University of Reading

Aspects of British and Irish Mesolithic and early Neolithic woodworking practice, technology and change with case-studies from south-west Britain

PhD in Archaeology

Department of Archaeology

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Declaration:

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Adam Turner

Abstract

This thesis investigates prehistoric woodworking technology, techniques and traditions based on multi-site comparative analysis of assemblages and new data from excavated collections. The timeframe under review is the Mesolithic and early Neolithic periods in Britain and Ireland, with a particular focus on the nature of changing organic material culture during the transition between these periods. This work provides an updated review of the transition debate alongside original synthesis of relevant worked wood assemblages, detailed metric analysis of woodworking evidence from specific case-studies, and a focus on outstanding issues in understanding manufacturing toolmarks on wooden artefacts. In-depth original analysis of data from specific collections has been based on study of two significant primary case-studies; Goldcliff East (Gwent, Wales) and the Sweet and Post tracks (Somerset, England). The opportunity to study these assemblages, some of the material as yet unpublished, has allowed for comprehensive analysis of worked wood artefacts and comparison of wood working traditions in the late Mesolithic southern Wales and early Neolithic south-west England. Results of this analysis revealed the presence of a previously unreported working technique identified in both assemblages, one later Mesolithic, the other initial Neolithic, and has provided a useful mechanism to compare activity across the sites and periods. This in turn led to the development of a programme of experimental archaeology devised to investigate the nature and differences in toolmark morphology produced by different relevant tool types. Such research into prehistoric organic material culture and worked wood assemblages provides a mechanism to test and inform some of the theories and assumptions that have been proposed for these periods in wider archaeological analysis. With the results demonstrating the variety of woodworking skills available to people in the past, and highlighting the nature of resource management and wood selection choices, networks of connectivity, social organisation and specific tool use. By offering new data and understanding of activity, technology and cultural practice over the course of the Mesolithic to early Neolithic in this area of Europe, fresh perspective on the complexity of this important period is provided.

This thesis is dedicated to Emily, Ella and Oscar.

It is also dedicated to my parents, Gill and Alan, whose love of archaeology meant this was all your fault.

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Chapter 1. Introduction to thesis

1.1 Overview of thesis

Mesolithic studies have long been dominated by a focus on lithic analysis and typology, perhaps unsurprisingly as this is by far the dominant artefact type to have survived in the archaeological record (Mithen 1999; Tolan-Smith 2008). In comparison, the evidence from the Neolithic can be seen to offer more data types for study with the arrival of aspects such as pottery, monuments, animal husbandry, new subsistence practices, long-lasting occupation sites, monument building and increased activity to alter the landscape (Cummings 2017). However, even then, aspects of material culture such as stone tools have arguably overshadowed better understanding of wider material culture in these periods and the range of organic objects used in everyday life. Scholars such as Coles *et al.* (1978) and Hurcombe (2007, 2008, 2014) have addressed this issue, pointing out that in all likelihood the vast majority of objects in day-to-day use would have been made up of organic materials such as bone, antler, plants, leather, and wood. This aspect has been elegantly defined as 'the missing majority' by Hurcombe (2008, 85), and this work seeks to help address that imbalance in the archaeological record.

Fortuitously, the recovery of new samples of British and Irish Mesolithic worked wood in the first two decades of the 21st century (set out in **Chapter 3**), alongside a significant number of analogous early Neolithic sites with wood, now allows comparative site analysis to be undertaken. The study of wooden artefacts, and their working techniques, from these sites offers a potential avenue to address one aspect of that neglected organic part of cultural practice and technology and provides ways to expand our understanding of the context and lifeways of communities. The process of Britain and Ireland becoming Neolithic has been a source of long-standing, and continued, academic debate (Thomas 2013; Sheridan 2017) and the ability to provide datasets of organic material culture that can be compared with the interpretations from other sources of information offers a new opportunity to evaluate those past and current models.

The importance of using such new dataset from worked wood assemblages in the transition debate lies in the need for fresh ways to test and understand the seemingly pronounced shift in technology and lifestyle between the Mesolithic and Neolithic societies in Britain and Ireland. Mesolithic life was based on a mostly mobile hunter-gatherer lifestyle of relatively small groups of people using a wide of variety of resources dictated by the seasonal availability (Bailey & Spikins 2008; Tolan-Smith 2008). Whereas, Neolithic communities relied primarily on a system of domesticates and crop cultivation much more closely tied to one area (Miles 2016). Two principal explanations have been proposed for the change between these contrasting lifestyles, the first one of indigenous development (Thomas 1999, 2007), the second change driven primarily by Neolithic groups arriving from continental Europe (Sheridan 2003a, 2010). This work provides new information to test those different theories.

Archaeological analysis relies on comparing artefact types from within sites or regions, countries, and whole periods (Coles 1984a). In that context, the potential benefit of worked wooden analysis is that artefacts can hold information on aspects such as species selection, stylistic shape and form, woodworking manufacturing techniques, history of use, deposition context, and dating (Sands 2013). Wooden objects also have the benefit that they may contain environmental information such as the distribution of species, felling season, climate and management of woodlands (Coles & Coles 1986; Sands 2013). The problem of worked wood can of course be its potential for survival. It will only survive for archaeological investigation if deposited in anaerobic environments where it can be preserved (Brunning 2007c). However, the potential wealth of information it holds means, that if suitable artefact types are recovered, then analysis should be attempted as its very scarcity in the record means it will provide a more complete picture of the material cultural for a given period.

1.2 Objectives and methods

Five key specific research objectives are identified:

1. **What are the current models for British Mesolithic and early Neolithic lifeways, and the Mesolithic to Neolithic transition?** A review of current and historic models for these periods will be undertaken, considering the debates and current evidence of economic, cultural, social, technological, dietary practices and the impact of aDNA evidence on the model for change over these periods.

2. **What is the current state of knowledge on the use of wood in Mesolithic and early Neolithic Britain?** Use will be made of previous reviews, site reports, unpublished grey literature, and information available from sites awaiting publication, to provide an up-to-date assessment of the current state of understanding about woodworking and the use of wood as a raw material in these periods.

3. **To what extent is there variability in the Mesolithic and early Neolithic woodworking 'toolkits' at different sites?** A review of published worked wood assemblages alongside analysis of two key case-studies will be provided.

4. **Can experimental archaeological investigation help compare woodworking practice and tool use between the Mesolithic and Neolithic periods?** An experimental programme will be designed based on analysis of the selected case-studies to investigate the range of probable Mesolithic and early Neolithic wood working tools and to produce qualitative data on the morphology of manufacturing traces produced by specific tool types.

5. **To what extent does woodworking vary between the Mesolithic and early Neolithic? And what information does this provide related to the transition?** The final discussion

will provide an overview of how this work fits into current Mesolithic and Mesolithic to early Neolithic transition theoretical models in Britain and Ireland. Areas of key future potential research are also identified.

1.3 Chapter outlines

The following describes the contents of the chapters:

- **Chapter 1** introduction to this work.
- **Chapter 2** defines the current state of knowledge on Mesolithic and early Neolithic lifeways. It reviews historic and current models of the Mesolithic to Neolithic transition, the timing, scale and duration of that change and importance of new evidence from isotopic and aDNA studies to the debate as set out in Objective 1.
- **Chapter 3** provides a review of prehistoric woodworking in the context of understanding prehistoric communities, a review of previous work on Mesolithic and early Neolithic woodworking, the current data on Mesolithic and early Neolithic worked wood, and analysis of the potential and importance of organic material culture as required in Objective 2.
- **Chapter 4** is a description of the analytical methodology employed in this study, including the case-study site selection, definitions of key terminology, a description of toolmark investigation as an analytical tool, and the data collection procedures used.
- **Chapter 5** considers the previously excavated worked wood assemblage from sites at Goldcliff East (Bell 2007; Brunning 2007) alongside analysis of newly found (2017-present) unpublished worked wood evidence from the sub-site of Goldcliff East, Site T.
- **Chapter 6** considers the Somerset Levels, Sweet and Post tracks worked wood assemblages, with analysis of the preserved artefacts and excavation archive to interrogate the evidence for woodworking practice, species selection and tool use in the period.
- **Chapter 7** includes an introduction to relevant experimental archaeology theory and practice, previous work, relevant ethnographic examples, skill acquisition, record of skill training, experimental programme design, tools used and results of experiments.
- **Chapter 8** produces a synthesis and discussion of evidence for woodworking practice based on the analysis in Chapters 3-7. This includes a summary of the current state of knowledge, the importance of the newly identified-manufacturing techniques identified in this work, broader identification of woodworking toolkits in the discussed periods, results in terms of wider transition debate, and potentially fruitful future research avenues identified during the course of this research.

Chapter 2. The Mesolithic and early Neolithic in Britain and Ireland

2.1 Defining Mesolithic and early Neolithic Britain and Ireland for this study

The term 'Mesolithic' or 'Neolithic' in this study normally refers to the British and Irish record and chronology alone, unless explicitly stated otherwise. 'British' or 'Irish' in this context is defined as a part of what has historically been called the 'British Isles', but the author prefers to use terms such as 'Britain and Ireland' or 'British and Irish' when considering the whole area as better reflective of past cultural differences and modern identities. British here is taken to mean England, Wales and Scotland. It does not include the Channel Islands as their current political alignment does not reflect a more dominate cultural relationship and connection to northwest France during the Mesolithic and early Neolithic (Garrow & Sturt 2011, 2017; Scarre 2011). Ireland is taken to include the whole island of Ireland as suggested by Bradley (2007). Choosing to consider both Britain and Ireland together also takes into account the point raised by Bradley (2007, 22) that our perception of the division between Britain and Ireland is largely skewed by contemporary politics, and we should ask 'whether these distinctions had any relevance to social identities in the past'. He points out that this division perception seems particularly extraordinary when they are so geographically close that they can be seen from one another from as little as 30km (Bradley 2007).

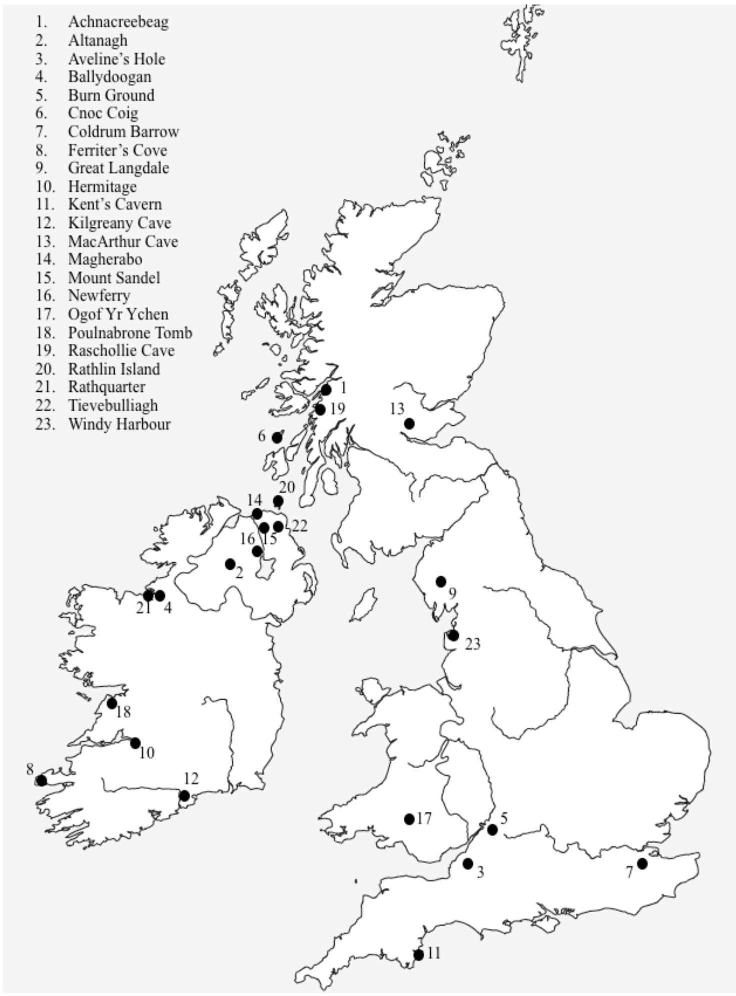


Fig 2.1 The Mesolithic and Neolithic sites discussed in this chapter

As set out in **Chapter 1** this study focuses on objects of worked wood in the British and Irish Mesolithic (starting 9,700 cal BC in Britain and 8,000 cal BC in Ireland) and early Neolithic (4,050 cal BC in Britain and 3,800 cal BC in Ireland)(Conneller et al. 2016; Cummings 2017), with a specific focus on the models and evidence for changes in material cultural over the transition between those periods. Given those research objectives, a concise review of the current understanding of Mesolithic and early Neolithic culture, technology and lifeways is provided in the sections below, followed by a review of models explaining the transition and finally the impact of recent emerging isotopic studies and genetic population modelling data on this debate. It should be noted this chapter does not seek to discuss the wider issue of why communities may have taken up or resisted the Neolithic package, the implications it may have had for cultural complexity, or what this change may have meant for cultural beliefs and social systems. These are all fascinating subjects in their own right, but detailed discussion was deemed beyond the scope of this work given the primarily functional and technological focus of this research work. On occasion reference is also made to important sites or worked wood assemblages from other parts of continental Europe as it is also clear that Britain has not developed in isolation and that our cultural changes were, and will always be, inextricably linked to broader social and technological trends within Europe as whole (Bradley 2007). However, it should be noted this study does not attempt to be an exhaustive study of the comparisons between the Irish, British and wider continental European worked wood record from the Mesolithic and early Neolithic. With no existing synthesis it was originally hoped that some limited examination of key worked wood assemblages from continental Europe would be undertaken, but such travel was made impossible as a result of the successive Covid-19 pandemic restrictions during 2020-22.

2.2 Mesolithic Britain and Ireland

2.2.1 Mesolithic Britain

In Britain the start of the Mesolithic period is defined as the post-glacial Holocene occupation by humans at the end of the Younger Dryas interstadial cold snap, conventionally starting from approximately 9,500 cal BC and lasting until approximately 4,000 cal BC (Conneller 2022; Cummings 2017; Bell 2007g). Mesolithic culture is loosely defined as following a mostly mobile hunter-gatherer lifestyle, accessing animal and plant resources from within a reasonably large geographical territory, with likely seasonal movement based on the availability of resources (Bailey & Spikins 2008; Bell 2007a; Warren 2005). Up until the start of the 21st century, the period was traditionally further separated into just two broad parts; one 'early' (9,600 – 8,000 cal BC) and one 'late' (8,000 – 4,000 cal BC), based on the replacement of Mesolithic microlith 'broad blade' type technology with later 'narrow blade' types (Blinkhorn & Milner 2014; Miles 2016; Warren 2005). The period has been more generally characterised by a distinctive suite of such tool assemblages, that include a variety of diagnostic microlith forms, core and flake axes, tranchet adzes, along with less common organic finds such as antler and bone adzes, axes and harpoons (Bell 2007a; Mithen 1999; Tolan-Smith 2008). Recent comprehensive review by Conneller (2022) of the period has now suggested an updated division of the period in Britain into four; Early Mesolithic (9,400 BC – 8,200/8,000 BC), Middle Mesolithic (8,200 BC – 7,000 BC), Late Mesolithic (7,000 BC – 5,200 BC) and Final Mesolithic (5,200 BC – 3,900 BC), which may help to advance debates yet further on the period.

A recent study by Conneller *et al.* (2016) has also shown the potential of applying Bayesian radiocarbon modelling for clearer, more refined, typochronological models for specific Mesolithic lithic assemblages. For example, work demonstrated that 'Star Carr-type' early Mesolithic assemblages first appeared in Britain at around 9,400 cal BC, followed some 500 years later by the 'Deepcar-type' assemblages, with the two seemingly co-existing together for a millennium. The interpretation being that the two types may reflect specific regional and cultural differences, with the Star Carr-type representing the first coastal 'pioneer colonisers' , followed half a millennium later by groups using Deepcar-type microliths entering Britain primarily by via river valleys (Conneller *et al.* 2016, 14). After these two types, a broader general technological development emerged in 'basally modified' microliths around 8,690 – 8,335 cal BC that overlaps with two previous technologies (Conneller *et al.* 2016, 13). Finally, the smaller 'scalene triangles' appeared and may have overlapped briefly with the previous three industries, but only for a matter of a 'few centuries' around 8,000 cal BC (Conneller *et al.* 2016, 15). For the late Mesolithic, a detailed chronology has historically proven difficult to set out with precision (Conneller 2022). However, similar typochronological work is likely to help this, along with the contribution of large-scale investigations such as at Bexhill, Sussex, where detailed excavation of hundreds of thousands of lithics from well-dated contexts, and the identification of a new very late Mesolithic microlith type, 'the Bexhill Point', may give clarity on connections with continental European assemblages (Lawrence pers. comms.).

The British Mesolithic period was also a time of significant, and sometimes highly dramatic, environmental and ecological change (Conneller 2022). At the start of the early Mesolithic sites such as Star Carr, first occupied in 9,300 cal BC, show a generally lightly wooded landscape dominated by birch, populated by large herbivores such as red deer, elk, auroch and wild pig (Conneller *et al.* 2016; Milner *et al.* 2018). As average temperatures gradually rose during the period, by 6,000 cal BC, warm and mild conditions had allowed the forest cover of much of lowland Britain to become significantly denser, dominated by species such as hazel, elm, alder and oak in a mixed climax temperate deciduous woodland (Bell 2007g; Bell & Walker 2005; Mithen 1999). Specific topographic and soil conditions also played a part on a local scale, with particularly wet areas enabling species such as alder and willow to flourish, and as Coles (2006) demonstrated, important animals such as beavers engineering entire wetland landscapes. As well climatic changes, there was a process of sea level rise over the course of the Mesolithic, with its effects perhaps most pronounced in the North Sea Plain where a large area of inhabitable land between modern-day England, Belgium, the Netherlands and Denmark, known as 'Doggerland', was subject to rising sea levels and Doggerland itself eventually submerged by 6,000 cal BC (Coles 1998; Gaffney *et al.* 2009; Walker *et al.* 2020). Operating in this changing environment, Mesolithic people adapted, with the introduction of the scalene triangle considered a technological response to dealing with hunting in dense woodlands and increasing late Mesolithic evidence for higher levels of burning in the environment an attempt to artificially manage the landscape (Conneller *et al.* 2016; Bell 2007g; Dark 2007; Noble 2017). As sea level rise altered British coastal areas, and the flora of the inland landscape developed, the period was therefore not one homogenous, static, set of environmental conditions. Rather one of transformation, where the ecological challenges and opportunities of the people at early Mesolithic Star Carr would have been significantly different to those encountered by the people of the final Mesolithic in southern England.

In terms of lifeways, there is currently no clear evidence for use of pottery, dairy products or domestication of cows or sheep in the British Mesolithic record (Ray & Thomas 2018; Whittle *et al.* 2011b). With the only animal clearly known to have been domesticated in the traditional sense the dog, as evidenced by early Mesolithic aged finds from Star Carr (Clark 1954) and late Mesolithic Blick Mead (Rogers *et al.* 2019). For subsistence, a variety of wild large animals were hunted in late Mesolithic Britain including red deer, roe deer, wild pig and auroch, as well as a wide variety of aquatic species, shellfish and birds from wetland edge sites (Bell 2007g; Cummings 2017). However, plants were also an important part of diet, as Zvelebil (1994) estimated there were some 450 useful or edible wild plants available in Britain, likely providing a very significant amount of calories and nutrients to mobile groups travelling the landscape to access resources at the right time of year. By the late Mesolithic, stable isotope analysis on human remains also suggests increasing exploitation of marine resources (Schulting & Borić 2017). Although, the actual picture on a region level of fishing is likely quite incomplete as it is limited by the small number of human remains from the period and the fact that much of the prime coastal zone available for Mesolithic activity is now submerged due to rising sea levels (Cummings 2017).

On a local scale, occupation sites such as Goldcliff East, Wales, or in the Western Isles, Scotland, suggests late Mesolithic groups normally comprised small mobile groups, visiting locations for fairly brief amounts of time, although sometimes repeatedly over a long timescale (Bell 2007g; Mithen & Wicks 2018). The vast majority of structures appear to be small-scale, although there are some examples such as the large post-holes at Stonehenge, Wiltshire, and Warren Field, Aberdeenshire, that may indicate some form of more permanent, monumental, activity in the landscape may have been taking place (Conneller 2022; Mithen & Wicks 2018). The noticeably very small number of late Mesolithic human remains has been suggested to show that treatment of the dead perhaps took the form of systems such as excarnation (Cummings 2007). Although, here again it is worth noting the evidence across the period as whole is mixed, with the early Mesolithic cave burials at Aveline's Hole and Gough's Cave, both in Somerset, suggesting that we may only have an incomplete picture of the range of traditions and practices that existed (Conneller 2006). With some traditions, such as disarticulation of remains and use of caves in the late Mesolithic potentially demonstrating more continuity with later Neolithic practices rather than differences (Hellewell & Milner 2011). Finally, there is also evidence that certain material culture, such as polished axeheads, may pre-date the arrival of the Neolithic, with examples recovered at Nab Head, Wales, dated to 7305-6701 cal BC (OxA-1497: 8070 +/-80) (David & Walker 2004, 323-5). Taken as a whole, the picture of Mesolithic Britain is thus one of significant environmental change, where diverse and changing social practices and complexity existed, along with evidence for and technological innovation and introduction of certain new ideas, but set within a overall durable set of cultural traditions that had served people well for thousands of years.

2.2.2 Mesolithic Ireland

The Mesolithic occupation of Ireland also starts in the early Holocene, but the environmental, flora and faunal history of the island is considerably different (Woodman 2015). By around c.12,000 BC the melting of the Greenland ice cap caused rising sea levels that had produced a continuous sea barrier to the arrival of animals and humans (Edwards & Brooks 2008). The earliest Holocene evidence for human occupation in Ireland currently dates to approximately 8,000 BC and thus demonstrates the presence of a watercraft technology in some form to access the island (Bradley 2007; Woodman 2004, 2015). Living in Ireland in the early Mesolithic may also have been a substantively different proposition to southern Britain, the former having been covered almost entirely by ice in the last glaciation (Woodman 2015). Miles (2016, 172) describes it as 'a wasteland, the ground striated and scarred by glaciers…a landscape of lakes, hollows, eskers, dumps of gravel and bare, scoured rock'. The establishment of an early post-glacial sea barrier also means that there were significant differences in native fauna between Ireland and Britain, as certain species had not migrated in time before sea levels rose, such as aurochs, elk, red deer and roe deer missing from Ireland, with wild boar the only large ungulate for example (Bradley 2007; Woodman 2004, 2015). Mallory (2013, 30-36) has proposed that in terms of prey for hunting it was arguably one of the poorest areas in Europe. Terrestrial meat was of course not the only, nor perhaps the most important, food source with Bell & Walker (2005, 167) estimating 30% of the flora species found in Britain were also missing from Mesolithic Ireland, which includes useful tree species such as lime and beech. The initial settlers of Ireland used a lithic technology that included broad blade microliths broadly comparable to that being utilised in Britain at the same time, suggesting early cultural similarity and connections as it was first occupied (Bradley 2007). However, from 6,500 to 4,000 cal BC lithic styles appear to diverge and late Mesolithic Ireland can be classed as a separate cultural entity in its own right (Cooney 2007; Costa *et al.* 2005; Woodman 2015). In Bradley's (2007, 35) terms, 'Ireland became isolated from Britain and Britain became isolated from the

European mainland'. This change in material culture is exemplified by the appearance of the macrolithic Bann flakes that were made using hard hammer percussion with carefully trimmed butts (Woodman 2015; Woodman *et al.* 1999), with microliths seemingly going out of use in late Mesolithic Ireland (Costa *et al.* 2005). Understanding such connections also highlights a wider problem in the reliance on lithic studies analysis to assess the nature of Mesolithic cultural differences between Ireland and Britain in general. As Cummings (2017, 20) notes it is also highly likely that the majority of Irish and British Mesolithic artefacts were organic in nature, and it would be these that may have 'been the medium for expressions of social and kin relations'.

2.3 Early Neolithic Britain and Ireland

The start of the British and Irish Neolithic is defined here as the appearance of a material culture that includes the consistent repeated use of new lithic forms such as polished ground stone and flint axe-heads and adze-heads, deep shaft lithic mining and leaf shaped arrowheads (Cummings 2017). New structures appear such as rectangular timber buildings, with substantial stone, timber and earth monuments, the manufacture of pottery, and changes in diet such as the appearance of dairy and cereals, animal domestication and cultivation of crops originating in the Eastern Mediterranean (Bayliss *et al*. 2011, 731). Other aspects may have been equally important such as permanently occupied structures, taboos over consumption of fish, consistent clearance and management of the landscape, as well as new mortuary practices, although as Bayliss *et al.* (2011, 731) state it is harder to be absolutely sure of the chronological boundary and cultural affiliation for the arrival(s) of these practices. It is also worth noting that some traditionally Neolithic practices and 'things' may have been developed within earlier Mesolithic communities, with polished axes and adzes known from Irish Mesolithic contexts at Hermitage, Mount Sandel and Newferry (Little *et al.* 2017; Woodman 1977). There is no current evidence for use of pottery, dairy products or domestication of cows or sheep in the British Mesolithic record (Ray & Thomas 2018; Whittle *et al.* 2011b). However, in Ireland there is clear evidence of apparently domesticated cattle at Ferriter's Cove, dated to 4495-4165 cal BC (Woodman *et al.* 1999), and at Kilgreany Cave, Co. Waterford, cattle bones were found and dated to 4240-3790 cal BC (5190+/-80. OxA-4269, Woodman *et al.* 1997) in association with a Mesolithic lithic technological package. Whether this represents the transport or trade of live animals, joints of meat or only defleshed bones, is not yet clear. Neither the auroch, nor the domesticated cow, were native to Ireland so these bones clearly indicate a link to Neolithic communities of Europe, with Sheridan (2010) proposing they could have been lost or stolen from an abortive Neolithic settlement attempt. How or why these Neolithic connected species had made their way to late Mesolithic Ireland is intriguing, and at least points to regional complexity in cross-channel contacts and the process of Neolithisation. There is no direct British Mesolithic evidence for the domestication, husbandry, or use of similar Neolithic-connected animal species, but Ray & Thomas (2018, 65) suggest that it is possible that indigenous species such as deer herds may have been managed or 'harvested' in some form. McCormick (2007) suggested that there may have been management of wild boar in Ireland, traversing rigid hunter-gather and farmer economic boundaries, and perhaps hints at complex resource specialisation and planning. Mallory (2013) went one step further to propose wild boar were actually introduced into Ireland to structure the fauna to the needs of Mesolithic communities. McCormick (2007) and Warren *et al.* (2014) have also proposed that Mesolithic groups imported bears into Ireland, perhaps for cultural reasons rather than consumption, but if true these this illustrates an ability to manipulate the fauna when necessary. There is also strong late Mesolithic evidence for the control of the environment through organised burning that has been interpreted as the organised management of ecological resources to enable specific useful plants, trees and fauna to thrive, hinting at a desire to control some aspects of the local environment (Bell 2007, 2020).

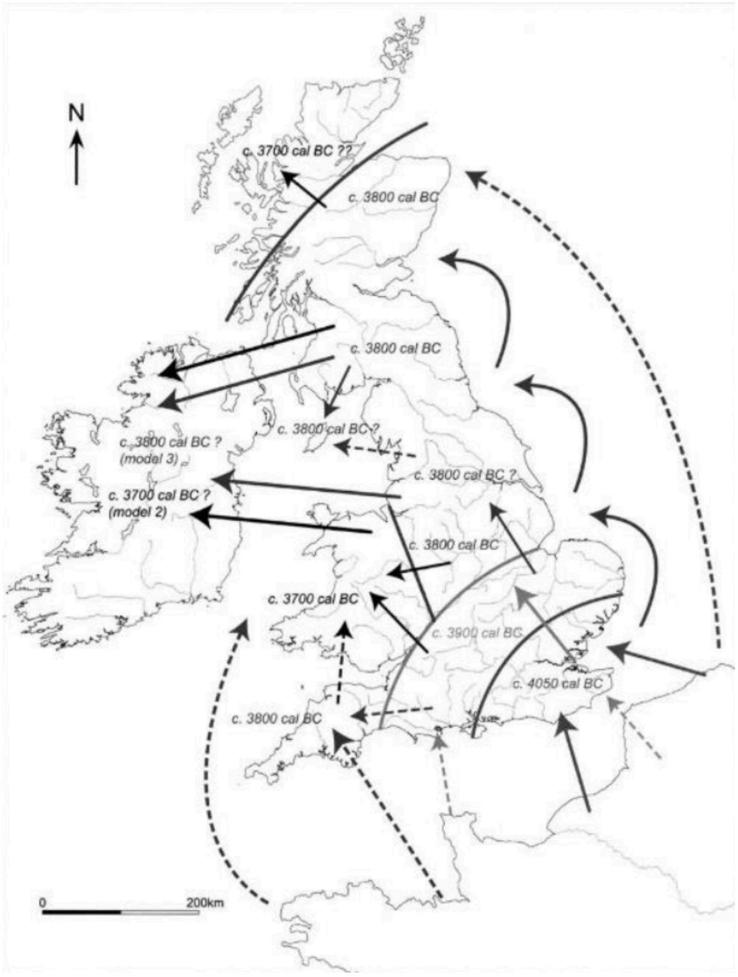


Fig 2.2 A proposed model for the development and spread of the Neolithic in Britain and Ireland (Whittle et al. 2011a, 869)

To understand the chronology of the introduction of Neolithic practices recent use of Bayesian statistics and modelling of radiocarbon dates by Whittle *et al.* (2011a) focused on early Neolithic causewayed enclosures from England proposing a model for the first appearance and spread of the Neolithic ‘things’ and ‘practices’ in Britain and Ireland. This analysis suggested it began in southeast England in the Greater Thames Estuary around 4,050 cal BC, gradually spreading into southern and central England around 3,900 cal BC and then rapidly spreading across the rest of Britain by 3,800 cal BC, perhaps 3,700 cal BC in northwest Scotland, and into Ireland a little after 3,850 cal BC (Whittle *et al.* 2011b, 869). One important result was an indication that the Neolithic did not appear everywhere at one single point in time, and in their model had an initial entry, or origin, around the Thames valley (Bayliss *et al.* 2011; Whittle *et al.* 2011b). The study also suggested that the Neolithic package did not arrive as a complete suite of technologies, with pottery and domesticates the very first things to appear, and houses and monuments first built several generations afterwards (Whittle *et al.* 2011b, 840). Their model also suggested that the Neolithic that eventually appeared in Britain and Ireland around 3,800 cal BC was essentially fully formed and associated with a rapid replacement of pre-existing hunter-gatherer lifestyles. Ray & Thomas (2018, 101) date the first phase of the Neolithic to 4,050 – 3750 cal BC and this is the version that spreads to the rest of Britain. Various authors describe it as including the first long barrows and cairns, the first appearance of the carinated bowl pottery, new lithic forms such as leaf shaped arrowheads, new customs of pit-digging and deposition, new types of polished axes such as jadeite axe-heads from the Alps, individual inhumation burials, widespread and large-scale stone and flint mines in areas such as the South Downs, Wessex and Great Langdale, houses and new timber 'halls', and finally the use of dairy, cereals and animal domesticates (Cummings 2017; Edinborough *et al.* 2020; Ray & Thomas 2018; Sheridan 2010; Bayliss *et al.* 2011). Given the presence of some of these individual aspects in earlier periods, such as polished axes in Ireland as described above, it is the consistent presence of a combination of these aspects, in particular pottery and domesticates, at a given location that should be taken as providing the clear arrival of this new cultural and technological way of life (Whittle *et al.* 2011b).

In Ireland, Whittle *et al.* (2011b) suggested that the Neolithic arrived as one cohesive package around 3,800 cal BC broadly comparable in type to the first British phase set out above. However, there is evidence that Irish sites may predate this suggested scheme, such as the late Mesolithic cow bones at Ferriter's Cove, so we should be wary of accepting this timeline in Ireland at present. The first stage of the Irish Neolithic was a culture broadly comparable with the first phase of the British Neolithic with apparent close cultural networks between early Neolithic Ireland and Britain illustrated by the transportation of axe-heads, with over 100 Langdale axe-heads found in Ireland (Cooney 2000, 25), and some 200 Group IX axe-heads from Tievebulliagh and Rathlin Island found in Britain (Cooney 2000, 205). Sheridan (2017) further set out the evidence aside from lithics, with architectural and ceramics similarities between Ireland and Scotland throughout the early Neolithic showing continued interactions. Recent radiocarbon dating work by Edinborough *et al.* (2020) showed that mines operated during the first initial period of Neolithic activity in both countries, reflecting a comparable industrial axe-producing focus for community activities on both islands. However, differences exist with the appearance of causeway enclosures so numerous in southern Britain yet rare in Ireland (Whittle *et al.* 2011a, 5) and the Irish use of trimmed lithic forms reminiscent of the Bann flake style continuing into the early Neolithic (Cummings 2017, 50). As the Neolithic progresses, the Irish chronology and culture becomes increasingly distinctive in own right, an example being the so-called 'Irish house horizon' of large timber buildings rapidly built across the island of Ireland and used over a specific period of 3730 – 3660 cal BC before they are seemingly intentionally burnt down (Cooney *et al.* 2011, 598).

Considered more broadly at a pan-European scale, the Neolithic of Britain and Ireland shares fundamental similarities to the Neolithic communities of continental Europe, although each area of northwest Europe developed regionally different adaptations of a shared general package (Robb 2013). For example, illustrated by the regionally specific new monument styles and stone passage graves of Late Castellic Brittany (Scarre 2011). It is also clear that there were regional varied responses by preceding hunter-gatherer groups, such as the co-existence of hunter-gatherers and farmers in the coastal margins of Brittany for several hundred years around 5,000 BC (Cummings 2017). In Belgium and the Netherlands there was a clear hiatus in the spread of the Neolithic package, with distinct cultural groups of hunter-gatherers and Neolithic *Bandkeramik* groups co-existing and sharing ideas for as much as a thousand years, 6,000-5,000 BC, in this area (Louwe Kooijmans 2007; Thorpe 2015). Even as these distinct Mesolithic groups ultimately disappeared, the nearby Swifterbant culture of the Rhine Delta, using a mobile hunter-gatherer lifestyle, persisted until around 4,300 BC. This incorporated pottery and stone adzes likely traded from nearby farming communities (Thomas 2013). Domesticated animals only appear here from 4,600 BC and are eventually incorporated into a new 'Michelsberg' northern European Neolithic group by 4,300 BC (Louwe Kooijmans 2007). Cummings (2017) suggests that a complete switch to an agricultural system was perhaps as late as 3,400 BC in this area, illustrating the capacity for cultural distinct groups to co-exist in select rich wetland edge areas. In the Mesolithic Ertøbelle of Denmark the take-up of aspects such as locally made pottery and imported shaft holed adzes indicates cultural contact alongside the continuation of existing hunter-gatherer ways of life. This continued until an apparently final and rapid incorporation into the Neolithic *Trichterbecherkultur* culture in as little as a hundred years at 4,100 – 4,000 BC (Larsson 2007). Against this context of the Neolithic across northwest Europe the relatively delayed, or complex, take-up of the package in Britain and Ireland is not unprecedented. However, what is important is that no one individual version of the continental Neolithic is paralleled by the archaeological evidence in early Neolithic Britain, which would suggest no clear single point of origin or an entirely comparable mechanism for the changes (Thomas 2013; Whittle *et al.* 2011b). Perhaps even more interestingly there is very little direct evidence for contact, or the spread of ideas, across the channel until the rapid transition period itself (Sheridan 2007, 2010, 2017). This may be simply a product of a lack of good sites illustrating very late Mesolithic life or the transition period (Bradley 2007), but there is no strong evidence for British Mesolithic groups using Neolithic practices, such as pottery or cereals for example, until it rapidly appears as a cohesive assemblage at the start of the Neolithic (Sheridan 2007, 2010, 2017; Whittle *et al.* 2011b). Considering the good indication of some form of late Mesolithic seafaring capability from activity on Scottish islands (Mellars 1987; Mithen 2000), the question is does this reflect an active preference for cultural isolation between the first Mesolithic Irish and British worlds and their Neolithic neighbours or are we missing the evidence? Cummings

(2017) and Bradley (2007) suggested it is possible the most important late Mesolithic activity areas were in the coastal wetland edge and on islands, with most now submerged by rising sea levels and it is here where the evidence is to be found. Very recent discoveries like the rare late Mesolithic wetland edge site at Windy Harbour, Lancashire, with evidence of occupation over the key transition period, may help to address these questions as post excavation analysis proceeds (Gosden *et al*. 2021, forthcoming).

2.4 The importance of the Mesolithic – Neolithic transition in Britain and Ireland

The change in technology, culture and lifestyle between the conventional Mesolithic and an established Neolithic society in Britain and Ireland that followed was pronounced. The preceding Mesolithic culture saw a mobile, or mostly mobile, hunter-gatherer lifestyle of relatively small groups of people using a wide of variety of resources and accessing different ecological zones largely dictated by seasonal availability (Bailey & Spikins 2008; Tolan-Smith 2008). The Neolithic saw the arrival of a new economic system using domesticates and crop cultivation that would result in the majority of a community being tied much more closely to one area and impacting their local environment in new ways (Miles 2016). More sedentary lifestyles led to the construction of more durable dwellings and different methods to commemorate the dead with new practices and stone monuments (Ray & Thomas 2018; Whittle *et al.* 2011a). Small-scale constructions occurred in the Mesolithic, but the organisation and application of large-scale labour for collective building tasks associated with more elaborate shelters, houses, trackways, pit and mines, and the social motivations behind them was a new development in Britain and Ireland (Bayliss *et al.* 2011, 719). The need to retain control and ownership of land and resources in some form also brought with it the potential (but not necessity) for changes in social stratification, population increase, accumulation of inherited wealth, social complexity and potential for inter-community competition (Bradley 2007; Miles 2016; Whittle *et al.* 2011b). Hodder (1990) and Bradley (1998) also speculated that the Neolithic represents new profound changes in concepts around nature, beliefs and ways to understand the world that are important departures from Mesolithic hunter-gatherer cultural systems that viewed themselves as primarily interlinked to a natural world and beneficiaries of its 'vital forces and energies' (Thomas 2007, 865). Neolithic farmers were intent on imposing control on the landscape, along with its animals and plants, with more emphasis on commodities and possessions as a result (Miles 2016, 203). In accepting this economic change, people gave up a system that had served hominins well for many hundreds of thousands of years as the basis for our evolutionary development and allowing us to thrive in a variety of ecological zones across the world and through dramatic climatic changes such as ice-ages (Turner & Antón 2004). The effect has been profound, as the development of an agrarian system provided largely stable and enduring settlement of the landscape that has continued to form the foundation of society and culture to this day. While the significance of the change between these systems is thus clear, understanding and reconstructing the cause, process, pace and duration of the change in Britain and Ireland has remained difficult. At its extremes the reasons for the change in material culture in Britain and Ireland have come down to two opposing models; the first being indigenous development or acculturation (Thomas 1999, 2003, 2007, 2013), the second the introduction of new practices through the arrival of new groups and the effective replacement of the previous indigenous inhabitants (Sheridan 2003a, 2003b 2007, 2010, 2017). Given this archaeological context, data collection in this work has focused, where possible, on early Neolithic sites with assemblages dated between **4,100-3,800 cal BC** as these can be considered the most relevant when attempting to better understand the cultural changes across the transition period.

2.5 Explanations for transition process

Until the 1970s the dominant academic view, as expressed by leading figures such as Piggott (1954), and Childe (1936), had been that the Neolithic represented arrival of large numbers of incoming settlers dramatically supplanting previous indigenous communities. As more sites and archaeological evidence started to accumulate, there was an increasing awareness of complexity in the lithic evidence, with Mellars' (1974, 89) review of the Mesolithic citing five possible sites with very late Mesolithic lithic industries, and thus possibly persistent communities, extending into the Neolithic period. This allowed researchers to examine physical evidence for the possibility that it was the adoption of Neolithic practices, but not necessarily an influx of people, that spread and caused the observed change in material culture. Zvelebil & Rowley-Conway (1984, 1986) produced an important framework that usefully set out that there could be a number of phases in the take-up of farming practise by hunter-gatherers that blur the sharp boundaries of cultural change and exchange. In their model first came availability but not adoption, second was the substitution of some aspects of foraging with farming and finally there was consolidation and reliance on farming. Importantly this set out the idea that the change to farming was not always inevitable and reflections of this framework can be seen in the archaeological evidence from differing regional responses of Mesolithic communities in northern Europe as discussed above. Dennell (1983) further speculated that local animal domestication of cattle and pigs could have independently developed in Britain, with Armit & Finlayson (1992) and Thomas (1991) arguing that subsistence was still reliant on hunting in the early stages of the Neolithic and imported domesticates and exotic foods were mainly used for special occasions. Thomas (1991) argued that the sudden appearance of full sedentism and an agrarian economy as was favoured in the earlier part of the twentieth century was overly simplistic. An important publication by Whittle (1996), also challenged archaeologists to consider the role of indigenous groups in the take-up of the Neolithic, advocating for more gradual economic change, contending that whatever the transition process, significant mobility still existed in the earliest Neolithic communities. Thomas (1999) supported this by arguing that there was use of both wild and domesticated animals, all alongside limited, or targeted, small-scale crop growing potentially showing a blended culture.

Towards the end of the last century broader models that allowed for a combination of movement of people and ideas gave way to more entrenched positions favouring, or emphasising, one over the other (Cummings 2017, 39). A model suggested by Ammerman & Cavalli-Sforza (1984) and Cavalli-Sforza *et al.* (1994) envisioned something of a physical advancing 'wave' of farmers spreading the Neolithic across Europe. In opposition Thomas (1999, 2007) proposed a gradualism model of indigenous-led endeavour as the driving force of change by developing or adopting Neolithic ideas, citing the lack of direct analogy between the British and Irish Neolithic with a continental Europe origin (Thomas 1999, 2007). In Ireland, researchers such as Cooney (2000, 2003, 2007) stressed that a gradual model did not fit the early Neolithic evidence of sedentary lifestyles and cereal production appearing very rapidly in the landscape. Instead that evidence best suggested some process of colonisation in Ireland. Thomas (2003, 2007) downplayed the contribution of cereals to subsistence and resisted the need for the movement of people from the continent to begin the process of Neolithisation. With a substantial review Thomas (2013) restated this hypothesis for one driven by indigenous development, now allowing for small-scale appearance of Neolithic settlers, but importantly not as a primary or sole force for the change. In his view the Neolithic was a 'co-creation' occurring through contact and the transformation of indigenous people into a Neolithic culture. In this model he suggested the appearance of elements such as jadeite axes may have reflected Mesolithic pre-transition contact with continental Europe as indigenous culture changed (Thomas 2013). However, a recent comprehensive study by Walker (2015) failed to find any reliable evidence to support the idea that jadeite axes pre-dated the Neolithic in Britain. The most recent work by Thomas (Ray & Thomas 2018, 83) has continued to strongly resist the idea that Neolithic settlers overtly imposed themselves on Mesolithic society, arguing we are too reliant on analogues based on more recent history of European pioneers or invaders in the New World of 'Native Americans and Pilgrim Fathers'. In their current view the first Neolithic in Britain was a hybrid one, with progressive 'interpenetrating' between Continental Neolithic and British Mesolithic groups that may have mixed individuals from different areas of northern Europe joining into complex new communities (Ray & Thomas 2018, 83). In this model, people moved over, but did not take over, and joined the existing Mesolithic communities through long-standing pre-existing relationships. They again cite the unusual combinations of material found in British early Neolithic sites that is without direct Europe analogy, including assemblages missing certain object types or seemingly using the 'wrong' ones, as reflecting 'social flux, reformulation, and interaction rather than the simple transfer of populations from one region to another' (Ray & Thomas 2018, 89).

2.5.1 Evidence from isotope analysis

Problematically for the indigenously driven model, other forms of evidence such as bone isotopic evidence provided new, conflicting, perspectives on issues such as mobility, sedentism and resource use through the prism of diet (Richards & Hedges 1999; Richards *et al.* 2003; Schulting 1998). Study of bone stable carbon and nitrogen isotope analysis from British and Irish human remains suggested a rapid and major shift in diet from one containing a substantial amount of coastal resources in the Mesolithic to one dominated by terrestrial ones in the Neolithic, even in people living in areas where coastal resources were still accessible and available (Schulting & Richards 2002; Schulting 2013). The contention has not been universally accepted with other researchers such as Milner *et al.* (2004), emphasising that there can be other causes such as simple proximity to resources to complicate the picture. However, further work by Schulting (2013) further set out that Neolithic diet seems to very likely be based on domesticated crops and animals, as domesticates clearly dominate Neolithic faunal assemblages and lipid residues on pottery show the importance of dairying from the inception of the Neolithic. Schulting & Borić (2017, 92) recently summarised the situation to state that this reflects a clear and profound shift in diet between the two cultures to a much more farming focused one over the transition, with importantly very little evidence for any experimental phase and the Neolithic thus appears in terms of material culture, diet and practices as a fully formed entity pursed by 'highly competent practitioners'. This would be consistent with the arrival of new groups, living in new ways, and less likely to reflect a pattern of indigenous-driven change as Thomas (2013) contends.

2.5.2 Current models for the transition

In light of this important isotopic evidence and by considering available material culture, Sheridan (2003a, 2007, 2010) proposed a very different scheme based on the typological similarity of the material culture to explain the complex and nuanced process and evidence of change in Britain and Ireland over this period. Her important framework sought to account for the noted differences in the Neolithic of Britain and Ireland and northern Europe with several strands of contact and colonisation from Europe originating from different areas of Neolithic Europe. In this proposed model, a first, perhaps failed, 'false start' phase in Ireland accounts for the Ferriter's Cove cow bones that are dated to 4495-4165 cal BC, something she proposed perhaps stolen or lost from an abortive Neolithic settlement attempt in this area (Sheridan 2003a, 2010). A second 'Atlantic' strand then emerges from Morbihan area of Brittany, 4,300-4000 BC, reaching Northern Ireland and Scotland evidenced by ceramics from Achnacreebeag, western Scotland, similar to late fifth millennium Breton 'late Castellic' style and megalithic tombs found around the Irish Sea comparable to Breton ones (Pailler & Sheridan 2009; Sheridan 2003a, 2010, 91-5). In Sheridan's (2010) view this movement of people reflects wider social and cultural changes and upheaval in late 5th millennium Neolithic France. In her model next came a movement of people from north-east France and Belgium with the full range of the Neolithic package at around 4,000 BC, called the 'Carinated Bowl Neolithic' or 'trans-Manche east,' with introduction of elements such as carinated pottery that mixed north French Chassey and early Michelsberg traditions, leaf shaped arrowheads, jadeite axe-heads, timber halls, cereals and livestock along with the influx of new people spreading across Britain and Ireland (Sheridan 2007, 2010, 99, 2017, 302). Finally, the fourth, 'trans-Manche west' strand dating from 4,000 – 3,800 BC saw another early Neolithic movement of people from Normandy and perhaps Brittany, suggested by the identification of precursor pottery forms to Hembury pottery styles along with distinctive passage tomb types (Sheridan 2010, 2017). In Sheridan's view the relatively small indigenous Mesolithic groups were integrated into the new, and constantly expanding, various immigrant Neolithic groups and thus rapidly disappeared archaeologically.

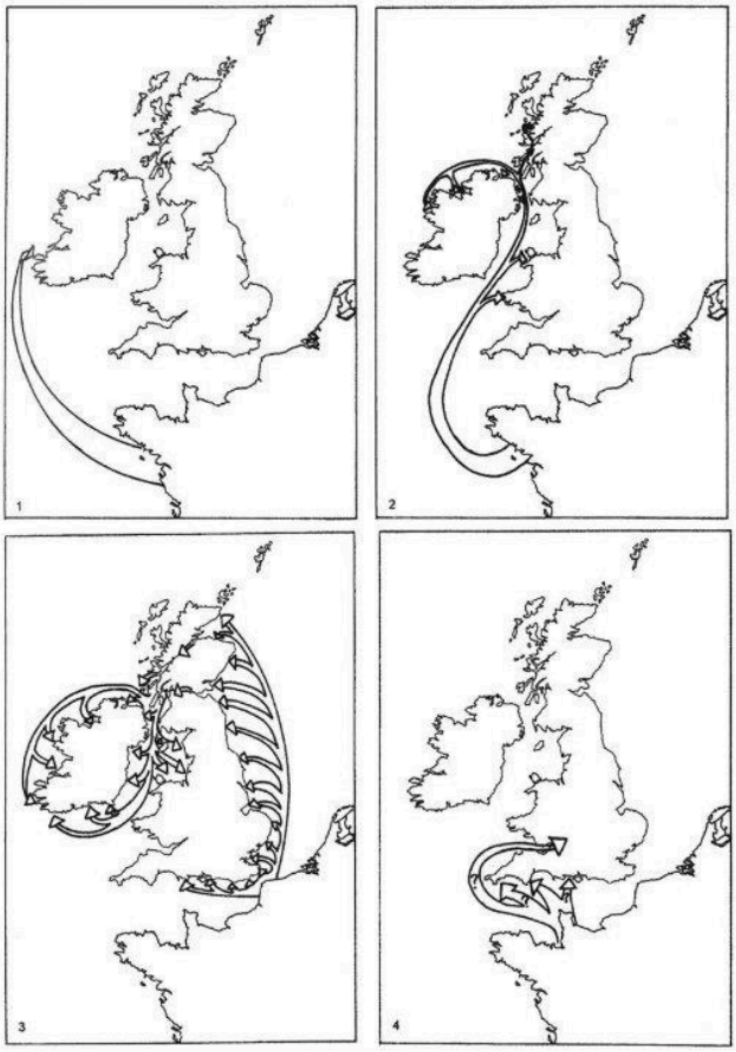


Fig 2.3 A proposed four strand model for the transmission of a Neolithic way of life, chronological from mode one (top, left), to model 4 (bottom right) (Sheridan 2010, 93)

This complex model is not without detractors, with Ray & Thomas (2018, 81) noting that Sheridan's (2010) tomb analogue for the second strand is not based on clear diagnostic comparisons, and there are no early Neolithic radiocarbon dates from these Brittany source tombs to support the chronology of the model. They also argued that the Castellic type pottery at Achnacreebeag could have arrived as part of the more general spread of Neolithic practices into Scotland around 3,800 cal BC. A point also made by Whittle *et al.* (2011b, 850-1), stating it 'can be fitted without difficulty into local developments', which questioned Sheridan's (2010) interpretations for the dating or distinctiveness of the tomb as well as the lack of more supporting late fifth millennium sites along the Irish Sea with Neolithic items as one might expect. Whittle *et al.* (2011b, 852) also did not accept the other site examples that have been cited to support the purported Breton second strand phase of contact. Finally, Ray & Thomas (2018, 81) have pointed out that while there are good reasons to make direct links between areas of Britain and a specific area of northern Europe when the material culture appears similar there is little evidence of a wholescale importation of a specific complete culture from one place as one might perhaps be expected. Rather the first Neolithic generations appear to have been selectively taking parts of wider 'extensive repertories' and leaving other parts behind.

Whittle *et al.*'s (2011b, 852) recent analysis has favoured a simpler explanation for the transition process, critiquing Sheridan's (2010) model for the second Breton strand, and any significant movement of people into the Irish sea and southwest England, but agreeing with the general premise of the third strand 'Carinated Bowl Neolithic' model. However, Whittle *et al.*'s (2011, 853) interpretation disagreed with Sheridan's (2010) view that the carinated bowl phase spread rapidly across Britain and Ireland, instead proposing that the transition started with a clear, but not necessarily large, Neolithic 'colonisation' in southeast England at around 4,050 cal BC. This produced a new and regionally distinct first phase of the Neolithic in Britain, mainly confined to south and southeast England at the start. In their view an understanding of the benefits of the Neolithic by Mesolithic groups built on existing contact networks and allowed these pioneering groups to easily move into Britain in tandem with a fusion with a changing indigenous culture. After a period of blending and further arrivals, this distinctly new mixed British Neolithic culture then spread across the country after a hiatus of some 150 years, first in southern England by 3,900 cal BC and then across the rest of Britain and Ireland with the incorporation and take-up of ideas by hunter-gatherer groups leading to the rapid spread across the country by approximately 3,800 cal BC (Whittle *et al.* 2011b). This makes early Neolithic sites such as the Sweet Track dated to 3807/6 BC (Hillam *et al.* 1990) very important, being the first evidence of Neolithic culture in western Britain. With perhaps the more workable position being that inter-culture interactions likely existed but it is the chronology, degree and manner on a regional scale that is key to understanding the complex transition process in a given area.

However, one significant problem in this suggested current chronological framework comes from sites in Ireland with cow bones such as Ferriter's Cove and Kilgreany Cave as discussed above. Potentially these sites may be explained by short-lived, or failed, Neolithic settlements in these areas as suggested by Sheridan (2010) in her first 'Northwest strand'. Whittle *et al.* (2011b, 632) have also speculated that perhaps the cow bones were actually aurochs, although as this species was not native this would suggest significant contact between western Ireland and western Britain in the late Mesolithic, which would be notable in its own right. Much more problematic is the clearly Neolithic causewayed enclosure at Magheraboy, Co. Silgo, in northwest Ireland, dated to 4115-3850 cal BC and associated with Carinated Bowl pottery, a broken porcellanite Antrim axe-head and leaf shaped arrow heads (Cooney *et al.* 2011, 665). Sheridan (2017) adds to this charcoal from two pits with Carinated Bowl Pottery and Neolithic lithics at Rathquarter 1, Co. Sligo, dated to 4240-3960 cal BC (Murphy 2015), and at a pit at Ballydoogan 1, Co. Sligo, dated to 3947-3782 cal BC (Hession 2012). Sheridan (2017, 303) further cites very early fourth millennium dates from Poulnabrone tomb, Co. Clare, and court tomb at Altanagh, Co. Tyrone, to indicate 'non-megalithic precursors for court tombs' amongst the range of material culture in Ireland that seemingly pre-dates the Irish 'house boom' that arrives in the 38th millennium. Whittle *et al.* (2011b, 667) have suggested that potentially the dating samples at Magheraboy may be at fault, although they acknowledged that 'special pleading' is needed as overall the site dates do seem secure even if it does not fit the rest of their model that envisioned 3,800 cal BC as a start date for the Neolithic in Ireland. However, if these dates are actually accurate, they instead imply that northwest Ireland may had separate strands of Neolithic contact and settlement at least around the same time, and even possibly before, southeast England. This suggests significantly more complexity to interactions and the transmission of the Neolithic in Ireland than Whittle *et al.*'s (2011b) general chronological model proposes. Given the difference in dating it would perhaps seem to better fit Sheridan's (2003a, 2007, 2010, 2017) general hypothesis for different strands of contact, although one might also question her model's process for the 'Carinated Bowl Neolithic' moving along the eastern seaboard of England, into Scotland and then into Ireland (Sheridan 2010, 93). If established contact networks and knowledge between Ireland and northern France existed from the end of the fifth millennium as shown by Ferriter's Cove and then later Achnacreebeag tomb, then continued movement from these areas through the Irish Sea would arguably be more logical. Why and how northwestern Ireland should potentially be among the first area for the successful transmission or settlement by Neolithic people is intriguing and may reflect regionally complex interactions at play in this specific area.

Cummings' (2017, 42) recent review of the explanations has stressed that while the archaeological record can appear to show abrupt change, a process over hundreds of years can actually be a far more gradual lived experienced over several generations with new practices gradually incorporated and old ways slowly dropped. She emphasised the porous border between the two worlds, suggesting there is good reason to see considerable contact between Britain, Ireland and elsewhere in northern Europe in the fifth millennium with likely well-established kinship, trade and contact networks in place (Cummings 2017, 41). These contact processes did not inevitably lead to the initial Neolithisation of Mesolithic groups, but these pre-existing networks would allow small-scale settlements and permit change to develop at a gradual pace in terms of the generations involved, enabling new practices to become attractive to individual people and groups. Analysis and research by Noble (2006), Garrow & Sturt (2011), Andersen-Whymark & Garrow (2015) and Garrow & Sturt (2017) have favoured and highlighted the possibility and importance of maritime connections, proposing there may have been a particular seagoing culture in the western seaways that helped facilitate the spread and interaction of Neolithic practices, genes and items. This potentially accounts for the evidence from Ferriter's Cove of cow bones on a Mesolithic site, through a process with 'long-term origins and a dynamic in both directions' (Garrow & Sturt 2011, 69). The important point here perhaps is that the process was complex, and needs to be viewed on a local and regional scale as the response was varied. As Cummings (2017, 46) states, 'there may have been many transitions, at different times, in different places, with different people and tempos'.

This complexity was also pointed out by Ray & Thomas (2018, 67) highlighting how our perception of 'revolutionary' change may have been experienced very differently for actual people in a process taking hundreds of years and 'occurring at various rates of change at different places'. Cummings (2017, 43) also noted that a small group with 'only a few boat loads of domesticated animals would have been needed to establish the entire British populations of domesticated cattle, sheep/goats and pigs'. Allowing for the presence of a small Neolithic influx in the initial transition period of 4,050 cal BC in southeast England, seeing 'no need to evoke migration from mainland Europe as the driving force of change' into the rest of the country, with 'it more likely that a process of indigenous adoption took place' in areas such as south-central England (Cummings 2017, 44).

2.6 Genomic evidence in the transition debate

It is some thirty years since the first ancient (human) deoxyribonucleic acid (aDNA) molecules were successfully extracted, and it was only in the last decade that complete ancient genomes could be fully studied with the invention of high-throughput sequencing (Booth 2019; Orlando *et al.* 2021). This development has had substantial impact on models for genetic ancestry, effectively reversing the results of mitochondrial DNA (mtDNA) studies that had suggested modern Europeans inherited 80-90% (Soares *et al.* 2010) of their ancestry from hunter-gatherers. This has been replaced with new interpretations suggesting dramatic demographic changes at important points in European prehistory (Booth 2019). Complete genome analysis has now been used to show new evidence for substantial demographic replacement that appeared to be linked to material culture changes such as the emergence of Neolithic farming practices and groups deriving from the Aegean into Europe around 6,000 BC (Gamba *et al.* 2014; Skoglund *et al.* 2014; Haak *et al.* 2015; Broushaki *et al.* 2016; Lazaridis *et al.* 2016; Omrak *et al.* 2016; Olalde *et al.* 2015; Brace *et al.* 2019), the mass influx of steppe ancestry into Central and Eastern Europe in the late Neolithic at around 2,700 BC (Allentoft *et al.* 2015; Haak *et al.* 2015) and dramatic late Neolithic demographic change around 2,450 BC in Britain associated with the Bell Beaker-complex phenomenon (Olalde *et al.* 2018). This latter demographic change has been suggested to have been so dramatic it was nearly a complete genetic ancestry turnover in the country of around 90% (Olalde *et al.* 2018, 193). Most relevant to this work has been a recent study by Brace *et al.* (2019) and Cassidy *et al.* (2020) that provided important new information to the transition debate by reporting that a major, overwhelming, demographic change occurred in Britain and Ireland over the course of Mesolithic to Neolithic cultural change, and which suggests the influx of a genetically new population.

In the aDNA debate it is firstly important to note that problems exist in this new source of information, with Ray & Thomas (2018) highlighting that it can be difficult, if not all but impossible, for non-specialists to assess the validity of the scientific or statistical methodology of aDNA analysis and so to judge the reliability of the results themselves. It is therefore only the archaeological interpretations that can be examined, and unfortunately here there has been a noted failure to consider the pre-existing wider archaeological context or evidence, alongside the problematic use of theoretical paradigms in certain studies that are reminiscent of culture-history invasionist theories of the early 20th century (critiqued by Furholt 2017; Heyd 2017; Hofman 2015; Van der Linden 2016). An additional important problem in the analysis of people from early Neolithic Britain is that very few individuals were interred in monuments, which effectively means that for the vast majority of the population their remains have not survive for study (Ray & Thomas 2018, 91). As sampling is mainly restricted to such monuments, the people studied might therefore not necessarily be reflective of the genetic profile of a community as a whole. Rather, these curated remains may have had specific ancestral ties that determined their placement in these places making them representative of a particular sub-section of the community, interred for cultural specific reasons (Ray & Thomas 2018, 119).

A wider interpretative problem is that archaeologists have questioned the apparent uncritical recycling of old-fashioned grand culture history narratives, which have seemed to implicitly associate cultural change with demographic characteristics and have a tendency to evoke broadstroke generalisations in their final conclusions (Furholt 2017; Heyd 2017; Hofman 2015; Van der Linden 2016). Ray & Thomas (2018, 34) describe it as the 'echoes of the 'ethnic prehistories' of the 1920s and 1930s, with their folk movements and genetically homogeneous communities of 'hunters' and 'farmers''. Booth (2019) has countered that the need to rapidly publish in high-profile journals for early genetic researcher careers, with little room for wider comprehensive interpretative discussions, should be seen as primarily at fault here. However, a lack of consideration of wider and complicated archaeological context reflects somewhat poorly on the research interpretations when work can come across as somewhat unaware of the broader evidence and overconfident in the conclusions. Booth (2019, 1) has set out that, 'antagonism…stems from misunderstanding regarding each other's implicit methods, questions and epistemologies'. He provides the example that 'population replacement' means very different things to a geneticist, archaeologists, and unfortunately journalists writing for public consumption. In purely aDNA study terms, it relates to the long-term genetic ancestry alone and does not evaluate aspects such as process or personal perceptions of ancestry or culture (Booth 2019). The clear answer here would seem to be that better collaboration and discussion in the future between geneticists and archaeological specialists, particularly with reference to terminology and definitions, will enable improved analysis and interpretations of the data coming out from aDNA studies to the benefit of all.

Directly relevant to the transition in Britain and Ireland was the recent significant results that appear to show that a very significant demographic change occurred between late Mesolithic and early Neolithic Britain and Ireland (Brace *et al.* 2019; Cassidy *et al.* 2020). The aDNA results from Ireland by Cassidy *et al.* (2020, 387) supported a 'prolonged period of island isolation'. However, interestingly, the study did find evidence of a recent introgression event as the Neolithic progressed, with a Neolithic individual at Parknavinna tomb, Co. Clare, dated to 3632-3372 cal BC (4707+/-42, UBA-39194) having a Mesolithic ancestor four generations before. That would approximately be a hundred years after the purported arrival of the Neolithic in Ireland, suggesting the survival of separate Mesolithic communities for some time, as well as complex interactions between groups in the landscape. These conclusions built on other recent comparable aDNA studies by Gonzáles-Fortz *et al.* (2017), Lipson *et al.* (2017) and Mathieson *et al.* (2018) that demonstrated that while there had been a process of genetic admixture with Mesolithic communities as Neolithic groups spread through western Europe, the ancestry of later Neolithic communities was consistently dominated by the people with Aegean origins. The general conclusions of these studies has been that while population intermixing occurred to different degrees in different areas, the introduction of farming and the wider Neolithic package seems largely the result of a consistent process of new genetically distinct groups gradually moving across Europe and genetically overriding any local groups (Booth 2019). In Britain, the importance of the Brace *et al.* (2019) results was that it provided a powerful, if not compelling, strand of evidence to suggest that the process of demographic replacement was even more pronounced than in continental areas. Importantly there was no evidence for a substantial proportion of indigenous ancestry surviving in the established early Neolithic British communities as a whole. This is turn leaves little realistic potential, from a genomic perspective, for the core hypothesis proposed by Thomas (2013) that the development of farming and the Neolithic range of technologies was primarily driven by Mesolithic groups. Schulting & Borić (2017, 92) go as far as to state that the claims for an indigenous adoption process 'seems untenable, particularly in the light of the new emerging genetic evidence'. Instead, based on the genomic data, the final result of the great change would seem to have been clearly compelled by a sizeable influx of new, culturally Neolithic, groups into Britain broadly around the transition period. This would seem to better fit the model that Sheridan (2010) proposed. However, it is worth considering the prophetic words of Richards (2004, 318) that 'in the study of human demographic history, the truth is rarely pure and never simple', and that these new genetic results may not be capturing the complete picture as discussed below and may themselves be challenged in the fullness of time as the interpretations of mtDNA studies were before them.

Considered in detail, Brace *et al.* (2019, 765) assessed the genomic relationship between six British Mesolithic (covering 8750-3803 cal BC) and 67 Neolithic individuals (covering 3951-2347 cal BC), finding 'small, geographically structured levels of hunter-gatherer ancestry', but 'no resurgence of hunter-gather ancestry at any time during the Neolithic in Britain'. They calculated that on average >56-74% of the ancestry in British Neolithic individuals derived from Aegean Neolithic farmers, with the majority of the hunter-gatherer contribution being previously collected as people moved through Europe and already present in these people before they arrived in Britain, with only a further <10% from British Mesolithic sources (Brace *et al.* 2019, 768). The level of admixture with indigenous groups was suggested as particularly limited in Wales, southwest and central England, and slightly higher levels in southeast England and Scotland, although the authors attributed this to likely older mixture events before those groups moved into Britain and thus reflecting source variation in the Neolithic populations that entered different areas of Britain. Only two examples from the 67 sampled early Neolithic individuals had ancestry that suggested Mesolithic introgression events in Britain itself, both from Raschollie Cave in Scotland, and suggested to have occurred 3-4 generations before they lived (Brace *et al.* 2019). The rest exhibited Mesolithic ancestry over 10 generations before and thus likely accumulated in continental Europe.

The study also provided chronological modelling based on aDNA comparisons and direct radiocarbon dates from the early Neolithic individuals sampled. This suggested population arrival by 3975-3722 cal BC, which interestingly they suggested potentially began first in the west before quickly dispersing across Britain (Brace *et al.* 2019, 768). Intriguingly, their results suggested regional differences with the latest appearance of the early Neolithic actually appearing in central England (Brace et al. 2019, 768). Chronologically and geographically this is clearly at odds with the results of the Whittle *et al.* (2011b) study, with one explanation perhaps being the lack of Neolithic aDNA samples from around the transition period in these areas. Genetically, the six British Mesolithic aDNA samples clustered with other examples from European Western and Scandinavian hunter-gatherers, and had closest affinities with the individual from Loschbour Mesolithic rock-shelter, Luxemburg, and the individual from Ranchot, France (Brace *et al.* 2019). The authors suggested this likely reflects a continuation of connections through the late Mesolithic even once there was a sea barrier in place and diverging lithic traditions (Brace *et al.* 2019, 769). The Neolithic aDNA samples clustered genetically near Iberian and Central European Middle Neolithic examples, with their inference being that the Iberian Neolithic was the origin source for the populations moving into Britain. The work also suggests a shared connection between British and Irish Neolithic individuals (Brace *et al.* 2019, 767) as also suggested by Cassidy *et al.* (2015). More recent work by Cassidy *et al*. (2020) further supported Irish Neolithic groups ultimately originating from the Iberian Neolithic.

In terms of process, the study favoured an explanation of multiple Neolithic source populations from northern France, with pre-existing variable amounts of Mesolithic ancestry before they entered Britain, then mixing to only a very limited degree with British indigenous populations in regionally varied ways. Why the pace and extent of cultural and demographic change in Britain appears to have been comparatively more dramatic than most areas of northern continental European offers interesting challenges to archaeological interpretation. However, it is important to say that the interpretations and conclusions of Brace *et al.* (2019) do not actually address the *scale, pace* and *physical* nature of the cultural and demographic change over the few hundred years of the transition period itself. As with other aDNA studies there can be a tendency for large-scale ambitious explanations on publication that can seem superficially to suggest the debate has been resolved, rather than acknowledging that while the genomic ancestry of later early Neolithic Britain may now be clearer the actual process of change itself and that the fate of indigenous of Mesolithic communities is still to be understood. The study stated it 'strongly reject[ed] the hypothesized adoption of farming by indigenous hunter-gatherers as the main process', which would overall seem sound in conclusion. However, the statement that this 'indicate[s] that the appearance of Neolithic practices and domesticates in Britain was mediated overwhelmingly by immigration of farmers from continental Europe' (Brace *et al.* 2019, 769), is more problematic for associating Neolithic practices with farmers when the spread of aspects of the package may have been more prolonged and complex as set out above. It also implicitly promotes the simplistic model that Sherratt (1995) critiqued, whereby changes in subsistence practice inevitably creates or relates to social and cultural developments. Based on the genetic evidence they also made the somewhat sweeping statement that British early Neolithic groups derived from Iberian populations following the Mediterranean route. These groups had mixed with local Mesolithic groups as they moved through France by an Atlantic or southern inland route, moved into northern France and then 'mixing to a limited degree with Neolithic populations from Central Europe *before* travelling across the English Channel' (Brace *et al.* 2019, 769, emphasis the author). This interpretation should be treated with caution and certainly does not match with the range of known archaeological evidence for the earliest British Neolithic, such as the presence of jadeite axes or carinated bowl pottery in the initial transition process that are associated with the northern Danube route as a source or strand of very early Neolithic settlement (Sheridan 2007, 2010; Walker 2015). Whittle *et al.* (2011, 872) also noted the clear similarities between the LBK of northwest Europe timber long houses and long mounds with comparable structures in Britain. Cummings (2017, 123) has also cited the comparable style of some long mounds with examples found in the Cerny culture of Paris Basin, France, and the TRB of northern Europe. All this evidence suggests that the initial phase of the British Neolithic may have origins in these areas and is seemingly at odds with the genomic-based conclusions put forward by Brace *et al.* (2019) and require further explanation.

One clear methodological problem in the interpretations of demographic change in Britain over the transition (considered here as 4,100-3,800 cal BC) is that the individual samples obtained are less instructive over this narrow period when actually considered in detail. Of the six Mesolithic samples one comes from Cheddar Cave and two from Aveline's Hole and thus date to the early Mesolithic (ranging from 8750-7982 cal BC), two more can be grouped at the very start of the late Mesolithic from Kent's Cavern and Ogof Yr Ychen in Wales (7593-7146 cal BC) and only one from Cnoc Coig on Oronsay can be said to directly reflect the very late Mesolithic population of Britain around the transition dating to 4256-3803 cal BC (5492±36 BP, SUERC-69249) (Brace *et al.* 2019). This also means that these six individuals actually represent a huge span of time in Holocene prehistory terms, some 4,500 years, while only actually providing genetic and demographic information for principally the earlier Mesolithic of southwest Britain (**n=5**) and just one is a late Mesolithic example from western Scotland (**n=1**). There is also a problem of Neolithic sample chronology. The Neolithic can roughly be said to start around 4,000 cal BC in southeast Britain, and potentially even earlier in Ireland as discussed above. If we can accept these timeframes then none of the 67 Neolithic samples provide a directly radiocarbon dated individual living in this period. The earliest individuals lived perhaps 6-8 generations after this initial period and most far longer. The nearest two directly dated are from Burn Ground, Gloucestershire, dated to 3930-3710 cal. BC (5023±34 BP, OxA-17173) and MacArthur Cave, Scotland, dated 3951–3780 cal. BC (5052±30 BP, SUERC-68701) (Brace *et al.* 2019). Coldrum Barrow in Kent is one of the earliest Neolithic monument structures in Britain, from probably the first area that became Neolithic, and the aDNA sample retrieved here can be contextually dated to 3980 – 3800 cal BC (Wysocki *et al.* 2013). The vast majority of the rest of the samples in the Brace *et al.* (2019) study date from many centuries after the initial transition period of c.4,000 cal BC. It is therefore possible that failure to find admixture events in these samples may be the result of not sampling the first generations of the early Neolithic founding community that originally migrated into Britain. This is particularly important if the initial wave of settlers came from a different area of continental northern Europe than the Mediterranean route Iberian group who ultimately end up replacing them and dominating early Neolithic genomic ancestry. The result would be that Brace *et al.*'s (2019) picture of aDNA demographic change may not be reflecting the process of transition itself at all. If the general scenario proposed by Sheridan (2010) of multiple strands of contact taking place from different sources in Europe is accurate, then this current genome picture may more accurately be capturing the consequences of a large, and increasing, influx of early Neolithic people with Iberian Neolithic ancestry coming into the country several hundred years after the transition period, possibly in her fourth Normandy derived strand. If these new groups were sizeable enough, and there was limited inter-Neolithic group mixing with previous groups, they may have demographically swamped the signals from the first founding generations as Ray & Thomas (2018) suggest, obscuring the original geographical source and the true extent of the initial admixture contact process with pre-existing Mesolithic groups.

The reliability of the aDNA interpretations also rests on these samples reflecting the genetic profile of the whole of Mesolithic Britain, and it seems somewhat improbable that this could be the case from this single sample from Cnoc Coig. The archaeological evidence of late Mesolithic lithic variation and possible movement of people from the loss of Doggerland (Coles 1998; Waddington 2015) suggests the potential for significant regional diversity. We need more data on the genomic makeup of late Mesolithic people from southeastern and eastern England (who are currently totally unsampled) to be confident that this lone late Mesolithic sample is truly representative of the wider population. Hypothetically, if a Mesolithic community in southeast or eastern England was significantly different, as Cummings (2017, 45) proposed, it may have had very little contact with the west Scotland Cnog Coig group, with a recognisable genetic difference thus developing by the terminal Mesolithic – something missing from this current aDNA analysis. The Cnoc Coig individual was living a regionally specific hunter-gatherer-fisher lifestyle on the northwesternmost reaches of late Mesolithic Britain, and as Brace *et al.*'s (2019) own aDNA results, and Charlton *et al.*'s (2016) isotopic and genetic evidence for this area suggests, this particular population may have been geographical and culturally isolated. Perhaps living in separate co-existence with early Neolithic farming groups for several centuries. Thus, this single person's genome, and the nature of admixture events in this one area, should be treated with caution when expanded to represent the rest of the country. If the Brace *et al.* (2019, 767) estimate that the late British Mesolithic contribution to the ancestry of arriving early Neolithic communities is in the order of <10%, but that their pre-existing continental European hunter-gatherer ancestry was in the order of 25-45%, then it is conceivable that a distinct southern or eastern British Mesolithic population that was more closely affiliated to continental Europe hunter-gatherers and farmers is being missed in the interpretations of this study. This would not perhaps affect the ultimate picture of large demographic change that Brace *et al.* (2019) propose in the later stages of the early Neolithic, but it might make the nature of cultural change over the actual transition more complex and regionally varied than this study suggests in its interpretations. Brace *et al.* (2019, 767) attribute the differences, between minimal hunter-gatherer ancestral contribution in the Welsh early Neolithic groups of c.18% compared to the c.30% in southern England, to these older (>500 years), pre-arrival, continental European introgression events. An alternative explanation could be that a long history of contact and partner exchange between a genetically distinct late Mesolithic southern British group and northern Neolithic Europe had very gradually driven up the hunter-gather British ancestry component of Neolithic communities in Northern France and is obscuring the interactions, or nature, of groups that then first crossed into southern Britain. As Ray & Thomas (2018, 86) have argued, long-term and expanding population 'infiltration' might have dramatic genomic consequences but would have produced far less vivid cultural effects or individuals' actual lived experience. More British human remains of late Mesolithic and the earliest Neolithic date, particularly from southeast England, are required to help clarify these possibilities or perhaps help provide further detail and support to the model now proposed by Brace *et al.* (2019). Having reviewed the diverse models of the transition from the Mesolithic to the Neolithic, it is clear that the interpretations have tended to become polarised with some scholars emphasising the complex archaeological record to suggest there was an adoption of farming by indigenous hunter-gather communities. Contrasting models emphasise scientific data such as isotopic and aDNA evidence to favour models suggesting significant population turnover and dietary change at the transition. However, as noted, these hypotheses currently rest on small aDNA sample numbers, especially from the key transition period around 4,000 cal BC. Such debates highlight the value of investigating the transition using a wider range of material cultural evidence including the woodworking techniques as discussed in subsequent chapters.

Chapter 3. Worked wood traditions in Mesolithic and early Neolithic Britain and Ireland

This chapter provides a review of the worked wood assemblages from Mesolithic and early Neolithic sites in Britain and Ireland. **Section 3.1** begins with a discussion of the difficulties in British and Irish Mesolithic studies, due in part to the dominance of lithics as the best surviving artefact type from the period. The section also sets out the overall relevant benefits, differences and drawbacks between data from worked wood and lithic assemblages, and notes the potential of organic objects to illustrate the more complete range of material culture. **Section 3.2** and **Section 3.3** sets out the analysis of previous published and unpublished worked wood reviews and the information that they have provided. **Section 3.4** details a comprehensive original review of the sites and assemblages with worked wood from Mesolithic Ireland and Britain from published and unpublished sources, with analysis of the information from artefacts from those sites. **Section 3.4.3** sets out the comparable worked wood assemblages from early Neolithic sites, the information they provide relevant to the transition debate and the potential of waterlogged sites for preservation of more wooden artefacts in the future. **Section 3.5** sets out how to make best use of the artefact types from worked wood sites, and the rationale for investigating specific artefact types such as pointed ends. Finally, **Section 3.6** reviews the results of this analysis, and the potential of studying Mesolithic and early Neolithic woodworking as a subject in its own right.

3.1 Mesolithic material culture studies; comparing wood and lithics

British Mesolithic studies have historically been focused on lithics with much less investigation of other find types that can be analysed to understand or reconstruct past communities. Historically, there has been small numbers of organic objects such as antler, bone, and wood to understand the wider range of cultural activity (Bell 2007; Mellars 1974; Woodman 2015). The problems caused by this lack of broader material culture have been consistently emphasised in the recent general reviews of the Mesolithic by Mithen (1999), Milner (2006), Bell (2007) and Tolan-Smith (2008). Tool types such as the ‘microlith’ have thus tended to dominate any regional, cultural, and chronological models for the period (Bell 2007; Mithen 1999; Tolan-Smith 2008; Warren 2005). For example, in the 1970s Mellars (1974) could only cite the single British site of Star Carr as holding any wooden finds. Some 30 years later by the turn of the 21th century only two British Mesolithic sites of Star Carr and Eskmeals had published and dated worked Mesolithic wood, providing very little comparative data or scope to assess the use of wood in the period (Bonsall *et al.* 1994; Clark 1954; Taylor 1998a). Compare that with struck flint assemblages in thousands, if not tens of thousands, from important sites found in that century such as early Mesolithic Thatcham, Berkshire, (n=20,000) or Oakhanger V, Hampshire, (n=200,000) (Healy *et al.* 1992, 47;

Rankine 1953, 25), which illustrates why lithics have long dominated the available evidence for study.

However, over-reliance on lithic analysis to reconstruct prehistoric activities and communities can be problematic as there can be no security that there are always clear correlations between use and meaning in the distribution and variation in recovered assemblages. Bell (2015) has previously drawn attention to the need to provide more than one source of independent information to reconstruct prehistoric lives, through multi-proxy approaches and the 'triangulation' of information, to provide more reliable interpretations. Ethnographic research in Papua New Guinea by Sillitoe & Hardy (2003), with some of the last communities to use stone in preference to metal tools, has shown the considerable complexity in patterns of lithic use, manufacture, and disposition. The work revealed that patterns of use and deposition could be due to a varied combination of sometimes intentional, other times opportunistic, and sometimes practical concerns, such as burying unwanted lithics so they did not cut the feet of people (Sillitoe & Hardy 2003). The study also noted that 'the majority of Wola material culture, including all clothing and decoration, all musical instruments, all evidence of hunting and food processing, axe hafts, agricultural tools, fire lighters, bags and containers would be unlikely to survive archaeologically' as it was organic (Sillitoe & Hardy 2003, 556). Authors such as Coles *et al.* (1978), Coles & Coles (1986, 1989, 1996) and Hurcombe (2008, 2014), have approached this topic from the archaeological perspective, all arguing that for stone-age prehistoric communities the vast majority of everyday objects were likely organic and are thus similarly now largely invisible in the record. Coles (1984, 11-12) provided a useful summary of the prehistoric material culture categories, with 13 types that are relevant to the Neolithic and Mesolithic, estimating that using ethnographic evidence 75-90% of material culture will be organic in nature, with some sites even 'entirely organic' and lost without wetland or waterlogged preservation. **Section 3.5** below sets out the range of information on aspect of every-day life, social interactions and resource management that organic objects like worked wooden artefacts can provide. The wider importance of the organic and environmental aspects of hunter-gatherer life has also been explored by Zvelebil (1994) and Hurcombe (2000), who persuasively argued that incorporating the wider organic element in the archaeological record was vital as plants likely formed a substantial part of prehistoric hunter-gatherer diets and raw materials. The lack of recognition or analysis of this type of material culture almost certainly reflects the limited potential for organic preservation on most sites, rather than the relative importance of lithics and organics in past communities.

These views have been supported by Coles & Coles (1986, 1989), who proposed that the extensive evidence of their work in the organic rich sites of the Somerset Levels demonstrated this reality, with less durable materials (such as wood) originally forming the vast majority of the everyday practical objects of a given community's needs. In their view directing energy into finding sites with good organic preservation was essential if reliable interpretations were to be made (Coles &

Coles 1989). Coles (2001, 22) further made the point that it is not the everyday lives of elites, but rather the ordinary folk, or 'commoners' that wetland archaeology and preserved organics can most usefully investigate. Hurcombe (2008, 85) has succinctly defined this overlooked information as the 'missing majority'; reflecting again her view that material culture of past people was likely dominated, and perhaps driven, by organics.

Taking into account all these arguments, it seems reasonable to suggest that the cultural nuances, changes, or sophistication of the full community are likely concealed if we are only analysing the output of members, or the specific activities, that were knapping and sometimes using stone tools. It also perhaps remains to be established how widespread and skilled lithic knapping was within a given Mesolithic group, as it is conceivable that it may not have been a universal practice. Instead, the ability may have remained constrained to a select number of skilled individuals by customs or cultural agendas. Walker (2015) highlighted that it is possible that the production of Neolithic axe-heads for example could have been controlled in a similar way to ethnographic examples identified by Toth *et al.* (1992) in the New Guinea Highlands, where adze-head production was a reserved skill and carefully curated by a master maker. If this were the case for comparable Mesolithic tool types then it could mean that some tools may have remained conservatively, and purposefully, unchanged by cultural design and did not develop in tandem with wider cultural or social transformations and assessing them for such information will be inherently problematic.

3.1.2 The significance of stone and worked wood artefacts

It is certainly the case that individual scatters or assemblages may be the product of small numbers of skilled knappers. Expert knapper John Lord produced a lithic reference collection for use in woodworking tests in this study that was recorded in detail during its manufacture. Using Norfolk flint, in five hours he prepared nine blade cores that in turn produced 191 blades, the most productive core producing 30 blades alone. From this blade collection nine were made into microliths, while core preparation flakes were used to make 10 side scrapers, 10 end scrapers, five microscrapers, seven burins, five truncated pieces, five microdenticulates, five denticulates, two fabricators, five pierces and two drill bits (see Table 3.1 below). On a second day of work, he managed to produce a total of seven flaked tranchet adzes, two flaked core axes and two Neolithic rough outs in just over an hour and a half. During this process, Lord was able to produce a flaked tranchet adze in as little as four minutes, on average taking just eight minutes, and make a Neolithic rough out in 11 minutes as set out in Table 3.2.

Tool	No. of tools	Time taken	No. tool types	Notes
Prepared blade cores	9	Not individually recorded	1	
Blades	191	1 hour 15 mins	2	Including time to prepare 9 cores, blades then used to make other tools.
Microlith blanks	30	15 mins	3	20 left unused
Burins	7	Not individually recorded	4	No. 3-15 timed as one category, taking 3hrs 30 mins.
Drill bits	2	Not individually recorded	5	
Crescent microliths	4	Not individually recorded	6	Made from blades
Scalene microliths	5	Not individually recorded	7	Made from blades
Microscrapers	5	Not individually recorded	8	
Awls/piercers	5	Not individually recorded	9	
Fabricators	2	Not individually recorded	10	
Denticulates	5	Not individually recorded	11	
Microdenticulates	5	Not individually recorded	12	
Truncated pieces	5	Not individually recorded	14	
End scrapers	10	Not individually recorded	15	
Side scrapers	10	Not individually recorded	16	
Total	**295***	**5 hours (all tools)**	**16 types**	

Table 3.1 Day 1: John Lord lithic tool production

Tool	Time: Tool 1	Time: Tool 2	Time: Tool 3	Time: Tool 4	Time: Tool 5	Time: Tool 6	Time: Tool 7	Total no. tools	Total (min.)
Tranchet adze	9	4	8	9	6	7	13	7	56
Mesolithic flaked core axe	7	7						2	14
Neolithic axe rough out	15	11						2	26
							Total	**11**	**96 (1 hr 36min)**

Table 3.2 Day 2: John Lord axe and tranchet adze production

*This is the number of tools individually made, some items reworked; blades becoming microlith blanks then crescent microliths.

These results cited above were not obtained with the goal of a comprehensive ‘work-time’ analysis study, and it seems probable that if the aim was to maximise production many more tools could no doubt have been produced over a single day. However, they do illustrate how quickly (at a minimum) Mesolithic assemblages can be produced by single highly skilled individual. Just for comparison at the recently published early Mesolithic site of Asfordby, Leicestershire, with several episodes of activity dating from 8310-7220 cal BC interpreted as a temporary hunting camp, the excavators recorded 196 finished tools of various types and 242 blades and crested blades (Cooper 2017, 56). Based on John Lord's level of production, even if that came from one specific occupation period it could perhaps represent the work of one skilled knapper in the group over as little as a single day. The speed at which he is able to produce a large lithic tool like an adze or axe also raises the question of whether it was the axe-head or haft that was in fact the most valuable part of a tool. Experimental work by Harding (2014, 41-51) showed that the manufacture of even one wooden haft using a collection of replica lithic tools can be much more time consuming (3-4 days for him) than producing the polished flint axe-head itself (eight hours of polishing plus time to knap). This suggest that even a skilled woodworker may have needed multiple days to create the haft for a flaked axe-head that could itself be made in a matter of minutes. Scholars such as Edmonds (1995), Walker (2015) and Cooney (2008) have also argued that the further complete polishing of objects required significant investment of labour and that as a result axe-heads of the Neolithic may reflect a different, possibly wider, cultural identity and contained symbolic value outside of simple utilitarian concerns of a more durable polished blade edge. This also reinforces the notion that that a flaked axe may be quite different objects to more highly worked lithics in terms of skill, time spent and perhaps relative value. This appreciation of time invested, and the skill level required, should also remind us that that cultural models based on lithics alone may not necessarily reflect the whole community, nor the most time consuming, perhaps even skilled, aspects of producing certain composite tools like a flaked axe-head and haft.

Finally, it is also useful to consider what bias may exist in lithic site survival or discovery. Over 50 years ago Mellars (1974) tentatively suggested that other non-microlithic stone tools such as tranchet adzes or flaked axes could form the basis of data to define cultural groups. However, there is a problem in that typology, morphology or even presence versus absence may reflect only functional aspects and not cultural features. For example, the need to cut trees in more densely forested lowlands, but not in temporary highland camps, makes cultural or chronological comparison using this tool type between sites problematic (Mithen 1999). Factors such as the quality and accessibility of suitable raw materials will also affect the use and production of large tools such as adzes and axes, thus likely influencing the interpretation of lithic assemblages on given sites by archaeologists (Edmonds 1995). The term 'lithic' may of course include other forms of stone material culture, for example the shale beads of Nab Head (David 2007), or even the wonderful inscribed pendant from Star Carr (Milner *et al.* 2016). However, these important artefact types have proven to be frustratingly rare and have been limited to too few sites to form the basis of coherent large-scale models of Mesolithic culture and change on their own at present. Bell (2007) also noted that the information from lithic datasets themselves can be an issue, with many deriving from older collections or scatters with little stratigraphic integrity. There is also a problem in basing chronological models and site function models on measures of relative 'artefact' frequencies of microlith types, as microwear analysis has demonstrated that even defined tools such as the microlith can be multi-functional, not just projectiles, and were thus likely hafted in a variety of ways and used on different materials (Evans 2017, 72; Grace 1992; 60). There is also evidence from British microwear studies of Mesolithic assemblages such as Goldcliff East and Thatcham that unmodified struck flakes were an important source of ad-hoc lithic tools in their own right and should be considered when interpreting site function, tool use and perhaps even chronological changes (Grace 1992, 60; van Gijn 2007, 118).

Overall, the nature of the archaeological record dictates that Mesolithic lithic datasets are vital tools to understand chronology and social change. However, they can be subject to bias, issues in analysis, and are likely to only represent a part of the objects used and manufactured as discussed above. It then follows we should ideally also try to avoid relying on this one type of evidence alone to reconstruct and interpret broad cultural patterns and changes over time. To really get to a better understanding of how people lived and transformed lithics are one (but not necessarily the most) important aspect of a given prehistoric community's past activity and culture. More accurate understanding will come with the study of the full range of objects and materials used by groups such as wood. Exceptionally rare and important artefacts such as the Clacton yew spear now dated to Lower Palaeolithic interglacial Marine Isotope Stage 11 (Bridgland *et al.* 1999; Oakley *et al.* 1977) and latterly the recovery of the Schöningen spears excavated in Germany in 1994-8, now dated to around 337-300,000 BP, (Conard *et al.* 2015; Richter & Krbetscheck 2015) show the potential for ancient wood survival if the right sedimentary conditions are present and can be explored. In the context of the Mesolithic, the potential for locating, accessing, and excavating sites with surviving wood is potentially far greater than these often deeply buried Palaeolithic sediments, particularly given the frequent association of Mesolithic sites with wetlands and wetland edge locations (Bell 2007; Bell 2020). Brunning (2000), Sands (2012) and Coles & Coles (1986, 1989) have persuasively set out the case for examining artefacts made from wood as a source of archaeological information, highlighting the important information it has provided in understanding of prehistoric communities. These researchers have shown that worked wood, its artefacts, species used, manufacturing techniques and the waste products, are all a very useful record of the technological choices and decisions of past communities. What is analytically required is recording sufficient numbers of artefacts to reach a necessary threshold to sustain comparative analysis and review of a coherent artefact group. If suitable organic find assemblages can be identified and analysed then it allows comparison with the knowledge and models set out by lithic analysis with that goal of triangulation from independent data sources. Recent work by Elliott (2012) on British Mesolithic antler tools, axes and adzes undertook this for one aspect of the Mesolithic organic record and this study aims to provide more material culture data via assessing the nature of worked wood in a complementary way. More broadly, this should allow for the testing of current chronological and cultural interpretations, and perhaps assumptions, based on the study of stone tools and see to what extent they apply across wider material culture categories.

3.2 Previous worked wood reviews and knowledge

3.2.1 Historic review and investigation of British prehistoric worked wood

Worked wood is the primary category identified and under investigation in this work. However, if it is to be used to analyse material culture and changes over time then access to suitable datasets is necessary. Some of the first clear indications of surviving worked wood of Mesolithic and Neolithic age in Britain and Ireland emerged in the 19th century with work such as Mackinlay's (1862) identification of polished axe type toolmarks on timbers form the Dhu loch crannog, Scotland, and Munroe's (1890) wide-ranging synthesis of lake dwelling evidence noted the association of worked wood with stone polished 'celts' and flaked lithics artefacts. At Ehenside Tarn, Cumbria, finds such as an axe haft with *in situ* - axe-head, paddle and ad-hoc wooden tools revealed the British presence of Neolithic communities combining lithic and sophisticated wooden objects (Darbishire 1873). The investigation and publication by Dymond (1880) of the Abbot's Way Neolithic trackway in Somerset in the 1830-70s showed that major structural timbers could survive, although its actual age was not understood at the time, but it was one of many such finds of waterlogged trackways in the 19th century that came through peat cutting, gravel extraction, road building and river canalisation (Coles & Coles 1986; O'Sullivan 2007). In Ireland, Dawkins (1880, 269) discussed a possible Neolithic timber 'house' or structure with two levels reportedly found in peat at Drumkelin Bog in 1833 apparently associated with a 'stone celt' that left chisel type marks on the wooden timbers and had timbers fitting together in rough mortice joints (Mudge 1836). Other wood artefacts such as dugouts or log boats were also regularly disturbed and noted during this period across Ireland and Britain, though sadly many did not survive for later study (Coles *et al.* 1978; Gregory 1997; McGrail 1978). Towards the end of the century the identification and excavation of the Iron Age Glastonbury Lake Village by Bulleid and Gray from 1893 demonstrated that *in situ* wooden artefacts and very extensive remains of prehistoric structures, comparable in scope to the famous Neolithic Alpine lake sites, could survive millennia and provide new information for prehistoric settlements and craft activities (Bulleid & Gray 1911, 1917). As more finds were uncovered, the increasing use of radiocarbon and dendrochronology dating in the 1960s allowed for more direct scientific dating of wooden artefacts rather than relying on associated typological grounds alone (Baille 1982; Renfrew 1973). These 20th century scientific advances also coincided with notable major wetland projects that contained Neolithic archaeology such as the work of Bryony and John Coles in the Somerset Levels of England (*Somerset Levels Papers* 1-15), Barry Raftery in the Mountdillion Bogs of Ireland (Raftery 1996), the Irish Archaeological Wetland Unit's investigation of thousands of peatlands and wooden structures (set out by O'Sullivan 2007, 154), and the 1990s survey of the Shannon Estuary in Ireland (O'Sullivan 2001). These illustrated the exciting possibilities for archaeological investigation of large assemblages of Neolithic structural worked wood and survivability of rare items such as domestic objects. In comparison to the Neolithic record, knowledge of the British and Irish Mesolithic worked wood technologies has historically been much more limited. In Mellars' (1974) review of British Mesolithic material culture he could only discuss two types of known wooden artefacts; the wooden paddle and birch bark rolls both found and identified at Star Carr by Clark (1954).

3.2.2 Recent worked wood assemblage reviews

Coles *et al.* (1978) recognised the need consider worked prehistoric wood in detail and provided an important development with the first wide-ranging examination of British and Irish prehistoric woodworking. This attempted to provide some information on the geographical spread and potential across the Palaeolithic to Iron Age periods. However, only five Mesolithic sites and 63 Neolithic (or probable Neolithic) sites with worked wood could be identified in the work (Coles *et al.* 1978, 5). Coles *et al.*'s (1978, 5) report explicitly did not set out to provide a fully comprehensive account of every site, record or tabulation of every piece of worked wood – highlighting the fact that a single trackway excavated may contain hundreds if not thousands of individual cut pieces and thus artefacts. The work also purposely excluded 'a vast quantity of wooden artifacts that may well be of pre-Roman date' such as posts, stakes, dugouts and 'roughly prepared logs' from crannogs in their review and numerical tabulation as it principally attempted to illustrate the overall breadth and variety of remains rather than the actual number of finds (Coles *et al.* 1978, 5). In this goal it was certainly successful, highlighting the broad survival of different structures, artefact types and aspect of prehistoric culture in suitable waterlogged areas.

No.	Review	Description	Area covered	No. Mesolithic sites	No. Neolithic sites
1	Coles *et al.* (1978)	Survey of sites, select finds, find types and woodworking techniques of worked wood from Palaeolithic - Iron Age	Ireland, England, Wales Scotland	5	63
2	Nayling (1989)	Assessment of structural wood excavated 1968-87.	England, Wales, Scotland	2	32
3	Murphy (2001)	Study of wood and wood charcoal.	England:West and East Midlands, East of England	0	2
4	Smith (2002)	Review of wood analysis work on excavated assemblages.	Southern England	1	27
5	Brunning (2007 [2003])	Results of 2003 survey on structural wood in England. Wider discussion includes worked wood sites in Wales not in survey dataset.	England (survey) and Wales (select results & sites).	10	75
6	Huntley (2010)	Waterlogged wood and charcoal from excavated sites	Northern England	1	5
7.	Brophy & Sheridan	Structural wood and finished worked wood artefacts	Scotland	0	8

	(2012)				
8	Gearey *et al.* (2013)	Survey of archaeological sites in the Bord Na Móna peatlands	Republic of Ireland: Only the Bord Na Móna (government owned) peatlands,.	1	13

Table 3.3. Reviews and surveys of worked wood assemblages in Britain and Ireland

To date there have only been a number of later partial British overviews of different aspects of wooden artefacts, types or records relevant to these periods as listed above. In Ireland, the potential of waterlogged sediments has been well attested to by the huge number of trackways discovered as recently set out by Bell (2020). However, in terms of Mesolithic and Neolithic Irish artefacts, there is as yet no up-to-date comprehensive synthesis of the complete worked wood assemblages to explore connections between sites and periods. The recent Irish Bord Na Móna (BNM) peatland survey report by Gearey *et al.* (2013, 27) identified 4,358 archaeological sites in these areas alone to illustrate how profitable such a review would likely be. For Britain, the study by Nayling (1989) focused on structural wood recorded and excavated exclusively between 1968-87 in England, Wales, and Scotland, noting 32 sites with Neolithic wood. Although these were in fact concentrated in England and none from Wales or Scotland, with 28 from the Somerset Levels alone as the product of the intensive research and recording by the Somerset Levels Project (SLP). No detailed review of Mesolithic wood was undertaken in Nayling's (1989) report as only two sites had been found in the survey's timeframe: a possible line of roundwood in the Vale of Pickering (Nayling 1989, 24 citing Schadla-Hall pers. comms.) and a worked tree trunk at Sproatley, Humberside (Nayling 1989, 24 citing Crowther pers. comms.). Other relevant, if tightly focused, studies had specific geographical remits, such as Murphy's (2001) overview of wood and macroscopic wood charcoal from west and east Midlands and the east of England, with no Mesolithic sites recorded and only very cursory discussion of the important Neolithic Etton Causewayed enclosure and Haddenham mortuary structure sites. As the author (Murphy 2001, 4) noted this was intended to be mainly a focused review of the 'more substantial and/or informative reports'. Smith's (2002) review of wood analysis in southern England provided details on species and woodland clearance analysis from various sites, with one Mesolithic site and 27 Neolithic ones noted in this constrained geographical area. Brunning's 2003 survey of English prehistoric waterlogged wood identified 738 sites in his comprehensive and immensely useful PhD analysis of structural wood in England (Brunning 2007, 14). More information, including sites in Wales, was included in the work's detailed discussion and overview section (Brunning 2007, 14). Even here Brunning (2007) was only able to increase the possible number of Mesolithic sites to 10, with 75 Neolithic sites with structural wood recorded and discussed (Brunning 2007, 18). More recently, the study by Huntley (2010) on wood and charcoal from excavations in Northern England reported one Mesolithic site and five Neolithic ones with waterlogged worked wood artefacts in this area. The recent publication of the Star Carr excavations allowed for an up to date, if fairly limited and brief, review of British Mesolithic woodworking sites and finds, with some comparison against other European sites, but did not have space for in depth analysis of overall worked wood assemblages (Taylor *et al.* 2018). Overall, with these reviews English sites have received a reasonable, if often constrained, level of review to date, areas such as Wales have had little specific overview since Nayling's (1989) general study and Brunning's (2007) focused work on the structural wood sites. In Scotland, review of worked wood in the SCARF National Framework (Brophy & Sheridan 2012) noted a total absence of Mesolithic wooden artefacts, and only eight sites with securely, or very likely, dated Neolithic work wood artefacts described. All suggesting that an up-to-date review of the range of worked wood sites is a timely endeavour.

3.3 Previous topic specific studies of Mesolithic and Neolithic woodworking

Whilst broader synthesis work has thus far been lacking for this subject, usefully there have been a number of studies on wood artefact classes relevant to the British and Irish Mesolithic and Neolithic that have produced some very useful analysis on specific features of worked wooden artefact categories. These include considerable discussion of lake dwellings or crannogs (Cavers 2010; Crone 2012; Dixon 2004; Fredengren 2002; Garrow & Sturt 2019; Midgley & Saunders 2012; Munroe 1890; Wood-Martin 1886), bows (Clark 1963; Prior 2000; Sheridan 1992), hafts (Harding 2014; Harding & Young 1979; Green 1978; O'Sullivan 1996; Taylor 1998b; Sheridan 1992), a variety of topics including hafts, bows, miscellaneous tools, vessels, trackways, boats, burial structures, coppicing, felling and wood working by Coles *et al.* (1978), roundwood pointed ends by Coles & Orme (1985b), dugouts (Fry 2000; Gregory 1997; Lanting & Brindley 1996; McElovgue 2002; McGrail 1978; Mowat 1996), wooden figurines (Coles 1990) and domestic objects (Earwood 1993). Raftery (1990, 1996, 1999) has previously considered the evidence and social implications of trackway building in Europe, followed by a detailed review of prehistoric structural wood in England and Wales by Brunning (2007), an up-to-date analysis of structures by Brunning & McDermott (2013) and recently a wide-ranging synthesis of trackways and prehistoric movement by Bell (2020). A consideration of aspects of Neolithic and Mesolithic timber and roundwood woodworking techniques have been evaluated by Bamforth *et al*. (2018a; 2018b), Brunning (2000, 2007), Coles & Orme (1983, 1985a, 1985b), Coles & Coles (1986), Darrah (2006), O'Sullivan (1996b), Taylor (1998a, 1998b, 2011a, 2) and Taylor *et al.* (2018). Finally, there have also been a number of experimental archaeology studies focused on tools and woodworking techniques of the Mesolithic and Neolithic, which are covered separately in detail in **Chapter 7** in the context of an experimental programme as part of this work.

While this study is primarily intended to investigate the use of wood in terms of its use as a raw material within finished objects and worked wood assemblages, it is worth noting that wood and woodlands can also be used as resource and harvested for other purposes. Firewood is after all a tool in its own right to keep you warm, safe from predators and used to prepare materials and food. Trees can also be managed by logistically simple practices such as selective draw felling, coppicing, and pollarding to ensure a regular supply of certain timber or roundwood types (Rackham 1977, 1979, 1980; Tabor 2012, 2013). Evaluation of the Mesolithic woodland landscape has been considered in terms of pollen evidence, from the notion of a whole landscape of wildwood by Fox (1932), to the more open ecology suggested by Vera (2000) through animal grazing, the impact of beavers (Coles 2006), or a consideration of the complex interaction of natural causes and human activity and a mosaic of woodland area types as set out by Bell & Walker (2005) and Bell (2020). The purpose of human activity in the regular cutting of woodland or burning of cover can be seen as an intentional strategy to manage and control clearings in the landscape for hunting, promotion of certain useful plant or tree species, enabling access for domesticates or even as part of social enculturing practices (Bell 2007; Davies *et al.* 2005; Mitchell 2005; Overton & Taylor 2018; Warren 2003). Noble (2006) highlighted the possible role of woodland and trees in ceremonial practices and belief systems, while the ritual impact and interaction of woodlands with specifically Neolithic groups was considered in his later monograph (Noble 2017).

Certain tree species can additionally produce very useful by-products such as lime bast cordage, tinder or birch bark for matting, containers, fish floats and tar that can become incorporated as elements within other more complex composite items (Earwood 1993; Fletcher *et al.* 2018; Taylor *et al.* 2018). Trees of course are also able to provide food products in their own right from fruit such as apples to oak acorns, leaf litter for domesticates to the very useful cobnut or hazelnut of the hazel tree (Lambert 2016; Mithen 1999; Mithen *et al.* 2001; Zvelebil 1994). Coles & Orme (1985a) analysed the potential properties of different woodland species and there has been extensive discussion over the evidence and extent in the use of burning in the Mesolithic to structure the flora (Bell *et al.* 2000; Bell 2007; Bishop et al. 2014b; Simmons 1979). Other evidence and arguments for and against forms of coppicing or woodland management have been covered by numerous authors (Bamforth *et al.* 2018a; Bishop *et al*. 2014; Brunning 2007; Coles & Coles 1986; Crone 1987; McQuade & O'Donnell 2007; Out *et al.* 2013; Rackham 1977, 1979; Warren *et al.* 2014) and use of trees for food production is an important topic in the overall economic basis of communities (Bishop *et al.* 2014a; McClatchie *et al.* 2019; Schulting 2008; Smith 2001, 2011; Warren *et al.* 2014; Zvelebil 1994). Finally, substantial, and on-going, discussion has also focused on the purportedly dramatic elm decline phenomenon dated roughly around the Mesolithic to Neolithic transition, originally interpreted as caused by human farming related activities such as land clearance and use of leaf litter as domesticate fodder (Iversen 1941; Parker *et al.* 2002; Troels-Smith 1960). More recently analysis has suggested that there is considerable complexity to the sequence, chronology, and anthropomorphic nature of this 'event' across Britain and Ireland(Batchelor *et al.* 2014; Bell 2020; Griffiths & Gearey 2017; Kearney & Gearey 2020; Whitehouse et al. 2014).

3.4 Recent investigations

The section above illustrates how much information can be gained from the study of the full range of wood and woodland uses. However, this study has chosen to focus on the new information from worked wood assemblages from the Mesolithic and early Neolithic periods as this is an area that has received less attention to date. Fortuitously, over the last few decades the number of sites, finds and overall British and Irish worked Mesolithic record has seen a significant increase and improvement with 31 dated, stratified or contextual dated sites now recorded or currently under investigation.

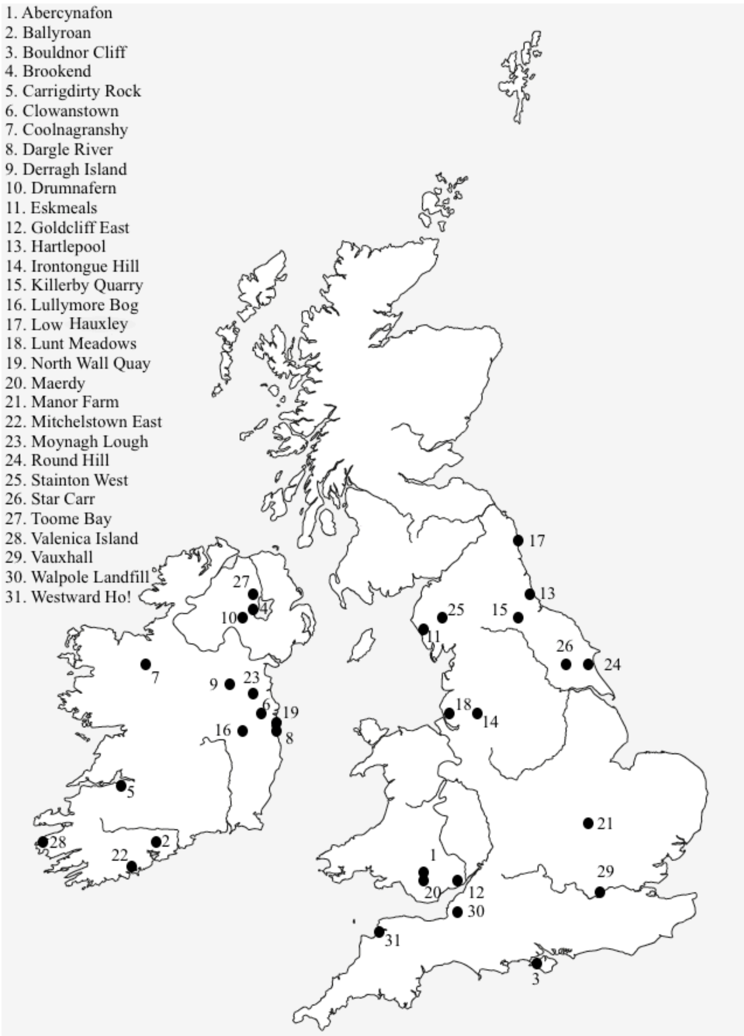


Fig 3.1 Location of Mesolithic British and Irish site with worked wood considered in this study

3.4.1 Worked wood assemblages from Mesolithic Ireland

In Ireland, notable important Mesolithic finds include the identification of worked wood, a possible platform, four baskets, and a series of substantial posts at a palaeolake site of Clowanstown, Co. Meath, with 12 radiocarbon dates dating a series of fish traps to 5300-4720 cal BC (FitzGerald 2007; Mossop 2009). Analysis suggested the baskets were made from alder, birch and rose wood, using a twinning basketry technique and probably made in one session of manufacture (FitzGerald

2007; Warren *et al.* 2014). Elliott & Griffiths (2018) highlighted that the radiocarbon evidence suggested the use of the baskets spanned multiple phases of activity across hundreds of years, indicating the consistent repetition of wood working skills and techniques. Woodman (2015, 112) also speculated that many more similar sites to Clowanstown may lie underneath the deep Irish peat awaiting discovery.

Fig 3.2 A large section of one of the Clowanstown, Co. Meath, basket after conservation (FitzGerald 2007, 14; photograph John Sunderland)

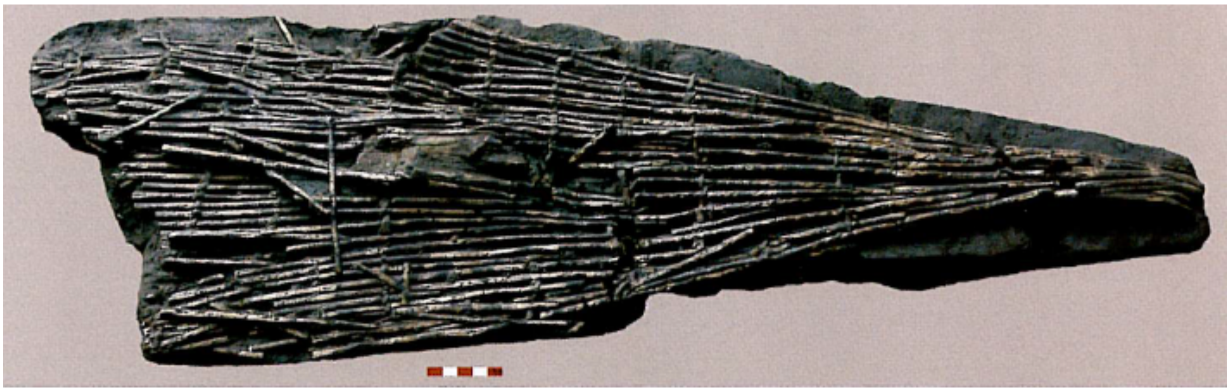


Fig 3.3 Part of one of the Clowanstown, Co. Meath, baskets with evidence of the twinning technique (FitzGerald 2007, 14; photograph John Sunderland)

At North Wall Quay, Dublin, excavation work recovered a variety of types of fish traps dated to 6100-5700 cal BC, with five distinct structures identified that included a wattle weir trap, two possible ebb weir traps, a basket trap, and a C-shaped trap (McQuade & O'Donnell 2007, 2009). Based on radiocarbon dating overlap for the five structures, it is likely they were used by perhaps the same, or at least within very close, generations of people (McQuade & O'Donnell 2007).

These appear to have worked on the basis of passive fishing, allowing the fish to be trapped as tidal waters receded (McQuade & O'Donnell 2007). The variety of trap types in just one location shows the sophistication and range of late Mesolithic fishing technology. The wood used was dominated by hazel, with some alder and one example of ash and dogwood respectively (McQuade & O'Donnell 2007, 574). Roundwood stake sizes clustered at 18-37mm in diameter and 7-10 years old, with the excavators suggesting the dominant selection of hazel of similar, consistent size, reflects management, possibly in a form of coppiced system, of nearby woodland resources (McQuade & O'Donnell 2007, 574). The North Wall Quay evidence is the earliest fishing structure evidence from Ireland or Britain, and these two sites have substantially improved knowledge of Mesolithic woodworking and fishing basketry in Ireland, providing useful data to compare with the Danish sites of northern Europe, and are of international significance.

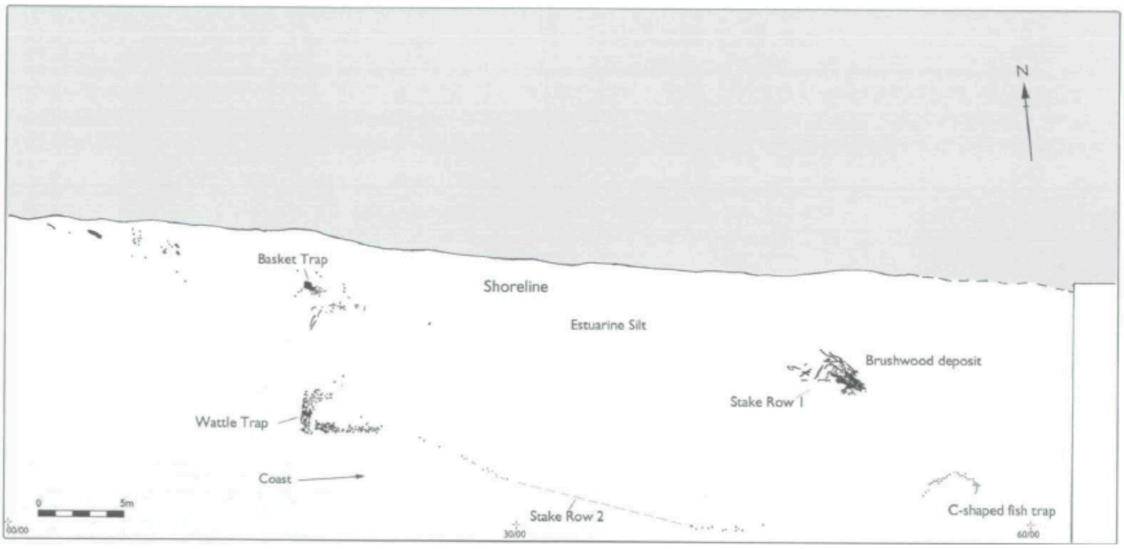


Fig 3.4 Plan of the North Wall Quay, Dublin, fishtraps (McQuade & O'Donnell 2007, 572)

Fig 3.5 Plan of the woven North Wall Quay basket and associated stakes (McQuade & O'Donnell 2007, 577)

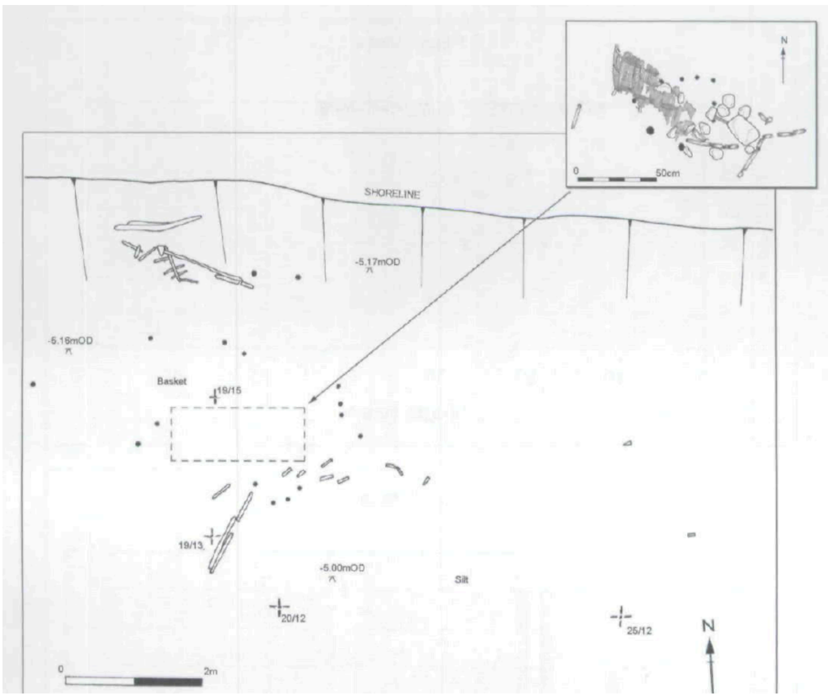


Fig 3.6 The North Wall Quay basket as shown in Fig 3.5 (McQuade & O'Donnell 2007, 576)

Elsewhere in Ireland, other potentially relevant sites include the possible Mesolithic brushwood and roundwood trackway at Ballyoran Layer 3, dated to 8200-7695 cal BC (8958±53, UB-6980) (Tiernery *et al.* 2010, 7-11). Although the excavators were not totally sure if its early date suggests natural causes, Woodman (2012, 8) appeared to accept it in later analysis. A lower Layer 4 may have included a possible plank-like timber, although undated – if it is anthropomorphic its stratigraphic position would suggest a similar early Mesolithic date (Tiernery *et al.* 2010, 7). Another possible trackway made of radially split pine was found at Lullymore Bog dated to 6210-4960 cal BC (Brindley & Lanting 1998), although Bell (2020) and Brunning (2007) were not convinced that it is securely a Mesolithic human-made structure. Bell (2020) further stated in his recent review that there is no unambiguous evidence for Mesolithic trackways in Britain or Ireland so the Mesolithic manufacture, or need, of such structures remains to be resolved.

There are few possible contenders for Mesolithic wooden watercraft known from Ireland, a poplar timber from Carrigdirty Rock, Co. Limerick, dated to 5490-5246 cal BC (5820±40, Gr-21936) has been suggested as a possible dugout (Lanting & Brindley 1996; O'Sullivan 1996a). Although O'Sullivan (2001, 72) later noted the unusual shape and species of the 'boat' compared to other Irish examples, the thinness of the plank, lack of toolmarks, and bark still intact on one side might mean it more likely had naturally split from a fallen tree. At Drumnafern, Co. Tyrone, a 6m long logboat was found although it is not reliably dated to the Mesolithic, and a poorly preserved possible logboat type object was found at Brookend, Co. Tyrone, dated to 5500 – 5300 BC (Warren 2020; Warren & Westley 2020).

Further Irish wood finds come from the excavations at Toome Bay, Co. Londonderry, by Mitchell (1955), which recorded a possible brushwood platform, *in situ* vertical pieces and some items of worked pine and hazel wood dated to 5726 cal BC (7680±110, Y-95). Other possible occupation sites with wood include Inch Island with a vertical post dated to the early Mesolithic at 7330-7050 cal BC and brushwood structure dated to 4230-3970 cal BC (Fredengren 2002). At Derragh Island, Lough Kinale, Co. Longford, Fredengren (2004, 2009) reported a platform or mound at around 20m wide made up of multiple brushwood layers, capped by what Woodman (2015, 114) calls an 'enigmatic stone platform' dating from 5500-4750 cal BC and thus into the Neolithic. Fredengren (2009) also reported several wooden stakes as well as thousands of Mesolithic and Neolithic lithics at the site. At Moynagh Lough, two and possibly three platforms were identified with brushwood bases located parallel to the shore (Bradley 1991, 2001). Platform 1 containing three occupation layers and 50 postholes, with Platform 2 dated to 4313-3980 cal BC (5270±60 BP, GrN-1 1443) (Bradley 2001, 300). Woodchip concentrations were reported and two pieces of worked wood were identified, a pine 20cm long 'wooden version of a bone point', and an elm worked roundwood piece 36mm long tentatively interpreted as part of a 'spear shaft' (Deevy & O'Sullivan 2007, 302). Woodman (2015, 114) cites an arrangement of 17 oak timbers at Dargle River, Co. Wicklow, dated to 4568-4356 cal BC (5642±46 BP, UB 4038) that may have been comparable wetland edge human structure although there were no associated lithics. O'Sullivan (1998, 54) described a wetland edge site at Coolnagranshy, Co. Roscommon, with Bann flakes, polished axe-heads and birch piles holding the structure in place. Finally at Mitchelstown East, Co. Limerick, a possible platform of oak and brushwood was found (Gown 1988; Woodman & Anderson 1990) and at Valenica Island, Co. Kerry, a form of timber and stone platform (Mitchell 1989) was dated to the Mesolithic but again had no associated lithics.

Overall, combined with the evidence from fish trap structures, dugout examples, and potential of wetland edge platforms and structures there seems the good reason to think that substantially more Irish Mesolithic worked wood can be found, if the right sites can be targeted and excavated. The use of wetland edge platforms appears to be a notable aspect in late Mesolithic activity in Ireland, although as some have few actual diagnostic finds, the best worked wood evidence currently comes from North Wall Quay and Clowanstown.

3.4.2 Worked wood assemblages from early Mesolithic Britain

In Britain, a series of important excavations and research projects has dramatically improved the Mesolithic worked wood assemblages with the detailed excavations, such as the large and complex Star Carr site, producing a huge amount of new information for woodworking technology and artefacts (Milner *et al.* 2018). Dating from 9385-9260 cal BC and then used for some 800 years the Star Carr assemblage now represents the single largest collection of worked Mesolithic wood and finished tools in Britain and Ireland, providing important information on species selection, roundwood sizes, potential evidence of woodland resource management and woodworking techniques and technology (Bamforth *et al.* 2018a; 2018b; Milner *et al.* 2018; Taylor *et al.* 2018). While the age of Star Carr is clearly very distant to period of the Mesolithic to Neolithic transition, the exceptional level of preservation and range of finds warrants detailed consideration as it provides a better understanding of Mesolithic organic culture and provides a reference point for the techniques employed in the late Mesolithic.

A reported 1602 pieces of worked wood were recovered in this project, with 38 finished objects defined as artefacts also identified (Bamforth *et al.* 2018b, 74). These finished tools included seven digging sticks, five stakes, three hafts, a peg, wedge, a plank, two containers, decorated item, ad hoc tools, and a possible bow made from a tangentially cleft length of willow (Bamforth *et al.* 2018a; Taylor *et al.* 2018). To this can be added the possible paddle, carbonised roundwood haft in an elk antler adze, and bark rolls originally found by Clark (1954). Taylor *et al.* (2018) noted that at least some artefacts were finished beyond simple functional concerns, showing some form of aesthetic appreciation as well. The identification of the bow, possibly a low powered one for fishing, is significant as it would make it the oldest 'irrefutable' bow from northern Europe' (Taylor *et al.* 2018, 415). However, a caveat to that interpretation might be that the use of willow is unusual as it is generally regarded as a poor species choice for bows (Allely *et al.* 2000), as shown by the low draw weight of the best experimental reproduction of just 10lb (Bamforth *et al.* 2018b, 382). Its reported asymmetrical shape also makes it a poor-quality end product, perhaps alternatively suggesting it could have other explanations such as a training bow, a child's toy, or conceivably not a bow at all and perhaps a type of spear haft for example.

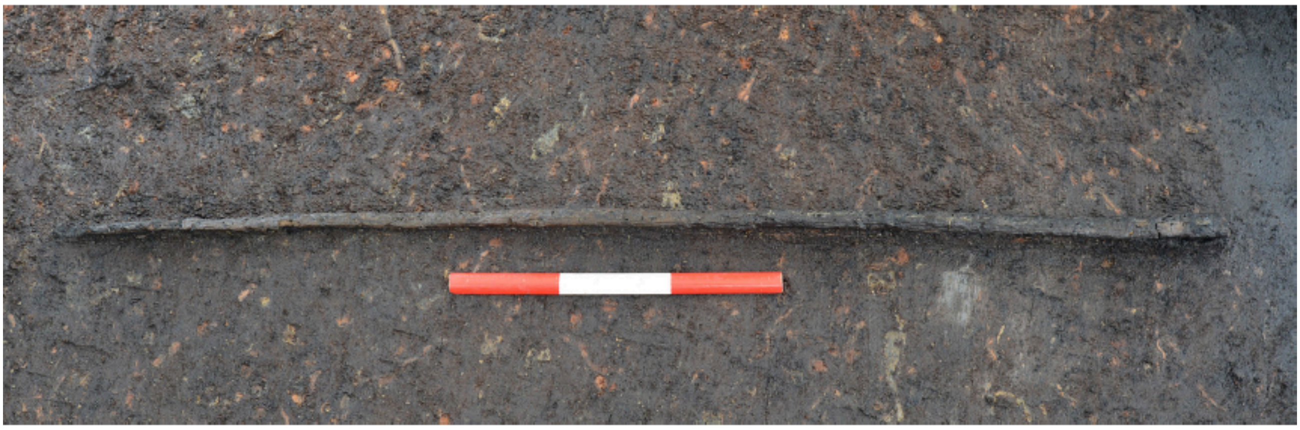


Fig 3.7 The suggested willow bow Taylor et al. 2018, 379; Copyright Star Carr Project, CC BY-NC 4.0)

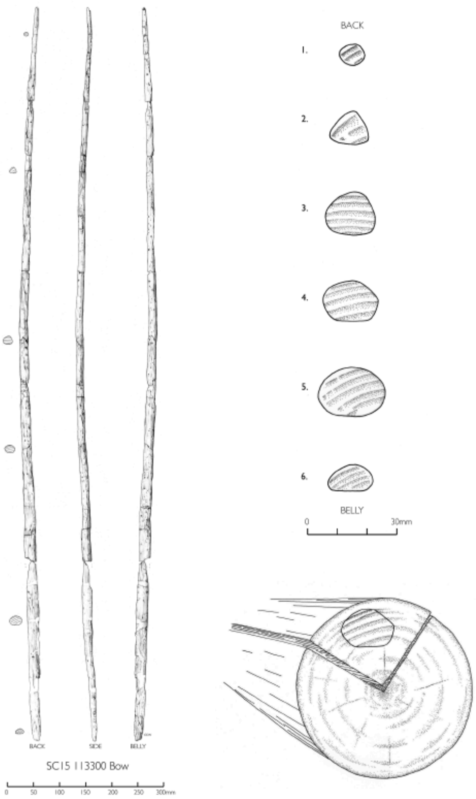


Fig 3.8 The willow bow object <113300>, with illustration that it was from a cleft piece of wood (Taylor et al. 2018, 382; Copyright Chloe Watson, CC BY-NC 4.0)

Analysis by Bamforth *et al.* (2018a; 2018b) and Taylor *et al.* (2018) also recognised a wide variety of woodworking techniques at Star Carr, including the tangential and radial splitting of wood, varied use of roundwood, the use of cleft sections of wood or timber to make more refined objects such as the bow, possible fire felling of trees, use of ‘notch-and-split’ for felling and plank production, use of ‘groove-and-split’ technique to produce tangential split lengths, use of ‘chop-and-tear’ technique for felling smaller diameter roundwood, some evidence of cross-grain cutting (something thought difficult without metal tools), possible boatbuilding based on woodchip types and Clark’s (1954) paddle, and finally the wide use of birch bark possibly for torches, fish floats, flooring fuel, adhesive, and boats. Earlier work by Taylor (1998) and Mellars *et al.* (1998) had recognised the presence of radial and tangential splitting of large trees and toolmarks in another area of the site, called the first evidence of ‘early prehistoric carpentry’ by Lillie (2005, 1). The identification of this sophisticated technique was subsequently substantiated by the more extensive 21st century excavations with the tangential outer splitting of trees, perhaps while still standing and alive, apparently regularly used and illustrating complexity in woodworking tasks (Bamforth *et al.* 2018a). Bamforth *et al.* (2018a, 354) showed that the most dominate woodworking technique in the assemblage appears to be this skilled splitting of wood, tangentially and radially, with some of the longest split timbers of 3.6m ‘unusually long’ in terms of the wider prehistoric woodworking record. Of these tangential splitting is by far the most dominant wood conversion method in the Star Carr assemblage (72.9%), with the next being radial splitting (25.8%). These figures are supported by comparable evidence from the sizeable 155 wood chip assemblage. For example, one notable artefact showing splitting techniques from ‘Clark’s area’ was a 755mm long timber <116651> that was radially split and possibly a plank.

Fig 3.9 ‘Groove and split’ debris from Star Carr (Bamforth et al. 2018, 364; Copyright Michael Bamforth, CC BY-NC 4.0)

Fig 3.10 Traces identified as diagonally cut toolmarks (Bamforth et al. 2018, 365; Copyright Michael Bamforth, CC BY-NC 4.0)

Conversion technique	**Frequency in assemblage (non woodchips)**	**% frequency in the assemblage**	**Frequency – woodchips**	**% frequency in woodchips**
Cross grain	8	0.7	2	1.3
Radial	276	22.5	40	25.8
Tangential	944	76.9	113	72.9
Total	**1228**	**n/a**	**155**	**n/a**

Table 3.4 Conversion evidence from wooden artefacts at Star Carr (Bamforth et al. 2018a)

Willow very clearly forms the vast majority of roundwood at the site, with the platform timbers mostly aspen (Bamforth *et al.* 2018b, 115). Bamforth *et al.* (2018a, 351; 2018b, 76) also suggested that there is potential evidence at Star Carr of coppicing and woodland management, with willow suggested as appearing to be the favoured species for this possible technique. In particular they identified an apparent preference for straight-stemmed roundwood, with larger pieces comprising trunks of entire trees or smaller saplings and smaller ones possibly containing evidence of coppice management (Bamforth *et al*. 2018). While acknowledging that the sample size for direct data on coppicing was limited – with 78 growth ring counts possible of which 48 showed morphological

Fig 3.11 Evidence of beaver and human activity at Star Carr, with a stem showing chop and tear evidence one end and beaver gnawing the other (Bamforth et al. 2018, 360; Copyright Michael Bamforth, CC BY-NC 4.0)

evidence of possible coppicing – their analysis did provide both circumstantial and limited direct evidence and further support for the idea of a form of resource management going back to the very early Mesolithic (Bamforth *et al.* 2018a, 349-352). Taylor *et al.* (2018) noted the fact that beaver cutting or damage can lead to re-growth of some trees while leading others to die, which means it is a relatively simple step from observing the benefits (or drawbacks) of beaver activity in creating useful straight rods to the development of a human managed, drawing felling or coppiced system, still within a very much mobile hunter-gatherer lifestyle.

Important evidence of Mesolithic structures was also found at Star Carr, as in addition to dryland habitation structures defined by postholes, three separate wetland edge structures (central, eastern and western) were constructed and used over a 175-year period, with few associated wooden finds but clear evidence of timber splitting (Bamforth *et al.* 2018b; Clark 1954; Mellars *et al.* 1998). Sadly, the wood in the interesting eastern wetland edge structure was also the most poorly preserved, producing little evidence for actual woodworking techniques and only one identifiable toolmark (Bamforth *et al.* 2018b, 72). The structural similarities between the wood platforms and lack of finds has led to interpretations they were primarily to stabilise access to the wetland edge, perhaps related to boat use or as access routes to deeper water (Bamforth *et al.* 2018b). Cole's (2006) older contention that the Star Carr wood platforms were a natural accumulation due to beaver activity was discounted by substantial evidence of woodworking debris and splitting evidence, although beaver gnawed wood was certainly present (**n=22**) in the area, as attested to by roundwood artefact <103190> with beaver gnawing one end and clear toolmarks the other as see in Fig 3.11 (Bamforth *et al.* 2018b, 87).

Taylor *et al.* (2018, 408) also discussed the possibility that Mesolithic people were also harvesting birch bark from woodland in an organised manner, as while bark rolls are produced by natural shedding in some birch species they can also be cut away from trees without killing it, if undertaken in spring and early summer. Preserving enough bark on the tree is important to enable the tree to regrow its bark successfully and allows for future resource gathering. Overall, the wood working evidence from Star Carr has been interpreted to show significant early Holocene sophistication and varied use of wood and woodland resources, with 'large groups of people working together and investing resources and labour' (Bamforth *et al.* 2018b, 121). It also highlights quite how much information can be gained by investigating just one waterlogged site with the necessary sedimentary and conservation conditions for organic survival.

3.4.3 Worked wood assemblages from late Mesolithic Britain

Elsewhere in Britain, the on-going recovery of a submerged Mesolithic wood at Bouldnor Cliff, Isle of Wight site BC-V dated by radiocarbon dates to 6220 – 5990 cal BC has shown the potential for a different site type, in this case an underwater intertidal eroding one (Momber *et al.* 2011, 75). Several prehistoric sites and features were identified in the area amongst which Bouldnor Cliff V (BC-V) contained burnt flint, charcoal, woodchips, trimmed pieces of wood and a length of string (Momber *et al.* 2011; Taylor 2011).

Fig 3.12 Twisted plant fibres from Bouldnor, interpreted as 'string' (Blinkorn & Milner 2013, 17; copyright Hampshire and Wight Trust for Maritime Archaeology)

At sub-site BC-V there was also a suggestion of a pit and elevated mound containing various wood elements that seemed unlike the surrounding fallen wood and tree stumps and was perhaps anthropogenic in nature (Momber *et al.* 2011; Momber *et al.* 2021). Other possible wooden Mesolithic structures or platforms were tentatively identified by divers at the site, with one feature (BC-V/CF02) containing 'flattened pieces of wood over a layer of roundwood' said to be laying in a parallel orientation (Momber *et al.* 2011, 66). However, unfortunately the published information of this structure does not provide enough information, such as toolmarks, to securely establish this interpretation, and within two years sea-life and fishing damage had disrupted the site (Momber *et al.* 2011, 68). The number of Mesolithic aged wood pieces from the site is fairly low at 50, and of these only 10 had reported evidence of working with a further 18 woodchips that contained radial and tangential evidence of working (Taylor 2011a, 84-89). Within this assemblage Taylor (2011a, 86) found evidence for roundwood trimming, half splitting, roundwood piece <S102> for example having been split and then squared and some examples of 'chop and tear' working. Of the worked pieces there is a very limited number of objects that could be said to be in any way diagnostic finished objects, with one possible post <S039>, one possible pencil-end stake < S057>, and one piece of twisted fibre material interpreted as cordage (Momber *et al.* 2011, 66-81). A further forked piece of roundwood <BS06> had an embedded worked flake whilst a piece of debris <MS39> had a possible jam curve toolmark measuring 31mm long by 2mm deep, with one flat and one 'crinkled' edge (Taylor 2011a, 86). The most notable artefact was the recovery of a tangentially split piece of oak <S061> 90cm long by 50cm wide dated to 6240-6000 cal BC (7340±60 BP, Beta 249735) with evidence of working and burning (Momber *et al.* 2011, 78). In her wood report Taylor (2011, 86) states that it derives from 'a large tree' and alongside the presence of thick bark fragments and evidence of wood charring may suggest that substantial trees were being worked in the area. Splitting of wood from larger trees (cited as >750mm diameter) necessitates tangential splitting, as radial splitting is more difficult according to Taylor (2011a). Taylor (2011a, 89) had also suggested that this piece is unexpected and would seem to suggest the presence of woodworking techniques only previously know from the Neolithic, and as it unlikely to be domestic 'might' reflect logboat building. Momber & Bailey (2011, 174) suggested the presence of advanced, Neolithic-type, woodworking that was said to have then been 'forgotten' or lost as groups moved.

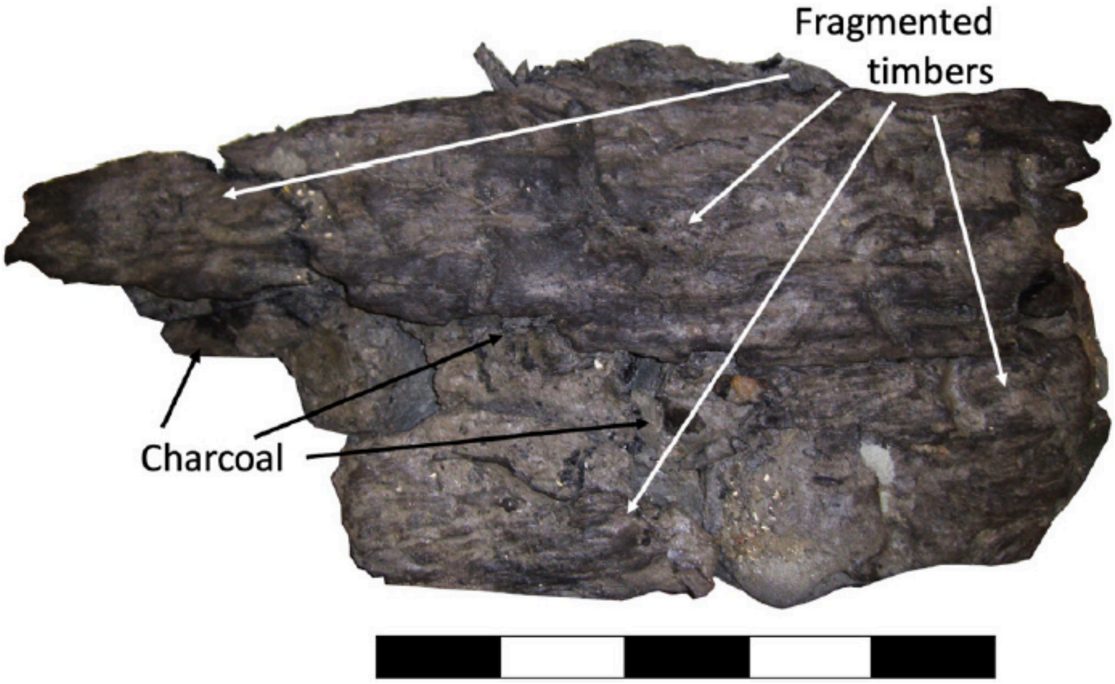


Fig 3.13 Split oak plank <S061> from Bouldnor Cliff, with evidence of charring one side (arrows and notes Momber et al. 2021) (image Copyright Maritime Archaeology Trust; taken by Garry Momber and enhanced by Jasmine Noble-Shelly)

This concept of such ‘pioneering technological artifacts’ was cited by Smith *et al.* (2015a) to support the purported discovery of Mesolithic dated wheat found at the site. Sedimentary DNA analysis (sedaDNA) found wheat evidence dated to 7935-7790 BP, approximately c.5,900 cal BC (full radiocarbon data not published, Beta-406961) (Smith *et al.* 2015b, 247-c). This would date it to some 2,000 years before its generally accepted earliest appearance in Britain, with the nearest source being the southern Mediterranean (Cummings 2017). The authors argued it may have arrived as flour through extremely long-distance Mesolithic continental trade and exchange networks (Larson 2015; Smith *et al.* 2015a). This interpretation has subsequently been contested by Bennett (2015) and Weiß *et al*. (2015), who raised methodological issues such as the possibly of contamination. These arguments have in turn been rejected by Smith *et al.* (2015b) and Momber *et al.* (2021). Given that the evidence from Star Carr above shows tangential splitting of substantial trees was an established technique by the early Mesolithic, the ‘advanced’, or Neolithic-influenced, nature of the Bouldnor woodworking traditions no longer appears a sustainable argument. Without such Neolithic-like advanced woodworking traditions, and with the sedDNA evidence still contested, the unprecedented and dramatic presence of 8,000-year-old Mesolithic traded wheat remains ambiguous, perhaps requiring corroborating support from other sites and further evidence from unequivocal future samples. Allowing that boatbuilding could be a possibility given the wetland edge Mesolithic context, the evidence from one tangentially split timber should also be treated with caution as the recent evidence of a wide range of working techniques and splitting evidence from early Mesolithic Star Carr, set out above, clearly shows that radially and tangentially splitting trees and timber had a long history of use, function and was perhaps not particularly difficult for the skilled communities involved. The oak timber <S061> is perhaps most valuable as it helps to fill in the technological gap between Star Carr and the Neolithic and usefully serves to perhaps show the danger of making assumptions about the lack of abilities of people in the past, and their technological knowhow, without physical evidence.

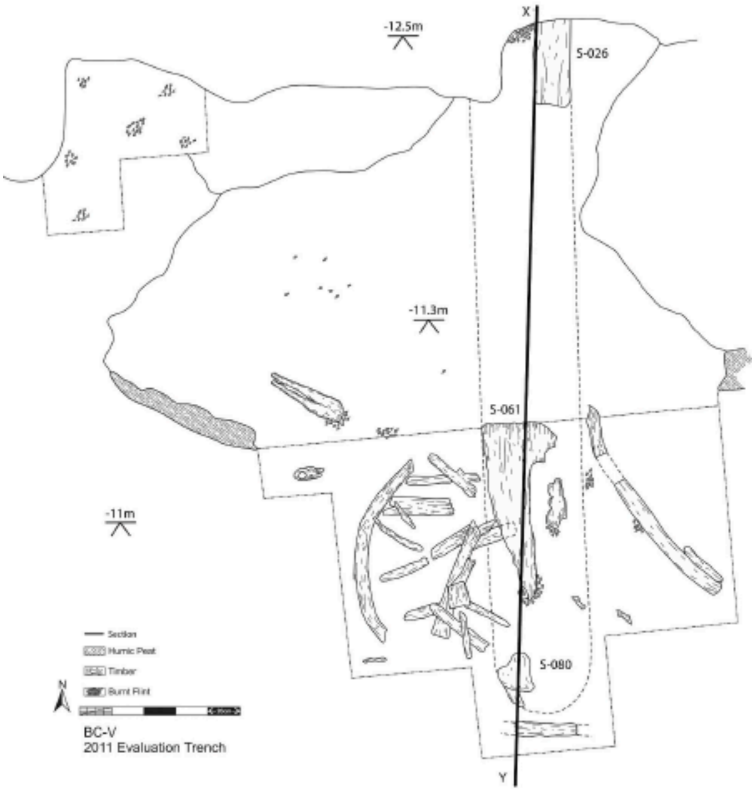


Fig 3.14 Plan of the Bouldnor Cliff Site BC-V, with interpretation by excavation team for possible evidence of timber working potentially for logboats (Momber et al. 2021, 120; image Copyright Maritime Archaeology Trust; Jasmine Noble-Shelly after Garry Momber)

Most recently, in the final stages of writing up this thesis, the Bouldnor team published a new review of material collected from the BC-V since the 2011 monograph publication (Momber *et al.* 2021). In this it was suggested that two more recovered in-situ pieces, <S-026> and <S-080>, were on a stratigraphic and horizontal alignment with that large worked timber <S061> described above and represented the 4m long remains of a ‘log-boat being constructed, but that was damaged and burnt’ with just some of the bottom sections surviving. The scalloped and hollowed shape of one timber <S-080>, resembling ‘the end of a log-boat’ with ‘6mm holes…drilled to test the thickness’, is said to be anthropomorphically made and cited as evidence of this (Momber *et al.* 2021, 125). The authors also argued that 21 pieces of wood with rounded sides and flat sides found some 14m to one side represented trimmed offcuts then used in a possible platform to stabilise access in the wet sediments (Momber *et al.* 2021, 121). Deciding whether these ambiguous items were archaeological artefacts was reportedly based on the result of comparing wood pieces with the results of experimental work done by Rich *et al.* (2016), although it should be noted no specific comparative images were provided in that experimental publication to independently assess this described connection. Finally, two further arrangements of ‘planks’ were reportedly found, one with 60 pieces of timber arranged in three layers at perpendicular angles to each other (Momber *et al.* 2021, 123). There were reportedly only a few examples with clear toolmarks near this feature, and those that did bear these marks were not actually part of the structure, with the authors acknowledging that when ‘assessed individually, they have few of the criteria necessary to categorise them as archaeological’ (Momber et al. 2021, 123). Overall, the evidence in this recent publication does seem to support the view that woodworking and substantial timber preparation in some form was likely present at the site, with combined evidence of toolmarks, burnt wood, charcoal and offcuts likely showing the presence of people. However, the two additional cited pieces of the putative logboat (<S-026> and <S-080>) do not appear to have been individually dated or clearly shown to come from the same tree as <S061> by tree ring orientation or wood grain in the analysis presented (Momber *et al*. 2021, 125). Also, no clear evidence was offered that they were also tangentially split in the same way or where even both also oak, so stating that they form together the remains of unfinished boat remains open to question. Even if they did come from the same timber other uses are possible, and with limited knowledge of the scale of Mesolithic structures, timbers, or use of substantial posts we should be wary of ascribing activity necessarily to boatbuilding. Without the opportunity to study the new worked wood artefacts from the site or undertake objective analysis on the spatial connectivity of all the woodworking finds, it is also hard to assess the potential new structures the team have identified. What perhaps can be said with some confidence is that the site is of great significance as the only excavated sub-marine Mesolithic site in the British Isles with important woodworking evidence worthy of continued investigation.

In England other worked wood sites include Westward Ho!, Somerset, with a line of stakes recorded, but not preserved, in the 19th century by Hall (1870, 1879) potentially found in association with lithics and a Mesolithic shell and bone midden that has now been dated to 5473-5425 cal BC (6100±200 BP, HAR-5632) (Balaam *et al.* 1987). More recently, Balaam *et al.* (1987) also recorded a structure of converging lines of stakes in Area 2 (some 40m away from the Mesolithic midden deposit), with most some 30mm in diameter and set around one metre apart. On further inspection another similar line of stakes was found in Area 3, thus closer to the midden deposits. All the sampled stakes from these structures were hazel apart from one alder one, with two stakes lifted from Area 2 dated to the early Neolithic 3780-3501 cal BC (4840±70 BP, HAR-5642) and reportedly pointed but without ‘diagnostic’ toolmarks (Balaam *et al.* 1987, 183). As the Area 3 structure was undated it remains unclear if it is Mesolithic or Neolithic, with the function of the structures also uncertain. The excavators suggested potentially the base of a trackway, but with the converging set of lines in a wetland edge site one might suggest a fish trap is a possibility.

At Vauxhall, London, a series of *in situ* vertical roundwood pieces, three 'timbers' up to 300mm in diameter and three 'stakes' up to 10mm in diameter, have been recorded at the bottom of the tidal range and dated by three radiocarbon dates to 4790-4530 cal BC and interpreted as a structure (Milne *et al.* 2011, 287). If this is indeed a Mesolithic structure it is highly significant, as not just the single site with Mesolithic worked wood from the Thames foreshore, but also with such sizeable *in situ* timbers unique in the use of structural timbers of such proportions in the British, Irish, and arguably European record. At present only the date, vertical or oblique orientation of the wood and nearby, but not associated, find of Mesolithic lithics provide corroborating support for a human agency. Excavation of some examples to establish whether there are worked ends is required to confirm their provenance.

Fig 3.15 One of the Mesolithic large roundwood objects at Vauxhall, possibly an in situ post (Milne et al. 2011, 288)

At Round Hill, Yorkshire, identified and first excavated in the 19th century, a possible Mesolithic layer with flints and worked wood was found at the bottom of a platform-like multi-period structure (Smith 1911). More recent work by Fletcher & Van de Noort (2007, 318) recovered a 'crudely hewn…stake lacking distinctive axe marks' dated to 8350-7940 cal BC (9080±100, GU-5451) and suggests the potential for an interesting Mesolithic base layer to this multi-period structure.

At Eskmeals, Williamson Moss, possible occupation areas with platforms and birch bark matting was found, along with reportedly radially split timbers and a single worked or cut piece of branch wood (Bonsall 1981; Bonsall *et al.* 1989, 1994). With activity centred around an inland lake 5473-5074 cal BC, excavation recovered over 30,000 lithics from the wider site, although problematically no artefacts were recovered in association with the putative structures (Bonsall *et al.* 1989) and the published images of worked oak branch <T13> do not appear to be conclusively worked in the author's opinion. More recent assessment by Hodgkinson et al. (2000) and Clare *et* *al.* (2001, 103) have suggested these wood structures may be natural in origin, with perhaps re-analysis or more excavation warranted to entirely resolve this site. Sites such as this and Bouldnor Cliff show how difficult it can be to properly investigate and distinguish human wood structures and natural accumulations in deteriorated remains with no associated finds. As noted by Brunning (2007) careful excavations at the Mesolithic dated site of Church Moss, Davenham, showed how easily natural fallen wood can look like felled timber due to differential decay (Howard-Davis & Buxton 2000). Here a purported squared timber was ultimately recognised as the naturally surviving part of a fallen tree as it decayed, the possible worked 'pegs' were the surviving harder parts of side branches, bark matting the waterlogged product of fallen and decayed natural 'tree shadows' and even the evidence of burning was probably natural and representing a forest fire that occurred through and over already fallen trees (Howard-Davis & Buxton 2000).

In Wales, a potentially very significant recent discovery has been the 'Maerdy Post', from Rhondda Valley, found as part of commercial work for a wind turbine installation in a highly visible and dramatic location near a stream bed running through rocky outcrops (Jones 2014; Jones 2019 pers. comms.). The 1.7m long by 0.26m wide oak timber <MW05> was reported as decorated with 'parallel running and alternating zigzags and…concentric ellipses', radiocarbon dated to 4270-4000 cal BC (5340±30 BP, Beta-333011) (Jones 2014). A further six high precision tree-ring radiocarbon dates by Nayling & Bale (2014) suggested a date of 4175BC for the outer ring of the timber. No associated finds were recovered with the timber, but there are reports of occasional stray Mesolithic style flints in the general vicinity (Jones 2014, 79). Consultation by the excavation team with archaeological wood experts Dr Richard Brunning, Dr Roderick Bale and Professor Nigel Nayling suggested the traces were consistent with 'human agency' and unlikely to be shaped by natural causes such as oak wood beetle action, a conclusion supported by insect expert Dr David Smith at Birmingham University (Jones 2014, 82). The author inspected the artefact in National Museum of Wales and would agree it appears to be anthropomorphically modified with a carved surface pattern. Stylistically, of particular note was appearance of four repeated concentric circle motifs, straight and curved zigzag and chevrons lines.

Fig 3.16 The Maerdy post, with the chevron type lines particularly noticeable (the author)

Fig 3.17 A detail of one of concentric circles, that shows fine workmanship and detailing (the author)

Brief recent review by Ray & Thomas (2018, 52) proposed its stylistic pattern was reminiscent of Scandinavian Mesolithic art and may illustrate the use of decorative carving and persistence of Mesolithic communities at the cusp of the Mesolithic to Neolithic transition. If it should prove to be solely Mesolithic in manufacture and origin by further study it would also be uniquely important as an item of British Mesolithic decorated artistic worked wood, with perhaps its closest parallel in simple terms of large wooden art to the famous, and much earlier, Shigir Idol from Russia most recently dated to around 9,600 cal BC (Zhilin *et al.* 2018, 344). However, on inspection by the author the patterning and decoration seem arguably more in keeping with early Neolithic circular and chevron stylistic schemes such as found in northwestern France or early Neolithic Ireland (see Jones *et al.* 2017). The overall shape of the timber tapers, so there is no clear surviving pointed end, so it is possible it originally came from a larger piece or perhaps even represents the first British evidence of a prehistoric living culturally modified tree as Bell (2020) noted have been recorded ethnographically in Siberia and Australian. Sheridan (2003a, 2010) suggested that Neolithic groups from northern Brittany may have been operating as far north as Scotland by 4,300 – 4,00 BC. As such, given its very late Mesolithic date, it would seem more rational to the author to suggest it may represent the remains of Neolithic activity and would thus be one of the first and most important evidence of the early establishment of Neolithic material culture in Britain. Further study of the item, the stylistic schemes and wider investigation and excavation of the site to find associated diagnostic lithics would seem to be highly recommend given its clear highly significant international importance.

Another Welsh site of Abercynafon, Talybont, Trench 4, contained evidence of a wetland edge structure with a reported 13 roundwood pointed ends of which four were vertically *in situ* on an alignment and may represent a possible platform along with onsite woodworking evidence from 20 fragments of split timber (Caseldine & Earwood 2004, 4). Trench 4 was dated by one post <589> to 4230-3790 cal BC (5180±80 BP, SWAN-211) with the precise function unclear, and no associated non-wood finds recovered from the context (Caseldine & Earwood 2004). This date would place it at the end of the Mesolithic or earliest Neolithic, although on balance as the rest of the worked wood finds were dated to the later Neolithic (Caseldine & Earwood 2004) it seems reasonable to suggest it may be associated culturally with the latter.

Other sites have emerged over the last decade through the process of commercial archaeology with details and analysis yet to be fully published but holding the exciting prospect of important new data for this topic. At the site of Killerby Quarry in Yorkshire two wooden structures have been found, reportedly one late Mesolithic 'A-frame' structure and one early Mesolithic 'conical' structure with 6-7m long poles with woodworking toolmarks and an *in situ* hearth (C. Waddington pers. comms.). At the impressive Stainton West site in Cumbria, a substantial occupation area on an island between palaeochannels has produced 302,744 flaked lithics including over 26,000 blades and 5,743 microliths (Civils 2011, 33). The presence of leaf shaped arrowheads and polished axe-heads in early Neolithic radiocarbon dated contexts in close association to earlier Mesolithic contexts has also suggested that there is the exciting potential to provide hugely important new information for assessing the Mesolithic to Neolithic transition in detail (Civils 2011). Early reports suggest that there appears to be recognisable cultural continuity across the transition period at the site, even when Neolithic practices and technologies have clearly been adopted (Myers & Stalibrass 2020). Most relevant to this study is that Mesolithic and Neolithic aged worked wood and debris has been excavated and recorded from the site, with five finished artefacts including two Neolithic tridents, 79 pieces of worked roundwood, 40 woodchips and a line of stakes and a collapsed hurdle that may be a fish weir (Civils 2011). Other reported information includes indications of roundwood coppicing, elm decline data, woodworking technique evidence, and surviving toolmarks – with work now currently underway to publish this significant site (Civils 2011; Myers & Stalibrass 2020).

Two more sites highlight the importance of wider review of the commercial sector in any future discussion of Mesolithic worked wood. At Manor Farm, Milton Keynes, two *in situ* obliquely position pointed ends were found in close association. One, <F12>, was 40-50cm in length and 20-30cm in wide and was dated to 4790 – 4500 cal BC (5790±60 BP, lab no. unspecified) (Cambridge Archaeological Unit 2008, 8). At Walpole Landfill Site two Mesolithic pointed ends dated to 435-4052 cal BC (5405±66 BP, WK25817) have been reported found *in situ* in a paleochannel, although the ends were found in such a poor state of preservation that toolmarks could not be accurately identified (Hollinrake & Hollinrake 2014). Additional examples of stray or disparate British finds include the unpublished excavations at Lunt Meadows, Sefton, with an inverted burnt tree stump reportedly intentionally deposited on the floor of a 5-6m structure dated to 5,800 cal BC (National Museums Liverpool accessed 2021 https://www.liverpoolmuseums.org.uk/lunt-meadows-sefton). At Hartlepool a line of Mesolithic dated wood stakes and wood structure possibly related to fishing activity have been reported (Rowe 2006, 18; Waughman 2005). Recently two unpublished worked wooden pointed ends were recovered from a late Mesolithic occupation layer at Irontongue Hill, Greater Manchester, in association with postholes, lithics and hearths (Kevin Wright 2019 pers. comms.). Finally, a piece of wood or timber of an unspecified species with possible evidence of stone tool working was recovered from the late Mesolithic peats at Low Hauxley, although that identification was deemed not totally secure and is included here as such (Taylor 2013, 7). In isolation such stray finds may provide limited data for site analysis itself, but if combined more broadly across the country there may be useful information to be gained for understanding Mesolithic exploitation and use of wood across time and space. Finally, the long-term investigation of the Severn Estuary site of Goldcliff since the 1990s has proven a particularly fruitful area for Mesolithic finds with *in situ* lithics, bones, footprints, worked wood and now *in situ* structures all identified (Bell *et al.* 2000; Bell 2007). These finds and their importance are set out in detail in the case-study review in **Chapter 5**.

3.4.4 Early Neolithic worked wood assemblages related to the transition

The total number of Neolithic sites with worked wood assemblages from the whole period would clearly be very much larger than those from the Mesolithic in **Section 3.4.1 - 3.4.3**, with the most recent comprehensive survey of English and Welsh Neolithic sites with structural wood by Brunning (2007) tallying 75 sites of this type alone. Bell's (2020) recent work on trackways suggested a minimum of a further 13 Neolithic trackway sites that can be added to this number from Ireland.

Fig 3.18 Location of early Neolithic British sites considered in this study

However, Moore (2021, 51) recently noted that the number of Irish Neolithic trackways is still fairly limited and smaller than might be expected given the large datasets from later periods, especially in comparison to areas such as the English Somerset Levels with 25 Neolithic trackways alone. This relative absence of Neolithic sites in the extensive Irish waterlogged deposits was noted by Raftery (1996) and May *et al.* (2004) some time ago, with Moore (2021) stating it remains unclear if the lack of Irish wetland Neolithic finds is a product of the depth of deposits and archaeological investigation. Or, alternatively, perhaps it may actually be reflecting patterns of activity and exploitation in Irish Neolithic wetlands. In this study as it focuses solely on Neolithic sites from 4,100 – 3,800 cal BC to cover the period of the early Neolithic most directly related to the ‘transition’ event (as set out in **Chapter 2**) we are limited to only the modest number of published British sites with worked wood to use for any comparative analysis (Table 3.5). No Irish Neolithic wood has yet been dated to this period and a wider analysis of all Neolithic worked wood sites is beyond the scope of this work.

No.	Site	Location	Date	Date BP	Lab. code	Description	Source
1	Yabsley Street	London, England	4230-3980 cal BC	5252±28	KIA-20157	Small plank of oak 0.6m long by 0.12m wide that had been split tangentially, interpreted as part of a grave. Found in association with a human skeleton, carinated pottery and a flint knife.	Coles *et al.* (2008)
2	Quarr Q23-26	Isle of Wight, England	4040-3710 cal BC (for Q24)	5100±60	GU-5251	A collection of small stake clusters and structures was found in palaeochannel. Most undated but Q23-26 potentially related or connected. Only Q24 dated. A possible hurdle also found that may related to Q24. Q25 was a Y shaped structure of 6 stakes, and Q26 a structure of 4 stakes that may connect. Where sampled wood was hazel. Function unclear but possibly fishing related.	Tomalin *et al.* (2012, 197)
3	Rotten Bottom	Dumfries shire, Scotland	4040-3640 cal BC	5040±100	OxA-3540	Yew flatbow broken at one end, currently measuring 1.36m long but originally 1.74m long, with estimated draw weight of 35lbs. Date may suggest it is early Neolithic, but given hunting use could be late Mesolithic community. Use of yew suggests imported from outside of Scotland.	Sheridan (1992)
4	Old Parkbury	St Albans, England	4035-3705 cal BC 3980-3790 cal BC	5080±75	OXA-3301	Burnt, fragmentary, remains of an oak trunk measuring 5.3m long by 1.07m originally, interpreted as part of a dugout and/or burial coffin. Found in association with cremated human and animal remains, two flint flakes and was burnt *in situ* within a pit.	Niblett (2001)
5	Belmarsh West, Structure 1	London, England	3960-3700 3960-3700 3640-3370	5023±44 5039±30 4709±30	WK-25054 WK-25055 WK-25056	Possible trackway and structure with tangentially and radially split timbers dominated by alder. Wood badly degraded, no associated finds and only one piece of roundwood with a possible cut end, so identification is not totally secure. Second nearby less secure ‘Structure 2’ of similar age.	Hart *et al.* (2015)
6	Hightown trackway	Sefton, England	3960-3690 cal BC 3920-3520 cal	5020±60 4910±60 4430±80	Beta-119008 Beta-119010 SD-29490	2m long, 1.4m wide and 0.3m deep brushwood trackway with longitudinal roundwood and oblique pegs at base and more 'haphazard' design above (Gonza-	Gonzalez & Cowell (2007)

			BC 3350-2985 cal BC			lez & Cowell 2007, 19). One faceted stake excavated and dated (Beta-119009), with two other possible cut pieces and two pieces charred. Evidence original length at least c.80m.	
7	Manor Farm	Milton Keynes, England	3960-3700 cal BC	5030±50	Not provided	One vertical *in situ* pointed end located near a palaeochannel, found some 10 metres away from two earlier Mesolithic ones.	Cambridge Archaeological Unit (2008)
8	Carr House Sands	Hartlepool, England	3932-3665 cal BC	4980±42	GU-5435 GU-5436 (x2 samples same artefact)	3.4 long by 0.8 high hazel wattle panel with 25 surviving sails and thin interweaving rods. Interpreted as part of a fish trap structure as sails were pointed to use upright and was of light construction.	Waughman (2005)
9	Winchester Wharf	London, England	3950-3630 cal BC	4960±70	Beta-147039	Stray cut alder timber in peat, with peat extending over 150m and 1-1.2m in depth.	Haughey (2007).
10	Walpole Landfill Site	Somerset, England	3962-3773 cal BC 3981-3784 cal BC 3940-3627 cal BC 3969-3530 cal BC	5063±39 5096±70 4941±60 4978±106	WK25807 WK25806 WK17289 WK17290	Structure 3 was composed of several radially split planks on a north-south alignment in association with *in situ* roundwood. There was a verity of species used in the roundwood, including oak, ash, hawthorn, and hazel. Structure 2 formed a line of stakes/posts across paleochannel stabilizing predominately hazel and dogwood roundwood. Also included radial split oak plank <W477>.	Hollinrake & Hollinrake (2008); A.Hollinrake unpublished data
11	Bell B trackway	Somerset, England	3950-3350 cal BC (1960s C14 date)	4840±100	GaK-1600	1-2m wide pegged brushwood track with base of split ash transverse timbers and twigs, heavier transverse ash poles on top with more twigs. Pegs of hazel and ash to keep in place. So called 'God Dolly' wooden figurine found underneath with associated flint flakes.	Coles & Hibbert (1968)
12	Bisgrove trackway	Somerset, England	3950-3350 cal BC (1970s C14 date)	4880±100	HAR-4078	Brushwood trackway 4.5m long and 1.5m wide with pointed ends used as pegs.	Orme *et al.* (1982); Coles *et al.* (1988)
13	Abercynafon	Talybont, Wales	3910-3520 cal BC	4890±80	SWAN-224	Small mire with very late Mesolithic line of pointed ends. A split and pointed stem of roundwood in Trench 15 was	Casledine & Earwood (2004)

						dated to the very early Neolithic. Substantial later Neolithic tree felling/woodworking evidence 2900-2700 BC.	
14	Sweet & Post tracks	Somerset , England	3836 – 3800 BC (dendro. dates)	n/a	n/a	Raised split plank and pointed roundwood ends to form a trackway c.2000m long, crossing the marshy ground between the Polden Hills and Westhay. Evidence of earlier trackway, the Post Track, in same location (see **Chapter 6**)	Coles & Coles (1986)

Table 3.5 Early Neolithic sites from Britain and Ireland relevant to the 'transition' period with worked wood assemblages

Some of these are isolated finds, whilst the other most dominant site type are trackways with the resulting assemblages of cut, trimmed and worked timbers and roundwood. Analysis by Bell (2020), Brunning (2007) and Raftery (1996) have usefully set out to compare the structures and broader characteristics of trackways type sites in some detail and are not repeated here. As detailed above there has also been a series of studies comparing some artefact types from the complete span of the British and Irish Neolithic such as dugouts, domestic tools, bows and hafts, although it is worth noting that in most cases these were published some time ago and up-to-date evaluations would seem useful. Initial data collection by the author also compiled a preliminary total list from published sources of a minimum of 128 securely dated sites from the whole Neolithic period spread across Ireland and Britain, with sites including trackways, post alignments, platforms, fish traps, dugouts, and stray finds such as bows, mallets and ad hoc tools. Further analysis of this data was beyond the means or goals of this research project. However, the cumulative number of recorded individual pieces of worked wood or finished objects contained in these is currently unknown, having never been calculated, although considering all the trackway structures it must now run into many tens of thousands of individual recorded pieces of Neolithic worked wood and significantly more finished portable objects than we have from the Mesolithic.

Due to the different data collection criteria of previous reviews, it is hard to compare even the number of locations with worked wood between the published overviews, with perhaps the 63 sites noted in Coles *et al.* (1978) the most meaningful baseline and showing how much larger the dataset of sites with dated Neolithic wood has grown since the 1970s. As Brunning (2007) and Bell (2020) have also set out overall the majority of these findspots are likely to be trackway or wetland edge platform sites, given the enhanced likelihood of such waterlogged sites surviving long enough to be covered by protective estuarine or peat accumulation. This has mean that crucially there has been a general lack of settlement, persistent occupation sites or buildings that would provide the level of information comparable to sites such as later Bronze Age Must Farm and Flag Fen, or Iron Age Glastonbury Lake Village (Bulleid & Gray 1911, 1917; Knight 2019; Pryor 2001). Partially comparable early Neolithic sites published in some form, with consistent use and occupation, would perhaps be the worked wooden artefacts, hearths and speculatively identified platform at

Ehenside Tarn in Cumberland (Darbishire 1874; Piggott 1954), wood finds including axe haft and woodworking evidence at Etton causewayed enclosure (Taylor 1998b), the well preserved structural wood crannog site of Eilean Dòmhnuill, North Uist, Scotland, (Armit 1991, 2003) and possibly the worked timbers, wooden bowl and pointed end from Storrs Moss, Lancashire (Powell *et al.* 1971). All of which have limitations due to the site type, extent of investigation or publication, age of discovery or number of finds produced.

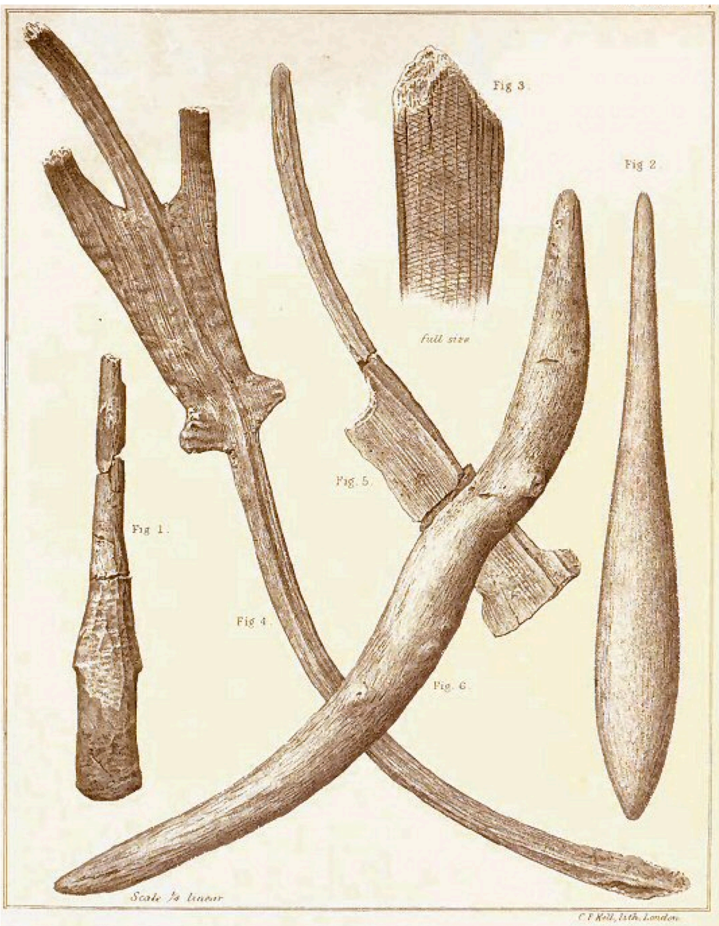


Fig 3.19 Some of the wood from early Neolithic Ehenside Tarn (Darbishire 1874)

In Ireland O'Sullivan (2007, 161) noted the presence of a rare surviving Neolithic wetland activity site at Carrigdirty Rock with organic survival, where over a 45m long wetland edge site provided important remains such as basketry using reeds dated to 3780-3531 cal BC (4880±50 BP, Beta-102087). A curving arc of stakes was also found, alongside roundwood with stone axe toolmarks, a stone axe, chert flakes, hammerstones, bone fragments, charcoal, hazelnuts, and even part of a human skull from a 25–35-year-old (O'Sullivan & Daly 1999). Perhaps to this can also be added the culturally complex Irish wetland activity sites with worked wood at Rathjordan, C. Limerick, where a crannog-like mound produced Neolithic stone axes, pottery, flints and hearths (Ó Ríordáin & Lucas 1946-7; O'Sullivan 1998), the Neolithic upper layers of the Clowanstown, Co. Meath, site (FitzGerald 2007; Mossop 2009) and a possible Neolithic site at Tivannagh, Co. Roscommon, with reported horizontal timbers, vertical posts and a dugout canoe dated by pollen analysis to before 3000 BC (O'Sullivan 1998, 64; Raftery 1957). For the Mesolithic, only Star Carr and now Goldcliff East have so far provided significant numbers of published worked wood objects from occupation sites on the wetland edge, although as mentioned above that situation may be improved by further investigation at known sites and forthcoming publications.

Fortunately, one important development in finding settlement occupation sites has been the recognition that artificial crannogs or wetland edge platform sites may hold Neolithic, or as recent Irish evidence may suggest possibly even earlier, layers in their sequences (Fredengren 2002; O'Sullivan 1998). O'Sullivan (1998, 56-61) noted the possibilities in Ireland that some of the wetland edge mounds with stone and brushwood layers may relate to Mesolithic activity, with the Neolithic lithics in the lower layers of historic crannogs often ignored but potentially evidence of 'Neolithic lakeshore occupation'. For example, at Inch Island, Lough Gara, Ireland, Fredengren (2002, 94-7) suggested brushwood and vertical posts at the lakeshore edge evidence dated to the early Mesolithic (7330-7050 cal BC, 8160±50 BP, KILA15:001) and late Mesolithic (4230-3970 cal BC, 5270±50 BP, KILA 15:002) indicated some form of Mesolithic wetland edge structure or possible proto-crannog building. This evidence also suggested to Fredengren (2002, 136) that potentially Mesolithic wetland edge structures could be the basis for a type of monumentality that we only normally associate with later periods. The potential has been more clearly demonstrated by the excavations at the artificial crannog Eilean Dòmhnuill site in Scotland, revealing *in situ* contexts dated from the early Neolithic at 3720-3510 cal BC with reportedly 12 layers of occupation, stone walls, multiple layers of wood with a minimum 30 pieces of structural wood reported, *in situ* stakes, wattlework, straw rope, pottery, wood with toolmarks other organics, and lithics (Armit 1991, 2003; CANMORE 10069; Dixon 1989). The forthcoming full publication of this site, and perhaps further investigation, holds good potential to dramatically improve understanding of early Neolithic woodworking at an occupation site. While Eilean Dòmhnuill is a fairly isolated British example it remains unclear if its presence represented usual atypical practice rather than widespread systems of occupation and perhaps domestic activity (Armit 2003). However, recent work by Sheridan *et al.* (2014) and Garrow & Sturt (2019) has reported important new discoveries of *in situ* early Neolithic pottery at five artificial islet sites in the Isle of Lewis. In particular, during investigation at Loch Bhorgastail, divers observed *in situ* horizontal timbers and vertical posts dated to the 3640-3360 cal BC along with pieces from 59 different pottery vessels that were likely intentionally deposited (Garrow & Sturt 2019, 676-679). There may well be differences in function between these various Scottish artificial island sites, or indeed comparable Irish examples, but the main result is to show that such locations hold significant Neolithic potential. There are over 2000 crannog-type sites in Ireland (O'Sullivan 2007, 156), with only 52 directly dated (Crone 2012, 140) and a further 60 contextually dated (Cavers 2010, 26) meaning just some 5.6% have been dated in total. In Scotland there are at least 571 comparable island type dwellings (Lenfret 2013, 123), with Garrow & Sturt (2019, 681) estimating only 10% have been dated in some way. This means there are at least 2,400 totally undated Scottish and Irish crannogs type structures that may potentially hold Neolithic, or even earlier, layers and the exciting potential to radically alter our understanding of Neolithic structures and wetland edge activity. A current

Scottish project, *Islands of Stone*, is researching crannogs to this end for more Neolithic examples, with an initial 24 potential sites reportedly identified so far (Blankshein 2020). As this type of site holds waterlogged conditions, and thus the potential for recovery of worked wood, this may also help address the current dominance of the earliest Neolithic wood assemblages by trackway sites and provide a more rounded view of worked wood use in the period.

3.5 Analysis of worked wood artefact assemblages

One result of the analysis in **Section 3.4** is that there is a continuing lack of knowledge about specific tool use and efficacy. Only three years ago, as part of analysis of the Star Carr assemblage, Taylor *et al.* (2018, 367) stated:

'Virtually nothing is known about which tools were used for specific tasks, methods of hafting and techniques of working and shaping wood'.

A principal method in archaeology is to compare discrete artefact types using different analytical scales, be that within or between single sites, regions, countries, and periods. The benefit of analysis of worked wooden artefacts when used in this way is that they hold the potential for several interlinking sets of information that can provide the basis for such analysis on the small or large-scale. Sands (2013, 308) has set out that the principal types of evidence that can be obtained from 'portable wooden objects' includes their species, stylistic shape and form, woodworking manufacturing techniques, residue analysis, history of use, deposition context, and dating. One might also add to that list given the right artefact type or preservation, distribution, frequency, information on season of felling, regional climate, woodland environment, potential woodland management, identification of individual workers and differences in specific tool type used. It is also worth noting Sands' (2013) further observation that wooden artefacts may have been more utilitarian and not necessarily exhibit cultural differentiation in the same way as artefacts made from other materials. Here the argument would be that their potential ubiquity might reduce the importance people attached to their actual form. However, this is certainly not always the case for other widely used domestic items of other materials such as pottery, that may be also made by a household, and it seems reasonable to suggest that people may well have valued organic day-to-day objects as much as ones of other materials. For example, it has been shown by Earwood's (1993) extensive study of portable wooden domesticate objects that they these can also hold the so-called 'culturally sensitive' information that Sands (2013, 316) describes. It is perhaps as important to acknowledge that often the relative scarcity of wooden artefacts in the archaeological record tends to hinder the potential for any wide-spread typological analysis so common in lithics or pottery studies. This means that for worked wood objects it presents something of a paradoxical problem to untangle, as low surviving artefact numbers inhibit attempts to assess the nature of typological, or cultural, distinctions across time and space. Given the compelling arguments that have been presented to view organics, including wood, as the most common materials in use in prehistoric communities as noted above (Coles *et al.* 1978; Hurcombe 2008, 2014), their often limited overall contribution to our understanding of cultural variation would seem most logically constrained by their generally poor survival on most sites. Analysis is thus primarily limited by the number and quality of artefacts preserved, rather than the potential information from a wooden artefact itself. If artefact types of suitable condition and quantities can be identified, replicated across sites and within sites, then analysis can be attempted and fed into the overall material cultural interpretations for a given period. As noted earlier previous studies on wood artefact classes have produced some very useful analysis on aspects of worked wooden artefact categories, such as Clark (1963) and Taylor *et al.* (2018) on bows, worked roundwood by Coles & Orme (1985b), figurines (Coles 1990), logboats (McGrail 1978; Mowat 1996), domestic objects by Earwood (1993) and Brunning (2007) on structural wood. As the overall worked wood assemblages increases in terms of the numbers of objects and sites it logically becomes possible to investigate other defined artefact categories.

In general, worked wooden artefacts can be separated into three main separate categories:

- Portable objects, such as handles, bows, boats, containers, and sculptures (Sands 2013).
- Structural objects starting from individual timbers, posts, stakes to larger assemblages of associated pieces that form one cohesive whole such as trackways, wharfs, platforms, fish traps and whole buildings (Brunning 2007).
- Debris from the production of the above.

3.5.1 The potential from analysis of pointed ends

In this work structural pointed ends were identified in preliminary analysis as one artefact class that can be usefully interrogated to meet the challenges set out in **Section 3.5** from the wetland edge sites with surviving worked wood. Often these artefacts are roundwood or split pieces of larger timber that have had an end sharpened for driving into sediments to provide support and substructures for a variety of constructions from building foundations, fish traps to trackways or even single posts of varying uses (Brunning 2007). Taylor *et al.* (2018) and Hurcombe (2007) have pointed out that one problem in analysis of worked wood artefacts is that producing wooden items is a reductive process, where material is intentionally removed to produce objects sometimes very finely finished. In final form they will often exhibit little evidence of the actual manufacturing process. The manufacture of a pointed end is often different as, while also reductive, the process will normally quickly produce an end that achieves the required final morphology – a sharpened end. Little further finish is required as the maker normally never intends for it to be anything other than functional, and indeed the cut facets themselves provide the shape that is necessary for the job in hand. Furthermore, the waste flakes from pointing may also sometimes be found and studied. Applying the analogy in lithic analysis of a polished Neolithic axe being a finely finished wooden object comparable to a finished bow or carved bowl, then a sharpened stake is the rough-out or simple flaked core axe. The manufacturing process of both can be studied, but the rough flaked version/faceted stake conserves more of the manner of production and manufacturing technique for archaeological analysis.

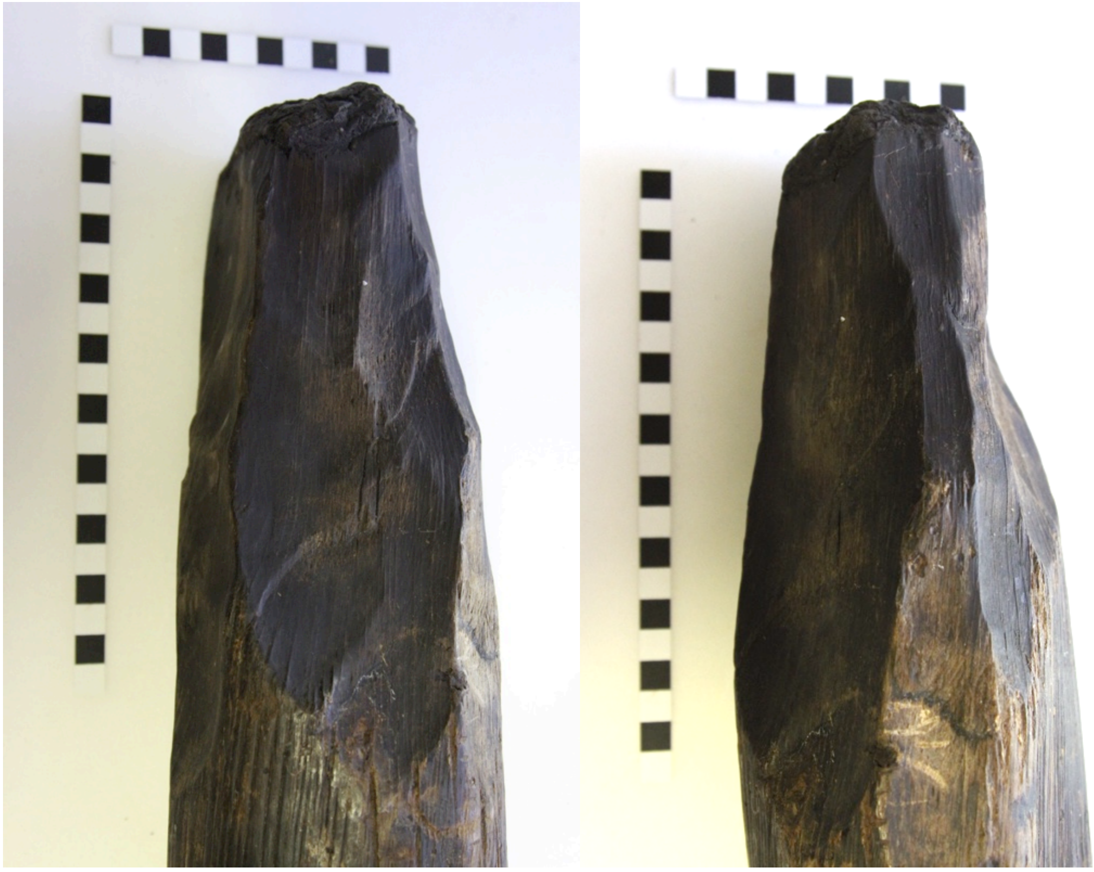


Fig 3.20 Two views of pointed end <SWF70P11> from the early Neolithic Sweet Track, Somerset, with toolmarks clearly visible.

Structural pointed ends also offer a potentially rich source of information due to an overlap between structural assemblages and 'portable objects', as defined by Sands (2013), which can offer new perspectives on sites and periods. While the type of pointed end considered here (as opposed to a wooden spear for instance) is primarily a structural object, they can provide some of the information on a par with portable objects as they are an individual record of the manufacturing and resource sourcing process of the community that produced them. In addition, while a trackway or building will likely be the product of a collection of people, pointing an individual stake or post is more likely to be the result of a single person's effort and skill, with the marks left showing how they worked, the tool they used and the working traditions that they knew. The basic technique of pointing a stake may seem fairly straightforward, but the precise technique, working angle, tool and material can be the product of a selection process by the maker and thus record information about their abilities, wider community decision-making and available tool types (Coles & Orme 1985b). Whether the method of creating a worked end would necessarily be replicated by every worker in the same way is less certain, as once made the worked section will be normally be invisible as it is then driven into the ground and requires investigation. The variation of the ends and manufacturing techniques offer a potential method to investigate aspects of cultural norms across a specific artefact class.

Coles & Orme (1985b) first studied this artefact class from sites in the Somerset Levels, recognising their potential for providing comparative date in terms of tool and technique manufacturing technology, species selection, season of felling, as well as woodworking techniques between sites, areas, countries, and periods. They noted the further benefit of their potential for wide geographical distribution and use, with often abundant use on wetland edge sites to support superstructures that thereby increases their potential for survival as waterlogged objects in the record (Coles & Orme 1985b). Outside of Coles & Orme's (1985b) innovative analysis there has been limited further British work on Mesolithic or Neolithic artefacts of this type, with work by Brunning (2013b) considering the very late Neolithic/early Bronze Age Peterstone, Gwent, palaeochannel pointed ends and finding toolmark evidence to suggest the use of stone tools alongside metal ones at the terminal end of the Neolithic. There has only been very cursory analysis of British Mesolithic structural pointed ends by Taylor *et al.* (2018) at Star Carr, although the assemblage of five possible artefacts offered limited analytical potential. For later periods there has been more work undertaken, with a number of studies considering the Bronze Age and Iron Age British structural pointed ends and assessing their features for toolmark analysis (Brunning 2013a; Brunning & O'Sullivan 1997; Sands 1997; Taylor 2001). In Ireland, O'Sullivan (1996, 2001) undertook valuable analysis of Neolithic and Bronze Age pointed ends from the Mount Dillion Bogs and Shannon Estuary and most recently Moore (2008) provided a review of the worked ends from the Neolithic Edercloon trackways EDC42 and EDC45. As more Neolithic, and now Mesolithic, British sites have begun to provide examples of structural pointed ends since Coles & Orme's (1985b) original publication it would suggest that this find type is a worthy, if neglected, source of potential data and considering the information they may provide is an important part of the case-study analysis in this work.

3.6 Worked wood assemblage datasets: scope and potential

Some 10 years ago, Taylor (2011a, 85) underlined a lack of knowledge in the earliest British prehistoric woodworking technology and traditions, stating;

> *'Virtually nothing is known about woodworking technology at this time* [Mesolithic]*; a small amount of material from the early Mesolithic has been studied at Star Carr, but there is very little material until the Neolithic. There is, in turn, very little Neolithic material which has been recorded in detail'.*

As shown in **Section 3.3** this assertion was certainly true of the British Mesolithic until the turn of the century although arguably Neolithic trackway assemblages have been better represented and studied in Britain and Ireland than perhaps Taylor allowed. The worked wood situation in Europe has historically been significantly different with sites in Scandinavian such as Tybrind Vig and Smakkerup Huse (Denmark), Friesack IV (Germany) or Shigir (Russia) providing hundreds of finished artefacts including boats, paddles, bows, hafts, fish traps, skis and pointed roundwood stakes (Andersen 2013; Gramsch 1992; Gramsch & Kloss 1989; Lillie *et al.* 2005; Price & Gebauer 2005; Savchenko 1999). Recent in-depth work by Klooß (2015) brought together the extensive German Baltic Mesolithic site and woodworking evidence from 13 sites in that area, for example, showing how useful such detailed synthesis work at a regional scale can be. Wood assemblages such as Tybrind Vig and Smakkerup Huse have been subject to some woodworking analysis, including some review of manufacturing techniques, roundwood use and potential for resource management to be investigated (Andersen 2013; Price & Gebauer 2005). Although Bamforth *et al.* (2018a) and Taylor *et al.* (2018) have noted that in these studies waste or working by-products, such as woodchips and toolmarks, have received relatively less attention, perhaps due to the richness of the finished artefact assemblages from these sites. Lillie *et al.* (2005) also highlighted that there has historically been limited integrated fusion of the woodworking finds and evidence into broader overviews of Mesolithic technology between disparate regions, particularly incorporating the significant number of finds from post-Soviet eastern Europe and Russia sites. The recent analysis by Taylor *et al*. (2018, 413-418) provided a brief review of a number of key artefact types of Mesolithic British finds such as bows, digging sticks, paddles and hafts, against European examples, but more use and integration of the wider available data from British and Irish sites with continental Europe is still required to better understand woodworking technology as a whole.

As discussed in **Section 3.4**, it is now clear from the analysis and results in this work that there is a rising number of artefacts and sites in Ireland and Britain that are now happily beginning to validate the original suggestion by Clark (1954) that Mesolithic organic and wooden artefacts will have survived millennia in the archaeological record and that targeted research (and perhaps an element of fortuitous luck) will provide for their discovery. The increasing number of organic finds also means that the archaeological record is now slowly starting to hold enough worked wood to allow for inter-site British and Irish comparison and consideration against the continental European evidence. With this welcome rise in number of known Mesolithic sites and worked wood artefacts in the British and Irish record it is also clear that there is a need to continue to bring this new information together in a more accessible format. For the British and Irish Neolithic (see **Section 3.4.4**), the series of important studies on specific artefact types, such as domestic items or logboats, have advanced understanding on specific topics, but what stands out even for this period is that there is no systematic or integrated review to bring together all that information up to date in a single, modern, user-friendly synthesis on the use of wood as a topic. Ideally, there is also a need to bring together what is known about wider direct or indirect use of wood and woodlands for fuel, coppicing and food production, as the exploitation and cultural interaction with wood and woodlands is an interconnected topic. After all, people's use and emotional interaction with their woodland landscapes as part of wider cultural systems is an important consideration in its own right (Austin 2000; Bell 2020; Moore 2003; Noble 2006, 2017; Warren *et al.* 2014). While this would be a considerable undertaking, at a minimum a study on the lines of Coles *et al.* (1978) or an updated expanded version of Nayling's (1989) survey to assess the available record worked wood sites would seem warranted and timely given the fact that there has demonstrably been a series of important finds and site excavations in the last 20-30 years (Nayling pers. comms. 2021). It is also worth reiterating the need to research, investigate and include the ad hoc results from commercially funded work described above. Stray finds such as Manor Farm, (see **Section 3.4.3**), usefully serve to illustrate that Mesolithic wood, and perhaps particularly pointed ends, may turn up in the course of commercial archaeology, but not be significant enough on their own to be disseminated into the wider archaeological community. Significant information may also be held in the older excavation reports and grey literature and with the increased accessibility of digitised online resources a dedicated in-depth study of that resource to see if more examples can be found would seem highly warranted. With Taylor's (2011a, 367) statement above in mind, this study identified two sites that stood out as important comparative case-studies that could inform the need for more detailed information on worked wood assemblages to add to the existing body of knowledge, with the relevant details for the selection of these sites set out in **Chapter 4. Methodology**. Consideration of Taylor's (2011a, 367) comment above also raised a further research question of whether a defined wooden artefact class existed relevant to the Mesolithic to Neolithic transition that could be usefully compared from these sites to understanding technological change and process across the transition. The identification of structural pointed ends as set out above in **Section 3.5.1** as a specific part of analysis of wider site worked wood assemblages is being suggested as potential fruitful source of information towards that goal.

Chapter 4. Methodology

This chapter sets out the rationale and methodology employed in this study behind the detailed case-study selection (**Section 4.1**), as well as definition of terms and methods behind the analysis of pointed ends (**Section 4.2**), the definitions and specific nature of the techniques applied in toolmark analysis (**Section 4.3**) and finally a description of the data collection methodology when studying assemblages used in this work (**Section 4.4**). The methodology for the experimental programme devised to test the manufacturing process of worked wood pieces identified from the case-studies is contained in **Chapter 7**, to enable all aspect of experimental research to be considered together in one complete, and distinct, section.

4.1 Case study selection

The review of debates and evidence related to the Mesolithic to Neolithic transition in **Chapter 2** and **3** identified the need for the integration of organic material culture to understand the nature of the process across that cultural change. The analysis of published Mesolithic and Neolithic sites with worked wood assemblages in **Chapter 3** also argued that worked wood assemblages could be useful mechanism towards that goal, especially if defined artefact classes could be compared between sites and periods. To that end, this work identified two case-studies that could be studied to provide more information on wood working traditions across the transition period, through comparison of working techniques and identification of specific tool types to understand the nature of the toolkits in these periods.

Case Study no.	**Site**	**Location**	**Period**	**Date**	**Description**
1	Goldcliff East	Newport, Wales	Late Mesolithic	5990-4710 cal BC (Bell 2007a, 2007g)	Dryland occupation, activity and intertidal sites with worked wood located on edge of what was an island next to a palaeochannel. Also, multiple wood structures in a palaeochannel.
2	Sweet & Post tracks	Somerset, England	Early Neolithic	3836 – 3800 BC (dendro. dating) (Hillam *et al.* 1990)	Two trackways across the marshy Somerset Levels between the Polden Hills to the south and a palaeo-island at Westhay.

Table 4.1 The principal case-studies in this work

Fig 4.1 Location of the principal case-studies in this work

The selection of these sites was influenced by a number of criteria as set out below:

I. Firstly, the sites selected contained activity as close to the timeframe of the Mesolithic to Neolithic transition as the archaeology allows, along with worked wood assemblages that can be compared in terms of artefact typologies, woodworking techniques and species selection.

Fig 4.2 Mesolithic worked wood <2018.47> from Goldcliff East (left) and conserved worked from the Sweet Track <SWRJZ2> (right) (the author)

II. Secondly, they contain wooden artefacts with good levels of preservation (Fig 4.2), comparable find types, and densities and have been excavated to modern standards. In all three cases toolmarks and manufacturing data were clearly observable and recorded by photography, context sheets and sometimes drawing after excavation. All have been excavated from well stratified, securely dated, deposits with available documentary and photographic records.

III. Thirdly, the sites provided assemblages of worked wood that held the potential for new analysis generating novel information not already easily accessible in the existing published record. In the case of the Sweet and Post tracks the wooden artefacts were published by the SLP in a series of Somerset Levels Papers in the 1970-1980s, but the full assemblage has not been subjected to detailed re-analysis since that point. At Goldcliff East, worked wood from Sites J, B and the laminated sediments has previously been published by Bell (2007) and Brunning (2007a, 2007b), but new work since 2017 has recovered a significant amount of unpublished worked wood requiring analysis.

IV. Fourthly, these sites are fortuitously located in close geographic proximity, within 40km of each other, either side of the Severn Estuary reducing to some degree some of the ecological or environmental differences that might influence their construction, species selection and technologies in the past.

V. Fifthly, they are all wetland sites and thus share some similar characteristics and uses. The wood structures at Goldcliff East Site T are interpreted as a fish trap(s) from an inter-tidal site, whereas the Sweet and Post sites are trackways in freshwater environments to facilitate passage over wetlands. As no certain Mesolithic trackway has clearly been identified anywhere in northern Europe (Bell 2020) no comparative analysis with that specific structure type is possible at present.

VI. Sixthly, amongst other examples of worked wood they both contain a valuable comparative collection of the same artefact type, the structural pointed end. At Goldcliff East, 13 have been excavated from Sites J, L and H, and a further 19 from Site T. From the Sweet and Post tracks 108 were preserved and examined. This allows for comparative representative samples to be obtained of this artefact type, with multiple examples having surviving toolmarks types to allow end morphologies and working techniques to be compared.

4.2 Structural pointed end analysis in this work

Chapter 3 set out the theoretical background to the analysis of worked wood assemblages and raised the possibility of analysing structural pointed ends as a distinct object class. Previous analysis of this type by Coles & Orme (1985b), O'Sullivan (1996), Sands (1997) and Moore (2008) has set out the methodological framework and provided a mechanism to compare pointed end morphologies as an aspect of prehistoric technology in terms of tool selection and working techniques. Based on those studies, end morphology can be divided into three main typological classes that can be compared against other variables such as raw material selection (tree species), tool efficacy, individual skill and cultural practices and traditions. The end types definitions in this work are set out in Table 4.2 and illustrated in the Figures below.

No.	Shape	Description	Reference
1	Chisel-end	Produced by chopping through wood from one side, using one or more blows until wood is removed. Other side of piece will be untouched. May form part of the chop and tear technique.	Coles & Orme (1985b); O'Sullivan (1996)
3	Pencil-end	Worked all around, like a pencil, on three or more faces to produce a point with multiple facets and normally no areas of unworked wood 'around the diameter of the trunk'.	Coles & Orme (1985b, 27); O'Sullivan (1996, 293)
2	Wedge-end	Chopping from two directions on two parts to form a point with intersecting facets (Coles & Orme 1985b, 27). Facets may be opposing or adjacent (O'Sullivan 1996, 293).	Coles & Orme (1985b); O'Sullivan (1996)

Table 4.2: Types of structural pointed ends identified in previous studies

Fig 4.3 Multiple facets on one side of worked roundwood <SWF44> from the Sweet Track to form a chisel-end point

Fig 4.4 Worked roundwood from the Sweet Track <SWC7> fashioned to a pencil-end with multiple toolmarks around the circumference of the stem leaving no bark near the point (the author)

Fig 4.5 Worked roundwood from the Sweet Track <SWC6> worked on two opposing sides to intersect and produce a wedge-end point (the author)

Another analytical tool that that has been applied to pointed end assemblages is 'toolmark analysis', previously used by other researchers to produce quantifiable data to investigate woodworking practice and compare finds between periods and sites (Brunning & O'Sullivan 1997;

Coles & Orme 1985b; O'Sullivan 1996; Sands 1997). A toolmark is the negative impression left on wood by the slicing, cutting or compacting action of a tool used to shape it. Since the 19th century it has been recognised that samples of surviving prehistoric wood can contain partial or whole marks from a variety of tools, and that these marks can correspond to the shape and dimensions of the original tool used (Brunning 2007; Sands 1997). Earlier work by the SLP demonstrated clearly that toolmark evidence survived on Neolithic excavated wood (Coles *et al.* 1973, Coles & Orme 1976, 1979, 1984). A further development was in Coles & Orme's (1985b, 25) work that linked toolmark evidence with the first comprehensive study of cut roundwood evidence from 30 sites dating from the Neolithic to Roman period in the Somerset Levels. A key finding in that work was that preserved pointed ends could be recorded not just by general end morphology or type, but facet measurements could produce comparable datasets for metric analysis to determine the tools used. Data such as overall facet dimensions, cross-sectional profile, the entry or cutting angle and type of facet junction could be recorded and analysed (Coles & Orme 1985b, 25-28). Importantly, toolmark dimensions were demonstrated to correspond with results from replica tool experiments (Coles & Orme 1985b). The development of further detailed toolmark analysis techniques allowed for the specific characteristics of each toolmark to be studied and the repeated use of even individual tools recorded (Sands 1997). Other important published studies using toolmark analysis data were able to relate the manufacturing marks or wear traces on wood to metal tools from a variety of prehistoric periods (Brunning 2000, 2007; Brunning & O'Sullivan 1997; Hogseth 2007; Goodburn 2003; Moore 2008; Ó Néill 2005; O'Sullivan 1996b; Taylor 1992, 2001; Sands 1994, 1997). A brief description of Coles & Orme's (1985b) toolmark analysis techniques in the table below.

Method no.	Method	Description
1	Individual toolmark analysis	Each toolmark can potentially be measured for length, width, depth, entry angle and cross-sectional curvature (Coles & Orme 1985b; O'Sullivan 1996). O'Sullivan (1996, 294) states that 'the maximum size of a facet is judged to represent the relative ability of an axe to remove large woodchips'. Thus, by analysing the dimensions of toolmarks types between artefacts and sites, the facet sizes and information about tool types used can be produced.
2	Tool signature analysis	Certain tools leave a 'signature' on the wood due to particular irregularities of their edge morphology such as nicks or edge damage as described by Coles & Orme (1985b, 25). The potential of this was illustrated by an example matching four pieces of roundwood to a single tool from worked wood found in two separate Somerset Levels Bronze Age trackways (Tinney's A and Tinney's D). The matching was enabled by a diagnostic blade signature (Coles & Orme 1985b, 44).
3	Identification of individual analysis	Coles & Orme (1985, 25) suggested that some toolmarks can indicate technique, type of tool used, and even possible evidence of individual users if there were unusual, 'idiosyncratic', traces left by their working style. What constitutes an atypical or idiosyncratic working method is hard to define and thus difficult to recognise but, given Coles & Orme's (1985b) recognition of the possibility of wooden artefacts for providing this level of detail, analysis of artefacts was undertaken in this thesis with this suggestion in mind.

4	Jam curve/blade profile/stop mark analysis	The negative trace left by a bladed tool sticking in the wood before it is removed produces the full or partial shape of the tool i.e., its 'blade edge profile' or 'jam curve' (Coles & Orme 1985b). Complete jam curves are the most diagnostic type of toolmark evidence for actual tool use. Recording them allows for tools and toolmarks to be matched, and where distinctive tool types can be distinguished, it can allow for the empirical evidence of actual use of tool type at specific points in time, and not just when objects were finally deposited as common with Bronze Age axes for example (Brunning 2007; Moore 2008).

Table 4.3 Types of toolmark analysis

4.3 Toolmark analysis in this work

Examples of comprehensive application of the study of jam curves include studies on the early Bronze Age Holme-next-the-Sea timber circle (Brennan and Taylor 2003), late Bronze Age Flag Fen timber alignment (Taylor 1992, 2001), and Bronze Age Caldicot (Brunning & O'Sullivan 1997). These illustrated the analytical potential if suitable collections can be found. Brennand and Taylor's (2003, 29) work on Bronze Age timber circle of Holme I, Holme-next-the-Sea, identified a minimum number of 51 axes, with 59 jam curves, and was the basis of suggesting 'at least 59 people could have been involved' in building the structure. The importance of such careful analysis of excavated timbers was also illustrated by the work on the nearby Holme II wood structure that was left *in situ*, and where sea erosion has destroyed toolmark and jam curve evidence to preclude such work (Roberstson & Taylor 2016, 235). However, it is important to acknowledge that problems do also exist in the application of jam curve analysis, as Brunning (2007, 97)'s later appraisal of the Holme-next-the-Sea work disputed aspects of Brennard & Taylor's (2003) conclusions and he suggested that the proposed individual 59 jam curves may actually only represent 11 actual axes. In Brunning's (2007, 97) view, the technique has limitations caused by a reliance on 'jam curves where less than the full blade width is represented' that may allow for replication, and recounting, of the same tool numerous times. Brunning's (2007) wider review of 14 published jam curve studies suggested that a recognisable difference exists within, and between, bronze and iron axe typologies when large samples are compared, making it 'possible to use jam curves [of metal tools] to distinguish between cut wood from these periods' (Brunning 2007, 102). Such evidence has the potential to help date actual use of specific tool types at peculiar points in time, especially if dendrochronology dates can be obtained as well and produce refined chronological resolution for transition points between tool traditions (Brunning 2007, 106). However, he cited the overlap of morphological features in Bronze Age axes to show that an individual jam curve is not normally sufficiently reliable to indicate the tool type on its own and large datasets of complete jam curves are required to produce reliable results. The efficacy and importance of this type of toolmark analysis was also demonstrated by Moore (2008, 660) who was able to show the use of both stone and metal axes at Edercloon EDC42 trackway in Co. Longford, Ireland, dated to 2870-2490cal BC (4087+/-43; WK-20956). This is important as it showed the presence of metal axes several centuries before other archaeological evidence had suggested they arrived in Ireland at c.2,500 BC and 'suggest that the manufacture of metal axes in Ireland began earlier than previously believed' (Moore 2008, 661).

In an ideal situation there would be a large quantity of these diagnostic jam curves on archaeological wood to measure and compare. Unfortunately, the nature of woodworking means that jam curves are often incomplete and more likely only general individual toolmarks are left on the surface of worked timbers and wood (O'Sullivan 1996). This can be a particular problem when assessing Neolithic and Mesolithic woodworking, with no studies published to date that have explored the evidence of British or Irish Mesolithic or Neolithic jam curves in detail to determine the range and variation in tool shape and working edge. In Britain, there are only two published Mesolithic examples identified from the limited British worked wood artefacts; one partial one at Bouldnor Cliff (Taylor 2011b, 86) and one at Star Carr (Bamforth *et al.* 2018, 354). It has been suggested that this is due to the nature of stone tools, with Brunning (2007, 95) stating 'stone axes do not tend to leave recordable jam curves'. O'Sullivan (1996)'s work on Neolithic Irish trackways of Corlea 9 (3620-3360 BC), Corlea 10 (3370-3040 BC) and Cloonbony (2850-2480 BC) analysed samples of 27, 20 and 46 roundwood stakes for each site respectively and makes no mention of any jam curves from the Neolithic material. The author stating 'jam curves are less common on cut points', and normally found on planks or mortices (O'Sullivan 1996, 294). The overall consensus has thus been that jam curve analysis can be successful with large datasets from metal tools, but that lithic tools are unlikely to leave sufficient numbers of such traces for study, and even less so on roundwood pointed ends.

In terms of the other toolmark analysis methods in Table 4.3 above, experimental work by Coles & Orme (1985b) illustrated that there is potentially a significant issue arising from the resharpening, or prolonged use, of a utilised blade that may drastically alter the nature of 'signatures' over time. Irregularities, or idiosyncrasies, of tool edges (ridges, grooves, and chips) were recorded as being worn smooth after substantial experimental use involving hundreds of blows (Coles & Orme 1985b). Work by Sands (1997, 1) on Iron Age crannog piles developed the signature analysis method but was also conscious of the sharpening and re-use issue, highlighting the problem that resharpening events may be separated by as little as hours on some tools or conversely up to years on others dependent on a variety of factors, cultural practices, and personal preference. This would mean that theoretically the same axe could be subject to several sharpening events and could appear multiple times in the data as 'different' axe as its signatures changed as a result. Substantial personal experience of using axes and adzes of steel, bronze and flint by the author would suggest that resharpening would have likely been a constant, repeated practice, perhaps before and even during any work. A sharp axe is more normally a more effective, and considerably safer, tool to use irrespective of whether it is steel, bronze, lithic or organic, and this remains a problem for the application of this technique.

Finally, Taylor (2001) has argued that analysis of individual toolmarks is problematic as they represent only the partial remains left from each blow of a tool. It is certainly true that the nature of woodworking often means many facets will be a truncated or incomplete record of each actual original mark. Wood working is a reductive process and the experimental work of Coles & Orme (1983, 22) suggested 50 blows with a bronze axe to point a stake might only leave ‘5 or 6 identifiable facets, the others lost by the sequence of action’. However, O’Sullivan (1996) has argued that complete toolmarks still provides an indication of the maximum blade edge, cutting angle and cross-section profile, even if the jam curve portion has not been preserved. In practical terms, analytical problems can arise if the dimensions of tools and their toolmarks are too alike, such as those left by similar shaped Bronze Age axe types for example, as then it may be difficult to reliable distinguish the tool responsible. However, where the dimensions of toolmarks have been recognised as quite different, such between as polished lithic axes and bronze axes at the Irish Ederlcoon trackways, then both partial and complete facets may help identify the original type of tool used (Moore 2008).

Considering all the points set out above, the methodology for analysis of pointed ends in this work is primarily based on the principals of Coles & Orme (1985b) and the detailed methodology set out by O’Sullivan (1996) for his analysis of the Neolithic Irish Mount Dillion Bog assemblages. Of particular relevance was that O’Sullivan (1996)’s work provided a mechanism for the measurement and analysis of general toolmark dimensions, along with other data points, and demonstrated that while individual toolmark analysis may not be able to directly address the original complete size of the blade edge of the utilised tool as accurately as jam curve analysis, it has other benefits. As work by O’Sullivan (1996) and Moore (2008) has demonstrated with their analysis of comparable Neolithic Irish assemblages, with reasonably large datasets useful information about the utilised tool morphologies can start to emerge. Given the theoretical and methodological context described above, in this work the artefact assemblages for each case study were thus assessed for general toolmark analysis, jam curve, tool signature or individual worker identification on a case-by-case basis with the results set out in the analysis for each site. Taylor’s (2001) point discussed above about the potential unreliability of an individual tool facet for identifying tool type is certainly still pertinent. However, it is also clear, as shown above, that the other principal toolmark analytical methods have their own drawbacks. As such, it is perhaps the focus of the research question and nature of the available archaeological record from each site that determines the best analytical system for inter-site comparisons. In some cases that may involve combining analytical toolmark analysis techniques, in others with more limited preservation conditions or toolmark types it may rely on one method alone. The incomplete nature of the archaeological record often means that there is a need to strike a balance between the data required from each artefact with creating a large enough dataset to be informative and representative when multiple sites are compared. In the fullness of time Mesolithic and Neolithic large-scale data of detailed complete jam curves may become available for study, but that is certainly not the case at present. As a result, this work considers the best evidence yet available for identifying actual tool use, variation and working techniques based on the toolmark evidence that currently exists.

4.4 Data collection methodology

The specific data collection goals in this study were designed to produce a review of the worked wood evidence from the case-studies investigated that would be comparable in output, data allowing, to the detailed recent work at Star Carr (Bamforth *et al.* 2018a, 2018b; Taylor *et al.* 2018) and thus aid understanding of material culture within the periods under review. Gearey *et al.* (2013, 89-90) recently noted the importance of following similar toolmark analysis methodologies, and creating comparable datasets, if inter-site analysis is to be realistically attempted. The methodology for this study includes the analysis of the utilised tools, raw material selection, evidence for portable objects, cultural styles, manufacturing techniques, and management of the wood as a resource from the case-studies. A particular focus was on producing comparable datasets for structural pointed ends that would allow for similarities and differences in woodworking practice and technology to be identified and evaluated.

The worked wood and toolmark analysis methodology adopted for this work follows the general scheme set out by Coles & Orme (1985b) in their analysis of the pointed ends of roundwood from the Somerset Levels, subsequently refined and set out in more detail by O'Sullivan (1996) for his analysis of the Irish Neolithic trackways of Corlea 9 & 10 and Cloonbony.

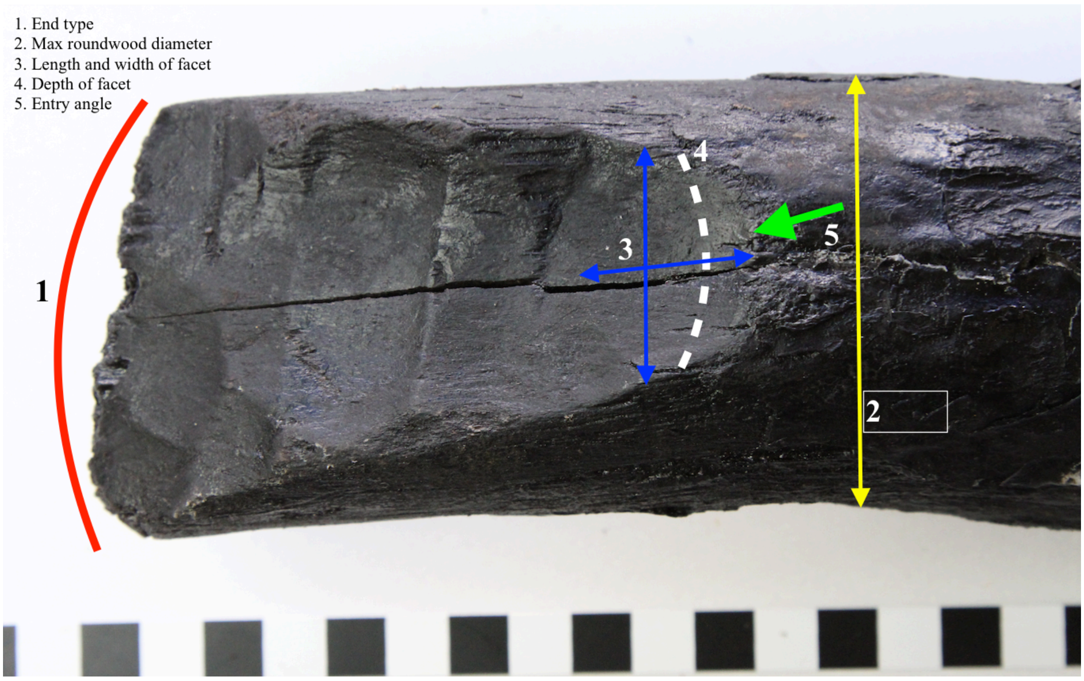


Fig 4.6 Data recorded from analysis of each worked wood pointed end (the author)

It has subsequently been applied by O'Sullivan (2001) on other Irish Neolithic assemblages from the Shannon Estuary and by Moore (2008) on Neolithic pointed ends from the Edercloon trackways. As such, the techniques for inter-site and intra-site analysis had previously been tested and validated against different stone-age assemblages and provides a useful framework for this work. In practical terms for pointed ends themselves, this means recording the point type, cutting angle, and dimensions of the toolmarks by maximum length, width, and depth.

On examination each artefact was studied with oblique light and a large desk magnifying glass, the end typology recorded (i.e., chisel, wedge or pencil as defined above) with measurements then made of the toolmark length, width, depth, and apparent cutting angle. The facet length was taken as the measurement of the toolmark parallel to the direction of the tools blow or working and width at right angles to that axis (O'Sullivan 1996, 294). The maximum depth of the toolmarks was also measured in this study as preliminary analysis suggested a possible correlation between length, width, depth, and cross-sectional curvature as a method to identify woodworking techniques. The depth of facets was measured using a depth gauge accurate to 0.5mm. When relevant a plastic contour gauge was used to measure and record curves and cross-section facet dimensions, accurate to 0.5mm. Although in practice this was not as successful or possible for fragile and soft prehistoric wood as might be hoped.

Fig 4.7 Tools used in the measurement of toolmark analysis (the author)

In practical terms, the best time for toolmark analysis is almost always soon after excavation (Sands 1997), when the wood is wet and the marks as fresh as possible. The analysis of prehistoric worked wood can also be affected by the warping or shrinking of objects as they dry out (Brunning & Watson 2010), which is another reason why ideally analysis should be conducted as soon as possible after excavation. However, when wood items have been properly conserved the toolmarks, and manufacturing traces, are normally identifiable and can be measured when they were seen first-hand by the author in the SLP Taunton and National Museum of Wales, Cardiff, archaeological archives. Any relevant conditions (such as shrinkage) specific to the excavation, post-excavation history and conservation of the assemblages from each site are set out in detail in a section within the relevant case-study chapters. Even when undertaken soon after excavation, the process of analysis can be a difficult one as non-conserved very ancient wood of Mesolithic and early Neolithic age can be fragile, easily damaged and should not be taken out of its temporary water protection for long (Brunning & Watson 2010; Taylor *et al.* 2018). At Goldcliff East, Site T, the author was fortunate enough to take part in excavation of many of the artefacts and have access to the worked wood before conservation, allowing for the best opportunity to study the wood working evidence in detail. In the case of the Sweet and Post trackways all had been excavated years or decades before with only access to published material, conserved items and the excavation archive possible.

During recording, a measurement of each artefact's diameter was also taken above the first toolmark or 'working area' as per O'Sullivan (1996, 292) methodology (see Fig 4.6 above). Where the roundwood had a particularly irregular shape the maximum roundwood diameter excluding knots or cut side branches was measured. As O'Sullivan (1996, 292) noted, the diameter of roundwood will affect resistance to tools – thicker wood has more and denser heartwood, whilst smaller pieces can be cut through in one chop (i.e., perhaps producing a chisel end). Diameter was measured to the nearest 1mm using a combination of steel callipers, digital plastic callipers and woodworking folding ruler as appropriate. The length of the roundwood was recorded but is unlikely to be of direct relevance to this study as it had normally been truncated by one of various processes; sometimes in antiquity, or by a combination of water-level determined deterioration, erosion, excavation procedure or conservation sampling priorities (Coles & Orme 1985b; O'Sullivan 1996). The morphology of end types, and shape and size of facets was the focus of data gathering for pointed ends alongside toolmarks as discussed above. The number of toolmarks was recorded, although the reductive nature of pointing stakes suggests this can be a problematic metric to assess woodworking techniques (Coles & Orme 1985b; O'Sullivan 1996), but it may still indicate the relative efficiency or minimum effort required in relation to the cutting efficacy of the tool used.

In terms of artefact sampling strategy, O'Sullivan (1996, 294) suggested that the largest or most complete facet should be recorded from each artefact for comparison. In his view consistent selection of the same type of facet from each pointed end allows for the tool use to be compared between artefacts as the 'best' facet is proposed to represent the maximum relative ability of the tool to remove the largest woodchip (O'Sullivan 1996, 294). The dimensions of the largest surviving facet will also indicate to a certain extent the maximum cutting edge length of the tool. If complete jam curves survived to allow for a more precise recording of that blade profile these were recorded. Where time allowed a further decision was made to also record all identifiable facets from artefacts to test whether this produced any improved clarity or reliability for comparing datasets between sites and end types. Analysis of the measured toolmarks is set out in the case-study chapters and the site datasets can be found in the relevant appendices.

All studied artefacts were recorded photographically during recording from at least two angles with a Canon 7D DSLR camera with a professional quality macro Canon Zoom EF lens 24-105mm and oblique light during physical examination. This camera takes high quality 18 mega pixels images, allowing for high quality continued reference in analysis outside of the archive. Notes were taken on the features of each artefact on a bespoke wood recording sheet, itself based on the format of sheets suggested by English Heritage (Brunning & Watson 2010). Toolmark data was entered into Excel spreadsheets during visits to collections, with any additional evidence of woodworking (such as branch removal), and general characteristics of the roundwood such as straight and uniform (potentially evidence of coppicing) noted where evident. Where possible, evidence for species, growth rate, number of growth rings and alignment of the central pith was recorded for resource management data purposes. No tree ring data for Goldcliff East Site T was available during the analysis in this work, and the Sweet and Post trackways data was reliant on the existing published and unpublished archive and studies of the original excavation teams. Goldcliff East Site T species identification was undertaken by wood expert Dr Catherine Barnett and the published and unpublished work of Ruth Morgan in the SLP Sweet and Post tracks archive.

Chapter 5. Case Study 1: Goldcliff, Gwent, Wales

5.1 Site context and date

The archaeological sites at Goldcliff, South Wales, represent an area of repeated late Mesolithic activity overlooking the Caldicot Levels to the north and broad river valley of the Severn Estuary to the south (Bell *et al.* 2000, Bell 2007). Analysis of the worked wood assemblage in this work was supported by different sources of information. Firstly the published and unpublished wood analysis of Brunning (2007a, 2007b) and Bell (2007c, 2007d), as well as study of the conserved assemblage of wood (n=20) held at the National Museum of Wales, Cardiff, in-person by the author (see **Section 5.3**). The second main source of data was the in-person study by the author of unpublished archaeological wood artefacts (n=36) recovered from excavations at Goldcliff East between 2017-2020 prior to conservation (see **Section 5.10**). A significant number of these were directly excavated by the author as part of Professor Martin Bell's archaeological team.

As an extensively studied example of British Mesolithic activity in the inter-tidal zone, Goldcliff has produced a range of organic and inorganic evidence including antler, bone and worked wood artefacts, wood charcoal, lithics, and a wide range of palaeoenviromental evidence (Bell *et al.* 2000; Bell 2007, 2020). Over the course of the Mesolithic period pronounced landscape changes occurred as sea level gradually rose and transformed what was a coastal hill to a seashore island from around 5,900 cal BC onwards (Bell 2007g, 220). By the final late Mesolithic, it formed an island that was a significant feature in the surrounding flat topography, measuring roughly around 900x300m (Allen 2000, 18). Most of this Mesolithic aged island is now eroded away to leave a truncated section of the original hill and a narrow band of the island edge continually exposed and eroded by the action of the sea (Bell 2007g).

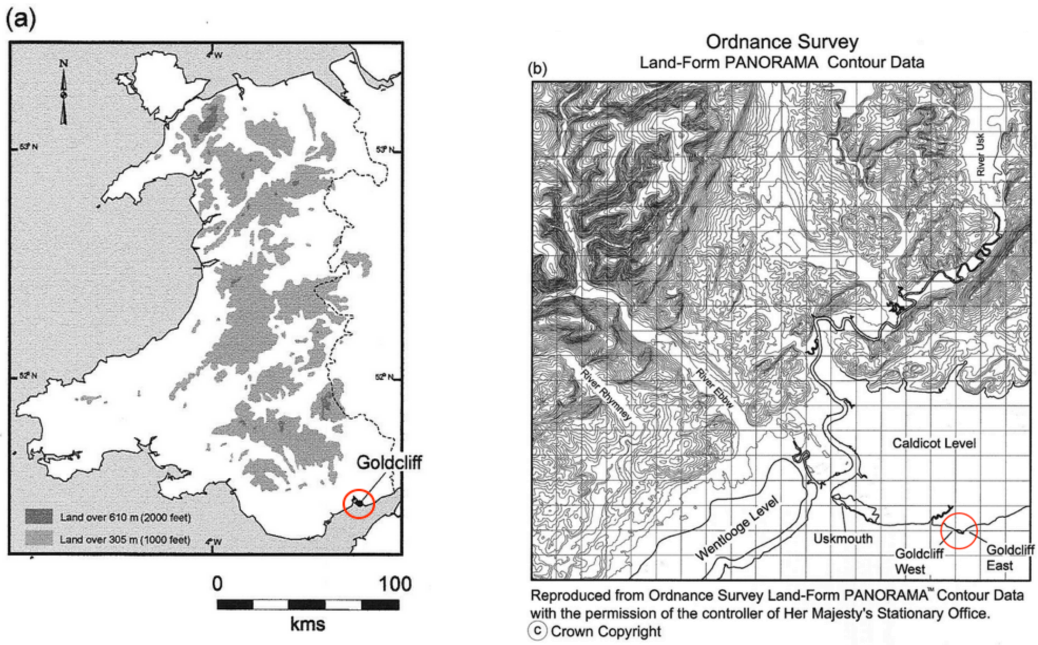


Fig 5.1 Locations of Goldcliff East in Wales (a) and in relation the Caldicot Levels (b) (red circles the author, after Bell 2007a, Fig 2.1)

Rising sea levels over the course of the Mesolithic also meant that the local ecology progressively altered from a forest of tall oak trees with some birch, to one surrounded by reedswamp, saltmarsh and fen woodland – with changing resources available as a result (Bell 2007g). As the only raised dryland location within a 6km area it would have been an attractive, and rare, supply of woodland species and dry landing spot in the area, with nearby ecologically rich wetlands for plants, mammal, birds, and aquatic species exploitation (Barton & Bell 2000; Bell 2007g). Significantly there was also a palaeochannel running north to south, east of the island that gradually moved eastwards over the course of the late Mesolithic period (Bell 2007d, 50). This feature, and its tributaries, would have been a useful source of marine resources and start of an access route into the wetlands and landscape beyond.

Goldcliff is also noteworthy, as it is not a single 'site', rather multiple chronologically distinct Mesolithic sites have been identified; Hill Pond Farm and Site W to the west, and Sites A, B, B2, D, J, I and T to the east of the island (Fig 5.2). Continued monitoring has identified a further eastern site, Site Z, with a hearth and lithics in 2021 (M. Bell pers. comms.). In this work each site is described as in keeping with the nomenclature of the published work on the site (i.e., 'Site B' or 'Site J') (Bell 2007). Radiocarbon results have suggested that activity took place between 6000 - 4500 cal BC (Barton & Bell 2000; Bell 2007a), although individual sites sometimes contain multiple phases. At the largest excavated area at Site J there were three different sedimentary periods of use (old land surface, estuarine introgression, and peat), with several successive phases and periods of activity identified within the old land surface for example (Bell 2007g, 227). Such consistent re-use underlines a general impression of repeated and activity over a long time span. There are also further published sites (C, E, F, G and H) in the laminated estuarine sediments that hold evocative, if transient, examples of Mesolithic footprints, with 270 examples counted by 2007, with 67% of these being made by seven different children aged 3–6 years old (Scales 2007, 153). This clearly demonstrates the presence, and likely contribution, of younger people on the island and such recurring evidence for small children suggests that a significant part of the overall community were visiting the location each time. Ongoing recording and analysis by Barr (2018) of more footprints continues to clarify the frequency of visitation and routeways, with Bell (2020, 90-97) now recording 342 identified footprints and 21 distinct Mesolithic trails.

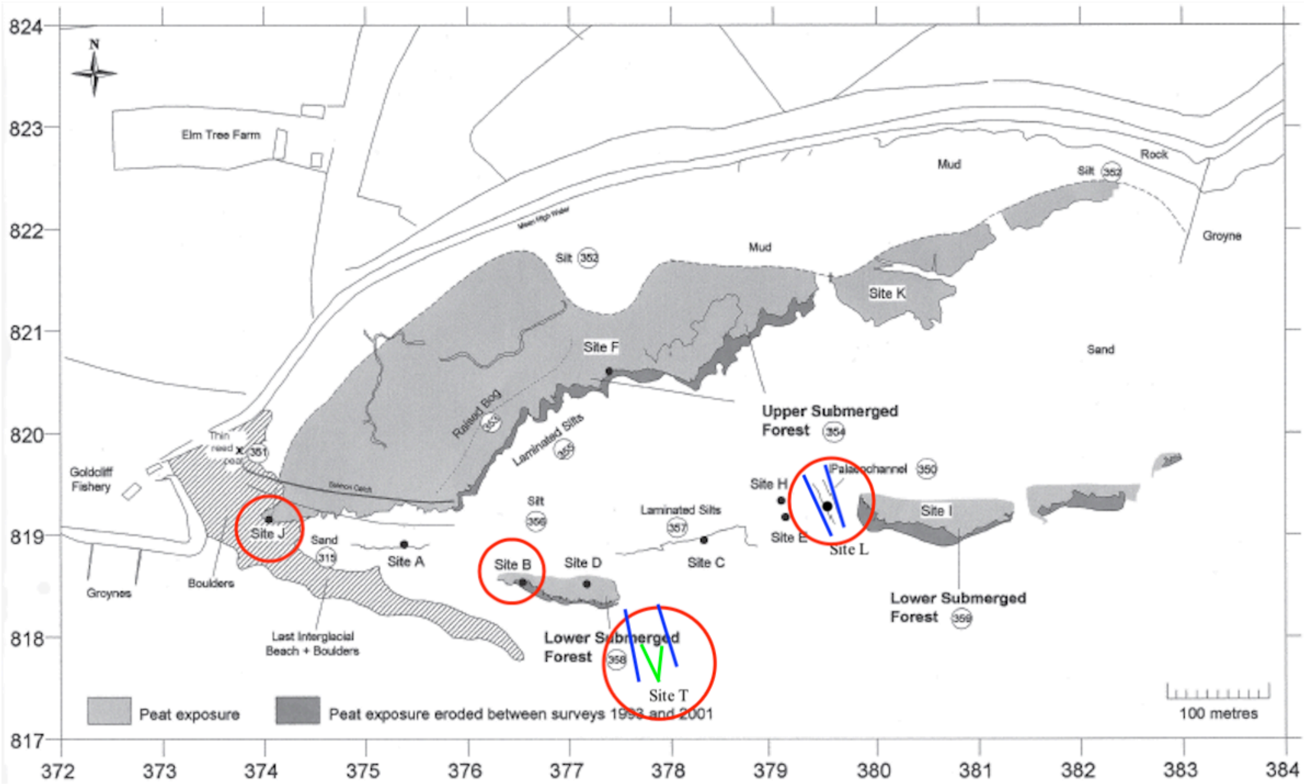


Fig 5.2 Locations of key Mesolithic sites at Goldcliff East with worked wood. Red = wood, blue = palaeochannel, green = wood structure (after Bell 2007a, Fig 2.3

Finally, there is currently no evidence of early Mesolithic use, but it would have been an inland hill some 30km from the tidal influences at around 8,230 cal BC and any activity was likely different in nature (Bell 2007g). Charred wood, charcoal, and hazelnuts, and stray occasional lithics higher in the stratigraphy at Site W (dating 4500-4000 cal BC) and evidence of later burning at Site J also provide some tentative evidence for activity after 4500 cal BC and perhaps limited activity even up to 4,000 cal BC (Barton & Bell 2000; Bell 2007f). From the sites investigated to date the overall evidence suggests intensity markedly decreased towards the end of the Mesolithic and there is no current evidence for any substantial Neolithic use or occupation of the location (Bell 2007g, 247). An early Neolithic landnam episode was originally reported in work by Smith & Morgan (1989) and Caseldine (2000), but subsequent pollen analysis and review of the earlier evidence has indicated that the vegetational changes could be explained by hydrological and coastal change rather than Neolithic activity (Dark 2007, 184-5).

Table 5.1 Summary Mesolithic sub-sites at Goldcliff East (excluding footprints sites in Barr (2018) and found since 2021)

Site	Archaeological evidence	Worked wood present?	Min. no. contexts/ phases	Context dated	Radiocarbon date	Lab code	Cal BC	Source
Site J	Possible structures, butchery, skin processing, cooking, limited knapping, microwear evidence, some woodworking and preservation of wooden tools onsite. Processing and craft activities.	Yes	3	328	5934±39; 5930±37	OxA-15549; OxA15550	4940-4710 (combined)	Nayling & Manning (2007, 96), Bell (2007f, 63-82)
Site T	Remains of *in situ* wooden structures in Mesolithic palaeochannel, interpreted as three V shaped fish traps with ends of stakes and withies in place.	Yes	3	Ta, Tb, Tc, Td	6072±50; 6107±45; 6169±31; 6181±36; 6245±35	UB-41503; UB-35012; UBA-41505; UBA-41504; UBA-41506	5310-4840 (combined)	Bell *et al. forthcoming*
Site G	Deer, aurochs and one human footprint below the Upper Peat and top of the lower Wentlooge laminated sediments	No	1	n/a	n/a	n/a	Est. 5500-5000 based on stratigraphic context and OD level	Bell (2007d, 48-55)
Site H	16 footprints of one human individual walking east to west.	No	1	n/a	n/a	n/a	Est. 5500-5000 based on stratigraphic context and OD level	Bell (2007d, 55), Scales (2007, 141-143)
Site L	Worked wood in laminated sediment eastern side of channel. 14 small diameter pieces of roundwood possible remains of a destroyed basket. One roundwood stake on its own in sediment.	Yes	2 (possible)	n/a	n/a	n/a	Est. 5500-5000 based on stratigraphic context and OD level	Bell (2007d, 49-52)
Palaeo-channel east of Site E	Two possible worked wood artefacts in Mesolithic laminated sediments interpreted as redeposited driftwood from other structures nearby lain down in palaeochannel	Yes	2 (possible)	n/a	n/a	n/a	Est. 5500-5000 based on stratigraphic context and OD level	Bell (2007d, 48-55)

Site E	Two areas of human footprints with 10 individuals, with one possibly showing evidence of shoe. Woodchip under a footprint, and nearby possible worked wooden artefact.	Yes	2	n/a	n/a	n/a	Est. 5500-5000 based on stratigraphic context and OD level	Bell (2007d, 48-55)
Site C	Several hundred human footprints of 10 people, including small children, as well as red deer, bird, and wolf.	No	14	n/a	n/a	n/a	Est. 5500-5000 based on stratigraphic context and OD level	Bell (2007d, 48-55)
Site W	Dryland/wetland edge short-term use with two possible hearth patches with some tool production, butchery, and processing of range of animals, cooking, consumption of red deer onsite and other species taken away. Fishing evidence and possible winter occupation evidence. Late Mesolithic activity (phase 2) with flints and charred hazelnut.	No	2	1202	6760±80; 6430±80; 6420±80; 5415±75 (phase 2)	Not specified Not specified Not specified OxA-6682	5600-5200 (combined) 4686-4493 (possible late activity)	Barton & Bell (2000, 59); Bell *et al.* (2000, 33-58)
Hill Pond Farm	Undated site, situated inland from Site W and likely older due to stratigraphic evidence. One microlith and some flint working and animal bone recovered.	No	1	TBC	n/a	n/a	n/a	Bell *et al.* (2000, 27-30)
Site A	Part of large dryland/wetland edge site with knapping, microlith production, cooking, extensive fish processing and likely drying, consumption of charred hazelnuts, hunting of wild animals, small structures.	No	2	315	6629±38	OxA-13928	5630-5480	Nayling & Manning (2007, 96); Bell (2007e, 57-59)
Site D	Peripheral occupation to main activity area, two phases of burning trees and reeds, area of human defecation. Possible second phase of activity.	No	2	345	6726±33; 6790±38	OxA-12358; OxA-12359	5740-5560 (combined)	Nayling & Manning (2007, 96); Bell (2007c, 36-45)
Site B	Short lived dryland/wetland edge occupation with knapping, cooking, and processing animal and plant foods. Later reuse for butchery, cooking and possibly hide processing in wetland edge environment.	Yes	2	321	7002±35	OxA13927	5990-5790	Nayling & Manning (2007, 96); Bell (2007, chpt 3)

5.2 Site interpretation

Bell (2007g, 243) proposed the island formed an important waypoint in the seasonal rounds of Mesolithic communities accessing different resources at different times of the year. The low density of artefacts in individual layers at all the sites supports this view of brief periods of use, perhaps constrained by the seasons, with likely short-term camps occupied for weeks at a time (Barton & Bell 2000, 58; Bell 2007g, 242). Artefact distribution patterns at Site J potentially have suggested the presence of a small 3m diameter structure, but if correct this was likely only a temporary one as no post-holes or elements of permanent structures were encountered (Bell 2007g). At the western side of the island at Site W the evidence was again for a short-lived occupation focused on deer, pig, fish, and plant gathering with possibly some form of temporary structure (Barton & Bell 2000). Part of a more extensive occupation layer or site, the area excavated at Site A had no significant structural remains and the focus appears to have been on processing and consuming food resources, particularly eels, within limited occupation windows (Bell 2007c). The presence and density of a human waste area at Site D, illustrated by human faecal parasites, was also suggestive of fairly small groups of people occupying and accessing resources at a given time (Bell 2007c).

The excavated remains showed evidence for a range of faunal exploitation although interestingly this does not seem to have been entirely consistent for each of the four major sites investigated. At Site B and J red deer, aurochs and roe deer were all hunted, but wild boar was only found at J and not within the smaller assemblage of Site B (Bell 2007g). Site W provided evidence for red deer, roe deer and boar hunting but no aurochs, whereas at Site A red deer, aurochs, wild boar and roe deer were all hunted (Bell 2007g). However, there were other clear inter-site differences, with fishing a major component of the assemblage from Site A and W but largely absent from B and J, showing that inter-site complexity at Goldcliff does exist (Bell 2007g). The use of the island for more than hunting terrestrial fauna is attested to by plant remains that showed processing and, potentially, gathering of resources such as hazelnuts alongside a wider record of consistent, deliberate and sustained widespread burning of the environment to modify the local environment on a regular basis (Barton & Bell 2000; Dark 2007). Bell (2007g, 241) identified direct evidence for 41 plant resources that would have been of use to people occupying the island, along with 10 other species identified as likely present given the ecological context. The combination of faunal bone and footprint evidence from all the combined sites showed the presence of six terrestrial mammal species, eight bird species, 12 fish species and six shellfish species available for human exploitation (Scales & Ingrem 2007). More recent, currently unpublished, recovery of seal bones at Site A adds another aquatic species to that list (Martin Bell pers. comms). Overall, this resource variety illustrates the rich economic potential of the location on the wetland edge interface for visiting groups and why it likely formed an important focus for people in the region.

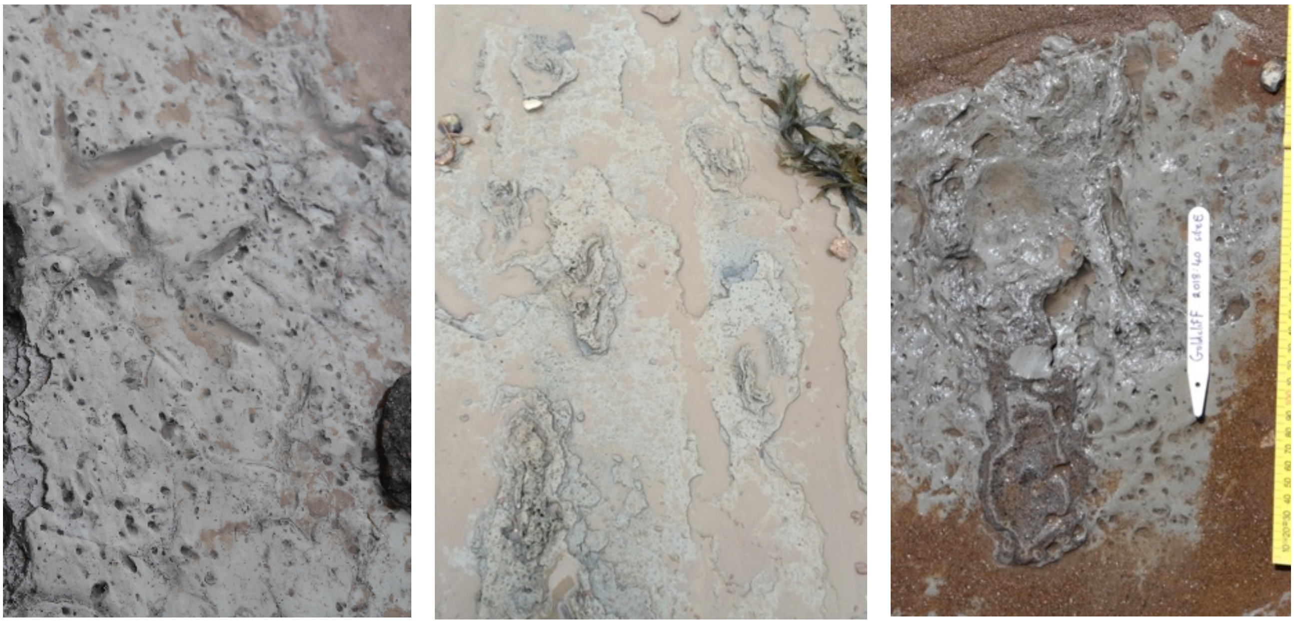


Fig 5.3 Footprints in the laminated sediments; Bird at Site C (left), human near Site T (middle) and human at Site E (right) (the author)

The nature of these estuarine laminate sediments has also allowed for exceptional temporal resolution on an annual scale and has, for example, shown four separate instances of Mesolithic people crossing the same part of the saltmarsh at Site C over a 16-year window some 7,000 years ago (Bell 2007d, 52). The general alignment of tracks at Site C and Site E suggests possible travel along the edge of the palaeochannel and perpendicular to the known dryland sites, though potentially the person at Site H was actually moving between the channel and known dryland sites in the regions of Site A or Site J (Bell 2007g, 235). Bell (2007g, 247) has tentatively suggested that based on the annual banding and the apparent frequency of footprints identified, yearly visitation is a reasonable estimate. Seasonality is also an important issue in reconstructing Mesolithic lifeways and the annually banded laminated footprint sediments provide key resolution to illustrate Goldcliff was mainly occupied during the warmer and calmer periods of the year of summer and early autumn (Bell 2007g). The plant evidence and faunal evidence from the sites on the east of the island also supports this main period of occupation model (Bell 2007g, 245-246). However, some evidence for seasonal complexity exists, as the faunal evidence from the west of the island at Site W shows wild boar being exploited during the winter and/or spring and it is possible that the west and east of the island were utilised in different ways and seasons (Coard 2000). Given the island's fairly exposed coastal position, perhaps the dangers of winter weather, high tides and the capability of the available watercraft restricted its use as a more permanent location and meant that, for all its ecological resources, it was not a favourable place to spend any significant length of time in the winter.

5.3 Worked wood assemblage (2001-2003) context and analysis

In this section the worked wood assemblage found prior to 2017 is summarised in Table 5.2 below by site from youngest to oldest in descending order as found in the stratigraphy, with artefacts and woodworking technology discussed first by site and then by artefact category. Site T was first identified in 2017 and, as currently unpublished, is considered in its own right in the second half of this chapter. Of the 65 recorded wood objects recorded from the Goldcliff 2001-2003 excavations, 20 have been conserved and are now held by the National Museum of Wales, Cardiff. These were examined by the author with notes, records and photographs taken under the protocols as set out in the data collection section of **Chapter 4** (list of artefacts physically examined can be found in Appendix 1). In this section the available published drawings have been generally relied upon to illustrate the features of the conserved artefacts, unless another angle was required, as it can be difficult to see fine detail on conserved wood in person let alone in research visit photographs taken after conservation. Analysis of the non-preserved finds from the sites has been reliant on the wood reports by Richard Brunning (Brunning 2007a, 2007b). The species identification data used the results published in reports by Bell (2007d) and Brunning (2007a, 2007b).

Site	Sediment type	Tool	Possible pointed end /section	Basketry	Split piece	Cut piece	Woodchip	Total	Source
Site J (context 327)	Peat	1				2		3	Brunning (2007a, 2007b)
Site J (context 331)	Estuarine	3	1	1 [possible]		6	3	14	Brunning (2007a, 2007b)
Site J (context 328)	Old land surface	4	5		3	11	2	25	Bell (2007f); Brunning (2007a, 2007b)
Site E	Estuarine		1				1	2	Bell (2007d); Brunning (2007a, 2007b)
Site L	Estuarine		5	14 [probable]				19	Bell (2007d); Brunning (2007a)
Palaeoc-hannel east of Site H	Estuarine		1					1	Bell (2007d)
Site B	Old land surface	1						1	Brunning (2007a)
Total		9	13	15 [14 probable]	3	19	6	65 [64 probable]	

Table 5.2 Summary of number worked wood artefacts by site and type

The worked wood assemblage listed above includes all the pieces recorded and described in the worked wood reports (Bell 2007d; Brunning 2007a, 2007b). It also includes the nine pieces (<9490>, <10547a>, <4576a>, <4576d>, <4555>, <4533>, <7562>, <4560b> and <4650a>) from Site J described as having less conclusive evidence of human manufacturing, 'due to decay, compaction and erosion' (Brunning 2007b, 2). As human modification was less secure for these pieces they were not conserved for study by the author and could perhaps best be considered possibly worked pieces. Based on their stratigraphic context and association with Mesolithic artefacts, and using the published wood report, they have been included in the analysis work of this section but with the proviso that there are often problems in identifying every piece of worked wood from such contexts.

Of the other recorded wood items from Site J, the cut piece with a chisel end <7878> from Context 327 that was described as potentially excavation damage is included as it appears (based again on the description alone as above) on balance to be an artefact as it is associated with another more clearly cut piece of wood <9181> and in a Mesolithic layer of activity. However, the single possible roundwood basketry piece <9403> from Context 331 at Site J has been excluded as it seems too speculative, as Brunning's (2007b, 4) description set out. The 14 pieces of roundwood in a pattern resembling a destroyed basket recorded at Site L are included, as given the recovery of several definitively worked pieces of wood from these Mesolithic sediments it is felt that this is a reasonable hypothesis. Aside from Site T artefacts, none of the worked wood objects from the laminated bands have been directly radiocarbon dated, but these sediments are indirectly dated to the late Mesolithic of c.5650-4700 cal BC (Bell 2007d, 49). The position of artefacts within these annually sealed deposits suggests that these artefacts will be broadly contemporary with bands surrounding them, or even if re-deposited at least *terminus ante quem* of a late Mesolithic age.

5.4 Worked wood assemblages by site

5.4.1 Site J assemblage

As shown in Table 5.2 above, the worked wood from Site J is spread amongst three main contexts or phases (328, 331, 327), with the oldest Context 328 representing the old land surface and holding the bulk of the wood artefacts from this site (25 artefacts, 60% of total). The survival of worked wood from all three contexts reinforces Bell's (2007g) proposal that a consistent agency bringing about the waterlogged nature of sediments existed in this area. This suggests that any future excavation of Mesolithic activity in this location may well produce more preserved wood. The decreasing density and number of worked wood artefacts between Site J's sedimentary phases, proceeding upwards from oldest to youngest, also matches a clear trend from the lithic and bone evidence for activity generally decreasing at Site J over time (Bell 2007h).

Comparing the three sedimentary phases it is clear that only Context 328 (old land surface) and Context 331 (estuarine sediments) really held significant number of objects, with similar numbers classed as tools (four in Context 328, 3 in Context 331 and one in Context 327) and cut pieces such as <10270> below (11 in Context 328, six in Context 331 and two in Context 327) broadly similar. Interestingly, the only split pieces of wood (**n=3**) and most artefacts identified as part of pointed ends (five of a total six recovered from Site J) were found in Context 328 and this may suggest that more substantial structures or more complex woodworking were occurring in the earliest phase of activity at Site J. Apart from one object from Site B, all the tools or portable objects from settlement areas at Goldcliff were recovered from Site J and six of the 13 possible or partial pointed ends were also recovered from this site. Cut pieces and potential woodchips are the final two categories of finds from Site J, with woodchips found in low numbers (two in Context 328, three in Context 331 and zero in Context 327) and offering some evidence of nearby woodworking, although likely not the true scale of activities at the site. The problem of identifying such woodchips from natural wood fragments during excavation may potentially be a factor in limiting the size of the woodchip assemblage.

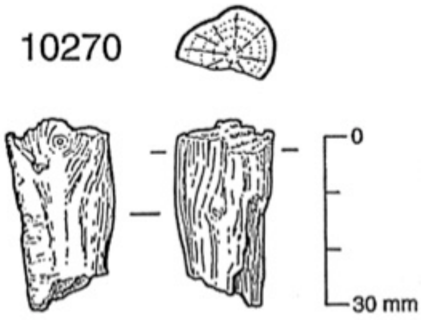


Fig 5.4 Example of worked wood cut piece <10270> from Site J (drawing L Collett, Brunning 2007a)

The recovery of 19 cut pieces from primarily Context 328 (**n=11**) and Context 331 (**n=6**) would reinforce an impression of some wood-cutting, preparation and working occurring in Site J. But this relatively low density over an excavated 49m^2 area would seem to suggest that if major woodworking tasks took place (such as preparation of pointed ends) then this was taking place elsewhere. The distribution of the excavated wood artefacts from the old land surface approximately followed a much more pronounced clustering of lithic debitage in the old land surface, the main one called Cluster B by the excavation team (Bell 2007f, 81). This central cluster was some 3.5m in diameter and was interpreted as a temporary lightweight structure with debris collecting at the margins of a wall of some form and may suggest that ad-hoc woodworking and wooden tool use took place in the same structure as other activities. Bell (2007g, 230) has suggested that the principal reason for the relatively high level of wood and bone preservation at Site J was the presence of continuously waterlogged sediment, suggesting there was a 'permanent spring discharge' in this specific area as wood was preserved before being covered by peat. Such a source of fresh ground water on a dryland island would of course offer yet another attractive resource to siting temporary camps of Mesolithic groups. This unusual feature also makes Goldcliff Site J a very rare example of a dryland site (if a short distance from the wetland edge) fortuitously located in an environment that allowed wood preservation. This offers a glimpse of what may likely be missing from many other comparable Mesolithic in Britain and where perhaps research energy might usefully be directed.

5.4.2 Site E assemblage

Site E is an area of laminated sediments within the palaeochannel margins that contained numerous human footprints and two items of worked wood. <13300> is a small undated hazel woodchip (24mm x 8mm x 1mm) found in a block lifted sediment 30cm underneath footprints, suggesting it pre-dates that particular set of prints by roughly some 30 years. <13302> was found 15m east and *c.*20cm below the Site E tracks (Bell 2007d, 50). This was another piece of hazel some 238mm x 58mm x 22mm tangentially or half split with an eroded, rounded, exterior surface. There is some indication of tapering towards one broken end, perhaps to use as a stake, along with the possible remains of a broken notch or hole at the other (Brunning 2007a, 128).

Bell (2007d, 51) also suggested it may be a small plank. The condition makes it hard to positively identify any cutmarks, or indeed any function, although a product of human manufacture and structural use in some way seems probable. The pronounced cross-section curve across its diameter it now exhibits in the archive does not seem to entirely correspond with the drawing before conservation, so it seems possible some post-excavation or conservation distortion has occurred. Such warping or 'cupping' is particularly likely to happen to tangentially split wood if it dries. It should be noted that curved cross-sectional facet is a feature of the Site T type pointed ends toolmarks (see Section 5.12.1 below), and possibly this piece may have been made in a comparable way, but condition of the object did not make a clear identification of the working technique or facets possible.

Fig 5.5. Hazel (Corylus sp.) woodchip <13300> (left) (the author) and split hazel (Corylus sp.) artefact <13302> (right) (drawing L Collett, Brunning 2007a)

Fig 5.6. Images of the split hazel (Corylus sp.) artefact <13302> on examination (the author)

5.4.3 Site L assemblage

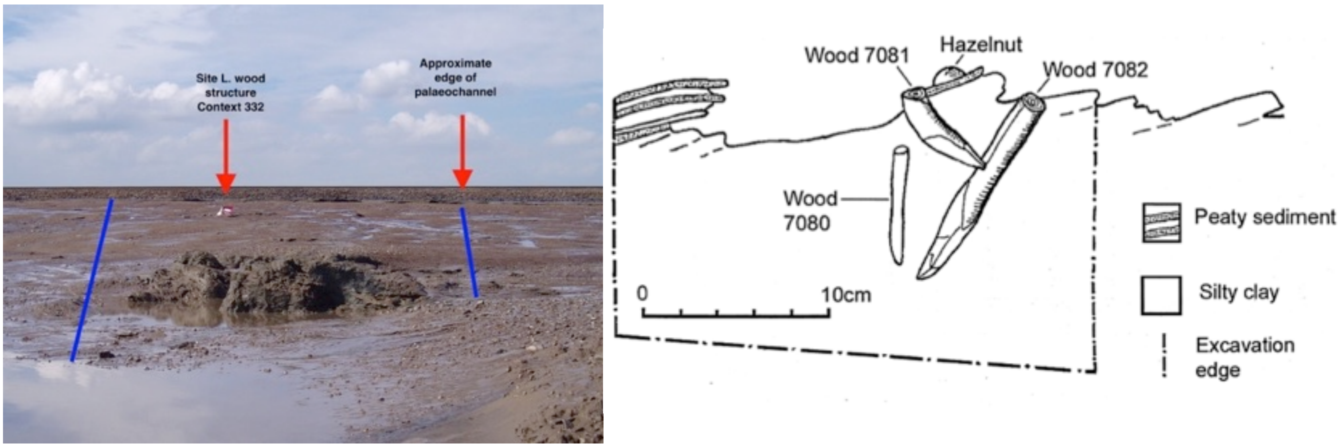


Fig 5.7. Location of Site L (right) and section drawing of wood in situ (right) (photo and drawing Bell 2007d)

Site L is located on the eastern location of the main palaeochannel and contained several small collections of wood. Context 332 contained four pieces of wood, with <7080> and <7081> illustrated and described by Brunning (2007a) and available for study in the National Museum of Wales. The interpretation was that these two alder pieces of roundwood in the assemblage were pointed ends cut to pencil points (Brunning 2007a). The third object, <7082>, was described as fairly substantial 110mm long by 70mm diameter piece of roundwood 'with possible working to a pencil point' (Brunning 2007a, 129). Unfortunately, this had not been preserved in the National Museum Wales for study, and from this it may be concluded that Brunning was not convinced it has been worked (Bell pers. comm). The fourth piece wood mentioned by Bell (2007d, 50) was not described, illustrated, or conserved and presumably again exhibited no clear evidence of working. On examination of the two conserved objects the pointed end interpretation seemed a potentially reasonable one, although as noted in the report they did appear quite eroded, with edges smoothed and it was not possible to measure or distinguish any toolmarks.

Fig 5.8 Images of <7080> and <7081> from the possible wooden structure Site L (the author)

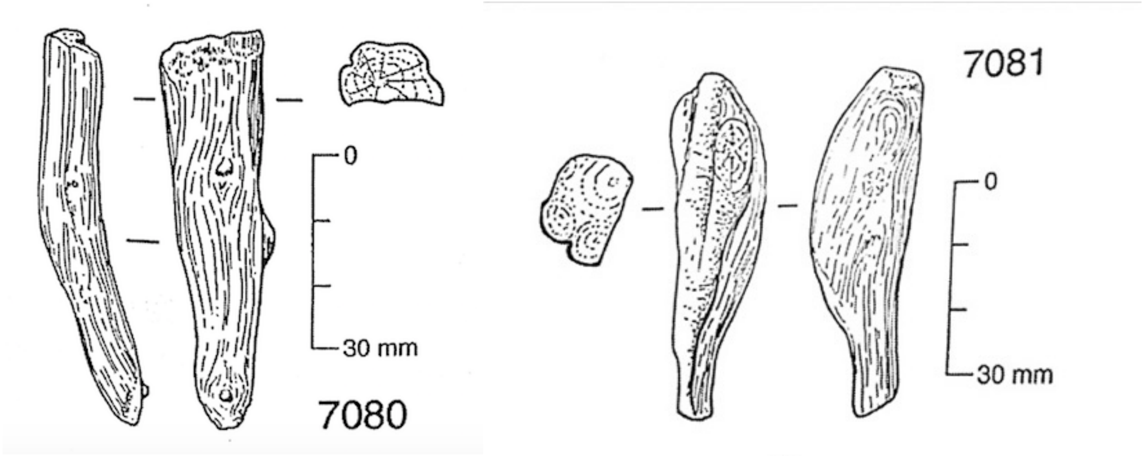


Fig 5.9 Drawings of the wooden artefacts from <7080> and <7081> (drawings L Collett, Brunning 2007a)

Artefact <14202> was another piece of worked wood found in isolation at Site L in the laminated sediments. It was a hazel roundwood, measuring 358mm long by 56mm in diameter cut on two sides to form a probable point, although this had broken off (Brunning 2007a, 129). On examination it appeared fairly eroded and rounded, with no clear toolmarks, or their manner of manufacture, discernible for more in-depth analysis, but its size and location in the laminated sediments further supports the idea of wooden structure(s) being built and located in this channel.

Fig 5.10 Artefact <14202> with possibly part of a structure, although human modification was unclear (drawing L Collett, Brunning 2007a; photo the author)

Another stratified, but isolated, object from this location was the pointed roundwood end <14201>, measuring 254mm long by 29mm by 22mm at its widest. Brunning (2007a) describes it as worked over its length and exhibiting an eroded end, suggesting it had worked loose and subsequently eroded in the channel. On examination this proved to be an important artefact, pointed as suggested, with what appeared a slight buckling at the tip as can be found with green stakes when driven in (Brunning 2007b). Importantly it also appeared to exhibit five toolmarks with similar characteristics to those observed from the pointed ends of Site T, namely long, dished in cross-section and relatively wide as illustrated in the graph below. The most complete of these measured 140mm long x 23 wide x 0.5mm deep, with another truncated facet measuring 42mm long x 21mm wide x 2mm deep and having a clearly pronounced dished cross-section across its truncated top. The eroded nature of the object made it impossible to accurately gauge the entry or exit point of these facets and it should be allowed that the condition means that these measurements are likely to be approximate, as sharp diagnostic features such as facet ridges are now lost. The object also appeared curved, or warped, over its length, which must surely have happened after any cutting into a point and does add some difficulty in being absolutely sure of measuring, or identifying, the toolmarks. However, on balance it is suggested that this item has been worked in a similar way to those of Site T (detailed in Section 5.12.1 below). It is from the Mesolithic laminated sediments, potentially displaced and found inland of Site T in later deposits so likely comes from other unknown structures and interestingly shows this working method of pointed ends was not solely confided to Site T.

Fig 5.11 Drawing (top, left) and images of artefact <14201> showing the curved cross-sectional profile across a facet (drawing L Collett, Brunning 2007a; photos the author)

The final artefacts from Site L were a collection of 14 roundwood pieces near the location of artefacts in Context 332. These measured on average 3mm in diameter though one was 12mm and the two longest 400mm and 500mm (Bell 2007d, 50). Fig 5.12 shows this feature in plan. Bell (2007d) states no cut ends were observed but has suggested it may be the remains of largely eroded artefact such as a fishing basket.

Without clear evidence of human agency, and as none of the objects were lifted, conserved, or could be examined by the author, it is impossible to be entirely sure about its function or identification. However, the general contention that it is a basket, and the other worked wood from Context 332 and artefact <14201> comprise the ruined and eroded remains of fishing related structures or gear, seems a possible one given the stratigraphic context and location. Considering the clear evidence from site W, A and now T for fishing and the possible similarity of working method between the Site T pointed ends and <14201> that interpretation would seem yet more plausible and adds more weigh to the perception that fishing was a central aspect to Mesolithic activity at Goldcliff.

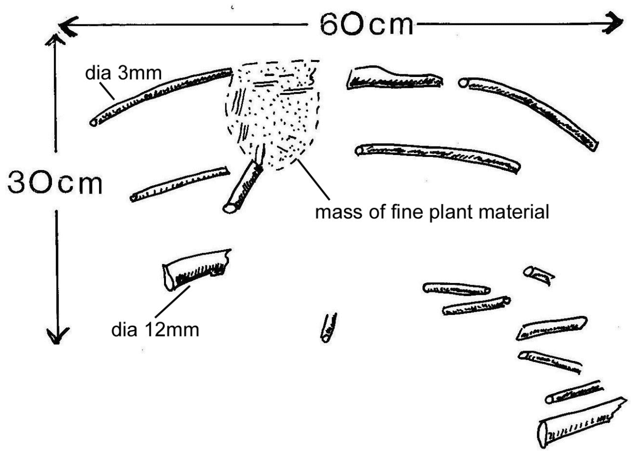


Fig 5.12 Drawing of the collection of small roundwood at Sit L, tentatively identified as possible basketry (Bell 2007a, CD project archive)

5.4.4 Palaeochannel tributary east of Site H assemblage

Bell (2007b, 50) also reported the recovery of a pointed stake <13303> in a tributary some 20m from the main palaeochannel towards site H. This was not described in the worked wood reports by Brunning (2007a, 2007b) and not available for study in the Cardiff Museum, so analysis of this object has not been attempted.

5.4.5 Site B assemblage

Only one wooden artefact, part of a spoon or stirrer <3718>, was recovered from Site B and is described in more detail with its drawing in the analysis of tools below. It was found in the mineral soil (Context 321) of Site B and may be debris from a nearby occupation area, as this context itself appears to show a range of activities, including being a toilet area (Bell 2007c).

5.5 Tools or finished portable objects

Site	Context	Sediment	Artefact no.	Species	Date (cal BC)	Date BP & Lab no.	Description
Site J	327	Peat	9224	Oak (*Quercus sp.*)	4910-4710	5930±37 BP, OxA-15550 (Nayling *et al.* 2007)	Digging stick or spear. Natural bend with cut faces to make square cross section.
Site J	331	Estuarine sediments	9431				Pronged shaped tool, finely worked in U shape
Site J	331 [328 interface)	Estuarine sediments	10665				Y-shaped tool made from roundwood and two branches. Has two grooves with possible polish, though may be post-excavation damage, not described in report so unclear.
Site J	331 [328 interface)	Estuarine sediments	10462				Tool (possible bead). Charred with dished surfaces, wear, and very fine cut marks.
Site J	328	Old land surface	4504				V-shaped tool. Worked to form asymmetrical tool, with wear from use.
Site J	328	Old land surface	9199		4932-4906	5934±39 BP, OxA-15549 (Nayling *et al.* 2007)	Carefully shaped Y-shaped wood tool, function unknown. From forked branch.
Site J	328	Old land surface	10266				Finely worked pin or point of tool, broken.
Site J	328	Old land surface	10159	Hazel (*Corylus sp.*)			Tool? Worked to pencil point and seems to fit on thumb, perhaps for crafting?
Site B	321	Old land surface	3718	Oak (*Quercus sp.*)			End of a spoon or stirrer.

Table 5.3 Wooden tools or finished utilised objects from Site B and Site J

The majority of objects that can be defined as tools or portable objects from Goldcliff derive from Site J, with the activity in Contexts 328 and 331 radiocarbon dated by two of these tools (<9199> and <9224) to 4940-4710 cal BC in combination. The inception of overlying reed peat that effectively caps Site J activity was dated to 4690-4530 cal BC (5749+/-23, OxA-12356), suggesting that the chronological separation between all three contexts 328, 331 and 327 is likely only at most a few hundred years. As a result, it seems reasonable to consider the worked wood tools or utilised objects as one assemblage, while acknowledging that they may represent slightly different phases and of course a wooden tool may be kept and used for a long time in its own right, so its radiocarbon age does not necessarily reflect when it was finally last used or discarded. The only other tool from Goldcliff from Site B, artefact <3718> in Context 321 is dated to 5990-5790 cal BC (7002+/-35, OxA-13927) – roughly 1000 years before the activity at Site J with its larger worked wood assemblage. The artefacts from both sites are considered in this analysis section and, whilst it is acknowledged that this is a significant chronological difference. the lithic evidence from all the sites would suggest broadly cultural continuity during the late Mesolithic (Barton *et al.* 2007). Whether the organic element of their material culture was stable over that time currently remains unknown but is at least possible. The eight 'tools' that have been found from Site J provide a tantalising, if perhaps frustrating, glimpse of what some classes of wooden artefacts may look like from the Mesolithic.

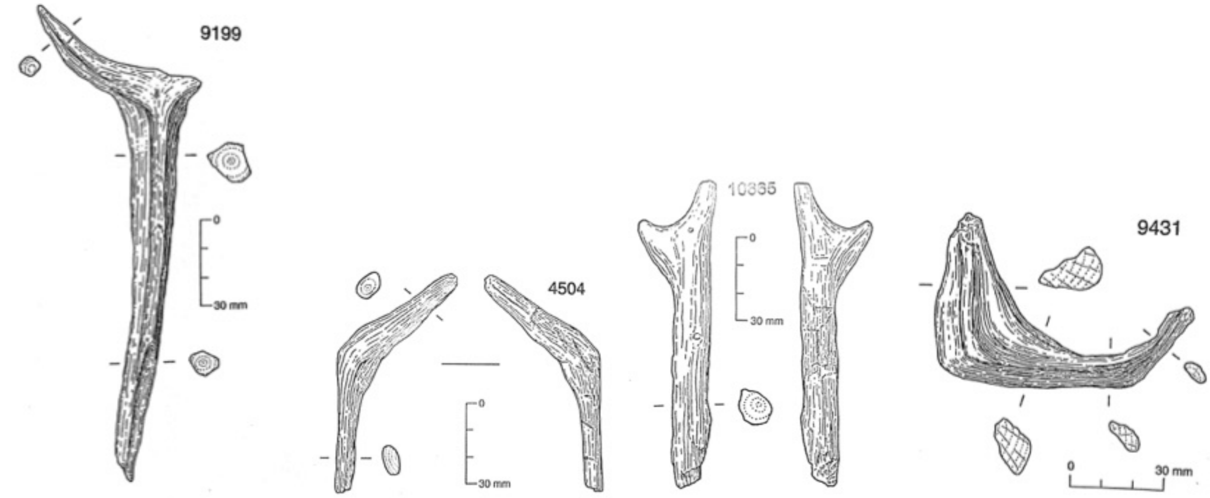


Fig 5.13 Worked wood tools <9199>, <10665>, <4505> and <9431> (drawings L Collett, Bell 2007a)

<9199> was carefully worked and is the best-preserved piece, with clear cut marks from a knife. It appeared to have originally had two prongs, one of which had been broken off, and the remaining prong was polished by abrasion at the end and the shaft of the Y was a broken end (Brunning 2007a).

<4504> had grooves of a type perhaps consistent from wear from string and given the context of the wetland edge location one possible function of these artefacts could be the production of cordage or string for fishing nets (Brunning 2007a). There was limited evidence of fishing from Site J itself but sites W, A and now T, all attest to this practice at the island.

<9431> was a pronged artefact that was produced in a slightly more complex manner, coming from a split stem and curving side branch. Its function is also unknown, but again a craft function such as string/net production might account for the pronged form.

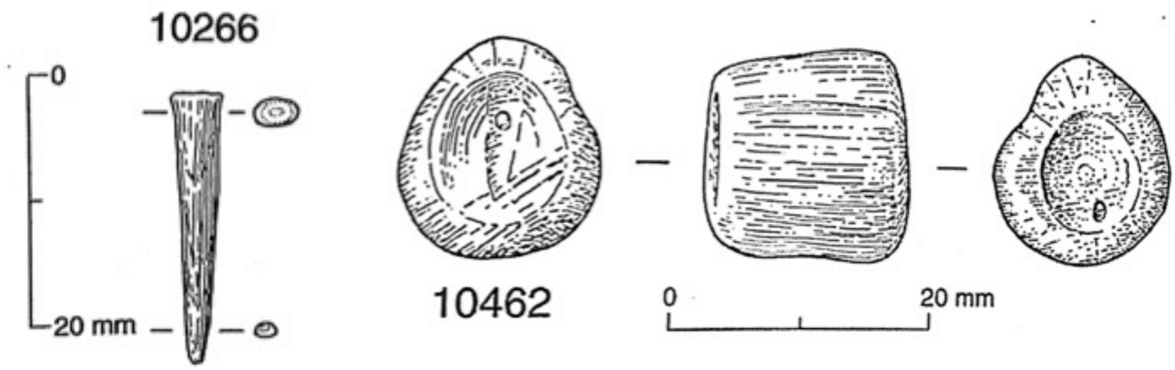


Fig 5.14 Worked wood tools <10266> and <10462> (drawings L Collett, in Bell 2007a)

<10266> was a finely worked roundwood pencil point interpreted as the possible end of a pin (Brunning 2007a).

<10462> was a curious smooth or polished roundwood object charred on the outside with bevelled edges on both ends and very fine cutmarks visible on one end (Brunning 2007a). It was interpreted as a tool or bead, although given the lack of obvious means of attachment, and possible presence of polish, it would seem a tool of unknown function is equally possible.

<10159> was a small (35mm long x 20 diameter) pointed piece of roundwood. On examination it appeared to be carefully worked and neatly fitted on the surface of a thumb. Given the evidence from bones and bone tools at Site J of butchering and skin working (Bell 2007j) it is conceivable that if these are tools they may have been used as part of that overall process in some way.

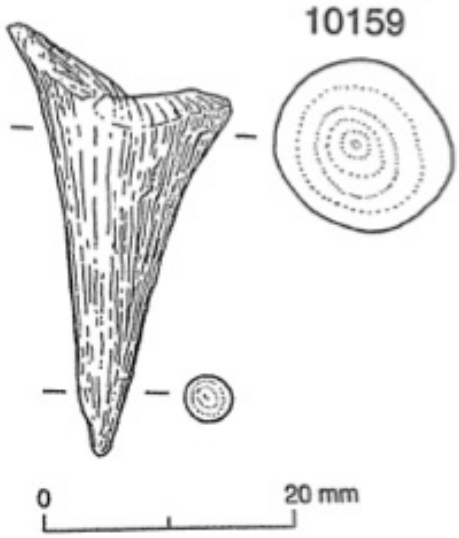


Fig 5.15 The worked point <10159> that fitted neatly on the thumb of one hand (drawings L Collett, Bell 2007a)

<9224> was the largest tool found at Site J and interpreted as a digging stick or possibly spear (Bell 2007g). On examination this 1160mm long slightly bent oak roundwood appeared most likely to be the former. It only corresponds very roughly to the shape of the clearer recent examples from early Mesolithic Star Carr (Taylor *et al.* 2018, 387), although it had clearly been carefully worked over its surface and squared off on several sides midway down the shaft. It also exhibits a distinct, worked, point at one end with the rougher, thicker end fitting neatly in the hand. In morphology this seems similar in fashion to the overall design of the Star Carr examples (Taylor *et al.* 2018, 387), if not precisely the same and with oak being a tough and durable species, a digging stick does seem a possible function.

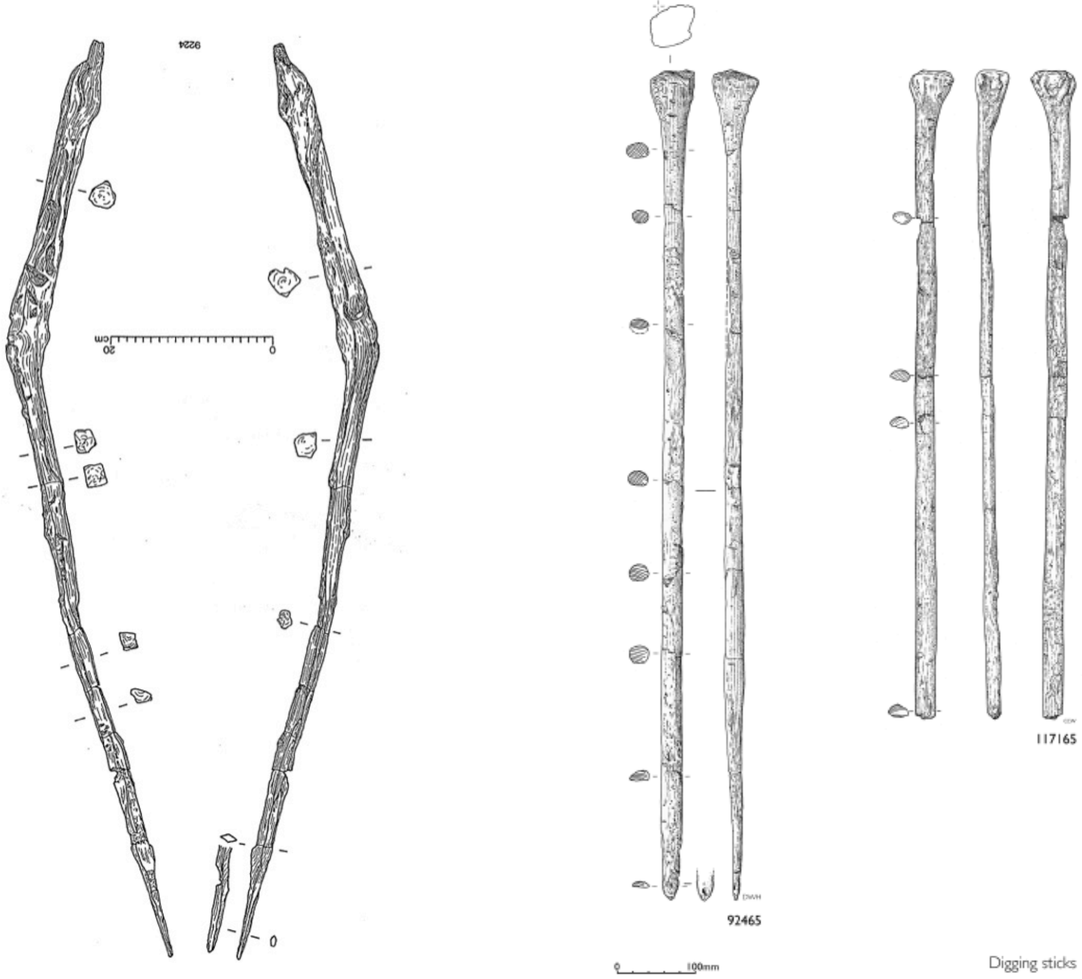


Fig 5.16 Digging sticks from Star Carr (Chloe Watson, in Taylor et al. 2018, 387) and the possible oak digging <9224> from Site J (right) (drawing J Foster, in Brunning 2007a)

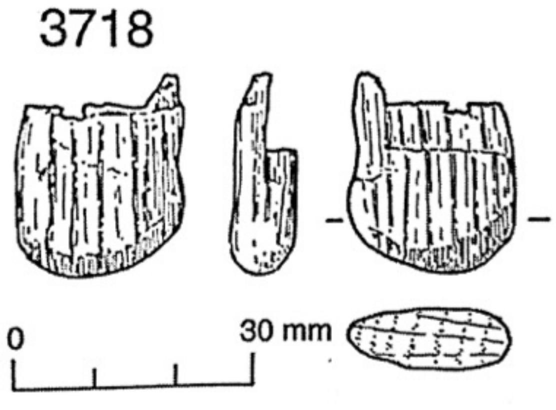


Fig 5.17 Oak spoon <3718> or stirrer from Site B (drawings L Collett, in Bell 2007a)

Of these tools, three – <9199>, <10665> and <4504> – appear to be superficially similar in that they have are carefully worked pieces of roundwood, of a size for holding in one hand, and worked to produce roughly symmetrical pronged ‘Y’ or ‘V’ shapes (Brunning 2007a). However, as fairly rough, not finely finished, portable objects they seem to represent fairly simple functional artefacts, perhaps used in some form of crafting activity. The very fact that the actual function is not clear from their morphology is perhaps one of the most important elements of their recovery and illustrates how little we know about the bulk of Mesolithic organic material culture from the British Isles. Small, somewhat finer, objects such as the possible pin

<10266> and bead/craft object <10462> may have been potentially more valuable, curated items, but perhaps their small size allowed for their unfortunate loss.

These seven possible craft tools were clearly carefully made, shaped, and presumably used, but their shape does translate into forms we easily understand in modern day functional terms. Partly this may be the result of not yet understanding the full range of Mesolithic activities, limited as we often are to the lithic components of material culture and our own practical modern knowledge of living in a comparable environment. There is also the analogy of multi-purpose flint tools with multiple functions such as microliths, as set out in **Chapter 3**, and wood tools may also have served multiple functions. It is also worth considering that not all wooden objects were necessarily distinctive or highly valued objects, rather the ubiquity of wood in the environment allowed useful and practical tools to be fashioned and discarded when a task was complete. If the functional speculation about <9199>, <4504>, <10665> and <9431> are accurate then they may reflect careful manufacture for tasks specific to Goldcliff, but not necessarily curated as they could be readily re-made again elsewhere without the need to transport them between sites.

5.6 Pointed end assemblage

Find No.	Site	Context	Description	Species ID	Length (mm)	Diameter (mm)	Roundwood	Split/cleft	Tangential	Radial	End type
13303	Tributary east of Site H	None	Interpreted as stake	NO	260	26	Y				Pencil?
13302	Site E	15m E. of Area 6113	Possible pointed end, split roundwood, with carved edge and possible perforation.	Hazel (*Corylus sp.*)	238	70	Y	Y	Y		Not clear
4552a	Site J	328	Interpreted as stake	Alder (*Alnus sp.*)	10	20		Y		Y	Not clear
4552b	Site J	328	Interpreted as stake	Alder (*Alnus sp.*)	47	21		Y		Y	Chisel?
4556a	Site J	328	Interpreted as stake	Willow (*Salix sp.*)	45	21		Y		Y	Pencil
10485	Site J	328	Roundwood cut on end and buckled one end, driven in green.	Alder (*Alnus sp.*)	94	30	Y				Chisel?
14202	Site L	Near 332	Roundwood cut from two sides to form possible point	Hazel (*Corylus sp.*)	358	56	Y				Not clear
10527	Site J	331	Stake missing end, very dished facet.	NO	85	35	Y				Not clear
14201	Site L	Near 332	Buckled and eroded roundwood stake with x5 large facets	NO	254	29	Y				Pencil
10648	Site J	328	Buckled section of stake, ends missing, burnt	Alder (*Alnus sp.*)	150	28	Y				Not clear

7082	Site L	332	Presumed stake, found *in situ* at oblique angle, possibly pencil end	NO	110	70	Y				Pencil?
7080	Site L	332	Presumed stake found *in situ* at vertical angle, possibly eroded cut mark	Alder (*Alnus sp.*)	63	13	Y				Pencil?
7081	Site L	332	Presumed stake found *in situ* at oblique angle, possibly buckled end	Alder (*Alnus sp.*)	55	16	Y				Pencil?

Table 5.4 Summary of all the recorded wooden artefacts from Sites H, E, J and L interpreted as structural pointed ends

Prior to the Site T 2017 excavations, 13 artefacts have been recovered from Goldcliff that can be identified as stakes, or probable sections of pointed ends. Analysis in this section has considered this collection as one cohesive group and, while acknowledging that the artefacts derive from different sites and contexts, the stratigraphic dating evidence would suggest they all roughly date from later occupation of Goldcliff around c.5650-4700 cal BC (Bell 2007d, 49) and such merging for discussion seems reasonable. Of these pointed ends seven could be physically examined by the author – <13302>, <14202>, <10527>, <14201>, <10648>, <7080>, <7081> – in the National Museum Wales, Cardiff. The remaining six had not been conserved as there was less convincing evidence of working (M. Bell pers. comm), so analysis is reliant on the monograph worked wood report (Brunning 2007a). It is also worth noting that apart from the possible Site L objects, these artefacts were not found *in situ* being actually used as stakes and, as Brunning (2007a, 2007b) noted, erosion, distortion of features and the fact that some artefacts are broken sections means that it is conceivable that these objects may have fulfilled various functions. However, based on the available evidence, context, and the description in the wood report (Brunning 2007a, 2007b) the functional interpretation of this group is overall suggested as useful and reasonable for the purposes of this analysis.

This sample demonstrates that there are only two observable types of pointed ends in this Goldcliff assemblage: pencil-ends and chisels. The overall sample is small (**n=13**) and it should be acknowledged that many of the finds are not absolutely certain to be structural pointed ends as pointed out in Table 5.4 above. However, even with those limitations, it is clear that no obvious evidence for other types of pointed ends such as wedge-ends was recovered from these sites.

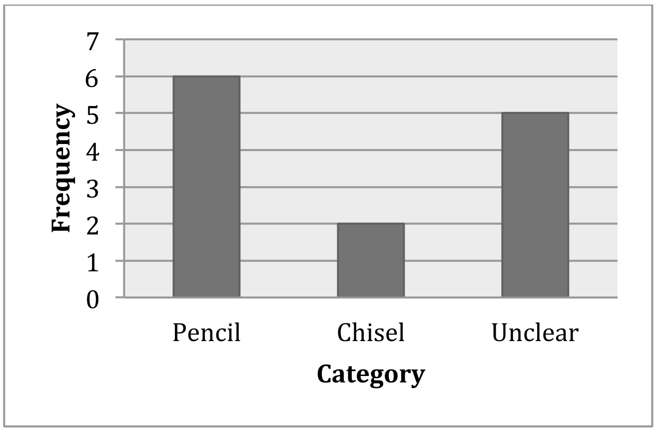


Fig 5.18 The relative frequency of pencil and chisel end points

One interesting artefact, <10527>, from Site J (Context 331), was illustrated but not described or given a function in the site monograph or worked wood report (Brunning 2007a, 2007b). On examination in the archive, features visible in the drawing appeared to confirm it was a section of roundwood with an apparent taper but missing end and features consistent with being part of a stake. While truncated it appears to have one facet within the proportions observed on the Site T stakes, measuring 64mm long by 23mm wide and 7mm deep. It also possibly preserved a partial jam curve (discussed in the woodworking technique section below). Given that these toolmark types are only currently known from wood used as pointed ends (see Section 5.12.1 below) it is suggested that this is section of a broken pointed end and treated as such in this work.

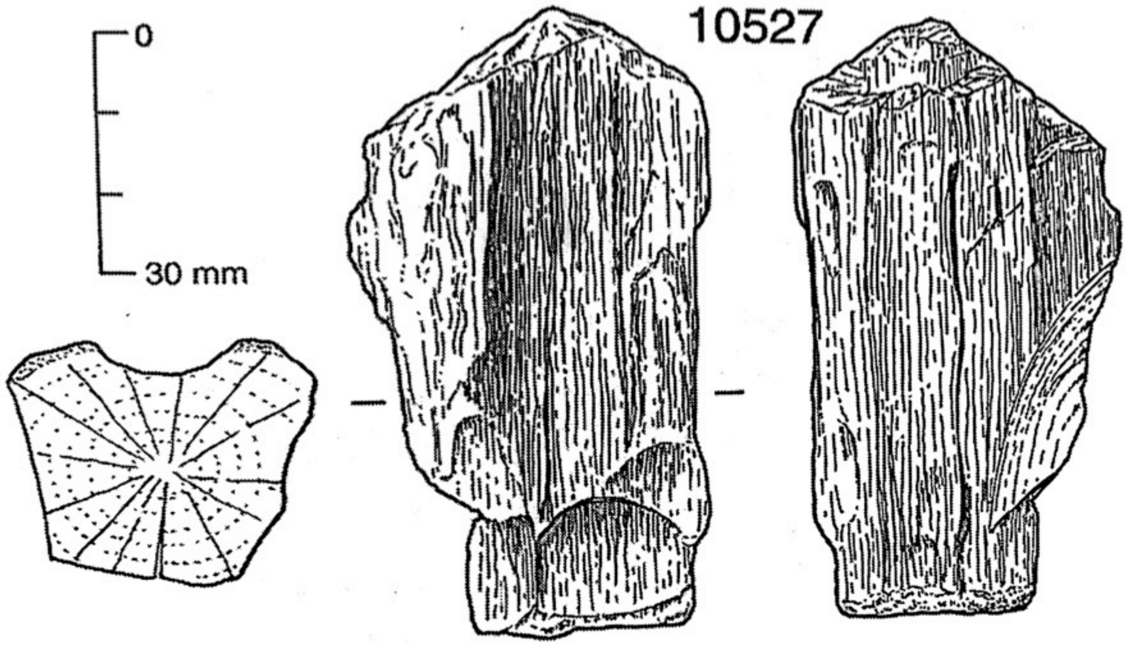


Fig 5.19 Artefact <10527> with a dished and deep toolmark visible in the cross-section drawing (drawing L Collett, Brunning 2007a)

Fig 5.20 The side view of possible cutmark on <10527> (left) and view of the dished cross-sectional view of another facet (right) (the author)

Of the other pointed ends, from Site J <10485> and <14201> had some slight evidence of buckling with Brunning (2007a) noting that <10648> appeared to represent the upper portion of a roundwood stem that buckled when driven into harder underlying sediments.

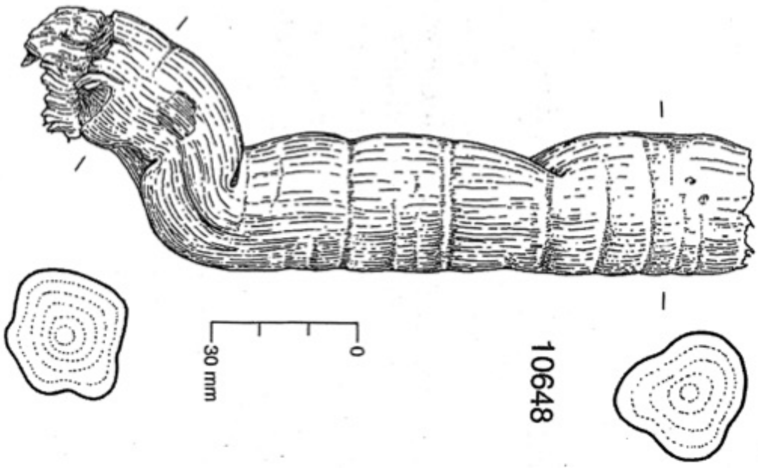


Fig 5.21 Roundwood <10648> from Site J with evidence of compression bend, consistent with being driven in when green to sediments (drawing L Collett, Brunning 2007a)

This evidence would suggest some of these stakes were green when driven in, perhaps logical if they were cut and then quickly used in the suggested summer or autumn occupation period (Bell 2007g). How <10648> could then have been extracted and come to rest on the old land surface (Context 328) at Site J is intriguing, especially given examination in the archive suggested it had been slightly charred as well.

Fig 5.22 Images of <10848> with detail of what appears to be charring

As O’Sullivan (1996, 292) has reflected on the Irish Mount Dillion Bog Neolithic pointed end assemblage, length is a fairly irrelevant aspect to roundwood or cleft stakes when examining incomplete examples focused on the pointed end working, with the rest often truncated by erosion and deterioration. None in this collection are considered complete and the longest is only 358mm (<14202>) long and comes from the estuarine sediments. Diameter is a more useful dimension for roundwood as it will influence how easily it can be felled and then worked (O’Sullivan 1996, 292). In this collection there seems to be a peak in wood of a 21-30mm diameter being used as pointed ends with 46% of the artefacts in this range. In woodworking terms 77% of the artefacts are normal roundwood but interestingly three artefacts, <4552a>, <4552b> and <4552b> from Site J (Context 328) are recorded as being radially cleft, with <4552a> and <4552b> reportedly both alder, roughly cut to a chisel end and a similar width (19-20mm) and thickness (4-7mm) so perhaps manufactured as the same time (Brunning 2007b). Only one pointed end was tangentially split, <13302> discussed above, from the estuarine sediments near Site E, but this is one of the least securely identified pointed ends and while worked it may be a structural artefact of different type as it may also have a notch or hole.

5.7 Tree species selection

The selection of tree species for worked wood artefacts can be considered in a number of ways:

(i) By species selection for total number of artefacts collected from all sites.
(ii) By species selection for each specific site.
(iii) By species selection for different artefact typology.

Species	**Site J artefacts by species (41 objects, 32 sampled)**	**Site E & L artefacts by species (22 objects, 5 sampled)**	**Site B artefacts by species (1 object, 1 sampled)**	**Total**
Alder (*Alnus sp.*)	11	3		14
Birch (*Betula sp.*)	1			1
Hazel (*Corylus* sp.)	9	2		11
Oak (*Quercus sp.*)	8		1	9
Willow (*Salix sp.*)	3			3
Total	**32**	**5**	**1**	**38**

Table 5.5 Wooden artefacts by site and species

In terms of the (i) first parameter, 38 items out of a total assemblage of 65 objects that have been reasonably identified as artefacts of worked wood had a species identification (Bell 2007d; Brunning 2007a, 2007b). From these there appears to be a clear preference for firstly alder, hazel and then slightly less frequently oak (See Fig 5.23). Most of these items with a species identification derive from Site J, with 32 (of the 41 total Site J worked wood artefacts) having a species identification. Of this Site J assemblage alder (n=11), hazel (n=9) and oak (n=8) dominate. The palaeochannel related laminated sediments produced 22 probable or certain wooden artefacts but only five have a species identification with only alder (n=2) and hazel (n=3) represented. At site B only one wooden artefact was recovered and that was oak.

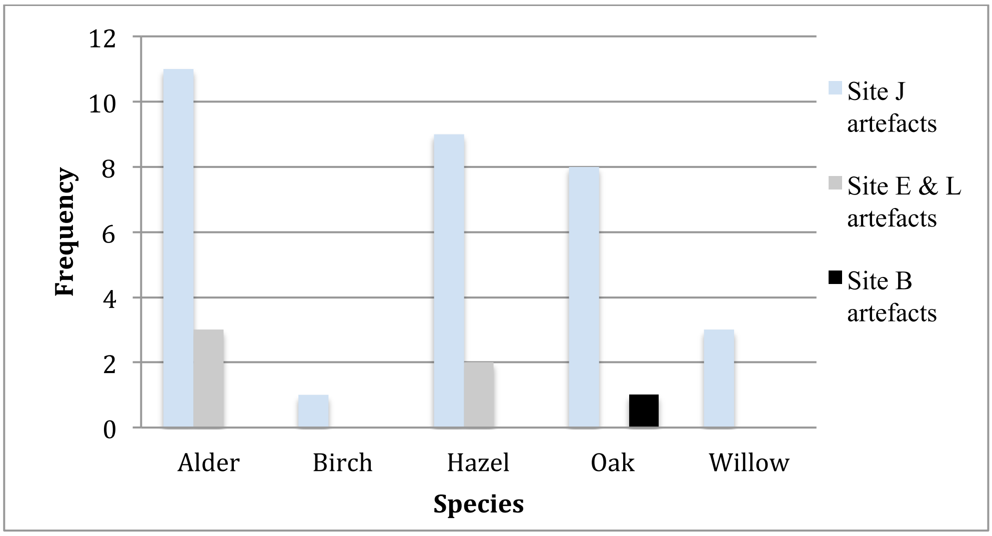


Fig 5.23 Wooden artefact frequencies by site and species

In terms of species selection by artefact typology, little can really be said about the tool or portable objects species selection. Of the eight identified tools only three were identified to species level; oak was used for the Site B spoon end <3718> and Site J digging stick <9224>, with hazel selected for the potential pointed Site J craft tool <10159>. Of the small pointed end artefact sample, nine had a species identification with alder, willow and hazel identified, with most artefacts being alder (see Fig 24). However, this sample is again quite small and with four pointed ends not identified to species this pattern may be a product of sampling rather than reality. Five probable woodchips were identified from Site J and had no pattern, with the four identified to species respectively being, birch, hazel, oak, and willow. The other woodchip in the assemblage, <13300>, came from the laminated sediments at Site E and was hazel. Simple cut pieces form the largest single artefact typology class (**n=18**) from Site J, and this is actually the category largely responsible for the data for the pattern of three main species being used.

Species	**Tool**	**Pointed end**	**Split piece**	**Cut piece**	**Woodchip**	**All artefacts**
Alder		6	1	6		14
Birch					1	1
Hazel	1	2		7	2	11
Oak	2		2	4	1	9
Willow		1		1	1	3
Total	**3**	**9**	**3**	**18**	**5**	**38**

Table 5.6 Wooden artefacts and by-products by type and species

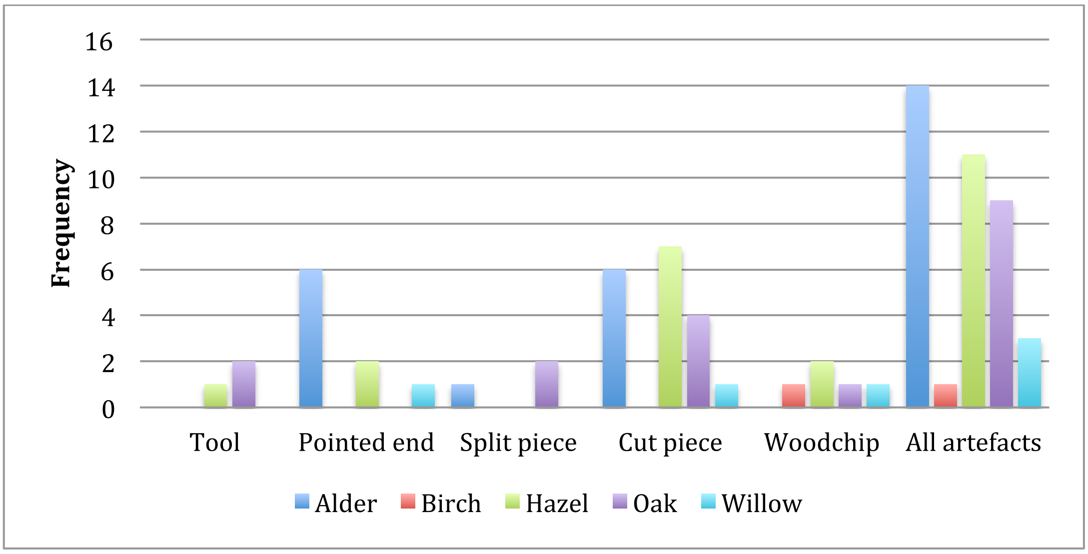


Fig 5.24 Wooden artefacts by type and species

The species selection data from Sites J, E, L and B in comparison to the wood charcoal and pollen evidence is interesting. At Site J the wood charcoal was dominated by hazel, and it seems likely that it may have been used as a fuel, possibly a reflection of a hazel dominated local woodland (Dark 2007, 182). The wood charcoal also suggested that oak, elm and hawthorn were 'well-represented' as well as smaller amounts of ash, blackthorn, elder and ivy but interestingly no alder, birch, or willow (Dark 2007). At Site J alder formed between 15-35% of the pollen record during Mesolithic occupation, so it was present in the area as one might expect of the nearby wetland edge. As discussed above, it appears to have been a species of choice for working certain objects, but seemingly not selected as fuel (Dark 2007). The minimal use of birch and willow for artefacts at Site J is in line with its low frequency in the area as suggested by the pollen record (<5%), although in both cases woodchips were found from these species suggesting they were being utilised in some way, but for what purpose is unclear (Dark 2007, 177). Site E and L were located in the laminated sediments, so any wood used there was necessarily transported from dryland sources such as around Site J, and the limited evidence does correspond (from a small sample of five) with the apparent preference for using alder and hazel as at Site J. At Site B, with only one wooden artefact of oak, it is hard to suggest anything significant about this isolated artefact. The pollen record suggests a nearby woodland ecology dominated by hazel and ferns, with little oak in the immediate area (Dark 2007). However, Site B was situated on the Lower submerged forest of oak and hazel, and the wood charcoal from the site shows the use of oak heartwood and hazel, and to a lesser extent alder and hawthorn (Gale 2007, 186). This would suggest usable oak was likely accessible not too far away, so this artefact could have been made onsite or travelled with groups from further afield.

5.8 Woodworking technology and practice

Of the 64 identified artefacts from sites B, E, L and J the majority 54 (84.4%) are roundwood stems cut or shaped in some way. Of these, 42 have recorded and published roundwood diameters. In most cases the original complete diameter is missing as the bark, cambium or outermost rings were not preserved so the original size may have been several mm larger. However, the results serve to show that a trend appears to exist for the overall use of roundwood with small proportions and diameters concentrated in sizes 11-30mm diameter. Only three roundwood artefacts were of a significantly larger size, <13302>, <14202> and <7082>, and all of these can be interpreted as pointed ends coming from the palaeochannel laminated sediments. Of the 13 artefacts identified as possible pointed the majority also fell within the 21-30mm diameter range as shown in Fig 5.25 below. This suggests that overall smaller sized stem and branchwood was being worked. It also highlights that the worked wood assemblage contains no suggestion of larger timber being worked on the dryland, such as the splitting of planks. There was no wood working evidence to suggest more substantial structures being built in the area of the excavated dryland sites – something in line with the activity information from other artefact types discussed above.

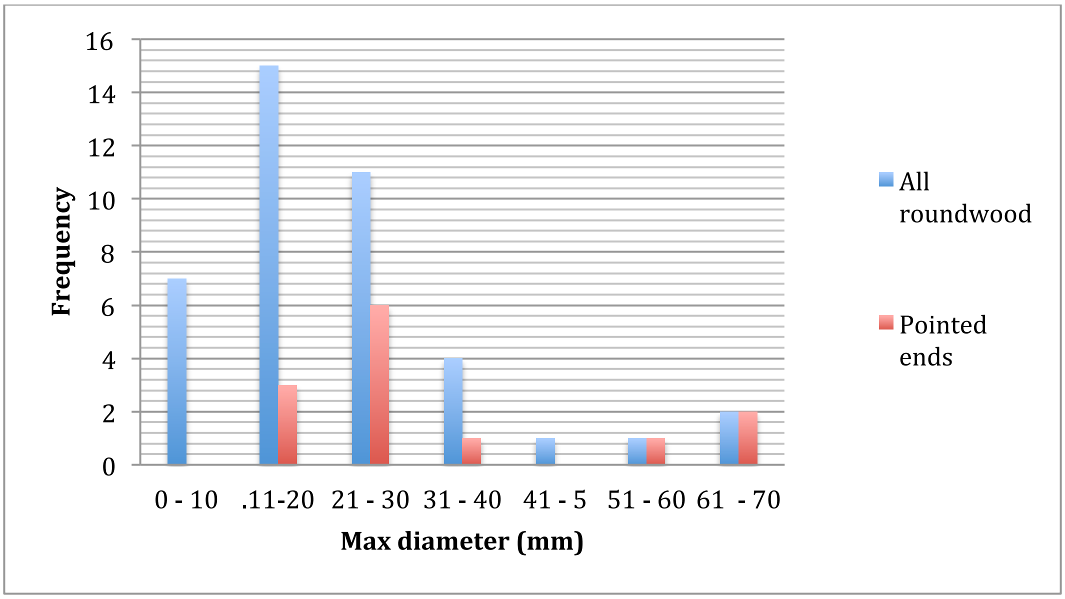


Fig 5.25 Roundwood and pointed end max diameters (n=54)

As discussed above, from the worked wood assemblage 11 artefacts had evidence for more complex conversion techniques such as radially or tangentially splitting. This represents a small assemblage spread across several sites occupied at different points and is also only those pieces where the working could be conclusively determined. So, we should be wary of drawing any firm conclusions for overall patterns, however what can perhaps be said is that there was variety in woodworking at Goldcliff, with tangential woodchips and split pieces alongside hints of sophisticated radial splitting of lengths of wood to produce tools and pointed ends at Site J.

Interestingly two pointed ends, stakes < 4552a> and <4552b>, measuring 20-21mm in diameter were alder from Site J that had come from a radially converted piece of wood. This is a fairly sophisticated method of working to first split a length of wood into radial sections for further use, particularly considering the end product would seem something as simple as a small stake. Alongside the 'spoon' <3718> from Site B this shows radial splitting of wood was part of the techniques used in late Mesolithic woodworking. <9431> was the pronged 'U' shaped tool that used a side branch and radially split section of part of a larger stem. Five artefacts had been tangentially split. Site J contained one oak tangential sapwood woodchip <4650a> and two tangentially split oak pieces, one heartwood, suggesting that that the species was being worked on occasion in this location. <7299> was a tangentially split woodchip of willow from a piece of roundwood. Artefact <14202> from the laminated sediments is the largest by diameter object from this assemblage, measuring 70mm and may possibly be a roundwood stake, and if so would suggest some substantial timbers and structures did exist in and around the palaeochannel at least.

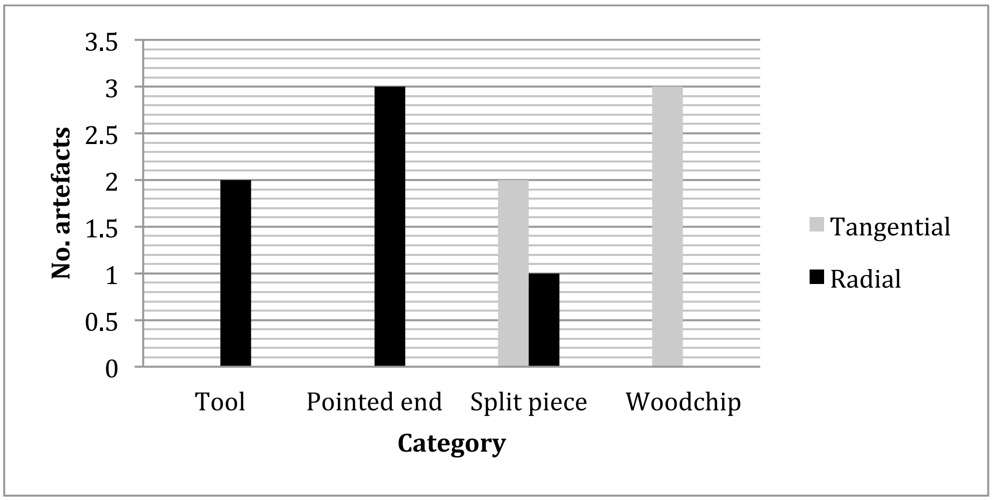


Fig 5.26 Wooden artefact categories with known conversion techniques (n=11)

5.8.1 Toolmark evidence

As discussed in sections above there is some evidence that potentially two of the artefacts, <14201> from Site L and <10527> from Site J, had long and cross-sectionally dished toolmarks in keeping with artefacts from Site T discussed later in this chapter. Other evidence for the Mesolithic woodworking methods toolkit comes from the tools and portable objects such as tools <9199>, <9431>, <10159>, <10266> and <10462> that exhibit fine, detailed shaping consistent with a sharp-edged tool such a lithic flake or blade. <4576a> and <4576d> were thin 6mm diameter roundwood cut at a very acute angle of 3° to produce a point, so the tool used is likely to have had a very sharp and fine edge morphology.

Other toolmark evidence noted by Brunning (2007b, 2) were two 18mm diameter roundwood cut pieces, <13897a> and <13897b>, with chisel ends that had flat toolmarks cut at 18° and 55° angle respectively. A 32mm diameter roundwood cut piece <9181> had two flat facets to make a chisel end and split piece <4556b> was 12mm wide and had a single flat toolmark struck at 45°. Roundwood <9490> exhibited the 'cut and tear' technique of cutting this 21mm diameter piece, with the tool used 'severing almost all the diameter' (Brunning 2007b, 3). Producing a chisel end with a single strike requires the tool to be both sharp enough and heavy enough to cut its way through in one go. The flatness of these toolmarks might suggest the central blade edge of a smooth tool – so are unlikely to be a simple flaked axe or tranchet adze with their rough surfaces and very uneven blade signatures. Probable stake section <10527> appeared to have, on examination by the author, a second toolmark that measured 35mm long by 25mm wide, was flat in cross section and with an entry angle of under 10°. This appeared to possibly end with the partial section of a jam curve that measured 14mm long by 1mm deep. The published illustration would support the presence of this feature, though no description of the item is available from before its conservation for an absolute confirmation that it is not modern damage of some type. A tool of smooth surface and sharp edge would again be the source if this was indeed a facet.

Other different toolmarks noted by Brunning (2007b) include the well-preserved cut piece <10547a> that had a chisel end with a rough toolmark cut by single strike from a tool with an edge at least 35mm wide at an angle of 25°. Pointed end <4552b>, and cut pieces <4533>, <4555> and <9479> were also described as exhibiting a 'rough facet' and it is conceivable that a different tool such as a flaked core axe or tranchet adze could have been used in their shaping. Heavy duty unstratified tuff adze/axes have been found and published by Barton (2000, 47) and Barton *et al.* (2007, 114-5) from Goldcliff that could certainly have been used as woodworking tools, possibly creating such rough facets. Microwear analysis by van Gijn (2007, 117-121) suggested that most lithics from Goldcliff were 'very suitable for a microwear analysis' although none of the 50 artefacts studied exhibited traces of woodworking to help identify the possible type of tools responsible.

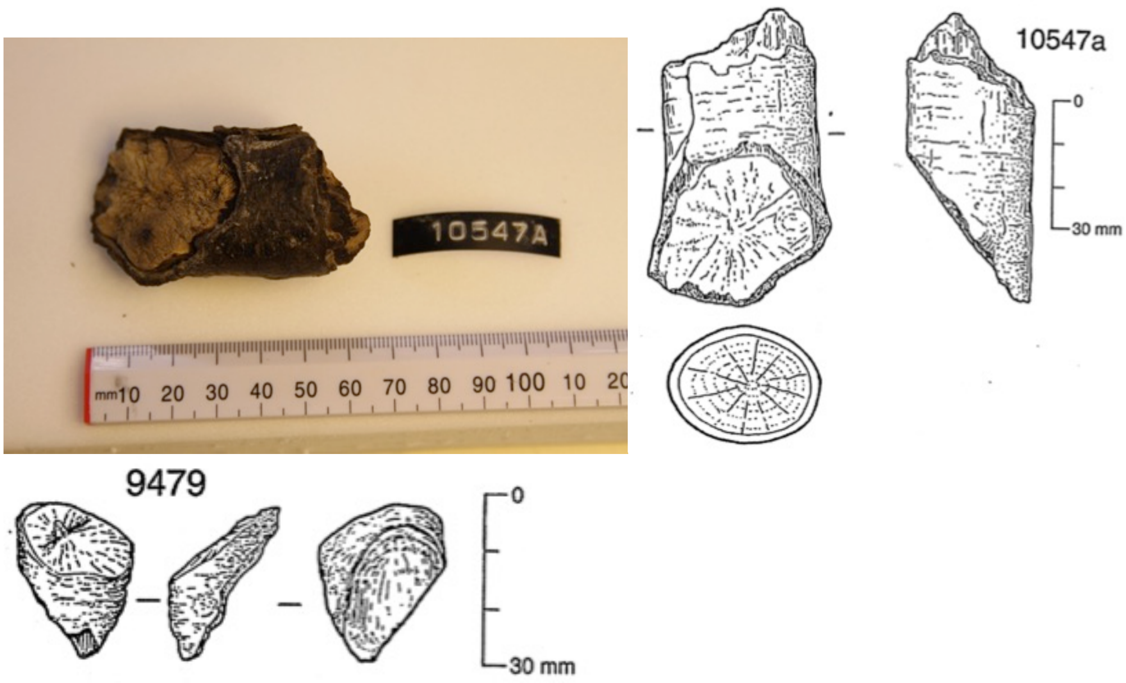


Fig 5.27 Worked wood artefacts with toolmarks (drawings L Collett, Brunning 2007a) (photo the author)

The analysis above of the limited described toolmarks from the non-Site T Goldcliff material suggests that there may be at least four different woodworking tools being used by Mesolithic people. Firstly, there is an indication of a tool used for producing pointed ends with long dished toolmarks as recognised on <14201>, secondly the presence of a sharp, likely small, tool with at least a straight central edge for fine working of items as recognised on <4576a>, thirdly a heavier sharp tool with a flat central blade edge which measures at least 21mm in width to produce chisel ends as seen in <9490>, and fourthly potential another heavy tool with a rougher surface that produces rough facets of <10547a> and chisel ends in a limited number of strikes. It may be the case that some artefacts could have been made by the same implement if the latter was used in different, unforeseen, or more skilled ways (the sharp curved tool possibly for fine working for instance), but there appears enough difference and variety of toolmark evidence from even this small wood assemblage to indicate the presence of different tools being used for woodworking tasks.

5.9 Woodland resource management

The published evidence from Site J, E, L and B does not provide sufficient data to directly form any reliable view on the selection or management of woodland resources for wood working purposes. As discussed above there does appear to a clear pattern that smaller roundwood was the being used and cut, but that may simply reflect the limited need for larger pieces of wood by people occupying the site. If Goldcliff was unoccupied for much of the year then it is likely a large quantity of fallen branch wood and driftwood accumulations would have been available when groups arrived. Ad-hoc felling of trees or selected stems may have been enough to produce softer, more malleable, greenwood as was required. While stakes, split and cut pieces have been worked on site it may also have been the case that the more useful wooden 'tools' may have travelled with people. Of the 13 artefacts identified as potential pointed ends there is no secure ring count or tree-ring size data available for analysis. Based on the published illustrations and physical examination of five of them in the National Museum Wales (artefacts <14202>, <14201>, <7080>, <7081> and <10648> from Site J) they appeared to have similar c.5-6 years' worth of rings but that only supports the view of small size roundwood being used. Two artefacts (<14202> and <10648>) may possibly have ring growth suggestive of very rapid growth in their early years that is consistent, but not diagnostic on its own, of coppiced type growth. Overall, such a small, unclear, sample is inconclusive, and no secure indication exists from the artefacts of woodland resource management.

One caveat to that lack of direct resource management evidence is the strong case for the organised and managed burning of the trees from all around the island as convincingly set out by Dark (2007) and Bell (2007g). It was suggested that this helped clear dense areas for hunting, attracting game, facilitating access to wetland edge plant resources, and allowing the regeneration of fast-growing resources such as hazelnuts with reed beds also subject to burning to stimulate new growth (Dark 2007). Such a practice would also possibly produce new and rapid regrowth of quick growing straight hazel stems dependent on the extent of burning and if the hazel stool survived, so it is conceivable that fire usage performed multiple functions. If there was a need for long, straight pieces of hazel and alder for fishing-related structures in the palaeochannel then it was perhaps achieved in a less formalised manner within a very different woodland management system than we might recognise employed by later, more sedentary, communities of the Neolithic, or in use today in traditional coppicing schemes and cycles.

5.10 Goldcliff, Site T

5.10.1 Site context

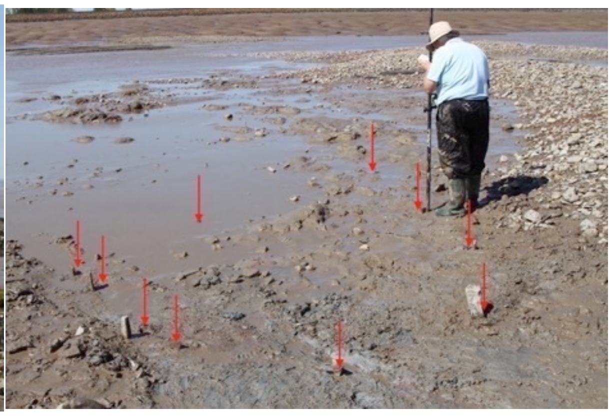



Fig 5.28. Site T as sea recedes (left), and conditions for surveying and excavation at bottom of the tidal range (right) (photos the author)

Site T was first identified in 2017, and as such is awaiting complete publication and ongoing analysis as more wood is exposed. In this work a concise description is provided to situate it in relation to the complex range of other sites at Goldcliff. The site is located towards the bottom of the tidal range at -5m OD on the modern-day foreshore of Goldcliff promontory. It is approximately 100m southeast of the nearest excavated site, Site D. The wood artefacts are located within the grey estuarine laminated sediments, surrounded by areas of shifting gravel to the southeast, south, and east. Between 1.5m and 0.2m to the west are Pleistocene Head sediments representing the palaeochannel edge, with the *in situ* wood located along the west edge of the channel (M. Bell pers. Comms). The estuarine sediments represent a Mesolithic palaeochannel complex that flowed north to south, migrating eastward from the island edge over a 240m wide area over the course of the later Mesolithic (Bell 2007g).

Fig 5.29 In situ roundwood from the structure, just visible with some association small roundwood (the author)

The Site T features were first identified by Dr Tom Walker during drone mapping of the site and the investigation and excavation is one of extreme difficulty, with the problem essentially one of time. Site T is next to, and sometimes under, shifting gravel banks towards the bottom of the tidal range. This means that is only really accessible for around one hour during the lowest tides of the year, effectively just a few days each year. Given the short window to investigate the site it was only normally possible to plot and extract one or two stakes before rapidly advancing tides might start cutting off workers from the shore. Another methodological issue is that the movement of gravel over months between visits and water pooling from previous work has meant that it was not always possible to access any one specific artefact, rather it was only realistic to investigate, excavate and lift what seemed most at risk and could actually be retrieved. Visually from the surface there is little to determine which items will be worked or not, and normally those selected for excavation were ones that were not in pools of water and could be accessed in a one-hour timeframe. Over the course of visits during 2017-2020 this has produced a reasonably representative sample of the worked wood onsite from all the main structures thought to be present.

Fig 5.30 Conditions encountered during excavation of Site T roundwood pointed (photo Martin Bell)

It is possible that more areas or other associated sites will be revealed in the future and repeated monitoring of the site is being maintained, with the potential illustrated by new unknown stakes possibly related to a fourth structure found in March 2020 seemingly extending the size of the site southward (Martin Bell pers. Comms). A number of worked wood pieces were retrieved in spring 2021, but these were found after the analysis was undertaken and completed in this work and are not included here although they are reportedly of comparable morphology (M. Bell pers. Comms.). However, now, only some five years after its original identification, the variability of the conditions means that the structures have been covered by new gravel, pools of water as of summer 2021 and are currently hidden from investigation. In these terms, the worked wood sample recovered from the site and analysed here represent a combination of what could be found, accessed, and lifted in different limited windows of opportunity over 2017-2020. Off-site physical examination and analysis was conducted by the author within the protocols as set out in the **Chapter 2**. Species identification was performed by Dr Catherine Barnett, with the identification data used in this study with many thanks.

5.10.2 Identification of structures

In situ each piece of wood often looked little more than a vertical or slightly oblique roundwood sitting proud of the surrounding sediments and gravel by a few centimetres. In between the large roundwood were lines of much small diameter roundwood artefacts, forming dense lines between larger stakes. The record of the position of these identifiable wooden pieces was plotted onto a permatrace plan in the field and also located using the GPS total station thus building up an overall plan from several visits. There was no stage at which they were all exposed and often some areas were obscured by mobile gravel. As a result, it is likely some areas have never been exposed for recording and others are below a permanent pool. The overall plan is seen in Fig 5.31 below. Even before lifting, the vertical and oblique orientation of the wood, driven in tough underlying sediments alongside a constant and repeated pattern of the wood and withies, would clearly suggest these structures are anthropomorphic in origin. The presence of clear toolmarks and working further confirmed that hypothesis.

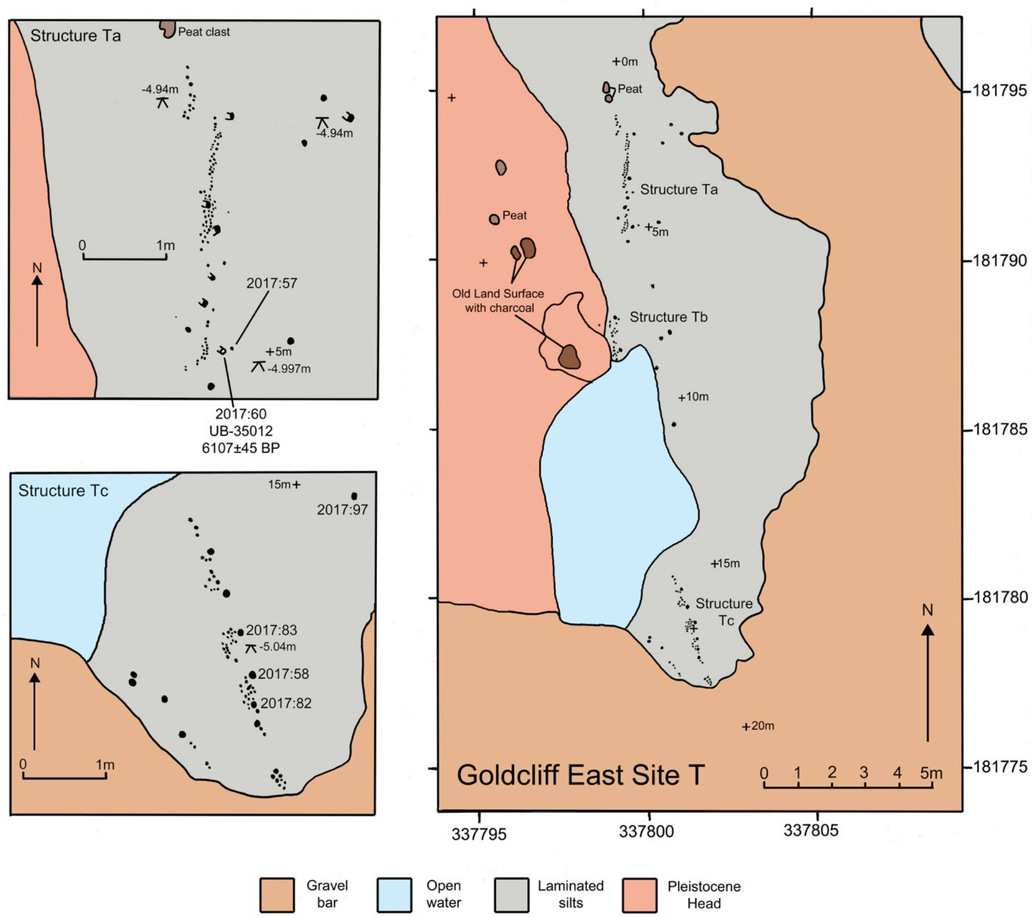


Fig 5.31 Site plan of Goldcliff East Site as of 2020 finds (copyright Martin Bell)

The plan of the wood suggests concentrations in keeping with the presence of at least three separate structures, named ‘Structure Ta’, ‘Structure Tb’, ‘Structure Tc’ and ‘Structure Td’. These separate arrangements all suggested ‘V’ shaped configurations, with the mouth of the ‘V’ facing northwards upstream. Further fieldwork by Martin Bell (pers. Comms. 2020) identified and recovered additional pieces of worked and unworked roundwood in vertical orientation outside of these three main structural groupings towards the east and south of the site and it seems probable that more structures may be present in this area. Given the context of position within a palaeochannel and the V-shaped configuration it seems highly likely that the Site T structures represent the remains of various fish trap structures. The position at the base of a channel, with an axis at an angle to the channel edge, perhaps makes it difficult to make a strong case for an alternative explanation. A trackway would normally have been at more or less right angles to the channel axis and formed a wider rather than very narrow feature. No fish basket remains were recovered at Site T so far, but the V-shape with dense collection of withies placed between more sturdy stakes or posts would suggest that fish were being compelled to travel down the arms of the V into a container or possibly to be caught by waiting people. The Mesolithic age was clearly demonstrated by five radiocarbon AMS dates, set out in the section below. Accepting these arguments and evidence, this makes the Site T fish traps the earliest evidence of fishing structures in Britain, and thus of national and international significance. In the British and Irish context, it can be considered comparable to the important late Mesolithic finds at North Wall Quay and Clowanstown, Ireland, covered in **Chapter 3** as well as further afield sites from mainland Europe (Brunning 2007a; McQuade & O’Donnel 2007; Mossop 2009). A review and comparison with those assemblages in made in the Discussion section of **Chapter 8**.

Fig 5.32 How the line of large and small pointed ends appeared before any excavation (the author)

5.10.3 Dating and duration of use

Five *in situ* roundwood artefacts were selected for radiocarbon dating at the time of writing, spread from across the perceived structures as seen in Fig 5.31. The current radiocarbon dates means that it is conceivable that the samples could be contemporary. However, the archaeological context and spread of dates do currently suggest that there may be three phases to the site, the earliest represented by <2019.10> in Structure Tc (east) dated to 5310-5073 cal BC (6245+/-35 BP, UBA-41506), the second phase represented by artefacts in Structure Ta and Structure Tc to 5225-5029 cal BC (two dates combined), and the third phase in Structure Ta dated to 5210-4840 cal BC (two dates combined). This preliminary interpretation is used for the analysis purposes of this work. If the phases of the site are yet to be clarified, what can currently be said with some confidence is that the Site T structure(s) provide clear evidence for the prolonged and repeated practice of fishing at the same location and comparable design for at least several centuries by late Mesolithic people over the period 5310-4840 cal BC.

Site	Phase	Structure/Context	Artefact	BP	Lab code	cal BC
Site T	1	Ta (east)	2019.10	6245+/-35	UBA-41506	5310-5073
Site T	1	Tb	2018.61	6169+/-31	UBA-41505	5216-5029
Site T	2	Tc	2018.47	6181+/-36	UBA-41504	5225-5010
Site T	3	Ta	2018.91	6072+/-50	UB-41503	5207-4840
Site T	3	Ta	2017.60	6107+/-45	UB-35012	5210-4912

Table 5.7 Dating of the Site T structures

5.11 Site T Worked Wood Assemblage

5.11.1 Analysis of the worked wood assemblage

Given the importance of the Site T structures as briefly discussed above, the worked wood artefacts from the site that were lifted between 2017-2020 are described in detail in this work for the first time since their identification, and a full record of each item is made in Appendix I. Table 5.7 below provides a quick aid for comparing some key characteristics of each recovered worked wooden artefact. The detailed descriptions in Appendix 1 provide a more complete individual record of each item, along with drawings and relevant photographs. In Appendix 1 artefacts are organised by Structure/Context and then numerically by find number with corresponding illustrations and photographs provided beneath the description. A review of the key aspects of woodworking evidence and most significant finds is made in this chapter. Many of the final illustrations were made by Dr. Jennifer Foster for publication and are very gratefully used here with permission and credited in each case. Artefact photographs are mainly the author’s but on occasion some from Prof. Martin Bell’s collection have gratefully been used, with ownership so noted and credited in each case. For each artefact the dimensions of toolmarks were recorded in line with this work’s analysis methodology set out in **Chapter 4**, and as described there the recording was based on the methodology for pointed end analysis proposed by Coles & Orme (1985b) and O’Sullivan (1996).

55 items have been identified and lifted from Goldcliff Site T as of summer 2020. Of these 29 have clear evidence of being worked with cutmarks or have tool facets that could be studied. The 55 items also includes a collection of 19 small roundwood, or withy, pieces (2017.60a-s) lifted when Site T was first identified but sadly in too poor condition for study. One item <2018.10b> from that total lifted number has been now identified as reed and likely an ethnofact and it is included in the table and descriptions below for the sake of completeness. During excavation it became clear that roundwood pointed ends could be divided into two main categories: large (>17mm diameter) and small (<13mm diameter) groups for analytical purposes. The reasoning for this differentiation is that the large roundwood was used as pointed stakes set at vertical or oblique angles into the palaeochannel to form the overall frame and anchor for the structure, with the smaller roundwood constituting cut lengths of more pliable small diameter roundwood stems or 'withies' placed in between these larger 'stakes' presumably to act as mesh like barrier to fish escaping the trap. No evidence of ropes, twine, or interlaced stems for tying the stakes and 'withies' together has been recovered by the time of the analysis in this work. However, given only the bottom section of structure, or substructure, has been identified the original superstructure design remains to be established and such elements may have existed. Full toolmark analysis in this work has concentrated only on the large roundwood pointed ends (>17mm diameter) as these have measurable and complete facets, the small roundwood or withies were often under 10mm in diameter and the facets normally incomplete. The 54 lifted wooden artefacts from Site T can be divided into five main categories:

(i) Large (or segments of) roundwood (>17mm diameter) with worked pointed end inserted vertically or obliquely.

(ii) Small (or segments of) roundwood (<16mm diameter) with worked pointed end inserted vertically or obliquely.

(iii) *In situ* large roundwood found in association with worked examples and interpreted as having the same structural function as (i) large roundwood pointed ends but without clear evidence of working themselves.

(iv) *In situ* small roundwood found in association with worked examples and interpreted as having the same structural function as (ii) small roundwood pointed ends but without clear evidence of working themselves.

(v) Unstratified cut pieces broken off from *in situ* roundwood found in close association with the structures but displaced during excavation.

No.	Context	Find No.	Typology	Radiocarbon BP	Species ID	Leng. (mm)	Dia. (mm)	End type	End working type
1	Ta	2017.59	Large pointed end		Alder (*Alnus glutinosa*)	118	21	Pencil	Cleave-end
2	Ta	2017.60	Large pointed end	6107+/-45 (UB-35012)	Hazel (*Corylus avellana*)	463	41	Pencil	Cleave-end
3-21	Ta	2017.60a-s	*In situ* small roundwood		Alder (*Alnus glutinosa*), 1 unknown	Not recorded	5-25	Not recorded	Not recorded
22	Ta	2018.91	Large pointed end	6072+/-50 (UB-41503)	Hazel (*Corylus avellana*)	376	42	Pencil	Cleave-end
23	Ta	2018.101a	Small pointed end		Hazel (*Corylus avellana*)	27	10	Chisel (possibly, end missing)	Sharp tool dished facet
24	Ta	2018.101b	Reed (ethnofact)		n/a	46	3	None	None
25	Ta	2018.101c	*In situ* small roundwood		Hazel (*Corylus avellana*)	43	10	None	None
26	Ta	2018.101d	Small pointed end		Hazel (*Corylus avellana*)	39	10	None	Sharp tool dished facet
27	Ta	2018.101e	Small pointed end		Hazel (*Corylus avellana*)	153	10	Chisel	Sharp tool dished facet
28	Ta	2018.101f	Small pointed end		Alder (*Alnus glutinosa*)	188	10	Chisel	Sharp tool dished facet
29	Ta	2019.31	Large pointed end		Alder (*Alnus glutinosa*),	207	27	Pencil	Cleave-end
30	Ta (east)	2019.10	Large pointed end	6245+/-35 (UBA-41506)	Hazel (*Corylus avellana*)	425	28	Pencil	Cleave-end
31	Ta (east)	2019.11	*In situ* large roundwood		Hazel (*Corylus avellana*)	138	41	Wedge	Too damaged to identify
32	Tb	2018.61	Large pointed end (segment)	6169+/-31 (UBA-41505)	Hazel (*Corylus avellana*)	211	56	Pencil	Surviving portion cleave-end
33	Tb	2018.61a	Large pointed end (segment); unstratified cut piece		Degraded Hazel/Alder (*Corylus/Alnus* sp.)	32	26 (incomplete)	Pencil (possibly, end missing)	Possible cleave-end working
34	Tb	2018.63a	Large pointed end (segment)		Alder (*Alnus glutinosa*)	101	33 (c.40 originally)	Pencil (possibly, end missing)	Surviving portion cleave-end
35	Tb	2019.9	Large pointed end		Unidentifiable	318	44 (c.50 originally)	Pencil	Cleave-end
36	Tc	2017.58	Large pointed end		Alder (Alnus glutinosa)	425	58	Pencil	Cleave-axed
37	Tc	2017.82	Large pointed end		Not identified	98	27 (incomplete)	Pencil	Cleave-end
38	Tc	2017.83	Large pointed end		Degraded Willow/Populus (*Salix/Populus* sp.	300	39	Pencil	Cleave-end
39	Tc	2017.97	Large pointed end		Hazel (*Corylus avellana*)	293	48 (c.55 originally)	Pencil	Cleave-axed
40	Tc	2018.46	Large pointed end		Hazel (*Corylus avellana*)	265	40 (c.55 originally)	Pencil	Cleave-axed
41	Tc	2018.47	Large pointed end	6181+/-36 (UBA-41504)	Hazel (*Corylus avellana*)	382	36	Pencil	Cleave-end
42	Tc	2018.48	Large pointed end		Hazel (*Corylus avellana*)	332	33	Pencil	Cleave-end
43	Tc	2018.49	Small pointed end		Unidentifiable	91	10	Pencil	Sharp tool cut flat facet
44	Tc	2018.52	Small pointed end		Hazel (*Corylus avellana*)	53	13	Pencil	Sharp tool dished facet
45	Tc	2018.53	Small pointed end		Not identified	38	12	Pencil	Sharp tool dished facet
46	Tc	2019.33	Small pointed end		Hazel (*Corylus avellana*)	66	13	Pencil	Sharp tool cut flat facet
47	Tc	2019.34	*In situ* small roundwood		Alder (*Alnus glutinosa*)	42	12	No clear evidence	No clear evidence
48	Tc	2019.55	Large pointed end		Not identified	192	32 (45 originally)	Pencil	Cleave-end
49	Tc (east)	2018.44	Large pointed end		Alder (*Alnus glutinosa*)	215	57	Pencil	Cleave-axed
50	Tc (east)	2018.47b	Large pointed end		Hazel (*Corylus avellana*)	93	35 (incomplete)	Pencil	Cleave-end
51	Td	2020.13	*In situ* large roundwood		Not identified	385	17	No clear evidence	No clear evidence
52	Td	2020.14	*In situ* large roundwood		Alder (*Alnus glutinosa*)	171	20	No clear evidence	No clear evidence
53	Td	2020.15	Small pointed end		Hazel (*Corylus avellana*)	63	9	Chisel	Possible cut mark, distorted
54	Td	2020.16	Small pointed end		Hazel (*Corylus avellana*)	143	11	Chisel	Sharp tool dished facet
55	Td	2020.17	Small pointed end		Hazel (*Corylus avellana*)	273	13	Chisel	Sharp tool dished facet

Table 5.8 Artefacts lifted from Site T (2017-2020) analysed in this work

5.11.2 Distribution and interpretation of worked wood at Site T

Structure/context	Large pointed end (incl. segment)	Small pointed end (incl. segment)	*In situ* large roundwood	*In situ* small roundwood	Unstratified worked roundwood	Total	%
Ta (incl. Ta east)	5	4	1	20		30	55.6
Tb	3				1	4	7.4
Tc (incl. Tc east)	10	4		1		15	27.8
Td		3	2			5	9.1
Total	**18**	**11**	**3**	**21**	**1**	**54**	

Table 5.9 Worked wood assemblage lifted from Site T (2017-2020)

The majority of wooden artefacts in Site T derive from Structure Ta (55.6%) and then secondly Structure Tc (27.8%). It is worth noting that the Structure Ta assemblage is larger, primarily due to the 19 small diameter roundwood collection lifted as one block from this site and categorised as *in situ* small roundwood in the table above. Unfortunately, as mentioned, this collection was in too poor condition for study by the author, with only a general record of their species (all Alder/*Alnus)* and range in diameter (5-25mm) being available as data. Given this situation the author was able to study in detail the remaining 35 wood artefacts from all structures, which are individually described for the first time in Appendix 1 with photographs taken by the author. To compare the woodworking features here the drawing are presented as deemed more easily comparable. A further structure, Structure Td, was most recently identified in Spring 2020 and is currently not directly dated but, given the stratigraphic context, is highly likely to be Mesolithic as well and included as such. Only five artefacts have so far been recorded and recovered from Td, of which only three contain clear evidence of working. At present it appears a somewhat more insubstantial structure to the others, but this may be due to poorer preservation (visually these artefacts appear more degraded and iron stained than others) and the fact that shifting gravel banks have only recently uncovered this section of Site T and more artefacts may eventually present themselves in the future.

Preliminary wider analysis by the excavation team of the site also suggested that the assemblages from Structure Ta and Structure Tc may possibly contain two separate sub-structures, designated Ta (east) and Tc (east). The artefacts from these sub-contexts are included in analysis as part of the larger Structure Ta or Structure Tc assemblages in this work, although it seems likely they represent different phases of activity at the site that may be clarified in the future with more dates and fieldwork. Given the relatively condensed timeframe suggested by the currently available five radiocarbon dates for all the wooden structures at Site T (5310-4840 cal BC) it seems reasonable to first discuss the worked wood assemblage by context and then considered it as one collection in the final analysis in the sections below. From the three main structures of Ta, Tb and Tc 20 large worked pointed ends have been studied in this work, alongside 11 worked small diameter pointed ends and two unworked small diameter roundwood items. This provides a reasonably large worked wood assemblage from these structures, particularly in the context of low numbers of wooden finds in British and Irish Mesolithic archaeology (as set out in **Chapter 3**).

5.12 Woodworking evidence by Structure

5.12.1 Structure Ta

Two radiocarbon dates make Structure Ta the youngest of the four potential structures, dating to 5210-4840 cal BC. Here 30 wooden artefacts were lifted from this part of Site T – six large roundwood artefacts and 24 small roundwood artefacts – although 19 (2017.20a-s) of these small roundwood pieces were not accessible for this work as mentioned. Of these <2018.91> is perhaps the best and most well-preserved pointed end example from the whole of Site T and can arguably be viewed as the 'type artefact' for the morphology of pointed ends at Mesolithic Site T.

Fig 5.33 Pointed end <2018.91> from Site T with its clear traces of cleave working (drawing Jennifer Foster; photos the author)

It is a roundwood pointed end of hazel (*Corylus avellana*) measuring 376mm long with a 42mm complete diameter dated by radiocarbon AMS dating to 5207-4840 cal BC (6072+/-50, UB-41503). This pencil-end was a worked point with the largest of its toolmarks untruncated and complete, dished in cross-section and measuring 325mm long by 25mm wide by 6mm deep with a facet exit angle of 10° and evidence of surface tearing up the stem. One more facet from the artefact is of similar size with sharp intersecting facet ridges with two smaller ones measuring under 90mm long. <2018.91> noticeably bends slightly along its length and most obviously towards the stem, away from the worked end.

This artefact was in exceptional condition but exhibited toolmarks unlike anything that could be seen from a preliminary review of the known lexicon of British Mesolithic or early Neolithic woodworking (Coles & Orme 1985b; Bamforth *et al.* 2018; Brunning 2007a, 2007b; Taylor 2011b; Taylor *et al.* 2018). Further literature review subsequently revealed that comparable examples had been identified by O'Sullivan (1996, 295) at the Irish Neolithic trackway site of Corlea 9 dated to 3620-3360 cal BC (4680+/-125 BP, GrN-16831). Here, two variants were identified, with one type defined as 'split-ends', and another example exhibiting both splitting and then axing the down the stem towards the pointed and defined as 'split-and-axed' ends (O'Sullivan 1996, 292-3). O'Sullivan (1996, 294) provided an image of a roundwood end <C9:138> that illustrated the nature of these Irish artefacts, and his description of the toolmarks, repeated here at length due to its relevance, strongly suggest that these artefacts are directly comparable to the examples at Goldcliff East.

O'Sullivan's (1996, 293) description of the split-end toolmarks:

> 'Tapers gradually to a broken point, not by means of chopped surface but by torn surfaces from which tapering strips of bark and sapwood can be seen to be removed. These torn surfaces measure between 15 and 30cm in length, and narrowest on the upper part of the trunk, widening gradually towards the tip of the point'.

O'Sullivan's (1996, 293) secondary note was also significant, as he stated the worked wood exhibited:

> 'slight steps or incisions present at the junction of the top of the split area and intact bark surface of the trunk, possibly as a result of a tool edge being struck here'.

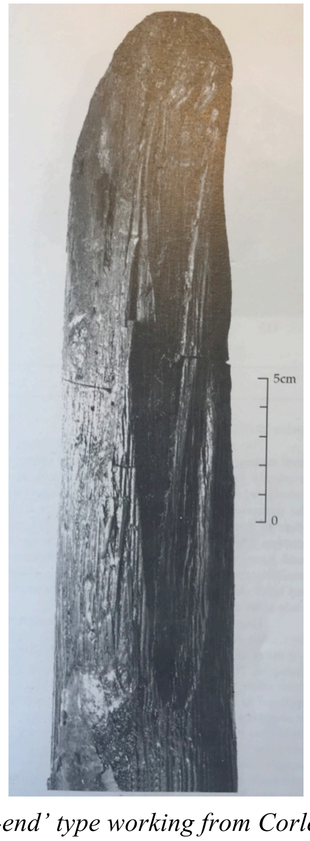


Fig 5.34 Neolithic pointed end with 'split-end' type working from Corlea 9, Mount Dillion Bogs Ireland, with site dated to 3620-3360 cal BC (4680+/-125 BP, GrN-16831) (O'Sullivan 1996, 295)

This is very clearly comparable to the traces observed on <2018.91> and importantly his interpretation was that a *tool* had been used to create and control these splits, not just a process using the natural splitting tendency of the wood along the grain that leaves a tear normally straight in cross-section. The use of an edge tool to work the wood is key, as this means that these traces can be defined as toolmarks of some type. O'Sullivan (1996) describes the processes as splitting, which is certainly technically accurate, but this author prefers the term 'cleave' or 'cleave-end' in this work as it indicates the purposeful working of wood with a tool to produce a specific shape. As a result, <2018.91> could be said to have been made through 'cleave-end' process, with four identified and measurable dished facets of similar morphology. The resulting facets can be described as distinctively long, fairly wide, often deep and curved in cross-section and taper upwards towards the stem with evidence of ripping of bark and fibres on the surface of the stem.

Two of the other Structure Ta large roundwood items, <2017.59> and <2019.31>, were noticeably similar in proportion and working style to each other being 21mm and 27mm in diameter respectively and had again been worked to pencil ends using the cleaved-end method. Their very clear similarity suggest they may possibly have been made at the same time using the same process, whether that could also be by the same person is unclear. Large pointed end <2017.60> was also finely pointed to a pencil point with clearly long, dished facets with ripping of the wood towards the stem again suggesting working from the point in a comparable cleave-end fashion to <2018.91>.

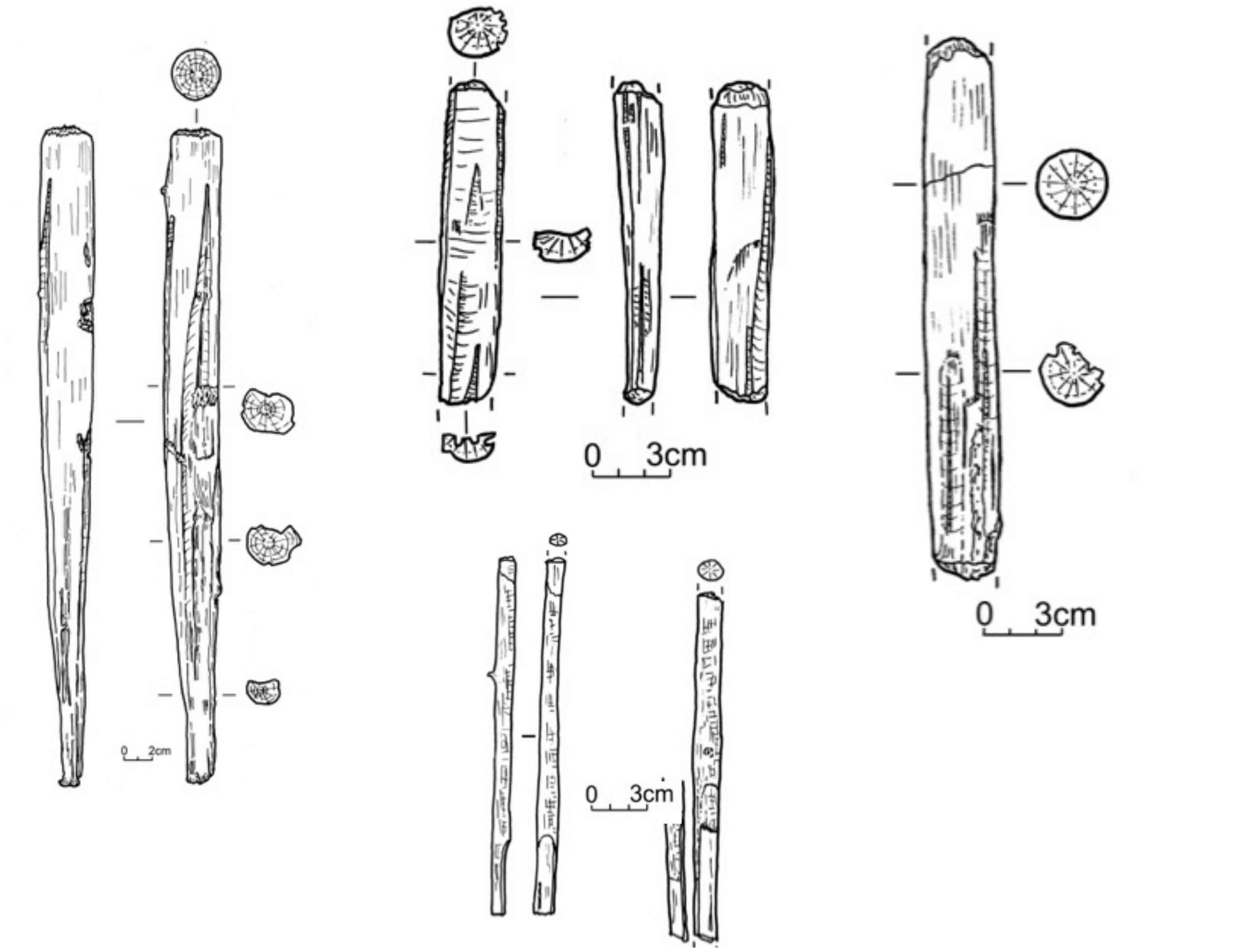


Fig 5.35 Worked wood <2017.91>, <2017.60>, <2017.59>, <2019.31>, <2018.101e>, <2018.101f> from Site Ta (left to right, top to bottom) (drawings Jennifer Foster)

Three of the small diameter pointed end roundwood or withy items (<2018.101d>, <2018.101e> and <2018.101f>) were very similar in morphology, all some 10mm in diameter and cut to fine chisel end points with a sharp tool in one go that produce slightly dished facets 10mm wide in each case. It seems probable that this does not represent the full width of the tool itself, as the facets are the complete width of the roundwood. The interpretation would be that a tool that had both a slightly curved, smooth, and sharp blade edge was used. The smoothness of the facet would also mean a tool with a rough blade edge such as an unpolished flaked axe or tranchet adze seems unlikely. That these three small pointed end artefacts were found next to one another with similar toolmarks might suggest there were manufactured by the same tool and at a similar time. Another 10mm diameter *in situ* small roundwood <2018.101c> was an unworked end inserted alongside <2018.101d>, <2018.101e> and <2018.101f>, which shows that on occasion these smaller roundwood pieces or 'withies' were driven in broken or snapped rather than cut.

Two further large roundwood artefacts, <2019.10> and <2019.11>, have been included in the Structure Ta analysis, but likely represent a different phase at the site, thus best described as Site Ta (east). This is supported by the quite different radiocarbon date of 5310-5073 cal BC (6245+/-35, UBA-41506) for one of these, <2019.10>. This would make Structure Ta (east) not only older than the main date of Structure Ta but the oldest date evidence for activity at Site T. The interpretation would seem to be that there was repeated re-use and re-building of similar structures in the palaeochannel in this same area, presumably to build new wood arrangements as older ones gradually disintegrated with exposure to the elements. The condition of these two artefacts was noticeably different than the other from Structure Ta, which would also support the view that this may be the remains of an earlier structure with the later artefacts of Structure Ta perhaps more quickly covered or less exposed and thus recovered in better condition. The woodworking method for one artefact <2019.10> was similar to those of Structure Ta as a whole, with a cleave-end working taking large facets from the end of the piece. This would suggest that this method of producing sharp pointed ends for stakes and fish traps was consistent across this period and area of Site T from 5310 – 4840 cal BC.

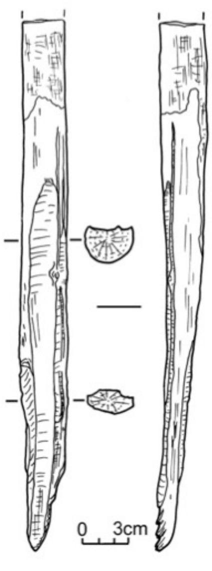


Fig 5.36 Artefact <2019.10> from Structure Ta (east), the oldest sample dated to 5310-5073 cal BC (6245+/-35, UBA-41506) (drawing Jennifer Foster)

The other artefact, <2019.11>, from the potential Structure Ta (east) was atypical and no other piece of worked wood from Site T is similar in morphology to this artefact. Its condition was quite poor with no clear facets identifiable on the worked end. However, it was found in an oblique orientation near to <2019.10> and is almost certainly anthropomorphic in origin with a wedge end shape. If correct and facets did originally exist on its wedge surface they were small in size and would suggest non-cleaving style of working and potentially use of a different tool, such as an organic or lithic axe or adze for example. It would also illustrate that the builders of the Site T fish traps did not always carefully shape the pointed ends to fine pencil ends in every instance. The artefact was not driven into the sediment anywhere as deeply as its neighbour <2019.10>. Plausibly this may have been because it was rather blunt and poorly finished compared to the majority of Site T pointed ends and thus harder to get in – although as it was found still *in situ* it appears it was still pointed enough to do the job required by the workers at Site T.

5.12.2 Structure Tb

One radiocarbon date from pointed end segment <2018.61> suggests Structure Tb dates to 5216-5029 cal BC (6169+/-31, UB-41505), with only four worked wooden artefacts having been retrieved from Structure Tb; two large pointed end segments (<2018.61> and <2018.63a) that are both missing the terminal pointed end, one medium sized unstratified pointed end segment (<2018.61a>), and one complete large pointed end (<2018.63a>).

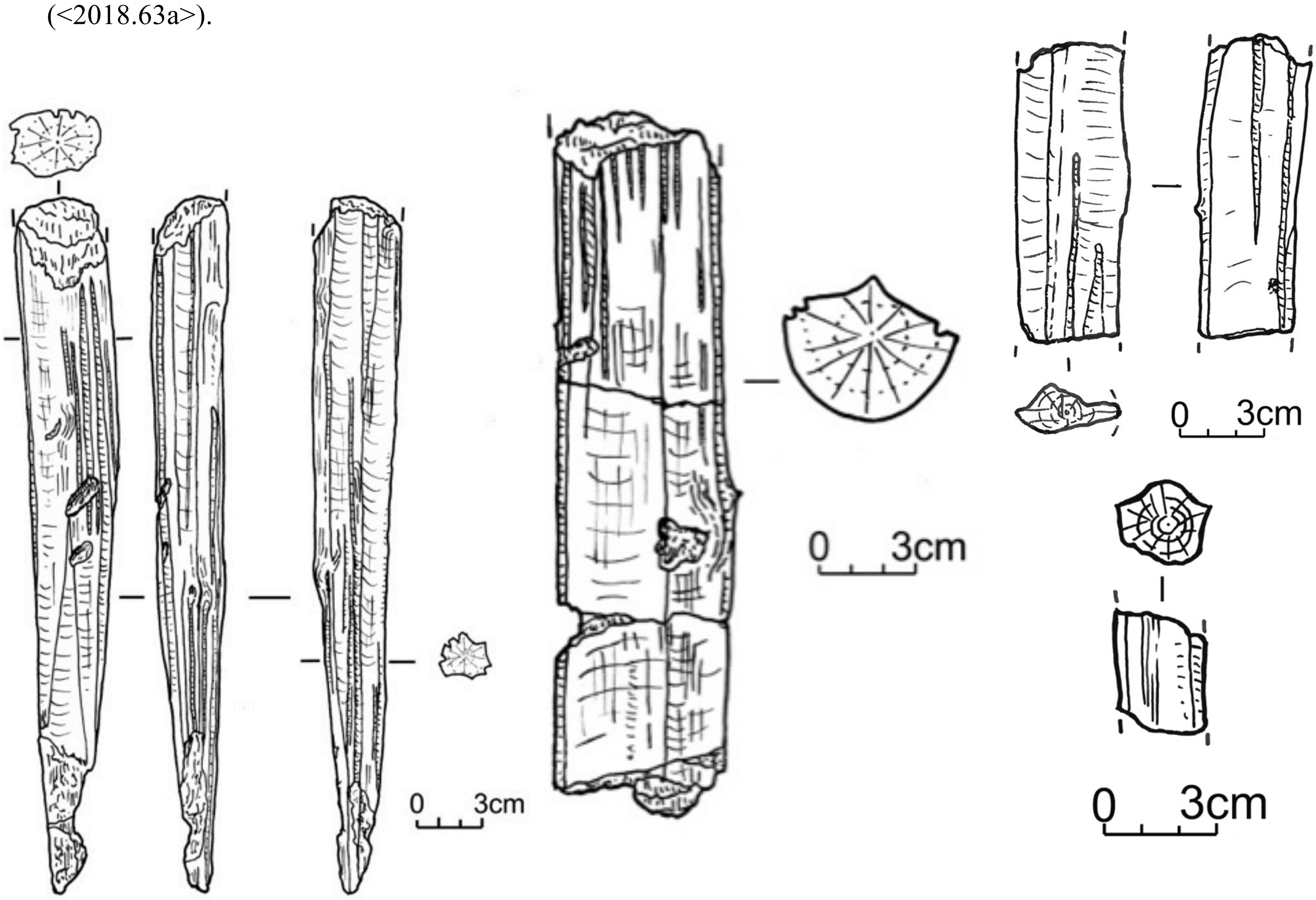


Fig 5.37 Artefacts <2018.61>, <2018.61a>, <2018.63a> and <2019.9> from Structure Tb (left to right, top to bottom) (drawings Jennifer Foster)

Of these, the unstratified segment <2018.61a> and incomplete pointed end <2018.63a> exhibited truncated tool marks consistent with the type of facet evidence from Site T of dished cutmarks, with both having facet examples 25-30mm in width and with evidence of ripping or tearing of the surface of the wood. <2018.63a> also exhibited smooth surfaces to part of its facets, something observed on the larger pointed end segment <2018.61>. Artefact <2018.61> also has the largest complete diameter (at 56mm) of any pointed end from Site T and was inserted vertically into very hard gravel-like sediment, with the tip lost in difficult excavation conditions. It has two large truncated toolmarks and exhibited a pronounced and sharp facet ridge between the two largest toolmarks, as shown in in Fig 5.37 with a pronounced cross-sectional curve left by removing long slices of wood.

The final artefact from this structure (<2019.9>) was another large pointed end of similar dimensions to <2018.61>, being an estimated 50mm in original diameter. This pointed end appears to have been worked in a slightly atypical fashion still using cleave-end working but with at least two facets that are smoother toward the stem and ripped wood towards the point suggesting the smooth blade edge of a tool atypically worked towards the point at the end of its manufacture. The facets are also slightly narrower than normal, as of seven facets identified none measured greater than 19mm in width or 1mm in dished depth. These narrow facets may be the product of the process of multiple intersecting removals that truncate the original wider toolmark that preceded it. This would suggest that this piece was more intensively worked than the exceptional example <2018.91> from Structure Ta for comparison, which had only four facets, one of which removed a large slice in a single go and measured 25mm in width. The reason for this combination of working techniques in <2019.9> could be that a difficult knot or branch needed to be dealt with and/or the initial remove of long slices and facets did not produce enough of a point, so it was finished off by more working toward the end to refine the shape. This shows that while the primary method may to be cleave or split off slices working from the pointed end upwards towards the stem, variety exists in the assemblage perhaps dictated by the density of larger roundwood or skill of the maker.

5.12.3 Structure Tc

One radiocarbon date from pointed end segment <2018.47> suggests Structure Tc dates to 5225-5010 cal BC (6181+/-36, UB-41504). The OxCal v.4.3.2 plot of this suggests it is almost identical to the radiocarbon date for <2018.61> from Site Tb and would appear to suggest that these two structures may have been built at roughly the same time or possibly may form part of one larger structure.

Site Tc has provided the largest number of lifted worked wooden finds from Site T available for study, with 10 large worked pointed ends and five small pointed ends (including one unworked *in situ* small roundwood). All of these larger pointed ends exhibited toolmarks consistent with features observed from Structures Ta and Tb, namely long dished facets that had evidence of ripping of the surface towards the stem of the roundwood. However, notable from Structure Tc are four examples of large roundwood pointed ends (<2017.58>, <2017.97>, <2018.46> and <2018.44>) worked using the 'cleaved-axed' technique. This represents the only clear evidence for the presence of this working technique from the Site T assemblage, although it should be allowed that incomplete pieces, as well as damage from compression combined with gradual deterioration in the sediments, may mean that small facets to the tip of other pointed ends to finish them off to a sharp point may be no longer identifiable.

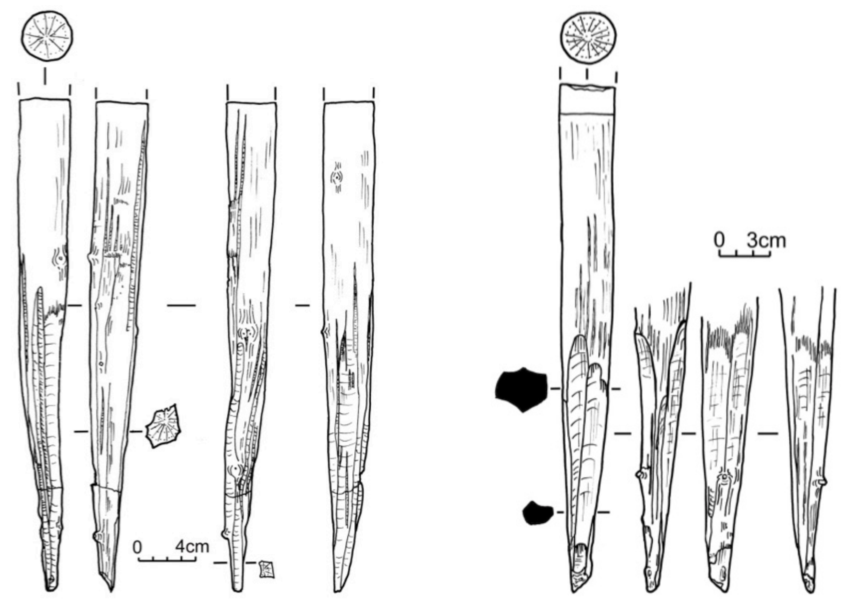
Find number	Surviving length	Original diameter	No. of identifiable facets	Max. facet length[1]	Max. facet width[1]	Max. facet depth[1]
2017.58	425	58	12	415 (truncated)	38 (complete)	5
2017.97	293	55 (est.)	8	290 (truncated)	33 (complete)	4
2018.46	265	55 (est.)	7	265 (truncated)	35 (complete)	3
2018.44	215	57	10	213 (complete)	37 (complete)	4

Table 5.10 Cleave-axed ends from Site Tc

[1]Figure for maximum dimension from any facet identified on this artefact (i.e., figures above not length, width, and depth of one particular facet alone).

Table 5.9 above illustrates that these four cleave-axed examples share several similar features. Firstly, they are amongst the largest roundwood examples from Site T, all having a small range of measured or estimated original diameter of 55-58mm. Secondly, for examples <2017.58>, <2017.97> and <2018.46>, they all exhibit very long truncated and dished facets with smooth surface, sharp facet ridges and evidence of tearing towards the stem. In these three examples the total original length of the largest facet is unknown as they were all truncated, but they were evidently sizeable with <2017.58> exhibiting one toolmark that was longer than 415mm in length – even truncated that makes it the longest from the whole Site T assemblage. <2018.44> was a more incomplete truncated pointed end than the others but appeared to be worked in a broadly similar fashion using the cleave-axed technique and with one complete facet of comparable size.

Fig 5.38 Artefacts <2018.47> with possible jam curve dated to 5225-5010 cal BC (6181+/-36, UBA-41504) and <2018.48> with visibly similar working technique (left to right) (drawings Jennifer Foster)



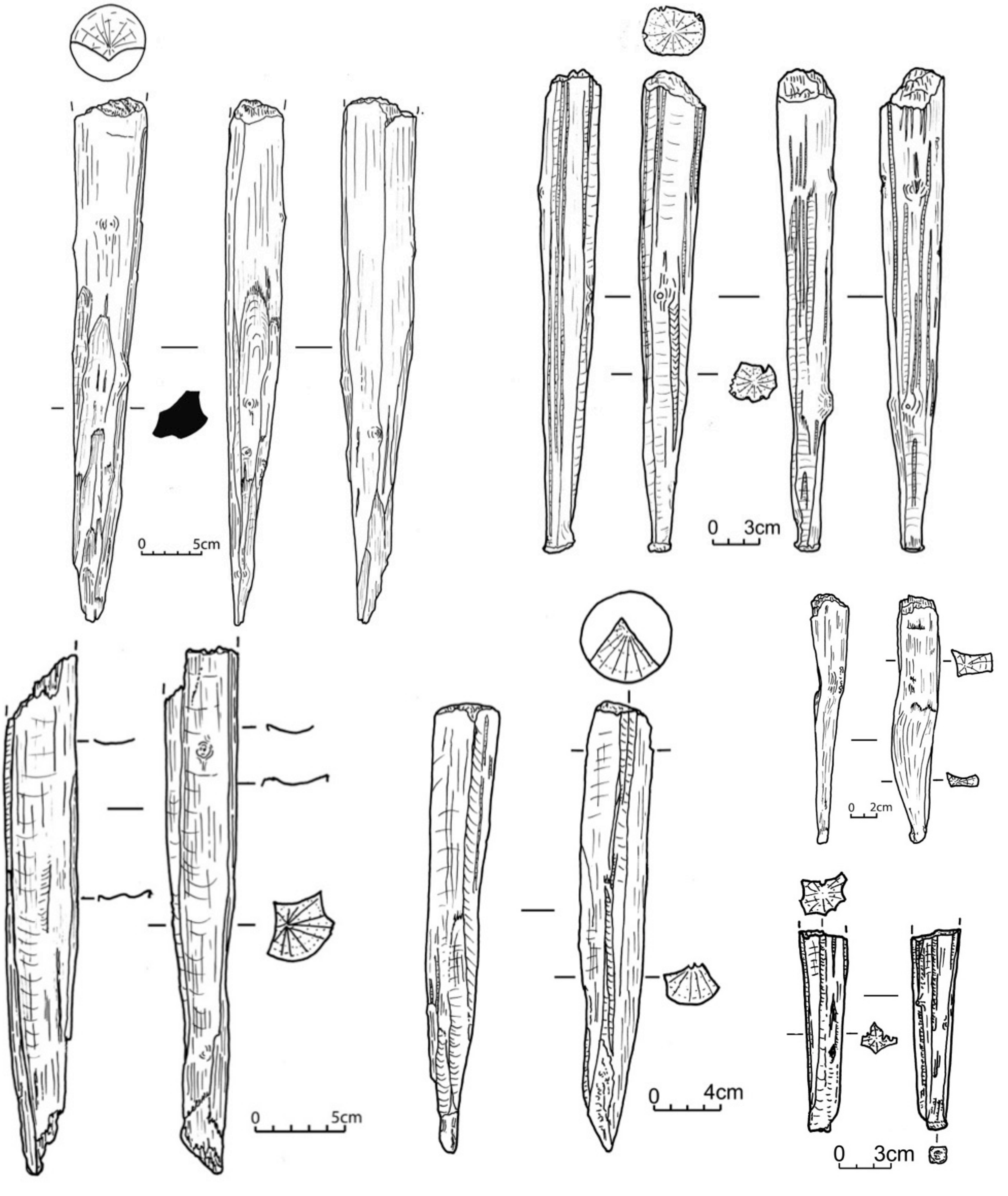


Fig 5.39 Artefacts <2017.58>, <2017.83>, <2017.97>, <2018.46>, <2019.55> and <2017.82> (left to right, top to bottom) (drawings Jennifer Foster)

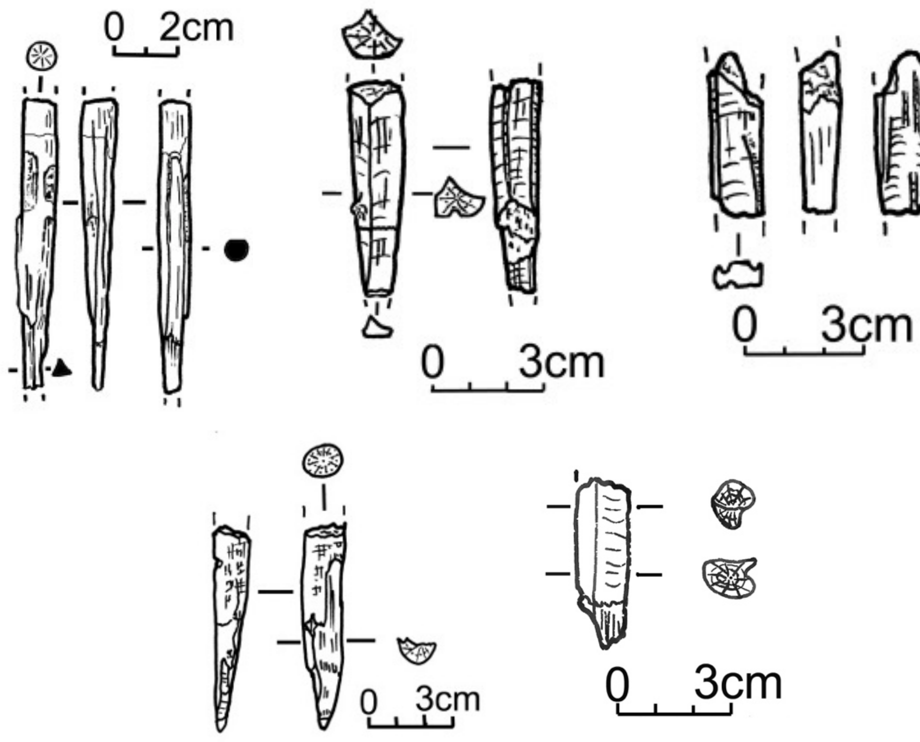


Fig 5.40 Small roundwood pointed ends <2018.49>, <2018.52>, <2018.53>, <2019.33> and <2019.34> (drawings Jennifer Foster)

The interpretation from these four examples would seem to be that larger stems (in the context of Site T roundwood) were initially being worked by cleaving off very long slivers of wood to reduce it to a point. The data from these four examples also possibly gives some suggestion of the sharpness and profile of the tool which produced these long-dished facets. The largest toolmark dimensions from <2017.58> suggest a tool with a blade edge at least 38mm in width and having a maximum curved depth of 5mm. The maximum facet widths and depths from the other four pointed ends are a little below these dimensions and thus it is possible the same tool, or a close replica of its form and shape, was used to produce the longer facets observed on all four cleave-axed pieces.

Of the other large pointed ends from Structure Tc four (<2017.83>, <2018.47>, <2018.48> and <2019.55>) are broadly similar in working style, with long dished facets that were normally ripped towards the stem. Of these <2017.83> exhibited slightly atypical working evidence, with several of its facets smoother near the stem end and torn towards the point suggesting that, similar to <2018.61> from Structure Tb, some reduction of this pointed end was carried out towards the tip. One of these was smoother and clearly above a substantial branch knot, with ripping below supporting a view that problems with knots may account for this change in working direction.

The other two pointed ends (<2018.47> and <2018.48>) were found in close proximity to each other and are remarkably similar being both hazel, measuring 36mm and 33mm respectively in complete diameter, and both had six identifiable facets of comparable dimensions. <2018.47> had a slight bend and was inserted growing end up while <2018.48> was inserted growing end down. Given <2018.47> was the slightly larger in diameter and had a possible slight bend to it, it seems conceivable that these are two pointed ends from the same original stem, divided and then sharpened to points. <2018.47> also contained a complete, or nearly complete, jam curve that is interpreted as a stop cut to avoid the wood splitting too far up the stem. This jam curve was 28mm in width and had a blade entry angle of approximately 20°, suggesting a sharp curved tool being used that was at least 28mm wide. This is consistent with a tool able to produce the dimensions of the complete facets on these two pointed ends, which are on average 16mm in width (**n=11** useable facets with width measurements), but on the face of it would seem too small a tool for the facets recorded on the cleave-axed pointed ends discussed above (the largest there being 38mm wide). The interpretation would be if this is indeed a full jam curve of the tool used then at least two curved sharp tools were being used to fashion the pointed ends at Structure Tc, one larger than the other but both smooth, curved, and sharp. Interestingly, the facet widths from pointed end <2019.9> from Structure Tb were also narrow and similar to <2018.47> and <2018.48>, possibly suggesting that a tool of similar size (or even the same tool given the comparable ages) was being used across both structures.

Four small pointed ends with working (<2018.49>, <2018.52>, <2018.53> and <2019.33>) and one *in situ* small roundwood were recovered from Structure Tc. Potentially two of these exhibited flatter facets in cross-section (<2018.49> and <2019.33>) and two more dished (<2018.52> and <2018.53>), potentially suggesting the use of a curved edge sharp tool as observed in Structure Ta alongside possibly another sharp flat edge tool such as a flint blade or flake to work these items to points. Two further terminal ends of pointed ends (<2018.44> and <2018.47d>) were recovered from Structure Tc (east), shown below. It remains unclear at present if these are parts of Tc itself or a different structure, as no radiocarbon dates currently exist, and more wood may eventually be revealed at the site to clarify the relationship between the artefacts. Analysis of the working technique for both pieces suggests they were pointed in comparable fashion, with long, dished facets and evidence of ripping of the roundwood surface from the point.

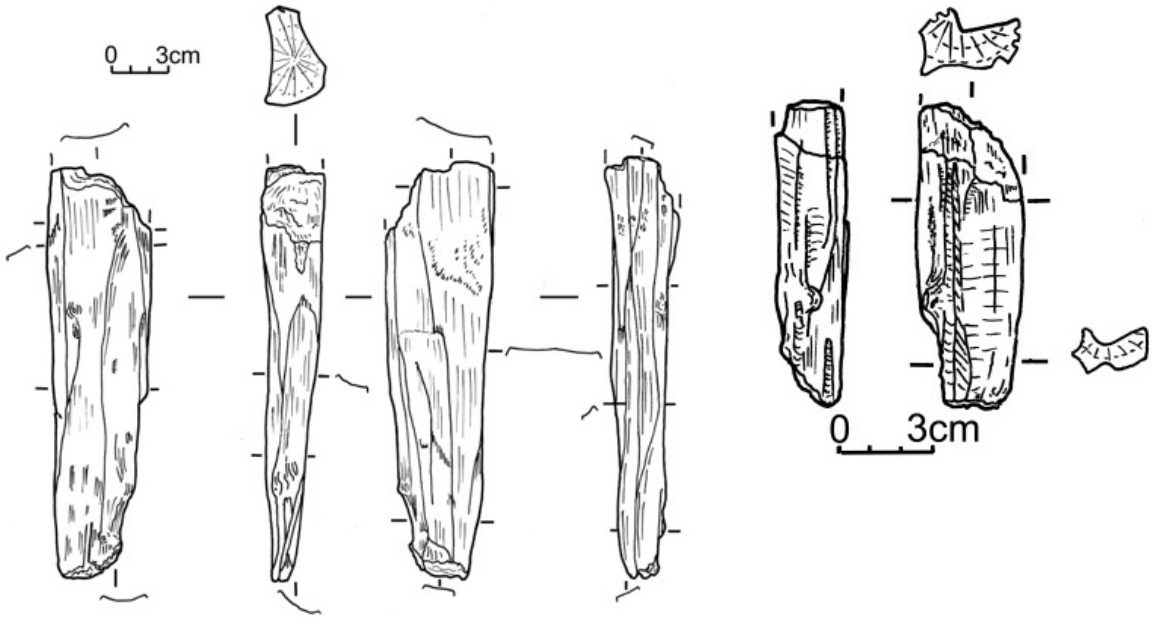


Fig 5.41 Structure Tc (east) truncated pencil type pointed ends <2018.44> and <2018.47b> (left to right) (drawings Jennifer Foster)

5.12.4 Structure Td

Structure Td is contextually and stratigraphically dated to the Mesolithic, although the condition of the worked wood appears more degraded and iron stained than structures Ta, Tb and Tc. Visually, they seem more similar to Ta (east), so it may be the case that this structure is also one from an earlier age and phase of use at Site T. The wooden artefact assemblage currently consists of two large *in situ* pieces of unworked roundwood found in vertical orientation (<2020.13> and <2020.14>) and three small pointed ends with evidence of working (<2020.15>, <2020.16> and <2020.17>) that were cut with a sharp curved tool, similar in working style to the examples found at Structure Ta and Structure Tc. The two unworked large roundwood items are actually of quite modest diameters (17-20mm) for Site T roundwood and without any clear evidence of working so it is possible that this structure may have been different in design, function and indeed possibly age to the clearer fish trap constructs from the rest of Site T.

Fig 5.42 Artefact <2020.13> from Structure Td (the author)

Fig 5.43 Artefact <2020.14> from Structure Td (the author)

5.13 Site T wood working evidence

5.13.1 Analysis of large pointed end assemblage (all structures)

There is a sample of 18 examples with intact (or known) end types from Site T, and from these it is clear that pencil-ends form the majority of the sample (94.4%). The only other type in this sample is <2019.11> that appears to have a wedge-end. As discussed above this example is atypical and appears likely to be the product of dividing a larger stem and simply using the semi-sharp end as a stake. A further two large pointed end segments, <2018.61a> and <2018.63a>, were recovered with missing terminal ends, although both have comparable evidence of cleaving or splitting technique on their surviving sections. Of the two, the longer surviving length of <2018.63a> more securely suggests it was a cleave-end, whereas <2018.6a> is consistent with the technique but too small to be reliably identified.

Artefact	Site	End type	Working method	Max roundwood diameter	Species
2017.59	Ta	Pencil	Cleave-end	21	Alder
2017.60	Ta	Pencil	Cleave-end	41	Hazel
2018.91	Ta	Pencil	Cleave-end	42	Hazel
2019.31	Ta	Pencil	Cleave-end	27	Alder
2019.10	Ta (east)	Pencil	Cleave-end	28	Hazel
2019.11	Ta (east)	Wedge	Axe/adze section?	41	Hazel
2019.9	Tb	Pencil	Cleave-end	50	Unidentifiable
2018.61	Tb	Pencil (identified in excavation but not lifted)	Cleave-end (probable)	56	Hazel
2018.61a	Tb	Unknown	Unknown	26 (incomplete)	Hazel
2018.63a	Tb	Unknown	Cleave-end (probable)	c.40 originally	Alder
2017.58	Tc	Pencil	Cleave-axed	58	Alder
2017.82	Tc	Pencil	Cleave-end	27 (incomplete)	Not identified
2017.83	Tc	Pencil	Cleave-end	39	Degraded Willow/Populus
2017.97	Tc	Pencil	Cleave-axed	55	Hazel
2018.46	Tc	Pencil	Cleave-axed	55	Hazel
2018.47	Tc	Pencil	Cleave-end	36	Hazel
2018.48	Tc	Pencil	Cleave-end	33	Hazel
2019.55	Tc	Pencil	Cleave-end	45	Not identified
2018.44	Tc (east)	Pencil	Cleave-axed	47	Alder
2018.47b	Tc (east)	Pencil	Cleave-end	35 (incomplete)	Hazel

Table 5.10 Large pointed end assemblage from Site T

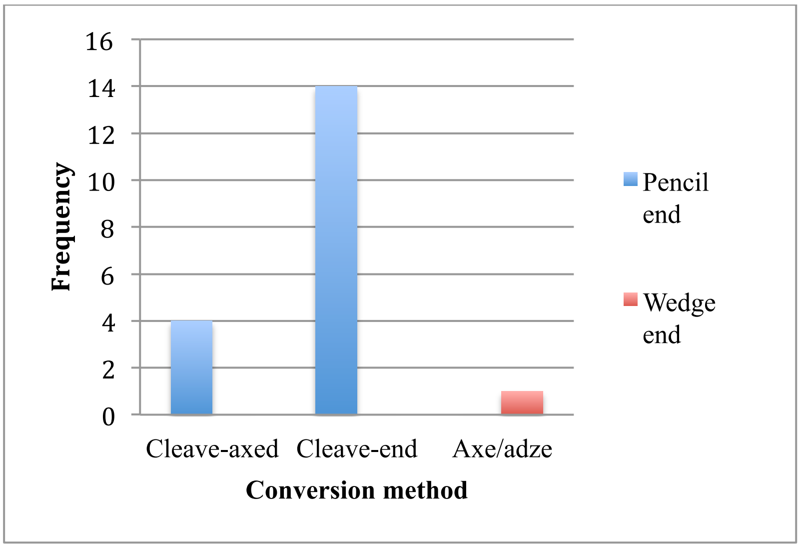


Fig 5.44 Site T point shape and working type (n=19)

Within the collection of pointed ends with known type, there is also a clear preference for the pointed ends to be worked using only the cleave-end technique, with only four finished by reversing the direction of work and worked in a cleave-axed fashion (frequencies shown in Fig 5.44). The selection of those four pieces for cleave-axed working appears to be related to the dimensions of the roundwood, with the large pointed ends with measured or reasonable estimated diameters show a cluster of cleave-axed ends within the largest sized roundwood. The diameters of worked pointed ends as shown in Fig 5.45 below also show a slight concentration for selection of larger roundwood in the 51-60mm range, although it is worth remembering the sample size is quite small. However, the logical interpretation would seem to be that smaller roundwood could be shaped to a point by splitting and cleaving alone, but larger pieces required additional work to produce a final sharp point and thus became cleave-axed ends.

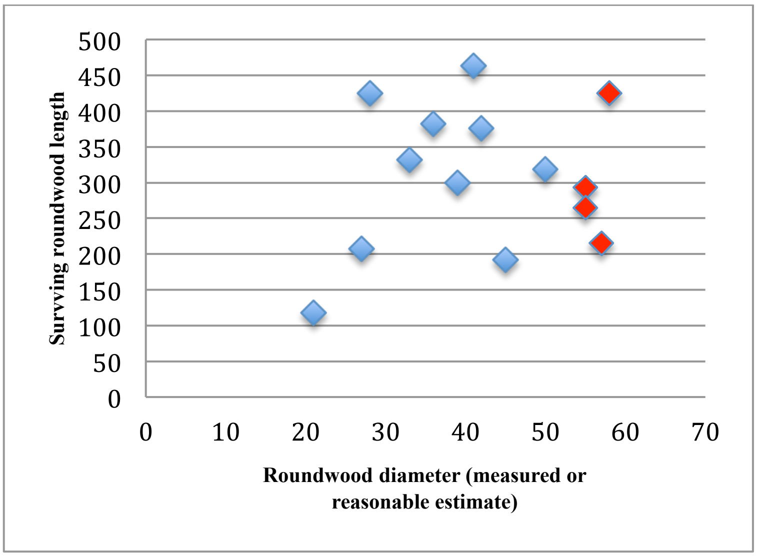


Fig 5.45 Artefacts with identifiable end type in relation to roundwood size (cleave-axed ends in red) (n=14)

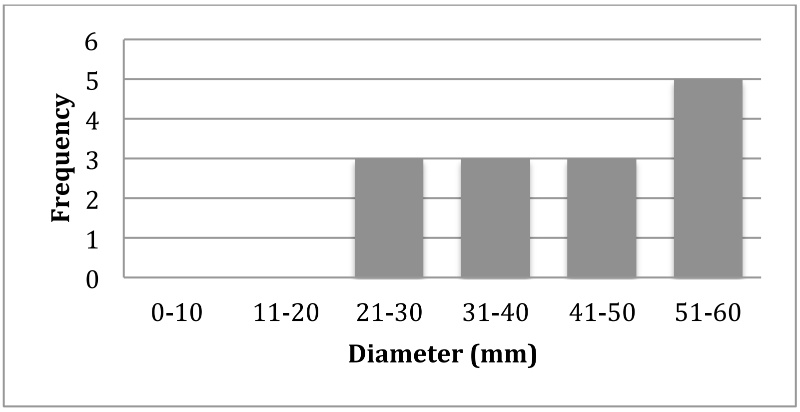


Fig 5.46 Large pointed ends sample with identifiable diameter of (n=14)

5.13.2 Species selection

Of the wooden artefacts from Site T included in this work that could be identified to wood species, 19 (66%) are hazel, nine (31%) alder and one (3%) willow/popular. Four further worked artefacts lifted in 2021 were also hazel and not included here other than to reinforce this overall composition (M. Bell pers. comms). This reveals an overwhelming dominance of hazel in selection of raw material for use in the fish trap structures as a whole, with a very constricted range of just three species being selected by the builders. The distribution of species by type of artefact is less clear-cut with 10 of the large roundwood artefacts being hazel and six alder and one willow/popular. For the smaller diameter roundwood nine are hazel and three alder. This would suggest that while hazel was the preferred species overall its use was not restricted to either large or small roundwood parts of the structure. The use of one species was also not restricted to particular structures either, as Structure Ta, Tb, Tc, Tc (east) and Td all had large and small pointed ends of both species in the samples taken. Only Structure Ta (east) seems to have been exclusively made with hazel, but this structure is only represented by two samples and considering the makeup of other structures this is likely a partial and incomplete picture. However, what can be said with more confidence is that interestingly a useful species such as willow was apparently available to some extent, as evidenced from other Goldcliff sites such as Site J, but was not being selected for the flexible rods or wattlework that made the fence or barrier of the fish trap structures. This would seem to be a noteworthy choice on the part of the Mesolithic fish trap builders, who seemingly avoided it not because of the total absence of willow in the wider environment but rather through a purposeful decision to consistently use hazel, and to some extent alder, for the fish traps. Useful further work will be to tie species selection into possible evidence of woodland management and seasonality, with tree-ring analysis ongoing at the time of writing with results to be published in due course (M. Bell pers. comms.)

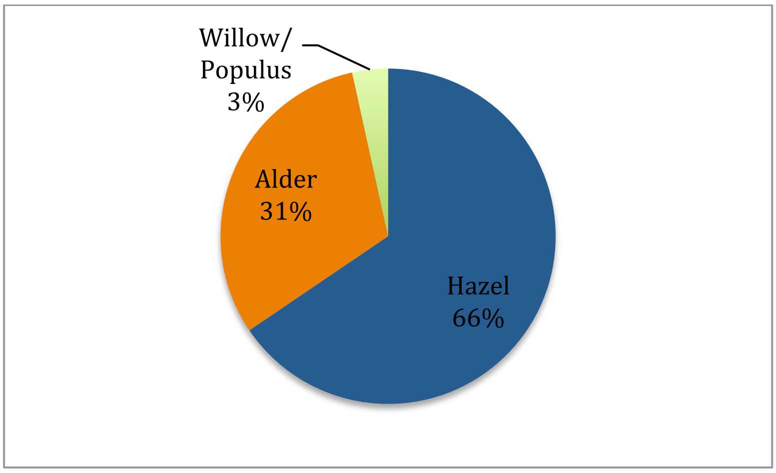


Fig 5.47 Species selection across all 29 Site T artefacts sampled

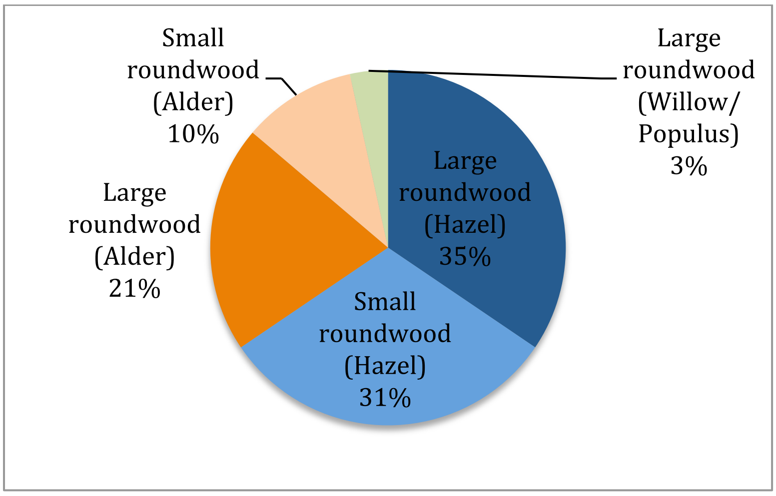


Fig 5.48 Species selection according to Site T artefact type

5.14 Toolmark analysis of pointed ends

The discussion of the evidence from the pointed ends in **Section 5.12** above provides evidence that there appears to be a consistent woodworking style across structures Ta, Ta (east), Tb, Tc and Tc (east), with comparable evidence for the repeated use of a sharp curved tool that split or cleaved long facets from the wood. There is also clear evidence for the consistent selection of similar sized roundwood and production of the same end type as discussed in the sections above. As the analysis has thus shown that the type of pointed ends used were broadly similar, it then asks the question whether the tools used to make the pointed ends across the structures also have similarities? Analysis of toolmark types, dimensions and frequencies is an approach that can be used to address that question as set out in **Chapter 4. Methodology** and results of analysis of that data are considered here.

5.14.1 Length vs width toolmark results

Comparative studies such as that by O'Sullivan (1996, 294) focused on investigating length to width ratios as seemingly the best diagnostic measure of facets, achieved by selecting 'the 'best' facet' on each worked end'. However, the work of O'Sullivan (1996) and Coles & Orme (1985b) did not set out in detail the relative benefits and results of using different toolmark data types to study different sample types of length and width facet dimensions, and given the reasonably large dataset collected for this work it also seemed appropriate to set out what information may be obtained by using different data selection criteria for toolmark analysis.

In this study a comparison is made below of five different ways of comparing the recorded facet dimensions:

(i) All facets
(ii) All complete facets.
(iii) Largest (by length) facet
(iv) Largest (by length) complete facet
(v) 'Best' facet, being the largest (by length) complete facet or largest available facet in-line with O'Sullivan (1996)'s methodology.

The results from these different criteria, below, serves to illustrate the different resolution and information that assessing the toolmark data in different ways can provide.

Fig 5.49 (i) All facets (n=91)

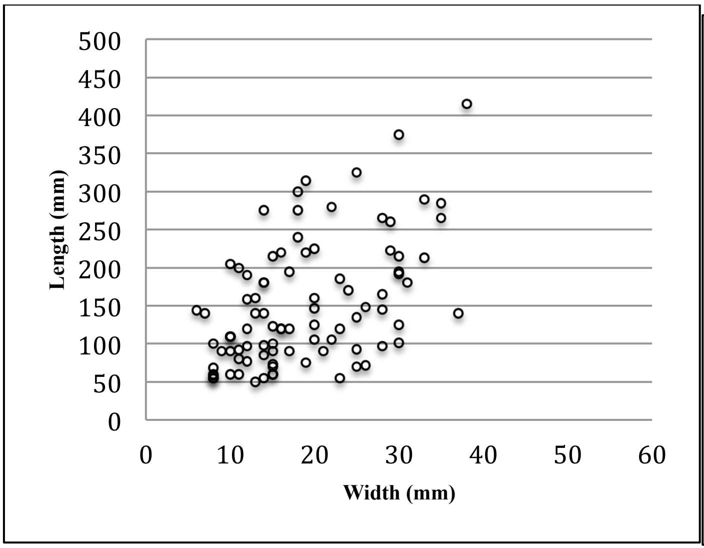
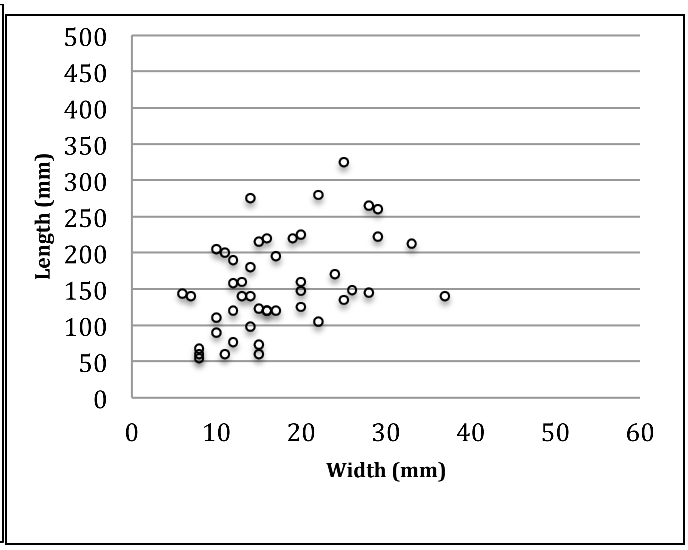
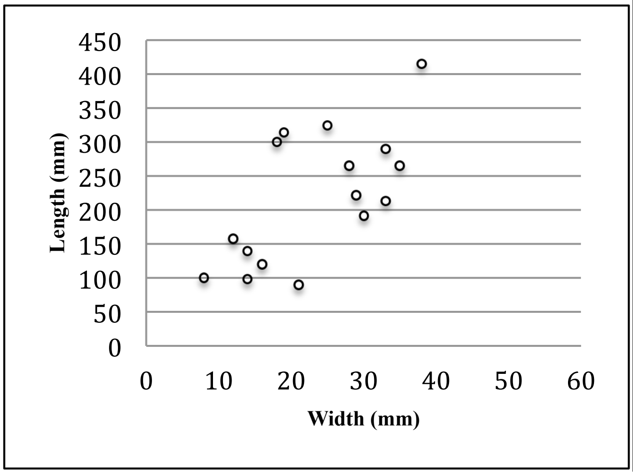


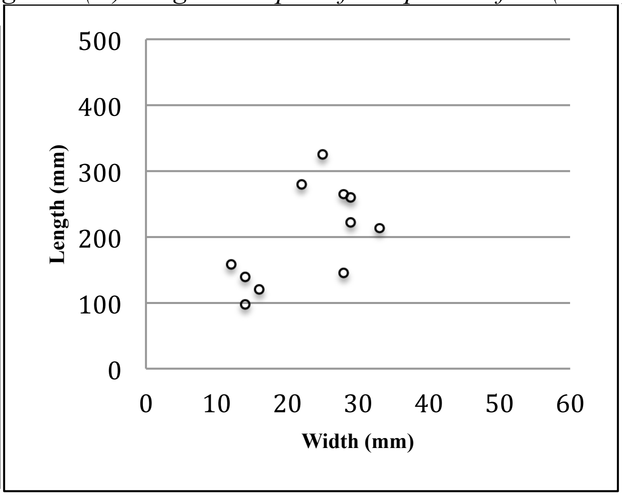
Fig 5.50 (ii) All complete facets (n=46)



The first two figures that express the data from (i) 'all facets' and (ii) 'all complete facets' show broadly comparable trends, with majority of facets being under 250mm in length and 25mm in width, with a gradual tapering off of sizes with only a few atypical examples that appear significantly longer (>300mm) or very wide (>30mm). Considering the scatter plots of the two types of data also suggests that both are viable ways to express the range in facet dimensions, what is perhaps striking is that there is clear evidence that the majority of facets are under 300mm (95.6%) and most importantly all are under 38mm in width. This suggests that while the length of a facet made using the cleaving or splitting of wood can vary in length there seems a clear maximum facet width of around 38mm from Site T, perhaps suggesting that the largest tool used was likely have had a maximum blade width close to this size.

Fig 5.51 (iii) Largest facet per artefact (n=16) *Fig 5.52 (iv) Largest complete facet per artefact (n=11)*





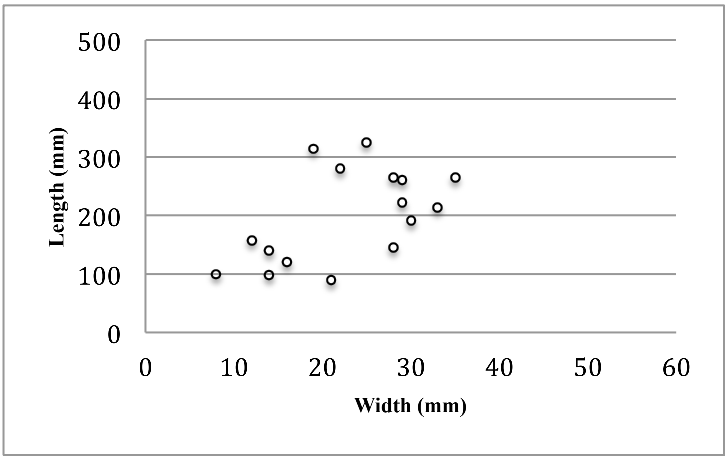


Fig 5.53 (v) 'Best' – Largest complete or largest facet available per artefact (n=16)

If the facet dimension data is considered by only one measurement per individual artefact, using the (iii) 'largest facet', (iv) 'largest complete facet' or (v) 'best' criteria, another interesting result emerges as it appears to show a striking potential separation within the data. This was seemingly obscured by the less exclusive parameters in criteria (i) and (ii). One possible explanation for this is that two different tool types have been used on the pointed ends, both able to produce long toolmarks through the cleaving method but leaving facets that can be distinguished by the maximum cutting width produced. This appears to be around the 19-22mm width mark for the smaller tool. Conceivably a tool of say 38mm in width that could make the largest facets from Structure Tc might also possibly produce narrow facets, if very carefully used, but one might expect these to be very flat if the maker was using the central part of the blade edge and small in length to finish a point off. However, the cross-sectional depth of the <20mm smaller width facets ranged from 0.5mm up to 6mm, so not noticeably flatter than other facets observed in this study. The noticeable separation in the scatter plots iii-v above can perhaps best be plausibly explained as showing at least two different sized tool types, with similar sharp and likely curved (in cross-section) blade edges represented. Interestingly, there is no clear concentration of the facet data by structure or context so it would appear that if this multi-tool hypothesis is accurate it means a comparable variation in tools existed across time and space at Site T if there were different phases present.

Finally, there are some useful methodological conclusions from the analysis of toolmark length vs width data, which would suggest that using (i) 'all facet' data perhaps provides a good representation of the actual range of facets sizes, particularly in terms of the variety in length of facets, and a large dataset. However, there are drawbacks in using this type of facet data as it allows for the inclusion of considerable variation resulting from facets that are truncated or only partially preserved. Using only (ii) 'all complete facet' data is perhaps a better, more accurate representation of the range of individual facets as they originally appeared before they were cut by subsequent removals. However, one drawback here is it drastically reduces the sample size as just over half (50.5%) of all the facets from Site T could be considered complete and thus using this criteria will exclude a significant section of the available data. Another issue will be that pointing roundwood by the cleave-end or cleave-axed method is a likely reductive process that gradually changes as the work progresses from long slices at the start to more delicate smaller ones at the end. This will produce a variety of facet sizes over the course of the procedure and thus using this criteria may produce a mixed picture of the whole process rather than help identify the dimensions of the actual tool that was being used.

Using the data from only one complete toolmark per artefact as in criteria (iii) 'largest facet per artefact' allows for the full range of facet dimensions to be illustrated and provides a reasonably large sample size, but the inclusion of truncated examples instead of complete ones may again potentially distort the results. Analysis based on criteria (iv) 'largest complete facet per artefact' arguably provides better and more reliable individual result for each actual facet, but this does reduce the studied sample to its smallest size and excludes certain artefacts altogether if no complete facets were observed. Using the data from criteria (v) the 'largest complete or largest available' as suggested by O'Sullivan (1996) would seem to allow for the benefits of criteria (iii) and (iv) to be combined and produced arguably the best, balanced, dataset to work with and, while not perfect, helps to identify the range of working method and type of tools used by the Site T builders and allows comparison with other sites and datasets.

5.14.2 A note on entry angle and depth as metrics for cleave-end toolmark analysis

When plotted there was no clear correlation between the entry/exit angle of the facets versus their width or length. The failure of entry/exit angle to reveal the tool used would seem logical in the analysis of the cleave-ends working as once the initial blow and cut is made the slice is then levered up using the tool before being ripped away from the stem. In this way it is not an 'entry/exit angle', rather the final part of the slice detaching from the stem and not the entry point of a tool. One caveat to this lack of comparable entry angle data to polished axe facets from other sites is the identification of four examples pointed using the cleave-axed method (<207.58>, <2017.97>, <2018.46> and <2018.44>), where they were finished with blows down the point. Here two artefacts (<2017.83> and <2018.61>) had possible long dished facets atypically worked towards the points. In all six cases the possible entry angle of these downwards directed toolmarks was very acute and less than 10 degrees, strongly suggesting that if these are toolmarks made down the stem then a tool with a very sharp curved edge was used, again perhaps sharp antler or bone tools, for these atypical toolmarks. Of the 46 complete facets recorded with the 'exit angle' intact 87% had an angle smaller than 10 degrees, and of the other six the two largest values were 20° from <2018.47> coming from an atypical jam curve and a 45° measurement from <2018.91> where a knot was worked around.

The final distinguishing feature of the Site T cutmarks is the pronounced depth, or dishing, to the facets that are often associated with a smooth facet surface along with sharp, well-defined facet ridges. Results from the analysis of the depth of the facets versus length or width failed to find an obvious correlation, with some of the narrowest facets also the deepest or longest amongst the flattest. This appears to suggest that the maximum depth of the facet did not directly influence how long or wide it was necessarily going to be, which would seem logical as the goal of the woodworkers was to control the wood and produce a fine sharp point not simply to remove as much wood as they could in one go. What is clearer from the data analysis is that the vast majority of facets measured were under 2.5mm in depth, with a few exceptional examples up to 6.5mm in depth. This suggests that for the most part fairly shallow slices were being removed, likely carefully refining the roundwood's shape after the first removal to produce the fine point observed on many of the examples.

The maximum dimensions of the observed facets also allows for some corroborating identification of the size of the largest tool used. Artefact <2018.91> from Structure Ta is one of the most complete and well-preserved pointed ends from Site T and has one facet clearly made first and left untruncated by later removals, measuring 315mm long by 25mm wide by 6.5mm deep. This is one of only two 6.5mm deep facets recorded and seems to represent the maximum depth that the workers attempted to take in any one slice. Pointed end <2017.58> from Structure Tc has the longest and widest toolmark at 415mm long by 38mm wide but only 4mm deep. This is actually truncated at its upper end, but likely represents the approximate maximum width and possible maximum length of any one slice removed in the pointing of the Site T roundwood. Based on these maximum facet sizes the interpretation would again be that maximum size of tool used for this work was one with a sharp curved edge, perhaps at maximum 6.5mm in cross-sectional profile depth and 38mm in width. A sharp, curved, and smooth bladed tool would seem to be the likely source of such marks.

5.15 Review of woodworking at Goldcliff East

The analysis of the wood in this chapter has reviewed the published assemblage from Sites J, B and L and now the important new collection from the fish trap structures of Site T. Of these sites, Site B is the oldest site at Goldcliff East dated to 5990-5790 (7002±35 BP, OxA13927) and represented by only one wooden artefact, the radially split oak wooden spoon or stirrer artefact <3718>. However, this sole find is actually quite significant as an exceptionally rare example of a Mesolithic domestic item produced using a sophisticated woodworking technique of splitting oak lengths radially into blanks to then be fashioned into objects. Other sites such as the multi-phased Site J (4940-4710 cal BC) has produced a large assemblage of worked Mesolithic wood, with eight finished objects or tools, six potential stems possibly used as pointed ends, 22 split and cut pieces and five woodchips. Of these, rare organic objects included the finely worked 'Y' shaped tool <9199> and pronged tools <10665>, <4504> and <9431> that may have had been used for crafting items such as fishing net. Other items include the possible fine pin <10266>, bead/craft tool <10462> and digging stick <9224>. The recovery of potential pointed ends and some 11 cut pieces in Context 328 at Site J may interestingly also potentially reflect the presence of structures and other woodworking at the site at this point, although current evidence would suggest any structures do not appear to have been particularly substantial. The late Mesolithic estuarine sediments of Site E and Site L have produced six pieces of likely worked wood, some of which may have been pointed ends as well as tentatively one possible collection of broken basketry. The conditions of these objects has meant that it has been difficult to be entirely sure of their morphology or manufacture, but significantly objects <14201> and <10527> exhibited characteristics with similar toolmarks to those on the Site T stakes, and if correct would thus extend the range of this technique in time and space. Their relative stratigraphic position would suggest these artefacts are younger than Site T and illustrates that the woodworking techniques of Site T persisted for some time into the late Mesolithic.

At Site T, this analysis has demonstrated that there was a consistent and repeated technological process at work in the production of pointed ends to build the structure of the fish traps, with 95% (n=19) of the large pointed end assemblage converted into pencil-end points. It is also noteworthy, that Site T represents the first time cleave-end technique has been identified in British Mesolithic contexts and, as noted above, the method has interesting parallels with early Neolithic assemblages identified in eastern Ireland (O'Sullivan 1996). Of the 15 large pointed ends that have surviving clear evidence of conversion method 66.7% were cleave-end, 26.7% cleave-axed and 6.7% wedge-end. The cleave-axed artefacts were also all present on the four largest diameter roundwood found at Site T and the logical interpretation would be that cleave-axing was a necessary technique to finish off large roundwood stems. The remarkable consistency of the morphology of these ends, overwhelming made using cleaving techniques, suggests repeated use of a woodworking skill by the Mesolithic community at Goldcliff, starting in at least 5310-5073 cal BC at site Ta (east) and persisting until 5207-4840 cal BC at Site Ta. If we also take into account the two possible pointed end artefacts from estuarine sediments detailed above that are likely younger that Site T, cleave-end working appears to have thus been used at Goldcliff for at least some 500 years.

The identification of this toolmark type in this study raises the interesting question of how they were produced, and can the tool responsible be established? The vast majority of the pointed ends inspected appeared to be uniformly smooth in appearance, and where there were surface striations these appeared to be the resulting of surface ripping of the wood during the cleave-end manufacturing process. This morphology suggested that tool signature analysis as described by Sands (1994, 1997), and described in **Chapter 4**, would be an unlikely method of research for this assemblage, as the necessary nicks and grooves left by blade edges were not obviously present. The possible use of jam curve analysis as described in **Chapter 4** was also problematic as on preliminary inspection it was not clear that such marks had been made on these pointed ends. That said, during the course of further detailed analysis it was found that artefact <2018.47> from Structure Tc did appear to exhibit at least a partial, potentially even complete, jam curve on its circumference to show such evidence can survive on occasion. The best mechanism to understand how these recorded toolmarks are made would thus seem to be a programme of experimentation, to see if a comparative collection produced under controlled conditions could be created, something undertaken and set out further in **Chapter 7.**

While the consistency of morphology and style of the pointed end woodworking from Site T is clear, there are also some atypical examples from the assemblage that stand out. Artefact <2019.9> for example appears to have been worked several times, possibly first upwards away from the point as normal with cleave-ends and then further removals to refine the shape working downwards. This suggests the worker was willing to spend time, and had the tool required, to refine the shape and produce perhaps a sharper and more refined pointed end. The atypical wedge point <2019.11> from Site Ta (east) is interesting as it is the only clearly non-pencil point from the large roundwood assemblage. Its facets were not distinctive, but with a basic wedge morphology it appeared remarkably similar to the author has produced using lithic axes when dividing a stem to produce shorter lengths. That it was apparently then used in this form driven into the sediments shows not all the crafting of the Site T structural pieces was always of a similar sophisticated standard. The identification of four cleave-axed worked ends from Structure Tc also shows that there can be variety to how pointed ends are finished, perhaps when larger roundwood needed more work to produce a fine point. Interestingly O'Sullivan (1996) similarly identified cleave-axed ends from the Corlea 9 early Neolithic trackway, also seeing them as being related to roundwood size and reinforces the impression of technological parallels between the two sites. The suggested type specimen artefact <2018.91> from Structure Ta is a very interesting find, and the fact it was produced with only four facets removed demonstrates that the cleave-end technique would seem to produce very sharp and fine stakes, and potentially quite quickly. How much skill is required for such work remains to be established and is explored in **Chapter 8**.

In terms of species selection at Goldcliff, of the 32 sampled artefacts at Site J alder was the dominant species, with hazel and then oak second and third. Useful species such as willow was only found three times and birch just once. Sites E and L also provided two hazel and three alder species artefacts, providing limited further support for the evidence of that species selection from Site J. The species evidence from Site T was even more dramatic in revealing a clear preference for the use of hazel (66%), and to a lesser extent alder

(31%). Only one example of a third wood species was found being either willow or poplar (3%). The overall absence of willow across the Goldcliff sites is notable as it normally it grows well in wetland edge environments (Abbott 1989), as one might expect in the area, although pollen evidence set out by Dark (2007) suggested there may have been a local absence around the island itself. As it is all but absent in the construction of the fish trap structures, it suggests that any available willow was ignored and there were sufficient nearby stands of alder and hazel that provided everything necessary for the builders. Interestingly within the Site T assemblage, there was no clear correlation between the use of wood species and manufacture of large or small roundwood artefacts at Site T. As hazel was used more often it forms the dominate species for use in both large and small pointed ends, but it is certainly not exclusive to one category and alder was used for both artefact types and at all the structures investigated at Site T. The only exception to this being the two artefacts from Structure Ta (east) that were both hazel alone, but with a sample of two from this possible structure we should be wary of drawing any definitive conclusions. Oak was used for all three of the tools that were identified to species from Site J and B, but was not found at all in Site T so this highly useful wood seems to have been avoided in the fish trap structure.

The dominance of hazel and alder as species of choice is also interesting as both can be managed and cut to produce fast growing, straight coppiced rods, and poles. Hazel is of course also well known as a part of the wider Mesolithic subsistence system providing the hazelnuts found charred in large quantities on many sites including Goldcliff (Bell 2007g; Cummings 2017). All recorded worked roundwood was seemingly consistently used in smaller dimensions of 11-20mm (36.5 %), with possible pointed ends from these sites concentrated (46.1%) in the slightly larger 21-30mm range. At Site T, there was a clear division in roundwood size, with small roundwood pointed ends well under 20mm in diameter (on average 11mm, n=13) and large pointed ends well above 21mm in diameter (on average 41.9mm, n=14). For pointed ends there was a slight trend for being towards the larger 51-60mm diameter bracket, although with a relatively small sample of the original full structure this may be an approximate indication of size selection. The clear size division of the Site T roundwood is also to be expected give the structural design of the fish traps as discussed in the sections above.

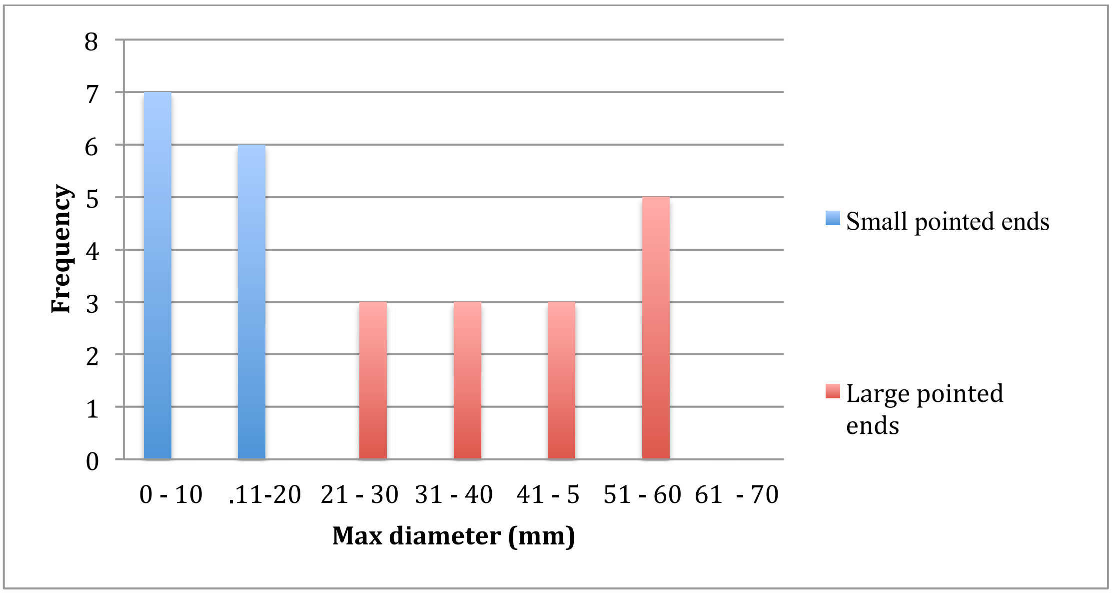


Fig 5.54 The diameter of the Site T roundwood by size and type

There was inadequate further evidence from the Site J, E, L or B assemblages to undertake any secure analysis about woodland management practices. However, the associated clear evidence of environmental burning would suggest Mesolithic people managed the local ecology to their benefit in certain ways and at times of the year (Bell *et al.* 2000; Bell 2007g; Dark 2007). Intentionally producing a source of long straight stems would be a logical addition to such practices, but we must acknowledge it has yet to be clearly demonstrated from these sites. From Site T the morphology of the pointed ends themselves provided limited clear evidence for or against practices such as coppicing and forthcoming work on the growing patterns and ring counts from Site T may help investigation of this aspect (M. Bell pers. comms). Of the roundwood sections to have been lifted from Site T, the surviving parts were normally straight along their length, but as they were often quite short this is not reliable evidence on its own. One caveat to that is the Structure Ta type example <2018.91> had a slightly curved morphology, with grown over knots and central pith that are all characteristics of stems that grow quickly in denser environments such as up and out from a central stool. This could be potentially associated with woodland resource management practices. At present it is the only such clear example of these features in combination from the Site T assemblage. Given it is hazel, a species that lends itself well to being cut back and regrown, it could at least show that at least ad-hoc repeated draw felling or using stems from previously cut hazel stool was part of sourcing suitable long stems for the Site T fish traps even if it were in quite an intermittent system.

Overall, the worked wood artefacts and tools from the sites of J and B are important in Mesolithic studies as they reveal something of the 'missing majority' of potential wooden objects that may have existed in the period. Some may have been ad-hoc tools for perhaps making nets, fishing, or digging, whilst others such as the radially split 'spoon' stirrer, polished bead and fine pin may have been more valuable and curated domestic objects, but perhaps more inconveniently lost by their owners. Site E and L had first presented tentative evidence for activity and possibly fish traps in the palaeochannel (Brunning 2007a), something now conclusively demonstrated by Site T. At Site T itself, we have no evidence for domestic items or tools, but rather the first evidence in the British Mesolithic record of using sophisticated cleaving techniques to produce finely pointed stems that could anchor fishing structures. It is unclear at present if the precise morphology of these cut ends has a particular practical use as a design, but it was noticed by the author that in cross-section they are reminiscent of the metal support spikes for modern large wooden fence posts. Reportedly the reasons that these metal feet are ‘X’ shaped in cross-section is that it provides both less resistance for the driving into sediments and more contact surface area than a simple rounded one to establish the foundation of the post. Whether Mesolithic people had developed this pointed end shape for similar real-world reasons requires further investigation, but we might do well to remember that they likely had an intimate knowledge of their tools, wood species and how to get the best out of local resources. They were of course experts at living in their own environment. The assemblage from Site T certainly shows that they were willing to produce objects that would appear more technological complex than their simple functional purpose of ‘stakes’ for a structure would at first imply. Usefully, the evidence and analysis here of Site T artefacts validates the view set out in **Chapter 3** that structural pointed ends can be a useful resource in the analysis of technological practice and are worthy of being studied as a distinct artefact class in their own right.

Chapter 6. Case Study 2: Sweet and Post tracks, Somerset, England

6.1 Site context

The 'Sweet' and 'Post' trackways in the Somerset Levels represent one of the largest worked wood assemblages excavated from Neolithic Europe, with the Sweet Track described as one of the 'best pieces of pre-fabrication in the Neolithic of western Europe' (Coles & Orme 1984, 109). The Levels has proven to be an important source of prehistoric wood finds, with the 19th century discoveries of sites such as the Neolithic split timber Abbot's Way track (later dated to 2629-2280 cal BC) and 1893 discovery of the Iron Age lake village at Glastonbury (150 BC – 50 AD) first attesting to the preservation potential (Bulleid 1911, 1917; Dymond 1880).

Fig 6.1 Location of the Sweet and post trackways in Britain

The survival of Neolithic aged wood was clearly demonstrated by the discovery of the first worked timbers from what would be identified as the 'Sweet Track' in 1970 in association with Neolithic artefacts (Coles *et al.* 1973). Radiocarbon dating of three worked trackway timbers established a very early Neolithic date of 4048-3927 cal BC (three secure combined dates), an age subsequently sustained by dendrochronology dating of sapwood from worked timbers suggesting the main phase of the construction was dated to 3807/6 BC (Coles *et al.* 1973, Hillam *et al.* 1990, 215). Brunning (2007c) has further suggested that the dendrochronology dates point to an actual construction event in early 3806 BC, with construction in spring of that year after winter water levels had dropped and the weather had improved. During the excavation of the Sweet Track, it also became clear that it was also associated with another earlier phase, with the so-called 'Post Track', dated by dendrochronology from a single ash plank sample <RWX> to 3838 BC (Hillam *et al.* 1990, 215). There are currently no radiocarbon dates associated with the Post Track itself, but if the dendrochronology date is correct it would suggest this trackway is 32-31 years older than the Sweet Track (Brunning 2007c, 146; Hillam *et al.* 1990). Artefacts found at the trackways support the radiocarbon and dendrochronology dating, with *in situ* polished jadeite and flint axes, carinated bowl pottery, and leaf shaped arrowheads attesting to the presence of what is considered as the early Neolithic cultural package in Britain (Coles & Coles 1986; Cummings 2017; Whittle *et al.* 2011a). Brunning (2016, 38) stating this represents 'the most complete representation of Neolithic material culture of any archaeological site in the UK'. Importantly, in terms of the transition debate, it places the Sweet and Post tracks at the very start of first early Neolithic communities in south-west England, and in line with the recent model of Neolithic appearance proposed by Whittle *et al.* (2011b) as discussed in **Chapter 2**.

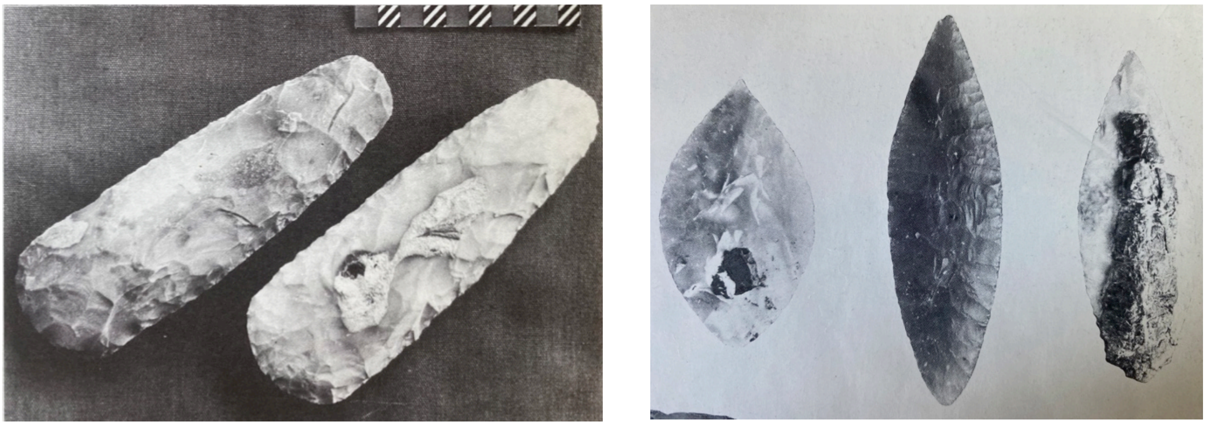


Fig 6.2 Flaked axes (left) and early Neolithic arrowheads (right) from the Sweet Track (Coles & Orme 1979, 60; Coles & Orme 1986, 99)

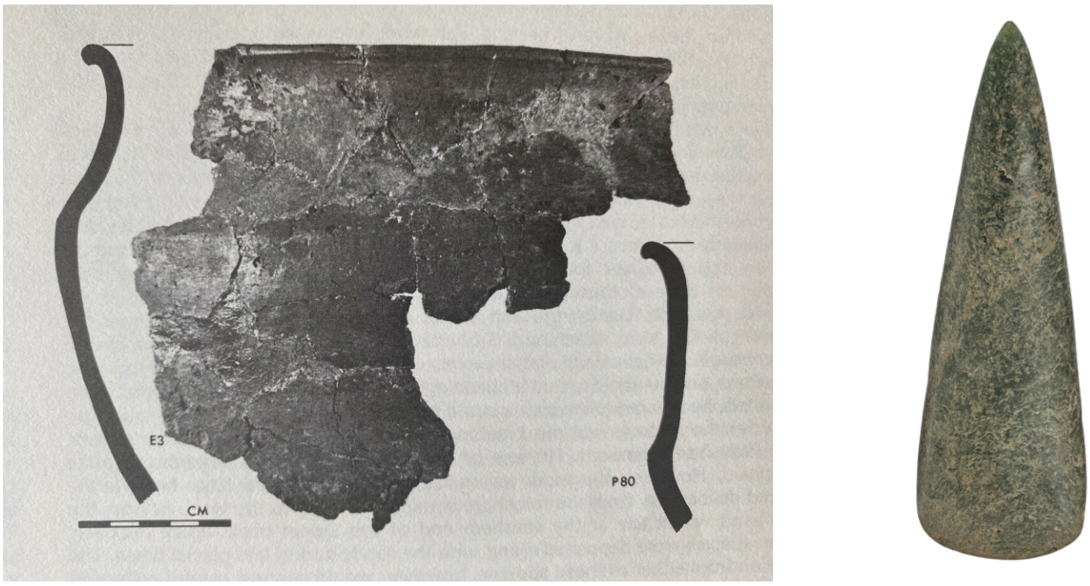


Fig 6.3 Pottery from SWR (right) (Coles & Orme 1976, 63), and jadeite axe from SWR (right) (Museum of Archaeology & Anthropology, Cambridge)

As the importance of the site was recognised it led to the establishment of the long-running Somerset Levels Project (SLP) (1973-1990), which excavated 14 sub-sites along 383m of the track, recovering some 5,877 pieces of worked wood, with 3,500 of those identified to species level and analysis conducted on 1,800 tree-ring samples (Coles *et al.* 1973; Coles & Orme 1976, 1979, 1984; Morgan 1979, 1984). This represents the single largest Neolithic assemblage of woodworking evidence in Britain and a resource of global importance in understanding technology and practice in this period. There has been restricted further direct investigation work conducted since the SLP's work, with a limited 1993 research excavation at the base of the southern Polden Ridge on the Sweet alignment, which revealed oak planks and worked wood at -2OD and was interpreted as possible evidence of the southern terminus of the Sweet Track extending south of Shapwick Burtle (Brunning 1993; Wells *et al.* 1999). Other direct investigation has only been undertaken in the form of small-scale excavations in 1995 to enable monitoring of the water table levels and preservation of the waterlogged wood in the Shapwick Heath National Nature Reserve that again confirmed the general design consistency and alignment of the Sweet Track (Brunning 1995). Recent investigations by Bell (2015, 173) on the Shapwick burtle edge were located some 20m west of the Sweet Track, but usefully helped clarify the scale and chronology of nearby early Neolithic activity and land clearance, along with some evidence for the presence of Mesolithic activity as indicated by charcoal and recovery of a late Mesolithic rod microlith.

Being situated in the Somerset Levels is also important in terms of wider landscape occupation, as the Levels themselves are a significant feature in south-west Britain, encompassing an area of some 650km^2 of low lying, naturally waterlogged, land situated between the topographically higher Quantock Hills to the west, Exmoor to the south and Mendip hills to the east (Coles & Coles 1986). Pollen analysis conducted during the excavation of the Sweet Track placed the structures locally within a waterlogged *Phragmites* reed and sedge marsh environment, and likely effectively submerged during the winter months (Beckett 1979; Coles & Orme 1984). Environment work by the SLP in the wider area suggested the surrounding landscape on higher elevations was one mostly of a dense climax Atlantic forest, but with potential signs of human activity and interference in the landscape possibly beginning to alter the natural tree cover for some 150 years before the Sweet Track was built (Coles & Coles 1986). Recent work based on more sophisticated vegetation modelling by Farrell *et al.* (2019) has complicated this interpretation somewhat, noting that woodland clearings can also be caused by natural processes and not finding specific evidence for this clearance event. Their analysis suggested there was a proportion of roughly 15% of natural background clearings in the immediate Levels and Moors areas, with a smaller c.5% in the wider wildwood landscape (Farrell *et al.* 2019). Their interpretation was that there was no wider significant change from that baseline late Mesolithic era of clearings until after 3,800 cal BC, when the proportion of wildwood clearing appears to double to a modest 10%. The most significant change was between 2,800-2,400 cal BC in the late Neolithic when there was an increase to some 22% of woodland clearings (Farrell *et al.* 2019). If accurate, this casts some doubt on the extent of human interference prior to the construction of the Sweet Track, although it may have occurred in specific areas, and of course whether that was through the activity of culturally Mesolithic or Neolithic groups remains to be established.

6.2 Site nomenclature, definitions, and data

For the purposes of analysis in this work the Sweet Track will often be considered and referred to as one overall single 'site', although in practice the archaeological investigation actually constituted 20 different and separate excavations, or sub-sites, spread across what has been estimated as 2000m of the original trackway (Coles & Coles 1986; Brunning 2007c). Material from the Post Track will normally be separately referred to and defined as such. The first publications on the Sweet Track sub-sites in the 1970s made use of names that denoted their proximity to local features; a nearby peat factory produced the designation 'Factory Site' that was interchangeably used with 'Site F' for example (Coles *et al.* 1973, Coles & Orme 1976). The final system used by the SLP, and following commentators, was based on identifying the most southerly terminus and sub-site as SWA (at the base of the Polden Ridge) and the most northerly as SWZ at Westhay (Coles & Coles 1986, 1990: Brunning 2007c). In this work that basic sub-site nomenclature of the later SLP publications for individual sub-sites has been adopted and continued, with the other earlier terminology of site names related to local features dropped to avoid confusion.

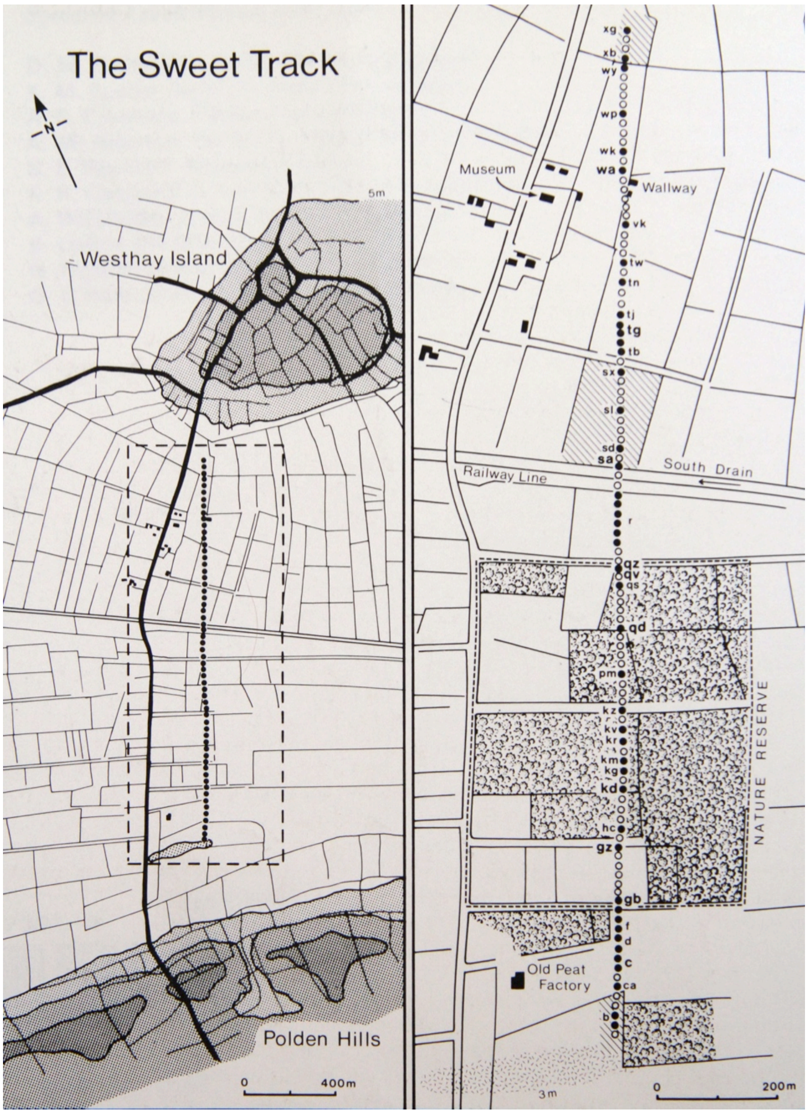


Fig 6.4 The Sweet track location and sub-sites (Coles & Orme 1984, 4)

A second nomenclature requirement was to provide a clear description and definition for the artefact types discussed in the published SLP reports (Coles *et al.* 1973; Coles & Coles 1986; Coles & Orme 1976, 1979, 1981, 1984). For example, the SLP divided pointed ends into categories based on observed functional differences within the site and called them 'pegs'. Within this section analysis has continued to use those distinctions when relevant, but in wider inter-site analysis all Sweet Track pegs will be referred to as pointed ends to provide easily understood comparative information.

Original description Sweet & Post Tracks (Coles *et al.* 1973; Coles & Orme 1984)	**Definition in this work**
Rail peg	Pointed roundwood driven in obliquely to hold rails and provide base for planks.
Plank peg	Pointed roundwood driven in vertically to hold planks in place, both in mortices, on top and sometimes alongside planks.
Other peg	Pointed roundwood with peg dimensions found unused along the trackway and or used as pegs but not clearly worked.
Post	Pointed roundwood driven in vertically and seen to be separate to Sweet Track, interpreted as main constituent of Post Track. Function unknown.
Plank	Radially and tangentially split timbers providing track walkway.
Rail	Long timbers place end to end as foundation of track.
Transverse	Timber horizontal and at right angle to track.
Board	Short pieces of planking not obviously related to either trackway, often with carefully shaped ends and notches. Function unknown.
Slat/sliver	Small pieces of wood, some from woodworking, some from disintegrated planks and rails.
Chip	Small pieces of wood produced by woodworking
Stray branches	Torn or chopped branch ends of irregular shape, assumed to be track manufacture debris.

Table 6.1 The structural worked wood definitions used by the SLP and in this work

Of the two trackway assemblages, it was clear through study of the dataset that the Sweet Track currently offers by far the most substantial, as well as better investigated and understood, assemblage; with secure dendrochronology and radiocarbon dating, extensive evidence for woodworking techniques at specific moment in time. It also provides a well dated southern British *terminus post quem* for specific find types including wooden tools, pottery forms, worked flint, flaked axe types, possible children's toys, yew pins and finally even direct evidence for long-distance cultural exchanges with exceptional finds like the polished jadeite axe sourced from the Alps (Coles *et al.* 1973; Coles & Orme 1976, 1979, 1981, 1984). Given the level of detail and extent of the Sweet Track assemblage it was primarily relied upon in this chapter's subsequent analysis, with comparison of the Post Track worked wood made where possible and appropriate.

The very timely publication of excavations in the *Somerset Levels Papers* (often just a year or two after excavation finished), means this continues to form the most accessible resource for detailed analysis and published data available on the sites, with the original primary data still being in the project archive in the Somerset Heritage Centre, Taunton, (Coles *et al.* 1973; Coles & Orme 1976, 1979, 1981, 1984). A site overview was provided in the public orientated multi-period publication *Sweet Track to Glastonbury* (1986), although there was limited specific discussion of woodworking techniques and species selection, thus allowing these topics to be usefully investigated in more detail in this work.

6.3 Trackway design

The Sweet Track was built in a systematic format on a largely repeatable design using a long rail or pole laid on the surface of the marsh with oblique 'rail pegs' driven in on either side to hold the rail beneath the cross of the pegs (Coles *et al.* 1973, Coles & Orme 1976, 1979, 1984).

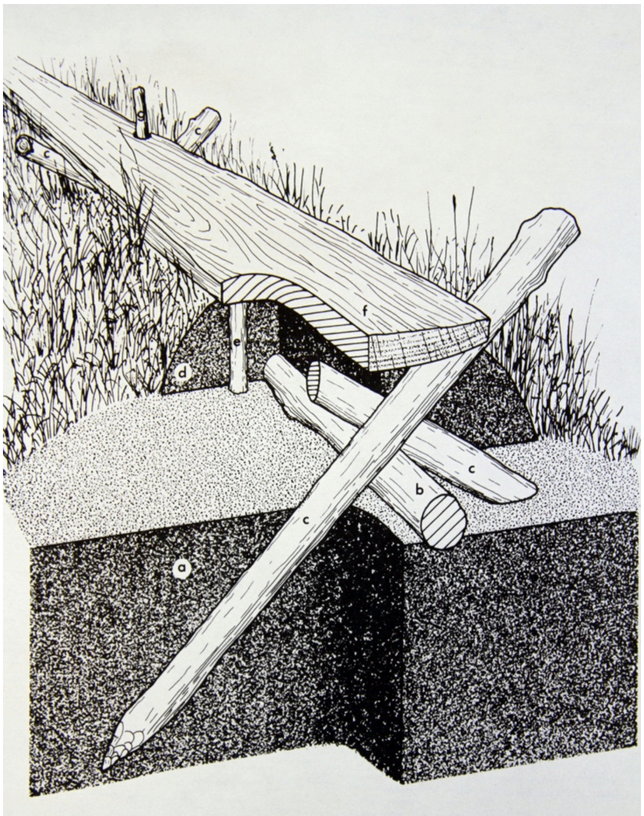


Fig 6.5 (left): Reconstruction drawing of the typical Sweet Track design by the SLP, with (a) underlying peat, (b) foundation rail, (c) rail pegs to hold it place and support walkway plank, (d) occasional use of peat packing, (e) supporting plank peg with resting plank above (f) plank, (g) plank peg through cut notch to hold plank in place (Coles & Orme 1976, 39)

Fig 6.6 (right): Reconstruction of Sweet Track when in use by E.Mortlemans (from Brunning 2016, 38)

Split planks then rested onto the crossed rail pegs, giving some 40cm of raised walkway above the average waterlogged level of the marsh. Peat packing was used for additional stability on occasion (clearly seen as cut blocks at SWR), although the excavators noted the evidence was varied and not always possible to identify so was perhaps used only as the situation required (Coles *et al.* 1973, Coles & Orme 1976, 1979, 1984).

Fig 6.7 Sweet Track at SWR showing something of how it appeared originally (Coles & Coles 1986, 96), and SWWA (right), with no in situ planks in this area (Coles & Orme 1984, 41)

The planks themselves were found to abut end to end in a line, creating a continuous raised narrow flat gangway that allowed for easy movement through the marshland (Coles *et al.* 1973). To aid in stabilising the planks, vertical ‘rail pegs’ were often driven through pre-prepared notches in the planks. On some occasions these vertical pegs were driven in first with the plank resting on a shallow notch on its downward side. Notably there was little use of brushwood or branches to support the structure, a design technique used in many of the other Neolithic trackways in the Somerset Levels (Bell 2020; Brunning 2007c; Coles & Coles 1986). The builders did deviate from this general form as required, with occasional transverse timbers lain down first to perhaps stabilise particularly wet areas such as at SWR, older bog oaks used at SWA and SWB, and some spreads of chopped roundwood at SWC (Coles *et al.* 1973; Coles & Orme 1976; Wells *et al.* 1999). The relationship of some aspects such as the large number of oak ‘boards’ at sites such as SWF (**n=30**) seemingly without a connection to Sweet Track remains an interesting anomaly, with the excavators suggesting the possibility of them being washed in from elsewhere and thus representing the remains of other unknown nearby structures (Coles *et al.* 1973, Coles & Orme 1976). Neither the north or south terminus of the trackway has been conclusively identified nor investigated, with some limited post-SLP work carried out in the area of the potential southern terminus identifying oak timbers on the probable alignment of the trackway (Brunning 1993, 1995; Wells *et al.* 1999).

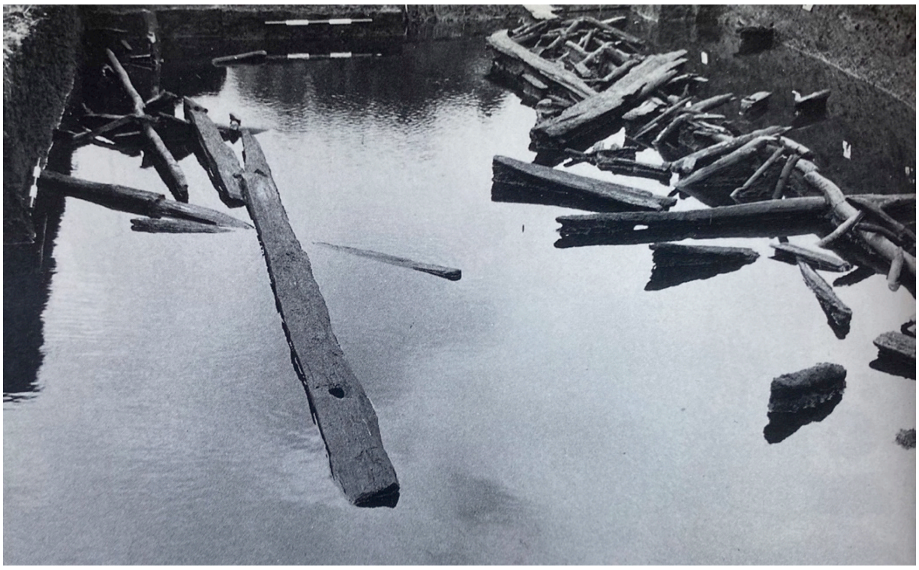


Fig 6.8 Sweet Track at SWR to the right in picture, the remains of ash and lime planks of the Post Track on the left in image. The two trackways are clearly separated by several metres at this point (Coles & Coles 1986, 98)

The most recognisable aspect of the Post Track were its substantial, normally 2-3m in length, posts that had been driven and hammered into the underlying marine clay, sometimes up to 1.5m deep and buckled by the driving force (Coles *et al.* 1973, 271). Projecting no more than 450mm above the plank level of the Sweet Track, the initial interpretation was that these had been driven in deeply to provide secure and immoveable anchor points in the reedswamp during the Sweet Track construction (Coles *et al.* 1973). However, further work revealed they had no clear relationship with the Sweet Track, as on occasion that track was built over the posts as at SWF, whereas at SWR the posts and Post Track was found to either side of the straight Sweet Track making a more meandering passage across the wetlands. Driving such large posts through the peat and into the clay was of course a substantial undertaking, and it would suggest they had a clear and defined purpose, although exactly what that was remains to be fully understood and their function remains enigmatic.

Apart from the diagnostic posts, Post Track elements such as rails or any pegs were reportedly often not easily distinguished in excavation from those of the Sweet Track and thereby not easily attributed to each track (Coles & Orme 1984). Only at some sub-sites such as SWR was its form and separate identity clear (see Fig 6.8), as here it constituted of long roughly worked planks and rails of ash or lime lying on the marsh surface between posts that were spaced every 3-4m along its length. When clearly identified the Post Track planks reportedly appeared to be longer, heavier, thicker, and more roughly worked (Coles & Orme 1984). Perhaps more importantly, planks and rails were placed on an alignment with the posts but not obviously attached to them, with the impression being one of a simple, temporary, alignment of timbers across the wetlands (Coles & Orme 1976, 1979, 1984). However, at SWD there was tentative identification of rails, pegs and posts all *in situ* that did not appear to be associated with the Sweet Track, along with a line of low rail pegs to the east of the Sweet Track that may have originally come from an earlier trackway (Coles & Orme 1979). There was also similar speculative evidence at SWR (at 100m) of a number of peg-like objects not from the Sweet Track but still *in situ*, perhaps again indicating a previous structure was present and dismantled in antiquity with some parts recycled into the Sweet Track and other objects displaced and lying abandoned (Coles & Orme 1976).

Fig 6.9 Section of the track at SWWA 4-6m with a rail from split timber and heap of dislodged wood. Pottery was found in this area (Coles & Orme 1984, 16)

6.4 Site interpretation

The overall purpose of the Sweet and Post tracks appears to be fairly clear, built on a north-south alignment they facilitated passage though low-lying waterlogged *Phragmites* reedswamp between the Polden Ridge to the south and Westhay paleo-island to the north (Coles *et al.* 1973; Coles & Coles 1986; Brunning 2007c). Both tracks followed the same general line between the Polden hills and Westhay, but the Post appears to have taken a more simple and quick route, avoiding problem areas or very wet patches. The Sweet Track was then subsequently built with a very straight alignment, in places directly over the top of the Post Track (at SWF) and at others only following its general path but maintaining its own very straight design (at SWR). In most areas the Sweet Track effectively consumed Post Track timbers, but on rare occasions the two trackways were both clearly separate and Post Track parts left *in situ* (Coles & Orme 1976, 1979, 1984). Functionally, the interpretation of the Post Track has varied from seeing it initially as a simply a preliminary 'exploratory track' that took the path of least resistance, with its more meandering path across the wetland (Coles & Orme 1976, 39), perhaps 'never more than a preliminary marking-out line and base from which to build the walkway' (Coles & Coles 1986, 47). A final view of the excavators was that it was a 'working stage for the building of the latter [Sweet Track]' and thus they suggested that the timbers felled decades earlier may simply have 'lay wet in the swamp for 31 years' or come from an older dismantled building or possibly wood store reused in 3807/6 BC (Coles & Coles 1990, 217). Evidence such as notches and holes on planks at SWF without apparent purpose in either trackway was cited as possible evidence of this (Coles *et al.* 1973). At SWTG chopped up planks used as pegs, or 'board pegs', also exhibited notches and perforations without obvious relationship to the Sweet Track, again suggestive they came from another structure (Coles & Orme 1984). If correct, this could make some of the trackway timbers potentially very important as they may contain timbers from other demolished very early Neolithic structures.

Fig 6.10 SWR site with Sweet Track material to the left and long, thick, Post Track plank to the right of image (Coles & Coles 1986, 97)

In terms of chronological relationship, the Post Track timbers were found to variously lie underneath by 'a few centimetres', sometimes alongside and on occasion reused within the later Sweet Track (Coles & Coles 1986). Importantly, when still *in situ*, they clearly preceded the Sweet Track as illustrated by rail pegs driven against Post Track posts at SWF or Sweet Track timbers over rails of the structure SWR (Coles *et al.* 1973; Coles & Orme 1976, 39). Evidence at SWR (between 10.5m-11m) of a lime rail directly under a Sweet rail with a rail peg driven between the two would suggest that the Sweet Track builders could also see the other structure and use it or avoid as necessary (Coles & Orme 1976). Direct dendrochronology results by Hillam *et al.* (1990) subsequently suggested that there were at least some timber planks, and possibly an earlier trackway structure, that pre-dated the Sweet Track by several decades dating to 3838 BC. Analysis by Brunning (2007c) also has emphasised these results to suggest that at least two distinct structures existed, separated by several decades. However, further complexity in the felling date, although not necessarily the build date, of worked wood has been illustrated by Morgan's (1976, 76) original floating tree-ring results. For example, from a sample of 57 Sweet Track ash pegs most were cut in arbitrary year '29' which likely corresponds to the 3807/6 BC main felling event. However, 18 (31% of her sample) were cut 11 years earlier and a further unspecified, but 'few', individuals scattered between these two main cutting events (i.e., variously cut over 11 year period). Of an alder peg sample (n=28) she analysed only 10 (35.7%) were felled in the arbitrary year '29' (i.e., 3807/6 BC) the rest also scattered over the previous 12 years. At site SWTG roundwood stem <SWTG260> was felled 14 years earlier. Roughly a third of a hazel roundwood sample (sample total n=62) was felled at different times, seven a few years either before, and 13 after the supposed main 'event' of floating hazel age '42' that most likely again represents 3807/6 BC (Morgan 1984, 56). Another 14 matching tree-ring samples from roundwood from SWD and SWR were felled at different times over the course of 10 years – the sample included both posts and pegs from the Post Track (n=5) and Sweet Track timbers (n=7), illustrating again that a significant portion of the roundwood from both tracks was felled over the course of decade before the main build (Morgan 1979). Finally, a sample (n=34) of different roundwood species with matching tree-rings suggested that while most were felled in the same year (highly likely to be the 3807/6 main event) at least five pegs were cut and used several years after at sub-sites, with one at SWR (2 years later), one at SWQV (seven years later), one at SWQZ (eight and nine years later) and one at SWWA (three years later) (Morgan 1984). The clear impression from these results is that in all roundwood tree-rings samples analysed there was evidence of one main felling event, but also other events spread across some 10 years before and after the main 'event' and probable Sweet Track build date. This indicates that the wood felling and build date are not necessarily the same, and roundwood was not all felled in one simultaneous event as seems commonly reported in the wider literature.

Arguably even more interestingly, tree-ring analysis of the Post Track posts by Morgan (1979, 1984) raised the possibility that the majority of these may actually have been felled at the same time as the main timbers of the Sweet Track. Supporting this view are excavation notes recording posts as being still surrounded by multiple well preserved associated wood chips all at the same stratigraphic level as the Sweet Track rails (<SWRB64>, Box 1, SLP archive Taunton), which seems somewhat improbable if they had lain exposed for three decades before the Sweet Track was built. As these posts are undated by radiocarbon or dendrochronology, this interpretation cannot not be properly further assessed and potentially Morgan's cross-matching different species may have caused problems in her analysis. But it should be allowed that there is good evidence for more complexity to the trackway and timber felling dates and lifecycle of timbers, possibly suggesting at least several phases such as:

(i) First the dismantling and reuse of terrestrial or other unknown structures.

(ii) Then an alignment built in 3838 BC (i.e., Post Track I).

(iii) Next possibly a line of large vertical posts placed in 3807/6 BC (i.e., Post Track II).

(iv) Construction of the main Sweet Track structure in 3807/6 BC.

(v) Renewal and repair of planks and roundwood in the Sweet Track structure up to 10 years afterwards, illustrated by finds of a later hazel peg physically forced through a decayed holly rail at 13-15m at SWF (Coles *et al.* 1973, 269) and two new ash planks at SWTG introduced up to seven years later (Morgan 1984).

In terms of duration of use, differentiation vertical preservation levels amongst the excavated worked wood suggested that the water level was approximately rail height for much of the year, but likely submerged on occasion by seasonal flooding (higher *in situ* planks badly degraded, dislodged and lower items better preserved for example) (Coles *et al.* 1973, 271). The consistent discovery of small finds at rail level would suggest this was the basic surface level of the marsh prior to peat build up and eventual covering of the trackway (Coles *et al.* 1973). Dislodged planks also ended up on this level and would suggest that the track did not function for very long before it started to fall apart and was then engulfed by new peat (Coles & Coles 1986). It is also clear that overall, the track must have been fairly quickly inundated and covered by peat to arrest any significant deterioration of the main timbers and thus ensure its long-term survival in such an excellent state of preservation (Coles *et al.* 1973; Coles & Orme 1976, 1979, 1984). This also seems to be the case for the Post Track posts, which were found to be well preserved at SWD indicating rapid burial (Coles & Orme 1979).

To understand its use, Brunning (2007c, 2016) cited the two examples of modern experimental archaeology work building replicas of the Sweet Track in the Shapwick Nature National Reserve that supported this apparent short life of the structure. After construction these were seen to last as little as four and no more than 12 years when subject to the elements, some mild use and natural irregular periods of wetting and drying throughout the seasons (Brunning 2007c, 148). In particular the noted failure of the oblique hazel rail pegs was cited as a clear design weakness of the trackway, as these slowly rotted and broke, allowing the planks to dislodge and also proved problematic to repair in the same place as it was difficult to drive new stake into a place with the snapped end already *in situ*.

Fig 6.11 Reconstruction of the Sweet Track in 1991 (Somerset HER Image 10777, Photo by Somerset County Council September 1991)

This is an interesting observation, suggesting vertically driven piles are perhaps a better long-term durable solution, as some of the Post Track posts at SWC were found still ‘hard’ and ‘firm’ in condition compared with rails, planks and pegs when excavated (Site notebook, Box 4, SLP archive Taunton). Brunning (2007c) also suggested that this design fault may have been so severe as to have led to the total abandonment of the structure as simply ‘not worth the effort’ (Brunning 2007c, 148). Evidence of rail peg tops ‘broken in antiquity’ at SWR would support this view that the trackway did not actually hold up very well to the elements or use in its short life (Coles & Orme 1976, 43). The experimental work would suggest that the design was arguably over-engineered, and even a slightly misguided solution to the local conditions, which perhaps indicates that while the builders had considerable woodworking knowledge their ability to design the right structures to last in wetlands was more limited.

The main importance of considering these complex site phases, palimpsest of activity, and possible inherent design flaws is that it offers a very rare window into the earliest Neolithic activity in south-west Britain from the perspective of organic material culture. If the first and last phases of the site are indeed chronologically decades apart it pushes yet further back the evidence for Neolithic cultural practices in south-west England by a significant number of decades in terms of the transition debate set out in **Chapter 2**. If there was then multiple phases of felling, construction, renewal, and reuse of timber from other structures it then hints at scale and intensity of wider Neolithic activity and occupation in the landscape. And finally, if the actual design of this substantial structure was poorly conceived it asks the question why a community able to work wood in sophisticated ways apparently had little understanding of how to build structures in wetland environments? Temptingly, given the wider context of new arriving early Neolithic settlement at the time, we might possibly speculate that such design flaws might illustrate that the builders were relative newcomers and novices to these specific type of locations.

6.5 Worked wood assemblage and species sample selection

Given the importance of the Sweet Track to our knowledge of early Neolithic woodworking, a preliminary methodological issue for this work was to determine how the worked wood assemblage itself could be studied and what the appropriate sample for the research objectives set out in **Chapter 1**. This proved to be more complex than originally envisioned, as preliminary analysis revealed that not all the sub-sites had been excavated in the same way, recorded to similar levels of detail, or artefacts preserved to the same degree. In total 395m of the track's length across 20 different sub-sites from the southern terminus at SWA to the most northerly site, SWWA, have been excavated between 1970 and 1995 (Brunning 1993, 1995; Coles *et al.* 1973; Coles & Orme 1976, 1979, 1981, 1984; Wells *et al.* 1999). During the 1970-80s period of SLP investigation, worked wood was normally universally excavated and lifted at sites (including SWB, SWD, SWF, SWR, SWSA, SWTG, SWWA), though on occasion sites were excavated but not all artefacts lifted (SWQD, SWQV and SWQZ). At three SLP excavations, SWGB, SWGZ, SWKD, no items were lifted, with worked wood only recorded and planned. The post-SLP work in 1993 at the potential southern terminus (SWA), and the small-scale 1995 excavations (SWGR, SWKP, SWPU and SWQF) only produced site plans and photographic record with no items lifted or sampled (Brunning 1993, 1995; Wells *et al.* 1999).

Site	**SWB[1]**	**SWC[2]**	**SWD[3]**	**SWF[1]***	**SWGB[2]**	**SWGZ[2]**	**SWKD[2]**	**SWQD[2]**	**SWQV[2]**	**SWQZ[2]**	**SWR1[4]**	**SWR2[4]**	**SWSA[2]**	**SWTG[2]**	**SWWA[2]**	**Total**
Date excavated	1971-72	1982	1977	1970-72	1981	1981	1981	1981	1981	1982	1971-75	1971-75	1979	1981	1982	n/a
Type of excavation	Full	Full	Full	Full	Planned & sampled	Planned & sampled	Planned & sampled	Full	Full	Full	Full	Full (partially published)	Full	Full	Full	n/a
Length excavated (m)	26	19.25	51	56	2	2	1.5	2.75	3.5	10.5	48	83.5	8	59	10	383
No. worked wood artefacts identified (all types)	18	626	668	762	50	50	102	64	100	155	455	1441	90	1126	170	5877

Table 6.2 The SLP Sweet Track sub-sites and total excavated worked wood assemblage, from south to north (published numbers)

*Numbers without Post Track posts, but possibly including some elements (rails etc) that cannot be separated from the available published material.
[1]Coles *et al.* (1973); [2]Coles & Orme (1984); [3]Coles & Orme (1979); [4]Coles & Orme (1976)

Given this variation in the type of investigation only sites with lifted artefacts and species identification samples could offer useful woodworking data for the purposes of this work. Although, it is perhaps worth noting that the identification of the trackway in the smaller later excavations did usefully illustrate the stable alignment, design consistency and impressive scale of the Sweet Track. Of the sites subject to full excavation a combination of reference to original SLP excavation sheets, individual item photographs or examination of the extant conserved artefacts themselves was all undertaken. The two sub-sites with the best written records and highest percentage of conserved artefacts were found to be SWD and SWTG, and these provide the clearest picture of variation in woodworking techniques and species selection from defined sub-sites. The Post Track was clearly identified at SWC, SWD, SWF, SWQZ and SWR by the SLP, although the numbers of recognised and published Post Track pieces (n=82) were significantly smaller than the Sweet Track, with most of those comprising the diagnostic large posts (n=60, 82%). This reflects a combination of factors including general problems in clearly identifying the Post Track, particularly in the early stages of the project when the difference between the two trackways went unrecognised at the initial excavation at SWF (Coles *et al.* 1973). As a result, this work has mainly relied on data from the posts of that trackway, as there are many outstanding problems in the analysis and identification of the wider Post Track beyond the scope or needs of this study as discussed in previous sections.

It is also worth noting here some particular problems with the Sweet Track excavated assemblage that may warrant future work outside this study. In the case of sub-site SWR the published report only provides detailed information on two sections from the whole site excavated; 0-24m and 48-72m, from a total excavated length of 131.5m of SWR (Coles & Orme, 1976, 34). Analysis in this work has relied on the published data, such as species selection, with the author deciding to give the fully published section of this sub-site the prefix of 'SWR1' when it is necessary to distinguish between the two, with the unpublished section referred to as 'SWR2'. Work in the project archive by the author also suggested that useful species selection dates and possibly records of utilised wooden artefacts in this section exists and is unpublished, but accessing this information was very time consuming and further investigation was considered beyond the needs and scope of this work. It is also perhaps worth mentioning that at 83.5m long this missing section SWR2 represents the largest single sub-site from the entire Sweet Track and some 21.1% of all the track excavated. This is longer on its own than any other excavated Neolithic wooden structure in Britain. As such full, and complete, publication and analysis of this this section would seem a worthy future endeavour outside of this work.

In terms of the objects selected for conservation it is also important to note that analysis of the archive showed their survival and preservation was a subjective process, with items selected for a variety of reasons including their interesting individual morphology, condition on excavation, location within the sub-site and even availability of funds for conservation (Coles & Orme 1984). For example, at sites SWB and SWF (excavated in 1970-72), worked wood was sampled for species but only a very limited number of track pieces were conserved, and not even all the 'equipment' or finished artefacts (Coles 1979; Coles *et al.* 1973, 257). By the last period of SLP excavation (1981-1982) the quantity of conserved pieces had all substantially increased, though sadly even during this last period of full investigation the excavation team lamented the necessity '*to discard such quantities of Neolithic wood is a regrettable one, but conservation is a lengthy and expensive process and thus only a small proportion of the worked wood can be saved from any site'* (Coles & Orme 1984, 9). Coles (1979) explained that those selected for conservation, especially from the early excavations, were thus determined by features such as workmanship, size, character and most vitally condition, all constrained by cost, space, and time during excavation. He compared this reduced, limited sample, to the 19th century method of keeping the flint axes at the expense of flakes and chips – undoubtedly problematic but the only method available to the SLP at the time (Coles 1979, 36). In this way the direct measurement and statistical analysis of these conserved artefacts as a research avenue is thus necessarily limited by bias in samples preserved and the vagaries of what was conserved by the SLP across all the excavated sites over the course of 12 years of investigation.

6.5.1 Sample size, selection, and analysis methodology

Given the large size of the original Sweet Track as described above it raised the question of what proportion of the original structure and investigated area can now be analysed? Coles & Coles (1986) have estimated that the original trackway was approximately 2000m in length, with 383m of this investigated by the SLP, equating to 19.2% of the original. The number of structural worked wood artefacts of all types excavated by the SLP was 5,877, of which there were 108 planks and 139 rails. Concentrating on the pointed ends alone, Coles & Orme (1984, 13) originally suggested that the original Sweet Track used 6000 pegs, equating to 3−4 pegs per metre based on the number of rail pegs found at sub-sites SWC, SWQZ, SWTG and SWWA. Of this original number, some 1,073 pegs were excavated by the SLP, which equates to 17.8% of the original number and is in rough agreement to the estimated proportion of the trackway excavated at 19.2%. Overall, this effectively means nearly a fifth of the Sweet Track has been comprehensively investigated and as sampling occurred at multiple separate points along its length, largely finding it to have the same design in each case (Coles *et al.* 1973: Coles & Orme 196, 1979, 1984; Coles & Coles 1986), this provides a good representation of the overall build, working methods and wood materials used in the structure.

Type	Number of original pieces in trackway	Number of pieces excavated & published	% excavated of est. original	Number of pieces held in Taunton archive	Number of artefacts analysed in this work	% of original
Pointed end assemblage (plank & rail pegs)	6000 (estimated)	1073	17.8	326	108 (no. accessed in the archive)	1.8
Pointed end from Post Track	667 (estimated)	60	8.9	16	10 (no. accessed in the archive)	1.5
Worked wood identified to species sample*	c. 29,385 (estimated)	5,877	20	n/a	3,411 (no. identified to species by SLP)	11.6
Tree ring analysis sample*	c. 29,385 (estimated)	5,877	20	n/a	1,800 (no. analysed for tree ring data by SLP)	6.1
Pointed ends identified to species*	6000 (estimated)	1073	17.8	326	962 (no. identified to species by SLP)	12
Post of the Post Track identified to species*	667 (estimated)	60	8.9	n/a	60 (no. identified to species SLP)	8.9

*Published data from Coles et al. (1973), Coles & Orme (1976, 1979, 1984) and Coles & Coles (1986).

Table 6.3 Breakdown of the sample types used in this work against the estimated original numbers and percentages

Of the worked wood objects excavated by the SLP, 634 have been conserved and are now held at the Taunton archive. The largest type of worked wood artefact in the collection is the 310 rail and planks ‘pegs’, with a further 16 posts of the Post Track. Subsequent analysis of this excavated Sweet Track worked wood proved to be limited by the physical access to artefacts in the archive. Time limitations in the archive meant not every single conserved artefact could be examined, as these were spread over many hundreds of large wooden boxes with the author only able to order 20 boxes for any one visit. Such problems were then exacerbated by the fact that boxes might only hold as little as two or three objects, and on ordering any single box it proved difficult to assess desired individual items as often the objects in archive boxes did not match those artefacts listed in the museum archive list. In real terms this mean that while objects of different types were investigated when possible, the most numerous artefacts that almost always appeared in boxes were pointed ends and these proved to be the most practical artefact type to assess and record. These pointed ends were selected on the basis on what actually was in the boxes, itself after the process of conservation selection by the SLP detailed above means that the studied sample of pointed ends is subject to the limitations of first survival, then selection and finally access. 10 repeat trips to the archive did allow for the study of 108 pointed end objects spread across the range of Sweet Track sub-sites. While this is a considerable number of individual objects, realistically this constitutes an indicative sample to show variability in types of woodworking rather than perhaps a statistically robust sample size in its own right. During analysis of this sample, it subsequently became clear that given the time constraints in the archive the most productive form of data collection was likely to be measurement of pointed end morphologies and toolmark dimensions. This was undertaken within the protocols set out in **Chapter 4**, with the aim of producing a comparative dataset to the material analysed from Goldcliff East in order to compare the roundwood working techniques between the two sites.

In terms of other types of wood analysis data, 3,411 of the 5,877 excavated Sweet Track items of worked wood were identified to species level by the SLP and 1,800 of those samples subject to tree-ring analysis. For the original pointed end assemblage as a type, 962 artefacts were identified to wood species by the SLP, which represents a substantial 12.0% sample of the total plank and rail peg assemblage. For the Post Track, 60 posts were recorded, lifted and identified to species by the SLP over a 216.5m length recognised to be from that track. Coles *et al.* (1973) and Coles & Orme (1976) suggested that posts were on average placed every three metres apart. At that spacing, and assuming the Post Track largely follows the 2000m line of the Sweet Track, then this would represent a robust sample of 8.9% (if c.667 posts were originally used) of the original assemblage. 10 Post Track posts were available for study in the archive and subject to physical analysis in this work, which is arguably useful as a sample illustrating working variability but perhaps not one that should be considered statistically objective on its own.

6.6 Finished portable wood objects

Analysis of portable wooden objects in this work was primarily reliant on the published accounts of the artefacts. Given the methodological issues set out at the start of this chapter it was going to be a difficult and very time-consuming process to try and physically access and investigate these objects in person. The majority of the portable wooden finds from the Sweet Track originated from the central sub-sites of SWF and SWR (Coles et al. 1973; Coles & Orme 1976). Coles & Coles (1986), Bond (2004) and Brunning (2007c, 2016) have speculated that this may reflect specific cultural activities related to deposition of artefacts in these central areas. It is true that of the 59 portable wood finds recovered, only four came from outside of these two sites, two from SWD (itself adjacent to SWF), and two from northerly SWTG. One caveat to this view is that it is also worth noting that these were the two largest areas excavated by the SLP, and at 187.5m long in combination, represents 49.0% of the all the trackway excavated so it is possible other portable wooden artefact rich areas still await investigation. However, overall, the apparent density of finds in the centre trackway supports the view that there was some form of intentional activity going on in these areas leading to these finds finding their way to the marsh floor.

Find Site	Find type	Species	Quantity	Source
SWD	Tomahawk or toy axe	Oak	1	Coles & Orme (1979)
SWD	Knife (possible)	Unspecified	1	Coles & Orme (1979)
SWF	Spear	Hazel	1	Coles *et al.* (1973)
SWF	Bow (part)	Hazel (3)	3	Coles *et al.* (1973); Coles & Coles (1986)

SWF	Club or mattock	Holly	1	Coles *et al.* (1973)
SWF	Paddle	Oak (3)	3	Coles *et al.* (1973)
SWF	Shaped stick (function uncertain)	Oak (2), hazel (1)	3	Coles *et al.* (1973)
SWF	Pointed tool	Oak (3), ash (1)	4	Coles *et al.* (1973)
SWF	Point with shaped handles	Oak (1)	4	Coles *et al.* (1973)
SWF	Awls	Oak (1)	2	Coles *et al.* (1973)
SWF	Pin	Yew (2)	2	Coles *et al.* (1973)
SWF	Knife	Hazel	1	Coles *et al.* (1973)
SWF	Polishers	Unspecified	3	Coles *et al.* (1973)
SWF	Toggle	Hazel (2)	2	Coles *et al.* (1973)
SWF	Notched slat	Hazel (2)	2	Coles *et al.* (1973)
SWF	Wedge	Hazel (1)	2	Coles *et al.* (1973)
SWF	Arrow shafts	Hazel (2)	2	Coles *et al.* (1973)
SWF	Funnel	Oak	1	Coles *et al.* (1973)
SWF	Dish or box	Oak	1	Coles *et al.* (1973)
SWR	Spoon or stirrer (carbonised)	Hazel/alder	1	Coles *et al.* (1973)
SWR	Pin	Yew (2)	2	Coles *et al.* (1973)
SWR	Notched slat	Unspecified	1	Cole & Orme (1976)
SWR	Haft (for flint insert)	Unspecified	1	Cole & Orme (1976)
SWR	Pointed tool	Unspecified	8	Cole & Orme (1976)
SWR	Toggle (double notched)	Unspecified	1	Cole & Orme (1976)
SWR	Arrowhead (possible, charred)	Unspecified	1	Cole & Orme (1976)
SWR	Comb	Unspecified	1	Cole & Orme (1976)
SWR	Wedge	Unspecified	2	Cole & Orme (1976)
SWTG	Pin	Yew	1	Coles & Orme (1984)
SWTG	Bow (possibly child's toy)	Hazel	1	Coles & Orme (1984); Coles & Coles (1986)
		Total no.	**59**	

Table 6.4 Worked wood finished or portable objects from the Sweet Track. Find type and species set out by SLP publications, with find numbers not published at the time.

Site SWF was the most productive area for portable objects, with 37 objects including items such as spear, bow parts, club or mattock, possible paddles, arrow shafts, knife, oak funnel and oak box or dish (Coles *et al.* 1973). Coles & Coles (1986, 62) even speculated that the box may have been the container for the flaked flint axes found nearby. There were also a number of objects at SWF of uncertain function, shaped pieces with points or apparent handles that had unclear roles but may have even had uses in the build of the trackway itself. There were also objects with more domestic functions such as toggles, polishers, and perhaps most interestingly two yew finely worked pins. Five such yew pins were ultimately recovered from the site as a whole, a further two at SWR and one at SWTG (Coles & Orme 1976, 1984). Coles & Coles (1986) speculated that these pins were likely a personal object, perhaps used as adornment or to fix clothing, having clearly been carefully shaped and polished. Other notable finds were the carbonised spoon or stirrer found at SWR in associated with a broken pot and hazelnuts, as well as examples of very rare potential children’s ‘toys’ with a wood ‘tomahawk’ at SWD and a small 100cm long hazel bow at SWTG split from a piece of roundwood and carefully fashioned in the shape of a bow (Coles & Orme 1976, 1979, 1984). Although possibly these could be some form of ritual offerings instead (Brunning 2014).

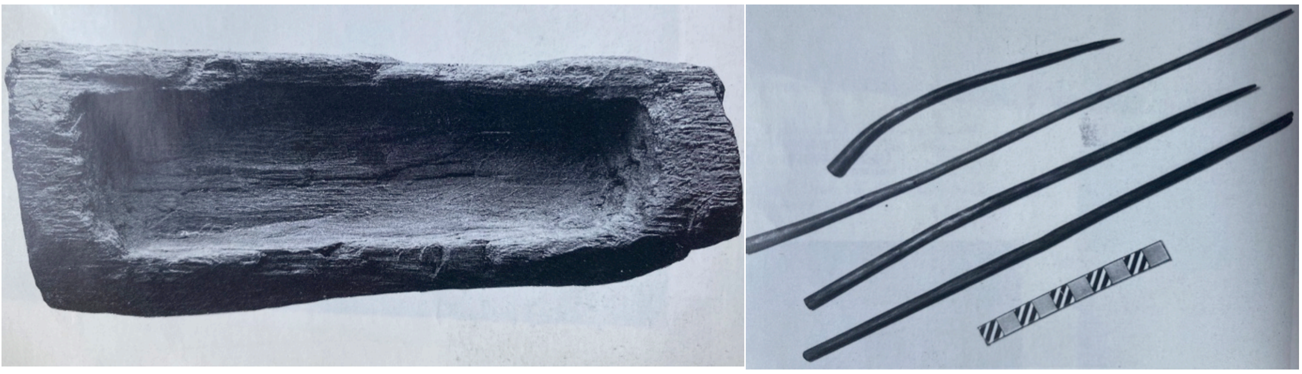


Fig 6.12 Oak box SWF (left) and the Yew pins from SWF and SWR (right)(Coles & Coles 1984, 100)

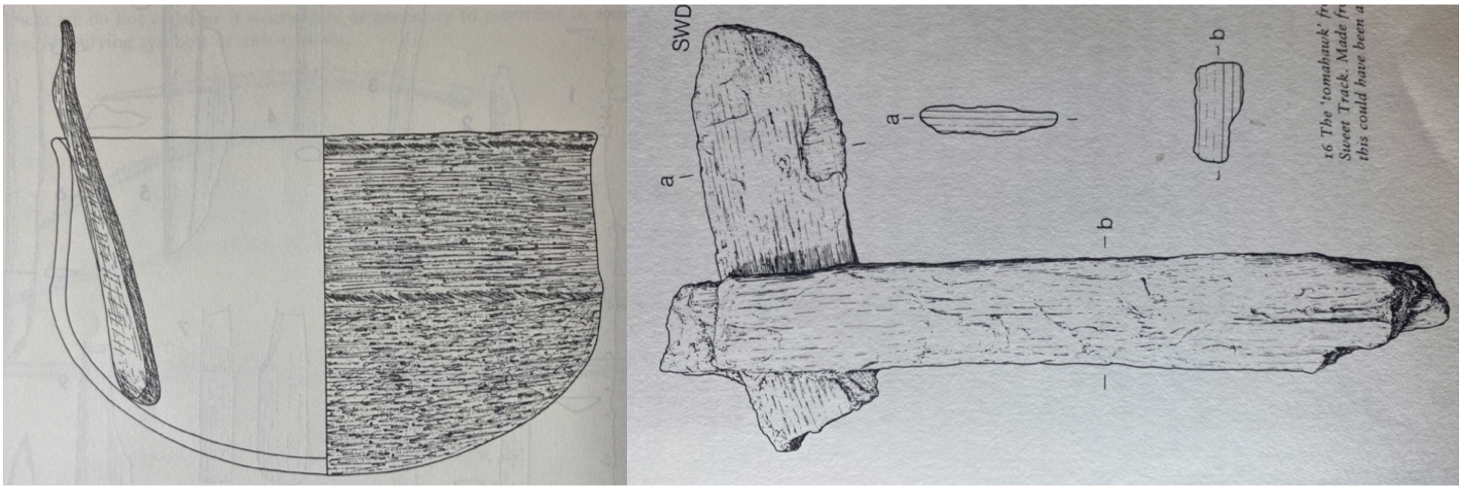


Fig 6.13 Reconstruction of hazel stirrer (left, Coles et al. 1973, 288) and the oak tomahawk (right) (Coles & Coles 1986, 61)

The wide range and variety of wooden find types from the Sweet Track is interesting, from hunting gear to tools possibly for woodworking or construction, domestic cooking objects, items for possible personal wear, children's toys, and even potentially more ritual type objects such as the oak box for axe-head. Interestingly, there is a very clear species selection for these objects, with hazel and oak objects dominating at 40% and 37% respectively, and coming third the five yew bows at 14% of the assemblage. The fact that yew was not used for any other object of this sizeable 57 strong assemblage, including the possible spear and bows, would arguably suggest that its use was infrequent and possibly held some sort of special significance for the Neolithic people. More broadly, how or why this range of items ended up lost along the trackway remains to be fully established, but at the very least it shows something of the array of organic material culture of the users. As a collection of material culture, it is currently the largest portable wood object assemblage from Neolithic British archaeology and illustrates just how much material we are missing in the archaeological record for this period.

Fig 6.14 A possible short hazel bow or child's toy from SWTG, measuring 100cm long (Coles & Orme 1984, 44)

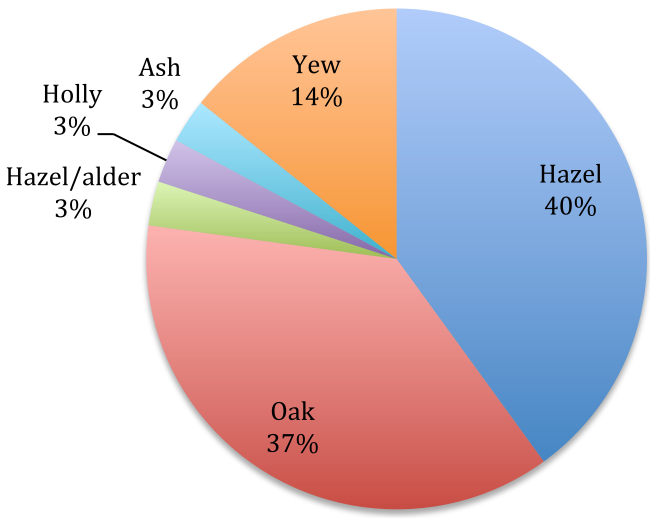


*Fig 6.15 The species used for Sweet Track portable wooden artefacts with known species (**n=35**) (Coles et al. 1973; Coles & Orme 1976, 1979, 1984; Coles & Coles 1986)*

In terms of understanding manufacturing techniques, Taylor *et al.* (2018) raised in their analysis of the Star Carr assemblage that finished wood objects can often be finely finished, sometimes highly polished, with little evidence for how they were actually made. Even with those constrains the importance of the collection means there is certainly a case for a re-evaluation of their morphology and typology in comparison to wider available assemblages. 50 years after their excavation there is an increased number of finds now available from the British and European Mesolithic and Neolithic worked wood record as set out in **Chapter 3** that may now help better establish the function of objects that did not have clear identities or purposes when first considered. Finally, it is also worth noting that there is also the possibility that more portable wood objects may be in the SLP excavation records for SWR2 sub-site awaiting recognition. As noted above, the majority of SWR work was only partially published in full. The fact that only nine wooden artefacts were mentioned in the published account by Coles & Orme (1984), but other finds such as the polished jadeite axe, pottery, lithics and leaf-shaped arrowheads were recorded along this large 131.5m long track section, may mean it is possible to identify more wood tools from this section in the future.

6.7 Structural timbers

6.7.1 Species selection

As Morgan (1984, 47) has set out, large sample numbers, or indeed if possible ‘total sampling’, is required to understand wood species selection and the detail of resource use across whole sites in time and space. The Sweet Track is unique in the British Mesolithic or Neolithic record due the vast number of wooden artefacts excavated and the extensive and lengthy sampling and analysis investigations that have taken place. The archive records and published reports of the SLP show it made a concerted effort to obtain species identification for the majority of worked wood excavated and used in the construction of the Sweet Track (Coles & Orme 1984). Although Coles *et al.* (1973, 265) did acknowledge the numbers published by the SLP were for those that were identifiable, ‘not to the total number of pieces in the track’ so the number of worked wood items excavated and those actually identified do not match. Over 1800 items were also analysed for tree-ring information across 14 sub-sites (Morgan 1984), with this extensive data collection allowing for informed inferences about woodland resource use, sources and even management. Wooden timbers from the Post Track were also identified to species level, but given the low number of artefacts recognized, apart from the distinctive posts, the best evidence for species selection overwhelmingly comes from the Sweet Track.

6.7.2 Sweet Track species selection

Results from sites across all artefact types from the Sweet Track (Table 6.5 below), illustrates that there are two obvious trees species that were the preferred option for the track’s builders: hazel (37.9%) and oak (26.4%). The use of hazel likely reflects that this species was abundant and readily available in the nearby woodlands, whether natural or managed in some way (Coles & Orme 1979). Ash is the third most common species used, though far behind the first two at just 8.7%. Rackham (1979) also noted that fast-grown ash poles (as found in the tracks) are very dense and hard to cut even with steel tools and its limited overall use may both reflect such problems and its well-known value for other uses such as handles or hafts (Edlin 1949a, 1949b). The apparent preferential use of durable hazel for pegs and oak for planks would also seem to suggest that the builders wished to build a reasonably long-lasting structure. The fact that the track was actually only in use for as little as 10 years, with some occasional repairs as noted above would therefore seem odd, with perhaps environmental, cultural, or design factors at work that remain to be properly understood.

*Table 6.5 All worked wood with species identified, used in building of Sweet Track**

Site	B[1]	C[2]	D[3]	F[1]	GB[2]	GZ[2]	KD[2]	QD[2]	QV[2]	QZ[2]	SW R1[4]	SA[2]	TG[2]	WA[2]	Total	%
Hazel (*Corylus*)	5	123	182	278	24	19	22	24	48	49	103	28	354	35	**1294**	**37.9**
Oak (*Quercus*)		104	100	200	6	12	7	7	4	30	130	35	203	62	**900**	**26.4**
Ash (*Fraxinus*)		53	50	74	6	4		3	5	7	43	2	45	4	**296**	**8.7**
Alder (*Alnus*)		5	4	78			1				141	1	6	7	**243**	**7.1**
Holly (*Ilex*)	4	25	62	86	8	9		4	1	1	15			1	**216**	**6.3**
Willow (*Salix*)		2									6	8	139	18	**173**	**5.1**
Elm (*Ulmus*)		1	27	3				2	6	13	50	2	15	4	**123**	**3.6**
Lime (*Tilia*)	1		20	30	2	2	2	18	15	1	11				**102**	**3.0**
Birch (*Betula*)	1	2		9				4	3		1	3	15	10	**48**	**1.4**
Dogwood (*Cornus*)										1			7		**8**	**0.2**
Apple (*Malus*)			4								3				**7**	**0.2**
Ivy (*Hedera*)													1		**1**	**0.03**
Total	**11**	**315**	**449**	**758**	**46**	**46**	**32**	**62**	**82**	**102**	**503**	**79**	**785**	**141**	**3411**	100

[1] Coles *et al.* (1973), [2] Coles & Orme (1984), [3] Coles & Orme (1979), [4] Coles & Orme (1976)
*Results not including Post Track elements securely identified as separate and not reused into Sweet Track.

What is also perhaps striking is that overall, no other tree species manages to get above 10% in overall use along the track, with alder, ash, holly, and willow all used in roughly the same proportions (5-9%), with lime and elm used less (3-4%) and a useful tree like birch hardly used at all (1.4%). Pollen analysis suggested that all of these trees were readily available in the local area and this absence surely reflects purposeful choice (Coles *et al.* 1973). This is perhaps striking when comparable, if slightly younger, nearby tracks such as the Chilton tracks (3645-3496 cal BC) are considered (Coles & Dobson 1989) Here much more basic tracks of cut roundwood brushwood, branches and stems were almost exclusively made from birch, a species almost certainly present in the local environment when the Sweet Track was being built (Coles *et al.* 1970). This suggests that Neolithic Sweet Track builders were choosing some species and avoiding others for specific reasons, rather than being dictated to by a significant lack of resources. Such consistency in raw material selection would also suggest a considerable level of prepared planning in the construction rather than some ad-hoc chaotic build. Perhaps suggesting a significant level of centralised community with the project control by the architects of the track.

Interestingly, given the wetland context of the Sweet Track, it might be expected that its builders would have made use of trees that thrive in the wetland edge such as alder and willow. Coppiced, pollarded, or even natural young willow would provide quick growing and straight rods for stakes

(Tabor 2012, 2013), if less durable than hazel and alder, but its limited use supports a view of selective resource choice by the track's builders. In the case of willow, and to a certain extent birch, it is perhaps more understandable that little use was made of these trees for the larger split timber as planks, as once split they do not resist water well and would quickly rot (Morgan 1984). Where willow was used it appears to be confined to the northern sections of the track (SWTG and SWWA), perhaps reflecting a useful stand source in that immediate area. Holly on the other hand appears confined to southern end of the Sweet Track, again perhaps reflecting the presence of a tree or trees in the immediate area (Morgan 1984). Elm seems to be used more towards the north of the trackway, and Coles & Orme (1979) suggested that this, alongside the pollen evidence, implies that it was more common on Westhay island. Their interpretation was that the woodlands of the Polden slopes had been altered by human activity for perhaps a few generations whereas Westhay island still held primary or wildwood habitats (Coles *et al.* 1973; Coles & Orme 1979).

The marked lack of alder is more curious and less easily understood, growing very well in nearby wetland edge areas and, being well known for water resistant properties, it also provides quick growing straight stems especially when coppiced (Tabor 2012). The one caveat to this lack of alder is SWR1 where it is unusually the dominant species (28% of all identified pieces), and perhaps reflects the presence of nearby useful stands of trees accessed by the builders at this section. The apparent higher than usual frequency of holly at SWC (7.9%), SWD (13.8%) and SWF (11.3%) compared to its overall general use across all sites, may also reflect this use of localised resources. Coles *et al.* (1973, 267) recorded SWF as 'littered with fresh chips of wood and stray chopped branches' and suggested there was ample evidence of the processing of a whole felled holly tree at the site. Interestingly, the evidence at SWF also illustrated the presence of some local growing trees in the immediate vicinity of the track, with roots from alder (n=5), birch (n=6), willow (n=7) and ivy (n=1) found on or under the track (Coles *et al.* 1973, 275). Of these, only alder was used in any significant way at this part of the track (10.3% of worked items), with birch only used nine individual times (from a total assemblage of 758) and willow and ivy not at all. This would suggest that to some degree the Sweet Track was not all made off-site and thus constructed very rapidly, with a pre-fabricated kit of pieces. Rather there is cumulative evidence that the builders had to spend time felling, snedding (removing branches) and transporting timbers from nearby stands of useful trees.

Finally, the domination of oak in species selection is largely a product of its use for the vast majority of planks, although this in of itself is significant as using stone, wood and antler tools for felling, splitting, working and then transporting of large oak timbers from dryland sites is no inconsequential task. This would illustrate a sophisticated knowledge and skill in the working of this tough, but incredibly durable and useful, tree species. The very dominate and specific use of oak for planks also suggests that the builders had a particular design in mind, perhaps with durability of planks a key determining factor, but seemingly not appreciating the weakness of the supporting plank stakes set at oblique angle until it was too late. The likely planned felling of chosen trees and groves in the landscape before the considerable effort of splitting and transporting the planks to the site reinforces the impression of a well-planned and controlled build by an organised group, or perhaps, several inter-connected communities. It is also worth considering more widely that if the builders were able to produce and use some 2000m of oak planks for a simple walkway their ability to fabricate sophisticated buildings, perhaps with large plank walls, would have been an entirely achievable undertaking.

6.7.3 The Post Track species selection

There are significant challenges in the analysis of species selection in the Post Track timbers, at SWF for example the only Post Track elements currently recognised are the posts as the two tracks lie over one another at this point and the Post itself was not recognised during the original excavation (Coles *et al.* 1973). As a result, the current data best reflects the choice of species for the driven vertical posts (**n=60**), with only 22 more pieces of worked wood that can be definitely ascribed to the Post Track with species identified. From that data the Post Track was interpreted as being the main source of lime timbers across both trackways, reportedly being very common to that track and rarer in the Sweet Track and when present thought to be evidence of reuse from that earlier phase (Coles & Orme 1976, 1979; Morgan 1979). Within the Sweet Track assemblage, lime appears to only be present when reused from Post Track, within Sweet Track pegs for example it was only used five times out of the entire total Sweet Track peg assemblage excavated. Lime planks from SWD (**n=5**) and SWRSX (**n=2**) exhibited matching tree-ring growth patterns, and while there is no definable sapwood zone to determine an absolute felling date Morgan's (1979) interpretation was that all the timbers were likely felled at the same time and thus this aspect of the Post Track constituted a cohesive assemblage. Morgan (1984) further suggested that ash was also exclusive to the Post Track, and only appears in the Sweet Track when it was being reused. This conclusion is perhaps more problematic, as ash was found as planks, rails, and pegs throughout the Sweet Track (the third most common wood species as noted above) and while reuse is a possible solution to this, its presence may be the result of simply being used in both as well as also recycled.

Site	SWC	SWD	SWF	SWQZ	SWR	Total	%
Hazel (*Corylus*)	7	12	15		3	**37**	**45.1**
Lime (*Tilia*)		8		3	8	**19**	**23.2**
Alder (*Alnus*)			2		10	**12**	**14.6**
Ash (*Fraxinus*)	4	1			2	**7**	**8.5**
Holly (*Ilex*)	3					**3**	**3.7**
Unidentified					**3**	**3**	**3.7**
Elm (*Ulmus*)					1	**1**	**1.2**
Total	**14**	**21**	**17**	**3**	**27**	**82**	**100**

Table 6.6 Post Track worked wood with species selection, including posts (Coles et al. 1973; Coles & Orme, 1976, 1979, 1984)

Coles & Orme's (1976, 1979, 1984) interpretation of this species data was that the considerable use of lime in the Post Track (23.2%), but hardly at all in the Sweet Track (3%), reflects very clear different choices by the builders. A proposed explanation was that lime may have been used for the Post Track as it was relatively easy to fell for a quick preliminary trackway, sourcing straight and tall trunks with no side branches that made useful rails, but perhaps proved less durable in wetlands than oak or hazel for long-term structures (Coles & Coles 1986; Morgan 1979). As common wood in the landscape at the time its overall absence in the Sweet Track is certainly marked and would seem to represent a selective decision pointing to wider resource management and selection. The fact that oak also does not appear to have been used in the Post Track but is clearly the species of choice for the planks of the Sweet Track again illustrates a specific set of choices by the builders of both tracks to use, or avoid, certain species. One possible reason for this could be that coming first the Post Track was built as simply and quickly as thought necessary, with useful nearby hazel, lime and perhaps ash stands. The selection of oak for the later Sweet Track perhaps attempted to correct for problems in longevity discovered in this first trackway by using more hardwearing split oak planks, but the inherent design flaws identified by experimental archaeology as set out by Brunning (2007c, 2016) may have meant that the second trackway also did not stand up to very prolonged use across the marshland.

6.7.4 Identification of woodland source

In her tree-ring analysis Morgan (1984) observed homogeneity in the growth rates of the 270 individual tree-ring samples from oak planks spread along the Sweet Track, strongly suggesting that the oak planks trees grew in the same general landscape, but likely not from the same stand of trees. Morgan's (1976) earlier tree-ring work had also suggested that certain parts of the Sweet Track were using timber from different locations in the landscape. This work showed that the sites north of SWGZ (63.3% of the trackway) used oak planks from large, mature trees (Morgan 1984). The southern section of the trackway (from SWGB south) appears to have used smaller, immature trees. At SWR large oaks from a single stand were felled are all aged around 400 years old and over 1000mm in diameter (Morgan 1984). The 'short-boled' slow growing nature of these trees indicated poorer growing conditions, suggested as perhaps from a growing area on Westhay and Meare island (Morgan 1979, 1984). At SWD and SWF younger and smaller oaks from the same stand of trees in one area of woodland were used, aged around 150 years old with average diameters of 500mm (Morgan 1984). The SWD oaks were found to be clearly different to those of SWR, growing faster and with 'tall slender-boled' trunks, suggestive of open and plentiful conditions (Morgan 1979, 68). These seem to have been limited to single radial planks due their reduced diameters, with a slightly higher proportion of southern sector trees tangentially split perhaps as the most effective way to produce planks from smaller diameter trees.

This preferential use of woodland resources based on position along the trackway was further supported by evidence from hazel roundwood that suggested a similar geographical relationship, with roundwood of similar growth pattern found in roughly two halves one in the northern sub-sites from SWQD to SWWA and another source used in the southern half from SWQD to SWD (SWB and SWA were not subject to tree-ring studies). The southern hazel roundwood also tended to have wider and more uniform rings, which suggested more open growing environments with better access to light and nutrients (Morgan 1984). This north versus south difference was also shown by tree-ring analysis of ash stems (for rails and pegs) from SWR (n=96 samples) and SWD (n=41 samples), which illustrated that while they were likely growing and felled at the same time, the ash stems at SWR were almost certainly from one specific area of trees whereas the stems at SWD were coming from a different and wider variety of woodlands elsewhere (Morgan 1979, 72).

Morgan (1979, 1984)'s interpretation, and later adopted by the excavators Coles & Coles (1986, 1990), was that this implied old trees from wildwood were being felled on Westhay island for the northern section of the trackway and younger quickly growing trees were felled on the Polden Ridge for the southern sections. Morgan (1984) proposed this may reflect two different groups working from either end of the trackway towards the middle, and if that were the case the northern builders seemed to have done somewhat more of the work. Alternatively, the dominate use of the suggested northern older oaks from wildwood might indicate that the build could have started there and ended in the southern end, using smaller oaks from further south only as the main timber ran out (Coles & Orme 1984) Without wider settlement evidence and investigation of the trackway termini the specific build chronology remains to be clearly established but hints at possibly interesting different community focus and settlement alternatives in the landscape.

It is also perhaps interesting to note that in the context of the different timber sources, SWR is effectively in the middle of the Sweet Track and also revealed the densest concentration of deposited pottery, flint, and wooden implements, and most strikingly the unused polished jadeite axe from the Alps (Coles & Orme 1984). It would seem reasonable to speculate that the concentration of these depositions could represent something more culturally significant that simply a collection of lost items, and that the middle of the trackway and the perhaps even meeting of two communal efforts was a recognised element during its construction. Another significance of recognising the use of an apparent re-growing oak forest in the southern sections is it may link to the tentative proxy date for the first major forest clearances in the wider landscape, 150 years earlier than the Sweet Track build or around 3987 BC in direct calendar years. This date is not incompatible with our current understanding of the emergence of the Neolithic in the Britain (Bayliss *et al.* 2011; Whittle *et al.* 2011b) and may prove a useful element in helping to directly tie down that cultural transition in this area if the cultural associations can be properly established.

6.7.5 Sweet and Post tracks timber woodworking techniques

Clear evidence of sophisticated woodworking techniques at the both the Sweet and Post tracks came from the presence of notches or holes in the planks and the radial and tangential splitting of large oak timbers (Coles *et al.* 1973; Coles & Orme 1984; Morgan 1979, 1984). The plank perforations were produced by working against the grain, using axes or other tools, and would have been a fairly labour-intensive task. Notches on sides of planks could partly have used the splitting properties of wood to wedge out pieces (Coles & Coles 1986).

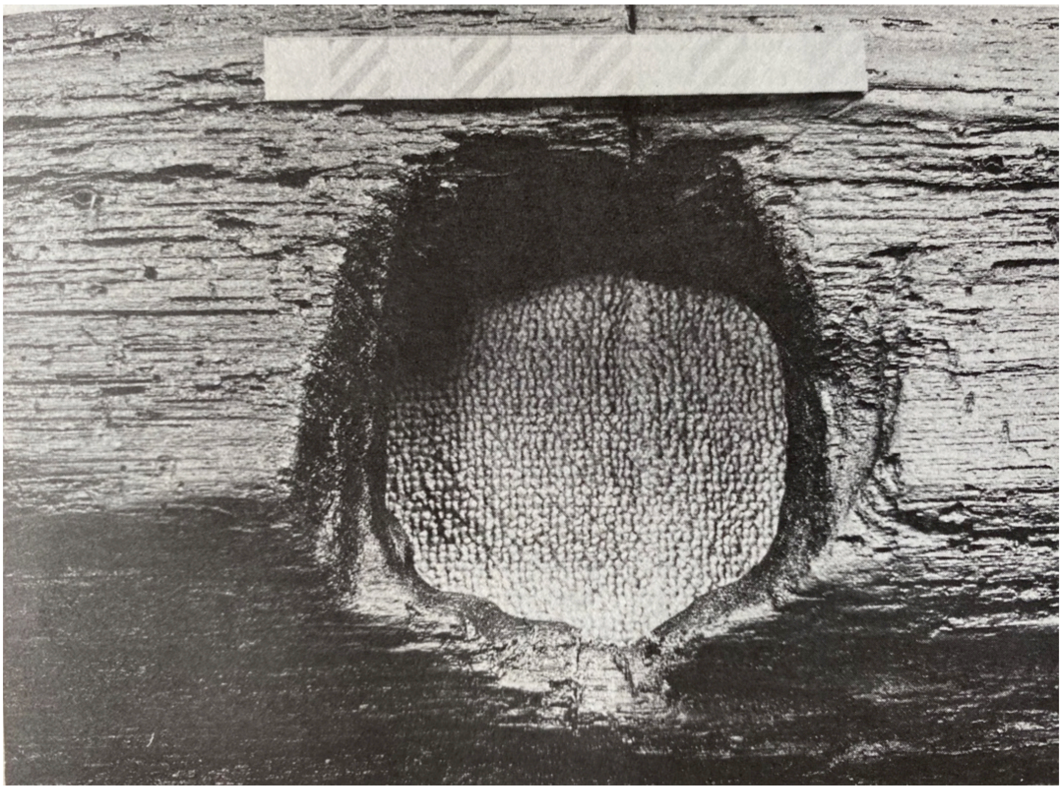


Fig 6.16 Post Track ash plank at SWR with carefully made hole, made from working on both sides (Coles & Orme 1976, 55)

Other evidence of woodworking skill included notches cut in the underside of planks that did not go all the way through to allow them to rest on vertical pegs for stability. Green wood seems to have been used for many roundwood pieces, with the recorded 'buckled' or 'shattered' nature of plank pegs and posts as they hit the underlaying marine clay suggesting that they were often fresh and not seasoned (i.e., more flexible, but less strength) (Coles & Orme 1976, 1984). Although noted above, there is also evidence of reuse of older pieces of roundwood from tree-ring analysis so there is certainly some variability in roundwood selection.

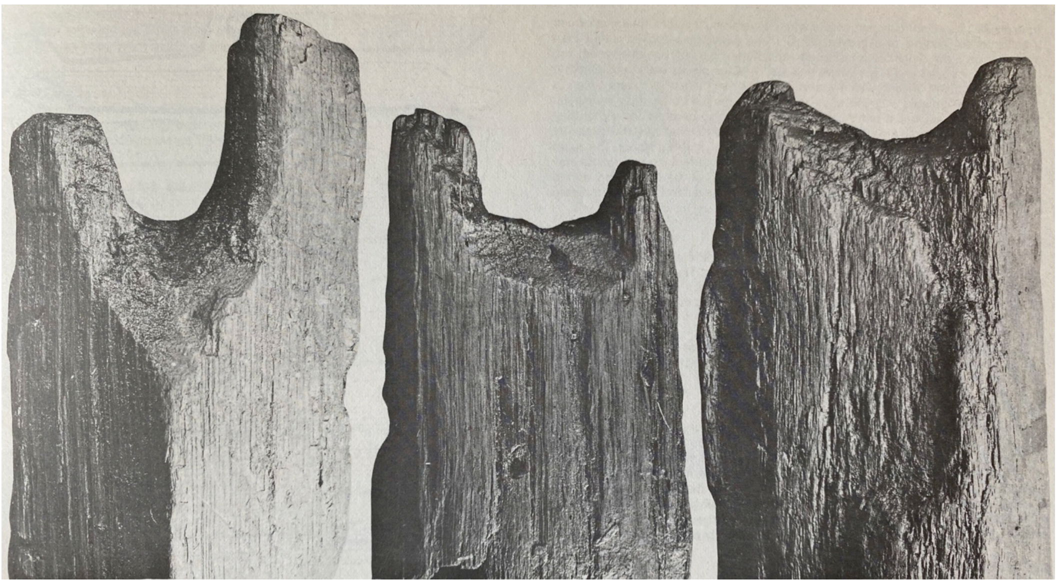


Fig 6.17 'Boards' from SWR with well made notches to the ends (Coles & Orme 1976, 57)

Fig 6.18 A dislodged plank at SWTG with carefully made hole and a 'scooped' end (Coles & Orme 1984, 15)

There are some individual examples of highly skilled roundwood or pole woodworking, such as large SWD ash post <SWD340> from the Post Track, which measured 170mm in diameter and was purposefully faceted noticeably flat on its top surface. It can be seen *in situ* in Fig 6.19, and clearly was a major piece of timber that would have been obvious to the Sweet Track builders. Why there should be a need for such a large, flat-topped post at this point in the Sweet Track or Post Track remains unknown but again suggests the Post Track posts served some unknown specific purpose when in use and was a sizeable undertaking in its own right.

Fig 6.19 Ash Post Track post SWD340 in situ in the middle of SWD and remains of the Sweet Track below (Coles & Orme 1979, 46)

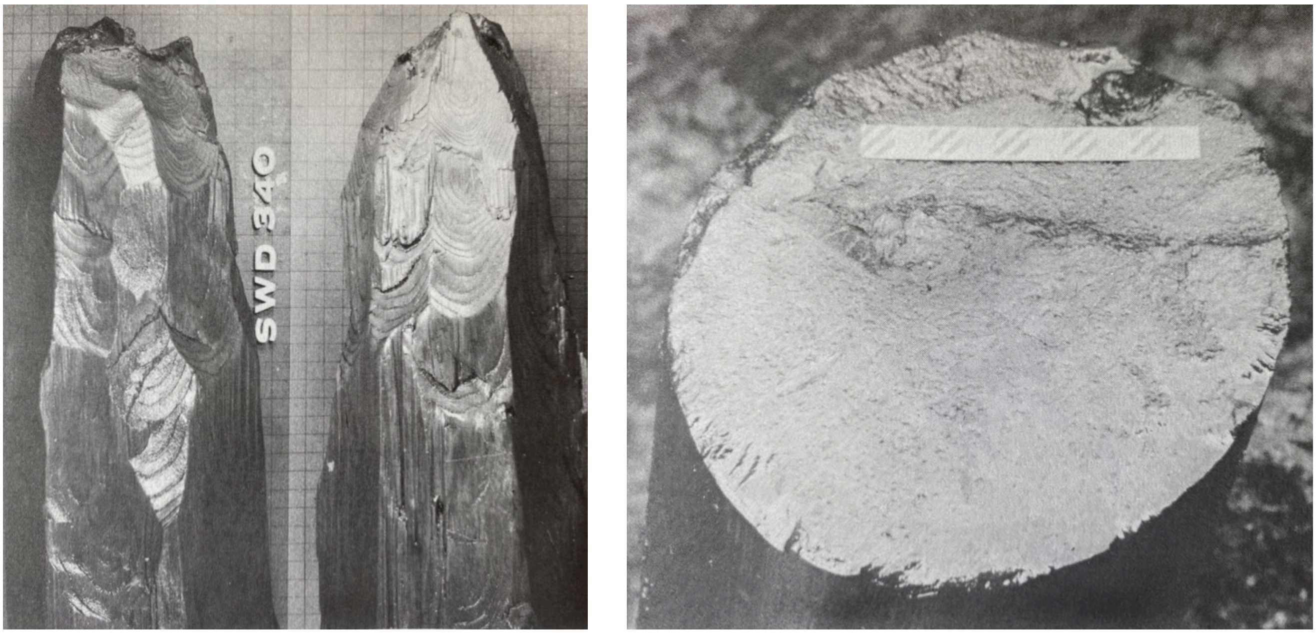


Fig 6.20 The worked end of SWD340 (left), finished to a pencil-end with large facets, diameter said to be 170mm at bottom of photo. The top of SWD (right) as found in excavation worked to a remarkably flat surface (Coles & Orme 1979, 51)

Use of oak roundwood stems at SWTG indicated the presence of another skilled woodworking technique. Of the total sample (n=29) 41.3% were half split, 31% quarter splits and just 27.6% whole and used as variously transverses pegs and rails (Morgan 1984). Also, at SWTG there was evidence of splitting of willow to make quarter stems and small tangential boards. The selection of this species and atypical working technique at SWTG seem to be quite specific to this section and may represent the presence of a particular individual or problem at this sub-site (Morgan 1984). Perhaps one of the clearest indicators of advanced woodworking technology was the conversion method of a large sample of the planks from all along the Sweet Track. The large numbers of planks manufactured illustrated the ability of the builders to split wood radially and tangentially, seemingly without any significant problems for even large trees (Morgan 1979, 1984). The splitting of a large tree (1m+ diameter) radially allows for the production of numerous long planks (as seen with the planks at SWR), with Morgan (1976, 1979) suggesting that such large trees even allowed for multiple smaller width planks to be made from one large original radial section. On smaller diameter trees a single plank may use the entire radius of the tree (Morgan 1979). Tangential planks were split along the parallel plane, on a large tree this would produce an excessively wide plank and in smaller trees it would be quite wasteful, producing less planks, quite narrow though normally perhaps a little thicker than radial planks (Morgan 1979).

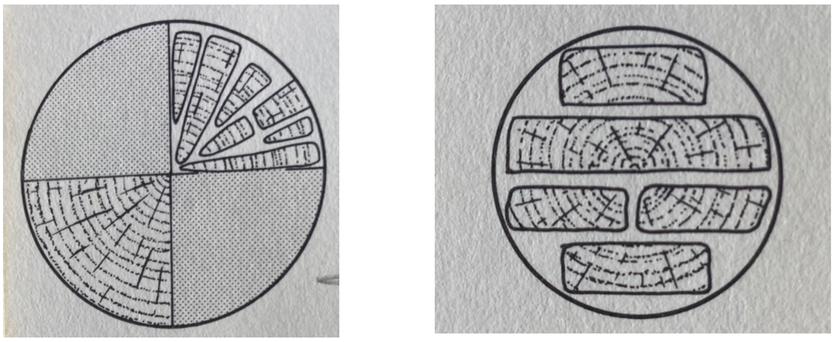


Fig 6.20 Radially splitting of wood (left), and tangential splitting of wood (right) (after Coles & Coles 1986, 50)

Table 6.7 Radial versus tangential plank splitting evidence, Sweet Track (oak and ash)

Site	Radial	Tangential	Other	Total	Source
SWC	18	7		25	Coles & Orme (1984)
SWD*	17	6		23	Morgan (1979)
SWF	19	2		21	Coles *et al.* (1973)
SWQZ	4			4	Coles & Orme (1984)
SWR	159	3	13	175	Morgan (1976)
SWTG	77	11		88	Coles & Orme (1984)
SWWA	18	2		20	Coles & Orme (1984)
Total	**312 (87.6%)**	**31 (8.7%)**	**13 (3.7%)**	**356**	

*Described as 'boards' on publication (Morgan 1979) but cross-checking with artefact numbers shows this was an error in terminology and these were indeed 'planks'.

Within the Sweet Track assemblage there a distinct preference amongst the builders of the Sweet Track for radial splitting, constituting 87.6% (or 312 of 356 planks) of those clearly identified. The presence of 31 tangential planks spread across the sub-sites of the Sweet Track (Table 6.7) indicates the builders also had the woodworking ability to manufacture this plank type when needed, with tree size perhaps the most important determiner not ability. Morgan (1976, 1984) suggested that the plank evidence illustrated felling and use of 400-year-old oak trees with 5m long, 1m diameter, trunks at SWR. She estimated that such trees would each have provided some 120 radial split average size planks commonly found in the trackway (around 2m long by 5cm at their thickest point), and in some cases even two radial planks from one initial large radial (Morgan 1976). As such, at site SWR just two or three trees would be sufficient to provide all planks for the 131.5m length (this sub-site being 6.7% of the entire trackway). Morgan (1984) also noted that while oak was the dominate species used for planking, ash was used, and it was predominately tangentially split – the reverse of the oak planks. A practice most likely explained by the reduced dimensions of the trees used; with 16 ash samples measured ranging from 50-150 years old and 200-500mm in diameter and thus a tangential plank the best use of the wood (Morgan 1984, 57). While there is inter-site variation with smaller trees and more tangential planks in the southern sub-sites, it seems likely that some 30-40 oaks over the whole 2000m length would have sufficed to produce all the planking in the trackway (Morgan 1976, 1979, 1984). The consistent, and repeated, use of split planks for the walkways is clear and is an effective way to produce sturdy lengthy timbers ideal for such a long trackway. The evidence from the Post Track for splitting technique is sadly much weaker, with the number of split planks with secure Post Track provenance and recognisable splitting method so low (n=4) that little can reliably be said for the preferred method of splitting other than both techniques were used; three radially and one tangentially. It may be the case that some or even most of the ash planks in the Sweet Track originated within the Post Track, but as discussed above the information currently available does not allow this to be confirmed either way at present.

Whilst the majority of the planks were radially or tangentially split, Morgan (1976, 69) also noted that a number of oak planks (n=13) at SWR had been worked as ‘quarter-sawn’ planks – cut at an angle of approximately 45 degrees to rings. She noted that this is a very unusual, and quite sophisticated, technique and ‘how this could have been achieved with stone tools is difficult to suggest’ (Morgan 1976, 69), though perhaps skilled use of wedges and splitting could perhaps produce this if necessary. Other skills demonstrated was Coles & Orme’s (1984) note at northern sub-sites there was direct evidence of a number of woodchips from planks (n=20) showing trimming of the feather edge (inner edge of the plank) or sometimes the sapwood (outermost edge). Morgan (1976, 1979, 1984) also lamented the lack of plank sapwood throughout the trackway assemblage for dendrochronology purposes, and suggested its consistent absence indicated it was purposefully removed and not simply lost through natural action. Removing these softer parts of the timber would help to strengthen the planks and make them more resistant to rot, again illustrating in-depth knowledge of timber properties. The appearance of both radial and tangential splitting along the trackway, and even the rare “quarter sawn” planks at SWR, would indicate the builders possessed a varied and sophisticated knowledge of woodworking timber plank techniques, simple carpentry methods and ability to make best use of the different species and their wood qualities as required.

6.7.6 Woodworking debris evidence

One research issue recognised when assessing the woodworking evidence from the tracks is that little published record exists on the number, type, size, and direction of the woodchip evidence. At SWR for example, ‘not all were recorded, particularly the case with chips’ (Coles & Orme 1976, 59). This is a reflection of changing attitudes to the value of such debris and woodchip data, as work such as at Etton causewayed enclosure was to later illustrate the importance of this analysis (Taylor 1998b). Coles & Orme (1984) reasoned that oak planks were split off-site, and while this may be true to a certain extent, the species identification data above and analysis of the published and unpublished wood chip archive suggested there is sizeable evidence to suggest a substantial amount of shaping, trimming and working of timbers and trees did take place all along the side of the trackway from SWC to SWWA and that on-site manufacture was a consistent and integral part of the build process.

At SWC the site notebook recorded, ‘a fair amount of small timber chips are also turning up’ (Keller, A., 28th June, 1982, Box 4, SWC notebook, SLP archive Taunton), described later on as enough to fill two buckets (Keller, A., 29th June, 1982, Box 4, SWC notebook, SLP archive Taunton) with one ‘for each half of the site’. The excavation sheets reveal a substantial quantity of individually recorded oak, hazel, and ash timber, roundwood and bark chips (n=476), with noted concentrations at 13-17m and 4.5m along the trackway (SLP archive, Box 4, SLP archive Taunton). Some of these chips may represent the fragmented and deteriorated remains of rails and planks as condition of the wood was generally poor (Coles & Orme 1984), but the marked high density in particular areas and presence of roundwood chips with chop marks (such as around artefact <SWC437>) would also suggest timbers and pegs were being worked on-site. At SWD, Morgan (1979, 66) reported ‘scattered among the track timbers were numerous chips’ and ‘chips of sapwood among the track timbers suggested on-site trimming of the planks’ (Morgan 1984, 50). Morgan (1979) also described onsite processing of timbers, with four tangential chips with sapwood with matching rings (<SWD228>, <SWD282>, <SWD504> and <SWD617>), all found within a 10-metre strip. In two cases, analysed chips were found near their parent tangential planks; chip <SWD228> near matching plank <SWD206>, and chip <SWD282> was near plank <SWD284>. Other stray branches and chips of hazel and holly at SWD further attest to onsite processing (Coles & Orme 1979).

Further along at SWF, the excavators suggested that much of the final shaping of the rails was done onsite, and the ‘site was littered with fresh chips of wood and stray chopped branches’ (Coles *et al.* 1973, 266). The SWF site notebook recorded that 1,730 ‘chips’ were found in a 22m excavated length, though sadly not individually recorded, and this would also suggest that there was woodworking on-site to a reasonably significant degree (Site notebook, ‘R1973 & RT3’, Box 9, SLP archive Taunton). The observed freshness of the cuts on the rail pegs was also cited to show they had been cut *in situ*, with some evidence from squashed faceted ends that one long stem may have been divided several times to produce multiple pointed pegs (Coles *et al.* 1973, 269). At SWR, Coles & Orme (1976, 59) stated small pieces of wood, rarely over 50cm long, 'lay scattered among the track timbers and in the surrounding peat' and that 'not all were recorded'. Of the larger 'slats and slivers' they did record (total n=61) from SWR1, 50% were oak, which is perhaps significant as 95% of the planks here were oak and it would therefore seem likely that a reasonable amount of work was carried out onsite to shape these pieces – cutting notches and holes for plank pegs for example (Coles & Orme 1976). Further north along the Sweet Track, plank pegs at SWSA, SWTG and SWWA were made from surplus planks and split and used as rail pegs suggesting a continued certain amount of on-site trimming of planks (Morgan 1984). This study has not attempted to analyse the woodchip and debris evidence in any more substantive detail than described above, but it would be an important avenue of further research as it may illustrate tool types and inform how much planning and preparation went into the build; was it pre-made in 'kit-form' or did it arrive on location as simple planks and very rough lengths of rods and poles? The former might suggest a significant level of central control and community organisation, the latter a more piecemeal and ad-hoc project that took considerably longer. Future research to re-assess the debris evidence and test such models may help untangle those questions.

6.8 The Sweet and Post pointed end assemblage

6.8.1 Roundwood size of pointed ends

As shown in Table 6.3 at the start of the chapter, the total pointed end assemblage excavated by the SLP from the Sweet Track was substantial, with some 1,073 individual pointed end artefacts. Analysis by the SLP revealed a clear functional difference within the peg assemblage with the rail pegs holding the foundation rails in place and supporting the planks, at SWF they were found to be larger on average at 40-90mm diameter, and 60-80cm in length, often more roughly worked and driven in somewhat haphazardly (Coles *et al.* 197, 269). The interpretation being that they were selected based simply on the need to do the job of holding the rail and providing support for the planks (Coles *et al.* 1973). At SWF vertical plank pegs were smaller on average (40-60mm in diameter) and more finely worked, with many being driven through well executed notches or holes in the planks when needed to anchor and stabilise the trackway timbers (Coles *et al.* 1973, 273). These overall sizes appear to have been consistent along the trackway, further north at SWR rail pegs were again reportedly measured at 50-80mm in diameter and 100cm long (Coles & Orme 1976, 43).

Type	Age average	Age range	Diameter average (mm)	Diameter range (mm)	No. in sample
Rail peg	19.4	8-45	60.7	36-90	62
Plank peg	11.8	5-20	45.3	25-70	27
Unspecified	20.2	6-40	66.1	35-100	35
				Total sample	**124**

Table 6.8 Rail and plank peg sample from SWD (Morgan 1979, 75)

It is has proved difficult to provide detailed re-analysis of the diameters of the pegs as the work of Morgan (1976, 1979, 1984) cited only the results and did not provide the original measurement data. The archive excavation sheets hold a certain amount of the original data, but these measurements were not universally noted for every sub-site nor artefact. However, the general pattern seems to have been repeated across the trackway, with Table 6.8 from SWD above showing data from Morgan (1979) again illustrating this general arrangement. As noted in the publication reports the Post Track posts were found to be considerably larger and more substantial (Coles & Orme 1976, 1979), with the author using data from the excavation sheets to sample 35 posts from sub-sites SWC, SWD and SWF that showed that average diameter was 100mm, with a diameter range of 70-200mm, indicating their relative larger proportions compared to pegs.

Site	Diameter average (mm)	Diameter range (mm)	No. in sample
SWD	109	70-200	14
SWF	91	80-110	10
SWC	97	85-120	11
Combined	100	70-200	35

Table 6.9 Posts diameter measurements from SWD, SWF and SWC (Excavation sheets, SLP archive, Taunton)

6.8.2 Species selection of pointed ends

The number of obliquely set rail pegs that have been identified to species (n=761) used in the Sweet Track is almost four times that of the vertical plank pegs (n=201), a ratio to be expected with what we understand of the tracks overall design. Hazel is the dominate species selected for both plank pegs (48.8%) and rail pegs (51.8%), although it would seem that there is more complexity in the detail of selection of wood for pegs as compared with planks and rails as 12 different species were used in all across the two artefact types. Alder was the second most frequently used across the two artefact classes (16.8% on average in combination), however this is mostly down to its use at two specific sites; SWR1 (where 67.9% of all alder pegs were used) and to a lesser degree SWF (24% of all alder pegs used). This strongly suggests occasional or ad-hoc use of more immediate resources during the build in these specific areas, in comparison to an overall trend towards the planned felling and preparation of large numbers of hazel pegs or lengths sometime prior to the construction event.

Site	**SWB**	**SWC**	**SWD**	**SWF**	**SWQZ**	**SWR1**	**SWTG**	**SWWA**	**Total**	**% of total pegs**
Hazel (*Corylus*)	3	31	41	115	30	52	114	8	394	51.8
Alder (*Alnus*)				34	6	81		2	123	16.2
Holly (*Ilex*)	2	6	13	50	1	6			78	10.2
Ash (*Fraxinus*)		8	7	19	2	12	6		54	7.1
Oak (*Quercus*)				4		7	14	20	45	5.9
Willow (*Salix*)						3	19	5	27	3.5
Elm (*Ulmus*)					1	15	1		17	2.2
Poplar (*Populus*)							16		16	2.1
Apple (*Malus*)			2			2			4	0.5
Lime (*Tilia*)				1		1			2	0.3
Dogwood (*Cornus*)							1		1	0.1
Birch (*Betula*)									0	0.0
Total	**5**	**45**	**63**	**223**	**40**	**179**	**171**	**35**	**761**	**100**

Table 6.10 Published identified species selection for rail pegs (Coles et al. 1973; Coles & Orme, 1976, 1979, 1984; Coles & Coles 1986)

Site	**SWB**	**SWC**	**SWD**	**SWF**	**SWQZ**	**SWR1**	**SWTG**	**SWWA**	**Total**	**% of total pegs**
Hazel (*Corylus*)	2	7	22	15	6	13	30	3	98	48.8
Alder (*Alnus*)				5	1	29	1	3	39	19.4
Ash (*Fraxinus*)		3	1	6		8	4	2	24	11.9
Holly (*Ilex*)	2	1	4	5		3			15	7.5
Elm (*Ulmus*)						8	4		12	6.0
Oak (*Quercus*)			4	1					5	2.5
Lime (*Tilia*)	1			2					3	1.5
Poplar (*Populus*)							2		2	1.0
Willow (Salix)							2		2	1.0
Birch (Betula)						1			1	0.5
Apple (*Malus*)									0	0.0
Dogwood (*Cornus*)									0	0.0
Total	**5**	**11**	**31**	**34**	**7**	**62**	**43**	**8**	**201**	

Table 6.11 Published identified species selection for plank pegs (Coles et al. 1973; Coles & Orme, 1976, 1979, 1984; Coles & Coles 1986)

The dramatic spike in the use of holly rail pegs at SWF (22.4% of all the pegs at this site), supports a view where the builders prepared the majority of the material beforehand, but again perhaps not all of it in occasional cases along the track with use of nearby trees. This flexibility is perhaps particularly highlighted by the use of split oak planks for the pegs used at SWTG and SWWA, in particular as at SWWA oak was used for 46.5% of all the pegs – a figure nowhere near replicated anywhere else on the entire track and perhaps suggests a plank was divided up. At SWD and SWF a few oak pegs were also used (n=4 and n=5 respectively), but here these were oak roundwood pegs from branches (Coles *et al.* 1973), which may either suggest manufacture on dry land beforehand or access to a tree during the build of this section.

Finally, the species selection for the large Post Track posts is very clear and of the 60 posts identified 61.7% were hazel. At sites such as SWD and SWF this proportion rises to 80% and 88% of all the posts at these sub-sites respectively. Overall, the pattern seems clear that large hazel roundwood was species of choice for the Post Tracks posts, some of it a considerable size of up to 3m in length and 200mm in diameter (Coles *et al.* 1973; Coles & Orme 1979). The dominate choice of hazel has a parallel with the peg choices and general species frequencies in the Sweet Track and suggests that this was the overall preferred species for the builders of both tracks, with the presence a of large hazel understory stands, managed or natural, in the surrounding woodland likely offering useful qualities of this versatile wood. Interestingly, Rackham (1979) and Morgan (1979, 1984) both noted that quantities of such large straight trunks of hazel are rare within a modern coppiced hazel woodland and may hint at some different resource management or natural structure to the woodlands of the Neolithic.

Site	**SWC**	**SWD**	**SWF**	**SWR**	**Total**	**%**
Hazel (*Corylus*)	7	12	15	3	37	61.7
Alder (*Alnus*)			2	7	9	15.0
Lime (*Tilia*)		1		3	4	6.7
Unidentified		1		3	4	6.7
Holly (*Ilex*)	3				3	5.0
Ash (*Fraxinus*)	1	1			2	3.3
Elm (*Ulmus*)				1	1	1.7
Total	**11**	**15**	**17**	**17**	**60**	100

Table 6.12 Post Track posts species identification (Coles et al. 1973; Coles & Orme, 1976, 1979, 1984; Coles & Coles 1986)

6.8.3 Pointed end morphologies

In this work 108 pointed ends were analysed in person, of which 98 were Sweet Track pegs and 10 Post Track posts. No ends of artefacts classed as the cut ends of the longitudinal rails were examined as these were only intended to be lain on the surface of the marsh and not inserted vertically or obliquely. For the purposes of comparison between artefacts, 100 could be identified to type of end point (i.e., wedge, chisel, or pencil) with the rest in too degraded, or inconclusive, condition. Fig 6.21 below shows how the majority of the finds came from SWD and SWTG, this reflects the nature of the limitations in the archive discussed above and the fact that more artefacts from these sites were preserved during the SLP programme resulting in large sub-sites such as SWF and SWR.1/ SWR.2 excavated early on by the SLP with few examples to analyse. However, this does still mean that artefacts from all the major sub-sites were investigated in this work, spread along the bulk of the trackway's length.

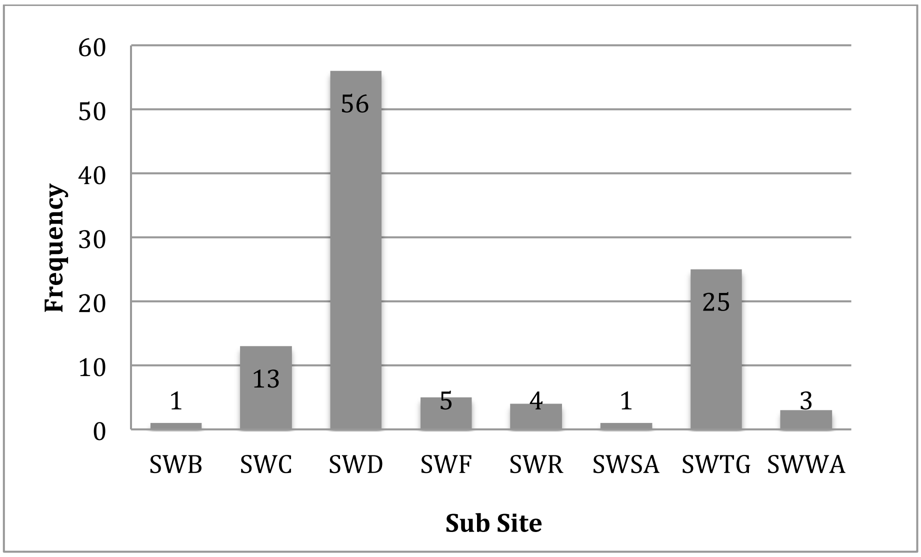


Fig 6.21 Number of artefacts examined from Sweet Track sub-sites

The initial impression from the published photographs and drawing from the SLP publications suggested there was likely to be relatively homogenous assemblage of pointed pieces at the trackways (Coles *et al.* 1973, Cole & Orme 1976, 1979, 1984). With the main difference being whether ends are chisel, pencil or wedge points in the scheme set out by Coles & Orme (1985b) and O'Sullivan (1996). Almost all the published images from those publications showed peg ends with axe facets measuring several centimetres wide and long, with slight cross-sectional dishing or scalloping that had morphologies consistent with the results known from experimental work conducted by the SLP to likely be product of polished axe working (Coles & Orme 1985b, 11-12).

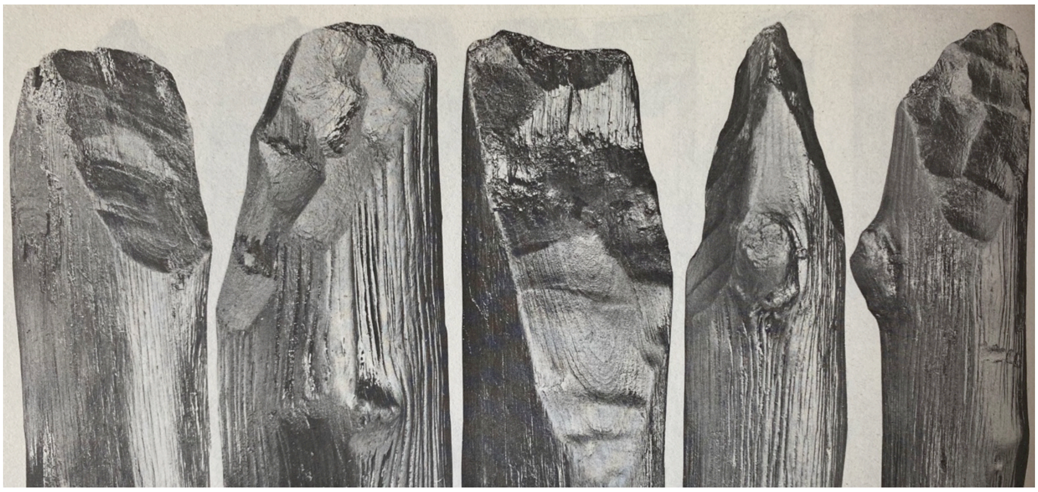


Fig 6.23 Pegs of hazel and alder from SWR. Artefact numbers not given (Photo J. M. Coles; Coles & Orme 1976, 54)

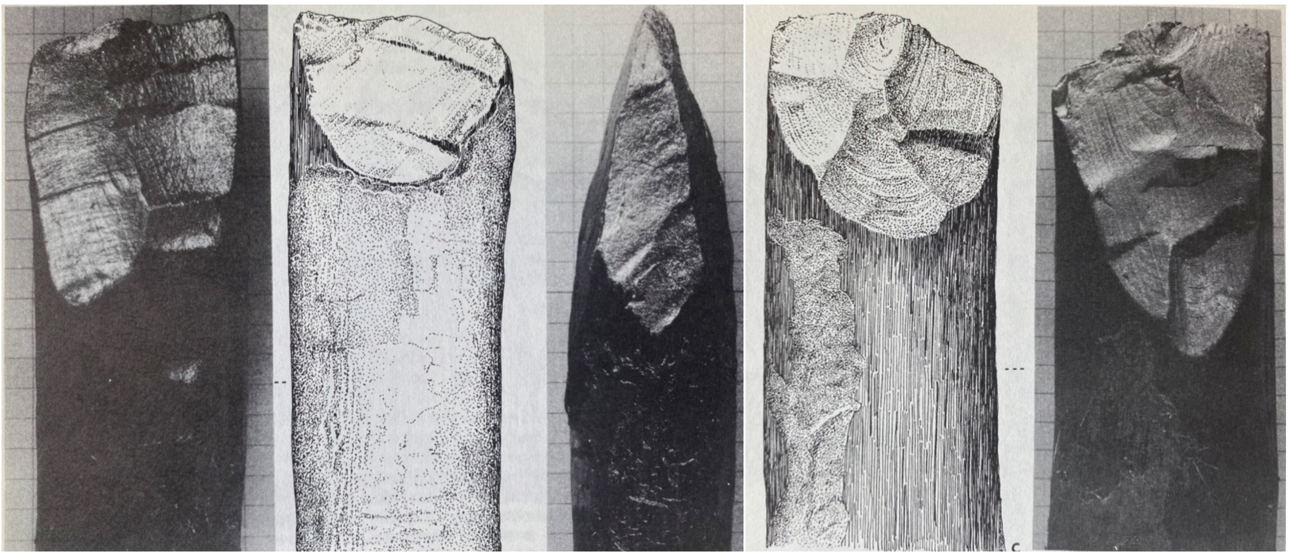


Fig 6.24 <SWR148> left and <SWR151> right worked to wedge points (photos of each side) and central one <SWR147> to a pencil end. (Photos J. M. Coles, drawings R. Walker; Coles & Orme 1979, 54)

Fig 6.24 Three rail pegs from SWR, from left to right two images of <SWR286> a pencil-end, two images of <SWR287> and one of <SWR289> to produce wedge ends. Diameter at based 65mm, 63mm and 70mm left to right (Photos J. M. Coles, drawings R. Walker; Coles & Orme 1976, 61)

However, subsequent analysis of the unpublished excavation sheets and preserved peg ends in the Taunton archive revealed that there were other end morphologies entirely unlike the published examples. As numerous examples of this type of working were gradually identified, it became clear that there was a different typology of pointed ends in the assemblage than only those with classic polish axe facets. By way of illustration of these artefact types, artefact <SWC34> from sub-site SWC was a very clear example of this type of working, and is proposed as a potential type artefact from this assemblage for other researchers to view this type of woodworking technique.

Fig 6.25 Two views of <SWC34>, showing long, wide facets with large removals and evidence of ripping of the roundwood fibres (the author)

Fig 6.26 A view of the largest facet on <SWC34> that measured 330mm long by 30mm wide and 2.5mm deep at its deepest point with a distinct cross-sectional curvature and sharp intersecting facet junctions. This is one long continuous toolmark, most likely started at the point of the piece and gradually rising to an end towards the stem. Its terminal facet end towards the stem showed evidence of ripping of the fibres (the author)

Fig 6.27 Second view of the distinctive and diagnostic toolmark type on <SWC34>, clearly entirely different from the toolmarks published by the SLP shown above (the author)

Fig 6.28 Showing how far up the stem of <SWC34> a single toolmark or slice removal can extend (the author)

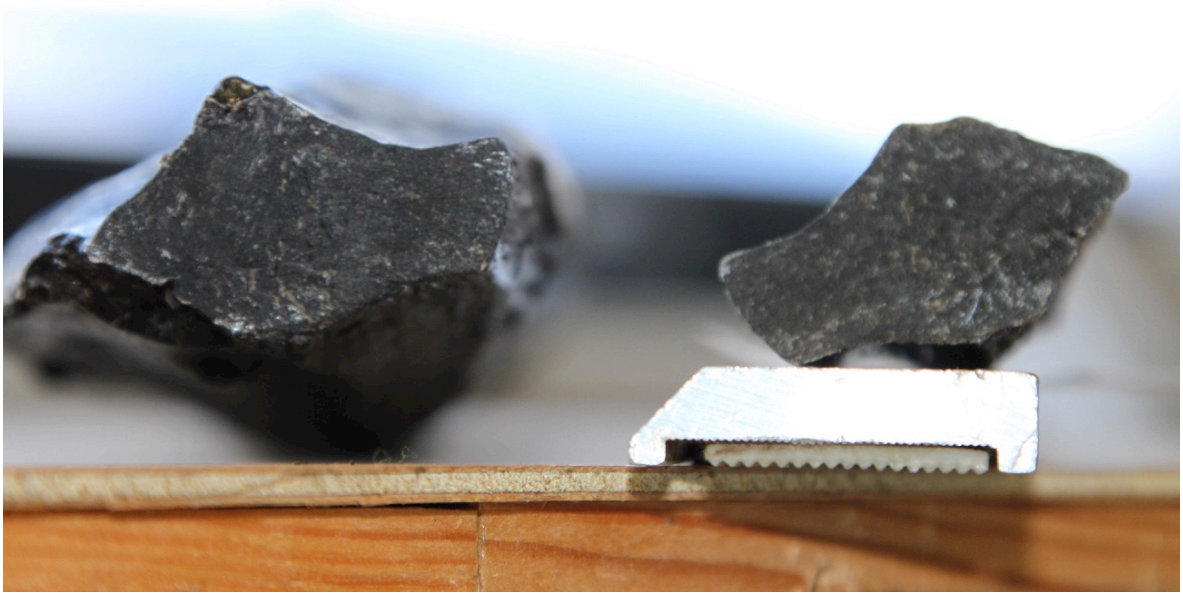


Fig 6.29 <SWC34> was broken towards the tip in antiquity or as part of the conservation process. Fortunately, this provides an opportunity to see the distinct cross-sectional curvature to the toolmarks that have formed to make it a pencil-end (the author)

A hazel pencil-end type pointed end, it measured 888mm long and 76mm in maximum diameter on excavation and was identified functionally as a rail peg with so-called ‘slashes’ type facets noted on recovery (SLP Taunton archive, Box 4).

Facet no.	**Max Length (mm)**	**Max width (mm)**	**Max Depth (mm)**
1	330	30	2.5
2	220	45	1
3	190	25	0.5
4	300	50	4
5	220	25	1.5
Average	**252**	**35**	**1.9**

Table 6.13 Facet dimensions from pointed end SWC34, Site C, Sweet Track. Artefact to be found in SLP archive Taunton artefact ID 130/1986/1369 also excavation sheet C34, BOX 4

On investigation it had five full facets in total, with the largest a complete one measuring 330mm long, by 30mm wide and 2.5mm deep. The estimated ‘entry angle’ of this largest facet was under 10 degrees, and the toolmark can be described as long, with a smooth facet surface, sharp facet junctions and noticeably dished in cross-section with evidence of ripping of the outer fibres towards the stem and away from the pointed end. This morphology was clearly very similar to the ones analysed and described in **Chapter 5** from Goldcliff Site T, and it is suggested here that a similar method of manufacture may have been responsible, and it can thus similarly be classed as a ‘cleave-end’ type pointed end.

Fig 6.30 Other examples of Sweet and Post track pointed ends with evidence of different amounts of the Goldcliff type of working, or cleaving of wood, all to remove large woodchips and produce a point. Left to right <SWC7>, <WRJX2> and <SWF70>. The differences in style and scope of the technique are apparent (the author)

On analysis it was also found that there were examples in the SLP archive of a third variety of pointed ends with the cleave-type working as shown in Fig 6.26. above, with examples that combine both the long facets typical of cleave-end working alongside those of probable polished axe working downwards towards the point of the object. In the Goldcliff East **Chapter 5** analysis this was described as cleave-axed type working. Artefacts such as <SWB38> from Site SWB had very clear evidence of this type of working. Identified as a hazel post with a wedge-end, it measured 1230mm in length and 95mm in maximum diameter on excavation. It had 16 facets identified in total, 12 of which could be measured, and six were of long, dish and smooth variety with evidence of ripping towards the stem. The largest toolmark was also complete and measured 270mm long by 50mm wide and 2mm deep, with an apparent 'entry angle' of 10 degrees. The other facets type present on this artefact were clearly very different, and comparable in morphology with the published polished axe facets identified by Coles & Orme (1976, 1979, 1984). This means it seems reasonable to suggest a similar 'cleave-axed' method set out **Chapter 5** was used to produce the point of this artefact. On examination many artefacts exhibited this type of dual working, with <SWT409> another example of some preliminary cleaving work followed by axe working to produce the final end.

Fig 6.31 Post <SWB38> with evidence of long cleaved facets and also smaller, polished axe type ones indicating cleave-axe working (the author)

Fig 6.32 Detail of both long cleave facets and polished axe type toolmarks on <SWB38>. It was unclear if the curved marks on the surface of the roundwood are excavation damage or prehistoric in nature (the author)

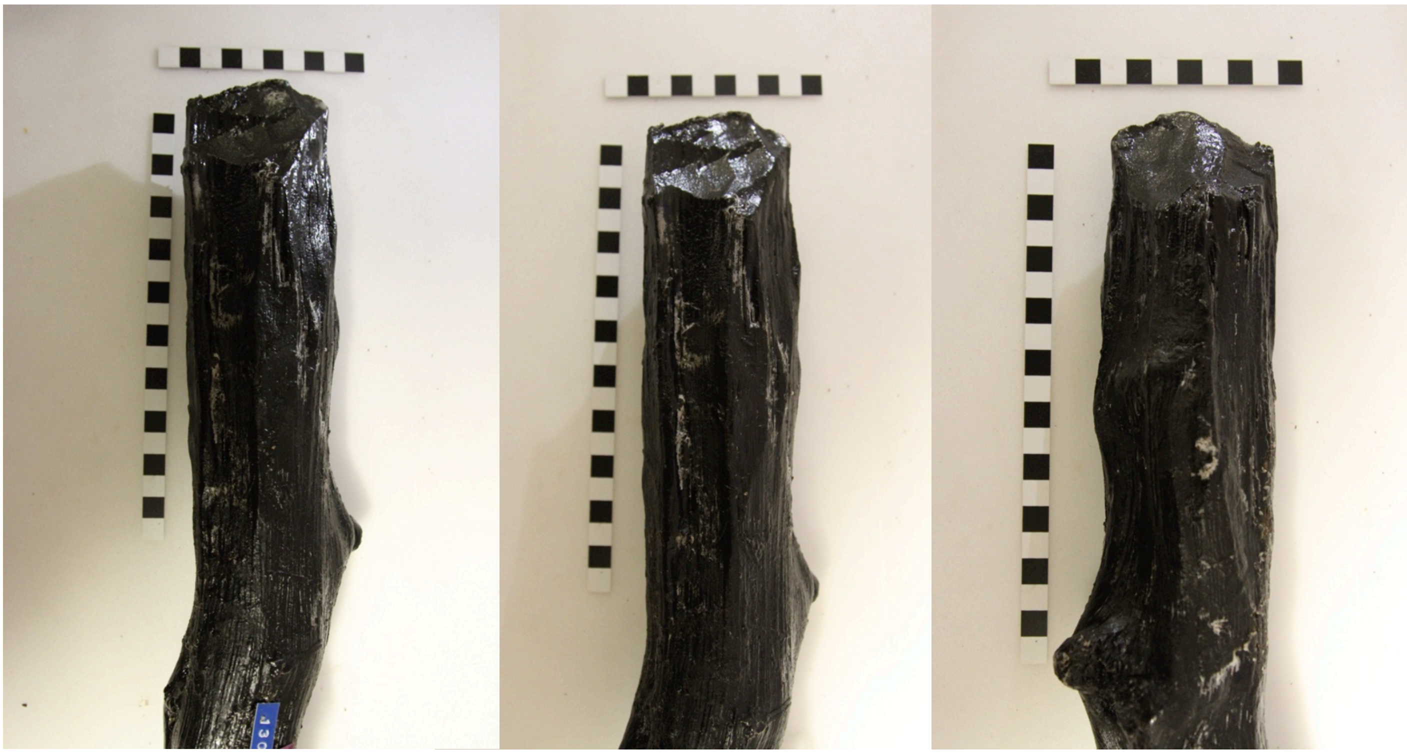


Fig 6.33 Three images of <SWTG409> with evidence of long slice removal (best seen on far side of image to the right) by cleaving and then working to a point using a polished axe in cleave-axed fashion (the author)

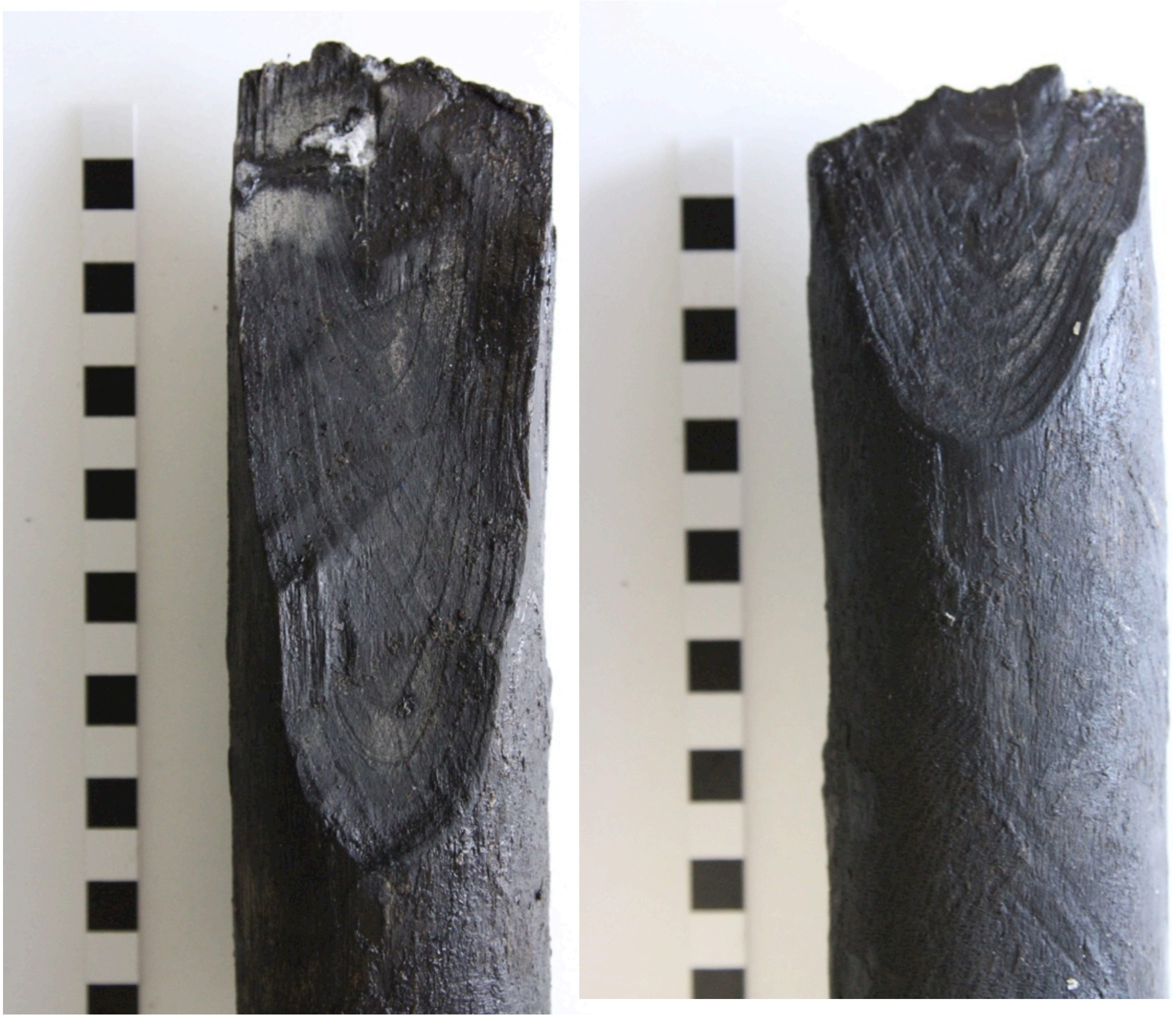


Fig 6.34 Artefact <SWC59> an example of polish axe type toolmarks down two sides ending in a wedge-shaped end (the author)

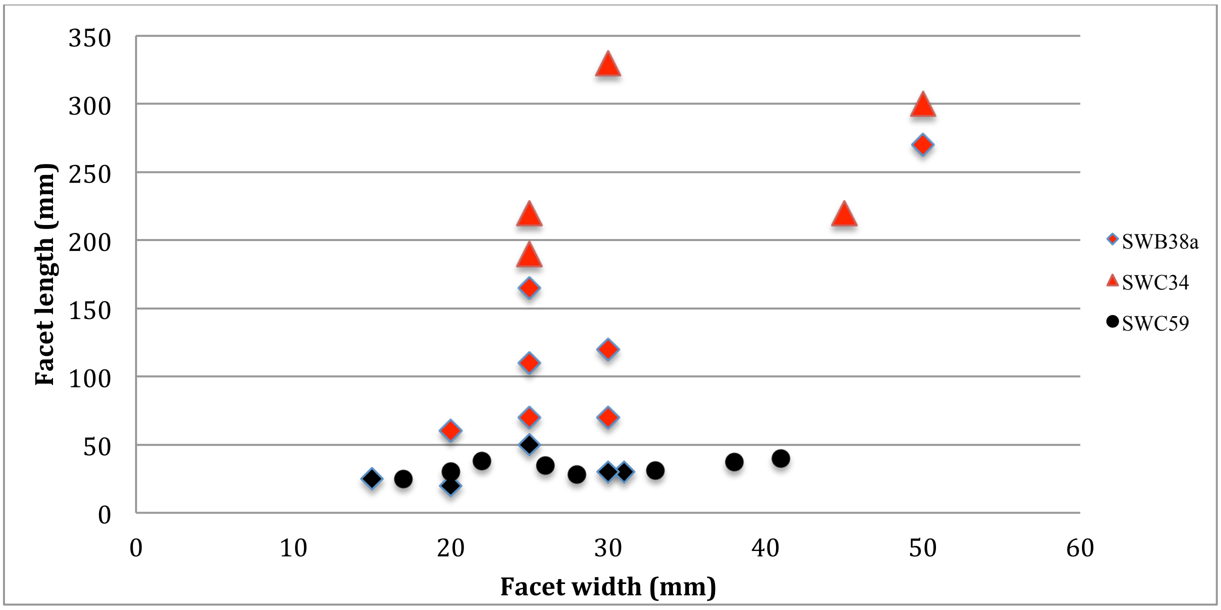


Fig 6.35 All the measurable facets from <SWC34> (red triangles), <SWB38> (blue diamonds) and <SWC59> (black dots). Red data point denotes a cleave-type toolmark and black a polished-axe type toolmark, thus cleave-axed <SWB38> exhibits both

With the goal of illustrative comparison, a scatter plot is shown above for the two cleaving pointed ends types and also the facet data from a different artefact type with only polished axe facets. Pointed end <SWC59> was an ash peg that measured 57mm in diameter with a wedge end and had 11 polish-axe type only facets down two sides to produce a point. Nine facets could be identified and measured, with comparative differences in toolmark sizes between these three artefacts clearly demonstrated in Figure 6.35 above.

The results from analysis of the complete pointed end sample subsequently showed the consistent presence of cleave-end type working along the length of the Sweet Track, with examples found at all the sub-sites in this sample apart from SWF and SWSA as shown in Fig 6.36 below. This can likely be accounted for by the fact that only five artefacts at SWF were examined and just one at SWSA. Sub-site SWD was the best represented in this sample, with 56 point-ends of the original 203 excavated analysed, which is 27.6% of the complete original assemblage. It was found on examination that 19 of those 56 pointed ends showed evidence of being worked using cleaving techniques, which is 34% of the available SWD sample. If this pattern was replicated near the same degree along the wider trackway it would suggest around a third of pointed ends were worked in this way. Of the 32 artefacts identified with cleaving evidence a majority at 65.6% exhibited the use of the cleave-axe technique.

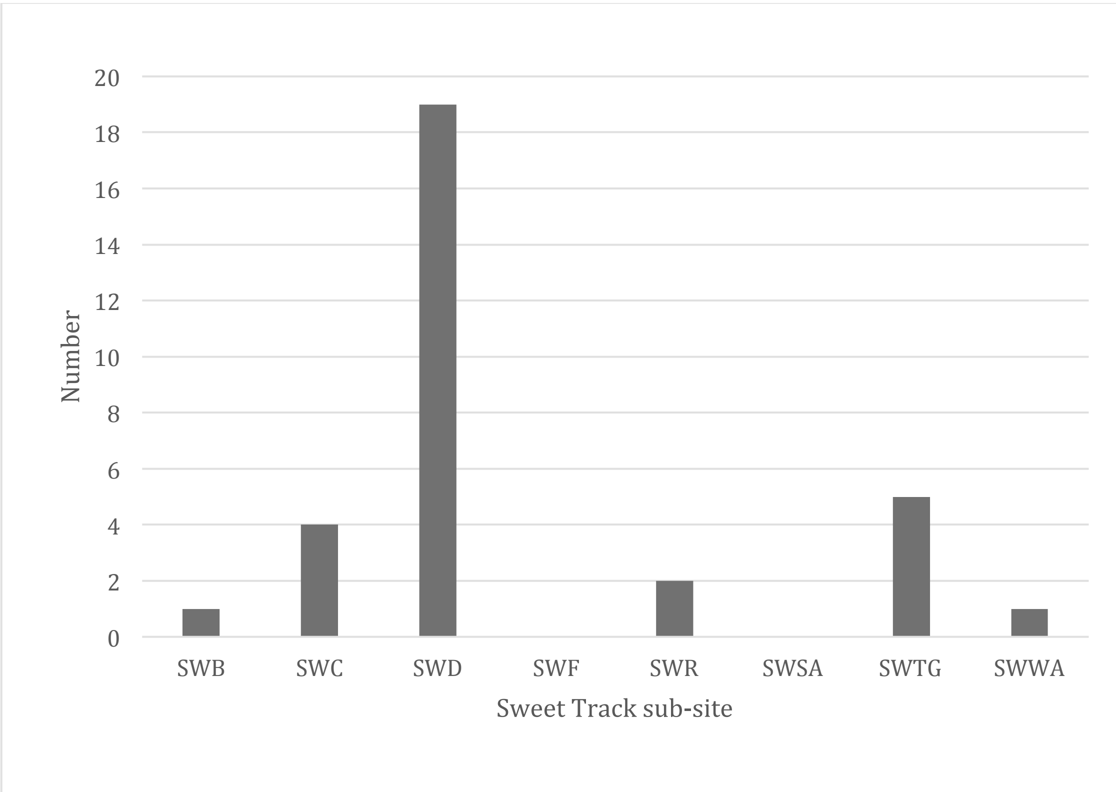


Fig 6.36 The number of examples of cleave-end working by Sweet Track sub-site in this sample

Evidence also suggests that not just pegs, but also Post Track posts, were worked using cleaving methods, with Post Track artefacts such as <SWC7>, <SWD409>, <SWRJX2> and <SWXXX> analysed by the author in the archive and having the diagnostic long facets of cleave-end type working. Of the small sample of 11 posts studied, five had cleave-end type facets. Overall, this firmly demonstrates that this woodworking technique occurred throughout the Sweet Track (as shown by <SWC34>) and also within the Post Track assemblages (as shown by the posts), and thus the method can be dated to the earliest Neolithic phase and structure at the site.

From the 100 pointed ends that could be identified to the end type, there seems to be fairly equal use of wedge-ends and pencil-ends in this assemblage, at 47% and 42% respectively. This pattern is repeated within the posts representing the Post Track assemblage, although the sample is small with only 11 examples examined in this study as stated above.

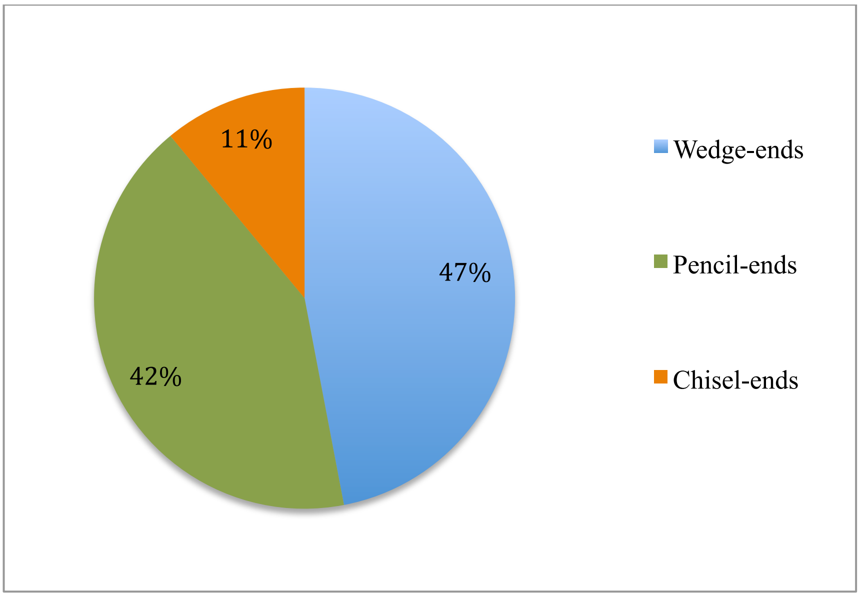


Fig 6.37 Overall end type frequency of all pointed ends in sample (n=100)

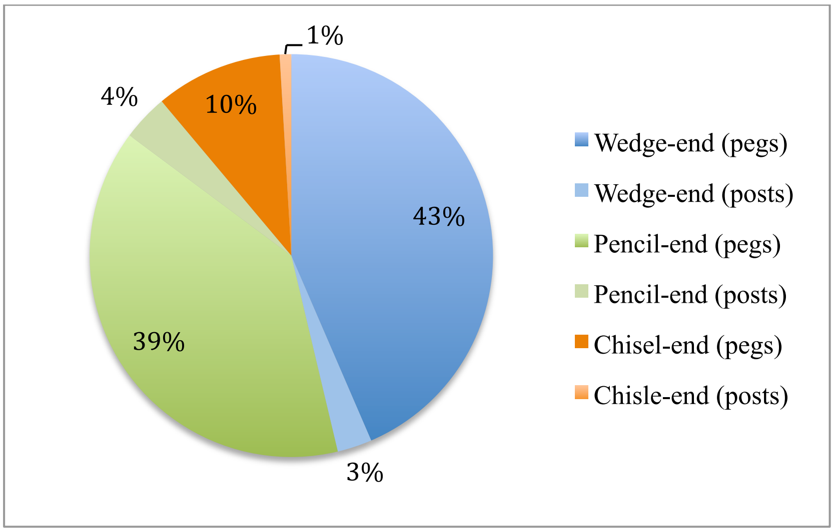


Fig 6.38 End type frequency by artefact type, Sweet Track pegs or Post Track posts (n=100)

However, as the different types of producing pointed ends have been recognised in this work it is useful to produce a more detailed breakdown of the end-type numbers against the type of working method. Fig 6.39 below shows that there is a clear preference (57%) for pointed ends made exclusively by polished axes to produce wedge-ends. Stems that were worked with cleaving techniques were also produced wedge-end to some degree, but the clear majority (68%) were made to a pencil-end type point. It thus seems clear that from this sample polished axe working tended to produce wedge-end and cleave-end working produced pencil-ends. There were also a few examples of chisel-end stems using both techniques, but the sample suggest that manufacturing pointed ends in this fashion was rarely undertaken whichever technique was being applied.

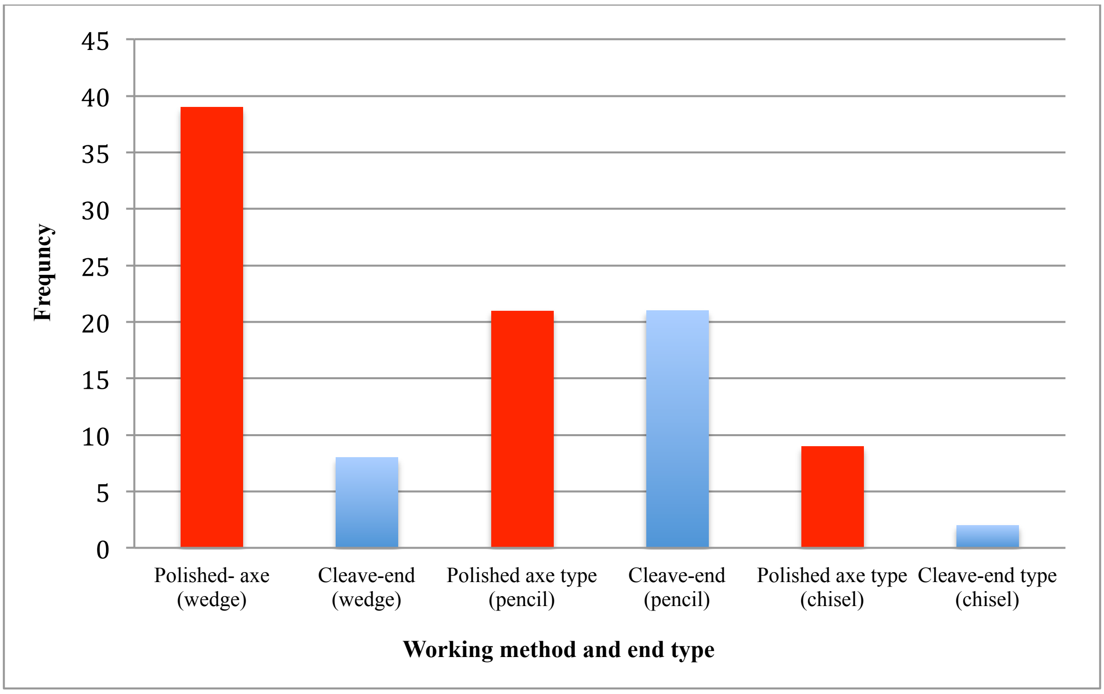


Fig 6.39 Showing the preference for end points against type of working

The reason that may account for the correlation in end types to techniques may be the size of the roundwood determining how a stem was finished; perhaps logically smaller pieces were suitable for conversion into wedge-end points using a polished axe. Larger, tougher stems perhaps required more work to reduce the circumference of the piece and required the use of cleaving techniques to remove substantial quantities of wood in one go. Fig. 6.40 below would seem to support that interpretation, as the stems with only polished axe facets are clearly smaller on the whole than those with the presence of cleave-end type working. If correct this suggests that the builders were applying a varied suite of working techniques to produced pointed ends as the wood dictated. Although there was certainly no totally rigid format as the two largest diameter pieces <SWTG196> and Post Track post <SWD100> in this sample were both a sizeable 120mm in diameter and reduced to a wedge point without any cleave-type working evidence. However, on balance it appears that smaller roundwood was suitable for axe work and larger stems needed more sophisticated cleaving techniques. A possible reason for the apparent selective use of cleaving techniques on larger roundwood could be related to function. Sharper ends are logically going to make it easier to drive in large posts than blunter wedge-ends, making it possible to secure such objects more deeply into resistant laminated sediments. The cleaving off of slices and facets is also likely to be a quicker method than attempting to reduce the circumference of large stems with a polished axe, as it uses wood's natural propensity to split as part of the method.

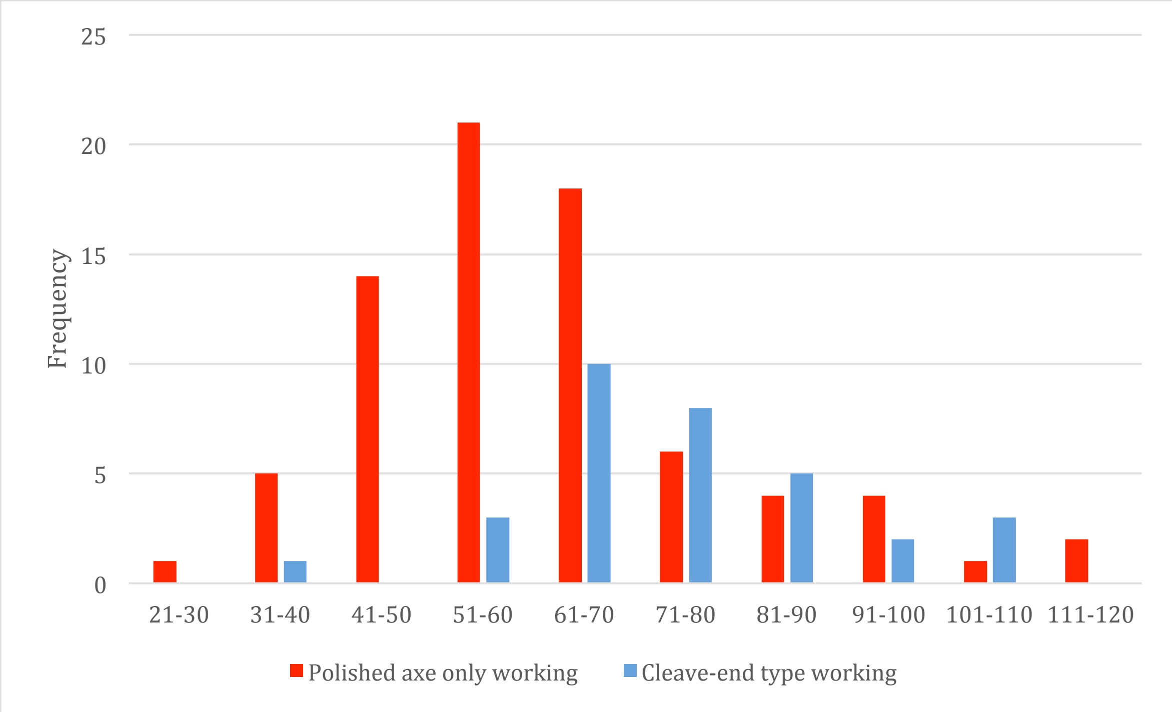


Fig 6.40 Results of how working type relates to the size of roundwood in the studied sample

6.8.4 Pointed end toolmark analysis

Of the 108 pointed ends analysed in the archive 23 had ends artefacts that were too degraded or damaged for any accurate facet measurements to be taken, although in some cases they were still usefully identifiable to the type of end as discussed above. Of the remaining 85 pointed ends, they all had the largest complete or largest surviving facet measurements taken in line with the methodology proposed by O'Sullivan (1996), that was shown by his work and the work of the author in **Chapter 5** to provide a balance between detail and a large enough dataset from comparable artefacts for useful analysis. Measuring every facet on each object was something not really feasible for every artefact when trying to balance data collection and time available in the archive as some objects could have anything up to 22 individual facets so samples were taken of the main types. 15 with only polish axe type working had each toolmark measured completely to provide a representative sample for that type. Four cleave-axed ends had all the identifiable facets measured, with the aim that this would help illustrate the clear difference in size between the two toolmark types even when present on the same artefact. Finally, cleave-end working as a whole was recognised on 32 pointed ends in this sample, of which 29 were in good enough condition to have facets both identified and accurately measured. 10 were cleave-end only working and had all their facets recorded.

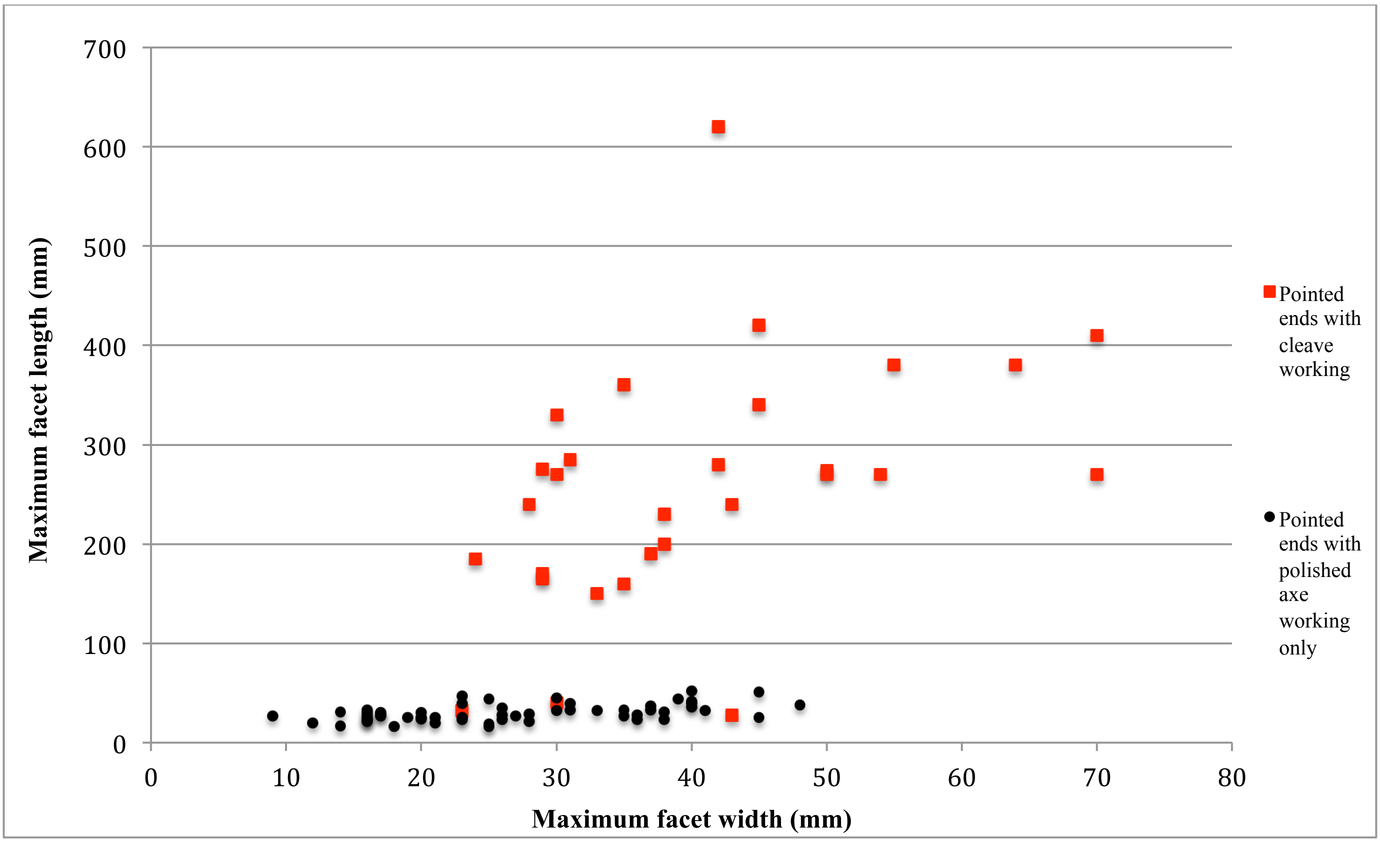


Fig 6.41 Showing results from the 'best' facet measurements for every artefact with identifiable and measurable toolmark. 'Best' facet being firstly the largest complete or then largest facet per pointed end, from all sampled pointed ends (n=85)

The results of toolmark analysis in Fig 6.41 above clearly show a consistent difference in the size of the 'best' facet per artefact. In the case of pointed ends with cleave type working, the vast majority of facets are over 150mm in length and 28mm in width, with most concentrated in the range of 150-360mm in length and 30-50mm in width areas. From this sample there were a few atypical examples, with some very long facets such as from artefact <SWD285> that was 620mm long and 42mm wide, or very wide facets such as those recorded on <SWTG1098> and <SWWA149> that were both 70mm in width. This illustrates the prolonged upper range of possible facet dimensions from cleave working. There were also three examples of reduced length facets from cleave-worked examples, from <SWD93>, <SWD90> and <SWTG299>, all under 40mm in length.

This is unusual for objects worked in this way and can be accounted for by the fact that all four of these examples had also been worked in the cleave-axe fashion, so these smaller facets were the result of using a polished axe to create the final point. Their presence in this dataset arguably highlights a methodological issue when using O'Sullivan's (1996) system for selecting only one facet per artefact, as if an assemblage contains multiple ways of working the roundwood to pointed ends his method can obscure the clear identification of cleave-working. However, given enough artefacts in the sample clear differences in the working type it should become apparent in the overall data analysis, as shown in Fig 6.41 above. For polished axe facets the measurements clearly sit very tightly in one group in terms of facet length, with no facet longer than 51mm, although there was a marked variation in width with some quite small. This can likely be the result of some facets only being the largest surviving example per artefact, which means in practice they will likely be incomplete. The largest facet in terms of width from this sample was 48mm wide, suggesting the blade edge of the largest polished axe used on these pieces may have been only a little larger than this.

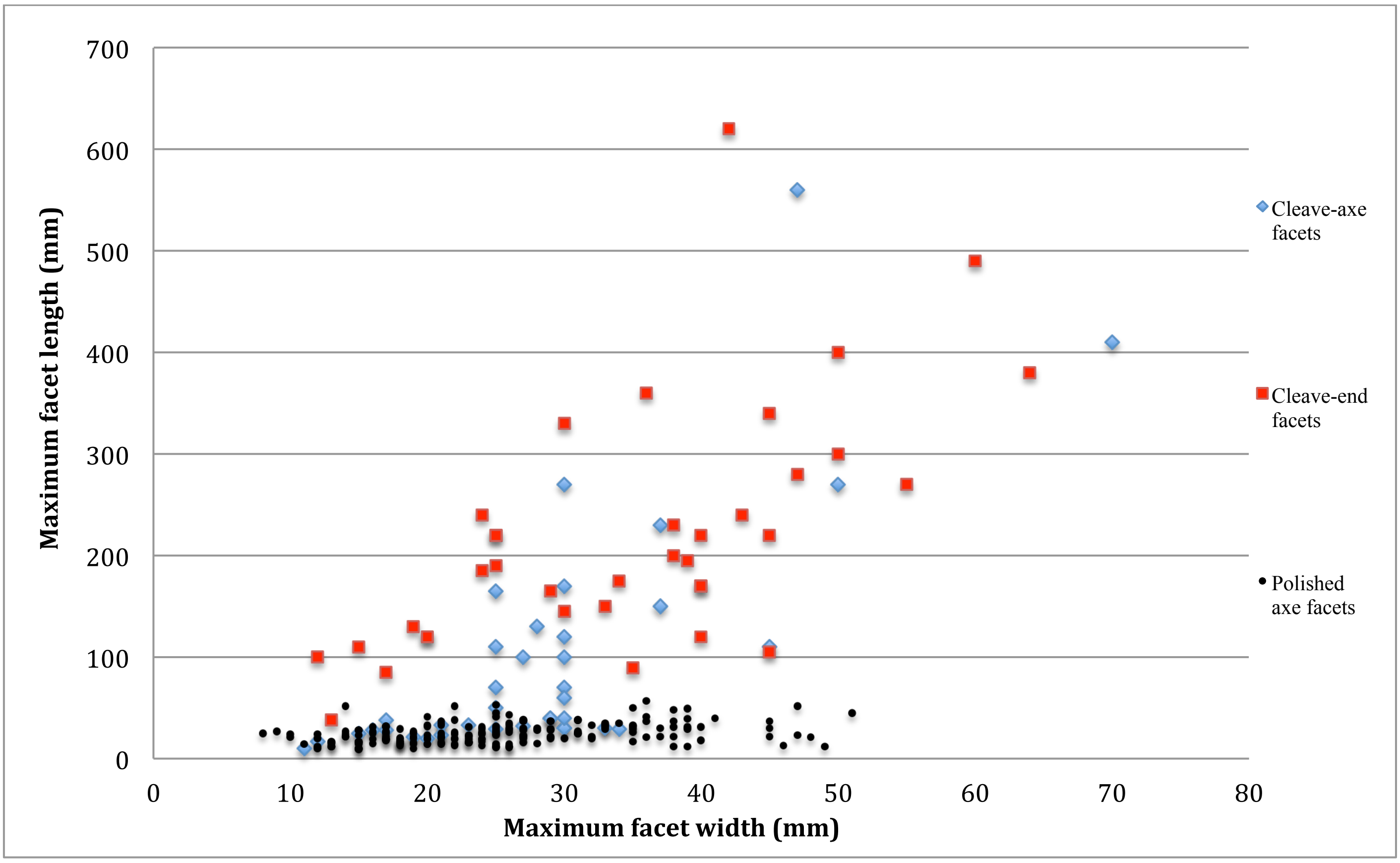


Fig 6.42 Comparative results from measuring all the identifiable facets on sample of cleave-axe examples (4 ends, 38 facets), cleave-end only (10 ends, 37 facets) and polished-axe examples (15 artefacts, 191 facets)

Another method to interrogate the data from toolmarks is to compare results from all facets measurable on pointed ends. Fig 6.42 above shows the results from a sub-sample of artefacts that were able to provide such multiple measurements from each object. The artefacts, their sub-site and the number of toolmarks is listed in Appendix I, but in summary includes four cleave-axe examples (with 38 facets), 10 cleave-end only examples (with 37 facets) and 15 polished axe only examples (with 191 facets). Using this type of data of every facet from an object is useful as it can provide better resolution to the range and variability of toolmark dimensions, and a way to check that the method of capturing only one facet per object, set out above, is not losing or creating an inaccurate representation of the traces. As can been seen from Fig 6.42 the results broadly support the previous toolmark analysis, with slightly more facets from cleave-end only examples found to be in the 85-120 mm in length range. The broad spread of cleave-axe facets (blue diamonds in Fig 6.42) reflects the fact that these items exhibit examples from both cleaving and polished axes as explained in the analysis above. From this sample there was only one example of a true cleaving facet of very small size from <SWC7> measuring 38mm long by 13mm wide. This was a truncated example and easily distinguishable in practice as it was narrow and small in length but had a pronounced cross-sectional curvature. The results from the sizeable sample of 15 polished axe pointed ends, using 191 measured facets, show a comparable tight correlation as already has been set out in Fig 6.42 above, with partial or truncated facets accounting for the small range of small sizes in terms of width but no example larger than 57mm in length. Again, there seems to be a clear maximum size to the width of polished axe facets, with the largest measured at 51mm and the vast majority 30mm or under. This reinforces the interpretation above for the maximum size of the axes being used around this size in terms of blade edge width.

Finally, there appears to be a slight separation in the plot for some polished axe facets, with nine of the 10 largest facets coming from eight individual artefacts and from the southerly sites of SWC, SWD and SWF. Conceivably, this could reflect the presence of a larger axe in this area, and perhaps not available elsewhere, that was making these pointed ends. However, this analysed sample was not able to equally sample objects from all the trackway, so it is also possible that simply more data is required from the whole site. Only five artefacts from the northerly SWR, SWTG and SWWA sub-sites were used in this polished axe sample and with sizeable facet variation when using ‘all facet’ data more examples is required to really understand if different particular tools are represented in the results.

6.8.5 Identification of cleave-end and cleave-axed working

In their analysis, Coles & Orme (1984, 14) describe the production of peg facets at the Sweet Track as 'a series of intersecting facets produced by a sharp *stone or flint* axe' (emphasis the author). The experimental work conducted as part of the SLP was explicit in describing their ability to produce similar facets to those observed on prehistoric wood, noting the dished shape and inability of stone axes to make shallow-angle facets (Coles & Coles 1986). Coles & Coles (1986, 51) were clear that 'the clarity of the facets indicates *a sharp bade* was wielded with precision' (emphasis the author) and attributed effectively this a single tool type to the manufacture of all the peg ends. However, the appearance of long facets, such as one on <SWD285> that measured 620mm length in 42mm in width is unlike anything that was produced experimentally by Coles & Orme (1985b). Instead, it suggests the presence of a woodworking technique or tools that were unrecognised in the original published analysis of the site. How or why investigation of this facet type was not made at the time is not clear, but the identification of these end types allows for useful original research in this study.

Of the 108 Sweet Track pegs and Post Track posts analysed in this work, 32 examples were identified with these types of long facets, which represents some 29.6% of the sample studied. This is intriguingly similar to the 34% of the 56 SWD sample that were made using cleave-end techniques. Allowing that the selected sample in this work is relatively small given the estimated 6000 pegs and 667 posts in the original two structures, it would still seem reasonable to suggest that cleave-end type working was an important component of the woodworking traditions in the build of the Sweet and Post tracks. This has been corroborated by examples being identified from both tracks and major sub-sites excavated by the SLP along the tracks. This strongly indicates it was not a one-off, occasional event, or use of a technique. That this type of working was also found in both trackways also demonstrates that this technique was a substantial part of the manufacturing process of pointed ends over a prolonged period of decades and can be thus confidently dated as part of the woodworking repertoire in the very earliest Neolithic communities of south-west Britain.

As discussed in previous sections, the current sample in this work is perhaps best described, as representative of the type of technologies being employed in the trackway builds, not necessarily the full extent or providing a clear picture of the detailed nature of working in each area. It cannot yet be said with any confidence if the use of cleave-end working was equally spread across the tracks or alternatively concentrated in specific locations for example. Given our wider understanding that there was a clear north versus south difference, with separate sourcing of split planks and roundwood (Morgan 1976, 1979, 1984), a useful area of future research would be to identify all the examples of this type of working in the excavated areas of the trackways and investigate whether trends and even perhaps specific working parties could be identified.

The large paper excavation record in the SLP archive was consulted at length by the author and proved to be of inconsistent use towards that goal, due to the nature of the information recorded at the time. However, usefully there is an extensive slide archive of the excavated objects that may help provide that data and could be analysed to identify working patterns by any future work. While outside the intended remit of this work, on physical examination it was also noted by the author that there was a surprisingly large number of partial jam curves identified (**n=33**), and even on occasion some that may have been essentially complete with more detailed study. The largest of these measured 43mm in width with examples of this size on <SWXXX> and <SWF70P11>, so considerably smaller than the suggest maximum blade edge tentatively suggested by toolmark analysis in this work. However, as finding such traces was something stated as highly unlikely based on the work in other previous comparative toolmark studies and analysis (Brunning 2007c; O'Sullivan 1996; Sands 1997), the number that survived seems unexpectedly high and it is proposed as a possible useful avenue of research outside of this work to see if more information can be gathered from these traces. Coles & Orme (1984, 13) also originally proposed that it is logical that certain assemblages of pointed ends would have been made by the same person, and it seems feasible that if more comprehensive samples could be studied from particular sub-sites we may be able to identify the presence of individual tools and even working styles.

6.9 Woodland resource management

The management of woodland resources and ecological impact of humans is an important aspect to understanding the complexity of Mesolithic and Neolithic woodworking activity in the landscape (Warren *et al.* 2014). Towards that goal an examination and interpretation of coppicing evidence was undertaken by Rackham (1979), with analysis of samples from SWD that he proposed represented probable evidence of coppicing, at least for the hazel poles and rods, and less certain but possible for the ash and oak poles. Rackham (1979, 59) cited there was only one actual example of a classic coppiced 'heel' from the sub-site SWD, with it appearing that most wood had been cut above the stool. This was interpreted as the result of the 'chop-and-pull' method of felling straight stems likely impractical for the larger diameter rods and poles, thus reducing the chance of finding diagnostic features on these pieces (Rackham 1979, 59). Of the ash poles examined (the sample size was unspecified) they were reportedly generally straight and uniform, fast grown and with few knots. Their wide first and second rings indicate vigorous regrowth and their overall morphology would suggest poles rather than individual young trees (Rackham 1979). There were also quick growing oak poles (the sample again unspecified) of underwood, which if representing intentional management is a woodland technique only previously known from much later periods that exhibit slightly less straight, but also fast-grown, morphologies (Rackham 1979).

Finally, hazel poles and rods (sample again unspecified) were noted as larger than those found in modern managed woodlands, but generally looked reasonably fast grown and broadly similar and consistent in morphology to suggest some form of selective sourcing or management (Rackham 1979). For the Post Track, possible evidence of coppicing of hazel posts at SWC was recorded in the excavation archive with artefacts having features described as 'straight uniform stem, no side branches' (Excavation sheets, Box 4, SLP archive Taunton). Posts <SWC2>, <SWC4>, <SWC5>, <SWC6> had 'straight, uniform' morphology while <SWC8> had evidence of being 'grown close to several others' as in a coppiced stool (Excavation sheets, Box 4, SLP archive Taunton).

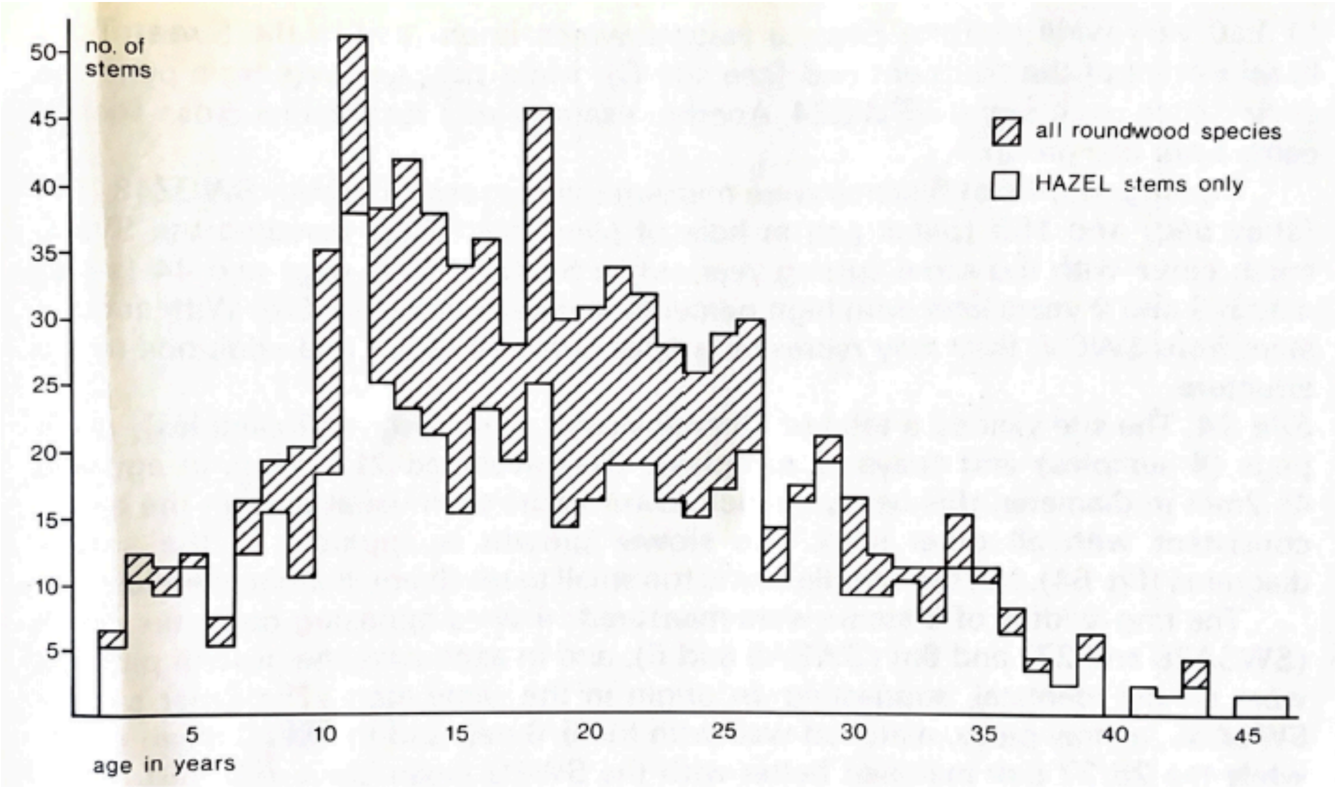


Fig 6.43 The age distribution and frequency of roundwood from along the excavated Sweet Track sites, with most aged 10-26 years of age (from Morgan 1984, 55)

Tree-ring analysis work by Morgan (1976, 75) suggested that at SWR features such as use of young trunks with central pith, no side branches, a corresponding winter felling, uniformity of number of rings and growing pattern lends itself to some form of woodland management or coppicing. At SWR, Morgan (1976, 75) stated that from an ash peg sample (**n=103**) the ages ranged from 9-66 years, with 80% clustered between 12 and 26 years. An alder peg sample (**n=40**) had 59% between 18-26 years old. Tree-ring evidence from 540 hazel roundwood samples from sites across the Sweet Track sites indicated apparent peaks at 4/5 years, 11, 18 and 25 years (**n=860** total sample) (Morgan 1984, 54). The average age of the roundwood sampled was found to be 18.2 years. This pattern of increased felling at seven year intervals of roundwood (from 4/5 years old onwards), against a residual background of a variety of other aged stems does seem to reflect a statistically important repeated pattern, possibly natural but given the quantities of roundwood involved arguably more likely human caused. Morgan (1984) suggested that modern-day traditional hazel coppicing work normally on seven-year cycles and that this evidence might suggest that a version of this practical system may have a long history of use.

At SWTG, for example, there was a clear peak from a large sample (**n=291**) at year 11, strongly suggestive of the clearance of a stool or area of hazel of similar age, though whether this stool was the product of natural re-growth from say a previous tree fall or from planned human organisation is unknown. Other growing evidence included material from SWQV where tree-ring analysis showed 17 of the 39 hazel roundwood stems analysed were identified as having a very narrow outer ring. This was tentatively suggested as evidence of an almost stop in growth as often seen in coppiced hazel stools where some stems fail to grow in competition for light and are then cut down (Morgan 1984, 55). Morgan (1984) also proposed that the variation in results from the large hazel roundwood sample (**n=540**) across all the sub-sites of the trackway indicated that diameter was not the principal concern, and the builders were pragmatically using anything over 35mm in diameter that did the job as pegs. However, it is worth noting that similar result is not universal throughout the Sweet Track, at the southern SWD site a sample of 41 ash stems used as pegs exhibited no 'close concentration of even-aged stems' and a wide variety of growth rates, and thus not what would be expected under a managed coppiced system (Morgan 1979, 71). This specific picture at SWD was supported by the hazel stem evidence (**n=105** samples), where a wide variety of ages was recorded and seasonal cutting inconclusive, suggesting no obvious coppicing system used for this sub-site's material in a manner we might understand or use today (Morgan 1979, 72). Potentially, this may relate to the different geographical sourcing of the trackway wood as discussed above (north versus south). If accurate it would also raise interesting questions as to why, if the Polden hills and southern areas was more intensively used, settled, and cleared in the early Neolithic, was the best evidence for a version of woodland management coming from the north on Westhay island? A problem not explored further in this work, but it remains to be properly understood.

Overall while the morphology of rods and poles seems to suggest that much of the hazel, ash and even oak underwood was growing straight and fast, it does not categorically demonstrate why. There has been critique by a number of authors such as Brunning (2007c), Crone (1987), Out *et al.* (2013) and Warren *et al.* (2014) on jumping to conclusions and seeing evidence of woodland management without grounding in robust modern and archaeological datasets and clear parameters. Brunning (2007c) and Warren *et al.* (2014) rightly point out that agency such as storm damage and tree fall, grazing herbivores and even beaver action can lead to natural regeneration of fast-growing straight stems. Crone's (1987) work on the age structure of modern coppicing system from 16 stools showed a very distinctive age structure with 54% of the stems 10 years old. She suggested that the roundwood profiles of early Neolithic wood from the Somerset Levels suggests something only partially comparable, more ad-hoc and opportunistic than that of a clear system. However, this is something Rackham (2006) thought not necessarily mutually exclusive, proposing semi-organised draw felling as perhaps a specific Neolithic practice instead of the fairly rigid coppice system that we might see in British woodlands today as described by Tabor (2012, 2013). Brunning (2007c, 63) agreed that while coppiced hazel stools were seemingly being used from the Neolithic, it was unlikely to be within a formal block rotation system as practised today, something that is purposefully designed for regular mass production of large quantities of stems for things such as charcoal. One possible further factor worth considering is that there were additional benefits to hazel as a species such as using nuts for consumption. Something directly attested to by sizeable quantities found along the Sweet Track and even associated with broken bowls at SWR (Coles & Orme 1976), which would of course make the controlling of such a versatile species a desirable proposition and thus management of this resource a logical aspect for Neolithic communities. It is also conceivable that access to suitable stems could also have been an indirect, unintended, by-product of the clearing of woodland for other purposes such as farming, resulting in stumps that then would then produce rapid re-growth. However, on balance, given the quantities of broadly comparably sized roundwood pegs alone at c.6000, it would seem reasonable to suggest organisation of some kind existed to ensure the supply of these useful stems. Analysis of the Sweet Track worked wood methods in this chapter has clearly shown an extensive knowledge of woodworking and varied use of wood species properties existed in the early Neolithic, so it would seem reasonable to see a form of woodland management as part of that general skillset.

6.10 Review of use of wood: Sweet and Post tracks

The core function of the Sweet Track was clearly a raised pathway across the wet reedswamp facilitating access between two dryland areas. Creating and maintaining this connection between the dryland areas was of significant importance for the placement of at least two trackways in short succession, with the Post Track likely an earlier phase built in a less rigid form. In both cases the tracks only lasted for a relatively short time, the Sweet Track perhaps weathering only as much as a decade of use before coming apart and being consumed by the rising peat. Memory and use of the path may have survived better than the actual structure with hazel post tops and colonising birch trees providing a visible and more solid route across the later reedswamp (Coles & Orme 1984). It is also possible that more uses than simply human traffic may also have been possible, with insect analysis at SWTG cited the presence of dung beetles at track level in amounts thought unlikely to be natural, possibly indicating livestock were being transported along the trackway (Girling 1984, 87). Published experimental work of reconstructed versions of the trackway illustrated that while inherent design flaws seem to reduce durability (Brunning 2007c, 2016) it did allow the trackway to fit together well, producing a strong and stable structure that was able to take the weight of several people and thus potentially larger animals as well (Coles & Coles 1986; Coles & Orme 1984b). Interestingly, the apparent lack of understanding for designing appropriate structures for use in wetlands does not appear to be due to any obvious deficiency in woodworking technology per-say. The reason behind its seemingly unfortunate design, but using relatively sophisticated woodworking, remains an intriguingly open question as a result.

Work by Morgan (1976, 1979, 1984) demonstrated that wood used in the trackways was clearly sourced from different areas, with the vast quantities of rods and poles with similar growth patterns and morphologies making it a reasonable proposition that there was management of woodland resources in some form (Brunning 2007c; Morgan 1979; Rackham 1979). At minimum this may have been an ad-hoc by-product of other activity in the landscape, although sourcing of materials combined with the trackway design arguably all points to a sophisticated level of community organisation, planning and resource management. This all involved a clear pattern of careful design and timber selection alongside the probable recycling of older disassembled structures already present in the landscape. Future in-depth study may even possibly reveal the demolished remains of other complex demolished structures reused and hidden within the larger trackway assemblages as at SWF (Coles *et al.* 1973). The published and unpublished project archive evidence has illustrated that the timber shaping and manufacture, along with possible felling of useful nearby trees, also took place on-site during the build. Combined with protracted sourcing of some of the roundwood as indicated by Morgan's (1976, 1984) tree-ring analysis a rapid build, perhaps just a week-long, as originally proposed by Coles & Orme (1984b) may not properly reflect the overall complex history of the constituent parts and wider considerable community effort involved. Overall, the sophistication of the woodworking technology and practices outlined above reveals a community with a wide range of skills, able to use and work all species of trees as the situation required.

Outside of its primary function, authors such as Bond (2004) have highlighted the possible ritual aspects to the Sweet Track. With Brunning (2016, 38) stating 'it is also the oldest religious monument in the country…the focus for the votive deposition of a wide range of artefacts'. Artefacts like the rare Alpine jadeite axe at SWR, and an apparent increased density of portable finds or offerings such as pottery, pins, toy axe and assorted wooden objects at the sub-sites of SWF and SWR when compared with other British Neolithic trackways, point to this interpretation (Coles & Coles 1986; Bell 2020). Their concentration in the middle of the trackway strongly suggests something more than simple accidental loss (Brunning 2007c, 2016). Farrell *et al.* (2019) have also speculated that perhaps given the evidence for relatively minor early Neolithic woodland clearance in the wider area, the mass felling of trees for the Sweet Track also raises the relative importance of its construction and significant as a structure. This may all indicate more cultural complex use and importance than has been recorded and examined at other comparative British early Neolithic trackways, something usefully examined recently in detail by Bell (2020). However, a note of caution is warranted here – the Sweet Track was excavated far more extensively than any other example but even then in some of its areas almost no small artefacts were found. So not all the trackway is equal, and it is possible that comparative artefact rich areas may have simply been missed in other sites. Additionally, to divide early Neolithic activity too neatly into functional and perhaps 'ritual' spheres misses the likely inter-linked complexity of how people lived, worked, and perceived their wetland edge landscapes. Planning, building, and using the track may have been both symbolic and ritual to users while also fulfilling necessary practical and functional needs – a point argued by Coles & Orme (1979) some time ago.

The rich range of traditionally Neolithic finds found at the Sweet Track (pottery, leaf-shaped arrowheads, polished axes), along with the secure early Neolithic dendrochronological dates, has also tended to obscure its potential proximity to the earlier cultural Mesolithic community (Bell *et al.* 2015). Coles *et al.* (1970, 145) and Coles *et al.* (1973, 278) originally suggested that there was the possibility of cultural and human overlap with that community and Sweet Track. They highlighted that at Shapwick Burtle there was no clear evidence to distinguish an early Neolithic flint tradition from a 'prolific' late Mesolithic one, and that Neolithic groups were perhaps following the established interests and lifestyle of preceding hunter-gatherers accessing resources on Burtle and Westhay (Coles *et al.* 1973, 277). Recent work by Bell *et al.* (2015) again reviewed the evidence for late Mesolithic activity, with new investigations recovering *in situ* flints and identifying the survival of relevant waterlogged late Mesolithic layers. In particular, their work near the southern site of SWB on Shapwick Burtle suggested that this area may well be a profitable place to investigate activity around the transition period itself (Bell 2015b). Intriguingly, towards the north of the Sweet Track there is also good evidence Mesolithic organics and even structures await investigation. A SLP radiocarbon date of 4780-4570 cal BC (HAR-4541) for three pieces of unworked oak 'from a single tree' was found on the alignment of the Sweet Track at the 'field boundary of SW/X/Y on Sweet Track alignment' (Box 48, SLP archive Taunton; Coles & Dobson 1989, 65). This is close to the logical position of the Sweet Track northern terminus and hints at what may be preserved in the area. This area is now scheduled (Cole & Orme 1984) and it may offer rich rewards to any future investigations of the termini and relationship between the Mesolithic to Neolithic communities.

Related to Mesolithic evidence and the wider transition debate discussed in **Chapter 2**, one important product of in-depth analysis in this work was the recognition that examples of pointed ends existed along the Sweet Track with facets unlike the typical polished axe types commonly associated with the trackway and normally mentioned as the most diagnostic feature of Neolithic woodworking (Coles *et al.* 1973; Coles & Coles 1986; Coles & Orme 1976, 1979, 1984). The combined characteristics in terms of length, width and cross-sectional profile of these facets is strikingly similar in morphology to the 'cleave-end' types observed from Goldcliff East as previously detailed in **Chapter 5**. While there was also certainly good facet evidence for the use of the classic polished Neolithic axe in the Sweet Track, analysis of the pointed ends from the Sweet and Post tracks suggests that there is at least one more, potentially non-lithic, tool type being used to work wood.

This analysis has demonstrated the consistent presence of these two distinct woodworking techniques spread across the Sweet and Post tracks. Potentially even occurring in as much as a third of pointed ends if the sample from SWD can be extrapolated across the whole trackway. As noted above the apparent preferential use of cleaving techniques on larger diameter stems may logically reflect a functional need to produce sharper points more easily. This again points towards a sophisticated understanding of woodworking by the early Neolithic builders of the trackways, and an ability to adapt their methods as the task required. Overall, the identification of wood tradition comparable to that of Goldcliff East and the Mount Dillion Bogs described in **Chapter 5** is a significant result. Expanding the known range of early Neolithic woodworking techniques and even potentially linking late Mesolithic and early Neolithic organic material culture technological practices in this area of north-west Europe. A more comprehensive review of the possible implications is set out in the **Chapter 8**.

Outside of the trackway assemblages, Coles & Orme (1979, 64)'s observation that, 'we do not know precisely why the Sweet Track was built in this exact position, nor the character of the settlement it served' is arguably as relevant now as it was some 40 years ago. Future research would be well spent in tying the arguably the most important Neolithic wooden structure in the country into its wider settlement and cultural context. Bell *et al.* (2015)'s recent work has shown that substantial early Neolithic occupation on the dryer Shapwick Burtle towards the south of the site is unlikely just for example. Given the clear evidence for a north and south sourcing of its constituent parts as discussed above, it would be well worth trying to identify the associated settlement(s) and the communities involved in the build, given these are likely to have been some of the earliest Neolithic ones in south-west Britain. Could the build, and movement of people, have originated from Westhay island southwards for example? If correct, this would have interesting implications for our understanding of how the earliest occupation of the area by Neolithic groups developed. Alternatively, the distinctive presence and use of quick-growing 150-year-old oaks in that southern part of the site provides a reasonable proxy for some form of landscape alteration a few generations before the build. Possibly this could represent the first substantial appearance of Neolithic communities in the area as tentatively proposed by Coles & Coles (1990). Although we should not discount Mesolithic people being responsible, as wetland edge environments are known to have sustained communities using a hunter-gatherer lifestyle long after the emergence of nearby Neolithic lifestyles in Germany and the Netherlands (Louwe Kooijmans 2007) for example. The persistence of a comparable community may have been feasible in the ecologically rich Somerset Levels and more work on this may produce important results for further understanding the nuance of transition period in this area.

Finally, leaving to one side the fascinating complexity of the Sweet and Post tracks themselves, a final recommendation from this re-analysis would be that there is a case for an up-to-date publication or resource that brought all the information, published and unpublished, together in a more accessible format that is currently available through the different publications and unpublished elements of the SLP archive in Taunton. This would do justice to the vast amount of information from the site to make it still a relevant undertaking. The analysis of the assemblage in this work has shown how farsighted the decision of the SLP to preserve the large sample of the excavated wood actually was, with the collection holding substantial potential for further research into woodworking technology. Given the technological developments in 3D laser scanning and photogrammetry, it would seem timely for these artefacts to be made more easily accessible for other researchers in the future and help promote the importance of this exception internationally important assemblage.

Chapter 7. Experimental programme: woodworking of Mesolithic and early Neolithic pointed ends

7.1 Introduction

The discovery and analysis of the pointed ends from the case-studies in this work has raised a series of specific morphological and technological questions about how they were manufactured. As noted in the case-study analysis of **Chapters 5** and **6** the toolmarks on those artefacts have a distinctive and consistent morphology that can be described as long, with normally smooth surfaces, sharp facet junctions, deeply curved in cross-section, and often with evidence of ripping of the outer roundwood layers towards the rest of the stem. That previous analysis also showed that examples of such pointed ends from Goldcliff East (**Chapter 5**) were not alone, with other morphologically similar examples identified from the early Neolithic Sweet and Post tracks (**Chapters 6**). In that context, this chapter sets out the steps undertaken to answer the following questions to assess the manufacturing and traces of these particular toolmarks on archaeological wooden artefacts.

i. Can the manufacturing method responsible be identified?
ii. Is it possible to identify the type and size of tool being used?
iii. Were the same tool(s) and/or method(s) responsible across the different case studies investigated in this work?

7.2 Role and purpose of experimental archaeology

Experimental archaeology is a research discipline where hypotheses about artefact use, function or manufacture can be tested against a range of probable solutions to better understand human behaviour in the past (Coles 1973, 13). Study methodology should be specific to the tools, raw materials and activities of the period being investigated. It requires the use of (a) planned, (b) controlled and (c) recorded experiments to test hypotheses in order to understand the observed nature of artefacts and features recovered from archaeological sites. All three aspects are important, as firstly any experiment must be relevant to the time period in question, and therefore a study must be (a) 'planned' to use appropriate tools, materials, and techniques in order to test functional ideas about artefacts in specific period. Point (b) 'controlled' is important as any experiments should only work within the confines of what has been planned and organised; if the intention is to investigate the pointing of freshly felled roundwood hazel with a core flaked axe then the experiment must only test for those conditions. Swapping green hazel for seasoned oak or using a polished axe halfway substantively alters the experiment and must be recorded as such. Finally, work must be (c) 'recorded' and described, including the range of methods, tools, techniques, materials, results, and variables, so the researchers and other studies can analyse the work, learn from its outcomes, or identify problems where necessary.

In this way, it not so much the results of each individual experiment itself that is used to interpret archaeological finds, but rather the cumulative development of practical knowledge and production of experimental results tested against controlled different parameters that provides a comparative collection and knowledge base to compare with archaeological artefacts. It is ultimately the ability of other researchers to recreate the conditions of experimental work and repeat the process to achieve the same results that will validate the study and its results. The description of some of the important methodological aspects and variables that are relevant to this study are outlined in this chapter to enable this particular work to be judged against the three main criteria set out above and thereby hopefully provide robust data for wider academic discussions.

7.3 Previous woodworking tool mark studies

It has been noted by experts in British prehistoric woodworking such as Harding (2014), Taylor (2011) and Taylor *et al.* (2018) that there is a glaring lack of knowledge about actual stone tool efficacy, techniques, wear traces, by-products, and overall woodworking technology for the early prehistoric periods. On further review of the literature, it can also be said that there has been something of a lopsided approach to investigating the function ability and traces left by possible range of pre-metal periods tool used for working wood. Tool types such as polished stone axes have received considerable experimental attention and testing, with Mathieu & Meyer's (1997) review some time ago citing some 26 separate publications on aspects of polished axe tree felling alone. It is thus perhaps more accurate to say that investigation of the wider range of methods has until recently been limited, with the contribution of organic tool types in the woodworking toolkit only slowly becoming fully appreciated.

Older but very relevant studies to this work were the well-organised and recorded experiments to test Neolithic type polished stone axe function and woodworking results of Jorgensen (1953), Iversen (1956) in Scandinavia and Harding & Young (1979) in Britain that showed the effectiveness, felling rate and type of toolmarks left behind. Practical experience gained through use of tools in these studies suggested that the different blade and tool cross-section profile of axe-type lithic tools required them to be used in different ways to modern tools; working at an angle of roughly 50 degrees, which is quite different to a modern steel axe that can cut at a shallow angle down the length of a tree or stem. The final synthesis of the large compendium of specifically tree felling work was published by Jørgensen (1985) entitled *Tree-Felling with Original Neolithic Flint-Axes In Draved Wood* and brought together the complete results of various felling experiments using actual Neolithic aged thin butted polished flint axes over the years of 1951-4, including for example one main experiment with felling 50 trees of birch, beech, alder, hazel, lime and rowan from an 1755m2 area in 16.5 days (Jørgensen 1985, 19).

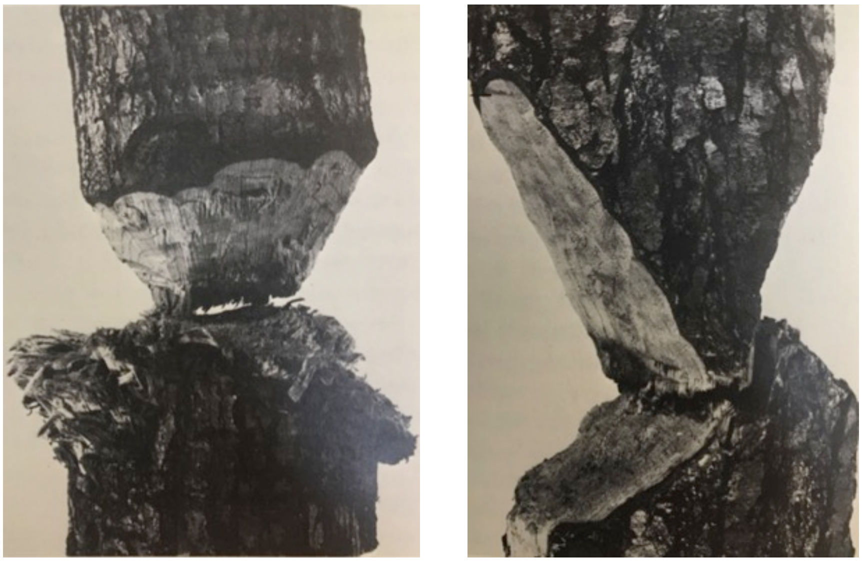


Fig 7.1 'Round-cutting' (left) and felling with two opposing notches by 'cut to fall' (right) using Neolithic axe-heads and replica hafts (Jorgensen 1985, 32)

Extensive practice and experimentation in this work again demonstrated the clear need for a specific stone axe cutting technique; essentially using lots of short cuts with mainly forearm movement at an obtuse angle (Jørgensen 1985, 28). The study showed that polished axe-heads do leave behind distinctive toolmark traces and chips, with trees sharpened like a pencil with round cutting around their circumference and the stump left quite roughly disorganised as seen in Fig 7.1. The resulting published toolmarks (Fig 7.1 above, left) on the trees appear often fairly small in size, sometimes with some smooth surfaces but also considerable ripping of the wood surface and on occasion evidence of partial jam curves – thus quite unlike the long facets on the archaeological wood under investigation in this work. Jørgensen (Jørgensen 1985, 33) also noted that with a growing level of skill and practice the wide, obtuse edge, of stone axes seemed 'better suited to cleaving than cutting wood'. With practice the suggested felling technique developed by the work was to cut two notches and then cleave out the intervening piece, which proved to be the most efficient felling system and the author cited Neolithic aged wood chips from Weier, Schaffhausen, Switzerland, as exhibiting the same features as the woodchips produced experimentally and illustrating the use of 'cleaving' as an important part of the lithic-age woodworking toolkit (Jørgensen 1985, 33). The work also identified the 'chop-and-tear' method of bending of smaller stems 20-50mm in diameter and chopping them on the curved convex side to produce stepped facets and splitting of the wood (Jørgensen 1985, 37). Only a drawing of the method was provided in the published work, but this does not suggest a toolmark morphology similar to the Goldcliff pointed ends so this method does not appear to be the source of those traces.

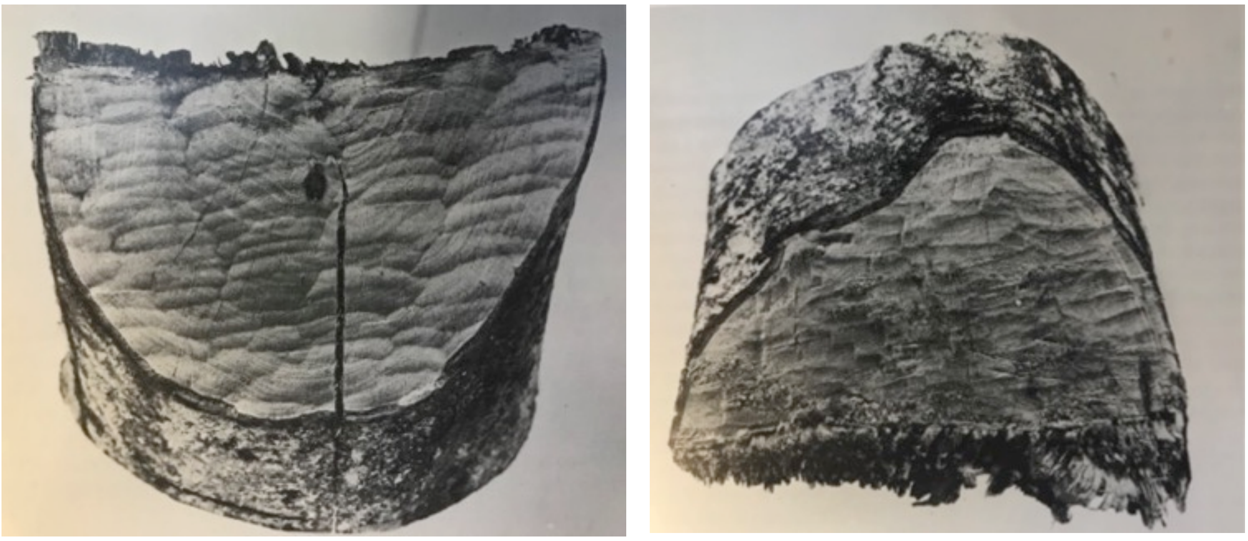


Fig 7.2 Toolmarks on notch surfaces from the notch and cleave method using Neolithic axe-heads and replica hafts (Jorgensen 1985, 45)

Work by Leechman (1970) in the Canadian Yukon had previously suggested that we may not fully appreciate the cleaving properties, and necessary specific working method, of lithic tools, citing the ability of stone wedges or axes to chisel out splinters around a spruce tree in that experiment and thus fell it comparatively quicker than simply using a steel axe. Coles (1973, 21) speculated that ringing or girdling large trees by removing a section of bark around the entire circumference and allowing them to die before then felling by tools or fire at a later date would actually have been a highly effective and relatively time-efficient way to fell more problematic sizeable hardwood trees. This methodology was later tested and demonstrated in the work of Jørgensen (1985, 19) through successfully girding and felling eight oak trees in this manner. As Bradley (1978) had also suggested we would be wise to resist assuming that all axe or adze heads necessarily had to be used in long handled hafts, and they may have been taken out and used in more multi-functional and different ways than we understand. Other work replicating the Walton Heath Neolithic hurdle from the Somerset Levels published by Coles (1979, 107) and Coles & Darrah (1977) was relevant to the roundwood size being investigated in this study and tested the use of hafted polished axes on coppiced stems, finding that they were 'eminently suitable' for the task, but it was the accuracy of the strike, and thus skill, that was a key part of using these tools. Practical experience revealed that a misdirected strike could break the handle or even lose the axe-head entirely. The published images of this useful work showed an end product from chopping and then tearing or twisting away the 25-30mm diameter coppiced hazel from its stool (Fig 7.3) that appears clearly different to the wood artefacts from the case-studies in this work, so while not precluding the use of a polished axe the method of working is clearly dissimilar to this version of the 'chop and tear' technique used in this particular experiment.

Fig 7.3 Using a Neolithic axe with two-handed powerful blows on 3–4-year-old hazel coppice in Suffolk (left).The results (right) show partly chopped and then splintered stems with chopping and twisting action used (Coles & Darrah 1977, 33)

The most directly relevant published British experimental work to this study was undertaken in the 1970-80s under the auspices of the SLP to test marks left on Neolithic, Bronze Age, and Iron Age roundwood and produce a collection that could be compared to a variety of archaeological observed worked ends found in the Levels (Coles & Orme 1985, 25). 100 experiments tested a variety of wood species, with stems of hazel, ash, willow, birch, and alder from 2-6 years old using a variety of cut angles (90° - 20°) – although the precise number of experiments that used a Neolithic polished axe is unclear from the published results (B. Coles pers comms. 2019; Coles & Orme 1985, 30). Importantly, the work demonstrated that roundwood tool facets and wear traces reflected working techniques and could be diagnostic and identifiable to particular technologies and periods (Coles & Orme 1985, 36). Different species, and different parts of a tree from the same species, such as seasoned or green, trunk or branch, were recognised as holding different properties, being relatively easier or harder to work (Coles & Orme 1985, 30). Relevant to this study, hazel and alder were found to split easily and retain toolmark traces fairly clearly, but species such as birch or willow left more ragged and crushed facets (Coles & Orme 1985, 30-33). Counting the number of facets on roundwood was suggested by the authors as a problematic source of data collection, as in their experiments 20 chops might only leave as little as six recognisable toolmarks at the end, with the authors concluding that recording and analysing archaeological artefacts against this benchmark is problematic (Coles & Orme 1985, 33).

Fig 7.4 Alder 36mm branch with rough facet ridges and split wood (Coles & Orme 1985, 39)

Fig 7.5 Hazel 36mm roundwood chopped into wedge end taking 35 strikes (left, left centre), Hazel 37mm roundwood chopped to 'point' (centre right) and Birch 49mm roundwood chopped to 'point' using 32 strikes. All made using 'stone axe' (Coles & Orme 1985, 39-41)

The authors also established that based on their work the marks left on the surface of worked wood could illustrate the type of tool used, the technique of use and even repeated work by one individual if they had an 'idiosyncratic' method (Coles & Orme 1985, 33). Practical experience working with a polished axe confirmed the findings of other studies described above that a specific technique was required, with shallow cuts bouncing off and the axe penetrating less deeply than a metal one and leaving 'coarser facets' behind (Coles & Orme 1985, 30). However, the facets left could still be clear and distinctively dished across their width, normally shorter than ones made using a bronze axe although wood species or condition could limit facet size due to an inability to produce shallow angle slicing cuts. The study recorded that facet junctions were often distinctive and sharp, with facet surfaces clear enough to identify irregularities or idiosyncrasies of a blade edges and thus detect the repeat use of the same tool (Coles & Orme 1985, 25-30). While the study is thus hugely useful it did not investigate the wider range of tool types available in the Neolithic, with just one individual polished axe tested and any data records or archive of the dimensions of the facets sadly no longer available for study (B. Coles pers comms. 2019). In the research publication there are images for three of the stone axe experiments undertaken (Coles & Orme 1985, 39 – 41, Fig 7.5 above) with results that clearly replicate some of the pointed ends types recovered from the Sweet Track and analysed in **Chapter 6**, however none look similar to the Goldcliff type facets under investigation in this chapter. Interestingly, the authors of this work also noted that there were a significant number of ends pointed with 'shallow slashes' from the Sweet Track assemblage (Coles & Orme 1985, 38), and as their experimental work demonstrated that a polished axe could not work in such a shallow cutting fashion to produce these 'slashes' the tool used for this was thus not identified. Analysis set out in **Chapter 6** suggests these 'slashes' are morphologically similar to the toolmarks identified at Goldcliff and suggest a commonality of method and possibly tool.

Subsequent relevant experimental work by Harding (2014, 44) to reproduce the Shulishader wooden haft dated to 3500-2890 cal BC (OxA-3537, 4470+/- BP, Sheridan 1992b) using reconstructed Neolithic tools showed that a polished axe can be effective at removing 'long, thin parallel 'blade-like' wood chips' from a cleaved stave wood to produce a rough out of a haft. In the work, each chip was taken from an existing ridge and produced a rounded form with 'regular flutes' facets (Harding 2014, 44). While a pointed end was not produced in this work the expectation from Harding's and other's work suggested that a polished axe would likely be an effective tool and pointing roundwood in this experimental programme even if the toolmarks might be different.

Fig 7.6 Preparing cleft green oak for axe haft using part polished Neolithic replica axe, resulting in long thin wood chips and 'regular flutes' on surface of wood (Harding 2014, 44)

In terms of comparable polished tools, over several seasons, Elburg *et al.* (2015) further tested and reinforced the conclusion that polished asymmetrical adzes of the Neolithic *Linearbandkeramik* period with a domed upper side and flat bottom and bevel known as the 'flat hoe' or 'shoe-last celt' were effective woodworking tools at felling large (55cm diameter) oak hardwood trees and left toolmarks that appeared mostly small-medium in size but smooth, slightly dished, and with some partial jam curves.

Fig 7.7 Toolmarks left by stone adze (left) and moose bone chisel producing notches (right) (Elburg et al. 2015)

These experimental adzes could be used at an acute angle down the length of a trunk and reportedly left marks comparable to those on the Neolithic well timbers dated between to 5469 BC and 5098 BC (dendrochronology date) at Altscherbitz, Germany (Elburg *et al*. 2015; Tegel *et al.* 2012). Other work in this study with wooden wedges for splitting planks and bone elk metatarsal chisels for making notches showed that such organic tools were highly effective, durable woodworking tools that were likely an important part of the toolkit with toolmarks again comparable to those observed on the Altscherbitz well (Elburg *et al*. 2015) and should be tested in this study's experimental programme.

In terms of organic tool types, a 2012 Leiden University project to build a reconstruction of a 2,500 BC late Neolithic Vlaardingen culture house with only tools of the period again illustrated the versatility and range of woodworking lithic and organic tools (Van Gijn & Pomstra 2016). It made use of ground stone and flint axes and adzes, tranchet axes, antler and wood chisels and wedges, along with bone adzes and chisels and finally unretouched flakes, with some 120 tools used in total (Van Gijn & Pomstra 2016, 183, Fig 7.7 below, left). The first of the published results suggest toolmarks in keeping with other studies described in this section, with no suggestion that any of these tools produced unusually long or deeply dished toolmarks (Van Gijn & Pomstra 2016). Work by Bell (2007, 230) found that a replica of an unstratified 'mattock-hammer' used as a composite tool with a flint blade set in the antler socket performed well pointing roundwood, with the published image (Fig 7.7 below, right) appearing consistent with those of other flaked tools used in an axe or adze fashion of other studies.

Fig 7.8 The range of tools used in the Leiden University Neolithic house project (left), the toolmarks left by a reconstructed polished adze (centre) (Van Gijn & Pomstra 2016, 180) and flint blade in antler haft working hazel roundwood (Bell 2007, 231, photo S Bell)

A study by Lozovskaya & Lozovski (2013) explored the toolmarks on worked wood from the Russian Mesolithic sites of Zamostjie 2 (7000-5,700 cal BC) and Veretje 1 (8500-7500 cal BC), testing polished lithic and elk antler axes and adzes, lithic scrapers and blades and beaver mandibles. The various lithic and antler adzes and axes were used to cut down stems and trim wood, and although no pointed ends appeared to have been produced these tools created slightly dished toolmarks, somewhat curved in cross-section and sometimes smooth fairly distinct facet junctions, although in other cases the surface was left more truncated with partial jam curves. The authors noted that the tools could produce one chip with a single blow or a more frayed one if several blows were required for a removal (Lozovskaya & Lozovski 2013). Earlier work by Jensen (1991) had also demonstrated that the blade edge on antler axes and adzes could be effective as a woodworking tool, even if the end result did not appear in those experiments comparable to the toolmarks being investigated here.

Fig 7.9 Working traces from using hafted antler adze (left), polished stone axe/adze (centre & right) (Lozovskaya & Lozovski (2013, 75-76)

Watts's (2014) work on constructing a 7.5m long green pine logboat, The Eurybia Project, found that while tranchet flint adzes and antler picks were ineffective on trying to hollow out the boat even after some burning, seasoned oak wedges proved effective at splitting wood tangentially (Fig 7.9 below, left). The resulting toolmarks appeared fairly flat and ripped in the images provided, and thus are noticeably different from the toolmarks investigated here although the technique seems relevant.

Fig 7.10 Oak wedge splitting a green pine trunk for the Eurybia Project (left) and red deer antler wedge working tangentially on green oak producing 'scallop marks' (centre) and cow bone chisel used to split seasoned pine (right) (Bouldnor-Butser Mesolithic Woodworking Project 2017)

Comparable work by Rich *et al.* (2016) also explored the possible toolmarks on Mesolithic wood, testing the possibility that organic tools were responsible for marks on Mesolithic wood from Bouldnor Cliff that were said to relate to a possible logboat or boat building activity. Bone, antler and wood chisels, antler adzes and two flint adzes were used on pre-sawn timber lengths to tangentially split wood from green, seasoned, and waterlogged state oak, pine, ash, birch, and lime trees (Rich *et al.* 2016). Oak wood wedges were found to get damaged by hard woods, but useful once a groove was made with antler and bone chisels. The chisels were found to be effective tools at making stop cuts and then splitting out portions of wood (Rich *et al.* 2016, Fig 7.9 below, centre & right). The images provided in the associated blog show antler chisel toolmarks as 'scalloped' in appearance, thus partially similar to the traces under investigation here and once again indicate the ability of these organic tools to split wood (Bouldnor-Butser Mesolithic Woodworking Project 2017).

Another useful study by Groom *et al.* (2018) investigated the manufacture of sub-Neolithic pine and willow fish laths from fish weirs from the site of Purkajasuo, Finland, dated to 3934-2681 cal BC. The laths in these structures were made using split or cleaved pine roundwood. In the experiment the pine stems were initially split using a slate wedge, roundwood mallet and then completely cleft into two sections on a 'riving', or splitting, stick placed into the ground that had been shaped to triangular point with a slate flake. This technique produced nice symmetrical roundwood split halves, which, while quite different in appearance to the toolmarks or traces being investigated in this work, illustrates the functional ability of simple techniques and tools to work or cleave roundwood.

Fig 7.11 Splitting of pine stem with slate wedge and mallet (left), end of the riving stake after sharped to a 3-way point with slate flake (centre) and the half split roundwood after using the riving stake (right) (Groom et al. 2018)

Finally, recent experimental work based on the worked wood assemblage from early Mesolithic Star Carr detailed a series of experiments to test the interpretations for various artefacts of worked wood found at the site described in **Chapter 3**. A reconstruction of an elk antler adze found at Star Carr was tested and reportedly 'used successfully in a series of woodworking activities' – the published photographs appear to show this included tangentially adzing a half split piece of roundwood (Knight *et al.* 2018, 266) and to 'trim a piece of roundwood' (Bamforth *et al.* 2018, 406).

Fig 7.12 Elk antler adze reconstruction working wood tangentially (left, centre) (Knight et al. 2018, 266, copyright Aimée Little), and trimming roundwood (Bamforth et al. 2018, 406, copyright Aimée Little)

Interpretation of the site also revealed the presence of worked wood pieces with tangential outer splits, parallel sided split items, split timbers that feathered out at one or both ends, items with longitudinal parallel grooves and split items with diagonal groove and/or gouge marks on their faces (Bamforth *et al.* 2018, 355). Several experiments were undertaken to test manufacturing hypothesis including recreating use of the top and bottom cuts in the 'notch-and-split' technique to fell a tree as revealed by Jørgensen (1985), which used a flint tranchet adze to prepare a tree trunk by cutting a notch at the top and then using wood, bone and antler wedges used to split or cleave off a tangential outer timber from the standing tree. Some 50 minutes of work produced a 1600mm long tangential timber in this way (Bamforth *et al.* 2018, 362).

Fig 7.13 Flint tranchet adze cutting notch to split tangential outer timber (left) (Bamfort et al. 2018, 356, copyright Don Henson), and tangential outer timber being split using wood and antler wedges (Bamfort et al. 2018, 363, copyright Don Henson)

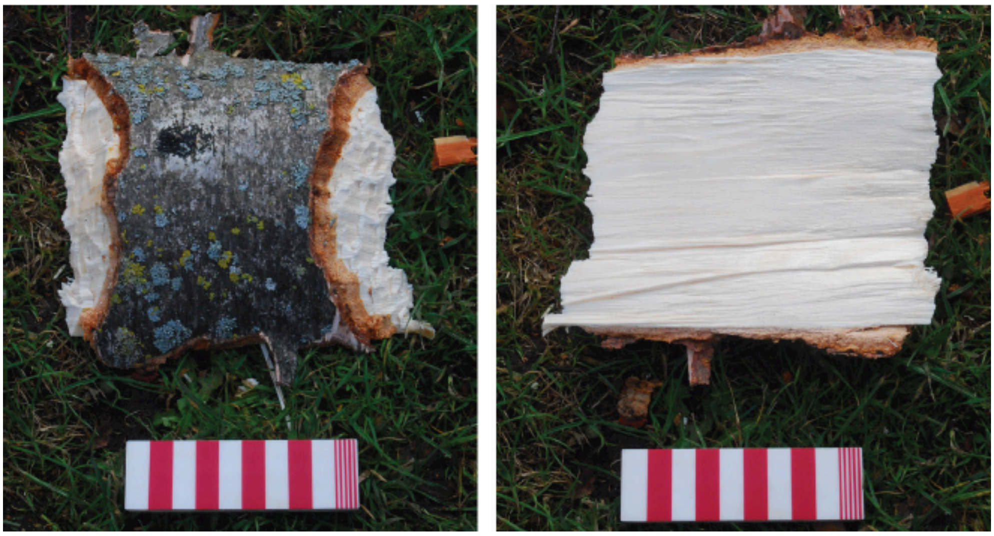


Fig 7.14 Debris when top and bottom notches cut before splitting out section, in variation of the notch-and-split technique (left, right) (Bamfort et al. 2018, 355, copyright Michael Bamforth)

Flint flake and antler chisel were used to produce longitudinal parallel grooves to test the 'groove-and-split' woodworking technique, with the section between the grooves then 'split away using antler tines and a bone chisel' (Bamforth *et al.* 2018, 365). This failed to reproduce the woodworking traces found on the archaeological examples, though it showed the ability of this organic toolkit to work wood even if the technique or goal remained unclear. Antler tines used as splitting wedges were also used to try and reproduce 'diagonal groove or gouge mark' found on the split surfaces of archaeological timbers (Bamforth *et al.* 2018, 365). While the antler tines were effective as wedges they did not leave comparable traces as found on the archaeological artefacts and as such the manufacturing process for these features remained unexplained (Bamforth *et al.* 2018, 365).

Fig 7.15 Flint flake (left) and bone chisel (centre) used as part of groove-and-split technique (Bamforth et al. 2018, 358, copyright Don Henson (left) and Michael Bamforth (right))

Three bow replicas were also made to test the interpretation of artefact <113300>, cleft 1411mm long piece of willow, as a bow, with experiments suggesting it might possibly function as a low powered fishing bow (Bamforth *et al.* 2018, 379). A birch digging stick was made from a radially quarter split birch log using wooden wedges, mallet, tranchet flint axe and flint flake and worked effectively to dig a 0.5m diameter and 0.4m deep hole (Bamforth *et al.* 2018, 386). Finally, a series of experiments tested the ability of birch bark to function as tapers, torches and to make bark tar (Fletcher *et al.* 2018). None of the Star Carr related experimental work dealt with the use of cleaving roundwood to produce pointed ends, although work on the using of splitting and cleaving tangential timbers is useful in terms of expanding the known range of Mesolithic woodworking techniques and reinforces the hypothesis for the use of cleaving and splitting as part of that toolkit. Importantly, the published images of elk adze and tranchet adze toolmarks in the work are comparable to the results from other published studies described in this section, even if they do not appear to reproduce the morphology of the toolmarks under investigation here.

Combining the results of these previous studies it has been repeatedly demonstrated across a variety of Mesolithic and Neolithic focused experimental studies that toolmark morphology can reflect the tool types used. Logically, this should mean it is then possible to understand the manufacturing process and nature of the traces on archaeological examples in the case-studies of this work by comparing an experimental reference collection to archaeological artefacts. Importantly, the demonstrated effectiveness of non-lithic tools for cleaving or splitting in some of these publications has served to show that organic tools are also highly effective woodworking tools in their own right that again can leave identifiable traces. However, as this review also sets out, to date there is no published study exploring the source of toolmarks morphologically comparable to those identified in the case-studies in work. A targeted programme of experiments was thus required to the investigate the manufacturing methods behind those traces and add to this growing body of knowledge about woodworking with stone age toolkits.

7.4 Experimental methodology

To create the required experimental programme, preliminary practical research, discussion, and testing was undertaken with expert modern greenwood worker Ben Willis over a two-day greenwood working course and a day spent using various heritage steel woodworking tools in the museum's collection (Fig 7.15) with heritage woodworking expert Julian Bell at the Weald and Downland Museum. The author also had several discussions over different days with well-known expert replica prehistoric tool practitioner John Lord and a day at Ramscoat Coppice Estate, a modern working hazel coppice in the Chilterns, working with coppicing expert Graham Thorne. All the photos in the following sections are the authors unless stated otherwise.

Fig 7.16 Different 20-21st century woodworking tools tested at Weald & Downland Museum (left), timber framing gouge that produced the comparable results when cleaving roundwood to make a point (right top, right bottom)

Preliminary practical testing and discussions was undertaken with these experts to firstly gain a better appreciation of the properties of different ways of working and to ascertain if the toolmarks could conceivably be reproduced through the striking action of axes and adzes. Ultimately, this practical experience with experts showed it was unlikely that any tool could produce the Goldcliff East type traces in a single very acute strike down the stem as even sharp steel axes or adzes appeared unable to do this. Further experience and investigation with these greenwood workers showed that splitting or cleaving wood with a bladed tool applied to the end grain down a stem or trunk was a probable solution. This solution was first proposed by O'Sullivan (1996) in his Mount Dillion Bog study and accepted in the analysis of the case studies in **Chapters 5** and **6** but had not until now been tested in practice. Straight bladed tools such as steel axes, froes or wedges produced facets or were found to produce only partially similar facets to those of the case-studies in this work, as the wood naturally splits along the grain following the path of least resistance to produce basically flat sided lengths with angular facet junctions in cross-section when view across their length and width. However, it was found that using a convex bladed tool, such as chisel or gouge, will also split or cleave the wood, but the curving blade will allow the manipulation and control of the wood to produce more curved facets or toolmarks more akin to the Goldcliff type facets.

The preliminary consensus from this work was that the controlled cleaving of the wood using a gouge chisel shaped tool in some form was likely a necessary part of the manufacturing process (such as framing gouge Fig 7.16 above). With this knowledge it seemed sensible for a research design to primarily test this way of working, but by exploring the range of traces from the main relevant tool types of the period. It was further decided to still test some representative axe and adze tool types for comparison to understand the variety of toolmark traces and thus better assess the overall nature of the technique.

With these preliminary findings in mind the following hypotheses were selected for testing:

- Hypothesis (1): That a representative range of Mesolithic and early Neolithic tools used in an axe and adze strike fashion would produce identifiably different toolmark traces to those observed on the Goldcliff type pointed ends.

- Hypothesis (2): That a tool with a sharp blade edge and cross-sectional curved profile and a mallet could be used to cleave roundwood working from the cut end upwards towards the stem to produce the woodworking traces identified from Goldcliff type pointed ends.

7.4.1 Testing the techniques for manufacturing pointed ends

Based on the preliminary results, and discussion with skilled experts set out above, a decision was made to split tools into three main categories for testing:

- Category (1): Tools used in a traditional adze or axe action chopping *down* the stem towards the intended point to provide a reference point for this type of method. This would be axe and adze type tools.

- Category (2): Tools would cleave or split the stem and remove slices/woodchips to produce a point, working *upwards* from the intended point end towards the rest of the stem.

- Category (3): A set of additional tools would be used in the same fashion as Category (2) tools, but without the same level of prior practice, simply to judge the potential of a wider range of tools for cleaving in the hypothesised method.

For Category (1) and Category (2) tools it was decided that five preliminary practice and training attempts would be undertaken on sawn-end green hazel roundwood to produce pointed ends. Then a ‘Final Test’ was undertaken on 40mm diameter green hazel roundwood that had been prepared on its pre-cut end by using the flint tranchet adze to produce a roughly flattened end to better reflect the actual form of the cut end prehistoric woodworkers would have been working with. For the Category (3) tools one preliminary training test and one 'Final Test' on 40mm diameter tranchet adze cut green hazel roundwood was undertaken.

This system was devised to allow for a reasonable amount of replication and practice with each main tool types to help validate the 'Final Test' results, but also to enable the testing of a fairly large number of tool types (n=13) to better gauge the possible range and variety of woodworking traces that might be achieved. This meant in total 13 tools were tested, of which nine were tested with six attempts each and four with just two each – producing a total of 62 pointed ends in all during these experiments.

Fig 7.17 Flint tranchet adze used to point training 40mm diameter hazel roundwood on willow chopping block (left, centre right)

The working method for Category (1) tests was for the author to be situated on his knees (Fig 7.16), holding the roundwood in the author's left hand at approximately 30-40 degrees off vertical and the tool in the right hand, with tranchet adze pre-cut end resting on a flat willow roundwood chopping block and cuts made down the stem towards the intended end. The use of the willow chopping block seemed a reasonable experimentation compromise, as without it any blade edge can become damaged or quickly become full of dirt and grass. The author had previously cut pointed ends with the flint tranchet adze on a fallen birch tree in the preliminary training phase of this research, which seem to produce the same effect and such fallen trees would logically been something easily available for people in the past.

For the Category (2) and (3) tests, the stem was held at 20-30 degrees off vertical in a metal vice (Fig 7.17) attached to a workbench with the pre-cut end upwards. This is also suggested as a reasonable experimental compromise as it seems a similar effect to another person holding the stem in place against a fallen tree (something not available to the author), or alternatively it is possible a simple brace utilising branches of fallen tree or even possibly constructed from roundwood could have been built as these are effective and easily made greenwood aids with a long history of use (Edlin 1949a, 1949b; Tabor 2012, 2013). The cutting blade of the gouge or chisel action tool was placed on that cut end and a hazel mallet in the author's right hand was used to strike its end and achieve a transverse first cut across the roundwood. An early Neolithic yew mallet is known from the Somerset Levels (Coles & Coles 1986), and something as simple as a decent sized part of a fallen branch can perform this job. Once a cut had been achieved further blows from the mallet and the pushing of the tool into the widening space as the wood cleaves and pulling away of the breaking away slice would lead to the removals of a slice or woodchip. A more detailed description and explanation of this specific method is set out in the Section **7.10.1 Cow Bone Chisel** test below. After tests were conducted, a photographic record was taken of each experiment, with the toolmarks, facets and working method for the Final Test pointed ends recorded in detail and subject to comparative metric analysis in this chapter to investigate whether differences and trends in the results could be identified.

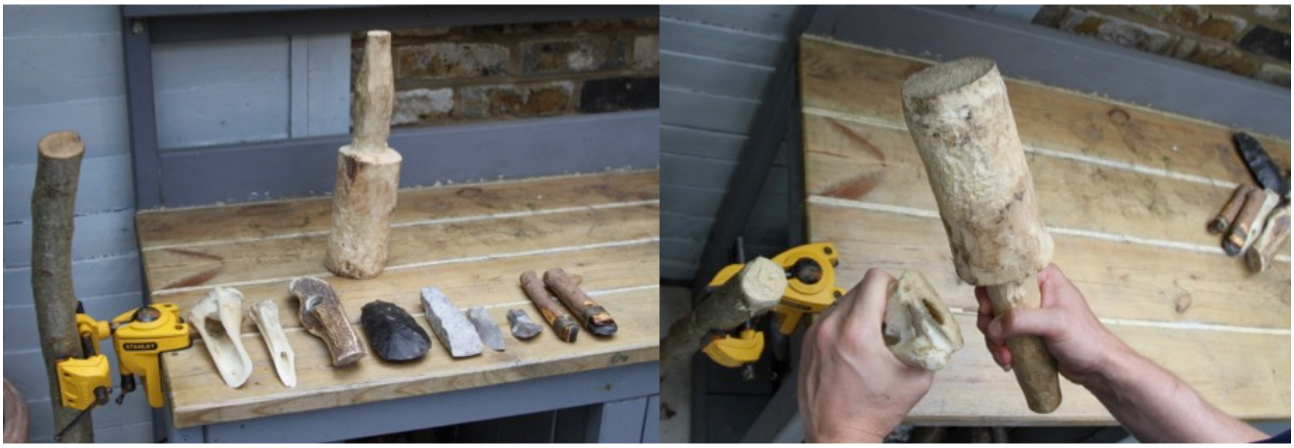


Fig 7.18 Vice station and mallet before use (left) and vice station and mallet in use for cleaving type experiment (right).

7.5 Control of variables

For any experimental programme it is also important to consider and account for the primary variables that could affect the methodology set out above and its resulting outcomes. The principal variables for this study are considered below:

7.5.1 Tool types tested

Only reasonable approximations of tools and raw materials that were available in the late Mesolithic and early Neolithic were tested, with the tools for testing selected based on characteristics that make them likely and possible contenders. Any results of previous published experimental work were also used to inform the range of experiments. The tool reconstructions were based on archaeological examples from dated, stratified contexts, or agreed typological Mesolithic and early Neolithic types and made by knowledgeable experts in the production of prehistoric replicas. Reconstructions were made using comparable raw materials available to late Mesolithic and early Neolithic people, including flint, red deer, and cow bone (suggested as a reasonable replacement in place of Mesolithic extinct aurochs) and sharpened before use. Lithic and the majority of the bone tools tested had been made by an experienced maker of prehistoric replicas (see Table 7.1 below), with only two antler tools made by the author based on published experimental studies and instructions as unfortunately an issue of funding and expense precluded all the organic tools being made by the experimental specialist John Lord as well. The hafting of replica tools was based on British or Irish excavated or recovered examples where possible, such as the Neolithic polished axe from Shulishader or Etton Causewayed enclosure (Sheridan 1992a; Taylor 1991). If no British or Irish examples existed continental finds such as at adze hafts at Danish Tyrind Vig (Anderson 2013) formed the basis of the reconstructions as necessary. It is perhaps worth noting that we have no British surviving haft for a tranchet adze or axe, a tool so commonly associated with the Mesolithic (Edmonds 1995), and it is conceivable that these were used hafted in ways we do not fully appreciate that possibly could have affected their function and performance.

Table 7.1 List of tool reconstructions and their sources tested in this programme of experiments

No.	Tool	Test type	Max blade edge (mm)	Raw material	Haft raw material	Period	Comparative archaeological example	Source	Replica maker
1	Flaked tranchet adze	Category (1): 5 practice, 1 Final Test	51	Norfolk flint	Yew	Mesolithic	Bouldnor Cliff, England	Momber *et al.* (2011)	Karl Lee
2	Flaked tranchet adze	Category (1): 5 practice, 1 Final Test	55	Goldcliff tuff	Hazel	Mesolithic	Goldcliff East, Wales	Bell *et al.* (2000); Bell (2007)	John Lord
3	Polished axe	Category (1): 5 practice, 1 Final Test	58	Norfolk flint	Ash	Mesolithic / Neolithic	Shulishader, Scotland	Sheridan (1992a)	Karl Lee
4	Antler adze	Category (1): 5 practice, 1 Final Test	40	Old red deer antler	Birch	Mesolithic / Neolithic	Uskmouth, Wales	Elliott (2012)	Author
5	Bone chisel	Category (1): 5 practice, 1 Final Test	40	Cow	Hazel mallet	Early Mesolithic	Star Carr, England	Clark 1954	John Lord
6	Bone chisel	Category (2): 5 practice, 1 Final Test	18	Fresh red deer	Hazel mallet	Mesolithic	Goldcliff East, Wales	Bell & Scales (2007)	John Lord
7	Polished axe-head chisel	Category (2): 5 practice, 1 Final Test	67	Norfolk flint	Hazel mallet	Mesolithic / Neolithic?	To test range of tooltypes, see test (3)	Edmonds (1995); Walker (2015)	John Lord
8	Polished chisel	Category (2): 5 practice, 1 Final Test	42	Norfolk flint	Hazel mallet	Mesolithic / Neolithic	To test range of tooltypes, see test (3)	Walker (2015)	John Lord
9	Antler chisel	Category (2): 5 practice, 1 Final Test	40	Old red deer antler	Hazel mallet	Mesolithic	Goldcliff East, Wales	Bell & Scales (2007)	Author
10	Blade	Category (3); 1 practice, 1 Final Test	16	Norfolk flint	Hazel mallet	Mesolithic	To test range of tooltypes, see test (3)	Harding (2014)	John Lord
11	Flake	Category (3); 1 practice, 1 Final Test	30	Norfolk flint	Hazel mallet	Mesolithic / Neolithic	To test range of tooltypes, see test (3)	Harding (2014)	John Lord
12	Hafted transverse arrowhead	Category (3); 1 practice, 1 Final Test	20	Norfolk flint	Hazel	Neolithic	To test range of tooltypes, see test (3)	Harding (2014)	John Lord
13	Hafted scraper	Category (3); 1 practice, 1 Final Test	31	Norfolk flint	Hazel	Mesolithic / Neolithic	To test range of tooltypes, see test (3)	Harding (2014)	John Lord

A methodological decision had to be made in this work to rationalise the number of tool types being tested, with a decision made to test a 'representative' range of tool types, blade edge sizes and haft lengths available in the periods under investigation. This means that not every possible tool type or permutation of different variations of the same type have been tested for. For example, in this study two fresh bone chisels, one cow at 40mm wide and one red deer at 18mm wide, were tested, but only one base antler adze type and a single polished axe shape. In an ideal world, a fully comprehensive variety of chisel, axe or adze sizes and types would be tested to assess whether they left diagnostically different toolmark traces. However, any experimental programme needs to a find a balance between testing a reasonable range of probable tool options in controlled conditions but with enough repetitions to help validate the test results.

Fig 7.19 The range of experimental axe and adze action tools (left) and cleaving action tools (right) used in this study

One of the primary goals of this work was also to identify the overall method of producing the toolmarks on the archaeological examples, with the actual tool used being a secondary goal. With that mind, tool types such as the antler beam or 'T' axes and adzes were not tested in this work as it was felt that these duplicated the basic blade edge profiles of items such as the base antler adze and thus likely, but not certainly, the results from these tool types. Preliminary experimentation described above had also suggested that using an axe or adze action tool was an unlikely source of the Goldcliff type pointed ends and so tools that could be used to cleave the wood seemed the more important types to test. No polished adze or antler sleeve tranchet adze or axe, either flaked or polished, was tested in this programme as it was felt their blade profile broadly matched that of the polished axe or tranchet adze being examined and with no surviving British or Irish examples it is not clear if these tools formed part of the British record (Edmonds 1995; Walker 2015). It also seems unclear if, or when, the polished 'shoe' gouge adze appears in the British Neolithic with no evidence it was used in Mesolithic Britain or Ireland (Edmonds 1995; Walker 2015) so this tool type was not tested.

A range of organic tools made from bone and antler would have been available to Mesolithic and early Neolithic communities (Edmonds 1995; Elliott 2012). However, the evidence for the tool range is fairly limited as animal bones tools are relatively rare in Mesolithic British and Irish sites, with the most significant samples coming from early Mesolithic Star Carr (Clark 1954; Milner *et al.* 2018) and the late Mesolithic 'Obanian' sites and middens in Scotland (Lacaille 1954), with smaller samples at sites such as Goldcliff East (Bell & Scales 2007). Finds from Star Carr help inform the type of tools and species that were available such as aurochs, elk, wild boar, red and roe deer (Fraser & King 1954), although elk was seemingly extinct or rare in most parts of the country by the late Mesolithic (Mithen 1999). The Irish large terrestrial fauna was much more restricted, with wild boar the only possible source of bone tools (Woodman 2004) – aside from human bones themselves. Work by Smith (2002) and Elliott (2013, 2015) has set out the current knowledge on British antler tools, typology, and manufacture. Antler mattocks, with a perforation for hafting, are made with the oblique transverse truncation of the antler beam. At Star Carr they are made from elk antler and seem to be replaced by red deer mattocks in the Late Mesolithic, possibly due to the disappearance of British elk in the Postglacial period (Tolan-Smith, 2008, 148).

Elliott's (2013) comprehensive research set out the different types of hafted antler axes, persuasively arguing that earlier interpretations as simply digging tools, i.e., Clark's (1954) termed 'mattock', are likely inappropriate and that while multi-functional they are particularly efficient items in tasks such as woodworking. Elliott (2013) also identified the presence of the 'Lame de hauche' hafted elk antler axe type tool in the early British Mesolithic record at Thatcham – thus a period and raw material not directly relevant to this study. Elliott (2013) also suggested the lack of comparable early Neolithic dated antler axe or adze examples may show that they fell out of use in that period, although he noted there are late Neolithic finds and use of red deer antler is known from the very early Neolithic Sussex flint mines so the lack of such items may potentially reflect preservational issues in the record. The antler chisel tested in this study had already been used as a soft hammer on one end by John Lord, it was then used as a hafted adze by the author and also then used unhafted as a chisel. The antler was old and very hard, although those previous uses did not appear to affect its function as a chisel in any obvious way, and it seems reasonable to suggest that such tools may have multifunctional uses in the past. In terms of bone tools, from Star Carr there are scrapers or chisels from split aurochs metapodial (Clark 1954; Knight *et al.* 2018). At Goldcliff split long bones with 'U' shaped curved ends with polish were classified as 'scrapers', (Bell & Scales 2007, 134), but that could potentially have had other uses. Overall, in this study it was decided to try and test a simplified range of these organic tools, broadly representative of the blade edge types of the tools described above, while acknowledging that there can be significant variation in the size of these tools, the blade shape, the edge profile and even the density, species or age of the bone that could potentially all affect function and use.

For lithic tools the tranchet adze or axe is commonly attributed to the Mesolithic in British and Irish context and is often associated with woodworking tasks (Mellars 1974; Mithen 1999), although Walker (2015) notes that the chronological affinities of tranchet type tools are actually unclear as few have been found in stratified contexts so their use could possibly persist into the early Neolithic. Mithen (1999) has pointed out that tranchet adzes seems to be absent from Scottish assemblages, which may reflect lack of raw materials, the subsistence needs of those communities, or as Warren (2005) had proposed the use of antler axes or adzes in areas such as Scotland instead. There is evidence of polished Mesolithic axes and adzes from Ireland (Little *et al.* 2017; Woodman 2004), and possibly ground stone axes from western Britain (David 2007; Saville 2009), but polished adzes do not appear to be a Mesolithic British tool form. In this work, the testing of a single polished flint axe was deemed sufficient for these tool types given the preliminary work above, with other morphologically similar early Neolithic tools such as Langdale axes not considered likely to produce significantly different toolmarks. Narrow bladed jadeite axe-heads could conceivably function differently, but these are generally considered to have been mainly important and prized symbolic items rather than practical tools (Thomas 2013; Walker 2013). It is perhaps worth considering the suggestion of Harding & Young (1979, 105) that flint and ground stone axes may offer different durability and potentially working roles so more comprehensive testing over longer timeframes may be worthwhile in future work but, given the preliminary hypothesis that striking with axes or adzes would not make the toolmarks in question, this seemed unnecessary for this study. Other types of Neolithic lithic tool types used in this work were the polished axe-head and polished chisel for comparative purposes as their blade edge and shape morphology suggested that could work wood with a mallet and potentially produce different toolmarks. Walker (2015, 236) states polished flint chisels in Britain can be attributed to Grooved Ware culture and are thus late Neolithic in date, but as few examples are directly, or contextually, dated conceivably some may be earlier in date and it was thought worthwhile to investigate their results. A single large flint blade and flake was also used along with a mallet as it seemed possible that these could be used to reduce wood to some form of point. Finally, a hafted end scraper and transverse arrowhead were tested as experimental work by Harding (2014) who had illustrated their woodworking potential when used in this configuration.

7.5.2 Wood for testing

For the practice and training preliminary experiments, roundwood was felled and then prepared and cut into lengths using a steel saw, with the training work both carried out down the remaining stem towards this flat end and from a cut end up the stem to cleave the wood to form the point. This was done to allow comparison between the pointed ends and clear recognition of when complete pencil pointed end had been achieved. In the Final Tests the ends to be pointed were pre-prepared to a reasonably flat end with by a Mesolithic tranchet adze, as this better replicates prehistoric working conditions.

This combination of preparation of stems is suggested as being a reasonable experimental compromise reducing the time-consuming preparation of training stems while still allowing for reasonable reconstruction of prehistoric conditions. Indeed, there is no certainty how the roundwood was prepared in the past before its pointing, but logically it is most likely to have at least been chopped down and then cross-cut into suitable lengths first. However, it could also be argued that while unusual to do so before pointing a stake, finds like the flat topped 170mm diameter ash post <SWD340> from the Post Track, Drove Site, (Coles *et al.* 1979, 51) showed that wood could be faceted extremely flat using Neolithic aged tools when necessary so gauging tool performance on very flat end prior to pointing is also a useful benchmark.

Fig 7.20 A 40mm roundwood prepared by saw for training (left, left centre) and 40mm roundwood for Final Tests prepared by tranchet adze (centre right, right)

The available archaeological evidence such as examples of shattered, ‘zigzagging’ stems at Goldcliff and the Sweet Track suggests that green wood was used at the two key case-studies in this work (Brunning 2007; Coles *et al.* 1973), with previous experimental work supporting the view that seasoned wood is very difficult and arduous to then work with stone tools (Coles & Orme 1985). At both Goldcliff and the Sweet Track, hazel forms one of the dominate roundwood species being used in the structures (see analysis in **Chapter 5** & **6**). As a result, easily available British green coppiced hazel stems from the Chilterns were selected for the raw material in this study, as coppiced hazel roundwood has the benefits of having stems that are normally quick growing, reasonably uniform in diameter and length, and free of knots and side branches to avoid that excessively affecting how stems can be worked. Rackham (1979) proposed reasonable evidence for coppicing at the Sweet Track (see **Chapter 6**) and analysis in this work (see **Chapter 5**) suggests that some form of resource management is potentially possible, though not absolutely demonstrated, at Mesolithic Goldcliff East. At Goldcliff occupation may have focused on the warmer summer into autumn months (Bell 2007g) and Coles & Coles (1986) suggested the Sweet Track may have been built in autumn or winter, although the wood may have been cut and prepared at different times of the year (see **Chapter 6**). So, on balance it seems reasonable to use cut fresh summer growth hazel to reflect this archaeological context, with the roundwood stored in shade and kept wet and tested as quickly as possible after cutting. ‘Green’ in this work qualified as wood used ideally within days and no more than one week after cutting. At Goldcliff occupation may have focused on the warmer summer into autumn months (Bell 2007g) and Coles & Coles (1986) suggested the Sweet Track may have been built in autumn or winter, although the wood may have been cut and prepared at different times of the year (see **Chapter 6**). So, on balance it seems reasonable to use cut fresh summer growth hazel to reflect this archaeological context, with the roundwood stored in shade and kept wet and tested as quickly as possible after cutting. ‘Green’ in this work qualified as wood used ideally within days and no more than one week after cutting.

Fig 7.21 Seven-year growth hazel coppice stool prior to harvesting (left), felled hazel stems being processed for experiments in this study (right). 50cm long forester axe for scale

Coles & Orme (1985) suggested that the age and size of roundwood has implications for how easy it is to work, with older being normally being larger, denser, and harder. With that in mind roundwood of consistent size and age was used in this study. The majority of the Goldcliff and many of the Sweet Track pointed ends are < 50mm in diameter, so in the Final Test stems approximately 40mm in diameter size were used in the final experiments for each tool type. All the roundwood was from the main coppice stem, not side branches, and were seven years in age taken from a traditional coppiced woodland. These were cut by the author from fairly new stools planted 10 years ago, having had an initial growth cut at three years and then a further seven years of natural growth for the second harvest. It seems reasonable to propose that this is likely to represent a realistically comparable raw material to the prehistoric roundwood used in the Mesolithic and early Neolithic sites, either as stools and stems selected from natural woodland open edge environments produced by herbivores or tree falls, or potentially as part of managed or semi-managed prehistoric woodland system.

7.5.3 Skill and expertise

One aspect that was immediately apparent when setting out on a course of experimental testing is that many tasks that replicate activities in the past require certain levels of skill to perform, especially in the context of reproducing items comparable to archaeological artefacts with similar levels of finesse and final morphology. Observation and recording by the author of unskilled University of Reading (UoR) undergraduates using sharp steel, bronze and flint axe and adze replicas to point green alder roundwood in 2018 illustrated that lack of practical knowledge can affect the efficiency and type of toolmarks produced. A basic pencil point was eventually produced, but often poor technique meant it was often a very laborious process and the end product surprisingly morphologically similar irrespective of whether the tool was metal or stone (see Fig 7.22 below).

Fig 7.22 Pointed ends made by unskilled UoR undergraduates - Flint tranchet adze (from left 1-3), polished flint axe (4-7), bronze flat axe (8-11) and steel (12-15)

For this work, the ultimate purpose of learning a technique for experimentation is not, of course, to be able to describe oneself as actually comparable in performance to a Mesolithic of Neolithic woodworker. Realistically, there are few people in the western world who will have spent the hours over a lifetime that a person in the past, from childhood onwards, may have spent doing such tasks and learning from older experts in the group (Elburg *et al* 2015; Jørgensen 1985). That problem is also compounded by the fact that prehistoric people in these periods will have learnt these skills using stone, bone and antler tools, not steel ones, which also means that that any ability gained in modern greenwood working will likely not be entirely transferable.

As it was not possible to have access to extant indigenous experts with a continued tradition of woodworking with only stone tools for this study, the issue ultimately relies on determining if the practical abilities are 'reasonably' comparable for the task in question. The recent experimental Mesolithic focused work carried out by Bamforth *et al.* (2018, 366) and building Neolithic houses using polished axes at Leiden University (Van Gijn & Pomstra 2016; Wijnen *et al.* 2018) also noted this 'skill' factor in the aspects of prehistoric woodworking experimentation they tested. In particular they noted a significant difference in the quality and speed of work carried out by skilled versus unskilled practitioners (Bamforth *et al.* 2018; Wijnen *et al.* 2018). In the case of the experimental use of a tranchet adze by Bamforth *et al.* (2018) they observed that the more experienced person was more efficient and produced larger woodworking chips, which they suggested was the result of more consistently accurate working. The importance lies in being able to define the experimenter's skill level, their overall proficiency and how comparable their work is likely to be to archaeological examples so that others can judge the reliability of the work and results produced. Ideally, this should form part of all experimental archaeological work, although it is striking that in the vast majority of published work little attention or description is made to how proficient and able the experimenters actually were for the work they undertook – an unfortunate continued deficiency in the field.

Table 7.2 Practical experience of the author in using steel, bronze, stone, antler, and bone woodworking tools

No.	Time spent	Date	Instructor	Tools used	Description
1.	3 hours	5th & 6th May 2018	Prof. Martin Bell, self-taught	Neolithic axe, Bronze flat axe and steel Viking age	Preliminary practice with range of prehistoric reconstructions to test the function and performance of tools. 10 pointed ends made.
2.	4 hours	27th June & 23rd August 2018	UoR PhD researcher Katy Whitaker	Steel axes	Introduction to safe use of steel axes, cross-cutting, splitting wood, spoon carving.
3.	12 hours	27th, 28th & 29th July 2018	Jonny Crockett and instructors at Bushcraft Survival School	Steel axes and wedges	Three-day practical course on axe safety, splitting, felling three trees, snedding, making pegs, pointing stakes, cross-cutting logs and splitting large roundwood with wedges.
4.	4.5 hours	24th & 25th August 2018	Charlie Russell, owner of small woodland	Steel axes, mauls, and wedges	Felling two hazel trees, splitting large rounds with mauls, axes, and wedges for use as firewood and pointing stakes.
5.	8 hours	11th & 18th Feb 2019	Self-taught, Butser Ancient Farm	Steel foresters axe	Cross-cutting large 200mm diameter roundwood with an axe to section lengths into useful parts. Also pointed roundwood stakes.
6.	6 hours	1st & 2nd March 2019	Ben Willis, Ben Willis Woodcraft	Steel axes, froes, and chair adzes	Use of axe and froe to split and work ash 300mm diameter roundwood into chair legs lengths. Use of chair adze to carve seat for chair.
7.	6 hours	3rd, 4th & 28th Oct 2019	Self-taught	Tranchet flint and tuff adzes	Preliminary tests and training with flint and tuff adzes. 12 pointed ends made.
8.	4.5 hours	20th Oct 2019	Julian Bell, curator Weald and Downland Museum	Steel axes, adzes, gouges, and chisel tools	Range of tools to tested with experienced curator to test function of tools when trying to produce Goldcliff type facets.
9.	3 hours	25th May 2021	Grahame Thorne, Ramscoat Coppice Estate	Steel axes, billhooks, and saws.	Practical experience of working alongside experienced coppice worker to harvest coppiced lengths for testing.
10.	12 hours	27th May - 2nd June 2021	Self-taught	Range of prehistoric reconstructed tools	Practice sessions producing five pointed ends for each of the nine main tools under investigation, followed by the nine Final

				in this study	Tests. For the four Secondary Experiments a preliminary test and then one Final Test was undertaken.
Total	**63 hours**				

For this study as no specific or accessible training course exists for the use of stone-age tools it was felt that the most profitable method was to learn the correct and safe use of steel axes and adzes as a basis for then moving onto practicing with the range of Mesolithic and Neolithic tools to be tested. To that end, the author undertook a three-day workshop called the ‘Axe Proficiency Qualification’, Level 3 NCFE accredited and included a practical exam, with the ‘Bushcraft Survival School’ based in Staffordshire led by ex-Royal Marine Jonny Crockett who holds a MA in experimental archaeology from Exeter University. This provided instruction in correct and safe handling of steel axes, technique for felling trees, roundwood splitting, snedding to produce brash (cutting off branches) and pointing of roundwood to produce stakes. Further taught experience included time with professional green woodworker Ben Willis on a two-day green woodworking course that again involved instruction in the use of axes to split and hew wood and adzes to carve out hollows.

The practical experience by the author of pointing roundwood using steel tools over the days set out in Table 7.2 above, suggested that the techniques, level of skill and fitness levels for these experiments did not appear excessively high or difficult and were deemed achievable for this study. The process of working roundwood to a point was not found to be intrinsically hard, although achieving good technique and accuracy were evidently the product of proper instruction and practice. The single most important aspect recognised was that correct technique and accurate striking were the largest determining factors for how tools performed if everything else was equal. Skilled woodworkers performed tasks more quickly and more easily with fewer blows, as each time they struck it was where and how they intended for maximum efficacy of the task with the most wood removal each time.

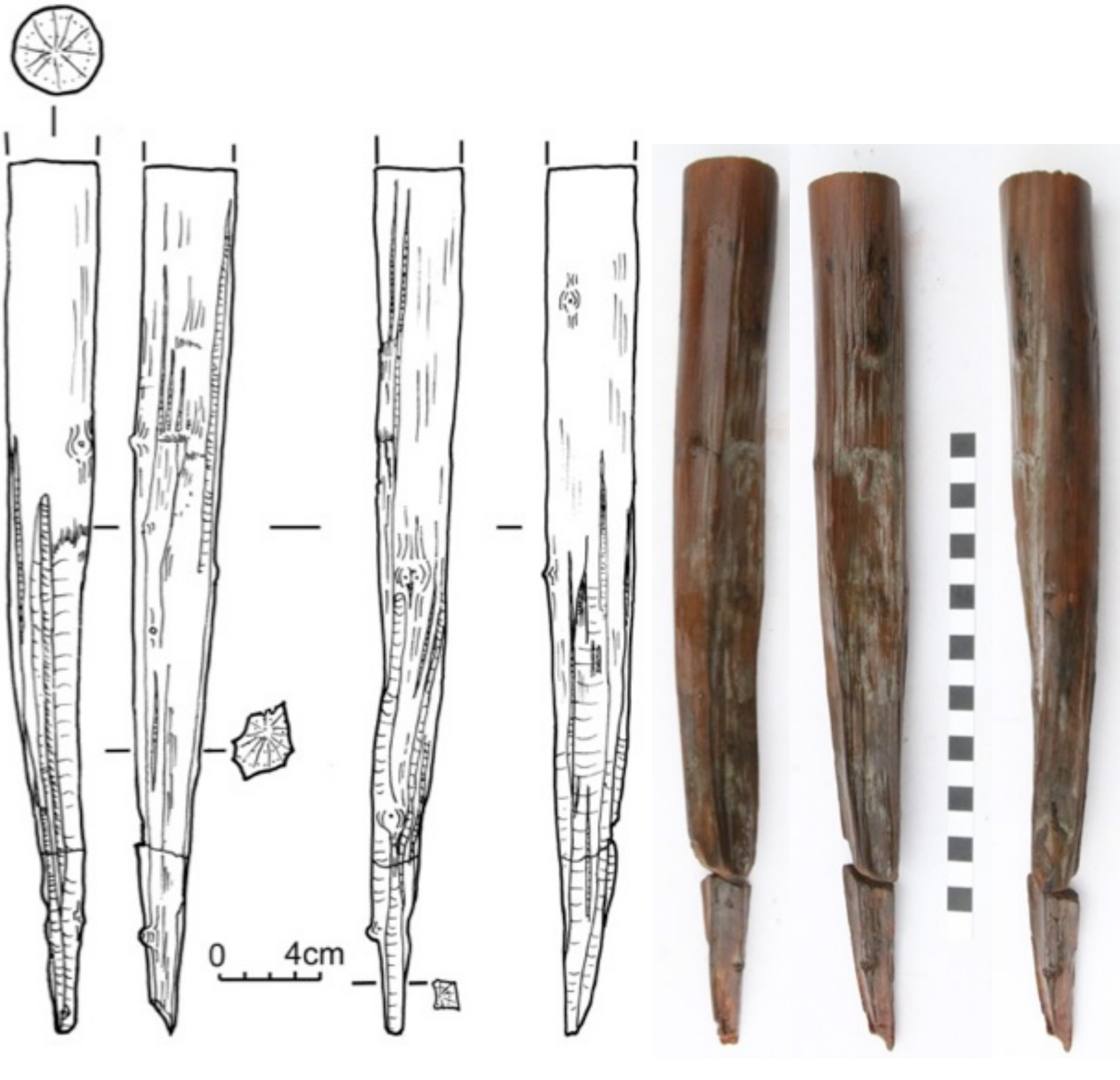
Fig 7.23 Training work pointing hazel and alder roundwood with flint tranchet adze (left) and tuff adze (right)

To that end, prior to commencing the experimental programme for an approximate skill level of the author over 50 hours over 18 separate days on training and building skill in greenwood working was logged using steel axes and adzes, as set out in Table 7.2 above. Over this time some 50 pointed ends were made using steel axes and adzes. A further nine hours of work over three days was undertaken in preliminary training using the Mesolithic and Neolithic tools meaning 54 practice pointed ends were produced prior to three hours conducting 13 Final Tests in this programme. In combination this equates to approximately some 63 hours of greenwood working essentially focused on aspects of manufacturing pointed roundwood using a variety of tools. This was felt to be adequate for the experimental purposes, as it was focused on one single activity and end product – arguably effectively compressing the learning process that may occur over years in a wider variety of general greenwood tasks. Whilst the author makes no claim to be able to precisely replicate the skills and experienced of likely skilled prehistoric people, it would seem reasonable to propose that this amount of practice is reasonable for this specific experimental programme to reduce the chance that the results detailed in this study were dramatically affected by a lack of practical ability. This is to say that if in using a certain tool it proved impractical or impossible to replicate the observed morphology of the Goldcliff type facets then it was rational to conclude that that tool and its action was likely the cause, rather than the hopefully the author.

7.5.4 End product

For this work the Goldcliff East Site T type pointed ends with long and dished facets producing a pencil point was the target end product of experimentation. That 'pencil point' was considered made when facets have been cut around the entire roundwood circumference with no outer surface or bark left between facet junctions and the end having been worked to a clear sharp point (see artefact <2018.47> from Goldcliff East Site T below). Once this morphology was achieved further refinement was stopped that might alter yet further the woodworking traces. This allows for comparison between tool tests but may not of course allow for the perspective of someone in the past who may have stopped sooner if a basic point was made or alternatively continued working if a pointed end was only considered finished when it had met certain pre-determined visual or cultural standards. The repeated use of consistent methods and criteria across tests allows for comparisons to be drawn and provides a mechanism to gain better understanding of the *probable* source of the facets in the case-study type pointed ends in this work. However, it is worth acknowledging it cannot easily address the cultural or social context that the task was undertaken in that may have influenced the methods and ways of working in unforeseen ways.

Fig 7.24 An example of a 'pencil-point' pointed end from Goldcliff East, Site T, Structure Tc. Artefact <2018.47> measuring 382mm long by 36mm diameter dated to 5225-5010 cal BC (6181+/-36, UBA-41504) (Drawing Jennifer Foster, photographs the author)



7.6 The Axe and adze action tools (Category 1 tests)

Fig 7.25 Details of the replica experimental tools used for axe and adze tests in this work: (1) flint tranchet adze, (2) tuff tranchet adze, (3) flint polished axe, (4) antler adze

(1)

(2)

(3)

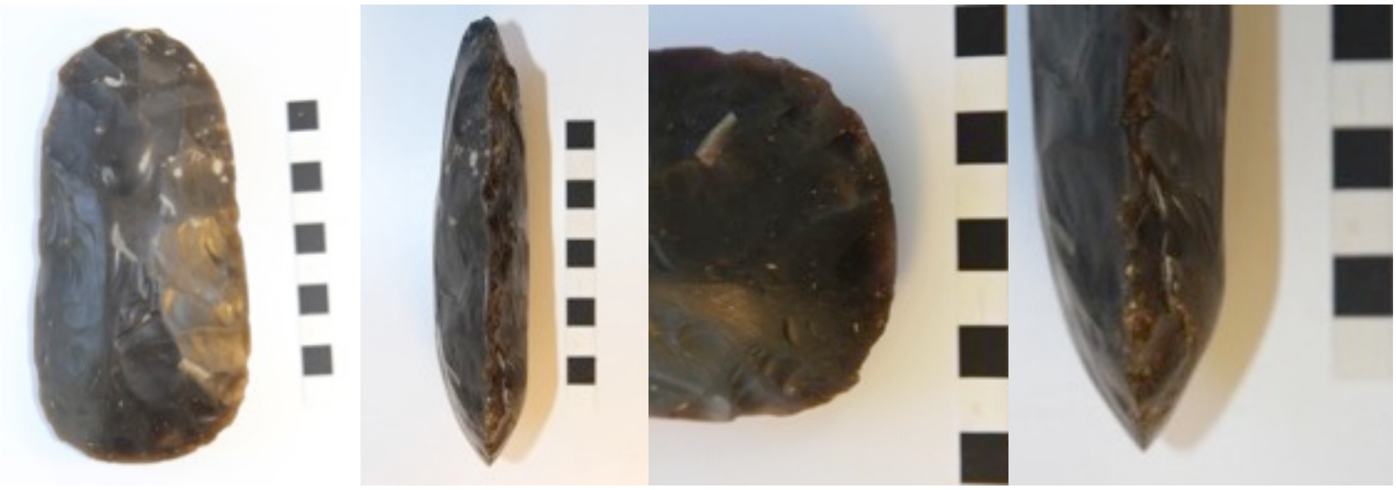
(4)

7.7 The cleave or splitting action tools (Category 2 & 3 tests)

Fig 7.26 Details of the replica experimental tools used cleaving and splitting tests in this work: (1) cow bone chisel, (2) red bone deer chisel, (3) polished flint axe-head as chisel (4) polished flint chisel (5) flint blade, (6) flint flake, (7) hafted flint end scraper, (8) hafted flint tranchet arrow head

(1)

(2)



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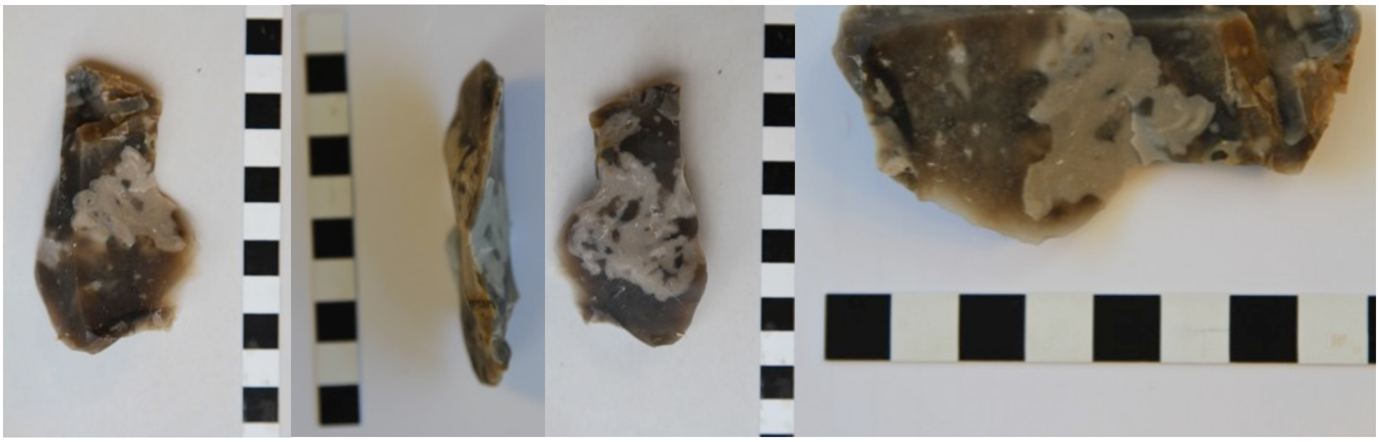

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7.8 Experimental results: Category 1 axe and adze action tools

7.8.1 Tranchet adze (flint)

Producing a pointed end with a flint tranchet adze was a very straightforward and effective method, with a 40mm diameter green hazel roundwood stem made into a point in 4 minutes 34 seconds working with 130 strikes in the Final Test. The working technique makes use of the fine and sharp nature of the tranchet blade edge for the first strike to make a very acute angle cut down the stem at under 10 degrees. Lifting this initial portion then allows the repeated striking of the adze in the same place which proceeds to lift an initial slice down the stem and if properly controlled can be a good length of 100mm, although this initial removal is then truncated by further cuts and removals. The largest surviving facet on the final test piece measures 30mm long, 22mm wide by 1mm deep. The wood chips exhibit frayed and slightly crushed ends at the end that took the initial strike and were essentially flat in cross-section towards the end of the facet or woodchip. The end product was a sharp and fine pencil point with few clearly identifiable complete individual facets but evidence of lots of smaller partially truncated ones, with their surfaces normally fairly smooth, but with, on occasion, crushed and ripped partial jam curves across the cut sides. Where the tool jams the surface is normally more ripped and crushed reflecting the irregular flaked cross-sectional outline of the tool.

It was noticeable that with practice, improved accuracy and increased controlled power in the tool strikes greatly improved the efficiency of the tool and the tranchet adze proved a particularly effective tool for controlled fine working to make a very sharp final point. For example, the first practice use of the tool took 11 minutes to point a 40mm hazel roundwood stem, but by the end of the experimental programme the author was easily doing it in four minutes. The tranchet blade edge did appear to suffer microchips with prolonged use (having worked over 30 pointed ends), and was still surprising durable and effective, with the amount of work needed to fully blunt it not tested in this work but seems likely to be considerable.

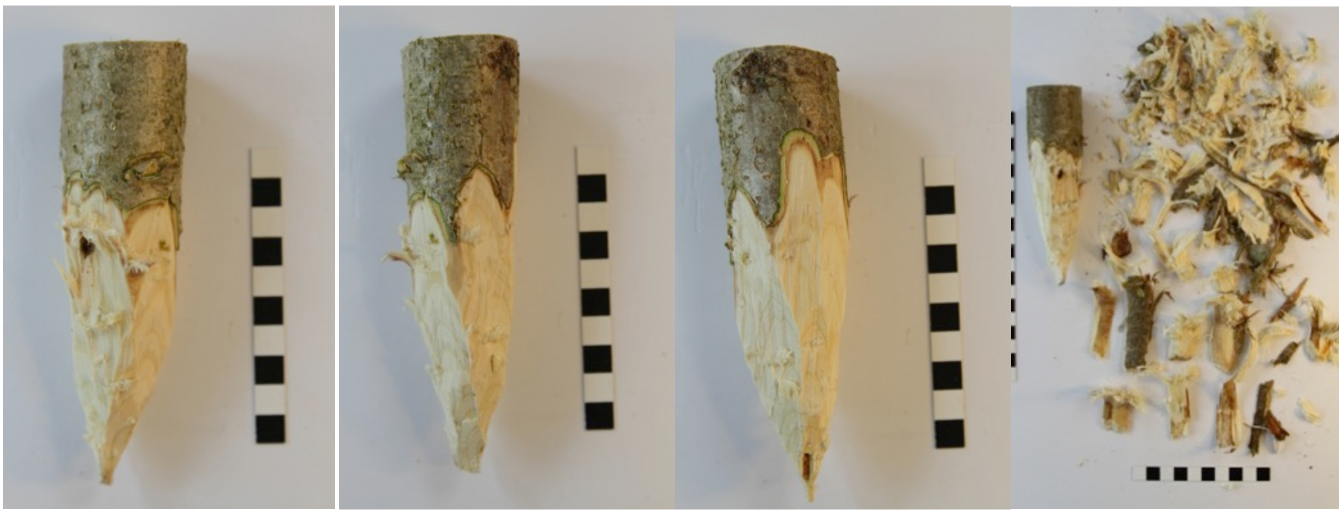


Fig 7.27 Results of the Final Test with tranchet flint adze

7.8.2 Tranchet adze (tuff)

A second version of the tranchet adze was also tested in this work made from a nodule of unstratified previously unworked volcanic tuff sourced at Goldcliff East and probably eroded from Pleistocene Head by Martin Bell and made into an adze with hazel haft by John Lord. Using this tool in this initial hafting configuration proved difficult and a second haft was made by the author that improved the power and ease of use of the tool. Experimentation with this tool occurred in early, preliminary, stages of this research work before a clear experimental methodology was established so its use was not precisely the same as for the later larger programme, with the tool then donated for the opening of a new prehistoric gallery at Newport Museum that occurred in Autumn of 2019. However, as this tool is arguably the most direct reconstruction possible for one of the case-studies in this work it seems reasonable to include the results.

In the John Lord haft configuration, the tool pointed a freshly cut 35mm diameter hazel stem (illustrated below) in seven minutes. The angle of the haft and orientation of the blade edge proved somewhat awkward for this task and the facets were very small (the largest on the hazel being 15mm long by 14mm wide by 0.5mm deep), leaving torn surfaces and numerous torn partial jam curves. The second birch haft configuration made by the author was much easier to use and three 21mm diameter hazel stems were cut in five minutes each, along with three alder stems 25, 30 and 35mm in diameter cut in four minutes each. These second batch of stems had been cut two weeks before testing took place. Importantly the final pointed ends produced, whether green or two weeks old, hazel or alder, for both haft configurations were all broadly similar in morphology to each other (see Fig 7.26 below bottom left) with this particular tool reconstruction producing small, often partial and truncated facets, the largest measuring 25mm long by 14mm wide and flat in cross section with evidence of blade jamming and tearing of the wood. It also produced a clear sharp point using the sharp cutting edge of the tool but was clearly different in morphology to the pointed ends from Goldcliff under investigation in this chapter.

Fig 7.28 Results of the Final Test with tranchet tuff adze

7.8.3 Polished axe

The initial stages of producing a pointed end with a polished axe proved a relatively straightforward if slightly laborious task, with a 40mm diameter green hazel roundwood stem worked for six minutes 30 seconds of working and roughly worked nearly into a point. The working technique requires the axe to be used at roughly 50 degrees as suggested by other experimental work discussed above, as it proves impossible to attempt to cut into the wood with a too acute angle down the stem due to the wide cross-sectional profile of the axe-head. The method would appear to be to use short, strong strikes to lift an initial section of the outer layer and then repeated strikes into this lifted area to enable a good sized slice or woodchip. This requires good accuracy and some force to be able to effectively repeatedly hit the same place each time. The process also required considerable effort with 190 strikes required in the Final Test and after the initial large chips down the stem were removed it proved noticeably difficult to produce a fine end point to the piece.

While the blade edge of a polished axe is relatively sharp and certainly cuts wood, the wide angle it has to be wielded at and the rapid widening of the blade into the body of the axe-head means it is harder to produce fine cuts and control whether it ends up crushing rather than cutting the final point of the roundwood. Much effort and time was therefore expended towards the end of the process trying to make a decent finished point, which was not really achieved although the end product was a basic pencil point and could be used as a stake. Working like this left the surface battered and ripped, without any clear toolmarks, and no clear facet junctions. The wood chips produced were often fairly small in size, the largest for the final test 65mm in length, 30mm in width and 5mm in depth with a clearly frayed proximal end where repeated strikes had hit the wood, and a short intact section at the terminal end and flat in cross section. Based on the results of this test, using this specific reconstruction, it appears unlikely that a polished axe could produce the toolmarks under investigation in this chapter.

Fig 7.29 Results of the Final Test with flint polished axe

7.8.5 Antler adze

The antler adze proved to be a partially effective tool that was able to work wood, however it appeared less suited to this particular task. The initial working technique was similar to that of the tranchet adze, if less efficient, with the starting working angle fairly acute working down the stem. The first bite of the tool removes an initial section and then requires repeated accurate strikes to work down a fraying woodchip to remove a decent sized first slice. While the angle of the tool and haft was comfortable in this reconstruction the author found that the fairly small surface area of the blade edge, with its pronounced cross-sectional curve following the circumference of the antler, was a significant problem as the work progressed as it proved difficult to cut rather than crush the wood to produce the smaller facets required for the point. Five similar smaller diameter practice ends were produced successfully on sawn roundwood, but in the Final Test piece even after 10 minutes of working a 40mm diameter hazel roundwood, and an estimated 500 strikes, the final sharp pencil end had not been produced. No clear facets were left on the surface of the final test for measurement, with the wood chips produced being torn and frayed at the top where they start and flat across the bottom and cross-sectional where they lift off from the wood. The largest of these woodchips measured 65mm long by 30mm wide and 5mm deep. While still functional as a stake this partially finished end product suggests there was a problem in this test. The reconstruction of the adze seems reasonably comparable to relevant archaeological examples, so conceivably it may be the case that considerably more practice or a different technique is required to effectively wield this tool in this task. However, based on the evidence here it does appear unlikely that this tool could have produced the toolmarks under investigation in this test. It was also noted that some polishing and blunting of the blade edge of the adze had appeared even after the pointing of five training stems and one Final Test, so the long-term durability of this tool when used in this fashion seems open to question.

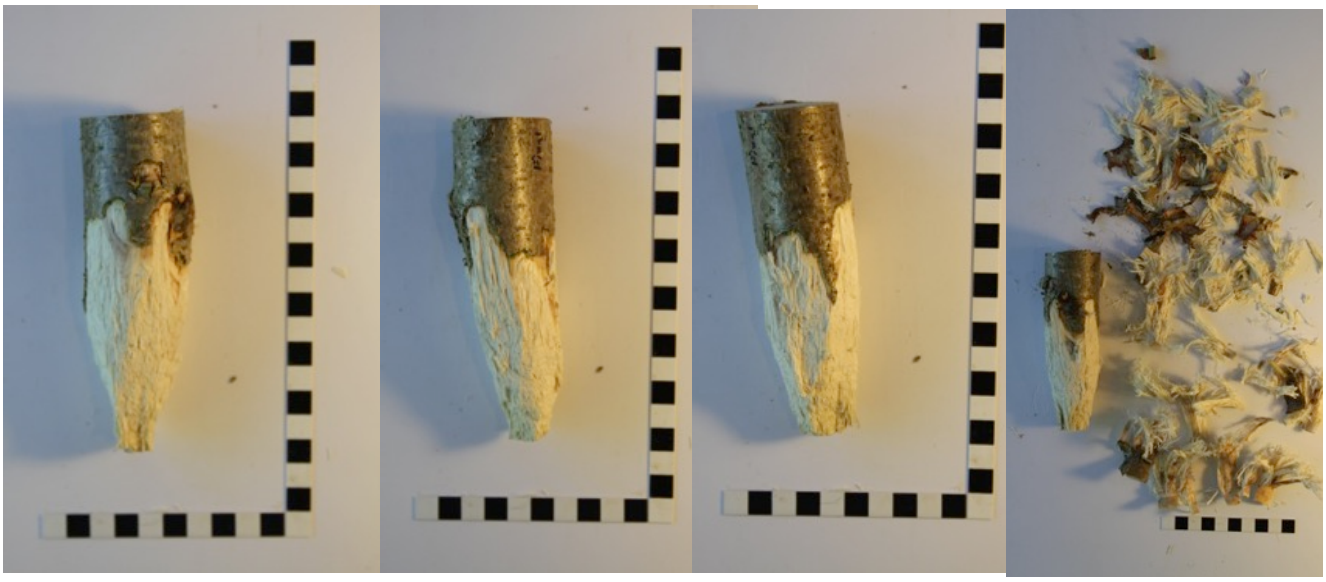


Fig 7.30 Results of the Final Test with antler adze

7.9 Experimental results: Category 2 cleaving type experiments

The preliminary tests and training outline above had suggested that cleaving or splitting of roundwood from the cut end upwards towards the rest of the stem was likely to produce results comparable to the archaeological examples. As noted above this means working from the intended point, or pre-cut, end upwards towards the rest of the stem in these cleaving type experiments.

7.9.1 Cow bone chisel

Producing a pointed end with a 40mm wide blade edge fresh cow bone chisel and mallet proved to be very simple and effective method, with a 40mm diameter green roundwood hazel stem worked into a long fine pencil point in 4 minutes 30 seconds, with 16 individual slices removed and requiring approximately 80 strikes of the mallet. The wood had to be held in a vice for the purposes of the experiment, but it would be equally possible to use another worker to hold the roundwood against a tree or fallen log. Very large roundwood might have required a simple brace to be used to hold it in place. The initial working technique is to position the sharp end curved blade end on the pre-cut end that will become the point and strike with the mallet to produce an initial curved cut across the roundwood rings. The important part is to not take too much wood off at first, the author roughly aimed for between and eighth to quarter of the diameter for the first slice. The reason for this is that once the initial cut is made then the slice can be cleaved or levered off using the bone chisel pushing between the slice and rest of the stem and pulling on the cut end. This can be controlled and to a certain extent the length of the removed slice selected by the worker. The curvature of the blade edge is useful in this process as it directs the cross-sectional split of the wood quickly to the roundwood circumference and thus stops the wood being cleaved too straight and removing too much material in one go. The depth of the initial chisel and mallet cut is important as it does determine to certain extent how long and curved the slice will be; too deep and it is harder to not end up with a very long and deeply dished removal. If the initial cut is too central it is also easy to end up splitting the roundwood rather than making a point. Further chisel and mallet strikes to the cut end are then performed in a similar fashion to removed subsequent slices until the desired final pointed end is produced. If desired the chisel also proved a useful tool to remove fine final facets working down the stem towards the point to make it sharp and more regular.

Fig 7.31 The sequential process of producing a pencil pointed end with cow bone chisel and mallet. The process can be halted as soon as a point is made or continued until a very sharp point is made, with the process reliant on the curvature of the tool blade, the cleaving properties of wood and decisions of the worker

The resulting facets are long, curved and normally smooth in cross-section, with ripping of the bark at their ends towards the rest of the stem, and will rip around side branches or knots rather than cutting through them. There was evidence of the initial chisel strike on the wood chip end that had been part of the pre-cut end with slight evidence of crushing. The longest toolmark produced for this final test piece was 245mm long by 21mm wide and 1.5mm deep. A training roundwood piece was larger at 50mm in diameter and larger slices or facets ended up being removed to reduce the wood, the longest being 375mm long by 35mm wide and 1mm deep. If the removed chips or slices are retained it is possible to refit them to the pointed end and recreate the process of their removal

Fig 7.32 End result of the process of cleaving roundwood with cow bone chisel and mallet. The woodchips or slices are clearly different to those made using axe or adze action tools

There was some very minor damage or flaking to the blade edge of the bone chisel itself, but generally it appeared still very sharp after use, and it is worth noting that bone tools appear to offer the potential for sharp blade edges comparable to flint blades although the durability may differ. The toolmaker can potentially decide how durable or sharp they wish the edge to be by the angle they cut across the bone, or perhaps by making an additional blade edge bevel. Other factors such as seasoning or age of bone, or potentially the use of a denser bone and species such as prehistoric aurochs may also all affect the potential versatility of bone tools. From this experiment the working potential of the tool for woodworking and particularly pointing roundwood to achieve toolmarks of the type under investigation seems clear.

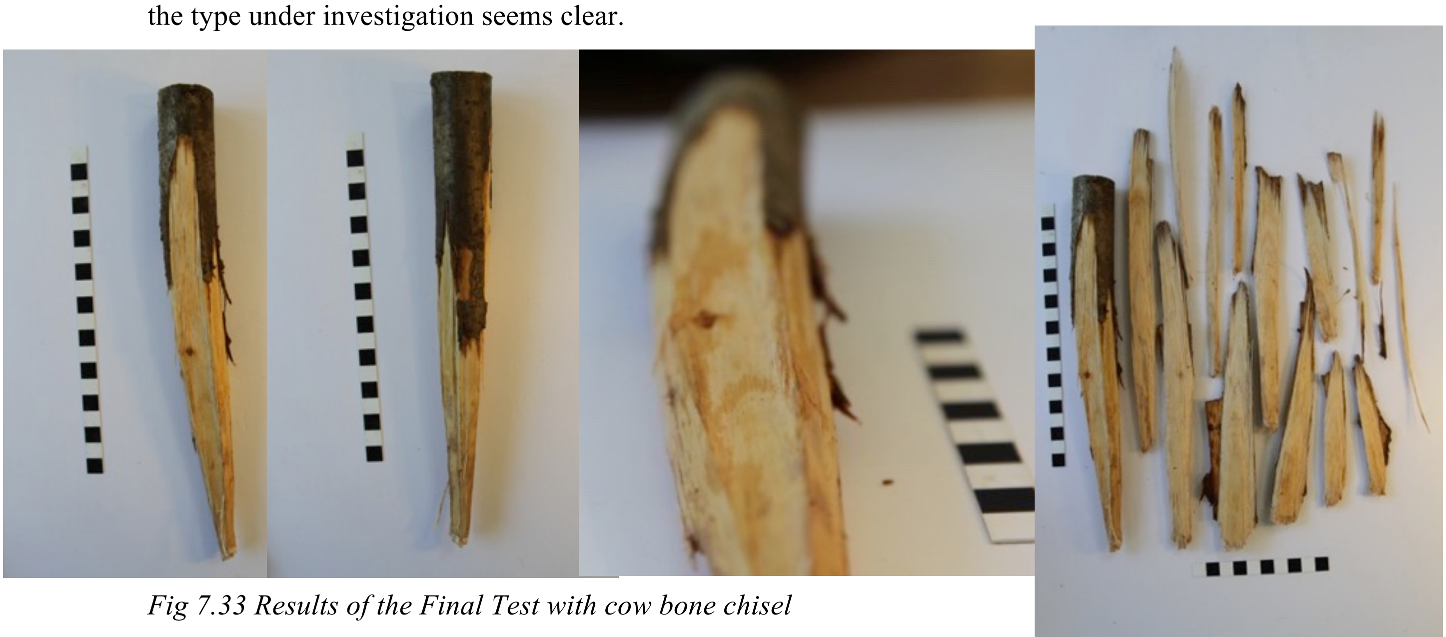


Fig 7.33 Results of the Final Test with cow bone chisel

7.9.2 Red deer bone chisel

Producing a pointed end with a 18mm blade edge wide fresh red deer bone chisel and mallet followed the same working method as that set out above for the cow bone chisel, with a 40mm diameter roundwood produced in four minutes 30 seconds minutes and with 95 strikes and 16 removals. The general properties of the facets, woodchips and resulting end product were also very similar to the cow bone chisel with long facets, smooth and dished in cross section with ripping at their terminal end towards the rest of the stem. The longest one produced for this piece was 320mm long by 32mm wide and 2mm deep. If the removed chips or slices are retained it is possible to refit them to the pointed end and recreate the process of their removal, with the working edge of the tool still in good condition for this limited number of experiments. The use of the red deer chisel proved very effective at controlling the last fine removals to produce a fine pointed end. It is possible that prolonged use or significantly larger diameter roundwood might potentially prove beyond the capabilities of this relatively small in width tool or damage its blade edge, but those factors were not tested for in this study.

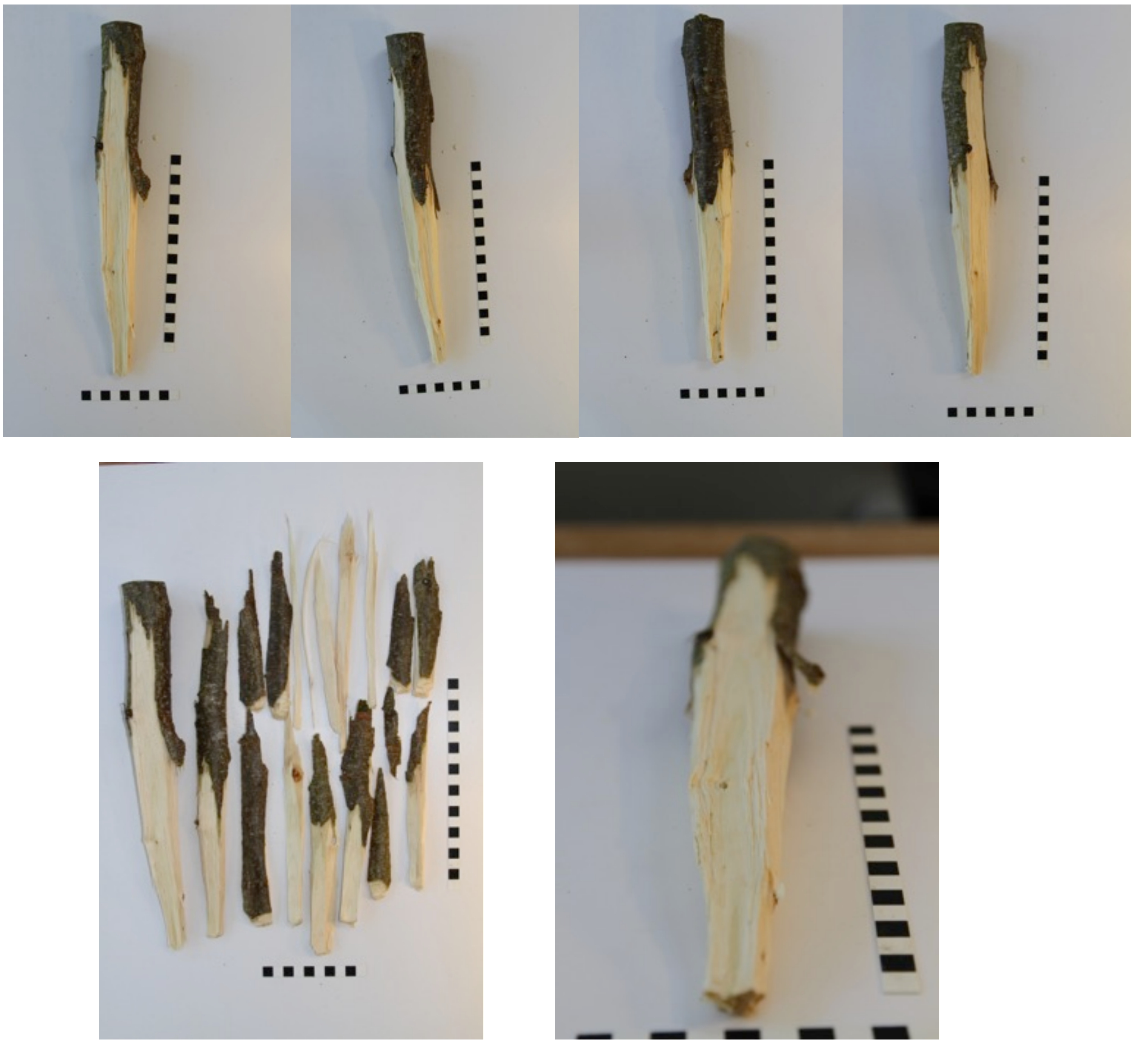


Fig 7.34 Results of the Final Test with deer bone chisel

7.9.3 Polished axe-head chisel

A secondary test for a polished axe-head was undertaken by using an unhafted Norfolk flint part polished axe-head to cleave the wood with a mallet. The working method was similar to that of the bone chisel described in full above, with a 40mm diameter green hazel roundwood stem worked for 4 minute 30 seconds, but ultimately with a failure to make a pencil point. An initial powerful quick strike did enable it to dig into the wood and produce the initial cut, but subsequent cuts became progressively harder to achieve with a tendency to simply crush and not cut the end surface. After initial slices were removed it proved very difficult to accurately position the axe-head blade edge on the reducing pre-cut roundwood end. Even on sawn training roundwood it very clearly ran into difficulty at the end of the process where it was very hard to use the comparative wider and larger blade edge over the small remaining end of the roundwood to make the final cuts to produce a decent sharp pencil point. It was all too easy to place it too centrally and thus split the roundwood, with three of the five preliminary training tests ending this way. The facets produced were similar to the ones made by the bone chisel, being long, smooth on their surfaces, curved in cross-section, with sharp facet junctions and with tearing of the bark towards the terminal facet end and stem. The largest measured 190mm long by 26mm wide and 3mm deep. However, ultimately the pencil point in the final test could not be achieved and the conclusion would seem to be that while a possible source of large initial slice removals, the use of an unhafted polished axe-head in chisel form to finish a point seems unlikely or requires technique beyond the author and possibly the use of a different more fine bladed polished axe-head for more controllable finishing. It is also worth pointing out given the results of this test it is conceivable that the hafted axe and adze used above could be struck with a mallet to produce the facet type under investigation although the problem of finishing the point would still remain. Such tests were not attempted in this experimental programme as it was felt that it may possibly break the hafts or tools and thus ruin further tests. However, it perhaps illustrates the point that a composite tool may have been used in a multitude of ways, hafted and unhafted, for all or only parts of a woodworking processes and perhaps may have required techniques only developed by skilled and experienced woodworkers.



Fig 7.35 Results of the Final Test with polished axe head

7.9.4 Polished flint chisel

Producing a pointed end with a medium sized partially polished flint chisel and mallet proved to be an unlikely method of producing a pointed end. After working a 40mm diameter green hazel roundwood for five minutes thirty seconds with over 100 strikes the end became too crushed to work further. While conceivably still functional as stake it did not exhibit the morphology of the archaeological pointed ends under investigation in this work. The basic working method was similar to that of the cow bone chisel described above but required more consideration of the placement of the blade edge on the cut roundwood end, with the author finding that the curved edge should face into the central pith of the roundwood and the flatter blade edge face away to produce the most effective mechanism of producing the necessary initial cut. As the cutting edge of the tool in this experiment was less sharp in comparison to a bone chisel it required more force to produce that initial cut, but once achieved it was possible to initially remove long slices and the tool appear able to cope with this hard striking of the mallet as might be expected from its chisel shape. The resulting facets were comparable being long, smooth in surfaces and notably curved in cross section. The wood removed would rip around knots and leave rips or striations in the wood towards the facet terminal end. The largest one produced in this experiment was 195mm long 24mm wide and 2mm deep. However, due to the less sharp blade edge it proved impossible to produce a final sharp point in the final test working on the tranchet adze pre-cut stem. It was also hard to avoid splitting at the roundwood towards the end of the process as fine control was very difficult to achieve – a problem comparable to that seen with the polished axe-head described above.

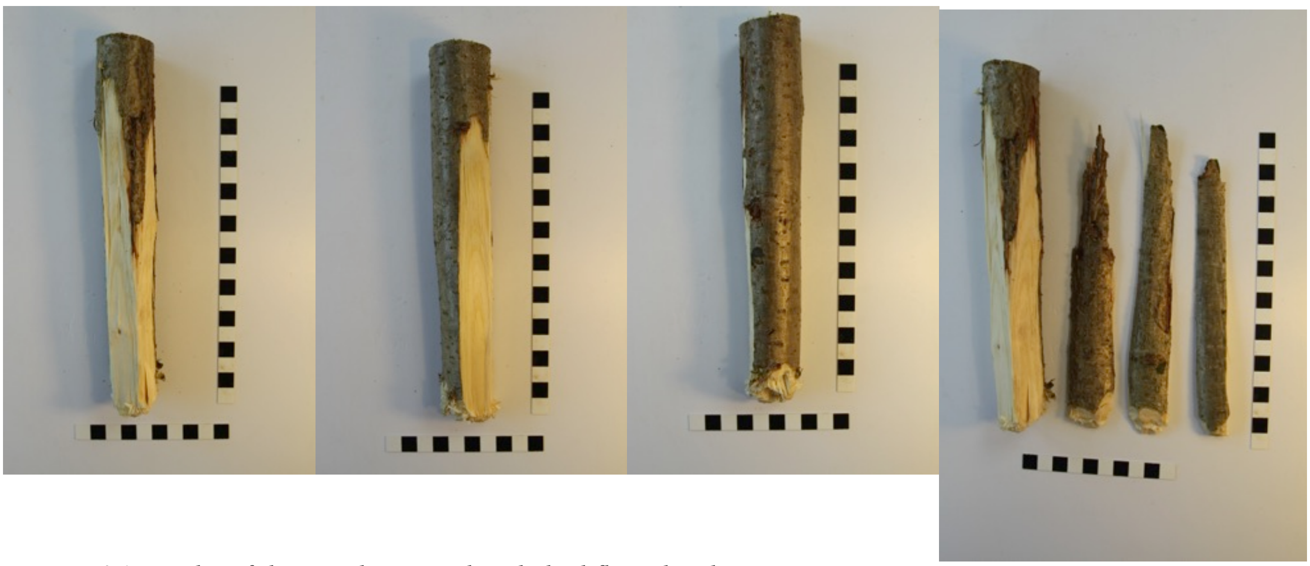


Fig 7.36 Results of the Final Test with polished flint chisel

7.9.5 Antler chisel

Producing a pointed end with an antler chisel was an effective method to working roundwood to a pencil point. In use it appeared to be a durable and hard-wearing tool for woodworking. The working method was similar to that described for the cow bone chisel above and with 3 minutes and 58 seconds of working, and 70 mallet strikes, a pencil point was produced. There was perhaps slightly less fine control than using the very sharp and curved bone chisels, with it more difficult to work the end to a very sharp and fine point. The resulting facets appeared to be medium to large in length and size, with the longest in this experiment 280mm in length and 25mm wide and 2.5mm deep. The facets had sharp facet junctions and were curved in cross-sectional with ripping at the terminal end up the stem.

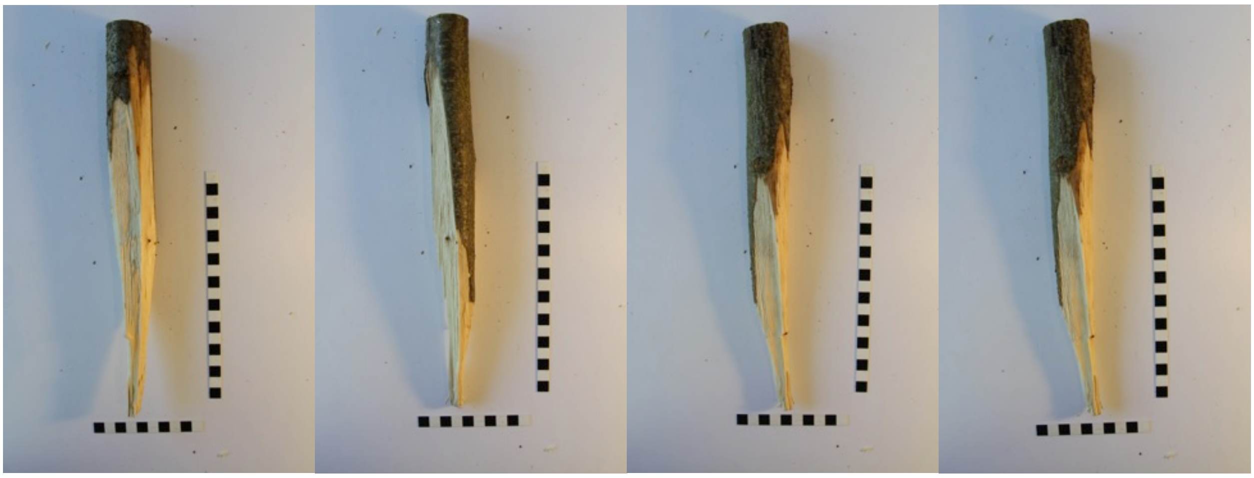


Fig 7.37 Results of the Final Test with antler chisel

7.10 Experimental Results: Category 3 cleaving type experiments

7.10.1 Blade

Producing a pointed end with the end of a relatively large, 95mm long, 25mm wide and 16mm deep, flint blade and mallet proved to be a surprisingly effective method in the initial stages of producing a point end, but a fine pencil point was not achieved. The working method was similar to that of the bone chisel described above but required more delicate positioning of the blade edge on the pre-cut end to ensure it got purchase and was not damaged. The sharpness of the flint blade and its fairly robust nature due to its size meant that it was an effective way of producing the initial cut that could then be cleaved or prised open to take a slice off the roundwood. However, as the surface area of the pre-cut end reduced it was increasingly difficult to accurately position and strike in the right place for the next slice and it was all too easy to split the wood centrally. The resulting facets appeared to be medium to large in length and size, with the longest in this experiment 320mm in length and 30mm wide and 2.5mm deep. The facets had sharp facet junctions and were curved in cross-section with ripping at the terminal end up the stem. The initial entry point on the already cut end was sharply cut, with little crushing reflecting the sharpness of the flint. It seems likely a blade of this particular size would struggle to be as effective for larger pieces, denser species, or seasoned wood, and would possibly also suffer from damage over prolonged use, but for small to medium roundwood it could have been used in the initial stages but not for the whole task of producing Goldcliff type cleave-end points.

Fig 7.38 Results of the Final Test with flint blade

7.10.2 Flake

Producing a pointed end with a medium size leftover axe-head thinning flint flake made by John Lord, measuring some 75mm long, 48mm wide and 18mm in maximum depth, along with a mallet proved to be an effective method of producing a point end with a 40mm diameter green hazel roundwood pointed in some 4 minutes 30 seconds and 70 strikes. The flake edge in contact with the wood measured some 22mm in bladed edge width and was slightly curved and concave. The working method was similar to that of the cow bone chisel described above but was more difficult and required delicate positioning of the flake edge on the roundwood cut end to ensure it cut where intended and was not damaged. The sharpness of the flint flake and its fairly robust form meant that it was an effective way of producing the initial cut that then allowed a slice to be cleaved or prised open to a portion off the roundwood. The resulting facets appeared to be medium to large in length and size, with the longest in this test being a sizeable 475mm in length, 30mm in width and 2.5mm in depth. The facets were smooth in surface, curved in cross section, sharp facet junctions with evidence of tearing and ripping of the wood towards the terminal stem end. Whether a flake edge would prove suitably durable for long-term use and on larger roundwood was not explored here, but the effectiveness of this one medium-sized flake in this task suggests the wider potential for this tool type.



Fig 7.39 Results of the Final Test flint flake

7.10.3 Hafted tranverse arrowhead

Producing a pointed end hafted end transverse arrowhead with a 20mm wide blade edge proved to be a possibly effective initial method of working with a 40mm diameter green hazel roundwood with slices cleaved off using the sharpness of the blade edge. Unfortunately, after 2 minutes 30 seconds of working on a second training stem to assess the feasibility of using the tool the jarring force of the mallet pushed the hafted tool out of position and it could no longer be used to complete the test. The general working method was similar to that of the cow bone chisel set out above with the sharp and fairly robust blade edge performing well and producing a nice clean initial cut with normally one or just two initial mallet strikes. The wood slice then could be cleaved off the roundwood end in a combination of pulling it off and pushing the tool into the space. However, the straight edge of the blade made it more difficult to produce the final sharp point on the first training test as it was required to move the position of the edge to just the right spot to not removed too much material – too central and the roundwood splits down the middle. The resulting facets were medium in size with smooth surfaces, sharp facet junctions and some ripping of the bark towards the stem end, the largest measuring 150mm in length, 19mm in width and 1.5mm in depth. Normally they were fairly flat in cross-section, with a few exhibiting more pronounced cross-sectional curvature.

Fig 7.40 Results of the Final Test with hafted flint transverse arrow head

7.10.4 Hafted end scraper

Producing a pointed end with a hafted end scraper with a 31mm wide blade edge proved an unlikely method of trying to point roundwood. After 70 strikes and 3 minutes and 30 seconds of working a 40mm diameter green hazel roundwood stem it proved possible to produce some initial removals but not finish a fine point to the piece. The general working method was similar to that of the cow bone chisel set out above however the less sharp blade edge of the scraper proved to require more force in the mallet strike and generally more strikes overall to be able to produce the initial necessary starting point on the cut end. It was also noticeable that the force of the strike proceeded to move the hafted flint out of position and the edge of the scraper started to have microflakes and began to blunt after the production of as little as one pointed end. The resulting facets were small to medium in size with smooth surfaces, sharp facet junctions and some ripping of the bark towards the stem end, the largest measuring 195mm in length, 18mm in width and 1mm in depth. Normally they were fairly flat in cross-section, with a few exhibiting more pronounced cross-sectional curvature. Once a series of slices or facets were removed it proved difficult to produce the final sharp point with smaller removals as this form of tool has a tendency to crush rather than cut the wood. The conclusion would seem to be that while this version of the reconstructed tool could just possibly do the initial job of slice removal, the combination of durability of the knapped edge unlikely to last long-term and the blade edge morphology making it difficult to produce a final sharp point means it seems an unlikely contender for consistent working of anything except very small diameter roundwood.

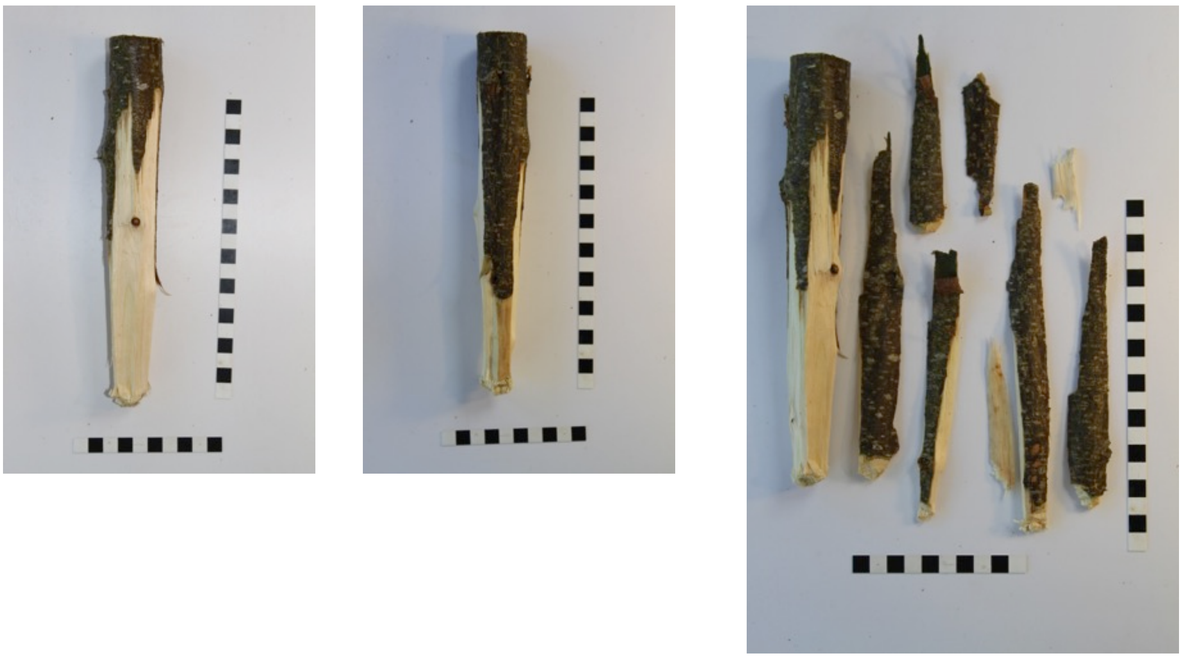


Fig 7.41 Results of the Final Test with hafted flint end scraper

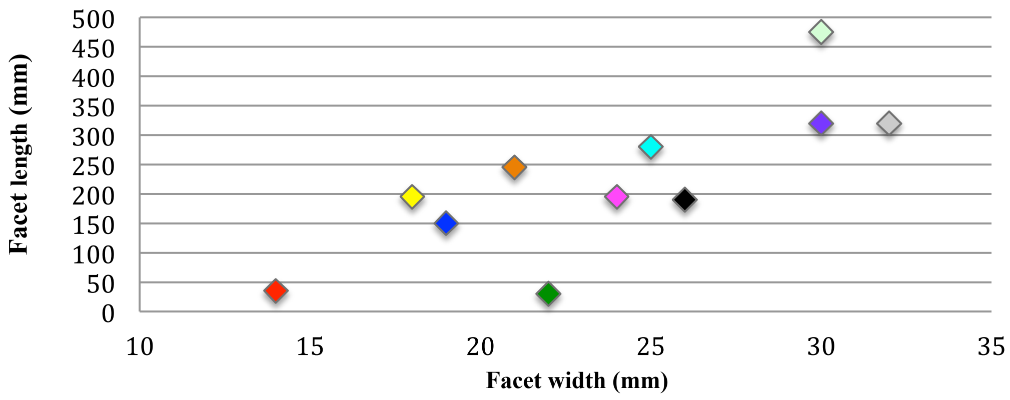
7.11 Results and Toolmark analysis

Table 7.3 The results of the 'Final Tests' carried out for each tool replica in this experiment

Test	Tool	Raw material	Tested raw material	No. of strikes /mallet hits	Time taken (Final Test)	No. of removals/ chips	Largest complete or available facet (mm)	No. of facets measurable on end (% = facets left vs woodchips actually produced)	Able to produce Goldcliff type facet?
1	Flaked tranchet adze	Flint	Green 40mm hazel	130	4 min 34 secs	60 (over 5mm in length)	30L x 22W x 1D	8 (13.3%)	NO
2	Flaked tranchet adze	Tuff	Green 35mm hazel	Not recorded at time	7 mins	35 (over 5mm in length)	25L x 14W x 0D	6 (original not recorded at time)	NO
3	Polished axe	Flint	Green 40mm hazel	190	6 min 30 secs	30 (over 5mm in length)	None measurable	0 (0%)	NO
4	Antler adze	Red deer antler	Green 40mm hazel	>500	10 min	55 (over 5mm length)	None measurable	0 (0%)	NO
5	Bone chisel	Cow	Green 40mm hazel	80	4 min 30 secs	16	245L x 21W x 1.5D	5 (31.3%)	YES
6	Bone chisel	Red deer	Green 40mm hazel	95	4 min 30 secs	16	320L x 32W x 2D	5 (31.3%)	YES
7	Polished axe-head chisel	Flint	Green 40mm hazel	>200	4 min 30 secs	3	190L x 26W x 3D	3 (100%)	Not completed, initially only
8	Polished chisel	Flint	Green 40mm hazel	>100	5 min 30 secs	3	195L x 24W x 2D	3 (100%)	Not completed, initially only
9	Antler chisel	Red deer	Green 40mm hazel	70	3 min 58 secs	11	280L x 25W x 2.5D	5 (45.5%)	YES
10	Blade	Flint	Green 40mm hazel	>150	5 min 30 secs	6	320L x 30W x 2.5D	4 (66.7%)	Not completed, initially only
11	Flake	Flint	Green 40mm hazel	70	4 min 30 secs	8	475L x 30W x 2.5D	5 (62.5%)	YES
12	Hafted transverse arrowhead	Flint	Green 40mm hazel	Broke in experiment	2 min 30 secs	9	150L x 19W x 0.5D	6 (66.7%)	Broke in training, initially only
12	Hafted scraper	Flint	Green 40mm hazel	>70	3 min 30 secs	7	195L x 18W x 1D	6 (85.7%)	Not completed, initially only

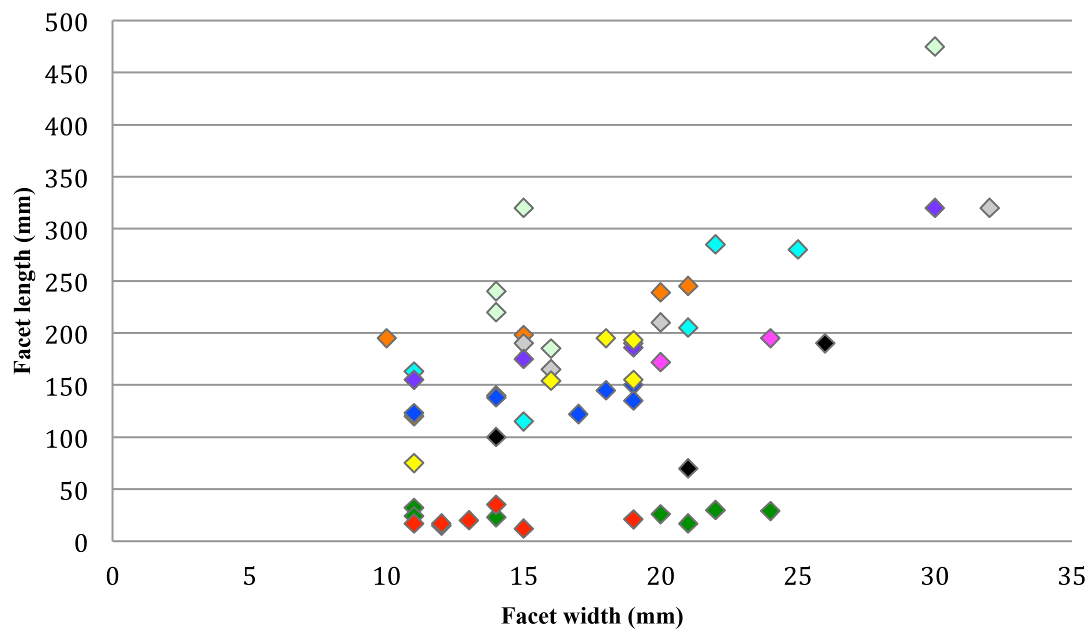
The identifiable facets left on the surface from each tool's Final Test pointed end were measured to provide a database to compare the results metrically. The outcomes from the 'Largest complete or available facet' and 'All measurable facets' data from each pointed end showed a wide variety of results from each tested tool, with the largest single facet produced by the flint flake (475mm long by 30mm wide), followed by the antler chisel (320mm long by 32mm wide) and blade (320mm long and 30mm wide) coming a close second for largest facets. The results did show a separation between axe or adze method tools (red and green below) and the chisel and mallet method tools, with the flint and tuff adzes consistently producing facets (**n=15**) under 36mm in length and 25mm in width.

Fig 7.42 Largest complete or avaliable facet per Final Test pointed-end (n=13)



Key: Green - flint adze, Red – tuff adze, Orange – Cow chisel, Grey – Deer chisel, Black – Polished axe-head, Violet – Polished chisel, Light Blue – Antler chisel, Purple – Blade, Light Green – Flake, Blue – Hafted arrowhead, Yellow – Hafted scraper

Fig 7.43 All measurable facets on each Final Test pointed-end (n=55)



Key: Green - flint adze, Red – tuff adze, Orange – Cow chisel, Grey – Deer chisel, Black – Polished axe-head, Violet – Polished chisel, Light Blue – Antler chisel, Purple – Blade, Light Green – Flake, Blue – Hafted arrowhead, Yellow – Hafted scraper

Unfortunately, as set out in the results description section for the polished axe and antler adze, these tools did not leave identifiable individual facets on the roundwood after producing a point end for comparison, but observation of that process and woodchips by the author would suggest facets of approximately comparable proportions to the flint and tuff adzes. In comparison, the smallest facets produced by the chisel and mallet method were clearly larger than the adzes at 75mm long by 11mm wide for the hafted scraper and 70mm long by 21mm wide for the blade.

Based on these results, it would seem that the length of facets can clearly differentiate the main two types of tool and working methods investigated here, with the chisel and mallet action tools producing identifiable and measurable toolmarks in this work always exceeding 70mm in length. The width of toolmarks as a metric showed less clear clustering, with 92.7% of all the measured facets (n=55) measuring 10-25mm in width, and no clear separation based on this single criteria alone. As noted in **Chapter 5**'s analysis of the Goldcliff pointed ends, the overall morphology of these facets is perhaps best described in 3D terms by referencing their length, width and even cross-sectional depth when comparing them to other toolmark types.

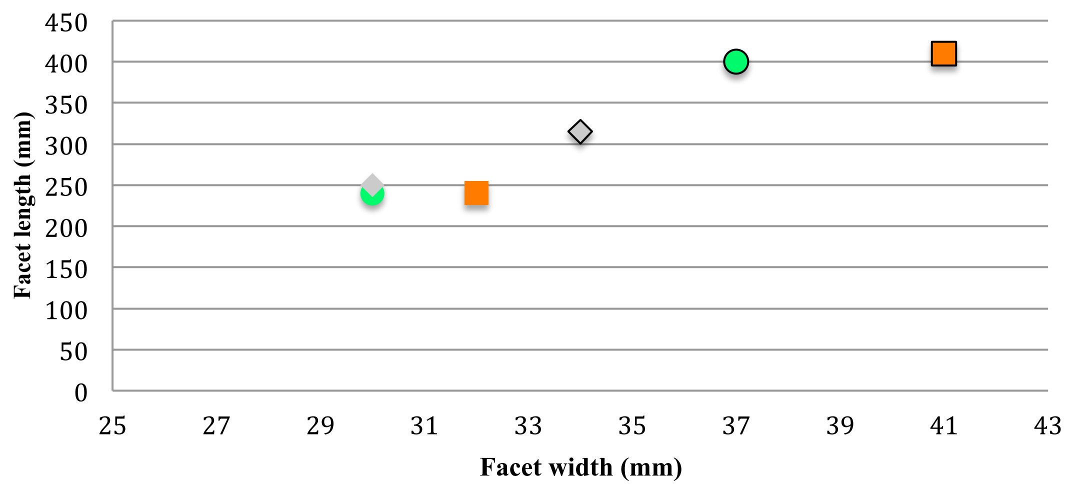
7.11.1 Relationship between blade edge width and facet test

Given the results of the tests for each tool, a further limited targeted experiment was conducted to assess if the width of the blade edge was an obvious limiting factor on the size, and particularly width, of the facets produced. For this further experiment the 40mm wide cow bone chisel, a 30mm cow bone chisel and the 18mm wide red deer chisel were used on sawn cut green hazel roundwood measuring first 40mm in diameter and then 50mm diameter. For each test a concerted effort was made to try and use the same technique, comparable power in the mallet strike and selection of how much wood to remove on the initial cut. The goal was to try and let the tool work optimally and consistently across the different tools, with the goal being the removal of just one large, but controlled slice each time to assess if there was an obvious functional difference in performance of the tools. The results are set out in Table 7.3 below:

Table 7.3 Results of limited testing of maximum facet production of bone chisel tools

Tool	**Raw Material**	**Tested material**	**Facet length (mm)**	**Facet width (mm)**	**Max. facet depth (mm)**	**Key in scatter plot**
Bone 18mm chisel	Red deer	40mm dia. green hazel	250	30	4	Grey, no line
Bone 30mm chisel	Cow	40mm dia. green hazel	240	30	5	Bright green, no line
Bone 40mm chisel	Cow	40mm dia. green hazel	240	32	6	Orange, no line
Bone 18mm chisel	Red deer	50mm dia. green hazel	315	34	5	Grey, with line
Bone 30mm chisel	Cow	50mm dia. green hazel	400	37	6	Bright green, with line
Bone 40mm chisel	Cow	50mm dia. green hazel	410	41	4	Orange, with line

Fig 7.44 Comparison of maximum slice/facet removal for bone chisel types

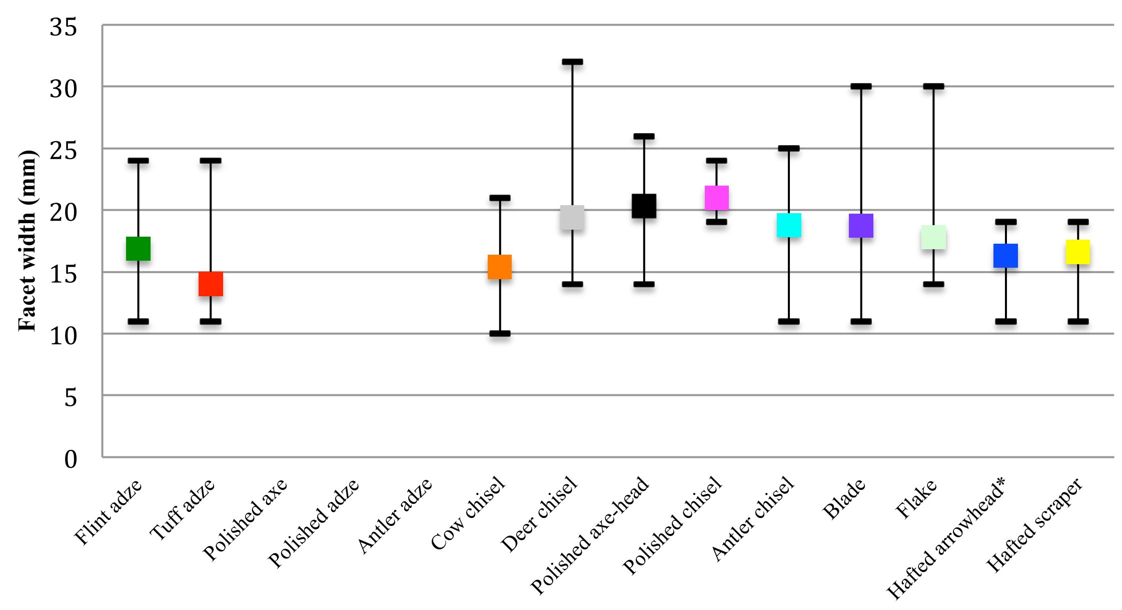


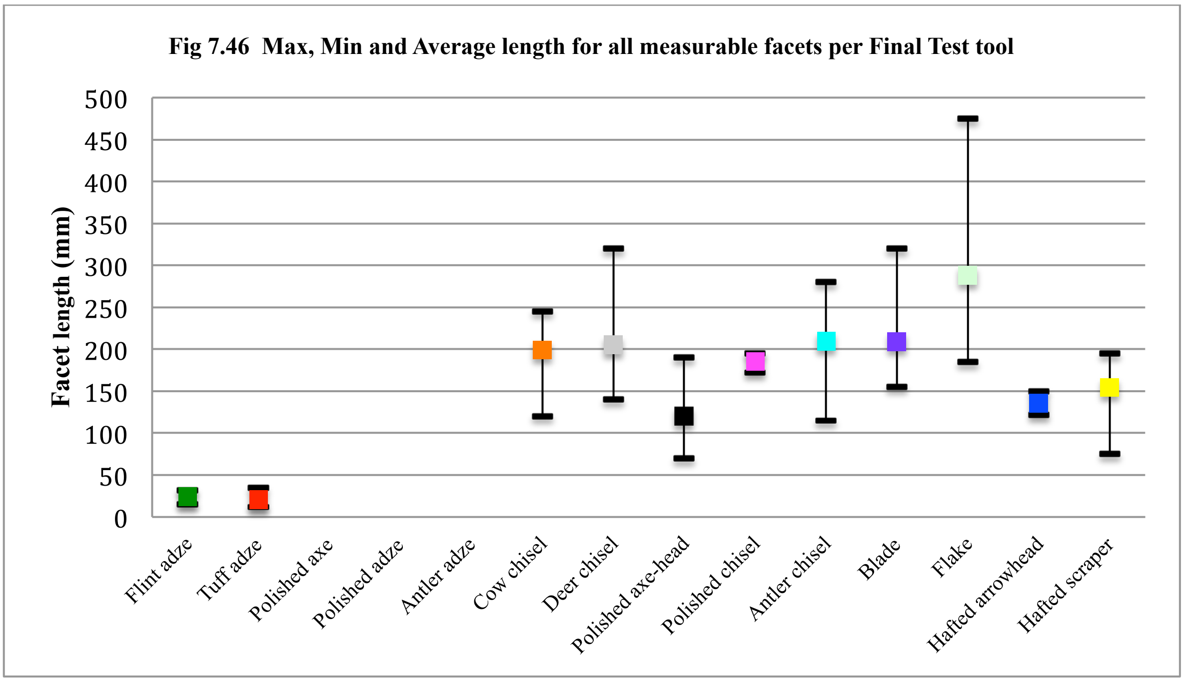
From these limited tests it appeared that for chisel blade edges working on medium sized 40mm diameter hazel roundwood there was little clear functional difference in how they comparatively performed, or the maximum facet size they produced. That is to say it was possible to leave a toolmark of similar dimensions on the 40mm roundwood with the small 18mm wide red deer chisel as the larger 40mm wide cow bone one. Working on the larger, and somewhat denser, 50mm diameter hazel roundwood experientially it did appear that the smaller 18mm wide red deer chisel was less able to cope with wood of this size and the results suggest the larger tools may start to produce somewhat larger facets. Potentially this would mean that as roundwood size increases, more separation in the facet sizes left by different tools might become apparent with further testing. Interestingly, for five of the six tests on 40mm and 50mm diameter roundwood the maximum width of the facet exceeded the complete width of the blade edge of the tool, so the interpretation here would seem to be that the maximum width of a surviving facet on a cleave-end pointed end does not necessarily indicate the absolute maximum size of the tool used to produce the toolmark.

7.11.3 Cleaving action tool results

Considering the facet dimensions of the tests of chisel and mallet tools used in cleaving action alone, the relationship between facet length and width and the cleaving tool type used is less clear, as in these experiments the tools with the smaller blade edge (flake, blade, and antler chisel) actually produced the single largest facets, but by no means consistently. The author's interpretation, based on experiential experience in these tests, would suggest two main reasons why no clear correlation between facets and chisel and mallet type tools was clearly established. Firstly, the number of facets that could be measured in the experiments that were successfully completed (defined as the production of a complete pencil point) was clearly significantly fewer than the number of slices or woodchips actually removed so the dataset was considerably reduced. In the case of the cow and red deer chisels only five facets were left from 16 known removals, representing just 31.3% of the original. This is down to the sequential removal of slices to produce the point, which means that the facets left on the surface of the wood are a limited proportion of the total number of removals and the reductive nature of the process means they often are the truncated remains of the original facet that was removed. This is even more stark in axe or adze method tools, where 130 strikes using the flint tranchet adze produced 60 woodchips (>5mm in length) but left only eight rather indistinct and often truncated facets that could actually be separately identified and measured on the surface of the point. The second factor is that while all the chisel and mallet action tools could work the roundwood to remove initial slices, only the bone and antler chisels and flint flake proved suitable to manage the process from start to finish. Of these the bone chisels were notably easier to manipulate and fine control the process, with one explanation for the wide variety of facet sizes produced by the flint flake being that while it was an effective tool for this task it was quite hard to control the actual cleaving of the wood and thus govern the size of the facets or slices removed.

Fig 7.45 Max, Min and Average width for all measurable facets per Final Test tool





In undertaking the experiments it seemed clear to the author that the amount of wood removed each time, and thus the trace or facet ultimately left on the wood, was highly dependent on the technique and choices of the worker rather than necessarily constrained by the tool itself. Some tools such as the bone chisels were easier to use, but the test results here suggest a wide range of overlapping results from each tested tool, so that a tool with a suitable curved sharp blade edge can produce a wide range of facets that can appear morphologically similar. A possible way to resolve these problems would be to conduct a further, significantly more exhaustive, set of experiments on a range of chisel and mallet action tools to assess whether with a much larger dataset clearer trends in the facet dimensions and the relationship to specific tool types might be identifiable. The production of a large reference collection of woodchips might also provide another source of data to understand the relationship between tool types, facets, and by-products such as woodchips on archaeological sites.

7.12 Discussion

This study has investigated which methods and tools were used to produce the pointed ended wooden artefacts from case-studies analysed in this research. The results from the five tools that use an axe or adze action to cut the wood – the two tranchet adzes, polished axe, and antler adze – produced conspicuously different results to the archaeological examples. What was clear is that as one might expect all five tools could basically work roundwood to pencil points, but not all the reconstructions tested in this work appeared to undertake this task equally well. In experiential terms, the author was much happier to be using the tranchet adze (either flint or tuff) for this task then the polished axe or antler adze. This was something of a surprising result, as the Neolithic polished axe is synonymous with clearing of the landscape by felling and working wood in the general literature that it had been the expectation of the author that it would perform well at this task. However, in practice this specific polished axe tool type reconstruction used here seemed better suited to heavier duty tasks than working on roundwood to make a pointed pencil end. The wide cross-sectional profile of the polished axe meant it was difficult to work down a cut stem as cuts could not be made at an acute angle and the final end product was noticeably difficult to achieve, with it all too easily becoming bashed and in the end leaving no measurable toolmarks at all. This problem is perhaps exacerbated by the fact that after the first successful woodchip removals that are made longitudinally and horizontal to the grain, the final point is made by cutting more perpendicular to the grain – something Elburg (2015) noted is much harder to do with stone blades. By comparison, the tranchet adze was found to be a quicker and comparably far more useful real-world tool to wield for this specific task. Able to effectively and quickly work down a stem to create a sharp, fine point with resulting toolmarks that were often small and truncated, with some smooth and some rough and with occasional partial jam curves. This was clearly different to the toolmarks being investigated in this study, but the end result produced was totally functional all the same. Perhaps too little consideration is given to these rough looking tranchet adzes or axes, as being easily and quickly produced they are versatile tools that appear to lend themselves well to working wood in a variety of ways and proved a favourite of the author to use. There were no clear or significant differences in the results between the flint and tuff adzes types tested in this work, and while it may be the case that a difference in durability, or function, would emerge between flint and tuff raw material adze types with more extensive use, as suggested by Harding & Young (1979) for flint and ground stone axe-heads, that was not apparent from this work.

Fig 7.47 Results from the axe and adze action tools, left to right: Flint tranchet adze, Tuff tranchet adze, Polished axe, and Antler adze

The sharp and tough blade edge of the antler adze was clearly able to deal with the green hazel in this test but again it appeared to be ill-suited to this particular task as the small surface area of the blade edge on the curving circumference of the antler meant it was difficult to complete the later stages of producing a pencil point, with the end result again being quite bashed and without surviving distinctive toolmarks. It is conceivable that these results may reflect the need for very different techniques for polished-axe or antler adze when making pencil point pointed ends. Not tested in this work for example would the standing two-handed use of the axe or adze on bent over stems in the chop-and-tear technique suggested by Jørgensen (1985) and Coles & Darrah (1979), which would produce a more powerful and possible acute strike and possibly different toolmarks with these axe and adze action tools. The goal of this experimental programme was to comparatively test different tools across one single method, but further testing of adze and axe tools in that manner would be an interesting endeavour. It should also be allowed that the results of this work may not fully reflect the possible outcomes achievable by skilled people in the past, but it does seem unlikely that the toolmarks on making pointed roundwood from cut stems with these particular tested tool reconstructions would be able to replicate the archaeological examples being investigated. In the opinion of the author, based on the work undertaken and results from other tools, the polished axe and antler adze simply did not appear well suited to this particular woodworking task and none of the axe or adze tools in this programme appeared able to produce woodworking marks in anyway comparable to the long dished, smooth, and curved facets under investigation.

Testing a representative range of reconstructed tools using the cleaving or splitting of the wood method with sharp chisel type tool struck by a mallet type tool produced notable different results to axe and adze tools. Working from the terminal pointed end towards the stem these tools cleave off facets or slices, with the results from several different tools in this study showing that is possible to successfully produce toolmarks that are morphological comparable to those observed on archaeological artefacts described in **Chapter 5** and **6**. Notably, experiential experience also illustrated that this is relatively simple, highly effective and quick method for producing pointed end with long sharp points that can be then be used as objects such as stakes. It was also apparent that bone and antler chisels were well suited to the task of producing the first cut and then cleaving off a long slice of wood. However, another surprising result was that this technique was not exclusively associated with these tools. Based on the experiments in this study, it was also possible to produce, to certain degrees, the initial slices or chip removals with the polished axe-head, polished chisel, blade, hafted end scraper and hafted transverse arrowhead tools. However, as the Final Tests progressed it became increasingly difficult to successfully place the blade edge of these tools on the remaining portion of the pre-cut end to undertake the final, smaller, and perhaps more delicate removals. This illustrates the importance of ensuring reasonable replication of past conditions, as when first attempted on sawn roundwood training stems this had not been such a significant problem for these tools. In the Final Tests, prepared first with the tranchet adze, it became clear these particular reconstructions could only realistically perform part of the method.

Fig 7.48 Results from the chisel action tool tests, left to right; Cow bone, Red deer bone, Polished flint axe-head, Polished flint chisel, Red deer antler, Flint blade, Flint flake, Flint transverse arrowhead and Flint scraper

Perhaps, the most surprising result was that a humble axe-head thinning flake was able to produce pointed ends of comparable morphological character to bone chisels, being able to both make the initial cut and then been used to accurately remove more facets while withstanding the hardship of being repeatedly struck by the mallet. Indeed, as noted above, the largest single facet or slice removal in the Final Tests came from the use of the flake tool, although perhaps part of the reason for the large removals was that it was comparable harder to control the flake than a bone chisel for example. As Harding (2014) noted with the ability of a snapped blade to shape the mortice for an axe-haft reconstruction, it is worth bearing in mind that so-called simple 'waste' products objects may have had specific and useful woodworking roles. Over 900 flint flakes were recovered from the Goldcliff East excavations (Barton *et al.* 2007). As a pilot study for usewear analysis conducted by Van Gijn (2007) showed diagnostic working traces had survived, an interesting area of future research would be to compare an experimental collection with the archaeological assemblage. Assessing the possible function of so-called 'pièce esquillé', or bipolar cores, as wedges in the assemblage would seem a particularly worthwhile endeavour, given examples were found at Site A and Site W at Goldcliff (Barton *et al.* 2007). With flakes themselves requiring little investment of time to make, the results here also illustrate the potential and versatility of these less prepared items, and it is worth considering that analytical bias in the perception of what constitutes a functional or finished lithic tool may mean we fail to appreciate the actual range and individual use of items available for tasks such as woodworking.

From all the experiments conducted in this programme the author had a clear personal preference for the use of the bone chisels with a mallet as this was simply an incredibly effective set of tools for the job. Able to accurately produce the right cut in the right place, with a sharp and curved bladed edge the top was able to withstand the blows of the mallet, while the durable blade edges were able to resist significant damage over the course of the number of tests in this work. Compared with the cow bone 40mm chisel, using a smaller width 18mm red deer bone chisel tool took a little longer to reduce the roundwood, although there appeared no other noticeable functional difference between cow and deer bone for the purposes of this experiment. Both bone chisels were found to be easier to manipulate than using the antler chisel or flint flake, although as stated both of those tools did appear to produce morphological similar final results. Perhaps one further caveat to those latter tools would be that the three additional limited tests using 50mm diameter hazel roundwood hinted that smaller tools organic or lithic flake tools might have a problem with cleaving or splitting much larger roundwood examples such as found at the Sweet Track (some 200mm in diameter). It seems reasonable to propose that a larger and more robust tool such as an aurochs bone chisel would be better suited to that task. The conclusion would seem to be that while all three successful tool types (bone, antler, and flint flake) can work small to medium roundwood in comparatively similar ways, the bone tools appear slightly more functionally versatile and have more scope as a general tool type to work a wider variety of roundwood sizes. Any future testing of exclusively chisel action tool types would help clarify the situation, establish the effectiveness of tool types across roundwood sizes and aid in better understanding of the relationship between toolmark dimensions and tool types.

Overall, this study has provided clear evidence to support O'Sullivan's (1996) original hypothesis that cleave or splitting action of the wood would produce these cleave-end or split-end toolmarks. The use of axe or adze or action tools on pre-cut stems can still produce pointed ends, but they appear demonstratively different in appearance and, in the author's experience, required significantly more effort and technique to work roundwood to a pencil point. What has not been identified by this work is the individual tool or tools responsible for the toolmarks on the archaeological examples analysed in the case-studies. It seems probable that a curved bladed tool such as a bone, or possibly antler, chisel was responsible, but the results from the flint flake suggest more testing is required to see if there are limits to the application of that tool type in using this method and a separation in toolmarks dimensions can actually be demonstrated.

Chapter 8: Discussion and Conclusion

8.1 British and Irish Mesolithic woodworking evidence

The detailed synthesis and discussion of Mesolithic and early Neolithic woodworking assemblages from Britain and Ireland in **Chapter 3** is arguably the first such attempt to review the broad range and scope of such finds and sites since Coles *et al.* (1978) nearly 50 years ago. As the review showed, the total number of Mesolithic sites in these two countries has now grown substantially, from just a tentative five in 1978 to some 31 sites today. The listing of 14 early Neolithic sites in this work was naturally subject to more restricted selection, analysing only assemblages from the first 300 years of the start of the period as those were considered the most relevant to the transition period. The total number of sites with Neolithic worked wood from the whole of the Neolithic period would no doubt now be significantly larger than the 1978 study, with Brunning's (2007a) study listing 75 structural sites in England and Wales alone. That the number of sites, and thus finds, has grown in this time is important, as there has been limited subsequent work to bring all this information together in one place. As covered in **Chapter 3** there have been a series of useful studies on different specific types of worked wooden artefacts of Mesolithic and early Neolithic date. However, these are often limited in scope, and it was clear more overview work is required, along with a need for the consideration of aspects that have received relatively little attention such as manufacturing traces and by-products (Taylor 2011a; Taylor *et al.* 2018).

Another key outcome from the analysis in **Chapter 3** was to reiterate that Ireland holds great potential for organic preservation due to the vast areas of waterlogged peatland sediments (Coles 1984; Coles & Coles 1989: Woodman 2015). Sites such as Clowanstown, Co. Meath, with evidence of fish trap basketry dated to 5300-4720 cal BC, have shown the repeated use of locations and maintenance of consistent techniques over hundreds of years (FitzGerald 2007; Mossop 2009). The internationally important five fish trap structures of North Wall Quay, Dublin, dated to 6100-5700 cal BC, provided clear evidence of fishing and the possible use of woodland management as they were dominated by similarly sized and predominately hazel stems (McQuade & O'Donnell 2007, 2009). Ireland also has some evidence for Mesolithic dated dugout canoes from sites such as Brookend, Co. Tyrone, that if correct again highlight a relationship with wetland edge activities (Lanting & Brindley 1996; Breen & Forsythe 2004). There is also strong reason to believe that dedicated investigation of wetland edge areas may reveal more Irish Mesolithic sites with seven sites listed in **Chapter 3** with surviving wood, posts, brushwood platforms, and sometimes Mesolithic lithics such as Toome Bay, Inch Island, Derragh Island and Moynagh Lough (Bradley 1991; Mitchell 1995; Fredengren 2002, 2004). The speculation that this may even represent a particular focus and set of repeat activities in Mesolithic Ireland means that this type of site warrants more investigation (Cummings 2017; Fedengren 2009; Woodman 2015).

The situation in Britain for Mesolithic worked wood has dramatically changed in the last 20 years with most recently the investigations at Star Carr providing 1602 pieces of worked wood and 38 items that were considered finished objects (Bamforth *et al.* 2018; Taylor *et al.* 2018). These included items such as seven digging sticks that are morphologically somewhat similar to the oak one found at Goldcliff East and helps support the interpretation of that example's function (Brunning 2007a; Taylor *et al.* 2018). One other notable Star Carr object was identified as a possible willow bow, which would be the oldest in Europe if correct (Taylor *et al.* 2018, 415) although analysis in this work raised a number of problems with that interpretation as set out in **Chapter 3**, as it may have other functions as a toy or spear shaft. Perhaps most importantly from Star Carr, was the recognition of a wide variety of timber working techniques, with different ways of splitting of wood an apparent widespread and dominate aspect of early Mesolithic woodworking. Willow was the species of choice within the Star Carr assemblage, with some suggestion that there may have been management of nearby stands to produce consistent stems of a useful similar size (Bamforth *et al.* 2018). However, as noted by Taylor *et al.* (2018), other factors such as beaver action cannot be entirely dismissed. Other evidence of woodworking techniques such as the splitting of planks from living trees, harvesting of birch bark, and felling of large trees for potential platforms (Bamforth *et al.* 2018) suggests that there was a sophisticated appreciation of how to work large trees by these groups from the start of the Holocene. The presence of a variety of ways to split wood is also interesting in the context of findings from Goldcliff East, with its evidence for the splitting or cleaving of stems to produce the fish trap stakes. The prominence of splitting wood perhaps suggests that we may be too preoccupied with judging past standards of carpentry and woodworking on what we would choose to do today using our knowledge of modern tools and practices. This was a point demonstrated to the author on discussing the morphology of the Goldcliff cleaved pointed ends with the curator of historic tools at the Weald and Downland Living Museum, who, interestingly, could not initially suggest how or why such an object would have been made based on his own considerable experience with steel tools. Practical testing later showed that cleaving proved to be an extremely effective way to produce sharp stakes with a minimum of effort with sharp bone tools as set out in **Chapter 7**.

Other finds from Bouldnor Cliff on the Isle of Wight have illustrated the potential to investigate *in situ* Mesolithic organics even while underwater. To date the most significant finds have been evidence of processing and working large timbers, the oldest piece of cordage from Britain, and the recovery of woodchips indicating the radial and tangential splitting of wood (Momber *et al.* 2011; Taylor 2011b). It was clear that a variety of techniques was present with other methods such as half splitting, squaring of roundwood, and the 'chop and tear' technique (Taylor 2011b). Most notably, the large split oak timber <S061>, measuring 500mm wide and dated to 6240-6000 cal BC (7340±60 BP, Beta 249735), had been split tangentially (Momber *et al.* 2011, 78). Taylor (2011b) suggested that such finds represented good evidence of working large trees (>750mm in diameter) and sitting chronologically between Star Carr and Goldcliff East it helps to expand our understanding of the scope and styles of woodworking across the period as a whole. It also provides further support to the idea that sophisticated splitting techniques seem to have been routine within Mesolithic practices. As set out in **Chapter 3,** claims by the excavation team for 8,000-year-old wheat sedDNA and being a boat building site (Smith *et al.* 2015a; Momber *et al.* 2020) remain to be established, but given the clear organic preservation at the site the evidence may perhaps be forthcoming in the future. Elsewhere, the late Mesolithic Maerdy Post in Rhondda Valley dating to 4270-4000 cal BC (5340±30 BP, Beta-333011) (Jones 2014) appears to be of importance and has not seemingly received the attention that it warrants. If it is indeed the earliest decorated wood post from Britain or Ireland it is of international significance. The contention of the author that the carved artistic schemes is more in keeping with Neolithic styles than Mesolithic ones is a very important issue and it is to be hoped that this artefact, and the site itself, may be subjected to more detailed analysis in the future. Outside of these prominent sites the smaller assemblages such as at Round Hill, Manor Farm and Walpole show that late Mesolithic worked wood can be found, and that in particular driven in stakes are often the most likely object to survive (Fletcher & Van de Noort 2007; Cambridge Archaeological Unit 2008; Hollinrake & Hollinrake 2008, 2014). Finally the future for Mesolithic wood appears to be bright with more new finds reported at sites such as Stainton West awaiting full publication (Civils 2011).

8.1.1 Results of analysis of Goldcliff East

The detailed case-study analysis of the worked wood assemblages at Goldcliff East showed that even a limited collection of finished objects can still provide useful data and expand our understanding of material culture as a whole. The oak spoon or stirrer <3718> from Site B is a small object, but significant. From a context dated to 5990-5790 cal BC (7002±35 BP, OxA13927) it is a rare Mesolithic domestic item fashioned from splitting oak radially into blanks and then into objects. This is a sophisticated level of woodworking and if one such object was made, it is probable that other objects were being produced at the same time in a similar fashion. The array of possible crafting tools from Site J illustrated otherwise hidden activities at the site, perhaps related to activities such as the fabrication of fish nets (Brunning 2007a). Very small finds from Site J like the fine pin <10266> and polished bead/craft tools <10462> also give tantalising hints of the interesting objects we very rarely see in Mesolithic assemblages. Recovery of worked wood in the sealed laminated palaeochannel sediments at Site L and near Site E and Site H had further tentatively suggested the possible presence of fishing related structures and equipment in nearby watercourses. This hypothesis has now been conclusively demonstrated by the structures at Site T, and with a series of structures in the palaeochannel showing consistent and repeated fishing activity at the location. Here a series of radiocarbon dates starting in 5310-5073 cal BC at Site Ta (east) and continuing until 5207-4840 cal BC at Site Ta demonstrated the repeat construction and use of V-shaped structures that can be confidently identified as fish traps. Detailed toolmark and manufacturing analysis from Site T (**Chapter 5**) also demonstrated the presence of a repeatable woodworking practice using cleaving or splitting methods to turn stems into finely worked pencil-end points with 95% of the 19 sampled following this morphology. Of these, 15 large pointed-ends had clear enough evidence of the actual conversion method to show that 66.7% were cleave-end, 26.7% cleave-axed and 6.7% wedge ends. The cleave-axed artefacts were found on the four largest diameter roundwood pieces from the assemblage, likely showing it was a necessary part of the method to deal with these larger items. Overall the roundwood stems were of modest size, being 21-60mm in diameter, with sizes essentially evenly spread across that range from this small sample. The ends were dominated by hazel (66%), followed by alder (31%) and a few examples of willow/poplar. Within the wooden artefacts from the other Goldcliff East sites, alder dominated with 36%, followed by 28.9% hazel and lastly oak 23.7%, which shows the repeat use of the same two species. The absence of oak at Site T likely reflects it perhaps being ill-suited to a making large roundwood structures like fish traps that may have needed repairing each season with nice straight accessible stems. There was no conclusive evidence for woodland management from the worked wood assemblages excavated and examined from Goldcliff East, although current tree-ring analysis (M. Bell pers. comms.) may help clarify this in the future. It was noticed that many of the surviving Site T stem sections were morphologically straight, fast growing, and rarely had side branches, which is in keeping with growing from a fast re-growth stool and as there was burning of the local environment it is entirely possible some form of resource planning was present.

In functional terms the clearly intended consistent form of the Site T pointed ends, perhaps over hundreds of years, would suggest that at the very least that morphology was the consistent goal of the makers. In **Chapter 5** it was suggested that the form may have even been more well considered, being sharp and driveable into dense sediments. The long and curve toolmarks with sharp facet junctions are also an excellent way to increase the surface area of the pointed end and increase suction and thus stability once in place. This contention remains to be investigated, but as argued there we should remember the Mesolithic people of Goldcliff were experts at not just surviving but thriving in their environment. The surviving sections from the Site T structures themselves do seem to suggest a specific design and function as illustrated by the density of withies (or small pointed ends) between the larger vertical or oblique stakes (large pointed ends). Where preserved, the smaller roundwood pieces were packed in so tight as to seemingly touch each other in a continuous barrier, and if this was a system replicated across and throughout the different structures it may suggest that species of fairly small proportions were being trapped. No dryland site or associated faunal remains have yet been recovered from the Site T structures to substantiate that hypothesis, however eel bones (*Anguilla anguilla*) were recovered in large numbers from Site A (**n=415**, 83% of bones from the 12 species found at the site). The people at Site A were occupying the site around 5630-5480 cal BC (OxA-13928; 6629+/-38 BP), some c.300 years before the probable construction of earliest Site T phase of Structure Tc (east), so trapping eels could well have been part of Site T's intended function. The site's structures are now the first Mesolithic fish traps as yet identified in Britain, and seemingly complemented by other dryland excavation evidence, strongly suggesting aquatic resources were a significant part of diet and economy for people accessing Goldcliff island.

As noted in **Chapter 3** the important fish trap structures at North Wall Quay, Dublin, are an important direct comparison to the Goldcliff East Site T assemblage, although are somewhat older dating from 6100-5700 cal BC (McQuade & O'Donnell 2007, 2009). Here, the excavators noted the dominant use of hazel, of comparable size to those at Site T, at 18-37mm in diameter, and possibly the product of resource management (McQuade & O'Donnell 2007). However, most importantly the toolmark data would seem to be very different from this site, with most of the pointed ends reportedly cut to a chisel point with facets measuring 15-30mm in width, normally flat in cross-section suggesting that 'relatively thin bladed, convex, smooth, stone axe were use' (McQuade & O'Donnell 2007, 578). This is very different from the examples observed at Goldcliff East Site T, but those dimensions are in keeping with the polished axe data observed at the Sweet Track in **Chapter 6**. The only caveat is that from the published dimensions one large facet measuring approximately 66mm long by 28mm can be seen (Fig 8.2 below). This is in keeping with the Site T facet sizes, but as no mention is made of this in the published report it is unclear whether it was significant or an accidental result on one lone artefact. As polished and ground adzes and axes are known from the Irish Mesolithic (Little *et al.* 2017; Woodman 2015), the current evidence suggests that the Mesolithic people of eastern Ireland were not using the same techniques or tools to produce fish trap stakes as the people of Goldcliff. As noted in **Chapter 2** there is a clear difference in lithic traditions between late Mesolithic Ireland and Britain (Woodman 2015) and comparison of these two sites here would support that general model.

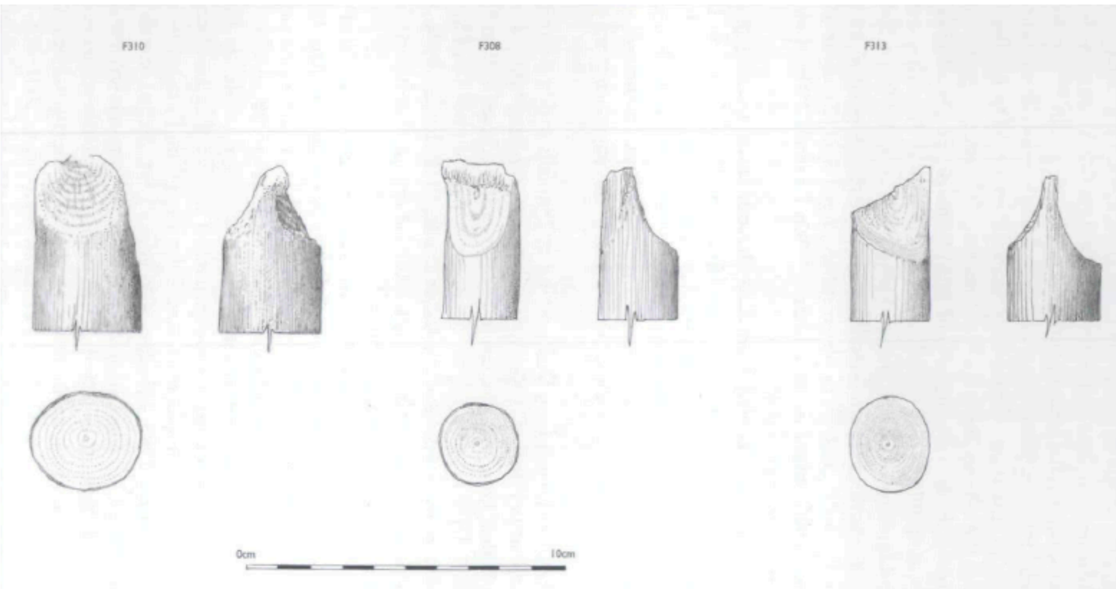


Fig 8.1 A selection of ends and toolmarks from North Wall Quay (<F310>, <F308> and <F313>, left to right) (McQuade & O'Donnell 2007, 579)

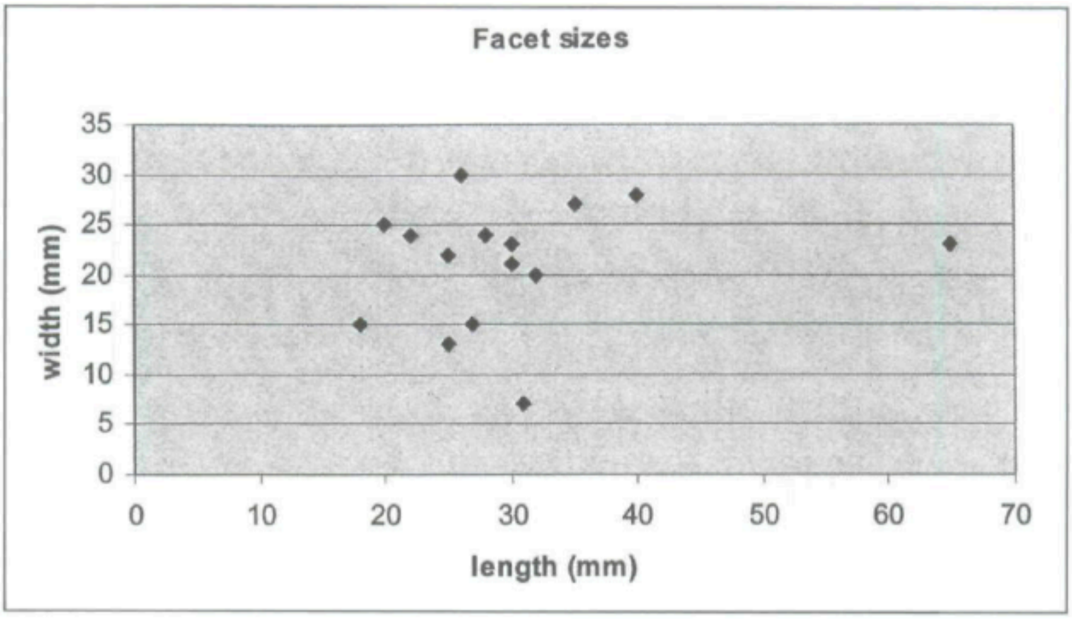


Fig 8.2 Largest facet dimension per pointed end in the fish traps (McQuade & O'Donnell 2007, 578)

8.2 British and Irish early Neolithic woodworking evidence

14 sites fell within the study age range for the transition period, all of which were found to be from Britain and none from Ireland. This may partially be a reflection of the chronological spread of the Neolithic if it does indeed start from southeast England as suggested by Whittle *et al.* (2011b). However, as noted in **Chapter 2,** there are some noticeable discrepancies with sites such Magheraboy, Co. Silgo, that pre-dated that model in Ireland (Cooney *et al.* 2011). Potentially, this may also reflect practices by the people themselves, with Moore (2021) suggesting it remains unclear if the small number of Irish Neolithic wetland sites, compared to say the Somerset Levels, is a product of research or activity in the past. Of these 14 sites the best represented are the five trackways, along with one line of stakes, two stray worked timbers, a wattle panel, two possible coffins, a bow, and a possible fish trap (see **Chapter 3**). From this collection the Sweet and Post tracks are by far the most complete and important collection of worked wood, quite different in design to the peg bushwood ones of Bisgrove, Bell B and Hightown (Orme *et al.* 1982; Coles & Hibbert 1968; Gonzalez & Cowell 2007). There is the possibility the Belmarsh West trackway, dated 3960-3370 cal BC, could have some similar features with tangentially and radially split timbers dominated by alder, but the condition was so poor that its anthropomorphic origin is not certain (Hart *et al.* 2015). The important very early Neolithic burial at Yabsley Steet, London, dated to 4230-3980 cal BC (5252±28, KIA-20157) had a piece of tangentially split oak interpreted as part of the grave (Coles *et al.* 2008). If accurate, this early date supports the view that the tangential splitting of oak was also something present in Neolithic groups from their earliest arrival. Finding more such London sites with late Mesolithic and early Neolithic wood is an important future goal if Whittle *et al.*'s (2011b) model for the arrival of the Neolithic in southeast England is to be properly investigated. At the moment there is little comparative data relevant to

the transition to attempt this, with the only significant late Mesolithic wood find being the Vauxhall site objects that have yet to be lifted for study or to determine if they are indeed anthropomorphic in origin (Milne *et al.* 2011, see **Chapter 3**).

The Rotten Bottom bow from Dumfriesshire dated to 4040-3640 cal BC (5040±10, OxA-3540) is perhaps one of the most notable other early Neolithic finds; a yew flatbow originally 1.74m long imported from outside Scotland (Sheridan 1992). It shows a sophistication in species selection with yew being a well know wood for making excellent bows (Allely *et al.* 2000). It is clearly very different from the proposed willow roundwood bow from Star Carr (Taylor *et al.* 2018), although with roughly 5000 years in difference between them that perhaps means little on its own. Coles *et al.* (1973) tentatively identified three hazel bows from the more comparably aged Sweet Track, although one was so small it may more likely be a child's toy or possibly offering of some type. Later Neolithic bows of yew are known from the Somerset Levels (Coles & Coles 1986), but with a lack of clear British or Irish Mesolithic examples it is hard to say anything substantial about changes in this type of technology over the transition. One final notable aspect from the analysis in **Chapter 3** was that there is a need to identify early Neolithic residential occupation sites with waterlogged deposits, especially considering the evidence emerging from sites such as Star Carr and Goldcliff East. Trackways are of course useful but offer a different set of activities, with forthcoming publication of Eilean Dòmhnuill, Scotland (Armit 1991, 2003) and the investigation of crannog sites in Ireland and Scotland offering the potential for exceptional assemblages towards that goal (Blankshein 2020; Garrow & Sturt 2019).

8.2.1 Results of analysis from the Sweet and Post tracks

The re-analysis of the Sweet and Post tracks in this work has provided the most comprehensive re-evaluations of the assemblages since their original excavation and publication in the 1970-80s. Within the Sweet Track in particular the extraordinary level of wood preservation, range of finds, and early Neolithic age means that the structures also offer a remarkable resource to compare Mesolithic and early Neolithic woodworking technology, techniques, and wider resource selection (Brunning 2007; Coles & Coles 1986; Hillam et al. 1990). Analysis of the portable or finished objects compiled an important collection of 59 objects, with a wide variety of types from possible child's toys, to hunting equipment, tools, domestic items and possibly even decorative items for clothing showing how much we likely miss from the record on most sites. The yew pins are particularly noteworthy, the only use of this species in the assemblage, and the rarity of using it at the site may hint at the relative importance the tree may have had. Hazel (40%) was the dominate species used for most portable objects, followed closely by oak (37%) which interestingly complements the late Mesolithic evidence from Goldcliff East and reflects how useful and important hazel appears to have been at this point in time. Hazel was the dominant species used for all the roundwood structural parts of the Sweet and Post track as well, with the split plank timbers predominately made from oak in the Sweet Track and lime in the Post Track. Again, this supports a view that hazel was a key species in early Neolithic woodworking, with the use of oak an important secondary choice. Such results do suggest that the management of hazel for a reliable source of straight stems would be a logical undertaking, especially with 6000 needed for the Sweet Track pegs alone and other evidence such as hazelnuts in bowls found along the tracks emphasising its versatility (Coles & Orme 1979; Coles & Coles 1986). The species and tree ring data also revealed that there was distinct north and south divide to the sourcing of the constituent parts of the Sweet Track (Morgan 1976, 1979, 1984), with a useful area of future work being to try and understand how activities on the nearby dryland areas related to the tracks. In terms of woodworking itself, the sophisticated evidence of notches and countersunk full and partial holes in the planks, along with the splitting of large oak trees into radial and tangential planks, all shows a high level of skill and woodworking knowledge. It seems perfectly clear that the early Neolithic groups building the trackways had a wide repertoire of techniques at their disposal and were familiar with getting the most out of the individual wood species. The finely faceted massive post <SWD340> illustrates this attention to detail well (**Chapter 5**), and while there is good evidence, as outlined above, for skilled Mesolithic ability to split wood, the best evidence of complex carpentry techniques seems to appear with the early Neolithic.

In the case-study, 108 pointed ends were subject to toolmark analysis, with 85 in good enough condition for accurate facet measurements to be taken. From the data available, rail pegs were often larger than those encountered at Goldcliff East, on average around 60mm in diameter, whilst plank pegs were more comparable and normally smaller and around 45mm in diameter. The posts of the Post Track were significantly larger and from a sample of 35 found to be on average 100mm in diameter. From this roundwood pointed end assemblage there was a fairly even split between wedge-ends (47%) and pencil-ends (42%) in the sample, with a small number of chisel-ends (11%). Importantly, the technique of cleaving wood using both only cleaving and cleave-axing to produce a point was identified on 32 artefacts from the trackways. Examples were found along both the Sweet and Post tracks indicating the technique was not a one off occurrence, but used extensively across time and space. The SWD collection of 56 ends from the original 203 excavated was the most complete sample in the study from one sub-site and analysis found that 19 (34%) exhibited evidence of cleaving techniques. If replicated more broadly across the trackway this suggests that around a third of all the driven-in roundwood was worked in this way. More future work on GIS mapping of the cleave-worked artefacts might be able to demonstrate if the method was focused in certain areas, and even related to specific working parties. Of the two splitting types, cleave-axe ends were found to be in the majority (65.6%), appearing to be the preference of the two types along the tracks. In terms of the overall end types there was a clear preference for the majority of wedge-ends to normally be fashioned with just a polished axe, whereas, when present, cleave working produced pencil-end type points. There also appeared to be a correlation with roundwood sizes as the smaller 20-70mm roundwood tended to wedge-end and the larger ones, 51-110mm in diameter, were more dominated by cleaving evidence. The proposed rationale for this difference was that smaller roundwood was possibly easier to convert to a point with just axe work. Larger and tougher roundwood perhaps needed the use of cleaving or splitting techniques to remove enough material to produce a point, and thus also often resulted in pencil-ends. A possible further interpretation is that that cleaving off of facets was purposefully undertaken on those pieces that needed driving in more deeply and thus needed a sharper point. The toolmark analysis in **Chapter 5** also showed clear morphological differences between the three types of methods described here, allowing them to be identified within the data scatter plots and supported the analysis in **Chapter 5** that there was a clear morphological difference between the traces left on roundwood subject to these various methods. The final significant results of the Sweet and Post assemblage analysis was the identification of some stems with surviving partial, and even rarely on occasion, full jam curves. The importance of this is that previous jam curve studies (Brunning & O'Sullivan 1997; O'Sullivan 1991, 1996; Sands 1994, 1997; Taylor 1984, 1992) had stated that there was limited potential for stone axes to leave such marks. However, during the process of analysis in this work such examples were encountered more regularly that had been expected and further work might explore if even partial jam curves may hold the potential for understanding lithic tool types.

Finally, one significant results of data collection by the author was recognised after the completion of the Sweet Track analysis, with artefacts from the Walpole Landfill assemblage found to be directly comparable in terms of woodworking techniques. At the site, two small structures were dated to the early Neolithic transition period covering 3962-3530 cal BC (Hollinrake & Hollinrake 2008, 8), which is very close in date to the Sweet Track's age of 3807/6 BC by dendrochronology (Hillam *et al.* 1990). The oldest was Structure 3 dated to 3962-3773 cal BC (5063±39 BP, WK25807), comprising a collection of radially split oak timbers and roundwood on a north-south alignment.

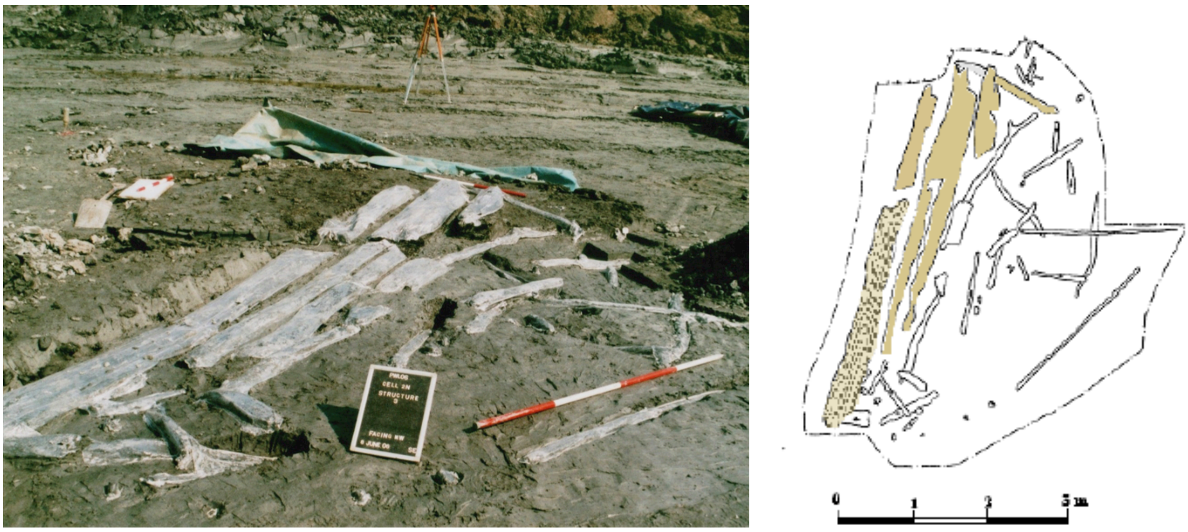


Fig 8.3 Structure 3 with a series of large radial split oak planks (images and plan courtesy of A. Hollinrake)

Structure 2, dated to 3989-2530 cal BC, formed a line of stakes stabilising a collection of roundwood crossing a paleochannel and also included a radially split oak plank. The dominance of hazel and oak in the species selection at both structures and presence of large radial split oak planks at both is noticeably similar in woodworking traditions to that of the Sweet Track, and with Walpole Landfill being only some 12km in a straight line from the Sweet Track a connection seems entirely possible.

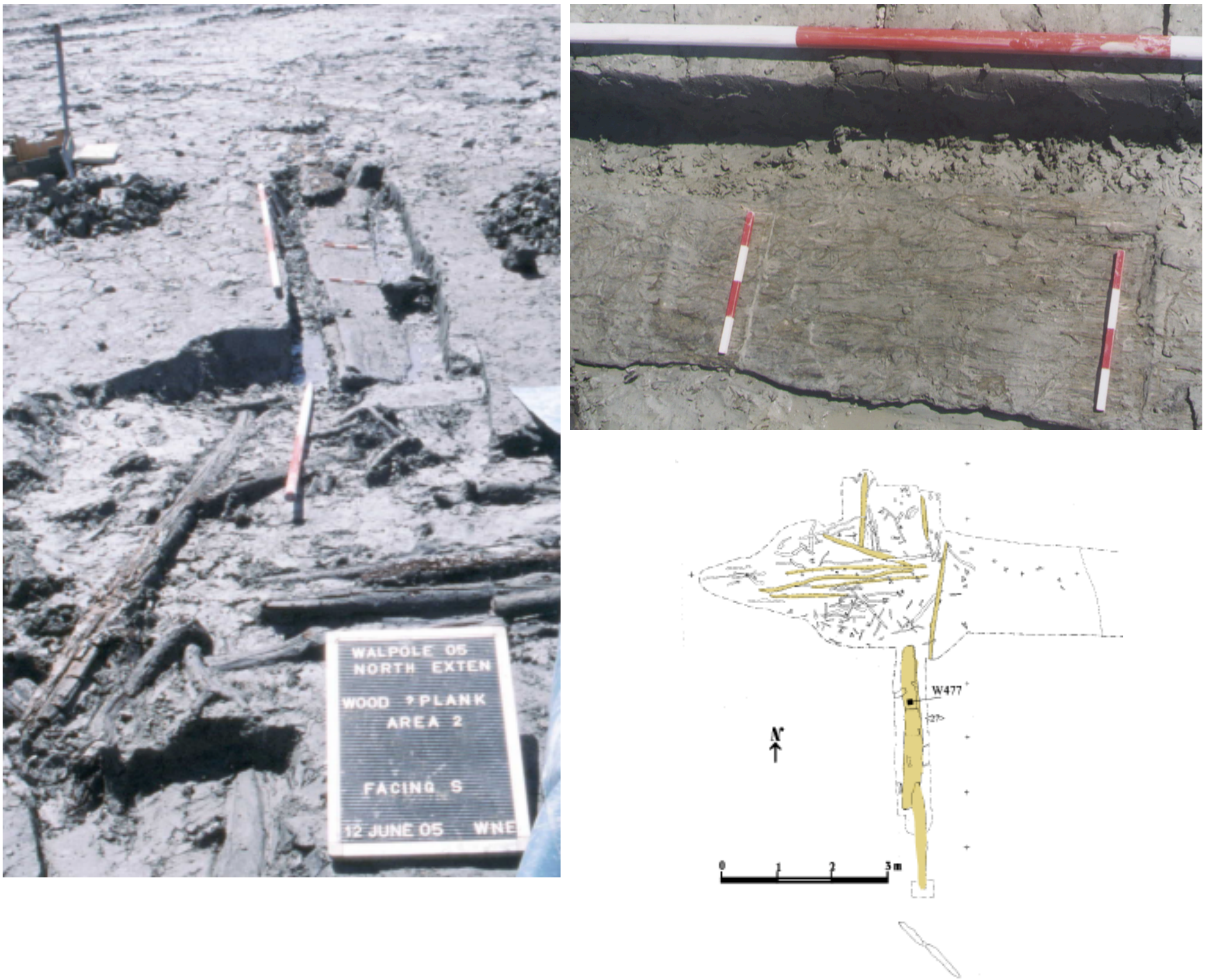


Fig 8.4. Structure 2 with the large radial split oak plank (images and plan courtesy of A. Hollinrake)

One further similarity was noticed by the author with at least two very clear examples examined from the preserved Structure 3 assemblage with evidence of cleave pointed ends. Pencil-end <W27> was identified as a cleave-end and pencil-end <W47> was identified as a cleave-axe end. Time with this collection was very limited, at only a single afternoon, but other similar examples were noted and with some 49 of the roundwood timbers preserved, and many more still in water tanks held by the archaeological unit (A. Hollinrake 2019 pers. comms.), full analysis may yield interesting results. The interpretation offered here is that the builders of the Walpole trackways were following the same woodworking traditions as demonstrated at the Sweet Track, and, given the proximity in date and distance, it seems most likely they were being built by part of the same overall community. The valuable laser scans kindly provided by A. Hollinrake for this research (Fig 8.5 and Fig 8.6) also show how useful such modern recording can be, allowing later research and preservation of the data from these fragile artefacts.

Fig 8.5 Laser scanned image of Walpole <W27> from Structure 3 (scanned image courtesy of A. Hollinrake; photo the author)

Fig 8.6 Laser scanned image of Walpole <W47> from Structure 3 (scanned image courtesy of A. Hollinrake; photo the author)

8.3 Cleave-end working and experimental study results

In response to these findings, work in **Chapter 7** presented an experimental programme to directly test the interpretations in the case-studies of this work by examining previous work in detail and assessing whether it was possible to identify the tool responsible for the observed facet types. Through a large-scale set of comparable experiments it was shown that it is highly unlikely that atypical long facets observed in Goldcliff and the Sweet Track were made using a polished axe. Tests with tranchet flint and antler adzes also strongly suggested that no striking tool of axe or adze type could work down the stem at an acute enough angle to produce the necessary single very long, dish and smooth facets observed archaeologically. Conversely, numerous experiments revealed that cleaving wood from the point upwards towards the stem produces the type of toolmarks that were observed at these sites and thus that type of technique would seem to be fairly securely identified as the source for these traces. What proved more problematic was conclusively demonstrating the actual type of cleaving tool applied. As noted in **Chapter 7** it was possible to cleave wood with a series of lithic and non-lithic tools struck by a mallet to produce a pointed end, however importantly this was the result of working on a series of flat, and sawn, cut ends when training in the method. Such a type of sawn flat end would self-evidently not have been available to Mesolithic or Neolithic workers without metal tools. When working on a final test end, cut by an experimental tranchet adze first, it was shown that a sharp, curved and durable tool was ideally required as once the first one or two facets were removed it became very difficult to remove later ones with a blunter tool such as polished chisel.

This highlights how important trying to accurately replicate key past conditions can be for reliable experimental results. Even under these controlled conditions, it was found that a simple straight edge tool like a heavy flake was still able to make cleave-end type pointed ends to some degree. However, in practice it was much more difficult to control the amount of wood removal at the end of the process and the final facets were normally conspicuously flatter in cross-section and thus unlike the vast majority of toolmarks observed in this study. The toolmark measurements and the practical experience of the author suggested that organic items such as the curved edge cow bone, or possibly antler chisel, appeared to produce the most comparable result. So it is seems reasonable to propose that in most cases a robust chisel shaped bone tool is the most likely source for the majority of the observed archaeological examples and should be viewed as likely an important component in the woodworking toolkits of Mesolithic and early Neolithic groups. This seems especially logical in the case of large roundwood such as the Post Track posts, as it is hard to envision how a lithic tool could work on such sizeable 200mm diameter timbers. Finally, one informative general experiential result from the work that stood out to the author was that producing sharp pencil-end points with the chisel and mallet cleaving technique is remarkably quick and easy once you understand the properties of the wood and tools. It was noticeably far easier in terms of effort than trying to produce a pencil-end with axe or adze on a pre-cut stem for example, taking just 16 careful slow blows using a bone chisel whereas it took 130 'strikes' with a tranchet adze to produce a pointed end for example. Perhaps most noticeably, the experimental polished-axe used in this study required a lot of time and effort to produce such a point on a pre-cut end and seem strikingly unsuited to this particular type of task.

8.4 Conclusion: The Mesolithic to Neolithic transition and woodworking traditions

As set out in **Chapter 2** the results from isotopic studies, and now the aDNA studies for genetic turnover, have presented compelling evidence that appears to largely resolve the overall debate over whether the Neolithic was an indigenous development in Britain and Ireland (Schulting & Borić 2017). The results show a major demographic change occurred over the course of late Mesolithic to early Neolithic periods with a sizeable influx of a genetically new population (Brace *et al.* 2019; Cassidy *et al.* 2020). However, while the likely driving force of the cultural change and the ultimate result in genetic terms is now clearer, the genomic results do not reveal the precise process, pace and scale during the initial transition period itself. There is a notable, and important, lack of human aDNA samples from across late Mesolithic Britain and Ireland, which means we should still be wary of assuming that we truly understand the complexity of interactions between different areas and incoming Neolithic populations around the transition point itself. Complexity in the archaeology set out in **Chapter 2** also argues against relying on broadstroke interpretations that can be seemingly offered by aDNA results. As a consequence, it is clear that more evidence from around the actual change, both genetic and archaeological, is still required to test interpretations and assess whether they are accurate or if the important regional nuance is being missed.

One mechanism pursued in this work to address these outstanding questions of scale and process has been the comparative differences and similarities in woodworking traditions. As shown in the review of the range of Mesolithic woodworking practices in **Chapter 3**, along with the detailed analysis of the finely worked pointed ends from Site T in **Chapter 5** and investigation of manufacturing techniques in **Chapter 7**, Mesolithic people held sophisticated levels of woodworking skill to produce the objects they needed in their day-to-day lives. The evidence from this work shows that a high-level level of woodworking know-how existed from even the early Mesolithic, and appears to have been particularly focused on the splitting and cleaving of wood. With the evidence across the period showing that the application of splitting was a skill consistently applied during the Mesolithic period in Britain. Study of pointed ends from the Goldcliff East Site T fishtrap structures have also shown that Mesolithic people were producing exceptionally well designed utilitarian objects with specific functions in mind. These were produced through an elegantly simple, but effective, process that proved extremely practical once learnt and far quicker to produce sharp stakes than using a lithic or antler tool hafted in an axe or adze fashion. It should of course not come as any surprise that Mesolithic people were such capable woodworkers, as they were experts of their own environment with likely an intimate knowledge of their tools, wood species and how to get the best out of local resources. The results of this work have enabled us to start to see concrete examples of those abilities in practice. It still remains to be established how this woodworking was organised socially, across ages or genders, but from a practical point of view the experimental work undertaken in this study required no exceptional level of strength. Skill and technique was far more important, with no reason to suppose these objects were beyond the ability of any member of the community other than perhaps the smallest of the children.

Mesolithic knowledge of how to best operate within the landscape is also illustrated through the purposeful collection and use of certain species for specific tasks from the start of the Holocene, with birch bark and willow a notable aspect to the lifeways of Mesolithic Star Carr for example. By the late Mesolithic and into the early Neolithic, hazel, alder and oak appear to have been consistently important species, and it is notable that hazel and oak are dominant at both Goldcliff East and the Sweet Track. Charred hazelnuts have long been connected with Mesolithic subsistence activities, and this work has demonstrated it was also a species of choice for worked wood items as well. However, although the number of finished wood items is now fortuitously rising, the review in **Chapter 3** illustrated that we still do not yet have very many defined artefact classes that can be easily compared. In this study, analysis of structural pointed ends has proven to be a valuable way to address this, with detailed toolmark analysis in the case-studies showing that important comparable metric data can be gained from the measurement of facet dimensions.

Analysis of pointed ends has also usefully led to the identification of a comparable woodworking tradition and technique that spanned the Irish Sea from late Mesolithic Wales into the early Neolithic of eastern Ireland and south-west England. The identification of this technique allowed for a targeted experimental programme to examine the nature of the traces left by relevant tools of the transition period, and provided a strong explanation for how, and by what tool, these pointed ends were produced. What now remains to be established is if the presence of this cleaving wood technique across time and space reflects the sharing of ideas between different cultural groups or an unrecognised common solution when using non-metal tools. The case of the Post and Sweet tracks is particularly important, as this site represents the earliest dated Neolithic activity in this area of south-west Britain and is directly relevant to the transition debate. There is strong evidence for the presence of a late Mesolithic flint tradition in this area (Coles & Coles 1986) and it is reasonable to expect that some form of inter-community interactions took place. The fact that there is a clear mixture of woodworking techniques to produce pointed ends at the trackways is at the very least intriguing. The question for future research is to understand if more examples can be found and analysed to test how this technique relates to cultural groups.

One way to examine such questions is to determine the extent and range of this technique, both in Ireland and Britain, but also more broadly across Mesolithic and Neolithic Europe. This study has not attempted that huge task, but there is good potential from the excavated archaeological assemblages that could be investigated to that end. The identification of the method at Corela 9, Ireland, and Walpole Landfill, Somerset, in this work is a first step in that direction and shows the potential for such analysis. Usefully, identifying the technique may also enable comparison between important sites such as the fish traps of Goldcliff East with similar sites in Britain, Ireland and more widely across Europe such as Danish sites of Margrethes Næs, Smakkerup Huse and Tybrind Vig with their large assemblages of pointed ends (Pedersen et al. 1999; Price & Gebauer 2004; Andersen 2013). Finally, given the reasonable proposition that the vast majority of prehistoric material culture was organic in nature (Coles *et al.* 1978; Hurcombe 2007, 2008), the study of organic artefacts is demonstratively necessary if we are to gain a holistic overview of cultural change. This study has illustrated that evidence such as the day-to-day use of ordinary organic material culture can be a powerful way to gain a more complete view of such processes. Archaeological worked wood of all types is an exceptional resource and store of information about technological practice, change, species selection, resource management, and cultural styles. If found in wetland edge sites, it offers the valuable opportunity to investigate ways of living that can go unseen on the typical dryland terrestrial sites. With that in mind this work shows that both newly excavated and old archives of worked wood are useful sources of such data, worthy of being excavated and preserved for future study.

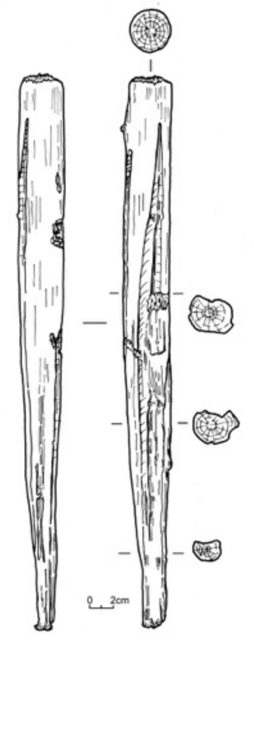
Appendix I

Goldcliff East Wood report

Appendix I.I Site T, Structure Ta

<2017.59>
A roundwood pointed end of alder (*Alnus glutinosa*) measuring 118mm long with a 21mm complete diameter. Has a pencil-end point with cleave-end working with four dished facets produced by working from end towards the stem as shown by tearing at their terminal end. The largest toolmark was also complete and dished, measuring 98mm long by 14mm wide by 2mm deep and a facet exit angle of 10° with evidence of tearing towards the stem. Three smaller facets finished the piece to a point. The tip of the point was missing with considerable compression from being driven in. The pith appears central, with some bark remnants and it not clear which way it was inserted (growing end up or down).

<2017.60>
A roundwood pointed end of hazel (*Corylus avellana*) measuring 463mm long with a 41mm complete diameter, and dated by radiocarbon AMS dating to 5210-4912 cal BC (6107+/-45, UB-35012). Has a pencil-end point and cleave-end working produced by working away from the end with four identifiable and measurable facets. The largest toolmark was also complete and dished, measuring158mm long by 12mm wide by 6mm deep and a facet exit angle of 10° with evidence of tearing towards the stem. It has two other facets of similar sizes with sharp intersecting facet ridges




and one smaller facet measuring 68mm long by 6mm wide and 0.5mm deep in comparison. The facets have rough surfaces and have distinctive evidence of tearing away the point toward the upper portion of the stem suggesting the tearing of wood to remove material. The largest toolmark described above clearly illustrates this by forming a very sharp ‘V’ at its upper end as seen in Fig XXX. It has some slight tip compression from being driven in, with the artefact placed growing end downwards. It has a central pith, with four small branch knots, three grown over and one appearing broken, residual bark and straight in surviving section.

<2017.60a-s> (19 items)
18 small roundwood of alder (*Alnus* sp.), one unidentifiable to species ranging in diameter from 5-25mm. These were lifted in the early stages of the investigation of Site T and provided as a sample for species identification.

<2018.91>
A roundwood pointed end of hazel (*Corylus avellana*) measuring 376mm long with a 42mm complete diameter dated by radiocarbon AMS dating to 5207-4840 cal BC (6072+/-50, UB-41503). Has a pencil-end point with cleave-end working produced by working away from the end with four identified and measurable dished facets. The largest toolmark was also complete and dished, measuring 325mm long by 25mm wide by 6mm deep and a facet exit angle of 10° with evidence of tearing. One more facet is of similar size with sharp intersecting facet ridges with two smaller ones measuring under 90mm long. The pointed end bends slightly most obviously towards the stem, away from the worked end. The driven in end has evidence of 10mm of compression at its point from impact and has been inserted growing tip downwards. Central pith with a slight bend along its length and five knots, with three clearly grown over and some surviving bark.

/

<2018.101a>
A small diameter piece of roundwood of hazel (*Corylus avellana*) measuring 27mm long by 10mm wide found in association with pointed end <2018.91> and other cut-pieces <2018.101d>, <2018.101e> and <2018.101f>. Had one incomplete slightly dished toolmark truncated towards the stem that measured 28mm long by 8mm wide. The piece does but not form a clear point, but this may potentially have been lost when driven in or alternatively on excavation as these smaller diameter roundwood were often less well-preserved with a tendency for the bottom portion to be shattered in the sediment. It has a central pith, a little bark and it was uncertain which way it inserted.

<2018.101b>
A hollow reed 46mm long by 3mm diameter lifted in association with pointed end <2018.91> and cut-pieces <2018.91a>, <2018.101d>,<2018.101e> and <2018.101f>. It exhibits no evidence of working, is quite different in size and material to another item from Site T and would seem most likely co-incidentally accumulated with the pointed ends and worked wood, perhaps caught by the numerous and closely placed smaller roundwood pieces that form part of the fishtrap structure. It is thus interpreted as likely an ethnofact.

<2018.101c>
A small diameter roundwood of hazel (*Corylus avellana*) measuring 43mm long by 10mm in diameter lifted in association with pointed end <2018.91> and cut-pieces <2018.91a>, <2018.101d>, <2018.101e> and <2018.101f>. There is no evidence of working or toolmarks but the end is missing and may have been lost when driven in, on excavation or possible a broken end was pushed into sediment. Its context alongside similar sized worked pieces suggests it is an artefact. It has a central pith, a little bark and it was uncertain which way it inserted.

<2018.101d>
A small diameter piece of roundwood of hazel (*Corylus avellana*) measuring 39mm long by 10mm wide cut to chisel point and broken at the other end found in association with pointed end <2018.91> and other cut-pieces <2018.101 a>, <2018.101e> and <2018.101f>. It has one incomplete toolmark truncated toward the stem that measured 38mm long by 10mm wide and was slightly dished in cross-section. The end was not compressed. It has a central pith, a little bark and it was uncertain which way it inserted.

<2018.101e>
A small diameter piece of roundwood of hazel (*Corylus avellana*) measuring 153mm long by 10mm wide cut to a chisel point and broken at its upper stem end found in association with pointed end <2018.91> and other cut-pieces <2018.101a>, <2018.101d> and <2018.101f>. Had one complete slightly dished toolmark measuring 55mm long by 10mm wide and that appeared to have be cut from the pointed end in one action, with a possibly a partial curving jam curve 5mm in width towards the stem end where the blade edge stuck. The end was slightly compressed from being driven in. A central pith and essentially straight over its length, with bark attached and one broken branch knot. It was uncertain which way it inserted.

<2018.101f>
A small diameter piece of roundwood of alder (*Alnus glutinosa*) measuring 188mm long by 10mm wide cut to a chisel point and broken at its upper stem end found in association with pointed end <2018.91> and other cut-pieces <2018.101a>, <2018.101d> and <2018.101e>. Had one complete slightly dished toolmark measuring 43mm long by 10mm wide cut from the stem end towards the point in one action. The end was slightly compressed from being driven in. Exhibited a central pith, straight over its length, with bark attached and one broken side branch. It was uncertain which way it inserted.

<2019.31>
A roundwood pointed end of alder (*Alnus glutinosa*) measuring 207mm long with a 27mm complete diameter. The tip was missing but as it was worked from three directions likely a pencil end with cleave-end working carried out away from the end. The largest, nearly complete, dished toolmark measuring 120mm long by 16mm wide by 0.5mm deep and a facet exit angle of 7° with clear evidence of tearing towards the stem. At least one more facet from a second direction was observed, but with the tip of the point missing, considerable tip damage and compression there was suggestion of a third small facet that could not be clearly identified and it is possible it could have been cleave-end or cleaved-axed end in original form. <2019.31> is medium sized for this assemblage it appears very similar in working style and roundwood dimensions to <2017.59>, as this was clearly a pencil-end and it is most likely to have been of similar morphology in its original intact form. It exhibited a slightly off-centre pith, was straight over surviving length and had a few bark remnants. It was uncertain which way it inserted.

Appendix I.II Site T, Structure Ta (east)

<2019.10>

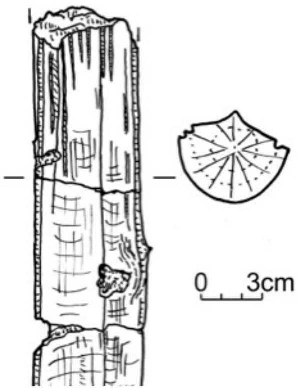
A roundwood pointed end of hazel (*Corylus avellana*) measuring 425mm long with a 28mm complete diameter dated by radiocarbon AMS dating to 5310-5073 cal BC (6245+/-35, UBA-41506) inserted at an oblique angle. It was found in close association with <2019.11> slightly to the east of the main Structure Ta area and may possibly represent a different structure. Finely worked to a pencil-end point with cleave-end working it was produced by working away from the end with four dished facets identifiable and measurable. The largest toolmark and was complete and dished, measuring 265mm long by 28mm wide by 1mm deep and a facet exit angle of 10° with evidence of tearing towards the stem. Three further smaller facets could be identified, although the condition of this artefact was somewhat poorer than others, with iron staining and some surface deterioration of the wood so it is possible others on the point had not survived for identification. The tip was slightly compressed and appeared to have been driven into gravel. Which end was the growing end was unclear. It had a central pith, was straight over its surviving length, with some intact bark and one knot. It was hard to accurately assess the tree-rings due to the condition of the piece but on examination it did appear to have wide first rings so may be fast-grown.

<2019.11>
A section of roundwood of hazel (*Corylus avellana*) measuring 138mm long with a 41mm complete diameter found inserted at an oblique angle and in close association with <2019.10> slightly to the east of the main Structure Ta area. It does not have any clear evidence of working or toolmarks, with the driven in end possibly shaped to a rough wedge-end, though its damaged condition from being driven in has crushed the potentially worked end. The end was damaged and compressed and it is not clear which way it been inserted. No knots on surface and it appears

straight over its surviving length.

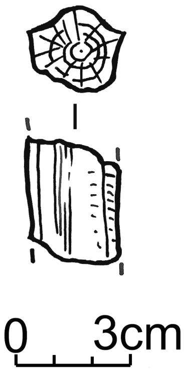
Appendix I.III Site T, Structure Tb

<2018.61>
A segment of larger sized roundwood of hazel (*Corylus avellana*) measuring 211mm long with a 56mm complete diameter and dated by radiocarbon AMS dating to 5216-5029 cal BC (6169+/-31, UB-41505) inserted at a vertical angle. The end was not retrieved due to difficult excavation conditions but author noted at the time it was driven deeply into very hard gravel like sediment and appeared to be a pencil-end with cleave-end working. The largest surviving truncated toolmark has a pronounced dishing in cross-section and measures 195mm long by 30mm wide by 3mm deep. This facet was truncated at both ends so the final exit angle could not be measured. It contained one toolmark of comparable dimensions and one much shorter at 72mm long by 26mm wide. The facet ridge between the largest and second largest facets was sharp, with both having a pronounced cross-sectional curve that met at the ridge intersection (as seen in Fig. XXX below). It had a central pith with some bark attached and at one knot and had been inserted the growing tip upwards.



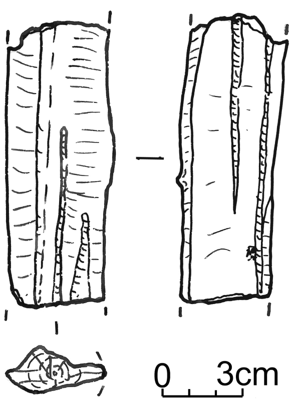
<2018.61a>

A segment of medium sized roundwood of hazel/alder (*Corylus/Alnus* sp.) found in close association with <2018.61> but not from that artefact. It measures 32mm long by 26mm in diameter. There is no sapwood and all the sizes are worked so its diameter is unknown but in comparison with other worked wood from Site T it is likely to be a faceted mid-section part of a pointed end. It had four toolmarks, all truncated at top and bottom with the largest and most complete measuring 15mm long by 25mm wide but was too incomplete and deteriorated for any measurable analysis of facet dished nature, depth or working angle. The dimensions of the facets (slightly dished and c.25mm wide) would be consistent with the cleaved working noted elsewhere form Site T but with such truncated facets it cannot be assured. The presence of working in four directions around the roundwood does suggests it comes from a pointed end finished to a pencil-end. It exhibits a central pith but no surviving bark and it was unclear which way it had originally been inserted.



<2018.63a>

A segment of roundwood of alder (*Alnus glutinosa*) measuring 101mm long by 33mm in diameter, with the tip lost on excavation. Sapwood and outer ring is present so original roundwood diameter is estimated to have been c.40mm. It has three toolmarks truncated at their top and bottom, the largest incomplete and truncated facet measured 101mm long by 30mm wide and 1 mm deep, with a most complete facet somewhat smaller measuring 90mm long by 17mm wide by 2mm. Given its truncated nature it was not possible to measure the original angle of working but this facet appeared smooth and dished in cross-section with possibly a slightly unusual twist along its length indicating a variation in working technique. All three facets appear to have been created working from the pointed end, with other two having clear signs of surface tearing along their length indicative of cleaving or splitting of the wood from the point. Given it had been worked around its



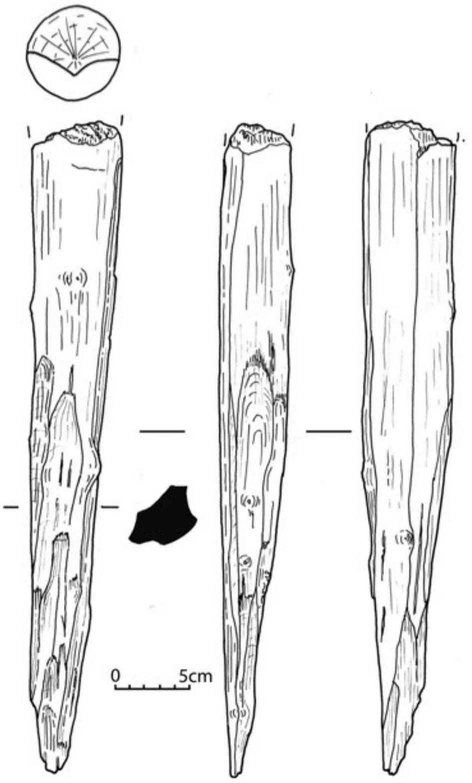
circumference at this surviving point it is likely that the original end type would have been pencil-end. The pith was central and there was one grown over knot but no bark, and it was unclear which way it had been inserted.

<2019.9>
A roundwood pointed end, unidentifiable to species, measuring 318mm long by 44mm in incomplete diameter. The original roundwood diameter is estimated to have been at least 50mm. The artefact has a pencil-end with cleave-end working with seven mildly dished identifiable toolmarks with sharp intersecting facet ridges. The most complete facet measured 195mm long by 17mm wide by 1mm deep and an exit angle of 9°. Clear tearing of some facets towards the stem end indicates that they were likely worked from the pointed end, although in two cases the facets appeared to start with tears at the pointed end and finish with smoother sections above towards the stem (as shown in Fig XX below). This would seem an unlikely outcome from cleaving from the pointed end and may suggest that some variation in technique or direction of working does exist. The end had a missing section due to excavation damage but there was no obvious evidence for compression of the end and it was unclear which way it had been inserted. The pith was central, with no surviving bark, the piece straight in surviving section and had two grown over knots.

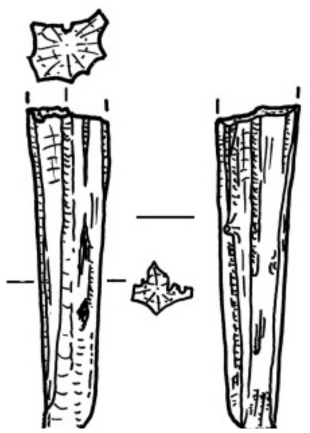
Appendix I.IV Site T, Structure Tc

<2017.58>
A large finely worked roundwood pointed end of alder (*Alnus glutinosa*) measuring 425mm long by 58mm in complete diameter. It has a pencil-end but unusually for this assemblage has been cleaved-axed, or that is to say, large cleaved facets have first been removed and then later smaller ones working towards the point to produce the final shape. It exhibited five larger dished facets and at least seven other partial smaller ones located near the pointed end, one for example measuring 70mm in length and 25mm in width and relatively flat in cross-section. The largest, though truncated at the top, facet measured some 415mm in length by 38mm wide and 4mm deep with an

exit angle of 8° - effectively a single complete lengthwise slice of surviving section of the stem. The junction between the larger facets was very sharp and pronounced with drawing in Fig. XXX below clearly showing the dished cross-sectional nature of the facets and their sharp intersection. The end was intact and did not appear compressed from being driven in and it seemed to have been inserted growing end upwards. The pith is central, small amounts of surviving bark on sections of the piece and straight in surviving length. It has five knots over its length, and one that appeared very smooth and may have been cut off.

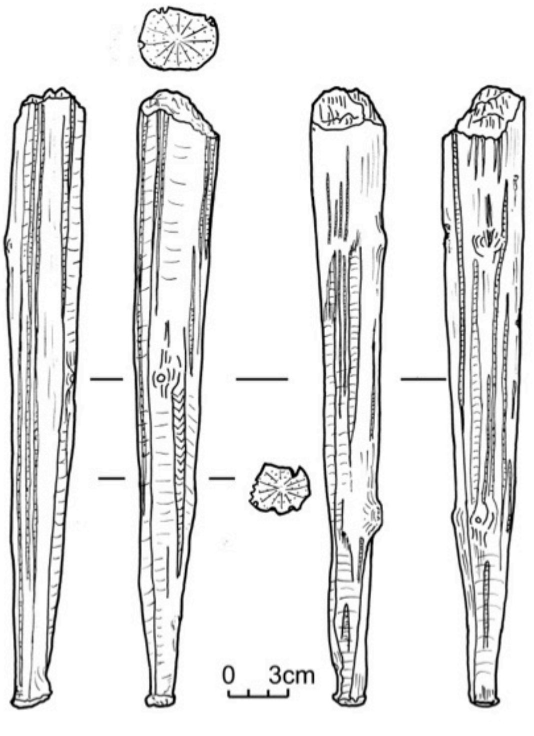


<2017.82>
A truncated end-section of a roundwood pointed end, not identified to species, measuring 98mm long by 27mm in incomplete diameter. The original roundwood diameter is unclear as the sapwood was missing and this is the terminal end only of the original worked stem. The surviving section had been finely worked to a point around its circumference suggesting it is a pencil-end. At least five dished facets could be measured that were smooth in parts and then torn, thus probable cleave-end working from the point. The most complete, though truncated, toolmark measured 93mm long by 25mm wide and 1mm deep. The exit angle could not be measured due to the truncation. One facet was smooth until it reached a knot and then torn behind towards the main stem of the pointed end consistent with being worked from the point. The point appeared quite compressed from having been driven in and it was unclear which way it had been inserted. The pith appeared nearly central in the part available, though as only the end portion survives that is hard to confidently



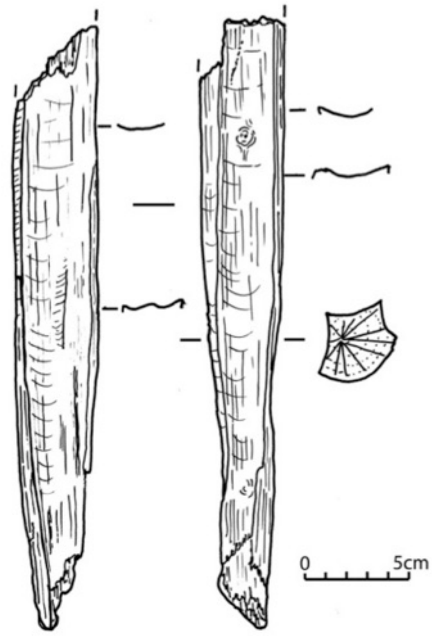
determine if it would be the case for the whole stem. There was one knot from a broken side branch and no bark.

<2017.83>
A roundwood pointed end of degraded willow/populus (*Salix/Populus* sp.) measuring 300mm long by 39mm in complete diameter. A finely pointed pencil-end with cleave-end working it had eight identifiable facets, of which five were complete enough to measure the original facet. The largest toolmark was also complete and dished, measuring 280mm long by 22mm wide by 1mm deep and had an exit angle of 5°. It also had one facet that was noticeable flatter in cross-section and measured 300mm by 18mm wide and was truncated at its upper end towards the stem. Possibly this may reflect the presence of a flatter curved tool or alternatively an example of more natural splitting of wood along the grain in this instance. Several facets appeared more torn towards the point and smoother at their start towards the unworked stem and it is possible that these were worked towards the point. One facet that met a knot appeared noticeably smoother above the knot and torn below it towards the point and may reflect a need to work differently around this problem towards the point. There was mild compression to the end from being driven in and it was inserted growing end downwards. The pith was central, with one grown over knot and two appearing

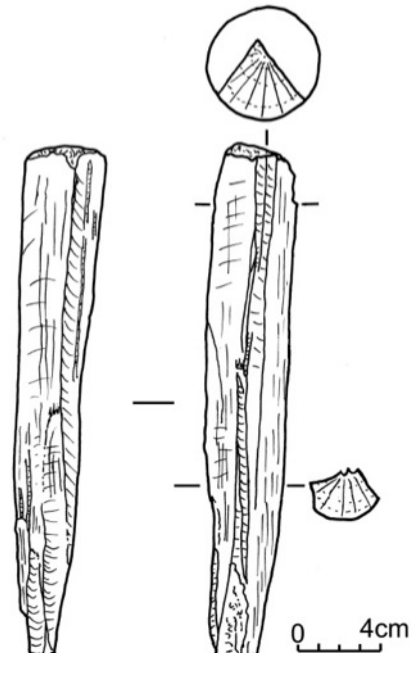


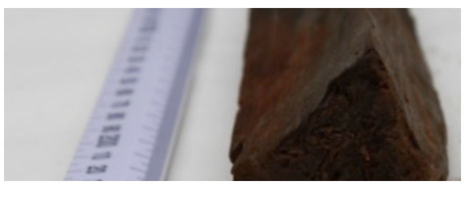
broken off.

<2017.97>
A roundwood pointed end of hazel (*Corylus avellana*) measuring 293mm by 48mm in incomplete diameter. Bark was present so the complete roundwood diameter is estimated to be have been around 55mm. This makes it a larger than normal roundwood pencil-end with cleave-axed working, with large slices of wood removed by two large facets and then smaller ones near the point to produce the final shape. Eight facets could be identified and measured, with second largest almost complete facet dished and measuring 260mm by 29mm wide by 4mm deep and exit angle of 8°. The largest facet measured 290mm by 33mm wide and 2mm deep but was truncated at the top towards the stem with its complete original length unknown. The end appeared very slightly compressed from being driven in and it was not clear which way it had been inserted. The pith appears central and it had some bark attached with two knots, one grown over, and the visible tree-ring growth suggested it was fairly fast grown.



<2018.46>
A roundwood pointed end of hazel (*Corylus avellana*) measuring 265mm long by 40mm in incomplete diameter. Bark was present and the complete roundwood diameter is estimated to have been around 55mm. The surviving section has been roughly quarter split and then finely worked to a pencil-end point with cleave-axed working with eight dished facets identified and measured. It had two large facets that had removed large slices of wood and then smaller ones made to finish the roundwood to a point. These largest two facets were truncated so their original complete dimensions unknown. The largest truncated facet measured 265mm long by 35mm wide and 2mm deep with its exit angle unknown. Whether the original piece of wood was split in quarter stem fashion along its entire length is unknown due to loss of the rest of the piece but no other pointed end was worked in such a fashion so seems unlikely. The end was intact and did not appear compressed from being driven in and it was not clear which way it had been inserted. The pith is





central and item had some bark attached to the roundwood surface that became detached on excavation.

<2018.47>

A roundwood pointed end of hazel (*Corylus avellana*) measuring 382mm long by 36mm in complete diameter and dated by radiocarbon AMS dating to 5225-5010 cal BC (6181+/-36, UBA-41504). A finely worked pencil-end with cleave-end working, it had six dished fairly narrow facets that could be identified and measured with evidence of tearing of the wood and bark towards the stem. The largest facet was also complete and measured 222mm long by 29mm wide 1.5mm deep and had an exit/entry angle of 20°. This facet was actually atypical as it appears to be partly a normal cleave facet but that also terminates in a jam curve with some tearing below and above the jam curve. The interpretation for this is that it was split from the point towards the unworked stem and then a tool with a curve to its blade was used to create a stop cut to avoid the tear running too far up the length of the stem. The jam curve measure 3mm long by 28mm wide by 3mm deep and blade angle of 20° and appears to be nearly complete with possible facet edges. The end was intact and did not appear compressed from being driven in with the pointed end inserted growing way up. The pith was central and it had a slight bend over its surviving length most pronounced towards pointed end. It had three grown over knots and visual inspection of the tree-rings seem to suggest

fairly slow growth.

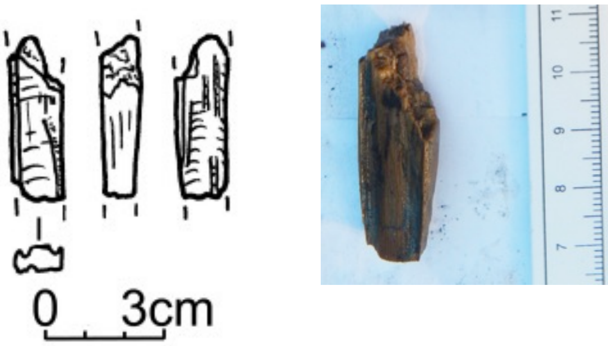
<2018.48>

A roundwood pointed end of hazel (*Corylus avellana*) measuring 332mm long by 33mm wide in complete diameter. A finely worked pencil-end with cleave-end working, it had six dished fairly narrow facets that could be identified and measured with evidence of tearing of the wood and bark towards the stem. The largest facet was also complete and measured 140mm long by 14mm wide by 0.5mm deep and had an exit angle of 9° and evidence of tearing at its terminal end. The end was intact and did not appear compressed from being driven in and appears to have been inserted growing end downwards. The pith was central and the piece was straight over surviving length. It has one branch that appears to have been broken off towards the tip and visual estimate of the tree-rings seem to suggest slow growth with around 13 years worth of growth.

<2018.49>
A small diameter roundwood pointed end, unidentifiable to species, measuring 91mm long by 10mm in complete diameter. Finely worked to a pencil-end with one clear facets, and three other less well preserved toolmarks which may have been worked from the pointed end. The largest and most complete facet measured 70mm long by 9mm wide and appeared flat in cross-section. The pith was central, with some bark attached and straight over its surviving length. The end was intact and did not appear compressed from being driven in and it was unclear which way it had been inserted.

<2018.52>
A small diameter piece of roundwood pointed end of hazel (*Corylus avellana*) measuring 53mm long by 13mm in complete diameter. Cut to a pencil-end with four truncated facets and the largest and most complete measuring 57mm long by 8mm wide by 0.5mm deep. One facet may have been more flat in cross-section and measured 55mm long by 14mm wide. The pith was central, no bark attached and straight over its surviving length. The end was not retrieved so any evidence of compression is unclear and it was uncertain which way it had been inserted.

<2018.53>
A small diameter piece of roundwood pointed end, not identified to species, measuring 38mm long by 10mm in complete diameter. Cut to a pencil-end with four slightly dished truncated facets, the largest and most complete measuring 43mm long by 11mm wide by 0.5mm deep. The pith was central, no bark attached and straight over its surviving length. The end was not retrieved for any evidence of compression and it was unclear which way it had been inserted.

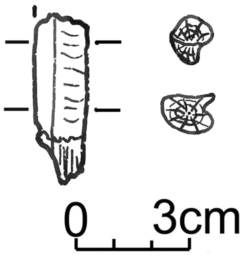


<2019.33>
A small diameter piece of roundwood pointed end of hazel (*Corylus avellana*) measuring 66mm long by 13mm in complete diameter, found parallel and 150mm from <2019.34>. Cut to a pencil-end with two facets, the largest and also complete one measuring 56mm long by 9mm wide and flat in cross-section. The pith was central, some bark attached and straight over its surviving length. The point was damaged so no clear evidence for any compression and it was unclear which way it

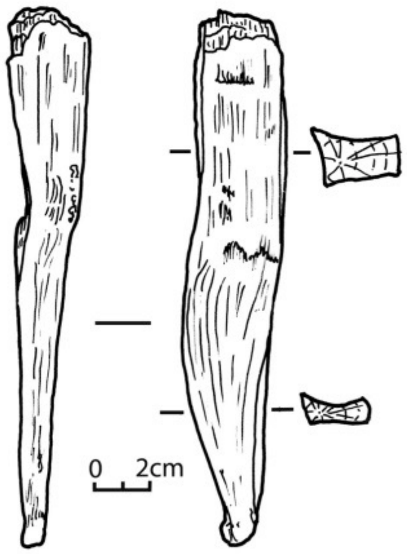
had been inserted.

<2019.34>
A small diameter piece of roundwood of alder (*Alnus glutinosa*) measuring 42mm long by 12mm in complete diameter found parallel and 150mm from <2019.33> but with no clear cut-marks. The

pith was central, some bark attached and straight over its surviving length. The end was too damaged, possibly broken, for any evidence of compression and it was unclear which way it had been inserted.



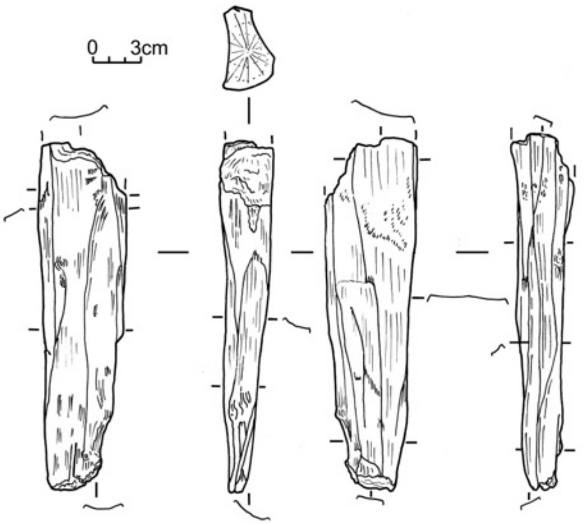
<2019.55>
The truncated terminal end of a roundwood pointed end, not identified to species, measuring 192mm long by 32mm in incomplete diameter. Possibly some bark is present on one section of the artefact so the original roundwood diameter is estimated at c.45mm. It is a pencil-end with cleave-end type working with three dished facets identified and measureable, with the largest dished facet truncated and measuring 192mm long by 30mm wide and 2mm deep. The entry or exit blade angle could not be measured and the direction of working is not entirely certain due to facet truncation but ripping in places suggests working from the point. The preserved section of the pointed end appears more 'squared off' to create rectangular shape with sharp facet junctions, one nearly 90°, something atypical for Site T pointed ends, but as it was an incomplete truncated part of the original artefact that may only reflect the particular morphology of the surviving part. 110mm along the largest facet a possible partial jam curve with a negative curve working towards the point was identified that measured 3mm long by 17mm wide by 1mm deep and with an entry angle of 25°. This may be the remains of creating a stop cut, to stop too much tearing from the cleaving of the end. The pith was off centre and an unusual slight twist or warp to the pointed end with some mild compression to the tip that might indicate it becoming distorted as it was driven into the palaeochannel. It was unclear which way it had been inserted



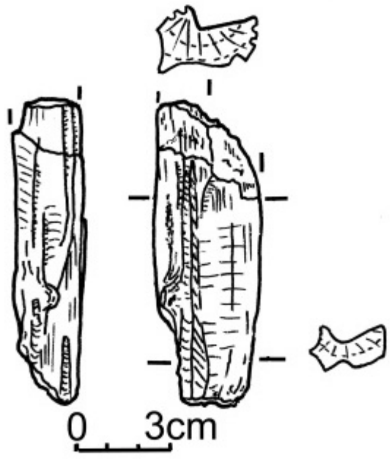
Appendix I.V Site T, Structure Tc (east)

<2018.44>

The truncated terminal end of a large roundwood pointed end of alder (*Alnus glutinosa*) measuring 215mm long by 57mm in complete diameter. It is a pencil-end with cleave-axed type working with 10 dished facets identified and measureable with evidence of ripping towards the stem. Three toolmarks were truncated in length and width as narrow and short remnants from previous facets. The largest dished facet is also complete and measures 213mm long by 33mm wide by 2mm deep with an exit angle of 15°. The preserved section of the pointed end appears to have been worked primarily along two opposite sides and then finished to a pencil-point with multiple smaller facets. The tip was mildly compressed and abraded showing it was damaged by being driven into sediment with it inserted growing end downwards. The pith was off centre with no bark preserved and one small broken branch knot.



<2018.47b>
The truncated terminal end of a roundwood pointed end of hazel (*Corylus avellana*) measuring 93mm long by 35mm in incomplete diameter. No sapwood was present on the piece so the original roundwood diameter cannot be reliably estimated. It is a pencil-end with cleave-end type working, with three dished facets identifiable and measured. The condition of this piece was somewhat poorer than usual for Site T and the surface of the wood more irregular, perhaps due to tearing of wood when worked or deterioration since it was placed in the palaeochannel. The largest facet was truncated and measured 90mm long by 21mm wide and 3mm deep. There was slight compression to the end from driving it in with it unclear which way it had been inserted. The pith was not



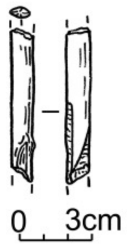
central in this segment with one branch knot possibly broken.

Appendix I.VI Site T, Structure Td

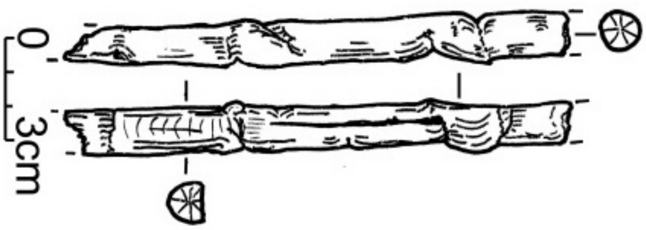
<2020.13>
A piece of roundwood measuring, not identified to species, 385mm long by 17mm in complete diameter. There is no clear evidence of working, with the end found inserted in the sediment roughly chisel shape but appearing quite abraded and deteriorated with iron staining, so it may have been chopped through but the clear cutmark evidence has been lost. Alternatively it may have been simply torn by hand or found naturally broken and then used in a fishtrap structure. It was found in a vertical orientation in association and alignment with artefacts <2020.15>, <2020.16> and <2020.17> that did have cutmark evidence so an anthropomorphic origin for its position seems probable. The pith location and which way it had been inserted was unclear, with the surviving stem having a slight bend along its length.

<2020.14>
A piece of roundwood of alder (*Alnus glutinosa*) measuring 171mm long by 20mm in diameter. There is no clear evidence of working, with the end found inserted in the sediment with a roughly chisel shape but appearing quite abraded and deteriorated with iron staining, so cutmark evidence may have been lost or it was simply broken rather than cut to be used in a fishtrap structure. It was found in a vertical orientation with the growing tip downwards in association with artefacts <2020.15>, <2020.16> and <2020.17> that had cutmark evidence so an anthropomorphic origin for its position seems probable. The pith location is unclear but the stem is broadly straight along its length, inserted growing end downwards, with a knot and a side branch snapped or broken off near the inserted end.

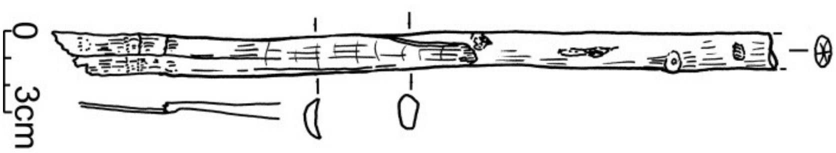
<2020.15>
A small piece of roundwood of hazel (*Corylus avellana*) measuring 63mm long by 9mm wide inserted at a vertical angle. Has a chisel shaped end and probable cut marks but roundwood has been distorted and compressed so not possible to take accurate measurements. Compressed into oval shape possibly from being in contact with other pieces of roundwood in a structure. The pith location and which way it had been inserted is unclear, with it straight along its surviving length.



<2020.16>
A small piece of roundwood of hazel (*Corylus avellana*) measuring 143mm long by 11mm wide worked to produce a chisel-end. It has one clear facet 56mm long by 10mm wide and slightly dished worked towards the end. The tip is missing but clear signs of being squashed when driven in has three compression bends, which would suggest it was likely green and when inserted quite forcefully into the sediments. Whether that was growing tip down or up is unclear. Central pith and appears to have been straight when originally cut and used.



<2020.17>
A small piece of roundwood of hazel (*Corylus avellana*) measuring 273mm long by 14mm wide, slightly oval with compression, worked to produce a chisel-end. It has one clear long facet 130mm long by 14mm wide and slightly dished worked towards the end. The tip is ragged and not well preserved. The pith is central, the stem straight over its preserved length and it was unclear which way it had been inse



Appendix II

Note on post-conservation change of Sweet Track assemblage

A key source of information in this study is toolmarks left on the surface of archaeological wood to investigate the methods of working and tools used. Coles & Coles (1986, 42) noted of the SWF pointed ends, 'at the end of each stem the facets, cut to a sharp point, showing as clearly as the day they were made' and as noted in **Chapter 4** recording these features as near to excavation would be the most ideal time for study. However, the trackways were excavated nearly 50 years ago and preserved artefacts have been subject to the process and effects of conservation, with the resulting potential for warping or shrinkage an important aspect to consider before analysis (Coles 1979, 36). Polyethylene glycol (PEG) was the stated preferred method for preserving the Sweet Track wood, and forms the method used for almost all pointed Sweet Track pointed ends in the archive (Coles 1979; SLP archive Taunton). Coles (1979, 42) gave two examples of pegs conserved with this method with very little change other than a slight loss of the detail of the facets and damage to the feather-edge of one end and that general assessment appears to be predominately still correct for the objects examined. On personal examination of a sample of preserved artefacts (**n=108**), it was found that for the majority of pegs and posts preservation is still good, with the PEG method producing a deep black colouring with a slight oily sheen that often still allows for clear identification of toolmarks and facet ridges. Of that 108 ends sampled only 20 were so poorly preserved that facets could not be accurately measured, and only five in such bad condition that the type of end pointing was totally unrecognisable.

Assessment of the post-conservation artefact changes by the SLP around the time of conservation (1970-1980s) revealed that shrinkage of artefacts using PEG was found to be in the range of 0-5%, with 2-3% normally recorded (Coles 1979, 36). An attempt was made in this work to assess if this estimate is still accurate by taking a diameter measurement at the widest observed part and comparing that to the dimensions on the artefact excavation sheet. It must be allowed that this is only a rough method at best, as there is no way of knowing which precise section of a peg was originally measured. Choosing to measure one area over another would of course affect the results by at least several millimetres. However, even with those limitations it was deemed a useful indicative exercise to gauge if drastic change has affected the artefacts some 50 years after excavation. For this test sample any results bigger than the original excavation sheet record, or considerably smaller (such as -25%), were excluded as considered likely unreliable or evidence of erroneous measurements on excavation or during this analysis data collection. Allowing for these problems, from a random conserved sample (**n=48**) of pegs and posts from six sub-sites (SWB, SWC, SWD, SWF, SWR, SWTG) observed maximum diameters against the dimensions recorded on their excavation sheets showed an average shrinkage of 5.5%, ranging from zero (**n=12**) to a maximum of 17.3% (**n=1**). As such, it would seem realistic to propose that some artefact shrinkage is probable, but on average it is likely within the SLP's predicted magnitude of 0-5%, or say at the most four millimetres for a peg originally 70mm in diameter. For the purposes of this work, it is therefore considered that conserved pieces do allow for reasonable accurate measurements of features such as facet sizes, but with caveat that the measurements are likely to be *minimum sizes* and some shrinkage may have occurred during the post-excavation and conservation process. As it seems unreliable to try to directly compare individual conserved artefacts against their excavation record (as discussed above), the dimensions of individual artefacts and their features are presented in this light and with these acknowledged limitations

Fig Appendix II.I. Artefacts still wrapped but with leeching damage (left) Sweet Track plank disintegrating once packaging remove (right)

Finally, one unfortunate issue of note discovered during examination of the Sweet Track conserved wood archive was the leaching of salts from artefacts in almost every archive box examined and in some cases resulting in the start of total disintegration of artefacts (see Fig. Appendix II.I above). For example, 9 of 14 artefacts (64%) in both SLP wooden archives boxes two and four (<BR13 AS/B1/BOX2>; <BR13 AS/B1/BOX 4> at SLP archive Taunton) had evidence of substantial salt leeching and disintegration of artefacts as shown above. This problem seems to be particularly acute for smaller items and those with sharp edges such as the plank as shown in Fig. Appendix II.I. Fortunately, artefacts such as pointed roundwood appeared to largely still be in good condition, but this is obviously a very serious problem that would warrant proper study outside of this work.

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