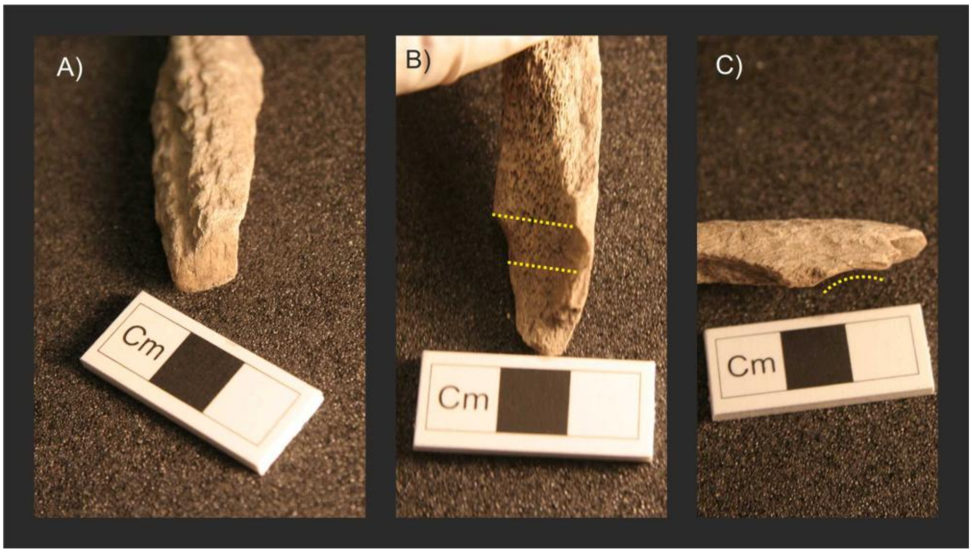


Figure 98: HP 299 from Cnoc Sligeach. A) Longitudinal striations underlying polish of working edge B) Alignment of SEN and DEX perforations C) DEX perforation

5.8.3 Barbed points from Cnoc Sligeach

Five fragments of barbed antler points from Cnoc Sligeach were located within collections at the National Museum of Scotland. Three of these (Figure 100) could be seen to correspond to those illustrated by Bishop. However, a further two did do not appear in Bishop's publication. The material excavated by Mellars is still held at Cambridge University, and so it was deduced that the remaining two fragments of barbed point must have been recovered during the poorly documented excavations of Galloway and Grieve. X.1997.1122 is a detached tang, which demonstrates evidence of the use of scraping on the external surface, and at the SEN and DEX edges to produce a thin tang with tapering SEN and DEX edges. X.1997.1123 is heavily weathered, but shows signs of the use of sawing to define on barb on the SEN and DEX side of the piece. This sawing has been carried out exclusively from the external aspect, and this may be indicative of a fragment of an unfinished barbed point.

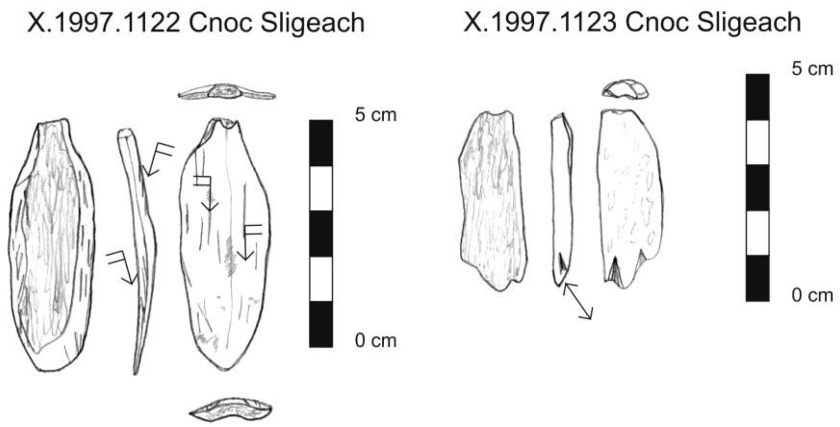


Figure 99: Barbed point fragments recovered by Galloway and Grieve from Cnoc Sligeach

Of the Bishop and Buchanan barbed points (Figure 100), all three represent broken fragments – HP 641 and HP 462 being from the distal tip and HP 643 being a proximal tang. The flexion breaks correspond with areas which are put under extreme stress when used – the point of impact or point of hafting – suggesting that these fragments were detached from larger points during use. However, HP 641 presents an exception to this. Not only has this piece been broken at the tip and proximal end, it has also been split down the central axis of the point. This highly unusual break pattern makes the positive attribution of a biserial point difficult. It could equally be the only barbed edge of a uniserial point. HP 642 displays the characteristic profile of a bevel-ended tool working edge at the proximal end.

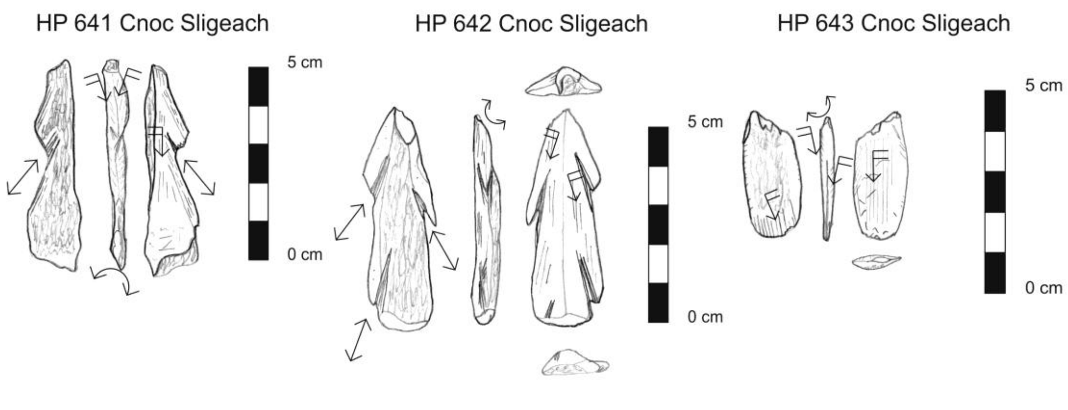


Figure 100: Barbed points recovered by Bishop from Cnoc Sligeach

5.8.4 Awl from Cnoc Sligeach

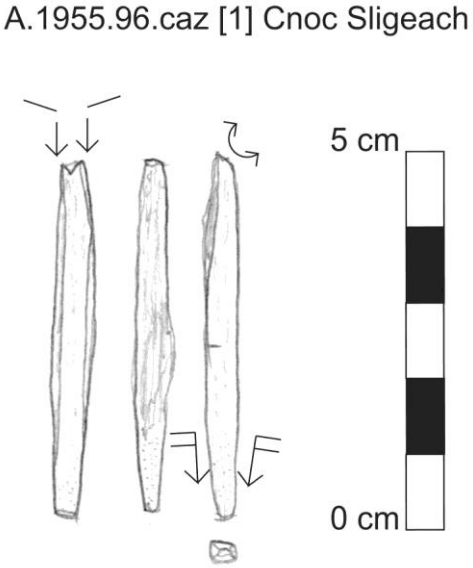


Figure 101: A.1955.caz [1] antler awl from Cnoc Sligeach

The single antler awl on display at the Kelvingrove Museum was recovered from the site of Cnoc Sligeach, Oronsay (see Figure 101). This has been produced through flake breakage of the SEN and DEX edges, before scraping of the proximal end to create a tapering point. A flexion break has occurred at the distal end of the piece – whether in manufacture or use is impossible to distinguish. The damage to the extreme tip is assumed to have been sustained during use, as this would be a particularly fragile part of the artefact onto which force would have been exerted.

5.8.5 Summary and discussion of antlerworking at Cnoc Sligeach

The material analysed above can be broadly divided into two separate assemblages – that recovered by Galloway and Grieve from the apex of the Cnoc Sligeach hill and that recovered during Bishop and Buchanan's more extensive excavations. Whilst the precise extent of these excavations is not known, comparisons between the two assemblages appear to show some interesting patterns. Despite the apparent size difference between the two sets of excavations, the museum catalogue entries suggest that they have both produced similar quantities of antlerworking evidence (although this could not be verified as some material could not be located). This apparent consistency within the quantities of antlerworking recovered could suggest that the deposition of antler material was concentrated in the areas excavated by Galloway and Grieve and more dispersed in the areas excavated by Bishop and Buchanan. If the antler material was distributed evenly throughout the midden, it might be expected that the more extensive excavations of Bishop and Buchanan would recover larger quantities of antler than found by Galloway and Grieve. In a similar vein, it could be argued that the deposition of bevel-ended tools was focused to a certain extent on the upper mound, and that mattock fragments were deposited onto the slopes of the Cnoc Sligeach hill. However, the lack of spatial data for the finds means that it is impossible to attribute which trench they were recovered from – it remains possible that the mattock fragments and bevel-ended tools were discovered in the upper levels of the cutting which ran through the centre of the midden. As such, they would represent a continuous episode of antler deposition.

5.9 Priory Midden, Oronsay

5.9.1 Context of recovery

The Priory Midden site (Figure 94) was discovered by Mellars in 1975 (1987d). This small, elongated mound measures 25-30m at its widest point and is 1.5m high at its apex. A single trench was excavated running through the centre of the mound (Mellars 1987c, 183), which allowed a three-phase depositional sequence to be observed within the midden's stratigraphy. The earliest phase (Phase I) of the consisted of a series of stratified wind-blown sand deposits (Mellars 1987, 184–186). Thin, localised layers of shells were observed in association with thin soil horizons within these stratified sands, and are interpreted as evidence for small, local occupations at the site during periods when sand accumulation had slowed. Phase II consisted of a thick layer of shell midden deposits, 60-80cm deep and containing evidence of burning in the form of fire-cracked stones and charcoal. This phase was divided by two sand horizons into an upper layer and a lower layer. The lower layer was characterised by almost pure shells, and contained evidence for two *in-situ* hearths. The upper layer is noted to have had a higher proportion of dark, organic-rich matrix alongside high frequencies of shells. Phase III (Mellars 1987c, 189) is noted to be similar in character to Phase I, with stratified sand deposits containing occasional, localised evidence of human occupation in the form of discrete, thin shell horizons. These were overlain by a sterile layer of blown sand and finally turf (Mellars 1987c, 184). ^{14}C dates obtained from several of deposits relating to the three phases at Priory Midden (Figure 102) support the theory that the three phases follow each other, and show the site to have been occupied during the early to mid 5th millennium cal. BC.

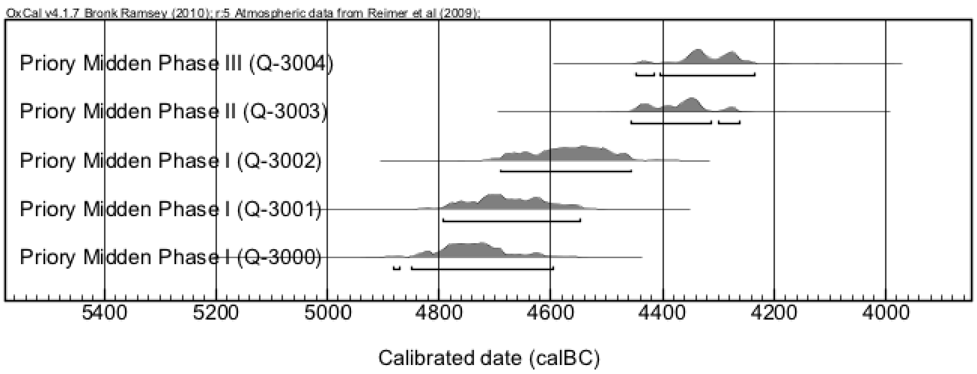


Figure 102: ^{14}C dates from Priory Midden (Mellars 1987c, 187)

5.9.2 Mattock from Priory Midden

A red deer antler mattock was recovered from the site (Mellars 1987b, 123), although no reference is made to this within the excavation report itself. The artefact is currently held at the National Museum of Scotland. The mattock consists of a red deer antler beam from the region of the trez tine junction. Whilst the lack of stratigraphic provenance for the piece means it cannot be precisely placed within the broader chronology of the site, its occurrence demonstrates that mattocks were used and deposited on the site at some point in the mid fifth millennium cal. BC.

The working edge has been shaped through scraping, and this appears to have been carried out in two phases. The distal end of the working face is at a notably shallower angle to the steeper proximal end. Despite weathering, a thin polish still adheres to the steeper part of the working face, and there is considerable damage to the spongy tissue, indicative of use. Numerous nicking marks are observed at the trez stump, and the break surface in this area is level, suggesting the execution of a prepared break following an episode of nicking. The spongy tissue has also been hollowed out of this area, and smooth edges with a thick characterise the lip of the break. This has been created through the application of drilling to the trez stump, after the removal of the trez tine, and the subsequent insertion of a haft into this perforation. Another perforation is present on the opposite SEN edge off the piece, with a similar circular profile, steep edges and internal polish. This implies that the tool was perforated on both the SEN and DEX sides, and that a haft was inserted through the diameter of the artefact. A long and wide crack runs along the SEN edge of the mattock, and is continuous with the distal break of the piece. This piece shows clear dental marks and is assumed to have been created through flexion. The association of this damage with the perforation may indicate that its creation was linked to the point of hafting.

When viewed from the SEN or DEX aspect, the INT surface of the mattock is tapers notably before terminating at the DIST break. Whilst no striations are visible in this area (root etching is particularly apparent in this region), a thin polish does adhere and the angle of the tapering is strikingly similar to that of the proximal end of the working face. This is interpreted as another working edge, which has been severely damaged. The connection between the crack at the perforation and the damage at the proximal working edge suggests that this may have been sustained in use – as impact stress would have been placed on the working edge and point of hafting simultaneously. Based on the relationship between the different working actions, the *chaîne opératoire* of X.1997.123 can be synthesised (Figure 104).

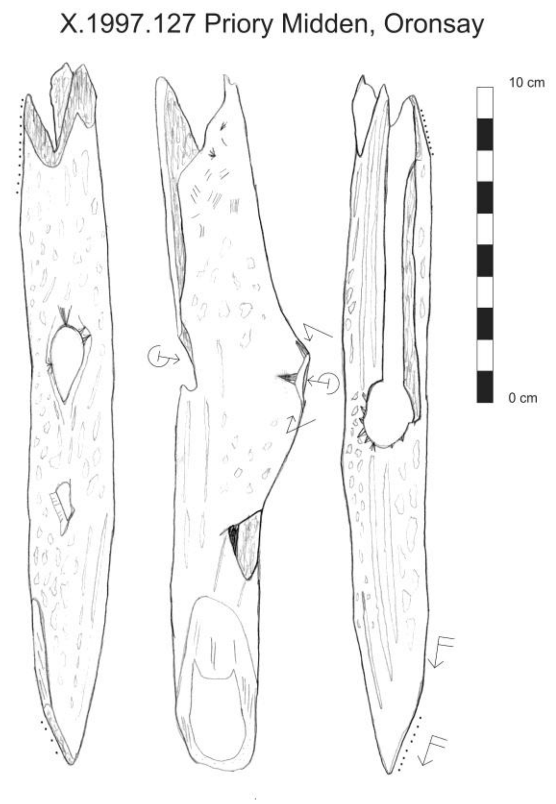


Figure 103: Antler mattock x.1997.127 from Priory Midden

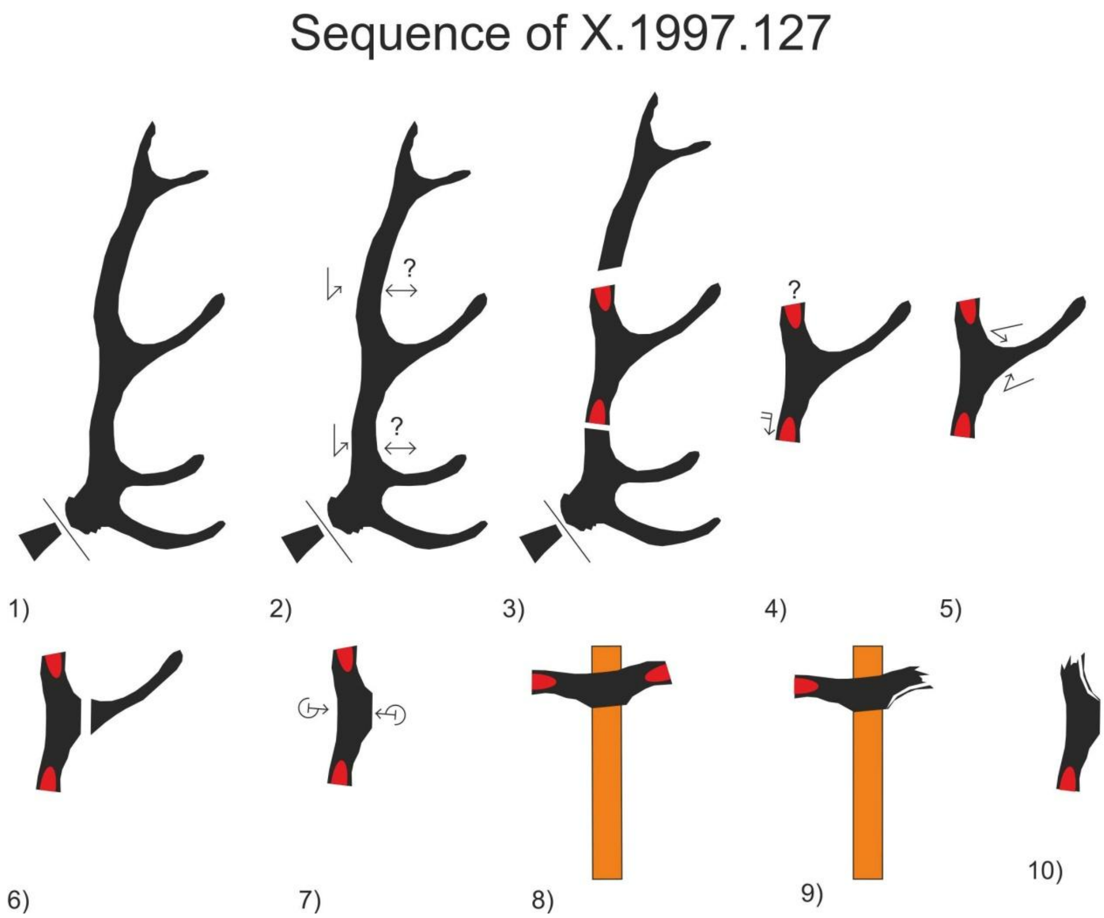


Figure 104: Sequence of X.1997.123 Priory Midden

5.10 Croch Riach/Cnoc Coig, Oronsay

5.10.1 Context of recovery

Archaeological material excavated by Galloway and Grieve in the early 1880's (Anderson 1898, 312) from the shell midden site of Croch Riach (Figure 94) is currently held at the National Museum of Scotland. Although some confusion exists over the precise location of the Croch Riach shell midden (Mellars 1981), Mellars' argument that the site actually corresponds to the midden which was later excavated under the name "Cnoc Coig" (Mellars 1987, 123) is yet to be contested.

Anderson's original note on the Galloway's excavations at "Croch Riach" states that no record of the investigation at the site exists, but that the material culture attributed to the site is consistent with that of the other shell middens excavated on Oronsay (Anderson 1898, 312). An assemblage of bevel-ended tools of various materials was recovered from Croch Riach (Table 19).

Artefact	Stone	Bone	Antler
Bevel-ended tools	50	16	4

Table 19: Quantities of bevel-ended tools recovered from Cnoch Riach (Anderson 1898, 313)

Following an archaeological survey of the area marked as "Croc Riabhach" on a map produced by Grieve (Mellars 1987, 122), no trace of either *in situ* or disturbed midden deposits were located. Mellars makes the link between "Croch Riach" and a large and conspicuous shell midden which was located a short distance beyond the boundaries of a field named "Pairc Croc Riach" and which was excavated by Mellars under the name "Cnoc Coig". He notes that this site was known to have been referred to during later stages of the Galloway and Grieve fieldwork as "Croc Riabhach" (Mellars 1981). Excavation at the site revealed a small series of backfilled trenches which did not correspond to those of any other known excavator, leading Mellars to conclude that both "Croch Riach" and "Cnoc Coig" refer to the same site (Mellars 1987a, 218–219).

If this link is to be accepted, it has some important implications for the interpretation of the Galloway and Grieve material, as Mellars' excavations can provide a more detailed context for occupation at the site. From 1973-79, 75% of the midden deposits at the site of Cnoc Coig were excavated (Mellars 1987e). A large quantity of bevel-ended tools of stone, antler and bone were recovered during these excavations, although to date they remain unpublished and could not be accessed as part of this study. However, the stratigraphy and dating of the midden has been published and can therefore be considered.

Two extended section drawings suggest that the site had been built up during three major phases of shell deposition. The centre of each phase of deposition was located in a different zone of the midden (Mellars 1987, 223–228). These phases were shown to be stratigraphically discrete, and superseded each other at the site. Within the phases, *in situ* hearth deposits and associated concentrations of burnt bone, and localised lenses of fish bones attest to short-term episodes of specialised human activity. These different stages of midden deposition are important to consider when interpreting the material at the National Museum of Scotland, as they may have been deposited during differing periods of activity, or a single discrete episode. As such, care needs to be taken when extending the analysis of this small sample to discuss the role of antlerworking within the larger picture of human occupation at the site.

The ^{14}C dating of the Cnoc Coig midden indicates a late Mesolithic occupation. The six radiocarbon dates from *in-situ* charcoal are shown in (Figure 105). The calibration of these dates demonstrates a low level of temporal resolution, whilst the inability of Mellars to attribute these dates to specific archaeological contexts prevents a more precise dating of the three phases of deposition discussed above. However, despite the shortcomings of this dating it can be broadly said that human occupation and associated midden deposition at Cnoc Coig appears occurred during the mid-to-late fifth millennium cal. BC.

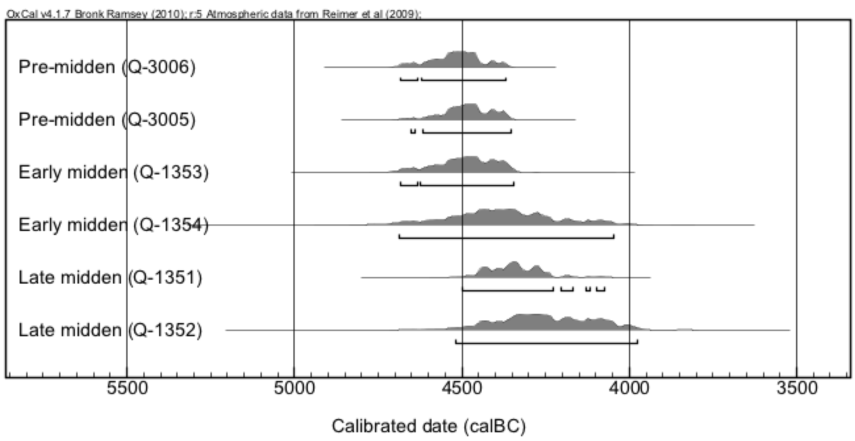


Figure 105: Radiocarbon dates from Cnoc Coig (Mellars 1987a, 233)

5.10.2 Bevel-ended tools from Croch Riach/Cnoc Coig

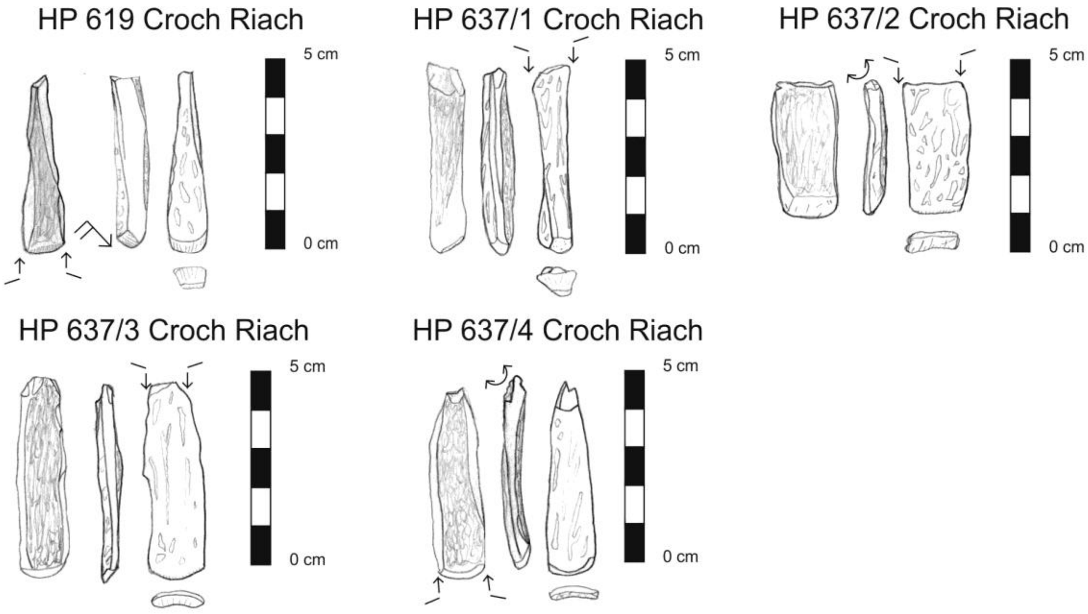


Figure 106: Bevel-ended tools recovered by Galloway and Grieve from Croch Riach

Seven antler bevel-ended tools from Croch Riach were analysed at the National Museum of Scotland. These included five tools accessioned with the Galloway and Grieve material (Figure 106), and a further two artefacts that the accession catalogue states were recovered by Sir Frank Mears at the site in 1929 (Figure 107). All of these artefacts show evidence of flake brakeage to define the SEN and DEX edges of the artefacts. Three of the tools (HP 619, HP 659 and HP 675) display longitudinal striations at the working edge, which underlie the smooth finish and discoloured use-polish observed on other tools (Figure 108). This has been interpreted as the traces left by scraping to shape the working edge, which have not been obscured by subsequent use.

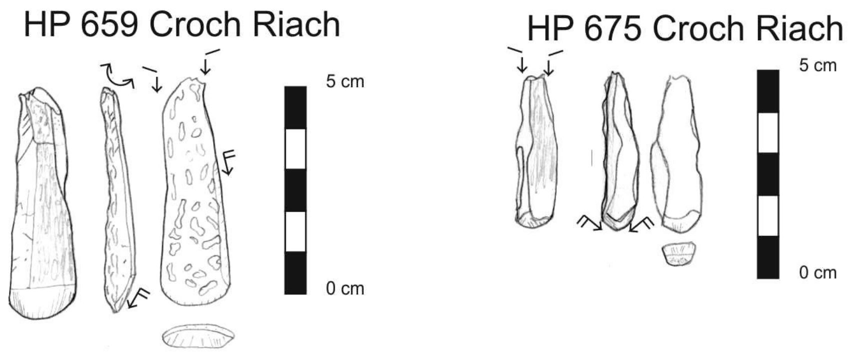


Figure 107: Bevel-ended tools recovered from Croch Riach by Sir Frank Mears

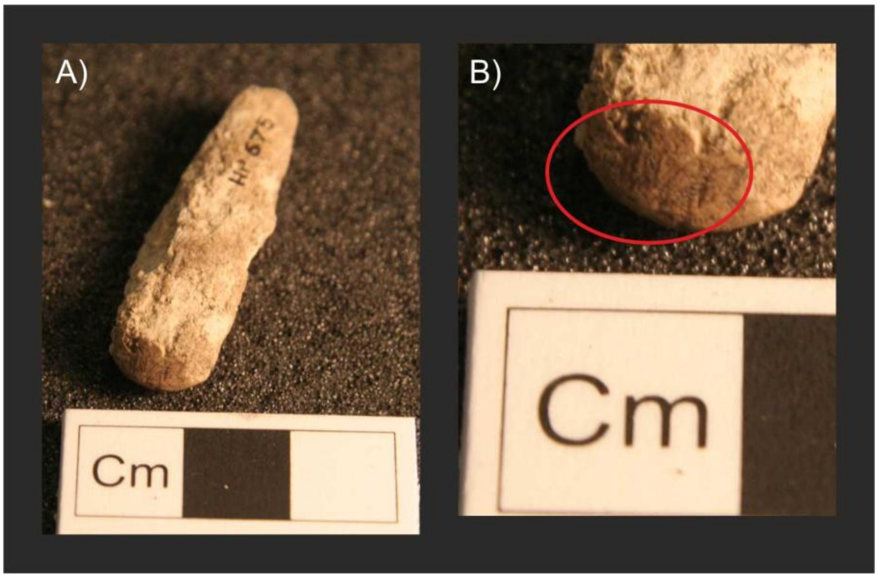


Figure 108: HP 675, Croch Riach. A) HP 675 B) Close-up of striations underlying polish on working edge

5.10.3 Summary and discussion of antlerworking at Croch Riach/Cnoc Coig

The antlerworking material from Croch Riach/Cnoc Coig needs to be interpreted with extreme caution. This is due to the confusion over the exact location of the site from which the material has been recovered, and the issues of multiple-phased deposition at the Cnoc Coig shell midden (Mellars 1987c). The presence of bevel-ended tools can be said to demonstrate their use and deposition at the site, although the precise point within the occupational sequence cannot be ascertained. Mellar's reference to "limpet-scoops" being deposited throughout the site would appear to indicate that the use and deposition of bevel-ended tools was persistent in multiple phases of occupation, although this cannot be confirmed without further access to the excavation archive.

5.11 Caisteal nan Gillean I, Oronsay

5.11.1 Context of recovery

Material excavated from the shell midden site of Caisteal nan Gillean I (Figure 94) by Galloway and Grieve (Anderson 1898, 306) is currently held at the National Museum of Scotland. Although the survey work of Mellars identified two separate shell midden sites at Caisteal nan Gillean, only one of these was believed to have been previously known to past excavators. This is renowned for its original, distinctly conical shape and in its current state can be seen to have been extensively excavated. As such, the material recovered by Galloway and Grieve can be assumed to have come from the site termed "Caisteal nan Gillean I".

Mellars (1987c, 172–173) provides a detailed description of the archive correspondence held at the Hunterian Museum which sheds light into the original excavations of Galloway and Grieve, carried out during the summer of 1881 and spring of 1882. These excavations initially took the form of a 70 foot long trench which ran from the foot of a conical, grass covered mound towards its apex. Following the identification of Great Auk bones within the deposits in July 1881, subsequent work focused exclusively on the apex of the mound. These excavations resulted in the removal of the upper third of the mound. They state that beneath the turf and wind-blown sand, a series of shell layers were encountered before being underlain by sterile sand. They note that the depth at which the midden deposits varied (reaching 2m thickness in some areas), suggesting that the profile of the midden was not conical, and that the current shape of the mound was largely the product of windblown sand deposition. Within these deposits, Galloway and Grieve observed a complex sequence of shell layers, with numerous *in-situ* hearth features. However, no section drawings or more detailed descriptions of these deposits were produced at the time.

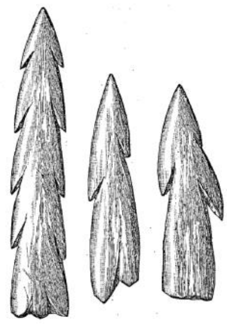


Figure 109: Bone biserial barbed points from Caisteal nan Gillean I (Anderson 1898, 308)

Anderson (1898) provides a report on the artefacts recovered by Galloway and Greive during their excavations at Casiteal nan Gillean I. He lists eleven fragments of bone biserial barbed points, two bone awls a tip of a bone awl, 50 flints showing no sign of secondary working and a "vast quantity" of stone, bone and antler bevel-ended tools (Anderson 1898, 307). He notes that the barbed point fragments have since been lost, although is able to provide a set of drawings for three of the points (Figure 109), which confirms their typological affinities with the other biserial barbed points from Western Scotland. Anderson states that there are 57 antler bevel-ended tools from Caisteal nan Gillean I and that these vary in size from 1 ½ inches to 3 inches in length. Although the majority have a tapering shape and are beveled at the broad end, Anderson notes that a small minority are beveled at both ends (Anderson 1898, 308). A further 93 bone bevel-ended tools are also listed in the site assemblage. In addition to these artefacts, Anderson also identifies eight fragments of perforated pieces of antler which are similar to the piece found at Druimvargie Cave. An unspecified quantity of "fragments of deer horn, roughly cut or hacked all around the circumference and then broken across" are also commented on as being indicative of the methods used to produce the blank splinters for bevel-ended tool manufacture (Anderson 1898, 309).

Further fieldwork was carried out at the site by Mellars (1987d). This included an auger and test pitting survey to establish the extent of the previous excavations and assess the possibility of further *in situ* midden deposits surviving at the site. This survey concluded that the deposits on the summit of the mound had been almost completely excavated. Mellars dug two trenches which overlapped with the edges of the original excavations, and extended them out into the small areas of remaining undisturbed midden deposits. These were supplemented by a further trench, in which a continuous section of the undisturbed depositional sequence was recorded.

The upper layers of this sequence were characterised by intercalated, thin layers of buried soils and light sands, with some phases of disturbance. This is interpreted as a period of fluctuating periods of sand accumulation, with soils forming during periods when the rate of sand deposition slowed. The sequence is interrupted by periods of erosion and so is not thought to be continuous. Below these soil and sand layers, a midden deposit was identified. This has a maximum thickness of 40cm and is seen to follow the general slope of the mound. Two distinct phases of deposition were observed with the midden layers. The earlier phase of deposition is characterised by a high frequency of loosely-compacted shells. The later phase contains a similar frequency of shells, but with a significantly higher proportion of sand within the matrix and a notable increase in the quantities of burnt material within the deposit. Below the midden layers, auguring was able to demonstrate that the underlying mound consisted of dune sand. Within this 5m deep deposit, a series of thin palaeosoil horizons were identified. These are interpreted by Mellars as short periods where sand deposition slowed enough for the dune to stabilise and soil to form, before dune accumulation recommenced.

During the course of the excavations, a number of ^{14}C dates were obtained from stratified material within the midden (Figure 110). These suggest that the upper layers post-date the lower midden, and that occupation at the site spans from the late 6th millennium cal. BC to the late 5th millennium cal. BC.

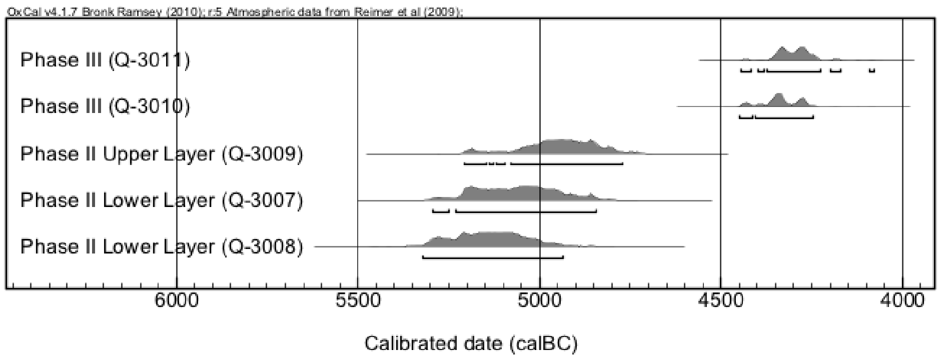


Figure 110: ^{14}C dates from Caisteal nan Gillean I (Mellars 1987, 177)

5.11.2 Bevel-ended tools from Caisteal nan Gillean I

42 bevel-ended tools from the Galloway and Grieve excavations were located within the collections of the Museum of Scotland (Figure 112, Figure 113 & Figure 114). Of these, 33 show signs of modification to the SEN and DEX edges. This modification is achieved through scraping on both the INT and EXT aspects of the edges. In many cases, this is accompanied by a layer of thin polish, which is interpreted as the result of hafting. A further insight into hafting is provided by HP 216, which features two nicking marks which overlie the modified DEX edge. It is possible that these marks were created in the removal of the haft, before the antler artefact was deposited. 16 of the 42 also have observable fracture planes associated with flake breakage, and this is the method by which the SEN and DEX edges are believed to have been created.

Of the 42 bevel-ended tools from Caisteal nan Gillean, 20 show signs of scraping on the working face which predate the accumulation of polish associated with use. Given the destructive nature of abrasive use-wear on the underlying working marks, it is possible that a similar method was employed to create the working edges of the remaining 22 tools.

HP 183 also displays further working marks which suggest that this artefact has a slightly more complicated *chaîne opératoire.* The distal end of this object displays a sharply defined arc-like profile, which features a smooth internal surface with an adherent polish. This suggests that the piece of antler from which the bevel-ended tool was manufactured from was perforated. Given the fact that the only perforated tools known from the shell midden sites of Western

Scotland are mattocks, it seems likely that this particular tool was manufactured from material produced in the fragmentation of an antler mattock.

Figure 111: HP 183 from Caisteal nan Gillean I

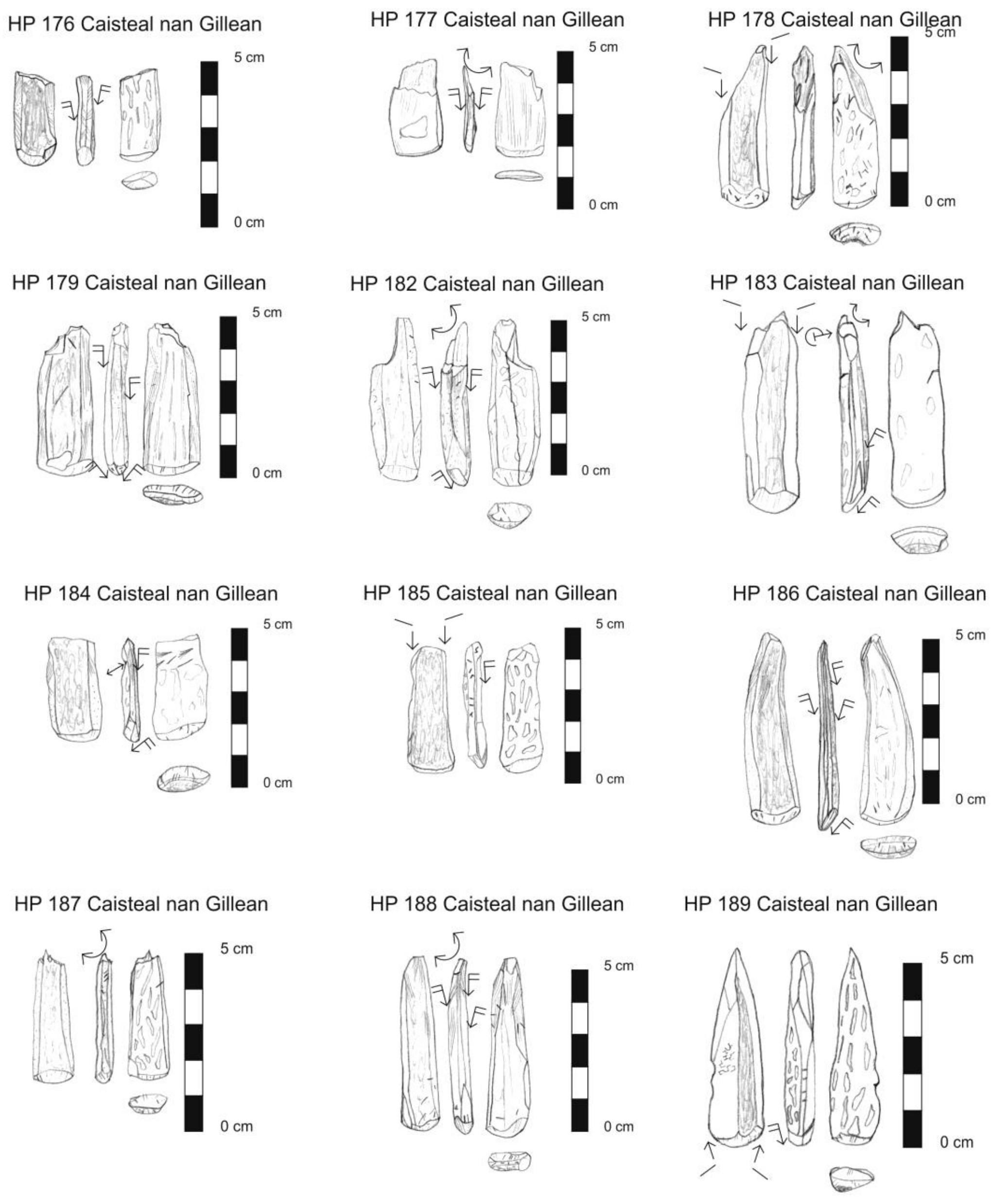


Figure 112: Bevel-ended tools from Caisteal nan Gillean I. 1 of 3

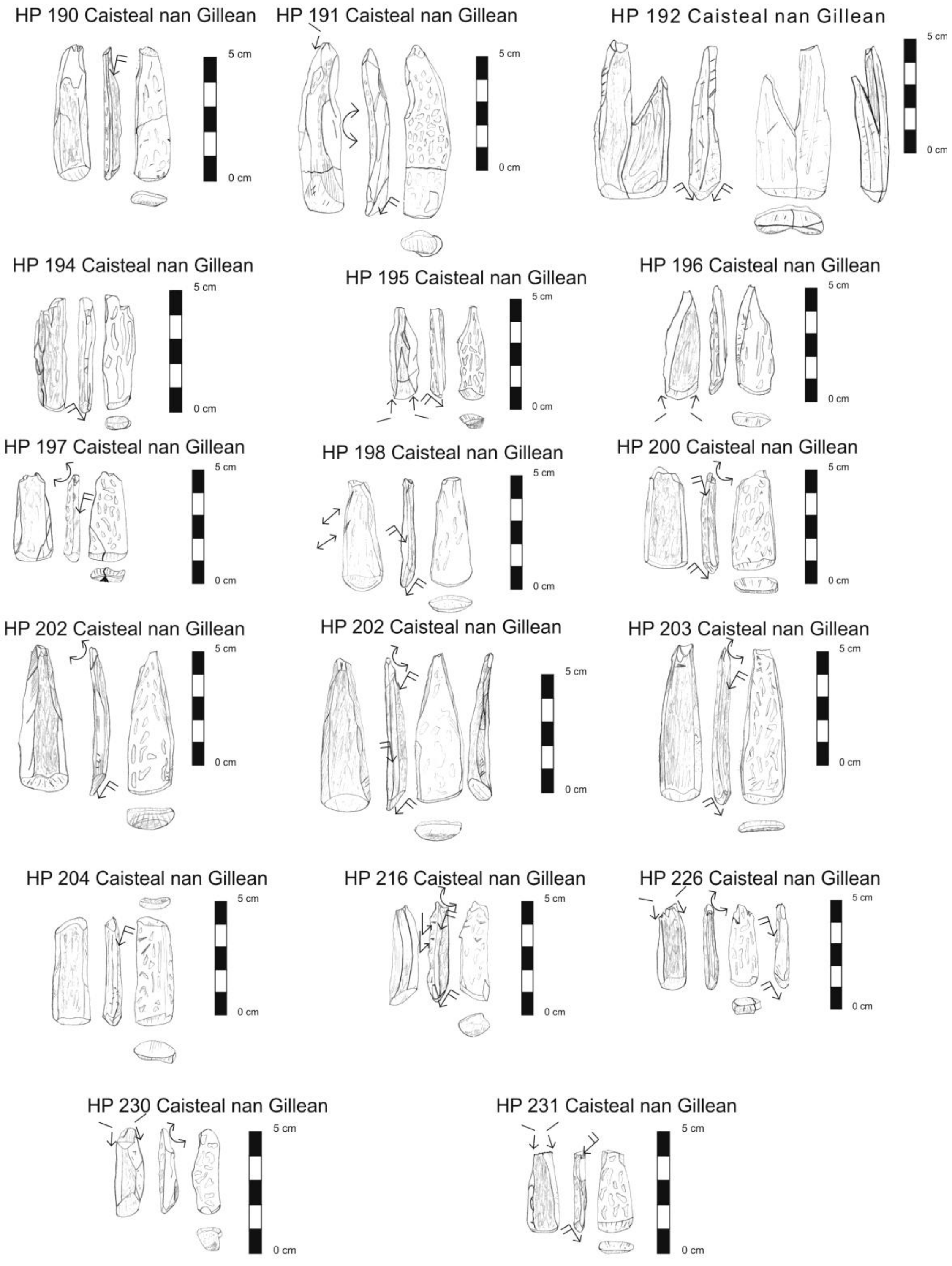


Figure 113: Bevel-ended tools from Casiteal nan Gillean. 2 of 3.

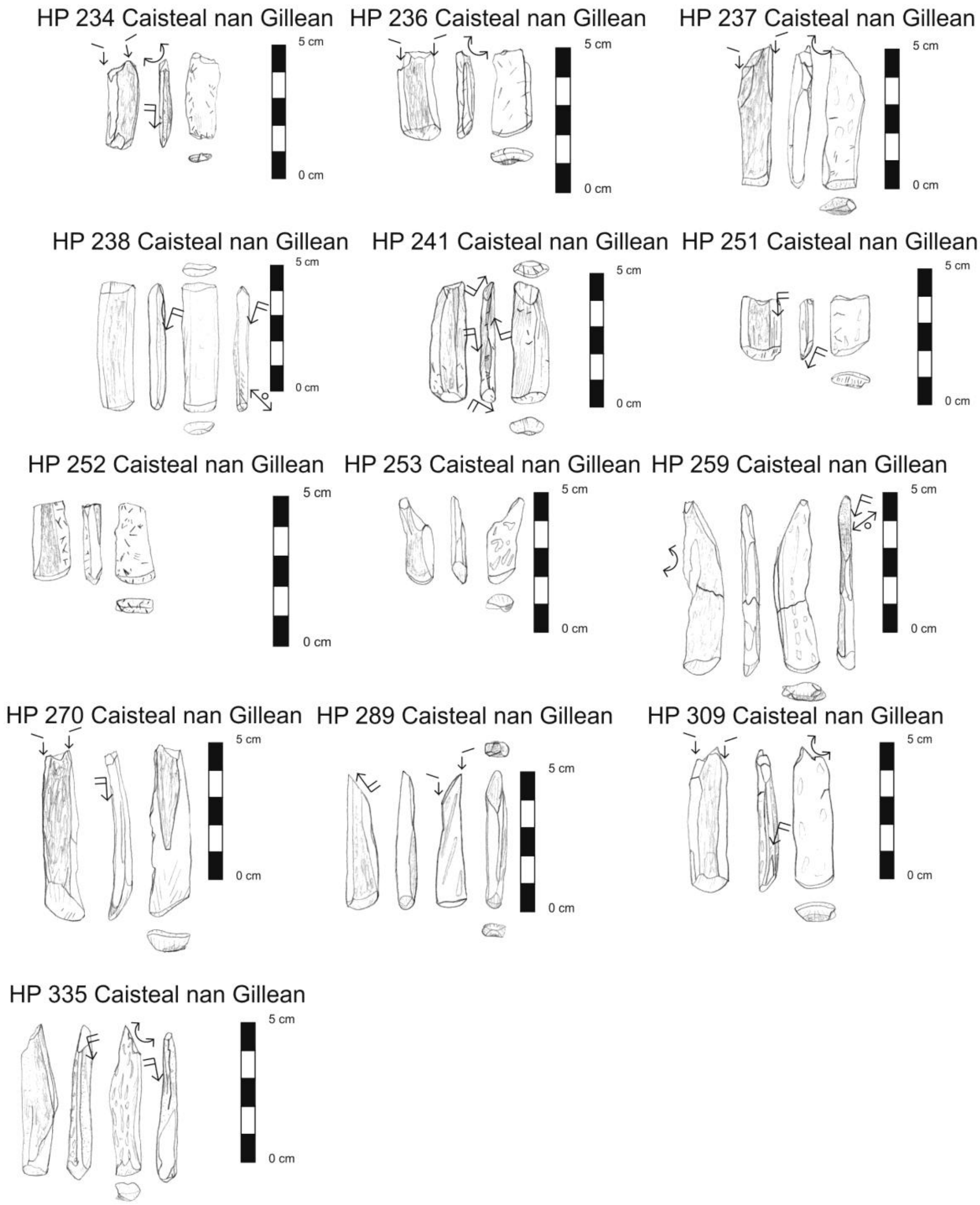


Figure 114: Bevel-ended tools from Caisteal nan Gillean I. 3 of 3.

5.11.3 Mattock fragments from Caisteal nan Gillean I

Nine fragments of antler mattocks were identified within the material from the Galloway and Grieve excavations (Figure 115), which is currently held at the National Museum of Scotland. These were identified through the characteristic traces of either perforations or mattock working faces on fragments of red deer antler. The markings visible on these surfaces indicate that boring and drilling were used to create perforations, and that hafts were inserted into these perforations – based on the polishes adhering to the internal edges. Working faces are presumed to have been created through the execution of prepared breaks to antler beams, and were then further shaped through scraping and/or grinding before being used. The SEN and DEX edges of these pieces are generally defined through flake breakage of the original artefacts, to produce roughly rectangular pieces of antler. Intentionality is shown in the production of these rectangular pieces of antler through the attention paid to controlling the form of the splinters produced. This is demonstrated in HP 209, where grooving appears to have been used to produce a straight, longitudinal SEN edge. It is also apparent on HP 348/25, where sawing has been employed to the internal surface (therefore *after* the original mattock has been broken) in preparation for a proximal break.

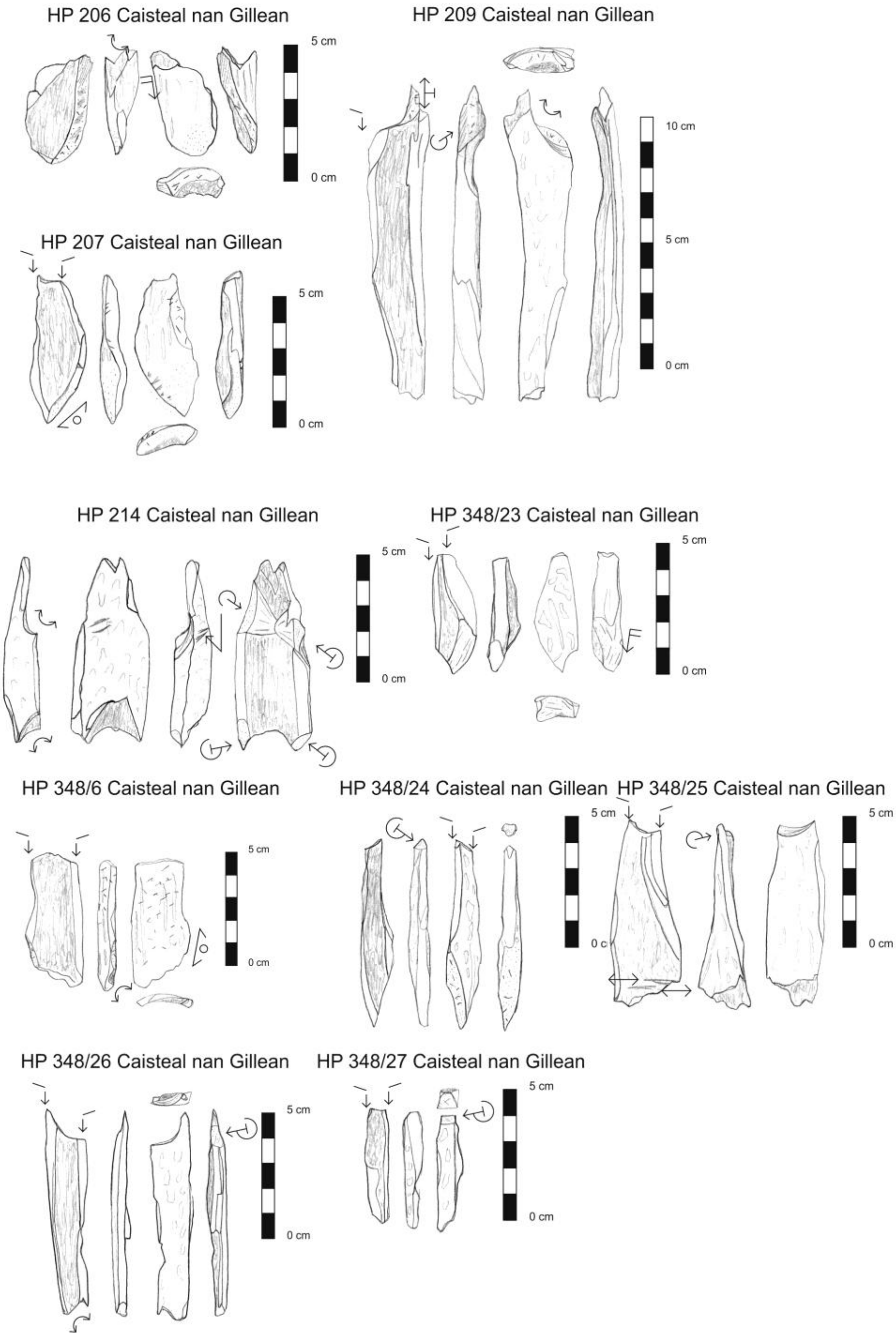


Figure 115: Mattock fragments recovered by Galloway and Grieve from Caisteal nan Gillean I

The working marks on these mattock fragments can also tell us something about the *chaîne opératoire* of the original artefacts. HP 214 displays fragments of perforations at four points, two on the SEN and DEX edges respectively. The alignment of these points indicates that the piece of antler was perforated twice, before the application of flake breakage to the SEN and DEX edges. This suggests a mattock which was perforated and hafted before subsequently becoming damaged at the point of hafting. A repair was then carried out through the creation of a second perforation, which was again hafted before the artefact was finally broken up.

Whilst no complete antler mattocks appear to have been recovered from Caisteal nan Gillean I by Galloway and Grieve, the occurrence of these fragments indirectly demonstrates the presence of the artefacts. The small sizes of the fragments, and the fact they do not seem to have been utilised further after being broken up implies that the tools became fragmented on-site.

5.11.4 Antler *debitage* from Caisteal nan Gillean I

22 pieces of antler *debitage* from Caisteal nan Gillean I were identified within the collections of the National Museum of Scotland. Three of these could be attributed to a specific element of a red deer antler – HP 349 and HP 350 being intact red deer tines whilst HP 352 is a portion of beam from below the trez tine junction. The presence of nicking marks and level break surfaces at the terminations of these pieces indicate that nicking and prepared breakage were employed to remove tines and divide beams.

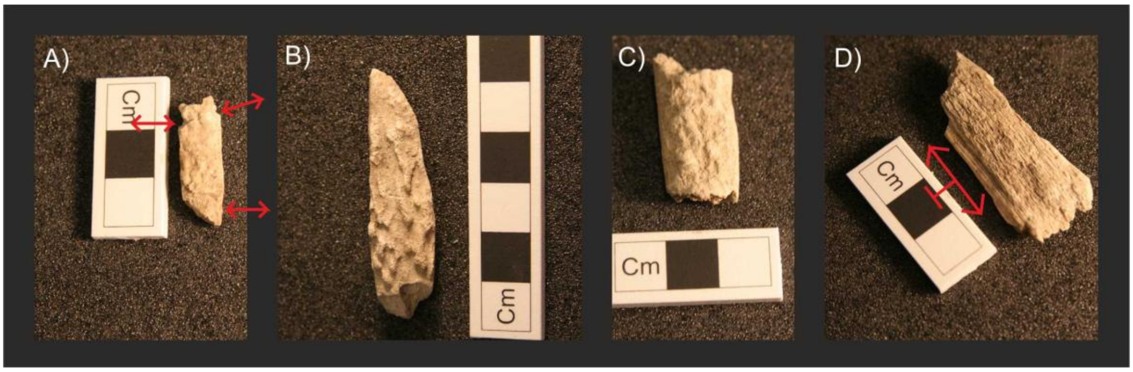
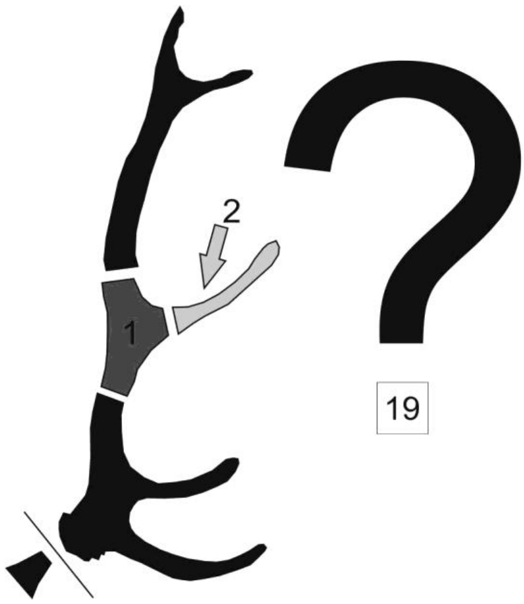


Figure 116: Antler *debitage* with scraping marks from Caisteal nan Gillean I, Oronsay. A) HP 348/22 B) HP 348/21 C) HP 348/17 D) HP 348/18

The remaining 19 consist of fragments of red deer compactor. These have been produced in a similar manner to that of the bevel-ended tools at Caisteal nan Gillean I, with flake breakage used to define the SEN and DEX edges and flexion breaks executed at the DIST and PROX ends of the pieces. A single example of grooving is noted on HP 348/18, although this appears to be an isolated exception and not representative of the method used in the vast majority of cases. Three pieces show further similarities to the bevel-ended tools, in that scraping has been applied to the SEN and DEX edges to modify the shape of the piece (Figure 116). HP 348/21 appears to be a failed attempt to create a bevel-ended tool, as the character of the proximal break surface is too irregular to be suitable for use as a tool. HP 348/22 shows signs of prepared breakage at both ends, with sawing marks in association with the terminal breaks. This may be an intermediate piece of antler, from which bevel-ended tools were produced at both ends. This interpretation implies that considerable effort was spent on controlling the length of the tools that were produced. Two tools could also have been produced with a single break, although this may have meant that the intended lengths could not be obtained. The fact that HP 348/22 has also had scraping applied to the SEN and DEX edges *prior* to the execution of prepared break also suggests that, in some cases, scraping was carried out before the final length of the bevel-ended tool was defined. The occurrence of these apparent interim pieces within the Caisteal nan Gillean I antler *debitage* suggest that bevel-ended tools were being manufactured at the site itself.

5.11.5 Summary and discussion of antlerworking at Casiteal nan Gillean I

It can be seen from the above sections that both bevel-ended tools and mattocks were being used and deposited at Caisteal nan Gillean I. In the case of the former, there is also evidence to suggest that manufacture was also being carried out at the site. Following the analysis of the worked antler from the Galloway and Grieve excavations at Casiteal nan Gillean I, an economy of *debitage* can be synthesised (Figure 117).



Element	Quantity
Trez junction	1
Tine	2
Unknown	19

Figure 117: Economy of *debitage* for Caisteal nan Gillean I,

This would appear to suggest that the tines, upper beam and lower beam were all being exploited for the materials needed to produce antler bevel-ended tools and mattocks at Caisteal nan Gillean I. The absence of burrs or basal portions in both the artefact and debitage assemblage from Caisteal nan Gillean I may also be taken to indicate that red deer antler was imported to the site with the basal portion already having been removed. However, analysis of the Galloway and Grieve material needs to be undertaken with extreme caution, given the multiple phases of deposition which are known to occur within the midden itself. This means that the economy shown in (Figure 117) is misleading, as the work of Mellars at the site has demonstrated that the midden layers are an accumulation of at least two phases of deposition. It is also important to stress that the Galloway and Grieve excavations were carried out in much deeper areas of the midden deposits, which are likely to be the product of many more phases of deposition. Antlerworking practices may vary between these phases, and without stratigraphic provenance for each piece of material it is impossible to characterise antlerworking *within* these deposits.

The Galloway and Grieve assemblage does allow a discussion of antlerworking at the site at a very general level. The practices that are positively demonstrated within the assemblage can be said to have been carried out at the site during human occupation in the late Mesolithic period – such as the manufacture of bevel-ended tools using the flake breakage technique, the modification of antler splinters through scraping of the SEN and DEX edges and the fragmentation of antler mattocks. The utilisation of fragmented mattocks as bevel-ended tools can also be said to have been carried out at the site. The high frequencies of scraping on bevel-ended tools and the effort invested in controlling the exact length of bevel-ended tools certainly seems to suggest that more control was exerted over the finished form of bevel-ended tools at Caisteal nan Gillean I than is apparent at other shell midden sites on Oronsay. However, it cannot be said that these practices were occurring simultaneously, or conversely that they were confined to specific periods of occupation. This presents an interesting set of questions that the material excavated by Mellars may be able to shed light into – given the fact that the 3-dimensional location of artefacts recovered during those excavations was recorded.

5.12 Blackness Bay/Carriden, Falkirk

5.12.1 Context of recovery

The chance finding of a biserial barbed point from the Forth foreshore between Blackness Bay and Carriden (Figure 66) allows a further artefact to be studied (Saville 2001). This was recovered by S Baird in 1993, whilst walking along the foreshore at low tide. The point was observed lying on the surface, “face down in a muddy sediment” (Saville 2001, 71). The artefact was acquired by the National Museum of Scotland, and AMS ^{14}C dated, producing a date of 5,198-4,786 cal. BC (OxA-7852).

5.12.2 Biserial barbed point from Blackness Bay/Carriden

The biserial barbed point from Blackness Bay/Carriden (Figure 118) is a virtually complete specimen, and features six barbs on the SEN and DEX sides respectively. The tang is intact, and shows no sign of perforation, and as such the artefact can be classified as a barbed point. Signs of heavy water damage are apparent across the piece, with a smoothing of the outer surface and a loss of working marks and polishes. Faint traces of sawing marks below some of the barbs suggest that sawing was used to define the barbs. A single instance of modern damage is observed at the tip of the third barb on the SEN side. The ovular profile of the point when viewed in section implies that the original splinter of antler was shaped through reduction of the INT and EXT aspects, but the method involved in this is obscured by the taphonomic processes that the artefact has been exposed to. Similarly, it is difficult to ascertain to what extent the final shape of the artefact in section is due to taphonomy. A thin polish is present at the extreme tip, and along the edges of the barbs. However, given the destructive nature of the taphonomy, this is thought to post-date the artefact’s recovery, and may have been created through handling in curation. An elongated cavity on the INT aspect is the result of drilling for AMS dating.

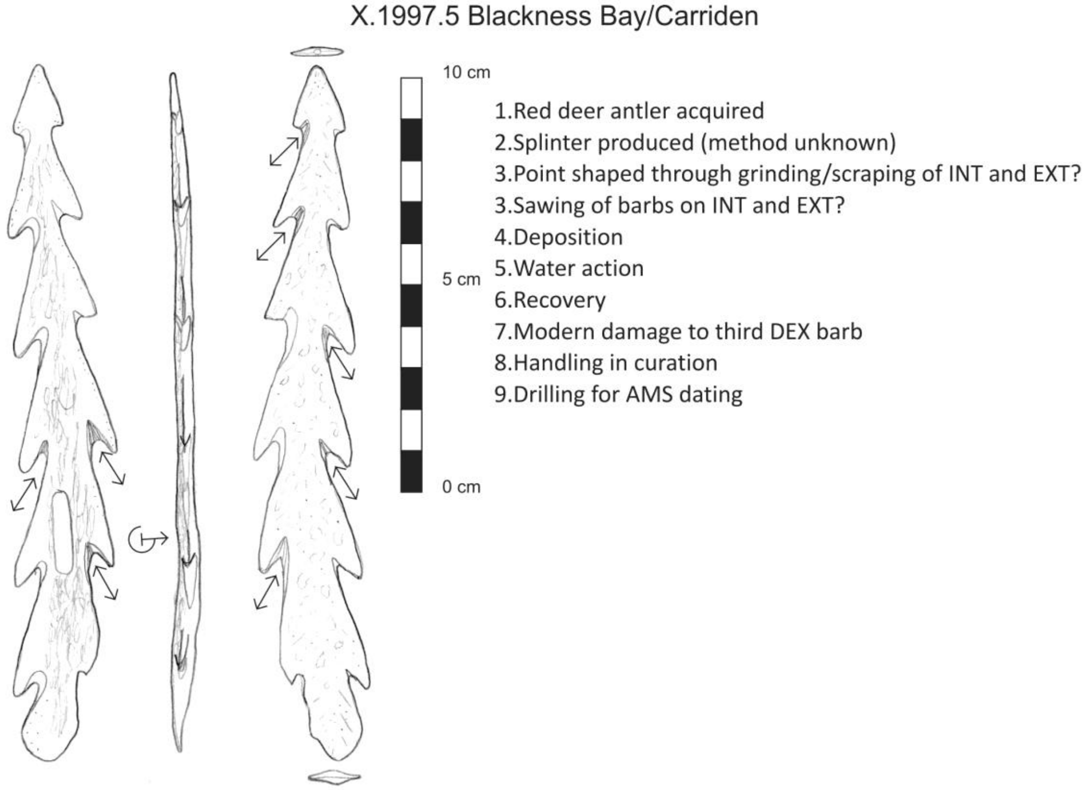


Figure 118: Biserial barbed point from Blackness Bay/Carriden, Falkirk

Synthesising the *chaîne opératoire* of the Carriden barbed point is severely complicated by the destructive nature of the tidal rolling to which the artefact has been exposed. What can be gleaned is summarised in Figure 118.

5.13 Shewalton, Irving

5.13.1 Context of recovery

The chance recovery of a biserial barbed point from the banks of the River Irving at Shewalton (Figure 66) has contributed further to the Mesolithic archaeological record of Mesolithic antlerworking in Britain (Lacaille 1938). The find was originally reported in the local newspaper – *The Irving and Fullerton Times* – in 1938. This attracted the attention of Lacaille, and he states that through correspondence with the original finder that:

"The antiquity had been recovered from the bed of the river (where it was noticed from the footpath, the water running low and clear), below the Shewlaton sandhills on the left bank, about the middle of the great bend northward."

(Lacaille 1938, 48)

More recently (Tolan-Smith & Bonsall 1999), the point has been AMS dated to 4,933-4,529 (OxA-1947).

5.13.2 Biserial barbed point from Shewalton

The specimen is currently held at the National Museum of Scotland. It is a large biserial barbed point, featuring five barbs on both the SEN and DEX sides. The tip of the point is intact, although flake scars are visible just below the tip on both the internal and external aspects –

possibly indicative of impact in use. A small bulge can also be observed on the DEX side, just below the tip. Closer inspection of this revealed two very small, but intersecting sawing marks, similar to those found below the fully formed barbs (B in Figure 119). The association of this feature with the flake scars may suggest that this represents the remnants of a barb which has been damaged in the same event which created the flake scar. Striations across the length of the piece and the diamond profile of the point indicate that scraping has been applied longitudinally to shape the splinter of red deer antler. The barbs have been defined by sawing from both the INT and EXT aspects, and small polished facets below each barb indicate that these areas were further worked through filing. A further episode of scraping is evidenced through striations which respect the angle of the barbs, indicating that they were created after the barbs had been defined. Interestingly, striations also overlie the flake scars at the distal end of the point (C in Figure 119). This suggests that scraping continued throughout the use-history of the point, as a means of repair. This is further supported by the profile of the first DEX barb, which runs directly from the tip, and is not interrupted by the area in which the damaged barb would have been, indicating that the tip was re-shaped after the damage to the initial first DEX barb. A conservation varnish has at some point been applied to the artefact during curation, which covers the entire point in a light polish and brown discolouration. At the proximal end of the piece, the tang is broken short. The contorted character of this break suggests a flexion break, potentially at the point of hafting. A small hole can be observed in the proximal region. This is the result of drilling for AMS ^{14}C dating.

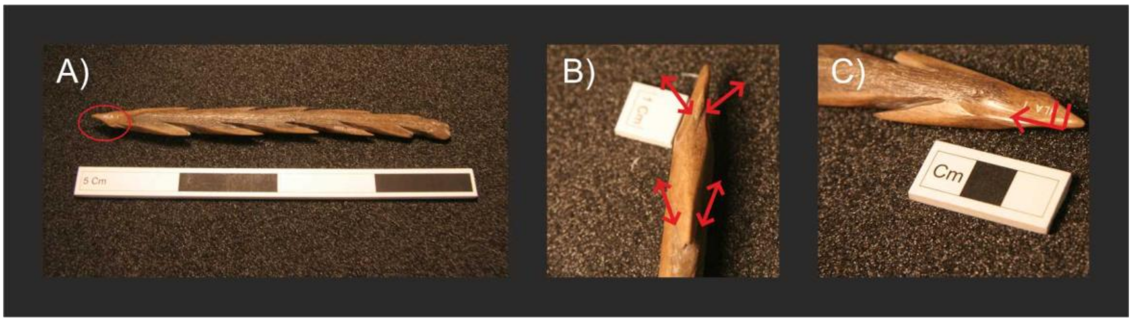


Figure 119: HLA 1 biserial point, Shewlaton. A) HLA1 with damaged first barb circled B) Sawing marks at damaged first DEX barb C)Scraping marks overlying flake scars at tip

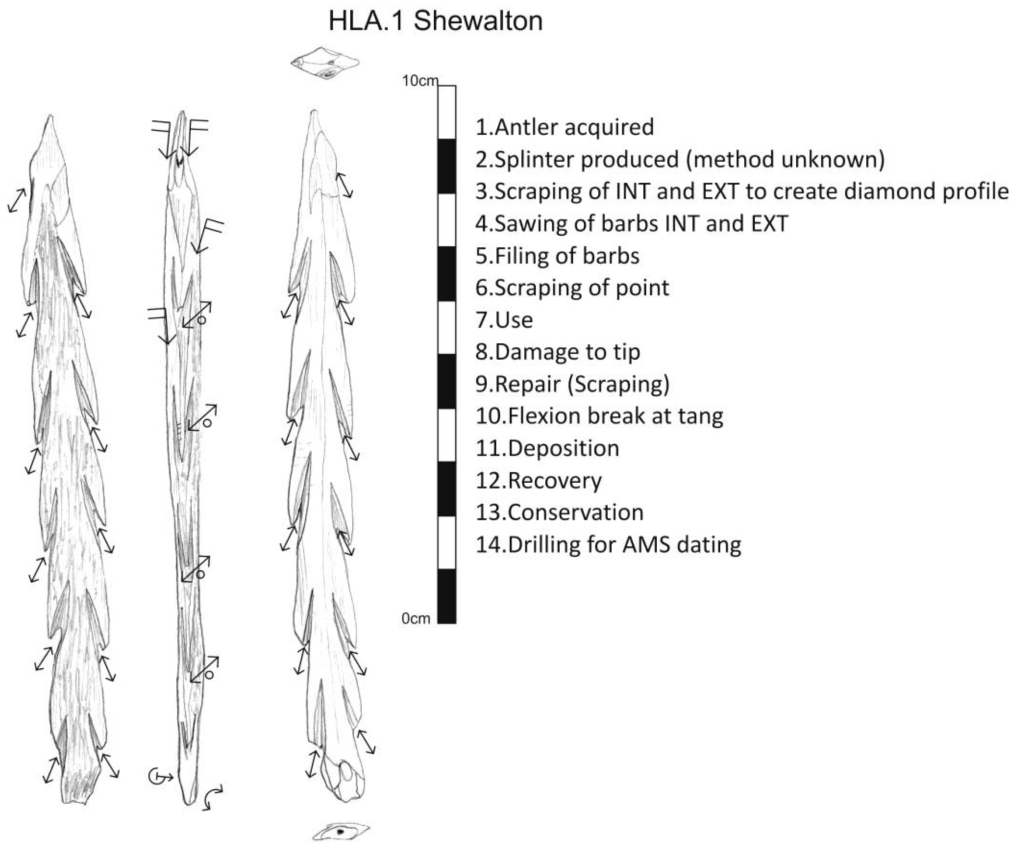


Figure 120: Biserial barbed point HLA1 from the River Irving at Shewlaton

5.14 Whitburn, County Durham

5.14.1 Context of recovery

A single antler biserial barbed point from Whitburn (Figure 66) is currently held at the Great North Museum, Newcastle. This was recovered 1852 and originally commented upon by Munro (1908, 231), who notes the similarities between this artefact and the biserial barbed points from western Scotland. Mellars (1970) provides a more detailed study of the history of the artefact, noting that it may have been eroded from either the cliffs at Whitburn, or from the submerged peat deposits known to exist along the Northumberland and Durham coasts. Given the high levels of organic preservation noted on the artefact, Mellars suggests that it must have been preserved within consistently waterlogged deposits and as such originates from the submerged coastal peat beds. He also provides a brief description of the methods used to manufacture the point, stating that the original splinter of antler was modified into a "lozangic outline partly by cutting and scraping with a flint knife, and partly by grinding on a rough stone; however subsequent abrasion and polishing of the surface (possibly through the action of the sea) has removed all traces of the original tooling from the surface of the piece" (Mellars 1970, 340). He also states that the barbs have been defined through "grooving" on both the interior and exterior sides of the antler, and that this contrasts with the upward sawing actions used to define barbs on uniserial barbed points. The perforation, which typologically defines this artefact a harpoon, is similarly grooved on both the interior and exterior sides of the antler. A small notch in the base of the perforation is said to have been created through the attachment of a line.

5.14.2 Biserial barbed point from Whitburn

The biserial harpoon from Whitburn is an intact harpoon (Figure 121), featuring three barbs on the SEN and DEX sides respectively, and with a perforation through the tang. The profile of the point is ovular, suggesting that the original splinter was modified through either scraping or grinding. Water action is apparent across the piece, creating a continuous polish across the external surface, with small pitting as a product of abrasive, water born sediments. This water action obscures much of the working marks which may have otherwise survived. However, in the deeper working marks created in the definition of the barbs, worked surfaces have been sheltered from water action and as such can be analysed. The barbs appear to have been defined through sawing, with multiple striations lining the inside of the saw marks. These sawing marks respect the ovular shape of the artefact, suggesting that their creation post-dates the primary shaping of the splinter. Although sawing marks are observed on both the INT and EXT aspects of the point, the second DEX barb lacks INT sawing marks. This suggests that the barb was defined by a single sawing action on the EXT surface, and that no further sawing was needed. As such, it can be said that sawing was applied to the EXT surface before the INT surface. At the proximal end of the piece, the tang has been perforated through application of grooving the EXT and INT. The grooves created in this action taper at the DIST and PROX ends, the perforation being achieved in the areas where the grooving from both sides is deepest. The way in which these tapering areas adhere to the dimensions and angle of the perforation groove suggests that they are associated with the creation of the perforation and not with wear from the attachment of a line - *contra* Mellars (1970, 340).

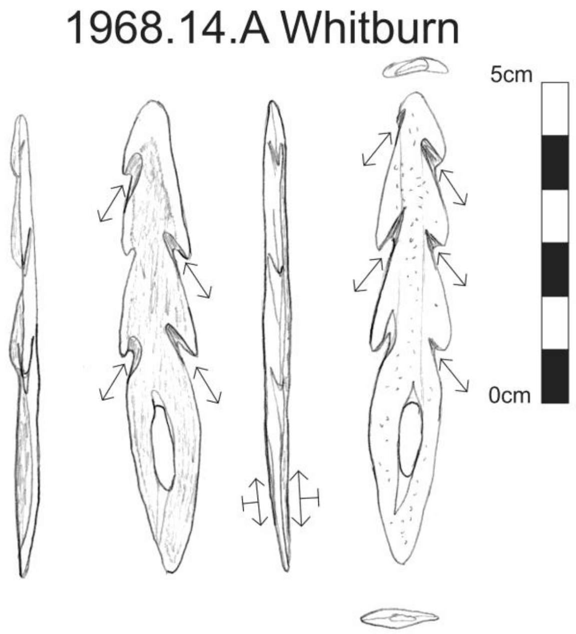


Figure 121: Biserial harpoon from Whitburn,

5.15 The River Dee, Cumstoun

5.15.1 Context of recovery

The chance recovery of a biserial barbed point from the River Dee at Cumstoun (Figure 66) has also contributed to the archaeological record of antlerworking in Britain. The earliest reference to this within academic literature is provided by Munro (1908), who comments on a “harpoon made of deer-horn” at the local museum of Kirkcudbright, which had been recovered from the bed of the River Dee in 1895. The point was subsequently AMS dated to 5706-5483 cal. BC

(Tolan-Smith & Bonsall 1999). No further information is available on the context of this artefact's recovery.

5.15.2 Biserial barbed point from The River Dee

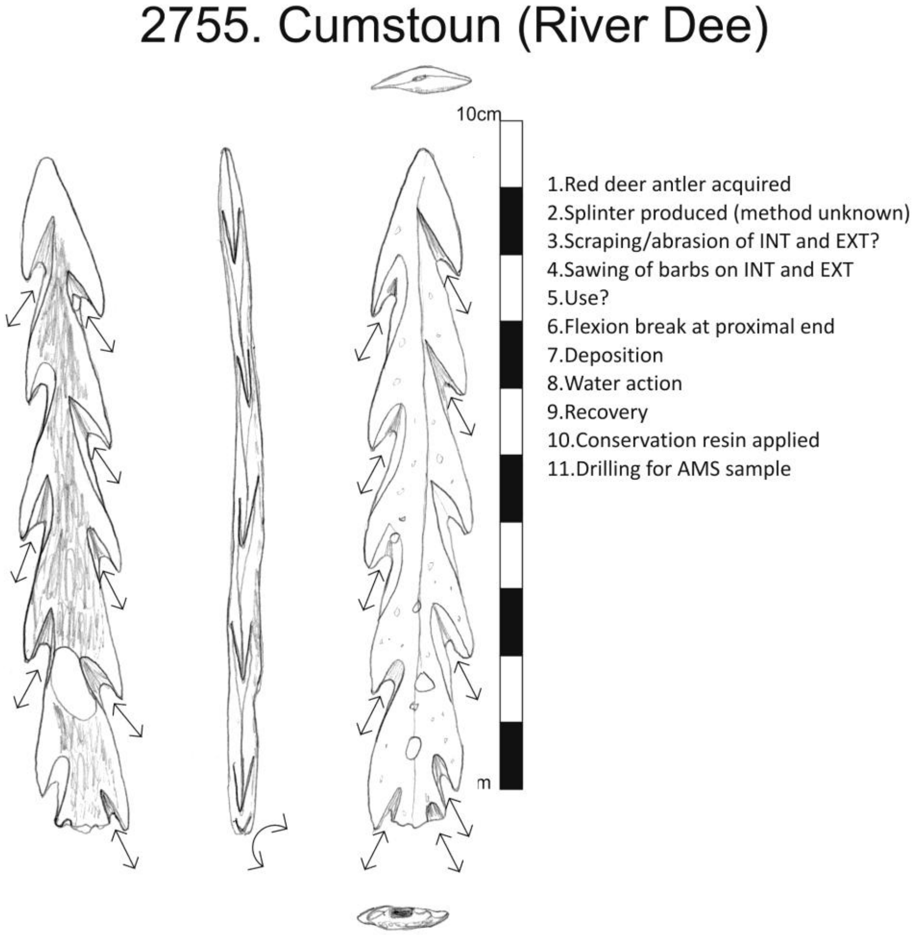


Figure 122: Biserial barbed point 2755 from the River Dee

The artefact was located within the collections of the Stewartry Museum, Kirkcudbright, and is an almost complete biserial point of red deer antler, with the tang removed. Due to the lack of tang, it is impossible to ascertain whether this is a harpoon or barbed point. There are signs of water rolling across the piece, with smooth surfaces and a rounding of barbs and the tip. Small pitting is also observed across the piece, and is interpreted as damage caused by water moving sediments against the artefact after deposition. A layer of dark brown polish is also present across the artefact, and is believed to be the result of conservation treatment. This further obscures any polishes which may have been created in the manufacture or use of the artefact. Sawing marks are present on the interior of the underside of the barbs, confirming that sawing was carried out on the INT and EXT aspects to define the barbs. The ovular profile of the artefact suggests that shaping has been carried out, although the method by which this was achieved has been obscured by subsequent water action. At the proximal end of the piece, the tang has been removed through a flexion break – potentially at the point of hafting. A drilling mark is apparent on the proximal break, where material has been removed for AMS dating. The working sequence is shown in Figure 122.

5.16 Seamer Carr, Vale of Pickering

5.16.1 Context of recovery

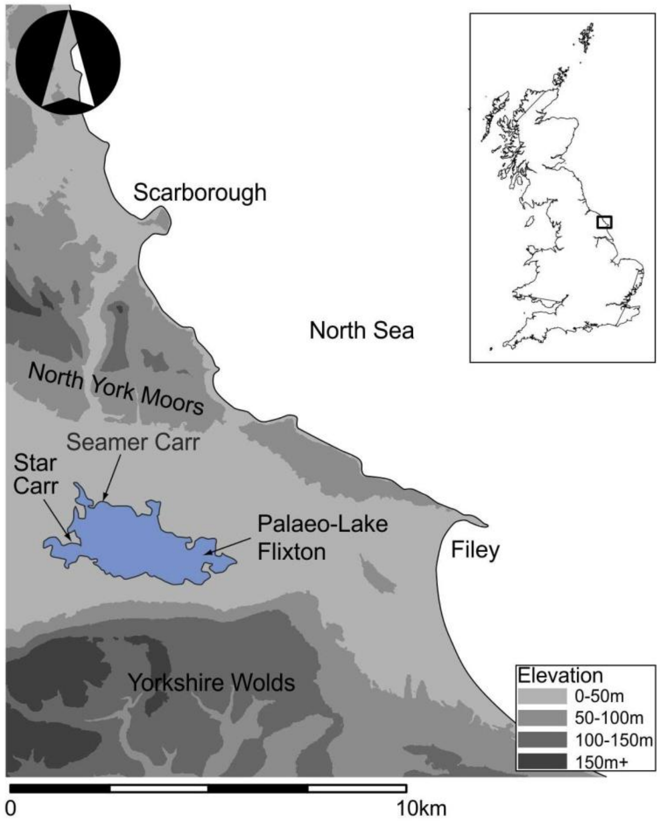


Figure 123: Location of Seamer Carr and Star Carr on the edge of Palaeo-lake Flixton

The site of Seamer Carr is situated in the eastern end of the Vale of Pickering, North Yorkshire. It was discovered and excavated prior to the development of a sizable landfill, in the same lake-edge peat deposits within which the site of Star Carr had been discovered in the 1940s (Figure 123). The site was excavated from 1976-1986 (Lane & Schadla-Hall Forthcoming) and although the full details of this work are still in preparation, access to the draft reports and the site archive has been kindly granted by P Lane. This includes a report on the faunal remains from the site (Uchiyama et al. Forthcoming) and a report on the excavation of the site (Lane & Schadla-Hall Forthcoming).

The large, open area excavations at Seamer Carr revealed a series of concentrations of archaeological material, which were termed as individual sites (Lane & Schadla-Hall Forthcoming). Although mammalian fauna were recovered from several of the archaeological "sites" identified at Seamer Carr, Uchiyama *et al.* identify antler in only a limited number of locations. At the site of Seamer "K", a single, worked piece of unshed red deer antler was recovered from a context which has been ^{14}C dated to the Early Mesolithic (although more precise details regarding the dating and stratigraphic context of this deposit are yet to be published).

5.16.2 Antler *debitage* from Seamer Carr

Two pieces of antler *debitage* were located within the collections of the Natural History Museum and analysed. Piece ARC.84.5029 showed significant signs of working, in the form of a 355mm long splinter scar (A in Figure 124). The edges of this scar showed signs of grooving, in the form of continuous, cut facets with longitudinal striations. This is consistent with the "groove-and-splinter" methods of antlerworking utilised at Star Carr for the production of red deer antler splinters for barbed point manufacture, and demonstrates the use of the groove-and-splinter technique at sites where uniserial barbed point deposition does not occur.

Figure 124: ARC.84.5029, Seamer Carr. A) Splinter scar created through the groove and splinter technique B) Striations along grooving mark

The only other piece of antler from Seamer Carr was found at site "U". This consists of a small, shed red deer antler. Although fairly robust, this piece is notable for having the original anatomical surfaces removed. As there are no signs that this piece may also have been utilised, this is interpreted as the result of some taphonomic process – possibly associated with water action. No further contextual information was available for this antler, and given that it is a typologically undiagnostic piece of *debitage*, it cannot be directly linked to the Mesolithic phases of activity at Seamer Carr. As such, discussion of its analysis cannot be said to contribute further to our understanding of Mesolithic antlerworking practices at the site.

5.17 Star Carr, Vale of Pickering

5.17.1 Context of recovery

Figure 125: Plan of plotted antler finds at Star Carr (produced by B.Taylor)

The contribution of Clark's original publication of the finds from Star Carr has already been summarised within Chapter 2. However, the ongoing excavations at the site have recovered antler material that offers the potential for further analysis. Both *in-situ* and re-deposited antler artefacts and debitage have been recovered from a number of contexts during the course of the current series of excavations at the site (Figure 125). Excavation along the extant lake edge adjacent to the previous excavations in 2006 recovered a small, *in-situ* assemblage of antler *debitage* 30m east of Clark's original excavations in trench SC22. Further *in-situ* antler *debitage* was recovered in 2007, from trench SC24 directly adjacent to Clark's work. In 2008, large-scale excavations of the dryland deposits at Star Carr (SC23) resulted in the recovery of further *in situ* antler *debitage.* The results of the analysis of the material excavated prior to 2010 are published elsewhere (Elliott & Milner 2010, 2010; Milner et al. 2011).

Re-excavation of Clark's trench "Cutting II" in 2010 recovered several further pieces of antler barbed points and *debitage* from the backfill of the 1950's excavations. Extension of this trench also revealed an *in-situ* barbed point. Away from Clark's excavations, a small trench situated in between the excavations of Clark, and Mellars and Dark (SC33) resulted in the recovery of further *in situ* antler*.* This previously unstudied material (Table 20) has been analysed as part of this project and the results of this analysis will be presented below.

Year	Trench	Context	Finds number
2010	Cutting 2	Clark's Backfill	92433A
	Cutting 2	Clark's Backfill	92433B
2010	Cutting 2	Clark's Backfill	92441A
2010	Cutting 2	Clark's Backfill	92438
2010	Cutting 2	Clark's Backfill	92363
2010	Cutting 2	Clark's Backfill	92360
2010	Cutting 2 Extension	234	92454
2010	SC33	240	92822
2010	Cutting 2	235	92370
2010	Cutting 2	Clark's Backfill	92831
2010	Cutting 2	Clark's Backfill	92393

Table 20: Antler finds from recent excavations at Star Carr, Vale of Pickering

5.17.2 Uniserial barbed points from Star Carr

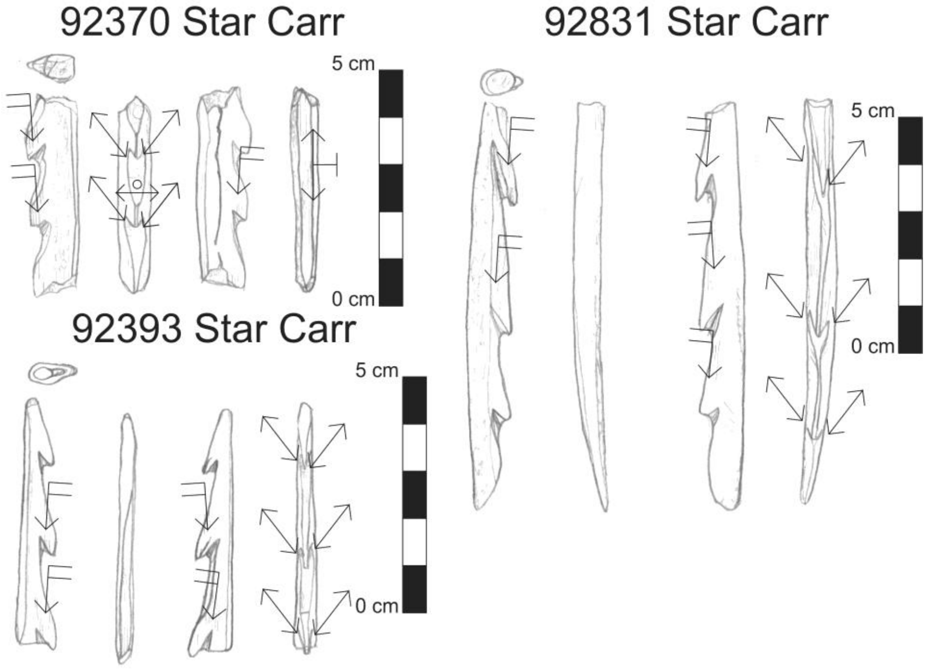


Figure 126: Uniserial barbed points from Star Carr

Three fragments of uniserial barbed points were recovered from Star Carr during the 2010 season of excavations. Two of these were within the backfill of Clark's Cutting II, whilst a further point was found *in situ* within the basal gravels underlying the peat sequence. By considering the antler material that has been previously recovered from the site, it seems safe to assume that all three points were produced using the groove and splinter method of red deer antlerworking. The style and form of the barbs does not suggest anything different from the sequence of working previously described (Clark 1954; Elliott & Milner 2010). However, there appears to be some variation in the working of the unbarbed edge within the newly excavated assemblage. 92370 features a flat SEN edge, which is at 90^{o} to the exterior and interior aspects (Figure 126). This flat aspect also still bears the longitudinal striations created in the original grooving of the splinter, indicating that it was been subjected to little or no further modification along the SEN edge. In contrast, the DEX edges of 92831 and 92393 have a curved shape, suggesting that the original grooved edge of the splinter has been smoothed away through either scraping or grinding.

5.17.3 Antler *debitage* from Star Carr

Eight pieces of antler *debitage* were also recovered during the 2010 excavations (Figure 127).

Figure 127: Antler debitage from 2010 excavations at Star Carr. A) 92433A B) 92433B C) 92441A D) 92482 E) 92454 F) 92363 G) 92363 H) 92438

These confirm some of the patterns of antlerworking previously noted at the site. Fragments of grooved compactor indicate the use of the groove-and-splinter technique whilst the presence of removed tines further confirms the removal and deposition of tines at the site. The unshed roe antler (E in Figure 127) demonstrates the observed pattern of ignoring roe deer antler as a resource for artefact manufacture. However, one piece does demonstrate a slightly different process to the standard *chaîne opératoire* for barbed point manufacture (Elliott & Milner 2010). 92482 (F in Figure 127) consists of an unshed right-sided red deer antler. Two parallel grooving marks run along the length of the antler, defining a scar created through the removal of a splinter. The tines have been removed from the antler, through the execution of prepared breakage. However, the relationship between the grooved facets and distal break indicate that the removal of the crown occurred *after* the grooving of the antler

5.17.4 Discussion of antlerworking at Star Carr

The tracelogical analysis of the red and roe deer antler recovered during the 2010 excavations can be said to broadly confirm the wider patterns of antlerworking already observed at the site. The basic *chaîne opératoire* of barbed point manufacture is adhered to, but with levels of slight variation within this sequence. In particular, the differential levels of shaping on the unbarbed edges of the finished points offers the potential for further discussion. For the first time, the improved understanding of the stratigraphic distribution of these artefacts can be considered in relation to variations in barbed point *chaîne opératoire* .

92831 – the *in situ* barbed point from the re-excavation of Clark's Cutting II – was recovered from the fine detrital mud immediately overlying the basal sand and clay at the site. Recent plant macrofossil analysis of these deposits (B Taylor 2011) indicate that they formed at a time when the area was permanently submerged by the lake water. Whilst these sediments are consistent with the earliest deposition of the barbed points recovered by Clark (B Taylor 2011, 227), Taylor notes that Clark recovered *in-situ* barbed points from other contexts of Cutting II. These include periodically flooded swamp (Zone II) and fen/carrland (Zone III) type environments (B Taylor 2011, 228).

The deposition of barbed points in different environments raises some interesting questions regarding the occurrence of variations in the *chaîne opératoire* of barbed points at the site. Do the occurrence of rounded unbarbed edges and flat unbarbed edges relate to separate episodes of deposition, or deposition into specific environment types? Clark identifies 19 barbed points which feature the "cut edge of the parent splinter" (Clark 1954, 128–136), and provides information on their height above the basal gravels (Table 21). These points occur at a range of levels, including both the highest and lowest height brackets given by Clark for the height of barbed points above the gravel surface at the site (Clark 1954, 126). This would suggest that these points were deposited into a range of environmental conditions, alongside the majority of the other points. In this respect, the variations within the *chaîne opératoire* relating to the modification of grooved splinter edges appear to occur throughout the deposition of barbed points at Star Carr and are a constant source of variation throughout the environmental changes at the site.

Point number	Depth above gravel
P6	>24.3cm
P8	<6.1cm
P9	Unknown
P10	<6.1cm
P12	6.1-15.2cm
P14	Unknown
P18	Unknown
P20	<6.1cm
P23	Unknown
P27	<6.1cm
P41	Unknown
P42	<6.1cm
P62	<6.1cm
P81	15.2-24.3cm
P101	Unknown
P106	Unknown
P114	<6.1cm
P132	15.2-24.3cm
P139	15.2-24.3cm

Table 21: Vertical distribution of barbed points featuring unbarbed edges where grooving remains apparent (Clark 1954)

5.18 Fosse Hill, Brandesburton

5.18.1 Context of recovery

Four barbed points have been recovered during quarry work at the site of Fosse Hill. Some confusion exists over the name and location of this site, which has resulted in it being referred to as "Hoveringham Gravels", "Fosse Hill" and "Milldam Beck" (Bartlett 1969; Davis-King 1980; Radley 1969). This is the product of the gravel extraction company who recovered the points (Hoveringham Gravels Ltd.) which has occasionally led to the site being referred to as "Hoveringham Gravels" (Davis-King 1980, 25) or "the Hoveringham Pit" (Bartlett 1969, 4). However, the actual name of the quarrying site is "Fosse Hill", and both Davis-King (1980, 23) and Bartlett (1969, 6) indicate on maps that the finds are from the same location. Milldam beck is a topographical feature within the immediate vicinity, which Radley (1969, 377) uses to refer to the site.

The first discovery of a barbed point at the site occurred in October 1968. This consisted of the forepart and tip of a bone uniserial barbed point, with 12 barbs still intact (Bartlett 1969). A further three artefacts were recovered subsequently. The first of these is known to have been found some time prior to 1973, the other two in the course of gravel extraction in August 1973 (Davis-King 1980). Of these three artefacts, one complete point is identified in the original publication as bone, another is said to be of red deer antler and a third fragment of a tang remains unclassified. The publication of the more recent finds also makes reference to a piece of worked red deer antler from Fosse Hill, although a drawing of this find is not provided (Davis-King 1980, 23). This is noted as having splinters removed from its length, and featuring a thick polish at its tip.

Further information regarding the deposits from which the artefacts were recovered from is lacking, other to say that one of the tang piece was recovered from silts approximately 15 feet below the current surface. The gravels upon which the silt deposits lie at Fosse Hill date to the Late Glacial, and are thought to form an outwash fan for a glacial intrusion from the North Sea region (Clark & Godwin 1956, 17).

5.18.2 Uniserial barbed points from Fosse Hill

The barbed points from Fosse Hill are currently held at the Kingston-Upon-Hull Museum. Two of the original artefacts are currently on public display within the museum, and due to the antiquated nature of the display cabinets and the limited curatorial support available, access to these artefacts could not be gained. However, a series of replica casts of the original artefacts were examined. The casting process does not allow the discolourations and localised polishes required for a full analysis, and the resolution involved is not high enough to accurately replicate the working marks to the level required for all working techniques to be identified. However, the study of these casts did offer some limited insights into the technical aspects of the barbed points from Fosse Hill, and so is included here.

KINCM:2011.379.4 is a cast of KINCM:1973.57 (a). This corresponds to the point which Davis-King (1980, 23) is unable to ascribe a raw material for. The artefact's extreme length, and character of the adhering spongy tissue (B in Figure 128), indicate that this is antler. The point is complete, with 6 barbs on the SEN edge. The DEX edge of this artefact is also notably flat and at 90^{o} to the external aspect (C in Figure 128), and although the working marks along this edge have been lost in the casting process, the continuous nature of this flat facet suggest that the antler splinter was produced through the "groove-and-splinter" technique. A series of 49 marks are also observed on the exterior aspect of the cast. These run transversley to the longitudinal axis of the point, and span the proximal half of the artefact, running along the tang and up to the 4th barb. They appear to be made through incision.

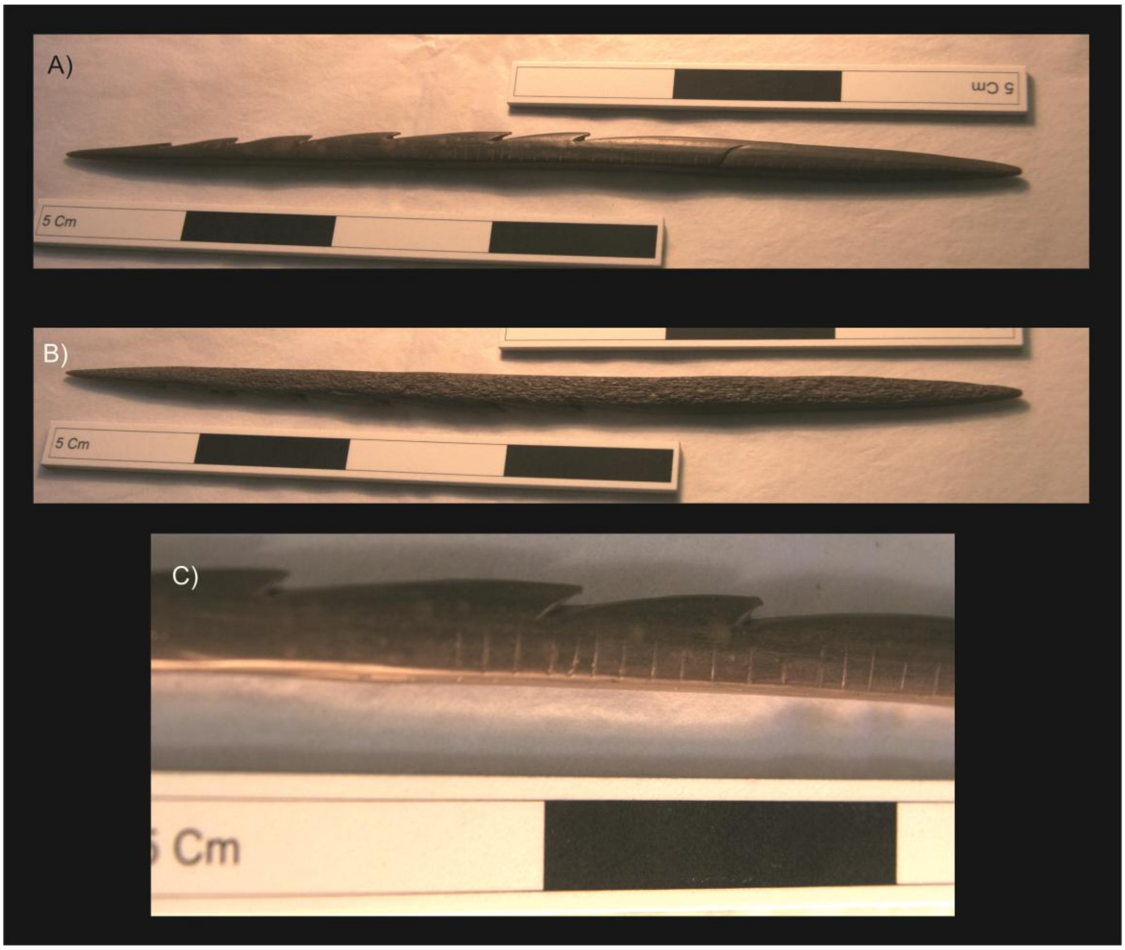


Figure 128: KINCM: 2011.379.4. Fosse Hill. A) External surface B)Internal surface C)4th, 5th and 6th barbs and DEX edge

KINCM.2011.379.5 (A in Figure 129) is a cast of KINCM.1973.57(b). This corresponds to the barbed point which Davis-King (1980, 22) describes as being made from antler. It has five barbs along the SEN side of the artefact. This point differs from KINCM.2011.379.4 in that the DEX edge has been modified, to produce a more rounded profile. However, this modification does not extend over the entire length of the point, and at the PROX end of the DEX edge the unmodified profile is intact. This is similar to that of KINCM:2011.379.4, in that it is a flat and continuous facet at 90^{o} to the external surface (C in Figure 129). As such, it appears to have been produced through grooving.

Also apparent at the proximal end of the cast is the original anatomical surface of the antler (B in Figure 129). This appears smooth, with occasional shallow and broad guttering. This would appear to be consistent with elk antler. However, this species ascription must be treated with caution, as this surface texture could be a product of the casing process. Further examination of the original artefact is needed to resolve this issue.

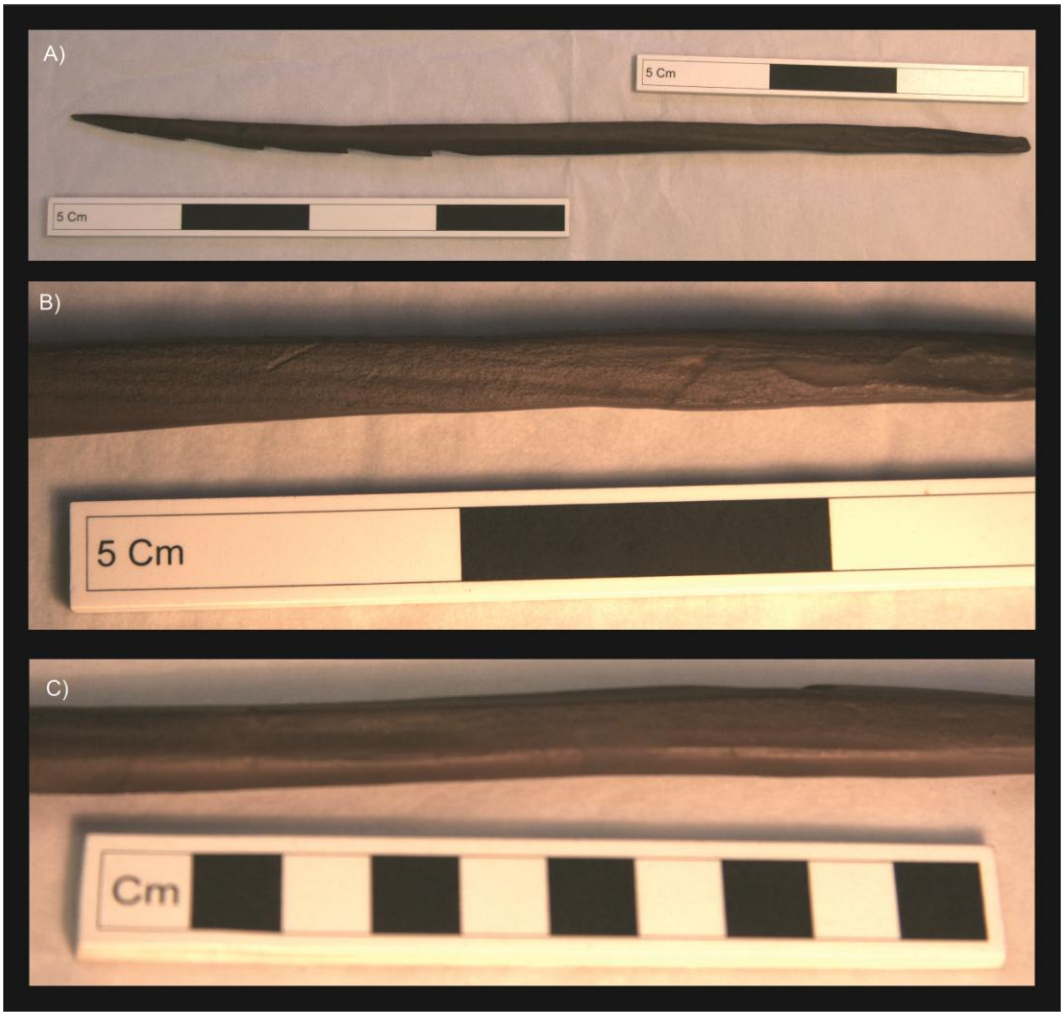


Figure 129: KINCM:2011.379.5 Fosse Hill. A) KINCM.2011.379.5 B) Anatomical surface at PROX C) DEX edge at PROX end

5.18.3 Worked red deer antler from Fosse Hill

The piece of red deer antler could not be located within the Hull Museum's collections. The museum archives showed that it had been loaned to Durham University in 1994, and had subsequently been lost. However, further archival research revealed a string of correspondence dating to 1984 between Nick Barton and David Crowther (a previous curator at the Kingston-Upon-Hull Museum). By this point, the antler appears to have been re-identified as elk, and the letter includes a revised description of the piece:

"It comprises a long segment of antler, broken at one end – the break appears to be prior to its utilisation. The illustrated broad face is the outer surface, the inner surface carries traces of the items cellular structure. The piece has been worked along both edges (one edge illustrated) and paring scars are evident along these. It has been pared to a point at one end. Both edges, the pointed end and 20-30mm of the broad face at the top, are highly polished.

I had originally thought that the worked edges may have been related to the creation of blanks for implements such as harpoons or needles. Now I'm not so sure – all the scars are so fine as to suggest deliberate, careful working of the piece itself. The polish is limited solely to the "worked" parts by the way, so even the possibility of re-use seems pretty remote."

(Crowther 1984)

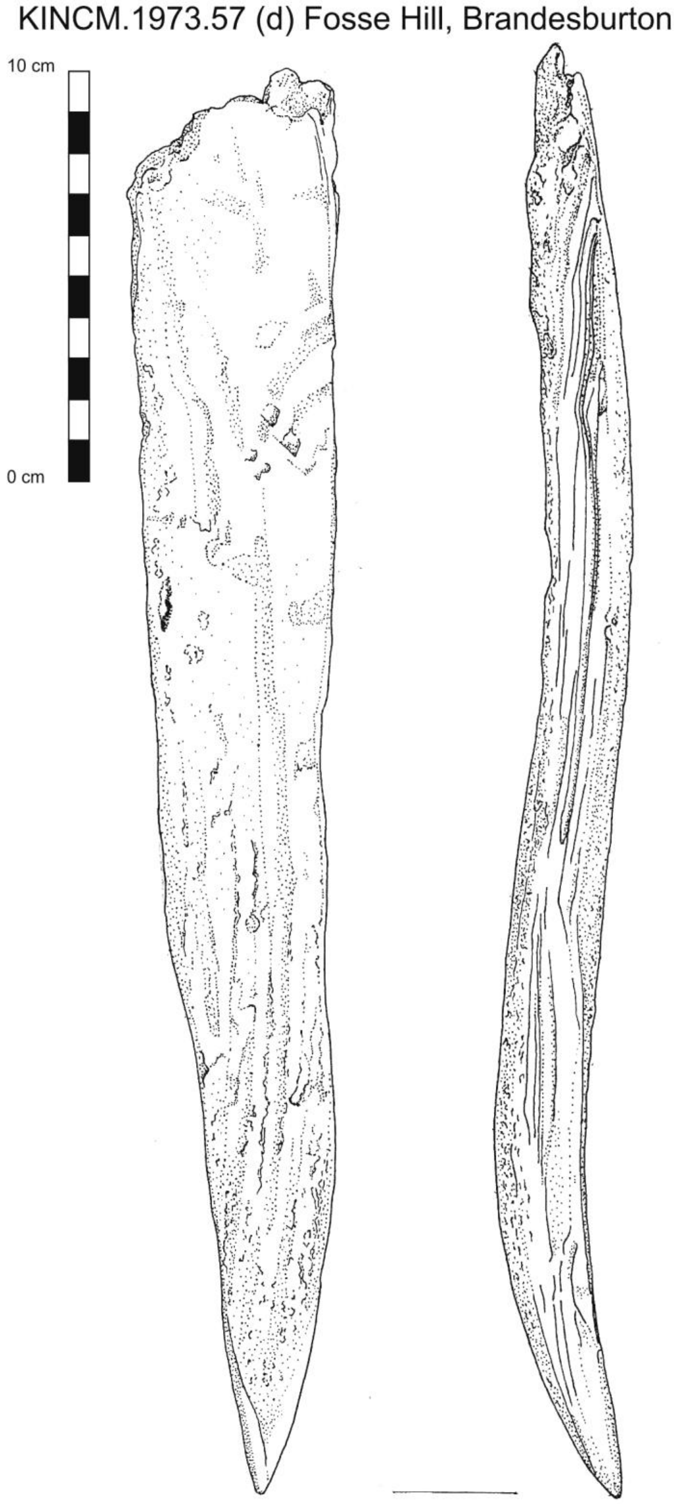


Figure 130: KINCM.1973.57 (d) Antler artefact from Fosse Hill (Crowther 1984)

The accompanying drawing to which Crowther refers was also located within the archive (Figure 130). It is unclear as to what Crowther means by "paring marks", and the fact that this artefact is only drawn from two aspects make both the typological determination and further traceological analysis of this artefact impossible.

5.18.3 Discussion of antlerworking at Fosse Hill

The presence of the 49 transverse incisions on the exterior surface of KINCM.2011.379.4 requires further discussion, as it contradicts some of the previous interpretations of the function of such markings. Clark (1954) links the occurrence of scoring marks on the external surfaces of the tangs of the Star Carr barbed points to hafting. He states that the scoring of these areas provides a rough texture to aid the binding of a haft. However, the markings on KINCM.2011.379.4 extend much further than the tang, encompassing over half of the total length of the point. This presents several possibilities for the interpretation of the markings on this artefact. Firstly, it could be argued that the bindings involved in the hafting of this artefact extended beyond the tang, and onto the stem of the point itself. Alternatively, it could be that these markings were not created with the intention of providing roughage for binding, but are for decorative or artistic purposes. These two hypotheses are not necessarily mutually exclusive, and it is possible that the purpose of these incisions is to both to aid hafting and to provide some form of decoration.

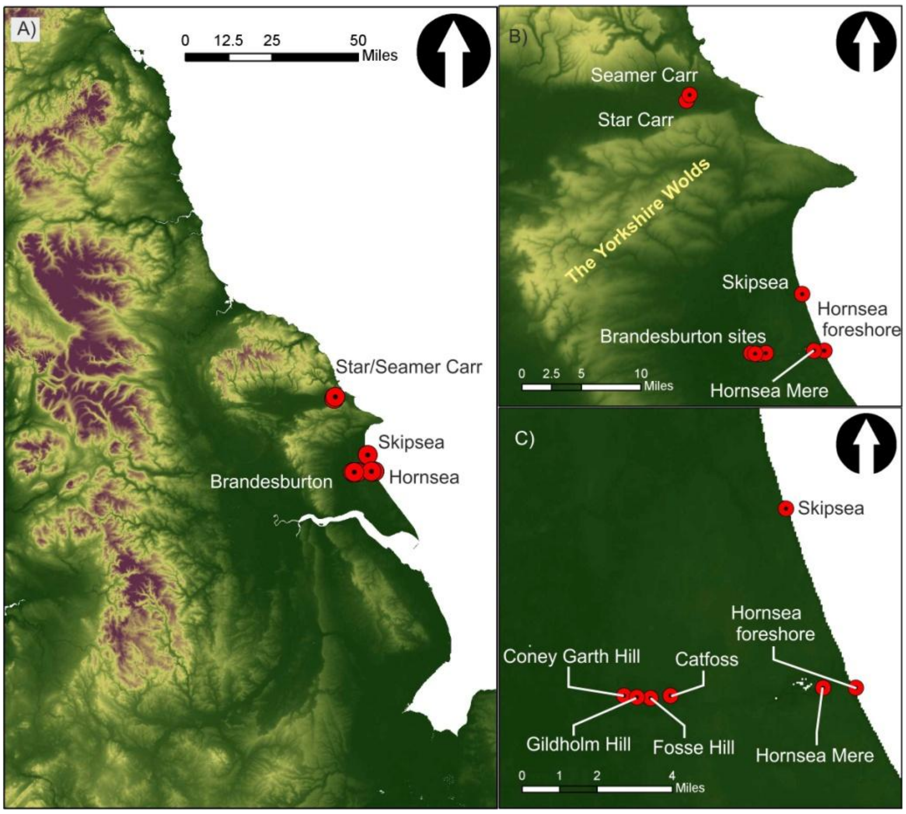


Figure 131: Location map of Holderness antler findspots

The limited insight gained from the analysis of the casts of two antler barbed points from Fosse Hill can be discussed in relation to a series of other barbed point findspots in the Brandesburton area (Figure 131). Five barbed points were recovered from a gravel pit at Coney Garth Hill, and a further two from quarrying at Gildholm Hill (Bartlett 1969; Clark & H Godwin 1956) between 1953 and 1965, although the initial reporting of these finds in 1953 suggests that more artefacts may have been present but simply not recovered (Clark & Godwin 1956, 6). A further intact bone point was recovered from gravel quarrying activities at Catfoss (Bartlett 1969). The points from Coney Garth Hill and Catfoss are described as being manufactured from bone and so are not of direct relevance to this thesis. However, given the misidentification of the point from Fosse Hill as bone when it was in fact antler, the Coney Garth Hill and Catfoss points were re-examined at the Kingston-Upon-Hull Museum. This confirmed the original identification of the artefacts – that they are made from bone and not antler.

It was also noted during this examination that two of the barbed bone points from Coney Garth Hill have been drilled in order to obtain sample material for AMS dating. Consultation with the museum catalogue and curators at the Kingston-Upon-Hull Museum revealed that two of the artefacts had indeed been sampled as part of the Bonsall and Tolan-Smith AMS dating project, but that these samples had failed to produce a reliable date. As such, It is prudent to remember that, from a typological perspective, uniserial barbed points do not date exclusively to the Mesolithic. There remains a chance that these artefacts could be Upper Palaeolithic in date.

Due to the lack of flint artefacts, knapping *debitage* other forms of Mesolithic material culture, the barbed point finds from the sites around Brandesburton have been interpreted as artefacts that have become lost or damaged during fishing or hunting activities (Clark & H Godwin 1956). This is further supported by the reinterpretation of the red deer antler with splinters removed (Davis-King 1980, 23) as an elk antler artefact (Crowther 1984), as these is therefore now no *debitage* evidence for barbed point manufacture at the site. Additionally, Bartlett (1969) notes the degradation of the upper three barbs of the point from Catfoss, which he links to the similar patterns observed at the Danish site of Aamosen – where barbed points were found in association with articulated pike bones. This is interpreted as the result of fish which had escaped from hunters with barbed points embedded in their bodies, and which the subsequent decomposition of the fish's gut had created acidic corrosion to the embedded tip of the point.

The apparent lack of occupation evidence, coupled with the differences between the materials used to manufacture barbed points, has led to Mesolithic human activity around Brandesburton being interpreted very differently to that of the near-by site of Star Carr. The assemblage at Star Carr suggests a site which is repeatedly occupied, and at which barbed points are being manufactured from red deer antler. It also appears to be a site that people are returning antler barbed points to, following use in hunting activities, before depositing them. In contrast, the finds from Fosse Hill, Coney Garth Hill and Catfoss appear to suggest that bone (and occasionally antler) barbed points were being taken to these sites having been manufactured elsewhere. The combination of both complete and broken specimens, alongside the parallels with the degradation patterns noted by Bartlett (1969) suggest that the deposition of these artefacts has occurred during their use in hunting or fishing activities which are being carried out in the area.

5.19 Splash Point, Rhyll

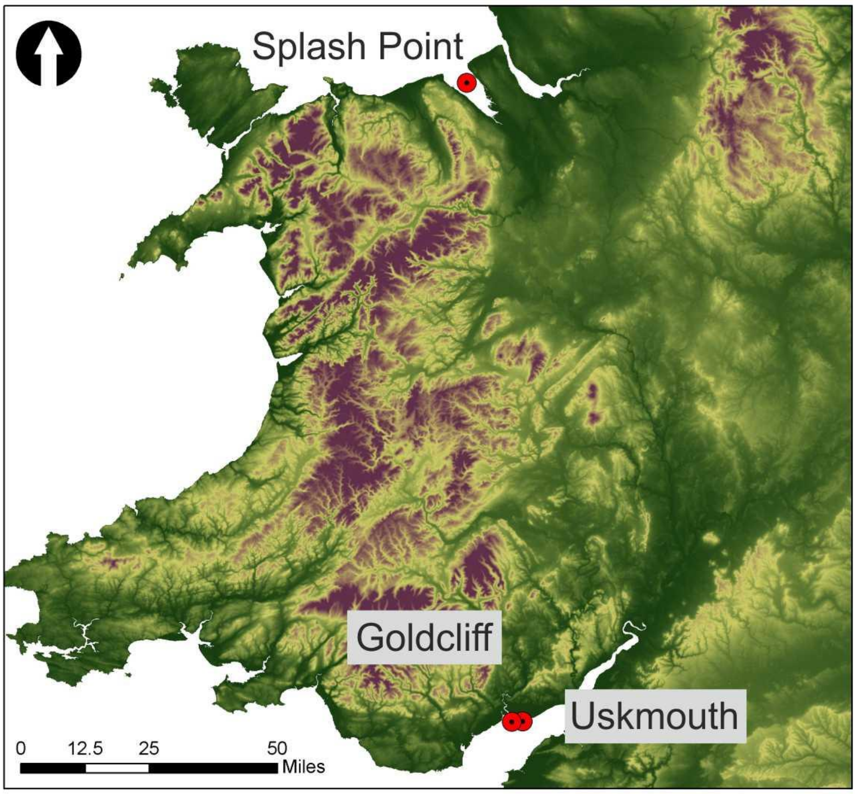


Figure 132: Mesolithic sites from which Wales which have produced evidence for Mesolithic antlerworking

5.19.1 Context of recovery

A single red deer antler mattock was recovered from the foreshore at Splash Point, Rhyll (Figure 132) on January 24th 1910 by Rev. J Davies (1949, 327), who described the context from which the mattock was recovered from as "in blue clay, where the tide had worn away the submerged forest". Bonsall and Smith's (1989) AMS dating of the Splash Point mattock has produced a date of 5636-5363 cal. BC (OxA-1009). The submerged peat deposits at Splash Point have been investigated by Bell (2007b). He notes that a considerable body of archaeological material has been recovered from the Splash Point foreshore, including Neolithic Graig Lwyd stone axes, worked flint, bronze chisels and spearheads, perforated stones and a small assemblage of domestic and wild faunal remains. He summarises that this material demonstrates human occupation at Splash Point spanning the Mesolithic to the Bronze Age.

5.19.2 Antler mattock from Splash Point

The red deer antler mattock from Splash Point (Figure 134) has been defined as a beam mattock (C Smith 1989). As would be expected given the context of its recovery, the artefact shows signs of water action across its length. This taphonomic damage has resulted in destruction of the working marks created in the shaping of the mattock's working face. However, a thick, localised polish and damage to the spongy tissue at the working face indicate that the artefact had been used prior to deposition. A gnawed facet is also apparent on the DEX aspect of the piece. Nicking appears to have been used to facilitate the removal of the trez tine, and the perforation created through drilling. At the distal break, a blackened area is observed in association with a series of dental marks around the break circumference (Figure 133). This carbonised surface terminates abruptly at the break surface, suggesting that it predates the flexion break of the distal beam. As such, it appears that the beam was locally charred in preparation for flexion breakage.

Figure 133: Charring at DIST end of Splash Point mattock

Figure 134: Antler mattock from Splash Point

5.20 Goldcliff East, Gwent

5.20.1 Context of recovery

A small assemblage of bone and antler artefacts was recovered by Bell during the course of extensive archaeological and palaeoenvironmental investigations at Goldcliff East (Figure 132). This included an antler artefact (Find 7065) described as a "mattock-hammer", recovered from the surface of gravel beach in close proximity to the site of Goldcliff C (Bell 2007c). Goldcliff C (Figure 135) consists of an area approximately 35m x 11m of exposed laminated silts and clays. These sediments are annually banded into discrete layers, defined by thin fine sand horizons. Dating of peat formations both above and below these laminated sediments indicates that they built up during the Late Mesolithic, between c. 5650 cal. BC and c. 4700 cal. BC (Bell 2007d). The footprints themselves indicate the presence of eight distinct individuals, four of which were defined as young children, two of which were sub-adult and two of which were adult – based on the size and shape of the footprints. The prints of wolf and red deer were also recorded at the site (Scales 2007). However, Bell stresses that the antler tool was recovered out of context, and as such cannot be linked directly with the human activity at Goldcliff C (Bell 2007c). He states that material culture recovered from the gravel beach may have been washed out of a variety of late Mesolithic sites situated around the Goldcliff East area, and re-deposited on the beach.

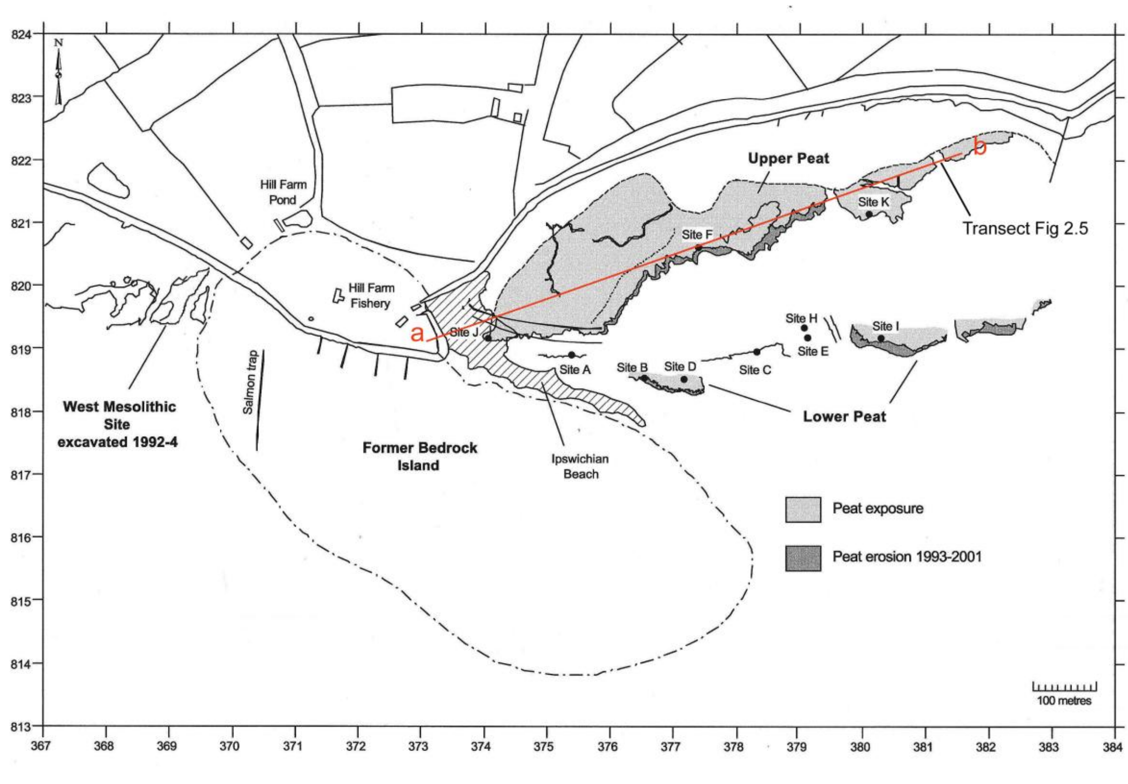


Figure 135: Location of sites at Goldcliff East (Bell 2007b, 24)

A further antler artefact (Find 2273) was recovered from the site of Goldcliff B (Figure 135). This site consisted of an *in situ* artefact scatter within both reed peat (Context 319) and organic sandy silt (Context 321). The lower, organic soil layer contained evidence for an *in situ* knapping event, and associated fragments of charcoal. The overlying peat layer contained two discrete concentrations of bone, associated with smaller quantities of flint. A single charred hazelnut from Context 321 produced a ^{14}C date of 5990-5790 cal. BC (OxA-12359), and is based on the broader stratigraphy of the East Goldcliff area is believed to be either contemporary or marginally later than the inundation of the Lower Peat formation c.5650 cal. BC. A date from a pollen core taken from the surface of the reed peat (Context 319) has produced a ^{14}C date of 5840-5670 cal. BC. The human activity within the reed peat is believed to have occurred c. 100-150 years after the deposition of flints in Context 321.

5.20.2 Antler artefacts from Goldcliff East

Find 7065 was located within the collections of the National Museum of Wales and consists of a right sided, shed red deer antler. There is considerable post-depositional damage, and evidence of modern repair in the form of gluing, to the basal portion of the piece where and the brow tine junction has been destroyed. The glued areas include longitudinal cracks running along the basal portion, which are consistent with those caused in drying. It is therefore impossible to ascertain whether the brow tine was removed through human action in the creation of the piece, or whether it was been removed in the same event which caused damage to this region. The bez tine is still intact and attached to the beam. At the extreme tip of the bez tine has been removed, and a single cut facet can be observed at the break, in conjunction with a flake scar created in the removal of the tine tip. As such this break can be interpreted as the result of prepared breakage. The beam is broken short above the bez tine junction.

There are signs of heavy water action across the piece, which are manifest in the smoothing of the anatomical and worked surfaces. Rounded ovular and circular pits are also distributed across the surface of the piece. These overlie the break surfaces of the beam beam (Figure 137), and therefore post-date this break. The pitting shows no adherence to any specific part of the piece, and as such is interpreted as the product of a taphonomic process – potentially damage caused by water-born stones given that the artefact was recovered from a gravel beach.

The beam break is characterised by a sloping break surface, and a lack of spongy tissue. On first sight, the angle of this break surface appears to mirror that of a mattock working edge. However, closer inspection of the break surfaces reveal that the characteristic polish and continuous surface of a mattock working face are absent from on this piece. In contrast, the break surfaces appear to undulate unevenly, and although smoothed through taphanomic action, several differentially angled fracture planes can be identified (Figure 137).

Figure 136: 2003.4723/27 from Goldcliff East

Figure 137: Distal break of 2003.4723/27, Goldcliff East. Red lines indicate distinct break facets on working edge

Two sets of sawing marks are observed on the EXT surface of the broken beam. These are deeply cut into the compactor tissue, although the edges have been smoothed through water action. However, these cut gorges have provided the interior surfaces with some protection from the effect of the water action apparent across the rest of the piece. The interior of these marks indicate that they have been created through sawing, with straight-edged, overlying striations within the sawing gorge. They are both cut by the break to the beam, indicating that they pre-date the beam break. Sawing appears to have been carried out from two aspects, and extended so that the sawing marks intersect and cover the entire circumference of the beam. In association with these sawing marks, areas of dark discolouration and carbonisation are apparent on the reverse of the EXT surface of the beam. These appear focused on the DEX side of the beam, and in particular it is more intensive around the sawing marks (Figure 137 and Figure 138). These are interpreted as the result of intentional burning, as considerable control must have been exerted to restrict the effects to such a specific area of the object.

Figure 138: 2003.4723/27, Goldcliff East. Sawing marks on DEX side of beam, whith associated discolouration

The sequence of 2003.4723/27 can be summarised as the following:

1. Shed red deer antler collected
2. Sawing around the circumference of the beam
2. Sawing at bez tine tip
4. Removal of bez tine tip
4. Charring of DEX beam and area of sawing
6. Prepared break of beam
7. Deposition
8. Water action
9. Recovery
10. Cracking in drying
11. Gluing

The stages associated with prehistoric anthropogenic actions are shown in Figure 139.

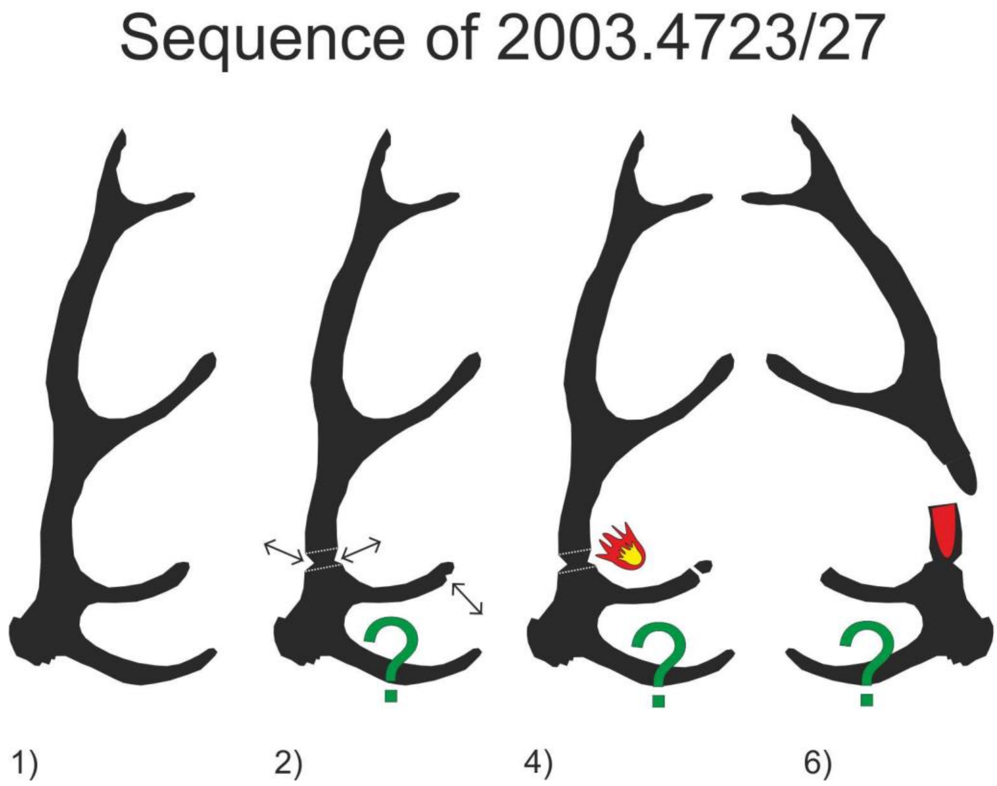


Figure 139: Sequence of the manufacture of 2003.4723/27, Goldcliff East

Find 2273 was also located within the collections of the Museum of Wales, under the accession number 2003.2273. This was swiftly re-identified as a split rib bone based on the size, shape, thickness of the cortical material and the character of the spongy tissue – which is notably less compact in rib bones than it is in antler (Figure 140). As such, it has no further relevance to this thesis.

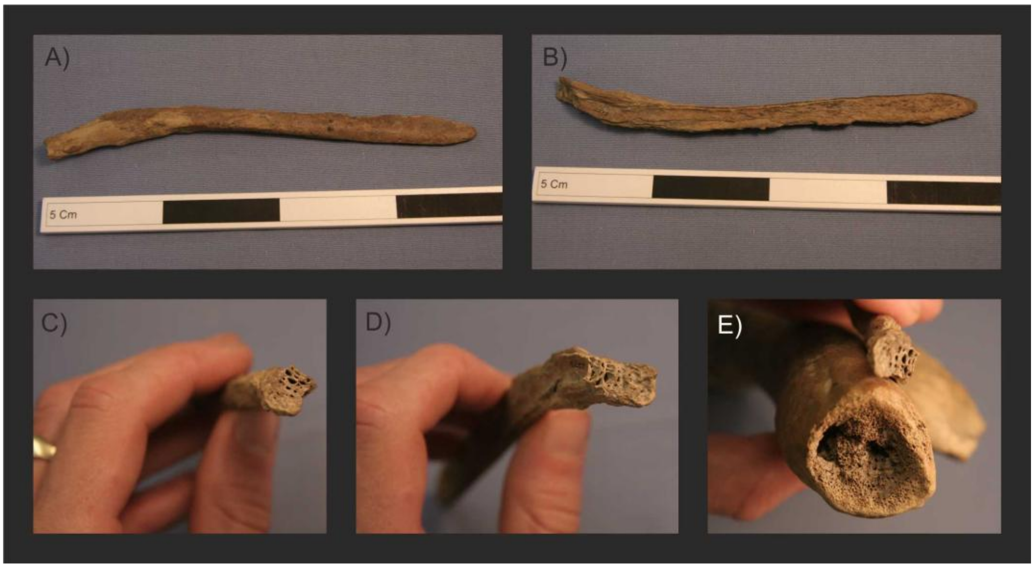


Figure 140: 2003.2273, Goldcliff East Site B. A) Exterior view B) Interior view C) Proximal view D) Distal view E) 2273with a piece of archaeological antler, highlighting the differences in spongy density

5.20.3 Discussion of antlerworking at Goldcliff East

The results presented above require some further discussion, as they contradict the original report on Find 7065 (Bell 2007c). Bell describes the artefact as "T-shaped", and states that the pedicle has been humanly modified (by pedicle, he presumably means burr as he later notes that the antler has been shed). The occurrence of "battery" marks and smoothing at the burr are interpreted as evidence of use as a hammer (Bell 2007c, 131). The damage at the brow tine is attributed to having been caused by the artefact striking beach stones during its erosion and redeposition. He also interprets the absence of spongy tissue from the distal beam break, and the angled nature of the break surface, as indicative of use as a sleeve for the insertion of a flint axe. This interpretation is supplemented by experimental work at Butser Ancient Village, where a replica composite antler/flint tool was created and used to work hazel wood (Bell 2007c, 230) The grooves on the EXT surface of the beam are identified, and interpreted as having been produced by the bindings necessary to secure a flint axe in place. The areas of burning noted above are also identified by Bell, who speculates that this may indicate that the bindings used were combustible, and that burning of the bindings may have produced such a localised area of charring on the artefact. He also identifies a polish on the bez tine, which he interprets as evidence that the bez tine has been utilised as a handle (Bell 2007e, 131). As such, he interprets Find 7065 as an antler sleeve tool, which has also been utilised as hammer around the pedicle.

The above analysis contests this. Firstly, the signs of battery and smoothing that Bell interprets as evidence for use as a hammer can actually be observed across the piece, including at the distal end of the beam where Bell suggests a flint axe may have been inserted. The damaging effects of the taphonomic processes to which 7065 has been exposed to are acknowledged by Bell, but only at the brow tine junction. The fact that the pitting and smoothing which Bell links to use as a hammer can be observed across the piece, and that these processes overlie all other working marks and break surfaces, suggest that they are the product of taphonomy and not anthropogenic action.

Secondly, the analogy with experimental work carried out at Butser is also problematic in demonstrating that the artefact has utilised as a sleeve. Photographs provided by Bell show a flat-ended sleeve tool, which has had the spongy core removed to create space for the insertion of a flint axe. This does not correspond to the form of the distal break of 7065, which is tapered. If this area was used as a sleeve, then the axe would have only been supported by antler on one side, and would have required considerable binding to secure it in place. The experiments carried out at Butser do not give any insight as to how secure this binding would need to be in order for the sleeve to be function – presumably any flexibility would result in the axe moving under pressure and not transferring force onto the subject material.

Figure 141: Experimental replication and use of Find 7065 at Butser Ancient Village (Bell 2007, 229–231)

Thirdly, the suggestion that the grooves around the circumference of the distal break could have been created by binding with plant fibres is problematic. Antler is a strong material, which requires a sharp working edge and considerable force in order to modify it. Whilst binding with plant fibres might apply some pressure to this region of the piece, it is difficult to envision how enough force could be applied through binding to create the deep grooves observed on Find 7065. The identification of sharply defined, overlying striations within the grooves confirms that they were created through sawing with a lithic tool.

As an alternative to Bell's interpretation of 7065, it can now be argued that the find is actually a piece of antler *debitage,* created in the manufacture of a beam mattock. As noted above, the break surfaces of the distal beam break show no signs of utilisation, and yet the angle of this break is reminiscent of the working face and edge of an antler mattock tool. The implication of this is that the piece of antler removed in the execution of this break would have a similarly-angled break on its proximal surface. This removed piece would also consist of the beam and trez tine junction of a red deer antler – typically the area of antler utilised in the manufacture of beam mattocks. Working appears to have been carried out around the circumference of the beam prior to the execution of this break – possibly to control the location and angle of the break itself. Burning also appears to have been carried out in this specific region of the piece – again it is possible that this was to facilitate a break at this location. Analogies can be drawn between Find 7065 and *debitage* pieces from the French Middle Neolithic site of Grotte

Sépultrale (Figure 142), which have been recovered within assemblages also containing artefacts which, under Smith's (1989) typology, would be termed beam mattocks (Billamboz 1977, 134). The distal break surface on this *debitage* shows some clear similarities with that of Find 7065 – notably a lack of spongy core, a stepped edge and multiple facets to the broken surfaces.

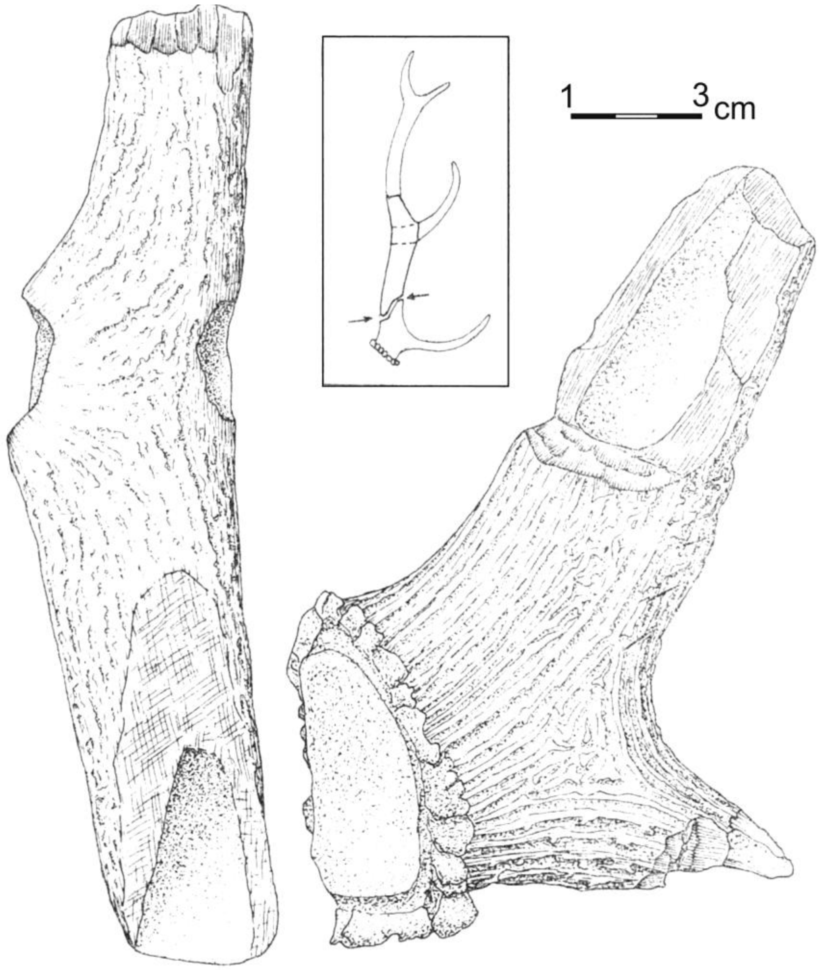


Figure 142: Beam mattock and mattock production *debitage* from Grotte Sépultrale, France (Billamboz 1977, 134)

This interpretation has some broader implications for the use of antler at Goldcliff East, during the Mesolithic. Whilst the *debitage* piece still lacks a secure date, the fact that it has been produced in the manufacture of a red deer beam mattock (itself a tool type associated strongly with the Mesolithic in Britain) would suggest that it is Mesolithic in date. As such, it indicates that beam mattocks were being manufactured in the Goldcliff East area, and that *debitage* from this process was being deposited at sites in the vicinity.

5.21 Uskmouth, Gwent

5.21.1 Context of recovery

A series of human and animal footprints were discovered at the site of Uskmouth, Gwent in the Severn Estuary (Figure 132). These footprints were formed within estuarine clays, stratified between bands of peat. ^{14}C dating of the peat deposits above and below the estuarine clay layer indicate that this deposit must have formed no earlier than 5313-4836 cal. BC and no later 4843-4464 cal. BC (Aldhouse-Green et al. 1992). The footprints themselves form three trails, each showing a single individual walking in a straight line. Two of the individuals are said to be adult males, whilst one is a child or young person of undeterminable sex. An antler mattock was found exposed on the ground surface, *c.*370m from the footprints at Uskmouth. It had been eroded out of the same estuarine clays as the footprints, although the precise position within these deposits could no longer be determined. The original publication of the find states that it reflects a "penecontemporaneous human presence locally in the intertidal zone" (Aldhouse-Green et al. 1992, 46). The authors speculate that the tool may have been used to dig soft, intertidal sediments – possibly in the exploitation of cockles (*ibid.*). AMS dating of the artefact (Aldhouse-Green & Housley 1993) has produced a date of 5319-4933 cal. BC (OxA-4574).

5.21.2 Antler mattock from Uskmouth

Figure 143: 92.242H from Uskmouth

The Uskmouth antler mattock was located in the collections of the National Museum of Wales (Figure 143). It consists of a left sided red deer antler beam from above and below the trez tine stump. The artefact has been heavily damaged through water action, with a noticed smoothing of both worked and anatomical surfaces, a continuous polish across the piece and localised staining (Figure 144).

Figure 144: Smoothed surfaces, localised staining and polish created by water action on 92,242H, Uskmouth

The working face of the mattock has been severely damaged, and shows signs of three scars which have removed material from the original face. Two of these, whilst distinct, do not allow a sequential relationship to be determined. The third, however, is observed to cut the adjacent damage scar, and as such can be said to post-date it (B in Figure 145). The polish observed here appears to have been created through taphonomy and not use *after* the damage to the working face had been sustained. A small fragment of the original working face does appear to survive on the DEX side of the tool – based on the angle, continuous nature and apparent pre-dating of the surrounding damage scars (Figure 145) - but bears no further traces of working.

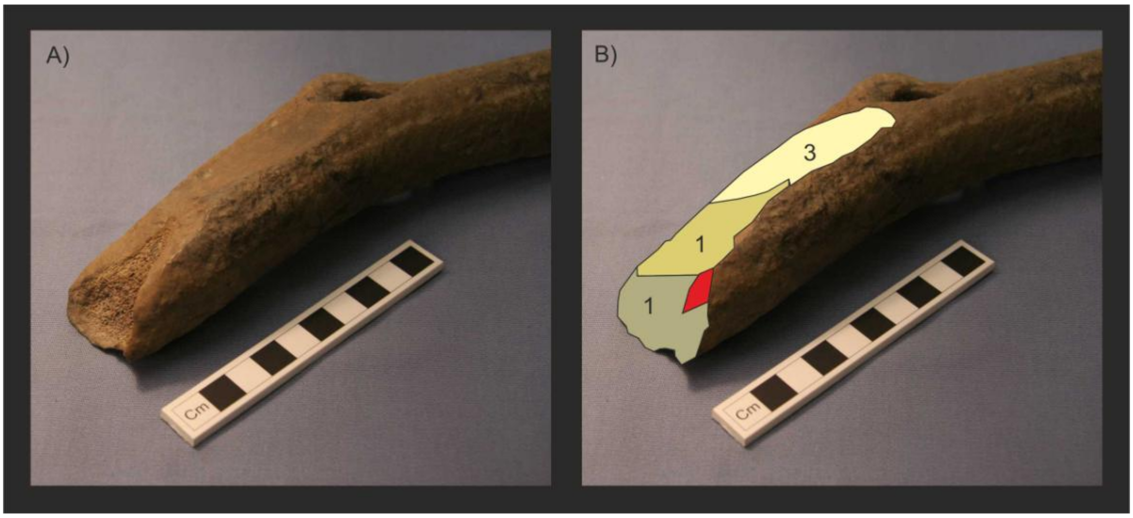


Figure 145: Damage to working face of 92.242H, Uskmouth. A) Working face B) Sequential relationship of the three damage events, and the fragment of the original working face (Red)

The interior edges of the perforation have been shielded somewhat from the effects of water action, and straight-edged, highly polish worked surfaces indicate that drilling has been employed from both the INT and EXT sides of the artefact. The INT surface around the perforation is notably lipped, and contains nicking marks which indicate that this surface was prepared with an episode of nicking before drilling took place. The trez tine stump features an uneven surface and a single impact negative on the EXT aspect which suggests breakage. At the distal break, a level surface is observed in association with nicking marks – suggesting a phase of nicking prior to the execution of a prepared break. A single, shallow drilled hole on the INT face of the artefact has been created in the collection of a sample for AMS dating.

5.22 County Hall, London

5.22.1 Context of recovery

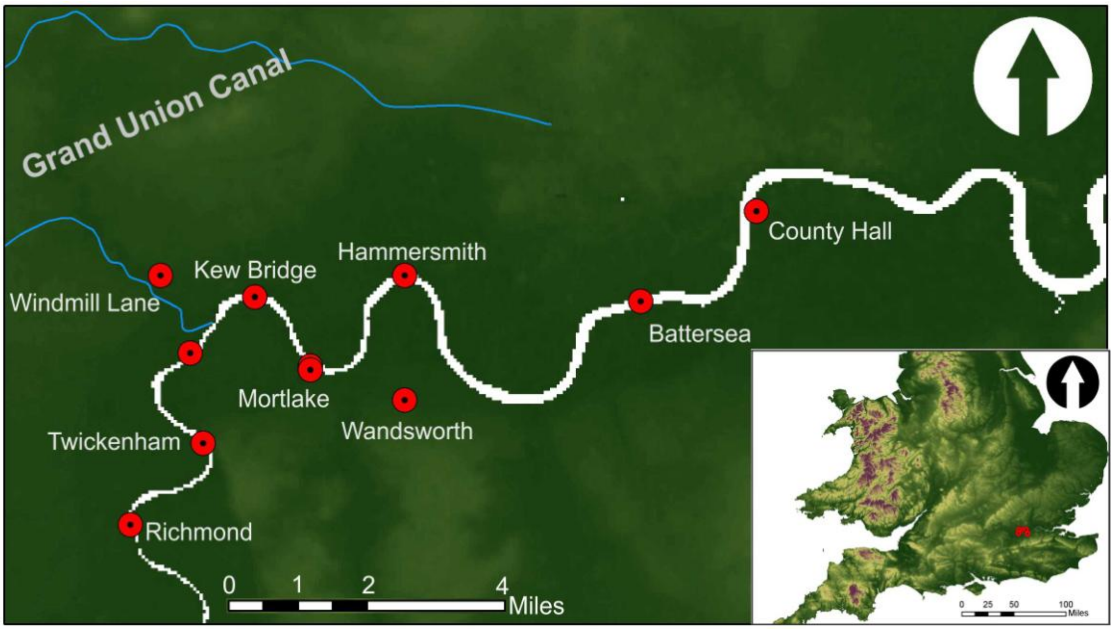


Figure 146: Location of London findspots where Mesolithic worked antler has been recovered

The earliest mention of prehistoric antlerworking from County Hall, London (Figure 146) is provided by Lawrence who lists "two stag's horn hoes" as being recovered from the site (Lawrence 1929, 93). Lacaille (1966, 17) refers to a collection of antler artefacts recovered from the site, during the construction of an extension to the existing building. These artefacts were acquired by the Museum of London in 1924 and 1925. He states that these included three base mattocks, but that they had been assigned an Iron Age affinity, based on the material culture that they had been found in association with. He also notes that these materials may have derived from the former marsh areas at the fringes of the river, and not the river bed deposits themselves.

5.22.2 Antler *debitage* from County Hall

Although the artefacts from County Hall are base mattocks (and thus not relevant to this thesis), a single piece of antler *debitage* from the site was identified within the collections of the Museum of London which may have Mesolithic affinities. This consisted of a rectangular piece of red deer antler. The SEN and DEX sides of the piece were sharply defined by continuous groove marks, whilst the distal and proximal terminations were noted to taper to a point, consistent with the removal of splinters of antler via flexion breakage. This removed splinter of antler appeared to represent the product of the "groove-and-splinter" technique, which is believed to be confined to the Early Mesolithic of Northern England (Clark & H Godwin 1956; Clark & Thompson 1953; Clark 1956; Tolan-Smith & Bonsall 1999; Wymer 1962; Wymer et al. 1975).

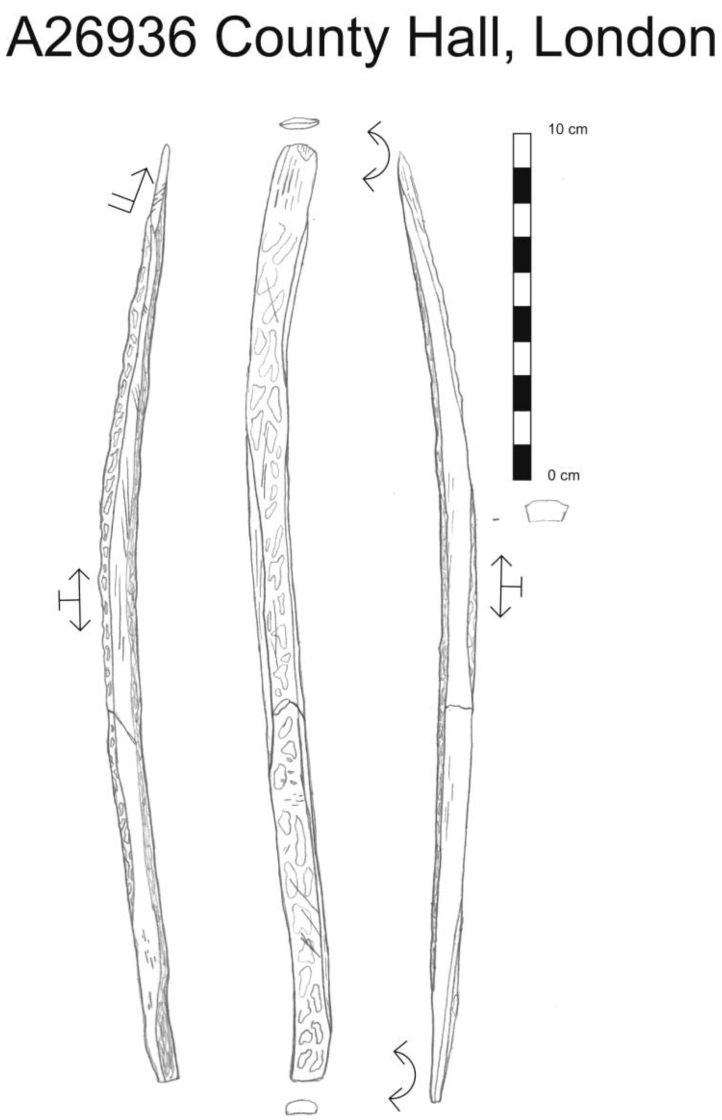


Figure 147: Antler debitage from County Hall

Given the potential significance of this *debitage* piece in understanding the geographical distribution of the groove-and-splinter technique across Britain, A26936 was included in range-finder dating project, funded by the Nature and Environments Research Council (NERC). With the assistance of Tom Higham, a small sample was removed ^{14}C AMS dating. This produced a Bronze Age date of 2458-2200 cal. BC (OxA-25513, 3834±27). The full significance of this date will be discussed in Chapter 7.

5.23 Windmill Lane, Brentford

5.23.1 Context of recovery

The only direct reference to an antler mattock from Windmill Lane, Brentford is provided by Lawrence (1929, 82) who lists "a stags-horn pick" amongst a diverse range of artefacts which had been recovered from a river-side site at Brentford during the 19th century. An indirect reference is then made by Lacaille (1961, 138) who notes that artefacts which are listed as being recovered from Windmill Lane are actually from Windmill Road – as the Windmill Lane address does not exist! The relocation of the Brentford find to Windmill Road is of some significance, as this new point is actually on the banks of the Grand Union Canal, and not the

River Thames (Figure 146). It is therefore possible that the artefact was recovered during dredging of the canal, and not the river.

5.23.2 Antler mattock from Windmill Lane

A beam mattock from Windmill Lane was located within the collections of the Museum of London (Figure 148). This artefact is made from a left-sided red deer antler, around the trez tine junction. In some areas, the surface of the artefact has become brittle and is actively flaking away – a product of ongoing drying damage. A light mineral deposit is also observed along the SEN edge of the working face. The angle of the working face is cut by that of the break created in the removal of the trez tine, indicating that the creation of the former predates that of the latter. The working face was subsequently shaped through at least two episodes of scraping – one running longitudinally and another running obliquely. A series of small, randomly orientated micro-pits are observed across the working face are interpreted as use damage. The distal end of the piece was defined through the execution of a prepared break, following an episode of nicking. The perforation has been created through two phases of drilling from both the SEN and DEX sides of the artefact.

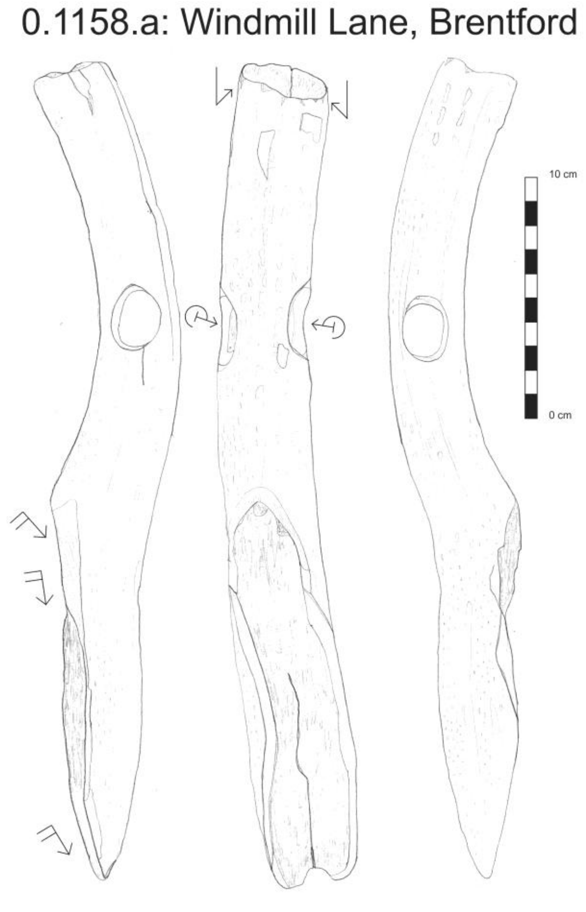


Figure 148: 0.1158a from Windmill Lane, Brentford

5.24 Hammersmith, London

Figure 149: Area from which material recorded as "Hammersmith" was recovered from (in red)

5.24.1 Context of recovery

Lawrence (1929, 85–88) notes a large, multi-period assemblage of prehistoric material culture, recovered from a site on the South bank of the Thames at Hammersmith, during the river dredging of the 19th century. He notes that these are concentrated at a southerly bend of the river, and extends from this bend down to the lower end of the reservoir bank – both to the north and south of the Hammersmith Bridge (Figure 149). Lawrence also notes that this area of the River Thames was used as a dumping ground for material dredged from the Thames, and as such the apparent concentration of prehistoric material at this site may not necessarily indicate a more intensive period of human occupation. He states that four "hoe's of stag's-horn" and "two hammers of horn" were recovered from the south bank of the river, below the Hammersmith Bridge. One of these "hoes" was apparently recovered with the wooden haft still intact, and a photograph of this is provided, taken at the Liverpool Museum. This photograph appears to show a hafted base mattock, but unfortunately this artefact was destroyed in the bombing of the Liverpool Museum during the Second World War (Lacaille 1961, 134).

5.24.2 Antler mattocks from Hammersmith

Five antler beam mattocks from Hammersmith were located within the collections of the Museum of London, whilst a further artefact was also located within the collections at the British Museum (WG 1223). These artefacts were analysed at their respective institutions, and show some interesting patterns of variation and consistency (Figure 150). All of these (with the exception of 71) are made from the beam of a red deer antler, in the region of the trez tine junction. However, the length of the beam used varies considerably (Figure 150). The location of the working face also varies – in some cases the working face encompasses the stump of the trez tine (A13648, WG1223), in others it is distinct from the trez tine stump (C714, A22556, A13728). This variation is sufficient to prompt a review of the Hammersmith mattocks' typological affinities. C714, A22556, A13648 and WG1223 are all classic beam mattocks, featuring a beveled working edge and a perforation. A13728 is slightly less clear cut, as the heavily damaged proximal end of the piece and unusual incorporation of the crown junction at the distal end make identification slightly more complicated. However, the presence of a perforation, the use of an antler beam and the tentative identification of a heavily damaged working face at the proximal end would point towards a beam mattock. In contrast, 71 is highly unusual in that it does not incorporate the trez tine junction of the beam. In fact, the narrow character and small size of the piece make it difficult to differentiate the element used in the manufacture of this piece – it may be a truncated tine and not a portion of beam. Typologically, this artefact would appear to be more similar to the small mattock from Cranit Farm, Orkney which has been dated to the Bronze Age. As such, it is very difficult to assign this artefact a Mesolithic affinity in the same way as the beam mattocks.

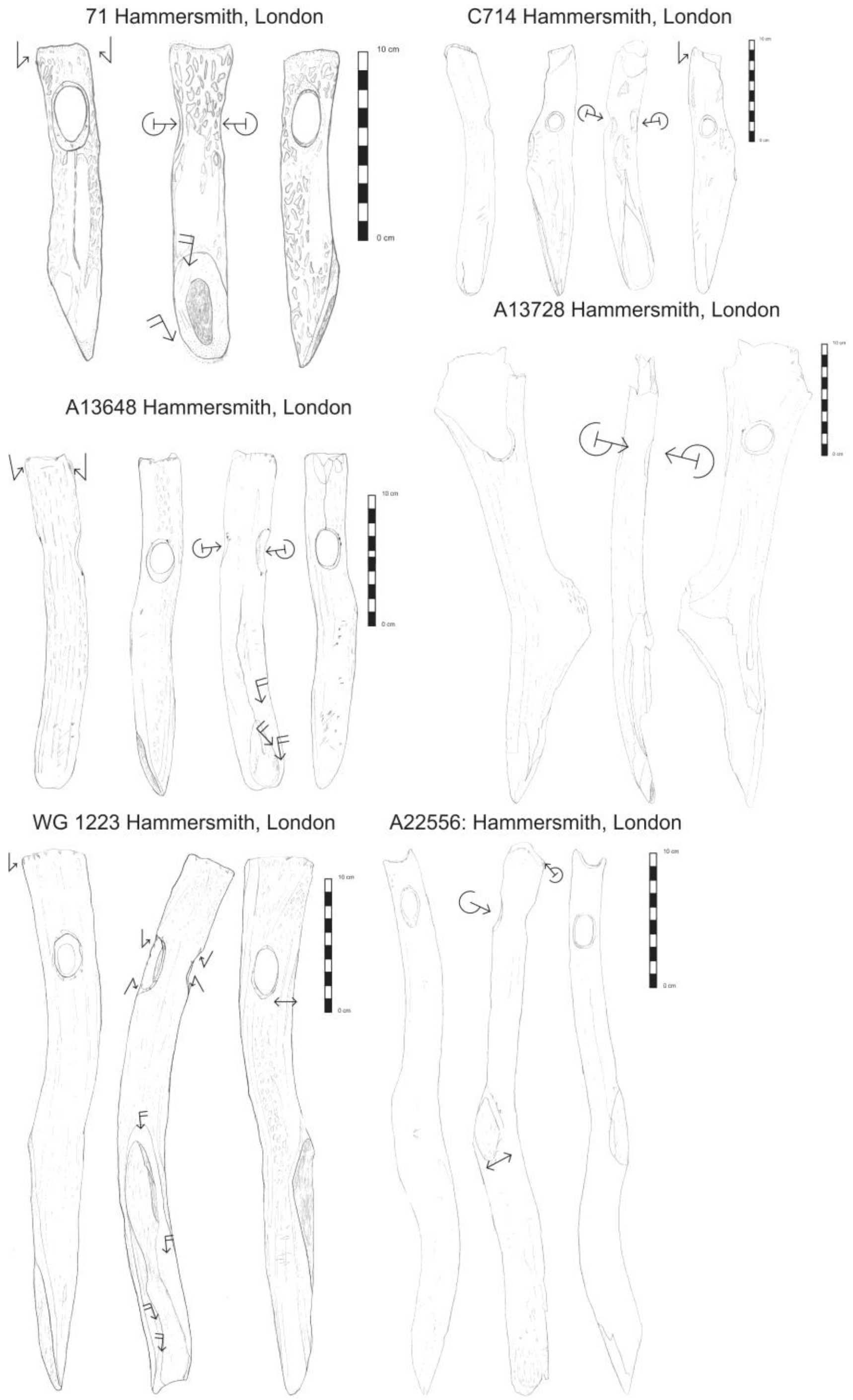


Figure 150: Antler mattocks from Hammersmith, London

Tolan-Smith and Bonsall (1999) provide an AMS date for one of the antler artefacts from Hammersmith. Although unable to typologically define artefact A22556, they note that a sample obtained from this artefact produced an Iron Age date of 731-4 cal. BC (OxA-1156). However, notes within the Museum of London accession catalogue state that there was serious doubt over the accuracy of this date (although this is not referred to by Tolan-Smith and Bonsall). Correspondence with Tom Higham at the Oxford Radiocarbon Accelerator Unit highlighted the fact that this sample may have been contaminated by subsequent conservation of the artefact, and that this could have produced a date that is notably younger than the artefact itself. The artefact was included in a successful range-finder project proposal to the NERC to date some of the larger beam mattocks within the collections of the Museum of London. With the assistance of Tom Higham, a sample was obtained from A22556 from a location which was unlikely to have been effected by conservation treatment. This produced a date of 5991-5839 cal. BC (OxA-25512, 7023±33), confirming its Mesolithic affinities.

In the cases where the working face is sufficiently well preserved, scraping marks are observed to be running both longitudinally and obliquely. This suggests that the working faces were subject to at least two phases of modification following the execution of the working edge prepared break. In the case of 71, oblique striations are overlain by longitudinal striations – suggesting that oblique scraping was carried out first. In the cases of A13648 and WG1223 longitudinal scraping appears to have been carried out before oblique scraping. Three methods are also utilised in the creation of perforations. Four of the artefacts feature perforations created through drilling, whilst one features a perforation created by coring (A22556), and another features a rough-edged perforation characterised by multi-directional nicking marks (WG1223). A22556 also features a fragment of a broken perforation at its distal end which has been made through drilling.

5.25 Hammersmith and Wandsworth, London

5.25.1 Context of recovery

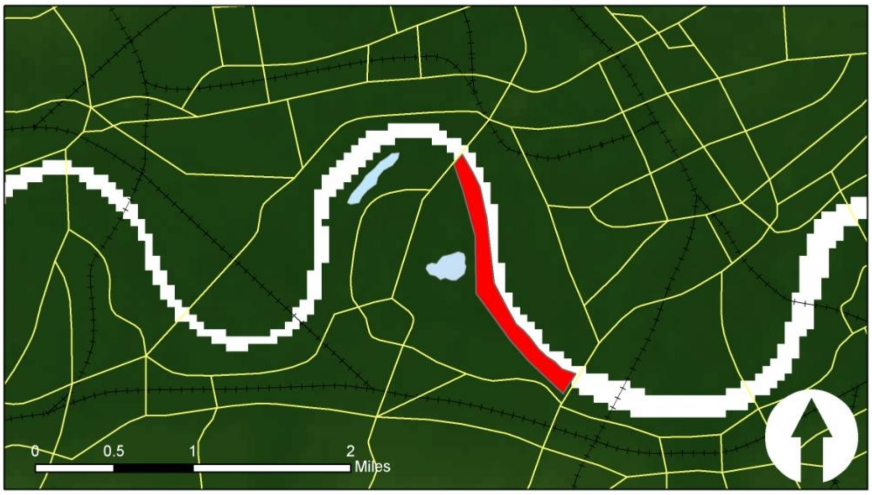


Figure 151: Area from which the Hammersmith and Wandsworth mattock was recovered (in red)

Whilst Lawrence provides some limited discussion of the finds made on the southern bank of the Thames at Hammersmith, no mention is made to an artefact located within the collections of the British Museum which is labelled "Hammersmith and Wandsworth". Presumably this find has come from the banks of the Thames, to the west of Hammersmith Bridge at a location some way between Hammersmith Bridge and Putney Bridge (Figure 151). However, no further reference to this artefact or findspot could be located in other catalogues of Mesolithic material culture from the area (Lacaille 1961, 1966).

5.25.2 Antler mattock from Hammersmith and Wandsworth

A beam mattock from Hammersmith and Wandsworth was located within the collections of the British Museum, under the accession number WG113. This consists of a portion of a red deer beam, from around the trez tine junction. The surface of the artefact is actively flaking away, due to ongoing drying. A longitudinal crack at the proximal end of the piece also attests to drying damage. Post depositional damage to the distal and proximal ends of the piece is also observed, in the form of negative flake scars. These overlie polishes and working marks, indicating that they were created after the artefact had been manufactured and used. The working face has been shaped through multiple episodes of longitudinal and oblique scraping. The perforation had been prepared by nicking, before drilling from both the SEN and DEX aspects. The distal end of the artefact has been defined through nicking before the execution of a prepared break – which has left a light polish at the extreme distal tip.

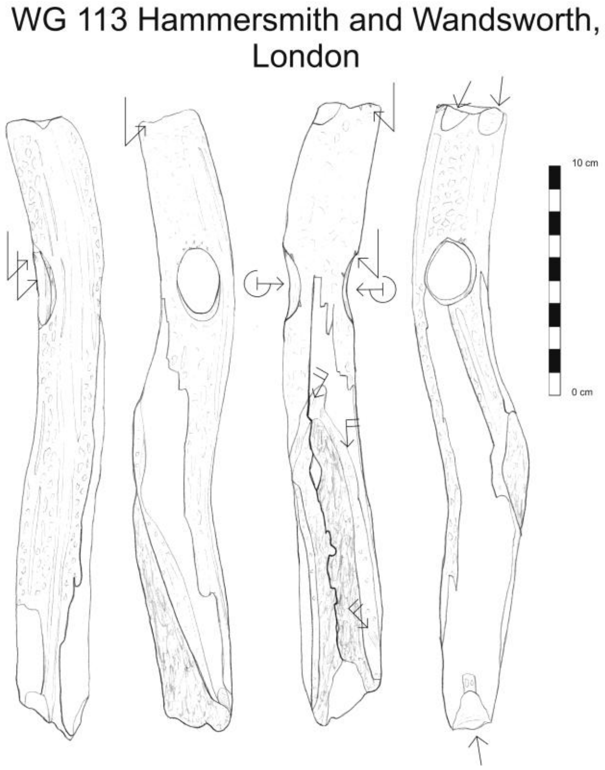


Figure 152: Antler mattock from Hammersmith and Wandsworth

5.26 Kew Bridge, London

5.26.1 Context of recovery

Lawrence (1929, 81) refers to a "a stag's-horn hoe" from the gravel below Kew Bridge, as part of a larger multi-period assemblage of artefacts which have been recovered from the same findspot (Figure 146). The artefact is commented upon further by Lacaille (1961, 133) who states that the a calcareous deposit overlies much of the object, and that this is indicative that it has lain at the bottom of the river for some time before recovery. This deposit is said to be rich in pollen, and has been analysed by Faith Topham. The full results of this analysis are not published, but Lacaille summarises the tree pollen values and concludes that this indicates a Late Boreal date. Smith (1989) identifies the artefact as a base mattock, and it has been AMS dated (Bonsall & C Smith 1992) to 8165-7793 cal. BC (OxA-1160). As such, it represents the only base mattock in Britain which can be positively linked to a Mesolithic date.

Pollen type	Percentage of sample analysed
Hazel	39
Pine	25.5
Willow	12
Maple	7
Ash	5
Elm	3
Oak	<0

Table 22: Lacaille's summary of Topham's analysis of pollen within the calcareous deposit recovered from the surface of the Kew Bridge antler mattock (Lacaille 1961, 133)

5.26.2 Antler mattock from Kew Bridge

The base antler mattock from Kew Bridge was located within the collections of the Museum of London (Figure 153). It is well preserved, although some discoloured damage to the brow and bez tine stumps indicate minor damage has been sustained during curation. The state of the burr indicates that the antler was shed from the left side of a red deer. A thin crack at the proximal end of the piece is also indicative of drying damage. The working face appears to have been shaped by multiple phases of scraping. Prepared breaks have been used to remove the brow and bez tines, with sawing and nicking being employed respectively. The perforation appears to have been drilled from the SEN side of the artefact. On the DEX side, the perforation is less well preserved and so it is difficult to ascertain whether drilling was also applied form this aspect.

Figure 153: Antler mattock from Kew Bridge

5.27 Kew, London

5.27.1 Context of recovery

Two antler mattocks were located within the collections of the Museum of London, which are provenenced within the accession catalogues to "Kew, London [River Thames]. No direct mention of these within published literature, other than their listing within the Wymer and Bonsall (1977) gazetteer – which provides an estimated national grid reference for the findspot which is equivalent for that of Kew Bridge itself (Figure 146).

5.27.2 Antler mattocks from Kew

A13647 is a well preserved beam mattock of red deer antler. Some drying damage can be observed in the flaking of the anatomical surfaces and some longitudinal cracking, but generally the artefact is robust and intact. A working face has been created and shaped through an episode of longitudinal scraping. A distinct plane of the working face can be observed towards the working edge, which is much smoother than the more distal regions of the face – this appears to have been created through a subsequent phase of grinding. The trez tine stump is visible in the form of an exposed area of spongy tissue, although this region has been subjected to a phase of scraping which has obscured the original break surface and thus the method of removal. Polish extends from the working face, over the modified trez tine stump, suggesting that this region may have formed part of the active working face during use. At the distal end of the piece, a fragment of a drilled perforation is visible which appears to have been broken during use. The artefact has been repaired through the creation of a second drilled perforation (Figure 155).

Figure 154: Antler mattocks from Kew, London

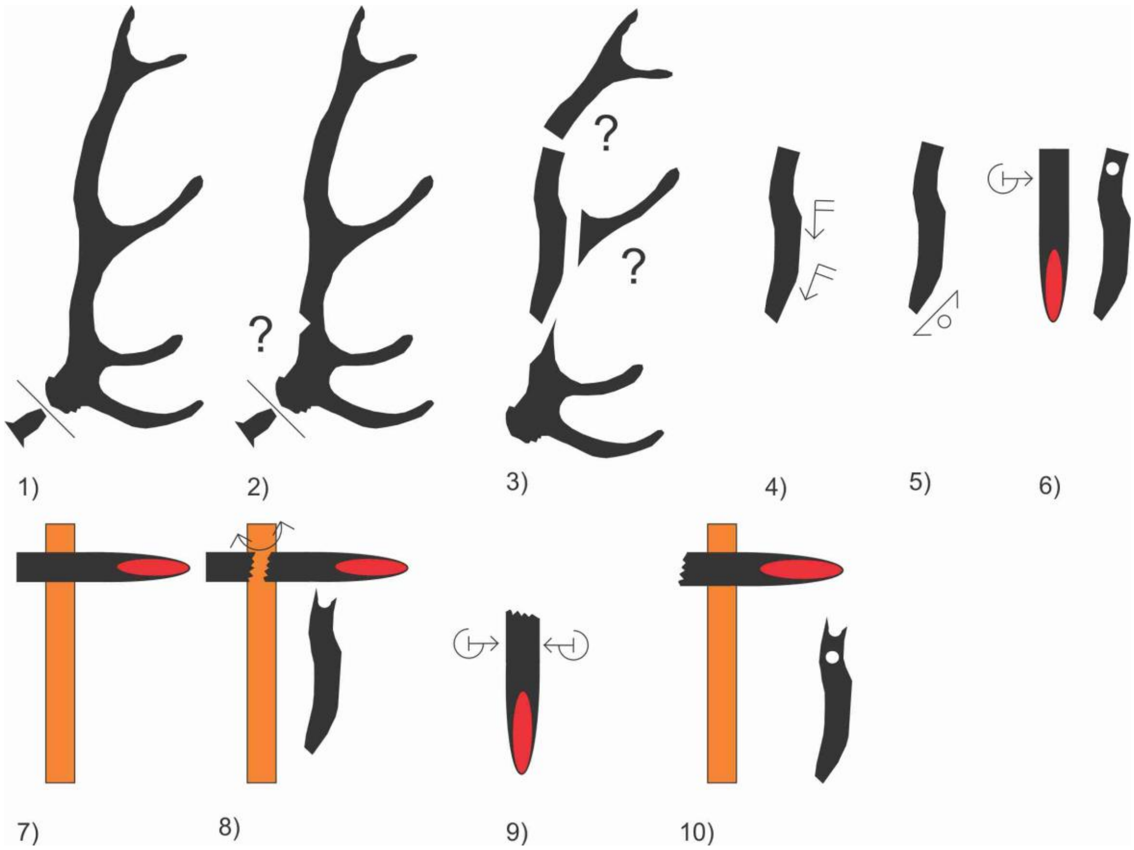


Figure 155: Sequence of A13647

Interpretation of A13685 is hampered by its unusual typological nature. The antler used for this piece is notably narrow, and has an elongated, ovular profile when viewed in section. This differs dramatically from the circular profiles of most red deer beam mattocks. The character of the intact anatomical surfaces are also unusual, with broad, shallow guttering channels running longitudinally but appearing to taper slightly across the piece. Two possible interpretations can be offered for this. The first is that it is a piece of a red deer antler from the base of a tine. In these regions, the antler is often flatter in section, particularly in the regions immediately adjacent to the junction. If this is the case, then the artefact can be categorised as a tine mattock, and as such is difficult to draw a confident Mesolithic affinity. However, an alternative interpretation for this piece is that it is made from elk antler – given the broad and shallow channels and unusual profile. Given the non-palmate character of the piece, it could correspond to an elk antler tine. If this in the case, then it would be very likely to be Mesolithic in date, as elk are thought to have become extinct in southern England during the early Mesolithic (Kitchener 2010). However, typologically this artefact would have very few parallels in Britain, as the elk antler mattocks from Star Carr are formed from the palmate portion and beam (Clark 1954, 157).

5.28 Battersea, London

5.28.1 Context of recovery

Lacaille (1966, 13) describes an antler barbed point from the banks of the River Thames at Battersea, although the absence of this artefact from Lawrence's (1929) account of material culture from the Thames suggests that it was recovered at some point in the first half of the 20th century. No further information regarding the context of the point's recovery could be obtained. An antler mattock has also been recovered from Battersea. Although listed by Smith (1989), no further information regarding the context of recovery could be obtained, other than the description of the findspot within the Museum of London accession catalogue which lists that artefact's as provenance as "Battersea, London [River Thames]" (Figure 146).

5.28.2 Antler barbed point from Battersea

The uniserial barbed point from Battersea was located within the collections of the Museum of London. It is a complete uniserial antler point with 13 barbs intact (Figure 156). The methods of blank splinter production are still visible in the form of a flat DEX edge, which suggests grooving. Scraping has been applied along the length of the point to give the artefact its shape. Sawing has been used to define the barbs, and then further scraping applied to create the point's profile. The smooth surfaces and apparent banding marks on areas between barbs suggest that filing was also used. At the tang, a series of dark bands are observed. As these are sharply defined and restricted to the tang region, they may be the result of staining from an adhesive used to bind the point to a haft. Damage to the extreme proximal tip of the tang is discoloured and sharply defined, suggesting modern damage.

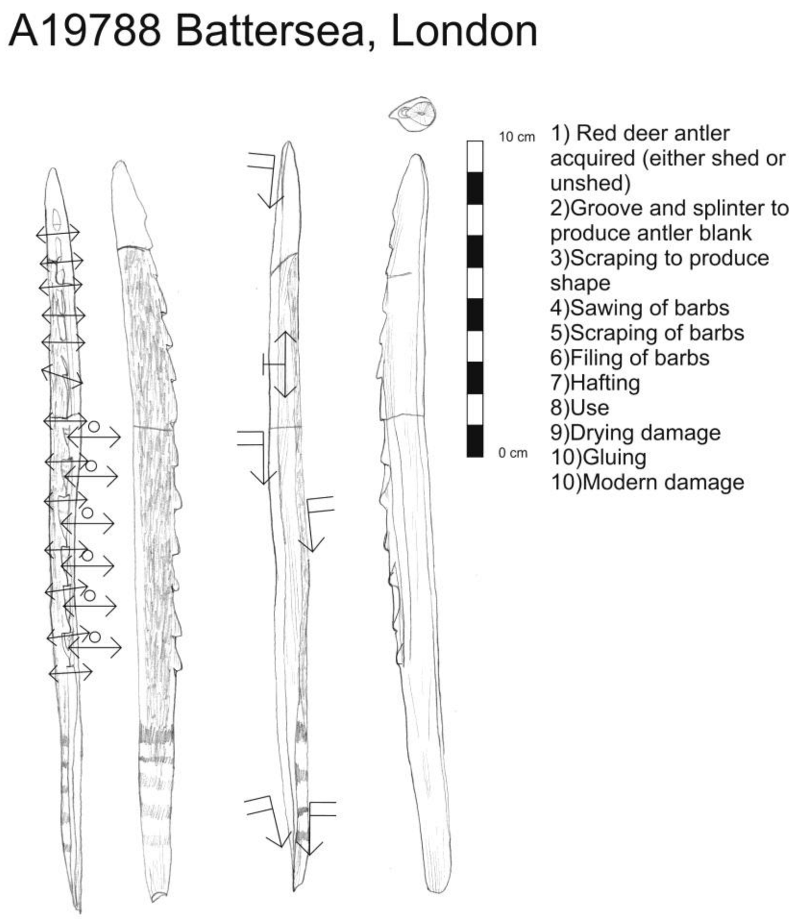


Figure 156: A19788 Battersea, London

5.28.3 Antler mattock from Battersea

A single beam mattock from Battersea was located within the collections of the Museum of London (Figure 157). It is made from red deer antler and consists of a beam mattock from the region of the trez tine junction. The working face shows a complex sequence of shaping and use, with multiple phases of scraping. Nicking is also observed at the trez tine stump to modify the working face *after* polish had begun to build up on the artefact. The extension of polish beyond the distal extent of the working face and across the trez tine stump would also suggest that a large surface of the artefact was active in use.

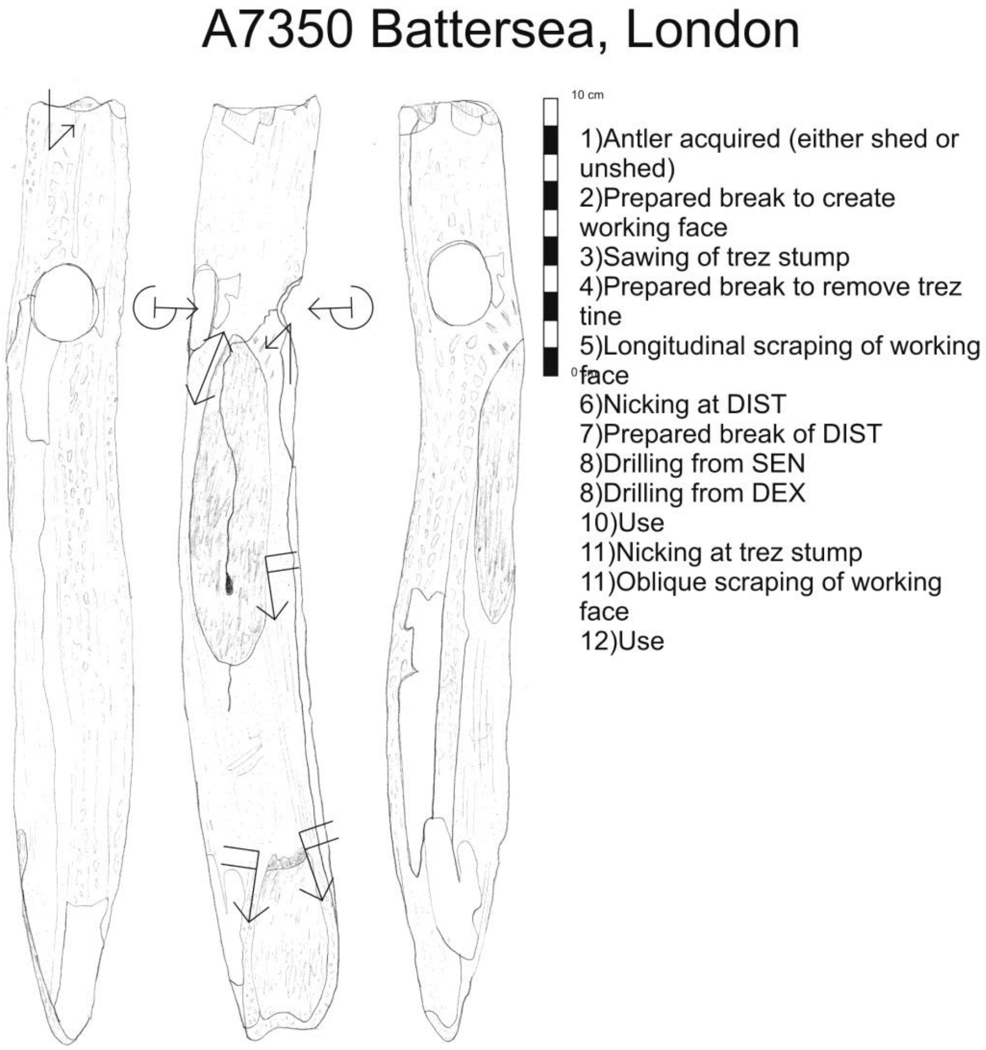


Figure 157: A7350 Battersea, London

5.29 Syon Reach, Brentford

5.29.1 Context of recovery

Lawrence refers to a "fair number of horn implements" being recovered from the north shore of the Thames at Syon Reach, Brentford (Lawrence 1929, 79). The specific location on the riverbank is said to be known as "Old England" (Figure 146), and Lawrence is explicit in stating that the material he discusses was recovered from the shore of the river (Lawrence 1929, 78), and not the adjacent marshland (which yielded various antiquities during the construction of Syon House).

5.29.2 Antler mattock from Syon Reach

A single beam mattock from Syon Reach was located within the collections of the Museum of London (Figure 158). The piece has been extensively gnawed across all surfaces. Water action has also created micro pitting across the artefact and drying damage is also apparent. The trez tine stump is observed to cut the working face, indicating that the removal of the trez tine post dates the creation and modification (through scraping) of the working face. At the distal end of the piece, a flexion break is observed in direct association with the perforation – suggesting a flexion break occurring at the point of hafting during the use of the artefact.

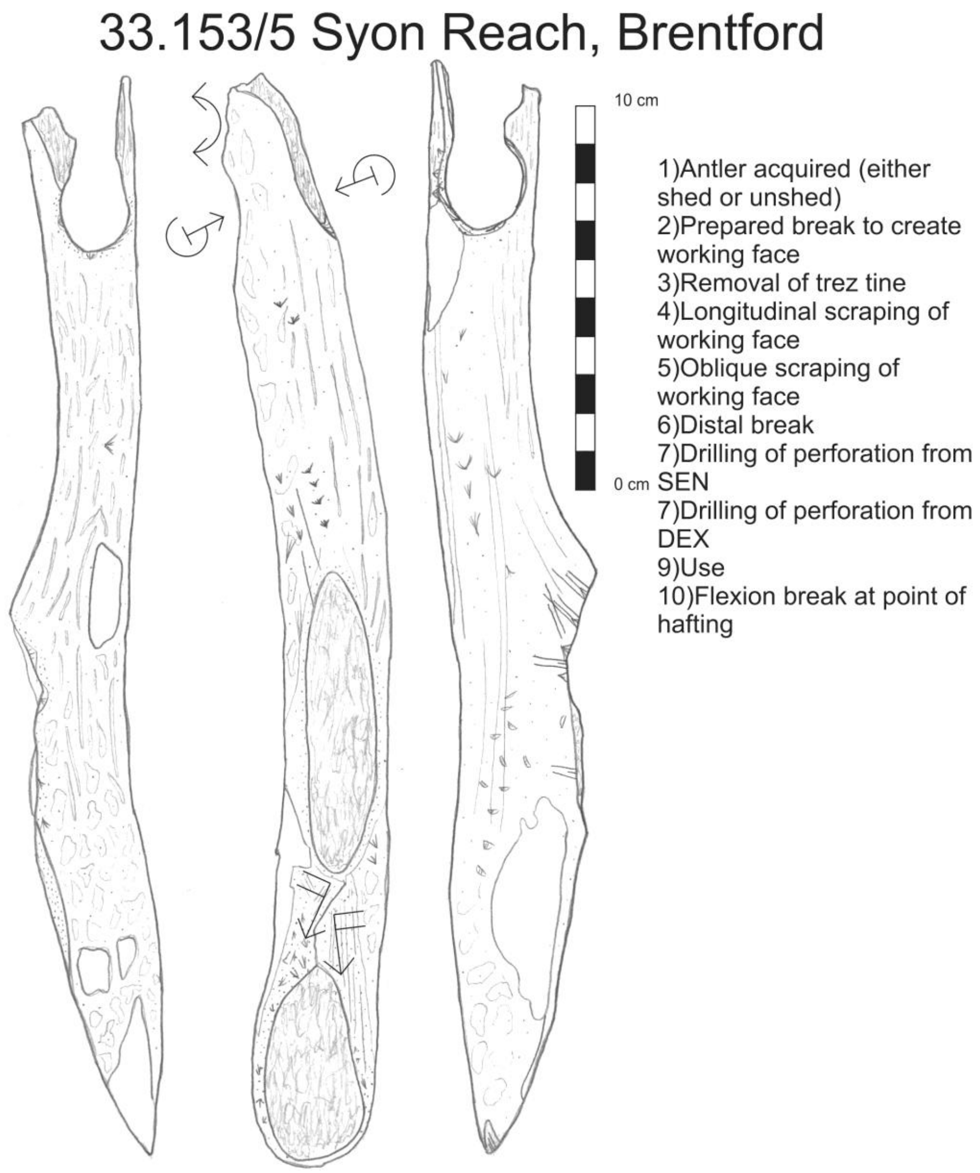


Figure 158: Antler mattock from Syon Reach, London

5.30 Mortlake, London

5.30.1 Context of recovery

Lawrence provides details of a findspot on the River Thames (Figure 146) which yielded a particularly rich assemblage of prehistoric material culture during the dredging of the river in the 19th century (Lawrence 1929, 82). These finds included a "fragment of stag's-horn with primitive cutting," and "a stag's-horn amulet" (*ibid.*). He states that the findspot is located slightly to the west of the Ship Inn on the south side of the river bank. He notes that at this site, the river gravels are coated in a layer of lime which cements the gravels and prevented the dredging machinery from moving the deposits. This "race" deposit had to be broken with poles to allow the dredgers to continue, and all of artefacts from the site originated from the layers of gravel below this lime seal. The accessions catalogue of the Museum of London also provided additional information regarding an artefact which was more recently donated by an amateur collector – F Berry. Berry recovered an antler beam mattock from the banks of the river Thames to the west of the Ship Inn at some point during the 1970s, and donated this object to the Museum of London in 2004.

5.30.2 Antler mattocks from Mortlake

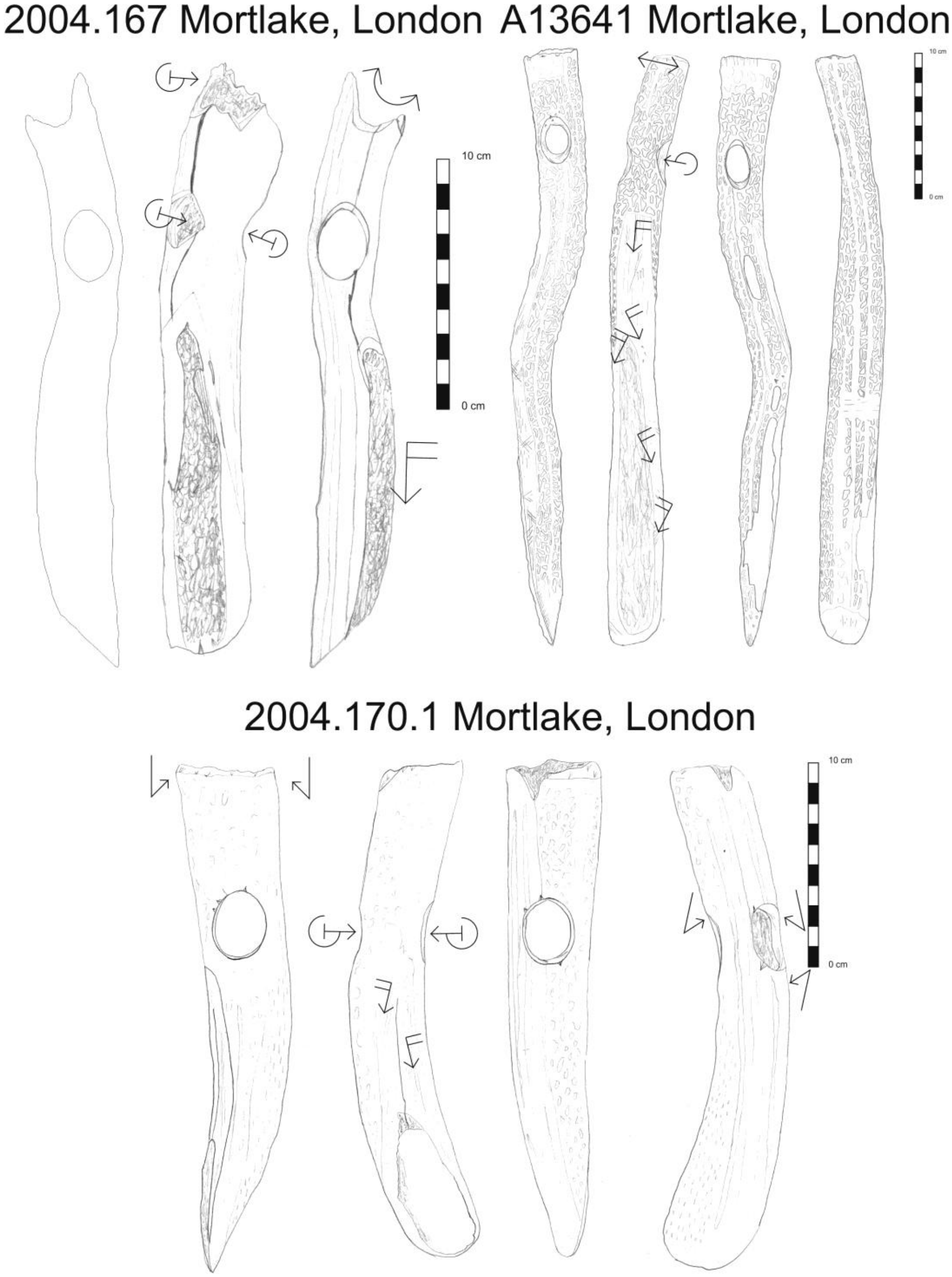


Figure 159: Antler mattocks from Mortlake, London

Typologically, all three mattocks from Mortlake can be classified as beam mattocks. However, there are some interesting differences in the elements of antler used to manufacture the artefacts. 2004.170.1 is unusual in that it has been made using a lower beam of a red deer antler, and does not incorporate any tine junctions or stumps. 2004.167 and A13641 are both made from the mid beam from around the region of the trez junction. In the case of A13641, this is elongated to include the majority of both the upper beam and mid beam to produce an unusually long beam mattock. In terms of working sequences, both 2004.167 and A13641 have the stump of the trez tine incorporated into the working face, which has subsequently been shaped through both longitudinal and oblique scraping. 2004.167 also features a fragmented perforation at the distal end of the piece, suggesting that the tool had broken at the point of hafting, and had subsequently been re-perforated and re-used before being deposited. A13641 is the only mattock which has been perforated using the boring technique, all other perforations on the Mortlake mattocks have been created using the drilling technique.

Given the unusual length of beam mattock A13641, it was included in a NERC range-finder dating project, which aimed to obtain direct dates for some of the typologically anomalous mattocks which lack parallels from dated contexts in Britain. With the assistance of Tom Higham, a small sample of A13641 was obtained for ^{14}C AMS dating. This produced a Neolithic date of 3367-3105 cal. BC (OxA-25511, 4547±28). The full significance of this date will be discussed in Chapter 7.

5.31 Wandsworth, London

5.31.1 Context of recovery

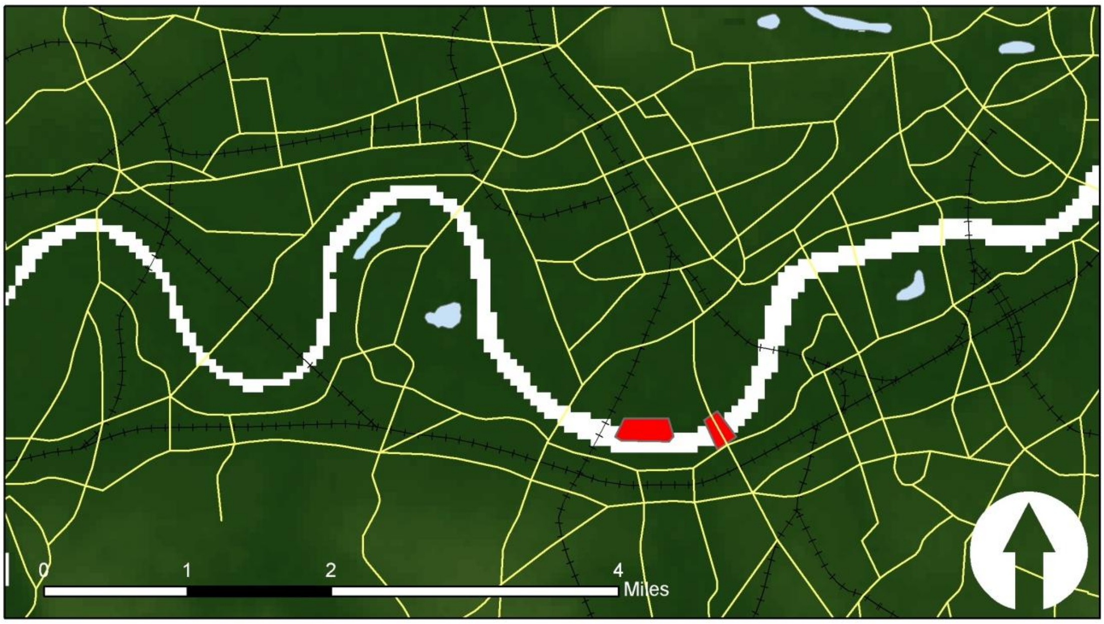


Figure 160: Two possible locations for the findspot of the Wandsworth barbed point (in red). Opposite Wandsorth Park, or below Wandsworth Bridge.

Lawrence notes that a "stag's-horn harpoon" was recovered from the shore of the River Thames, opposite Wandsworth Park (Lawrence 1929, 91). This artefact is also described by Lacaille (1966, 13–15) who provides a drawing of a uniserial barbed point from Wandsworth, which is held at the Museum of London. However, Lawrence also notes that another "horn harpoon-head" was recovered from the banks of the Thames directly beneath Wandsworth Bridge. This suggests that two antler barbed points have been recovered from the area, but that only one has been acquired by the Museum of London. Unfortunately, the accessions catalogue at the Museum of London gives no further insight into this matter. It is not known whether the "Wandsworth" barbed point was recovered from the shore opposite Wandsworth

Park, or beneath Wandsworth Bridge. Bonsall and Smith have dated the Wandsworth point, through direct AMS dating, to 8340-7949 cal.BC (OxA-3736).

5.31.2 Uniserial barbed point from Wandsworth

The uniserial barbed point form Wandsworth (Figure 161) consists of the tang and midshaft of an antler uniserial barbed point, with 14 barbs intact. The square profile of the SEN edge indicates that the groove and splinter technique has been employed to produce the blank from which the point was made. The barbs themselves are unusually angular, being triangular when viewed in profile. These have been created by first scraping the external and internal sides of the point along the DEX edge, to thin the splinter. Filing has then been used to remove material between the barbs, and create their shape. Finally, a further phase of scraping has been applied to thin the barbs further. At the distal end of the piece, the break has sediment adhering to the surfaces, suggesting that this occurred at some point in antiquity. A circular drilling hole is also apparent at the distal break, where material has been removed for AMS dating.

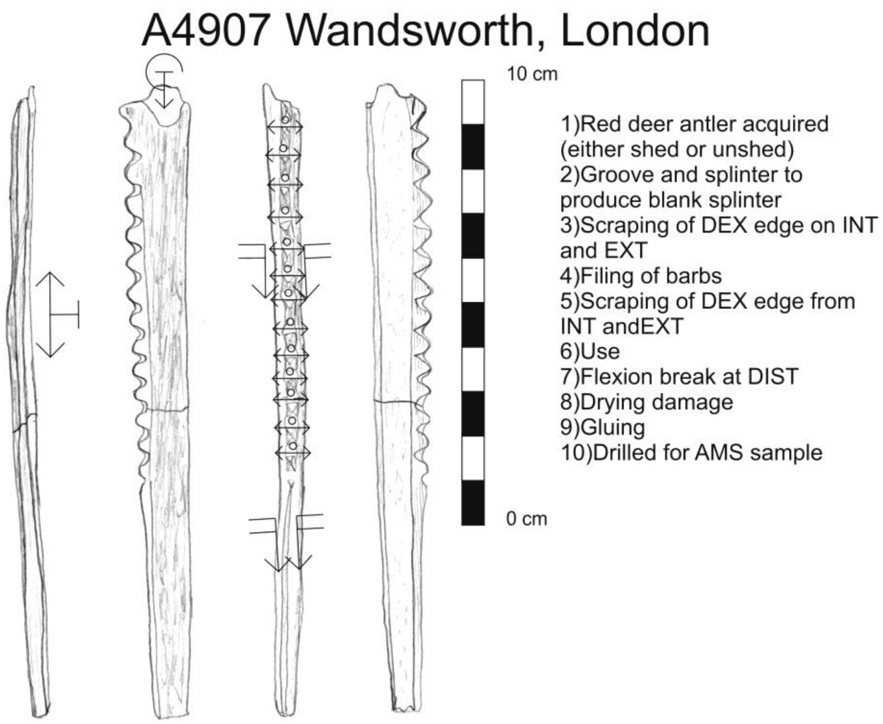


Figure 161: Uniserial barbed point from Wandsworth, London

5.32 Richmond, London

5.32.1 Context of recovery

Wymer and Bonsall (1977, 196) list a "perforated antler beam" within the Museum of London as being recovered from "Richmond", and reference this find to Lawrence (1929). Lawrence describes a multi-period assemblage of material culture which has been recovered from various points along the banks of the Thames at Richmond, including "below Richmond Bridge", "from the Thames at Richmond", "a channel made into the Thames for drainage-purposes near the Palace" and "the lock and weir" (Lawrence 1929, 77). However, Lawrence's account includes no specific reference to any antler artefacts. As such, it is impossible to give a more precise location for the artefact's findspot, other than to say it was most likely recovered from the Thames foreshore, somewhere in the region of Richmond (Figure 146).

5.32.2 Antler mattock from Richmond

A beam mattock from Richmond was identified within the collections of the Museum of London. It consists of a portion or a red deer beam, from around the region of the trez tine junction (Figure 162). Interpretation of this artefact was complicated by the fact that it had been soaked in a pungent dark varnish at some point during its curation – presumably as a conservation measure. However, this had not prevented drying damage, which has created longitudinal cracks and also extensive flaking of the artefact's surfaces. Small, shallow, randomly orientated pitting was observed on the distal portion of the working face, whilst the extreme tip and working edge were notably smoothed. These pits overlie all other working marks, and are interpreted as the product of water action following the deposition of the artefact. The working face itself is heavily damaged, which prevents the relationship between the removal of the trez tine and the creation of the working edge from being studied. Gnawing marks are also apparent in the vicinity of the perforation.

In terms of working, the mattock shows signs of longitudinal scraping of the working face towards the distal end. These are absent from the proximal extreme and working edge and have presumably been eroded during the use of the artefact. At the distal end of the piece, nicking has been used to prepare the upper beam prior to the execution of a prepared break. The perforation was created through drilling from both the SEN and DEX aspects. Below the perforation, above the distal end of the working face, a flat, stepped facet can be observed. Striations on the surface of this indicate that scraping has been applied to reduce the antler in this area, although the purpose of this action is unclear.

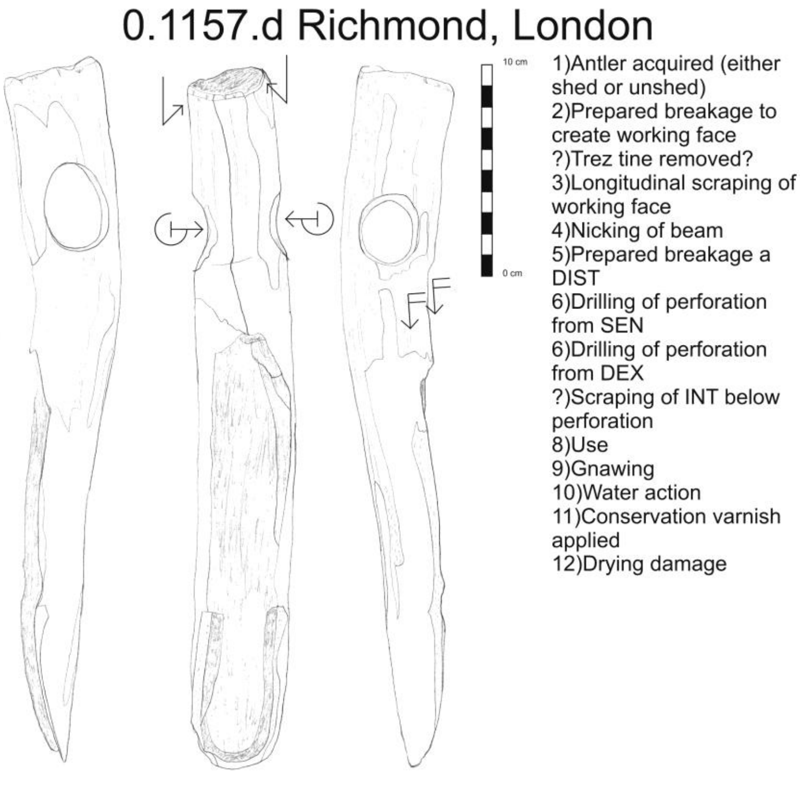


Figure 162: Antler mattock from Richmond, London

5.33 Twickenham, London

5.33.1 Context of recovery

Although not mentioned by Lawrence, Lacaille provides a drawing of a beam mattock which he describes as being recovered "from the river, nearby, at Twickenham," (Lacaille 1961, 135). Smith also identifies three beam mattocks from Twickenham (Figure 146) within the collections of the Museum of London (Smith 1989, 274–275), although is unable to provide a reference to any account of their acquisition. Two of the artefacts listed by Smith were located within the collections of the Museum of London – 49.107/899 and 49.107/902. These were linked to entries within the accessions catalogue which provided a provenance of "Twickenham" and a date of recovery (September 1897 and 15th June 1888 respectively), but no further details.

5.33.2 Antler mattocks from Twickenham

The two beam mattocks from Twickenham (Figure 163) are both made from a right sided red deer antler, in the region of the trez tine stump. Both artefacts have been badly affected by drying damage, resulting in extensive cracking, splitting and flaking of the original surfaces. 49.107/902 also shows signs of extensive gnawing across the working face and at the trez tine sump. However, it can be seen that in both cases, scraping has been used to shape the working face and drilling has been employed to create the perforations.

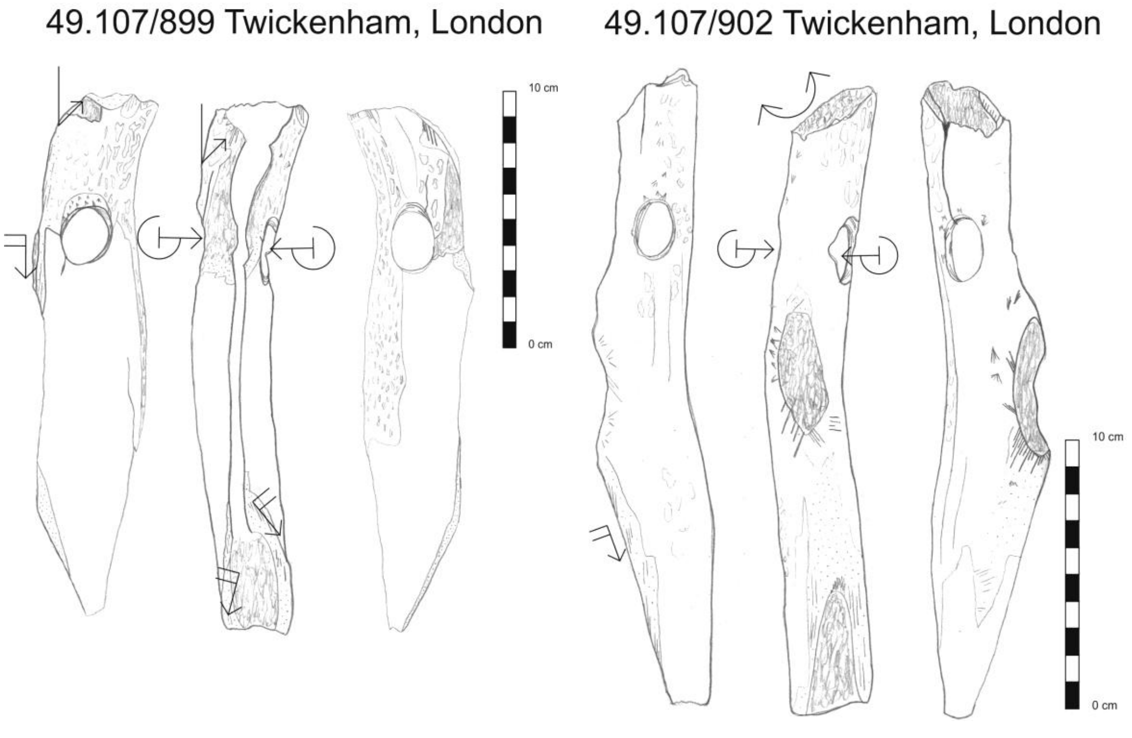


Figure 163: Antler mattocks from Twickenham, London

5.34 Chelsea, London

5.34.1 Context of recovery

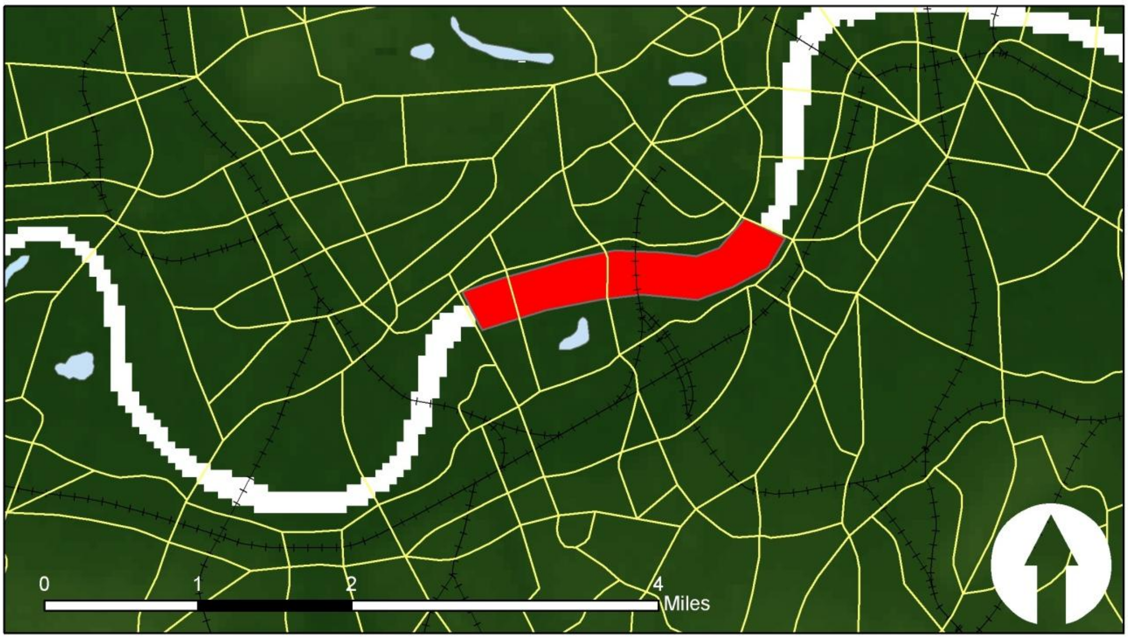


Figure 164: Area of the Thames at Chelsea where the Chelsea mattock may have been recovered from

Although Mesolithic material culture, alongside artefacts of other prehistoric periods, are noted in both Lawrence (1929, 92) and Wymer and Bonsall's (1977, 191) cataloguing of finds from the River Thames, neither publication refers to any antler artefacts from the Chelsea area. However, Smith (1989, 274) identifies an object within the collections of the Museum of London which he classifies as a beam mattock. The accessions catalogue at the Museum of London states simply that the artefact was recovered from the River Thames at Chelsea (Figure 165), with an accession date of 1911.

5.34.2 Antler mattock from Chelsea

The Chelsea beam mattock was located within the collections of the Museum of London (Figure 165). This has suffered from considerable damage in drying which had removed a significant portion of the original anatomical surface. Modern damage was also observed at the proximal and distal ends of the piece. The working face had been shaped through an initial phase of longitudinal scraping followed by a secondary episode of oblique scraping. An episode of nicking followed by the execution of a prepared break resulted in the removal of the trez tine. The perforation was created through drilling from the SEN side of the artefact.

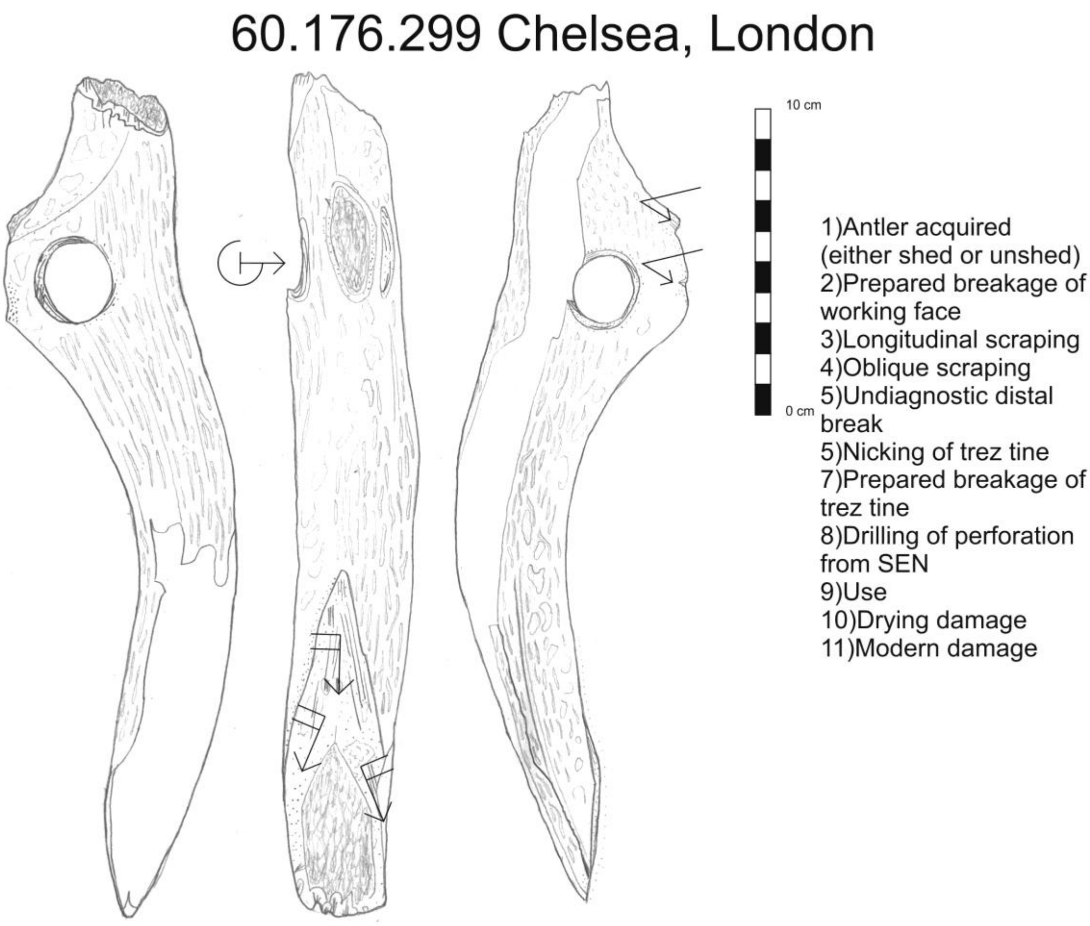


Figure 165: Antler mattock from Chelsea, London

5.35 Bovney Lock, Windsor

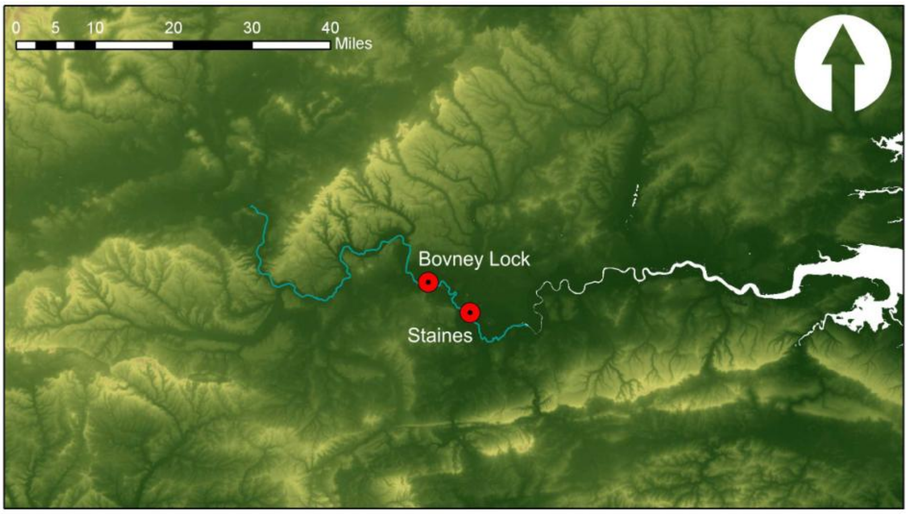


Figure 166: Location of the Upper Thames Mesolithic antler findspots

5.35.1 Context of recovery

In their gazetteer of Mesolithic sites, Wymer and Bonsall (1977) list a "perforated antler axe" which they state was recovered from the banks of the River Thames in September 1897 at Bovney Lock, Windsor (Figure 166). The artefact was located within the collections of the Museum of London, although no further reference to its context of recovery could be found.

5.35.2 Antler mattock from Boveney Lock

Although heavily damaged through extensive gnawing, drying, and also featuring fresh breaks indicative of more modern damage, this mattock can be identified as a beam mattock from the left antler of a red deer (Figure 167). The working face has been almost completely destroyed, but the surviving areas indicate that scraping was used to shape the object following the initial prepared break. A perforation was created through drilling from the SEN and DEX sides respectively. The uneven and jagged nature of the distal end suggests a flexion break, but the thinning of the compactor in this area may also suggest some deterioration and damage to the piece after deposition.

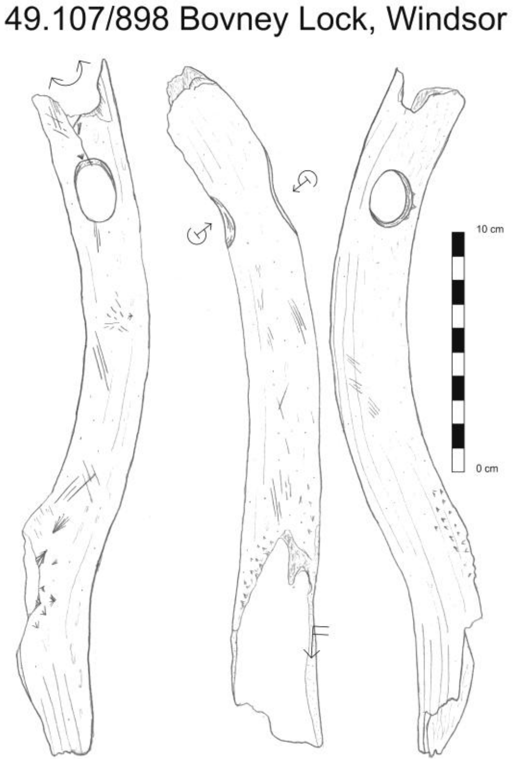


Figure 167: Antler mattock from Bovney Lock, Windsor

5.36 Staines, Surrey

5.36.1 Context of recovery

An antler artefact described as "a stag's-horn pick" is noted by Lawrence (1929, 74) as being found at Staines, Surrey (Figure 166). However, Lawrence states that he only obtained material from this area, and did not directly oversee its collection himself. As such, he is unable to shed any further insight into the exact context of their recovery. This artefact was later classified as a beam mattock by Smith (1989, 274), and has been directly AMS dated (Bonsall et al. 1995) to 4706-4358 cal. BC (OxA-1158).

5.36.2 Antler mattock from Staines

A beam mattock from Staines was located within the collections of the Museum of London. This showed signs of damage in drying, in the form of longitudinal splitting of the proximal end of the piece. Gnawing marks were also observed on the artefact, and discoloured, sharply defined break edges suggested that some modern damage had been sustained to the distal end. A drilled hole was observed at the distal break, where material had been removed for AMS dating. The working face has been shaped by an episode of oblique scraping, which is overlain by more longitudinally orientated striations - indicating a secondary phase of working. A thin polish extends across the working face and onto the stump of the trez tine, showing that this region of the tool was functionally active. The perforation features a failed drilling attempt on the DEX side, which is cut by a second, more successful drilling episode.

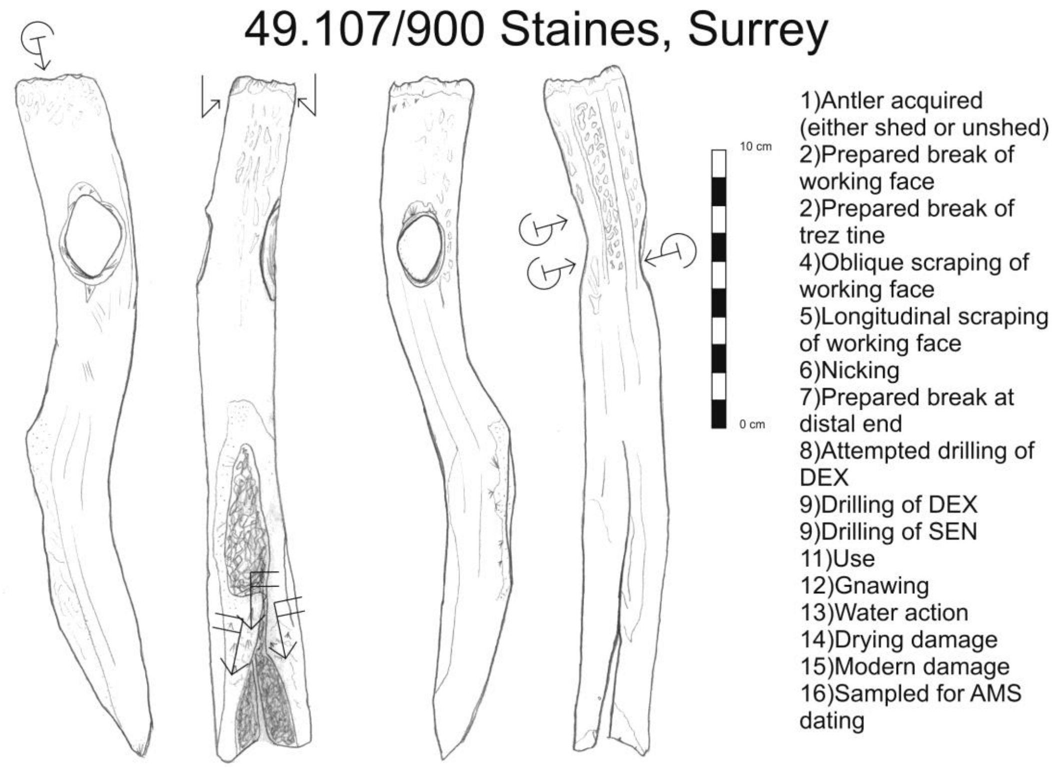


Figure 168: Antler mattock from Staines, London

5.37 Thatcham, Berkshire

5.37.1 Context of recovery

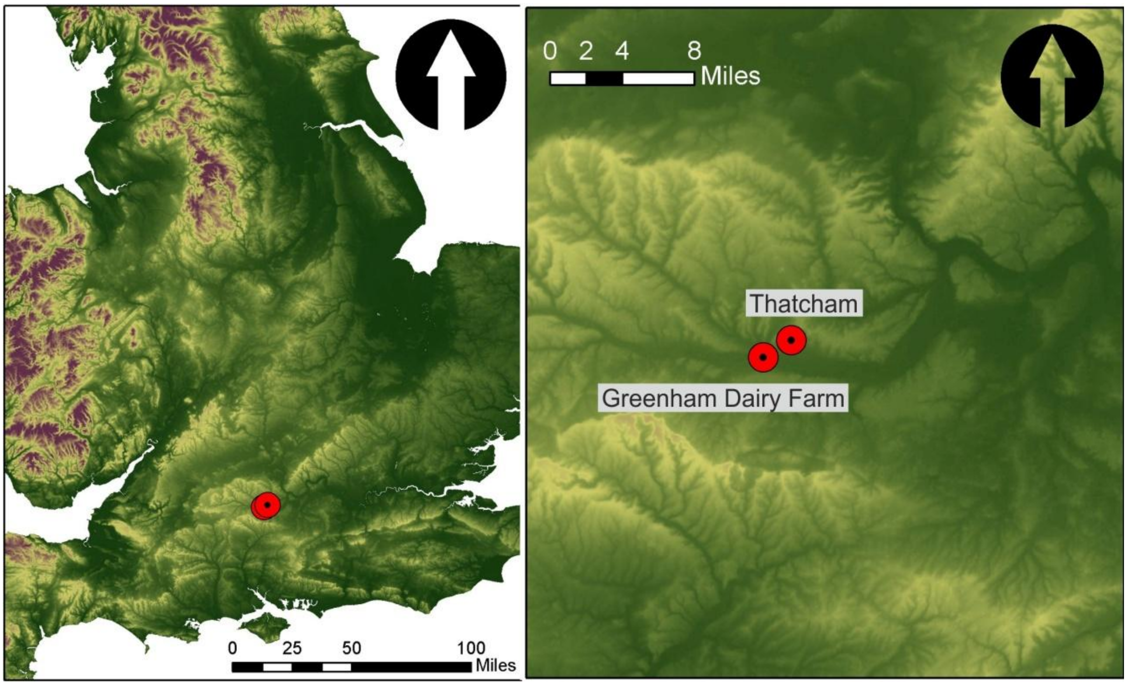


Figure 169: Location of Mesolithic sites within the Kennet Valley from which antler has been recovered

The Early Mesolithic site of Thatcham is situated in the Kennet Valley, Berkshire (Figure 169). Initial investigations of a surface lithic scatter, carried out by Peake and Crawford (1922), uncovered a flint assemblage and small quantities of animal bone, in a wetland context. Wymer (1962) excavated further deposits between 1957 and 1961, at a series of five different points along a wetland/dryland interface (Figure 170). Excellent organic preservation was recorded in some of these areas. Wymer recovered an extensive Maglemosian lithic assemblage associated with faunal remains, worked bone and antler, a cut feature believed to have been a fish trap, stone-lined hearths and burnt hazelnuts. He interpreted the assemblage in its entirety as being representative of a seasonally-occupied “base-camp”, from which people hunted deer, horse and auroch in the adjacent woodland, trapped smaller mammals and birds such as beaver, pine marten, fox and blackbirds, and fished on the lake (Wymer 1962, 336–337).

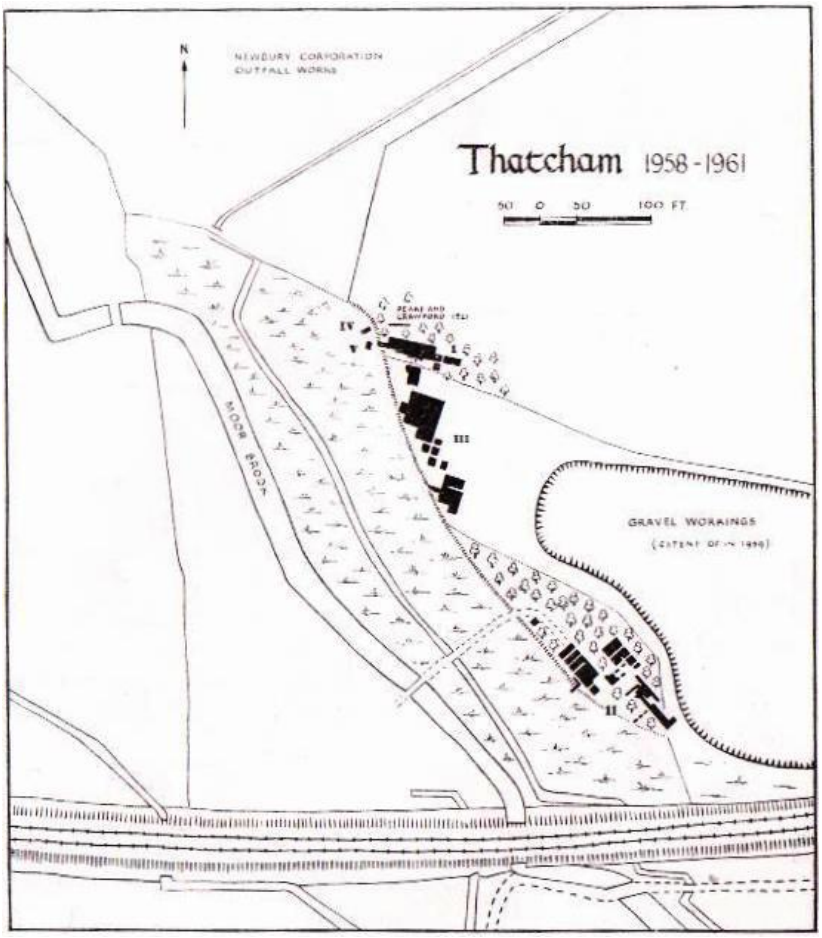


Figure 170: Map of the sites excavated by Wymer at Thatcham (Wymer 1962, 332)

When the Thatcham material was accessed for this study, the antler finds were seen to have been recorded with varying levels of detail and spatial resolution. Some pieces were marked with the site number, gridsquare, transect code and layer number. However, some were only denoted by site and others featured no further information other than the date of accession. In the case of the antler artefacts, Wymer (1962, 351–353) provides a report which identifies the site from which they originate. However, the report on the faunal remains does not provide these details, and so no further insight can be gained other than the details recorded on the piece itself. A full discussion of the spatial distribution of the antler from Thatcham will be provided in Section 5.37.4. This section will detail the stratigraphic sequences observed by the various excavators at the site, and the changing environmental conditions which occur throughout the period of occupation.

Thatcham I is situated on gravel deposits, which slope away into a lower area of swampland to the west of the site (Figure 170). Excavations down the slope (or "gravel bluff") demonstrate that the lithic scatter at Site I extended onto the slope itself, as well as the higher plateau of the gravel deposits. The most detailed description of the depositional sequence at Thatcham I (Wymer 1959, 6–10) states that a "loose, peaty humus" topsoil was encountered after cutting foliage in the area back, containing mixed finds of Mesolithic flint, Romano-British pottery sheds and modern material. This was underlain by 3-5 inches of a black, compact desiccated layer with a high organic content which Wymer terms the "charcoal layer". The written description of the sequence states that:

"A thin lenticel of soft shell marl thickened towards the bluff of the low terrace (i.e. the western end of Site I) and the charcoal layer thinned out correspondingly, so that at the extreme western end the occupational floor was covered by shell marl."

(Wymer 1959, 6)

A section drawing provided by Wymer shows the relationship between the "charcoal" and shell marl layers. Whilst the exact location of this drawn section is not specified by the author, it can be assumed to be east-west orientated trench wall, based on the thickening of the shell marl (Figure 171). However, as the marl does not come to overlie the gravel completely this may suggest that the section does not extend to the most westerly extents of the trench. This is supported by the fact that when the section drawing was published in 1959, the trench had not been extended onto the gravel bluff. Occasional flints and animal bones were encountered within the "charcoal layer" and the shell marl, towards the base of these deposits and at the interface between them and the underlying gravels. The marl was also noted to have been disturbed by the burrowing actions of badgers which at some points had cut the underlying deposits.

Below the charcoal and shell marl layers, gravel was encountered. The upper 3-6 inches of this gravel were notably mixed and humified, whilst the underlying deposits were observed to be pure and stratified. The majority of Mesolithic cultural material was recovered lying horizontally immediately below the charcoal/marl and on top of the gravel. Flints were also recovered from the disturbed gravel, and were interpreted as having been trodden and trampled into the landsurface during occupation.

The initial area excavated in 1958 (Wymer 1959) was subsequently extended to the south, and also in a westerly direction. The western extension explored the slope of the bluff, revealed a tapering and eventual disappearance of the "charcoal" layer. In its place, bands of humified shell marl were encountered, containing both flint and sand (Wymer 1960, 12). The depth of these deposits below the surface progressively decreased down the slope, so that at the base of the slope the Mesolithic cultural material was 12" below the surface. This meant that considerable disturbance through the action of tree roots was apparent, leading to a breakdown of the stratigraphic sequence. Although hearth features were encountered in this area, the lack of stratigraphic integrity prevented the confident dating of these features to the

Mesolithic occupation of the site. A sketch of the section of the gravel buff (Wymer 1960, 6) illustrates this sequence and disturbance (Figure 171).

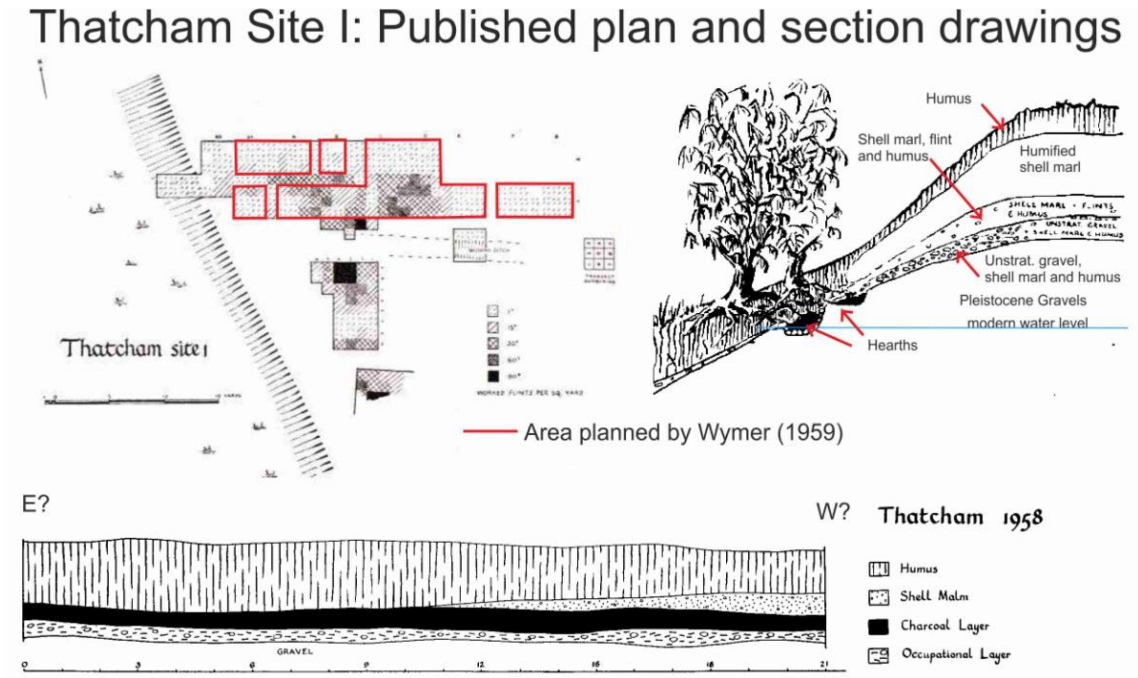


Figure 171: Plan and section drawings of Thatcham I (Wymer 1959, 1960, 1962)

At Thatcham II, a very similar sequence to that of Thatcham I was observed (Figure 172). This consisted of humus topsoil, underlain by the same black "charcoal" layer, which sealed the cultural material. Towards the gravel buff, the black charcoal layer thinned and disappeared, being replaced by a layer of shell marl. On the lower levels of the buff itself, the humus topsoil was observed to directly overlie "river deposits" of the lower terrace. These contained later artefacts including bronze age and Roman pottery and a halfpenny coin (Wymer 1960, 12). Away from the buff, where the marl and charcoal deposits intersect, the shell marl was observed to thinly underlie the charcoal layer. However, *in situ* occupational debris was observed to lie between the shell marl and charcoal layers, suggesting that the shell marl was deposited prior to Mesolithic inhabitation, and as such formed part of the landsurface.

A series of shallow (2-3ft) palaeochannels were also encountered on the gravels at Thatcham II. These were filled with silt, overlain by shell marl and sealed by the black charcoal layer (Figure 172). Again, cultural material was recovered from the interface between the shell marl, and a hearth at the most southerly gully indicated that *in situ* occupation was occurring on the marl fill of these gullies. Some later disturbances were also apparent in the channels, with a recent ditch being observed cutting through the humus and charcoal layers. Undulations within the charcoal and marl layers were attributed to the burrowing actions of animals (Wymer 1959, 12). Towards the eastern end of the site, a series of later channels were found to cut the Mesolithic occupation layers. These channels were filled with a re-worked marl deposit. Bones and flints from the fill of these channels were not thought to be the result of *in situ* deposition, but still considered to be associated with the main phase of Mesolithic occupation at the site (Wymer 1960, 13).

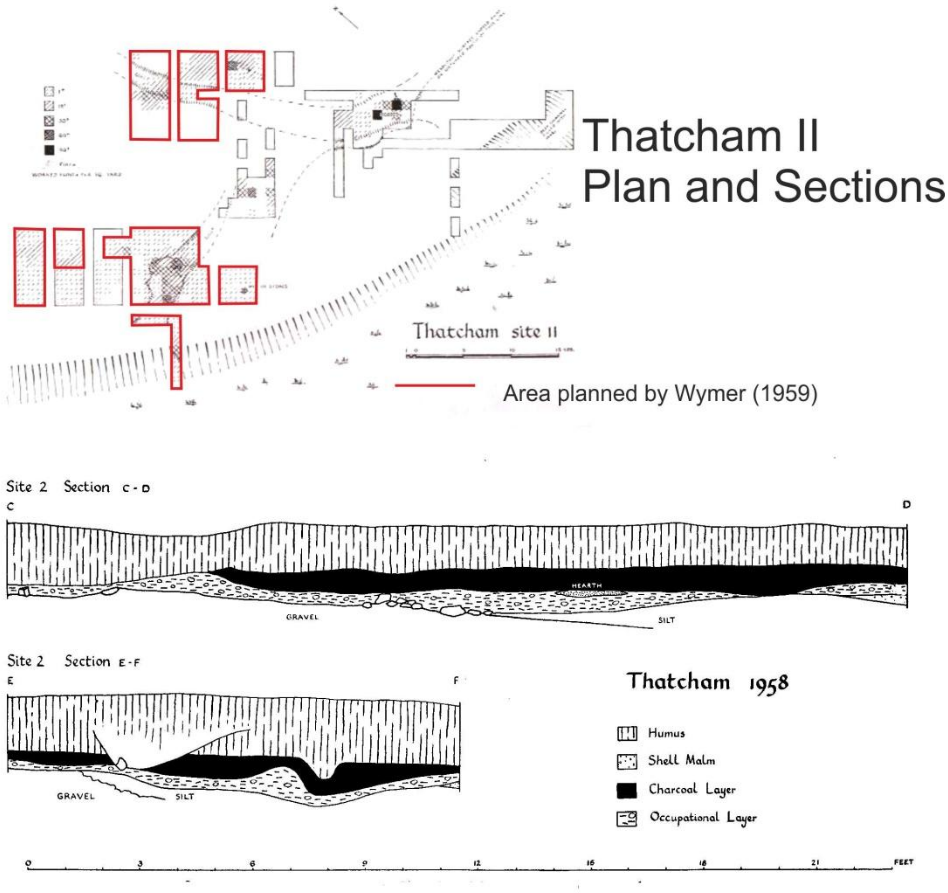


Figure 172: Plan and section drawings of Thatcham II (Wymer 1959, 1962)

Wymer (1960) also notes three pieces of red deer antler which were unusually arranged. He states that two unshed antlers were inverted, with the skull raised above the ground surface. An antler "hammer" was found resting across these upturned antlers, and Wymer interprets this as use of the skull as an anvil platform for flint knapping (Wymer 1960, 16). He states the antlers were inserted into the Mesolithic landsurface, with the sediments around the skull and hammer being identified as silty shell marl.

Site III is located in an area of lower ground between Sites I and II. Neither of the plans provided by Wymer (Wymer 1960, 1962) for the Thatcham excavations indicate a grid system which could be used to give a clearer indication of the distribution of antler within the trenches. Reynier's retrospective analysis of the flint assemblage (Reynier 2000) identified two distinct lithic scatters at Thatcham III, although this was not recognised during the excavation itself. Wymer (1960) describes the depositional sequence at two separate locations within the excavated areas. At a location which is said to be close to the gravel bluff and towards the northern extent of the trenches, Wymer gives the following depositional sequence:

Humus	9"
Mixed shell marl and silt	12"
Lenticels of silt, sand and derived shell marl	15"
Dark brown, crumbly silt	3"
Black, tenacious, greasy silt	6"
Natural gravel	

(Wymer 1960, 13)

A further section drawing, taken from the areas more to the south-east of the excavations is also provided by Wymer (Figure 173). This appears to show a slightly more complicated stratigraphic sequence, with the black "charcoal" layer again present, and apparently overlying the shell marl deposits in the same relationship observed at Sites I and II. Due to inconsistencies in the terminology used by Wymer in his descriptions of the depositional contexts (Wymer 1960, 1962), and the lack of a precise location for the section drawing or sequence description, it is unclear whether or not the deposits underlying the shell marl are consistent in both sections, or if they are the products of different depositional processes.

In the more northerly, undrawn section Wymer states that the majority of Mesolithic material was concentrated within the "black, tenacious, greasy silt", and that within this deposit flint was encountered at a higher density than at any other of the Thatcham sites. He interprets this silt layer as a beach deposit which was intermittently inundated by the water system beyond the buff (which he terms a "lake"). The marl deposits are said to have been formed by flooding events which post-date the Mesolithic occupation, and involve the re-deposition of the marl material which had originally formed within the adjacent "lake" (Wymer 1960, 14).

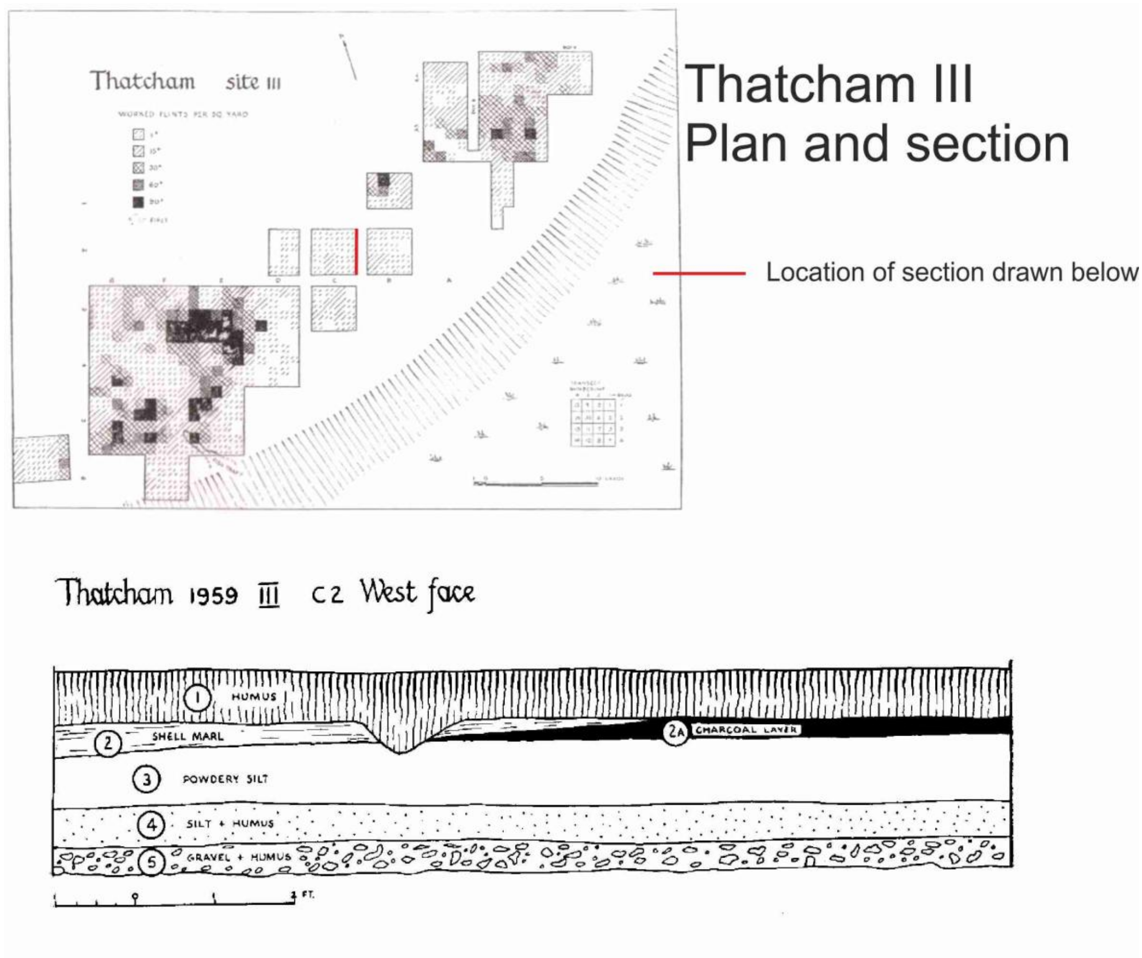


Figure 173: Plan and section drawing of Thatcham III (Wymer 1960, 1962)

Within the drawn section, flint is said to occur within layer three, but that it becomes notably less concentrated as the excavations moved progressively further away from the areas of higher ground to the south. As such, Wymer interprets the flint within layer 3 as having been washed down the slope from the occupation at Site II. The underlying layer 4 is said to be the

Mesolithic occupation layer, containing *in situ* flint, bone and charcoal. Material culture was also encountered within layer 5, and a flint core was refitted using pieces recovered from both layers 4 and 5. This is interpreted as being intrusive, and representative of material which was deposited during the occupation of layer 4, but which had become worked into the underlying deposit through trampling.

Although six ^{14}C dates have been obtained from material recovered from Thatcham III, the interpretation of these dates is problematic (Reynier 2000, 43). The early dates obtained by Churchill (1962) are both taken from bulk samples of charcoal, which was collected across several grid squares and as such cannot be relied upon to produce an accurate date for occupation. The animal long bones (Hedges et al. 1988) are noted to have an unreliably low collagen content (Reynier 2000), which has reduced the apparent age of the material. This leaves a single reliable date of 8636-8261 cal. BC (OxA-2848) from the "silt and humus" layer 4.

Lab code	^{14}C Age BP	Calibrated age BC	Reference	Layer
Q-658	10030±170	10426-9221	(Churchill 1962)	4
Q-659	10365±170	10677-9465	(Churchill 1962)	4
OxA-1202	5100±350	4711-3029	(Hedges et al. 1988)	4
OxA-940	6550±130	5722-5230	(Hedges et al. 1988)	4
OxA-2848	9200±90	8636-8261	(Roberts et al. 1999)	4

Table 23: ^{14}C dates from Thatcham III

The sequence of deposits encountered at Thatcham IV is less well recorded, due to the fact that it was machine excavated and treated as a test exercise for more controlled excavations at Thatcham V. The area investigated consisted of the waterlogged swamp environments on the lower side of the gravel bluff, to the west of Thatcham I. The sequence encountered (Wymer 1960, 15) is shown below:

Soft, black sedge and reed litter	36"
White shell marl	30"
Peat containing pine cones and branches	9"
Gravel	18"
London Clay	

As material was removed by the machine, it was sorted through on the trench edge in an attempt to identify material culture. Flints, bones and burnt wood was encountered from the lower levels of the white shell marl layer, but were absent in the underlying peat, gravel and clay. Wymer (1960, 15) states that the shell marl most likely formed in slow moving, clear water 6ft deep, and interprets the deposition of material culture as refuse disposal from the inhabitation of Site I.

Site V was located within the lower swamp area to the south of site IV. A coffer dam was used to prevent the areas under excavation from being inundated by water. Churchill (1962, 363) provides the only section drawing (Figure 174) and description of the sequence of deposits encountered at Site V. At the surface, a three foot deep layer of actively forming sedge peat was encountered, with living plant rhizomes penetrating the entire depth of the deposit.

Below this, Churchill identifies two types of marl within the sequence at site V – grey and white algal marls. He states that both of these deposits formed *in-situ*, with grey marl overlying white marl. The uppermost layers of the grey marl are said to be disturbed, based on the overturned nature of the concretions. Although three ^{14}C dates were obtained from wood samples taken from the algal marls within site V, their description indicates that each sample was taken from a range depths and that they are therefore bulk samples. As such, their utility in dating the deposits is heavily compromised.

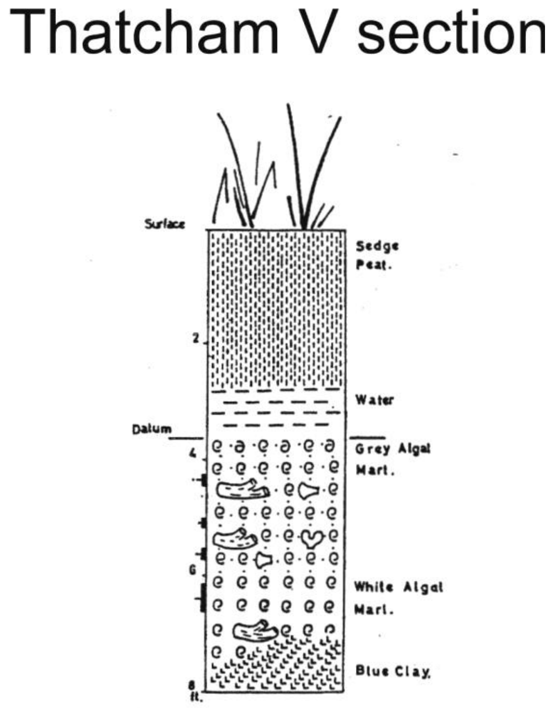


Figure 174: Section drawing of the depositional sequence at Thatcham V (Churchill 1962: 363)

In regards to cultural material within the deposits, Wymer states that flints were recovered from throughout the marl layers – indicating a prolonged period of occupation in the area. He also noted that well-preserved faunal remains were recovered from the marls, but that worked bone and antler was lacking (Wymer 1962, 336).

Churchill also draws a distinction between the *in-situ* algal marls which were encountered on the areas below the bluff and the "shell marl" layers which were consistently encountered in the higher areas (Sites I, II and III). He states that the presence of "randomly orientated algal concretions", the fact that the marl changes in consistency and thickness as it moves away from the gravel bluff, and the way in which it truncates the soft sediments which lie beneath it demonstrate that the "shell marl" has been re-deposited across the higher ground (Churchill 1962, 364) - leading to the term "terrace marl". He suggests that the terrace marl may have been washed across the upper terrace in flooding events which may have occurred in the lower terrace wetlands. This has important implications for the archaeological material recovered from the terrace marl, as it would have been originally deposited on the lower terrace and then re-deposited above the Mesolithic occupation sites by flooding action (Churchill 1962, 367).

Churchill also confirms that the "charcoal" layer, after inspection by Lambert, was re-identified as a desiccated peat deposit. Churchill re-terms the "charcoal" layer as "terrace peat"

(Churchill 1962, 366). This insight has implications for the stratigraphic sequences of Sites I, II and III as it means that the occupation episodes were sealed by a period of peat formation, and not a period of burning.

Further excavations of Mesolithic cultural deposits were carried out by Healy *et al.* (1992). These consisted of a 894m^2 open area excavation at a site to the north of Wymers work and set back from the gravel bluff on the higher terrace. The following general sequence of deposits was encountered across the site:

Mixed gravelly sand loam
Discontinuous dried silt containing re-deposited tufa
Localised layer of black, amorphorous, humified peat
Sandy loam
Basal gravels

(Healy et al. 1992, 43)

A large flint assemblage was recovered from the sandy loam, which immediately overlay the basal terrace gravels. This was plotted as two overlapping flint scatters, one focused in the north of the site and one focused in the south. Use wear analysis of a small sample of the assemblage showed a dominance of soft material working and scraping, and a general absence of the impact damage associated with projectile hunting. In the southern scatter, harder materials appeared to have been worked with using flint tools – possibly bone or antler. However, poor organic preservation at the site meant that no bone or antler was recovered during the excavations. A charred hazelnut shell (Healy et al. 1992, 71) from the sandy loam layer produced an AMS date of 8564-8008 cal. BC (BM-2744, 9100±100).

Chisham's (2004)work on the environmental history of the Kennet Valley offers further insight into the stratigraphy of the Thatcham sites. Although her palaeoenvironmental sampling was focused on the lower floodplain and not the upper terrace, she re-interprets the previous descriptions of the stratigraphic sequences (Churchill 1962; Wymer 1959, 1960, 1960, 1962) and re-identifies the "shell marl" deposits encountered across the upper terrace as tufa. She states that calcareous spring water running down the terrace, and into the floodplain would have created the system of shallow channels observed and planned by Wymer (1962), as water ran down the terrace through a braided channel system (Chisham 2004, 83). She notes that the same types of vegetation were recovered from within the tufa as were encountered within the upper peat of the floodplain – suggesting that substantial tufa formation occurred in the Early Mesolithic (based on ^{14}C AMS dates from the upper levels of said peat). The constriction of spring channels due to the formation of tufa may have also caused localised waterlogging on top of the terrace, and led to the formation of peat which was independent to the peat forming within the floodplain itself (Chisham 2004, 83).

5.37.2 Antler points from Thatcham

Two fragments of unbarbed antler points from Thatcham were located within the collections of the Reading Museum. 1962:213.1003 consists of the tang of a point, manufacturer from antler. Scraping has been applied to the SEN and DEX edges to shape the tang. At the proximal end, a series of faint nicking marks are observed – suggesting that nicking was used to thin the point at the proximal tip and create a tapering effect. The fact that these marking appear as faint traces implies that further finishing was applied to the tang before being deposited. At the distal end of the piece, a flexion break at the point where the tang joins the main point's stem suggests a break at the point of hafting.

Piece 1962.213:1004 consists of a cylindrical piece of antler, broken at both ends with a glued break visible halfway along the objects' length. It is interpreted as the midsection of an unbarbed point, with the tip and tang removed. Along the SEN and DEX edges, scraping facets are occasionally visible, but are obscured by a smoothing effect which is associated with a polish. As such, it appears that the point was shaped by longitudinal scraping, followed by grinding.

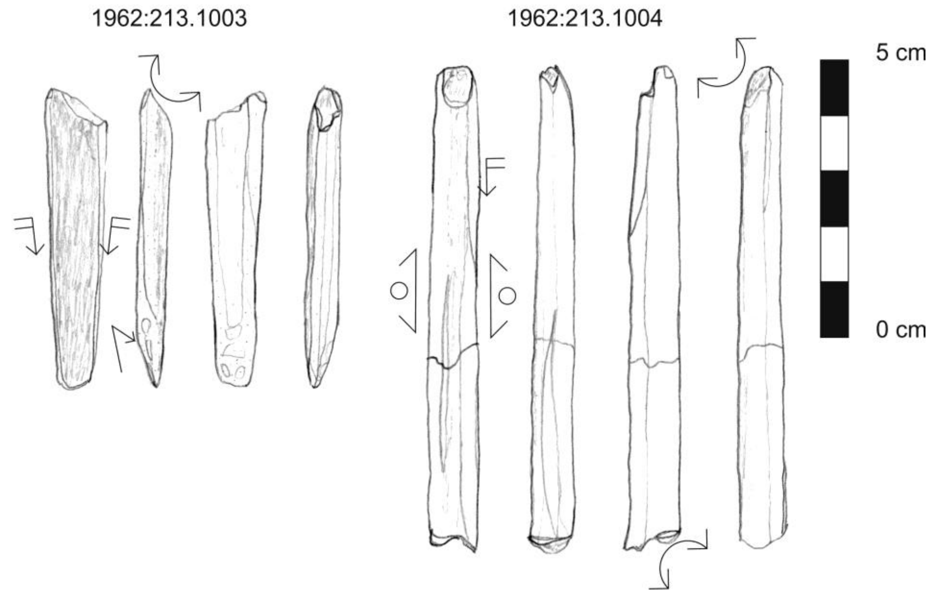


Figure 175: Fragments of antler points from Thatcham

5.37.3 *Lame de hauche* from Thatcham

A piece described as "worked antler tool" was recovered during Wymer's excavations at Thatcham IV at was located within the collections of Reading Museum (Figure 176). This artefact consists of a broad antler tine, based on the shape, length and tapering profile. The tine is elliptical in profile, and features broad channels along its length. It is notably dense, weighing 229g, despite lacking the heavy conservation work which can often add weight to archaeological antler. These factors combine to suggest that the artefact has been manufactured from an elk antler tine.

	Object length (mm)	Working face length (mm)	Angle (°)	Weight (g)
Maximum recorded by David	215.5	64	24	328
Minimum recorded by David	105	26	53	68
213:62.1005	205	83.7	27	229

Table 24: Comparison of dimensions of *lame de hauche* with 213:62.1005

Typologically, the artefact lacks the perforation required to be classified as an antler mattock (C Smith 1989). However, the form of the object is consistent with that of a *lame de hache* (E David 1998). This term can be roughly translated as "axe blade" in English. It features a working face and edge on one end, and shows signs of modification at the distal end of the object. The length of the object, the angle of the working edge and the artefact's weight fall within the ranges recorded by David (1998, 121–122) for a sample of 21 *lame de hauche* from Mesolithic contexts across Europe (Table 24). The length of the working face falls outside of the ranges noted (David 1998, 122), which may be attributable to the relatively small sample size used to define the typological category.

A working edge has been formed at the proximal end of the piece, and shows signs of subsequent scraping episodes and a dark polish. Jagged-edged damage is observed at the working edge, suggesting that the object was damaged in use. At the distal end of the object, a prepared break has been executed. Wymer originally commented that the distal end of the piece bore signs of grooving (Wymer 1962, 351). However, on review of the artefact, the area in question was not found to have been grooved. Two break edges were observed to intersect, but these edges displayed none of the internal cut surfaces or striations expected from grooving. A dark polish did adhere to the edges of the breaks, creating the impression of working marks. However, this polish was also observed across the distal break surfaces, and also extended along the EXT edge. The EXT edge is also marked by a series of nicking marks, associated with this polish. The modification of the profile of the object is interpreted as being produced to shape the artefact for insertion into a haft, whilst the polish is likely to have been created in the binding of the artefact to said haft.

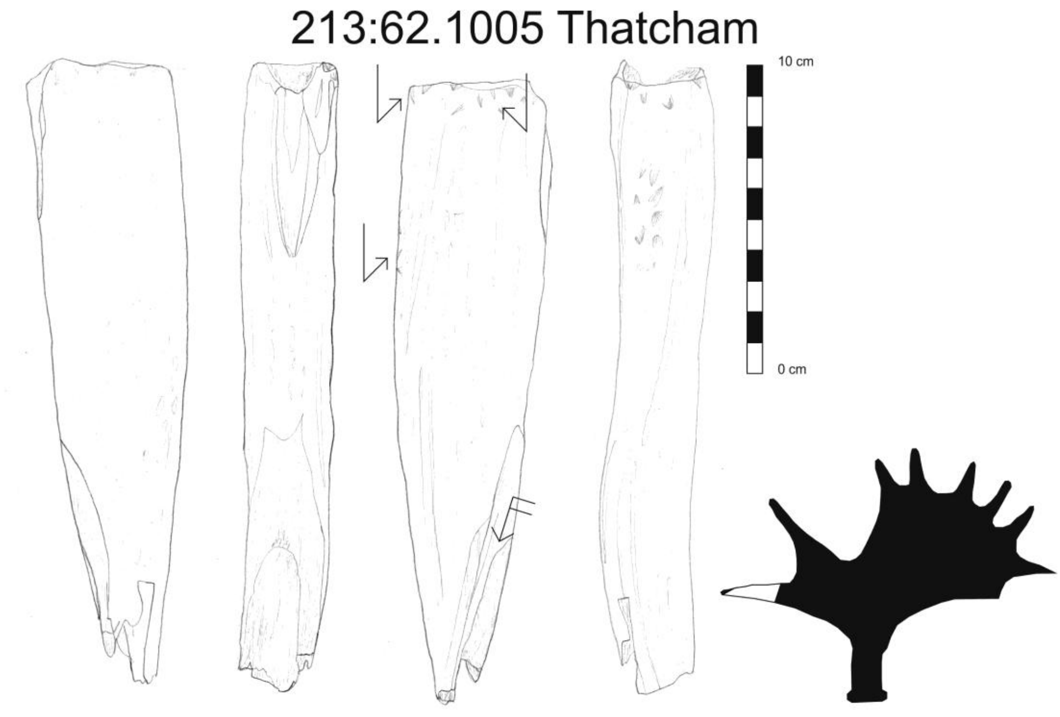


Figure 176: Antler *lame de hauche* from Thatcham

A fragmented working edge was also located within the collections of the Reading Museum. This consisted of the distinctive tip of a working edge, which had been broken into three pieces. Due to the presence of the *lame de hauche* at Thatcham, it is not clear whether this fragmented working edge formed part of another *lame de hauche* or a more conventional antler mattock tool. A thick polish adhered to the working edge and face of the piece and a series of randomly orientated, fine striations across the external aspect indicate that the object had been exposed to rodent gnawing after deposition. The fragmented nature of the working edge suggests that it was broken during use, as the working edge is the point of impact for tools of this type.

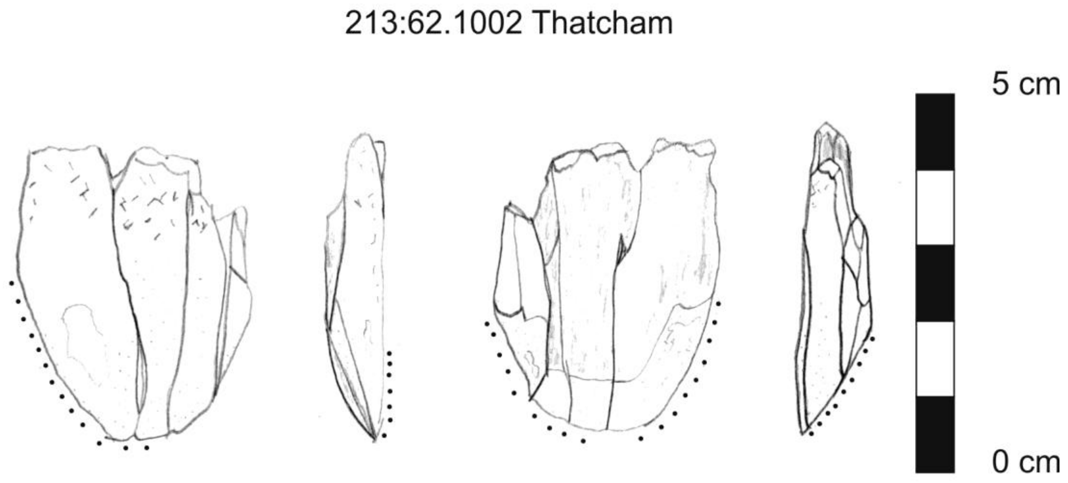


Figure 177: Fragmented working edge from Thatcham, Berkshire

5.37.4 Miscellaneous worked antler from Thatcham

A fragment of a miscellaneous artefact was located within the collections of Reading Museum, under the number 213:62.1007 (Figure 178). It features a scraped facet on the DEX edge, and a flexion break at the proximal end. On the internal aspect, an area of spongy tissue has been removed at the distal end (Figure 179). This area is sharply defined along its SEN and DEX sides, and features unidirectional longitudinal striations. It is consistent with the insertion of a sharp object into the antler, as might be expected with an antler sleeve haft fitted with a flint blade. However, the small size of the fragment implies that the inserted tool would have been proportionally sized. This is inconsistent with larger Mesolithic flint axes, but could well indicate the hafting of a smaller flint flake. The relationship of the scraped facet on the DEX edge with the insertion of a flint object is also unclear. If the piece represents the debitage of a broken sleeve, then it would be unusual for the exterior of the sleeve to be modified – particularly so close to the point into which the blade was inserted.

Figure 178: Miscellaneous antler debitage from Thatcham, Berkshire

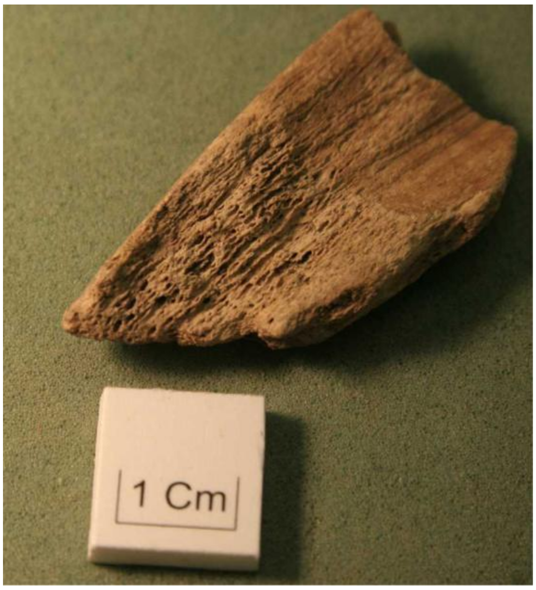


Figure 179: 213:62.1007 Thatcham. Negative from the insertion of a flint object

5.37.4 Antler *debitage* from Thatcham

Species	Quantity
Red deer	18
Roe deer	8
Elk	3

Table 25: Quantities of antler from Thatcham, in relation to species

29 pieces of red deer, roe deer and elk antler from Thatcham were located within the collections of the Natural History Museum and Reading Museum (Table 25). The material held at the Natural History Museum has been accessioned as a single collection, and is stored within its own cupboard. Individual numbers were assigned by the researcher for pieces, which incorporate the shelf number within the "Thatcham Cupboard". For instance, piece 3.5 would be the fifth piece of antler on the third shelf. Of these pieces, only five (three removed tines, a fragment of compactor and a re-fitted beam) showed clear signs of working (Figure 180).

Pieces 213:62.1014 and 213:62.1015 appeared to have been removed from the beam through nicking and a subsequent prepared break, and simple breakage respectively. Although covered in a thick, waxy conservation resin, 213:62.1021 features a tapering surface at the distal end, which was associated with nicking marks. This suggests that a prepared break was employed. However, at the proximal break, the surface was sharply defined and perfectly flat. This would appear to be consistent with sawing with a metal blade, but further examination was prevented by the obscuring conservation resin. The tip of piece 2.5 shows signs of modification and use (D in Figure 180). The extreme tip has been narrowed and sharpened through scraping, and displays a thick polish. Whilst fraying activities can create a polish and result in the tips of tines snapping, it is not possible for red deer to sharpen their antlers to this extent and with such precision through fraying (Jin & Shipman 2010). A further, highly fragmented and poorly preserved piece of red deer antler also displays a level break surface (E in Figure 180) at the beam, which suggests some form of prepared breakage. Unfortunately, the lack of preservation prevents any further insight into the methods of preparation.

Figure 180: Worked red deer antler from Thatcham, Berkshire. A) Removed tine 213:62.1014 B) Fragment of worked compactor 213:62.1021 C) Removed tine 213:62.1015 D) Worked tip of removed tine 2.5 E) Level break of unshed red deer antler beam 2.2

The remaining pieces show signs of being subjected to a range of different biological, taphonomic and post-depositional processes, but lack clear evidence for working. Many of the break surfaces observed do not display the characteristic surfaces which can be linked to the different methods of antler fracturation outlined in the Chapter 4, and such have been recorded as "undiagnostic". However, these breaks are often characterised by a thinning of the compactor tissue which is not associated with working marks, and a loss of spongy material. This may be symptomatic of a localised deterioration in the preservation of the antler (Milner et al. 2011). This suggestion is supported by the high proportion of material which has been glued during curation, which implied that material was either fragmented when recovered, or was recovered in a fragile state and has become fragmented during curation.

The roe deer antlers often display high levels of polish across the tines, and this may have been either created or accentuated through human utilisation. However, polish is also created through the fraying actions of the animals themselves, and so it is impossible to distinguish between the two processes. Gnawing marks of various sizes are apparent across the material.

Of particular note is the "antler hammer" which Wymer describes in association with two unshed pieces of antler. This piece features a series of randomly orientated marks, which are distributed across the anatomical surface of the antler (A and B in Figure 181). The form of these markings corresponds to the shape of mammalian canine teeth, and their random distribution and orientation makes it unlikely that they were created through repeated human action. If the piece had been utilised as a hammer, markings might be expected to be localised to a specific region (an area through which force could be consistently transferred into the subject material, in a controlled manner). The markings would also be expected to be associated with battery depressions or a general faceting of the antler surface. This does not appear to occur on the antler in question. The removed tines also lack any clear signs of working in the form of preparatory markings in association with the break edge (D in Figure 181), and crushing and gnawing marks are clearly visible at the distal break (C in Figure 181).

Figure 181: Red deer antler "hammer" from Thatcham. A) External aspect B) Internal aspect C) Chewing marks at distal break D) Unworked trez tine stump

5.37.4 Discussion of antlerworking at Thatcham

Analysis of the various pieces of worked antler at Thatcham can be brought together to facilitate a synthetic discussion of antlerworking practices at the site. Firstly, the spatial distribution of the material across the sites needs to be addressed. The level of spatial resolution to which each piece is recorded varies significantly (Table 26). Some pieces can be linked to sites, some to specific gridsquares and others to layers. However, as Wymer and Churchill fail to provide a numbering system for the layers within their section drawings, and the gridsquare system employed across the excavations appears to be inconsistently applied, the potential for discussing the spatial distribution of antlerworking practices across the Thatcham sites is limited.

Accession number	Label
213:62.1002	Thatcham E4/12 (4)
213:62.1003	Thatcham IV (5m)
213:62.1004	TII (4) T.D4
213:62.1005	Thatcham IV
213:62.1007	Thatcham site III
213:62.1014	N/a
213:62.1015	T2/AA1/6 (2)
213:62.1021	N/a
1.1	Thatcham 1961
1.2	Thatcham 1961
1.3	Thatcham 1961
1.4	Thatcham TIII/G4/9 (4)
2.1	N/a

2.2	Thatcham 1961 Thatcham III F3/3 (4)
2.3	TIII/52?/1/(4)
2.4	Thatcham
2.5	Thatcham 1961
2.6	Thatcham 1961 Thatcham III E4/10 (4)
2.7	Thatcham 1961 TIII/Channel 3 T4
2.8	Thatcham 1961
2.9	Thatcham 1961 T4? Back 4?
5.1	Thatcham V (5)
5.2	Thatcham V (5)
5.3	TII/GRID1/W10 (3)
5.4	TIII/G3-G4
5.5	TIII/4/10 (2)
5.6	TIII/A1/10 (2)
5.7	TI/07/2 (3)
5.8	N/a
6.1	Thatcham IV (5.nm)

Table 26: Labels of the antler material from Thatcham

It should also be noted that there is reason to believe that the material accessed does not constitute the entire Thatcham assemblage. One of the photographs provided by Wymer (1962, Plate XLVIII) shows a matching pair of what are identified as detached red deer crowns (but which may be roe deer crowns) from Site I. These could not be located within the collections of either the Natural History Museum or the Reading Museum. This implies that there remains a portion of the antler assemblage that has not been analysed (although as this is the only such piece, it can be assumed to be a relatively small portion).

Table 26 demonstrates that it is possible to ascribe the majority of the Thatcham material to at least the site level. Whilst this does not allow a discussion of antlerworking in relation to features such as palaeochannels, hearths or specific lithic scatters, it does allow some broad comparisons between sites (Figure 182) to be made. For instance, at Thatcham II it would appear that, although red deer antler beams were available for use, the material was not being intensively exploited as none of the beams themselves showed signs of working. However, the presence of the antler point fragment at Thatcham II indicates that tools were used and deposited at this location – as does the presence of the intentionally removed tine. What is lacking at Thatcham II is any clear evidence for *in situ* antlerworking. The unshed nature of the red deer antler appears to imply that some form of red deer carcass processing occurred at the site, but that this did not include the manufacture of antler tools.

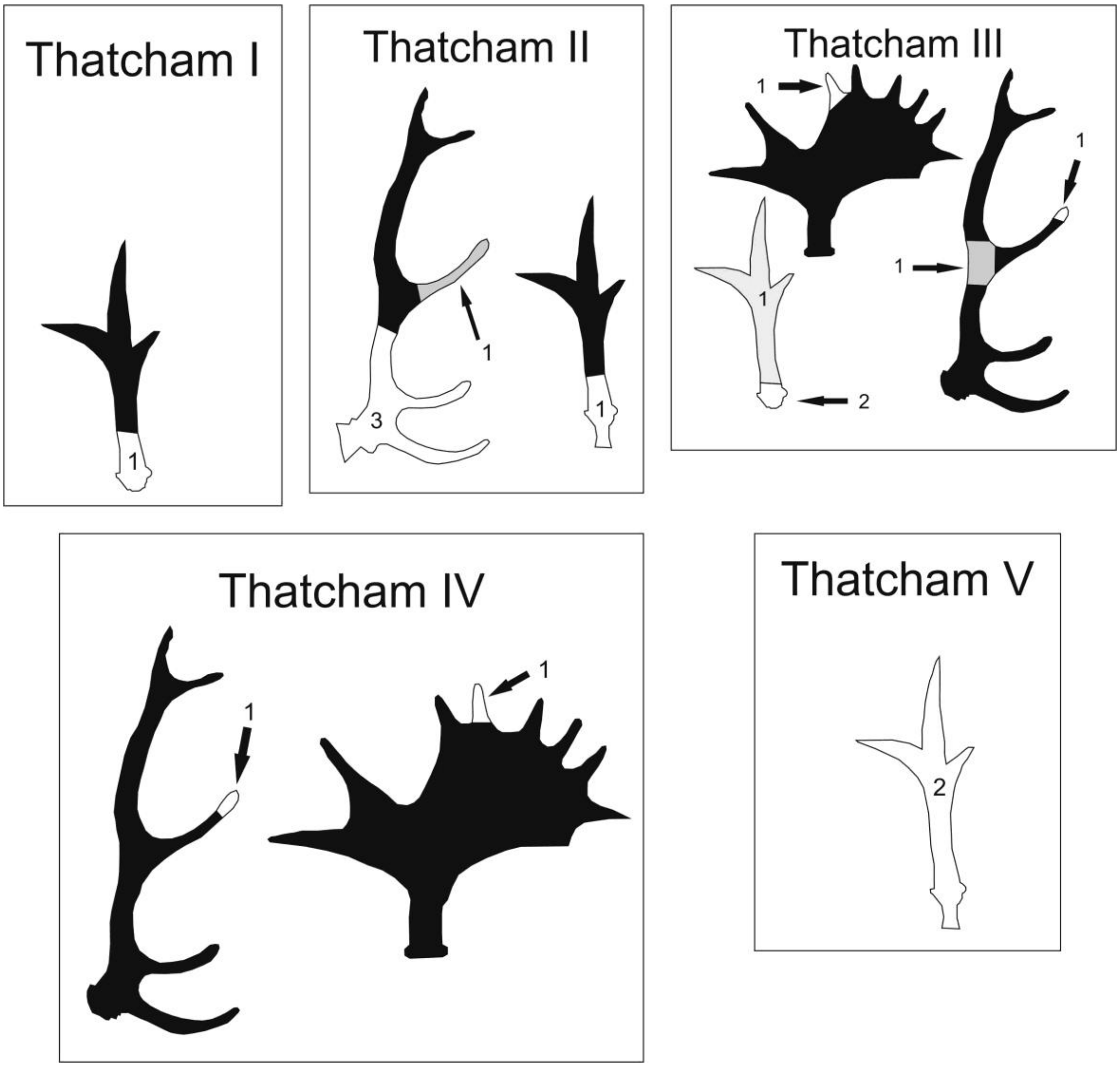


Figure 182: Economy of *debitage* for the Thatcham sites

At Thatcham I, the presence of a single portion of a shed roe deer antler indicates that this material was being collected and brought to the site. Whilst the lack of diagnostic working marks make the precise use of this material difficult to assess, the size and natural morphology of roe deer antler may have meant that it could be used without need of further modification (Clark 1954).

At Thatcham III, the antlerworking assemblage indicates a range of human activities. The enigmatic fragment of an antler sleeve would suggest that a hafted flint tool was used (and broken) at the site. Similarly, the fragmented mattock working edge would also imply that heavy tools were used at the site. However, the lack of large pieces of *debitage* would suggest that these tools were not manufactured *in situ* at Thatcham III. As with Site I, the presence of shed roe deer antler suggests that this was again being collected, but its utilisation is unclear. The presence of elk and red deer tines would suggest that these have also been brought to the site, as all other elements are lacking from the assemblage.

The occurrence of the two upturned, unshed red deer antlers with another unshed antler resting across the pedicle bones remains enigmatic. The antlers themselves appear to have been unworked, other than to have been removed from the deer's skull. Whilst the apparent hammer-marks referred to by Wymer have been re-identified as gnawing marks, the shell-marl around it may well be a tufa deposit. This would suggest that the original deposition of the antlers was followed by the covering of the area with spring water. However, as the antlers display gnawing marks, this gnawing must have occurred prior to the deposition as the gnawing activities of animals would have presumably dismantled the arrangement.

The recovery of tines alongside antler artefacts from Thatcham IV presents some interesting issues for the interpretation of this assemblage. This material was recovered from the lower floodplain area, within the lower levels of the deposit that Wymer describes as "white shell marl". Churchill identifies this deposit as *in situ* marl, which formed when clean open water conditions were present, and Chisham also identifies marl deposits at the northern end of the floodplain which she attributes to the formation of a narrow open water lake adjacent to the braided channel floodplain. This would seem to suggest that the material from Site IV was deposited into the open water. In the case of artefact 213:62.1005 this is particularly puzzling, as the working edge appears to have been broken in use. Either the artefact was broken whilst conducting activities in the open water and discarded, or it was broken elsewhere and transported to the open water before deposition. The presence of the tines and broken point tang suggests that other previously used antler material was also being deposited into the open water, although it is unclear how many discrete depositional events are represented within the assemblage.

The only antler material recovered from Thatcham V consists of two unshed roe deer antlers. Although the precise stratigraphic position of these pieces is unknown, Wymer states that the faunal remains from the site were recovered from within the marl. Unfortunately, this may mean that the antlers are from reworked marl (or possibly tufa) or the lower, in situ marl deposits. As such, it is impossible to ascertain whether the antlers were deposited directly into the open waters, or washed down by spring water running off the terrace.

To summarise the above discussion, the antlerworking assemblage excavated by Wymer at Thatcham appears to lack firm evidence for significant levels of *in situ* antlerworking at the sites. The use of red deer, roe deer and elk antler is documented in the small collection of antler artefacts and the apparent collection of shed roe deer antler. However, despite the availability of red deer antler at Site III (which had presumably been acquired in hunting and butchery activities), this material remained unused for the production of antler artefacts.

5.38 Greenham Dairy Farm, Berkshire

Although the existence of Mesolithic material culture at the Kennet Valley floodplain (Figure 169) site of Greenham Dairy Farm has been documented since 1894, systematic excavation was not carried out until the site itself came under threat from construction work in the 1960s (R Sheridan et al. 1967). Whilst clearing a forecourt area in preparation for concrete filling, a narrow gully was uncovered which contained large quantities of worked Mesolithic flint, bone and antler. Work on this area was carried out over five evenings resulting in the excavation of an area of gully roughly 75 ft^2. Occupational evidence appears to have been focused around this shallow, narrow gully which contained a series of stratified silt and marl deposits (Figure 183). The Mesolithic flint, bone and antler assemblage was found within this sequence, and was distributed within a black brown silt layer. A single radiocarbon date (Hedges et al. 2007) from a charred hazelnut shell recovered from within this layer produced a date of 8570-8210 cal. BC (OxA-5194, 9120±80 BP). When discussing the flint assemblage recovered from the site, Wymer (R Sheridan et al. 1967, 67) states that the presence of knapping *debitage* and finished tools suggests that the material was deposit as the result of *in-situ* occupational activity.

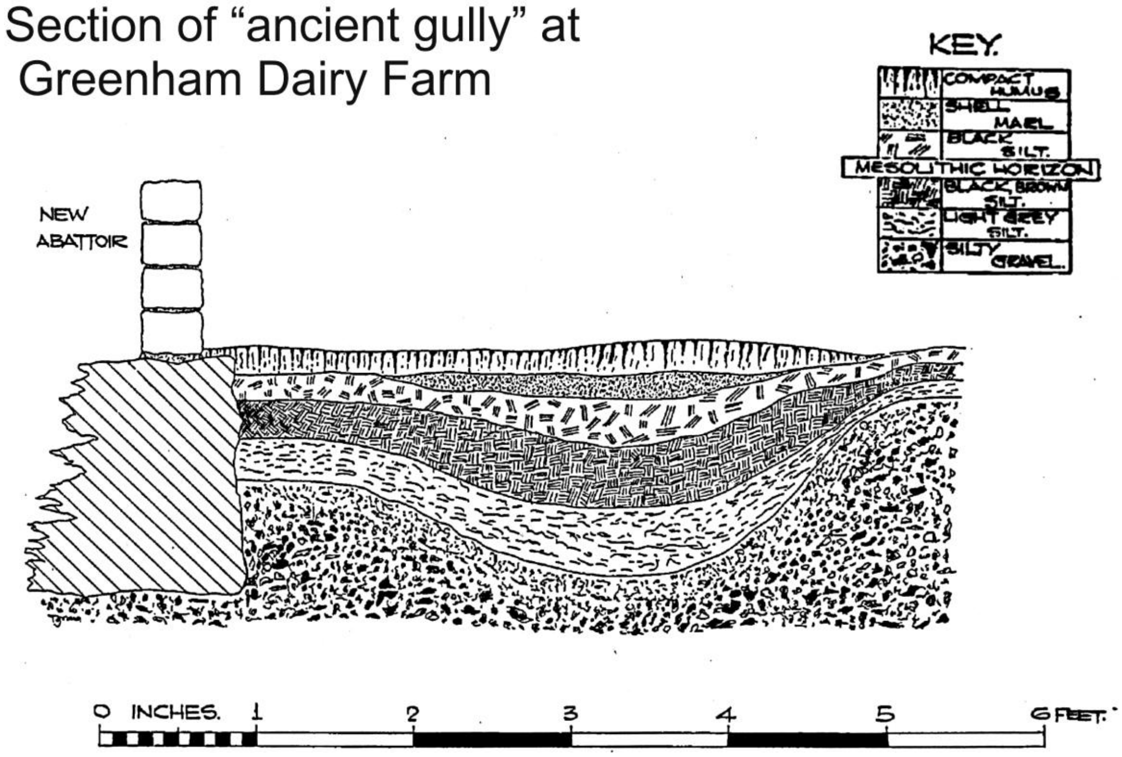


Figure 183: Section of deposits at Greenham Dairy Farm, Berkshire (R Sheridan et al. 1967, 71)

Unfortunately, the single antler artefact recovered during the excavations at Greenham Dairy Farm is currently housed at the Newbury Museum and is inaccessible whilst the museum undergoes a long-term renovation. The illustration provided by Sheridan *et al.* shows a piece of antler (which they identify as being red deer) which has been broken at an angle to create a working edge at the proximal end, and a level break around the circumference of the antler at the distal end. The authors describe this as a “chisel”, and make no reference to any form of perforation on the piece. Given the apparent form of this artefact, it can be tentatively identified as a *lame de hauche* and shares technological similarities with the specimen from Thatcham IV. This identification requires first hand analysis to be confirmed, as does the original species identification.

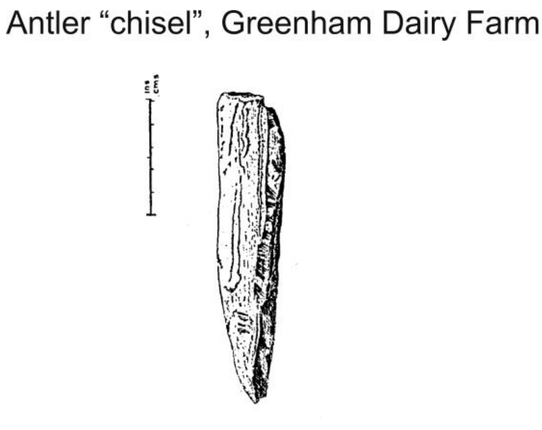


Figure 184: Antler artefact from Greenham Dairy Farm (R Sheridan et al. 1967, 73)

5.39 Westward Ho, Bideford Bay

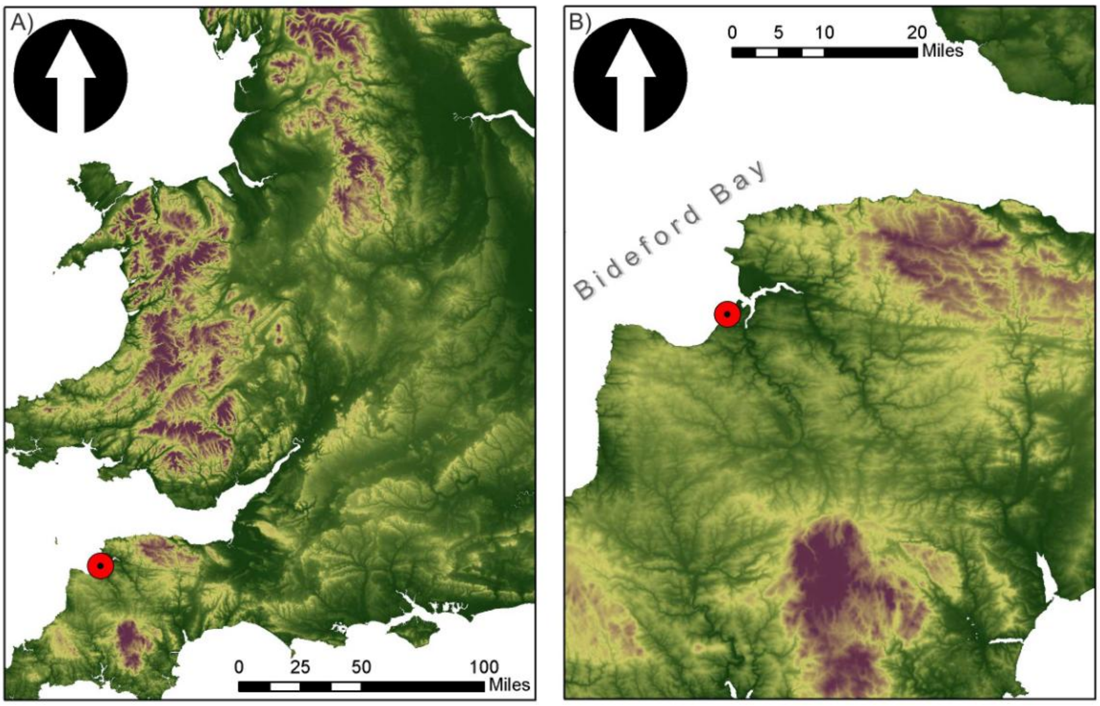


Figure 185: Location of Westward Ho, Bideford Bay

The existence of Mesolithic occupation evidence at Westward Ho, Bideford Bay (Figure 185) has been documented since the mid nineteenth century (Ellis 1866). However, there remains some considerable confusion over the dating of a series of deposits which have been observed at the Westward Ho beach, which creates subsequent complications for the dating of antler recovered from the site. The following section will take a historical approach to the published research on Westward Ho, to outline some of these problems.

Academic attention at Westward Ho was initially focused on the occurrence of a "submerged forest", and the significance of ancient tree-stumps preserved in peat in relation to the geology of the coast in the area. Ellis (1866) describes a sequence of deposits with a "forest bed" overlying a layer of carbonaceous grit and angular pebbles, overlying a blue mud (Ellis 1866, 80). Later, Young's (1906) work at the site describes the occurrence of "pygmy flints" (later to be known as microliths) within what he describes as a "blue clay" deposit, below the peat that Ellis originally identified (Young 1906, 267). He also notes the occurrence of faunal remains on the beach, which include examples of ox, deer and domesticated mammals. He refers to a collection of flints from a layer of yellow clay, which is only exposed at low Spring Tides following heavy storms, and terms this area of the beach a "kitchen midden" (Young 1906, 269).

I Rogers provides a more detailed description of the deposits themselves, and their history of discovery. He notes that the first documented exposure of the "submerged forest" occurred in the winter of 1963-4, when approximately 70 tree stumps were seen protruding from the peat (I Rogers 1908, 250). He notes that the deposits themselves were actively being eroded by wave action, with the thickness of the submerged forest peat being reduced from 4ft in 1879 to 1ft in 1908. Through the collection of well-preserved seeds from across the exposed peat layer, I Rogers interprets the environment as a brackish saltmarsh community (1908, 253). In regards to faunal material from the site, I Rogers notes that mammalian remains have been excavated from blue clay deposits across the beach and that “In my experience, no mammalian or other remains are ever seen at the shore free from clay” (I Rogers 1908, 254).

This statement is contradicted by Worth (1934), who reports on the recovery of a red deer antler from the beach at Westward Ho by the local collector B Webber. He notes a dark discolouration of the tip of one of the antler’s tines and suggests that this may indicate that it was deposited into the dark peat. This contradiction raises some significant issues for interpreting the antler from Westward Ho, which will be returned to later in this section.

Figure 186: Digitised version of section sketches provided by E Rogers (1946)

E Rogers (1946) gives a more detailed description of the depositional sequence at Westward Ho, and provides some of the first plans and section drawings for the site (Figure 187 and Figure 191). He notes the occurrence of two separate peat deposits – the inner peat and outer peat – and also a secondary pebble beach deposit which occurs at the low spring tide water level. E Rogers highlights the problems created by previous reports on the site, which have failed to plot spatially the precise location and character of the deposits, and suggests that multiple shell middens may have previously existed on the beach prior to recent erosion events. He also provides a series of photographs which document the stratigraphic relationship of the deposits he describes, helping to verify his section diagrams.

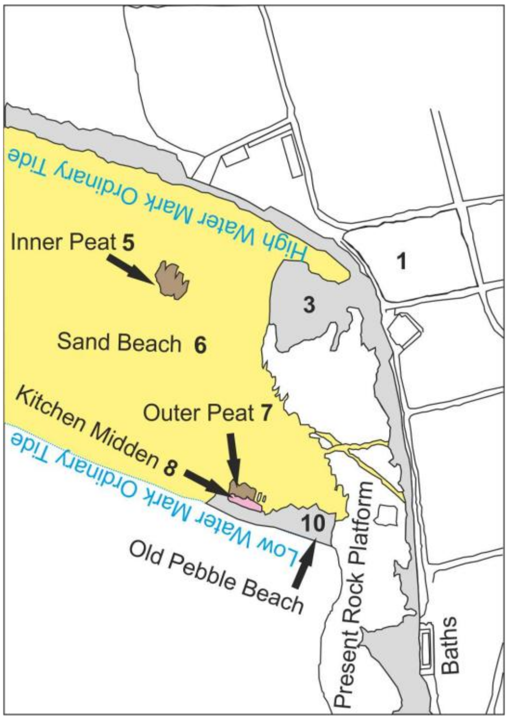


Figure 187: Digitised version of map provided by E Rogers (1946)

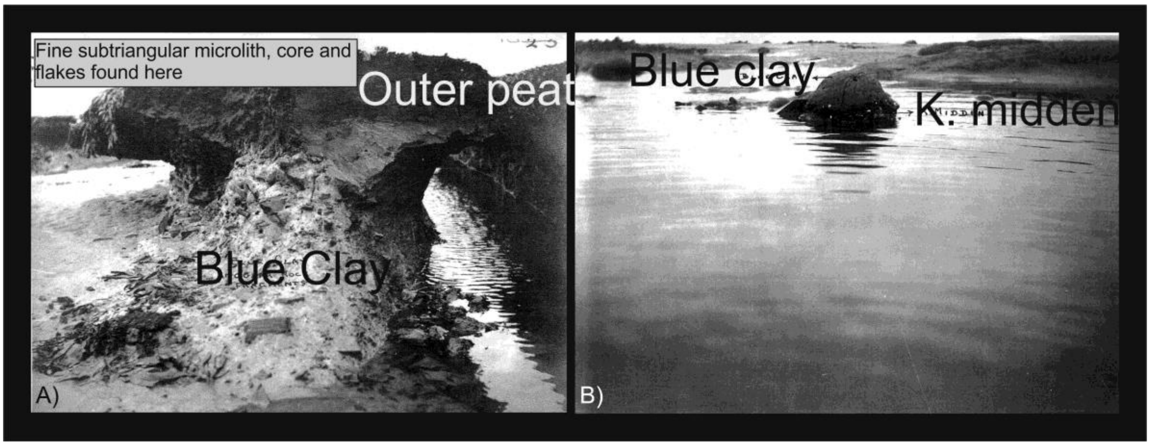


Figure 188: Photographs provided by E Rogers (1946) demonstrating stratigraphic relationship of different deposits at Westward Ho. A) Plate V showing outerpeat overlying blue clay B) Plate VII showing blue clay overlying kitchen midden deposit

Churchill (1965) later revisited Westward Ho to investigate the environmental conditions which were contemporary with the shell midden occupation. Churchill recorded and measured the visible deposits at the site and took samples for palaeoenvironmental analysis. He states that two outcrops of peat were visible on the beach, one of which (presumably the "outer peat") overlaid a kitchen midden layer. This layer was characterised by a high organic content and fragmented shell component. The midden was noted to occur within a shallow depression in the clay surface, and was just six inches in thickness. Churchill contrasts this to the thickness of two foot noted by Ellis (1866) and concludes that considerable erosion of the site has occurred. This is further supported by the absence of the clay deposit which E Rogers (1946) photographed sealing the peat above the kitchen midden. Churchill (1965, 75) ascribes this absence to wave erosion. Through pollen analysis of the samples taken from the kitchen midden and overlying peat, Churchill characterises the environment at the site as a mixed

Atlantic-period forest, featuring fen woodland species. A ^{14}C date from the upper peat overlying the midden produced a date of 5735-5306 cal. BC (Q-672 6585±130 BP), providing a chronological point that the midden itself my pre-date. He also concludes that the marine nature of the resources within the shell midden layer (the shell fish themselves) and the sealing clay layer described by E Rogers suggests strongly that the shell midden was located on the strand line during the time of occupation.

An extensive program of field work carried out by Balaam *et al.* (1987) has provided further insight into the character of human occupation at Westward Ho. Due to the ongoing erosion of the site, this projected aimed to record and evaluate the archaeological deposits at Westward Ho in as much detail as was possible. They note the practical problems faced when trying to record the precise locations of the deposits visible, which included the lack of accessible fixed reference points from which a survey could be orientated, and also the adverse weather conditions which are associated with the spring storms needed to reveal the deposits. However, a low resolution survey was carried out and supplemented by the use of aerial photography. From this, three areas of archaeological interest were identified (Balaam et al. 1987, 147). Area 1 consisted of an exposure of "inner peat" and a series of estuarine deposits immediately to the north of this exposure. Area 2 consisted of another exposure of peat midway between the high and low tide lines, which overlay the "blue clay". Area 3 consisted of an exposure of "outer peat" overlying a small area of shell midden and containing Mesolithic flints.

These three areas were investigated further through limited excavation and recording of sections to document the relationship between deposits (Balaam et al. 1987, 173). Samples were also removed for block excavation and palaeonvrinmental analysis. This work led the authors to propose the following basic sequence for the deposits at the Westward Ho beach:

Sand
Alluvium
Woody fen peat
Lower "blue clay"
Devenisan Drift
Ipswichian alluvium

However, the limited nature of the fieldwork leads Balaam *et al.* to concede that stratigraphic correlations between the areas are unreliable. As an alternative to presenting a holistic account of the depositional history of the beach (which would be undermined by the lack of secure stratigraphc correlation), Balaam *et al.* instead provide a more detailed description of the individual deposits themselves. They state that the "blue clay" is actually a uniform, fine silty clay loam (Balaam et al. 1987, 176). The acidic nature of the deposit lead the authors to believe that it was created under estuarine conditions (Balaam et al. 1987, 178), and the dating of charcoal from this layer produced two dates of 5470-4955 cal. BC (HAR-6215 6250±110 BP) and 5965-5482 cal. BC (HAR-5644 6770±120 BP). Material culture and charcoal was only encountered in the upper 10cm of the blue clay, and due to the disturbed nature of this area, this material was interpreted as having been worked down from human activity in the overlying peat (possibly through trampling).

A description of the intact midden deposit is also provided by Balaam *et al.* (1987). They echo Churchill's observation that the midden is formed within a shallow hollow of the underlying clay, and raise the possibility that this hollow has been created through anthropogenic action, due to the lack of associated disturbance with the cut itself. They state that root growth from the overlying peat layer has significantly disturbed the internal stratigraphy of the midden, with considerable mixing of the deposit observed (Balaam et al. 1987, 179). Balaam *et al.* provide two ^{14}C dates from bulk charcoal samples taken from within the midden – 5473-4585 cal. BC (HAR-5632 6100±200) and 5476-5061 cal. BC (HAR-5645 6320±90). They interpret the molluscan, insect fauna, pollen analysis and plant macrofossil evidence from the midden as indicative of an initial phase of mixed oak woodland with local pools of stagnant (but not brackish) water occurring. This is followed by a rise in the role of willow, birch and ivy within the pollen record, and the presence of more open ground and sand dunes in the general area – which is evidenced in pollen record, plant macrofossils and insect fauna (Balaam et al. 1987, 180). Analysis of the faunal material persevered in the midden demonstrated the presence of auroch, red deer and roe deer remains, and a highly fragmented collection of mussel and Peppery Furrow shell. A total of 1074 flints were recovered from both within the midden and at the interface between the midden and associated deposits. The presence of flints within the overlying peat and underlying clay was interpreted as the product of post-depositional mixing.

The "outer peat" deposit is confirmed as the "submerged forest" layer described by previous authors in Balaam *et al.*'s work, and was observed to overlie the midden deposit and surrounding blue clay. Fine laminations within this peat are interpreted by the authors as indicative of occasional, perhaps seasonal, flooding (Balaam et al. 1987, 180). A series of ^{14}C dates from the "outer peat" sequence indicate that peat formation began in the early sixth millennium cal. BC and continued into the early fourth millennium cal. BC (Figure 189).

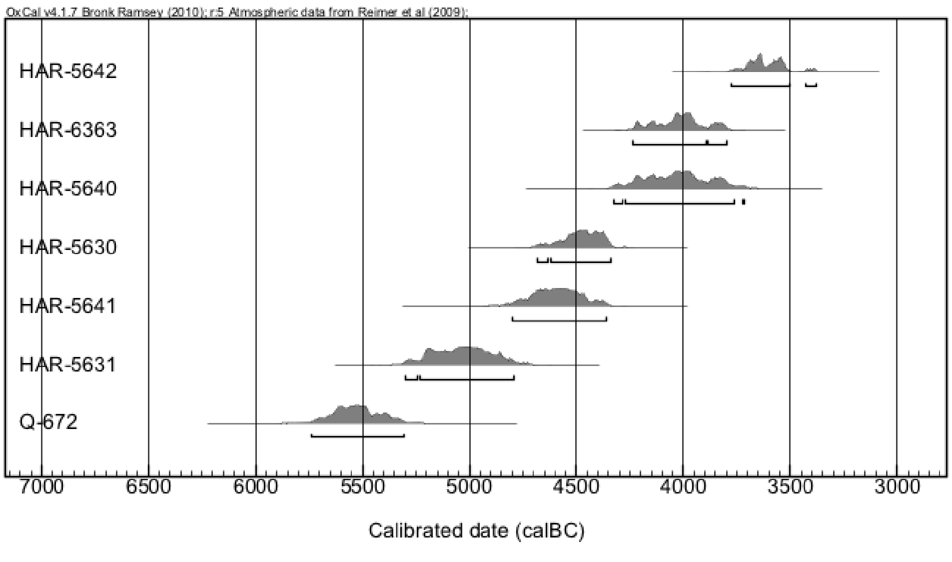


Figure 189: ^{14}C dates from the "outer peat" (Balaam et al. 1987; Churchill 1965)

Analysis of the palaeoenvironmental record preserved within the outer peat indicates that a typical Atlantic mixed forest, featuring oak, elm, ash, hazel and willow existed in the nearby vicinity during the peat formation (Balaam et al. 1987, 181). The pollen record and plant macrofossils suggest that oak, willow and hazel were actually growing in the peat itself, and that this in itself is indicative of areas of non-waterlogged ground within the peat during its formation. No direct evidence of human activity within the peat was encountered by Balaam *et al.* (1987, 182). However, a series of wooden stakes were found inserted *into* the peat from above, and these stakes were ^{14}C dated to 3776-3381 cal. BC (HAR-5642 4840±70 BP).

A small patch of a fine clay was encountered overlying the peat in Area 3 (Balaam et al. 1987, 183), and this was interpreted as the clay which had previously been observed to seal the peat at the kitchen midden site (E Rogers 1946). This was thought to be estuarine in its nature, and deposition post dated the latest period of "outer peat" formation (Figure 189).

Within Area 1, Balaam *et al.* describe the "inner peat" as a fen peat which in contrast to the "outer peat", lacked macroscopic wood fossils (Balaam et al. 1987, 185). Through the analysis of the pollen record preserved within the "inner peat" and the use of magnetic remanence dating, the authors state that the peat formed in the first century AD. The pollen and plant macrofossil record from the "inner peat" indicate more open conditions than during the formation of the "outer peat", with the presence of cereal grain pollen suggesting crop cultivation in the vicinity (Balaam et al. 1987, 186).

To the immediate north of the "outer peat", a series of silt filled channels were observed which were cut into a grey, estuarine silt (Balaam et al. 1987, 186). These were observed to overlie the "outer peat" itself, but the stratigraphic relationship between the various channels and their underlying deposit could not be established within the limited investigations of Balaam *et al.*'s project. This relationship was further complicated by extensive tidal erosion of these soft deposits. The channels themselves contained evidence of human activity in the form of collections of animal bone, wooden artefacts and shells. A ^{14}C date of 226-648 cal. BC (HAR-6513, 1560±80 BP) was obtained from an animal bone recovered from within one of these channels, whilst a date of 255-614 cal. BC (HAR-6440, 1600±80 BP) was obtained from a wooden artefact recovered in the silt underlying another channel.

Further material from Westward Ho beach is commented on by Quinnell (2003, 3–6), who publishes sherds of Beaker pottery recovered from the beach by an amateur collector, Mr Trapnell. Quinnell is able to establish, through correspondence with the finder, that the find was made on a patch of clay which was exposed during a low spring tide storm in 1992. However, the author notes that further to this it is unclear which of the estuarine deposits that these finds originated from (Quinnell 2003, 5). This find was followed by another sherd of prehistoric pottery – a piece of Peterborough Ware dated on typological grounds to the Early Neolithic (Quinnell & R Taylor 2007). The finder states that it was recovered floating in a pool of water which had formed on an exposed area of clay at the low tide line (Quinnell & R Taylor 2007, 231). These finds demonstrate that the deposition of material culture and human activity within the sediments at Westward Ho spans a range of prehistoric periods including the late Mesolithic, early Neolithic, early Bronze Age and Romano-British periods.

A large collection of 86 pieces of shed red deer antler has been recovered from the beach at Westward Ho, and is currently held at the Royal Albert Memorial Museum, Exeter. The museum accessions catalogue and archives indicates that these have been donated by a series of private collectors, who have been recovering material which has become exposed on the beach during storms or low spring tides. Some of these collectors were collecting material over prolonged periods of time. Archived correspondence between collectors and the museum curators indicates that some first began collecting material in the 1930's and continued to do so until 2004. This is significant, given the ongoing erosion at the site, which has affected the cultural and non-cultural sediments at the site. It is possible that some of the material collected may have originated from deposits which no longer exist at the site itself. Unfortunately, there is also no record of the contexts from which this material has been recovered. None of these antlers show any signs of working which could indicate the period of time to which they date, and there is a total lack of any antler artefacts which prevents typological affinities being drawn. Additionally, none of the antler has been directly ^{14}C dated (Thomas Cadbury *Pers. Comms.*).

This makes the relevance of this assemblage to this thesis problematic. It remains possible that they have eroded from the "outer peat" or shell midden layers and thus be associated with the Mesolithic occupation site. It is, however, impossible to ascribe any one piece to this context, due to the methods by which they were recovered and the lack of spatial recording on the part of the amateur collectors who recovered the material. Conversely, the lack of spatial data makes the definitive ascription of a post-Mesolithic data impossible for any one piece.

It is possible that the antler may have eroded from the Romano-British estuarine deposits or inner peat and therefore be much more recent in date. Balaam *et al.* note the occurrence of concentrations of animal bone and antler within the channels and fills to the immediate north of the "inner peat" deposit, and it is possible that more of the antler within the Royal Albert Memorial Museum collections originated from these deposits.

As there are no signs of human modification, and the antler has been shed, it is also difficult to ascribe their occurrence to human activity – they may have been shed naturally in the fen-woodland environments documented through the palaeonevinromental analysis of the "inner" and "outer" peats. Balaam *et al.* note the possibility of continuous peat formation from the late Mesolithic through to the Romano-British period – based on the character of the pollen spectra within the deposits and ^{14}C dates derived from material deposited into the peats. Over this period of time, it is entirely possible that the 86 pieces of shed red deer antler may have accumulated naturally in the area, as red deer shed their antlers directly into peat-forming deposits.

Furthermore, the presence of beaker pottery on the beach suggests that human occupation may have been occurring in periods other than the Mesolithic and Romano-British. The lack of *in-situ* evidence for these periods may be a result of the destructive erosion which has affected the beach, and given that the antler material has been collected from the beach for over a century, it may relate to another period of past human activity which have subsequently been obscured by erosion.

Given the unknown nature of all of these factors, it becomes impossible to demonstrate that any individual piece of antler in the Royal Albert Memorial Museum's collection of material from Westward Ho can be directly attributable to the dated Mesolithic deposits at the site. For this reason, the material was not considered relevant to this study. Even if the material could be linked to a specific type of deposit (peat, clay or sand) the fact that multiple deposits of similar sediments appear to form at different times during the development of the Westward Ho beach means that this cannot be used to demonstrate an affinity with a specific period of occupation. Furthermore, the fact that this material was collected *after* erosion means that the area from which a specific piece was recovered need not necessarily equate to an area into which a piece was originally deposited – material can be transported during the process of erosion itself. Short of a direct ^{14}C date from individual pieces of antler, it is difficult to envisage how any single piece of this assemblage can be positively linked with any of the periods of occupation at the site.

5.40 Romsey, Hampshire

5.39.1 Context of recovery

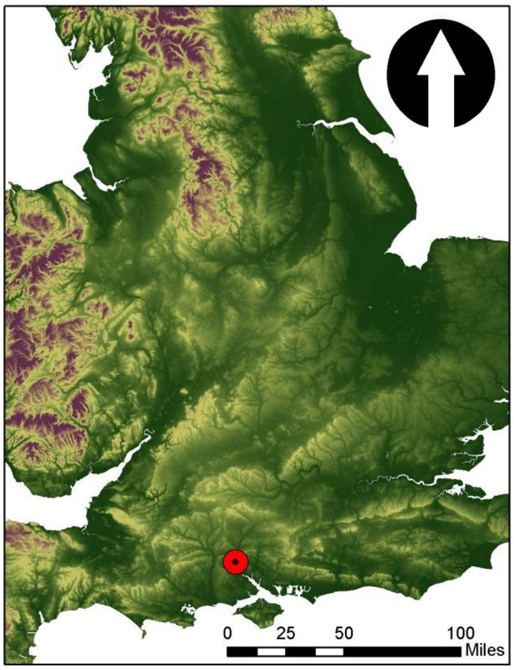


Figure 190: Location of Romsey findspot, Hampshire

Smith (1934, 144) describes the recovery of a decorated antler tine which was donated to the British Museum by S Percival in 1934. He states that the object was found during excavations for the construction of a septic tank, at a site where the Salisbury Road leaves Romsey. The tine itself was recovered from a layer of "greenish muddy sand mixed with gravel" at a depth of around 20ft below the surface and 8ft above the banks of the nearby River Test. No other material culture was found associated with the tine. Smith notes the parallels between the Romsey Horn and a decorated tine from Svaerdborg in Denmark, which shares a very similar style of chevrons. Clark (1969) has linked the chevrons observed on the Romsey Horn to similar finds from across Europe. He states that they created through incision with a fine and sharp tool, and that these methods of decoration are exemplified by the assemblages of Svaerdborg and Holmegaard in Denmark (Clark 1969, 162). He notes that they form part of a wider group of bone and antler artefacts featuring "single chevrons often one placed above another" which is "scattered indiscriminately over the whole of the North European plain," (Clark 1969, 172). However, due to the isolated nature of this form of decoration within Britain, Clark is unable to draw any more meaningful parrellels between the Romsey Horn and other sites in regard to its decoration. Although not published, the British Museum have directly AMS dated the Romsey Horn to 7595-7522 cal. BC (OxA-17161, 8517±40 BP).

5.39.2 Decorated antler tine from Romsey

The decorated antler tine from Romsey was located within the collections of the British Museum (Figure 191). The curved form of the tine suggests that it is a bez or trez tine of a red deer antler. The whole piece is covered by a red, lustrous opaque resin which has presumably been applied in conservation. This overlies some areas where the original surface of the object has flaked away, indicating that some drying damage was sustained before the application of the resin. The tine features signs of polish at the distal tip, and rounding consistent with the damage sustained in fraying. There are also signs of modification in the form of a small scraped facet in the tip region.

The decoration itself consists of four rows of chevrons which run along the length of the tine with 72 chevrons being observed in total. Three of the rows run from the base of the tine towards the tip, whilst the fourth is reversed with the chevrons "pointing" from the tip down towards the proximal break. The chevrons are made through the incision of two, short converging lines. The proximal break appears to have been made through breakage, and the break edge is observed to cut the incised grooves of the chevrons themselves. This suggests that the decoration extended onto the adjacent areas of the antler, prior to the execution of the proximal break, and that the tine is only a fragment of a larger decorated antler artefact.

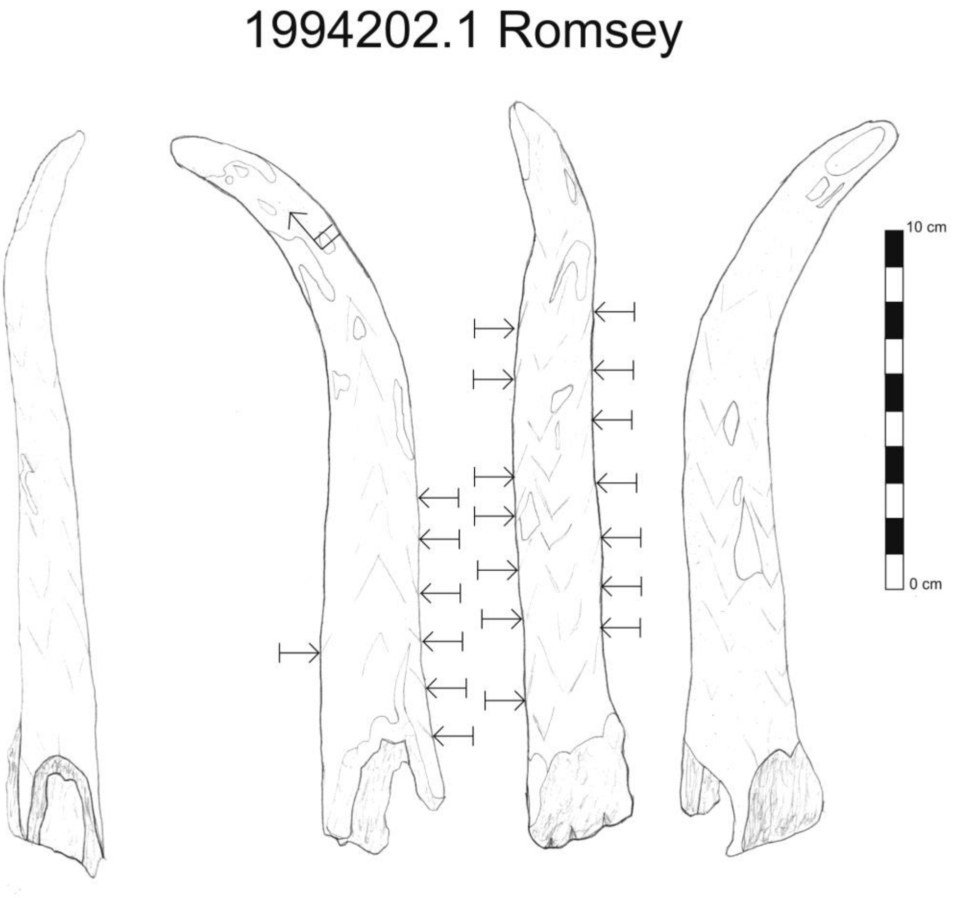


Figure 191: Decorated antler tine from Romsey

5.41 Conclusion

The above section has presented the results of the traceological analysis of antler material from 39 Mesolithic sites across England, Scotland and Wales. This has provided new insights into the technological sequences involved in the manufacture and use of a range of different types of antler-based material culture including uniserial and biserial barbed points, biserial harpoons, beam mattocks, base mattocks and bevel-ended tools. Further to the suite of tools that have been previously linked to the Mesolithic through ^{14}C verified typologies (Chapter 5), a new type of artefact can now be tentatively attributed to the Mesolithic in Britain – the *lame de hauche*. All three species of deer present within the British Mesolithic have evidence for the utilisation of their antler, although to dramatically varying extents. At sites where a range of antler artefacts and manufacturing *debitage* has been deposited, a site focused discussion of the *chaîne opératoire* has been possible, subject to a range of critical caveats. These sequences have been shown to include the re-use of antler material through both repair of broken objects and the intentional fragmentation of existing tools to create raw material for the manufacture of different antler objects. Patterns within this data will be explored within Chapter 7, which will discuss the deal with trends concerning temporal and spatial distribution and variations within the manufacture and use of antler objects, and the wider significance of these patterns in relation to the human/deer interaction within the Mesolithic.

Chapter 6: Deer in ecology in the British Mesolithic

6.1 Introduction

Having reviewed the literature on British Mesolithic antlerworking (Chapter 2), it is clear that any discussion of this practice needs to be considered within the wider context of people/deer relations. This approach of emphasising animal behaviour within interpretations of human action in relation to animal materials has been outlined and advocated by Conneller (2011). She highlights the role that the actions of animals can play in the way that humans perceive them, and the process by which this perception is constructed through a combination of both individual and collective encounters. She also notes ways in which these perceptions – shaped by animal behaviour – confer meaning on animal materials and exert agency over the ways in which they are acquired, used and deposited. This argument seems a key consideration then, when attempting to understand the use of antler as a material in the British Mesolithic. Whilst it may be impossible to provide the more traditional types of contextual data retrospectively, it *is* possible to discuss the dynamic, temporal and multi-gendered nature of human and deer interactions based on the biology of the species themselves and the variation in environmental conditions which characterise the Mesolithic period. Chapter 3 will address this, by examining the ways in which people and deer may have encountered each other at a landscape level during the British Mesolithic. This will form the context of human/deer interaction, into which the use of antler can be placed.

This chapter therefore aims to outline the characteristics of deer behaviour and ecology during the British Mesolithic, and thus characterise the relationship between people and deer during the period. In doing so, it will fulfill Objective 2 of this thesis. This will be achieved by first introducing some of the universal principals of antler biology and development, which apply to all species of antler-bearing deer. Following this, the physiology, diet and social structure of the relevant species will be discussed – these being widely accepted (Yalden 1999) as *Cervus elaphus* (Red deer), *Capreolus capreolus* (Roe deer) and *Alces alces* (Elk). In order to address the issue of changes in deer behaviour throughout the period, the various environmental conditions documented in the English, Scottish and Welsh Mesolithic palaeoenvironmental record will then be outlined, and their implications for human/deer interaction discussed.

6.2 Antler

Antlers are osseous organs which can be found on the vast majority of species belonging to the *cervidae* (deer) family (Whitehead 1964). Uniformly they are attached to the skull through an extension of the frontal bone, which is termed a pedicle. Although both male and female deer develop pedicles, it is usually the males which develop antlers (Muir 1985, 1). The most famous exception to this is the case of *Rangifer tarandus* (Reindeer), where antlers develop in both males and females. Hormonal imbalances and trauma to the pedicle region have also been known to lead to the anomalous development of antlers in females of other species (Chapman 1975, 157).

The annual cycle of antler development and loss is characterised by periods of vascular growth followed by the rapid ossification of this tissue. The cycle is concluded when the antlers are "cast" by separation at the pedicle – the original source of growth (Muir 1985, 2). The first cycle of antler growth typically begins when a male deer begins puberty. Initial secretions of testosterone trigger antlers to grow from the pedicles in a single, straight and thin protrusion known as a “spike” or “pricket”. These often lack the thick ring of osseous tissue which builds up around the interface between pedicle and antler, known as the “burr”.

Following this slightly anomalous first year, a more regular pattern is established and maintained for the remainder of the animal’s life. Growth at the pedicle begins with a layer of skin forming across the bone left exposed from the previous casting. This tissue begins to thicken, with a layer of chondroblast cells swiftly forming below the skin. Cartilage is rapidly built up below the tip of the newly growing antler, with the more proximal areas becoming progressively ossified in a manner similar to that observed at the cartilaginous growing plates of long bones (Macewen 1920, 8). Ossified material is laid down in a spongy, air-filled cortical structure at the centre of the antler, with a thick layer of compactor tissue around the exterior of the organ. The compactor tissues’ thickness is such that, once fully ossified, the material is technically dead due to the osteoblast cells’ isolation from vascular circulation. The tip of the antler is therefore the centre of growth, and in instances where tines are formed or antlers diverge, multiple growing centres are created in the form of cartilaginous caps at the tines and antler tips (Muir 1985, 5).The exact form of the antlers varies from species to species, and a description of the species relevant to the British Mesolithic is provided below.

As the cartilage cap advances further away from the pedicle, a specially adapted form of skin grows rapidly to cover the entire antler. This “velvet” differs from the skin which forms over bone in response to trauma, as it features high densities of hair follicles, glands and vascular channels. These not only provide the osteoblast cells with the amino acids required to synthesise collagen molecules, they also remove aerobic and anaerobic waste products and maintain optimum temperatures for rapid antler growth (Muir 1985, 6). Major vascular channels run along the length of the forming antler, between the velvet and the ossifying cartilage, and these form a lasting impression on the surface texture of the antler itself. Once antler growth is completed, the velvet is removed in the “cleaning” process. This commences after the full ossification of the antler and is fuelled by a behavioural change in the deer, which will rub or “fray” the antlers against abrasive surfaces. This removes the velvet tissue to reveal the fully formed and ossified antlers (Harris & Duff 1970, 20).

Antlers are cast annually through a standardised process which results in the removal of the antlers from the pedicle. This begins with the dissolution of the adjoining bony tissue between the live bone of the pedicle and the dead tissue of the antler. This is replaced by connective tissue, as the collagen molecules are broken down. The skin of the pedicle then begins to infringe on the connective tissue and form across the pedicle surface, further separating the pedicle from the antler and ultimately resulting in the casting of the antler itself (see Figure 192)

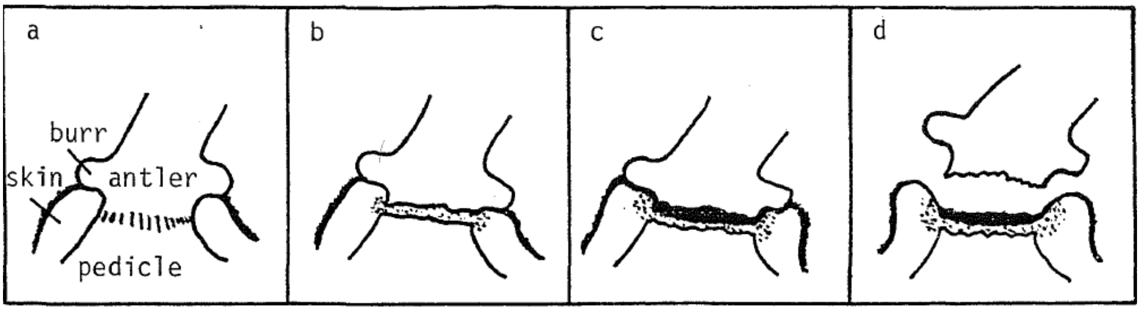


Figure 192: Sequence of antler casting (Muir 1985, 4)

6.3 Red Deer (*Cervus elaphus*)

6.3.1 Physiology

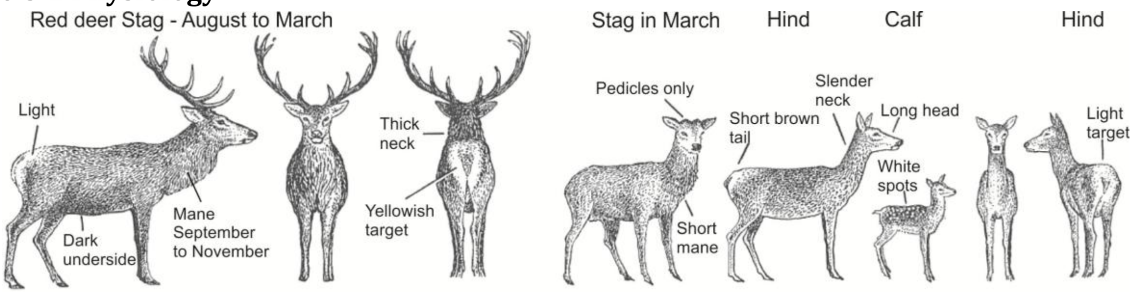


Figure 193: Guide to identifying Cervus Elaphus (Red deer) (Taylor Page 1971, 30)

The physiology of *Cervus elaphus* (red deer) varies considerably with environmental conditions, between sexes and throughout an individual's life-cycle. However, certain factors do remain constant and the basic physiology is shown in Figure 193 . Modern British red deer males grow to a shoulder height of 107-137cm, whilst females are slightly shorter at 107-122cm (The Deer Initiative 2008a). Breeding occurs during the "rut" season of the early autumn, with most conceptions occurring in the second and third week of October (Clutton-Brock et al. 1982, 54). Gestation periods last around 34 weeks (236 ±5 days), with most calves being born in and around June (Clutton-Brock et al. 1982, 62). The annual biological cycle of red deer is shown in Figure 194.

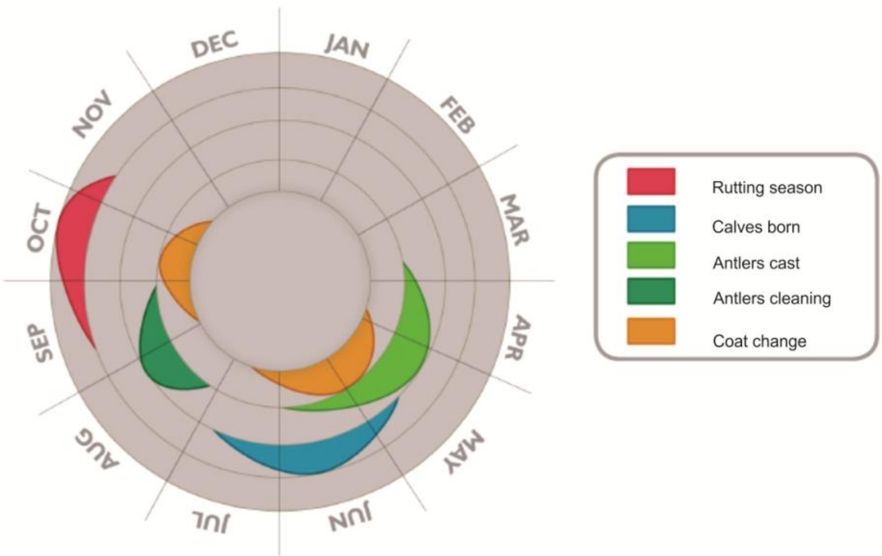


Figure 194: Annual biological cycle of red deer (The Deer Initiative 2008a)

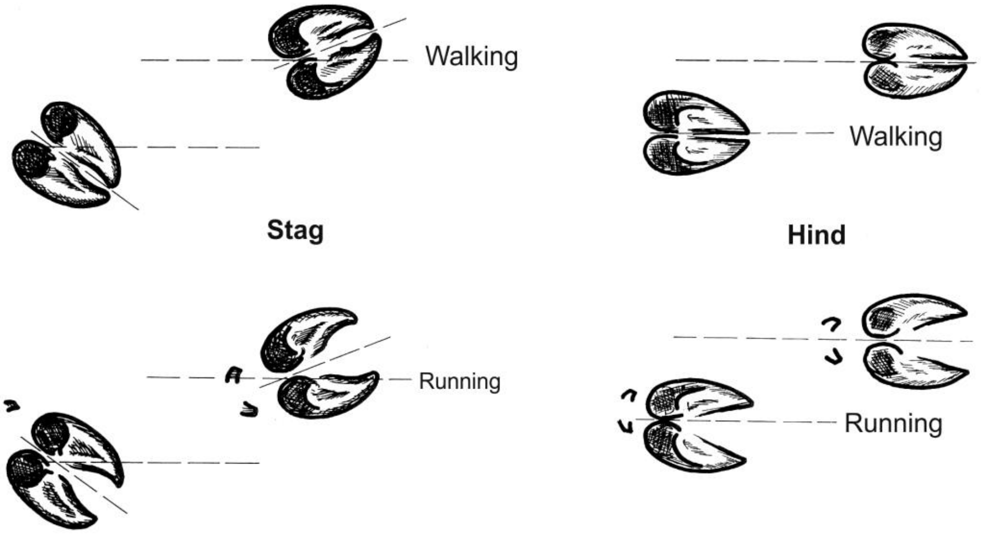


Figure 195: Red deer slots (de Nahlik 1987, 140)

The gait of the red deer is also distinctive (Figure 196), taking the form of a "trot" action which can be extended into a cantor or shortened into a slow walk (Taylor Page 1971, 42). The size, gait and form of the toe arrangement of red deer produces a characteristic print (or "slot") which can be identified and followed (Figure 195). These can convey information regarding the age and sex of the individual, as well as the pace at which the animal was moving (de Nahlik 1987, 138–142).

Figure 196: Trotting gait of a red deer stag (Taylor Page 1971, 42)

Body mass is one aspect of red deer physiology that is known to vary in different contexts. Figure 197 shows the "larder weight" of the red deer shot on the isle of Rhum, Scotland 1958-1976. These values indicate the weight of the deer's carcass following the removal of the alimentary tract and the bleedable blood. The term "milk hind" refers to a female red deer with a surviving calf, whilst "yield hind" refers to females without a calf. Whilst obviously not giving a sense of the total live-weight of the animals, Figure 197 does illustrate the variations between male and females within a population of red deer, and also the role that gestation plays in determining the size of individuals. In 21st century Britain, red deer stags are known to grow to a maximum live-weight value of around 150 kg, with equally large hinds being roughly one third lighter (Carne 2000, 11).

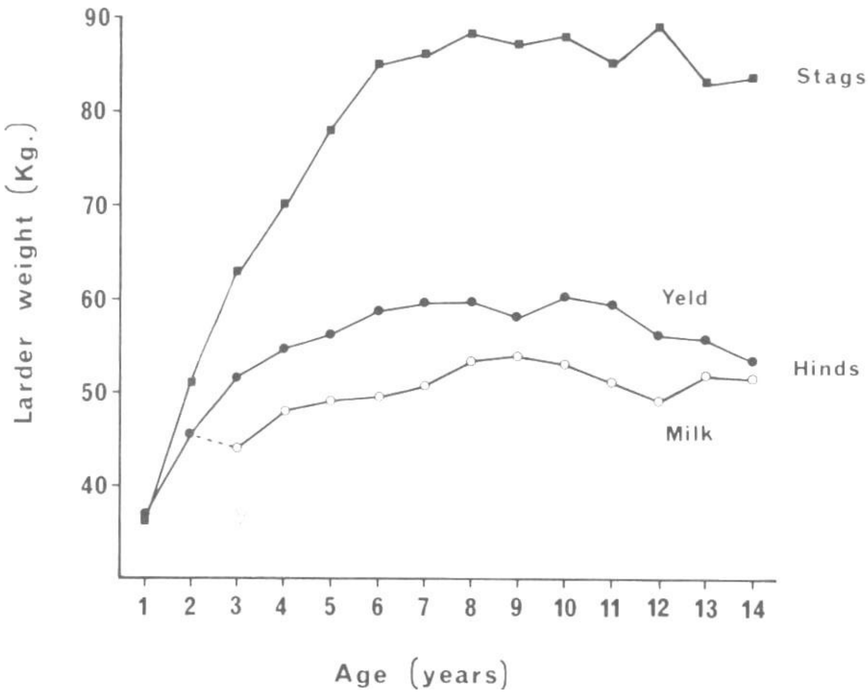


Figure 197: The "larder weights" of stags, milk hinds and yield hinds shot on Rhum 1958-1976 (Clutton-Brock et al. 1982, 18)

It has also been shown that weather can have a considerable influence on the size of individual red deer (Clutton-Brock & Albon 1989, 136–9). Small scale variations in climatic conditions can cause fluctuations in body size from year to year. This varies between males and females, with stag body weight being more reduced by cold winters, and hind body weight being more reduced by wet summers.

6.3.2 Diet

Red deer favour flowering plants, foliage and browse. In contrast to the closely related *Cervus canadenis*, grasses play a less prominent role in the diet. They have a low rate of digestive absorption, which leads to a higher food uptake rate than other, more efficient European mammals – a red deer's food uptake can be twice as much as that of a sheep, per unit of metabolic mass (Geist 1998, 208). Red deer browsing tends to be focused at a height of 1.6m above ground, producing a characteristic and identifiable pattern of damage on browsed foliage (The Deer Initiative 2008b).

In regards to browse preference, the work of Gerbert and Verheyden-Tixier (2001) in reviewing various studies of red deer stomach contents can cast some considerable insight. They found that the diet was wide ranging (including a total of 145 plant species, from the 16 populations examined), but generally dominated by four principal groups. These include grasses and sedges (29.6%), *Calluna* (Heather) and *Vaccinium* (Berries) (23.3%), leaves of deciduous trees and shrubs (10.2%) and conifers (8.8%) (Gebert & Verheyden-Tixier 2001, 194). However, Gerbert and Verheyden-Tixier note that differences in habitat can impact on the composition of the diet. Deer in moorland environments lack the leaves of deciduous trees, *Rubus* (Brambles) and twigs and bark which are replaced by heather, berries and forbes. In contrast, the diet of red deer living in mixed-deciduous forest conditions is characterised by the lack of heather and berries, and the consumption of twigs, bark and brambles. Animals living in mixed-coniferous forests have a diet which is lacking in twigs, bark and brambles, compensated for by an increase in heather and berries (Gebert & Verheyden-Tixier 2001, 196).

Clutton-Brock and Albon (1989) also provide a discussion of the ways in which red deer feed, based on observations of Highland deer populations in Scotland. They note that feeding is usually divided into 6-10 bouts of activity, interspersed with rest and rumination periods, with total grazing time amounting to 10-12 hours per day. Although foraging occurs throughout the 24 hours, less time is invested during the night than in daylight. Feeding is also noted to intensify at certain times of the year, with food intake dropping by as much as 40% between September and December. This recovers during the late winter to peak again during the early spring. This is believed to be linked to hormonal changes brought on by longer daylight hours (Clutton-Brock & Albon 1989, 83).

6.3.3 Social structure

The social structure of red deer changes on a yearly cycle, corresponding with hormone-driven reproductive behaviour. Generally, mature males will separate themselves from females and young for the majority of the year. During this separation, matriarchal and patriarchal groups co-exist amicably, sharing feeding grounds and moving around daily ranges with varying degrees of overlap. However, this pattern transforms during the Autumn rutting season, when males become aggressively territorial. Individual males will compete with each other for the right to breed with female groups – often driving away immature males from their mothers. Competition between the males is played out through a complicated sequence of behavioural practices which include roaring, parading, trotting alongside one another and finally the famous rushing where stags lower their antlers and charge towards each other in a contest of strength. Associated with this, stags also display increased levels of wallowing, masturbation, scent-spraying and urinate more frequently to mark their territory and warn off competitors (Clutton-Brock et al. 1982, 105–117). All stags participate in the rut, although most "contests" never progress further than the early stages. In the majority of cases, only prime-age individuals will successfully win the right to mate with a group of females (De Nahlik 1987).

Similarly to diet, red deer behaviour also displays varying levels of plasticity in different environmental conditions. Animals living in open conditions and at high altitudes are known to aggregate into large herds of up to 40 individuals, and migrate between upland to lowland in the Autumn and Spring (Clutton-Brock et al. 1982, 227–229). However, when inhabiting more heavily forested landscapes, red deer do not form the larger groups seen in the open. This has been highlighted by Legge and Rowley-Conwy (1988, 15–16), who note that the data provided by Ratclife and Staines (1982) shows a decrease in the modal group size from 40 in open conditions to just 2 in woodland. In the mixed forest and agricultural landscapes of Southern Sweden, Ahlen (1965) demonstrates that the modal group size for females consists of 2-3 mature does and 1-2 young, whilst stags are most commonly found to move in isolation.

6.3.4 Antlers

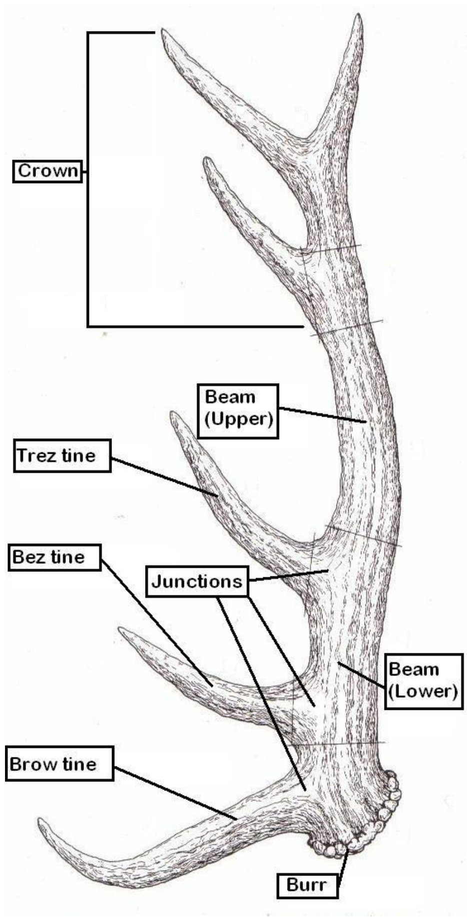


Figure 198: Annotated diagram of a red deer antler

Red deer antlers can reach considerable sizes, and their growth rates and form are affected by a number of interlinked factors. In the first year of growth, antlers take the form of a single "spike" or "pricket". Following this, the form of the antlers becomes gradually more complex, with more tines being added, until the deer enters old age (see Figure 199). At this point, the form begins to simplify regressively. The exact shape, weight and number of tines varies between individuals, even when they are of the same age and living in similar conditions. This makes antler form a key criteria for identifying and counting red deer populations in Britain today. Genetics are thought to play a prominent role in generating this variation (Mayle et al. 1999).

Typically, red deer cast their antlers in late March. However, the exact date of casting can be affected by population pressure (denser populated areas result in later casting dates (T Clutton-Brock & Albon 1989)), diet (well-fed stags casting earlier (Darling 1937)), age (older stags casting earlier than younger stags (Carne 2000, 12) and weather (T Clutton-Brock et al. 1982). These factors are inter-dependent but can combine in unusual ways to make exact casting dates difficult to predict.

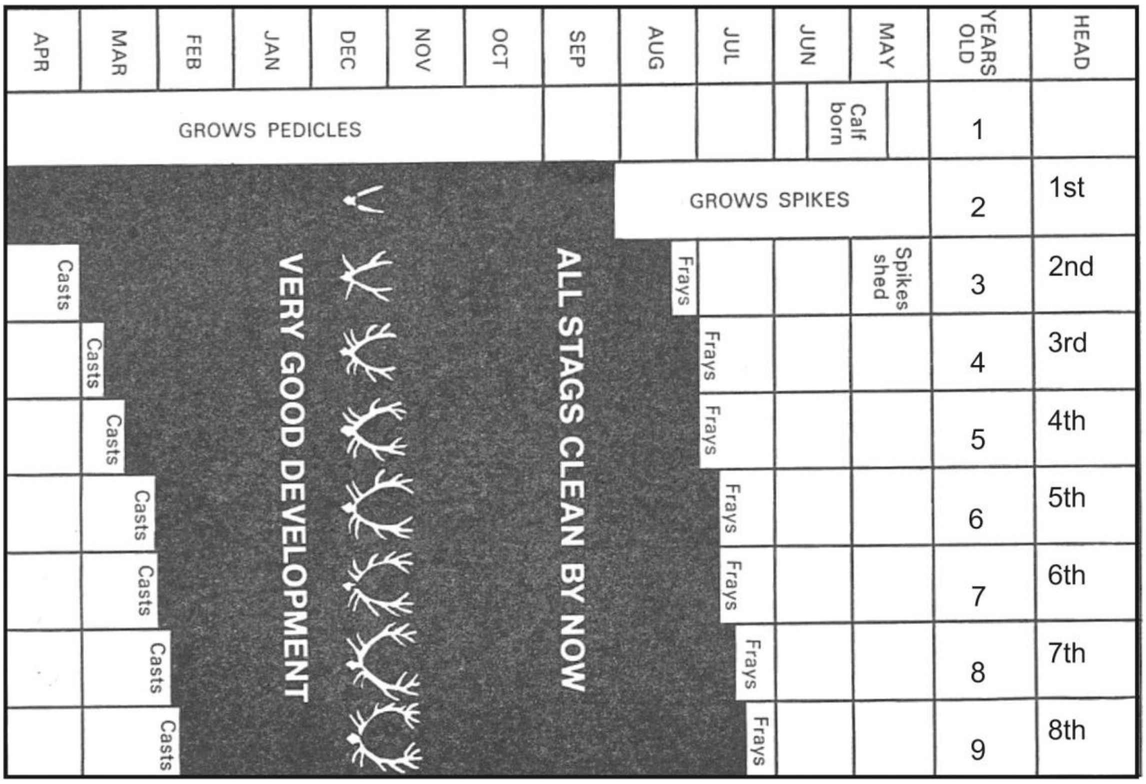


Figure 199: Development of red deer antlers with age (Taylor Page 1971, 36)

6.4 Roe deer (*Capreolus capreolus*)

6.4.1 Physiology

Capreolus caprolus (roe deer) are notably smaller than red deer, and are the smallest species of deer known to be present in Britain during the Mesolithic period. The basic body shape of males (bucks), females (does) and infants (kids) are shown in Figure 200. The average live weight for males living in modern populations is around 25kg, with females lighter at 23kg. Roe deer physiology displays much less environmental plasticity in comparison to red deer – even animals living in controlled, optimal conditions rarely obtain a liveweight of 30kg (Geist 1998, 306).

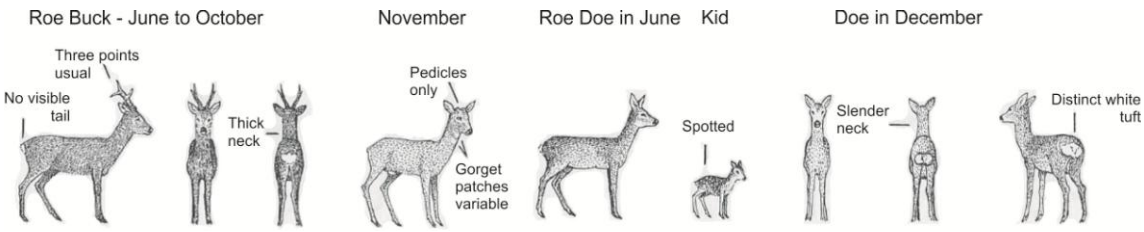


Figure 200: Guide to identifying *Capreolus capreolus* (roe deer) (Taylor Page 1971, 32)

Roe deer stand to a height (at the shoulder) of 60-75cm (Carne 2000, 13), existing for the most part below the cover of shrubs and undergrowth. Their short legs and springy gait (see Figure 201) is adapted to that of saltatorial runners, and roe will often hide rather than run from predators. Their low endurance levels result in them being easily run down by dogs in open land and a higher vulnerability to predation from wolves in comparison to red deer (Geist 1998, 308). Roe deer create similar tracks to those of red deer, but are notably smaller at about one third of the total length of a red deer slot (de Nahlik 1987, 143).

Figure 201: Gait of roe deer buck (Taylor Page 1971, 43)

Roe deer are noted for their unusual reproductive cycles, which feature delayed gestation as a means of postponing the annual birth of fawns. Following mating during the summer rut, fertilised eggs lie dormant in the uterus until late December, when the fetus begins to develop. From this moment onwards, the gestation period lasts 150 days resulting in the birth in late spring (Geist 1998, 303). This delayed impregnation allows a different structure to the annual reproductive cycle, and as a consequence males rut during the summer when browse and cover is abundant (see Figure 202).

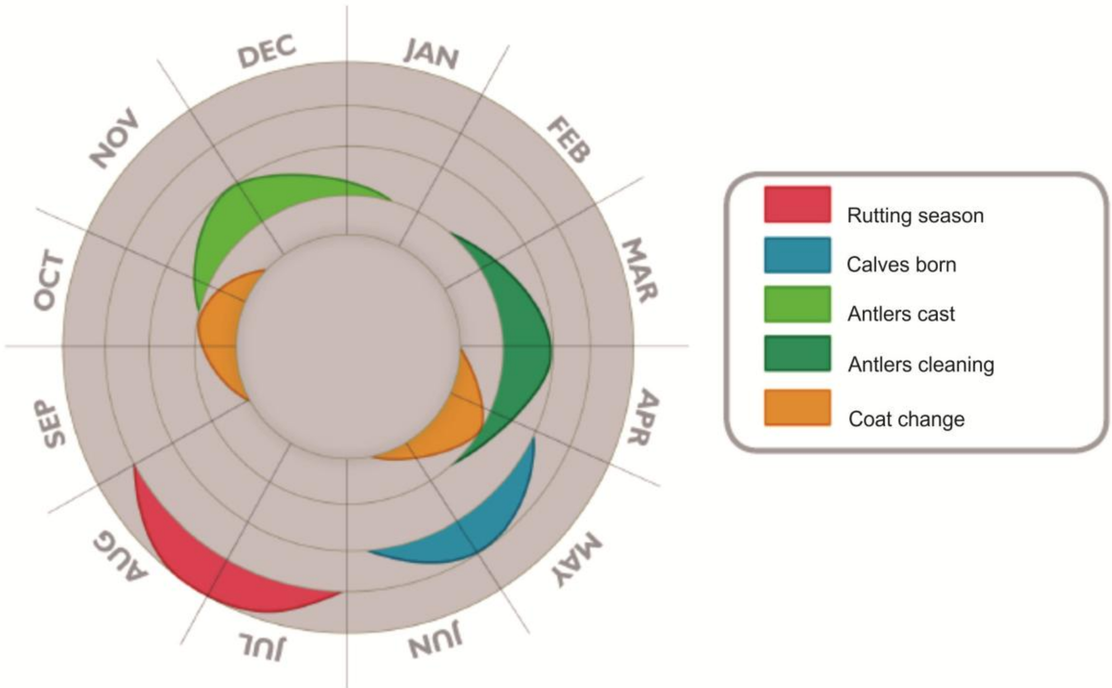


Figure 202: Annual biological cycle of roe deer (The Deer Initiative 2008c)

6.4.2 Diet

Roe deer diet shares several similarities with that of elk, both being noted to switch between concentrate feeding strategies in the summer months to high-fibre foraging in the winter (Geist 1998, 302). It is also characterised by a favouring of early succession plant communities (*ibid.* 303) and a subsequent attraction to areas affected by localised ecological disasters such as fires, flooding, deforestation, glacial action etc. The smaller stature of roe deer limits the height of browse that these animals are able to exploit, and as such the browse damage of roe deer tends to be focused around a 1.2m above ground level (The Deer Initiative 2008b). Cornelis *et al.*'s (1999) review of a multitude of studies into roe deer dietary composition has shown a closer correlation with habitat than season in triggering variations in roe feeding behaviour. Through the analysis of 36 primary studies of roe deer diet, weighted averages were calculated which summarise the variations in diet between seasons and habitats (see Table 27 and Table 28).

Habitat	Graminoids	Herbs	Ferns	Fungi	Half-woody plants	Dwarf shrubs	Coniferous browse	Deciduous browse	Cultivated plants	Others
Agricultural area	4.59	7.41	0	0.17	0.84	0	1.86	16.25	68.51	0.37
Coniferous forest	15.59	11.29	4.66	0.42	1.5	44.07	20.57	0	0	1.9
Deciduous forest	2.26	12.79	1	0.91	37.72	3.06	5.04	30.26	0.05	6.91
Mixed forest	3.91	8.38	0.59	2.36	27.46	18.05	5.17	17.62	1.48	14.98

Table 27: Weighted average values of roe deer dietary components in varying habitats (%) (Cornelius *et al*. 1999, 205)

Season	Graminoids	Herbs	Ferns	Fungi	Half-woody plants	Dwarf shrubs	Coniferous browse	Deciduous browse	Cultivated plants	Others
Spring	10.12	14.50	0.57	0.51	19.56	12.59	3.95	16.48	11.66	10.06
Summer	2.97	16.80	1.60	1.04	20.26	10.51	1.27	24.23	10.24	11.07
Autumn	3.74	7.86	1.29	3.94	22.58	17.93	3.40	20.39	8.62	10.24
Winter	5.22	4.80	0.96	0.54	19.57	17.01	11.60	12.64	20.94	6.71
Yearly weighted average	5.32	9.34	1.08	1.41	20.38	15.29	6.54	17.17	14.58	8.88

Table 28: Weighted average values of roe deer dietary components in varying seasons (%) (Cornelis et al. 1999, 204)

6.4.3 Social structure

Roe deer have an intricate social structure which is radically different to that of red deer, and is influenced considerably by the delayed impregnation of does during the autumn and early winter. One key factor of roe deer social structure is the establishment of both male and female territories in the spring, as a precursor to the summer rut (Geist 1998, 304). Bucks become gradually more aggressive and intolerant of other does and bucks as their antlers develop during the winter (*ibid.* 313). By spring they actively begin to compete for territories which offer good feeding grounds, but also shelter from the elements and cover from predators (Carne 2000, 14). These areas are established through visual markings and scenting – achieved in a number of ways. Urination, the marking of trees with antlers, pawing of the ground to create scrapes and the subsequent scenting of these scrapes through defecation and urination are all used to define an individual buck's territory (Harris & Duff 1970, 66). During the establishment of these territories, young males are driven from their nursery areas and weaker males also displaced. As a result, large numbers of old, young, injured and sick bucks are forced to exploit less favourable habitats for the remainder of the rut. These disorientated and exposed individuals subsequently become vulnerable to predation, leading to high mortality rates amongst those displaced (Geist 1998, 311). The annual displacement of a large proportion of the male population also results in the rapid dispersal of roe deer populations within favourable environments (*ibid.* 305).

Once dominant bucks have established their territories, does select a mate based on the quality and size of their territory. Following this selection the buck will "bond" a doe to the territory through a sequence of posturing, urinating, grooming, chasing and petting actions, which build a strong attachment between individual bucks and does (Geist 1998, 309). More time is invested by bucks in the bonding of yearling does than older individuals (*ibid*. 304).

Mating during the rut is initiated by does, when they come into estrus. They call with a soft, high pitched bark which draws the buck to their location. A circular chase then ensues, which can often take the form of a figure-of-eight, revolving around a single bush or tree trunk. This activity can last a considerable amount of time, with the doe taking rests which are respected by the buck, and results in the establishment of "rutting tracks", or a circular, linearly cleared path which is visible throughout the summer (Geist 1998, 309–10). Following impregnation, yearling does will establish their own territories which partially overlap with that of the selected buck. These are marked again through urination and scenting. During the summer, ranges of does overlap with each other, often with maternally related does living in closer proximity and loose kinship groups developing (*ibid.* 312).

As the rutting season continues, large bucks will successfully mate with the does bonded to their own territory, and will begin to roam and mate more opportunistically. This results in the impregnation of does who have not been able to establish their own territories (Harris & Duff 1970, 71), but also contributes to the breakdown of the buck territorial system, as the more dominant males abandon their home ranges to follow the calls of any available doe in the area (Geist 1998, 310). It is at this time that the only fights between bucks are likely to break out. These feature the characteristic locking of antlers in strength tests, but also butting from the side which can cause considerable damage through puncture wounds (see Figure 203). As a consequence, although roe buck fights are less frequent than in other species, they have a higher mortality rate (Harris & Duff 1970, 71).

Figure 203: Puncture wounds in the skin and flesh of a roe deer carcass, caused by fight during the rut (The Deer Initiative 2008c)

Following the rut, the enforcement of territories loosens somewhat, and roe deer confine themselves to their own home ranges. There is occasionally a resumption of rutting behaviour by some males during October, the so-called "false rut" which is thought to be linked to hormonal changes. Otherwise, roe deer revert to a solitary lifestyle in forested areas or parkland and form herds in open environments (Geist 1998, 305). Following the casting of antlers in the late autumn/early winter, bucks become much more passive and co-exist more peacefully and in closer proximity to other bucks and does. The distribution of maternally related deer in certain areas results in the development of loose kin-groups, where territorial boundaries are respected rather than physically enforced, and certain degrees of co-operation are observed through the use of warning barks to signal common threats (Taylor Page 1971, 29). This co-existence is interrupted by the birth of fawns during May/June. This results in the re-establishment of territorial behaviour on the part of the does, as they begin to maintain exclusive nursery ranges.

6.4.4 Antlers

Roe deer antler development commences following casting in November and December, and occurs throughout the winter months (Geist 1998, 304). The completion of growth is marked by the removal of velvet, though the precise date of velvet cleaning can vary between individuals with older and well-fed bucks clean before young or poorly nourished individuals. Cleaning also occurs after the initial phases of territory negotiation have begun, with the process being hastened by the use of antlers to mark trees during the spring (*ibid.* 310). The development of roe deer antlers is similar to that of red deer, in that the form of the antlers become gradually more complex as the buck becomes older. In yearling bucks, the antlers take the form of "buttons" or small knobular growths of antler tissue which develop 6 months after birth and are swiftly shed in February (see Figure 204). Following this, antlers become progressively longer and thicker, although the number of tines does not vary to the same extent as in red deer. The size of fully developed antlers has also been shown to be much less affected by environmental factors than those of red deer with an average length of 17cm, basal circumference of 11.3 cm and a density of 4.71 g/cm^3 being broadly adhered to by roe deer populations across Europe (Linnell et al. 1998). It has also been noted that roe deer does (females) are also much more likely to develop antlers due to hormonal imbalances than in other species of deer (Carne 2000, 14).

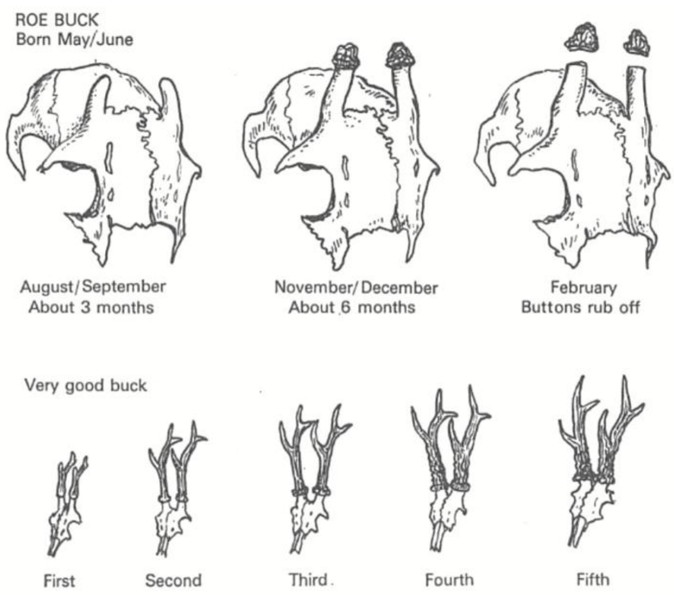


Figure 204: Development of roe deer antlers (Taylor Page 1971, 38)

6.5 Elk (*Alces alces*)

6.5.1 Physiology

Alces alces (Elk) are the largest member of the family *cervidae*, and have an unusual physiology in relation to other species of deer. Through the study of elk populations in North America, mean liveweights of around 530kg have been calculated for mature adults, but individuals can obtain weights of up to 700kg (Geist 1998, 254). Elk are noted for being extremely long legged, and reach shoulder heights of 2-2.3m (Whitehead 1993, 244). Their long limbs and broad feet give elk a distinctive gait which allows them to evade predators in heavily obstacalled terrain (Figure 205), and reach speeds of up to 35 mph (Geist 1998, 224). Their large feet also produce distinctive, elongated tracks (Figure 206). Elk are also noted for their ability to both swim and dive when crossing water or eating aquatic plants up to 5m below the surface (*ibid.* 227).

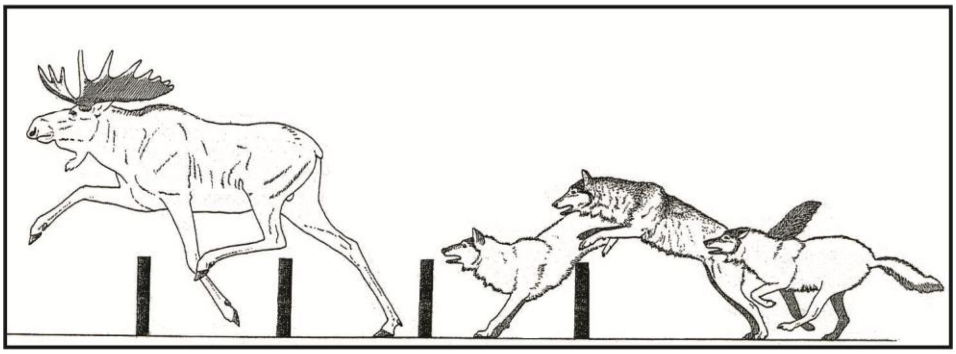


Figure 205: Elk trotting gait in fleeing predators (Geist 1998, 224)

Elk predator evasion strategies are linked closely to the size of an individual. As a consequence, elk calves need to grow rapidly in order to reduce the risk of predation by wolves, bears or people. The calf goes through two rapid periods of growth, one at 0-6 months (10-16kg at birth to 120-150kg), another at 16-18 months (120-150 - 280 kg) (Gaillard 2007, 3). Growth in bulls can continue until the animal reaches 9 years old, whilst cows stop growing at 3-4 years. This results in considerable sexual dimorphism, which is reflected in the tracks of the animal.

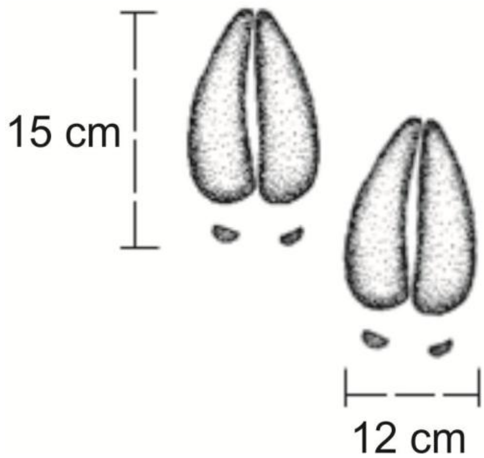


Figure 206: Elk slots (Alaska Department of Fish and Game n.d.)

In mature adults, body mass fluctuates through year. Bulls reach minimum weight at the end of winter and during the rut, whilst cows reach minimum weight after parturition. For both sexes, the main growth season comes between April and August, when elk intensively to replace the body mass lost in winter. During this period, bulls also grow antlers and cows produce milk (Geist 1998, 226).

Elk have a prolonged rutting period which lasts from of early September to late November. Gestation then lasts around 8 months (245 days) with calves being born in April and July (see Figure 207). As a consequence of the extended rut, conception dates can vary considerably within elk populations, which can in turn result in variations in birthing dates. Unusually for large ungulates, 10% of elk births involve twins (Edwards & Ritcey 1958).

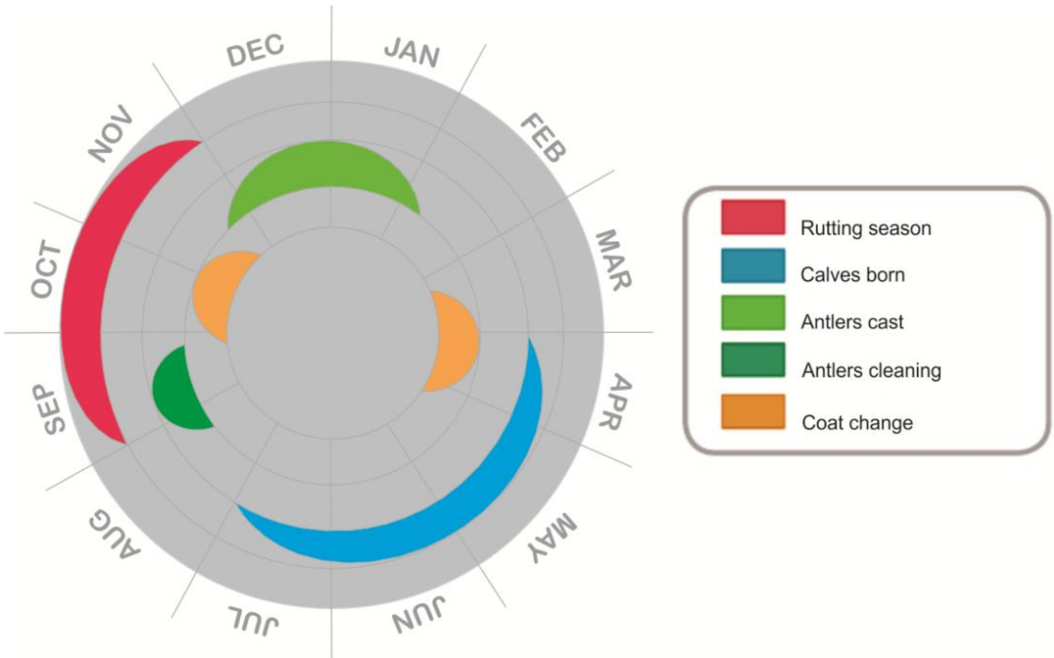


Figure 207: Annual biological cycle of elk

The presence of elk populations within Britain has been revised in the past 15 years due to new insights generated by the application of ^{14}C AMS dating. Prior to 1997, it had been believed that elk became extinct within Britain at the end of the Early Mesolithic. This was based on the cold-adapted nature of elk physiology and the rising mean temperatures of the post-glacial period (J Clutton-Brock 1991), in combination with a general absence of elk remains in archaeological contexts which post-date the Early Mesolithic (Yalden 1999). However, the dating of elk remains from the River Cree in Scotland produced a Bronze Age date of 2829-2145 cal. BC (AA-18508, 3925±80 bc). These remains formed a partially articulated skeleton which was discovered to be eroding from the river bed in the nineteenth century (Kitchener & Bonsall 1997, 7), and the Bronze Age date for this animal prompted the authors to suggest that refugia populations of elk may have survived within the cooler environmental conditions of the Scottish highlands until much later in prehistory than had previously been envisioned. They postulate that the lack of elk remains at archaeological sites may indicate that these populations existed in remote areas, undetected by human groups during this time (Kitchener & Bonsall 1997). This date has been widely accepted within the research community and elk are now believed to persist in Britain until as late as the Iron Age (Kitchener 2010; Yalden 1999).

6.5.2 Diet

Elk diet consists of highly nutritious low-toxin foliage and browse. Submerged and aquatic plants also play an important role in the diet of elk, especially during the spring and summer months, leading to a concentration of elk in wetland areas during this time of the year (Albright & Keith 1987). These foods are believed to be an important source of minerals, which is essential for the synthesis of new tissue and the re-establishment of body mass during the summer. During the winter, elk will also exploit mineral licks in order to make up for their general lack of minerals in the winter diet (Geist 1998, 226). Food scarcity in winter leads adult elk to break sizable branches and stems in search of the living plant tissue within (*ibid.* 237). They are also capable of rearing up on their hind legs, or pulling trees down, to access new growth in the canopy – which may have originally stood up to 6m above ground level (Whitehead 1993, 224). Due to the toxic nature of many of the plant species available in the environments that elk inhabit, they actively favour newly-growing forage which has not reached the stage of maturity required to produce toxins. This leads to a preference for areas of new growth such as fires and floods (Geist 1998, 226).

Elk have been described as “concentrate feeders”, in that they roam in search of pockets of food and once located, remain in these areas until the forage resources are totally exhausted. This strategy has implications for the mobility of individual elk as they stay confined to these areas when they are exploiting them and do not “roam” from them, but between them (Geist 1998, 225). The extent of this exploitation of specific food resources is known to fluctuate in accordance with the quality and digestibility of the browse on offer (Sæther & Reidar Andersen 1990). When faced with a higher quality browse resource, modern elk are known to become more mobile and active in their foraging but less intensive of their exploitation of one set resource. In contrast, when only low quality browse is available elk browse more intensively and are less active in their foraging (Sæther & Reidar Andersen 1990).

6.5.3 Social structure

Social structure and behaviour within elk populations is driven by the reproductive cycle, and also a complex set of predator evasion strategies. Elk are, for the most part, solitary foragers, that can roam up to 130km from their place of birth and still return (Geist 1998, 225). They form herds only in very snowy conditions and on open ground (*ibid.* 227). Individuals establish their own home ranges between 200-400 hectares in size, although considerable overlap between these ranges has been observed (Albright & Keith 1987). Studies of elk populations in Newfoundland have concluded that elk prefer to exploit different areas of the home range seasonally, with high fibre twigs and bark being sought in more densely forested areas during winter and aquatic resources being sought in the summer. It is the knowledge of the terrain and obstacles which allow elk to evade predators and preemptively plan escape routes when threatened so that they avoid obstacles. They also select specific roaming routes to coincide with rough terrain as a deterrent for would-be predators, and rarely cross large areas of open ground (Geist 1998, 225).

Elk employ a suite of techniques to avoid predation which include hiding, disguising their scent, attacking predators, and fleeing (Geist 1998, 225).They are able to disguise scent through zig-zagging maneuvers, exploiting wind direction and facing in the direction of previous travel before bedding down for sleep. This creates difficulties for trackers as the direction of elk markings are often contradictory and double back on themselves. Scenting hounds are also often confused by this behaviour, making elk notoriously difficult to track despite their size (*ibid.* 236).

Another unusual aspect of elk behaviour, in relation to other deer, is their tendency to aggressively attack predators in certain circumstances. When confronted by threatening situations, elk will puff up the hair on their necks and tails to make themselves more intimidating. They will also relocate rapidly to defendable ground before attacking. They are able to attack predators through flailing with the front legs, kicking with the hind legs and goring with antlers (in the case of bulls) (Geist 1998, 235).

At the beginning of the rut, yearling elk are driven away from their mothers and establish their own home ranges in adjacent territories. This leads to maternally related elk being concentrated in geographical areas in a manner similar to that of roe deer. This pattern of juvenile dispersal, combined with the preference for colonizing plant communities and their ability to swim makes elk well adapted to rapidly colonizing new areas (Geist 1998, 227).

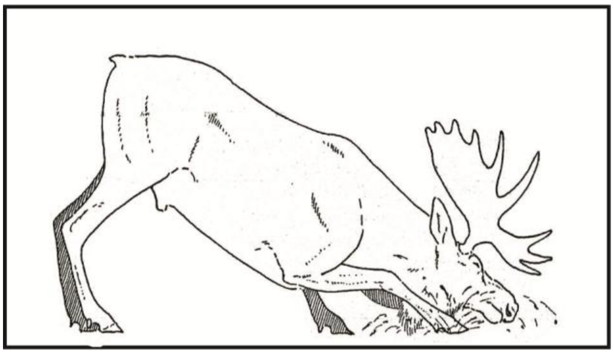


Figure 208: Elk bull wallowing in urine-soaked scrape (Geist 1998, 246)

During the rut, bulls create scrapes by thrashing undergrowth and scooping the earth using their antlers. They then soak these scrapes in urine and wallow in them (Figure 208). They flick urine-soaked mud onto their neck fur to scent themselves. Cows will also wallow in the bull's scrape (Geist 1998, 235).

Males compete for breeding rights through dominance displays (see Figure 209):

"In dominance displays to the rival, the bull approaches slowly, tips its antlers left and right, and calls in rhythm with its steps. The hair on the back of the neck, croup and withers is raised a little; the ears slightly lowered. The approach is not direct, but at a tangential angle. Eye aversions by both bulls at close ranges appear to "display" the antlers in profile. A bull may also tip its antlers in rhythm with its steps when walking after a female. The dominance display may be interrupted by horning of bushes by one or both partners."

(Geist 1998, 239)

Following the rut, male elk become less aggressive and return to their usual movements through the home range. Although they do not live in close groups, neighboring elk will signal to each other through roaring when a threat is perceived. This noise is notably different to the calls of other deer, and sounds much more like that of a large carnivorous mammal than an ungulate (Geist 1998, 237).

Cows become territorial immediately before birth, selecting areas of rich forage such as creek mouths with abundant aquatic plants as nursery ranges. Other elk will be driven away from these areas (Geist 1998, 228). Following birth, cows can become highly aggressive if disturbed – much more so than the bulls during the rut. Both cow and calf will hide in cover and attack any large mammal that intrudes. Maternal elk cows have been known to face down wolves, bears and even helicopters when threatened (*ibid.* 224). The cow suckles the calf whilst in hiding and when required to move the cow and calf stay very close, communicating through a series of soft grunts (*ibid.* 224). This behaviour leads to close bonding between calf and mother, and elk are unusual in that they are known to mourn the loss of a calf. Cows will return annually to the places where calves have died, and this is mirrored in the actions of bulls that return to the scene of hunting kills in which they have lost their mate (*ibid.* 228).

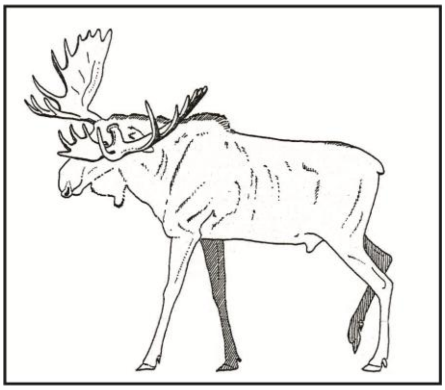


Figure 209: Elk bull in a dominance display, with head tipped in time with footsteps to display antlers (Geist 1998, 239)

6.5.4 Antlers

The form of elk antlers differs fundamentally from that of red and roe deer, in that they are said to be “palmate”. The burr and beam develop in a similar way to other species of cervid, but after a short length the beam widens out to form a broad and relatively flat concave shaped mass, from which tines develop as finger-like extensions. In European elk, the basic 3-tined form of a young bull becomes gradually more complex with age, the brow and 3rd tines being more likely to “branch” and produce further tines (see Figure 210).

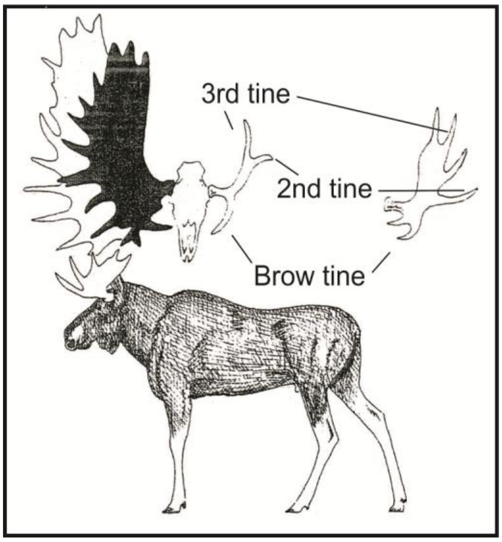


Figure 210: Antler development of elk (Geist 1998, 231)

Elk antlers can grow to large sizes, with dimensions that approach 2m in spread, palms of up to 140cm length and 55cm width. The largest sets of antlers weigh slightly more than 30kg (Stewart et al. 2000). Although antler dimensions are believed to play less of a role in rutting than other cervids (Geist 1998, 238), Stewart et al. (2000) have found that individual bulls between 4 and 10 years old invest more energy into the development of antlers, at the expense of total body mass.

6.6 Environmental variation in the British Mesolithic

As has been demonstrated, the behaviour of deer species can vary to different degrees when the animals themselves are placed under different environmental pressures. This is significant when considering the relationship between people and deer in the British Mesolithic, as the period is often characterised by environmental dynamism and change, driven to a certain extent by the general amelioration in climate seen across Europe, and the re-colonisation of Britain by tree species from refugia populations of Europe (Simmons 1996). In order to better understand the broader context of human/deer relations underlying the use of antler, it is necessary to consider the ways in which different deer species might respond to changing Mesolithic environments, as this may have a direct effect on the frequency, predictability and character of the interactions between people and deer during the period.

One possible approach to this question would be to examine the palaeoenvironmental evidence directly associated with the archaeological material itself, as this would provide the most secure link between the use of antler and its immediate environmental context. However, the methods of recovery employed for the majority of the worked Mesolithic antler from Britain do not allow this. The high proportion of material recovered prior to 1950 (Wymer & Bonsall 1977), the role of amateur collectors and excavators in the recovery of antler artefacts, and the large proportion of material which has been eroded from riverside deposits severely reduces the potential for placing the use of antler directly into a local environmental context. This is demonstrated by Clark and Godwin's (1956) attempt to provide a palaeoenvironmental context for a series of antler and bone barbed points recovered during quarrying activities at Brandesburton, East Yorkshire. Pollen cores were taken from areas close to the findspot, and the environmental changes associated with the late glacial and early Holocene periods were identified within these cores. However, the destruction of the original context of recovery for the Brandesburton finds meant that the actual finds themselves could not be directly linked to any point within this palaeoenvironmental sequence.

As an alternative to seeking to directly contextualise individual pieces of worked antler, it would seem logical to construct an environmental model for the British Mesolithic. If variations in environmental conditions were plotted in relation to time and space, it would allow the discussion of contemporary deer behaviour within the immediate surrounds of a Mesolithic antler findspot. However, there are a number of problems with this approach. These revolve around the sources of data used to construct Mesolithic environments, the unpredictable nature of environmental successions in the British Mesolithic, inconsistencies within the levels of chronological resolution available for both worked antler and palaeoenvironmental data and uncertainty over the areas of land over which people negotiated their relationships with deer.

Issues relating to the nature of the palaeoenvironmental record itself have been highlighted by Spikins (1999) in her modeling of forest composition across Northern England. She notes the problems with interpreting palynological evidence, with the varying dispersal rates for different species often making it difficult to determine which flora were present in the locality of the sampling site, and which may have been transported over longer distances. This also creates problems for extending the evidence of forest composition and plant communities from individual sampling sites to wider areas of the Britain (K Edwards 1979). There are also preservation biases within the pollen record, with the formation of peat deposits being favourable for the preservation of continuous pollen sequences, and thus an under-representation of non-peat forming environments within the palaeoenvironmental record (Spikins 1999). Scaife (2007, 44) notes that this has created problems for understanding the development of areas of calcareous geology, such as the downlands of southern England. He also critiques the molluscan evidence which is often offered as a substitute to palynology in calcareous contexts, stating that whilst this can give a broad indicator of environmental conditions, it does not give information on the distribution and frequency of specific floral species within an ecological community (*ibid.*).

Attempts to circumvent these problems have included the modeling of dominant tree species within forest communities through GIS analysis of underlying geology, altitude, sea level change and the colonisation rates of continental tree species (Spikins 1999; Sturt 2006). However, these fail to take into account the history of disturbances and events documented within the pollen record itself which can often lead to the establishment of communities which differ dramatically to that of the expected climactic succession (Simmons 1996).

There are also issues with the varying level of chronological resolution within the corpus. Some artefacts are dated on typological grounds as “Mesolithic”(Wymer & Bonsall 1977) - a period lasting c.5000 cal. ^{14}C years - whilst others are dated broadly to the Early or Late Mesolithic (Clark & H Godwin 1956). The lack of chronological resolution in the dating of these artefacts severely hinders the ability to accurately model the immediate environmental conditions for the archaeological contexts into which these artefacts were originally deposited, due to the dynamic nature of Mesolithic environments generally. Alongside these broad chronological distinctions, more “absolute” dates have also been obtained through the radiocarbon dating of worked antler. The ^{14}C AMS dating of some material (Tolan-Smith & Bonsall 1999) potentially allows the tying down of specific points in time and space, for which environmental conditions and subsequent deer behaviour could be modeled. However, the various plateaus observed in the ^{14}C calibration curve for the Early and mid Holocene (Ashmore 2004) mean that these “absolute” dates actually fall over considerable spans of time. Given the dynamic nature of Mesolithic environments, it then becomes problematic to pin-point a specific set of environmental conditions for which deer behaviour should be modeled.

A further, fundamental problem with attempting to place antler technology into an immediate environmental context is the levels of mobility within the lifeways of the human inhabitants of Mesolithic Britain themselves. The site of *in situ* recovery for Mesolithic antler represents the site of deposition for this material, but the movements of the people who crafted and used these artefacts may have led to encounters with animals in a variety of different environmental contexts and settings. Thus the environmental data from archaeological contexts containing antler material does not provide a representative picture of the wider suite of contexts in which people may have encountered deer.

In order to deal with these problems, a slightly different approach to Mesolithic environments will be presented here. It is clear from the above discussion that, for most of the corpus of worked antler from the British Mesolithic, it is not possible to obtain direct evidence for the environmental conditions into which the material was deposited. National models cannot provide the resolution required for discussions of specific findspots, and neither do they factor for the histological nature of environmental sequences - which can be heavily influenced by infrequent events and short-term processes such as deliberate human clearance, fires, storms and localised outbreaks of disease. It has also been shown that the context of deposition may not necessarily have been the representative of the wider suite of environmental conditions in which people encountered deer and over which the broader people deer relations were constructed and negotiated.

It is proposed here that a lower resolution approach is needed to tackle these problems. To achieve this, the classic “types” of environment and floral communities documented in the Mesolithic palaeonvironmental record will now be described, and their implications for deer behaviour discussed. The typological description of plant communities and their surrounds has been a long-established approach to documenting botanical variation within Britain (Tansley 1911). However, to attempt to link the types of environment documented within the palaeoenvironmental record to the types described in more recent characterisations of British ecology (Rodwell 1991, 1992, 1998a, 1998b, 2000) are flawed on a number of levels. Firstly, environmental conditions in the Early Holocene vary considerably to those in Britain today, as this is the period in which Holocene soils first began to form, sea levels changed, coastlines varied, and new flora and fauna arrived in Britain from continental Europe. This may have led to the establishment of ecological communities not seen in Britain today and thus not represented within current typologies. Secondly, the low resolution of some forms of palaeoenvironmental data mean that Mesolithic environments can never be reconstructed in the levels of detail that modern biologists are able to achieve when mapping environment types in Britain today. For instance, pollen data can often only be identified to a family level, and so the presence of specific species of plant in Mesolithic environments cannot be demonstrated using pollen analysis alone. However, in the characterisation of modern environments, distinctions between the 285 floral communities can rest on the presence, or dominance of a single species of plant (Rodwell 1991, 1992, 1998a, 1998b, 2000). As such, the types here will not conform to the level of detail necessary for studies of contemporary ecology, but rather work within the limitations of the palaeoenvironmental record to sketch out a broader set of Mesolithic environment types that have been previously defined by a range of palaeo-ecologists (Clapham et al. 1997; Clare 1995; Cloutman & A Smith 1988; H Godwin 1975; Mellars & Dark 1998; Scaife 2007; Svenning 2002; Timpany 2007).

The use of environment typology here aims to tackle some of the specific issues in situating Mesolithic antler technology into the wider context of people/deer relations outlined above. It should be stressed that the “types” discussed here are by no means intended to be seen as a comprehensive listing of every ecological community that existed within Britain during the Mesolithic period. The limitations of the palaeoenvironmental record alone mean that this could never be achieved, as we lack comprehensive data and sequences for every region of the study area due to the differential preservation levels within varying geological contexts. Instead, this is intended as a review of some of the most extensively documented and discussed types of environment within Mesolithic Britain.

It should also be noted that, conventionally, palaeoenvironmental narratives of the Mesolithic focus on the chronology of a general environmental succession of woodland types – following the model outlined by the original European pollen zones (H Godwin & M Godwin 1933). However, whilst these successions can often be observed with the palaeoenvironmental record at specific sampling sites, it is important to note that different successions occurred in different areas, and were influenced by factors such as localised climate, altitude and the character of the underlying geology (Innes et al. 2011, 101). This approach therefore will not attempt to provide a chronological limit to the environment types discussed below. Instead, the occurrence and extent of the "types" described below can generally be assumed to fluctuate over time and in different regions of Britain during the Mesolithic. These types will therefore illustrate the ways in which encounters between people and deer may have varied during the period, and thus present a more dynamic picture of people and deer relations on a national scale. The following palaeoenvironmental discussion is intended to provide a broad background to the different ways in which people may have encountered deer during the British Mesolithic.

6.6.1 Birch-pine "Pre-Boreal" environments

Due to the prominence of Star Carr within British Mesolithic Studies, much academic attention has been previously focused on the exploitation of birch-based environments of the "pre-boreal" period (D Walker & H Godwin 1954). These are often viewed as transition communities which were able to colonise the rapidly warming areas of Britain during the initial stages of the Holocene. They are charcaterised by scrub vegetation, featuring spaced and open areas of *Juniperus* (juniper), *Betula* (birch) and *Salix* (willow) trees and underlying grasses (M Walker et al. 2003). Godwin (1975) notes the occurrence of two species of birch – *Betula pubescens* and *Betula prendula*, alongside *Pinus sylvestris* (pine) in these initial colonizing communities. In Southern Britain, high pine pollen values show a balanced pine/birch woodland, whilst more sporadic pine values in samples from northern England and Scotland have been interpreted as a more birch dominated areas with occasional stands of pine. High *Corylus* (hazel) pollen values in samples from northern England and Scotland also indicate that hazel also formed a significant component of the initially expanding birch-pine forest communities in the higher latitudes of Northern England and Scotland (Godwin 1975, 457). Low background pollen levels of *Quercus* (oak) and *Ulmus* (elm) are present across Britain, indicating their minor role in the composition of these birch-pine forests. A similar pattern is noted for *Alnus* (alder), although with higher levels in west-central Scotland indicating a more prominent role in forest composition within this localised area (*ibid.* 459).

Within these birch-pine woodland environments, elk would enjoy a variety of food resource, and an abundance of understory cover over which to evade predators. Both birch and pine are known to play a prominent role with the diet of elk, particularly during the winter (Sæther & Reidar Andersen 1990) and so they can be expected to have inhabited these environments, albeit at the relatively low population densities that are observed in elk today. As a consequence, the chances of a direct encounter between people and elk may have been quite low within birch-pine woodlands. Yet the tracks and markings that elk create may have advertised their presence to the people who also moved through these environments, leading to an indirect form of people/elk encounter. The distinctively large tracks, wallows, damage to high-level vegetation and characteristic grunts and roars of the species would have meant that, even at low densities, elk would have advertised their presence within these birch-pine landscape. Seasonal variations in elk behaviour, such as an increase in wallowing and roaring during the autumn rut, the rubbing of velvet from newly grown antlers in late summer, the shedding of elk antler in mid-winter and the appearance of elk calf prints during mid-spring to mid-summer time would have varied the nature of these tracks throughout the year. The nature of direct encounters may also have varied, with increased levels of aggression from bulls in the autumn and cows in mid-spring to mid-summer in correspondence to the rut and calving seasons respectively.

Red deer would have also found open birch-pine woodland conditions favourable. In these conditions dispersed and small social units would have enjoyed cover from the elements and an abundance of diverse food resources. As such, large body sizes may have been obtained (Howard 2007) by red deer living in these conditions. However, this may have fluctuated as population pressure increased and decreased over time. The potential abundance of these large ungulates within the birch-pine woodland of Mesolithic Britain may have led to more frequent direct encounters with people. The nature of these encounters may have changed throughout the year, with males becoming increasingly aggressive during the rut, whilst females become particularly flighty and elusive during the initial stages of pregnancy in early winter. As well as direct, face-to-face encounters between people and red deer, the distinctive tracks and markings created by the activities of red deer may also have allowed people to observe their presence within birch-pine woodland through indirect encounters. Tracks and mid-level browse damage to flora, as well as the calls of the animals themselves, would have alerted people to the presence of red deer. Similarly to that of elk, the nature of these indirect human/red deer encounters would have varied seasonally. The roaring and marking of trees associated with the rut would be confined to autumn, the appearance of removed velvet to late summer, whilst doe tracks would vary during pregnancy and fawn tracks would have appeared after the early summer. Shed red deer antler would also have been accessible in late winter/early spring.

Roe deer living within the birch-pine woodland would have benefitted from the open nature of the forest composition, and consequent abundance of shrubs and understory browse. These would create highly favourable conditions for roe deer – providing cover from predators and a range of browse species. The territorial behaviour of roe deer would lead to the regular dispersal of individuals within these types of environments, although their reclusive nature may have resulted in a low frequency of direct encounters with people. However, the behaviour of these animals would create a distinctive suite of tracks and markings which would have alerted humans to their presence. Low-level browse damaged vegetation and tracks would have been visible throughout the year, but the demarcation of territories by tree marking, distinctive buck barking and the creation of scenting scrapes in the early summer would have also been visible to those inhabiting the birch-pine woodland areas during the Mesolithic on a seasonal basis. The behavioural changes of the rut would also result in the creation of the iconic chase tracks around certain trees and shrubs, whilst this late summer period would also be marked by an increase in the calling of does and bucks and fights between competing bucks. Shed roe deer antler would have been accessible in late autumn/early winter.

6.6.2 Mixed birch forests

Another woodland type which is documented in the palaeoenvironmental record for Mesolithic Britain is the mixed birch forest – which in many areas immediately succeeds the birch-pine forest environments (Cloutman & A Smith 1988; Cloutman 1988a). These "Boreal forests" are characterised in tree pollen diagrams by a strong birch presence, with a mixture of other deciduous species playing a significant role in the forest composition. Birch remained dominant in Scotland, Wales and northwest Britain, although oak, *Tilia* (lime), hazel and elm also featured notably. Evidence also exists for the composition of understory vegetation within mixed birch forest environments (Godwin 1975, 462). These include shrubs such as *Thelycrania sanguine* (dogwood), *Crataegus monogyna* (hawthorn), *Sambucus nigra* (elder), *Fabrangula alnus* (Alder Buckthorn), *Ilex auifolium* (holly), *Hedera helix* (ivy), *Lonicera periclymenum* (honeysuckle). Herbaceous plants are also documented within the pollen record for Boreal forests in Britain (Godwin 1975, 462); *Luzula sylvatica* (great wood rush), *Dryopteris filix-mas* (male fern) and *Digitalis purpurea* (common foxglove) are also found within the pollen record in association with the boreal community (Chisham 2004).

All three species of deer would appear to be comfortable within the mixed birch woodland conditions described above. Birch bark and twigs would provide suitable browse for elk, which have been shown to exploit these food resources throughout the year (Sæther & Reidar Andersen 1990) whilst understory vegetation would create the types of obstacles favoured for evading predators. As such, the nature of human/elk encounters within these mixed birch woodland habitats would have been similar to those discussed for birch-pine woodlands above. Red deer populations would have also thrived within the mixed-birch woodlands of Mesolithic Britain, and the nature and frequency of human/red deer encounters (whilst still being distinct to those of elk) could be said to be similar to those expected in birch-pine environments. People would have encountered red deer within these habitats relatively frequently and even when the deer themselves were not visible their tracks and markings would have attested to their presence. Roe deer would have also thrived within the browse-rich understory cover of these mixed birch woodlands, and the nature of human/roe deer encounters could also be expected to be broadly similar to those discussed for birch-pine woodlands above.

6.6.3 Pine forests

Although the national levels of pine pollen drops dramatically after the "birch-pine" environmental phase, localised areas of pine-dominated forest do appear to persist throughout the Mesolithic period (H Godwin 1975). These cluster around higher altitudes and more northerly latitudes, in conditions more suited to cold-adapted tree species (Bennet 1989). Despite the warmth of the Mesolithic "climatic optimum", pine trees also remained dominant in areas of forest with underlying limestone geology. These pine forest environments have also been found in association with the occurrence of localised rises in hazel pollen. These high hazel values have been interpreted as the presence of a hazel scrub community, also featuring *Populus tremela* (aspen). Godwin (1975, 459) suggests the passing growth of an open pine woodland with underlying hazel scrub as becoming common across

Britain and to a certain extent displacing the birch dominated closed forest environments present in the pre-boreal period.

Pine forest environments would provide favourable browse for elk during the winter months, when pine needles and bark play a key role within their diet. The occurrence of hazel scrub would also provide elk with the type of obstacles and undergrowth in which they could outrun predators, and so it is likely that people would have been more relatively likely to encounter elk within these pine forest communities during the Mesolithic, with a particularly high chances of encounter during the winter. The feeding activities of elk may also lead to visible damage to the pine-woodland vegetation itself, and the co-incidence of the antler shedding season with the rise of pine needles and bark within elk diets may also have meant that shed elk antler was more likely to be obtained in these pine forests. However, the diminished role of pine within the summer diet of elk may have meant that direct encounters between people and elk became less common in pine woodland during the summer. This would mean that elk may not have been present within pine forests during the peak periods of bull and cow aggression. This may have led to a distinction in the nature of direct human/elk encounters in different forest environments.

Coniferous food resources seem to play a lesser role within the diet of red deer, although animals living within these conditions are noted for the more prominent role that heather and berries plays within their diets. This may be suggestive of animals that live within mixed coniferous forests, but who's feeding patterns tend to concentrate on areas of forest fringes, in particular those associated with adjacent heather moorland. As such, it could be speculated that although red deer may have inhabited pine forests during the British Mesolithic – leaving tracks – feeding activities may have been focused on the pine-woodland fringes.

Modern roe deer populations are known to inhabit coniferous forests, although the composition of their diet varies considerably to that of roe deer living in mixed deciduous woodland. Gramoids and dwarf shrubs seem to be of particular importance to roe deer in coniferous forest conditions – contributing c.55% of their diet (Cornelis et al. 1999). With this in mind, it would appear that the understory composition of these pine woodland areas would play an important role in determining the extent to which roe deer would frequent them. Where shrubs and gramoids were available (potentially in more open areas of pine forest), stable roe deer populations may have existed throughout the year, in a similar manner to that within birch-pine and mixed birch woodland areas. As such, the way in which people encountered roe deer could be said to be similar to that expected for the birch-pine and mixed birch woodland types. However, areas of pine woodland which lacked the understory vegetation of gramoids and shrubs may have been the types of marginal, unfavourable habitats into which displaced males were forced during the spring and summer months. The lack of familiarity and cover available for these individuals may mean an increased likelihood of a direct encounter between people and roe deer bucks in these types of environments, whilst their activities may also produce tracks and low-level foliage browse damage, thus creating the possibility of people encountering roe bucks indirectly within these pine woodland settings.

6.6.4 Hazel thicket woodland

A sharp rise of hazel pollen has been noted in pollen diagrams from sampling sites across the British Isles, and has been interpreted in a number of different ways (Simmons 1996). Hazel can grow in both tree and shrub forms, and so the precise role of hazel within woodland communities can often be difficult to ascertain from pollen analysis (*ibid.*). In the Vale of Pickering, Mellars (1998, 230) describes the establishment of a dense hazel closed-canopy thicket woodland with associated scrubs and lichens as having a much lower biological carrying capacity than the previously open birch-forest conditions. This would have caused "a major decline in the overall density and local biomass of the animals," (Mellars 1998, 230) and caused the abandonment of human occupation in the Vale of Pickering until the later Mesolithic (*ibid.*). However, the density of this woodland has since been called into question by the episodes of burning which persist within the Vale of Pickering during the dominance of hazel pollen (Cummings 2003; Innes et al. 2011). This could be interpreted as evidence that people remained in the area during this time, and as such the hazel woodland was not as dense as was previously envisioned.

Whilst the occurrence of dense hazel thickets might make it difficult for large ungulates such as red deer and elk to move through these areas, the thick cover provided by these environments may have proven highly favourable for roe deer – particularly if shrubs were also available for browse. In areas with sufficient food resources then, hazel thicket woodlands may have supported roe deer populations throughout the year, and whilst direct encounters between people and roe would have been infrequent, the tracks, markings and sounds associated with their seasonal activities would have advertised their presence within these environments.

6.6.5 Mixed deciduous woodland

The environment most commonly associated with Mesolithic Britain is that of the mixed deciduous forest, or "wildwood". In broader prehistoric narratives, this is often portrayed as a static and stable climax community which covers the majority of the British Isles during the Mesolithic period. However, palaeoenvironmental data has shown variations in the composition of these forests and in particular the dominant tree species at certain locales (Simmons 1996, 13). Oak, lime, ash and alder have all been observed to be dominant tree species within the mixed deciduous forest communities at different points in time and space during the Mesolithic (Bennet 1989; H Godwin 1975: 464; Simmons 2001). More recent approaches to reconstructing Mesolithic environments have tended to view these deciduous climax woodland as "mosaic" forests (Brown 1997). This has been prompted by the acceptance of the limitations of pollen analysis in giving high resolution data on the density, layout and age of trees within a forest community (Clare 1995). As an alternative, palaeoenvironmentalists have looked to *in situ* plant macrofossil remains recovered from submerged peat deposits at coastal locations (Clapham et al. 1997), and also buried below alluvial floodplain deposits (Brown & Keough 1992). These have revealed an uneven distribution of tree species within mixed deciduous woodlands, with dense stands of older trees being surrounded by areas of thinner, more open distributions of younger trees and shrubs. Small openings in the forest canopy are also noted to occur (Clare 1995).

Considerable debate exists over the extent, frequency and causes of these clearings (Svenning 2002). It has been suggested that these may be the result of human action through deliberate burning (Simmons & Innes 1987) and tree-felling (Bush 1993), indirect human action through accidental fire-setting (Brown 1997), grazing of large herbivores (Vera 2000), storms, natural fires or localised outbreaks of disease (Brown 1997). Whilst the direct attribution of these clearance episodes to a single agent is notoriously difficult (Brown 1997), these disturbance episodes do feature throughout British Mesolithic pollen diagrams, and are supported in various instances by associated mollusc, charcoal, plant macrofossil and beetle remains analysis (Innes & Blackford 2003; Svenning 2002). The existence of larger scale, open landscapes has also been debated and is covered below.

Deer behaviour within these mosaic woodland habitats has some implications for the ways in which people may have encountered and interacted with them during the Mesolithic. These types of conditions would offer feeding opportunities and understory obstacles for elk, but their patchy distribution could lead to quite specific responses in foraging strategies and movements. Areas of more open woodland and clearings may have been avoided by elk, as they lack the obstacles required to evade predators. Instead, elk may have restricted their movements to denser areas of forest. Their preference for difficult terrain could lead to the establishment of set routes that elk followed through the Mesolithic woodland in search of food resources, resulting in a concentration of tracks and markings along these routes. The distribution of these denser areas of closed-woodland may have been particularly important for cows during calving, as cover and browse are essential resources for the early, sedentary stages of the calf's life. This could lead to higher chances of human/elk encounters in such areas, and even make these types of habitats a danger to people during the fiercely territorial period of calving during the spring and early summer.

However, elk behaviour may have varied in response to openings within the forest canopy. As noted above, the growth of plant communities associated with clearings do play an important role within the diet of elk and so these clearings may have attracted individuals into areas that they would not otherwise frequent. As such, there may have also been a higher chance of people directly encountering elk at the edges of forest clearings and in the initial stages of their re-growth, due to improved levels of visibility in these environments.

Red deer behaviour within the mixed deciduous woodland may have been similar to that expected within birch-pine or boreal woodland habitats. The preference for browsing on forbes may have resulted in both male and female red deer being attracted towards more open areas of forest and small clearings, and as such there being a higher chance of direct people/red deer encounters at these locales.

Roe deer would also have thrived in these mixed deciduous woodland habitats. The quality of territories within this habitat varied in terms of its ability to provide browse and cover for roe bucks and does, and so the level to which territoriality was displayed may have varied within the forest itself. In particular, the new growth communities associated with areas of clearings may have been particularly attractive for the browse on offer, and as such the focus of tree marking, scent scraping and barking during the spring.

As in other habitats, the elusive nature of roe deer behaviour may have meant lower chances of direct encounters between people and roe, although their presence would have been attested through their tracks, sound and impact on browse flora. Less favourable areas of forest, with little understory cover or browse may have been inhabited more seasonally by the displaced bucks during the late spring and summer rutting season. In these areas, the lack of cover would have potentially increased the chances of direct encounters between people and roe deer due to increased visibility within these environments.

6.6.6 Freshwater wetland areas

The formation of peat deposits in Early Holocene wetland areas has preserved a rich suite of palaeoenvironmental evidence, and allows a detailed understanding of freshwater wetland environments. The additional benefit of these peat deposits for the preservation of organic archaeological material has further increased their importance in our narratives of Mesolithic life. Freshwater wetland environments occurred in a variety of contexts, and as a result of a range of factors during the British Mesolithic. The formation of glacial lakes and the associated wetland conditions created during the progressive accumulation of peat deposits within these lakes is one of these contexts. Freshwater wetland environments also formed in conjunction with river systems, as demonstrated in the areas around the Thames (Sidell et al. 2000) and Colne (J Lewis & Rackham 2010) valleys. Both of these types of landscape feature areas of open water, with a mosaic of different environmental conditions including fen woodland, reed swamps and reedbeds.

Carr-type environments, with stands of alder and willow carr woodland are documented at multiple sites across Britain (H Godwin 1975). These generally consist of tree stands within wet ground conditions, with water tolerant species such as *Caltha* (Marsh marigold), *Typhaa angustifolia* (Reedmace), *Filipendula* (Meadowsweet), *poaceae* (grasses) and *cyperceae* (sedges) occurring at lower levels (Scaife 2007, 60).

Another type of wetland environment documented within the palaeoenvironmental record is that of reed beds. These tend to develop at the fringes of open water areas – such as river banks or lake-edges – and are primarily dominated by *Phragmities* (Reeds) growing in standing water conditions. These types of environmental conditions are documented at sites around the edges of the now extant Lake Flixton, Vale of Pickering (Cloutman & A Smith 1988; Cloutman 1988a, 1988b; M Taylor 1998; D Walker & H Godwin 1954).

Fluctuating water tables can also give rise to “reed swamp” conditions. These are also characterised by high occurrences of *Phragmities*, alongside *Dryopteris carthusiana* (Narow Buckler fern), *Thelypteris palustris* (Marsh fern), sedges and grasses. This “reed swamp” may occur in areas with small pools of standing water or seasonally flooding, but with generally water-logged ground conditions. This type of environment is documented at the Early Mesolithic site of Three Ways Wharfe (Lewis and Rackham 2010, 37-8), and across East Anglia (Sturt 2006, 133).

These wetland areas may have been attractive for elk during the summer months, when the seasonal need for aquatic plant resources would have drawn them towards bodies of freshwater. The more open nature of these fen and reedswamp environments, with tree stands rather than closed canopy woodland would have resulted in an increased levels of visibility for elk, which may have meant a higher chance of direct human/elk encounters. The movement and feeding of elk would also create observable tracks within these environments. The adaptability of elk gait to waterlogged conditions (with the high lift of feet preventing standing water from slowing the animal) would allow them to evade predators in these types of environments, and as such the patchy nature of understory cover may have played less of a role in discouraging elk from these habitats. The presence of elk within these wetland areas during summer would also mean considerable variation in elk behaviour in accordance with their annual biological cycle (Figure 207). In particular, the establishment of nursery ranges by aggressive pregnant cows during the spring and summer within areas of relatively drier, browse-rich ground may have changed the character of direct human/elk encounters. Calving in wetland areas would also result in a change in track patterns, with an appearance of calf tracks. The removal of velvet in the late summer may also have resulted in shifts in the character of elk tracks through the summer.

Twigs and branches of willow and alder may also have provided a source of lower quality browse for elk, and thus allowed elk to remain in wetland environments throughout the year, in areas where they were extensive enough to encompass an entire elk home-range. As a consequence, the types of tracks and markings associated with elk may have meant that people were aware of their presence without direct encounters taking place. In areas adjacent to open water, elk may also have been observed swimming and diving to feed on pondweed during the summer months.

Red deer are also known to inhabit wetland environments, although they are considerably less adapted to these conditions than elk. The forbes and gramoids available within wetland areas would have attracted red deer, and modern red deer populations are known to exploit freshwater marsh environments (Clutton-Brock et al. 1982, 330). However, red deer are unlikely to have spent prolonged periods of time in severely waterlogged areas as they favour dry areas for cover during regular rest periods. This may have been achieved through regular feeding forays into wetland areas, with retreats to drier environments for rest. The increased levels of visibility afforded by the more open nature of wetland plant communities may have led to a relatively high chance of direct people/red deer encounters.

Roe deer are also known to inhabit wetland areas in Europe today (Linnell et al. 1998), and as such it can be suggested that they would have inhabited such environments in Mesolithic Britain. The low-level browse available within the wetland fern, sedge and shrub vegetation would undoubtedly have been favourable for roe deer consumption. These plant communities would have also provided them with cover from predators and the elements. However, roe deer are very poorly adapted to spending prolonged periods of time in heavily waterlogged environments, as their low fat levels, heavy foot loading and low brisket height presents problems for maintaining their body temperature and high metabolic rate in cold, wet conditions (Holand et al. 1998). As such, their activities within the more waterlogged or swampy areas of wetlands may have been restricted to exploiting particularly preferable browse, with resting, rutting, calving and mating being carried out in drier areas. As such, roe deer browse damage may have been encountered by people across areas of wetland, but evidence associated with the other activities listed above may have been confined to drier locales within these wetland mosaics.

6.6.7 Coastal wetlands

The preservation of environmental material in coastal and inter-tidal deposits provides not only a record of the shifts in coastline throughout the Mesolithic period, but also the changes in environment associated with the advance or retreat of sea-levels. These have been extensively studied in the Severn Estuary, through the work of Smith and Morgan (1989) and Bell (2007b), although the palaeoenvironmental evidence for mudflat, salt marsh, alder carr and reedswamp conditions in a coastal context have parallels across the British Isles (Sturt 2006, 122). At Goldcliff Island, the work of Bell (2007b) has identified a prolonged sequence of silt deposition and peat formation which has been linked to periods of marine transgression (when tidal alluvial silts are deposited, creating mudflat environments or even open sea) and marine regression (when lower water levels allow the growth and decay of *in-situ* vegetation, and thus peat formation). Similar sequences are known from coastal sites around Britain, the East Anglia fens being an example of a large area of now dry land which underwent a series of marine transgressions and regressions during the Mesolithic (Sturt 2006).

Within the peat deposits themselves, several different types of plant community are represented in the pollen, macrofossil and spore record. Saltmarsh conditions are often demonstrated through the occurrence of maritime plant species, but without the dominance of a single taxon. At Goldcliff, this is demonstrated by Timpany (2007) with the presence of *Chenopodiaceae* (goosefoot) and *Aster*-type (michaelmas daisies) seeds. Salt marshes are notoriously difficult communities to define, as they generally include very similar lists of floral species, but can vary dramatically in terms of species composition (Rodwell 1991), often in relation to their position on the tidal plain. However, they are very generally characterised as "the herbaceous vascular vegetation on the intertidal silts and sands" of coastal locations (Rodwell 2000, 17).

In addition to their occurrence in freshwater wetland contexts, *Phragmities* is also known for its tolerance of more saline conditions and as such has been documented in coastal wetlands. At Goldcliff, Timpany (2007) notes the high frequency of *Phragmities* within both the pollen and plant macrofossil record, and interprets these alongside the remains of *Chenopodiaceae* (goosefoot family), *Eupatorium cannabium* (hemp argrimony), *Carex* (sedge), *Urtica dioica* (common nettle), *Lychnis*-type (catchflies), *Lotus*-type (bird's foot trefoils) as evidence for coastal reedswamp conditions. Pooling water is also present within these environments, with the occurrence of *Potamogeton* (pondweed).

Another process recorded at Goldcliff is the colonisation of existing coastal wetland areas by carr-woodland type environmental conditions, as part of a successional development. This is documented in the palaeoenvironmental record by a drop in *Phragmities* and a rapid increase in willow and birch pollen alongside plant macrofossil remains. These communities are also characterised by reduced numbers of reeds growing at ground level, around low stands of trees. Soon after the establishment of this willow-birch-reed carr environment, alder begins to rise and the other tree species decline. This is accompanied by a reduction in the occurrence of reeds and an increase in the quantities of sedge in the Goldcliff palaeoenvironmental record, and documents the existence of an alder carr environment with underlying occurrences of sedge within these coastal wetlands.

The detailed records and intensive palaeoenvironmental investigation of coastal wetlands at Goldcliff provide a fascinating insight into the mosaic of conditions present within these areas during the British Mesolithic. The extent to which deer species might have exploited these coastal wetland areas may be expected to vary between species. Modern populations of elk are known to exist in the coastal wetland areas of Newfoundland, where a lack of cover is combined with high levels of biological productivity (Ferguson 2002) in a similar manner to the conditions anticipated for Britain, based on the palaeoenvironmental evidence. Given the lack of cover and thus increased levels of visibility, direct encounters between people and elk in coastal wetland areas (Albright & Keith 1987) may have been a more regular occurrence during the Mesolithic period. The seasonal variations in elk diet may have resulted in annual fluctuations of elk populations within these areas, particularly if bad weather was also associated with winter and further discouraged elk from these areas at those specific times of year. As such, the character of summertime human/elk encounters might be expected to vary in a manner similar to that predicted in freshwater wetland areas. Fluctuating levels of aggression from cows may have altered the nature of direct encounters, whilst the appearance of calves and fraying of antlers created changes in the ways people indirectly encountered elk within these environments.

The presence of red deer within coastal wetlands is clearly attested through the occurrence of deer tracks within laminated silt deposits at multiple sites along the Western coast of England and Wales (Bell 2007b). These are dated to the Mesolithic period and are created on intertidal mudflats, documenting the movement of red deer across these environments. The browse offered within the mosaic of reedswamp and carr communities would have been attractive resources for red deer to exploit, but as with freshwater wetland areas, drier ground may have been favourable for rest periods. The sensitivity of red deer to wind and exposure may also have meant that their presence and behaviour within these coastal wetlands could have varied seasonally and in response to weather trends and events.

Notably absent from the footprint records of sites such as Goldscliff and Uskmouth (Aldhouse-Green et al. 1992) is the occurrence of roe deer tracks. It would appear that these animals were not travelling across intertidal mudflat zones as regularly as red deer were. Exploitation of denser, drier areas of carrland within the coastal wetland mosaic by roe deer is a distinct possibility, but encounters between people and roe deer in the wetter and more exposed locales may have been considerably less frequent. Again, these unfavourable habitats may have been inhabited seasonally by displaced bucks during the summer and as such human/roe deer encounters may have varied though the year.

6.6.8 High altitude peat moors

Palaeoenvironmentalists have long noted the advent of peat formation in the Early Holocene in high altitude areas of Britain. Simmons (2001, 39) notes that the occurrence of peat formation in areas where convex slopes draw water away from higher ground, as well as areas where water would naturally collect, such as in natural basins or along spring lines. He suggests that the steadily ameliorating climate would have allowed peat-forming conditions to occur in areas where water collects, but that further intervention would be required for peat to form on convex slopes. It is postulating that fire may have been used to remove deciduous tree cover, and thus increase the quantities of water present in the soil. Although the role of human agency within the occurrence of upland fires has been questioned by other authors (Brown 1997), environmental sequences clearly demonstrate the consistent deposition of charcoal throughout the Early Holocene (Simmons 1996). The deposition of this micro-charcoal associated with burning events also has an effect on drainage. The subsequent peat deposits gave rise to specific communities of vegetation, which Simmons describes as:

"heather moors, accumulating *mor* humus and becoming seasonally waterlogged (with underlying soild and ongoing gleying) and invaded by wet-tolerant sedges and *Sphagnum*, cotton-sedge mires, *Sphagnum* bogs, open hazel and birch scrub with a variety of wet-tolerant ground flora species and a high proportion of dead trees,"

(Simmons 2001, 40)

The occurrence of these open moorland environments would have had a profound influence of deer behaviour, which manifests itself differentially in the three species. Following on from the debate over the disappearance of elk in Britain, it could be argued that these colder, high altitude environments offered favourable conditions for refugia elk populations during the warmer lowland climes of the Atlantic climatic optimum. However, moorland environments would not offer the types of browse favoured by elk, as they lack the elk's preferred tree species. Additionally, as noted above, elk often avoid travelling through open landscapes due to the lack of cover and opportunities to escape predators in adverse terrain. Consequently, it may have been less likely for people to encounter elk on these open moorland environments.

Analogies with modern populations suggest a different behavioural response from red deer. Red deer are known to inhabit heather moorland in Britain today – most famously in the Scottish Highlands. Their adaptable diet allows them to digest the range of forbes available within moorland communities. However, the exposed nature of moorland conditions can lead to a reduction in the body size of individual red deer (T Clutton-Brock et al. 1982), and exploitation of open landscapes over mixed forests tends to occur as a result of a shortage of the high-quality browse, or as of a product of population pressure (T Clutton-Brock & Albon 1989). Consequently, it could be speculated that the likelihood of encountering red deer on open moorland may have varied throughout the Mesolithic. At certain times, when red deer populations existed at higher densities, individuals may have spent more time grazing on the forbes associated with the heather environments. As a consequence, these red deer may have had lower body masses than animals living in adjacent forested areas, due to the lower nutritional value of their diet, and exposure to the elements. At other times in the Mesolithic, when predation or disease drove local red deer populations down to lower densities, it would have been less common to encounter these animals in a moorland context.

Modern day roe deer populations also appear to generally avoid open moorland environments (Cornelis et al. 1999). This is due to a combination of factors – principally a lack of cover from predators, exposure to the elements and a general scarcity of preferential browse (de Nahlik 1987, 169). However, the occurrence of scrub and open birch woodland conditions at higher altitudes in the Mesolithic period may have allowed roe deer populations to exist throughout the year. Year-round roe deer presence may have therefore have been restricted to these specific areas of high altitude peat moor environments. There is also the possibility that of roe bucks which are unable to secure territories before the rutting season may have been driven into unfavourable peat moor areas, and thus become a seasonal presence in these areas.

6.6.9 Open grassland

Although the size and frequency of clearing areas within Holocene mosaic forests has been the subject of some considerable debate within palaeoenvironmental studies, the existence of more extensive areas of open grassland on chalk geology has also been suggested by various authors. These are generally characterised by the high frequencies of grasses and herbaceous pollen and a general lack of notable levels of tree pollen. This is argued for by Scaife (2007) for the low altitude chalkland valleys of Southern Britain through research on the Allen Valley around Crambourne Chase, Dorset (French et al. 2005). At higher altitudes, Bush (1993) has argued for similar extensive Early Holocene open grassland environments on the Yorkshire

Wolds – although this work has been criticised for being overly reliant on a small number of sites (Thomas 1989).

Large areas of open grassland have some direct implications for the behaviour of specific species living in these conditions. These types of environments are unlikely to have been attractive for elk during the Mesolithic, as they lack the low-level foliage that elk rely upon to slow down predators when fleeing. The lack of tree species would also severely limit the availability of birch and pine browse, and thus would not offer elk much in the way of food resources. As such, the chances of people encountering elk in these types of environments would have been relatively low.

Red deer are known to inhabit open areas in Britain today, and are perfectly capable of surviving on the graze offered by large areas of grassland. As with heather moorland, the increased levels of elemental exposure and lower-quality browse tends to produce red deer of lesser sizes to those living in more sheltered woodland conditions. Another notable change in red deer living on open grassland is their herding behaviour. As such, rather than moving around in small groups or as solitary individuals, larger groups of red deer would be expected to form. This change in social structure would have had a direct impact on the nature of any encounters between people and red deer on open grassland during the Mesolithic. The lack of cover in these open environments would also have made direct encounters between people and red deer more likely, as they would have a comparatively higher visibility than animals living in woodland environments. Another possible behavioural response of red deer to open grasslands may have occurred at the fringes of these areas, where red deer home ranges encompassed both woodland areas and grassland. Modern red deer populations living in similar, parkland conditions with a mixture of forest and grassland habitats are known to graze at the forest edges at specific times of the day. This is most notable at dusk and dawn, and rarely results in the herding of red deer. As such, it could be said that people would have been more likely to encounter red deer in these forest/grassland intersections at the rising and setting of the sun.

Open grassland environments would not have been particularly attractive for roe deer. The lack of canopy cover and low-level foliage would increase the risk of predation for this smaller species, and would prove a particularly vulnerable place for calving in the late spring. As a consequence, open grassland areas are unlikely to be the subject of male territorial contests or rutting and calving activities. The lack of favourable conditions for roe deer would seem to suggest that people would be less likely to encounter these animals on large expanses of open grassland. However, the distribution of roe deer across these environments may have varied seasonally. Following the onset of the rut, open grassland areas may be frequented by the older, weak, sick and juvenile bucks which were unable to establish their own territories prior to the rut. As described above, this represents a significant proportion of the male roe deer population, and can result in high mortality rates among the displaced themselves. Potentially then, encounters between people and non-dominant roe deer bucks in open grassland contexts may have been significantly more frequent during the establishment of territories and rutting seasons which span from spring to early summer. Roe deer are also known to herd when on open ground, and so rather than the dispersed, territorial populations observed in more favoured conditions, it is possible that displaced bucks moved in herds over open ground.

6.7 Summary

The above discussion has outlined a number of key points regarding the structural development and growth of antler, the biology and behaviour of the three species of deer present in the British Mesolithic, the approach required to contextualise antler technology within a broader understanding of deer behaviour, and the implications that environmental variation may have had for the ways people encountered deer more generally during the British Mesolithic period. The annual, cyclical process by which antler is formed and shed has been critically defined through reference to zoological studies. The way in which antler form varies within the life of an individual deer has also been explored, as has the variations in form between the three species relevant to this thesis – red deer, roe deer and elk.

In considering the biology and behaviour of these three cervids, the differences in physiology, gait, diet, habitat, biological cycle and social structures have also been outlined. It can clearly be seen that, despite all belonging to the family *cervidae*, red deer, roe deer and elk are three very distinct species, which would have been encountered by people during the British Mesolithic in a diverse number of ways. Whilst direct, "face-to-face" encounters between people and deer undoubtedly occurred during the Mesolithic, it was also possible for people to become aware of the presence of specific deer species through observation of their tracks and signs. The low population densities of elk, for instance, may result in relatively infrequent direct human/elk encounters; yet the high visibility of their tracks and obvious destruction of high level browse and plant material, coupled with a loud roar that can be heard over several kilometers, may have meant that people were still reminded of the elk's presence within the Mesolithic landscape, and were able to construct and negotiate relationships with these animals. In contrast to elk, roe deer may have been numerically abundant within Mesolithic woodland areas. However, their timid behaviour and small body size may have resulted in few direct human/roe deer encounters considering their high population density. Both direct and indirect encounters between people and roe deer may have been governed by seasonal changes in roe behaviour – with the territoriality and rutting of the summer months resulting in both an increase in tracks (with tree marking and barking) and an increase in direct encounters (with displaced males being forced into open areas with increased visibility). In opposition to both of these species, red deer are less discrete than roe deer and live at much higher population densities than elk, and as such direct encounters between people and red deer could be considered to be relatively more common during the Mesolithic. As the most adaptable of the three species of deer, human/ red deer encounters would also have taken place in the widest range of environmental contexts.

The variation in the nature of encounters between people and the different types of deer would have led to the construction of three diverse and distinctive relationships. A key element within these relationships would have been temporality, with the variations in deer biological cycles leading to changes in the way that people may have encountered them throughout the year, and the types of environment that these encounters took place. The character of these relationships would have also varied considerably in different environmental contexts, with certain deer behaviours being much more commonly expressed within certain environmental settings. As such, this chapter has highlighted the diverse and dynamic character of the relationship between people and deer during the British Mesolithic.

Chapter 7: Discussion

7.1 Introduction

The following chapter will discuss the results of the traceological analysis of worked Mesolithic antler material from Britain, thus fulfilling Objective 6 of the thesis. This discussion will be structured to cover two major aspects of the results. The first section will summarise and discuss the insights gained and questions generated for each of the four major categories of artefact – barbed points, mattocks and *lame de hauche* and antler bevel-ended tools. These subsections will first deal with the chronological and spatial distribution of the artefacts.

It is worth noting that, due to the combined effects of both radiocarbon calibration curve plateaus and the early sampling of some artefacts within the development of the AMS technique, many of the dates for individual artefacts have extended ranges. This creates some problems for plotting the presence of artefacts by millennia during the Mesolithic. However, each discussion will be supplemented by a plot of calibrated date ranges for the finds being discussed. Where direct dates are not available from the artefacts themselves, the earliest and latest dates for Mesolithic activity at the sites from which the material was recovered will be provided. This will avoid a broad ranging date from a single find creating an artificial impression of long-lived persistence for a particular type of artefact.

A further caveat to consider in the discussion of the distribution of antler artefacts within the British Mesolithic is small sample sizes. It should be stressed that, given the vast amount of time and national spatial scale of this study, sample sizes are obviously too small to make definitive statements on the geographical and temporal distribution of artefact types. With this in mind, the discussion within this chapter should be treated as speculative – addressing the patterns apparent within the data as it stands, but acknowledging the limitations of the small sample sizes for making definitive statements regarding the distribution of antlerworking practices within Mesolithic Britain.

After the distribution of each type of artefact has been dealt with, the subsections will then outline the most commonly observed *chaîne opératoire* for each type of artefact and discuss variations from this normative sequence in relation to spatial and temporal distribution within the British Mesolithic.

The second section of this chapter will address the choices in the materials used in the manufacture of these artefacts. This will compare the relative use of antler from the three different species of British Mesolithic deer, and place these choices in raw material into the wider context of the different ways in which Mesolithic people may have encountered the various species of deer living in Britain at the time. This will be followed by an assessment of the results presented in Chapter 5 for characterising the management of antler as a material during the Mesolithic. This will encompass a diverse range of themes, including evidence for the repair of antler artefacts, measures taken in the prepare antler for working, the management of antler resources on Oronsay and the management of antler at shell midden sites away from Oronsay. The chapter will conclude with a reflection on the methods used, and then a summary of the key issues raised during the course of this discussion.

7.2 Barbed points

7.2.1 Distribution of barbed points in Mesolithic Britain

Antler barbed points and harpoons have been recovered from a number of locations within both England and Scotland (Figure 211, Figure 212 and Figure 213). These figures include the material examined as part of this thesis, and also the specimens from Earls Barton and Waltham Abbey which have been AMS dated to the Mesolithic but which could not be located for access. British barbed points can be broadly separated into two groups – biserial barbed points/harpoons and uniserial barbed points. Figure 212 demonstrates that the spatial distribution of these groups appears to differ. Based on the sites plotted, it could be suggested that biserial points are distributed across northern Britain, whilst uniserial points are confined to central areas and the eastern coast of Britain. The exception to this pattern is the Thrumpton Harpoon from Nottinghamshire, which also appears to be anomalous in terms of working techniques.

Figure 212 and Figure 213 also demonstrate that uniserial barbed points do not persist later than the eight millennium cal. BC. The ranges of the calibrated dates for uniserial barbed points are also worth noting. Whilst Figure 211 displays the maximum range for 95% certainty of a calibrated BC date for each site, it remains possible that the actual chronological distribution of these artefacts is smaller and does not extend beyond the 9th millennium cal. BC.

In contrast, the occurrence of biserial barbed points and harpoons appear to be predominantly confined to the 6th and 5th millennia cal. BC. The apparent gap in the 7th millennium cal. BC may be due the general small nature of the sample size, but appears to indicate that, chronologically, biserial and uniserial barbed points did not overlap during the British Mesolithic.

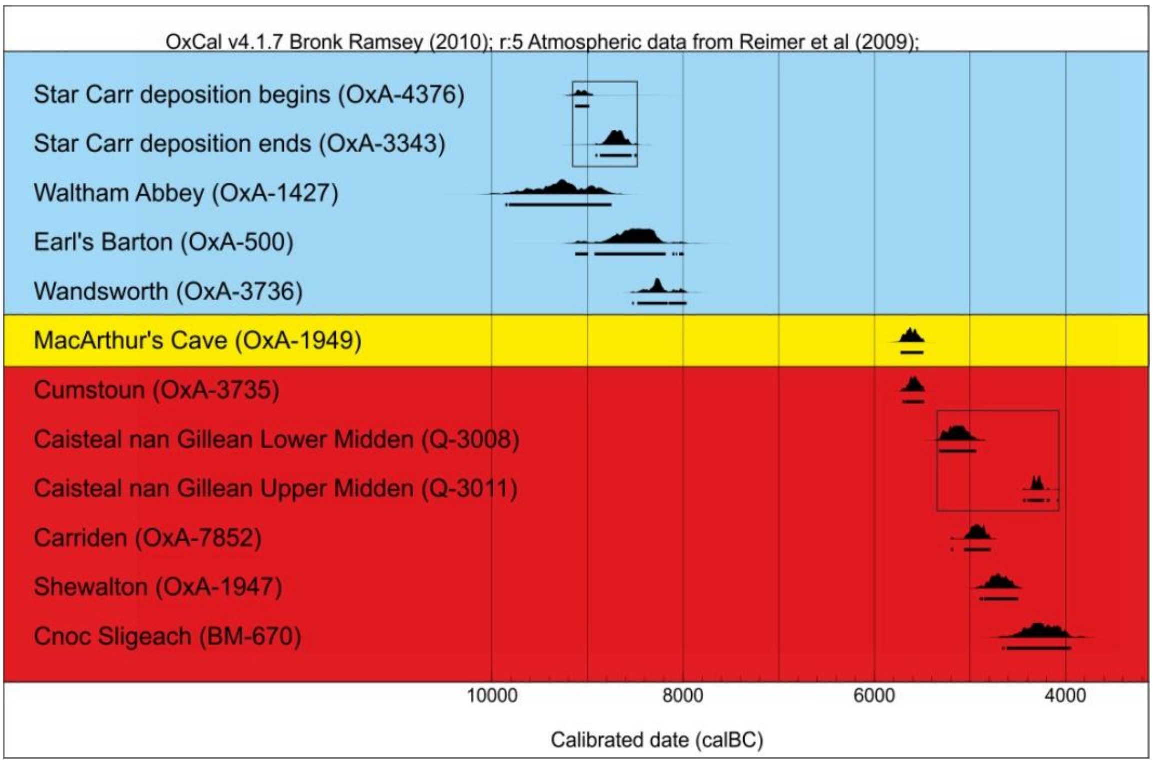


Figure 211: Plotted dates for Mesolithic barbed points. Uniserial points are shown in blue, biserial harpoons in yellow and biserial barbed points in red

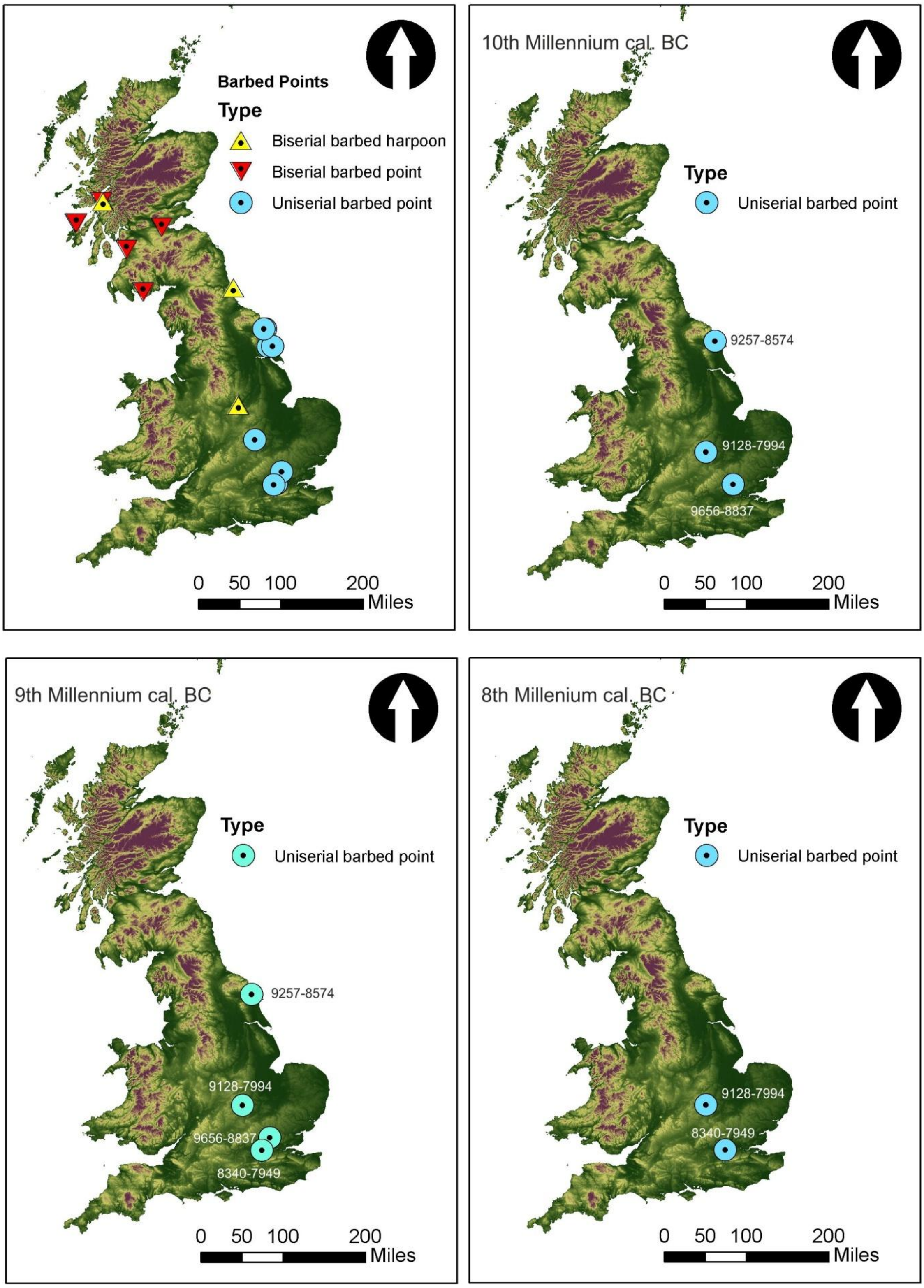


Figure 212: Spatial Distribution of barbed points/harpoons in the British Mesolithic. Date ranges in cal. BC (1 of 2)

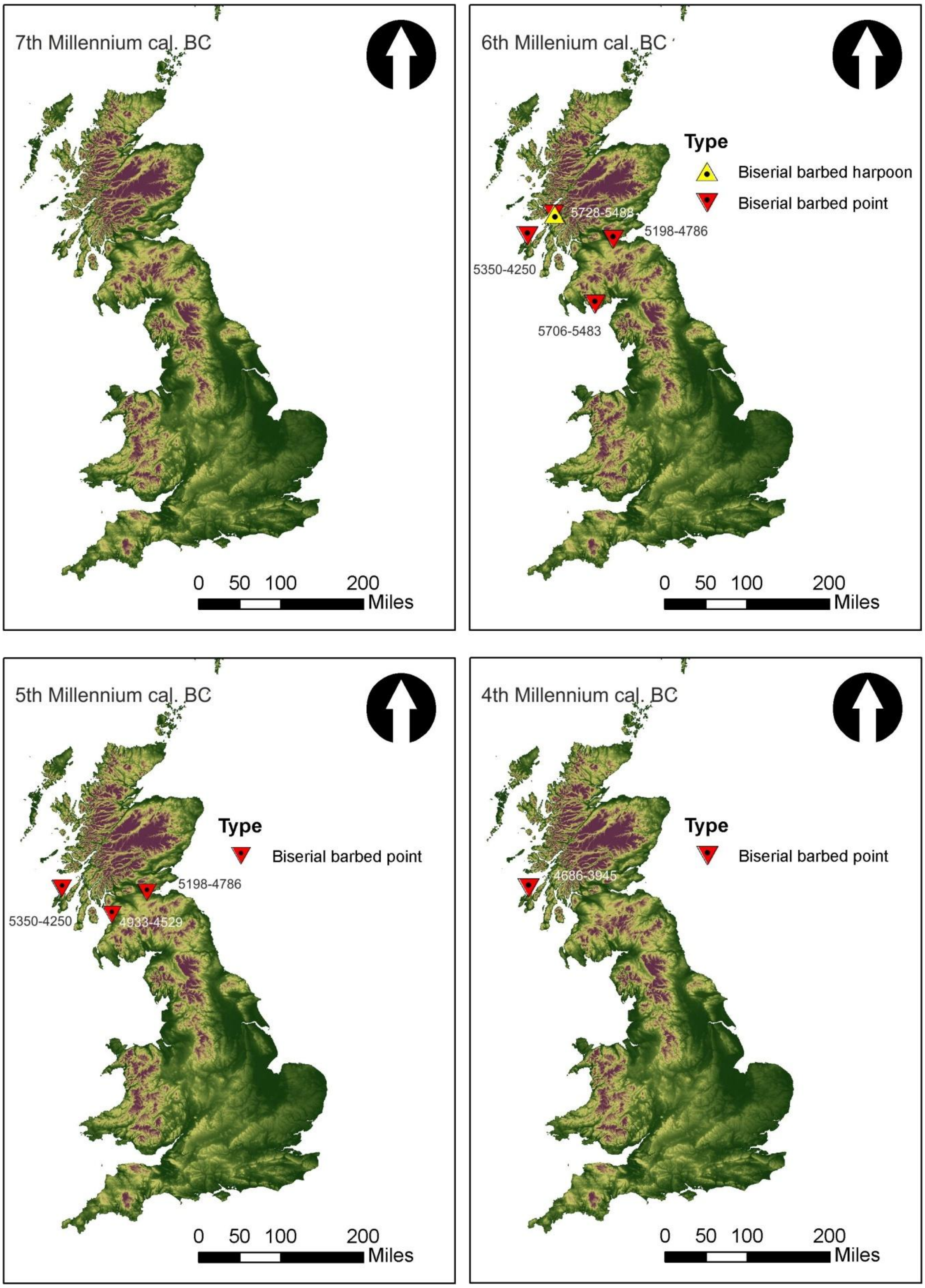


Figure 213: Distribution of barbed points/harpoons in the British Mesolithic. Date ranges in cal. BC (2 of 2)

7.2.2 Biserial barbed points and harpoons

A total of 15 complete and fragmentary biserial barbed points and harpoons were analysed as part of this study. In addition to these artefacts, the Thrumpton Harpoon (inaccessible due to current status on display) and the three artefacts excavated by Galloway and Grieve (Anderson 1898) from Caisteal nan Gillean I (which have been lost) can also be considered to produce a total of 19 artefacts from England and Scotland. The largest assemblage of antler biserial barbed points originates from MacArthur's Cave. In the absence of any partially finished biserial barbed points, the variety of tool forms within this assemblage offer the greatest insights into the methods used to manufacture these artefacts.

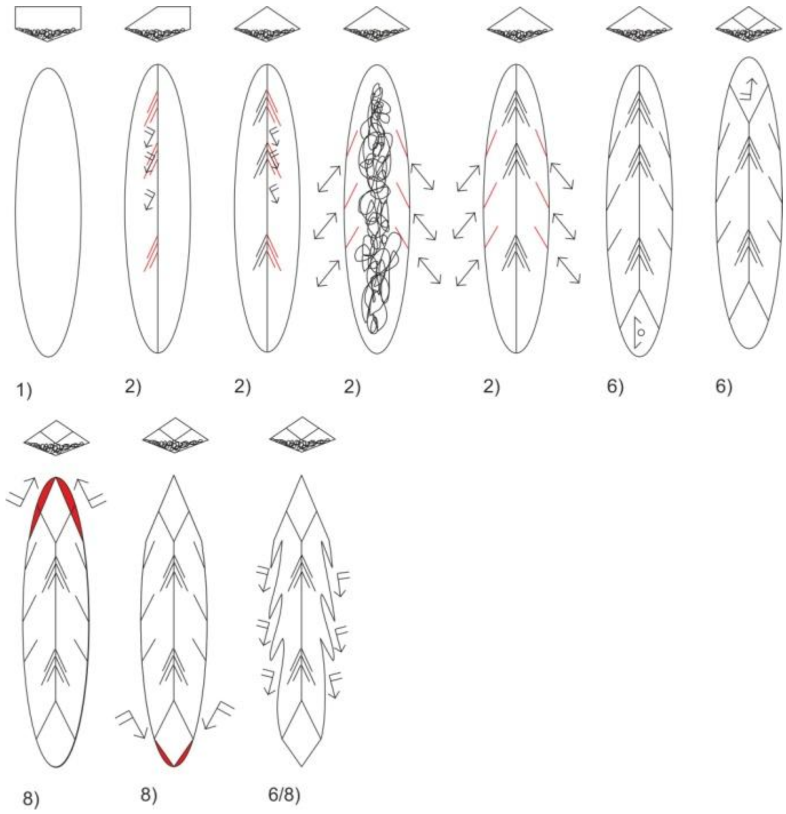


Figure 214: Chaîne opératoire of biserial barbed point manufacture

Whilst the latter stages of barbed point manufacture notably obscure some of the earlier steps of the *chaîne opératoire*, the methods used to produce "blanks" is eluded to through the large quantities of red deer antler which have been broken up using the flake breakage method, at biserial sites where *debitage* is also preserved (Caisteal nan Gillean I, MacArthur's Cave and Risga). Whilst direct evidence for the use of this method to create blanks for biserial barbed points and harpoons is lacking, it far outweighs the sparse evidence of grooving at these sites and as such appears to be the most likely method for blank manufacture.

Following the production of a roughly rectangular antler "blank", extensive shaping appears to have been carried out. A "diamond" cross-section is characteristic of the biserial barbed points, and the creation of this would involve the removal of material on both the SEN and DEX sides of the EXT surface, sloping away from a ridge which runs longitudinally down the centre of the artefact. This may have been achieved through grinding, followed by scraping – or simply scraping alone. This creation of the diamond section also resulted in the creation of a taper along the SEN and DEX edges which destroys the surfaces needed to directly diagnose the methods used to produce the original blank.

Barbs were then defined through sawing on both the INT and EXT sides of the blank. Once the sawing fully penetrated the thickness of the blank, scraping was applied to the underside of the barb in order to create a more sweeping profile and thus accentuate the barb. The shaping of the tip and tang was also carried out after the initial diamond section had been established. At the tip, scraping appears to have been applied from all angles to create a straight, sharply defined apex. At the tang, grinding appears to have been used to thin the compactor and spongy material.

One particular variation in the *chaîne opératoire* has a wider significance in ascertaining the typological affinities of the finished artifact. Of the six biserial points which feature intact tangs, two have been perforated. In both cases (from Whitburn and MacArthur's Cave), the perforation has been created through the application of grooving on both the EXT and INT aspects until the thickness of the tang is fully penetrated. This defines these two points as biserial harpoons, which implies a different form of hafting to that of an unperforated barbed point. Harpoons allow a line to be securely attached to the projectile point, and thus the haft is designed to allow the point to break away following impact with a target. Ethnographically, harpoon technology has traditionally been linked to marine mammal hunting, as the embedded point and attached line allow the recovery of the hunted animal from below the surface (Clark 1952, 1967). The location of these two findspots, on both the East and West coast of Britain, suggests that the spatial distribution of these harpoons is as broad as that of the biserial barbed points.

It should also be noted that the element of the artefact required to ascertain "harpoon" status is absent in a further nine of the biserial barbed points analysed. The three biserial barbed points from the Galloway and Grieve excavations which Anderson (1898, 308) provides drawings for are also lacking the tang element, and so cannot be classified as barbed point or harpoon with any certainty. It therefore remains possible that these fragments may have originally been harpoons before becoming damaged.

Figure 215: Biserial harpoon from Thrumpton, Nottinghamshire

The artefact from Thrumpton, Nottinghamshire (Figure 215) can also be classified as a harpoon, based on the perforation visible in the photographs provided by the Brewhouse Yard Museum. The low resolution and lack of scale severely limit the potential for typologically defining this object, but it can be seen that both the shape of the tang and the style of perforation differ from the biserial barbed points and harpoons from other British Mesolithic sites (Figure 215). The circular profile of the perforation suggests drilling or coring, although this is obviously speculative without a first-hand examination of the artefact itself. This technological variation may be indicative of regional trends in biserial harpoon manufacturing, or alternatively the undated nature of the Thrumpton Harpoon could mean that the object dates to an earlier point in the Mesolithic. It should also be born in mind that British biserial harpoons have also been dated to the Upper Palaeolithic (Chapter 4) and as such this apparent technological anomaly undermines the security of the artefact's Mesolithic affinities.

7.2.3 Uniserial barbed points

Previous discussions of uniserial barbed points have been dominated by the Star Carr assemblage, both in terms of typological variation within the finished artefacts and the *chaîne* *opératoire* of manufacture. A further seven uniserial barbed points were analysed as part of this thesis. These present nothing to contradict the established belief that uniserial barbed point blanks were produced through the groove-and-splinter process, and the flat edges of points from Star Carr, Fosse Hill, Wandsworth and Battersea demonstrate that uniserial points manufactured through the groove-and-splinter process were being deposited at sites across Eastern Britain.

Following the production of a blank, the point was shaped through the application of scraping to the INT and EXT aspects of either the SEN or DEX edge, creating a tapering edge and obscuring the grooving marks along one edge. The tip of the point was shaped through scraping from all angles, whilst the tang was created through the thinning and shaping of the compactor and spongy – either through grinding or scraping. The barbs were defined through sawing from the INT and EXT aspects and then scraping below the barb. Filing was then applied below the barbs to further accentuate their curvature. This creates a series of angled barbs along the length of the point. Following the definition of the barbs, longitudinal scraping of both the INT and EXT aspects was carried out along the length of the point.

Variation in this basic sequence is observed in the barbed points from Fosse Hill, Star Carr and Battersea. Some specimens from these sites show further modification along the unbarbed edge in the form of further scraping which has rounded the original grooved marks. This variation does not appear to relate to spatial or temporal distribution, as at Star Carr both rounded and unrounded specimens have been recovered from the same site.

Further variation also seems to occur in the methods by which barbs are incised. At Wandsworth, sawing does not appear to have been used to define the barbs. Instead, filing has been applied directly to the tapering edge, and a triangle of material removed to create prismic shaped barbs which are not angled in the same way as those observed on other specimens. The date of 8340-7949 cal. BC (OxA-3736, 9050±85 bc) from this point is the latest dated uniserial specimen from Britain, and it is possible that this change in manufacturing technique may be a temporal variation (Figure 212). However, the isolated nature of this find makes it difficult to establish whether it is representative of a broader chronological trend.

7.3 Mattocks and *lame de hauche*

7.3.1 Distribution of antler mattocks within Mesolithic Britain

The analysis of antler mattocks from England, Scotland and Wales has provided a variety of insights into their methods of manufacture and highlighted variations within their *chaîne opératoire*. However, before these new findings are summarised and discussed in depth, it is worth briefly considering the spatial and chronological distribution of the Mesolithic "mattocks" (Figure 216, Figure 217 and Figure 218) which were identified and defined by Bonsall and Tolan-Smith (1999). These include the analysed specimens which have previously been ascribed to the Mesolithic, and the two unlocated but AMS dated finds from Hutton (Middleton & B Edwards 1993) and Alton Longville (Bonsall & C Smith 1992).

Figure 216 shows that mattocks were present in Britain throughout the Mesolithic, although they appear most common during the 6th and 5th millennia cal. BC. Figures 217 and 218 would seem to suggest that they extend over England, Scotland and Wales, although within the Early Mesolithic they appear confined to southern England (Figure 217 and Figure 218). However, this apparent concentration may be due to smaller sample sizes for these periods, with less organic material being expected to survive over time. The dating of the large beam mattock from Mortlake (A13641) to the Neolithic (3367-3105 cal. BC) appears to show a residual persistence of this artefact type into Neolithic society, although the current isolated nature of this date means that this only appears to occur within south-eastern England. Aside from these general observations, it is difficult to draw further insight from the distribution of these artefacts without a more detailed understanding of their methods of manufacture and an awareness of associated technologies such as the *lame de hauche* identified in Chapter 6. As such, the spatial and chronological distribution of these artefacts will be revisited in Section 7.3.6 following a more detailed discussion of variation within the *chaîne opératoire* of these objects.

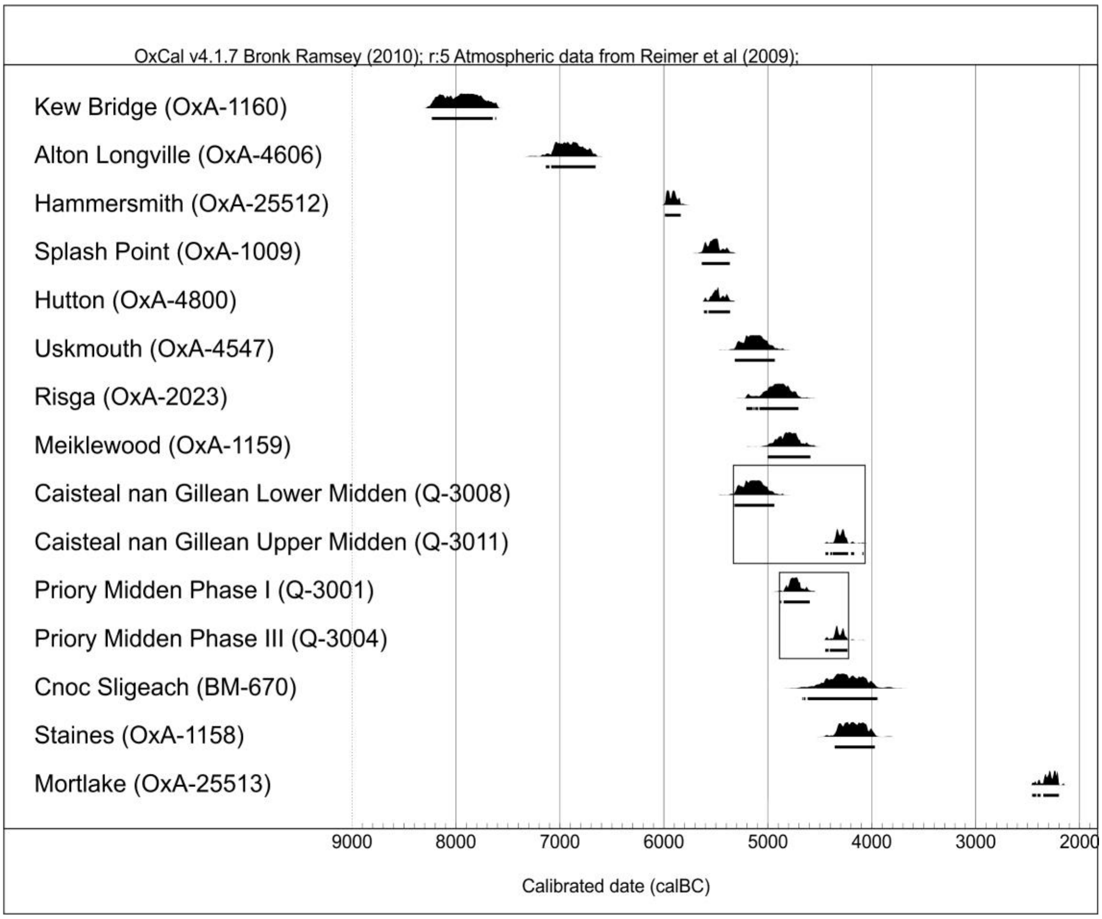


Figure 216: Plotted dates for Mesolithic antler mattocks. The boxes define the earliest and latest limits of occupation at sites with multiple ^{14}C dates.

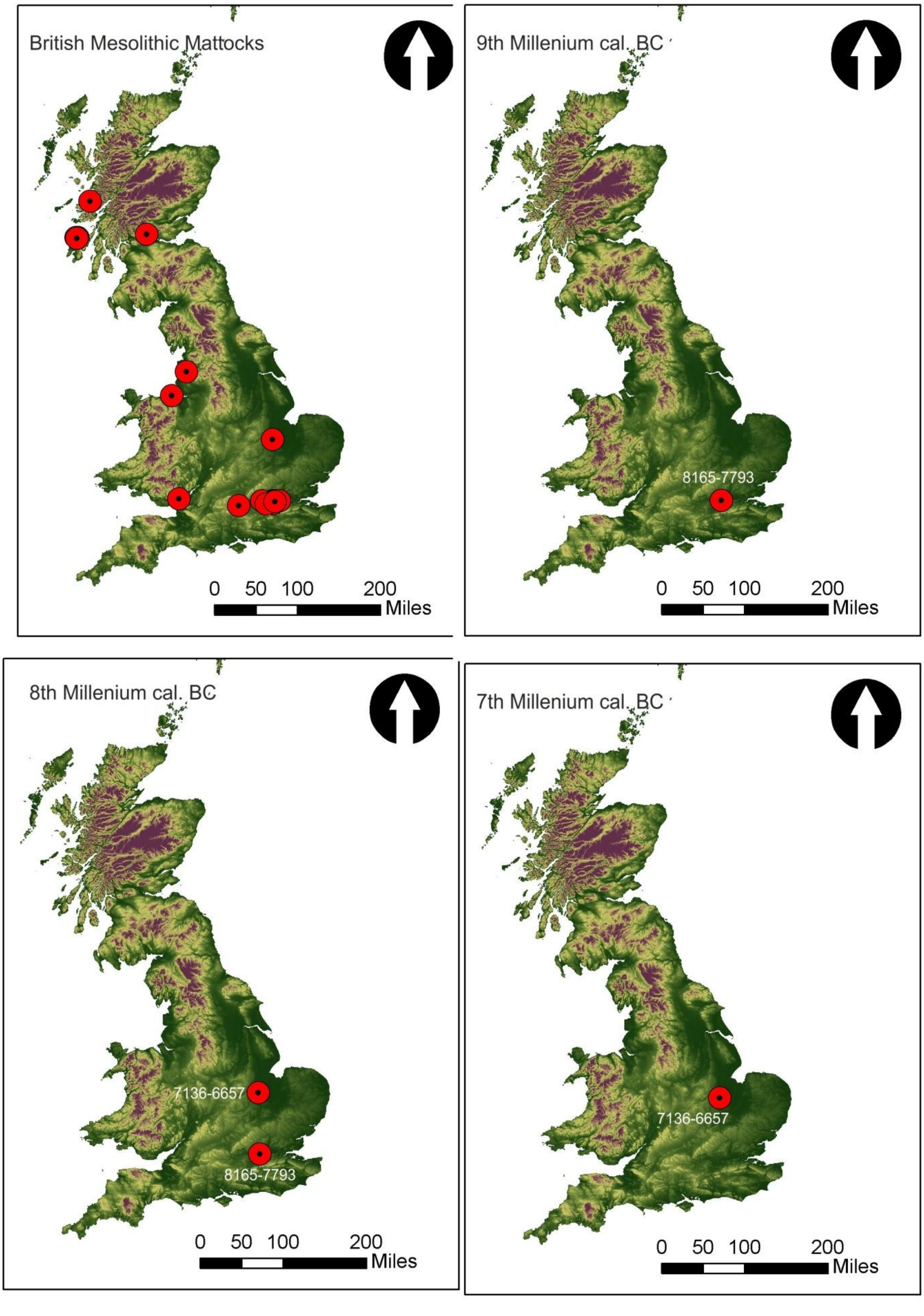


Figure 217: Distribution of mattocks with Mesolithic Britain. Date ranges in cal. BC (1 of 2)

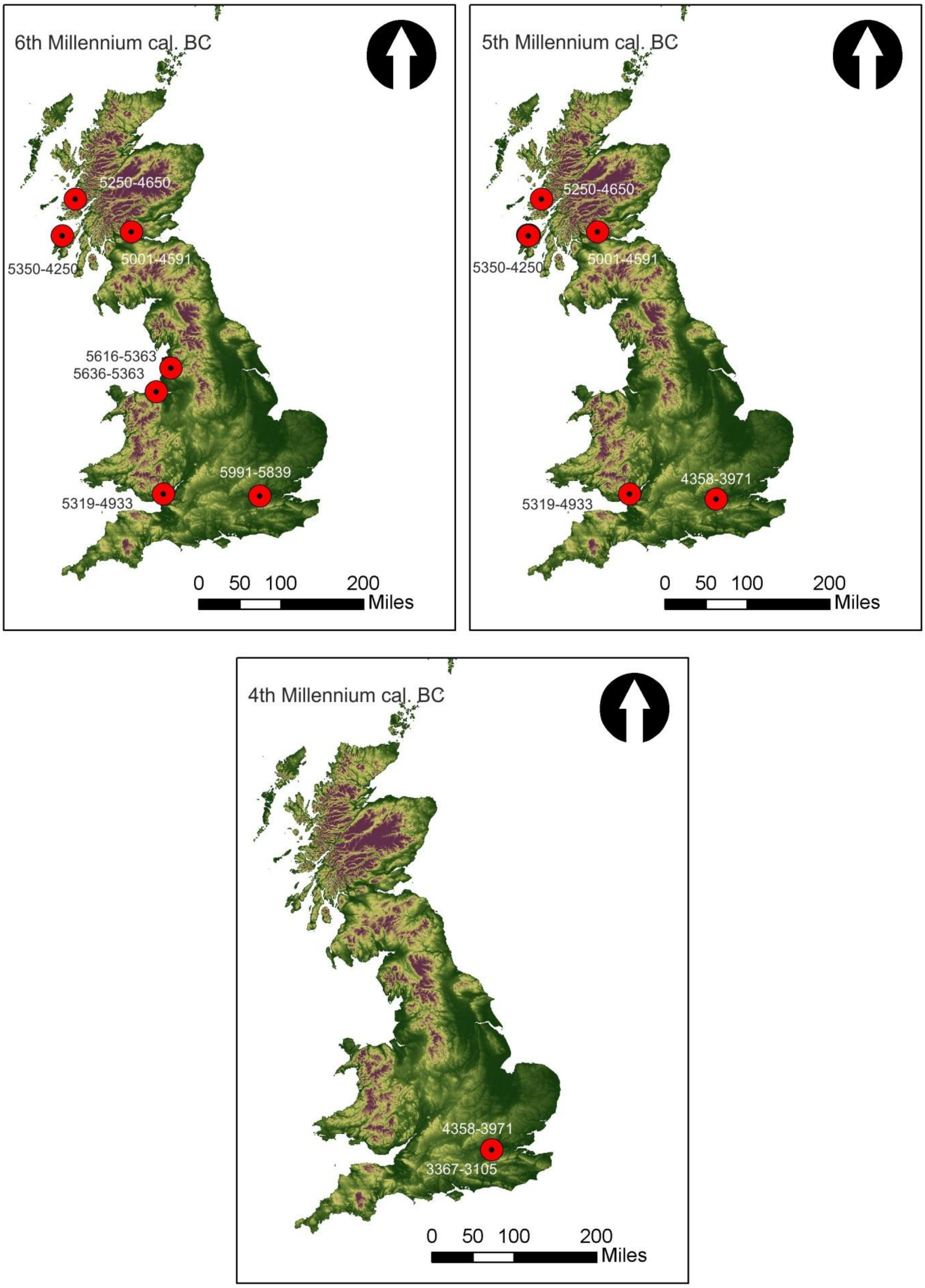


Figure 218: Distribution of mattocks within the Mesolithic Britain. Date ranges in cal. BC (2 of 2)

7.3.2 Beam mattocks

The shell midden site of Risga and the worked antler from Goldcliff East site C comprise the most convincing cases for mattock manufacturing *debitage*. These demonstrate the use of prepared breakage at the basal portion to create a beveled break surface on the removed portion of beam. In the absence of any evidence which contradicts this, and the overwhelming use of red deer beams from around the trez tine junction for beam mattock manufacture, it is assumed that the majority of British specimens were manufactured in this way. Whilst both of these pieces have been naturally shed, it is impossible to ascertain the state of the antler used for individual beam mattocks at other sites, and consequently it cannot be assumed that beam mattock manufacture used shed antler exclusively due to the small sample size of the mattock production *debitage.*

Beam mattock production (Figure 219) appears to have begun with the acquisition of either a shed or unshed red deer antler. The lower beam was prepared for breakage through nicking or sawing. The break was then executed to produce a beveled working face and edge on the upper beam. The trez tine and upper beam were then removed. In the case of the upper beam, this appears to have been most commonly achieved through an episode of nicking followed by the execution of a prepared break. The methods used to remove the trez tine are often obscured by the subsequent phase of shaping the working face, which consisted of multiple phases of scraping across the face itself. Perforations were usually created through application of drilling to both sides of the mattock on the internal and external aspects of the antler (thus creating a perforation which runs on an axis at 90° to that of the trez tine, and in line with the axis of the working edge). These tools were then hafted and used, resulting in the development of polish within the hafted perforation, across the working face, along the working edge and on the lower extremity of the proximal EXT aspect of the tool.

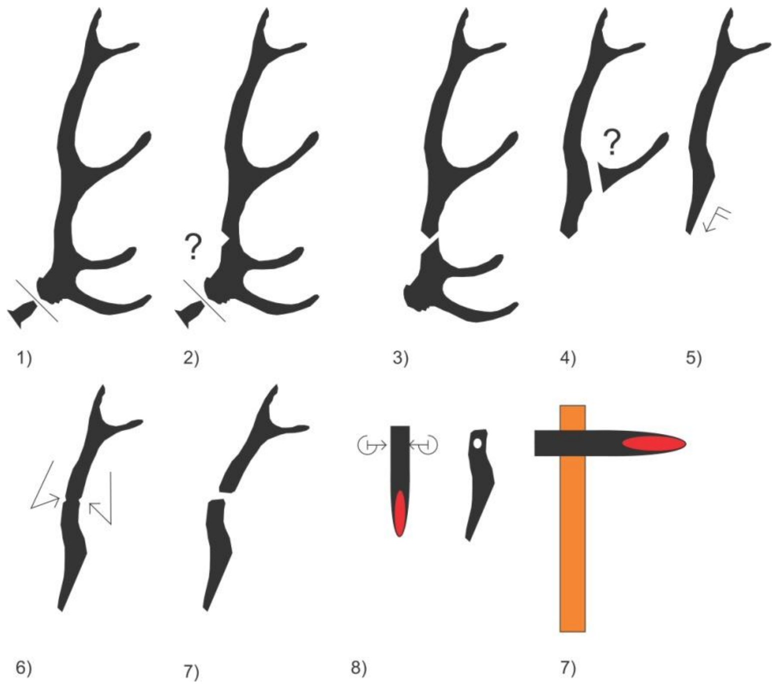


Figure 219: *Chaîne opératoire* of beam mattock

A particular element of variation in the *chaîne opératoire* which can be observed across Britain occurs during the secondary shaping of the working face. Although scraping appears to be used to create a smooth and angled working face, the intensity and duration of this scraping episode varies in different specimens. In some instances, unidirectional striations of a consistent depth are observed along the length of the working face. In others, multiple phases of scraping are evidenced through overlying striations which run at differing angles (Figure 220). The depth and definition of these marks also varies, implying different levels of force being applied. These variations can be interpreted as either varying levels of time which have been spent in the finishing stages of mattock manufacture, or alternatively may represent re-shaping episodes following the original production of the tool. This behaviour appears to be evenly distributed across Britain, and in a range of temporal contexts.

Figure 220: A13648 Hammersmith, London, with scraping marks highlighted to illustrate the repeated and multidirectional nature of working face shaping

Further variation in the *chaîne opératoire* of antler mattocks can be observed in the few artefacts which have been repaired following damage at the point of hafting. This is achieved through the re-drilling of a new perforation, with traces of the original perforation apparent at the distal end of the piece. Mattocks from Hammersmith (A22556), Kew Bridge (A13647) and Mortlake (2004.167) all display remnant perforations at their distal ends (Figure 221). Away from Southern England, there is also more fragmentary evidence from Caisteal nan Gillean I which suggests that the repair of mattocks also occurred at Scottish shell midden sites. HP214 shows signs of having been perforated twice before being fragmented through flake breakage. As no documented Mesolithic antler tools feature two perforations, it is assumed that these were created successively following damage to the initial perforation.

Figure 221: Broken perforations on repaired antler beam mattocks. A) A22556, Hammersmith B) A13647, Kew C) 2004.167, Mortlake

The single instance of variation in the element of antler used for the antler mattocks comes in the form of the base mattock from Kew Bridge, London. This artefact has been created on the basal portion of a shed red deer antler. The location of the prepared break on the beam is actually very similar to that used in the production of the beam mattocks, the difference being it is the lower piece which is used for the manufacture of the tool in this case rather than the mid and upper beam. Chronologically, the direct date from this base mattock has led previous authors to suggest that they are restricted to the Early Mesolithic (Tolan-Smith & Bonsall 1999).

7.3.3 British antler T-axes

Variation also appears to occur in the location of the perforation; beam mattocks from Risga, Meiklewood, and Priory Midden, all feature perforations through the stump of a removed trez tine. In the case of the Priory Midden and Meiklewood specimens, these perforations can be observed on both sides of the object, suggesting that a haft fully penetrated the width of the tool. This variation appears to be confined both spatially and temporally to the late Mesolithic of northern Britain (although it spans the width of Scotland with finds from both the East and West coast). Typologically, these tools can be classified as "T-axes" (Woodman 1989, 17–18).

Despite being previously identified as T-axes, the significance of their occurrence on a continental level has not been discussed. Within a broader European context, the occurrence of T-axes has long been associated with the Ertebølle culture of Southern Scandinavia (S Andersen 2002). However, the recovery of T-axes from agricultural contexts within Southern Scandinavia has triggered debate as to their role within exchange networks between foraging and farming groups present in this region of Europe during the fifth millennium cal. BC. Since the original characterisation of the T-axe as a type fossil of the Ertebølle, the geographical distribution of these artefacts has been found to extend across Europe (Zvelebil 1994), along the Baltic coast and into Poland (Bogucki 2008), and down the North Sea coast into Belgium and Holland (Crombé et al. 1999; Louwe Kooijmans 1971, 2001a, 2001b).

Whilst the persistence of the T-axe within Early Neolithic farming communities appears to vary across the continent, the dates for the initial appearance of these artefacts appear remarkably consistent across their geographical range. Through the application of ^{14}C AMS dating to finds dredged from the river Schelde, Crombé *et al.* (1999, 116) have established that the earliest T-axes appear in Holland and France at the beginning of the 5th millennium cal. BC and persist into the late 4th millennium cal. BC At the Dutch site of Hardinxveld-Giessendam Polderweg, antler T-axes have been recovered from the first phase of the site's occupation which has been dated to 5500-5300 cal. BC (Louwe Kooijmans 2001, 69). These axes predate the finds from Northwest Germany, with the site of Drümmer previously being recognised as featuring the earliest known T-axe finds from the early 5th millennium cal. BC (Andersen 2002, 228).

The dating of the three confirmed antler T-axes in Scotland also appears to fall within the earlier end of the T-axe chronological range (Figure 222). Whilst the occupation dates for Priory Midden strongly suggest that this specimen dates to the mid 5th millennium cal. BC, the direct AMS dates from the Risga and Mieklewood specimens fall into the late 5th/early 6th millennium (although as Figure 222 demonstrates, the broad error ranges for these dates make a more definite ascription problematic). Further dating is required to investigate this pattern fully, but the limited data available would seem to suggest that the earliest dates for T-axes originate from North Sea coastal contexts, with T-axe technology spreading rapidly into Baltic regions in the mid 5th millennium cal. BC.

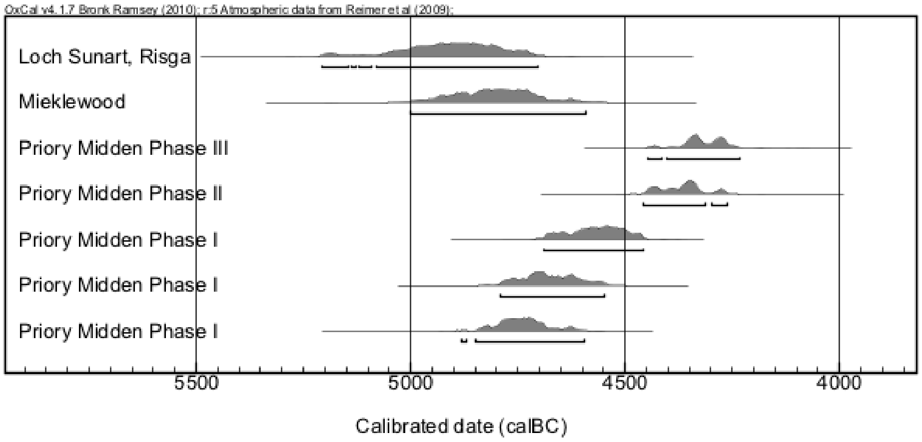


Figure 222: ^{14}C dates for antler T-axes from Scotland

7.3.4 Lame de hauche

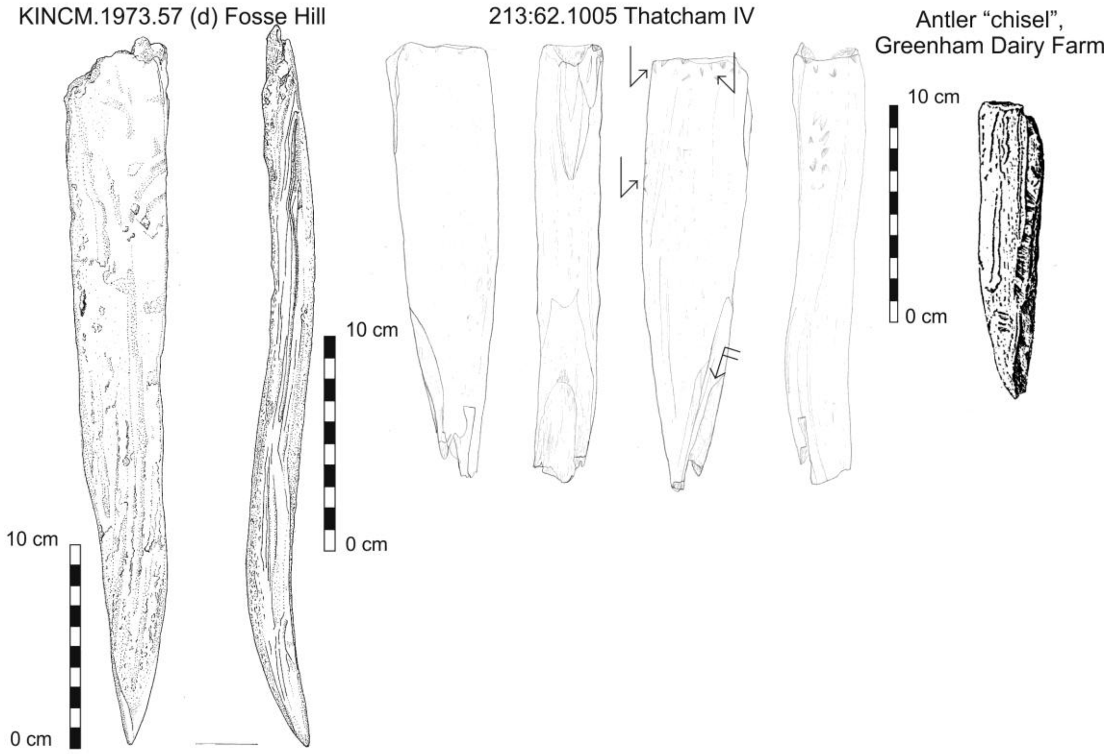


Figure 223: Possible lame de hauche from Britain

The *chaîne opératoire* of mattock manufacture also varies in the case of the *lame de hauche*. These appear to have been made predominately through the prepared breakage of elk brow tines to create a beveled working face and edge towards the distal end of the tine. The tine itself was then removed from the antler through nicking and then the execution of a prepared break at the tine's proximal end (the distal end of the artefact). The working edge was shaped through scraping, before the object was bound to a haft for use. The method of hafting must have differed from that used for the other "mattock" tools, given the absence of any perforation through which a haft could be fitted. It is possible that the *lame de hauche* were inserted into a prepared haft and used either as an axe, an adze or a chisel (Figure 224).

Chapter 6 shows that the presence of this tool type has been positively confirmed at Thatcham IV, whilst the specimens from Fosse Hill and Greenham Dairy Farm also appear likely to belong to this type but are still awaiting confirmation through first-hand analysis. Within the archived correspondence between Barton and Crowther at the Kingston-Upon-Hull Museum, Barton notes the strong similarities between this specimen and the find from Thatcham IV. Although the surviving drawings do not allow this theory to be positively confirmed, they also do not allow it to be ruled out and as such it remains a possibility.

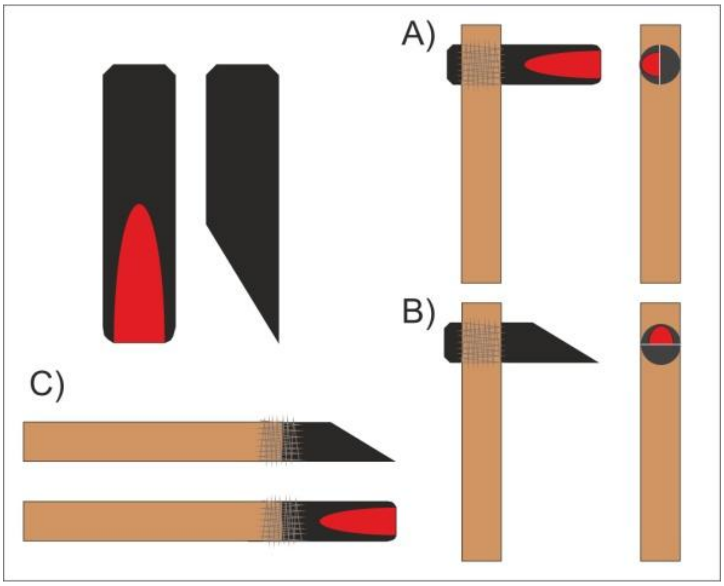


Figure 224: Possible hafting methods for *lame de hauche* A)As an axe B)As an adze C)As a chisel

7.3.5 Redefining antler beam mattocks

The distribution of scraping marks on the working faces of the mattock tools can also be interpreted to indicate an alternative function to that proposed by Smith (1989). Smith argues that the consistent presence of "chatter marks" and adhering sediment on the working faces of mattock tools suggests that they have been used in digging activities. Although a clear description of "chatter marks" is not provided by Smith, they are assumed to relate to the scraping marks which have been identified on mattock working faces across Britain. These scraping marks are often most clearly defined at the distal end of the working face, away from the working edge itself. Conversely, the use-polish which is frequently observed on well-preserved specimens is concentrated at the proximal end of the working face and along the working edge where scraping marks are either absent or less clearly defined (Figure 225). This relationship suggests that the use polish is created after the creation of the scraping/chatter marks, and obscures these marks in closer proximity to the areas where use-wear is focused (i.e. the working edge). The adhering sediment across the working edge may be attributed to the porous nature of the exposed spongy material in this region, which inhibits the cleaning of the artefact following recovery.

Figure 225: Examples of scraping marks at the distal end of mattock working faces, but which are obscured towards the working edge. A) Syon Reach, London B) Windmill Lane, Brentford C) Battersea, London

In light of the re-interpretation of "chatter marks" as evidence for scraping in manufacture, and the alternative explanation for the accumulation of sediment on the working face, there is very little evidence to positively confirm that these artefacts have been using in digging activities. Furthermore, the loss of spongy material at the working face is consistent with the patterns observed by Jensen (1991) when using antler axes for woodworking. Whilst it should be stressed that the form of the artefacts in no way inhibits their potential use in digging activities, there is a lack of positive evidence for this function, or any one function in particular, in the absence of more focused use-wear studies. As such, the terming of this category of artefact as "mattock" is problematic as it is suggestive of a certain activity for which there is no positive evidence. It also misrepresents the way in which the artefact was hafted, held and used. The modern analogy of a mattock (with which most archaeologists are familiar) features a working edge set at 90^{o} to the angle of the inserted haft. Given the similar orientation of the perforation in relation to that of the working edge it is proposed that these Mesolithic artefacts be re-classified as antler axes. This may not only help to avoid confusion regarding the possible function of the tools (Zvelebil 1994), but also aid comparisons with similar material from Europe where terminology has been more consistently applied (E David 1999).

The reclassification of "antler beam mattocks" as "antler beam axes" requires some critical adaptation if it is to be applied successfully to the material from Britain. The single instance of a "mattock" which features a working edge orientated at 90^{o} to that of the axis of perforation occurs at the site of Uskmouth, Gwent. As such, this artefact can be classified as an antler beam "adze" as opposed to an "axe". This typological distinction has a wider significance within a European context. Clark's (1969) description of the Maglemose and Ertebølle cultures of Southern Scandinavia notes that the former is associated with adze type antler tools, whilst the latter is characterised by a dominance of antler axe tools (Clark 1969, 112). The validity of this distinction within Britain appears to be compromised by the AMS dating of the antler beam axe from Alton Longville and the date of the Uskmouth adze itself. Whist it is unfortunate that the Alton Longville artefact could not be located for inclusion within this study, the late 7th millennium/early eighth millennium cal. BC date (OxA-4606, 8005±80 bc, 7136-6657 cal. BC) appears to suggest that antler axes are not solely restricted to the late Mesolithic in Britain. Equally, the late Mesolithic date of the Uskmouth specimen – when considered alongside late Mesolithic dates for antler beam axes across England, Scotland and Wales – suggests that the distinction between antler axes and adzes in Britain may be much less defined than Clark argues for Southern Scandinavia.

7.3.6 Distribution of beam axes, base axes, beam adzes, T-axes and *lame de hauche* in Mesolithic Britain

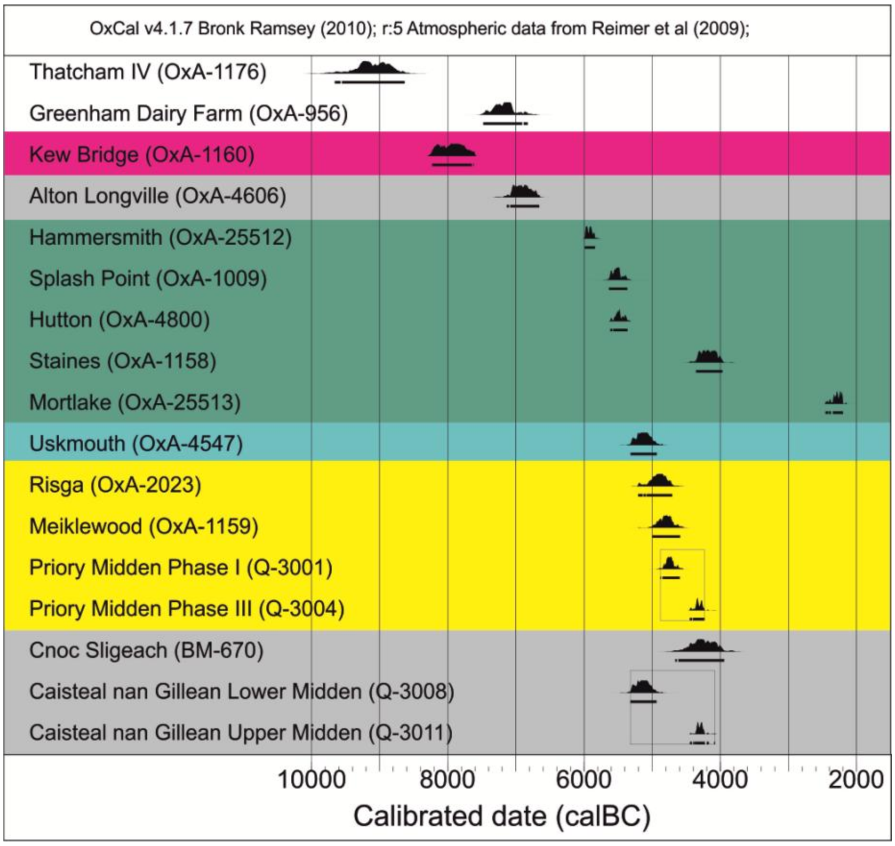


Figure 226: Plotted dates for antler axes, adzes and *lame de hauche.* Lame de hauche are shown in white, base axes in claret, unknown forms in grey, beam axes in green, beam adzes in turquoise and T-axes in yellow. The boxes define the earliest and latest limits of occupation at sites with multiple ^{14}C dates.

The re-classification of antler "mattocks" argued for above allows a more nuanced discussion of the distribution of these objects throughout the British Mesolithic. When these groups are plotted spatially and temporally (Figure 226, Figure 227 and Figure 228), alongside the AMS dated finds from Alton Longville and Hutton which could not be located for analysis, their distribution shows some interesting elements of patterning. It should be noted that the broad date ranges for some artefacts can result in them being plotted within multiple millennia (Figure 227 and Figure 228). Comparison with Figure 226 can help clarify some of this confusion.

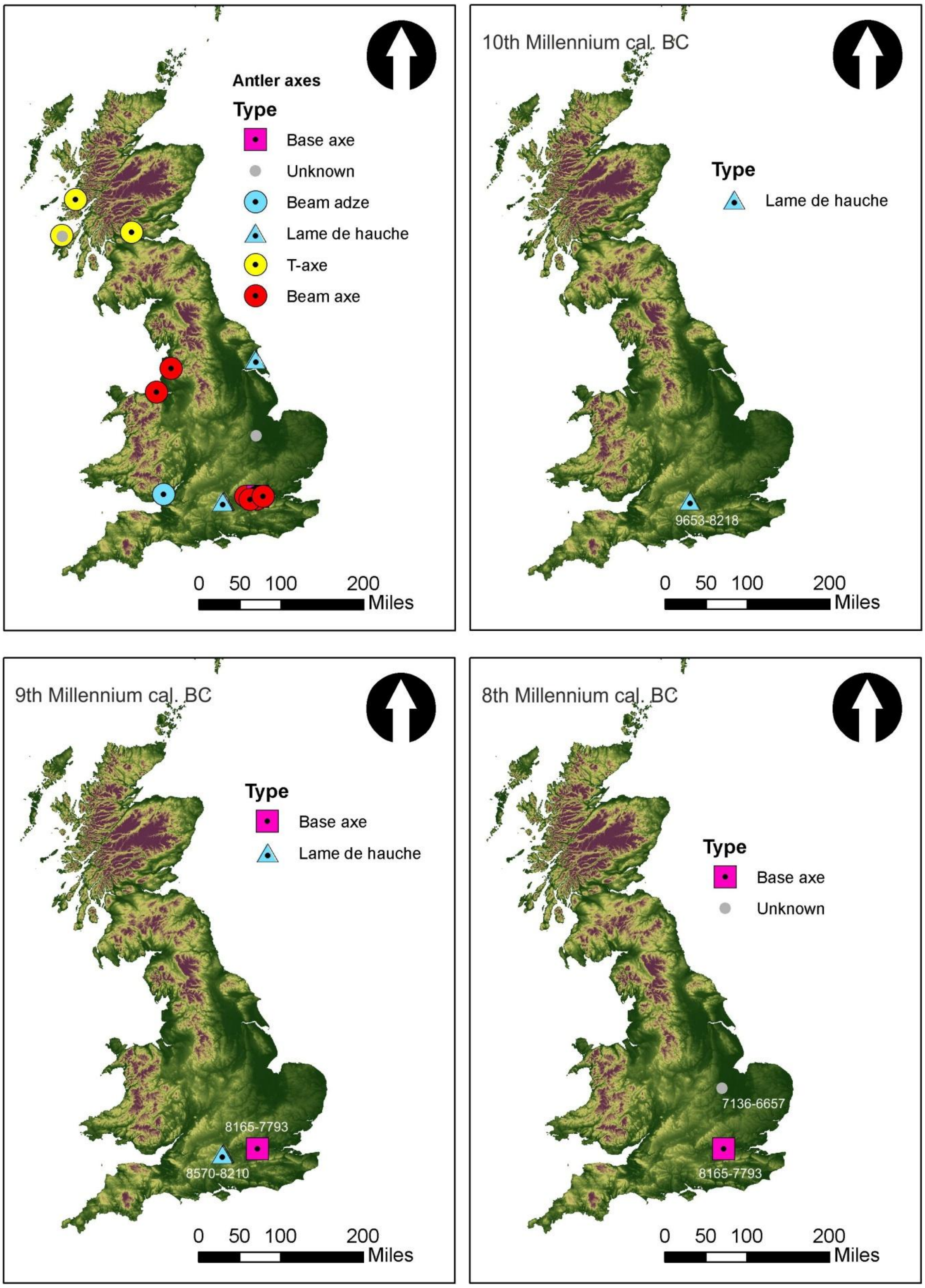


Figure 227: Distribution of mattock type tools in the British Mesolithic. Date ranges in cal. BC (1 of 2)

Both base axes and *lame de hauche* appear to have been in use during the 9th millennium cal. BC, but seem not to persist into the later Mesolithic. The spatial range of the *lame de hauche* appears to extend across a large area of Britain, although it should be stressed that the classification of the Fosse Hill find remains tentative and requires location of the artefact itself for full confirmation (Section 7.3.4).

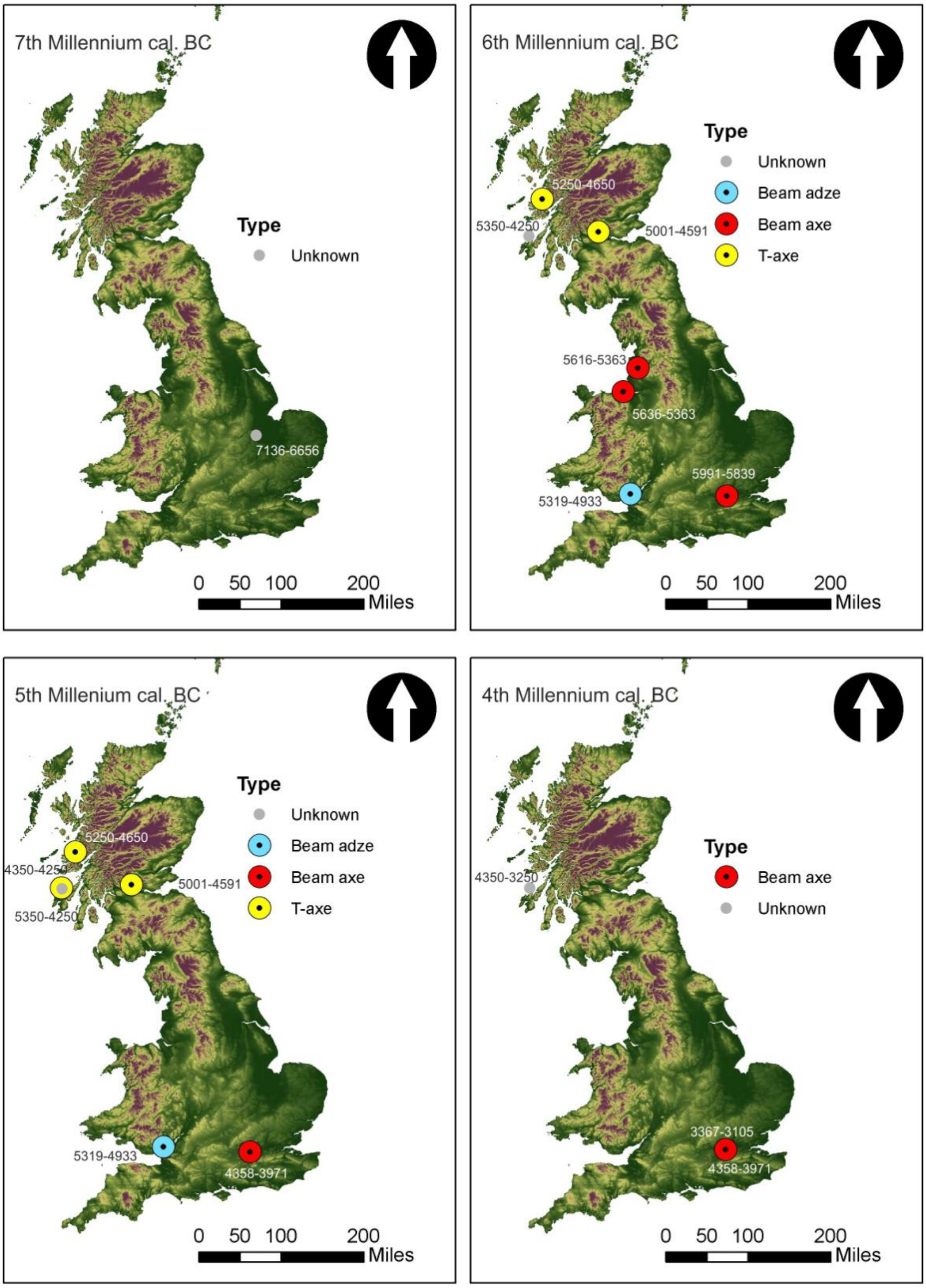


Figure 228: Distribution of mattock-type tools in the British Mesolithic. Date ranges in cal. BC (2 of 2)

Although the small sample size can only allow speculation at this point, the occurrence of T-axes appears to be confined to Northern Britain, from the 6th millennium cal. BC onwards. The wider significance of this is discussed in Section 7.3.3. Whilst at a superficial level it appears that T-axe and beam axe distribution within the 6th and 5th millennia cal. BC are discrete, it should be stressed that the undiagnostic nature of working edge fragments at Cnoc Sligeach and Caisteal nan Gillean I mean that the use of beam axes within Northern Britain cannot be ruled out.

The chronological range of the beam axes also requires some discussion. Although the earliest dates for beam axes also occur within the 6th millennium, it should be noted that the large number of undated specimens may mean that their chronological distribution is broader in reality. Of particular note is the dated find from Alton Longville (Figure 227 and Figure 228). As the previous classification of as a "beam mattock" presents some problems for establishing whether it is an axe or adze (Section 7.3.5) and the find itself remains unpublished, it is possible that this artefact may extend the chronological range of beam axes within Britain into the 8th millennium cal. BC.

7.4 Bevel-ended tools

7.4.1 Distribution of bevel-ended tools in Mesolithic Britain

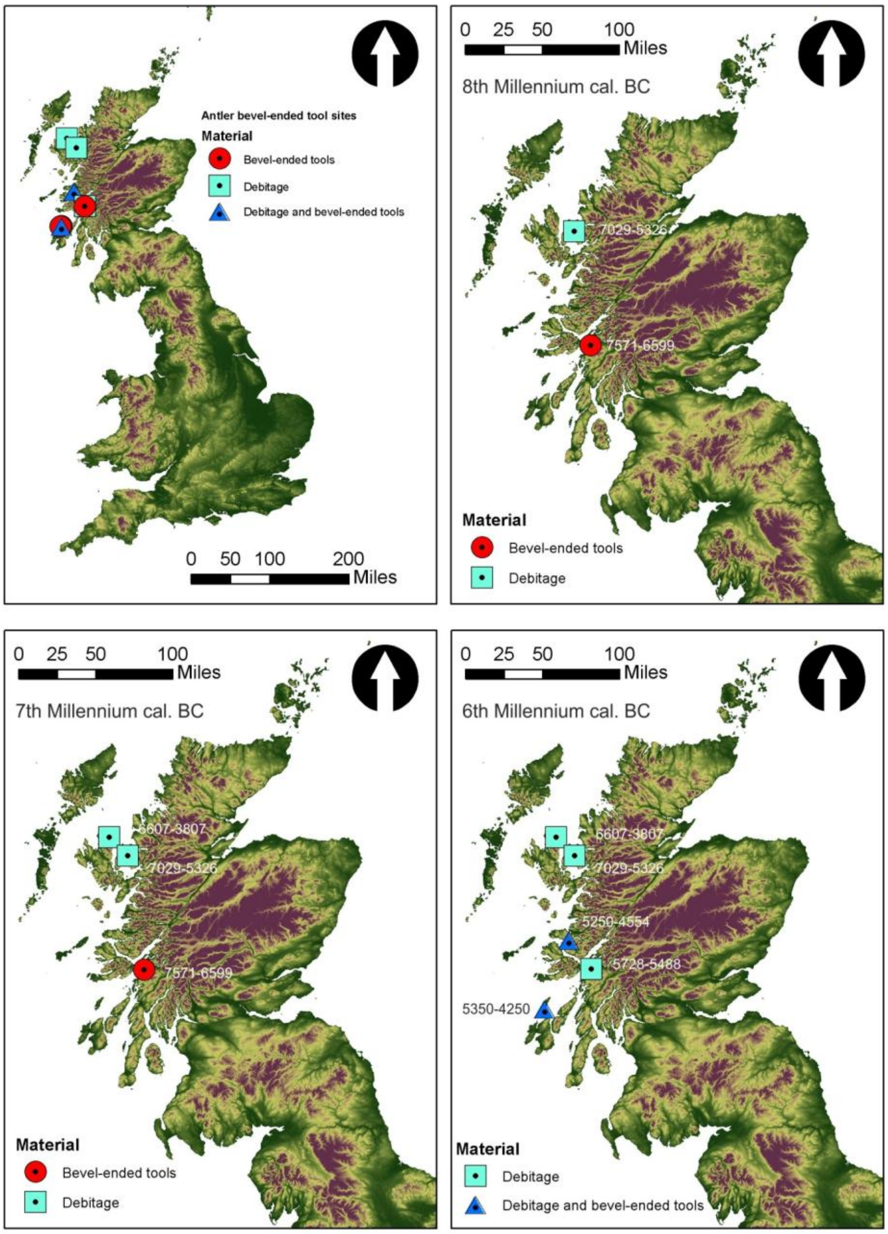


Figure 229: Distribution of antler bevel-ended tools in the British Mesolithic. Date ranges in cal. BC (1 of 2)

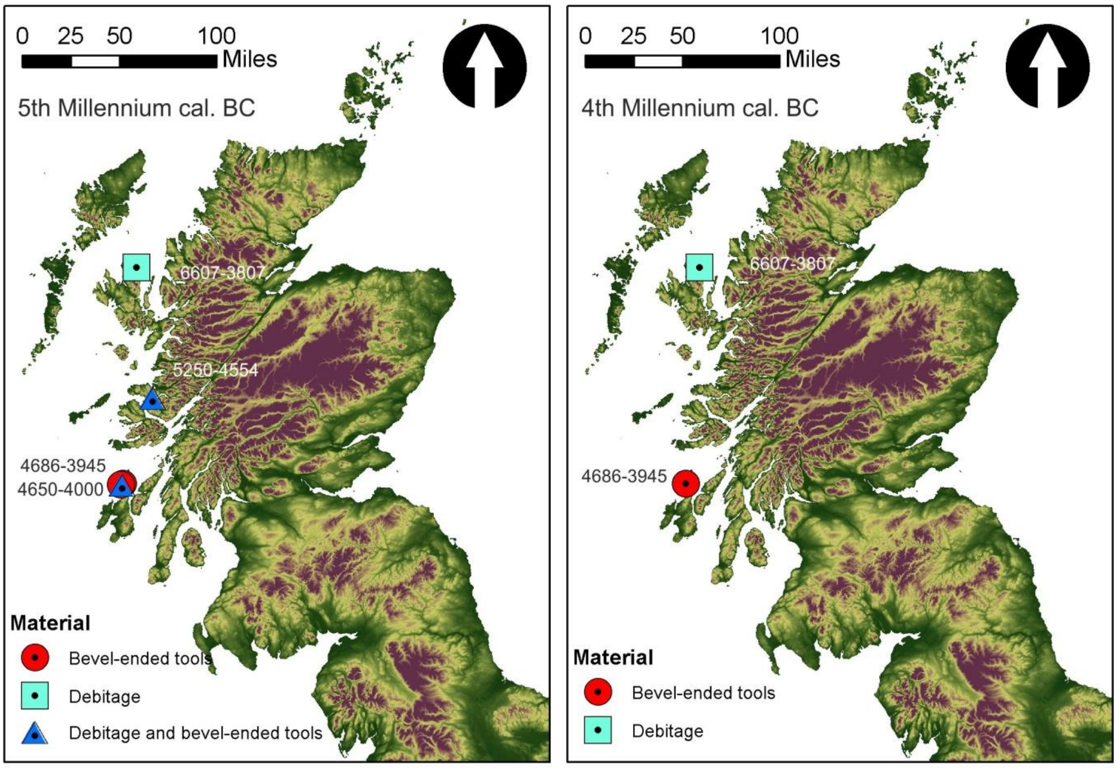


Figure 230: Distribution of antler bevel-ended tools in the British Mesolithic. Date ranges in cal. BC (2 of 2)

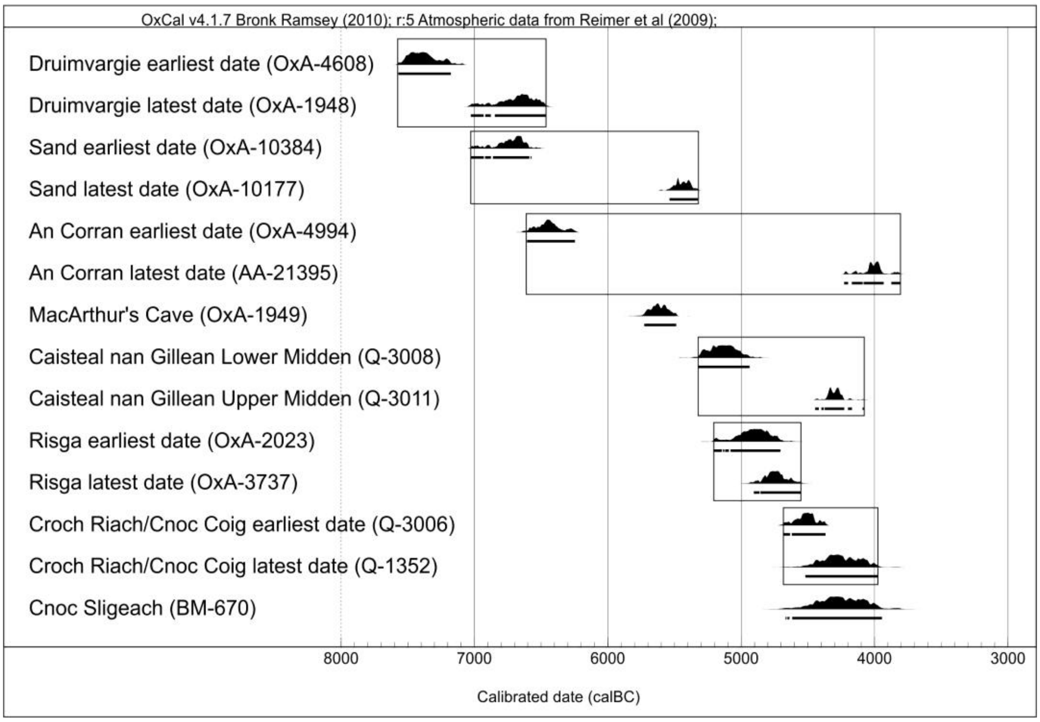


Figure 231: Plotted dates from British Mesolithic sites with evidence of antler bevel-ended tool manufacture and/or use. The boxes define the earliest and latest limits of occupation at sites with multiple ^{14}C dates.

The distribution of Mesolithic sites featuring evidence of antler bevel-ended tool manufacture and use is shown in Figure 229, Figure 230 and Figure 231. It can be seen that these sites cluster exclusively on the seaboard of western Scotland (Figure 229). They are all associated with shell midden deposits, although the disturbed nature of some of these sites and repeated re-visiting in later periods have led to extended date ranges for the episodes within which these bevel-ended tool production activities took place. It is unclear whether this exclusive association with shell deposits is the product of a preservation bias (with antler being highly unlikely to survive away from these shell deposits) or whether the artefacts themselves are associated with activities exclusively carried out during the occupation and deposition of shell middens.

Unlike the distribution of antler axes and barbed points, antler bevel-ended tools do not appear to predate the 8th millennium cal. BC, but extend throughout the remaining Mesolithic into the 4th millennium cal. BC.

7.4.2 The *chaîne opératoire* of antler bevel-ended tools

The large quantities of antler bevel-ended tools that have been recovered from Scottish sites allow an extensive discussion of the methods employed during their manufacture. The *chaîne opératoire* of bevel-ended tool manufacture and use is clearly documented in the artefact and *debitage* assemblages at Risga, Cnoc Sligeach and Caisteal nan Gillean I. Smaller assemblages from the sites of Croch Riach/Cnoc Coig, Druimvargie and MacArthur's Cave also contribute towards an understanding of the process of bevel-ended tool manufacture.

The standard process appears to have begun with the removal of the tines and crown from a red deer antler beam. This is evidenced through the relatively large quantities of tines recovered from the sites of Risga, MacArthur's Cave and Caisteal nan Gillean I, in association with large quantities of bevel-ended tools and fragmented pieces of antler. Following the removal of the tines, antler beams were subsequently divided into small, roughly rectangular pieces of compactor material through longitudinal application of the flake breakage technique. Tine tips which show signs of flake breakage from An Corran and Risga also indicate that once removed, some tines were also worked in this way to produce fragmented lengths of compactor. Flexion breaks were then executed to divide longer pieces of antler into a more useable size. This produces a collection of "blanks", of either rectangular or triangular shape. Following this, the proximal end of the tool was used in some form of abrasive task which resulted in the smoothing and rounding of this working edge. This abrasive activity appears to have been carried out on both the INT and EXT aspects of the tool.

Interestingly, a number of shell midden sites have evidence for only limited elements of this *chaîne opératoire.* The An Corran and Sand assemblages both contain evidence for the early stages of red deer antler fragmentation, but lack the finished antler bevel-ended tools themselves. At these sites, only bone and stone bevel-ended tools appear to have been deposited. This suggests that at some sites, either finished tools or antler blanks were removed for use and deposition at other locations within the landscape.

Individual bevel-ended tools from Risga, Cnoc Sligeach, Croch Riach/Cnoc Coig and Caisteal nan Gillean I also feature evidence for scraping of the working edge which appears to pre-date the smoothing of the working edge associated with use. It has been noted by previous authors that the abrasive-type tasks which bevel-ended tools were used for creates wear patterns which smooth over any previous working marks. However, in some cases it is possible to observe groups of faint, longitudinal striations running across the working edge, which are overlain by polish or discolouration associated with the use of the tools. These appear to be evidence of scraping actions carried out prior to the accumulation of use-wear, and as such may relate to scraping of the working edge to give it a basic shape before use.

Geographically, the occurrence of individual artefacts documenting this practice at a range of sites seems to suggest that it was not site-specific. However, given the problems with stratigraphic integrity and absence of spatial recording for individual finds at these sites, it is difficult to establish whether this practice was restricted to a certain period of time during the late Mesolithic of Western Scotland. Equally, the extent to which all antler bevel-ended tools were produced in this way is also unclear. Due to the destructive nature of the use-wear noted above, it is difficult to ascertain how common this practice of shaping the working edge prior to use was - many more of the tools analysed may have been worked in this way, but more extensive use may have obscured markings associated with these actions.

7.4.2 Technical variation in antler bevel-ended tools

Two instances of grooving demonstrate variation in the methods used to produce antler “blanks” for the production of bevel-ended tools. HP348/18 from Caisteal nan Gillean I consists of a piece of *debitage* with grooving marks along the DEX edge, whilst OB001 from Druimvargie Cave is a bevel-ended tool with a grooved SEN edge. It should be stressed that these instances are not representative of the wider pattern of technological practices across the shell midden sites of Western Scotland more generally (Table 29). The high percentage of bevel-ended tools at Druimvargie which display signs of grooving is most likely to be a product of small sample size. The broader pattern of technical behaviour across Western Scotland implies that this figure is misleading.

	Bevel-ended tools featuring grooving	**Total antler bevel-ended tools**	***Debitage* featuring grooving**	**Total antler *debitage***
Caisteal nan Gillean I	0	42	1 (3.2%)	31
Druimvargie	1 (20%)	5	0	0
Western Scotland	1 (1.1%)	95	1 (0.5%)	214

Table 29: Proportion of debitage and bevel-ended tools which show signs of grooving in relation to total assemblages analysed

Whilst these finds contest Clark’s (1956) conclusion that the groove-and-splinter technique of working antler is totally absent in the Mesolithic of Western Scotland, their low frequency implies that grooving played a very minor role within the regional technological tradition. The overall characterisation of the antlerworking industries of the Late Mesolithic Scottish sites still differs significantly from that of Star Carr, in the way outlined by Clark. However, it cannot be said that the inhabitants of these sites were incapable of grooving antler in the absence of flint burins, as his argument suggests (Clark 1956).

One form of technical variation in antler bevel-ended tools from Western Scotland has some wider implications for the *chaîne opératoire* of objects themselves. This involves the scraping of the SEN and DEX edges of the bevel-ended tools, and the polish patterns often observed in association with these actions. Risga, Cnoc Sligeach, Croch Riach/Cnoc Coig and Caisteal nan Gillean I all feature examples of bevel-ended tools which have been scraped along the SEN and DEX edges, removing the original break surfaces of “blank” production. This apparent shaping of the artefact raises some interesting questions in relation to its purpose. Experimental investigations into bevel-ended tool use (Birch 2009) suggest that many tasks are greatly aided by inserting the tool into a haft of either wood or antler. These experiments also note that the haft is often more difficult to produce than the bevel-ended tools, and so may have been retained and re-used after a bevel-ended tool had been discarded. Shaping of the tools – as shown by these episodes of scraping – could relate to attempts to fit specific objects into a pre-existing haft. The fact that these scraping events are also often associated with polish further supports this suggestion, as polish may build up during use in areas within the haft.

The proportion of bevel-ended tools which show signs of scraping on the SEN and DEX edges varies across different Mesolithic sites in Western Scotland (Table 30). The samples of material analysed from Caisteal nan Gillean I and Cnoc Sligeach display the highest proportions, where specimens featuring modified SEN and DEX edges form the majority. In contrast, Risga, MacArthur's Cave and Druimvargie feature much lower proportions (Table 30).

	Total number of bevel-ended tools analysed	**Number of bevel-ended tools with signs of scraping on the SEN and DEX edges**
Risga	23	2 (8.7%)
Druimvargie	5	0 (0%)
MacArthur's Cave	2	0 (0%)
Cnoc Sligeach	16	11 (68.8%)
Croch Riach/Cnoc Coig	7	1 (14.3%)
Caisteal nan Gillean I	42	33 (78.6%)
Total	95	47 (49.5%)

Table 30: Proportion of bevel-ended tools with scraping of the SEN and DEX edges

At a superficial level, this would suggest that this was practiced differentially at sites and may relate to higher instances of bevel-ended tools being hafted on Oronsay than on mainland sites. However, the conditions under which these artefacts were recovered may play a role in biasing this data. In many instances, the scraped bevel-ended tools can often appear more aesthetically pleasing than unmodified examples, as a certain geometric quality is imposed onto the form of the object. Additionally, the polish commonly associated with this action also makes the objects more eye-catching. Given these factors, and the antiquarian nature of the excavation of these sites, the higher proportions of scraped specimens may reflect a recovery bias. Further to this, it should also be noted that the material accessed also represents a smaller sample of the larger assemblage that was originally published by Anderson (1895, 1898). As proportions of these assemblages could not be located, it may well be that the remaining, accessible artefacts represent a sample that has been selected by either private or museum curators post-excavation. Again, aesthetics may have played a role in this, skewing the proportions of scraped and unscraped specimens.

Another variation in the *chaîne opératoire* of the bevel-ended tools which relates to controlling the finished shape of the object can be seen at Caisteal nan Gillean I. The apparent use of a prepared break at the distal end of piece HP184 implies consideration of the length of the tool being produced, and care being taken to ensure that this precise length was achieved. Additionally, *debitage* piece HP348/22 shows evidence of a similar practice, with two prepared breaks being used to remove material from a larger "blank" at both the distal and proximal end of the piece. This example is illuminating, as the intention of this action was presumably to produce two lengths of antler for the production of bevel-ended tools. Yet two pieces could also have been produced through the execution of a simple flexion break – prepared breaks were employed to ensure specific dimensions for the material removed. Again, this activity may be linked to the need to produce specifically shaped bevel-ended tools which would fit into a pre-existing haft.

Whilst the evidence for the use of prepared breakage to achieve this control over the length of the artefact appears exclusively at Caisteal nan Gillean I, it may be inaccurate to assume that the practice is restricted to this one site for a number of reasons. Firstly, the sample size may need to be considered. The Caisteal nan Gillean I assemblage constitutes the largest bevel-ended tool and *debitage* assemblage analysed as part of this study, and as such the absence of evidence at other sites may simply be attributable to smaller sample sizes. Secondly, although prepared breakage may have been used in the instances discussed above, it may also have been possible for flexion breaks to have been executed with the precision required to produce "blanks" of a controlled length. Given the thin nature of lengths of compactor created through the initial flake-brakeage of the antler, a skilled worker may have had sufficient confidence to carry out flexion breaks without the need for any preparation of the material. Although this would make the practice less visible in the archaeological record, it could mean that it was more widespread across different sites and also throughout the assemblages themselves. It is therefore possible (although difficult to confirm) that a high proportion of the bevel-ended tools with distal ends defined by flexion breaks were created with some consideration for the final length of the object.

Variation also occurs within the *chaîne opératoire* of the bevel-ended tools in the form of the tools with working edges at both the distal and proximal ends. Three of these were identified within the material from Caisteal nan Gillean I, and a further example from Cnoc Sligeach. All feature scraping marks and polish along the SEN and DEX edges, and so can be tentatively interpreted as having been hafted for use. If hafted, it would have been impossible for these working edges to have been utilised simultaneously and therefore it would appear that the antler "blank" was produced, the tools shaped, hafted, used, dehafted, rotated 180^{o}, rehafted and reused before being finally deposited.

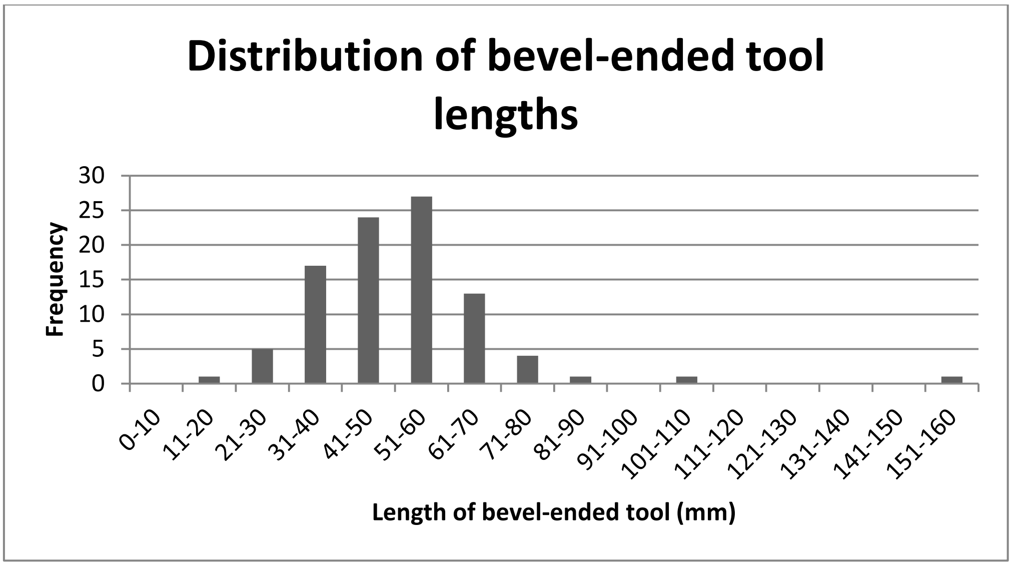


Figure 232: Distribution of bevel-ended tools lengths

This variation highlights an important question in the *chaîne opératoire* of bevel-ended tools – what factors determined the termination of use and deposition of the artefacts? Were individual tools considered "exhausted" and so discarded? One possible reason for the end of use could relate to the length of the objects. The destructive, abrasive nature of the use wear observed on the working edges of the bevel-ended tools could, over time, result in a shortening of the overall length of the tool (much like the sharpening of a pencil). After a certain point, the objects may become too short to be functionally viable, and thus have been discarded. However, there are a number of problems with this theory. Firstly, the length of the deposited bevel-ended tools shows some considerable variation (Figure 232). This makes it difficult to establish a threshold for object length, below which a bevel-ended tool's functional viability would be compromised. The apparent deposition of longer tools contradicts the hypothesis that artefacts were discarded after being reduced below a certain length.

Secondly, the utilisation of a haft has some serious implications for testing the theory that bevel-ended tools were deposited after being overly shortened through use wear. Birch's (2009) experiments concluded that the use and size of hafts varied depending on the task which was being undertaken, and that adapting the length of the haft allowed the same tool to be used for different tasks. Consequently, the length of the haft must also be considered when assessing the functional viability of the complete composite tool. Due to the preservation conditions within the middens themselves, no worked wood has survived at these sites and so there is no indication as to how long the hafts may have been, and the extent to which they could have varied. As such, it is impossible to assess the functional viability of the artefacts based on their length at deposition.

7.4.3 Re-use of other antler artefacts for bevel-ended tool production

One of the major findings of this study has been the recognition of the fragmentation of antler axes at Scottish shell midden sites and the re-use of this material in the production of bevel-ended tools. The practice of axe fragmentation is documented through the identification of diagnostic elements of mattock tools on highly fragmented pieces of antler. This has can be seen at the sites of Risga and Caisteal nan Gillean I. These pieces feature portions of either broken perforations or axe working edges. As the only type of Mesolithic antler tool known to feature both perforations and polished working edges of the character documented on these pieces, it seems reasonable to assume that they are pieces of broken antler axes. Additionally, they have all been fragmented through the use of the flake breakage technique. This flake breakage has been consistently applied to split the material along the original longitudinal axis of the antler. These pieces appear to demonstrate the intentional fragmentation of antler axe-type tools at these sites.

The presence of these fragments makes the providence of the other longitudinally split fragments of antler at these sites uncertain. It should be noted that only a small proportion of the overall exterior surface of an antler axe would feature diagnostic elements such as those discussed above (Figure 233). It would be entirely possible for a large proportion of a fragmented axe to be undetectable within a larger *debitage* assemblage.

Further to this, a number of bevel-ended tools from Risga, Cnoc Sligeach and Caisteal nan Gillean I also display remnant portions of diagnostic antler axe elements. These tools have also been produced through the longitudinal application of flake breakage. This demonstrates a complex *chaîne opératoire* for these specific examples (Figure 233), with antler initially being worked to create an axe, the use of this axe, the subsequent fragmentation of the antler tool through flake breakage, and finally the creation, use and deposition of the bevel-ended tools within the shell middens of these sites. The presence of these artefacts also suggests that the fragmentation of antler axes described above was carried out with the specific purpose of generating "blanks" for bevel-ended tool production.

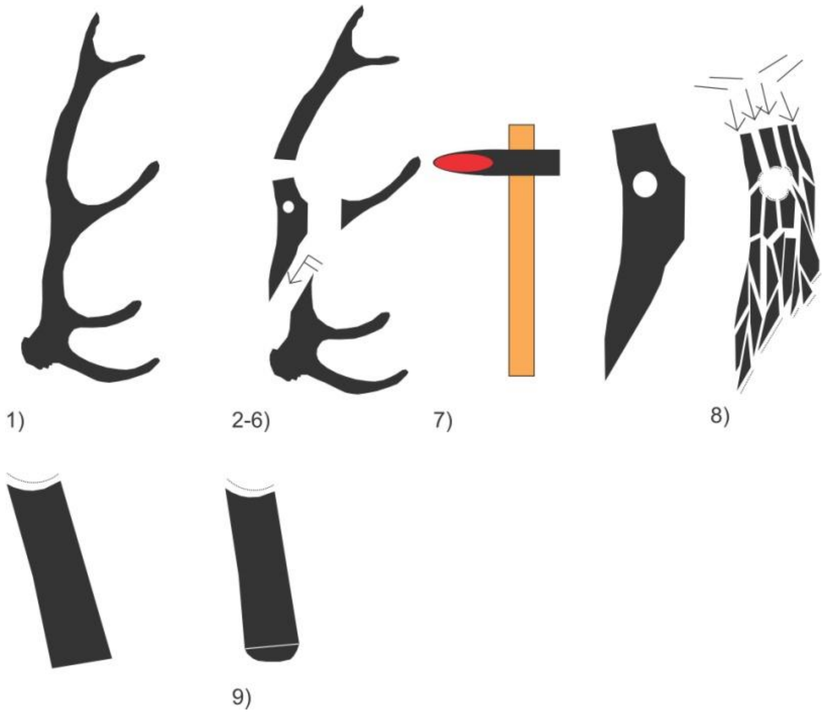


Figure 233: Sequence of bevel-ended tool manufacture from antler mattock fragment

A distinction can also be drawn between the flake breakage of axes and the axe working edges and faces which have been removed through flexion breaks at Risga and Cnoc Sligeach. In the latter instance, the character and location of the breaks (in association with the working edge) imply that they were created through use, as this area of the tool would be subjected to considerable impact stress. It is difficult to envisage how antler axes could become so extensively fragmented through use as to produce the pieces discussed above, whilst the consistent occurrence of longitudinal flake breakage marks strongly suggest intentional human action. This distinction does raise the question as to the state of the antler axes prior to fragmentation – it is unclear whether the artefacts which were broken up in this manner had first sustained damage in use, or whether they were fully functional tools which were being fragmented.

In addition to the fragmentation of antler axes to produce material for bevel-ended tool production, there is evidence that biserial barbed points were also re-used in a similar manner. Finds from MacArthur's Cave and Cnoc Sligeach indicate that broken tips of biserial points were re-used as bevel-ended tools, developing characteristic working edges along the proximal edge. The destructive nature of this use pattern obscures the original break surface, and so it is impossible to ascertain whether this breakage was intentional, or occurred through use. However, the re-use of biserial points/harpoons as bevel-ended tools at these sites is, to a certain extent, consistent with the treatment of antler axes at broadly contemporary sites within the region. This behaviour will be discussed in further detail within Section 7.6.

7.5 Choices in sourcing antler material

The results presented in Chapter 6 show an overwhelming preference for red deer antler for use in the production of antler artefacts during the Mesolithic period (Table 31). It can be seen that, with the exception of the *lame de hauche,* all of the antler tool types found in Britain are dominated by the use of red deer antler.

	Axes	**Adzes**	***Lame de hauche***	**Biserial barbed points/harpoons**	**Uniserial barbed points**	**Bevel ended tools**	***Debitage***
Red deer	32 (97%)	1 (100%)	0	12 (100%)	6 (86%)	94 (99%)	237 (96%)
Roe deer	0	0	0	0	0	1 (1%)	9 (3%)
Elk	1 possible (3%)	0	2 (100%)	0	1 possible (14%)	0	2 (1%)
Total	32	1	2	12	7	95	248

Table 31: Proportions of species used for different types of Mesolithic antler artefacts and debitage

The data presented in Table 31 needs to be treated with a certain degree of caution. There is still the potential for some of the isolated, unstratified finds to have been recovered alongside larger *debitage* assemblages which have either been ignored by the finder or which cannot be stratigraphically linked to the finds themselves due to a lack of recording or methodological excavation. As such, it remains possible that more elk and roe deer antler was being worked during the Mesolithic, but has suffered from a recovery bias. However, at sites where associated *debitage* assemblages (An Corran, Sand, Risga, MacArthur's Cave, Caisteal nan Gillean I, Seamer Carr, Star Carr and the Thatcham sites) have been analysed, the dominance of red deer is still apparent.

This preference for red deer antler needs to be considered in relation to the wider sets of interactions and encounters between people and deer in the Mesolithic if it is to be fully comprehended. The use of elk antler in particular needs to be considered within the context of changing climate and environmental conditions during the British Mesolithic, and the influence that this has on the distribution of elk populations. The use of elk antler appears to be confined to the Early Mesolithic in Britain, with worked antler being recovered from the sites of Star Carr (Clark 1954), Thatcham III, Thatcham IV, and possibly Fosse Hill and Greenham Dairy Farm. With the exception of Fosse Hill, all of these sites have been dated to the Early Mesolithic through radiocarbon dating. On typological grounds, the finds from Fosse Hill can be tentatively dated to either the Late Upper Palaeolithic or Early Mesolithic.

Previous discussions (C Smith 1989; Tolan-Smith & Bonsall 1999) have linked the exclusive use of elk antler in the Early Mesolithic to the post-Holocene climatic amelioration, which resulted in the loss of the environmental conditions favoured by elk and led to their extinction within Britain. However, the AMS dating of elk remains from the River Dee to the Bronze Age (Kitchener & Bonsall 1997) has given rise to the belief that refugia populations of elk remained in Northern Britain, where a combination of higher latitudes and altitudes would have provided the colder climates and associated environments required to support a breeding community of elk (Kitchener 2010; Yalden 1999). Thus, whilst the disappearance of elk antler working from southern Britain during the later Mesolithic can still be explained by a lack of elk themselves, the same argument cannot be applied to more northerly latitudes.

Given the behavioural characteristics of elk outlined in Chapter 6, it also appears unlikely that Mesolithic people in northern England and Scotland would have been unaware of the presence of a refugia elk population. Despite living at relatively low population densities, elk are capable of advertising their presence within a landscape over large distances through their distinctive calls, tracks, destructive feeding patterns and wallowing activities. Additionally, the threat that elk behaviour can pose to the physical safety of humans at certain times of the year may have further helped to emphasise their presence within the consciousness of Mesolithic people living in the same areas. When the character of elk behaviour is considered, it appears unlikely that even small populations could have survived undetected by humans for several thousands of years – as has been suggested by some authors (Kitchener & Bonsall 1997). With this in mind, the absence of elk antler within worked antler assemblages may reflect the choices made by the people who inhabited these sites – which could be linked to broader, cultural differences in the perception of elk and red deer respectively.

However, alternative explanations also require discussion - depositional practices and preservation biases within the archaeological record also need to be considered. The absence of elk antler within the assemblages analysed in this thesis may not necessarily reflect decisions to ignore elk materials for the production of artefacts throughout Mesolithic Northern Britain. The reliance of elk refugia on higher altitudes would suggest that human-elk encounters (and consequent antler sourcing through hunting or the collection of shed material) were most likely to have occurred within these northerly, highland landscapes. It remains possible that elk antler was sourced, worked, used and deposited exclusively within these high-altitude areas. If this was the case, then elk antler working evidence is unlikely to be reflected within the archaeological record as the biases within both the recovery and preservation of Mesolithic organic material from these areas are well-documented (Woodman 1989).

Yet even if this possibility is considered, the almost exclusive working of red deer antler at shell midden sites still appears to show a differential treatment of antler from differing species. As noted by Grigson and Mellars (1987), the inhabitants of Oronsay appear to have imported red deer materials (including antler) from larger islands and the Scottish mainland. This behaviour suggests the working of red deer antler, the use of antler artefacts and the deposition of antler materials was carried out in landscapes removed from the original points of contact between people and red deer, and that red deer materials were transported and exchanged across multiple land and seascapes (Warren 2006). If it is accepted that the absence of elk antler working evidence is due to the collection and working of this material within landscapes where sites are unlikely to be identified or preserved, then the treatment of elk antler and red deer antler still appears to differ considerably. Elk antler working and artefact deposition would be restricted to the landscapes in which people encountered elk, whilst red deer antler working and artefact deposition would be carried out in varied contexts and in landscapes where people would not have encountered red deer.

Whilst it is difficult to determine which of the two scenarios outlined above is more likely for the British Mesolithic (based on the evidence currently available), the differential treatment of animal remains does allow further discussion in relation to the ethnoarchaeological record. In the first scenario outlined above, it is argued that elk were actively avoided for both in terms of hunting, and also in the use of their antler during the Mesolithic in northern Britain – hence the general lack of elk antlerworking evidence or faunal remains at Mesolithic sites. Similar patterns of behaviour are noted by Politis and Saunders (2002) in their study of the Nukak – a group of hunter-gatherers indigenous to the Amazonian forests of Colombia. They have noted that, despite the potentially high economic value of deer, the Nukak will not hunt or eat these animals. A strict cultural taboo, rooted deeply within Nukak cosmology, forbids people to either kill or consume the meat of deer, as they are regarded as the archetypal prey species, and share a special relationship with the archetypal predator – the jaguar, which is also considered taboo (Politis & Saunders 2002, 124).

This example from the ethnographic record demonstrates that cosmologically-governed taboos can develop within hunter-gatherer societies. It could be argued that the general absence of elk antler technology or elk remains at Mesolithic sites within northern Britain is the result of such a taboo. Descola (1994) notes, again in reference to hunter-gatherer groups within the Amazonian forests of Colombia, that even within families of animals, specific species can be single out for taboo. He notes that within the Achuar group, only the Brocket deer are considered taboo – whilst the other three species of deer which inhabit these landscapes are hunted and eaten freely. It may be that this same level of species differentiation was occurring within Mesolithic Britain, with cosmologies which allowed roe and red deer to be exploited, but which considered elk as taboo.

Jordan's (Jordan 2001, 2003a, 2003b) work on the ways in which modern day Khanty communities enculturate the landscapes of western Siberia is also stimulating to consider in relation to the second scenario outlined above. In this instance, it is argued that, whilst elk antler was used to produce tools, the deposition of both elk remains and antler technology was restricted to certain areas within the landscape – areas which lack the conditions necessary for the survival of this organic material within the archaeological record. He highlights the relationship between the Malyi Iugan Khanty and two species in particular – elk and bears – and describes the way the physical remains of both species are treated. In both cases, the way in which bodily remains and materials are treated is governed by a strict set of rules which relate closely to the respective position of each species within wider Khanty cosmologies.

For the Malyi Iugan Khanty, elk hunting plays an important role within the local economy. Elk provide the main sources of meat and fat within the diet, and the thick hide of these animals also provides a valuable material for the manufacture of warm, snow-proof boots and clothing (Jordan 2001, 29). During butchery, the whole carcass is completely processed away from occupation sites, with no wastage of tissue or resources whatsoever – to the extent that clean bones are fractured to extract marrow once all meat has been removed (Jordan 2003, 133).

Within this complex sequence of processing actions, a series of rules are adhered to in accordance with wider cosmological attitudes towards elk and the act of hunting. Within Khanty belief systems, the head and heart of the elk are thought to contain the soul of the animal, and as such need to be treated with respect and care if the animal is to "revive" and ensure future hunting success. In order to allow the elk to "revive", the head and heart are taken to areas of forest far from human occupation or the interference of dogs for deposition. It is of particular importance that the head or heart are not fed to dogs, as this is deemed disrespectful to the elk's spirit, and would not allow the animal to revive fully. As such, it could potentially jeopardise future hunting success (Jordan 2001: 29).

Whilst not wishing to draw a direct analogy between the hunter-gatherer groups that inhabited northern Britain during the Mesolithic period and the Malyi Iugan Khanty, this example does raise some interesting points which appear relevant to this discussion. The differential treatment of specific body parts, and the species-specific rules regarding the ways in which animal bodies should be processed would appear to be concepts that could apply to the second scenario outlined above – if the deposition of elk remains was restricted to the areas which lack the conditions required for the survival of organic remains.

Whilst the distribution of elk within Britain is believed to be progressively restricted throughout the Mesolithic, it is widely accepted that both roe and red deer were abundant across mainland England, Scotland and Wales (Jarman 1972; Maroo & Yalden 2000; Yalden 1999) during the period. As such, the apparent preference for red deer antler over that of roe deer cannot be solely ascribed to the relative availability of the material.

It is possible that the morphological character of roe deer antler may have affected the ways in which it was utilised by Mesolithic people. The suitability of roe deer antler for piercing tasks, without any form of human modification, has been highlighted by previous authors (Clark 1954), and this may explain the absence of artefacts made from roe deer antler or large quantities of worked *debitage.* Additionally, the more irregular nature of the compactor surface of roe deer may also play a role in the relative effectiveness of different working techniques. For instance, various authors have noted the role that the natural guttering of red deer antler aids grooving in the groove-and-splinter process (Clark & Thompson 1953; Clark 1954; Elliott & Milner 2010). The relative scarcity of extensive, longitudinal guttering on roe deer antler and the obstructive nature of the "pearls" at the lower beam would therefore complicate the application of grooving in a similar manner.

The shorter length and narrow beam diameter of roe deer antler may have also limited the potential for working. The shorter length prevents the extraction of the long antler "blanks" required for longer barbed points and harpoons, whilst the narrow beam prevents the creation of broad working edges if roe deer antler was to be used in producing adze or axe type tools. Equally, perforating a roe deer beam would require a much narrower perforation than those observed on perforated red deer antler tools, and this may have consequences of the size of the haft and the overall resistance of the finished tool to impact stresses placed on the point of hafting.

However, the finds from Druimvargie and Risga would appear to imply that it was possible for people to work roe deer antler during the Mesolithic. At these sites, roe deer antler was very occasionally being worked in the same way as red deer antler to produce bevel-ended tools. Flake breakage is evidenced at Risga, producing similar fragments of roe deer antler as those used for bevel-ended tools. At Druimvargie, a finished bevel-ended tool of roe deer antler was observed. Whilst this appears to have been carried out on a much smaller scale in relation to red deer antler working, it does demonstrate that Mesolithic people possessed the skills, know-how and occasionally the inclination, to obtain and work roe deer antler.

It would therefore appear that, despite being capable of working red and roe deer antler, the vast majority of Mesolithic antlerworking activities involved the use of red deer antler. This difference in the treatment of the materials can be considered within the wider context of the ways in which Mesolithic people encountered live red and roe deer, in order to place these technical decisions within a broader understanding of the relationship between people and individual deer species. To do this, the character of both red and roe deer behaviour requires careful consideration.

As outlined in Chapter 6, the small body size and vulnerability to predators of roe deer plays a significant role in their behaviour. Despite being relatively abundant with a range of Mesolithic environments, the timid nature and preference for areas of low-level vegetation as cover can reduce and restrict the relative frequency of direct human/roe deer encounters. This is not to say that Mesolithic people would have been oblivious to roe deer living alongside them. The tracks, browse damage, shed antler, calls and scents of these animals would have alerted people to their presence within the landscape. The recovery of roe deer remains from Mesolithic sites also demonstrates that direct encounters between people and roe deer also occurred in a hunting context. However, when not actively hunting these animals, the frequency at which people came face-to-face with these animals may have been relatively low.

In contrast to this, the large body size of red deer eliminates the threat from smaller predators and thus the reliance on low-level cover observed in roe deer. Whilst larger predators remain a threat for red deer, the larger size and less timid behaviour of these animals creates a marked contrast to roe deer. This would also have an effect on the character of human/red deer encounters during the Mesolithic period. Firstly, the character of indirect encounters could be said to be different to that of roe deer. Larger tracks, different browse patterns, louder and deeper calls and distinctive shed antler would have allowed people to distinguish between the presence of roe and red deer even when the animals themselves were out of sight. The larger size, relatively less timid behaviour and ability to exploit environments which lack low-level cover may also have led to people directly encountering red deer more frequently than they did roe deer.

It can be argued that this difference in the way in which people encountered red and roe deer helped shape a set of distinct deer identities within Mesolithic Britain, and that the differential treatment of red and roe deer antler played an active part in the negotiation of these identities. The more elusive roe deer were less frequently encountered within the daily routines of Mesolithic life than the larger and less timid red deer. The visual familiarity with red deer was recognised and reinforced through the collection and working of red deer antler – activities which brought people into direct and intimate contact with materials derived from red deer bodies in a range of social contexts. Contact and familiarity with artefacts which were made from red deer antler also contributed towards the underlying development of this relationship.

In contrast, although living alongside people within Mesolithic environments, roe deer were much less likely to be seen during the course of daily practices. Whilst this did not mean that people were unaware of roe deer, or that they did not interact with them when hunting, the lower level of familiarity between people and roe deer is reflected within their decisions to not produce artefacts made from roe deer antler. The absence of roe deer materials from routine social contexts (such as antlerworking activities and the use of antler tools) within Mesolithic life would have further contributed to the comparative distancing of people and roe deer, in contrast to the developing familiarity between people and red deer. Whilst roe deer antler may have been used on an opportunistic basis, it was not routinely modified, curated and enculturated in the same way as red deer antler.

7.6 The management of antler resources in the Mesolithic

Traditionally, discussions of osseous technologies (and Mesolithic industries generally) involve a consideration of the way in which raw materials are sourced and managed. This has been addressed on a number of levels, including the extent to which individual antlers are exploited (Clark 1954, 1956; P Rowley-Conwy 1998), the decisions made between using bone and antler for specific tool production (E David 1999) and decisions made in the processing of entire animal carcasses – alongside the exploitation of hides, sinews, meat, fat and other animal resources (Leduc 2010). Whilst the majority of material from Britain lacks the stratigraphic integrity and associated antler *debitage* to fully explore these issues on a national level, there is evidence of a number of behavioural practices which could imply some form of material management strategies being employed during the period

7.6.1 Managing antler through repair

The analysis carried out in Chapter 5 demonstrated some instances where antler artefacts were repaired after sustaining damage. Finds from MacArthur's Cave, Shewalton, Hammersmith, Kew and Mortlake would appear to imply that antler artefacts were being maintained and repaired – potentially to gain the maximum use of the material. This could be interpreted as a response to a scarcity of resources. However, these isolated finds cannot be related to wider patterns of human behaviour. Without the *debitage* assemblages from the original sites of manufacture, it is impossible to establish whether these repairs are part of a wider pattern of intensive antler exploitation (suggestive of an underlying desire to exploit the resource to its maximum extent) or rather the actions of individuals responding to specific sets of circumstances which require the repairing and maintenance of their objects, in the course of daily activities.

7.6.2 Preparing antler for working

Another behavioural pattern hinted at within the record of British Mesolithic antlerworking is the use of fire to prepare antler for working. The physical properties of antler mean that the application of heat can make it more brittle and thus easier to fracture, and this has been long been understood by archaeologists (MacGregor 1985). Two particular pieces of antler from Britain appear to show signs of fire being applied in regions which have been subsequently worked – the antler axe from Splash Point, Rhyll and the axe *debitage* piece from Goldcliff East, Gwent. In both cases, charring is apparent in the region of a prepared break, alongside other forms of working. The localisation of these charring marks and their close association with prepared breakage indicates that considerable care was taken when applying heat to these artefacts so that only the intended areas were affected. As such, it seems likely that this burning was achieved by placing a red-hot piece of wood directly into contact with the desired area, rather than a more general placing of the entire antler into fire (J Clutton-Brock 1984).

This careful application of fire in the working of antler implies an intimate understanding of the material's properties, and a mastery of a specific working technique which is not seen elsewhere in the record for the British Mesolithic. It should be stressed that, as the majority of material from Britain comes in the form of isolated and unstratified finds, arguing for the absence of this technique at other sites is highly problematic. Nevertheless, it could be speculated on the basis of the currently-available evidence that the use of fire in working antler was not commonly practice throughout the British Mesolithic. The temporal and spatial distribution of these two instances is also interesting to note. Again, with such small sample sizes, any discussion of distribution is obviously speculative, but it may be significant that the evidence for the use of fire in working antler is restricted to Western Britain. Temporally, the Splash point beam axe has been directly dated to 5616-5363 cal. BC (OxA-1009), whilst Mesolithic activity at Goldcliff East is believed to have occurred between c.5650 cal. BC and 4700 cal. BC (Bell 2007f). This could be taken to suggest that the use of fire in antlerworking was restricted to areas of Western Britain within the mid 6^{th} – early 5^{th} millennium cal. BC. Again it should be stressed that this assertion is highly speculative, but that based on the current evidence this appears to be the period and region for which we have positive evidence for the use of fire.

The use of fire to work antler has a wider significance to discussions of antler technology within British Prehistory more generally. Clutton-Brock's (J Clutton-Brock 1984) analysis of the Neolithic antler picks from Grimes Graves, Norfolk and Durrington Walls, Wiltshire demonstrates the use of fire in precisely the method that it appears to have been used at Splash Point and Goldcliff. Here charring was found in association with prepared breaks – for the removal of crowns and tines in the creation of antler picks. The most recent Bayseian models for the use of antler axes at Durrington Walls (Darvill et al. 2012) links them to the construction of ditches within the Late Neolithic (2480-2450 cal. BC.). It is potentially interesting to note that, whilst the manufacture and use of antler picks does not appear to feature within the British Mesolithic, some of working techniques utilised in their production were being used in Britain from as early as the mid sixth millennium cal. BC – some three thousand years earlier.

Another method of preparing antler prior to working is that of soaking in water (MacGregor 1985). It has been previously argued that the large quantities of antler *debitage* at Star Carr is evidence for the soaking of material at the edges of Lake Flixton in preparation for working (Clark 1972; Elliott & Milner 2010; Price 1982). However, the general lack of in-situ *debitage* assemblages from around Britain prevents a more extensive discussion of this practice. At Thatcham, there appears to have been some deposition of antler within wetland contexts – although the general lack of evidence for the working of red deer antler at the Thatcham sites themselves would suggest that this material was not being intentionally soaked in preparation for working. The precise environmental context into which the Seamer K antler was deposited is also yet to be determined. Although the site itself is situated at the edge of Lake Flixton, it remains unclear as to the exact conditions into which the antler from Seamer K was deposited into, as full publication is still pending. The worked antler *debitage* from the shell midden sites of Sand, Risga and the Oronsay middens all appears to have been deposited into the shell midden matrix itself, and whilst water for soaking would have been locally available in at these sites (given their close proximity to the sea), it is difficult to argue with confidence that antler had been soaked unless it has been recovered directly from a context which can be shown to have been submerged at the time of deposition.

The key evidence for this will involve the recovery of *debitage* rather than finished artefacts, and although many Mesolithic antler findspots do centre on wetland areas, this cannot be used to argue that soaking was occurring during manufacturing for a number of reasons. Firstly, for artefacts such as barbed points and antler axes, it has been previously argued that their function was linked to marine exploitation in either spear fishing or marine mammal butchery tasks. As such, the association with finished artefacts and wetland contexts may have more to do with the activities that they were being used for, and may not necessarily be indicative of the contexts in which they were manufactured. Secondly, as organic material, antler artefacts are more likely to preserve within wetland contexts than dryland – as such, the apparent focus of antler artefacts within wetland environments is probably affected by a preservation bias. As such, the general pattern of Mesolithic antler artefacts being recovered from wetland contexts in Britain cannot be taken to suggest that the soaking of antler within wetland contexts was a common practice in Mesolithic Britain. Beyond Star Carr, conclusive evidence for this practice appears scarce.

7.6.3 Managing antler resources on Oronsay

Whilst the context of recovery for the majority of British Mesolithic "findspots" prevents any insight into the traditional questions surrounding the management of resources within antlerworking industries, a small number of sites do feature the required *debitage* assemblages needed to address these issues. The majority of these come from coastal locations in western Scotland (An Corran, Sand, Risga, Cnoc Coig and Caisteal nan Gillean I), although the Thatcham sites and Star Carr also provide an insight into spatial variations in the management of antler during the Early Mesolithic. One of the most interesting areas of the country in relation to the management of red deer antler is the island of Oronsay. There are, however, a number of limitations to the conclusions that can be drawn from the analysis of antler recovered in the 19th and early twentieth centuries from the sites of Cnoc Sligeach, Priory Midden, Cnoc Coig/Croch Rioch and Caisteal nan Gillean. Mellars (1987a) has demonstrated that the excavations of Bishop and Galloway and Grieve have only explored small areas of the midden sites on Oronsay. Due to the limited nature of the excavations within the wider context of the midden sites themselves these assemblages need to be treated as a small sample of a larger assemblage. Mellar's work has also shown that these sites are often stratigraphically complex (1987a), and given the lack of spatial or contextual recording for the previous excavations it becomes impossible to determine which phases of human occupation the National Museum of Scotland and Hunterian Museum material relates to. Thus it is difficult to ascertain which phase of human activity these assemblages are representative of.

Yet certain technical practices have been positively demonstrated at the Oronsay sites through the application of traceological analysis (Chapter 5). It is possible to build up a picture of the range of ways in which antler was treated on Oronsay during its occupation in the fifth millennium cal. BC by drawing these practices together from different sites. It must be stressed that, given the way in which the studied assemblages have been collected, absence of evidence cannot be taken to indicate evidence of absence. For this reason, establishing a definitive account of how antler was managed on a site level is virtually impossible. A more holistic approach to antlerworking is required – one which takes the island itself as the basic unit of analysis.

It has been noted that Oronsay itself lacks the space, food and shelter resources required to support a breeding population of red deer (Grigson & Mellars 1987; Mellars & Richards 1998; Mithen & Finlayson 1991). As such the quantities of red deer antler and bone which occur within the midden sites on Oronsay must have been brought to the island by people. Additionally, Grigson and Mellars (1987) have identified two distinct groups of deer within the assemblage excavated from Cnoc Coig, based on the sizes of their remains. This has been interpreted as evidence for the exploitation of two separate red deer populations – they suggest that the larger group falls within the ranges of red deer from mainland Britain and the group of smaller animals may originate from a dwarfed island population existing elsewhere in the Hebrides (Grigson & Mellars 1987, 260–262). Whilst debates over the seasonality of occupation on Oronsay and the precise source of the island red deer population are still ongoing (Mellars & Richards 1998; Mellars 1987a; Mithen & Finlayson 1991; Mithen 2000), it is now widely accepted that the red deer remains brought to Oronsay were not from animals native to the island itself.

The island nature of occupation on Oronsay, and the apparently limited antler resources available within this environment allows a more detailed discussion of the ways in which Oronsay's Mesolithic inhabitants managed their antlerworking activities. Some of the finds surrounding the fragmentation of red deer antler axes for the production of bevel-ended tools raise interesting questions in regards to the management of antler on Oronsay. Were axe tools being brought to the island, having been made and used in other landscapes, for the sole purpose of providing raw materials for bevel-ended tool production? Or were the extended and interlinked sequences of axe, biserial barbed point and bevel-ended tool production carried out in their entirety on Oronsay?

As mentioned above, the character of the Cnoc Coig assemblage strongly suggests that a mixture of shed and unshed red deer antlers were being brought to Oronsay from other landscape contexts (Grigson & Mellars 1987). The distribution of antler elements within this assemblage is also interesting. The presence of 16 basal portions of antler, for instance, could be interpreted as evidence for antler axe production at the site. Although these pieces could not be accessed for inclusion within this thesis, some of the photographs provided by Grigson and Mellars appear to indicate that angled breaks were being executed to remove the beam above the brow and bez tine stumps. These may well be the types of *debitage* created through the prepared breakage of beams when producing the working edges of antler axes and adzes. Although currently untested, if this theory is supported by future traceological analysis it would indicate that red deer antler was being brought to Oronsay, and antler axes produced on the island itself.

Further to this, there is also evidence that antler was being worked to produce "blank" splinters for bevel-ended tool and biserial point production at Oronsay. This is apparent in the Caisteal nan Gillean I material, with the presence of large numbers of removed tines and tine tips alongside longitudinally fragmented pieces of red deer antler. Again, although first hand analysis was not possible, the distribution of elements recorded by Grigson and Mellars (1987) would seem to suggest a similar pattern of antler working in the Cnoc Coig assemblage excavated by Mellars (1987a).

The presence of antler axes on the island is attested at the sites of Priory Midden, Cnoc Sligeach and Caisteal nan Gillean I. The specimens from Priory Midden and Cnoc Sligeach would appear to indicate that these tools were being used on Oronsay through their relatively intact state and the focus of damage on the working edge and face (as would be expected if damaged in use). As such, it can be said that there is tentative evidence for the production of antler axes at Oronsay, but a stronger case can be made for the use of these tools and subsequent deposition at midden sites.

There is also considerable evidence for the manufacture, use and deposition of biserial barbed points from red deer antler on Oronsay. This is demonstrated most clearly at Caisteal nan Gillean I, where evidence for the production of antler blanks and finished barbed points has been recovered. Further fragments of biserial barbed points are also present at Cnoc Sligeach. The deposition of both broken tips and tangs suggests that these pieces have been retrieved following damage in use, as both the tip of the point and the point at which a haft is attached are believed to bear the brunt of impact stress during use (Elliott 2009).

As discussed previously, the practice of intentionally fragmenting antler axes through flake breakage in order to produce “blanks” for bevel-ended tool manufacture has been demonstrated through the traceological analysis of antler from Caisteal nan Gillean I and Cnoc Sligeach. The instances of broken biserial barbed point tips which have been re-used as bevel-ended tools also demonstrates that this re-use of red deer antler was not restricted exclusively to antler axes.

These findings affect the interpretation of the apparent re-use of both antler axes and biserial barbed points for bevel-ended tool production on Oronsay. It seems unlikely that antler axes and biserial barbed points were brought to the island for the sole purpose of providing raw materials for antler bevel-ended tools. Both types of tool were apparently being used in activities on Oronsay, and became damaged through use before being deposited at shell midden sites. Further to this, the apparent extensive exploitation and re-use of red deer antler at Oronsay would superficially suggest that the material itself was being managed in response to its limited availability on the island. The material therefore appears to have possessed a value which extended beyond the use-life of the original artefact.

However, there are number of problems with this final supposition. Firstly, it ignores the large quantities of red deer antler which were not used in the production of bevel-ended tools. The fragmentation of red deer antler at Caisteal nan Gillean I produced large quantities of antler “blanks” which were not developed into finished artefacts. The mean dimensions of the unused fragments from Caisteal nan Gillean I are compared to the mean dimensions of the finished bevel-ended tools in Table 32. The only value which differs dramatically is the length of the pieces, with finished tools being (on average) shorter than unused blanks. However, this need not mean that the blanks were not used because they were too long. The evidence for the use of prepared breaks to control the length of blanks at Caisteal nan Gillean I has been discussed earlier, and this suggests that longer fragments could still be used to produce bevel-ended tools. Additionally, the destructive nature of the abrasive use-wear on bevel ended tools also could result in a shortening of the artefacts from the original blank length prior to deposition. As such, it seems that the exploitation of red deer antler on Oronsay was, in some instances, slightly less intensive than has been suggested earlier, with quantities of usable antler being deposited directly into shell middens and not being used for bevel-ended tool manufacture.

	Mean length (mm)	Mean width (mm)	Mean thickness (mm)	Mean weight (g)	Number
Bevel-ended tools	47.1	19.3	7.8	3.9	41
Fragmented pieces of compactor	61.1	18.2	9.0	5.5	29

Table 32: Mean dimensions of both antler "blanks" and finished bevel-ended tools deposited at Caisteal nan Gillean I

Further to this, the presence of larger portions of antler axes at Cnoc Sligeach and Priory Midden which have been deposited without being fragmented for bevel-ended tool production also implies a lower level of antler exploitation on Oronsay, as does the presence of broken biserial barbed point tips which have not been re-used.

Secondly, the apparent infrequent occurrence of double ended bevel-ended tools also seems to contradict the idea that antler was being heavily exploited. If these tools are interpreted as an attempt to prolong the active life of the object, then they could be expected to occur more frequently on Oronsay if people were trying to extract the maximum use from the material. Their apparent low frequency appears to suggest that red deer antler was not being used to its maximum extent.

One potential source for this apparent contradiction in the management of antler may lie in the stratigraphic and temporal distribution of the material. As outlined above, there is a high probability that the assemblages analysed are from a mixture of contexts, and as such the technical practices documented need not be contemporary. The changes in intensity of antler exploitation may relate to fluctuations in the availability of red deer antler on Oronsay over time. This would have been dependent on the movement of people between Oronsay itself and other landmasses in the region. Whilst these findings can offer no real insight into the ongoing debate on the extent to which people moved between the Inner Hebrides during the Mesolithic (Mellars & Richards 1998; Mellars & M Wilkinson 1987; Mellars 1987a; Mithen & Finlayson 1991; Mithen 2000, 2010), fluctuations within the availability of red deer antler would be intrinsically linked to the nature and regularity of contact between Oronsay, mainland Scotland and other Inner Hebridean islands.

Alternatively, variations in antlerworking at Oronsay may correspond to variation in the way in which the inhabitants perceived antler and deer more generally. The difference in the size of red deer remains observed by Grigson and Mellars (1987) at Cnoc Coig suggests that the two groups of animals from which the antler derived would have had obvious physical differences. Additionally, Grigson and Mellars' suggestion that these differences may relate to varying environmental conditions may have implications for the behaviour of these animals, and the way in which people encountered them. Unfortunately, due to the remaining confusion as to which Hebridean islands would have had been colonised by red deer in the late Mesolithic, it is impossible to predict the environments in which these different red deer populations lived in and thus gain a more detailed understanding of how human/red deer encounters may have varied in these respective contexts. As such it can only be said that, on a general level, these two red deer populations differed in terms of both their physical appearance and behaviour. Through differential treatment of the antler from these two populations, people may have simultaneously defined and negotiated distinct red deer identities at Oronsay, articulating their relationships with animals in different landscapes through the use of their materials. As such, the apparent contradictions in the management of red deer antler on Oronsay may relate to the negotiation of two separate deer identities, through the differential use of antler.

Whilst it is impossible to verify the above theories with the data in this thesis, further investigation may be possible through the analysis of the worked antler from Mellars' excavations at Oronsay. Access to this material could not be arranged for this study, but the combination of 3D recording of the data, a detailed understanding of site formation, the identification of stratigraphic contexts and ^{14}C dating at the site may allow these apparent variations in the management of antler to be plotted throughout the occupation of the site.

A further point that is worth making in regards to antler technology on Oronsay relates to the potential uses of antler axes. As has been argued above, the mainstream view of antler "mattocks" being used primarily as digging implements (C Smith 1989) has been challenged by both the comments of other authors and the findings of this thesis (see Section 7.3.5). Woodman has postulated that the association of antler axes on Oronsay with large quantities of seal and otter bones (Grigson & Mellars 1987) suggests that they may have been used in the butchery of marine mammals. Whilst there is nothing to suggest that this is not the case, the discussion in Section 7.3.5 has already stressed the range of tasks that these tools could have been used for – it remains possible that axes on Oronsay were used for multiple purposes.

The palaeoenvironmental record for Oronsay and Colonsay may hint towards antler axes being used for activities other than marine mammal butchery. The work of Birks *et al.* (1987) in the collection and analysis of three pollen cores on Oronsay and Colonsay has shown that the environment and flora of the islands has changed significantly during the Holocene. Whereas today woodland communities are restricted to the sheltered embayments of the Eastern side of Colonsay, during the early Holocene the both islands would have featured large areas of birch-hazel scrubland with oak and elm sporadically occurring, and willow and alder carr developing in wetland areas (Birks et al. 1987, 72). Birks *et al.* note the disappearance of tree pollen and a period of soil erosion which they interpret as the deforestation of these environments, within two separate pollen sequences. They date this process to a period c.4000-3500 bp (2000-1500 bc) - a good 2000 years after the occupation of the Oronsay middens in the mid-late 5th millennium cal. BC. They link this date to a general reduction in the ranges of tree-growth which occurs across much of Western Scotland – and suggest that this is due to changing weather patterns which effect the West Coast (Birks et al. 1987, 74). As such, it would appear difficult to link Mesolithic activity to the disappearance of tree cover from the majority of the islands.

However, there are some problems with the dating methods employed by Birks *et al.* in their study which make their conclusions slightly problematic. Firstly, they rely on a relatively small quantity of ^{14}C dates within their pollen sequences, with which to structure their interpretation of environmental change on Oronsay and Colonsay. For instance, the deforestation process falls between two dates; 7870±80BP (Q3158) and 3350±50BP (Q3159). When calibrated, these dates can be seen to be a considerable chronological distance apart (Figure 234).

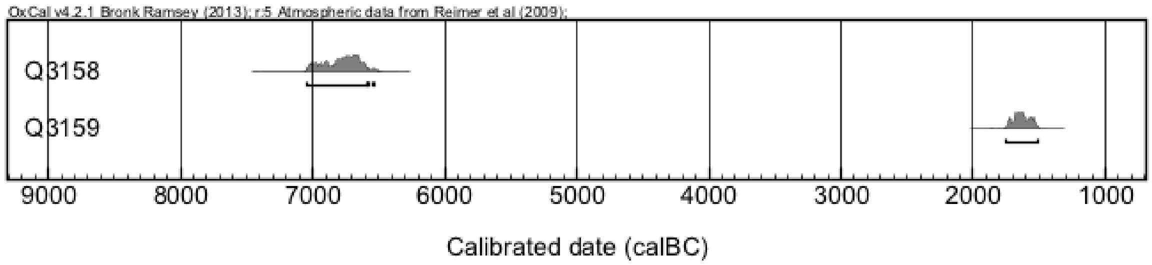


Figure 234: Calibrated of Birks *et al.* (1987) dates between deforestation and soil erosion occurs on Oronsay

The lack of calibration within the discussion of the palaeoenvironmental sequences presents problems in itself. The Mesolithic occupation of Oronsay is said to occur "c.6000 BP", whilst it has been shown above through calibration of the Oronsay dates that this actually appears to span from the early to late 5th millennium cal. BC. As can be seen, the level of chronological resolution for this pollen sequence is also low. Furthermore, within their discussion Birks *et al.* note that the sequences may have been interrupted by human action in the past – specifically peat cutting activities during the Bronze and Iron Ages. As such, it appears difficult to tie the relative position of changes within the pollen record to these dates.

The question marks surrounding the dating of the clearance of significant portions of the Oronsay tree cover has implications for the use of antler axes at the island. It remains possible that the disappearance of the birch and hazel scrub over much of the islands surface was linked to human action – and if this was the case then it is important to stress that the inhabitants of Oronsay had access to tools which are more than capable of felling trees and working wood (Jensen 1991). It is therefore possible that antler axes were being used in carpentry and woodland management activities on Oronsay during the Mesolithic. Obviously, further palaeoenvironmental work is required in this area if this suggestion is to be explored in more detail. Given the current ambiguity surrounding the dating of pollen sequences from Oronsay and Colonsay, it is equally possible that the scrub woodland may have retreated *prior* to the occupation of the shell middens on the island – and as such this point would be instantly moot. The key issue here is that, just because the lithic assemblages from the Oronsay shell middens appear to lack the axe and adzes (Pirie et al. 2006) usually associated with carpentry and woodland clearance, the presence of antler axes still leaves this option open.

7.6.4 Managing antler at shell midden sites away from Oronsay

Interestingly, the pattern of red deer antler use observed on Oronsay is also documented at the site of Risga. Here the presence of large quantities of tines, worked basal portions, fragmented pieces of compactor and an absence of intact portions of beams suggests that antler was being worked to produce axes and bevel-ended tools. The deposition of finished artefacts showing signs of use also suggests that axes and bevel-ended tools were used and deposited at the site. Additionally, the fragments of antler axes and instances of bevel-ended tools featuring signs of previous use as axes also indicate that axes were being broken up and the material re-used for bevel-ended tools at the site. Yet there still remain large numbers of unworked fragments of flake-broken compactor material which have not been selected for bevel-ended tool production.

The interpretation of these findings presents some interesting challenges. It is difficult to argue that this variation in the exploitation of red deer antler was linked to a dependence on the same kinds of movements of people apparent at Oronsay. The island of Risga lies 200m from the coast within Loch Sunart and can be reached in rowing boats piloted by relatively inexperienced seafarers (Pollard 2000, 145). In recent times, red deer are known to swim to the island from the shore for brief periods of grazing (although the island itself does not offer the food or cover needed to support a breeding population on a more permanent basis (*ibid.*)). As such, access to red deer antler would not appear to have been as restricted as on Oronsay. The lack of zooarchaeological analysis of the Risga red deer remains also means that it is impossible to compare the distribution of animal sizes within the Risga midden to those of middens on Oronsay (Grigson & Mellars 1987). As such, there appears to be no suggestion that the differential exploitation of antler at Risga can be linked to separate deer identities.

However, it still remains possible that fluctuations within the local populations of red deer may have placed occasional stresses on the availability of antler, and thus resulted in varying levels of antler exploitation. Peaks and troughs within local red deer populations may have been triggered by a variety of factors including bad weather, pressure from predators, outbreaks of disease or changes in the local environment (T Clutton-Brock et al. 1982). As at Oronsay, further discussion of this issue would require a clearer understanding of the distribution of the worked antler material throughout the Risga midden to better establish the extent to which working practices varied within the occupational history of the site. Unfortunately, the work of Pollard (T Pollard 2000; T Pollard et al. 1996) has failed to positively identify any remaining, undisturbed midden deposits which could be investigated to better understand the occupational sequence of the site. As such, it appears that the opportunity to investigate these issues further at Risga is now gone.

It is also important to stress that in, in addition to antler, bone and stone were also used to produce bevel-ended tools at Risga and on Oronsay. As such, the management of red deer antler also needs to be considered within a broader suite of materials. Variations in the availability of these other materials may have had an influence on the management of antler, although further work is needed to establish if they show any similar variations in the level of exploitation. The Sand assemblage appears to indicate that red deer antler was being brought to the site and worked through the removal and deposition of tines and crowns. The absence of intact beam portions suggests that either beams were removed from the site and taken to other locations for working, or that bevel-ended tool manufacture occurred at the site.

However, the absence of antler bevel-ended tools within the Sand assemblage suggests that, if the latter was the case, the tools themselves were being deposited elsewhere. This differs from the patterns observed on Oronsay and Risga where antler bevel-ended tools were being made, used and deposited at the same sites. It is also interesting to note that bevel-ended tools at Sand were made exclusively from bone and stone (Hardy 2009c), despite the apparent availability of antler at the site. This suggests that at Sand, antler was valued less for its use in bevel-ended tool production than at other sites in the region, and instead other materials were preferred for the manufacture of these tools. This implies that antlerworking practices were varied at different shell midden sites. The pattern of antler exploitation discussed earlier for the Oronsay and Risga middens cannot be assumed to be a practice which is inextricably linked to the human activity at shell middens in the Scottish Mesolithic.

However, a further examination of the choices made in the raw materials for bevel-ended tools allows this variation to be viewed in a slightly different light. Table 33 shows the published quantities of bevel-ended tools from the shell midden sites discussed in this thesis. This data does need to be treated with a certain degree of caution, as the excavations of Galloway and Grieve cannot be treated as providing a representative sample of the artefacts present at the site. Equally, Mann and Buchanan's excavations at Risga, whilst apparently extensive, lack the levels of recording necessary for confident assertions regarding types of artefact which are *absent* from the Risga assemblage. However, even when these caveats are born in mind, it can be seen that in the areas of Caisteal nan Gillean, Cnoc Sligeach and Croch Riach that were excavated by Galloway - Grieve and Mann – Buchanan, there are differences in the preference of raw materials for bevel-ended tools between sites.

Site	Bone	Antler	Stone	Reference
Sand	42	0	0	(Hardy & Wickham-Jones 2009)
Risga	481	42	0	(Foxon 1991)
Cnoc Sligeach	36		150	(Anderson 1898)
Priory Midden	Unpublished	Unpublished	Unpublished	
Croch Riach	16	4	0	(Anderson 1898)
Caisteal nan Gilllean	93	57	210	(Anderson 1895)

Table 33: Proportions of bone, antler and stone bevel-ended tools from Mesolithic shell midden sites in Scotland

It is tempting to ascribe these differences in raw materials to economic factors and availability. Foxon's (1991) suggestion that bevel-ended tools were casually fashioned and deposited from whatever materials were most readily available would appear to support this. This would imply that, at times when animal bone was freely available at these sites (following a successful hunting trip, for instance), it was used to make bevel-ended tools. At times when bone resources were exhausted, it could be speculated that stone was used. Based on the findings of this thesis, it could also be speculated that antler axes and barbed points, once they served their purpose, could also be dismantled to provide raw materials for bevel-ended tool production.

However, this would not seem to fit with the archaeological assemblage of Sand, where antler was freely available and clearly being worked, but did not feature as a material in the bevel-ended tool assemblage. A purely economic approach to this issue also overlooks the radical implications for the *chaîne opératoire* of individual artefacts that raw material choices have (Warren 2006). The experimental investigations of Birch (2009) have shown that although bevel-ended tools can be used successfully for a range of different activities, certain materials are more suited for specific activities than others. For instance, stone tools are apparently more suited to the removal of limpets from rocks, whilst antler tools are superior to bone in the removal of tree bark (Birch 2009). As such, it is entirely possible that people in the Mesolithic considered certain materials more suitable for use in to carry out specific tasks and within specific contexts.

Considering the *chaîne opératoire* of these different materials then may be vital to understanding why the levels of raw material exploited for bevel-ended tool production fluctuate from site to site. Although further direct research into this issue is beyond the aims of this thesis, a speculative discussion may provide some interesting stimulus for future work. In regard to stone tools, Anderson (1895) notes that the pebbles from which bevel-ended tools are made are found abundantly on the modern day shorelines of Western Scotland, and given the immediate association of most of these sites with the Mesolithic coastline it seems likely that the raw materials could have been acquired from nearby beaches. The process of collecting and these materials would therefore involve trips along the tideline, with the active selection of suitable stones based on their morphological characteristics.

In contrast to this, the sourcing of animal bone would require successful hunting trips and subsequent skinning and butchery. Specific long bones would have been selected, which allowed the production of the desired shape of tool. Whereas beach pebble procurement would involve visiting specific points in the landscape (e.g. the tideline), the procurement of animal bone may have occurred at much less predictable locations – with the route of hunting trips being directed and determined, to some extent at least, by the actions of the animals being hunted. The variable nature of hunting success may also have led to an element of unpredictability in the sourcing of bone for bevel-ended tool manufacture.

The sourcing of antler for bevel-ended tool production may have occurred in several different contexts. The material could have been acquired in an almost identical manner to that of the bone discussed above – through butchery following a successful hunting trip. Alternatively, shed antler may have been collected without the need for actively hunting deer. The presence of shed antler at Risga and Cnoc Coig suggest that in some cases, this was occurring. A final alternative way in which antler could have been acquired for bevel-ended tool production would have been through trade and exchange with other people. Again, the presence of red deer antler on Oronsay, where there is no native red deer population, has been interpreted by some authors (Finlayson 1995) as evidence for the trading of antler. It should also be noted based on the discussion above, that, once acquired, antler may have been used to produce axes or barbed points before finally being made into a bevel-ended tool.

It seems then that the differences between bone, antler and stone bevel-ended tools are actually quite profound. Not only would the context in which the materials were originally sources have varied in terms of predictability and setting within the landscape, but also the mechanical properties of the materials would have had an effect on the suitability of specific tools to specific tasks. It is possible that, although they shared a similar finished form when discarded, Mesolithic people regarded bone, antler and stone bevel-ended tools as three distinct types of artefact – each with its own distinct method of production and suited to its own task (or set of tasks).

In classifying these tools differently, the fluctuations in relative frequency of these materials at different sites can be interpreted in a different light. Consider, for example, the Sand bevel-ended tool assemblage. This features 42 bone bevel-ended tools and evidence for antler bevel-ended tool production, but lacks the stone or antler bevel-ended tools themselves (Table 33). It therefore seems likely that antler bevel-ended tools were being produced, but removed and transported to another point in the landscape for use and deposition. However, bone bevel-ended tools were being utilised and deposited within the midden. It could be speculated that bone bevel-ended tools were suitable for specific tasks that were also being carried out at Sand, whilst antler bevel-ended tools were required for tasks which were being carried out elsewhere in the landscape. In contrast to both of these, no evidence of stone bevel-ended tools is recorded at the site. It can therefore be argued that not only do differences in materials have substantial implications for the *chaîne opératoire* of individual artefacts, but also that people were treating bevel-ended tools differently at the site, on the basis of the material that was being used.

This interpretation has some further implications for the role of bevel-ended tools in defining the activities that are were carried out at specific shell midden sites. With further experimental work, it may be possible to define the precise activities and actions that each material is more suited to, and thus gain a firmer grasp of the types of tasks that the presence of bone, antler or stone bevel-ended tools might indicate.

This re-definition of bevel-ended tools into three distinct artefact types has some further implications for broader debates regarding the role of shell middens within coastal settlement patterns during the late Scottish Mesolithic. As reviewed in Chapter 2, there are several conflicting models for settlement pattern in this region. Finlayson argues for the development of a complex social structure during the late Mesolithic, in which individuals specializing in hideworking occupy the shell midden sites of Oronsay. Through the production of high status hide-based material culture, these individuals were able to support themselves without directly involving themselves within subsistence practices. Food resources (such as red deer meat) were acquired through trade within wider social networks along the Western Scottish seaboard.

In contrast to this, Bonsall argues that shell middens represent specialised shellfish exploitation sites, where groups of people gathered seasonally to exploit coastal resources on a large scale. To support this, Bonsall has cited his own experimental work on bevel-ended tools – which he interprets as showing a predilection towards the tools being used to remove limpet flesh from their shells. However, this argument has been critiqued by Hardy (2009b).

The excavation of Sand has prompted further discussion of the role of shell middens within Mesolithic settlement patterns in coastal regions. Wickham-Jones and Hardy (Wickham-Jones & Hardy 2009) note that Scottish shell middens are not a uniform phenomena, and that considerable variation exists in the nature of occupation at a range of different sites. They also note that at Sand, a specialised suite of activities appear to have been carried out – focusing on the working of red deer hides.

The variation in antlerworking practices documented at Mesolithic shell midden sites has already been summarised above. As such, it could be said that this variation (with a distinction between the use of antler at the Oronsay middens, Sand and Risga) supports the argument that shell midden sites are not a uniform phenomena, and that their character and meaning varies dramatically within the Mesolithic. This would appear to also undermine Bonsall's argument that Mesolithic shell midden sites fulfill a specific function within wider coastal settlement patterns, as there appears to be considerable variation in the actual nature of occupation at these sites. Whilst this is difficult to argue based on purely the antlerworking evidence, there is a wider context of factors which involve environmental conditions, occupational activities in adjacent areas, duration of use, burial practices and material choices which cumulatively suggest (alongside the variations within the use of antler) that a single "function" cannot be assigned for Mesolithic shell middens – in the manner outlined by Bonsall.

7.7 Applying the traceological methodology to material in Britain

Reflection on the analysis undertaken as part of this thesis also allows the discussion and assessment of the suitability of traceological analysis for studying material from Britain. This can be defined as having two major differences to previous applications of the technique and approaches to ancient osseous technologies, both of which are linked to the fact that this study is focused exclusively on the British Mesolithic. Firstly, as demonstrated within Chapter 2, the theoretical climate within British Mesolithic studies has, in the recent past, stressed the importance of considering osseous technologies within the context of human/animal relations. This has been advocated through the extension of traditional *chaîne opératoire* to include the context in which materials were acquired. Secondly, as highlighted in Chapter 4, the insecure and frequently unstratified nature of the majority of British Mesolithic antlerworking findspots leads to a slightly biased understanding of the *chaîne opératoire*, which focuses more on the final stages of artefact production, at the expense of a more detailed and secure understanding of the early phases of working. This is due to the fact that insecurely stratified finds cannot be directly linked with *debtiage* assemblages (when present), which best demonstrate the methods used in the initial breaking up of antler into the desired forms of material required for specific artefacts. It is also compounded by the tendency of earlier phases of working to be obscured by later actions, usewear and taphonomic processes.

The first aspect has a direct relevance to the potential for future application of the approach taken here, in studies elsewhere in Europe. Whilst it has been noted in Chapter 6 that there are difficulties with constructing models of deer behavior for the contexts into which many British Mesolithic antler artefacts have been deposited, it should be noted that in other areas of Europe there are many sites which have much been methodically excavated from secure *in-situ* contexts, within landscapes with extensively studied palaeoenvironmental sequences. In particular, the wetland areas of Southern Scandinavia and Northern Germany feature a relative dearth of this combination of data. These offer the potential for more detailed models of deer behavior within Mesolithic landscapes to be constructed elsewhere in Europe, and for antlerworking practices to be situated within these models. As such, there is the potential for a more secure and specific link between the behavior of deer within a landscape and the precise ways in which deer materials are worked, used and deposited to be drawn. Given that this is also precisely the area of Europe where traceological analysis has been applied in the past (E David 1999; Leduc 2010), there is considerable potential for the construction of deer behavioural models and their subsequent integration with the existing *chaîne opératoire* data generated in previous studies.

The second aspect of a British-focused application of traceological also presents some interesting implications for the character of the data generated by this thesis. As noted above, the weighting towards unstratified and isolated finds creates an emphasis on the finishing stages of antler artefact production, at the expense of the earlier stages of the process. The decisions involved in finishing actions can generally be linked to more closely to choices regarding the final form or aesthetic properties of the antler object, whilst the earlier (and lesser known in this case) stages have a closer association with the management of the material itself.

Additionally, the lack of in situ *debitage* assemblages also presents problems in discussing the scale of antlerworking practices – a key theme within studies of prehistoric osseous industries elsewhere in Europe (e.g. Billamboz 1977; E David 1999).Previously, sites have been characterised in terms of the quantity of antlerworking carried out – with distinctions drawn between sites where bone and antlerworking activities appear to constitute a major aspect of life, and sites where antlerworking is considered to play a relatively minor role. This quantitative assessment of antler artefact production has also been applied to the manufacture of barbed points at Star Carr, with precise estimates of the numbers of artefacts which were made at the site (Clark 1954; P Rowley-Conwy 1998). However, when analysing material from insecure contexts it becomes impossible to gage the scale of antlerworking activities carried out at the site, as there is no guarantee that all of the material originally deposited has been recovered and analysed. The finds analysed may represent the only antlerworking activity carried out at the site, or a small part of a larger suite of practices (evidence for which has not been recovered). Further to this, the problems with dating unstratified assemblages consisting entirely of *debitage* (see Section 4.3.1) mean that some of the sites which potentially could allow a more confident assessment of the scale of antlerworking at Mesolithic sites. Thus, the application of traceological analysis to material from insecure contexts cannot give any real insight into the scale of antlerworking activities.

The inability to quantify the scale of antlerworking practices, or assess the ways in which antler as a material is being managed in these insecure contexts severely inhibits the ability of this material to be used in the characterisation of antler industries in the British Mesolithic. However, this is not to say that the analysis of this material is futile – the positive evidence present in the material recovered can be said to document Mesolithic antlerworking practices – but it should be stressed that the negative evidence from these sites cannot be used to infer that specific antlerworking practices *were not* being carried out. As such, the contribution of this isolated and unstratified material is that of snap-shots; a restricted, key-hole view of antlerworking practices which might or might not be indicative of wider patterns of behaviour.

This can be seen clearly with the instances of antler axe repair documented at Hammersmith, Kew and Mortlake (Figure 221). Whilst these finds cannot be used to argue for the consistent maintenance and repair of antler axes during periods of Mesolithic activity at these sites or within these regions, they show that, around the River Thames, *some* people at *some* times did make a concerted effort to prolong the active life of their antler axes through repair. In itself, this does mark a step forward of our understanding of the way in which antler as a material was managed during the Mesolithic.

Figure 235: A13648, Hammersmith

The restricted, but non-the-less informative, insights into antlerworking practices that the traceological analysis of unstratified finds provides also leads to a subtle but key shift in the focus of the data generated by this material. Rather than characterising the normative antlerworking practices repeatedly carried out by a collective group, the material from unstratified Mesolithic contexts focuses on the isolated decisions and choices of individual people. As such, these results could be said to characterise the antlerworking *craft* in Mesolithic Britain, rather than an antlerworking *industry*. The word "industry" implies a shared schema or template for antlerworking, which is adhered to by a group of people over a period of time (E David 2006). As such, it could be considered normative behaviour within a group. The collective mindset demonstrated through consistently repeated osseous tool making procedures has allowed previous authors to suggest that these practices are indicative of a common cultural identity (E David 2009).

It is clearly difficult to argue for the same kinds of repeated and collectively held schemas of antlerworking when dealing with the isolated and unstratified material which characterises the majority of Mesolithic Britain. However, the term "craft" emphasises the role of individual craftspeople in the creation of artefacts, both through the importance of personal levels of skill and a valuing of the properties of the material itself in the decisions made during the creation of material culture (Faulkner 1996). As such, the *chaîne opératoire* sequences that this thesis has produced for isolated and unstratified antler artefacts would seem better suited for characterising antler craftworking practices within the British Mesolithic.

The distinction between "craft" and "industry" that the traceological analysis of unstratified antler artefacts from Britain creates a new set of questions and interpretations within study of Mesolithic antler artefacts, and the people who made them. For instance, in a craft context, the aesthetic qualities of certain antler artefacts might be viewed in a different light. It has already been noted that the bevel-ended tools with scraping along the SEN and DEX edges have a certain symmetry and aesthetic quality which may have originally attracted their antiquarian collectors, and many more of the artefacts illustrated within Chapter 5 display similar properties. The antler axe A13648 from Hammersmith (Figure 235), which shows extensive evidence for shaping of the working edge can be taken of an example to explore some of these issues. As noted above, this axe has had repeated episodes of scraping carried out to create a balanced and symmetrical-shaped working face and edge. From a craft perspective, this behaviour could be interpreted as the actions of a specific, highly skilled individual, who had both the ability and time required to create a more aesthetically pleasing piece of material culture. As such, the extra investment shown in the production of this piece could be taken as evidence for the presence of skilled craftspeople in the Mesolithic.

Figure 236: Antler artefacts displaying a commitment to symmetry which could be interpreted as displays of craftwork

However, care needs to be taken when applying the concept of "craft" to the interpretation of Mesolithic antlerworking *chaîne opératoires.* Firstly, the contemporary perception of a craftsperson is someone who has an above-average level of skill. As discussed earlier, the isolated nature of unstratified finds make it impossible to relate individual artefacts on stratigraphic grounds. As such, there is little way of defining the makers of objects such as antler axe A13648 as "highly skilled", as we have no understanding of the relative skill levels of their contemporaries. Whilst A13648 provides positive evidence for a level of investment and commitment to certain aesthetic values (e.g. symmetry), it need not mark the artefact's maker out as a notably skilled antlerworker within their contemporary social context.

Secondly, whilst a commitment to the production of a symmetrically-shaped finished artefact is taken here to be an aesthetic itself this need not necessarily be the case. The aesthetic tastes of both individuals and collectives could vary considerably, and there is obviously no way of knowing whether or not asymmetrical artefacts were actually simply conforming to a distinct (and to us unknown) set of aesthetic values. The key aspect of A13486 which could potentially mark it out as a piece of craftwork is the repeated and varying scraping marks – which seem to suggest a considerable investment of effort into the creation of the finished form – which in this case is symmetrical. A range of artefacts of different types which show a similar level of investment through repeated working actions are shown in Figure 236. Incidentally, many of these artefacts also display a symmetrical finished form.

The value of applying traceological analysis to isolated and unstratified antler artefacts is clearly shown in the discussion of craft and the choices of individuals within the Mesolithic. There is considerable potential for this discussion to be extended further across Europe. The areas of North West Europe where traceology has been applied previously contain similar quantities of isolated and unstratified bone and antler artefacts (Nash 1998). Previous work has sought to characterise the artistic motifs present within this material, but little work has been done on the technical aspects of their production. Given the emphasis of that craft theory places on the relationship between artistic expression and functional design (Adamson 2010), this corpus of data could be of particular interest if approached from a craftwork perspective.

Additionally, the success of this thesis in characterising antler working practices also creates the potential for further application of the technique to other regions of Europe. The above discussion demonstrates that areas which lack the wetland expanses or rich research history that Southern Scandinavia enjoys can still benefit considerably from this approach. The Mesolithic of Southern Europe, for instance, has a record of osseous technologies which in many ways is similar to Britain in that it is characterised by (for the most part) isolated and unstratified finds – many of which originate from cave deposits. Whilst, as discussed above, a full characterisation of osseous industries within these regions may be difficult to achieve, the application of traceological analysis may help develop an understanding of bone and antler craft work in these areas.

7.8 Summary

The key issues raised in this discussion chapter can now be summarised. It has been shown here that the traceological analysis of Mesolithic worked antler material from across Britain has helped to establish a normative *chaîne opératoire* for their manufacture. Due to the nature of the data and its context of recovery, this often requires the synthesis of the analysis of finds from across the country. However, this has helped to highlight several aspects of British Mesolithic antlerworking which have not previously been discussed. This includes the use of "groove-and-splinter" technology for the production of uniserial barbed points being practiced along the east coast of Britain and extending beyond the Vale of Pickering.

Having established these normative sequences for manufacture and use, deviation from these sequences can be identified. This has helped to highlight the significance of finds from Thatcham IV and Greenham Dairy Farm and the recognition of a Mesolithic artefact previously unrecognised within the British archaeological record - the *lame de hauche*. It has also helped to stress the potential significance of the Thrumpton Harpoon for understanding the spatial and temporal distribution of biserial technology within Britain. The significance of the presence of antler T-axes in Britain has also been highlighted through the study of variation in the technical choices made by people working antler in the Mesolithic period. This in particular has raised questions over the relationship between the technical choices made by people living in Northern Britain, and similar choices made by people living across Europe in the late 6th millennium/early fifth millennium cal. BC.

Traceological analysis of the British antler material has raised questions over the appropriateness of the term “mattock” for finds from Britain. As an alternative, the term “axe” is proposed for the vast majority of these artefacts. Re-terming these “mattocks” as “axes” will also facilitate future discussions of the relationship between antlerworking in Britain and Europe by standardizing terminology and thus helping to illustrate areas of similarity and difference. For example, application of the term “axe”, and distinguishing “axes” from “adzes” has helped to show that the distinction between antler use in the Kongemose and Ertebølle of Southern Scandinavia (Clark 1969) cannot be recognised within the British Mesolithic.

This chapter has also discussed antlerworking within the broader context of human/deer relations. It has been argued that, in northern Britain, the absence of elk antlerworking evidence cannot be solely attributed to a lack of availability and that more complex processes may be at work. It has also been suggested that the differential treatment of red and roe deer antler is linked to wider differences within the relationships between people and these respective species. This involves the articulation of distinct deer identities intimately linked with the differences in the ways people encountered the animals themselves on a daily basis.

A series of strategies for the management of antler were also discussed wihtihn this chapter. This included the practice of repair, and the possible implications that this couls have for he way in which Mesolithic people managed their antler resources, and also the evidence for the application of fire and water in preparing antler prior to working.

The recognition of the practice of re-using antler material from axes and biserial barbed points at Scottish shell midden sites has been a major finding of this thesis, and has resulted in considerable discussion. Its implications for the management of red deer antler on Oronsay has been discussed in relation to the potential fluctuation of available antler on the island, and the negotiation of distinct red deer identities through antlerworking practices. The occurrence of this practice in different contexts has also been discussed in relation to Risga, where in theory; the availability of red deer antler would have been less restricted. It has also been established that the use of antler varied at different shell midden sites through comparisons of assemblages from Risga, Oronsay and Sand.

The variation in the use of antler, in relation to other raw materials, for the production of bevel-ended tools has also been discussed within this chapter. This has led to the suggestion that, given the radically different ways in which these raw materials were sourced, the functional properties of the materials themselves, and the apparent differences in the spatial structuring of the manufacture, use and deposition of bevel-ended tools at Mesolithic shell midden sites, bone, antler and stone bevel-ended tools could be considered as separate types of tool. The implications for this new approach to bevel-ended tools have also been discussed in relation to the ongoing debate over the role of Mesolithic shell middens within wider settlement patterns, with this approach broadly supporting Hardy and Wickham-Jones’ argument that the role of shell middens varies considerably.

The discussion was rounded off with a reflection on the suitability of the traceological methodology for the study of antlerworking practices in Mesolithic Britain. This found that the inclusion of isolated and unstratified material within the study fundamentally shifted the focus of project from the characterisation of antlerworking industries (as achieved in other areas of North West Europe) towards an understanding of antler craftworking practices, on a national level. This was based on the character of the data itself, and the general emphasis that this placed on the finishing stages of antler artefact manufacture. It should be noted, however, that this does not prevent the characterisation of industrial practices at certain sites where securely provenance *debitage* is available for analysis.

Chapter 8: Conclusion

8.1 Introduction

The final conclusions of this thesis will be presented in the following chapter. These will summarise the key findings of the previous chapters and demonstrate the fulfillment of the original aim of the thesis: **To characterise the use of antler in the British Mesolithic, and to place this within the broader context of human and deer relations during the period** (Chapter 1). The significant conclusions of Chapters 2-4, which outlined the theoretical and methodological potential for research into the use of antler in the British Mesolithic, will be presented first. This will be followed by the major conclusions drawn from Chapters 5 and 7, on the results of traceological analysis of the worked antler from Mesolithic Britain. Together, these findings meet the first part of the thesis aim, and characterise the use of antler in the British Mesolithic. These will be followed by the major conclusions on the role that antlerworking played in the relationship between people and deer during the period, summarising findings from Chapters 6 and 7. This will fulfill the second element of the thesis aim, and place the use of antler within the wider context of human/deer relations in the British Mesolithic. Finally, the questions that this thesis has raised for further research will be summarised, outlining new directions for future work.

8.2 Conclusions on the potential for research into the use of antler in the British Mesolithic

Chapters 2-4 sought to outline the potential for research into the use of antler during the Mesolithic period in Britain. It was found that there is a considerable body of evidence for the use of antler throughout the British Mesolithic, at a variety of sites across England, Scotland and Wales. However, previous research has focused heavily on the antler assemblages from Star Carr and Oronsay. Not only does this narrow focus neglect material from other areas of Britain, it also leads to an understanding of antlerworking based on evidence from sites dating to the very start and end of the period – antler technology *throughout* the period remains very poorly understood.

In addition to this, it has been demonstrated that recent theoretical trends in Mesolithic Studies have stressed the importance of considering the use of antler within the wider context of human/deer relations. However, these discussions have continued to focus on Star Carr – partly due to the sparse faunal record for the British Mesolithic, which makes it difficult to discuss the relationship between people and deer on a large scale without an over reliance on a limited number of sites.

However, Conneller's (2011) approach of emphasising the nature of human/deer encounters at a landscape level, and the importance of the character of these encounters in the formation of interspecies relations, has considerable potential for exploring these issues. By considering the different environment types present in Mesolithic Britain, and the implications that these have for the behaviour of the three species of deer present within Britain during the Mesolithic, it is possible to characterise the different ways in which people may have encountered deer during the period. This leads to a dynamic and multi-layered understanding of human/deer interactions, which draws on the behaviour of contemporary red deer, roe deer and elk populations and the palaeoenvironmental record for the period itself.

It has also been shown that the technique of traceological analysis offers a method for the characterisation of antlerworking in the British Mesolithic. In doing so, it creates the potential for comparisons with similar studies in continental Europe. It also offers the opportunity to impose some consistency over the terminology and orientation of antler artefacts from Britain, which has been previously lacking within academic discussions. Additionally, it satisfies the recent theoretical demands for an understanding of the *chaîne opératoire* of antler artefacts.

Although Mesolithic antler artefacts have been recovered from all over Britain, the vast majority come from insecure or unstratified contexts with minimal contextual information. This has been a major deterrent for research in the past, and has contributed significantly towards the Oronsay/Star Carr bias in previous discussions of antlerworking in the British Mesolithic. However, the application of ^{14}C AMS dating has helped to refine the chronological affinities of many artefact groups, and has led to a more secure understanding of the material that can be linked to the Mesolithic on typological grounds. This is particularly important when studying prehistoric antlerworking in Britain, due to the lack of artefacts from securely dated contexts. A critical review of the dating of typological groups can help identify artefacts likely to date to later periods of prehistory, such as antler maceheads and base antler mattocks. It can also help to identify typological groups which span multiple periods, including the Mesolithic.

The application of traceological analysis to this unstratified material produces a slightly different characterisation of antlerworking practices to that of previous studies of stratified artefact and *debitage* assemblages. This is explored in chapter 7, demonstrating that the analysis of isolated and unstratified material is more suited to the characterisation of antler craft practices, rather than that of antler industries. These focus more on the decisions of individuals, who cannot be assumed to be representative of a larger pattern of contemporary behaviour. The emphasis on finished artefacts also stresses the latter stages of artefact manufacture, and so privileges the decisions involved in determining the final form and aesthetic properties of antler objects. This links in with certain aspects of craft theory, which stresses the role of artistic expression in the creation of everyday objects.

8.2 Conclusions on the characterisation of the use of antler in the British Mesolithic

The results presented in Chapter 5 and discussed in Chapter 7 lead to a characterisation of the treatment of antler in the British Mesolithic. At shell midden sites in Western Scotland, red deer antlerworking is characterised by the removal and deposition of tines, and the longitudinal fragmentation of antler beams using the flake-breakage method. This occurs even at sites where fragmented antler is not used to produce antler bevel-ended tools or biserial barbed points – such as Sand or An Corran where only bone and stone bevel-ended tools are deposited. This suggests that these sites represent the initial sites of fragmentation, but that antler “blanks” are removed from the site for further processing, use and deposition elsewhere in the landscape.

Bevel-ended tools of red deer antler were manufactured through the use of fragments produced by flake-breakage. In some cases these were further shaped through scraping along the sides of the tool and at the working edge before prior to use. Areas of polish on these tools also suggest that they may have been hafted for use. Very occasionally, roe deer antler was also worked to produce bevel-ended tools at these sites. This was achieved using flake-breakage and grooving techniques.

When considered alongside the use of bone and stone, antler bevel-ended tools appear to form part of a complex economy of raw materials, the proportions of which vary significantly between different Mesolithic shell midden sites. A speculative discussion of this has suggested that the differences between material choices in bevel-ended tools would have had major implications for the processes by which the materials were acquired, and the aptitude of the finished tool in performing specific tasks. As such, the group of artefacts we class as "bevel-ended tools" may actually represent three separate tool types – each associated with a different set of activities. This would appear to be reflected at Sand, where the manufacture, use and depositional practices associated with bone, antler and stone varies considerably. This discussion and suggestion has some wider implications for the ongoing debate over the role of shell middens with wider settlement patterns during the Mesolithic of Western Scotland.

Biserial barbed points and harpoons recovered from Mesolithic contexts in Northern Britain were created from fragmented portions of red deer antler, most likely produced by the flake-breakage technique used for bevel-ended tools. They were subsequently shaped using scraping and grinding, and had barbs defined by sawing from both the internal and external aspects. In the case of harpoons, perforations were created through grooving on the internal and external aspects.

The use of red deer antler "mattocks" is documented at Mesolithic shell middens such as Cnoc Sligeach and Risga through the occurrence of fragments of tools which have been damaged during use. These include breaks of the working face which imply a lateral stress being placed on the tool, and damage at the points of hafting which can also become the focus of physical stress during percussive actions. In contrast to this, the intentional fragmentation of red deer antler "mattocks" at these sites is also attested by the presence of fragments of red deer antler, created through the flake breakage technique, which feature diagnostic "mattock" working edges or perforations. In some instances these fragments have been re-used for the production of bevel-ended tools. In a similar manner, broken distal tips of biserial barbed points/harpoons were also re-used as bevel-ended tools at shell midden sites.

In contrast to the methods used for the production of biserial barbed points/harpoons, uniserial barbed points were manufactured using the "groove-and-splinter" technique described by Clark (1954). This is demonstrated through finds from Star Carr, Seamer Carr, Fosse Hill and Wandsworth, and as such extends over a much larger area of Britain than had previously been demonstrated. The use of the groove-and-splinter technique has also been shown to persist into later periods of prehistory, with the AMS dating of a grooved splinter to the Bronze Age.

Antler beam "mattocks" are known from sites across Britain, and were generally produced from the trez tine region of a red deer antler. Prepared breaks were used to create working edges, detach crowns and remove trez tines. Further shaping of the working face was achieved through episodes of oblique and longitudinal scraping. A perforation was created through drilling from both sides of the artefact. Several red deer antler beam mattocks from the River Thames show signs of damage, repair and reuse. Flexion breaks at the perforation, presumably caused by stresses placed on the point of hafting, were responded to by the creation of a new perforation. Further hafting and use is attested by the presence of polishes within these secondary perforations.

A new type of antler tool – the *lame de hauche* - can be tentatively identified at a number of Early Mesolithic contexts within Britain. The specimen from Thatcham IV has been positively confirmed, whilst other possible candidates include the artefacts from Fosse Hill and Greenham Dairy Farm – neither of which could be accessed as part of this study.

A major conclusion of this thesis is the variation in the form of the antler "mattocks", which is considerably greater than has previously been suggested (C Smith 1989; Tolan-Smith & Bonsall 1999). These include the groups of extremely long beam mattocks from the River Thames, which have been shown through AMS dating to span both the Mesolithic and Early Neolithic. The beam "mattocks" from northern Britain can be classified as T-axes (Woodman 1989), based on the location of the perforation through the trez tine stump. These form part of a wider technological tradition which can be found throughout Northern Europe form the 6th millennium cal. BC onwards. The specimen from Uskmouth features a working edge which is set at a different angle to that of the other "mattocks" from Britain, and could be better described as an adze for the sake of consistency with other forms of material culture and the definitions used elsewhere in Europe.

These variations have led to a re-appraisal of the terminology used to describe these artefacts, and the proposition that "mattock" be replaced with "axe", based on the lack of evidence for using these tools in digging activities and the orientation of the working edge in relation to the haft. This creates a series of new artefact classes; antler T-axes, antler beam axes, antler base axes and antler beam adzes, alongside the newly identified *lame de hauche* described above. The spatial and temporal distribution of these new classes of artefact within the British Mesolithic illuminates significant levels of variation within the use of antler during the period. These include the confinement of the use of base axes and lame de hauche to the 10th- 8th millennium cal. BC, with beam axes, T-axes and beam adzes appearing in the 6th millennium cal. BC. In the case of the elongated beam axes, these persist into the early Neolithic of the 4th millennium cal. BC. The distribution of T-axes appears to be exclusively confined to Northern Britain, and follows the trend for the adoption of T-axe technology along the Baltic and North Sea coastal regions in the 6th millennium cal. BC.

8.4 Placing the treatment of antler within the wider context of human/deer relations

In terms of considering the use of antler within the wider context of human/deer relations, it has been noted that red deer antler appears to have been utilised far more extensively than that of elk or roe deer during the Mesolithic. Specifically, elk and red deer antler appear to have been used very differently in Northern Britain during the period. It has been previously suggested that a refugia population of elk survived in the more northerly latitudes of the British Isles (Kitchener 2010), and so the absence of elk antler from Mesolithic sites in this region cannot be attributed solely to the absence of the animals themselves. The behavioural characteristics of elk make it unlikely that even small populations could have survived undetected by people in these areas. As such, the lack of elk antler on Scottish Mesolithic sites may be the result of a difference in the nature of interactions between people and elk, based on the restricted nature of their geographical distribution. This difference would have helped shaped a unique relationship between people and elk, in which either elk antler was either not used for the production of material culture, or that elk antlerworking was restricted exclusively to the high altitude landscapes which the animals themselves inhabited. In contrast, within the relationship between people and red deer, antler was transported across and between landscapes, with both red deer antlerworking and artefact deposition demonstrated in environments which would not have supported breeding populations of the animals themselves.

The general lack of roe deer antler artefacts at Mesolithic sites can also be interpreted as the result of differences in the character of human/deer relationships. Material from Druimvargie and Risga indicates that Mesolithic people possessed the access to roe deer, and also the technical knowledge required to work this material in a similar way to that of red deer antler. As such, the very low usage of roe deer antler in the production of Mesolithic material culture in Britain requires further explanation. It has been argued in this thesis that the more extensive artefact biographies documented in the synthesised *chaîne opératoires* of red deer antler artefacts suggest a more intensive and intimate relationship between people and red deer materials. This can be placed into the context of variations in the ways in which people encountered red and roe deer during the period, with the size and behaviour of red deer resulting in more frequent direct encounters during the course of daily Mesolithic life, in comparison to the more elusive and flighty roe deer.

The technical decisions in the *chaîne opératoire* of red deer antler bevel-ended tools and antler axes on Oronsay have also been considered within the wider context of human/red deer relations across the Inner Hebrides during the late Mesolithic. It has been suggested that, the apparent differences in the levels of red deer antler exploitation at the Oronsay shell midden sites may be explained by variations in the perception of animals from different red deer populations along the seaboard of Western Scotland. As noted above, there is evidence for the intentional fragmentation of antler axes in order to generate material for the production of bevel-ended tools. Yet at the same sites, there are also quantities of red deer antler, suitable for bevel-ended tool production, which have not been worked at all. Grigson and Mellars (1987) have suggested that the remains of two distinct populations of red deer were brought to Oronsay, as raw materials for the production of bone, antler and hide objects. The size differences in these two populations suggest that they may originate from different environments and as such people would have encountered them within different landscape settings. This may have led to the development of discrete red deer identities, with the antler of one population being extensively exploited whilst the antler of another population was less intensively used.

The previous two sections have summarised the key findings on the characterisation of the use of antler in the British Mesolithic, and has placed these findings within the wider context of people/deer relations during the period. As such, it can be seen that this thesis has fulfilled its primary aim.

8.5 Future research

This project has also outlined some key questions for future research, which need addressing in order to further advance our understanding of antler technology in the British Mesolithic. This thesis has stressed the importance of contextual information in the recovery of Mesolithic antler artefacts. The limitations imposed on the interpretation of Mesolithic antler artefacts and *debitage* are stressed at various points in Chapter 5, with questions surrounding the consistency of antlerworking activities throughout the occupational history of specific sites. These can only be addressed when individual pieces of antler can be attributed to specific stratigraphic contexts. Additionally, the spatial organisation of antlerworking activities on a site-level is also an area which requires further investigation, and would ideally be facilitated by the use of 3D recording for all antler finds on Mesolithic sites.

As such, the large assemblage of antler artefacts and *debitage* from Mellars' (1987a) excavation of Cnoc Coig – which has been stratigraphically excavated using 3D recording methods – offers huge potential to address these issues. Unfortunately, access to this material could not be arranged during the course of this thesis. However, it is hoped that this can be addressed at some point in the future and the publication of the analysis of this material is eagerly anticipated.

A further question raised by the Scottish shell midden sites is the relationship between antler, bone and stone bevel-ended tools. As discussed above, it has been suggested here that bevel-ended tools of bone, antler and stone were sourced, manufactured, used and deposited in different ways at Scottish Mesolithic shell middens – and as such should be regarded as discrete tool types. Further experimental work, building on that of Birch, to investigate the precise nature of relationship between raw material choices and aptitude in carrying out specific tasks could help refine an understanding of what specific bevel-ended tool types may have been used for. If accompanied by further microwear analysis (albeit with a better understanding of the relationship between manufacturing traces and usewear traces than has previously been employed), this experimental work could potentially contribute towards an understanding of the specific types of activity that each group of bevel-ended tool is associated with, and thus lead to a better understanding of human action at previously excavated shell midden sites. In focusing exclusively on the use of one material, this thesis has been unable to explore this issue properly, but the finding of antlerworking evidence at sites where only bone and stone appear to have been used for bevel-ended tools implies a complicated economic structure to these sites. Further investigation into the use of these materials may help to place shell middens within the context of a wider pattern of material management.

The linking of T-axes in Eastern and Western Scotland to the wider pattern of T-axe technology across Northern Europe sets up a series of interesting questions for future research. This spread of similar material culture across the Baltic and North Sea region in the 6th millennium cal. BC needs further work before its significance can be fully comprehended. Investigations into the distribution of other forms of material culture or settlement patterns during this period would help to place the spread of T-axes into a wider context of 6th millennium cal. BC Mesolithic archaeology. Additionally, a full investigation into the dating of T-axe sites across Europe would strengthen an understanding of the chronological distribution of these artefacts, and possibly allow the plotting of their origins and subsequent spread.

This thesis has also demonstrated the key role that river-eroded assemblages of bone and antler artefacts can play in understanding prehistoric osseous material culture. The application of traceological analysis on this material has allowed several key insights into the use of antler in the British Mesolithic to be made, although careful consideration needs to be paid to the methods used in the recovery of this material and the biases that this may create. Whilst working at the Museum of London, a very large assemblage of later prehistoric bone and antler artefacts from River Thames was observed. As with the Mesolithic material, this has been largely ignored by previous research based on its unstratified nature. However, if the traceological analysis of this material offers as many insights as has been gained from the study of Mesolithic antler artefacts from the Thames, this assemblage offers a huge potential for better understanding the use of bone and antler in later periods of prehistory.

Finally, the exploration of the idea of Mesolithic antler craftwork has highlighted a number of ways in which isolated and unstratified material can contribute to our understanding of Mesolithic life more generally. By focusing on the choices and actions of individuals documented within the record of antler artefact *chaîne opératoire*, it is possible to discuss some of the ways in which Mesolithic people may have expressed themselves artistically in the creation of osseous artefacts. There is potential to examine this theme in other regions of Europe, where the isolated finds are complemented by more secure and contextualised assemblages of worked bone and antler. In these conditions, a discussion of variations in the levels of skill and craftwork may be possible, adding a new dimension to our understanding of bone and antler working practices.

Appendix 1: Layout of artefact drawings

The following appendix provides a series of schematic drawings which show the standard layout for bevel-ended tools, barbed points and antler mattocks. These are based on the principals outlined by David (1999).

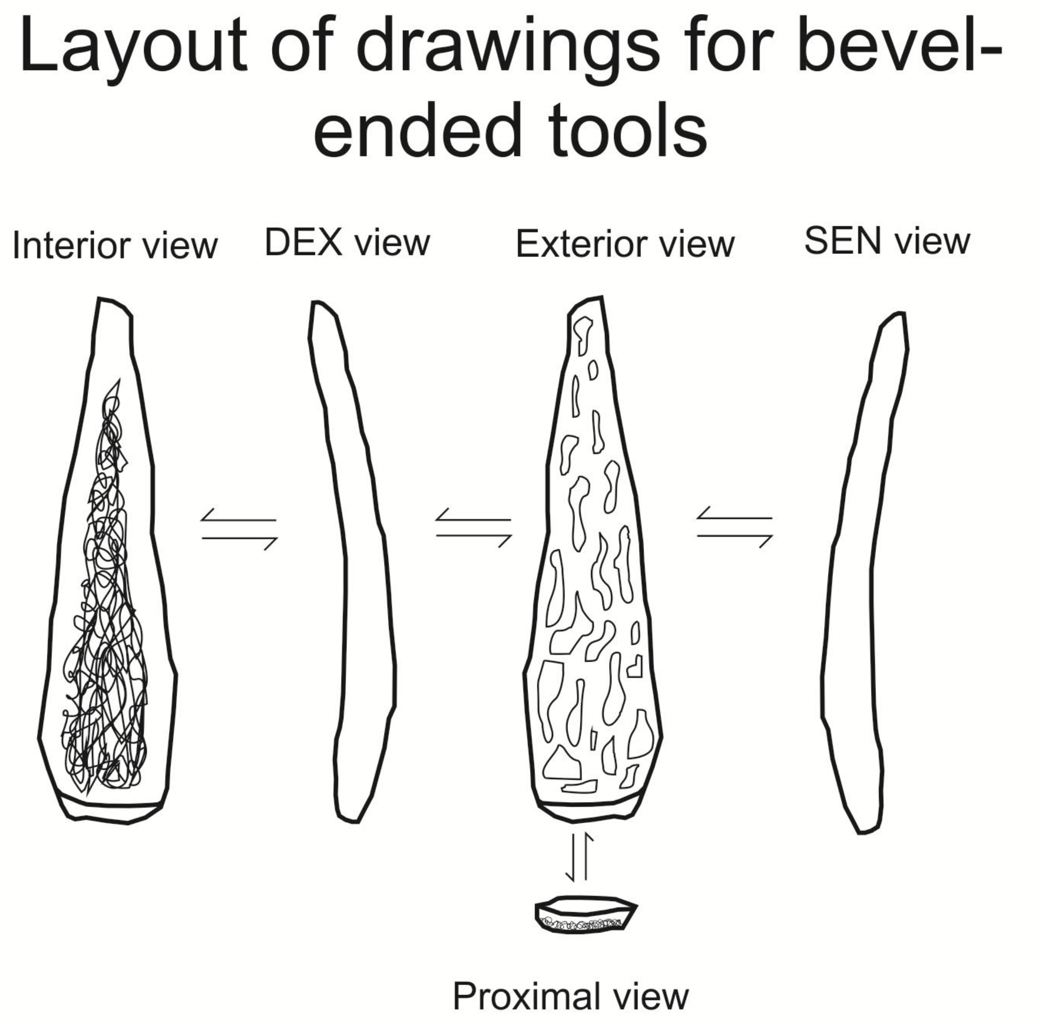


Figure 237: Layout of bevel-ended tool drawings

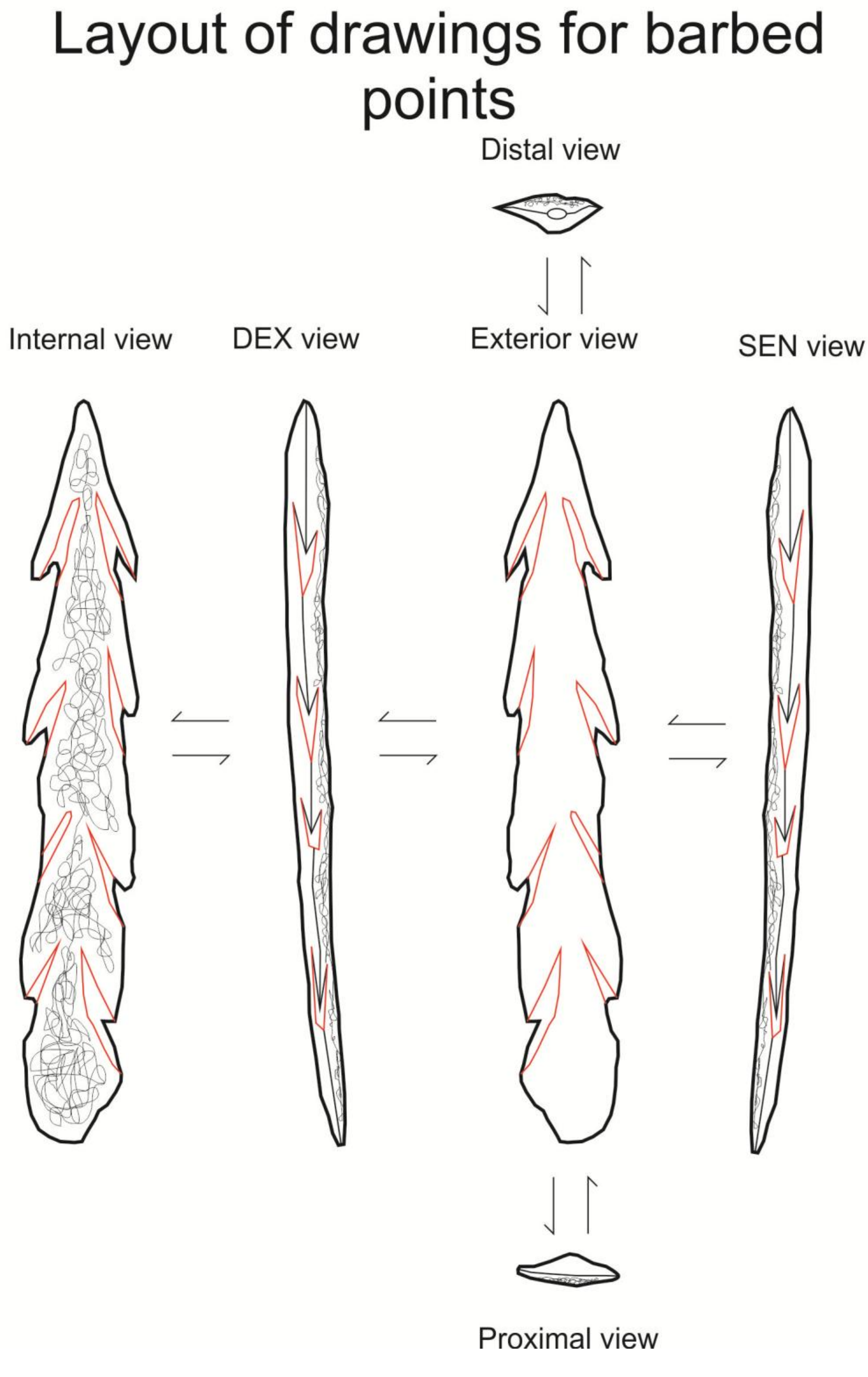


Figure 238: Layout of barbed point drawings

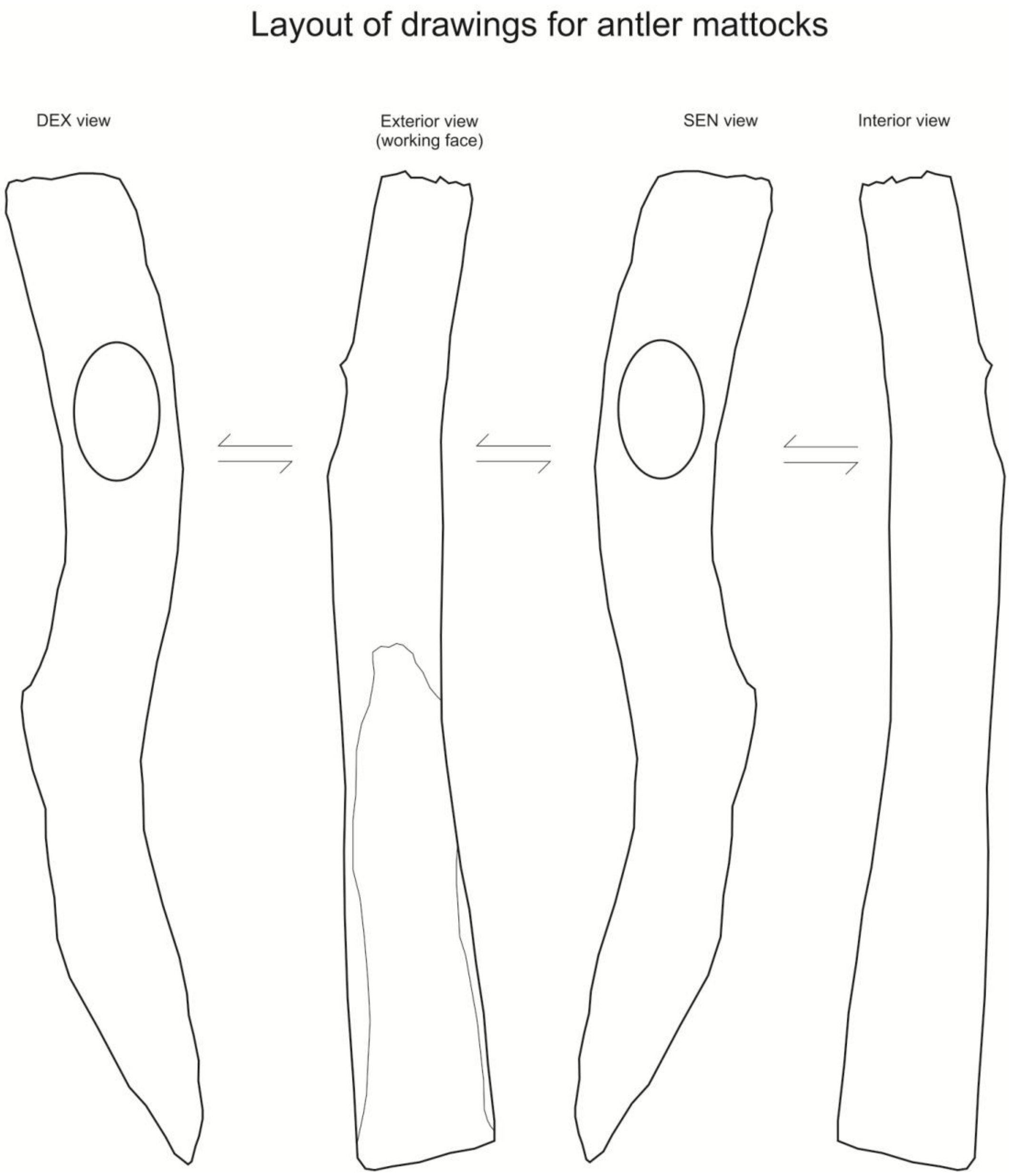


Figure 239: Layout of antler mattock drawings

Appendix 2: Listings of "Mesolithic" antler material from England, Scotland and Wales

The following consists of a list of findspots in England, Scotland and Wales from which Mesolithic antler is thought to have been recovered. The general format of the table is based on Wymer and Bonsall (1977), with information from more recent discoveries being added by the researcher. Variations in the spatial resolution of the National Grid Reference co-ordinates given in the following table are represented in the "Accuracy" column: "A" = accurate, "E" = estimated location, "G" = general vicinity. These abbreviations follow the system employed by Wymer and Bonsall (1977, xi) , for the sake of consistency with the earlier data.

Location of findspot	NGR	Accuracy	Current holding	Material recovered	Quantity
Airthrey	NS81700 96500	E	Unknown	Mattock	1
Alton Longville	TL159968	E	Unknown	Mattock	1
An Corran	NG49100 68400	A	National Museum of Scotland	Worked antler	Unknown
An Corran	NG49100 68400	A	National Museum of Scotland	Unbarbed point	1
Bankside, Power Station	TQ32000 80500	A	Museum of London	Axe	1
Barnes	TQ21700 77000	G	Museum of London	Sleeve	1
Battersea	TQ27000 77500	G	Museum of London	Uniserial barbed point	1
Battersea	TQ27000 77500	G	Museum of London	Axe	1
Battersea	TQ27000 77500	G	Museum of London	Roe antler	1
Battersea	TQ27000 77500	G	Manchester Museum	Sleeve	1
Bell Weir	TQ01800 72000	E	Museum of London	Hammer	1
Bethnal Green	TQ36000 88000	G	British Museum	Hammer	1
Between Methwold Hyde and Wissington Factory	TL650009 3000	G	King's Lynn Museum	Hammer	1
Boveney Lock	SU94500 77800	A	London Museum	Axe	1
Brandesburto n	TA13440 4666	G	Hull Museum	Uniserial point	3
Brentford or Kew, Old England	TQ17900 76900	E	Museum of London	Axe	1
Brentford,	TQ17900	E	Museum of London	Sleeve	2

Old England	76900				
Brentford, Syon Reach	TQ17500 76500	E	British Museum	Hammer	1
Brentford, Syon Reach	TQ17500 76500	E	Museum of London	Unfinished antler tool	1
Brentford, Windmill Lane	TQ16800 78300	E	Museum of London	Hammer	2
Brentford, Windmill Lane	TQ16800 78300	E	Museum of London	Unfinished antler tool	3
Brentford, Windmill Lane	TQ16800 78300	E	Museum of London	Axe	5
Burnbank, Blair Dummond	NS72900 99400	E	Unknown	Mattock	1
Caldey Island	N/A	N/A	Tenby Museum	Antler tool	1
Caisteal nan Gillean	NR35820 87970	A	Unknown	Bone or antler biserial barbed point	11
Caisteal nan Gillean	NR35820 87970	A	National Museum of Scotland	Bevel ended tool	57
Catfoss	TA13400 46600	A	Hull Museum	Uniserial barbed point	1
Chiswick	TQ20000 77000	G	Museum of London	Unfinished antler tool	1
Chiswick	TQ20000 77000	G	Museum of London	Hammer	1
Clerkenwell, St. John's Square	TQ31700 82800	A	Museum of London	Atypical axe	1
Cliff Creek	TQ71000 77000	G	Sunderland Museum	Mattock	1
Cnoc Coig	NR36050 88570	A	Cambridge	Antler base shed	11
Cnoc Coig	NR36050 88570	A	Cambridge	Antler base unshed	5
Cnoc Coig	NR36050 88570	A	Cambridge	Antler forks	7
Cnoc Coig	NR36050 88570	A	Cambridge	Severed tine	64
Cnoc Coig	NR36050 88570	A	Cambridge	Mattock fragments	10
Cnoc Coig	NR36050 88570	A	Cambridge	Pin	Unknown
Cnoc Coig	NR36050 88570	A	Cambridge	Awl	Unknown
Cnoc Coig	NR36050 88570	A	Cambridge	Worked tine	Unknown
Cnoc Coig	NR36050 88570	A	Cambridge	Bevel ended tool	400

Cnoc Riach	NR36050 88570	A	National Museum of Scotland	Bevel ended tool	4
Cnoc Sligeach	NR37280 89090	A	National Museum of Scotland	Biserial barbed point	1
Cnoc Sligeach	NR37280 89090	A	National Museum of Scotland	Bone and antler bevel ended tool	36
Cnoc Sligeach	NR37280 89090	A	N/A	Biserial barbed point	1
Cnoc Sligeach	NR37280 89090	A	N/A	Severed tine	2
Cnoc Sligeach	NR37280 89090	A	N/A	Shoe horn	3
Cnoc Sligeach	NR37280 89090	A	N/A	Bevel ended tool	Unknown
Carriden	NT03900 80700	A	National Museum of Scotland	Biserial barbed point	1
County Hall	TQ30700 79800	A	Museum of London	Axe	3
County Hall	TQ30700 79800	A	Museum of London	Needle	1
Cranitit Farm	HY43809 7	A	N/A	Tine mattock	1
Cumstoun	NX68149 53669	E	Stewartry Museum	Biserial barbed point	1
Druimvargie, Oban	NM8557 629592	G	National Museum of Scotland	Bone and antler bevel ended tool	Unknown
Earl's Barton	SP850886 3764	E	N/A	Uniserial barbed point	1
Edmonton	TQ35000 93000	G	Enfield Museum	Sleeve	1
Elton	SU96000 78000	G	Eton College Museum	Sleeve or hammer or macehead	1
Eton Water Works	SU95000 77000	G	Windsor Museum	Tine mattock	1
Feltwell	TL710009 0500	G	King's Lynn Museum	Axe	1
Finsbury	TQ31500 82500	G	Museum of London	Axe	1
Finsbury Circus, Eldon St.	TQ32800 81400	A	Museum of London	Axe	1
Thames Foreshore	TA21400 47000	E	British Museum	Uniserial barbed point	1
From Lea Valley	N/A	N/A	Bridlington Museum	Axe	1
From Thames	N/A	N/A	Museum of London	Axe	1
From Thames	N/A	N/A	Museum of London	Hammer	1
From Thames	N/A	N/A	Museum of London	Sleeve	1
Glenavon	N/A	N/A	Hunterian	Uniserial	1

				barbed point	
Goldington	TL075005 0500	G	British Museum	Sleeve	1
Goldscliff East	ST374758 1964	A	National Museum of Wales	Mattock	1
Goldscliff East	ST374758 1964	A	National Museum of Wales	Worked antler	1
Grays	TQ61000 77000	G	Colchester Museum	Pick	1
Greenham Dairy Farm	SU47700 67300	A	Newbury Museum	Severed tines	Unknown
Halfway	SU40000 73000	G	Reading Museum	Unworked antlers	Unknown
Hammersmit h	TQ22500 78300	G	British Museum	Axe	2
Hammersmit h	TQ22500 78300	G	British Museum	N/A	3
Hammersmit h	TQ22500 78300	G	British Museum	Tine mattock	1
Hammersmit h	TQ22500 78300	G	Liverpool Museum	Axe	1
Hammersmit h	TQ22500 78300	G	Museum of London	Sleeve	3
Hammersmit h	TQ22500 78300	G	Museum of London	Unfinished tool	1
Hammersmit h	TQ22500 78300	G	Museum of London	Sleeve	1
Hammersmit h	TQ22500 78300	G	Museum of London	Unworked antlers	1
Hammersmit h	TQ22500 78300	G	Museum of London	Unfinished tool	1
Hammersmit h	TQ22500 78300	G	Museum of London	Hammer	1
Hammersmit h	TQ22500 78300	G	Museum of London	Unfinished antler tool	2
Hampton Court	TQ15500 68500	E	Museum of London	Sleeve	1
Hampton Kempton	TQ12700 69000	G	Museum of London	Sleeve	1
Haverton Hill	NZ48000 21300	A	British Museum (cast), Original in North Tees Power Station	Sleeve	1
Hoveringham Gravel Pit	SU91500 78400	G	Reading Museum	Worked antler	1
Hoveringham Gravels	TA12540 46540	G	Hull Museum	Uniserial point	2
Hutton	SD48800 28800	G	Unknown	Mattock	1
Isleham	TL705006 7300	E	Bury St.Edmunds	Axe	2
Kew Bridge	TQ19000 7780520	A	Museum of London	Axe	1

Kew Bridge	TQ19000 77800	A	Museum of London	Hammer	1
Kew Bridge	TQ19000 77800	G	British Museum	Sleeve	1
Kew Bridge	TQ19000 77800	G	Museum of London	Pick	1
Kew Bridge	TQ19000 77800	G	Museum of London	Sleeve	1
Kew Bridge	TQ19000 77800	G	Museum of London	Tine mattock	1
Kew Bridge	TQ19000 77800	G	Warrington Museum	Sleeve	1
Leman and Ower Bank c.25 miles NE of Corner	N/A	N/A	Norwich Museum	Uniserial barbed point	1
Lock and Weir	TQ17000 75000	A	Museum of London	Hammer	1
Lock and Weir	TQ17000 75000	A	Museum of London	Pick	1
MacArthur's Cave	NM8588 830519	G	National Museum of Scotland	Biserial barbed point	2
MacArthur's Cave	NM8588 830519	G	National Museum of Scotland	Bone and antler bevel ended tool	140
MacArthur's Cave	NM8588 830519	G	National Museum of Scotland	Fragment of biserial barbed point	5
Meiklewood	NS71400 95000	E	National Museum of Scotland	Mattock	1
Mortlake	TQ20300 76200	E	A Marshall Collection	Hammer	2
Mortlake	TQ20300 76200	E	A Marshall Collection	Axe	1
Mortlake	TQ20300 76100	G	London Museum	Pick	1
Mortlake	TQ20300 76100	G	Museum of London	Sleeve	2
Mortlake	TQ20300 76100	G	Museum of London	Tine mattock	1
Mortlake	TQ20300 76100	G	Museum of London	Worked tine	1
Mortlake Reach	TQ20300 76100	E	Museum of London	Axe	1
Muirtown	NH65200 45700	A	Unknown	Worked antler	1
Near Kew	TQ19300 77800	G	Museum of London	Axe	1
New Scotland Yard	TQ30400 79800	A	Museum of London	Axe	1
New Windsor MB	SU95000 77000	G	British Museum, Cambridge Archaeology and	Hammer	1

			Ethnography, Reading Museum, Torquay Museum, Windsor Museum		
New Windsor MB	SU95000 77000	G	British Museum, Cambridge Archaeology and Ethnography), Reading Museum, Torquay Museum, Windsor Museum	Hammer	3
New Windsor MB	SU95000 77000	G	British Museum, Cambridge Archaeology and Ethnography), Reading Museum, Torquay Museum, Windsor Museum	Curved pick	1
New Windsor MB	SU95000 77000	G	British Museum, Cambridge Archaeology and Ethnography), Reading Museum, Torquay Museum, Windsor Museum	Pick	2
New Windsor MB	SU95000 77000	G	British Museum, Cambridge Archaeology and Ethnography), Reading Museum, Torquay Museum, Windsor Museum	Sleeve	2
No Name Hill	TA05780 8	A	Durham	Worked antler	Unknown
No Name Hill	TA05780 8	A	Durham	Barbed point	1
North Clay	TQ50500 64200	G	Bexley Public Library Collection	Unworked antlers	Unknown
Old Mere	TA20000 47000	G	British Museum	Uniserial barbed point	1
Opposite Battersea Park	TQ28000 77700	E	Museum of London	Hammer	1
Petersham	TQ17100 73300	E	Museum of London	Hammer	1
Priory Midden	NR34616 88942	A	National Museum of Scotland	Mattock	1
Putney	TQ24000 75900	E	Museum of London	Sleeve	1
Putney	TQ24000 75900	E	Museum of London	Unbarbed point	1
Redgroves Lead Mine,	NY81000 41000	G	Bowes Museum	Worked antler	1

Wellhope					
Richmond	TQ17800 74400	G	Museum of London	Mattock	1
Risga	NM6111 0059900	A	Hunterian and Kelvingrove	Mattock	1
Risga	NM6111 0059900	A	Hunterian and Kelvingrove	Shoe horn	2
Risga	NM6111 0059900	A	Hunterian and Kelvingrove	Bone or antler bevel ended tool	Unknown
Risga	NM6111 0059900	A	Hunterian and Kelvingrove	Awl	1
Romsey	SU32000 21500	G	British Museum	Decorated tine	1
Sand	NG68410 49340	A	National Museum of Scotland	Worked tines	4
Sand	NG68401 49340	A	National Museum of Scotland	Worked antler	71
Seamer Carr	TA03181 7	A	National Museum of Scotland	Worked antler	Unknown
Shewalton	NS35200 37000	E	National Museum of Scotland	Biserial barbed point	1
Splash Point	SJ020825	A	National Museum of Wales	Mattock	1
Staines	TQ03000 71500	G	London Museum	Axe	1
Stannergat Midden	NO43400 30900	G	Dundee Naturalists Society	Severed tine	2
Star Carr	TA02700 08100	A	British Museum, Natural History Museum, Cambridge (Archaeology and Ethnography), Scarborough Museum, T. Lord Collection	Uniserial barbed point	181
Star Carr	TA02700 81000	A	British Museum, Natural History Museum, Cambridge (Archaeology and Ethnography), Scarborough Museum, T. Lord Collection	Uniserial barbed point	24
Star Carr	TA02700 81000	A	British Museum, Natural History Museum, Cambridge (Archaeology and Ethnography), Scarborough Museum, T. Lord Collection	Uniserial barbed point	110

Star Carr	TA02700 81000	A	British Museum, Natural History Museum, Cambridge (Archaeology and Ethnography), Scarborough Museum, T. Lord Collection	Uniserial barbed point	2
Strand on the Green	TQ19400 77700	E	British Museum	Axe	1
Strand on the Green	TQ19400 77700	E	Rotherham Museum	Sleeve	1
Sunbury Lock	TQ11000 68500	G	Kingston Museum	Adze	1
Taplow Mound	SU91000 82000	G	Museum of London	Sleeve	1
Taplow Mound	SU91000 82000	G	Museum of London	Hammer	1
Taplow Mound	SU91000 82000	G	Museum of London	Tine mattock	1
Teddington	TQ16500 71600	G	British Museum	Axe	1
Teddington	TQ16500 71600	G	British Museum	Sleeve	1
Teddington	TQ16500 71600	G	British Museum	Hammer	2
Teddington Reach	TQ16200 7250	E	Museum of London	Hammer	1
Thatcham	SU50200 68800	A	Newbury Museum, Reading Museum	Bone or antler artefacts	13
Thrumpton	SK51331 8	A	Nottingham Castle Museum and Art Gallery	Biserial barbed point	1
Twickenham	TQ16100 72500	G	British Museum	Hammer	1
Twickenham	TQ16100 72500	G	Museum of London	Sleeve	1
Twickenham, Eel Pie Island	TQ16500 73100	E	Museum of London	Sleeve	2
Twickenham, Eel Pie Island	TQ16500 73100	E	Museum of London	Axe	1
Uskmouth	ST340881 930	A	National Museum of Wales	Mattock	1
Waltham Abbey	TL379940 0697	E	Unknown	Uniserial barbed point	1
Walthamsto w	TQ35000 88000	G	British Museum	Decorated axe	1
Wandsworth	TQ22500 75400	G	British Museum	Axe	1
Wandsworth	TQ22500 75400	G	Museum of London	Uniserial barbed point	1
West Row	TL652007 7500	E	Midenhall Museum	Axe	2

West Row	TL652007 7500	E	Midenhall Museum	Mattock	1
Westward Ho!	SS427292	E	Royal Albert Memorial Museum	Antler	Unknown
Whitburn	NZ40733 61186	E	Great North Museum, Newcastle	Biserial barbed point	1
Willington Quay	NZ32400 66200	E	Newcastle	Mattock	1
Wormingford	TL932003 2900	A	Stratford	Axe	1

Table 34: Mesolithic antler findspots from England, Scotland and Wales

Appendix 3: Relevance of antler material from Britain, ascribed to the Mesolithic, to this thesis

The following list replicates the entries to Appendix 2, but also contains information as to their relevance to this thesis (i.e. the security of their Mesolithic affinities – see Chapter 5). Information regarding the material that has been accessed as part of this study is also included in the list.

Location	Material	Relevant	Accessed
Airthrey	Mattock	Y	N
Alton Longville	Mattock	Y	N
An Corran	Worked antler	Y	Y
An Corran	Unbarbed point	Y	Y
Bankside, Power Station	Axe	Y	Y
Barnes	Sleeve	N	Y
Battersea	Uniserial barbed point	Y	Y
Battersea	Axe	Y	Y
Battersea	Roe antler	N	N
Battersea	Sleeve	Y	N
Bell Weir	Hammer	N	N
Bethnal Green	Hammer	N	N
Between Methwold Hyde and Wissington Factory	Hammer	N	N
Boveney Lock	Axe	Y	Y
Brandesburton	Uniserial point	Y	Y
Brentford or Kew, Old England	Axe	Y	Y
Brentford, Old England	Sleeve	Y	Y
Brentford, Syon Reach	Unfinished antler tool	Y	Y
Brentford, Syon Reach	Hammer	N	N
Brentford, Windmill Lane	Axe	Y	Y
Brentford, Windmill Lane	Hammer	N	N
Brentford, Windmill Lane	Unfinished antler tool	N	N
Burnbank, Blair Dummond	Mattock	N	N
Caldey Island	Antler tool	N	N
Caisteal nan Gillean	Bevel ended tool	Y	Y
Caisteal nan Gillean	Bone or antler biserial barbed point	N	N
Catfoss	Uniserial barbed point	Y	Y
Chiswick	Unfinished antler tool	N	N
Chiswick	Hammer	N	N
Clerkenwell, St. John's Square	Atypical axe	Y	N
Cliff Creek	Mattock	Y	N
Cnoc Coig	Antler base shed	Y	N
Cnoc Coig	Antler base unshed	Y	N
Cnoc Coig	Antler forks	Y	N
Cnoc Coig	Severed tine	Y	N
Cnoc Coig	Mattock fragments	Y	N
Cnoc Coig	Pin	Y	N

Cnoc Coig	Awl	Y	N
Cnoc Coig	Worked tine	Y	N
Cnoc Coig	Bevel ended tool	Y	N
Cnoc Rioch	Bevel ended tool	Y	Y
Cnoc Sligeach	Biserial barbed point	Y	Y
Cnoc Sligeach	Bone and antler bevel ended tool	Y	Y
Cnoc Sligeach	Biserial barbed point	Y	Y
Cnoc Sligeach	Severed tine	Y	Y
Cnoc Sligeach	Shoe horn	Y	Y
Cnoc Sligeach	Bevel ended tool	Y	Y
Carriden	Biserial barbed point	Y	Y
County Hall	Axe	N	Y
County Hall	Needle	N	Y
Cranitit Farm	Tine mattock	N	N
Cumstoun	Biserial barbed point	Y	Y
Druimvargie, Oban	Bone and antler bevel ended tool	Y	Y
Earl's Barton	Uniserial barbed point	Y	N
Edmonton	Sleeve	Y	N
Elton	Sleeve or hammer or macehead	N	N
Eton Water Works	Tine mattock	N	N
Feltwell	Axe	Y	Y
Finsbury	Axe	N	Y
Finsbury Circus, Eldon St.	Axe	Y	N
Foreshore	Uniserial barbed point	Y	N
From Lea Valley	Axe	N	N
From Thames	Hammer	N	Y
From Thames	Axe	N	N
From Thames	Sleeve	N	N
Glenavon	Uniserial barbed point	Y	N
Goldington	Sleeve	Y	N
Goldscliff East	Mattock	Y	Y
Goldscliff East	Worked antler	Y	Y
Grays	Pick	Y	N
Greenham Dairy Farm	Severed tines	Y	N
Halfway	Unworked antlers	N	N
Hammersmith	Axe	Y	Y
Hammersmith	N/A	Y	Y
Hammersmith	Sleeve	Y	Y
Hammersmith	Sleeve	Y	Y
Hammersmith	Unfinished tool	Y	Y
Hammersmith	Unfinished tool	N	N
Hammersmith	Unworked antlers	N	N
Hammersmith	Hammer	N	N
Hammersmith	Unfinished antler tool	N	N
Hammersmith	Tine mattock	Y	N
Hammersmith	Axe	Y	N

Hampton Court	Sleeve	N	Y
Hampton Kempton	Sleeve	Y	N
Haverton Hill	Sleeve	Y	N
Hoveringham Gravel Pit	Worked antler	N	N
Hoveringham Gravels	Uniserial point	Y	Y
Hutton	Mattock	Y	N
Isleham	Axe	Y	N
Kew Bridge	Hammer	N	Y
Kew Bridge	Sleeve	N	Y
Kew Bridge	Tine mattock	N	Y
Kew Bridge	Axe	Y	Y
Kew Bridge	Pick	Y	Y
Kew Bridge	Sleeve	Y	N
Kew Bridge	Sleeve	Y	N
Leman and Ower Bank c.25 miles NE of Corner	Uniserial barbed point	N	N
Lock and Weir	Hammer	N	N
Lock and Weir	Pick	Y	N
MacArthur's Cave	Biserial barbed point	Y	Y
MacArthur's Cave	Bone and antler bevel ended tool	Y	Y
MacArthur's Cave	Fragment of biserial barbed point	Y	Y
Meiklewood	Mattock	Y	Y
Mortlake	Axe	Y	Y
Mortlake	Pick	Y	Y
Mortlake	Sleeve	Y	Y
Mortlake	Hammer	N	N
Mortlake	Tine mattock	N	N
Mortlake	Worked tine	N	N
Mortlake Reach	Axe	Y	Y
Muirtown	Worked antler	N	N
Near Kew	Axe	Y	N
New Scotland Yard	Axe	Y	N
New Windsor MB	Curved pick	Y	Y
New Windsor MB	Hammer	N	N
New Windsor MB	Hammer	N	N
New Windsor MB	Pick	Y	N
New Windsor MB	Sleeve	Y	N
No Name Hill	Barbed point	Y	Y
No Name Hill	Worked antler	Y	N
North Clay	Unworked antlers	N	N
Old Mere	Uniserial barbed point	Y	N
Opposite Battersea Park	Hammer	N	N
Petersham	Hammer	N	N
Priory Midden	Mattock	Y	Y
Putney	Sleeve	Y	Y
Putney	Unbarbed point	Y	Y

Redgroves Lead Mine, Wellhope	Worked antler	N	N
Richmond	Mattock	Y	Y
Risga	Mattock	Y	Y
Risga	Shoe horn	Y	Y
Risga	Bone or antler bevel ended tool	Y	Y
Risga	Awl	Y	Y
Romsey	Decorated tine	Y	Y
Sand	Worked tines	Y	Y
Sand	Worked antler	Y	Y
Seamer Carr	Worked antler	Y	Y
Shewalton	Biserial barbed point	Y	Y
Splash Point	Mattock	Y	Y
Staines	Axe	Y	Y
Stannergat Midden	Severed tine	N	N
Star Carr	Uniserial barbed point	N	N
Star Carr	Uniserial barbed point	N	N
Star Carr	Uniserial barbed point	N	N
Star Carr	Uniserial barbed point	N	N
Strand on the Green	Axe	Y	N
Strand on the Green	Sleeve	Y	N
Sunbury Lock	Adze	Y	N
Taplow Mound	Hammer	N	N
Taplow Mound	Sleeve	Y	N
Taplow Mound	Tine mattock	Y	N
Teddington	Hammer	N	N
Teddington	Axe	Y	N
Teddington	Sleeve	Y	N
Teddington Reach	Hammer	N	N
Thatcham	Bone or antler artefacts	Y	Y
Thrumpton	Biserial barbed point	Y	N
Twickenham	Sleeve	Y	Y
Twickenham	Hammer	N	N
Twickenham, Eel Pie Island	Axe	N	Y
Twickenham, Eel Pie Island	Sleeve	Y	Y
Uskmouth	Mattock	Y	Y
Waltham Abbey	Uniserial barbed point	Y	N
Walthamstow	Decorated axe	Y	N
Wandsworth	Uniserial barbed point	Y	Y
Wandsworth	Axe	Y	N
West Row	Axe	Y	N
West Row	Mattock	Y	N
Westward Ho!	Antler	Y	Y
Whitburn	Biserial barbed point	Y	Y
Willington Quay	Mattock	N	N
Wormingford	Axe	Y	N

Table 35: List of antler material deemed relevant to this thesis, and antler material to which access could be gained

Appendix 3: Data from the analysis of British Mesolithic worked antler assemblages

A3.1 Introduction

The following appendix provides the metric data and records of working sequences identified on the *debitage* and artefacts analysed as part of this thesis. The methods used to identify specific working techniques are outlined in Chapter 4. The data is presented in a series of standardised tables, which due to their size will be orientated at a landscape perspective.

Although the character of the material from each site varies, this appendix will present data tables in a consistent format; the first table giving details of the length, width, thickness and weight of each piece analysed, and the second listing the species, element and the working sequences observed at the distal and proximal ends, and along the SEN and DEX sides. The term "biological and post-depositional processes" refers to observed biological processes which have left marks on the material, taphonomic factors, and any fresh breaks or work undertaken in conservation. Where no working marks could be observed, or the piece in question lacked the element referred to by the table header, the field is left blank. When sequential relationships can be determined, the order of these working actions or processes is demarked by numbering. In some cases, these sequences can extend across an entire piece; in other cases the sequences are restricted to a specific break surface.

Due to the high levels of working, specialised tables were produced for barbed points and mattocks to record the key information such as the method by which barbs were defined and the finished shape was produced. Where additional measurements were taken or working marks observed, these are included in a separate table.

A3.2 An Corran, Skye

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
98	29.3	8.6	6.8	1
254	45.2	23.5	26.2	11
497	108.3	27.5	26.5	29
498	147.1	46.3	44.2	62
504	62.5	17.8	12.4	8
506	69.9	19.3	17.7	11
508	71.1	45.2	28.5	36

Table 36: Basic metric data from the antler artefacts and *debitage* at An Corran

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
98	Undiagnostic	Distal tip	Cracking in drying	Undiagnostic	Scraping	Sawing	1

Table 37: Working sequences identified on the antler barbed point from An Corran

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
254	Red	Fragment of compactor				1)Flake breakage	1)Flake breakage
497	Red	Crown tine	1)Fraying damage 5)Weathering		2)Flake breakage 3)Sawing 4)Breakage		
498	Red	Brow tine	3)Cracking in drying	Flake breakage	1)Nicking 2)Prepared breakage		

504	Red	Tine tip	2)Weathering 3)Modern damage		1)Flake breakage		
506	Red	Tine tip	1)Fraying damage		2)Breakage		
508	Red	Beam, below trez junction	3)Weathering 4)Drying damage	1)Nicking 2)Prepared break of upper beam and trez tine	1)Breakage 2)Removal of spongy core		

Table 38: Working sequences identified on the antler *debitage* from An Corran

A3.3 Sand, Applecross

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
1884	196	194	28.7	127
3172	71.4	20.5	20	12
14	45.2	42.3	24.2	6
16	32.6	11.4	12.3	2

Table 39: Basic metric data from the antler *debitage* at Sand

Accession number	Beam width (mm)	Beam thickness (mm)
1884	58.8	28.7

Table 40: Additional metric data from the antler *debitage* at Sand

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
1884	Red	Right-sided. Upper beam and crown	1)Gnawing by rodents 1)Chewing by mammals 5)Modern damage 6)Drilled for dating		1)Chewing by large mammals 3)Nicking 4)Prepared breakage		
3172	Red	Crown tine tip	1)Fraying damage 2)Gnawing by rodents		2)Flexion break		
14	Red	Tine tip	1)Gnawing by rodents 1)Weathering 3)Modern damage		3)Modern damage		
16	Red	Tine tip	2)Gnawing by rodents 2)Weathering		1)Undiagnostic		

Table 41: Working sequences identified on antler *debitage* from Sand

A3.4 Risga, Loch Sunart

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
A.1955.96.cag	119.8	59.61	39.31	168
A.1955.96.cah	88.66	38.82	14.84	19
ARCHNN.1685.3.1.A	72.61	23.81	15.77	8
ARCHNN.1685.3.1.B	47.34	12.51	6.93	2
ARCHNN.1685.3.1.C	47.53	9.28	9.04	1
ARCHNN.1685.4.1.A	40.59	20.41	12.13	5
ARCHNN.1685.4.1.B	48.87	13.65	7.64	4

ARCHNN.1685.4.1.C	53.18	12.88	9.37	4
ARCHNN.1685.4.1.D	49.6	12.2	6.93	3
ARCHNN.1685.4.1.E	38.65	14.18	6.84	2
ARCHNN.1685.4.1.F	58.57	14.38	5.74	3
ARCHNN.1685.4.1.G	41.44	10.11	6.65	1
ARCHNN.1685.4.1.H	20.46	12.28	5.7	1
ARCHNN.2350.[2].2.A	55.47	13.89	8.29	10
ARCHNN.2350.[2].2.B	37.45	12.45	8.8	3
ARCHNN.2354.1.A	57.09	12.37	7.53	3
ARCHNN.2354.1.B	51.03	12.11	5.17	4
ARCHNN.2354.1.C	34.99	10.24	5.8	1
ARCHNN.2354.1.E	63.84	10.8	9.26	6
ARCHNN.2354.1.D	31.91	11.95	8.38	2
ARCHNN.2416.[3]	147.04	86.2	43.39	157
ARCHNN.2416.[1]A	143.24	29.6	23.62	48
ARCHNN.2416.[1]B	128.52	20.83	21.2	26
ARCHNN.2416.[1]C	127.15	19.41	17.78	23
ARCHNN.2416.[1]D	95.83	22.55	21.15	19
ARCHNN.2420.A	105.8	80.41	55.67	63
ARCHNN.2420.B	76.13	42.46	19.21	17
ARCHNN.2420.C	71.72	50.36	13.43	11
ARCHNN.2420.D	79.24	63.29	38.42	28
ARCHNN.2420.E	53.92	22.75	11.3	5
ARCHNN.2420.F	67.93	46.08	33.58	20
ARCHNN.2420.G	63.31	16.89	15.45	7
ARCHNN.2420.H	23.64	17.97	8.74	2
ARCHNN.2420.I	63.59	18.76	17.92	10
ARCHNN.2420.J	88.18	65.3	23.02	29

ARCHNN.2420.K	66.39	49.35	13.85	13
ARCHNN.2420.L	78.14	25.23	21.86	19
ARCHNN.2420.M	68.49	48.82	21.95	16
ARCHNN.2420.N	70.49	20.98	18.94	16
ARCHNN.2420.O	54.81	22.18	10.81	16
ARCHNN.2421.1.A	31.28	19.69	9.33	2
ARCHNN.2421.1.B	45.08	14.19	13.24	4
ARCHNN.2421.1.C	35.64	20.73	7.5	2
ARCHNN.2421.1.E	28.45	17.84	8.22	1
ARCHNN.2421.1.F	16.34	10.84	7.81	2
A.1955.cam.A	133.44	81.11	47.14	173
A.1955.cam.B	181	40.43	48.7	84
A.1955.cam.C	135.94	33.14	30.53	39
ARCHNN.2354.A	71.82	51.28	32.87	26
ARCHNN.2354.B	128.05	66.84	23.49	55
ARCHNN.2354.C	106.76	26.41	13.48	19
ARCHNN.2354.D	75.01	35.67	15.57	16
ARCHNN.2354.E	55.52	32.01	5.53	6
ARCHNN.2354.I	48.68	31.76	13.52	10
ARCHNN.2354.J	45.81	34.27	12.12	7
ARCHNN.2354.K	33.62	27.02	19.14	7
ARCHNN.2354.L	46.19	27.79	6.91	6
ARCHNN.2354.M	43.55	22.11	9.87	5
ARCHNN.2354.N	47.5	24.55	13.54	8
ARCHNN.2354.O	54.21	20.01	9.6	5
ARCHNN.2354.P	52.56	26.41	19.34	11
ARCHNN.2354.Q	35.46	25.01	14.13	5
ARCHNN.2354.R	45.46	26.02	7.87	7

ARCHNN.2354.S	59.96	13.94	7.98	4
ARCHNN.2354.T	69.39	15.8	8.62	5
ARCHNN.2354.U	47.32	25.71	7.14	4
ARCHNN.2354.V	50.14	18.06	5.53	2
ARCHNN.2354.W	26.86	9.83	7.45	1
ARCHNN.2354.X	26.65	8.59	9.79	1
ARCHNN.2354.Z	30.15	9.13	4.61	1
ARCHNN.2354.A1	27.07	11.09	5.73	1
ARCHNN.2354.B1	22.5	7.22	5.28	1
ARCHNN.2354.C1	29.46	12.29	10.74	1
ARCHNN.2354.D1	35.14	7.97	6.83	2
ARCHNN.2354.E1	50.39	10.91	9.92	2
ARCHNN.2354.F1	22.59	12.16	6.49	1
ARCHNN.2354.G1	40.57	12.29	7.83	3
ARCHNN.2354.H1	47.56	19.43	8.93	4
ARCHNN.2354.I1	36.9	12.67	4.48	2
ARCHNN.2354.J1	51.98	15.01	9.17	2
ARCHNN.2354.K1	37.78	20.84	8.44	2
ARCHNN.2354.L1	34.22	13.07	10.51	2
ARCHNN.2354.M1	40.3	17.91	10.06	5
ARCHNN.2354.N1	43.83	14.24	7.83	3
ARCHNN.2354.O1	33.71	19.19	10.62	4
ARCHNN.2354.P1	32.7	17.5	9.07	2
ARCHNN.2354.Q1	27.43	23.46	8.87	2
ARCHNN.2354.R1	42.84	17.08	6.99	2
ARCHNN.2354.S1	55.06	14.18	7.19	4
ARCHNN.2354.T1	42.22	11.86	10.56	3
ARCHNN.2354.U1	41.94	15.04	4.88	2

ARCHNN.2354.V1	39.37	12.72	7.52	2
ARCHNN.2354.W1	33.93	9.66	5.96	2
ARCHNN.2354.X1	96.88	20.69	6.9	4
ARCHNN.2354.Y1	29.57	10.36	5.55	2
ARCHNN.2354.Z1	39.78	7.95	7.32	2
ARCHNN.2354.A2	43.91	17	8.56	4
ARCHNN.2354.B2	28.01	13.05	5.29	1
ARCHNN.2421.1 Bag 2.A	61.96	16.17	17.06	2
ARCHNN.2421.1 Bag 2.B	49.68	20.84	19.93	4
ARCHNN.2421.1 Bag 2.C	25.8	24.23	13.59	2
ARCHNN.2421.1 Bag 2.D	42.57	31.06	12.65	2
ARCHNN.2421.1 Bag 2.E	48.94	17.82	14.46	1
ARCHNN.2421.1 Bag 2.F	28.14	28.04	23.14	11
ARCHNN.2421.1 Bag 2.G	33.35	14.54	10.9	2
ARCHNN.2350.[2].3.A	44.85	13.04	13.35	3
ARCHNN.2350.[2].3.B	88.46	24.48	23.81	16
ARCHNN.2350.[2].3.C	68.68	39.94	20.25	10
ARCHNN.2350.[2].3.D	43.86	29.54	13.96	6
ARCHNN.2350.[2].3.E	50.73	19.78	10.38	2
ARCHNN.2350.[2].3.F	62.44	26.53	9.09	5
ARCHNN.2350.[2].3.G	47.79	18.58	10.31	2
B.1951.1969.A	146.1	34.8	35.9	52
B.1951.1969.B	155	45.8	42.5	133
B.1951.1969.C	60.3	24.5	90	9
B.1951.1969.D	32.5	37.8	10.8	5
B.1951.1970.A	102.6	14.5	14.6	18
B.1951.1970.B	92.2	15.6	9.31	8
B.1951.1970.C	68.4	16.4	8.82	6

B.1951.1970.D	46.61	18.6	8.7	3
B.1951.1970.E	41	14.6	7.7	2
B.1951.1970.F	77.8	22.4	10.7	17
B.1951.1970.G	70.2	28.1	12.5	14
B.1951.1970.H	77.8	30.8	12.5	12
B.1951.1972.B1.A	50.6	15.8	9.7	3
B.1951.1972.B1.B	47.7	17.1	6.7	4
B.1951.1972.B1.C	61.5	21	9.9	8
B.1951.1972.B1.D	64.5	23.1	10.8	8
B.1951.1972.B1.E	57.2	15.2	8.1	4
B.1951.1972.B1.F	70.4	28.4	11.1	13
B.1951.1972.B1.G	49.7	20.3	8.2	6
B.1951.1972.B1.H	52.3	21.5	9.3	5
B.1951.1972.B1.I	40.7	21.7	10	5
B.1951.1972.B1.J	70.7	25.7	13.4	15
B.1951.1972.B1.K	100.3	35.1	12.5	15
B.1951.1972.B1.L	114.1	42.3	33.1	59
B.1951.1972.B1.M	99.4	32	28.9	41
B.1951.1972.B1.N	147.3	46.6	24.4	53
B.1951.1972.B1.O	99.1	49.6	23.7	31
B.1951.1972.B1.P	98.4	43.2	22.5	30
B.1951.1972.B1.Q	155	41.4	31.2	61
B.1951.1972.B1.R	83.5	23.2	23.1	22
B.1951.1972.B1.S	41.1	19.3	19	7
B.1951.1972.B1.T	62.3	19.2	17.4	10
B.1951.1972.B1.U	124.4	29.14	24.8	42
B.1951.1972.B2.A	68.55	23.3	19	11
B.1951.1972.B2.B	55.7	14.1	14.3	4

B.1951.1972.B2.C	80.5	19.5	18	13
B.1951.1972.B2.D	16.2	21	18	9
B.1951.1972.B2.E	29.6	8.5	7.9	1
B.1951.1972.B2.F	43	14.2	11	2
B.1951.1972.B2.G	38.9	15	13.2	4
B.1951.1972.B2.H	64.1	16.8	17.7	8
B.1951.1972.B2.I	81.9	19.5	20	12
B.1951.1972.B2.J	65.3	22	20.2	11
B.1951.1972.B2.K	66.1	21.1	17.7	8
B.1951.1972.B2.L	53.3	17.5	16.8	7
B.1951.1972.B2.M	72.2	16.9	17.5	8
B.1951.1972.B2.N	66.3	15.6	14.3	8
B.1951.1972.B2.O	57.1	20.6	19.3	7
B.1951.1972.B2.P	53.9	20.7	17.4	9
B.1951.1972.B2.Q	57.7	17.2	16.7	7
B.1951.1972.B2.R	98.6	26.9	23.1	22
B.1951.1972.B2.S	48.5	22.5	17.7	6
B.1951.1972.B2.T	64.4	20.6	13.4	8
B.1951.1972.B2.U	60	24.7	20.2	13
B.1951.1972.B2.V	47.6	17.3	14.5	6
B.1951.1972.B2.W	53.7	20.4	18.5	7
B.1951.1972.B2.X	117.4	26.2	27.7	26
B.1951.1972.B2.Y	146.8	21.9	22.8	33
B.1951.1972.B2.Z	68.14	17.9	20	10
B.1951.1972.B2.A1	59.6	20.3	17.6	7
B.1951.1972.B2.B1	96.1	23.7	22.4	24
B.1951.1972.B2.C1	107.4	24.9	21.9	20
B.1951.1972.B2.D1	82.7	23.3	21.1	14

B.1951.1972.B2.E1	121	23.8	19.1	19
B.1951.1972.B2.F1	87.4	25.9	25.1	18
B.1951.1972.B2.G1	117	48.1	22.1	38
B.1951.1972.B2.H1	112.5	21.9	22.7	23
B.1951.1972.B2.I1	50	14.8	13.7	6
B.1951.1972.B2.J1	92	21.3	20.2	17
B.1951.1972.B2.K1	57.9	17.5	16.8	6
B.1951.1972.B2.L1	218	34.1	26.2	95
B.1951.1972.B2.M1	61.5	17.4	18.3	10
B.1951.1972.B2.N1	108.2	32.4	24.1	36
B.1951.1972.B2.O1	116.8	22.7	22.1	28
B.1951.1972.B2.P1	53.8	20.2	14.2	6

Table 42: Metric data from antler artefacts and *debitage* at Risga

Accession number	Working face length (mm)	Working face thickness (mm)	Working face width (mm)	Burr diameter (mm)
A1995.96.cag	116.63	41.18	29.53	N/A
ARCHNN.2416.[3]				69.46
A.1955.cam.A				73.25
B.1951.1969.A	100.4	28.5	33	
B.1951.1969.B	97.5	41	38.2	

Table 43: Additional metric data from the antler artefacts and *debitage* at Risga

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence
A1995.96.cag	Red	Left	Beam	Lower beam	7)Weathering 8)Drying damage	1)Prepared break 2)Oblique scraping 2)Longitudinal scraping 3)Use	1)Nicking 2)Prepared break to remove trez tine 3)Boring 4)Hafting 5)Use 6)Flexion break at point of hafting	1)Flexion break at point of hafting
A1955.96.cah	Red	Undiagnostic	Undiagnostic	Working face and edge	7)Gnawing by mammal	1)Prepared break 2)Longitudinal scraping 3)Use 4)Flake breakage		4)Flexion break 6)Flake breakage
B.1951.1969.A	Red	Undiagnostic	Undiagnostic	Working face and edge	5)Gnawing 6)Damage in recovery 7)Drying damage	1)Prepared breakage 2)Longitudinal scraping 3)Use 6)Damage in recovery 7)Drying damage		4)Flake breakage of SEN 4)Flake breakage of DEX 5)Gnawing
B.1951.1969.B	Red	Undiagnostic	Undiagnostic	Working face and edge	5)Weathering	1)Prepared breakage 2) Longitudinal scraping 3)Use		4)Flexion break 5)Weathering

						5)Weathering		
B.1951.1969.C	Red	Undiagnostic	Undiagnostic	Working face and edge	3)Gnawing 5)Drilled for AMS sample	1)Prepared breakage 2)Use 3)Gnawing 4)Flake breakage		5)Drilled for AMS sample
B.1951.1969.D	Red	Undiagnostic	Undiagnostic	Fragment of working edge		1)Prepared breakage 2)Use		3)Flexion break

Table 44: Working sequences identified on mattock tools at Risga

Accession number	Species	Biological and post-depositional processes	Working edge sequence	DISTAL working sequence	SEN working sequence	DEX working sequence
ARCHNN.1685.3.1.A	Red	6)Drying damage	5)Use	1)Nicking 2)Prepared break	Flake breakage	Flake breakage
ARCHNN.1685.3.1.B	Red	6)Modern damage	4)Use 5)Damage in use 6)Modern damage	SEN and DEX converge	1)Scraping 2)Hafting 6)Modern damage	1)Scraping 2)Hafting 6)Modern damage
ARCHNN.1685.3.1.C	Red		1)Use 2)Damage in use	Undiagnostic	Flake breakage	Flake breakage
ARCHNN.1685.4.1.A	Red	7)Weathering	6)Use	5)Flexion break	1)Prepared break 2)Scraping 3) Use	4)Flake breakage
ARCHNN.1685.4.1.B	Red	5)Gnawing by rodents	4)Use	2)Flexion break 3)Hafting	4)Use	1)Flake breakage
ARCHNN.1685.4.1.C	Red	5)Weathering	3)Scraping 4)Use	SEN and DEX converge	1)Flake breakage	1)Flake breakage
ARCHNN.1685.4.1.D	Red	5)Weathering 6)Drying damage	4)Use	3)Flexion break	1)Flake breakage	1)Flake breakage

ARCHNN.1685.4.1.E	Red		2)Scraping 6)Use	1)Flexion break	2)Longitudinal scraping 5)Hafting	2)Longitudinal scraping 5)Hafting
ARCHNN.1685.4.1.F	Red	5)Weathering 6)Modern damage	4)Use	3)Undiagnostic	1)Flake breakage 6)Modern damage	1)Flake breakage
ARCHNN.1685.4.1.G	Red	6)Gnawing by rodents 7)Weathering	4)Use	2)Flexion break	1)Flake breakage 3)Hafting	4)Use 5)Flake breakage
ARCHNN.1685.4.1.H	Red	5)Weathering 6)Gnawing by rodents	3)Scraping 4)Use	3)Flexion break	1)Flake breakage	1)Flake breakage
ARCHNN.2350.[2].2.A	Red	5)Weathering	4)Use	3)Flexion break	1)Flake breakage	1)Flake breakage
ARCHNN.2350.[2].2.B	Red	5)Weathering	4)Use	3)Undiagnostic	1)Flake breakage	1)Flake breakage
ARCHNN.2354.1.A	Red		4)Use 5)Damage in use	3)Flexion break	1)Flake breakage	1)Flake breakage
ARCHNN.2354.1.B	Red	4)Weathering 4)Deposition of calcareous substance 6)Drying damage	3)Use	2)Flexion break	1)Flake breakage	1)Flake breakage
ARCHNN.2354.1.C	Red		3)Use 4)Damage in use	2)Undiagnostic	1)Flake breakage	1)Flake breakage
ARCHNN.2354.1.E	Red		4)Use	SEN and DEX converge	1)Flake breakage 3)Hafting	1)Flake breakage
B.1951.1970.A	Red	7)Drilled for AMS sample	1)Prepared breakage 2)Longitudinal scraping 3)Use as working edge 6)Use as BET	5)Undiagnostic 7)Drilled for AMS sample	4)Flake breakage	4)Flake breakage

B.1951.1970.B	Red	4)Weathering	3)Use 4)Weathering	SEN and DEX converge	1)Flake breakage	1)Flake breakage
B.1951.1970.C	Red	4)Modern damage	3)Use 4)Modern damage	SEN and DEX converge	1)Flake breakage	1)Flake breakage
B.1951.1970.D	Red	4)Weathering	3)Use 4)Weathering	SEN and DEX converge	1)Flake breakage	1)Flake breakage
B.1951.1970.E	Red	5)Weathering	3)Scraping 4)Use 5)Weathering	SEN and DEX converge	1)Flake breakage	1)Flake breakage
B.1951.1970.F	Red	5)Weathering	4)Use 5)Weathering	3)Flexion break	1)Flake breakage	1)Flake breakage

Table 45: Working sequences identified for the bevel-ended tools from Risga

Accession number	**Species**	**Element**	**Biological and post-depositional processes**	**DIST working sequence**	**PROX working sequence**	**SEN working sequence**	**DEX working sequence**
ARCHNN.24 16.[3]	Red	Burr, basal portion and part of brow tine	3)Drying damage 4)Gluing of cracks on brow tine 5)Application of Reconstruction putty 6)Modern damage	1)Nicking 2)Prepared breakage			
ARCHNN.24 16.[1]A	Red	Tine tip	1)Gnawing 2)Modern damage 3)Reconstruction putty applied at PROX		Undiagnostic		
ARCHNN.24 16.[1]B	Red	Tine tip	3)Chewing by ungulates 3)Gnawing by rodents 5)Drying damage 6)Modern damage		1)Sawing 2)Prepared breakage 3)Chewing by ungulates 6)Modern damage		
ARCHNN.24 16.[1]C	Red	Tine tip	3)Chewing by ungulates 3)Gnawing by rodents 5)Weathering 6)Reconstruction		1)Nicking 2)Prepared breakage 3)Chewing		

			putty applied 7)Modern damage		by ungulates 6)Reconstruction putty applied 7)Modern damage		
ARCHNN.24 16.[1]D	Red	Tine tip	4)Gnawing by rodents 5)Reconstruction resin applied 6)Modern damage	1)Fraying of antlers 4)Gnawing by rodents 5)Reconstruction resin applied	2)Nicking 3)Prepared breakage 5)Reconstruction resin applied 6)Modern damage		
ARCHNN.24 20.A	Red	Fragment of junction	4)Drying damage 5)Gluing	1)Flake breakage		1)Flake breakage	1)Flake breakage
ARCHNN.24 20.B	Red	Fragment of tine	5)Damage in recovery to edges of SEN and DEX 6)Modern damage	1)Flake breakage (continuation of SEN	1)Nicking 2)Prepared breakage	1)Flake breakage 6)Modern damage	1)Flake breakage 5)Damage in recovery 6)Modern damage
ARCHNN.24 20.C	Red	Fragment of beam compactor	5)Gnawing by rodents 6)Modern damage	1)Flake breakage 6)Modern damage	1)Nicking 2)Prepared breakage	1)Flake breakage	1)Flake breakage
ARCHNN.24 20.D	Red	Fragment of crown junction	10)Gnawing by dogs	1)Flexion break 2)Flake breakage SEN 3)Flake breakage DEX	1)Flake breakage SEN 2)Flake breakage DEX 3)Flake breakage EXT 4)Flexion break	1)Flake breakage	2)Flake breakage
ARCHNN.24 20.E	Red	Fragment of compactor		1)Flexion break	1)Flexion break	1)Flake breakage	1)Flake breakage
ARCHNN.24 20.F	Red	Fragment of junction		1)Nicking of tine stump 2)Prepared breakage of tine	1)Flexion break		1)Flake breakage

				3)Flake breakage			
ARCHNN.2420.G	Red	Tine tip	1)Fraying 3)Gnawing by rodents 4)Modern damage	1)Fraying of antlers 3)Gnawing by rodents	2)Flexion break 3)Gnawing by rodents		
ARCHNN.2420.H	Red	Fragment of compactor	2)Modern damage	1)Sawing	1)Flexion break	1)Flake breakage 2)Modern damage	1)Flake breakage
ARCHNN.2420.I	Red	Fragment of tine	4)Gnawing by rodents 5)Modern damage	5)Modern damage	1)Nicking 2)Sawing 3)Flake breakage 4)Gnawing by rodents		
ARCHNN.2420.J	Red	Fragment of compactor	5)Drying damage 6)Gluing	1)Nicking 2)Prepared breakage	1)Flake breakage continuation of SEN	1)Flake breakage	1)Flake breakage
ARCHNN.2420.K	Red	Fragment of compactor	5)Calcareous deposit on DIST 6)Drying damage 7)Gluing 7)Modern damage	1)Flake breakage 5)Calcareous deposit	1)Flexion break	1)Flake breakage	4)Flexion break
ARCHNN.2420.L	Red	Fragment of tine	4)Modern damage	1)Sawing 4)Modern damage	1)Flake breakage 2)Breakage		1)Flake breakage in association with PROX
ARCHNN.2420.M	Red	Fragment of junction and underformed tine	5)Calcareous deposit on tine tip 6)Gnawing by rodents at tine tip	1)Nicking 2)Prepared breakage 3)Flake breakage INT 3)Flake breakage EXT	3)Flake breakage INT 3)Flake breakage EXT 4)Flexion break	1)Scraping	
ARCHNN.24	Red	Fragment of tine		1)Breakage	2)Breakage		

20.N							
ARCHNN.24 20.O	Red	Fragment of tine	5)Gnawing by rodents	2)Flexion break	2)Flexion break	1)Flake breakage 2)Flexion break DIST 2)Flexion break of PROX 4)Flake breakage of DEX	4)Flake breakage
ARCHNN.24 21.1.A	Red	Fragment of tine		1)Breakage	1)Flexion break	1)Flake break	1)Flake break
ARCHNN.24 21.1.B	Red	Tine tip	1)Fraying of antlers 2)Gnawing by rodents 3)Modern damage	1)Fraying of antlers 2)Gnawing by rodents 3)Modern damage	3)Modern damage		
ARCHNN.24 21.1.C	Red	Fragment of compactor		SEN and DEX converge	1)Flexion break	1)Flake breakage	1)Flake breakage
ARCHNN.24 21.1.E	Red	Fragment of compactor	1)Modern damage	Undiagnostic	Undiagnostic	Undiagnosti c	Undiagnostic
ARCHNN.24 21.1.F	Red	Fragment of compactor	1)Drilled hole on INT - dated?	Undiagnostic	UNDIAGNOSTIC	Undiagnosti c	Undiagnostic
A.1955.cam .A	Red	Basal segment of beam and burr	3)Gnawing 4)Modern damage	1)Nicking 2)Prepared breakage 4)Modern damage			

A.1955.cam .B	Red	Tine	3)Reconstruction resin applied 4)Modern damage		1)Nicking 2)Prepared breakage			
A.1955.cam .C	Red	Tine	1)Damage in recovery 3)Modern damage		1)Breakage 3)Modern damage			
ARCHNN.23 54.A	Red	Fragment of junction	6)Modern damage	1)Breakage	1)Flake breakage 2)Breakage 6)Modern damage	1)Flake breakage INT 2)Flake breakage EXT		
ARCHNN.23 54.B	Red	Fragment of compactor	5)Charring 6)Modern damage 6)Drying damage 7)Gluing	2)Flexion break	1)Breakage	1)Flake breakage	1)Flake breakage	
ARCHNN.23 54.C	Red	Fragment	6)Gnawing	1)Flexion break	1)Flexion break	1)Nicking 2)Flake breakage 6)Gnawing	1)Flake breakage	
ARCHNN.23 54.D	Red	Fragment	7)Modern damage 7)Drying damage 9)Gluing	1)Nicking 2)Flexion break	1)Flexion break	1)Attempte d flake breakage towards PROX 2)Flake breakage 7)Modern damage	1)Flake breakage 2)Drying damage 9)Gluing	
ARCHNN.23 54.E	Red	Fragment	5)Modern damage 6)Gluing	1)Flexion break	4)Flexion break	1)Flake breakage	1)Flake breakage	
ARCHNN.23 54.I	Red	Fragment	5)Modern damage	1)Breakage	1)Flexion break 5)Modern damage	1)SEN and DEX converge	1)Flake breakage	

ARCHNN.2354.J	Red	Fragment	5)Weathering 6)Modern damage	1)Flexion break	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.K	Red	Fragment of junction	5)Modern damage	1)Breakage	1)Breakage 5)Modern damage to tine stump	1)Flexion break	1)Flake breakage
ARCHNN.2354.L	Red	Fragment	5)Weathering 6)Modern damage	1)Flexion break	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.M	Red	Fragment	5)Modern damage	1)Breakage	1)Flexion break	4)Flexion break	1)Flake breakage
ARCHNN.2354.N	Red	Fragment	5)Modern damage	1)Breakage	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.O	Red	Fragment	6)Modern damage	1)Flexion break	1)Breakage	1)Flexion break	1)Flake breakage 5)Flake breakage
ARCHNN.2354.P	Red	Fragment	5)Modern damage	1)Breakage	1)Breakage	1)Flake breakage	1)Flake breakage
ARCHNN.2354.Q	Red	Fragment of tine	5)Modern damage	1)Modern damage	1)Breakage 5)Modern damage	1)Breakage	1)Flake breakage
ARCHNN.2354.R	Red	Fragment		1)Flexion break	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.S	Red	Fragment	5)Modern damage	1)Flexion break	1)Breakage 5)Modern damage	1)Flexion break	1)Flake breakage
ARCHNN.2354.T	Red	Fragment	5)Modern damage	1)Flake breakage	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.U	Red	Fragment	5)Modern damage	1)SEN and DEX converge	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.V	Red	Fragment	3)Modern damage	1)Flexion break	1)Flexion break	UNDIAGNOSTIC	UNDIAGNOSTIC
ARCHNN.2354.W	Red	Fragment of spongy		Undiagnostic	Undiagnostic	1)SEN and DEX	1)Flake breakage

						converge	
ARCHNN.23 54.X	Red	Fragment of spongy		Undiagnostic	Undiagnostic	1)Modern damage	1)Flake breakage
ARCHNN.23 54.Z	Red	Fragment of spongy		Undiagnostic	Undiagnostic	1)Breakage	1)Flake breakage
ARCHNN.23 54.A1	Red	Fragment of spongy		Undiagnostic	Undiagnostic	1)Flexion break	1)Flake breakage
ARCHNN.23 54.B1	Red	Fragment of spongy		Undiagnostic	Undiagnostic	1)Breakage 2)Modern damage	1)Flake breakage
ARCHNN.23 54.C1	Red	Fragment of spongy		Undiagnostic	Undiagnostic	1)Flexion break	1)Flake breakage
ARCHNN.23 54.D1	Red	Fragment		1)Flexion break	1)SEN and DEX converge	1)SEN and DEX converge	1)Flake breakage 2)Flake breakage
ARCHNN.23 54.E1	Red	Fragment		1)SEN and DEX converge	1)Flexion break	1)Flexion break 2)Modern damage	1)Flake breakage
ARCHNN.23 54.F1	Red	Fragment	5)Modern damage	1)Modern damage	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.23 54.G1	Red	Fragment	6)Weathering	1)Flake breakage on DEX side 5)Flexion break	1)Flexion break	1)Breakage	1)Flake breakage
ARCHNN.23 54.H1	Red	Fragment		1)Flake breakage on SEN side	2)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.23 54.I1	Red	Fragment	3)Weathering 4)Modern damage	1)Flexion break	1)Flexion break	4)Modern damage	Undiagnostic
ARCHNN.23	Red	Fragment	6)Modern damage	1)Flexion break	1)Flexion break	1)Flake	1)Flake breakage

54.J1						breakage of DEX 5)Breakage	6)Modern damage
ARCHNN.2354.K1	Red	Fragment	4)Modern damage 5)Reconstruction resin applied	1)SEN and DEX converge	1)Flake breakage	1)Nicking 3)Prepared break 4)Modern damage 4)Reconstruction resin applied	
ARCHNN.2354.L1	Red	Fragment		1)Flexion break	1)Breakage	1)Breakage	1)Flake breakage
ARCHNN.2354.M1	Red	Fragment	4)Gnawing 5)Modern damage	1)SEN and DEX converge (mark from flake breakage impact?)	1)Flexion break	1)Breakage 4)Gnawing	1)Flake breakage 5)Modern damage
ARCHNN.2354.N1	Red	Fragment		1)Flake breakage on DEX side	1)Flexion break	1)Breakage	1)Flake breakage
ARCHNN.2354.O1	Red	Fragment	5)Charring 6)Gnawing 6)Weathering	1)Breakage	1)Flexion break	1)Breakage 6)Weathering	1)Flake breakage
ARCHNN.2354.P1	Red	Fragment	5)Modern damage	1)SEN and DEX converge	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.Q1	Red	Fragment	2)Modern damage	Undiagnostic	Undiagnostic	1)Breakage	
ARCHNN.2354.R1	Red	Fragment	4)Modern damage	1)SEN and DEX converge	1)SEN and DEX converge	1)Flake breakage	Undiagnostic

						2)Breakage	
ARCHNN.2354.S1	Red	Fragment	5)Modern damage	1)Flake breakage on SEN side	5)Modern damage	1)Nicking on SEN side 3)Prepared break of SEN side 4)Breakage of DEX side	4)Flake break
ARCHNN.2354.T1	Red	Fragment	5)Modern damage	1)Flexion break	1)Breakage	1)Flexion break	1)Flake break
ARCHNN.2354.U1	Red	Fragment	3)Modern damage	3)Modern damage	1)Flexion break	1)Flexion break	3)Modern damage
ARCHNN.2354.V1	Red	Fragment	5)Modern damage	1)SEN and DEX converge	1)Breakage 5)Modern damage	1)Flexion break	4)Flake breakage
ARCHNN.2354.W1	Red	Fragment	2)Weathering	1)Flexion break	1)Flexion break	Undiagnostic	Undiagnostic
ARCHNN.2354.X1	Red	Fragment		3)SEN and DEX converge	3)SEN and DEX converge	1)Flake breakage	1)Flake breakage
ARCHNN.2354.Y1	Red	Fragment	5)Modern damage	1)Flexion break	1)Flexion break 5)Modern damage	1)Flexion break	1)Flake breakage
ARCHNN.2354.Z1	Red	Fragment		3)SEN and DEX converge	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2354.A2	Red	Fragment		1)Breakage	1)Breakage	1)Flexion break	1)Flake breakage
ARCHNN.2354.B2	Red	Fragment		1)Flexion break	1)Flexion break	3)Flexion break	1)Flake breakage
ARCHNN.2354.1.D	Red	Tine tip	1)Fraying 4)Gnawing 5)Modern damage	1)Fraying 4)Gnawing	5)Modern damage	2)Flexion break	2)Flake breakage
ARCHNN.24	Red	Tine tip	1)Fraying 4)Modern damage	1)Fraying	3)Breakage	1)Flexion	1)Flake breakage

21.1 Bag 2.A						break	2)Flake breakage
ARCHNN.24 21.1 Bag 2.B	Red	Fragment of tine	5)Modern damage 6)Reconstruction resin applied	5)Modern damage 6)reconstruction resin applied	1)Nicking 2)Prepared breakage 5)Modern damage 6)Reconstruction resin applied	3)Flake breakage	3)Flake breakage
ARCHNN.24 21.1 Bag 2.C	Red	Fragment of tine		1)Breakage	1)Breakage	1)Breakage	1)Flake breakage
ARCHNN.24 21.1 Bag 2.D	Red	Fragment of compactor	4)Gnawing 5)Modern damage 6)Reconstruction putty applied	1)Flexion break 5)Modern damage	1)Breakage 4)Gnawing	1)Flexion break	1)Flake breakage
ARCHNN.24 21.1 Bag 2.E	Red	Fragment of tine	4)Gnawing by dogs	1)Flexion break	1)Breakage	1)Flexion break	1)Flake breakage
ARCHNN.24 21.1 Bag 2.F	Red	Fragment	3)Weathering 4)Modern damage	Undiagnostic	1)Breakage 3)Weathering	1)Flexion break	1)Flake breakage
ARCHNN.24 21.1 Bag 2.G	Red	Fragment		1)Flexion break	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.23 50.[2].3.A	Red	Tine tip	1)Fraying 3)Gnawing 3)Weathering	1)Fraying	2)Breakage	Undiagnosti c	Undiagnostic
ARCHNN.23 50.[2].3.B	Red	Fragment of tine	5)Gnawing 6)Modern damage	6)Modern damage	1)Flake breakage 4)Breakage	1)SEN and DEX converge	1)Flake breakage
ARCHNN.23 50.[2].3.C	Red	Fragment of junction	9)Modern damage	1)Flake breakage SEN 1)Flake	1)Nicking on SEN side 2)Prepared	9)Modern damage	1)Flake breakage

				breakage DEX 3)Nicking 4)Prepared breakage	breakage of SEN side 3)Breakage of DEX side		
ARCHNN.2350.[2].3.D	Red	Fragment	6)Modern damage	1)Nicking 5)Prepared breakage	1)Flexion break	1)Breakage	1)Flake breakage
ARCHNN.2350.[2].3.E	Red	Fragment	5)Modern damage	4)SEN and DEX converge	1)Flexion break	1)Flexion break	1)Flake breakage
ARCHNN.2350.[2].3.F	Red	Fragment	5)Modern damage	1)Breakage	1)Flexion break	1)Breakage 5)Modern damage	1)Flake breakage
ARCHNN.2350.[2].3.G	Red	Fragment	3)Weathering 4)Modern damage	Undiagnostic	Undiagnostic	1)Flexion break	1)Flake breakage
B.1951.1970.G	Red	Fragment of perforated tool	7)Weathering	5)Undiagnostic	5)Undiagnostic	3)Flake breakage	1)Drilling 2)Hafting 3)Flake breakage
B.1951.1970.H	Red	Fragment of mattock working edge	6)Weathering	3)Undiagnostic	1)Prepared breakage 2)Use	4)Flake breakage	4)Flake breakage
B.1951.1972.B1.A	Roe	Fragment of compactor	3)Weathering	Undiagnostic	Undiagnostic	1)Flake breakage	1)Flake breakage
B.1951.1972.B1.B	Red	Fragment of compactor		1)Undiagnostic	4)Flexion break	2)Flake breakage	2)Flake breakage
B.1951.1972.B1.C	Red	Fragment of compactor	3)Weathering	Undiagnostic	Undiagnostic	1)Flake breakage	1)Flake breakage
B.1951.1972.B1.D	Red	Fragment of compactor	5)Drying damage	Undiagnostic 5)Drying damage	1)Nicking 2)Prepared breakage	3)Flake breakage	3)Flake breakage
B.1951.197	Red	Fragment of		SEN and DEX	3)Undiagnostic	1)Flake	1)Flake breakage

2.B1.E		compactor		converge		breakage	
B.1951.197 2.B1.F	Red	Fragment of compactor		3)Sawing	Undiagnostic	1)Flake breakage	1)Flake breakage
B.1951.197 2.B1.G	Red	Fragment of compactor		1)Undiagnostic	4)Undiagnostic	2) Flake breakage	2) Flake breakage
B.1951.197 2.B1.H	Red	Fragment of compactor	5)Weathering	3)Undiagnostic	3)Undiagnostic	1)Flake breakage	1)Flake breakage
B.1951.197 2.B1.I	Red	Fragment of compactor	3)Weathering	Undiagnostic	Undiagnostic	1)Flake breakage	1)Flake breakage
B.1951.197 2.B1.J	Red	Fragment of compactor	3)Weathering	Undiagnostic	Undiagnostic	1)Flake breakage	1)Flake breakage
B.1951.197 2.B1.K	Red	Fragment from junction	3)Drilled for AMS sample	Undiagnostic 3)Drilled for AMS sample	2)Flake breakage	Flake breakage	1)Flake breakage
B.1951.197 2.B1.L	Red	Portion of tine	3)Conservation resin applied	Undiagnostic	1)Nicking 2)Prepared breakage 3)Conservation resin applied		
B.1951.197 2.B1.M	Red	Portion of tine		Undiagnostic	1)Nicking 2)Prepared breakage		
B.1951.197 2.B1.N	Red	Portion of tine at junction	3)Gnawing	Undiagnostic	1)Flake breakage of INT 1)Flake breakage of EXT	3)Gnawing	3)Gnawing
B.1951.197 2.B1.O	Red	Portion of tine at junction	3)Gnawing 4)Modern damage	Undiagnostic	1)Flake breakage of INT 1)Flake breakage of EXT 4)Modern damage	3)Gnawing	3)Gnawing

B.1951.197 2.B1.P	Red	Portion of tine		Undiagnostic	1)Breakage		
B.1951.197 2.B1.Q	Red	Crown tine	1)Fraying 4)Drying damage	1)Fraying	2)Nicking 3)Prepared breakage 4)Drying damage		
B.1951.197 2.B1.R	Red	Portion of tine	1)Fraying	1Undianostic	1)Undiagnostic		
B.1951.197 2.B1.S	Red	Portion of tine	3)Gnawing	1)Flexion break	1)Undiagnostic	3)Gnawing	3)Gnawing
B.1951.197 2.B1.T	Red	Portion of tine	1)Fraying	Undiagnostic	Undiagnostic	1)Fraying	1)Fraying
B.1951.197 2.B1.U	Red	Portion of tine	1)Fraying 4)Gnawing	1)Fraying 2)Undiagnostic	2)Undiagnostic	1)Gnawing	N/a
B.1951.197 2.B2.A	Red	Tine tip	1)Fraying 3)Gnawing 4)Modern damage	1)Fraying	2)Undiagnostic	1)Fraying 3)Gnawing 4)Modern damage	1)Fraying 3)Gnawing 4)Modern damage
B.1951.197 2.B2.B	Red	Tine tip	1)Fraying 3)Gnawing 4)Damage in recovery	1)Fraying	2)Undiagnostic	1)Fraying 3)Gnawing 4)Damage in recovery	1)Fraying 3)Gnawing 4)Damage in recovery
B.1951.197 2.B2.C	Red	Tine tip	1)Fraying	1)Fraying	2)Undiagnostic	1)Fraying	1)Fraying
B.1951.197 2.B2.D	Red	Tine tip	1)Fraying 3)Root etching	1)Fraying	2)Undiagnostic	1)Fraying 3)Root etching	1)Fraying 3)Root etching
B.1951.197 2.B2.E	Red	Tine tip	1)Fraying 3)Modern damage	1)Fraying 3)Modern	2)Undiagnostic 3)Modern damage	1)Fraying 3)Modern	1)Fraying 3)Modern damage

				damage		damage	
B.1951.1972.B2.F	Red	Tine tip	1)Fraying 2)Gnawing 3)Modern damage	1)Fraying	2)Undiagnostic	1)Fraying 2)Gnawing 3)Modern damage	1)Fraying 2)Gnawing 3)Modern damage
B.1951.1972.B2.G	Red	Tine tip	1)Fraying 3)Gnawing	1)Fraying	2)Undiagnostic	1)Fraying 3)Gnawing	1)Fraying 3)Gnawing
B.1951.1972.B2.H	Red	Tine tip	1)Fraying	1)Fraying	2)Undiagnostic	1)Fraying	1)Fraying
B.1951.1972.B2.I	Red	Tine tip	1)Fraying	1)Fraying	2)Undiagnostic	1)Fraying	1)Fraying
B.1951.1972.B2.J	Red	Tine tip	1)Fraying	1)Fraying	2)Undiagnostic	1)Fraying	1)Fraying
B.1951.1972.B2.K	Red	Tine tip	1)Fraying 3)Gnawing	1)Fraying	2)Undiagnostic	1)Fraying 3)Gnawing	1)Fraying 3)Gnawing
B.1951.1972.B2.L	Red	Tine tip	1)Fraying	1)Fraying	2)Undiagnostic	1)Fraying	1)Fraying
B.1951.1972.B2.M	Red	Tine tip	1)Fraying 3)Weathering	1)Fraying	2)Undiagnostic	1)Fraying 3)Weathering	1)Fraying 3)Weathering
B.1951.1972.B2.N	Red	Tine tip	1)Fraying 3)Gnawing	1)Fraying	2)Undiagnostic	1)Fraying 3)Gnawing	1)Fraying 3)Gnawing
B.1951.1972.B2.O	Red	Tine tip	1)Fraying 3)Charring	1)Fraying	2)Undiagnostic	1)Fraying 3)Charring	1)Fraying 3)Charring
B.1951.1972.B2.P	Red	Tine tip	1)Fraying 3)Weathering	1)Fraying	2)Undiagnostic	1)Fraying 3)Weathering	1)Fraying 3)Weathering
B.1951.1972.B2.Q	Red	Tine tip	1)Fraying 3)Root etching	1)Fraying	2)Undiagnostic	1)Fraying 3)Root	1)Fraying 3)Root etching

						etching	
B.1951.1972.B2.R	Red	Tine tip	1)Fraying 3)Root etching 4)Modern damage	1)Fraying	2)Undiagnostic 4)Modern damage	1)Fraying 3)Root etching 4)Modern damage	1)Fraying 3)Root etching 4)Modern damage
B.1951.1972.B2.S	Red	Tine tip	1)Fraying 3)Drying damage	1)Fraying	2)Undiagnostic	1)Fraying 3)Drying damage	1)Fraying 3)Drying damage
B.1951.1972.B2.T	Red	Tine tip	1)Fraying	1)Fraying	2)Flexion break	1)Fraying	1)Fraying
B.1951.1972.B2.U	Red	Tine tip	1)Fraying 3)Drying damage	1)Fraying	2)Flexion break 3)Drying damage	1)Fraying 3)Drying damage	1)Fraying 3)Drying damage
B.1951.1972.B2.V	Red	Tine tip	1)Fraying	1)Fraying	2)Flexion break	1)Fraying	1)Fraying
B.1951.1972.B2.W	Red	Tine tip	1)Fraying 3)Charring	1)Fraying	2)Flexion break	1)Fraying 3)Charring	1)Fraying 3)Charring
B.1951.1972.B2.X	Red	Tine tip	1)Fraying 3)Root etching	1)Fraying	2)Flexion break	1)Fraying 3)Root etching	1)Fraying 3)Root etching
B.1951.1972.B2.Y	Red	Tine tip	1)Fraying 3)Weathering	1)Fraying	2)Flexion break	1)Fraying 3)Weathering	1)Fraying 3)Weathering
B.1951.1972.B2.Z	Red	Tine tip	1)Fraying 4)Weathering	1)Fraying	2)Flexion break	1)Fraying 2)Nicking 4)Weathering	1)Fraying 4)Weathering
B.1951.197	Red	Tine tip	1)Fraying	1)Fraying	2)Flexion break	1)Fraying	1)Fraying

2.B2.A1							
B.1951.197 2.B2.B1	Red	Tine tip	1)Fraying	1)Fraying	2)Flake breakage of INT 2)Flake breakage of EXT	1)Fraying	1)Fraying
B.1951.197 2.B2.C1	Red	Tine tip	1)Fraying 4)Gnawing	1)Fraying 4)Gnawing	2)Flake breakage of INT 2)Flake breakage of EXT	1)Fraying 4)Gnawing	1)Fraying 4)Gnawing
B.1951.197 2.B2.D1	Red	Tine tip	1)Fraying 4)Root etching	1)Fraying	2)Flake breakage of INT 2)Flake breakage of EXT	1)Fraying 4)Root etching	1)Fraying 4)Root etching
B.1951.197 2.B2.E1	Red	Tine tip	1)Fraying 4)Gnawing 5)Weathering	1)Fraying	2)Flake breakage of INT 2)Flake breakage of EXT	1)Fraying 4)Gnawing 5)Weatheri ng	1)Fraying 4)Gnawing 5)Weathering
B.1951.197 2.B2.F1	Red	Tine tip	1)Fraying	1)Fraying	2)Flake breakage of INT 2)Flake breakage of EXT	1)Fraying	1)Fraying
B.1951.197 2.B2.G1	Red	Tine tip	1)Fraying 4)Root etching	1)Fraying	2)Flake breakage of INT 2)Flake breakage of EXT	1)Fraying 4)Root etching	1)Fraying 4)Root etching
B.1951.197 2.B2.H1	Red	Tine tip	1)Fraying 6)Root etching 7)Modern damage	1)Fraying 4)Scraping 5)Use	2)Nicking 3)Prepared breakage	1)Fraying 6)Root etching 7)Modern damage	1)Fraying 6)Root etching 7)Modern damage
B.1951.197 2.B2.I1	Red	Tine tip	1)Fraying	1)Fraying 4)Scraping 5)Use	2)Nicking 3)Prepared breakage	1)Fraying	1)Fraying
B.1951.197	Red	Tine tip	1)Fraying 4)Modern damage	1)Fraying	2)Nicking	1)Fraying	1)Fraying

2.B2.J1					3)Prepared breakage 4)Modern damage		
B.1951.197 2.B2.K1	Red	Tine tip	1)Fraying	1)Fraying	2)Nicking 3)Prepared breakage	1)Fraying	1)Fraying
B.1951.197 2.B2.L1	Red	Tine tip	1)Fraying	1)Fraying	2)Nicking 3)Prepared breakage	1)Fraying	1)Fraying
B.1951.197 2.B2.M1	Red	Tine tip	1)Fraying 4)Damage in recovery	1)Fraying	2)Nicking 3)Prepared breakage	1)Fraying 2)Damage in recovery	1)Fraying
B.1951.197 2.B2.N1	Red	Tine tip	1)Fraying 4)Conservation resin applied	1)Fraying	2)Nicking 3)Prepared breakage	1)Fraying 4)Conservat ion resin applied	1)Fraying
B.1951.197 2.B2.O1	Red	Tine tip	1)Fraying	1)Fraying 4)Root etching	2)Nicking 3)Prepared breakage	1)Fraying 4)Root etching	1)Fraying 4)Root etching

Table 46: Working sequences identified on antler *debitage* from Risga

A3.5 MacArthur's Cave, Oban

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HL 183	45.5	16.1	7.5	5
HL 184	51.6	14.4	8.4	5
HL 185	51.1	19.8	7.8	5
HL 186	54.1	13.9	6	4
HL 188	107	15.5	5.7	8

HL 189	164.3	16.1	8.7	15
X.HL 52	74.5	14.6	8.9	8
HL 403	153.5	20.1	8.8	13
HL 293	94.9	115.2	45.3	97
HL 287	248	26.5	25.6	89
HL 288	139.3	24.2	21	33
HL 290	99.3	26.4	23.1	35
HL 292	74.7	22	19.6	13
HL 289	104.1	22.9	24.1	34
HL 426	112	21.7	25.5	37
HL 399 1 of 3	55.6	12.5	13	5
HL 399 2 of 3	52.5	15.3	13.8	6
HL 399 3 of 3	49.1	19	16.8	8

Table 47: Metric data from antler artefacts and *debitage* at MacArthur's Cave

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
HL 183	Biserial	Tip and first pair of barbs		Undiagnostic	1)Oblique scraping 2)Sawing on INT 2)Sawing on EXT	1)Oblique scraping 2)Sawing on INT 2)Sawing on EXT	2
HL 184	Biserial	Tip and first pair of barbs		Undiagnostic	1)Oblique scraping of SEN 1)Oblique scraping of DEX 3)Longitudinal scraping	1)Oblique scraping 2)Sawing on INT 2)Sawing on EXT 4)Use 5)Damage to barbs	2
HL 185	Biserial	Tip and first pair of barbs		Undiagnostic	1)Oblique scraping of SEN 1)Oblique scraping of DEX 3)Longitudinal scraping	1)Oblique scraping 2)Sawing on INT 2)Sawing on EXT	2
HL 186	Biserial	Tip and first pair of barbs	1)Weathering	Undiagnostic	1)Oblique scraping of SEN 1)Oblique scraping of DEX 3)Longitudinal scraping	1)Oblique scraping 2)Sawing on INT 2)Sawing on EXT 4)Use 5)Damage to barbs	3

HL 188	Biserial	Complete		Undiagnostic	1)Oblique scraping of SEN 1)Oblique scraping of DEX 3)Longitudinal scraping	1)Oblique scraping 2)Sawing on INT 2)Sawing on EXT 4)Use 5)Damage to barbs	8
HL 189	Biserial	Complete		Undiagnostic	1)Oblique scraping of SEN 1)Oblique scraping of DEX 3)Longitudinal scraping	1)Oblique scraping 2)Sawing on EXT 3)Sawing on INT 4)Use 5)Damage to barbs	8

Table 48: Working sequences identified on biserial barbed points from MacArthur's Cave

Accession number	Working at proximal end	Method of perforation	Distal sequence
HL 183	1)Grinding on INT 1)Grinding on EXT		
HL 184	1)Grinding on INT 1)Grinding on EXT		1)Use 2)Flexion break at point of impact
HL 185	1)Grinding on INT 1)Grinding on EXT		1)Use
HL 186			1)Use
HL 188	1)Grinding on INT 1)Grinding on EXT		1)Use
HL 189	1)Grinding on INT 2) Grinding of EXT	1)Grooving on INT 1)Grooving on EXT	1)Use

Table 49: Additional working sequences identified on the biserial barbed points from MacArthur's Cave

Accession number	Species	Biological and post-depositional processes	Working edge sequence	DIST working sequence	SEN working sequence	DEX working sequence
X.HL 52	Red	3)Gnawing	Use	Undiagnostic	1)Flake breakage 2)Long scraping	1)Flake breakage 2)Long scraping
HL 403	Red		Use	Undiagnostic	1)Flake breakage	1)Flake breakage

Table 50: Working sequences identified on the bevel-ended tools from MacArthur's Cave

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
HL 293	Red	Basal portion		1)Flake breakage 2)Flake breakage 3)Sawing on INT 4) Prepared break		1)Brow tine = flexion break	
HL 287	Red	Tine			1)Nicking 2)Prepared break		
HL 288	Red	Tine	4)Weathering		1)Flake breakage 2)Flake breakage 3)Flexion break		
HL 290	Red	Tine	2)Gnawing 3)Modern damage 4)Drying damage		1)Prepared break		
HL 292	Red	Tine	3)Weathering		1)Sawing 2)Prepared break		

HL 289	Red	Tine		1)Breakage	1)Sawing 2)Prepared break 3)Flexion beak		
HL 426	Red	Tine	3)Modern damage 4)Drying damage		1)Sawing? 2)Prepared break		
HL 399 1 of 3	Red	Tine tip	1)Fraying damage 4)Modern damage	1)Fraying damage 3)Drying damage	2)Flexion break		
HL 399 2 of 3	Red	Tine tip	1)Fraying 3)Modern damage	2)Sawing with metal tools	2)Sawing with metal tools		
HL 399 3 of 3	Red	Tine	5)Drying damage	1)Scraping 2)Incising	1)Sawing 2)Prepared break		

Table 51: Working sequences identified on antler *debitage* from MacArthur's Cave

A3.6 Druimvargie Cave, Oban

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
OB 001	58.1	12.1	11.1	6
OB 002	49.3	16.9	10	6
OB 003	43.1	13.5	7.5	3
OB 004	54.2	13.1	6.7	4
OB 005	40.7	13.9	7.3	4

Table 52: Metric data from the bevel ended tools at Druimvargie Cave

Accession number	Species	Biological and post-depositional processes	Working edge sequence	DISTAL working sequence	SEN working sequence	DEX working sequence
OB 001	Red	4)Calcareous deposit 5)Modern damage	3)Use	5)Modern damage	1)Grooving	1)Undiagnostic
OB 002	Roe	3)Weathering 3)Calcareous deposit 5)Drying damage	2)Use	2)Flexion break	1)Flake breakage	1)Flake breakage
OB 003	Red		6)Use	1)Scraping 2)Sawing 3)Flexion break	1)Flake breakage	1)Flake breakage
OB 004	Red		4)Use	1)Flexion break	1)Flake breakage	1)Flake breakage
OB 005	Red	5)Drying damage	4)Use	1)Flexion break	1)Flake breakage	1)Flake breakage

Table 53: Working sequences identified on the bevel-ended tools from Druimvargie Cave

A3.7 Meiklewood, Sterling

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HLA 3	279	58.9	47.1	510

Table 54: Metric data from mattock at Meiklewood

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
HLA 3	85.8	41.2	34.2	17.9

Table 55: Additional metric data for mattock at Meiklewood

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence
HLA 3	Red	Right	Beam	Mid beam at trez tine	8)Gnawing 9)Modern damage	1)Prepared breakage 2)Scraping oblique 3)Scraping longitudinal 7)Use	4)Nicking 5)Prepared break 6)Drilling 7)Use	4)Nicking 5)Prepared breakage 9)Modern damage

Table 56: Working sequences observed on mattock from Meiklewood

Accession number	DEX working sequence
HLA 3	5)Nicking 6)Drilling 7)Use

Table 57: Additional working marks observed on mattock at Meiklewood

A3.8 Cnoc Sligeach, Oronsay

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HP 544	59.5	12.8	6.5	5
HP 540	47.7	14.5	6.1	2
HP 538	41	12	6.4	1
HP 539	61.1	16.9	8.4	5
HP 537	50.1	19	6.9	5
HP 536	62.6	18.5	7.4	6
HP 535	53.1	18.1	8	5
HP 533	40	11	8.1	2
HP 532	57.2	17.4	7.7	4
HP 531	54.1	17.5	8.6	5
HP 530	53.6	20.2	10.1	7
HP 529	61.8	18.4	11	8

HP 528	60.1	16.7	7.9	6
HP 527	66.1	19.5	8	7
HP 641	55	16.1	6.7	2
HP 642	57.5	18.9	7.6	5
HP 643	32.8	14.5	5.6	1
X.1997.1123	40.1	14.9	5.5	2
B.1951.1842.A	32.5	37.8	10.8	5
B.1951.1842.B	106.2	38.1	18.9	25
B.1951.1845.A	58.8	17.2	9.1	7
B.1951.1845.B	65.1	16.5	8.7	5

Table 58: Metric data from antler artefacts of Cnoc Sligeach

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	DIST working sequence
B.1951.1842.A	Red	Undiagnostic	Undiagnostic	Working face and edge	4)Gnawing 5)Drying damage 6)Gluing	1)Prepared breakage 2)Use 3)Flexion break at DIST 4)Gnawing 5)Drying damage 6)Gluing	3)Flexion break
B.1951.1842.B	Red	Undiagnostic	Undiagnostic	Working face and edge	4)Drying damage 5)Gluing	1)Prepared break 2)Use 3)Flexion break at DIST 4)Drying damage 5)Gluing	3)Flexion break

Table 59: Working sequences observed on fragments of antler mattocks from Cnoc Sligeach, Oronsay

Accession number	Species	Biological and post-depositional processes	Working edge sequence	DISTAL working sequence	SEN working sequence	DEX working sequence
HP 527	Red	5)Modern damage 6)Gluing	4)Use	1)Flexion break	2)Scraping	2)Scraping
HP 528	Red		4)Use	1)Flexion break	2)Scraping	2)Scraping

HP 529	Red		3)Scraping 4)Use	Flexion break	1)Drilling 2)Flake breakage	1)Drilling 2)Flake breakage
HP 530	Red		Use	Flexion break	Scraping	Scraping
HP 531	Red	5)Gnawing 6)Weathering	4)Use	3)Undiagnostic	1)Flake breakage	1)Undiagnostic
HP 532	Red	4)Weathering 5)Modern damage	3)Use	Unbroken	1)Flake breakage	2)Scraping
HP 533	Red	5)Weathering	4)Use	2)Scraping	1)Flake breakage	2)Scraping
HP 535	Red		4)Use	1)Flexion break	2)Scraping	2)Scraping
HP 536	Red	5)Weathering 6)Modern damage	4)Use	2)Flexion break	3)Scraping	1)Flake breakage
HP 537	Red	5)Root etching 6)Weathering	4)Use	3)Undiagnostic	1)Flake breakage	1)Flake breakage
HP 538	Red	5)Weathering 6)Gnawing	4)Use	2)Flexion break	1)Flake breakage	1)Flake breakage
HP 539	Red		4)Use	2)Undiagnostic	1)Undiagnostic	3)Scraping
HP 540	Red	5)Gnawing 6)Root etching 7)Weathering	4)Use	2)Scraping	2)Scraping	1)Undiagnostic
HP 544	Red	5)Weathering 6)Root etching	3)Use	3)Use	1)Flake breakage	2)Scraping
B.1951.184 5.A	Red		4)Use	1)Drilling	2)Flake breakage	2)Flake breakage
B.1951.184 5.B	Red		4)Use	2)Scraping	2)Scraping	1)SEN and DEX converge

Table 60: Sequences of working marks observed on the bevel-ended tools from Cnoc Sligeach

Accession number	EXT working sequence
HP 528	Scraping
HP 532	Scraping
HP 536	Scraping
HP 537	Scraping
HP 539	Scraping

HP 540	Scraping
HP 544	Scraping

Table 61: Additional sequences of working marks observed on the bevel-ended tools from Cnoc Sligeach

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
HP 641	Undiagnostic	DEX edge	Weathering	Undiagnostic	1)Long scraping of EXT 2)Scraping of EXT at DEX 2)Scraping of INT at DEX	1)Sawing EXT 1)Sawing INT	1
HP 642	Biserial	Distal tip	1)Root etching 2)Weathering	Undiagnostic	1)Scraping of EXT	1)Sawing EXT 1)Sawing INT 3)Long scraping of EXT	4
HP 643	Undiagnostic	Tang	1)Root etching 2)Modern damage	Undiagnostic	1)Scraping of EXT 1)Scraping of INT		0
X.1997.1122	Undiagnostic	Tang	Weathering	Undiagnostic	1)Scraping of EXT 1)Scraping of INT		0
X.1997.1123	Biserial	Distal tip	Weathering	Undiagnostic		Sawing EXT	2

Table 62: Working sequences observed on barbed points from Cnoc Sligeach

Accession number	Proximal sequence	Distal sequence
HP 641	Flexion break	Flexion break
HP 642	1)Break (unknown method) 2)Use as bevel-ended tool	1)Modern damage
HP 643	N/a	Undiagnostic
X.1997.1122	N/a	Undiagnostic
X.1997.1123	Undiagnostic	Undiagnostic

Table 63: Additional working sequences for barbed points from Cnoc Sligeach

A3.9 Priory Midden, Oronsay

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
X.1997.123	222	46.6	30.5	97

Table 64: Metric data from antler artefacts at Priory Midden

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
X.1997.123	52	29.3	15.9	14.5

Table 65: Additional metric data from antler artefacts at Priory Midden

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence
X.1997.123	Red	Left	Beam	Mid beam at trez tine	9)Weathering 10)Root etching 11)Modern damage	1)Prepared breakage 2)Scraping 3)Scraping 7)Use	4)Nicking 5)Prepared break 6)Drilling 7)Use 8)Break in use	1)Prepared breakage8)Break in use

Table 66: Working sequences observed on antler artefacts at Priory Midden

Accession number	SEN working sequence	DEX working sequence
X.1997.123	8)Break in use	11)Modern damage

Table 67: Additional working sequences observed on antler artefacts from Priory Midden

A3.10 Croch Riach/Cnoc Coig, Oronsay

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HP 619	59.2	11.8	9.1	3
HP 637/4	50.9	14.5	7.4	2
HP 637/3	51.9	15.4	6.1	3
HP 637/1	49.4	9.5	8.1	3
HP 637/2	35.9	16.8	7.1	2
HP 659	55.6	18.1	7.8	6
HP 675	38.6	12.3	8.1	2

Table 68: Metric data from antler artefacts at Croch Riach

Accession number	Species	Biological and post-depositional processes	Working edge sequence	DISTAL working sequence	SEN working sequence	DEX working sequence
HP 619	Red		1)Scraping 2)Use	Undiagnostic	1)Flake breakage	1)Flake breakage
HP 637/4	Red		1)Use	1)Flexion break	1)Flake breakage	1)Flake breakage
HP 637/3	Red	Weathering	1)Use	Undiagnostic	1)Flake breakage	1)Flake breakage
HP 637/1	Red	1)Gnawing 2)Modern damage	1)Use	1)Modern damage	1)Flake breakage	1)Flake breakage
HP 637/2	Red	Weathering	1)Use	1)Flexion break	1)Flake breakage	1)Flake breakage
HP 659	Red		1)Scraping 2)Use	1)Flexion break	1)Flake breakage 2)Scraping	1)Flake breakage
HP 675	Red	Weathering	1)Scraping 2)Use	1)Flexion break	1)Flake breakage	1)Flake breakage

Table 69: Sequences of working marks observed on the bevel-ended tools from Croch Riach

A3.11 Caisteal nan Gillean I, Oronsay

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HP 176	27.6	12.9	6.4	1
HP 177	30.4	16	4.8	1
HP 178	48.5	13.8	8.5	4
HP 179	47.2	17.9	7.1	4
HP 182	54.3	17.8	9.7	6
HP 183	63.8	15.5	11	6
HP 184	33.6	27.8	7.8	3
HP 185	41.7	15.8	6.9	3
HP 186	58.9	16.8	6.4	4
HP 187	37	12.1	6.1	2
HP 188	55.5	13.4	6.7	4
HP 189	54.5	14.4	8.2	4
HP 190	55	15.1	7.2	4
HP 191	76.1	20.2	11.1	11
HP 192	69	33	12.4	13
HP 194	47.9	12.9	7	3
HP 195	43.2	13.5	9.6	3
HP 196	58.6	16.1	7.5	4
HP 197	39.9	18.1	7.9	3
HP 198	49.3	18.6	7.1	4
HP 200	24.6	19.1	8.4	5
HP 202	64.8	21	8.8	7
HP 203	69.5	19.8	8	6
HP 204	47.3	16.4	8.1	5
HP 216	45.3	14.4	9.5	4
HP 226	39.1	13.6	8	2

HP 230	36.2	12.1	9.7	2
HP 231	34.1	15.	6.8	2
HP 234	33.6	11.7	6.3	1
HP 236	31.1	14.5	6.8	1
HP 237	52.1	13.4	7	4
HP 238	51.3	15.3	7	4
HP 241	45.5	13.2	6.6	3
HP 251	23.5	158	7.1	2
HP 252	26.9	13.4	6.5	2
HP 253	31.5	10.7	7.6	1
HP 259	62.6	12.9	6.9	4
HP 270	63.6	15.1	8.3	6
HP 289	49.7	12.5	7.5	3
HP 309	52.6	14.7	7.8	5
HP 335	55.2	12.8	9	4
HP 206	42.6	25.2	12.4	6
HP 207	56.5	23.5	11.2	6
HP 209	123.8	25.3	12.8	20
HP 214	74.2	30	15.4	14
HP 348/6	59	26.9	8.3	6
HP 348/22	51.9	12.8	8.4	6
HP 348/23	46.8	17.9	12.8	5
HP 348/24	72.2	13.9	9.5	4
HP 348/25	71.1	26.3	8.4	8
HP 348/26	80.7	16.6	7.7	6
HP 348/27	45.8	9.5	8.7	3
HP 348/1	143.8	29.5	8.9	13
HP 350	160.2	26.1	25	54

HP 349	104.7	21.2	26.9	42
HP 352	110.9	40.5	20.5	44
HP 348/16	44.1	17.2	6.6	4
HP 348/22	51.9	12.8	8.4	6
HP 348/21	26.4	8.6	5.6	1
HP 348/8	43.2	21.3	10.9	5
HP 348/35	75.4	12.7	6.2	2
HP 348/17	33.8	16.1	6.7	3
HP 348/13	38.4	16.4	9.5	3
HP 348/11	53.4	12.7	6.9	1
HP 348/5	76.2	15.3	10.6	6
HP 348/19	42.9	10.2	6	3
HP 348/10	50	19.8	9.4	4
HP 193	45.4	8.9	6.1	1
HP 205	46.9	23.5	9.6	4
HP 348/9	37.8	16.9	7.8	2
HP 348/18	48.2	18.5	7.4	3
HP 348/3	74.2	16.7	8.8	5
HP 348/4	80.8	16.1	8.9	6
HP 348/2	69.1	21.4	7.9	7

Table 70: Metric data from antler artefacts and *debitage* of Caisteal nan Gillean I

Accession number	Species	Biological and post-depositional processes	Working edge sequence	DISTAL working sequence	SEN working sequence	DEX working sequence
HP 176	Red	5)Modern damage	3)Use 4)Damage to SEN side	5)Modern damage	1)Scraping 2)Hafting	1)Scraping 2)Hafting
HP 177	Red		4)Use	3)Flexion break	1)Scraping	2)Scraping
HP 178	Red	6)Root etching	5)Use	2)Flexion break	1)Flake breakage	3)Use 4)Flake breakage?

		7)Weathering				
HP 179	Red`	4)Modern damage	2)Scraping of INT 2)Scraping of EXT 3)Use	4)Modern damage	1)Scraping 2)Hafting	1)Scraping 2)Hafting
HP 182	Red	6)Modern damage 7)Gluing	4)Scraping 5)Use	1)Flexion break 6)Modern damage	2)Scraping 3)Hafting	2)Scraping 3)Hafting
HP 183	Red		5)Scraping 8)Use	1)Drilling 4)Flexion break	2)Flake breakage 5)Scraping	2)Flake breakage 5)Scraping
HP 184	Red	7)Root etching	5)Scraping 6)Use 7)Root etching	3)Sawing 4)Prepared breakage	1)Scraping 2)Hafting	1)Scraping 2)Hafting
HP 185	Red	4)Weathering 5)Root etching	3)Use	4)Weathering	1)Flake breakage	1)Flake breakage
HP 186	Red	5)Root etching	3)Scraping 4)Use	Undiagnostic	1)Scraping 3)Hafting	1)Scraping 3)Hafting
HP 187	Red	4)Gnawing 5)Root etching	3)Use 5)Root etching	1)Flexion break	2)Hafting	2)Hafting
HP 188	Red	5)Root etching	2)Damage 3)Use	3)Scraping INT 4)Flexion break	1)Scraping	1)Scraping
HP 189	Red	4)Gnawing 4)Root etching	2)Scraping 3)Use	Intact	1)Flake breakage	1)Flake breakage
HP 190	Red	5)Weathering 6)Root etching 7)Drying damage 8)Gluing	4)Use 5)Weathering	1)Flexion break 3)Hafting	2)Scraping 3)Hafting	2)Scraping 3)Hafting
HP 191	Red	5)Weathering 6)Modern damage 7)Gluing	3)Scraping 4)Use	5)Weathering 6)Modern damage	1)Flexion break	1)Flake breakage
HP 192	Red	4)Gnawing 5)Modern damage 6)Drying damage 7)Gluing	1)Scraping 3)Use	5)Modern damage	2)Hafting	2)Hafting 4)Gnawing

HP 194	Red	3)Weathering 4)Drying damage 5)Modern damage	1)Scraping 2)Use	5)Modern damage	3)Weathering	3)Weathering
HP 195	Red	5)Modern damage	3)Scraping 4)Use	5)Modern damage	1)Flake breakage 5)Modern damage	1)Flake breakage
HP 196	Red	5)Gnawing 6) Root etching	4)Use	Intact	1)Flake breakage 3)Hafting 5)Gnawing	1)Flake breakage 3)Hafting
HP 197	Red	5)Weathering 6)Root etching 7)Drying damage 8)Gluing	3)Use 5)Weathering	2)Hafting 4)Flexion break	1)Scraping 2)Hafting	1)Scraping 2)Hafting
HP 198	Red	4)Weathering	1)Scraping 3)Use	Undiagnostic	1)Scraping 2)Hafting	1)Scraping 2)Hafting 3)Sawing
HP 200	Red	7)Root etching	2)Scraping 6)Use	1)Flexion break	2)Scraping 5)Hafting	2)Scraping 5)Hafting 7)Root etching
HP 202	Red		2)Scraping 5)Use	1)Flexion break	2)Scraping	2)Scraping
HP 203	Red	7)Root etching	2)Scraping 6)Use	1)Flexion break	2)Scraping 5)Hafting 3)Root etching	2)Scraping 5)Hafting 7)Root etching
HP 204	Red	4)Root etching	2)Use	2)Use	1)Scraping	1)Scraping 4)Root etching
HP 216	Red	7)Modern damage	2)Scraping 5)Use 6)Damage in use	1)Flexion break 7)Modern damage	2)Scraping	2)Scraping
HP 226	Red	6)Modern damage	3)Scraping 5)Use 6)Modern damage	2)Flexion break	1)Flake breakage 3)Scraping	1)Flake breakage
HP 230	Red	5)Weathering 7)Root etching	4)Use 7)Modern damage	3)Flexion break	1)Flake breakage 6)Root etching	1)Flake breakage 6)Root etching
HP 231	Red		1)Scraping 2)Use	1)Scraping 2)Prepared breakage	1)Flake breakage 2)Scraping 3)Hafting	1)Flake breakage 2)Scraping 3)Hafting
HP 234	Red	6)Root etching 7)Modern damage	5)Use 7)Modern damage	3)Flexion break	1)Flake breakage 4)Hafting	1)Flake breakage 4)Hafting

HP 236	Red	5)Weathering 6)Root etching 7)Drying damage	4)Use 2)Weathering	3)Flexion break	1)Flake breakage 5)Weathering	1)Flake breakage 5)Weathering
HP 237	Red	6)Root etching 7)Weathering	4)Use	2)Flexion break	1)Flake breakage 3)Hafting	1)Flake breakage 4)Use
HP 238	Red		5)Use	5)Use	1)Scraping 4)Hafting	1)Scraping 3)Filing 4)Hafting
HP 241	Red	10)Root etching 11)Modern damage	8)Scraping 9)Use 11)Modern damage	3)Scraping 6)Use 7)Damage in use	1)Scraping 4)Hafting	4)Scraping 4)hafting
HP 251	Red	1)Root etching 2)Modern damage	1)Scraping 2)Use	Modern damage	1)Scraping 2)Hafting	1)Scraping 2)Hafting
HP 252	Red	2)Weathering 3)Root etching	1)Use	Undiagnostic	Undiagnostic	Undiagnostic
HP 253	Red	2)Modern damage	1)Use	2)Modern damage	Undiagnostic	Undiagnostic
HP 259	Red	6)Modern damage	5)Use	6)Modern damage	2)Scraping 3)Filing 4)Hafting	1)Flexion break
HP 270	Red		3)Use	2)Flexion break	1)Flake breakage	1)Flake breakage
HP 289	Red	5)Weathering	4)Use	1)Prepared breakage 2)Scraping	3)Flake breakage	3)Flake breakage
HP 309	Red		7)Use	3)Flexion break	1)Flake breakage 4)Scraping 6)Hafting	1)Flake breakage 4)Scraping 6)Hafting
HP 335	Red	6)Drying damage	5)Use	1)Flexion break	2)Scraping 4)Hafting	2)Scraping 4)Hafting

Table 71: Working sequences observed on bevel ended tools from Caisteal nan Gillean I

Accession number	EXT working sequence	INT working sequence
HP 177	Scraping	
HP 185		Scraping
HP 186		Scraping
HP 216	Nicking	
HP 234	Scraping	
HP 270	Scraping	

Table 72: Additional sequences of working marks observed on the bevel-ended tools from Caisteal nan Gillean I

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
HP 206	Red	Fragment of mattock working edge	5)Gnawing 6)Modern damage	4)Flexion break	4)Flexion break	1)Prepared breakage 2)Scraping 3)Use as mattock working edge 5)Gnawing	Undiagnostic
HP 207	Red	Fragment of mattock working edge	5)Gnawing	Undiagnostic	1)Prepared break 2)Grinding 3)Use	4)Flake breakage	4)Flake breakage
HP 209	Red	Fragment of mattock perforation	4)Gnawing	1)Boring 2)Flexion break	Undiagnostic	3)Flake breakage	3)Grooving
HP 214	Red	Fragment of mattock perforation		1)Drilling 2)Flexion break	3)Drilling (DEX) 4)Boring (SEN) 5)Hafting 6)Flexion break	7)Undiagnostic	7)Undiagnostic
HP 348/6	Red	Fragment of mattock working edge	7)Weathering 8)Root etching	4)Flexion break	6)Undiagnostic	5)Flake breakage	1)Prepared break 2)Grinding 3)Use 5)Flake breakage

HP 348/22	Red					Flake breakage	Flake breakage
HP 348/23	Red	Fragment of mattock working edge	5)Modern damage	1)Prepared breakage 2)Scraping 3)Use 6)Modern damage	4)Undiagnostic	4)Flake breakage	4)Flake breakage
HP 348/24	Red	Fragment of mattock	6)Root etching	1)Prepared break 2)Grinding 3)Use	1)Drilling 2)Hafting 3)Flexion break	4)Flake breakage	4)Flake breakage
HP 348/25	Red	Fragment of mattock perforation		5)Prepared breakage	1)Boring 2)Hafting	3)Flake breakage	3)Flake breakage
HP 348/26	Red	Fragment of mattock perforation	5)Gnawing	4)Flexion break 5)Gnawing	1)Drilling	2)Flake breakage	2)Flake breakage
HP 348/27	Red	Fragment of mattock perforation			1)Drilling	2)Flake breakage	2)Flake breakage

Table 73: Working sequences observed on mattock fragments from Caisteal nan Gillean I

Accession number	**EXT working sequence**	**INT working sequence**
HP 206	Modern damage	
HP 214	Nicking	
HP 348/25		4)Sawing

Table 74: Additional sequences of working marks observed on the mattock fragments from Caisteal nan Gillean I

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
HP 348/1	Red	Fragment of compactor		Undiagnostic	Undiagnostic	Flake breakage	Flake breakage
HP 350	Red	Tine	1)Fraying 3)Gnawing 3)Weathering 4)Modern damage	1)Fraying 4)Modern damage	2)Flexion break		
HP 349	Red	Tine	1)Fraying 3)Gnawing 4)Modern damage	1)Fraying	2)Flexion break		
HP 352	Red	Trez tine junction	3)Root etching 4)Modern damage 5)Drying damage 6)Gluing	4)Modern damage 5)Drying damage 6)Gluing	1)Nicking 2)Prepared break		
HP 348/16	Red	Fragment of compactor	3)Drying damage 4)Modern damage 5)Gluing	4)Modern damage	4)Modern damage	1)Flake breakage	1)Flake breakage
HP 348/22	Red	Fragment of compactor			2)Flexion break	1)Flake breakage 2)Scraping	1)Flake breakage
HP 348/21	Red	Fragment of compactor		1)Sawing 2)Prepared break	1)Sawing 2)Prepared break	Scraping	Scraping
HP 348/8	Red	Fragment of compactor	2)Gnawing 3)Modern damage	Undiagnostic	3)Modern damage	1)Flake breakage	1)Flake breakage
HP 348/35	Red	Fragment of	3)Weathering 4)Root etching 5)Drying damage	Undiagnostic	Undiagnostic	1)Flake breakage	1)Flake breakage

		compactor					
HP 348/17	Red	Fragment of bevel-ended tool		Flexion break	Flexion break	Scraping	Scraping
HP 348/13	Red	Fragment of compactor		Undiagnostic	1)Nicking 2)Prepared breakage	3)Flake breakage	3)Flake breakage
HP 348/11	Red	Fragment of compactor	4)Modern damage	4)Modern damage	4)Modern damage	1)Flake breakage	1)Flake breakage
HP 348/5	Red	Fragment of compactor	5)Modern damage	3)Flexion break 5)Modern damage	3)Flexion break	1)Flake breakage	1)Flake breakage
HP 348/19	Red	Fragment of compactor	4)Gnawing	1)Flexion break	1)Flexion break	4)Gnawing	4)Gnawing
HP 348/10	Red	Fragment of compactor	2)Weathering	2)Weathering	2)Weathering	1)Flake breakage	1)Flake breakage
HP 193	Red	Fragment of compactor	3)Weathering 4)Modern damage 5)Gluing	4)Weathering	4)Weathering	1)Flake breakage	1)Flake breakage
HP 205	Red	Fragment of compactor	5)Drying damage 6)Gluing	Undiagnostic	4)Flexion break	2)Flake breakage	2)Flake breakage
HP 348/9	Red	Fragment of compactor		3)Flexion break	3)Flexion break	1)Flake breakage	1)Flake breakage
HP 348/18	Red	Fragment	4)Modern damage	1)Flexion break	4)Modern	2)Grooving	2)Scraping

		of compactor			damage	4)Modern damage	
HP 348/3	Red	Fragment of compactor	4)Gnawing 5)Modern damage	5)Modern damage	1)Flexion break 4)Gnawing	1)Flake breakage	1)Flake breakage
HP 348/4	Red	Fragment of compactor	1)Gnawing 2)Weathering	Flake breakage	Flexion break	Flake breakage	Flake breakage
HP 348/2	Red	Fragment of compactor	5)Gnawing 6)Modern damage 7)Gluing	6)Modern damage	3)Sawing 4)Prepared breakage 6)Modern damage 7)Gluing	1)Flake breakage 5)Gnawing	1)Flake breakage 5)Gnawing

Table 75: Working sequences observed on antler *debitage* from Caisteal nan Gillean I

Accession number	EXT working sequence	INT working sequence	Trez stump sequence
HP 352			1)Nicking 2)Prepared break
HP 348/21		Scraping	
HP 348/11	1)Sawing		
HP 348/19		1)Scraping 4)Gnawing	
HP 205	1)Nicking		

Table 76: Additional working sequences observed on antler *debitage* from Caisteal nan Gillean I

A3.12 Blackness Bay/Carriden, Falkirk

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
x.1997.5	168	24.5	7.3	18

Table 77: Metric data from biserial point at Blackness Bay/Carriden

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
x.1997.5	Biserial	Complete	2)Water action 3)Handling in curation 4)Drilling for AMS sampling	Undiagnostic	Undiagnostic	1)Sawing INT 1)Sawing EXT 3)Handling in curation	12

Table 78: Working sequences observed on biserial barbed point from Blackness Bay/Carriden

A3.13 Shewalton, Irving

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HLA 1	191	18.7	10	29

Table 79: Metric data from antler artefact at Shewalton

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
HLA 1	Biserial	Complete point with tang removed	9)Conservation 10)Drilling for AMS sampling	Undiagnostic	1)Oblique scraping on INT and EXT	2)Sawing INT 2)Sawing EXT 3)Filling 4)Scraping 5)Damage in use 6)Scraping	10

Table 80: Working sequences observed on biserial point from Shewalton

Accession number	Proximal working sequence
HLA 1	7)Use 8)Flexion break at point of hafting 10)Drilling for AMS sampling

Table 81: Additional working sequences observed on biserial barbed point from Shewalton, Irving

A3.14 Whitburn, County Durham

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
1968.14.A Whitburn	98.5	13.2	4.3	4

Table 82: Metric data from biserial harpoon at Whitburn

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
1968.14.A	Biserial harpoon	Complete	3)Water action	Unknown	Unknown	1)Sawing on EXT 2)Sawing on INT	6

Table 83: Working sequences observed on biserial harpoon at Whitburn

Accession number	Perforation working sequence	2nd DEX barb sequence
1968.14.A Whitburn	1)Grooving INT 1)Grooving EXT	1)Sawing on EXT

Table 84: Additional working sequences observed on biserial harpoon at Whitburn

A3.15 Cumstoun, River Dee

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
2755	152	39.71	7.25	21

Table 85: Metric data from biserial barbed point at River Dee, Cumstoun

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
2755	Biserial	Complete point with tang removed	3)Water action 4)Conservation 5)Drilling for AMS sample	Unknown	Unknown	1)Sawing INT 1)Sawing EXT	11

Table 86: Working sequences observed on biserial barbed point from River Dee, Cumstoun

Accession number	Proximal working sequence
2755	2)Flexion break 3)Water action 4)Conservation 5) Drilling for AMS sample

Table 87: Additional working sequences observed on biserial barbed point from River Dee, Cumstoun

A3.16 Seamer Carr, Vale of Pickering

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
ARC.84.5029	660	43.5	45.38	1088
1983.5015	158	33.9	28.1	94

Table 88: Metric data for antler *debitage* from Seamer Carr

Accession number	Brow tine length (mm)	Bez tine length (mm)	Trez tine length (mm)	Burr diameter (mm)
ARC.84.5029	250	191	173	149.7
1983.5015				52.5

Table 89: Additional metric data for antler debitage from Seamer Carr

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
ARC.84.5029	Red	Left-sided pedicle bone, burr, beam, brow tine, bez tine and trez tine	4)Gnawing 5)Damage in recovery 6)Cracking in drying 7)Gluing	5)Damage in recovery	1)Breakage		2)Grooving 3)Flexion break to remove splinters 4)Gnawing
1983.5015	Red	Left-sided shed burr and beam. Brow and bez tine removed	2)Water action 3)Damage in recovery 4)Drying damage	1)Breakage 2)Water action			

Table 90: Working sequences observed on antler *debitage* from Seamer Carr

Accession number	Brow tine working sequence	Bez tine working sequence
ARC.84.5029	5)Damage in recovery	
1983.5015	3)Damage in recovery	1)Breakage 3)Damage in recovery

Table 91: Additional working sequences observed on antler *debitage* from Seamer Carr

A3.17 Star Carr, Vale of Pickering

Finds number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
92370	42.8	11.4	7.5	4
92393	53.1	9.7	5.1	2
92831	86.7	10.5	6.7	6
92433A	127.2	46.3	11.9	37
92433B	90.1	39.9	16.3	28.5
92441A	86.8	30.4	16.5	12.5
92438	183	46.1	39.9	122.5
92363	91.3	44.9	48.8	44.5
92360	135.5	48.1	44.7	57
92454	284	97.5	38.2	54
92822				275

Table 92: Metric data from antler artefacts and debitage at Star Carr

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
92370	Uniserial	Midshaft	Drying damage	Groove and splinter	1)Abrasion 2)Scraping	1)Sawing from EXT 1)Sawing from INT 3)Longitudinal scraping of EXT 3)Longitudinal scraping of INT	3
92393	Uniserial	Tip and forepart		Groove and splinter	1)Abrasion 2)Scraping	1)Sawing from EXT 1)Sawing from INT 3)Longitudinal scraping of EXT 3)Longitudinal scraping of INT	3
92831	Uniserial	Midshaft		Groove and splinter	1)Abrasion 2)Scraping	1)Sawing from EXT 1)Sawing from INT 3)Longitudinal scraping of EXT 3)Longitudinal scraping of INT	3

Table 93: Working sequences observed on barbed points from Star Carr

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
92433A	Red	Fragment of compactor at junction		Flexion break	SEN and DEX converge	1)Prepared breakage 2)Grooving	Grooving
92433B	Red	Fragment of compactor from beam		Flexion break	Undiagnostic	Undiagnostic	Undiagnostic
92441A	Red	Crown tine		Flexion break	2)Flexion break	1)Grooving	Grooving
92438	Red	Upper Beam		1)Grooving 2)Flexion break	1)Grooving 2)Nicking 3)Prepared breakage	Undiagnostic	1)Grooving 2)Sawing 3)Flexion break
92363	Red	Crown junction		Breakage	Undiagnostic	Undiagnostic	1)Grooving 2)Flexion break
92360	Red	Crown tine		1)Sawing 2)Prepared breakage			
92454	Red	Complete unshed antler	1)Drying damage				
92822	Red	Unshed right antler, brow, bez, trez and crown removed	1)Demineralisation 2)Drying damage	3)Prepared breakage		1)Grooving 2)Flexion break to remove splinters	

Table 94: Working sequences observed on antler *debitage* from Star Carr

Accession number	Brow tine working sequence	Bez tine working sequence	Trez tine working sequence
92822	Undiagnostic	Prepared breakage	Flexion break

Table 95: Additional working sequences for antler *debitage* from Star Carr, Vale of Pickering

A3.18 Fosse Hill, Brandesburton

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
KINCM.2011.379.4	300	11.7	7.2	N/a
KINCM.2011.379.5	385	12.9	7.3	N/a

Table 96: Metric data from casts of antler artefacts at Fosse Hill, Brandesburton. Note the lack of weight data, as the cast material may have been of a higher density that the original artefacts

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
KINCM.2011.379.4	Uniserial	Complete	Casting	1)Groove and splinter	Undiagnostic	2)Sawing	6
KINCM.2011.379.5	Uniserial	Complete	Casting	1)Groove and splinter	Undiagnostic	2)Sawing	5

Table 97: Working sequences observed on barbed points from Fosse Hill

Accession number	External working sequence
KINCM.2011.379.4	2)49 transverse incisions on PROX half of point
KINCM.2011.379.5	

Table 98: Additional working sequences observed on the barbed points from Fosse Hill

A3.19 Splash Point, Rhyll

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
47.101.4	367	57.6	41.9	648

Table 99: Metric data from antler mattock at Splash Point

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
47.101.4	106.9	49.7	31.1	22.8

Table 100: Additional metric data from antler mattock at Splash Point

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
47.101.4	Red	Left	Beam	Mid beam at trez tine	10)Gnawing 11)Water action	1)Prepared breakage 2)Finishing? 8)Use 11)Water action	3)Nicking 4)Prepared break 10)Gnawing	3) Burning 4) Flexion break 10)Gnawing	7)Drilling from SEN side 8)Drilling from DEX side 9)Hafting

Table 101: Working sequences observed on antler mattock from Splash Point

A3.20 Goldcliff East, Gwent

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
2003.4723/27	210	67.1	46.5	327

Table 102: Metric data from antler artefact at Goldcliff East

Accession number	Burr diameter (mm)	Bez tine length (mm)	Bez tine width (mm)	Bez tine thickness (mm)
2003.4723/27	52	131.2	37.8	25.5

Table 103: Additional metric data from antler artefact at Goldcliff East

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	Brow tine stump sequence	Bez tine working sequence
2003.4723/27	Red	Right-sided shed antler with brow tine removed and beam broken above bez junction	7)Water action 8)Drying damage 9)Gluing	1)Sawing on SEN 1)Sawing on DEX 4)Charring 6)Prepared breakage 7)Water action	7)Water action 8)Drying damage 9)Gluing	7)Water action 8)Drying damage 9)Gluing	1)Sawing at tip 4)Prepared breakage of tine tip

Table 104: Working sequences observed on antler artefact from Goldcliff East

A3.21 Uskmouth, Gwent

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
92.242H	233	72	34.8	337

Table 105: Metric data from antler mattock at Uskmouth

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
92.242H	27.4	35.3	23.9	19.2

Table 106: Additional metric data from antler mattock at Uskmouth

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
92.242H	Red	Left	Beam	Mid beam at trez tine	10) Water action 11)Drilling for AMS sample	1) Prepared breakage 2)Finishing? 8)Use 9)Damage 10)Water action	3) Breakage	3) Nicking 6)Prepared break	3)Nicking 6)Drilling from SEN and DEX

Table 107: Working sequences observed on antler mattock from Uskmouth

Accession number	Working sequence at INT
92.242H	11)Drilling for AMS sample

Table 108: Additional working sequences observed on antler mattock from Uskmouth

A3.22 County Hall, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
A26936	276	16.44	12.01	55

Table 109: Metric data from antler artefact at County Hall

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
A26936	Red	Removed splinter	6)Gnawing 7)Drying damage 8)Gluing	3)Scraping 5)Flexion break	3)Flexion break	1)Grooving	1)Grooving 6)Gnawing

Table 110: Working sequences observed on antler artefact from County Hall

A3.23 Windmill Lane, Brentford

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
0.1158a	339	44.13	44.61	357

Table 111: Basic metric data from antler mattock at Windmill Lane

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
0.1158a	158	42.9	28.5	22

Table 112: Additional metric data from antler mattock at Windmill Lane

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
0.1158a	Red	Right	Beam	Mid beam at trez tine	10)Mineral deposition at SEN 11) Drying damage	1)Prepared break 2)Longitudinal scraping 3)Oblique scraping 9)Damage in use	4)Undiagnostic break	4)Nicking 6)Prepared breakage	7)Drilling from SEN 7)Drilling from DEX

Table 113: Working sequences observed on antler mattock from Windmill Hill

A3.24 Hammersmith, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
71	168	32.19	32.55	151
A13648	242	35.15	36.54	230
A13728	413	77.64	35.16	394
A22556	409	38.07	45.42	440
C714	228	71.81	53.94	375
WG1223	407	48.3	51.7	480

Table 114: Metric data from antler mattocks at Hammersmith

Accession number	Working face length (mm)	Working face thickness (mm)	Working face width (mm)	Perforation diameter (mm)
71	58.73	30.67	18.58	22.22
A13648	137.54	35.15	25.99	21.35
A13728	47.77	13.46	28.23	23.49
A22556	59.39	34.22	24.15	20.03
C714	40.72	39.08	31.35	21.72
WG1223	206	41.4	38.4	28.3

Table 115: Additional metric data from antler mattocks at Hammersmith

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
71	Red	Left	Beam	Upper beam/base of tine	10)Gnawing 11)Drying damage	1)Prepared breakage 2)Oblique scraping 3)Longitudinal scraping 8)Use	N/A	4)Nicking 5)Prepared breakage	6)Drilling from SEN 6)Drilling from DEX 9)Sawing at proximal edge
A13648	Red	Right	Beam	Mid beam at trez tine	11)Gnawing 12)Drying damage	1)Prepared breakage 3)Longitudinal scraping 8)Use 9)Oblique scraping 10)Use 11)Gnawing 12)Drying damage	2)Undiagnostic 8)Use 11)Gnawing	4)Nicking 5)Prepared breakage 11)Gnawing 12)Drying damage	6)Drilling from SEN 6)Drilling from DEX 11)Gnawing 12)Drying damage

A13728	Red	Right	Beam	Mid beam at trez tine and crown junction	12)Gnawing 13)Mineralised deposit 14)Drying damage	1)Prepared breakage 2)Shaping? 9)Use 10)Flexion break at working face 14)Drying damage	3)Prepared breakage 10)Flexion break at working face 12)Gnawing	3)Nicking 4)Prepared breakage 10)Flexion break at point of hafting 12)Gnawing 13)Mineralise d deposit	7)Drilling from SEN 7)Drilling from DEX 10)Flexion break at point of hafting 12)Gnawing
A22556	Red	Right	Beam	Mid beam at trez tine	8)Gnawing 9)Drying damage 10)Modern damage	1)Prepared breakage 7)Use 8)Gnawing 10)Modern damage	2)Sawing 3)Prepared breakage 8)Gnawing	4)Drilling from DEC 5)Prepared break	6)Boring from SEN 8)Gnawing
C714	Red	Right	Beam	Mid beam at trez tine	8)Gnawing 9)Mineralised deposit 10)Drying damage	2)Prepared breakage 7)Use 9)Mineralised deposit 10)Drying damage	1)Undiagnostic 8)Gnawing	3)Nicking 4)Prepared breakage 10)Drying damage	5)Drilling from SEN 5)Drilling from DEX
WG1223	Red	Right	Beam	Mid beam at trez tine	9)Gnawing	1)Prepared breakage 2)Longitudinal scraping 3)Oblique scraping 7)Use 9)Gnawing	1)Prepared breakage	4)Nicking 5)Prepared breakage	6)Nicking from SEN 6)Nicking from DEX 8)Sawing

Table 116: Working sequences observed on antler mattocks from Hammersmith

A3.25 Hammersmith and Wandsworth, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
WG113	407	48.3	51.7	219

Table 117: Metric data from antler mattock at Hammersmith and Wandsworth

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
WG113	137	29.8	31.3	22.7

Table 118: Additional metric data from antler mattock at Hammersmith and Wandsworth

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
WG113	Red	Right	Beam	Mid beam at trez tine	10)Post-depositional damage 11)Drying damage	1)Prepared breakage 2) Longitudinal scraping 3)Oblique scraping 9)Use 10)Post-depositional damage 11)Drying damage	Undiagnostic	4)Nicking 5)Prepared breakage 10)Post-depositional damage	4)Nicking 5)Drilling from SEN 5)Drilling from DEX

Table 119: Working sequences observed on antler mattock at Hammersmith and Wandsworth

A3.26 Kew Bridge, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
49.107/897	298	59	88.1	776

Table 120: Metric data from antler mattock at Kew Bridge

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)	Circumference at burr (mm)
49.107/897	54.4	47.3	28.8	34.4	301

Table 121: Additional metric data from antler mattock at Kew Bridge

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Brow tine working sequence	Bez tine working sequence	Perforation sequence
49.107/897	Red	Left	Base	Shed burr and lower beam with brow and bez tines removed	11)Calcareous deposit 12)Drying damage 13)Modern damage 14)Sampled for AMS dating	1)Prepared breakage 2)Longitudinal Scraping 3)Oblique scraping 4)Oblique scraping 10)Use 12)Drying damage 14)Sampled for AMS dating	5)Sawing 6)Prepared breakage 13)Modern damage	5)Nicking 6)Prepared breakage 13)Modern damage	9)Drilling from SEN 11)Calcareous deposit

Table 122: Working sequences observed on antler mattock from Kew Bridge

A3.27 Kew, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
A13685	133.8	36.6	24.5	81
A13647	217	42.7	41.1	264

Table 123: Metric data from antler mattock at Kew

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
A13685	52.2	22.6	18.1	13
A13647	89.3	40.4	27.7	15.4

Table 124: Additional metric data from antler mattock at Kew

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
A13685	Red/Elk?	Undiagnostic	Tine?	Base of tine?	9)Drying damage	1)Prepared break 2)Nicking 3)Scraping 7)Use		8)Flexion break 9)Drying damage	4)Attempted drilling from SEN 5)Drilling from SEN 6)Boring from DEX 8)Flexion break 9)Drying damage
A13647	Red	Right	Beam	Mid beam at trez tine	11)Drying damage	1)Prepared break 2)Longitudinal scraping 3)Grinding at proximal tip 7)Use 10)Use 11)Drying damage	1)Undiagnostic 2)Scraping 7)Use	6)Drilling7)Use 8)Flexion break	9)Drilling from SEN 9)Drilling from DEX 11)Drying damage

Table 125: Working sequences observed on antler mattock from Kew

A3.28 Battersea, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
A19788	133.8	36.6	24.5	81
A7350	333	46.8	46	454

Table 126: Metric data from antler artefacts at Battersea

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
A7350	268	45.5	45.3	23.4

Table 127: Additional metric data from antler mattock at Battersea

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
A19788	Uniserial	Complete	1)Drying damage 2)Gluing	Groove and splinter	Scraping	1)Scraping 2)Sawing 3)Scraping	13

Table 128: Working sequences observed on antler barbed point at Battersea

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
A7350	Red	Right	Beam	Mid beam at trez tine	13) Gnawing 14)Water action 14)Calcareous deposit 16)Drying damage	1)Prepared breakage 4)Longitudinal scraping 9)Use 10)Oblique scraping 12)Use 13)Gnawing 14)Water action 16)Drying damage	2)Sawing 3)Prepared breakage 9)Use 10)Nicking 12)Use 16)Drying damage	5)Nicking 6)Prepared breakage 7)Gnawing 8)Drying damage	7)Drilling from SEN 7)Drilling from DEX 14)Calcareous deposit 16)Drying damage

Table 129: Working sequences observed on antler mattock from Battersea

A3.29 Syon Reach, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
33.153/5	287	32.8	31.3	246

Table 130: Metric data from antler mattock at Syon Reach

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
33.153/5	96.4	34.7	23.1	16.3

Table 131: Additional metric data from antler mattock at Syon Reach

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation working sequence
33.153/5	Red	Right	Beam	Mid beam at trez tine	9)Gnawing 10)Water action 11)Modern damage 11)Drying damage	1)Prepared break 2)Longitudinal scraping 3)Oblique scraping 7)Use 9)Gnawing 10)Water action 11)Modern damage 11)Drying damage	4)Undiagnostic 8)Gnawing	5)Undiagnostic 8)Flexion break	6)Drilling from SEN 6)Drilling from DEX 7)Use 8)Flexion break 9)Gnawing

Table 132: Working sequences observed on antler mattock at Syon Reach

A3.30 Mortlake, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
2004.176	237	47.4	34.1	240
2004.170	248.4	39	46.1	272
A13641	408	43.4	46	486

Table 133: Metric data from antler mattocks at Mortlake

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
2004.167	144.6	38.9	33.5	21.2
2004.170	166.2	39	24.2	33.8
A13641	290	42.35	30.94	23

Table 134: Additional metric data from antler mattocks at Mortlake

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation working sequence
2004.167	Red	Right	Beam	Mid beam at trez tine	10)Water action 11)Drying damage	1)Prepared breakage 2)Longitudinal scraping 5)Use 9)Use 10)Water action	1)Prepared breakage 5)Use 9)Use 10)Water action	2)Undiagnostic 3)Drilling from SEN 3)Drilling from DEX 5)Use 6)Flexion break 11)Drying damage	7)Drilling from SEN 7)Drilling from DEX 9)Use 10)Water action
2004.170.1	Red	Right	Beam	Lower beam	9)Drying damage	1)Prepared breakage 2)Longitudinal scraping 7)Use 9)Drying damage		3)Nicking 4)Prepared breakage	5)Drilling from SEN 5)Drilling from DEX 7)Use 8)Nicking
A13641	Red	Left	Beam	Mid beam at trez tine	9)Gnawing 10)Drying damage	1)Prepared breakage 3)Longitudinal scraping 4)Oblique scraping 8)Use 9)Gnawing 10)Drying damage	2)Undiagnostic 3)Longitudinal scraping 8)Use 9)Gnawing	5)Sawing 6)Prepared breakage	7)Boring from DEX 8)Use

Table 135: Working sequences observed on antler mattocks at Mortlake

A3.31 Wandsworth, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
A4907	141.4	15.7	8.0	21

Table 136: Metric data from barbed point at Wandsworth

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
A4907	Uniserial	Tang and midshaft	1)Drying damage 2)Gluing	Groove and splinter	Scraping	1)Scraping 2)Filing 3)Scraping	14

Table 137: Working sequences observed on barbed point from Wandsworth

A3.32 Richmond, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
0.1157d	329	47.9	47.3	472

Table 138: Metric data from antler mattock at Richmond

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
0.1157d	234	48.7	26.4	25.3

Table 139: Additional metric data from antler mattock at Richmond

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation working sequence
0.1157d	Red	Right	Beam	Mid beam at trez tine	8)Gnawing 9)Water action 10)Conservation varnish applied 11)Drying damage	1)Prepared breakage 2)Longitudinal scraping 7)Use 9)Water action	Undiagnostic	3)Nicking 4)Prepared breakage	5)Drilling from SEN 5)Drilling from DEX 8)Gnawing

Table 140: Working sequences observed on antler mattock from Richmond

Accession number	Internal aspect working sequence
0.1157d	Scraping

Table 141: Additional working sequences observed on antler mattock from Richmond

A3.33 Twickenham, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
49.107/899	265	35.9	40.5	204
49.107/902	242	44.1	33.3	190

Table 142: Metric data from antler mattocks at Twickenham

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
49.107/899	75.4	33.5	20.8	20
49.107/902	93.8	29.5	26.4	18.9

Table 143: Additional metric data from antler mattocks at Twickenham

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation working sequence
49.107/899	Red	Right	Beam	Mid beam at trez tine	9)Drying damage	1)Prepared breakage 3)Longitudinal scraping 4)Oblique scraping 8)Use 9)Drying damage	1)Undiagnostic 9)Drying damage	5)Nicking 6)Prepared breakage	7)Drilling from SEN 7)Drilling from DEX 9)Drying damage
49.107/902	Red	Right	Beam	Mid beam at trez tine	8)Gnawing by dogs 9)Drying damage	1)Prepared break 3)Longitudinal scraping 7)Use 9)Drying damage	1)Undiagnostic 8)Gnawing	4)Flexion break	5)Drilling from SEN 5)Drilling from DEX 8)Gnawing

Table 144: Working sequences observed on antler mattocks from Twickenham

A3.34 Chelsea, London

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
60.176/299	270	62.1	41.3	220

Table 145: Metric data from antler mattock at Chelsea

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
60.176/299	115.4	36.16	29.9	21.11

Table 146: Additional metric data from antler mattock at Chelsea

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation working sequence
60.176/299	Red	Left	Beam	Mid beam at trez tine	9)Drying damage 10)Modern damage	1)Prepared breakage 2)Longitudinal scraping 3)Oblique scraping 8)Use 9)Drying damage 10)Modern damage	4)Nicking 5)Prepared breakage 10)Modern damage	5)Undiagnostic 10)Modern damage	7)Drilling from SEN 8)Use

Table 147: Working sequences observed on antler mattock from Chelsea

A3.35 Boveney Lock, Windsor

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
49.107/898	299	34.9	34.8	230

Table 148: Metric data from antler mattock at Boveney Lock, Windsor

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
49.107/898	48.64	35.0	23.9	21.1

Table 149: Additional metric data from antler mattock at Boveney Lock

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation sequence
49.107/898	Red	Left	Beam	Mid beam at trez tine	6)Gnawing 7)Drying damage 8)Modern damage	1)Prepared breakage 2) Scraping 5)Use 6)Gnawing 7)Drying damage 8)Modern damage	Undiagnostic 6)Gnawing	3)Flexion	4)Drilling from SEN 4)Drilling from DEX 6)Gnawing 7)Drying damage

Table 150: Working sequences observed on antler mattock from Boveney Lock

A3.36 Staines, Surrey

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
49.107/900	256	34.5	33.2	220

Table 151: Metric data from antler mattock at Staines

Accession number	Working face length (mm)	Working face width (mm)	Working face thickness (mm)	Perforation diameter (mm)
49.107/900	61.1	33.2	20.2	20.9

Table 152: Additional metric data from antler mattock at Staines

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	Trez tine working sequence	DIST working sequence	Perforation working sequence
49.107/900	Red	Left	Beam	Mid beam at trez tine	11)Gnawing 12)Water action 13)Drying damage 14)Modern damage 15)Sampled for AMS dating	1)Prepared breakage 3)Oblique scraping 4)Long scraping 10)Use 11)Gnawing 12)Water action 13)Drying damage	1)Prepared breakage 10)Use 11)Gnawing	5)Nicking 6)Prepared breakage 14)Modern damage 15) Sampled for AMS dating	7)Attempted drilling from DEX side 8)Drilling from DEX 8)Drilling from SEN 11)Gnawing

Table 153: Working sequences observed on antler mattock at Staines

A3.37 Thatcham, Berkshire

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
213:62.1002	38.9	30.0	9.11	5
213:62.1003	54.11	10.85	7.19	3
213:62.1004	86.612	10.81	9.02	5
213:62.1005	205	45.93	34.61	229
213:62.1007	43.9	23.2	7.4	4
213:62.1014	251	34.2	29.8	110
213:62.1015	186	29.6	33.6	79
213:62.1021	65.7	42.48	15.99	23
1.1	433	48.12	43.66	1027
1.2	392	50.25	45.96	615
1.3	264	66.13	49.51	802
1.4	71.73	41.99	33.39	39
2.1	69.86	33.65	24.52	20
2.2	238	30.44	28.82	138

2.3	72.94	50.26	24.31	40
2.4	96.26	20.23	18.13	26
2.5	309	30.19	24.31	156
2.6	96.89	20.31	18.47	18
2.7	129.51	29.4	24.73	42
2.8	213	24.44	22.94	66
2.9	171	30.09	24.26	53
5.1	228	30.14	26.47	85
5.2	299	126.37	22.07	125
5.3	136.21	22.43	29.25	65
5.4	136.51	20.3	18.02	31
5.5	73.75	28.83	25.81	32
5.6	69.95	24.46	27.11	30
5.7	74.2	34.24	30.57	34
5.8	73.42	13.02	12.25	6
6.1	97.41	79.6	19.21	54

Table 154: Metric data from worked antler at Thatcham

Accession number	**Working face length (mm)**	**Working face width (mm)**	**Working face thickness (mm)**	**Angle of working edge (°)**
213:62.1005	83.7	29.2	31.8	27

Table 155: Additional metric data from *lame de hauche* at Thatcham

Accession number	Burr diameter (mm)	Brow tine length (mm)	Brow tine width (mm)	Brow tine thickness (mm)	Bez tine length (mm)	Bez tine width (mm)	Bez tine thickness (mm)	Trez tine length (mm)	Trez tine width (mm)	Trez tine thickness (mm)
1.1	80.8	240	35.3	34.7	219	28.3	32.1	172	32.1	30.2
1.2	75.1									
1.3	69.6				198	34.7	32.2			
2.1	52.08									
2.2	34.8	113.5	23.3	20.6						
5.2	53.8									
5.3	41.3									
5.4	36.0									
5.5	38.9									
5.6	37.5									
5.7	46.1									
5.8	53.8									

Table 156: Additional metric data from antler *debitage* at Thatcham

Accession number	Species	Side	Type	Element	Biological and post-depositional processes	Working face sequence	DIST working sequence	EXT working sequence
213:62.1005	Elk?	Undiagnostic	Lame de haute	Tine	6)Drilling for AMS sample	1)Prepared breakage 2) Oblique scraping 5)Use	1)Nicking 2)Prepared breakage 4)Hafting 6)Drilling for AMS sample	3)Nicking 4)Hafting
213:62.1002	Red	Undiagnostic	Undiagnostic	Working edge	4)Gnawing 5)Gluing	1)Prepared breakage 2)Use	3)Impact break	4)Gnawing

Table 157: Working sequences observed on lame de haute and working edge fragments from Thatcham

Accession number	Type	Element	Biological and post-depositional processes	Method of blank production	Method of point shaping	Method of barb definition	Number of intact barbs
213:62.2003	Undiagnostic	Tang	3)Conservation resin applied	Undiagnostic	1)Nicking 2)Scraping		
213.62.2003	Unbarbed	Midshaft	3)Gluing	Undiagnostic	1)Longitudinal scraping 2)Grinding		

Table 158: Working sequences observed on antler points from Thatcham

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
213:62.1007	Red	Undiagnostic		Insertion of flake object	Flexion break	Undiagnostic	Longitudinal scraping

Table 159: Working sequences observed on miscellaneous piece of worked antler from Thatcham

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
213:62.1014	Red	Tine	1)Fraying 3)Drying damage 4)Gluing	1)Fraying	2)Breakage		
213:62.1015	Red	Tine	3)Gnawing 4)Modern damage 5)Gluing 6)Conservation resin applied	4)Modern damage	1)Nicking 2)Prepared breakage 3)Gnawing		
213:62.1021	Red	Fragment of compactor	4)Modern damage? 5)Conservation resin applied	1)Nicking 2)Prepared breakage	4)Modern damage?	3)Flake breakage	3)Flake breakage
1.1	Red	Pedicle,	1)Fraying	2)Undiagnostic			

		lower beam, mid beam brow and bez tine	3)Conservation resin applied 4)Modern damage				
1.2	Red	Pedicle, lower beam, mid beam	2)Gnawing 3)Conservation resin applied	1)Undiagnostic 2)Gnawing 3)Conservation resin applied			
1.3	Red	Pedicle, lower beam, mid beam and bez tine	2)Gnawing 3)Conservation resin applied	1)Undiagnostic 2)Gnawing			
1.4	Red	Upper beam? In association with trez junction	2)Conservation resin applied	1)Undiagnostic	1)Undiagnostic 2)Conservation resin applied		
2.1	Red	Shed burr fragment	2)Conservation resin applied	1)Undiagnostic 2)Conservation resin applied		1)Undiagnostic 2)Conservation resin applied	1)Undiagnostic 2)Conservation resin applied
2.2	Red	Pedicle, lower beam, mid beam, brow tine. 2 year old animal?	1)Fraying 3)Gnawing 4)Gluing	2)Prepared breakage 3)Gnawing 4)Gluing	4)Gluing	3)Gnawing 4)Gluing	3)Gnawing 4)Gluing
2.4	Red	Tine tip	1)Fraying 3)Gnawing	1)Fraying	2)Breakage	3)Gnawing	

			4)Conservation resin applied	3)Gnawing 4)Conservation resin applied		4)Conservation resin applied	
2.5	Red	Brow tine	1)Fraying 5)Gluing 6)Conservation resin applied	1)Fraying 3)Scraping 4)Use	2)Undiagnostic 5)Gluing 6)Conservation resin applied		
2.6	Red	Tine tip	1)Fraying 3)Gnawing 4)Conservation resin applied	1)Fraying 3)Gnawing 4)Conservation resin applied	2)Undiagnostic 4)Conservation resin applied		
2.7	Elk	Tine tip	2)Drying damage 3)Conservation resin applied	2)Drying damage	1)Undiagnostic 3)Conservation resin applied		
2.8	Red	Tine tip	2)Conservation resin applied 3)Reconstruction putty applied	2)Conservation resin applied	1)Undiagnostic 3)Reconstruction putty applied		
2.9	Red	Trez tine	1)Fraying 3)Modern damage 4)Gluing 5)Conservation resin applied 6)Modern damage	1)Fraying	2)Undiagnostic		
5.1	Roe	Pedicle, burr, beam and crown	1)Fraying 2)Modern damage 3)Conservation resin applied	1)Fraying 3)Conservation resin applied	2)Modern damage		
5.2	Roe	Pedicle, burr, beam and crown	1)Fraying 2)Modern damage 3)Conservation resin	1)Fraying 3)Conservation resin applied	2)Modern damage		

			applied				
5.3	Roe	Pedicle, burr, lower beam	1)White mineral sediment deposited	1)Undiagnostic	1)White mineral sediment deposited		
5.4	Roe	Burr, beam, first tine	1)In situ damage 2)Gluing	1)In situ damage			
5.5	Roe	Burr		1)Undiagnostic	1)Undiagnostic		
5.6	Roe	Burr	3)Conservation resin applied	1)Undiagnostic	1)Undiagnostic		
5.7	Roe	Burr and lower beam	2)Conservation resin applied 3)Modern damage	1)Undiagnostic 2)Conservation resin applied 3)Modern damage			
5.8	Roe	Crown tines	1)Fraying 2)Gnawing 3)Damage in situ 4)Gluing	1)Fraying 2)Gnawing 3)Damage in situ 4)Gluing		3)Damage in situ 4)Gluing	
6.1	Elk	Palmate tine	1)Burning 3)White mineral sediment deposited 4)Modern damage 5)Drilled for AMS sample	1)Burning 4)Modern damage	1)Flexion break 3)White mineral sediment deposited 5)Drilled for AMS sample	1)Burning	

Table 160: Working sequences observed on the antler from Thatcham

Accession number	Brow tine working sequence	Bez tine working sequence	Trez tine working sequence
1.1	1)Fraying 3)Conservation resin applied		4)Modern damage
1.2	1)Undiagnostic	3)Conservation resin applied	1)Undiagnostic 2)Gnawing
1.3	1)Undiagnostic 2)Gnawing 3)Conservation resin applied		
2.2	1)Fraying		

Table 161: Additional working marks observed on antler from Thatcham

A3.38 Westward Ho, Bideford Bay

Accession number	Species	Side	Element
RAA a4288Fos 150V	Red		Removed tine
RAA a4287 Fos i50U	Red		Lower beam and brow tine
RAA a4270 Fos222a	Red		Lower beam, brow and bez tine
RAA a4432 Fos 4525	Red		Lower beam and brow tine
Fos 192a a 9378	Red	Left	Beam and brow tine
F4107	Red	Right	Beam
F173f	Red		Beam
F173	Red	Right	Basal portion
F173a	Red		Tine
F173b	Red		Tine
F173c	Red		Tine
F173d	Red		Tine
F173s	Red		Crown junction and tine.
F 4522	Red	Right	Crown and upper beam
F150	Red	Left	Crown and upper beam
F173h	Red	Right	Lower beam and brow tine
F172b	Red	Left	Lower beam

F150g	Red		Tine tip
F150k	Red	Left	Lower beam and burr
F150d	Red		Tine tip
F150j	Red	Left	Lower beam and burr
F150h	Red		Tine
F150f	Red		Fragment of beam
F150i	Red	Right	Upper beam
F150e	Red		Tine tip
F150sot	Red	Left	Brow tine and lower beam
F150sot	Red	Left	Lower beam
F173k	Red		Tine tip
F173p	Red	Left	Lower beam
F173j	Red		Tine fragment
F173n	Red		Tine tip
F173l	Red		Tine tip
F173r	Red	Right	Lower beam
F173o	Red		Crown
F173q	Red	Left	Upper beam
F173m	Red		Lower beam
F192c	Red		Brow tine
F192e	Red	Left	Brow tine and burr
F192d	Red	Right	Lower beam and burr
F192b	Red		Fragment
F222g	Red		Fragment of beam
F222b	Red	Right	Brow tine and burr
F222f	Red		Crown junction and tine.
F222d	Red		Crown junction and tine.
F222e	Red	Right	Lower beam and brow tine

F222c	Red		Brow tine
F4165	Red		Fragment of compactor
F4159	Red	Right	Crown with two tines and upper beam
F4163	Red		Fragment of compactor
F4526	Red	Left	Brow tine
42/2003.1	Red		Tine and portion of upper beam
42/2003.2	Red	Left	Beam
42/2003.3	Red	Right	Brow tine and lower beam
42/2003.5	Red	Right	Beam with brow and bez tines intact but broken short
42/2003.6a	Red		Tine
42/2003.6	Red	Right	Crown and upper beam
42/2003.7	Red		Tine
42/2003.8	Red		Crown and upper beam
42/2003.9	Red		Tine
42/2003.10	Red		Fragment of compactor
42/2003.11	Red	Left	Lower beam
42/2003.12	Red		Tine
42/2003.13	Red		Tine
42/2003.14	Red		Tine tip
42/2003.15	Red	Left	Brow tine
42/2003.26	Red		Crown with one tine
42/2003.27	Red		Fragment of tine
43.2003.16	Red		Lower beam
43.2003.131	Red		Tine tip
43.2003.133	Red		Fragment of compactor
43.2003.134	Red		Fragment of compactor
43.2003.135	Red	Right	Lower beam
43.2003.156	Red		Fragment of compactor

43.2003.157	Red	Right	Brow tine
43.2003.158	Red	Right	Crown
42/2003.1	Red	Right	Lower beam
42/2003.2	Red		Tine
42/2003.3	Red		Crown
42/2003.4	Red	Right	Beam and burr
42/2003.5	Red	Left	Beam and brow tine
42/2003.6	Red	Right	Upper beam
42/2003.8a	Red		Burr
42/2003.8	Red	Left	Beam, brow and bez tines
42/2003.9	Red		Tine
42/2003.10	Red	Right	Lower beam, brow and bez tine
42/2003.11	Red	Right	Lower beam and brow tine

Table 162: Description of antler from Westward Ho

A3.39 Romsey, Hampshire

Accession number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
1994202.1	210	38.3	30.3	95

Table 163: Metric data from decorated tine at Romsey

Accession number	Species	Element	Biological and post-depositional processes	DIST working sequence	PROX working sequence	SEN working sequence	DEX working sequence
1994202.1	Red	Bez/trez tine	1)Fraying 6)Drying damage 7)Conservation resin applied 8)Drilled for SMS sample	1)Fraying 2)Scraping 6)Drying damage 7)Conservation resin applied	5)Breakage 7)Conservation resin applied 8)Drilled for AMS sample	2)Incision of chevrons	2)Incision of chevrons

Table 164: Working sequences observed on the decorated tine at Romsey

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