Woodworking technology and the utilisation of wood resources at Star Carr

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Abstract

This study examines the evidence for woodworking technology and the utilisation of wood resources using the waterlogged wood assemblage from the site of Star Carr. 4516 pieces of wood were recovered from Star Carr during excavations between 2013 and 2015; 1602 of these items had been split, trimmed or hewn. The recent campaign used a fine-grained approach to the wood analysis, individually recording each item. The efficacy of this approach has allowed a re-interpretation of the 'brushwood habitation platform' first identified by Clark, has furthered our understanding of the lake-edge platform first encountered in 1985, and has identified two further similar platforms. A previously unknown extensive scatter of detrital wood is interpreted as a possible trackway giving access to the lake.

An interdisciplinary approach has allowed a possible Mesolithic woodworking toolkit to be identified with flint, antler, bone and wood all playing important roles in Mesolithic carpentry. Analysis of the wood has identified a single, distinct, woodworking tradition spanning the 800 years of human activity at Star Carr, describing a mature tradition of carpentry with evidence for widespread use amongst the general population as well as possible specialisation in the production of specific artefacts. A slight but distinct signal for woodland management in the form of coppicing of roundwood stems is discussed, and a practice of harvesting tangential outer splits from living trees has potentially been identified.

Although the relationship between Mesolithic people and the wooded environment they lived in remains opaque, the cultural richness and layers of meaning imbued in the woodland are clear, as is the detailed knowledge the inhabitants had of available woodland resources. Furthermore, the nature of the wooden structures – illuminated through this latest phase of analysis – supports the assertion that group sizes may have been larger, and perhaps more settled in the landscape, than has previously been thought.

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Nicky Milner both led the POSTGLACIAL project and supervised this Masters by Research. Huge thanks are due for her kind support and advice during a period of my life that has seen me get married, start a family (welcoming the twins, Henry and Isla) and move into my own home.

The POSTGLACIAL project was funded by the European Research Council from 2012-2016 (POSTGLACIAL 283938) and my position as Project Manager was funded by Historic England (grant 6793). I am very thankful to The University of York, Department of Archaeology, who provided a bursary for this Masters by Research in the form of a fee waiver.

Maisie Taylor has been by mentor throughout my archaeological career and continues to be an excellent source of wood-related information, endless entertaining stories gleaned from many years in the field and 'One Recipe for Everything'.

Although it is not possible to list all the members of the POSTGLACIAL team, without whom this research would not have been possible, thanks are due to Becky Knight (the best house mate ever), Ben Elliot, Harry Robson, Shannon Croft, Charlie Rowley, Diederik Pomstra, Aimée Little, Neil Gevaux, Hen Goodchild, James Taylor, Chloe Watson, Barry Taylor and Chantal Conneller.

Finally, I would like to thank my wife, Lou, who has provided seemingly limitless practical and emotional support both during my time on the POSTGLACIAL project and whilst compiling this thesis.

Author's Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as references.

The recording, analysis and subsequent publication of the non-artefactual wood was carried out by me with limited assistance from others in the project team. During the 2013-15 investigations, I was on site for all three 8-week seasons in my role as project manager. During this time I completed the majority of the 4516 wood records, while Maisie Taylor completed 700 of the wood records and provided advice and support regarding stone tool woodworking practices. The subsequent data entry, processing and analysis of non-artefactual wood was carried out entirely by me.

Substantial parts of Chapters 3 and 4 are included in the Star Carr Monograph (Bamforth et al. in press, a, b). These chapters were initially written by me (which is the work contained herein) with other authors making limited contributions to the subsequently published text:

> Bamforth, M., Taylor, M., Pomstra, D., Little, A., and Radini, A. (in press, a). Woodworking Technology. In: N. Milner, C. Conneller and B. Taylor (Eds) Star Carr, Volume 2: *studies in technology, subsistence and environment*. York: White Rose University Press, Chapter 28.

> Bamforth, M., Taylor, M., Taylor, B., Robson, H. K., Radini, A. and Milner, N. (in press, b). Wooden Structures. In N. Milner, C. Conneller and B. Taylor (Eds). *Star Carr, Volume 1: A persistent place in a changing world*. York: White Rose University Press, Chapter 6.

Limited information contained in the above-mentioned Star Carr monograph chapters and this thesis has also been used to support the production of two papers:

> Blockley, S., Candy, I., Matthews, I., Langdon, P., Langdon, C., Palmer, A., Lincoln, P., Abrook, A., Taylor, B., Conneller, C., Bayliss, A., MacLeod, A., Deeprose, L., Darvill, C., Kearney, R., Beavan, N., Staff, R., Bamforth, M., Taylor, M. and Milner, N. (in preparation). The resilience of postglacial hunter-gatherers to abrupt climate change. *Nature*.

> Taylor, B., Elliot, B., Conneller, C., Milner, N., Bayliss, A., Knight, B. and Bamforth, M.

(2017). Resolving the issue of artefact deposition at Star Carr. *Proceedings of the Prehistoric Society*. (DOI:10.1017/PPR.2017.8).

A GIS model of the 2013-15 excavations, including the wood data, was built by me and placement student Julian Carty, under my supervision. I carried out much of the data capture for, and all processing of, the Agisoft Photoscan models used to produce the orthophotos contained herein. Much of the background mapping data for the GIS (including trench outlines and topography) was provided by Barry Taylor. James Taylor kindly assisted in the production of the final map figures.

All tables were produced by me. Many of the figures appear in the forthcoming Star Carr monograph and have been cited as such and assigned copyright as defined for that volume, either to the individuals who produced them or, as many of these figures were produced collaboratively, to the 'Star Carr project' (SCP).

Anita Radini, Steve Allen, Allan Hall and Dana Challinor carried out the taxonomic identifications of wood included in this volume. Anita Radini carried out the growth ring counts and recorded the season of felling for the roundwood, while I carried out the analysis of species utilisation and branch age / diameter. Kirsty High provided advice regards the chemical condition of the wood. Barry Taylor offered advice and support regarding the analysis of the wooden structures. Harry Robson and Aimée Little offered advice regarding comparable sites and wooden structures in the UK. Aimée Little carried out the microwear analysis of wood and other artefact types excavated at Star Carr.

During 2014, 2015 and 2016 Aimée Little co-ordinated a series of experiments with various material types and artefacts recovered from Star Carr. These were often carried out alongside the ancient technology specialist Diederik Pomstra and other project specialists, particularly Ben Elliot and Becky Knight. I designed and participated in the majority of the experimental work involving wood but I'm grateful to all involved for discussing their insights, particularly in terms of flint and osseous technology, and the perceived relationships of these material types to Mesolithic woodworking practices.

1 Introduction

1.1 Aims and objectives

The overall aim of this dissertation is to reconstruct the woodworking technologies that were practiced at Star Carr and understand more about how people utilised their woodland environment for timber resources.

The site of Star Carr is critically important to our understanding of the Early Mesolithic, both in the UK and in northern Europe in general. The exceptional organic preservation, unparalleled in the UK during this period, has provided a broad range of well-preserved material types, giving us the opportunity to learn about the social organisation and human-environment interactions of early Mesolithic populations. Recent research at Star Carr has – among other things – challenged our understandings of hunter-gatherer mobility patterns (Conneller et al. 2012) and illuminated the earliest example of Mesolithic art in the UK (Milner et al. 2016).

Despite the waterlogged wood assemblage representing an important and unique resource for understanding the site, previous work has underplayed its significance and it has tended to be overlooked in favour of studies of other finished organic artefacts (particularly antler frontlets and barbed points) and the large lithic assemblage.

A detailed examination of the exploitation of wood resources at Star Carr will provide valuable further insight into how Mesolithic people interacted with their local environments. Furthermore, an exploration of the woodworking methods and practices employed by Mesolithic people will in turn enable us to understand more about skillsets and specialisms, and enable a more holistic consideration of the use of stone tools and other materials in these contexts.

This research will first critically appraise the history of the excavation, recording and analysis of wooden remains at Star Carr before presenting the data obtained from the recent excavation and addressing the analytical potential of the wood data to interrogate both woodworking practices and the past lifeways of the inhabitants of the site. Particular research goals include:

a consideration of woodworking technology. This includes an identification of the presence or absence of different carpentry techniques, with an attempt to characterise the Mesolithic 'woodworking toolkit' and a discussion of the potential evidence for specialist woodworking.

a discussion of the exploitation of wood resources by Mesolithic people and a consideration of the relationships that the inhabitants of Star Carr may have had with the forest around them. This includes an investigation of the potential evidence for woodland management, and a consideration of the implications regarding time that may have been invested in the construction of the wooden structures.

To address these aims, this research analysed the non-artefactual wooden remains excavated at the site of Star Carr between 2013 and 2015. A total of 4516 pieces of waterlogged wood were recorded, 1602 of which had been split, trimmed or hewn. There are a total of 38 finished artefacts which are not considered in detail in this thesis (Taylor et al. in press). A critical review of previous work on the Star Carr wood provided a framework for the development of a more stringent approach to wood recording and analysis at the site. This research will consider the social significance of wood as a material and the role of woodworking technology in society, touching upon raw material selection, the organisation of production, craft specialisation, technological choices and innovation. The structures recorded at Star Carr are considered against other Mesolithic wooden structures from the UK.

1.2 A short background to Star Carr and its wood assemblage

Star Carr occupies a promontory on the north shore of Palaeolake Flixton in the Vale of Pickering, North Yorkshire (Figure 1.1). Recent research has shown that around 11,000 years ago, over the course of at least 800 years, people used this space and the landscape around it to live in small, round houses, to hunt, to cook, to build platforms along the edge of the lake and probably to carry out ritual performances in the liminal zone of the lake-edge (Milner et al. in press, a and b). During the span of human activity recorded at Star Carr (c. 9300 and c. 8500 cal BC; Milner et al. in press, c), the postglacial, preboreal environment would have seen much of the landscape covered with woodland formed predominantly of pioneer trees, including willow, aspen and birch (Milner et al. in press, a), and which would have provided abundant resources for the Star Carr inhabitants.

The site was first excavated by Grahame Clark in the mid-20th century. Clark (1954) encountered a scatter of flint, bone and antler artefacts within what he believed to be a brushwood occupation platform. The site was subjected to further excavation in the 1980s, which revealed a lake-edge timber platform (Mellars and Dark 1998). The excavation evidence has been revisited many times, with the site often interpreted as a seasonally-occupied basecamp or hunting camp (Clark 1972; Jacobi 1978; Legge and Rowley-Conwy 1988). The recent campaign, extending from 2013 to 2015, saw a large open area excavated encompassing all the known waterlogged remains. Two further lake-edge timber platforms and a significant scatter of detrital wood were encountered in the wetland at the edge of the lake and at least two small hut circles describing stake-built, bender-like structures were revealed on the dryland, close to the lake-edge (Milner et al. in press, a).

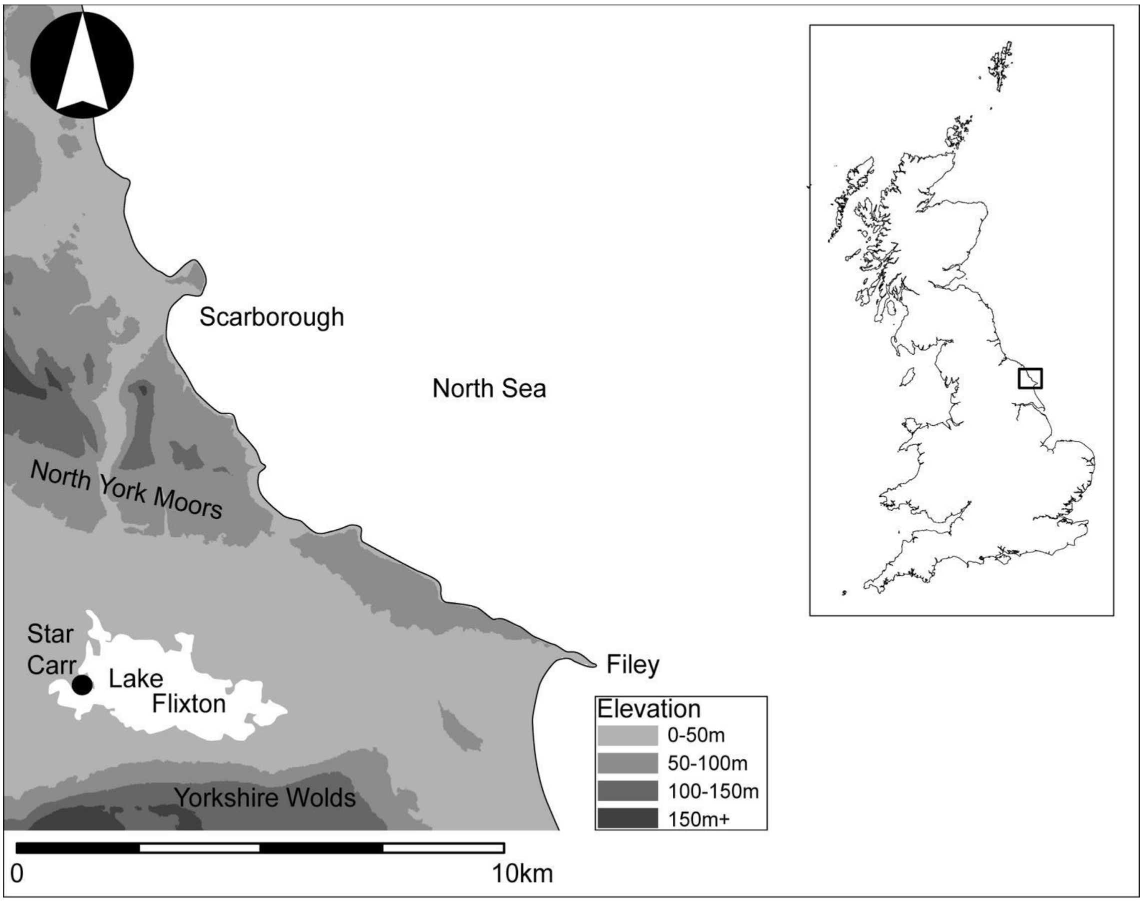

Figure 1.1 Location of Lake Flixton and Star Carr (Milner et al. in press, a: Figure 1.1; adapted from Conneller et al. 2012).

Plotting the shifting discourse of academic thought at Star Carr does, in some ways, mirror the progression of British archaeology. Through our shifting engagement with our shared past, we can identify a shift in the attitudes towards the treatment and interpretation of wood in the archaeological record, with wood given increasingly higher prominence and greater attention.

This story begins with Clark's initial large-scale excavations of Star Carr. Clark had been actively seeking a waterlogged Mesolithic site, convinced that the study of well-preserved organic artefacts (known to form an overwhelming part of Early Mesolithic material culture) alongside enhanced environmental data, would lead to a huge leap forward in his ability to understand the period (Clark 1954: xxi). John Moore's initial discovery of Early Mesolithic organic remains at Star Carr in the late 1940s provided Clark with the opportunity he had been looking for, and three seasons of excavations commenced in 1949 (Clark 1954: xxi).

Despite Clark's clear understanding of the huge potential of organic artefacts, he did not treat the extensive wooden remains he encountered with anything like the reverence of other materials. Primacy of place was given to finished organic artefacts, particularly the headdresses (frontlets) and antler and bone barbed points. The original Star Carr excavation report (Clark 1954) is in many ways an exemplary publication, in terms of layout, contents and the relative speed it was brought to press. However, although it runs to some 200 pages, including lengthy chapters for faunal remains (26 pages) and the antler and bone industry (50 pages), wood is relegated to the end of the 'Miscellaneous' chapter, warranting a mere half page, with 'Birch-bark and birch-pitch' given a full page. Only four pieces of wood are individually represented with illustrations or photographs out of a total of 80 figures and 24 plates – a wooden paddle (Clark 1954: Figure 77, Plate xxi), a charred wooden haft in an elk-antler mattock-head (Clark 1954: Figure 69, Plate xv), felled birch trees (Clark 1954: Plate iv) and a cut birch branch (Clark 1954: Plate xx, g). In terms of specialist input, Donald Walker examined a sub-sample of a 'birch' paddle (Clark 1954: 178). Clark also describes the presence of the felled butt-ends of two birch trees, the larger of which he describes as being "ring felled" with a "pencil point", and the smaller as being worked from mainly one direction, "cut to fall" style (Clark 1954: 2).

There are occasional general trench plans and photos that depict the wooden remains. The 'birch brushwood platform' as a whole is described in Clark's general overview, where he interprets it as an occupation platform. It is interesting to note that the brushwood platform has since been interpreted in several different ways during subsequent re-interpretations of the site (e.g. Price 1982; Mellars and Dark 1998: 221; Rowley-Conwy 2010: 79-80), but that the lack of detailed recording or publication of the wood that forms the 'platform' means that previous discussion has generally been articulated by the wood's relationship to other material types and lake water levels, as opposed to the nature of the wood itself.

The diligence given to recovering wood artefacts during Clark's excavations is also questionable. During the 2013-15 excavations, 76 m^2 directly adjacent to Clark's trenches were excavated, encountering 18 wooden artefacts, representing 1 per 4.2 m^2. This stands in stark contrast to Clark's investigations where two wooden artefacts were identified from the 258 m^2

excavated, representing an artefact density of 1 per 129 m^2. It is likely that one of these items (Clark's 'mattock haft') is not actually an artefact (Taylor et al. in press) dropping the density to 1 per 258 m^2. This represents a difference in the density of wooden artefacts recovered of between 30 and 60 times within a similar deposit. This disparity is even more striking when one considers that the area Clark excavated was the focus of activity in this area with by far the highest finds density in terms of both lithic and faunal remains and by extension, presumably wooden remains too. Indeed, Clark himself seemed to be aware that insufficient wooden artefacts had been recovered: "although wood must have been extensively used for handles, shafts, bows and other purposes, disappointingly little was found in the way of finished objects, owing no doubt in part to the soft condition in which it survived" (Clark 1954: 178).

However, there is seemingly no reflection by Clark (1954) that this might represent collection bias as opposed to survival. The two artefacts identified by Clark either had an unusuall gross morphology (the wooden paddle, Clark 1954: Figure 77, Plate xxi) or were recovered in association with easily recognisable artefacts of other material (carbonised haft of antler mattock, Clark 1954: Figure 69, Plate xv). Despite dowels being the most frequent type of artefact encountered during the recent campaign (both overall and in the area directly around Clark's excavation, Taylor et al. in press), Clark did not identify any. This might be because dowels require specialist knowledge of woodworking practices to identify, and these skills were not present on-site during Clark's excavations. Given the relatively ubiquitous nature of wood as part of modern material culture, and the wide-spread knowledge within the general population of basic woodworking and carpentry skills, the relatively poor understanding of wood in the archaeological record until recently, seems odd. Perhaps it is the sheer volume of wood at the site that caused a problem. It is incredibly time consuming to dig a site when the matrix itself is formed of wood as much as any mineral deposit (in the case of Star Carr, organic muds and peat).

In sum, despite being an incredibly rare organic material with huge analytical and interpretative potential, the wood at Star Carr did not receive focused, specialist attention in Clark's study (Table 1.1). The wooden remains were dealt with as a deposit, described broadly as a 'context', with only limited attempts made to record and analyse the individual constituent elements that formed the accumulation. The lack of specialist knowledge of wood at Clark's excavations means that many wooden artefacts may also have been overlooked and discarded.

By the 1985-89 excavations the situation had improved somewhat (Mellars and Dark 1998). In the monograph for these later excavations, wood has a chapter of its own, 18 pages long, reporting the presence of a lake-edge timber-built platform. This represents 7.4% of the monograph, a major increase from the 0.25% afforded by Clark (Table 1.1). The larger pieces of wood were planned and several pieces were numbered. However, no wood specialist was present on site and only ten sub-samples were submitted to a specialist for full recording and analysis (Taylor 1998b). Perhaps if a wood specialist had been on site during the excavations it may have prevented the scenario whereby, during the excavation of the western half of the 1985 trench, the wood encountered was thought to be naturally accumulated “shoreline detrital accumulation” and was removed without recording (Mellars et al. 1998: 30). It was only during the excavation of the eastern half of the trench that it was realised that the timbers represented a “deliberately constructed platform or trackway” (Mellars et al. 1998: 30-1) laid down on the edge of the lake.

	Clark 1954	**Mellars and Dark 1998**
Is there a wood chapter?	Sub-section in Miscellaneous	Yes
Pages used to report wood	0.5	18
Approximate % of the publication used for wood	0.25%	7.40%
Was the wood author a ‘wood specialist’	No, although Mr. D. Walker was consulted regards the paddle	Yes
Was there a wood specialist on site	No	No
Was the wood numbered	No	Some
Was the wood planned	Some	Some
Is seasonality addressed through the wooden remains?	No	No
Which interpretative themes is the wood used to interrogate	None	None

Table 1.1 Overview of wood reporting in previous excavation reports.

Taylor (1998b: 62-3) does consider the function of the platform, suggesting that it was constructed to provide access to the lake, perhaps for fresh water, or for access to boats. The woodworking is considered, with radial and tangential conversions of material up to 35 cm in diameter and 3 m in length recorded and some thought given to the tools that may have been used to work the wood, including flint axes, red deer antler tines and elk antler mattocks (both used as splitting wedges).

In the postscript, Mellars returns to the key interpretative themes of the site to reappraise various issues, armed with the data from the latest round of investigations including seasonality of occupation, social and economic status, location within the landscape and the nature of the wider environment. Despite having stated that the presence of the wooden platform was one of the key findings, its presence and form and the differences from Clark's 'brushwood platform' are not considered in Mellars' reinterpretation of the key research themes, relying heavily on the faunal and lithic evidence (as is the norm in these debates) and the newly-published charcoal evidence (Mellars 1998).

Although Clark's 1954 publication does not analyse the wooden remains in detail, this is not unusual for the time and it has, after all, provided enough information to inform further work. Taylor's (1998b) work is much more detailed but was hampered by comprising only a sub-sample of the material, and for being recorded off-site, rather than in-situ during the investigations.

These factors were considered in detail when the 2013-15 excavations were planned, and it was decided that it would be of great value to have wood specialists present on-site during the excavations. A project manager with extensive experience of excavation and recording of prehistoric wood (myself, MB) was also specified to ensure the constant presence of an archaeologist with expertise in wood throughout the excavations. Furthermore, as will be set out in the excavation and recording method in Chapter 2, the individual elements of wood that formed the structures and accumulations were recorded individually, on-site, allowing a fine-grained, reflective approach to excavation, recording and subsequent analysis. This has hopefully enabled a greater appreciation of the wood assemblage at Star Carr and a detailed insight into the use of wood at the site.

1.3 Summary and chapter outline

As much as Star Carr has a physical and temporal location, it also occupies a unique space within the psyche of British archaeology. Investigations have taken place sporadically over the last seven decades and each new round of research has brought new techniques, new theoretical approaches and new insights. Not many archaeological students complete an undergraduate degree course in the UK without writing at least a few lines about the site, often reflecting on the history of the changing interpretations. Indeed, as an undergraduate student at UCL Institute of Archaeology in 2003-04, I was asked to propose a research question for the site of Star Carr. I wrote the following:

> *If the site were only occupied for short periods of time, it would seem unlikely that a lot of effort would have been put into the construction of a timber platform. An analysis of the amount of time spent on this endeavour may shed light on the question of duration of stay at this site.*

Within the chapters that follow, I hope that I will finally be able to address this question, at least in part.

The following chapter, Chapter 2, provides an overview of the previous excavations and reports of the wooden remains encountered at the site. The methodological approach adopted in the excavation and analysis of wood during the recent 2013-15 campaign, which forms the basis of this thesis, is also set out in detail. The 2013-15 non-artefactual wood assemblage itself is then described and analysed in Chapter 3. This chapter explores the construction of the wooden structures and compares it with other Early Mesolithic evidence for wooden structures within the UK, as well as providing a comprehensive description of the non-artefactual wood assemblage. Chapter 4 presents the woodworking practices in evidence at Star Carr and proposes the identification of a Mesolithic woodworking toolkit whilst also considering the evidence for possible woodland. Chapter 5 extends this discussion, to explore the wood and woodworking technology within a social context, exploring the interaction between the people of Star Carr and the heavily wooden environment they inhabited. The research goals are then revisited in Chapter 6 – the concluding chapter – which provides a summary of the research, revisits the aims and objectives as set out above, and offers suggestions for the direction of future work into early woodworking technology. Additional data regarding evidence for preservation conditions, species identification, and beaver modification support the main focus of this research and are available in the Appendices.

2 Studying the wood at Star Carr

2.1 Introduction

The previous chapter provided an overview of the changing emphases on the excavation and recording strategies of wood at Star Carr from Clark's excavations in the mid-20th century, to the recent 2013-15 research. This chapter will now move on to discuss the past wood record in more detail, providing a critical review of past approaches and interpretations, with a specific focus on changing models of the constructions and use of the wooden structures. This will then be followed by a detailed description of the methods and approaches used in the 2013-15 excavation, and the recording strategies that were employed.

2.2 Previous interpretations of wood at Star Carr

In the years following Clark's excavations at Star Carr, archaeological attention focused primarily on the large assemblage of osseous material culture and faunal remains that his team recorded. However, an equally important feature of the site's archaeology was the platform of birch 'brushwood' that appeared to have been constructed at the edge of the lake to serve as an occupation surface (Figure 2.1). Although the individual elements were not recorded in detail, the platform as a whole is summarised in Clark's first interim excavation report:

> *The most interesting feature revealed by methodical excavation of the culture zone was the presence of a rough flooring of birch brushwood (plate. ix). Some of the birch stems retained their bark and they were evidently thrown down with their side-branches intact. In certain cases the wood appeared to have been split and in places the upper surface showed signs of charring. […] there was more than one phase of building: a lower level, rich in cultural material and interlaced with bone and antler, dipped with the surface of the gravel; and an upper one, more deliberately constructed of stems thrown across the line of our cutting, running out more or less horizontally […] Although a few timbers had been rammed in obliquely, no certain traces of piles were found. No traces of any superstructure were observed, but the brushwood was covered in places by flattened birch-bark* (Clark 1949: 56).

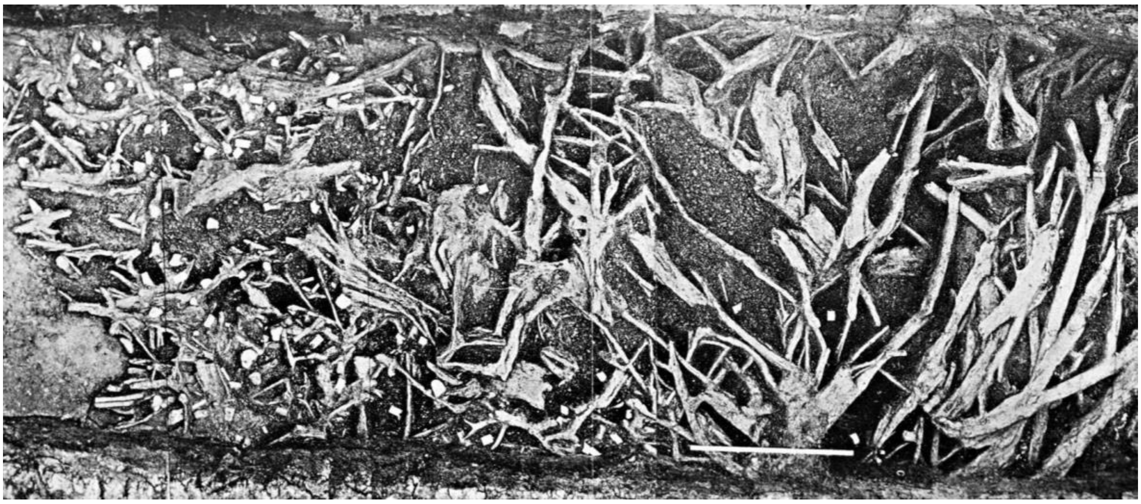

Figure 2.1 Composite photograph of the 'brushwood' from Clark's excavations (Bamforth et al. in press, b: Figure 6.1, courtesy of David Lamplough).

By 1950, following the second season of excavations, Clark's understanding of the brushwood layers had developed further. To begin with, more thorough excavations of the upper layer showed that it was a natural accumulation of material rather than an archaeological horizon (Clark 1950: 109-10) (Figure 2.2). However, the lower layer continued to be interpreted as an occupation surface, based largely on the presence of material culture and in particular the close correlation between the highest densities of worked flint and the extent of the brushwood (Clark 1950: 110-11). From the palaeoenvironmental analysis, Clark argued that the wood had been laid down to stabilise the surface of the swamp to enable the inhabitants of the site to camp at the edge of the lake (Clark 1950: 113; Clark 1954: 9). He also recorded stones and wads of clay which he argued had been laid down to consolidate the brushwood and the two large birch trees that had been deliberately felled (Clark 1950: 113), which he later suggested may have served as a 'primitive landing stage' (Clark 1954: 2) (Figure 2.3).

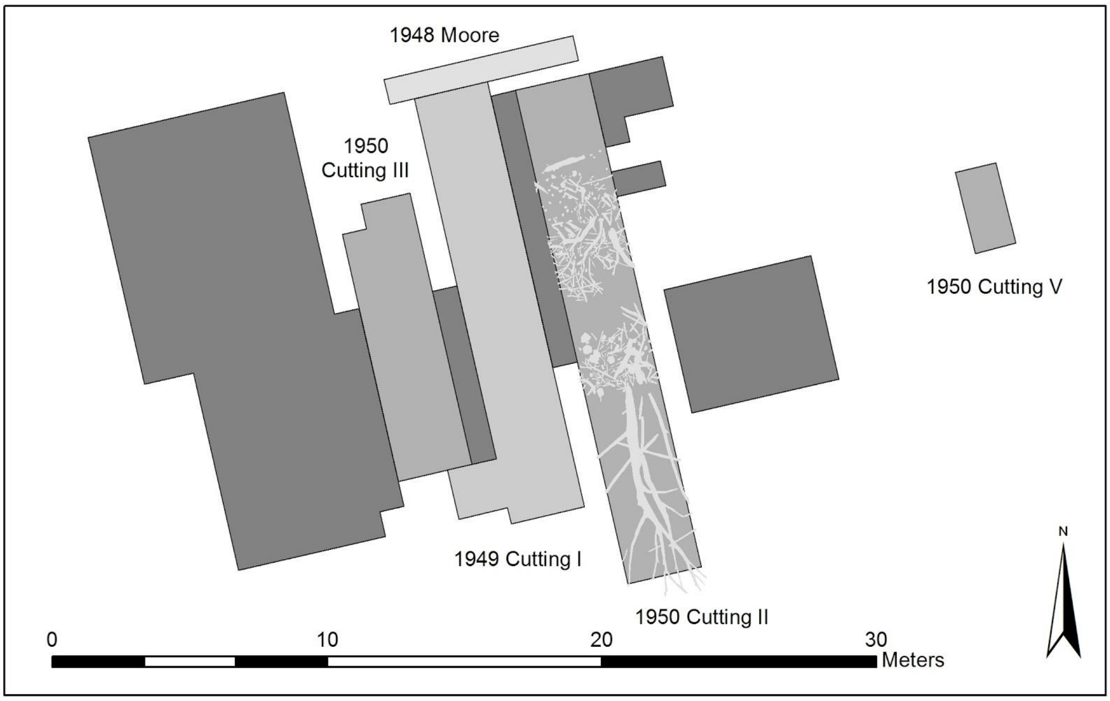

Figure 2.2 The excavations of Moore and Clark. Trenches excavated in 1949 and 1950 were assigned numbers by Clark (Cuttings I, II, III and V); those excavated in 1951 were not and are marked in darker grey. The ‘brushwood’ and two trees from Cutting II have been digitised from Clark’s excavation monograph and superimposed on the trench plan (Milner et al. in press, a: Figure 2.3, © SCP).

Figure 2.3 The 'brushwood' platform encountered during Clark's excavations. The wood in this photo is now thought to be the 'upper' level of brushwood (as noted by Clark) and which is probably the equivalent to the layers of roots noted in the recent excavations (Milner et al. in press, a: Figure 2.4, courtesy of Scarborough Archaeological and Historical Society).

Subsequent reinterpretations of the site have questioned the anthropogenic nature of the platform and have suggested that the material probably represents a natural accumulation of wood that built up at the edge of the lake (e.g. Price 1982). However, Mellars countered this by arguing that the distribution of worked flint recorded by Clark from the brushwood reflected in-situ activity areas and, as such, the wood must represent an occupation surface (Mellars and Dark 1998: 221). Reconciling these two arguments, Rowley-Conwy (2010) suggested that as the site was occupied in the summer when lake levels would be seasonally low, the area where the wood was accumulating could have served as a temporary occupation area (Rowley-Conwy 2010: 79-80).

In 1985, a more substantial wooden structure was recorded during the excavation of trench VP85A, twenty metres from Clark's trenches. This consisted of a series of large timbers laid roughly parallel to each other and running diagonally across the trench. Analysis of the timbers showed that they had been split tangentially, radially and across the grain with several pieces showing additional working traces. Tool marks were identified on one piece that probably represented cleaving (Mellars et al. 1998; Taylor 1998a). It was posited that the wood had been worked using either flint adzes and axes or elk antler mattocks, whilst aurochs metapodials, red deer tines or roe deer antlers could have served as wedges (Mellars et al. 1998). Samples taken from the timbers identified the species of wood as aspen (*Populus tremula*) or willow (*Salix* sp.) (Mellars et al. 1998).

The structure was interpreted as a platform laid to consolidate the wetland deposits or as a trackway to facilitate access to the lake itself, presumably for watercraft (Cloutman and Smith 1988: 52; Mellars et al. 1998: 62). Based on the stratigraphy of the timbers it was suggested that at least two episodes of wood accumulation had taken place (Mellars et al. 1998: 50). Importantly, this structure bore no resemblance to the brushwood platform or the two trees that Clark had encountered, either in terms of its form or the material from which it was composed.

A primary objective of the 2013-15 project – in particular the open-area excavation of the lake-edge deposits between Clark's trenches and the area to the west of VP85A – was to provide a far more detailed record of the construction and use of wooden structures within the Star Carr wetlands. A total of 4516 pieces of wood (including the material classed as artefacts) were recorded, of which 1602 had been split, trimmed or hewn. Three large timber platforms were recorded (the central, eastern and western platforms) as well as a more diffuse scatter of wood, which may also have performed a structural function (the detrital wood scatter). A deposit of largely unmodified roundwood (the brushwood area) was also recorded, as was an assemblage of wood from the unexcavated baulk between Clark's Cuttings I and II, and the area to the south of his trenches (CDA). These structures will be discussed in detail in Chapter 3, but the methods used to expose and record the archaeological wooden remains will first be introduced below.

2.3 Excavating and recording the Star Carr wood: the 2013-15 campaign

2.3.1 Excavating the wood

Figure 2.4 The upper levels of the central platform under excavation.

When the 2013-15 campaign of excavation was planned, Nicky Milner – in consultation with Maisie Taylor – decided that it was of critical importance to have wood specialists on site during excavations. As such, the wood was excavated on site by teams of diggers who were provided with training and oversight by myself, the on-site wood specialist (Figure 2.4). The external wood specialist (Maisie Taylor) visited the excavations every two weeks. All wood encountered was hand-excavated using fingertip techniques and non-metal implements, usually wooden clay modelling tools. The excavation and analysis was carried out in accordance with Historic England guidelines for the treatment of waterlogged wood (Brunning and Watson 2010) and recommendations made by the Society of Museum Archaeologists (1993) for the retention of waterlogged wood. Each discrete item was recorded individually using a *pro forma* wood recording sheet (Figure 2.2), based on the sheet developed by Fenland Archaeological Trust for the post-excavation recording of waterlogged wood. Every effort was made to refit broken or fragmented items. However, due to the nature of the material, the possibility remains that some discrete yet broken items may have been processed as their constituent parts as opposed to as a whole. The system of categorisation and interrogation developed by Taylor (1998a, 2001) has been adopted for the work reported in this dissertation.

Site:
Wood Number:
Area:
Grid E:
Grid N:
Same as:
Context:
Layer:
Level:

Sampled for ID: Y/N
Species:
Growing *in-situ:*
Type of wood:
Notes on wood type:

Coppicing evidence: Y/N
Coppicing notes:

Tool-marks: Y/N
Tool-marks on ends: Y/N
Tool-marks on other faces?
Tool mark notes:

Bark alone? Y/N
Bark condition:
Damaged: Y/N
Ancient Damage? Y/N
Damage notes:

Bark / Sapwood / Heartwood?

Condition: 1 2 3 4 5

Woodworking evidence? Y/N
Type of ww evidence:

Woodworking notes:

Charred? Y/N
Charring Notes:

Wear evidence? Y/N
Wear Notes:

What function?
Function notes:

Length(mm):
Max breadth:
Min breadth:
Max thickness:
Min thickness:
Dia Distorted? Y/N
Long axis:
Short axis:
Dia (not distorted):

Original dia:
Dimension notes:

Associations:
Association notes

Photographed?: Y/N
Film nos:
To be drawn?: Y/N
To be conserved?: Y/N
Conservation notes:

Missing data notes:
Form entered by:
Data-base entered by:
NOTES:

Figure 2.5 Wood recording sheet.

Where possible, discrete structures and accumulations of wood were excavated fully in plan. Extensive root scatters were present along much of the lake-edge, particularly in the base of the wood peat. Where present these were roughly revealed, sub-sampled and removed. Where in-situ tree boles were encountered, these were individually recorded and located. All excavated wood was assigned a unique finds number and was 3D located.

All extensive spreads and discrete structures were photographed and 3D models were produced using Agisoft Photoscan Pro. This was generally undertaken using DSLR cameras mounted on a tripod or an extendable pole, the exception to this being the eastern platform which was modelled by Dominic Powlesland using a drone-mounted compact digital camera.

In addition, all spreads and structures were hand planned at 1:10. Prior to the 2014 season this was undertaken using planning points, hand tapes and planning frames. During the 2014 and 2015 seasons, orthophotos were printed out at 1:10 and used as an underlay to produce a hand-drawn plan on site.

The wood was recorded using a three stage 'triage' system of data selection designed by myself (Table 2.1). This concentrated the recording, sub-sampling and retention/discard process at the point of excavation. The metric data were measured with hand tools including rulers and tapes and tool marks were measured using a profile gauge. The preservation condition of each item was recorded (see Appendix A), and all recorded items were sub-sampled to allow later identification to taxa via microscopic identification as necessary (see Appendix B).

Type	Method	Location	Retained?	Information	Criteria	Aims	Typical Item
Basic	wood sheet	on site	sub-sample and discard	metric and conversion data	poor condition and/or no toolmarks or evidence for nature of woodworking	to provide data for analysis of woodworking assemblage	roundwood
Full	wood sheet	on site	may be retained	metric, conversion and surface data	moderate condition and/or evidence for nature of woodworking	as above and to inform in terms of woodworking techniques	worked timber
Enhanced	wood sheet and illustration	on site and lab	retained for cleaning and further analysis	metric, conversion and surface data	good condition and/or toolmarks or evidence for nature of woodworking	as above and to inform in terms of woodworking techniques	heavily worked timber or artefact

Table 2.1 Details of three stage 'triage' recording system (Milner et al. in press, b: Table 15.1).

The rapid degradation of waterlogged wood of this antiquity when removed from the burial environment necessitated a rapid workflow. Several exceptions were made to the standard recording process. Where extensive spreads of natural roundwood were present, these were characterised and recorded via a c. 10% sub-sample. Where diffuse scatters of natural roundwood were encountered throughout deposits these were also subjected to characterisation and a c. 10% sub-sample was recorded in detail. Finally, the extensive layer of brushwood located around the western end of the western timber platform was subjected to rapid recording whereby each item was recorded only in terms of diameter, condition and presence/absence of bark.

Identification to taxa and ring counts for the main 2013-15 assemblage were carried out by Anita Radini (AR, University of York). In the first phase of excavation (pre-2013), a small sample of the wood was identified by Allan Hall (AH, University of York, retired). Steve Allen (York Archaeological Trust) identified the wooden artefacts to taxa and Dana Challinor (University of Oxford) identified some of the material submitted for radiocarbon dating.

2.3.2 **Spatial classification of the wood assemblage**

The wood assemblage was broken down into a series of six spatial analytical groupings reflecting either coherent, identifiable structures or discrete spreads of material (Figure 2.6 and Figure 2.7). These were labelled brushwood area, detrital wood scatter (DWS), central platform, eastern platform, western platform and Clark's deposition area (CDA). All material that did not fall into one of these spatially-defined groups was assigned as 'other'.

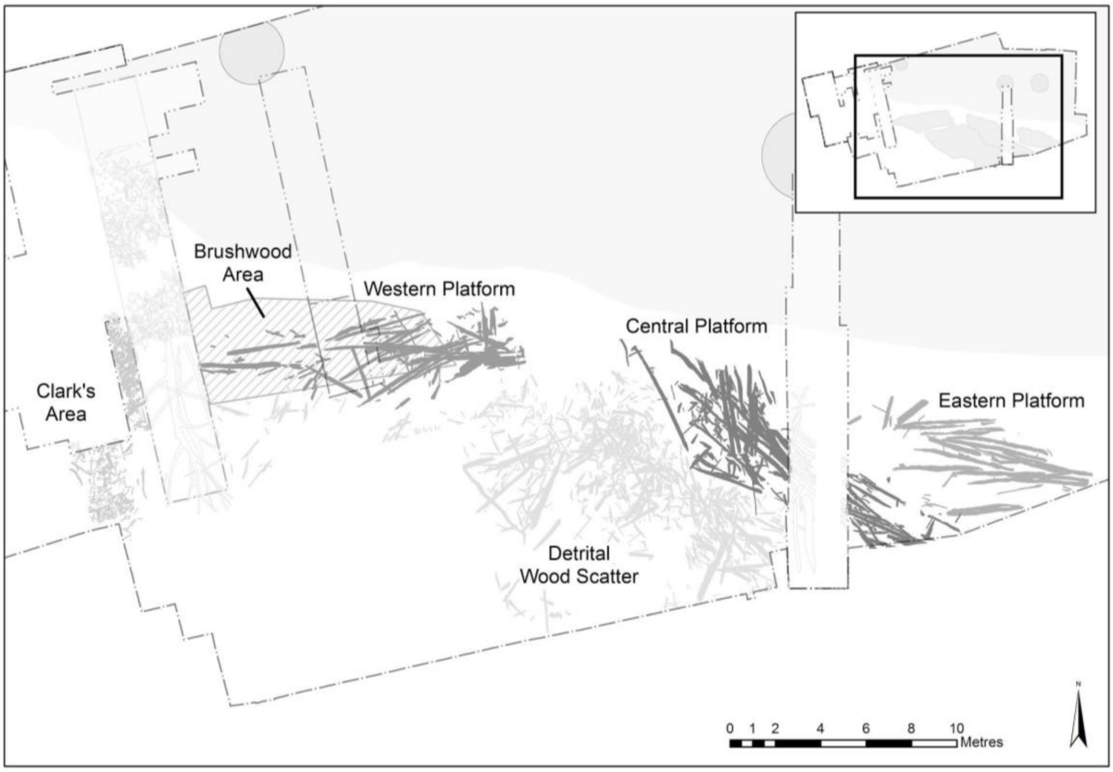

Figure 2.6 Location of the principal wooden remains (Bamforth et al. in press, b: Figure 6.3, © SCP).

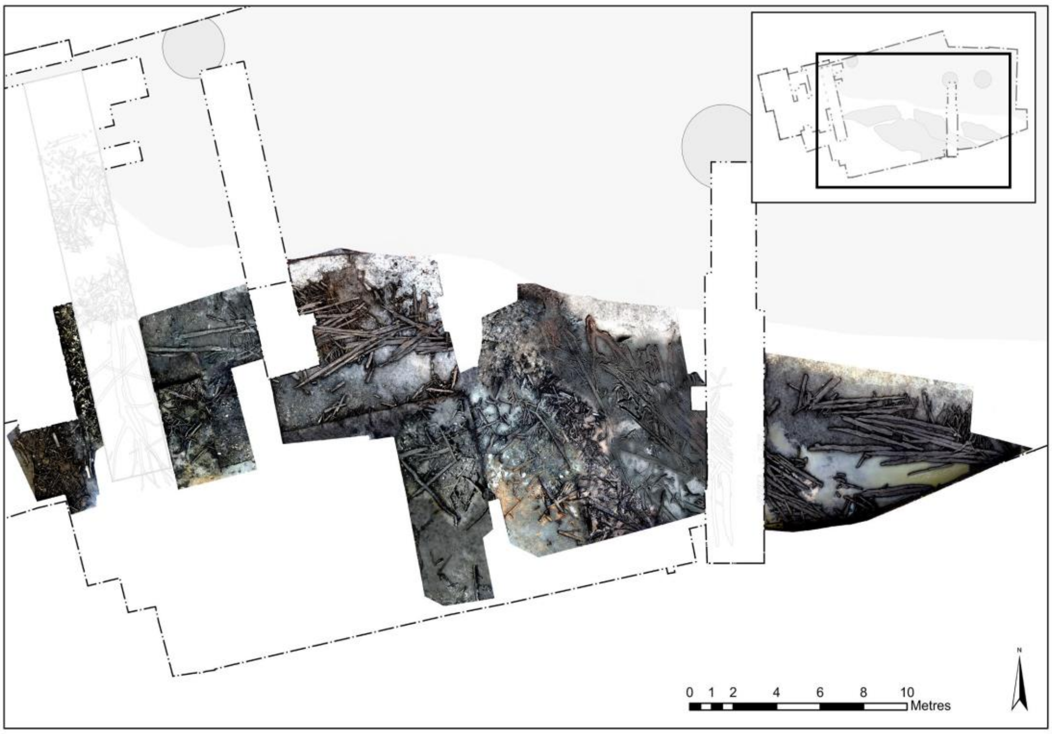

Figure 2.7 Composite orthophoto showing the principal wooden remains on site and what the site would have looked like had it been possible to excavate them all at once (exported from Agisoft Photoscan Pro). However, it should be noted that these wooden structures were not all in use at the same time (Bamforth et al. in press, b: Figure 6.2, © SCP).

Although every care was taken when assigning items to an analytical group, the DWS and the central platform are not clearly defined in plan. Although there is a clear delineation between the DWS and the middle and bottom layers of the central platform, there is a possibility that some of the material assigned to the upper layer of the central platform may have formed part of the DWS and vice versa.

2.3.3 **Wood categories and recording**

As well as being assigned to a spatial group, each wood item was categorised according to its macromorphology, with the assemblage subdivided into a series of categories (Table 2.2). Although every effort was made to ensure the categorisation was as objective as possible, it is still a subjective process.

The principal categories are:

Artefacts (ART): items that are objects (such as bowls), tools (such as hafts) or items that have been utilised as tools (ad-hoc tools). For the purposes of this study, stakes have also been included.

Timber (TIM): converted or unconverted material derived from trunk or branch wood, generally with a diameter above c. 100 mm. An item's length may also be considered. Material is generally classed as timber if it has a diameter over c. 150 mm (Goodburn 1992: 108), but this has been reduced for the purposes of this study as the trees are somewhat smaller in this postglacial period (aspen, birch and willow) than the trees generally used as timber in later periods in the UK (ash and oak), to which this system is commonly applied. A further sub-division has been applied to timber from the Star Carr assemblage:

> *Trees (TIM - TREE)*: a substantially-complete trunk of a tree that may or may not have been cleaned up: 'topped-and-lopped'.

Roundwood (RW): small diameter material in the round derived from understorey growth, small trees (saplings), top-and-lop from older trees or coppice/pollard-derived material. This category includes all the unconverted material smaller than timber (c. 100 mm in diameter).

Root (ROOT): the below-ground, woody element of a tree. As roots are often intrusive, they have been recorded but do not form part of the analytical assemblage.

Debris (DEB): culturally- or naturally-split material. It is sometimes possible to categorise debris further, and so there are several additional and distinct sub-categories that debris may be assigned to:

- *Roundwood debri*s *(RWDEB)*: roundwood that has been split by cultural or natural processes.
- *Woodchips (WC)*: the small pieces of wood that are detached by a single blow of a tool, such as an adze or an axe.
- *Timber debris (TIMDEB)*: larger pieces of more complex split/worked woodworking debris or off-cuts derived from the reduction of timber. As it is difficult to distinguish debris/timber debris and split timber debris, split debris and timber debris are considered together.

Original diameters are suggested for split material where a complete radius from pith to bark or bark-edge is present. Several abbreviations are used to describe the features of waterlogged wood and the types of woodworking seen: side branch (SB), trimmed (TR), split (SP), hewn (HE), beaver-damaged (BE), radial (RAD) and tangential (TAN).

	Brushwood	DWS	Central platform	Eastern platform	Western platform	CDA	Other	All	All
Wood category	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**%**
artefact	5	8	0	0	2	18	5	**38**	**0.8**
bark	83	12	3	0	0	1	4	**103**	**2.3**
debris	34	397	44	6	26	126	26	**659**	**14.6**
roundwood	1885	424	91	7	43	178	114	**2742**	**60.7**
roundwood debris	16	25	3	1	5	46	8	**104**	**2.3**
timber	8	225	94	27	55	14	15	**438**	**9.7**
timber debris	8	156	37	9	10	8	23	**251**	**5.6**
woodchips	31	82	4	0	0	59	5	**181**	**4.0**
total	2070	1329	276	50	141	450	200	**4516**	**100.0**

Table 2.2 Principal wood categories by analytical area (Bamforth et al. in press, b: Figure 6.1).

2.4 Chronology

Before presenting the results of the wood analysis, it is important to briefly introduce the most recent chronology for the wood parts of the site. Dated human activity at Star Carr spans approximately 800 years, with the principal wooden structures excavated at Star Carr broadly describing the span of dated human activity (Table 2.3 and Figure 2.8).

9340–9190 cal BC	Brushwood deposition start	95% probability
9315–9245 cal BC	DWS deposition start	95% probability
9115–8915 cal BC	DWS deposition end	95% probability
8985–8925 cal BC	Central platform	95% probability
8945–8760 cal BC	Eastern platform	95% probability
8915–8775 cal BC	CDA	91% probability
8805–8755 cal BC	Western platform	95% probability
8820–8510 cal BC	Brushwood deposition end	83% probability

Table 2.3 Dates of principal spatial analytical groupings (based on data from a Bayesian chronological model, incorporating all suitable radiocarbon dates acquired from the site, as described in Milner et al. in press, c).

The earliest of the principal analytical areas is the start of deposition in the brushwood area, completely bracketing the other wooden structures with a duration of 410-765 years (83% probability, Milner et al. in press, c). The DWS also has a relatively long duration of deposition, spanning 135-310 years (95% probability, Milner et al. in press, c). CDA saw a shorter deposition lasting 1-145 years (95% probability, Milner et al. in press, c), although the shape of the distribution is reported as suggesting a much shorter time frame, perhaps only a few years (Milner et al. in press, c).

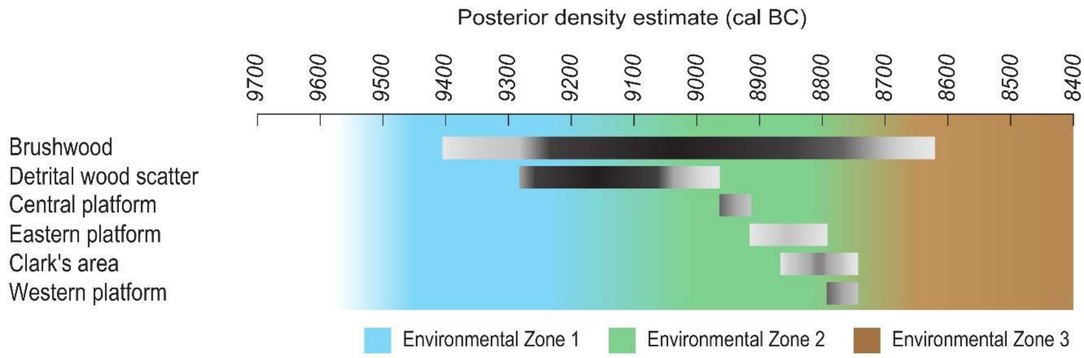

Figure 2.8 Schematic diagram showing chronology of principal analytical groupings of wood. The darker the shading the more probable that an element was present in a 25-year period (after Milner et al. in press, a: Figure 9.1, © SCP).

3 Excavation and analysis of the wooden structures

3.1 Clark's deposition area (CDA)

3.1.1 Introduction

This assemblage comprises a scatter of material that was recorded in 2015, during the excavation of the baulk between Clark’s Cuttings I and II and the deposits immediately to the south of Clark’s excavations (Figure 3.1 and Figure 3.2). It consists largely of roundwood and debris, though a wide range of other material is also present, including artefacts, woodchips and small quantities of timber.

The excavations in this area represent a small window into the deposits that were the focus of Clark’s original excavations. The wood here comprises a diffuse scatter of material at the bottom of the lake in an area of shallow water, with the densest concentration of material to the north, where Clark perceived the focus of activity to be (Clark 1954), becoming more diffuse to the south. The limits of the spread are unknown as it extended outside the area of investigation to the south and west. There is no suggestion that this material was deposited as a formal structure.

Clark (1949, 1950, 1954) describes encountering two distinct layers of material in this area. The written descriptions and published images of the lower layer closely resemble the material encountered during this campaign that has been assigned to Clark’s depositional area. However, the upper ‘brushwood’ layer, as described by Clark, does not. The descriptions of bifurcating ‘brushwood’ with oblique items diving through the deposits closely matches dense areas of root that have been encountered in places around the site. This is further supported by the description of ‘flattened birch bark flooring’. Although a single birch bark matt was encountered during the recent campaign (Fletcher et al. in press), heavily rooted areas often contained linear patches of flattened bark where the internal structure of roots or other large items had degraded away, leaving a collapsed bark ‘sock’. Although there is a high degree of confidence that Clark’s upper ‘brushwood’ layer does in fact represent a layer of roots, it is unclear if this lay within the lower wood peat or the upper reed peat.

Figure 3.1 CDA showing the wood excavated by Clark in Cutting II (digitised from his plan) and the wood found during the recent excavations (Bamforth et al. in press, b: Figure 6.6, © SCP).

Figure 3.2 Composite orthophoto of CDA (exported from Agisoft Photoscan Pro) (Bamforth et al. in press, b: Figure 6.7, © SCP).

3.1.2 **Analysis**

The densest part of the assemblage lay within the baulk and was excavated and recorded in its entirety. Significant quantities of wood forming part of the same diffuse scatter were also encountered in the area to the south of Clark's trenches. However, due to time constraints, only a sub-sample of this material could be recorded (though this included all the worked timber recovered and a sub-sample of other worked material).

A total of 450 wood records are assigned to CDA (Figure 3.3). The majority (396, 88%) were within reed peat with smaller quantities (54, 12%) within the underlying detrital mud, several being in contact with the basal gravel. Roundwood and debris make up the bulk of the assemblage, though there is a relatively high proportion of artefacts (the most recovered from any of the analytical areas) and woodchips. No material classed as trees was encountered in this area, though two birch trees were recorded during the original excavation of Cutting II. There is evidence of charring on 51 items (11%). This occurs on a broad range of wood categories and is spread throughout the deposit (Appendix C: Table 9.1). In addition, two items, both recovered from the reed peat have been gnawed by beavers: roundwood

<116085> at one end and roundwood debris <116509> on a single side branch (Appendix D). The preservation in this area is good. However, four items have ancient damage: two have ancient breaks at one end, a single timber seems to have been exposed and degraded prior to becoming waterlogged and one timber appears to have been broken in the ground in antiquity, the two halves becoming slightly dislocated from one another. It is interesting to note that the wooden artefacts recovered from this area also have an unusually high prevalence of ancient damage (Taylor et al. in press).

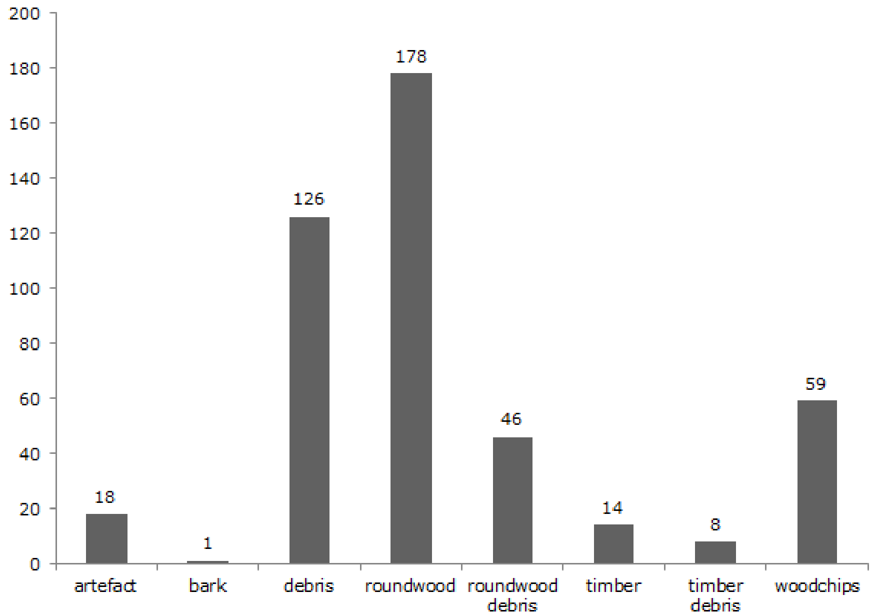

Figure 3.3 Wood categories from CDA (Bamforth et al. in press, b: Figure 6.8, © SCP).

The unsplit material consists of 180 pieces of roundwood (two of which are stakes, <116654> and <116678> and a single piece each of bark, debris and timber. Excluding the stakes, the 178 pieces of roundwood are located throughout the area. Forty-six (26%) have bark present and 78 (44%) show morphological features that may be indicative of coppicing. Twenty-one pieces (12%) are charred (Appendix C: Table 9.1). The roundwood varies in length from 45-1715 mm and in horizontal diameter from 10-89 mm. The roundwood in this area is noted as being particularly straight and long, with a high proportion of good quality poles present. Sixteen items display some evidence of woodworking: seven pieces are trimmed, generally at one end or at a side branch from one and occasionally two directions; two of these items are also torn in what has been described as a ‘chop and tear’ end; a further five items have been torn and one item has been snapped. Three items have been split at one end: two tangentially and one radially. Of these <116675> is noted as having very small, ‘choppy’ tool facets with a maximum width of 15 mm and length of 16 mm. A single piece of roundwood <116085> has been beaver gnawed at one end. The single unsplit timber <115981> seems to have been exposed and become degraded prior to waterlogging. It has also been heavily charred at one end and measures 320 x 130 x 60 mm. The single piece of bark <115753> is derived from a large timber and measures 180 x 55 x 9 mm and the one piece of debris <114884> has been heavily charred all over and measures 340 x 40 x 25 mm.

The 251 items of split material consist of 13 timbers and 238 pieces of debris (Table 3.1). The split material classed as timber is spread throughout CDA and forms a smaller part of the assemblage than in other analytical areas. The material varies in length from 505-1395 mm, in breadth from 45-230 mm and from 6-100 mm in thickness. A single reconstructable original diameter was calculated as 210 mm. None of the material has bark present and four items are charred.

Conversion	**Timber**	**Timber debris and unclassified debris**	**Woodchips**	**Roundwood debris**	**Total frequency**	**Total %**
Rad	2	31	13	1	47	18.7
Rad 1/2	2	1	0	37	40	15.9
Rad 1/3	0	1	0	1	2	0.8
Rad 1/4	0	4	0	2	6	2.4
Tan / Rad / Square	0	2	0	0	2	0.8
Tan	5	63	35	2	105	41.8
Tan outer	4	23	3	3	33	13.1
x-grain	0	1	0	0	1	0.4
Off RW	0	0	6	0	6	2.4
U/K	0	7	2	0	9	3.6
total	13	133	59	46	251	100.0

Table 3.1 Conversions from CDA (Bamforth et al. in press, b: Table 6.3).

31% of the timbers are radially cleft (two thin radial splits and two radial half splits) and 69% are tangentially cleft (including four items that are tangential outer splits) (Table 3.1). No tool faceting was seen and unusual traces are limited to two items where the split fades out at one end and two items where the split fades out at both ends. Timber <117168> had been broken and become dislocated in the ground in antiquity. Two of the timbers stand out as having a somewhat ‘structural’ appearance, perhaps originally forming parts of small buildings or structures. Timber <117153> is a radial half split that has broken at one end, probably in antiquity, and is charred through at the other end. Measuring 735 x 165 x 100 mm (original diameter 165 mm), this is a very large timber to have snapped. The charring is also unusual, representing a possible ‘protection mark’ where it may have been in contact with, or perhaps jointed to, another timber (Figure 3.4). Timber <116651> is a thin, radially split plank measuring 755 x 140 x 6 mm (original diameter c. 280 mm) with a particularly neat and regular appearance, suggesting it may have been ‘finished’ (Figure 3.5).

Figure 3.4 Charred timber <117153> showing possible protection mark (Bamforth et al. in press, b: Figure 6.9, © SCP).

Figure 3.5 Timber <116651>: potentially finished radial plank (length 755 mm) (Bamforth et al. in press, b: Figure 6.10, © SCP).

The 133 pieces of timber debris and the unclassified debris are considered together. This material was spread throughout the area of investigation. No bark was present and 13 items are charred. The material varies in length from 47-670 mm, in breadth from 14-150 mm and in thickness from 5-52 mm. Original diameters could be calculated in nine cases, and these varied from 54-160 mm. Some 28% of the material is radially aligned, including thin radial splits and radial half, quarter and third splits (Table 3.1). A total of 66% of the material is tangentially aligned, including 23 outer splits. Some 7% are of unknown conversion and a single item, <117185>, is cross-grained. Two items are knots which have been split off, one of which <116521> displays tool facets that describe being trimmed at one end from one direction. Several items show working traces distinct to this assemblage: seven items are parallel sided; one item has a lenticular cross section and one item displays an inner split face that follows the ring structure and has two chamfered edges.

Of the 59 woodchips that were identified, 22% are radially aligned, 65% are tangentially aligned (including one slab and two tangential outers), 10% are from roundwood and 3% are of unknown conversion (Table 3.1). Only the slab has bark present and a single item is charred. No tool facets were recorded from any of the woodchips. The material varies in length from 32-189 mm, in breadth from 9-81 mm and from 1-12 mm in thickness.

The 46 pieces of roundwood debris are, as might be expected, dominated by radially aligned items (89%). These are frequently half splits but also thin radial splits, radial third and quarter splits. Tangentially aligned items (11%) included three outer splits (Table 3.1). One piece retains its bark, one piece is possibly coppiced while some 20% of the material shows evidence of charring. The length varies from 20-596 mm, the breadth from 14-57 mm and the thickness from 5-33 mm. The 27 reconstructable original diameters vary from 14-60 mm. A single item has been gnawed by a beaver <116509> and a single item has been trimmed to a point at one end <116695>.

3.1.3 Discussion of Clark's deposition area (CDA)

The scatter of material recorded in CDA is most closely comparable to the DWS. Both represent accumulations of wood in the base of the lake with no obvious structure, spatial patterning or, indeed, function. In both cases, there are a high proportion of bone, antler and, to a lesser extent, flint artefacts present.

However, there are also some key differences between these analytical areas. The dating model for the site suggests that the DWS built up over quite a broad temporal frame (around two to three centuries, Milner et al. in press, c), whilst the material in CDA is suggested to have been deposited within a much tighter time frame (probably less than a century, Milner et al. in press, c) (Table 2.3 and Figure 2.8).

The nature of the wood assemblages within the two areas are also different. The material in CDA is somewhat smaller with fewer large items such as timbers and more smaller pieces of woodworking debris, including woodchips. Although there is a low prevalence of timbers, the only two items from the site that display evidence of perhaps forming part of a dryland structure were recovered from this area, as were the greatest quantity of artefacts by both frequency and percentage. The wooden artefacts showed an unusually incidence of ancient breakage (Taylor et al. in press). Although it is unclear why, there is also a higher prevalence of charring (51 items / 11%).

There is no indication that the material represents a deliberately built platform or trackway, such as pieces laid parallel to one another or to create a formal surface. The location in the base of a lake strongly suggests it is not an occupation surface. As with the DWS, it is unclear if this material represents a consolidation deposit or perhaps a midden-like dump of material.

On reflection, it seems most likely to represent the disposal of waste material, with the presence of so many wooden artefacts (many of which are broken) alongside many antler frontlets and de-hafted barbed points, suggestive of structured deposition (Elliot et al. in press and Taylor et al. in press).

3.2 Brushwood Area

3.2.1 **Introduction**

This is a large deposit of mostly unworked roundwood, lying close to (and parallel with) the lake-edge, and extending c. 10.7 m east of Clark's Cutting II (Figure 3.6 and Figure 3.7). Much of the roundwood was crooked and had smaller side stems/branches still attached, giving it the appearance of brushwood or brash. Interspersed among it were intrusive roots that radiate out from tree boles along the lakeshore, very low levels of worked wood (woodchips, timber, and debris) and five wooden artefacts (Taylor et al. in press). The timbers of the western platform extend into this deposit but are discussed separately. Other archaeological material was very sparse in this area, comprising very small assemblages of animal bone, antler and flint, which accumulated gradually – over a period of 410-765 years, commencing in the 93rd century BC (83% probability, Milner et al. in press, c) (Table 2.3 and Figure 2.8) – and probably represents a build-up of largely natural material at the edge of the lake.

The material was first encountered in 2007 during the excavation of SC24, and again in 2010, during the re-excavation and extension of SC24 and Clark's Cutting II. The western extent of the deposit was truncated by Cutting II (but clearly extended into that trench), and the central area had been partially excavated during Clark's 1951 campaign. Given its proximity to Clark's excavations the deposit was tentatively interpreted as a continuation of the 'brushwood platform' recorded and described by Clark (Conneller et al. 2012). For this reason, the area between SC24 and Cutting II was exposed and excavated in its entirety in 2013. The deposit was excavated and recorded in nine arbitrary spits, numbered sequentially from the top down. All worked and charred pieces were fully recorded along with a sub-sample of the unmodified roundwood, and a brief record was made of the remaining roundwood (each item being recorded only in terms of diameter, condition and presence/absence of bark).

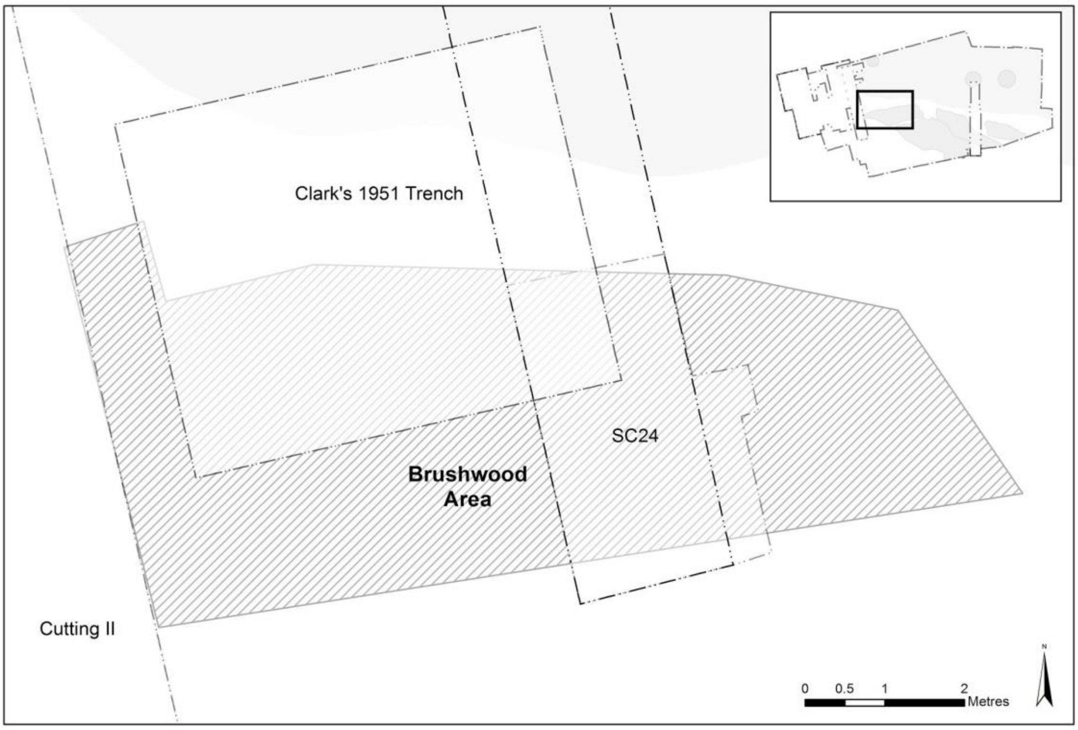

Figure 3.6 Plan showing the extent of the brushwood (shaded) (Bamforth et al. in press, b: Figure 6.11, © SCP).

Figure 3.7 The brushwood exposed in 2013. The photograph looks to the south-east of the site and the far edge of the brushwood is truncated by the previously excavated trench SC24. The

western timbers of the western platform are visible (Bamforth et al. in press, b: Figure 6.12, © SCP).

3.2.2 **Analysis**

A total of 2070 wood records are assigned to the brushwood. The overwhelming majority are classed as roundwood, most of it unworked and of small diameter, though low levels of worked material (112 items) are also present (Figure 3.8). Most material was found within the detrital mud, with just under a third from the reed peat and a small proportion from the basal organic sand (Table 3.2). A total of 41 taxonomic identifications were made on samples taken from this deposit. Of these, willow was the most common species (and the most frequent species of roundwood), though aspen was also well represented and in several cases identification could not distinguish between the two. Birch was represented by a single item (Figure 3.9).

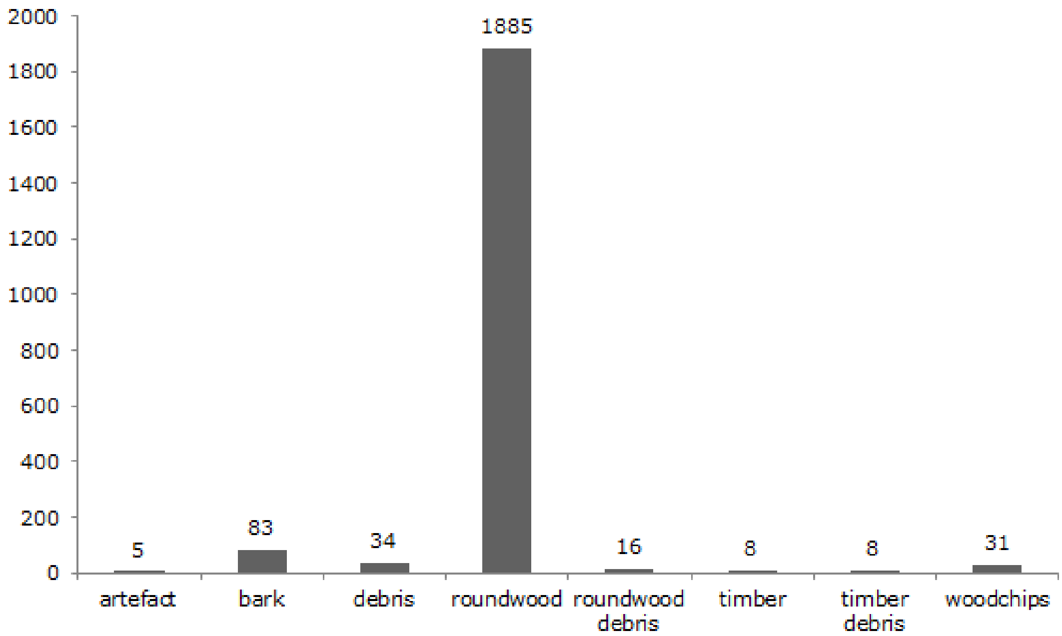

Figure 3.8 Wood categories from the brushwood (Bamforth et al. in press, b: Figure 6.13, © SCP).

Context	Description	Frequency	% of assemblage
312	reed peat	617	29.8
317	detrital mud	1414	68.3
320	organic sand	39	1.9
total		2070	100.0

Table 3.2 Material from the brushwood by context (Bamforth et al. in press, b: Table 6.4).

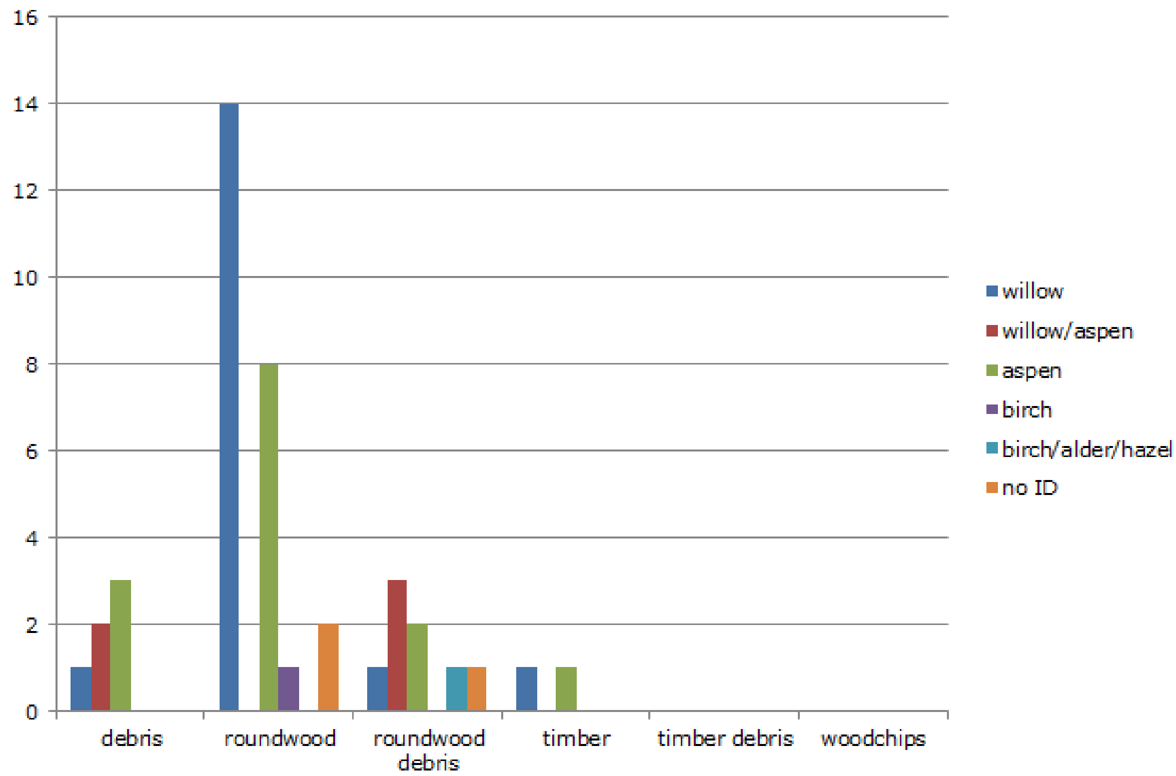

Figure 3.9 Frequency of taxonomic identifications from the brushwood by wood category (Bamforth et al. in press, b: Figure 6.14, © SCP).

A total of 22 items, representing 1% of the material recorded from the brushwood, show evidence of charring, with a tendency towards heavily charred material (Appendix C: Table 9.2). A broad range of wood categories are represented and the charred material is spread throughout the deposit (Appendix C: Table 9.2). Six pieces of roundwood display evidence of beaver modification (Appendix D: Table 10.1). This generally takes the form of gnawed ends and side branches, though one item shows evidence of bark removal and another has been gnawed along an edge (Appendix D: Table 10.1). It is of note that <99927> has been charred, probably after it was beaver gnawed and <103190> has been trimmed and torn at one end and beaver-gnawed at the other. Although one item is from relatively high in the sequence (spit 2) the remainder were recovered from near the base of the deposit (spit 8).

A single timber from this area has been classed as a tree trunk: <98005>. This item was truncated by the excavation of Cutting II, with the remaining portion measuring 2420 mm long with a horizontal diameter of 135 mm. No bark was present and there is no evidence of woodworking.

There is a total of 1971 unsplit items that are not classed as trees, consisting of 1885 pieces of roundwood, one timber, two pieces of debris and 83 pieces of bark (Figure 3.8). Of the 1885 pieces of roundwood, 166 were recorded with a full wood record and a further 1719 via rapid recording. The material was distributed throughout the deposit forming a dense layer of intermingled material. The vast majority of the roundwood had a ‘brushwood’/‘brash’ appearance, being of small diameter and often crooked stem with frequent side stems. However, there were some straighter lengths, and 14 items (<1%) showed morphological features suggestive of coppicing (see Chapter 4). Bark is present on 963 items (51%), which is somewhat higher than that noted from the debris scatter (38%) and the three platforms (central 24%, eastern 14% and western 0%) raising the possibility that the material in this area has shed its bark to a lesser extent than the roundwood recorded in other areas. The roundwood varies in length from 103-2175 mm and in horizontal diameter from 1-95 mm. Eight items have been trimmed at one or two ends, six of which have also been snapped or torn with an appearance often described on site as ‘chop and tear’. One of the trimmed items <103190> has also been beaver-gnawed. Five other pieces have been modified by beavers, one has been snapped and twelve have been charred.

The single timber has been truncated at one end by Cutting II. The remainder of the timber measures 1200 mm long with a horizontal diameter of 150 mm and no bark is present. The two pieces of debris are both heavily charred amorphous lumps.

Eighty-three pieces of bark were recorded. Whilst none shows any evidence of woodworking, the majority is derived from timber and some pieces are quite substantial (the largest measuring 270 x 25 x 5 mm). As timber represents such a small percentage of the assemblage recovered from this area the bark cannot all have become detached from timbers present in the brushwood. Although much of the material may be naturally-occurring it seems plausible that the bigger pieces may represent discards from an unknown bark-related process taking place in the vicinity.

There are 93 split items, consisting of six split timbers with the rest debris (Table 3.3). The six split timbers were present in the reed peat (four items) and detrital mud (two items), and vary in length from 500-1075 mm, in breadth from 86-260 mm and from 5-62 mm in thickness. The material is generally straight-grained and knot-free with a single side branch noted on one timber. Bark is present on the underside only of the same piece and is noted as being thick (6 mm). All six items are tangentially aligned, two of which are outer splits. Evidence for tooling is limited with light faceting indicative of hewing present on the faces of two items. Three items (50%) show traces of grooves on one face, potentially indicative of 'groove and split' (see Chapter 4). The upper face of <94047> is heavily charred to a depth of around 10 mm. Although the split material is spread throughout the brushwood, there is a concentration of material within spits 7 and 8, suggesting that some of this material probably relates to the western platform (see below). However, it is not possible to determine this association with confidence.

Conversion	**Timber**	**Timber debris and debris**	**Woodchips**	**Roundwood debris**	**Total frequency**	**Total %**
Rad	0	13	6	2	21	22.6
Rad 1/2	0	0	0	8	8	8.6
Rad 1/3	0	0	0	2	2	2.2
Rad 1/4	0	0	0	1	1	1.1
Tan / Rad / Square	0	0	0	0	0	0.0
Tan	4	21	19	1	45	48.4
Tan - surface split away	0	0	0	0	0	0.0
Tan outer	2	5	1	2	10	10.8
x-grain	0	1	0	0	1	1.1
Off RW	0	0	2	0	2	2.2
U/K	0	0	3	0	3	3.2
total	6	40	31	16	93	100.0

Table 3.3 Frequency of conversions from the brushwood (Bamforth et al. in press, b: Table 6.7).

The eight pieces of timber debris and 32 pieces of debris are considered here together (totalling 40 items) (Table 3.3). These were recovered from all three contexts. The material varies in length from 60-498 mm, in breadth from 14-125 mm and from 1-30 mm in thickness.

A single original diameter was reconstructable as 40 mm. Bark is present on two items (2.5%). Twenty-six items are tangentially aligned (32.5%), five of which are outer splits. Thirteen items are radially aligned (14.25%) and a single item is cross-grained (Table 3.3). No tool facets were noted but possible traces of 'groove and split' working were noted on 17 items, 16 of which are parallel-sided and one with parallel grooves on one face. Three items are heavily charred.

The 31 woodchips were also recovered from all three contexts. They vary in length from 32-193 mm, in breadth from 16-62 mm and from 3-23 mm in thickness. Again, the material is dominated by tangentially aligned material with 20 items (64.5%) aligned in this plane, one of which is a tangential outer. Six of the chips are radially aligned, two are off-roundwood and three are of unknown conversion (Table 3.3). One chip has possible faint tool facets at one end and two items are charred.

A total of 16 pieces of roundwood debris were recovered from the reed peat and detrital mud. Two pieces have bark present and the material varies in length from 76-509 mm, in breadth from 16-62 mm and from 7-40 mm in thickness. Reconstructable diameters (obtained from nine items) range from 18-62 mm. As might be expected from material formed of converted roundwood, radial conversions predominate with 13 items (81.25%) in this plane and three items tangentially aligned (Table 3.3). One piece has possibly been trimmed at one end and one item has been moderately charred.

3.2.3 **Discussion of the brushwood**

When initially encountered, the assemblage of wood in this area appeared to be very similar to Clark's descriptions of the brushwood platform recorded during the 1949-51 excavation. Although the subsequent excavation of the baulk between Cuttings I and II in 2015 recorded a very different wood assemblage (described above), the 2013 brushwood area clearly extended into the area investigated by Clark, and could represent at least part of the material that he interpreted as the brushwood platform or the upper, natural layer of wood.

However, it is very unlikely that this assemblage represents a deliberately-constructed platform or that it served as an occupation surface. Given the extremely long duration of the deposition of broadly homogenous material in this area (135-310 years, 95% probability. Milner et al. in press, c), the majority of which is unmodified brushwood, it seems likely that this represents, for the most part, a natural build-up of small diameter roundwood that has fallen from trees along the lake-edge and built up in this area. The much higher proportion of roundwood that still retained its bark is also very different to the roundwood associated with the more obviously anthropogenic structures, such as the three platforms and the DWS (though this in itself does not preclude the possibility that the material was deliberately deposited). Nevertheless, throughout this natural build-up, charred and culturally-modified material, including wooden artefacts, have also been deposited in this area, presumably indicative of woodworking tasks being undertaken along the lake-edge. Most evidence for beaver-modified wood lies at the base of this deposit, suggesting that beaver activity may have been decreasing as human activity increased and intensified.

3.3 Detrital wood scatter (DWS)

3.3.1 Introduction

The DWS represents the largest analytical wood group of worked wood at Star Carr in terms of both physical spread and number of items. Lying in the base of the palaeo-lake, to the south of the western timber platform and the west of the central timber platform with a broadly north-west/south-east alignment, measuring 25.8 m long and up to 8.5 m wide (Figure 3.10 and Figure 3.11). The scatter, consisting of roundwood, split and unsplit timbers, and (more occasionally) entire trees, continues outside the area of excavation to the south-east. The DWS lacks any appreciable form or formalised layers, or construction or accumulation phases. It appears as a disorganised jumble of wood with the greatest intensity of deposition seen along the north-east edge of the scatter. However, the scatter respects an accumulation of animal bone towards the southeast / open water edge, formed of the limbs and parts of the bodies of at least two red deer and two antler frontlets (Figure 3.10) (Knight et al. in press). The broadly linear shape of the scatter suggests that the wood was deposited to consolidate the soft lakebed deposits and to aid access from the shore into areas of deeper water. The presence of the bone and the frontlets shows this was, at least at times, to enable the deposition of animal remains.

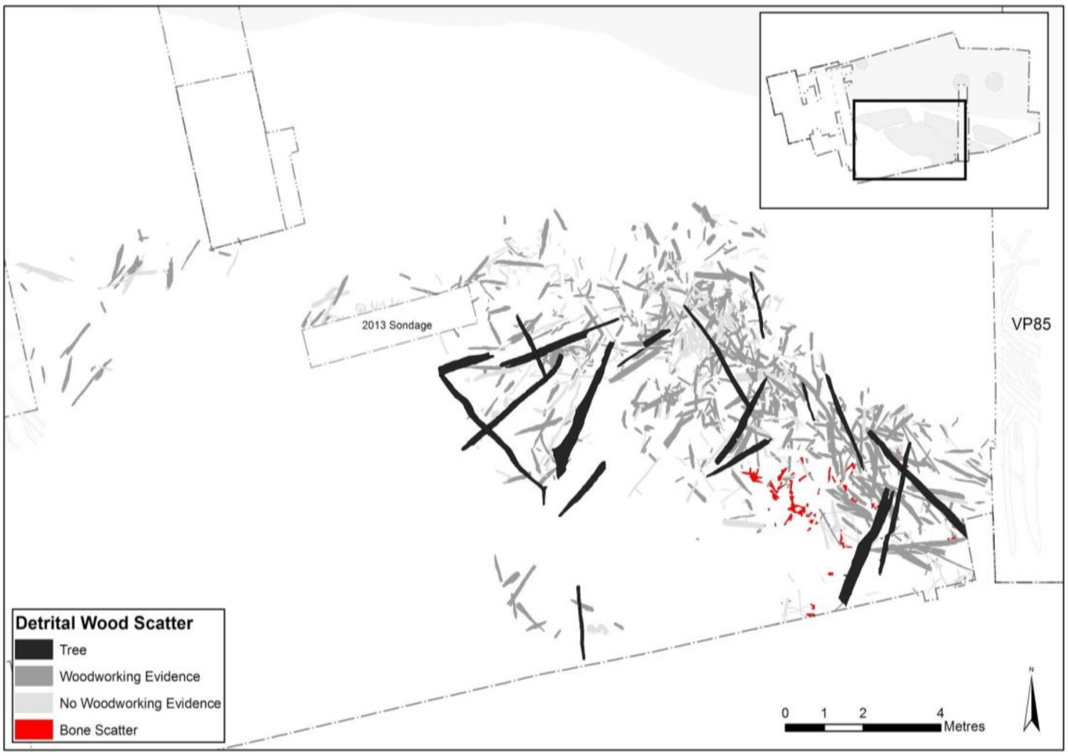

Figure 3.10 Plan of the DWS highlighting trees and differentiating between woodworking and no woodworking evidence. In addition, the bone scatter (Knight et al. in press) is located (Bamforth et al. in press, b: Figure 6.15, © SCP).

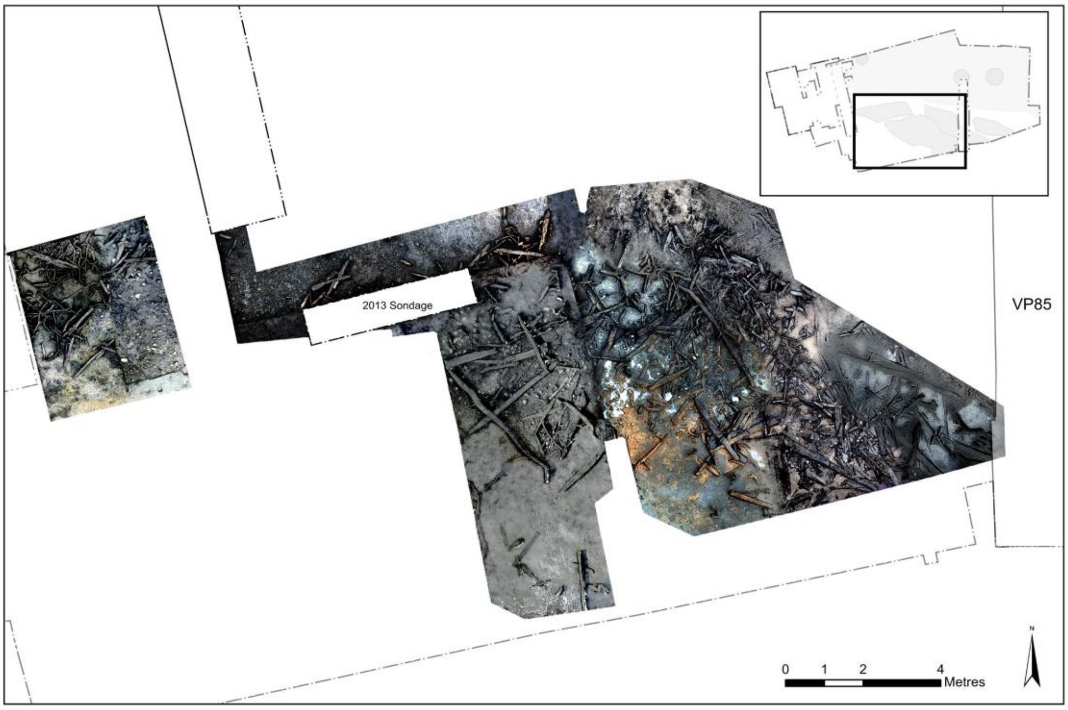

Figure 3.11 Composite orthophoto of the DWS (exported from Agisoft Photoscan Pro) (Bamforth et al. in press, b: Figure 6.16, © SCP).

3.3.2 **Analysis**

A total of 1329 wood records are assigned to the DWS, 127 of which are roundwood recorded in plan only, making this the single largest assemblage of fully recorded material from the site. The scatter is also amongst the stratigraphically-earliest assemblages on the site, with 36% recorded from the basal sandy gravels and organic sand and 46% from the overlying detrital mud and a much smaller proportion recovered from the reed peat (Table 3.4). There was a tendency for the basal timbers, particularly in the eastern half of the scatter, to be in direct contact with the 'hard' geology below the lake deposits, suggesting that deposition began at a very early stage in the sedimentary sequence.

Context		**Frequency**	**% of assemblage**
312	reed peat	109	8.2
317	detrital mud	609	45.8
319	sandy gravel	110	8.3
320	organic sand	374	28.1
unrecorded	plan only	*127*	9.6
total		1329	100.0

Table 3.4 Material from the DWS by context (Bamforth et al. in press, b: Table 6.9).

The most prevalent single category of material is roundwood, forming 32% of the total scatter, with only slightly smaller quantities of debris (Figure 3.12). Timber forms a relatively high proportion of the overall assemblage with 225 items (17%), 20 of which are classed as trees. Interestingly, there is a particularly low prevalence (only five items) of unsplit timbers that are not classed as trees. Woodchips and timber debris are also relatively common and if one considers the woodworking waste together (roundwood debris, timber debris, debris and woodchips) it forms half of the entire assemblage. Eight wooden artefacts were also recovered (Taylor et al. in press), including stake <107784>, found embedded vertically in the sediments at the south-west edge of the scatter. A total of 98 taxonomic identifications have been carried out from this area, though the only trend is for willow to dominate the roundwood assemblage (Figure 3.13).

As would be expected, condition generally improved with both depth and distance from the lake-edge, though a high degree of compression was noted throughout (Appendix A). There is also some interesting ancient damage present: 11 items appear to have weathered before they became waterlogged and five items have snapped in antiquity, three of which have become physically dislocated from their constituent parts but mechanically refit with a high degree of confidence.

A total of 29 items (2%) are charred (Appendix C: Table 9.3). This occurs on a range of materials at varying intensities, which are spread throughout the deposit. Of particular interest is the charred distal/top end of stake <107784>, which suggests that the stake was burnt when it was in the ground. A total of 11 pieces of roundwood show evidence of beaver modification in the form of gnawed ends and side branches (Appendix D: Table 10.2). These are spread throughout the deposit but with a tendency to be towards the base of the scatter.

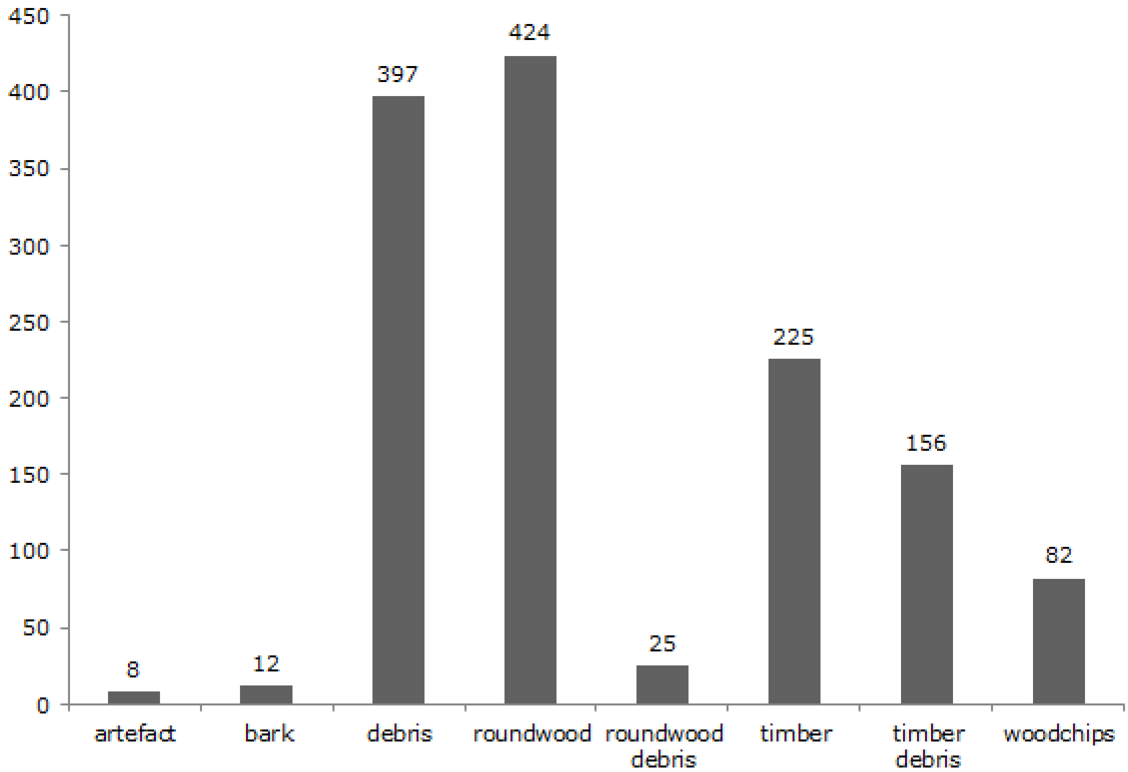

Figure 3.12 Wood categories for the DWS (Bamforth et al. in press, b: Figure 6.17, © SCP).

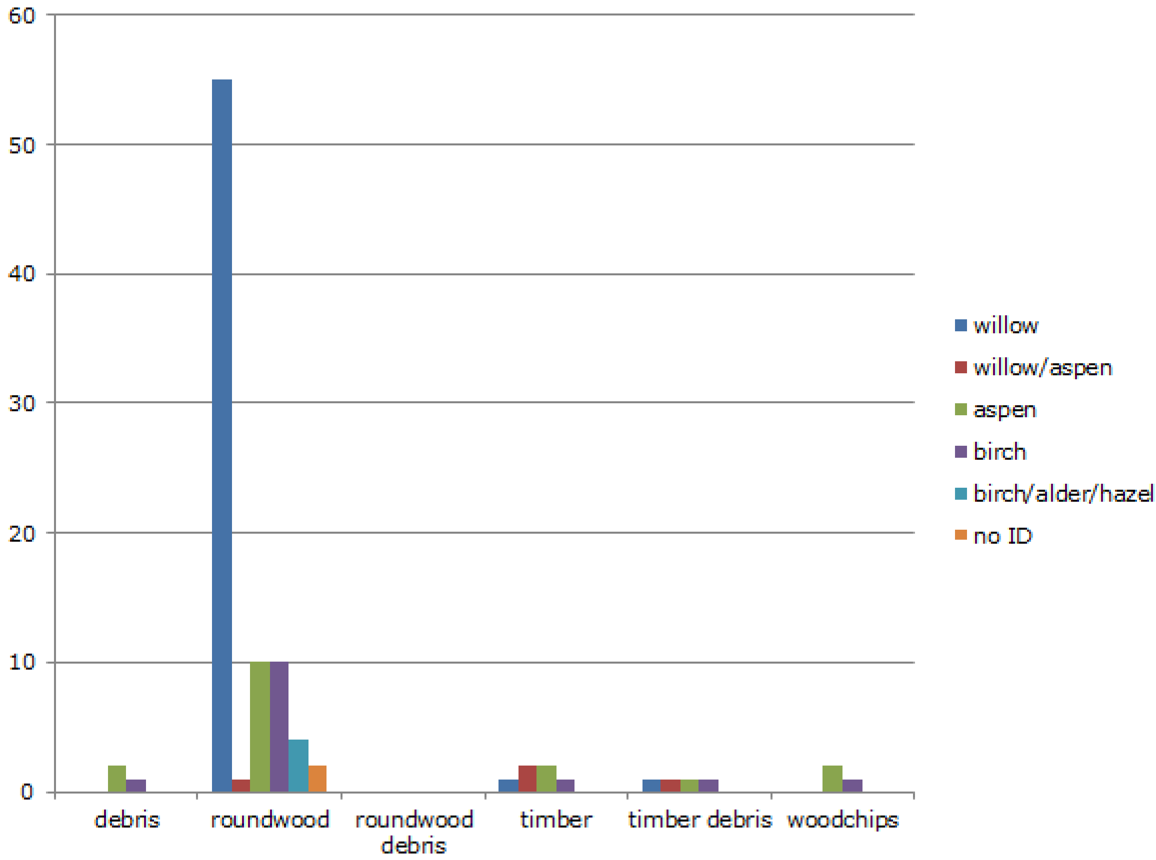

Figure 3.13 Frequency of taxonomic identifications from the DWS by wood category (Bamforth et al. in press, b: Figure 6.18, © SCP).

The 20 timbers classed as tree trunks (Appendix E: Table 11.1) vary in length from 1030-5530 mm and in horizontal diameter from 85-277 mm. The vertical diameters describe the high degree of compression seen in this area varying from 18.8-76.0% of the horizontal values. The trees are generally straight-grained with slow, even growth. They tend to have either no or occasional small diameter (20-40 mm) side branches. The exception to this is <99932> which is noted as having frequent small diameter (c. 20 mm) side branches present. Bark is generally absent and is only noted from two items. One tree <109903> still had the root bole attached at the south-west end, suggesting this tree had fallen naturally and two others, <110390> and <110192>, also have some of the root bole remaining.

Woodworking evidence is noted from three of the trees. Of these, <99949> has had the upper surface tangentially split away. This is a negative of the conversion which produces the regularly occurring tangential outer split timbers. Tree <109557> is tangentially cleft at one end and has possible tool facets describing trimming to length at the other end, and <110365> is radially half split at the proximal end where tearing and parallel chop marks cutting across the axis of the grain are visible on the split face.

There is a total of 443 unsplit items that are not classed as trees, consisting of 424 pieces of roundwood, five timbers and 12 pieces of bark (Figure 3.12). Due to the high volume of roundwood encountered in the DWS (425 items), a sub-sample of the material was recorded in detail (298 items) whilst the remainder (127 unworked items) were recorded in plan only.

The roundwood is distributed throughout the DWS. This material varies in length from 40-2060 mm and in horizontal diameter from 6-95 mm. A total of 114 pieces have bark present and 74 (17%) have morphological traits that may be indicative of coppicing. A total of 45 pieces have tool facets describing trimming. The majority have been trimmed at one end and from one direction, though seven have been trimmed and torn, one has been trimmed at one end from two directions and one has been trimmed at both ends from one direction. A further two items have had side branches trimmed away, one of which has subsequently healed over. Roundwood stake <107784> has been trimmed at the proximal end from all directions to a point, whilst the distal/upper end is charred and possibly trimmed. There are a further 12 items that have been torn at an end and 11 items that have been beaver-gnawed or probably beaver-gnawed at one end, one of which has also had three side branches beaver-gnawed. The beaver-gnawed material is distributed throughout the DWS. Eleven charred items are distributed throughout the deposit.

The five unsplit items classed as timber are located throughout the DWS. No woodworking or unusual taphonomy was noted and none of the timbers had any bark remaining. The timbers vary in length from 930-1690 mm and in horizontal diameter from 92-224 mm.

None of the 12 pieces of bark shows any evidence of woodworking and it seems likely that this material has become detached from other items present in the scatter. The bark pieces were all very small, the largest piece measuring 162 x 48 x 8 mm.

There are 860 split items, consisting of 200 split timbers, 156 pieces of timber debris, 397 pieces of debris, 82 woodchips and 25 pieces of roundwood debris (Figure 3.12 and Table 3.5). The split material classed as timber is present throughout the DWS and varies in length from 500-3175 mm, in breadth from 28-205 mm and from 8-65 mm in thickness. It is only possible to estimate original diameters in four instances: 66, 70, 72 and 120 mm. The material is generally straight grained with side branches or knots noted from only six items (3%). Bark is only present on four items (2%).

Conversion	Timber	Timber debris and debris	Woodchips	Roundwood debris	Total frequency	Total %
Rad	12	56	14	1	83	9.7
Rad 1/2	8	0	0	4	12	1.4
Rad 1/3	5	3	0	2	10	1.2
Rad 1/4	2	1	0	1	4	0.5
Tan / Rad / Square	0	5	0	0	5	0.6
Tan	123	346	51	10	530	61.6
Tan - surface split away	0	1	0	0	1	0.1
Tan outer	46	58	2	7	113	13.1
x-grain	0	5	2	0	7	0.8
Off RW	0	0	1	0	1	0.1
U/K	4	78	12	0	94	10.9
total	200	553	82	25	860	100.0

Table 3.5 Frequency of conversions from the DWS (Bamforth et al. in press, b: Table 6.13).

13% of the split timbers are radially aligned with thin radial splits, radial half, third and quarter splits all represented (Table 3.5). Tangentially cleft material accounts for 85% of the split timbers with tangential outer splits well represented and four items (2%) are of unknown conversion. Evidence for tooling is limited with six items (3%) showing faint traces of possible tool faceting describing trimmed ends, one of which <103807> appears cross cut. There is also a high prevalence within this material of the distinctive working traces seen in this assemblage. Nineteen items have a distinctive lenticular cross section, 25 items have splits that fade out, 11 of which have this feature at both ends. In terms of possible evidence for 'groove and split' 54 items are parallel-sided, 20 items display traces of longitudinal parallel grooves on split faces and seven timbers have scars that describe the cleaving away of smaller split pieces. Five split timbers show light or moderate charring, generally to part of one face.

The timber debris (156 items) and debris (397 items) are considered together (totalling 553 items), forming the largest component of the DWS assemblage (Figure 3.12). The material varies in length from 53-500 mm, in breadth from 10-130 mm and from 1-67 mm in thickness, and bark is present on 17 items (3%). The material is dominated by tangentially aligned material (410 items, 73%), 58 (10%) of which are tangential outer splits, and two of which are slabs (Table 3.5). Interestingly, there are five square cross sectioned pieces with tangentially and radially aligned edges, possibly representing the 'streamers' which form between surfaces during cleaving. The radially aligned material (60 items, 11%) includes thin radial splits, radial half, third and quarter splits (Table 3.5). There are five cross grained items (1%) and 94 items (14%) that are of unknown conversion.

A total of 49 items (7%) have been trimmed. Of these 36 have been trimmed at one end and from one direction, several of which are also torn, one item had been trimmed at one end but from two directions and two items have had side branches trimmed away. Six items (1%) show faint traces of possible hewing on split surfaces. There is also a high prevalence of the distinctive working traces noted from this assemblage: 16 have a lenticular cross section and 33 items have splits that fade out, 24 of which have this feature at both ends. In terms of possible evidence for 'groove and split' working, 201 are parallel-sided, 59 items display traces of longitudinal parallel grooves on split faces, and four pieces have scars that describe the cleaving away of smaller split pieces. Twelve items show evidence of charring, typically light or moderate and generally to part of one face.

The 82 items classed as woodchips are present throughout the DWS. They vary in length from 43-220 mm, in breadth from 16-115 mm and from 3-22 mm in thickness. As with other categories of split material, the woodchips are dominated by tangentially aligned material (53 items, 65%), two of which are slabs: a tangential outer split consisting of bark and sapwood only, possibly indicative of bark removal (Table 3.5). There are also 14 radially aligned chips, two cross-grain, one off-roundwood and 12 of unknown conversion. Unusually for a woodchip assemblage, but as is the norm at Star Carr, evidence for tool facets is limited. One item appears trimmed at both ends <103678> and two items at one end: <109198> and <109367>. Two of the chips are gnarled and appear to have been detached from around a knot: <103776C and D>.

Finally, a total of 25 items are classed as roundwood debris and are present throughout the DWS, varying in length from 78-440 mm, in breadth from 23-60 mm and from 9-32 mm in thickness. Where original diameters are reconstructable, they vary from 26-60 mm. Bark is present on two items. Eight items (32%) are radially aligned with thin radial splits, radial half, third and quarter splits all present. 17 (68%) are tangentially split with tangential outer splits well represented (Table 3.5). One item has possibly been trimmed at one end and one <99808> is moderately charred on the underside at the proximal end.

3.3.3 **Discussion of the detrital wood scatter (DWS)**

There is little apparent coherency or organisation to the DWS and, given the low energy environment of the lake bottom, it seems likely that this reflects the original form of the deposition.

There are clear differences between the overall form of the DWS when considered against the three lake-edge platforms and these differences are reflected in the makeup of the assemblage. Timber stands out as forming a much smaller part of the DWS than the lake-edge platforms. Timber is the most frequent class of material for all three platforms but is third most frequent in the DWS, constituting only half to a third the percentage of timber forming the platforms. The prevalence of trees is also much lower, both in terms of the timber assemblage and the entire assemblage, the latter being 1.5% for the DWS, 11% for the central platform, 21% for the western platform and 34% for the western platform. There is also a much lower percentage of timbers in the round from the DWS than for any of the platforms.

Woodworking is a reductive technology and there is a higher prevalence of off-cut/by-product material within the DWS than the platforms. Summing the timber debris, debris, woodchips and roundwood debris we can see that 50% of the DWS is formed of this material, compared to around 30% for the timber platforms. In contrast to the lake-edge platforms, there is no evidence that the material making up this assemblage has been manufactured or selected specifically for deposition in this area (such as uniformity in size, shape, or form). As such, it resembles an accumulation of waste material produced through a range of woodworking activities, most (if not all) of which were probably carried out on the dryland parts of the site.

Whilst it is possible that smaller items, such as woodchips and small diameter roundwood may have been transported into the lake through natural processes, or thrown from the dryland, this is unlikely to have been the case for the larger material, such as the 5 m long trees or the 3 m long split timbers which seem highly likely to have been deliberately placed.

Rather than representing ad-hoc disposal or natural accumulation, and given the long temporal duration of deposition of wood into the DWS (135-310 years, 95% probability, Milner et al. in press, c), it seems likely that the scatter formed through episodic deposition of material to consolidate the lake bed sediments and allow access into an area of deeper water away from the shore. This is supported by the broadly linear arrangement exhibited by the main concentration of material perhaps functioning as some form of trackway. Furthermore, there are several cases of items that have broken and become dislocated in antiquity, hinting perhaps at some trample occurring within the deposit.

Finally, the DWS respects a dense concentration of animal remains, including whole limbs which were deposited whilst still articulated (and probably still fleshed) into the wetland along with two red deer antler frontlets and several animal skulls deposited towards the south-east end of the scatter (Knight et al. in press). As this material appears to have been deliberately deposited between 9.5 m and 14.5 m from the shore, it is possible that the DWS was laid down to facilitate access to areas of deeper water. The interplay of the deposition of wood and the placement of animal remains in the lake hints at a similar process of structured deposition within the wetland as is described by the material recorded in CDA.

3.4 The lake-edge platforms

Three lake-edge platforms (western, central and eastern) were excavated during the current campaign. The central platform, first encountered in the 1985 excavations (Trench VP85a) was an early target of the investigations. However, the size, complexity and presence of two further lake-edge platforms came as a surprise. The setting, form and construction of the three platforms is markedly similar, with each starting at the base of the contour describing the lake-edge drop-off, and running through the wetland, either parallel to the shore or (in the case of the central platform) at an angle from it. Each is broadly linear in plan and is defined by a series of large trees and split timbers defining the primary axis of the feature (Figure 2.6). All three platforms sit relatively high within the wetland sequence and are, as a result, the least well-preserved wooden remains encountered (Appendix A: Figure 7.5). Each platform will be considered individually, with a summary discussion at the end of the section.

3.4.1 **Western platform**

3.4.1.1 Introduction

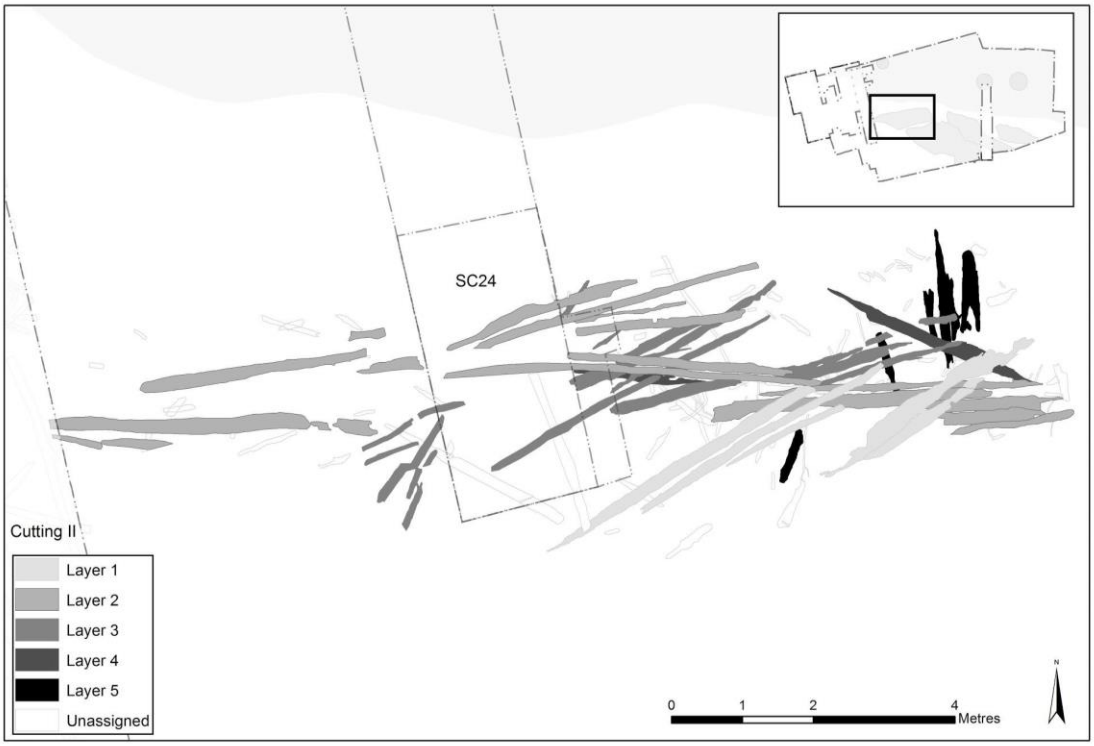

Figure 3.14 Plan of the western platform showing the five layers (Bamforth et al. in press, b: Figure 6.19, © SCP).

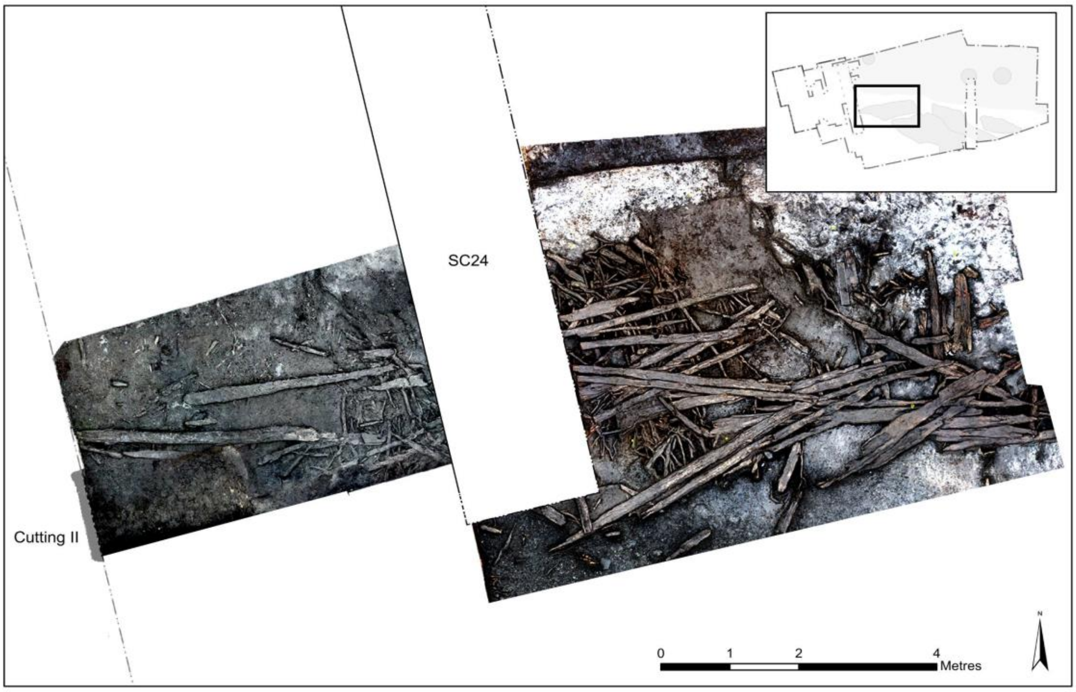

Figure 3.15 Composite orthophoto of the western platform (exported from Agisoft Photoscan Pro) (Bamforth et al. in press, b: Figure 6.20, © SCP).

The western platform is a broadly linear arrangement of split timbers and entire trees that runs through the lake-edge wetland, almost parallel to the shore on the western side of the site. It is a substantial structure, 4.7 m wide (north-south) and over 14.7 m long (east-west), though its full extent would have taken it several metres further to the west, into Cutting II (Figure 3.14 and Figure 3.15). The platform is formed of a series of five semi-discrete layers of timber, including split timbers and trees, with a dense horizon of generally north-south aligned roots above and deposits of largely unworked roundwood (mostly brushwood) below. The roots above the platform are markedly similar in appearance to the upper brushwood reported by Clark and could represent a similar deposit (Figure 2.3). Although built in several layers, the structure shows no evidence for separate phases of construction or use, there being no build-up of wetland deposits between the layers of wood; it appears to have been built in a single episode.

The platform was first encountered in 2007, when a series of split timbers, roughly parallel with the lake shore were recorded during the excavation of trench SC24 (Conneller et al. 2012). The continuation of these timbers was recorded in 2010 when SC24 was extended 0.5 m to the east to assess deterioration levels (Milner 2010), and a series of split timbers – assumed to be the westerly extension of the same structure – were recorded in the section of Cutting II (Conneller et al. 2012). The remainder of the platform was excavated and recorded in its entirety during the 2013 and 2014 excavations. Due to the difficulties of recording degraded wood within the limited exposure of SC24 it has not been possible to link the 2007/2010 wood records with the material excavated in 2013/2014.

3.4.1.2 Analysis

A total of 141 wood records are assigned to the western timber platform. Of these, 110 form the platform itself (including two stakes classed as artefacts: <98878> and <110020>). Most were timbers, including 23 items classed as trees, though there are also quantities of roundwood and debris (Figure 3.16). There are a further 29 sub-samples from the underlying brushwood and two beaver-gnawed pieces of roundwood from beneath the platform: <113449> and <113772>. The timbers of the structure lay predominantly within reed peat, though several items were recovered from the detrital mud and the basal mineral sediment. The two pieces of beaver-gnawed roundwood were recovered from a grey-orange mottled till beneath the platform.

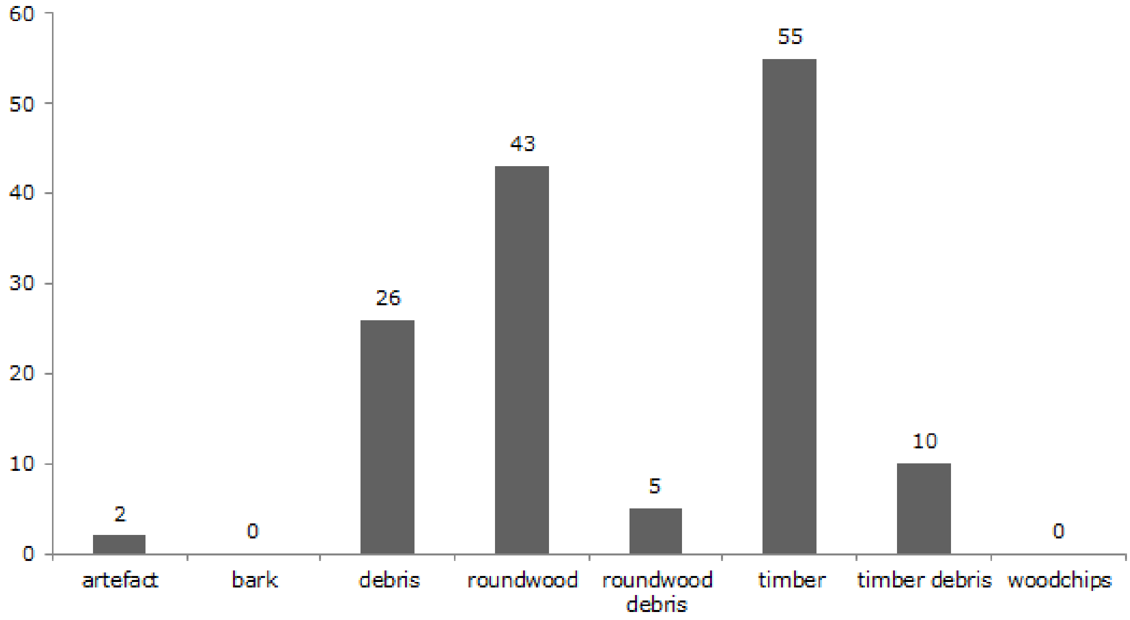

Figure 3.16 Wood categories from the western platform (Bamforth et al. in press, b: Figure 6.21, © SCP).

Taxonomic identification of material from the 2010 excavations was carried out by AH. This showed that the larger timbers and trees were exclusively identified as aspen (n= 10), whilst most of the roundwood were identified as willow (n=20) with occasional identifications of aspen (n=2). A further 13 items from 2013-15 have been examined by AR. These show the same pattern, with all 10 samples from the large timbers identified as aspen (Figure 3.17).

Figure 3.17 Frequency of taxonomic identifications from the western platform by wood category (2013-2015) (Bamforth et al. in press, b: Figure 6.22, © SCP).

Five items with evidence for charring were recorded from within the platform (three classed as timber and two as timber debris) representing 7% of the material (Appendix C: Table 9.4). Charring varies from slight to heavy with three items charred at one end, one item charred on one face and one item completely charred into an amorphous lump. Four pieces of roundwood display evidence of beaver modification having been beaver-gnawed at one or both ends (Appendix D: Table 10.3). Two were recovered from the basal till beneath the platform, one from the brushwood beneath the platform timbers <109909> (which also has a possibly trimmed end) and one from amongst the timbers of the platform.

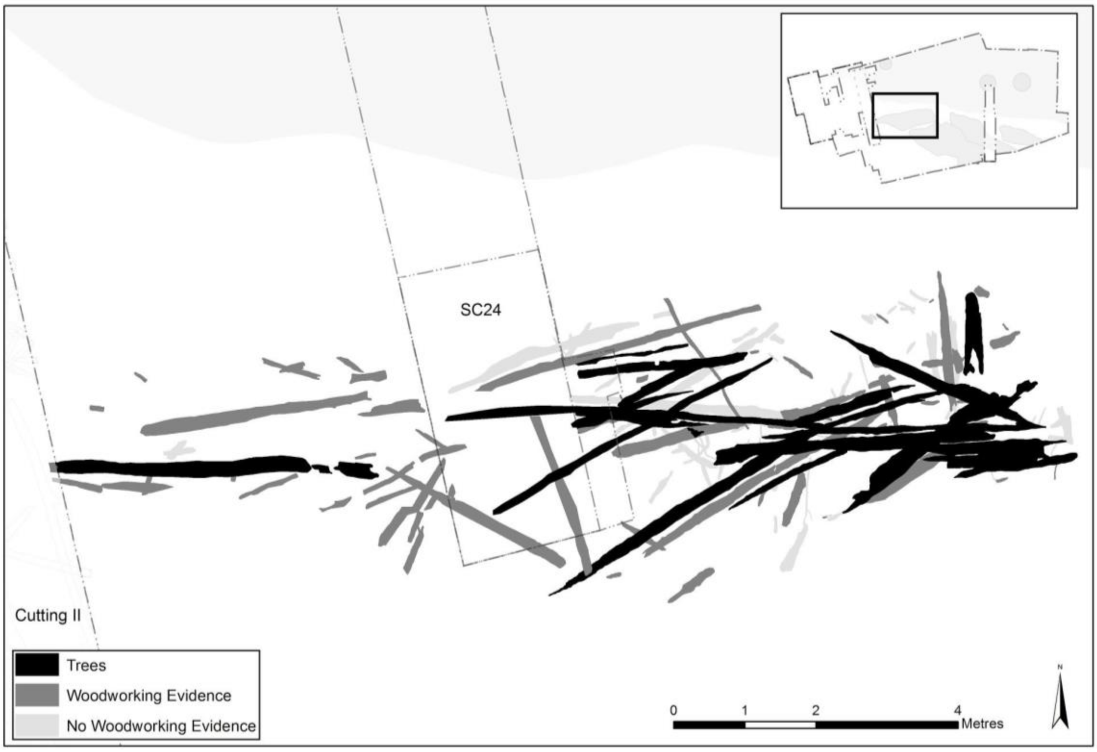

Figure 3.18 Plan of the trees, woodworking evidence and no woodworking evidence from the western platform (Bamforth et al. in press, b: Figure 6.23, © SCP).

Twenty-three of the timbers are classified as tree trunks (Figure 3.18 and Appendix E: Table 11.2). These vary in length from 1100-4485 mm and in horizontal diameter from 50-270 mm. The high degree of compression is evidenced by the vertical diameters, which vary between 11-62% of the horizontal values. The proximal/distal orientation of the trunks is only apparent in five cases, with no pattern noted. Timber <109924> has a possible root bole present at the southern end which may represent the reuse of a fallen tree. The timbers are generally straight grained, with occasional small (diameter c. 20 mm) side branches or knots present, and no large side branches were noted. Bark was generally absent. The material is in poor to moderate condition with little surface data visible and many of the ends are degraded and 'feathering' away. Possible evidence for trimming was noted from a single item <110101>

which may have been trimmed from one direction at the distal end. In addition, timber <110134> is truncated along its upper surface, though it is unclear if this is due to degradation, splitting or possibly even wear, and timber <109556> has a visible tear running from halfway along its length to the distal end.

The main body of the platform, excluding the material classed as trees, contains 25 unconverted items: 19 pieces classed as roundwood and six classed as timber (Figure 3.16). These items vary in length from 90-3165 mm and the long axis of the diameter from 12-195 mm. No facets on trimmed ends or side branches were recorded. Roundwood <99246> shows signs of beaver gnawing at both ends. Timber <110103> is also of interest having been smashed in the middle, probably in antiquity. It is also charred at one end.

In addition, a discrete layer of roundwood lay under the central and eastern timbers of the platform, most of which resembled brushwood (crooked stems with small side branches still attached). A sub-sample of 29 items were recovered and recorded from this deposit. These consist of two items classed as timber debris (both tangential outer splits), four pieces of debris (two tangentially aligned, one radially aligned and one of unknown conversion) and 23 pieces of roundwood, one of which is half split. The majority of the roundwood has bark present and varies in length from 72-940 mm and the long axis diameters vary from 7-56 mm. The only evidence for secondary working was recorded from <109909> which has been trimmed and beaver-gnawed at one end. A comparable deposit of brushwood with smaller quantities of worked material lay beneath the western end of the platform, where it extended into the brushwood between SC24 and Cutting II (see above).

The main body of the platform contains 60 split items: 26 classed as timber, eight as timber debris, 22 as debris and four as roundwood debris. Tangentially converted material dominates the assemblage with 35 items (59%) aligned in this plane. There are 14 radially split items (23%) and 11 items of unknown conversion (18%) (Table 3.6). The split material classed as timber varies in length from 505-3075 mm, in breadth from 66-230 mm, in thickness from 9-91 mm and is dominated by tangentially aligned material (17 items) with six radially split items and two of uncertain conversion. The timber debris and debris varies in length from 83-498 mm, in breadth from 29-145 mm, in thickness from 3-65 mm and is dominated by tangentially aligned items (n=18) with seven radially aligned items and nine of uncertain conversion.

Conversion	Timber	Other	Total frequency	Total %
Rad	1	3	*4*	6.7
Rad 1/2	3	2	*5*	8.3
Rad 1/3	3	0	*3*	5.0
Rad 1/4	0	2	*2*	3.3
Tan	14	17	*31*	51.7
Tan - surface split away	1	0	*1*	1.7
Tan outer	2	1	*3*	5.0
U/K	2	9	*11*	18.3
total	26	34	60	100.0

Table 3.6 Conversions from the main body of the western platform (Bamforth et al. in press, b: Table 6.17).

3.4.2 **Central platform**

3.4.2.1 Introduction

The central platform is the largest and most substantial of the lake-edge platforms, consisting of three layers of material (mostly large split timbers and trees) that form an overall structure that is 6 m wide and over 17 m long. It runs on a north-west to south-east alignment through the wetland part of the site, with its northern end close to the lake shore and its southern end extending beyond the edge of the excavated area (Figure 3.19 and Figure 3.20). The platform consists of three layers of timber but was constructed in a single event, probably to facilitate access into the wetlands and possibly to areas of open water further from the shore. With the exception of a discrete cluster of worked flint, there is very little other archaeological material associated with it, though small quantities of animal bone, flint, and worked antler were recorded in the immediate surroundings.

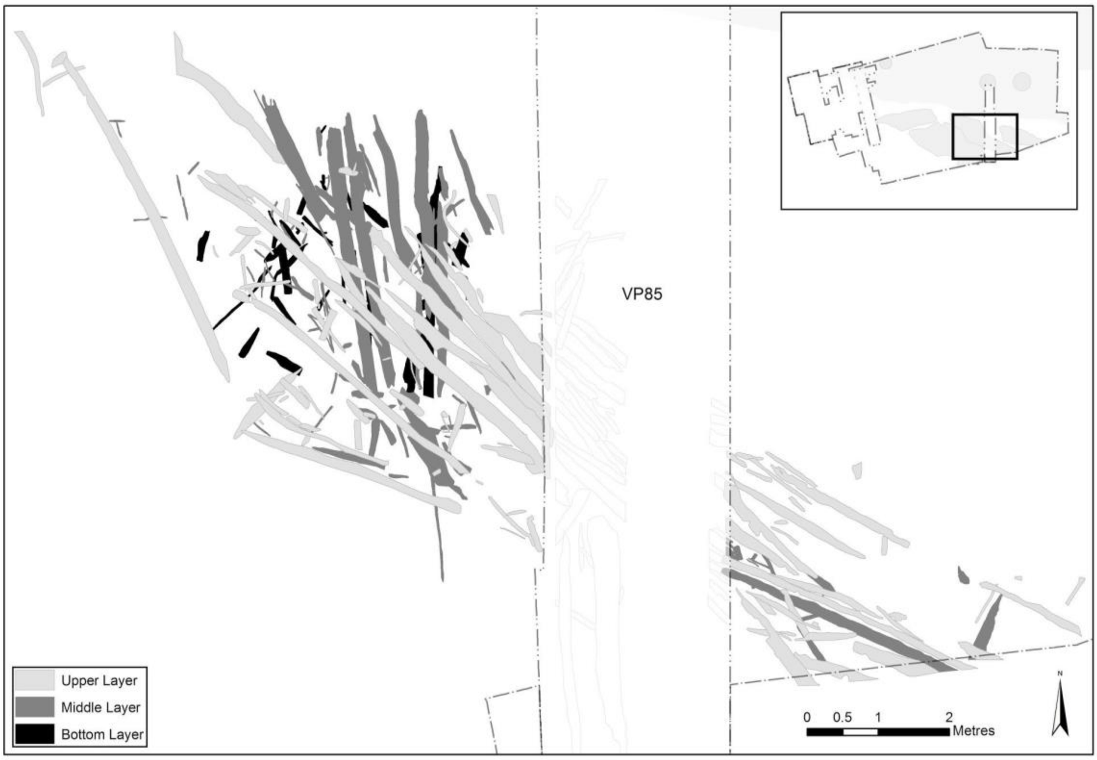

Figure 3.19 Plan of the central platform by layer (Bamforth et al. in press, b: Figure 6.24, © SCP).

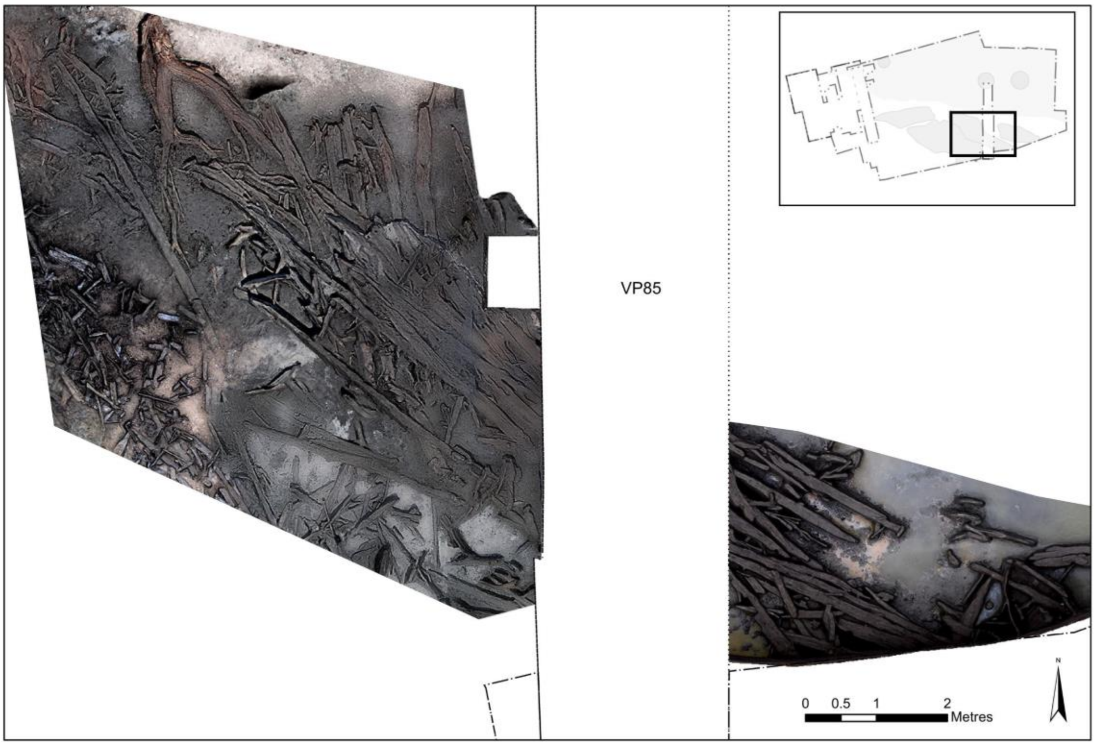

Figure 3.20 Composite orthophoto of the central platform (exported from Agisoft Photoscan Pro) (Bamforth et al. in press, b: Figure 6.25, © SCP).

This platform was first encountered during the 1985 excavation of trench VP85A and again during the extension of the same trench in 1989 (Cloutman and Smith 1988:39; Mellars et al. 1998: 47). A group of parallel timbers were recorded running diagonally across the trench, with two further timbers to the south. Analysis of this material identified both radially and tangentially cleft timbers as well a piece of roundwood with a 'chop and tear' end, and a pointed stake displaying significant surface charring (Mellars et al. 1998). The timbers produced some clear surface data and evidence of tooling and secondary working including clear, parallel, longitudinal grooves, which form part of the suite of evidence that has given rise to the style of woodworking described as 'groove and split' (see Chapter 4).

Trench VP85A was re-excavated and extended to the west in 2010, exposing a continuation of the same, parallel timbers. The western extent of the platform was then fully excavated during the 2013 season and a short section to the east was excavated in 2015.

3.4.2.2 Analysis

A total of 276 wood records are assigned to this structure (Figure 3.21): 130 to the upper layer, 66 to the middle layer and 80 to the bottom layer. Most are timber (including 26 trees) and roundwood, though significant quantities of debris and timber debris are also present alongside very small quantities of roundwood debris, woodchips and bark. Of the 91 items classed as roundwood, 49 were recorded in plan only and not subjected to detailed recording. A total of 15 items from this area were submitted for taxonomic identification with willow, aspen and birch all represented (Figure 3.22). Willow was the most common species identified for roundwood, whilst the timbers were identified as willow and aspen.

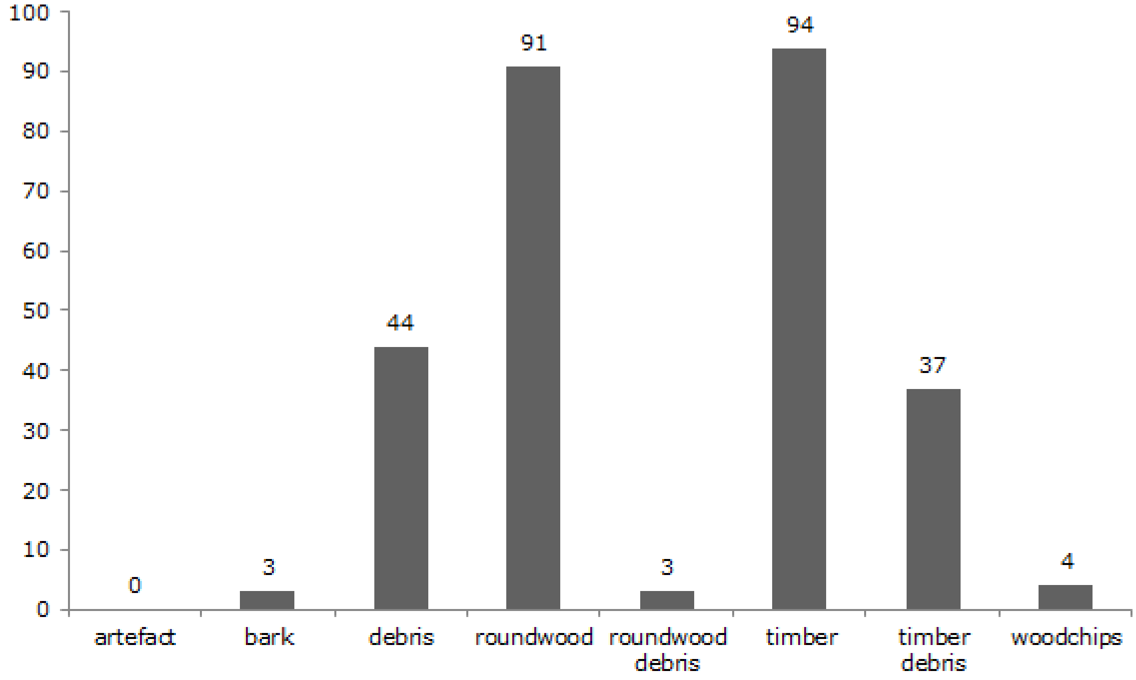

Figure 3.21 Wood categories for the central platform (Bamforth et al. in press, b: Figure 6.26, © SCP).

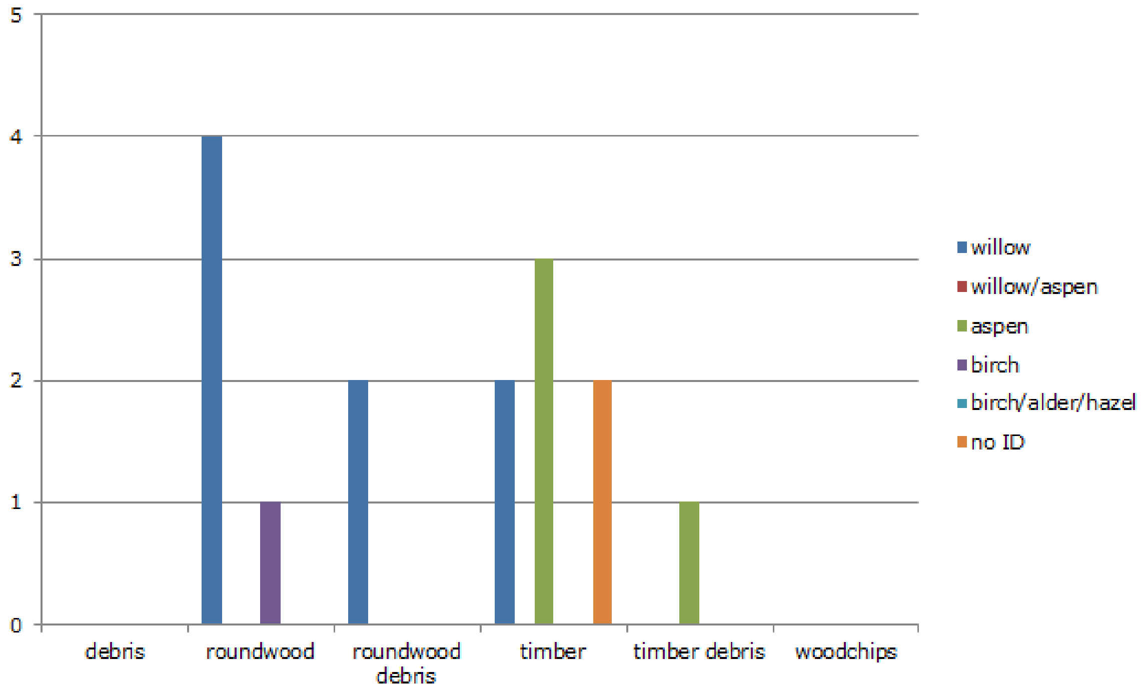

Figure 3.22 Frequency of taxonomic identifications from the central platform by wood category (Bamforth et al. in press, b: Figure 6.27, © SCP).

Most of the wooden remains of this structure lay within reed peat, with the lowest elements recovered from detrital mud. Sections of the middle and lower layer were truncated by a deposit of intrusive sand, deposited by a natural spring and forced through the peat deposits from the underlying geology by artesian pressure. The spring has destroyed the wood it passed through and dislocated timbers it passed in close proximity to (Figure 3.23).

Figure 3.23 Intrusive sand in the middle layer of the central platform (left); detail of resulting dislocation of timbers (right) (Bamforth et al. in press, b: Figure 6.28, © SCP).

A total of 11 items representing 2% of the material assigned to the central platform showed evidence of charring (Appendix C: Table 9.5). The majority (n=10) came from the top layer (five larger charred items and five pieces of roundwood) though a single piece of charred roundwood was present in the middle layer. In addition, there were six pieces of charred roundwood, five from the upper layer and one from the middle layer. Three pieces are charred heavily on one end or face, two are moderately charred all over and one item is lightly charred along one edge.

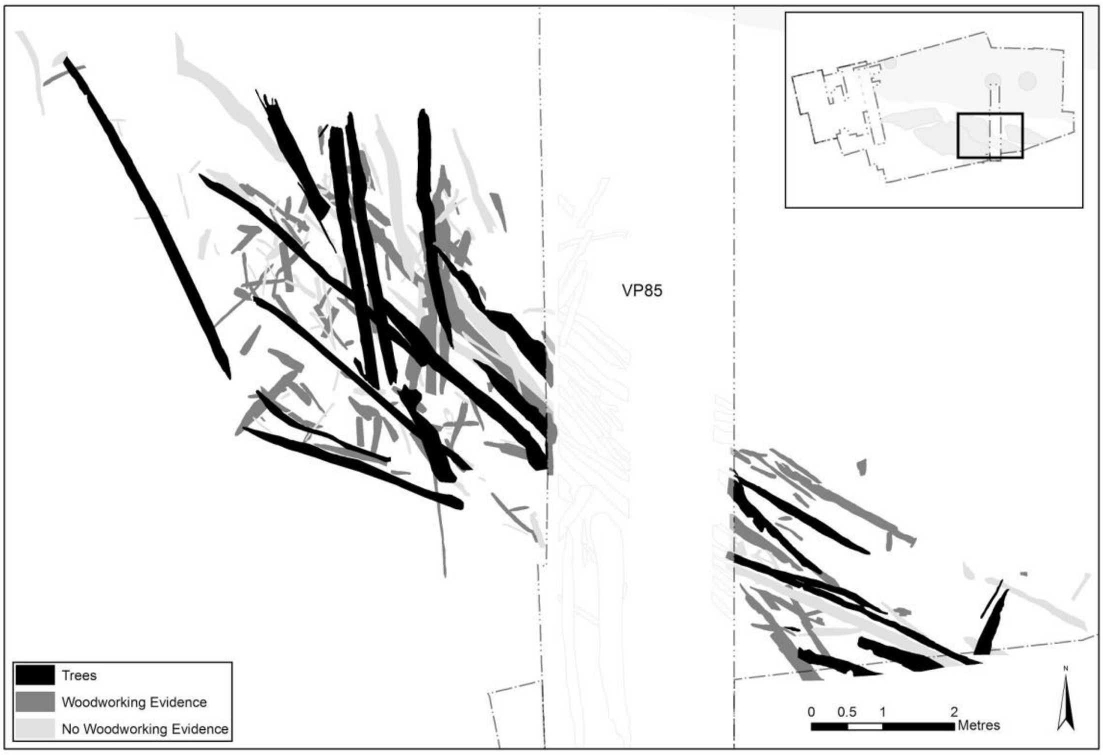

Figure 3.24 Plan of the trees, woodworking evidence and no woodworking evidence in the central platform (Bamforth et al. in press, b: Figure 6.29, © SCP).

Twenty-six items are classed as tree trunks (Figure 3.24 and Appendix E: Table 11.3). Most of these (17 items, 65%) are in the upper layer with eight (31%) in the middle layer and one (4%) in the lower layer. These vary in length from 895-5180 mm and in horizontal diameter from 80-230 mm. The high degree of compression seen in the material from this structure is described by the vertical diameters which vary from 10-65% of the horizontal values. Bark was only noted from a single item <99893> on which a long strip of bark 12 mm thick was present. The trees are straight grained with moderate small side branches (diameter c. 30-40 mm) noted on three items (<99746>, <99803> and <99893>) and a single side branch noted on two items (<99804> and <116054>), diameter c. 25-30 mm.

Three items display evidence of conversion including timber <99803>, which had faint parallel grooves on its surface, probably relating to 'groove and split' type woodworking (see Chapter 4). In addition, the distal end of a side branch from <99804> had probably been beaver-gnawed (though the condition of the wood precluded a definite identification of beaver-gnawing), and the distal end of <116054> is radially quarter split (though it is unclear if this is a cultural or natural conversion).

There are 58 unsplit items, not including material classed as trees. These include 91 pieces of roundwood, 11 timbers, three fragments of bark and two pieces of debris (Figure 3.21). Due to the large volume of roundwood encountered, a sub-sample of the material was recorded in detail (42 items) with the remainder (49 items) marked on plan only.

The roundwood is spread fairly evenly through the top, middle and bottom layer of the platform. Ten recorded items have bark present and seven items (8%) have morphological traits often associated with coppiced material (see Chapter 4). There are no tool facets present, although two items (<103262> and <103498>) are clearly torn at the proximal end. Three pieces are charred heavily on one end or face, two are 100% moderately charred and one item is lightly charred along one edge. Five of the charred items are from the upper layer and one from the middle layer. The recorded roundwood varies in length from 80-3740 mm and in horizontal diameter from 15-105 mm.

The 11 items classed as timber are generally good quality, straight grained, knot free material, none of which has bark present. These larger items occur almost exclusively in the top layer with a single item present in each of the middle and lower layers. No woodworking, charring or unusual taphonomy was noted. The material varies in length from 394-3010 mm and in horizontal diameter from 100-160 mm.

None of the three fragments of bark shows any evidence of woodworking. Although these may have formed an integral part of the construction of the platform, it is equally likely they have fallen away from other items used in the construction of the platform. The largest piece measures 534 x 142 x 9 mm.

Both pieces of debris are from the top layer. One of the pieces <99728> is a long piece of roundwood that has degraded into a radial half, the other <99813> is a completely charred amorphous lump measuring 270 x 105 x 10 mm.

A total of 143 split items form part of this structure (Table 3.7): 57 items classed as timber, 37 as timber debris, 42 as debris, four as woodchips and three as roundwood debris. The majority of the material is tangentially aligned (112 items, 78%), with only 18 items radially aligned (13%) whilst 13 are of unknown conversion (9%).

Conversion	Timber	Timber debris and debris	Woodchips	Roundwood debris	Total frequency	Total %
Rad	3	9	1	0	13	9.1
Rad 1/2	0	0	0	3	3	2.1
Rad 1/3	0	0	0	0	0	0.0
Rad 1/4	0	1	0	0	1	0.7
Rad 1/8	1	0	0	0	1	0.7
Tan	28	47	3	0	78	54.5
Tan - surface split away	0	0	0	0	0	0.0
Tan outer	23	11	0	0	34	23.8
U/K	2	11	0	0	13	9.1
total	57	79	4	3	143	100.0

Table 3.7 Conversions from the central platform (Bamforth et al. in press, b: Table 6.20).

The split material classed as timber is present throughout the three layers and varies in length from 515-3600 mm, in breadth from 34-210 mm and from 2-53 mm in thickness. This material is generally straight grained, with side branches only noted on one item, and generally lacking bark (present on one item only). Four items are thin, radial splits with the remainder tangentially aligned, 23 of which are the outer split (Table 3.7). No tool facets pertaining to trimmed ends were recorded. There is a tendency for these items to be parallel sided (n=15), and seven items show traces of parallel longitudinal grooves on the split surfaces, possibly related to 'groove and split'. Seven items also have a chamfer running down one or both edges and three have a lenticular cross section. In addition, a single timber from the top layer <99960> has moderate charring at one end on the outer/sapwood surface (Appendix C: Table 9.5).

The timber debris and debris are present through all three layers of the platform and are considered together. The material varies in length from 74-540 mm, in breadth from 17-150 mm, in thickness from 4-80 mm, and is dominated by tangentially aligned items (58, 11 of which are outer splits), with ten radially aligned items and 11 of uncertain conversion (Table 3.7). Several items display characteristics associated with 'groove and split' woodworking; three have longitudinal grooves, 17 are parallel sided and the morphology of eight items has led to the suggestion that they may be debris produced by the 'groove and split' technique (see Chapter 4). In addition, two items have a lenticular cross section. Two items, both from the top layer, are charred; radially split timber debris <99888> is lightly charred on both faces at one end, whilst debris <99240> of unknown conversion is completely charred (Appendix C: Table 9.5). Finally, one tangential outer split <99241> is a piece of woodworking debris where a knot has been removed from a larger timber – a common carpentry practice.

Four woodchips were present in the upper (1 item) and lower (3 items) layers. They vary in length from 76-155 mm, in breadth from 12-35 mm and from 5-10 mm in thickness. Three are tangentially aligned and one is radially aligned (Table 3.7). The three pieces of roundwood debris were located in the middle and lower layer. All are half splits from small diameter wood (original diameters vary from c. 33-56 mm) (Table 3.7).

3.4.3 **Eastern platform**

3.4.3.1 Introduction

The eastern platform is a linear arrangement of timbers running north-west/south-east, roughly parallel with the lake shore, at the eastern end of the site. The platform is 4.5 m wide and extends for at least 11 m. Its eastern extent is difficult to establish but timber <114883> extends beyond the edge of trench and it is possible that the platform continues in this direction (Figure 3.25 and Figure 3.26).

Figure 3.25 Plan of the eastern platform showing evidence for trees, woodworking and timbers with no signs of woodworking (Bamforth et al. in press, b: Figure 6.30, © SCP).

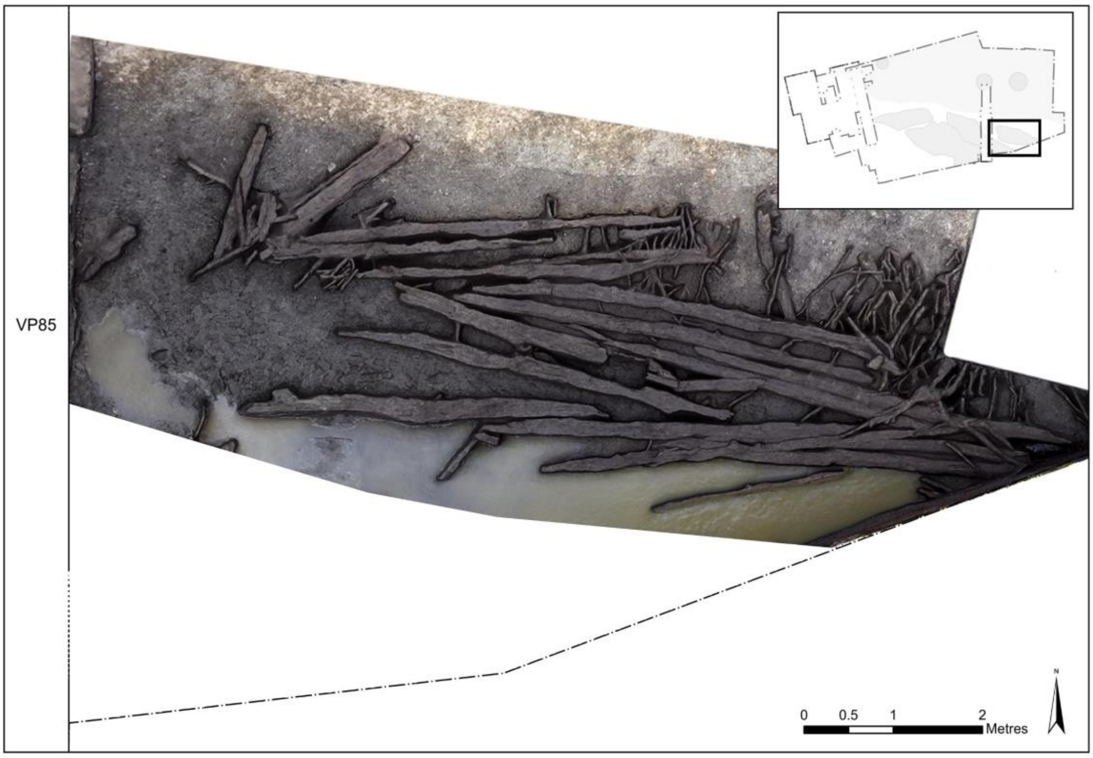

Figure 3.26 Orthophoto of the eastern platform (exported from Agisoft Photoscan Pro) (Bamforth et al. in press, b: Figure 6.31, courtesy of Dominic Powlesland, © SCP).

The bulk of the platform timbers lie in a single discrete layer and consist mostly of timber (including 17 trees) with smaller quantities of debris and roundwood. This appears to have been constructed in a single phase and acted either as a trackway through the wetland edge or a platform on which activities could be undertaken. A second layer of material, consisting entirely of medium-sized split items (all but one of which are tangentially aligned), lay below this and was separated by approximately 100 mm of sediment. These are either related to an earlier phase of activity or perhaps are residual timbers associated with the DWS.

3.4.3.2 Analysis

A total of 50 wood records are assigned to this structure, 43 items forming part of the main structure and seven lying beneath. A single item, radially split timber debris <115333> from the lower layer, displays light charring. The wooden remains of this structure lay entirely within reed peat with the lowest elements of the structure recovered from the base of this deposit. The material is mostly timber, much of which is classed as trees. There are also small quantities of roundwood and assorted debris present (Figure 3.27). Four timbers were identified to taxa, all of which were identified as aspen.

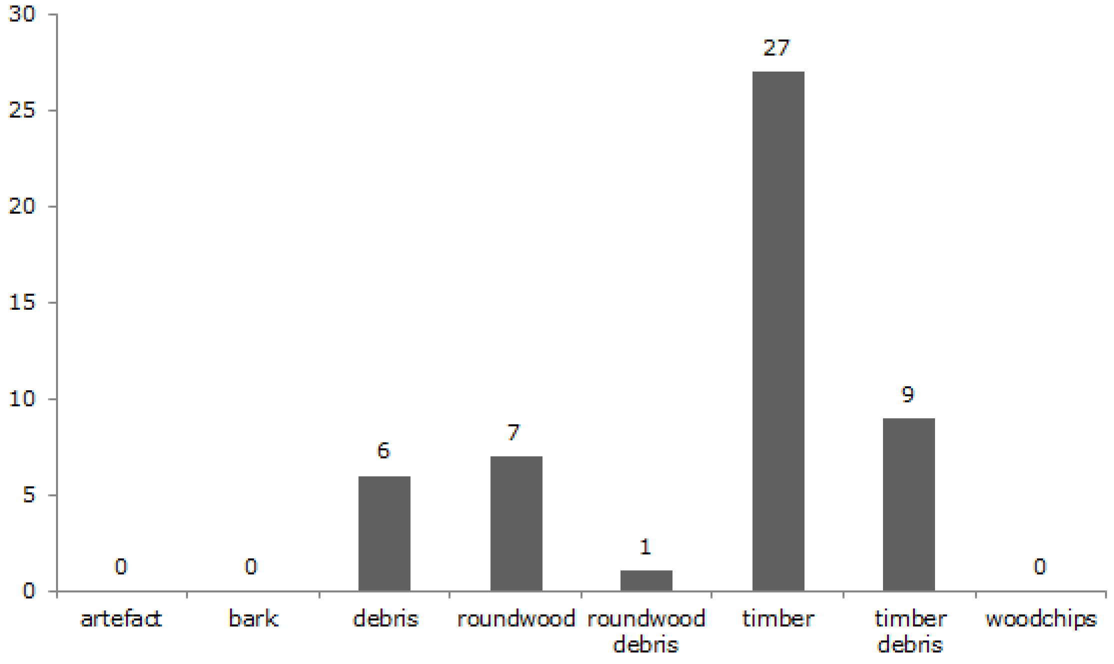

Figure 3.27 Wood categories for the eastern platform (Bamforth et al. in press, b: Figure 6.32, © SCP).

The platform contains 17 timbers classed as tree trunks (Appendix E: Table 11.4). Four of these were identified as willow/aspen. The trees are all straight grained with no evidence of side branches noted, none have bark present and none indicate woodworking. Due to the poor condition of much of the material it was only possible to identify the proximal/distal orientation of a few of the items, from which no particular trends are apparent. The trees vary in length from 1510-4735 mm and from 90-280 mm in horizontal diameter. The high degree of compression is evidenced by the vertical diameters, which vary between 10-47% of the horizontal values (Appendix E: Table 11.4).

With the exception of the material classed as trees, there are a total of 11 unsplit items forming part of this platform: seven classed as roundwood and four classed as timber (Figure 3.27). Only one of these items has bark present. These items vary in length from 195-1070 mm and from 13-170 mm in the horizontal, long axis of the diameter. One item, <114875> has been trimmed to length at the proximal end from two directions.

A total of 22 split items form part of this structure: six classed as timber, nine pieces of timber debris, six pieces of debris and a single piece of roundwood debris (Figure 3.27). Tangentially converted material dominates the assemblage with 16 items (72%) aligned in this plane (Table

3.8), whilst three are radially split items (14%) and three are of unknown conversion (14%). The split material classed as timber varies in length from 565-2520 mm, in breadth from 55-200 mm, in thickness from 7-18 mm and is all tangentially aligned (Table 3.8). The timber debris and debris are considered here together. This material varies in length from 91-465 mm, in breadth from 30-170 mm, in thickness from 10-34 mm and is dominated by tangentially aligned items (n=10) with 3 radially aligned items and 3 of uncertain conversion (Table 3.8).

Conversion	Timber	Other	Total frequency	Total %
Rad	0	3	3	13.6
Rad 1/2	0	0	0	0.0
Rad 1/3	0	0	0	0.0
Rad 1/4	0	0	0	0.0
Tan	5	9	14	63.6
Tan - surface split away	0	1	1	4.5
Tan outer	1	0	1	4.5
U/K	0	3	3	13.6
total	6	16	22	100.0

Table 3.8 Conversions from the eastern platform (Bamforth et al. in press, b: Table 6.22).

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3.4.4 **Discussion of the lake-edge timber platforms**

The three lake-edge platforms are the most substantial wooden structures on the site. Each is constructed from large timbers (including trees and split material) that have been laid down directly onto the peat that was forming within the lake-edge wetland. From their form and composition they are clearly deliberately-built structures and not natural accumulations of material and represent significant investments of resources and labour, on a par or greater than the building of the huts/houses several metres away on the dry land (Milner et al. in press, a). Although both the dating model (Milner et al. in press, c) and the timbers of the structures suggest that each of the structures were short-lived (multiple layers of material physically contact each other, wood-to-wood, with no build-up of lacustrine deposits between them), the occurrence of the platforms stretches across some two centuries.

The central platform is the earliest, largest and most complex of these structures, consisting of three clearly-defined layers of material. The timbers of each layer lay directly over each other with no sediment present between and had probably been deposited in a single event. The top layer is dominated by a series of large, unconverted trees, split and unsplit timbers, up to 3.8 m long, lying parallel to one another and aligned north-west/south-east (Figure 3.19). This forms the main axis of the structure, which runs for over 17 m (extending beyond the limits of the excavation). Where identifiable, the proximal ends of these timbers were generally lying to the south-east, away from the water's edge, and so cannot represent trees that have simply fallen into the lake-edge wetland. Below these were a layer of parallel timbers, orientated north to south, which in turn lay on top of a series of parallel, tangential outer splits that followed the same north-south alignment. These lower layers lie towards the north-west (shoreward) end of the platform and may have been laid down to provide additional support to this part of the structure or perhaps to elevate it further above the peat.

Although it is less coherent, the western platform is also a relatively complex structure, consisting of five semi-distinct layers of wood sat above a brushwood base. The main axis of this platform was made up of a layer of east-west aligned timbers running along its full extent. Again, this material was very large with most of the timbers between three and four metres in length. At its eastern end, this material was overlain by an upper layer of timbers, which ran at an angle to the platform's main axis, whilst three further layers of timber lay at the base of the platform, presumably to stabilise the structure and prevent it from sinking into the peat. As with the central platform there is no sediment between the layers of timber, as the platform has probably been constructed as a single event.

The eastern platform is the simplest of the structures, made up of a single layer of material, though as with the other platforms, this consisted of very large timbers (including whole trees), some over four metres long. Though an underlying layer of timber was present, this is separated from the main concentration of material by a layer of sediment and probably represents an earlier phase of activity.

Though there are some differences between them, the three timber platforms are very similar in terms of their construction, each possessing a principal axis made from large timbers (including whole trees). There is a strong tendency for the timbers of each of the platforms to be aspen, including all the identified timbers from the eastern platform (n=4) and the western platform (n=20), and the majority of the identifiable timbers from the central platform (3 aspen, 2 willow). In addition, the platforms are notably different from the other large concentrations of wood at the site, with a far higher proportion of timbers than either the DWS or CDA, and the highest prevalence of timbers classed as trees (1.5% for the DWS, 11%

for the central platform, 21% for the western platform and 34% for the eastern platform). There is also an extremely low prevalence of wooden artefacts recorded from the platforms: just two timber debris stakes recorded from the western platform (Taylor et al. in press), and very low quantities of other archaeological material (Knight et al. in press and Conneller et al. in press, b).

3.5 Other wooden remains

A total of 200 wood records were recovered from parts of the site not assigned to any of the spatial analytical areas defined in the introduction to this section. These records have been sub-divided into four groupings: 1) the peat above the marl: 27 items; 2) wood peat: 65 items; 3) Clark's backfill: 2 items; 4) unassigned: 106 items.

3.5.1 The peat above the marl

A total of 27 items were recorded from the area above the marl dome, the majority were recovered from the reed peat and detrital mud, with a single item from within the basal organic sand. A range of material is represented, including timber, roundwood, forms of debris, and a single artefact: <107799>, an ad-hoc tool (Figure 3.29). Four items are charred, seven display morphological traits that may be indicative of coppicing, 14 items are split, and three have trimmed ends.

One of the timbers, <109922> is a fallen tree that may be in situ. Lying approximately north (proximal)/south (distal), the proximal end is very heavily charred on the upper surface for the first 2000 mm terminating in a totally charred end. Numerous side branches are visible around what appears to be the crown, the first occurring approximately 400 mm from the charred proximal end. The surviving portion of the trunk measures 4.5 m x 310 mm x 70 mm. The charring may be a result of a burning event in the surrounding reed beds.

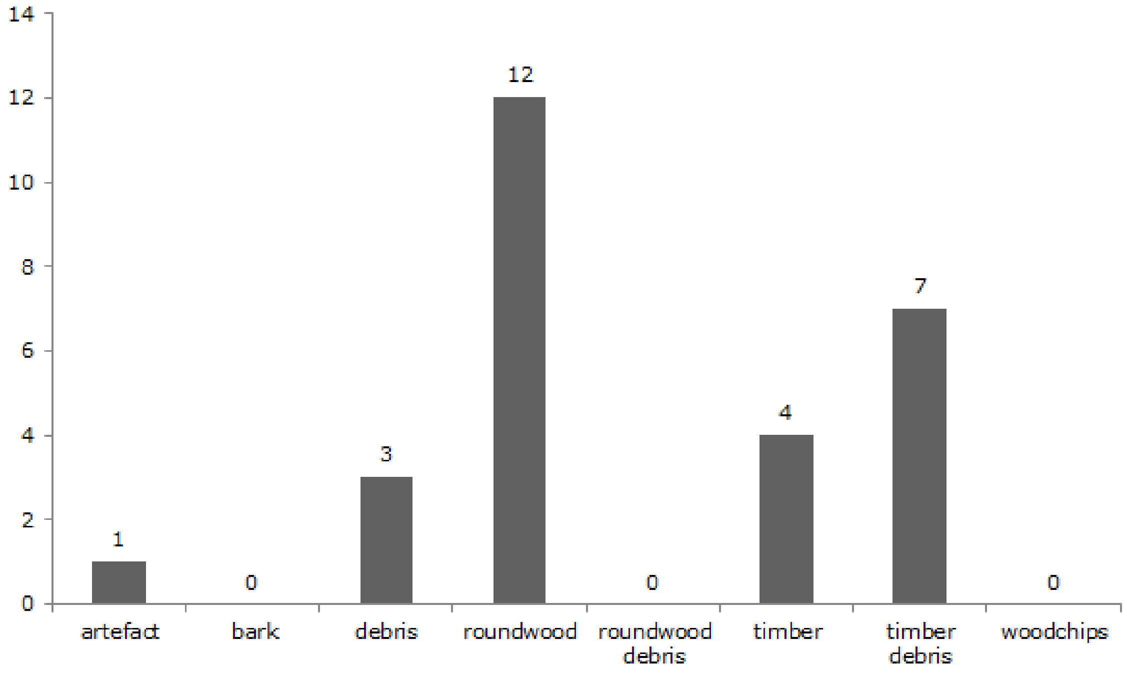

Figure 3.28 Wood categories for the area classified as peat above the marl (Bamforth et al. in press, b: Figure 6.33, © SCP).

3.5.2 **Wood peat**

A total of 65 items were recorded from within the wood peat (Figure 3.29). Roundwood is the most common material, though other items are also present, including timber, debris, and a single artefact: an ad-hoc tool <107755> (Taylor et al. in press). Most of the material (89%) is in moderate or worse condition, as might be expected given the relatively high position in the sequence of the material. The character of the assemblage is broadly similar to that seen in other areas: 17 items (26%) are charred, often heavily; 12 items (18%) show morphological traits that may be indicative of coppicing; 17 items (26%) are split. No evidence for tool facets was recorded.

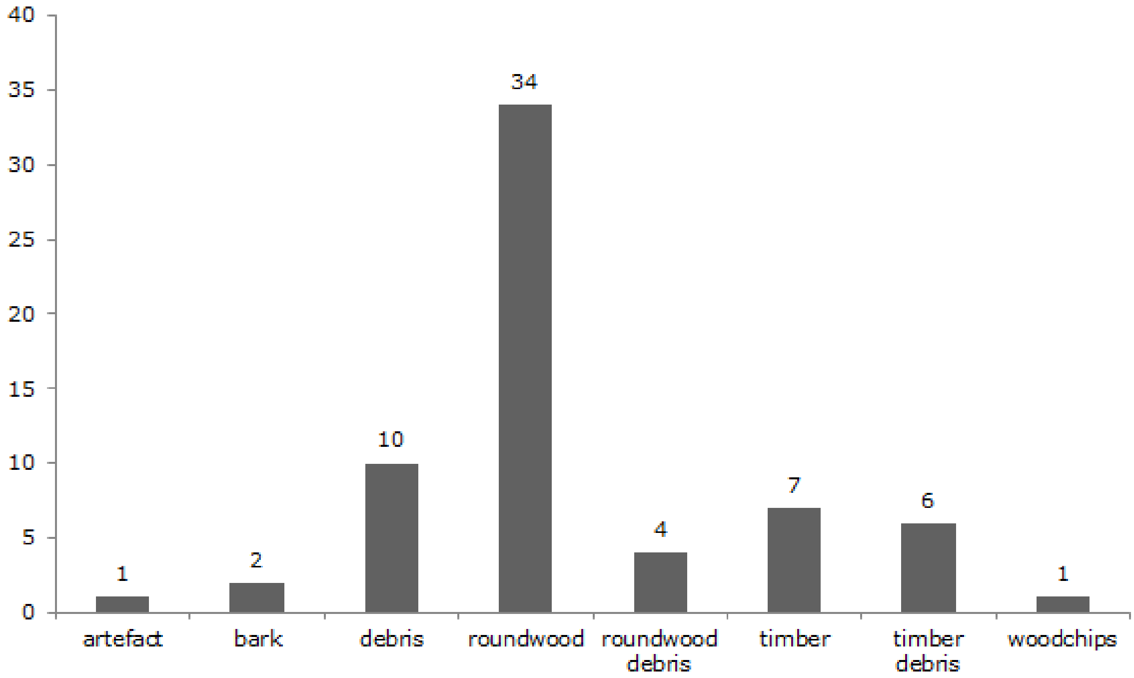

Figure 3.29 Wood categories assigned to other, wood peat (Bamforth et al. in press, b: Figure 6.34, © SCP).

Among this material is an interesting group of three pieces of tangentially split timber debris (<107759-61>), 18 m south-west of the dryland deposits, that appear to represent in-situ primary woodworking debris derived from a single episode. One of the items is a tangential outer split and two are moderately charred on one face. The items are visually very similar and may represent debris from the working of the same parent timber. They vary in length from 120-255 mm, in breadth from 60-73 mm and from 8-14 mm in thickness.

None of the seven timbers recorded were worked and four are thought to be fallen trees, probably lying in-situ. The first of these, <98866>, is a large fallen tree aligned roughly north-south that lies above the timbers of the central platform. The proximal (north) end is 350 mm in diameter and lenses out at the edge of the waterlogged deposits against the slope of the lake-edge. The distal end of the tree passes out of the excavation area 10.3 m to the south (at which point its diameter is 80 x 110 mm). The first side branch is located 5.2 m from the proximal end and a major crux some 6.5 m. There are numerous side branches and the trunk is somewhat curved in the crown of the tree (Figure 3.30).

Figure 3.30 Fallen tree <98866> lying above timbers of the central platform (Bamforth et al. in press, b: Figure 6.35, © SCP).

The second <113275> is a section of tree trunk, lying approximately north-south, to the south of the brushwood some 7.5 m from the dryland deposits. The north end is truncated by previous excavations and the south end is degraded. Bark was present on the underside and moderate small side branches were noted. The trunk measures 1530 x 150 x 35 mm.

The remaining trees, <113763> and <113764>, are represented by lengths of highly compressed trunks, in very poor condition, measuring 1530 x 260 x 35 mm and 1530 x 260 x 35 mm respectively. In both cases bark is present and both ends are degraded. The trees were aligned north-south, above the timbers of the eastern platform, extending out of the trench to the south.

3.5.3 **Clark's backfill**

Occasional pieces of smashed waterlogged wood were present within the backfill of several of Clark's trenches. For the most part, this material was too heavily mechanically damaged to be analysed. However, two relatively intact pieces were recorded from the backfill of Cutting V.

Both were heavily charred and appear to be woodworking debris. Of these, <96111> is tangentially aligned and measured 197 x 60 x 10 mm whilst <96112> is an extremely unusual transverse aligned item measuring 140 x 82 x 12 mm.

3.5.4 **Unassigned material**

A total of 106 items are not assigned to any spatial analytical group. These were recovered from the reed peat and detrital mud and are spread across the site. The material is similar in terms of character, appearance and woodworking evidence to that seen in other analytical groups (Figure 3.31). Three artefacts are present: a digging stick/haft or handle <113765>, small radial dowel <113768> and a sub-rectangular radial dowel <113778> (Taylor et al. in press). A total of 18 items are charred, 34 are split and two have ‘chop and tear’ trimmed ends. Much of the roundwood recorded in this area represents sub-samples of larger deposits of brushwood. However, seven pieces displayed possible morphological evidence of coppicing.

Two fallen trees were recorded. The first, <109112> is degraded at both ends and measures 1560 x 125 x 65 mm. Located to the south of the DWS, part of the crown of the tree was present and partially recorded as roundwood <109113-117>. The second, <113251> was lying proximal end north/distal end south above the timbers of the western platform, where it extended out of the area of investigation. The first side branch occurred 2500 mm from the degraded proximal end and the excavated portion measured 5530 x 255 x 32 mm. The tree was in poor condition.

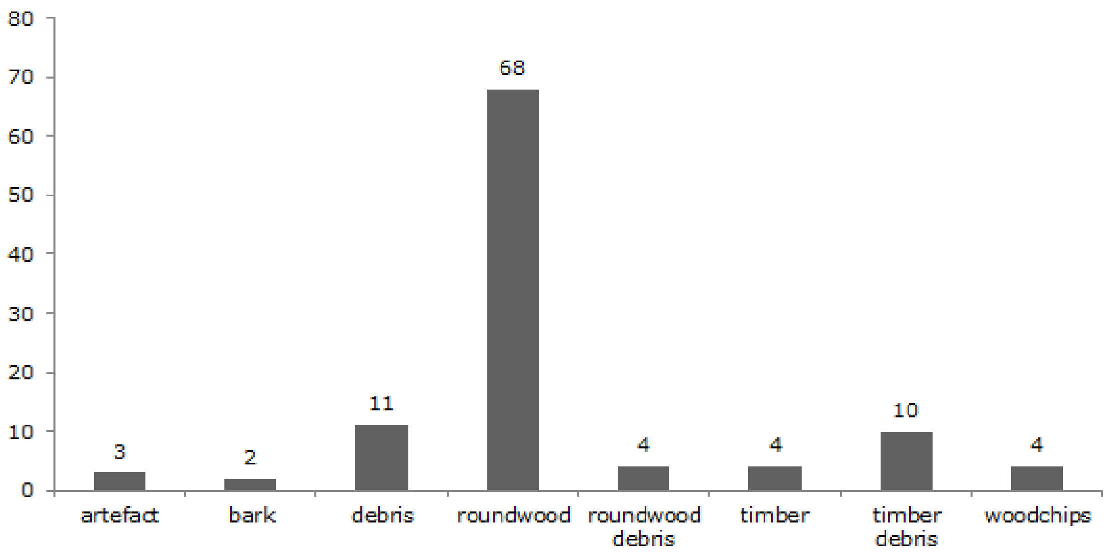

Figure 3.31 Wood categories classified as unassigned material (Bamforth et al. in press, b: Figure 6.36, © SCP).

3.6 Summary and contextualisation of the Star Carr wooden structures

The extensive wooden remains encountered at Star Carr represent the earliest known wood-built structures in the UK and probably Europe. There are significant quantities of split, trimmed and hewn wood which represents the earliest evidence for early carpentry in the UK and possibly Europe. The recent investigations have enabled a greater understanding of the wooden remains encountered during previous campaigns as well as shedding light on how extensive and varied the deposition of wood as platforms, structures and midden-like depositions has been.

The most significant of the structures, in terms of their physical size, and the labour and resources they entailed, are the three large timber platforms. These structures have much in common in terms of their form, setting and the raw materials used in their construction. They all lie close to the edge of the lake and have been laid directly onto the peat. Their primary axis is defined by a mixture of entire 'cleaned-up' tree trunks and extremely large split timbers, some up to 3.5 m in length, and due to the absence of sediment between overlying timbers each appears to have been built in a single event.

The intentionality of these deliberately constructed platforms is reinforced by the regular, linear arrangement of the primary timbers, the layering of the central and western platforms and the use of straight-grained trees with fewer side branches, suggesting they have been imported from an area of denser woodland than the naturally fallen trees growing on the shore. Furthermore, much of the material is split, with evidence of tooling visible on the better-preserved timbers from the 1985 excavations (Mellars et al. 1998).

Whilst the intentionality of these structures is clear, the motivation behind their construction is more difficult to interpret. Given the platforms' positioning parallel to the edge of the lake, it seems highly likely that all three were built to aid access to the resources of the lake. Be this for hunting, the mooring of boats, the processing of food or other materials or simply ease of access to the open water remains unclear. In light of the lack of associated material culture, making any firm interpretation remains difficult. Furthermore, the platforms may have had multiple uses either in parallel or series, and whilst the similarity in the appearance of the platforms makes it tempting to suggest they all shared the same function, the broad temporal frame across which they occur warns against such a simplification. Nevertheless, whatever the function, the building of the platforms, alongside the building of the dryland habitation structures represents an investment in the physical infrastructure of the site by its ancient inhabitants.

Although it lacks the formal structure of the lake-edge platforms, the DWS also seems to represent a deliberate anthropogenic deposition of material to facilitate access to the deeper water away from the shore. This is described by the high percentage of woodworking waste as well as the presence of several large worked and unworked timbers that have built up through successive episodes of deposition, rather than a single phase of construction. The scatter appears to have been used (at least in part) for the purpose of depositing parts of animal carcasses into a discrete part of the wetlands (Knight et al. in press).

There is no evidence that the wood encountered by Clark in the west of the site formed either a platform or occupation surface. The accumulation of material in the brushwood area is strongly suggested to be composed of naturally-accruing brushwood derived from trees growing along the edge of the lake, mixed with occasional pieces of woodworking debris and artefacts that are likely to represent casual discard from activities taking place on the dryland adjacent to the lake-edge. This material clearly extended into Clark's Cutting II and must have been part of the assemblage of wood that he recorded.

Equally, the wood from the baulk and to the south of Cuttings I and II which was interpreted by Clark as an occupation platform seems too diffuse to have served this purpose and would have been under the surface of the lake (Taylor et al. 2017). The scatter is formed of relatively small material with fewer large timbers and greater volumes of roundwood debris and woodchips than in other areas of the site. This material seems to represent a mixture of casual discard / midden-like deposit of small woodworking waste mixed with material that hints at more formalised structural deposition, associated with the same practices through which a large assemblage of animal bone, worked antler and flint was deposited, as reflected in the high volume of wooden artefacts recovered from this area.

Whilst interpretations of the structural and functional aspects of these assemblages are clearly important we should also consider how the nature of the material provides other insights into the character and scale of woodworking at Star Carr. To begin with, the presence of large quantities of roundwood rods and poles with morphological traits associated with coppicing hints at either some deliberate management of woodland resources or perhaps simply a high degree of selection for long straight poles (see Chapter 4). Furthermore, the extensive wooden remains encountered at the site provide evidence for the use of significant quantities of split, trimmed and hewn wood. All the major wood categories are present from large timbers (including the utilisation of entire felled trees and naturally fallen tree trunks) through timber debris (off-cuts), smaller woodworking debris, woodchips, roundwood, and roundwood debris. Whilst some of the woodworking waste may relate to the construction of the platforms, much of the material has been generated through other, unknown woodworking tasks which are presumed to have taken place on the adjacent dryland. Perhaps some of the waste was generated during the construction of the circular, stake-built house structures or their presumed interior fittings. Other activities that may have taken place and resulted in the production of woodworking waste include the production of furniture, such as beds and stools, transport, such as frame-built boats or perhaps travois (sledges), animal traps or hide-drying frames. The lack of survival of so much of the wood-built material culture means such activities are rarely considered in our narratives of Mesolithic lifeways, but the presence of such extensive wooden remains at Star Carr shows that such items would have been just as much a part of people's lives as things made from stone, bone and antler. Indeed, the materials would often have been used together to construct composite artefacts.

In terms of species selection, aspen dominates the timber assemblage with moderate willow and occasional birch also present (Appendix B). Willow is the most frequent taxa amongst the roundwood assemblage, perhaps due to its propensity to regenerate as stems and rods, either because of deliberate management or as a by-product of either human or beaver tree felling. Aspen and birch were also present in the roundwood assemblage. Interestingly, the findings of this research are at odds with Clark's reporting of the wooden remains as being comprised entirely of birch (Clark 1949; 1950; 1954), perhaps a product of assumption rather than rigorous scientific study.

Given the relative fragility of wood as an organic artefact it is astonishing that material of this antiquity has survived (Appendix A). In the first instance, wood must enter a stable anoxic burial environment – in this case the peat and organic muds forming at the lake-edge – and remain there, wet, buried and secure for the entire intervening period until its subsequent discovery and excavation. As the timescale increases, so does the chance of the burial environment being disturbed and the wood broken down by oxygen-metabolising microbes and bacteria. Furthermore, the wood becomes gradually more fragile over time as cellulose is leached away and the remaining lignin structure is slowly broken down by other suites of slow-acting bacteria that can exist in an anoxic environment. It is unsurprising that the farther back in the archaeological record we go, the less likely wooden remains that have become buried are to survive. The extent to which the paucity of Early Mesolithic wooden remains at a national level reflects simply preservation bias or the lifeways of Mesolithic people is hard to ascertain.

Within the UK, Mesolithic wooden structures are extremely rare (Figure 3.32). Modern (1994) re-excavations of a possible 'lake-edge platform' at Round Hill (Skipsea, East Yorkshire, Figure 3.32: 4) recovered a single desiccated, worked stake radiocarbon dated to the Early Mesolithic, raising the possibility that at least some of the timbers previously recorded and reported from this site (Smith 1911) represent an Early Mesolithic lake-edge platform (Fletcher and Van de Noort 2007: 318).

Figure 3.32 Mesolithic and Neolithic Wooden Structures: (1) Stirlingshire, (2) Williams's Moss, (3) Star Carr, (4) Round Hill, (5) Hatfield Moor, (6) London – Belmarsh, Vauxhall and Silvertown, (7) Somerset Levels – Honeygore, Honeycat and Sweet Track.

Three potential Late Mesolithic structures are recorded in a palaeochannel infill at William's Moss (Eskmeals, Cumbria, Figure 3.32: 2). Structure 1 is not convincing, consisting of oak branches overlain by birch brushwood. Woodworking evidence is limited to a single timber displaying a series of what are described as cut marks that could well represent post-depositional damage (Bonsall et al. 1989: 190). Structure 2 – two large oak tree trunks forming a revetment backfilled with earth and stones and topped with extensive layers of bark matting – does appear to be anthropogenic in origin. However, no woodworking evidence is reported and no supporting evidence (such as associated artefacts or the presence of stakes) is presented to support the hypothesis that the bark mats represent internal hut floors (Bonsall et al. 1989: 192). The presence of radially cleft oak timbers topped with brushwood in Structure 3 is of note as it represents the only definitive evidence for woodworking or carpentry from the site (Bonsall et al. 1989: 193).

More recently, three vertical timber piles have been recorded on the Thames Foreshore at Vauxhall (London, Figure 3.32: 6), radiocarbon dated to the very Late Mesolithic (Milne et al. 2010). Though there is no evidence for the form of this structure, the posts suggest a substantially-sized structure, such as a small raised platform or jetty. As the posts were not extracted from the ground and remained in the round, no evidence of woodworking was recorded.

Evidence for comparable Mesolithic wooden platforms or trackways from other parts of Northern Europe is also sparse. Indeed, it is not until the Neolithic that larger timber structures become more apparent in the UK. An early example was recently recorded during excavations at Belmarsh, Southeast London (Figure 3.32: 6) (Hart et al. 2015). This consisted of split timbers and an unsplit log, similar in size and shape to the Star Carr timber platforms. A fragment of another, potentially comparable, structure believed to form part of a trackway or platform was also excavated at Silvertown, London (Figure 3.32: 6), formed of three narrow, overlapping planks (Meddens 1996; Stafford et al. 2012). Similarly, an Early Neolithic platform in Stirlingshire, Scotland (Figure 3.32: 1) consisted of large split and unsplit timbers (including tangential outer splits) supported on a timber and brushwood frame, creating a structure that extended 9 by 4.5 m (Ellis et al. 2002). Other forms of wooden structure include the Late Neolithic Corduroy trackway excavated at Hatfield Moor in the Humberhead Levels (Figure 3.32: 5) (Chapman et. al. 2013), and the brushwood trackways at Honeygore and Honeycat alongside a hurdle trackway at Honeycat (all in the Somerset Levels, Figure 3.32: 7) (Coles et al. 1985) and the relatively complex Sweet Track, also in the Somerset Levels (Figure 3.32: 7) (Coles and Orme 1984).

Past narratives of Mesolithic lifeways have tended to assume a lack of investment in infrastructure as a reflection of the high degree of mobility coupled to the small size of social groups making such an outlay undesirable or unnecessary. However, the wooden structures excavated at Star Carr show that these assumptions may be misplaced and that perhaps the lack of evidence for investment in infrastructure relates as much to poor archaeological visibility or preservation as describing an absence of such structures in the past. The wooden structures and the houses discovered at Star Carr suggests groups larger than we conventionally expect were investing resources and labour in the production of settlement infrastructure at this site.

4 Wood and woodworking technology

4.1 Introduction

Woodworking brings a unique and specific series of physical experiences and emotional connections. The smell of freshly-worked wood, the thunk of an axe, the slow cracking of a timber being cleft, the warm feel of wood in the hand, the vibration up the arm from a miss hit with an axe, the beauty of a well-finished, smoothed artefact, the interplay of grain and woodworker. Human and plant.

As described in detail in the previous chapter, there are 1602 pieces of worked wood recorded from Star Carr (2013-15) that have been split, trimmed or hewn and these form the earliest and largest Mesolithic woodworking assemblage in the UK. The assemblage is varied and contains finished artefacts, large split and unsplit timbers, entire trees and roundwood stems, rods and poles. However, woodworking is a reductive technology and there is also a significant quantity of woodworking debris of various sizes from large off-cuts (timber debris), to small woodchips detached by a single blow of an axe. Traces recorded from the wood assemblage provide evidence for the Mesolithic woodworking tool-kit and the material itself provides a glimpse of the types of woodland that were being exploited, and possibly even managed. Overall, the wood assemblage and the evidence of woodworking it contains is relatively uniform across the site and across the centuries of occupation and appears to represent a single, distinct, woodworking tradition.

There are several unusual and distinct woodworking traces seen amongst the worked wood assemblage at Star Carr. These include items with lenticular cross sections and chamfered edges, the reason for which is unknown but might relate to the natural properties of the wood species whilst being cleaved. There is also a propensity for tangential outer splits and splits that fade/feather out at one or both ends. Similarly, there are many parallel-sided split items and pieces with traces of longitudinal parallel grooves on split faces, both of which may be indicative of 'groove and split' woodworking. Further traces that may be related to this practice consist of timbers which have scars on split faces that describe the cleaving away of smaller split pieces.

This section sets out how the raw material itself may have been selected and the potential relationship between people and the landscape around them. It examines the possible evidence for coppicing, before examining in detail the tools, technology and skills required to work the wood. A programme of experimental work was undertaken during 2013-15, to which the author contributed extensively in terms of experimental woodworking. This work is drawn upon within this chapter, to understand how the archaeological wood may have been worked, and what debris forms during different woodworking practices.

4.2 Raw material selection

Selecting the right tree is essential to successful woodworking. Choosing a tree with the required characteristics, be it straightness or curve of the grain, the presence or absence of side branches and knots, or size and form is the first step to successfully manufacturing the wooden objects required. The people living at Star Carr would have had a close relationship with their surrounding landscape, spending time hunting large and small prey and gathering food and other materials from the surrounding woodland. These forays into the woodland would have drawn their attention to a wide range of woodland resources. Warren (2003: 22) reminds us that Mesolithic gatherer-hunter communities would have had personal relationships with the woodlands they lived alongside and within, and that the woodlands themselves were not the pristine, wild spaces sometimes invoked in archaeological narrative, but living spaces criss-crossed by paths and route ways (produced by humans and animals) and with locations imbued with memories and meaning.

From the material evidence for specific woodworking practices at Star Carr it is clear that people were knowledgeable and selective regarding the type and quality of wood they utilised and, by extension, aware of the location of suitable trees in the surrounding landscape. As Taylor (2010) points out, trees are the largest living things encountered by most human beings. They exist on a timescale that is often longer than that of a human and as a result might have appeared ‘other worldly’. Wood can be harvested without killing the tree, as is the case with coppiced or pollarded rods and perhaps, as discussed below, by cleaving planks from the outer surface of a standing tree. Alternatively, a tree can be felled, making all its wood available, though bringing the life of the tree to an end.

Most larger diameter pieces of wood encountered at Star Carr are derived from the trunks of trees as opposed to the limbs, as inferred from the centrally located piths. This is based on the propensity for hardwood trees (dicotyledons) to form reaction wood in branches above the pith, in tension, leading to an eccentrically located pith (Jane 1970, Figure 108). The largest piece on site has a diameter of 350 mm; however, a large proportion of the assemblage is below 180 mm (Figure 4.1). The pieces with the largest diameters are generally complete trees which have either been utilised within the lake-edge timber platforms or have been growing at the lake-edge and have fallen into the upper lacustrine deposits. The longest is a tree which is 10.3 m long (Figure 4.1). The trees that have been used for the wooden platforms have straighter grains and fewer side branches, suggesting that these have been growing in denser woodland cover than those growing along the edge of the lake (Figure 4.2 and Figure 4.3).

A significant part of the assemblage is formed of rods, poles and other small diameter roundwood. The larger items are likely to be the trunks of smaller trees and saplings whilst some of the smaller material has morphological traits suggestive of coppicing (Figure 4.2 and Figure 4.3). Whether derived from coppiced woodland or not, the presence of so many straight stemmed roundwood rods and poles points to strong selection criteria for this trait.

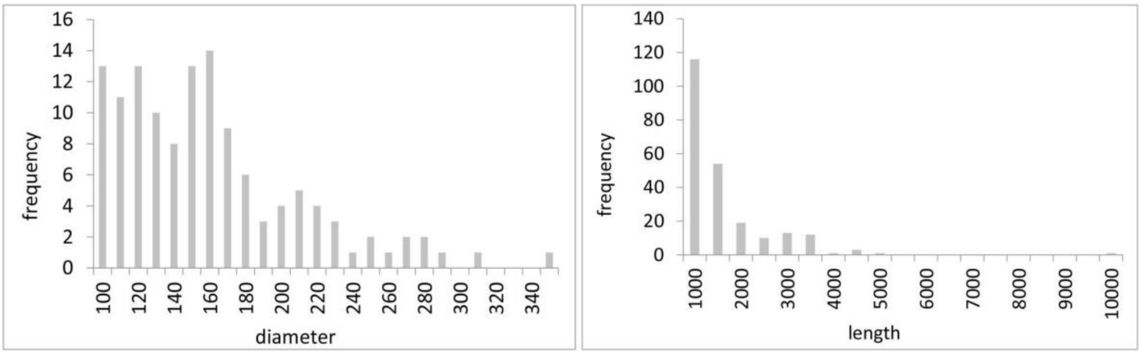

Figure 4.1 (left) frequency of diameters and reconstructed diameters over 100 mm (n=127). Reconstructed diameters have been inferred where a complete radius from pith to bark edge is present; (right) lengths greater than 1000 mm (n=250) (Bamforth et al. in press, a: Figure 28.2, © SCP).

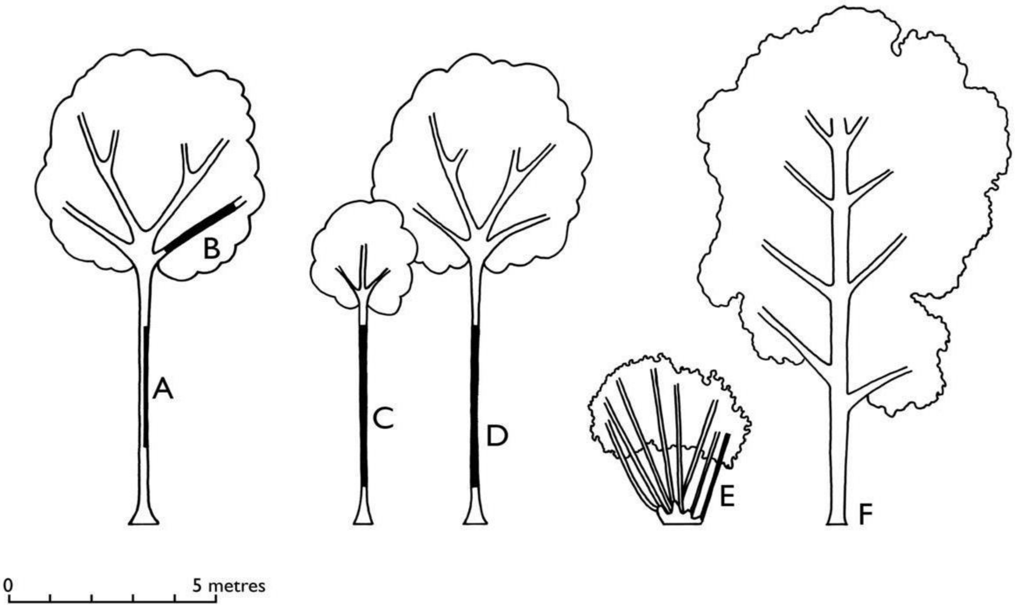

Figure 4.2 Woodscape model. A) tangential outer split from knot free trunk; B) tree limbs; C) trunks of young trees; D) entire straight grained tree trunks; E) 'coppiced' rods; F) lake-edge trees with frequent low side branches (Bamforth et al. in press, a: Figure 28.3, © Chloe Watson).

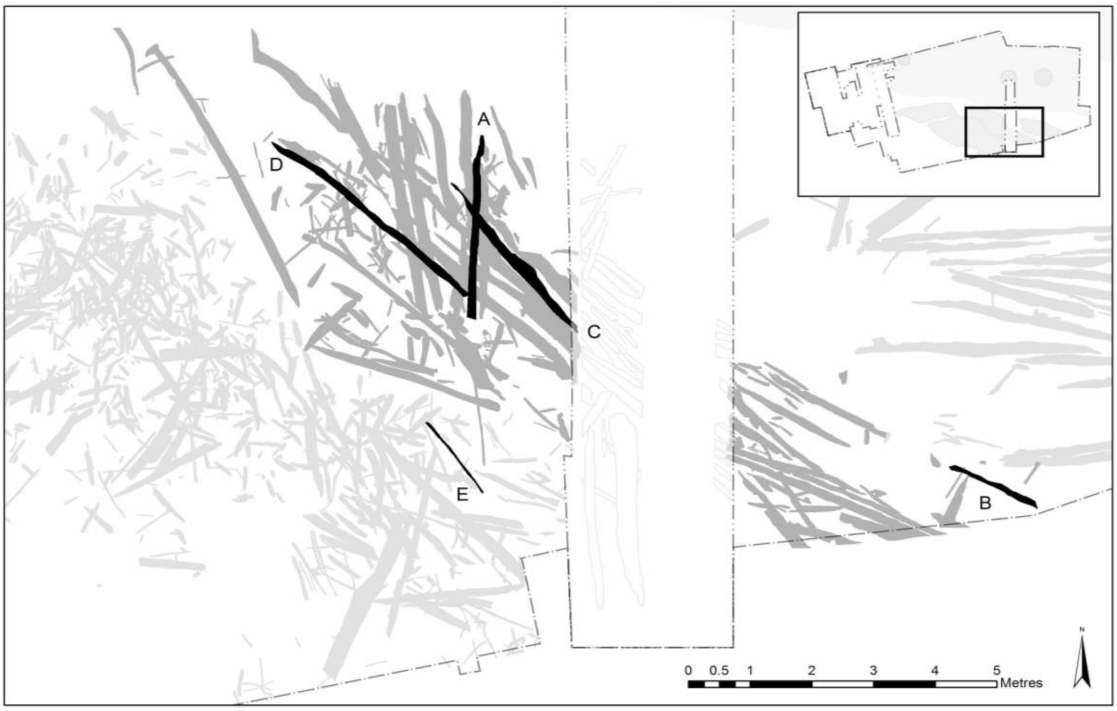

Figure 4.3 Elements used to construct the woodscape model seen within the central platform (see Figure 4.2) (Bamforth et al. in press, a: Figure 28.4, © SCP).

There is widely accepted evidence from historic periods in the UK for extensive woodland management in the form of large standards interspersed with understorey coppice. The resulting rods were utilised for basketry, construction (wattle) and charcoal production. During later periods, coppicing was often carried out on a rotation cycle of several years (Rackham 2006). Evidence for possible managed coppice from Britain and Ireland dates back to the Late Mesolithic in the Liffey estuary, Dublin, Ireland (McQuade and O'Donnell 2007).

The problems inherent in attempting to identify possible woodland management or forestry in assemblages of roundwood stems has been discussed in detail elsewhere (Out et al. 2013; Warren et al. 2014). Warren et al. (2014) rehearse a series of debates around the nature of any possible resource management in terms of both purposive versus opportunistic resource exploitation (Brown 1997) or the visibility of less defined practices such as adventitious coppice (Crone 1987) or draw felling (selecting stems for the required diameter) (Rackham 2006). Caution in inferring management practices is advised.

Throughout this volume, reference is made to pieces of roundwood that appear to be coppiced. There is no assertion that these are the result of planned or deliberate coppicing or pollarding, although this is a possibility. There is clear evidence of both beaver and human populations felling trees, and many of these would have regenerated, producing coppice stems or rods. Whether coppicing was carried out as a deliberate act or the stems resulted from felling, such stems would almost certainly have been available within the local landscape and people presumably would have harvested them for use. The presence of a large number of long straight stems and poles recovered from the site shows a strong selection criteria for the harvesting of this type of material, which would have been useful for building structures, such as those seen on the dryland (Milner et al. in press, a), or perhaps for weaving wattle or baskets.

In the analysis of the wood from Star Carr, roundwood was noted as having possible morphological evidence for coppicing when a straight stem with a relatively uniform diameter and a central pith was present (Figure 4.4). Additional morphological characteristics that may be indicative of coppicing as identified by Rackham (1977) were also noted, such as a curved or flared butt/proximal end, or stems with evidence of topping. In terms of the prevalence of possibly coppiced roundwood across the different spatial analytical areas, there is a tendency for the two scatters of wood (DWS and CDA) to have a higher incidence than the three lake-edge platforms (Table 4.1).

Figure 4.4 Long straight stem <103437> (Bamforth et al. in press, a: Figure 28.5, © Michael Bamforth).

Area	Roundwood with morphological evidence suggestive of coppicing
Brushwood	1%
DWS	17%
Central platform	8%
Eastern platform	0%
Western platform	10%
CDA	44%

Table 4.1 Percent of roundwood assemblage, by area, which displays morphological traits associated with coppicing (Bamforth et al. in press, a: Table 28.1).

Growth ring count studies are often carried out on archaeological assemblages of roundwood that appear to be the result of coppicing, with the intent of identifying rotational cycles. However, coppicing can also be carried out on an ad-hoc basis and even if a rotational cycle is in place, practices such as draw felling can negate the evidence of any possible rotational cycle. Although recent research (Out et al. 2013) highlights the potential difficulties of identifying deliberate coppicing through growth ring count analysis, particularly of stems with a diameter of less than 20mm, it seems pertinent to consider this data.

Growth ring count and seasonality of felling analysis was attempted from the Star Carr assemblage for roundwood items identified as having morphological traits associated with coppicing and a control group that did not. Unfortunately, the relatively poor condition of the material at a cellular level, combined with the high rates of compression, severely hampered data collection and it was not possible to acquire a large enough dataset to be statistically viable for meaningful analysis. However, the data that were acquired are considered below.

A total of 78 growth ring counts were recorded (76 of these were from roundwood and two from roundwood debris with a complete radius from pith to bark edge present), 48 of which showed morphological evidence for possible coppicing (Table 4.2). Although it has been suggested that analysis only be carried out using an individual species from an individual context (Out et al. 2013), the lack of available data has necessitated the growth ring counts derived from all the spatial analytical groups and across species are considered together (Table 4.2 and Table 4.3). Given willow's propensity for regrowth, it is unsurprising that this is the most frequent taxa to show morphological evidence that may be indicative of coppicing (Table 4.3).

Morphological evidence for possible coppicing?	**Brushwood**	**DWS**	**Western platform**	**Central platform**	**Other**	**Total**
Yes	3	36	1	4	4	48
No	1	27	1	0	1	30
Total	4	63	2	4	5	78

Table 4.2 Frequency of roundwood and roundwood debris growth ring counts assigned to area (Bamforth et al. in press, a: Table 28.2).

Morphological evidence for possible coppicing?	willow	willow/aspen	aspen	birch	birch/alder/hazel	Total
Yes	12	1	5	9	3	30
No	39	0	6	3	0	48
Total	51	1	11	12	3	78

Table 4.3 Frequency of roundwood and roundwood debris growth ring counts assigned to taxa (Bamforth et al. in press, a: Table 28.3).

It is often possible to record the season in which an item has been felled, via microscopic examination, from the presence of early or late wood at the bark edge (Jane 1970: 68). However, due to the poor condition of the wood, this deduction was only possible for ten items, all of which have approximately two growth rings, the results of which provide no discernible patterning regarding seasonality of felling or harvesting (Table 4.4).

Morphological evidence for possible coppicing?	**c. 2 years growth, early wood**	**c. 2 years growth, late wood**	**Total**
Yes	3	3	6
No	2	2	4
Total	5	5	10

Table 4.4 Early and late felled/harvested material (Bamforth et al. in press, a: Table 28.4).

Due to the poor condition, many of the ring counts were given as an estimated range which for the purposes of this study have been assigned a median value (e.g. 3-4 years = 3.5 years). Out et al. (2013) have shown that stems in the 20-60 mm range will often have an older age for a given diameter when derived from un-managed as opposed to managed woodland resources. The age distribution for managed assemblages has also been shown to generally have a sharper cut-off in comparison to un-managed stems (Out et al. 2013). When plotting growth ring count against diameter, no clustering is noted for either roundwood with or without morphological evidence suggestive of coppicing (Figure 4.5). The roundwood with morphological evidence for possible coppicing does show this trend for slightly higher age for a given diameter but there is no sharp cut-off of growth rings (Figure 4.5). However, there is a marked tendency for the stems showing possible morphological coppicing evidence to cluster strongly in the 2-3 years of growth range, despite no such clustering being noted amongst the horizontal diameters, a trait that may be suggestive of some form of woodland management (Figure 4.6).

In sum, although no conclusive evidence for coppicing or pollarding has been found, there is certainly a strong selection bias for straight, even stems, rods and poles amongst the wood encountered at Star Carr, and deliberate woodland management strategies remain a strong possibility.

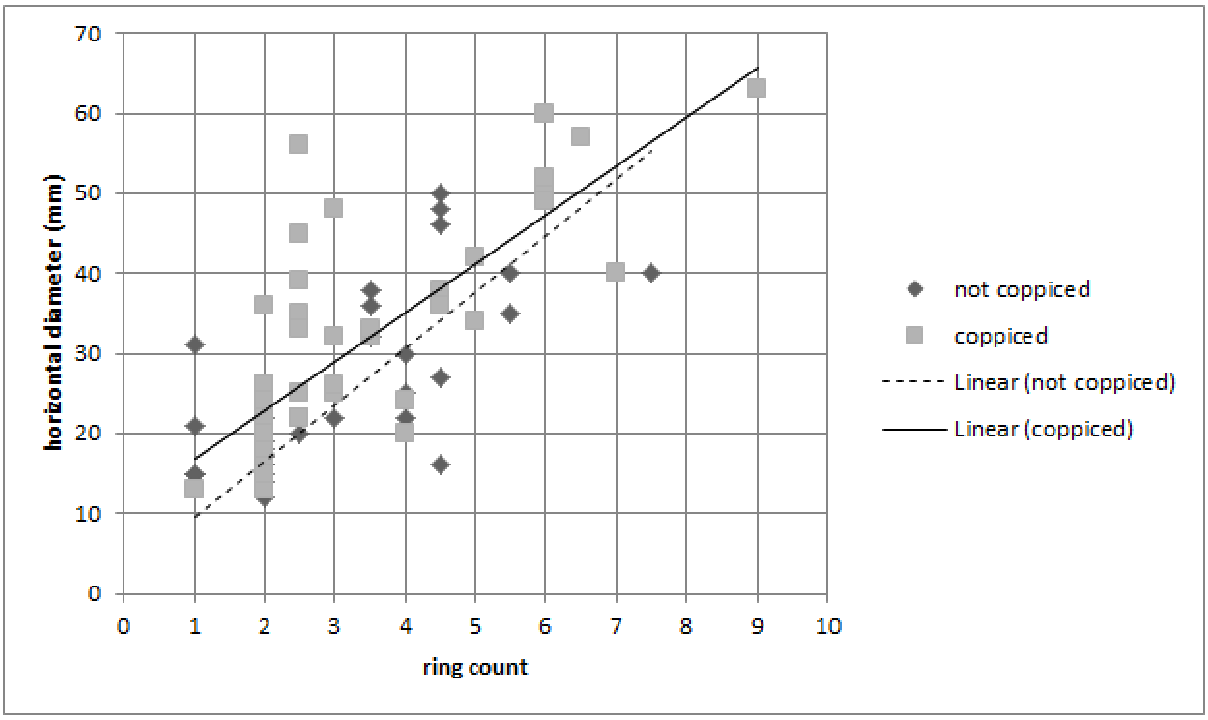

Figure 4.5 Growth ring count plotted against diameter for material with morphological traits indicative of coppicing and material without morphological traits indicative of coppicing (Bamforth et al. in press, a: Figure 28.6, © SCP).

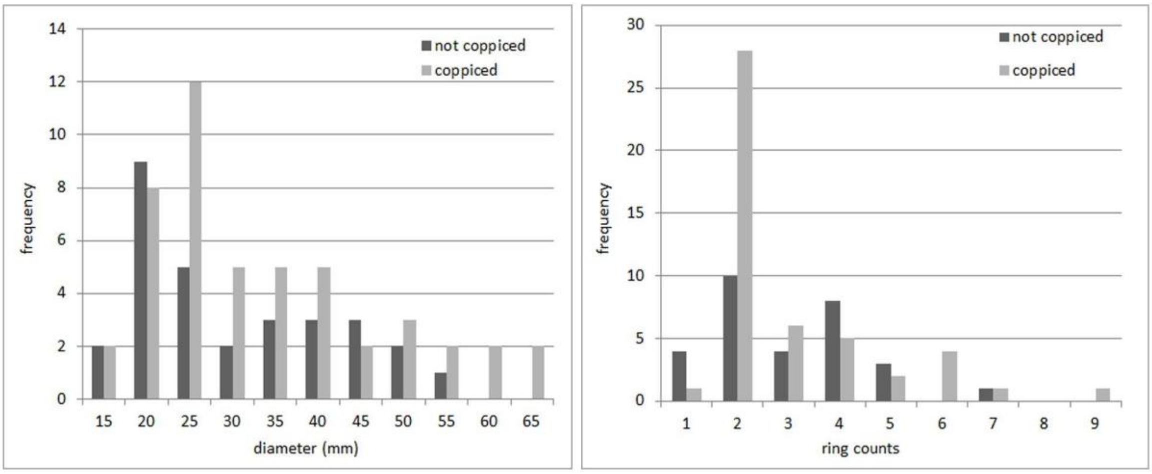

Figure 4.6 (left) frequency of horizontal diameters for material showing morphological signs of coppicing and material without morphological traits indicative of coppicing; (right) frequency of years of growth for material showing morphological signs of coppicing and material without morphological traits indicative of coppicing (Bamforth et al. in press, a: Figure 28.7, © SCP).

4.3 Technology

Prehistoric woodworking is based on two core principles:

1) Use of edged tools such as axes and adzes to fell trees and trim and hew timbers into shape by reducing the items down blow by blow, chip by chip.

2) Use of wedges and hammers to split or cleave logs longitudinally in the tangential and radial planes into the shapes required.

Perhaps unexpectedly for such an early assemblage, there is evidence for both techniques in the Star Carr material. In contrast, there is a low prevalence of vertical elements in the forms of stakes, posts or piles. The evidence for vertical elements is limited to five stakes: three roundwood and two utilised pieces of debris (Taylor et al. in press) and to the indirect evidence provided by the stakeholes and postholes of the dryland structures (Milner et al. in press). This is very unusual and worthy of note.

There is no extant evidence for the use of fire either to shape wood through charring and scraping or to harden wood amongst either the artefactual or the wider assemblage (Taylor et al. in press). In addition, with the exception of a small hole drilled through wooden artefact <115952>, probably with a flint awl (Taylor et al. in press), there is no evidence from Star Carr for joints or fixings. There is also no evidence for boat building, though it is likely that people at Star Carr had watercraft of some kind to navigate the lake and visit the islands, and a possible birch paddle was found by Clark (1954). However, more recent research has suggested that the artefact may in fact not be birch and that the item, although paddle shaped, may not have been used to propel a boat – instead being a possible plant processing tool (Taylor et al. in press). Although unlikely, there are three pieces of debris that may be derived from notch and split woodworking (Stewart 1984: 54; Christensen 1999: Fig. 9.2) that could conceivably be the by-product of log boat building (see section 4.3.2 Notch and split).

The following section will detail the specific methods that the Star Carr woodworkers were employing, and make suggestions as to the tools that they were using.

4.3.1 **Tools**

The wood assemblage provides us with indirect evidence of the tools used in the form of the traces they have left on the wood. Tool facets provide us with evidence for hewing and trimming and many of the well-finished wooden artefacts illustrate the woodworker's depth of understanding of dowel technology (Taylor et al. in press). The presence of a two-stem twisted willow-withy amongst the artefact assemblage similarly demonstrates an understanding of plying and cord production (Taylor et al. in press).

It is reasonable to assume that most of the pieces of wood displaying traces of working at Star Carr will have been trimmed to length with an axe or adze. However, there is a low prevalence of tool facets or stop marks; the ends of the majority of the wood assemblage (where the longitudinal cellular structure of the wood is truncated and exposed) have degraded to such an extent that few tool facets remain. Nevertheless, 171 items with tool facets and one item with a stop mark were recorded, with at least some examples seen in all the major analytical groupings. The survival of such marks appears to correlate with the condition of the material, increasing with distance from the lake-edge and being somewhat improved to the west of the site than the east (Appendix A: Figure 7.4). Where they are visible, the facets tend to be short, narrow and concave, as would be expected from the relatively obtuse cutting edge of stone tools (Coles and Orme 1978, 1984; Sands 1997). The single stop mark was recorded from debris <103726> and measured 40:4 mm (Figure 4.7).

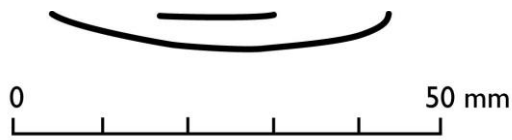

Figure 4.7 Tracing of stop mark left by the cutting edge of a flint axe or adze on the face of debris <103726> (Bamforth et al. in press, a: Figure 28.9, © Chloe Watson).

At Star Carr, a strong case can be made for woodworking activities being undertaken with bone, antler and flint tools. Microwear traces of woodworking on flint have been identified on a number of flint tools, initially by Dumont (1983; 1988), and more recently, as part of this project (Conneller et al. in press, b). Although it was not possible to identify wood traces on osseous tools due to the poor condition and, in the case of a bone chisel, a re-sharpening event (Elliot et a. in press), experimental research (co-ordinated by Aimée Little) demonstrated the high likelihood of their employment in woodworking tasks. Wood-hafting traces on flint tools provides further indirect evidence of the diverse uses of wood as a raw material at Star Carr.

Flint tranchet axes are well-represented in the flint assemblage and may have been hafted as either axes or adzes, most probably in a haft constructed from a willow heartwood dowel (Figure 4.8). Microwear traces of wood polish – suggestive of these tools being used for trimming and chopping wood – have been recovered from tranchet flake <98825> (Conneller et al. in press, a: refit group 89), axe <92077>, recovered from the eastern structure and two further small axes (Conneller et al. in press, a: refit group 88, <99469> and <94367>). Dumont (1983) also identified a core resharpening flake with woodworking traces.

Figure 4.8 Michael Bamforth using a flint tranchet adze to prepare a tree trunk for splitting a tangential outer timber from a standing tree (Bamforth et al. in press, a: Figure 28.12, © Don Henson).

Woodworking microwear traces have been recovered from several other flints. A Type E disc core (part of scatter AC8, Dumont 1983) is identified as a woodworking tool. Five burins with microwear traces of wood polish show evidence of scraping, grooving and whittling (Conneller et al. in press, b). Five blades show microwear traces resulting from use as woodworking tools: two utilised as borers and three as scrapers (Conneller et al. in press, b). Just one scraper displays woodworking traces, though it is possible that re-sharpening events removed evidence of use on wood and other contact materials from these tools (Conneller et al. in press, b). Notched/denticulate tools with transverse wood-working traces within the retouched zone indicate the use of these tools to scrape and/or burnish wood, possibly shafts (Conneller et al. in press, b). The circular, waisted, hourglass-shaped hole worked through wooden artefact <115952> provides indirect evidence for the possible use of flint awls on wood (Taylor et al. in press). This is further supported by Dumont's (1983) microwear work which identified two awls with traces of plant polish that may possibly indicate woodworking. Flint flakes were successfully used as part of 'groove and split' woodworking during experimental work (Figure 4.9).

Figure 4.9 (left) Flint flake being utilised to produce longitudinal grooves as part of 'groove and split' woodworking; (right) bone chisel used as splitting wedge as part of 'groove and split' technique (Bamforth et al. in press, a: Figure 28.13, © Don Henson, left; Michael Bamforth, right).

Elk antler mattocks were formed from either the beam, pedicle and adhering frontal bones or the beam and palmate portion (Elliot et al. in press). These tools would have been hafted with either a roundwood stem or heartwood dowel (Taylor et al. in press). Clark recovered six antler mattocks (Clark 1954) and the recent excavations uncovered a further finished example <113836> and an item interpreted as a possible roughout (Elliot et al. in press). Experimental work showed this type of tool to be effective as a woodworking tool; unfortunately the condition of the artefact did not allow for microwear analysis (Elliot et al. in press; Taylor et al. in press).

A single large bone chisel fashioned from a split aurochs metatarsal was recovered <117517> (Elliot et al. in press). Although analysed for use wear traces, any evidence of function had been obliterated by a sharpening event (Elliot et al. in press). The chisel does not seem to have been hafted and is of sufficient size to be held in the hand. There was clear bruising and percussion damage to the butt end of the tool to suggest that it was repeatedly hit with a heavy object; however, there was no breakage associated with this to suggest long-term or heavy usage (Elliot et al, in press). This item is of a suitable size and form to be used as a woodworking tool or a splitting wedge. Experimental work proved slightly smaller bone chisels to be very efficient and useful woodworking tools as well as splitting wedges (Figure 4.9).

It has been suggested that the numerous worked antler tines (n=175), originally identified by Clark, may have been utilised as wedges for splitting wood (Mellars and Dark 1998), and experimental work carried out in October 2014 proved them to be very effective for this undertaking. However, it is cautioned that these items are extremely numerous and would have been suitable for several different tasks (Elliot et al. in press). Two pieces of split willow, <116520> and <103149>, may have been wooden splitting wedges (Taylor et al. in press). In addition, there are several longitudinally split pieces of animal long bone that have been interpreted as the discards from which blanks have been split to fabricate barbed points (Elliot et al. in press); however, these could conceivably have been used as splitting wedges, though preservation of these items was too poor to allow microwear analysis (Elliot et al. in press).

Finally, stone <96759> has a series of parallel grooves that contain traces of microwear revealing wood and/or antler polish, raising the possibility that the item was used perhaps to sharpen barbed points or as an arrow straightener (Webb et al. in press).

4.3.2 **Notch and split**

Notch and split woodworking techniques can be used for felling trees (Jørgenson 1985; Stewart 1984: 38), facing up logs (Stewart 1984: 42) and hollowing out log boats (Stewart

1984: 54; Christensen 1999: Figure 9.2). The author is aware of this technique and the distinct 'blocks' of debris it produces (Figure 4.10 and Figure 4.11). Three pieces of debris that may have been produced by this technique were identified during the excavation:

- <99215>, 205 x 82 x 7 mm, tangentially split.
- <103715>, 160 x 74 x 10 mm, tangential outer split.
- <103805>, 418 x 115 x 65 mm, tangential outer split, torn down both sides, appears to be from base of small tree.

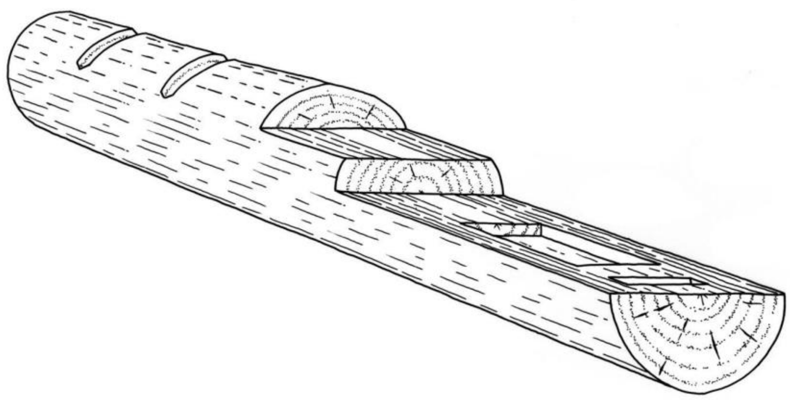

Figure 4.10 Notch and split technique (Bamforth et al. in press, a: Figure 28.10, © Chloe Watson).

Both <99215> and <103715> appear to represent debris from facing-up the outer surface of medium-sized timbers. Although it's not possible to ascertain what the purpose of this work may have been, the timbers might have been destined for use in small buildings or perhaps were having their upper surfaces prepared and flattened for use in lake-edge platforms. As <103805> seems to derive from the butt end of a small tree, it may represent debris from felling using the notch and split technique (See section 4.3.3 Felling and trimming and Figure 4.12).

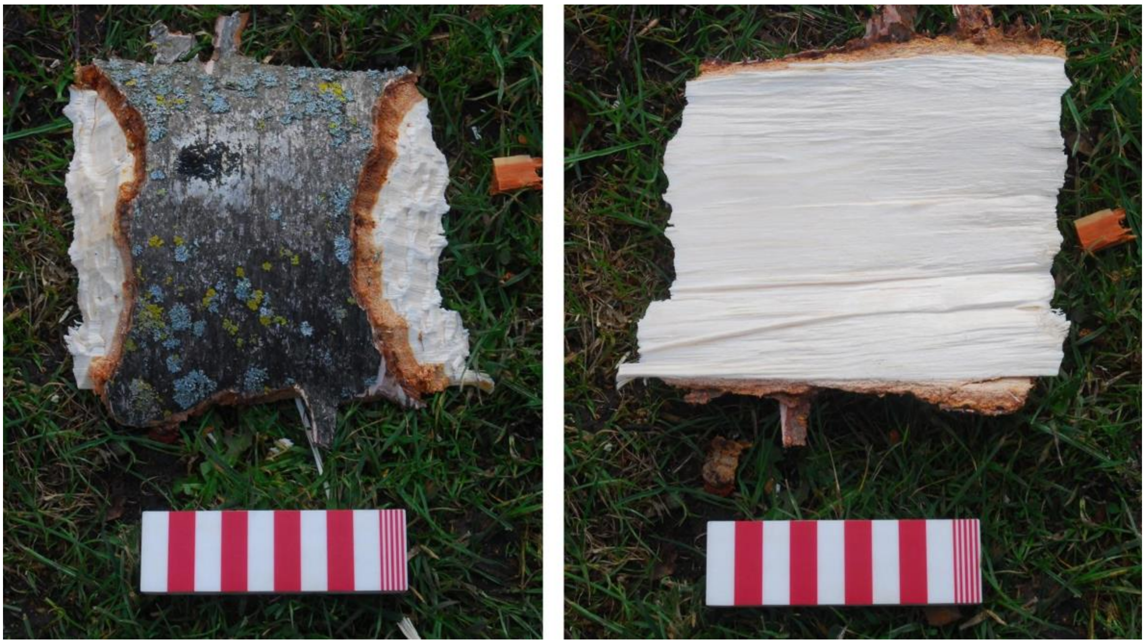

Figure 4.11 Notch and split debris produced during experimental work (Bamforth et al. in press, a: Figure 28.11, © Michael Bamforth).

4.3.3 **Felling and trimming**

There are several different felling techniques that the woodworkers of Star Carr may have used. It is possible that a tree may have been ringed 'beaver style'. Alternatively, a 'cut to fall' technique similar to modern practices with a front cut and back cut may have been used. Either of these techniques can be achieved through axing/adzing or by using a notch and split technique (Figure 4.12). A piece of notch and split debris possible derived from felling has been described above (see section 4.3.2 Notch and split).

There are 94 items identified as entire trunks of large trees. Seven of these were growing on the lake-edge and are lying in-situ where they have fallen into the waterlogged deposits and <109924>, which formed part of the western lake-edge platform, has a root bole present at the proximal end showing the use of a naturally fallen tree. However, only two trees display working at the proximal/butt end possibly related to felling. Both are from the DWS: tree <109557> has been tangentially split at one end and possibly trimmed at the other (it is unclear which end is proximal and which distal); tree <110365> has been reduced to a half split at the proximal end (the split face appeared torn, and parallel lines of chop marks were present, cutting across the grain). These may represent faint traces of notch and split felling.

It is also possible that fire may have been used to assist in the felling of trees. Two trees show evidence of charring: <99893> is lightly charred on one face at the proximal end, yet this charring does not seem extensive or intensive enough to be associated with felling. However, the proximal end of fallen tree <109922> has been completely charred through and it seems likely that this tree was felled by fire. However, there is no way to know if this was a deliberate cultural action designed to fell the tree or merely a by-product of a fire on the lake-edge.

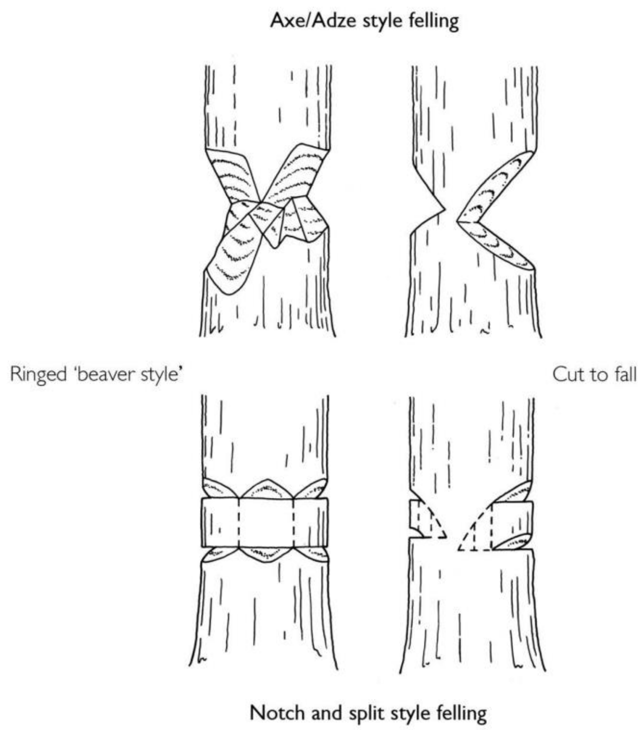

Figure 4.12 Possible felling techniques (Bamforth et al. in press, a: Figure 28.14, © Chloe Watson).

Generally limited to stone tool woodworking assemblages, the chop and tear technique of trimming small diameter roundwood stems (c. 20-50 mm) involves bending the stem and chopping it, allowing it to tear, and then chopping again to sever the stem, leaving a distinctive stepped edge. It is known from other UK stone tool woodworking assemblages such as Etton Neolithic causewayed enclosure (Taylor 1998a: Figures 169 and 170) and has been proved effective through experiment (Jørgensen 1985: 35-37 and Figure 41). Similar evidence was also recorded from the Danish Ertebølle site of Tybrind Vig (Johansen 2013: Figure 7). Twenty-four examples of chop and tear have been recorded from the Star Carr assemblage. This includes a particularly interesting example <103190> that shows evidence of both chop and tear and beaver gnawing (Figure 4.13).

Figure 4.13 <103190> showing chop and tear at distal end and beaver gnawing at the proximal end and side branch (Bamforth et al. in press, a: Figure 28.15, © Michael Bamforth).

Woodchips are detached using an edged tool during felling, trimming or hewing and 182 have been recorded (Table 4.6). These items represent a clear proxy for working with edged tools and, to some extent describe the work being undertaken. Tangentially aligned woodchips may describe pointing timbers, felling trees or perhaps trimming items to length. Radial woodchips are likely to represent facing-up the split surfaces of radially cleft timbers. The presence of two cross-grain woodchips is particularly interesting. When comparing the bronze tool-derived Bronze Age woodchip assemblage recorded at Flag Fen to the stone tool-derived Neolithic woodchip assemblage recorded at Etton, Taylor (2001: 182-3) points to the lack of cross-grained woodchips in the latter assemblage and suggests that it may be particularly hard to detach a cross-grained woodchip with a stone axe without suffering some damage to the tool. As such it is thought-provoking to note their presence in this, the earliest woodworking assemblage currently known from Europe. Further experimental work may help to elucidate the efficacy of stone axes when used to work across the grain.

4.3.4 **Splitting**

The woodworkers at Star Carr were prolific wood splitters and 1298 items (81% of the worked wood assemblage) show evidence of splitting with both finished timbers and debris/off-cuts well represented. The recorded items describe extensive splitting being undertaken in both the tangential and radial planes, producing split timbers up to 3.6 m in length (Figure 4.14). This is unusually long for any prehistoric woodworking assemblage (Bamforth 2010; Taylor 1998b, 2001) and shows a very high level of competence in this technique. The split debris is particularly useful as it provides supporting evidence alongside the finished timbers regards the types of work being carried out. The debris includes five items recovered from the DWS that appear to be the 'streamers' which form between split surfaces during the cleaving process. This overwhelming evidence for splitting (as detailed in Chapter 3) pushes back the earliest known evidence for the use of this technique in the UK into the Early Mesolithic and confirms that the technique was widely used at this point.

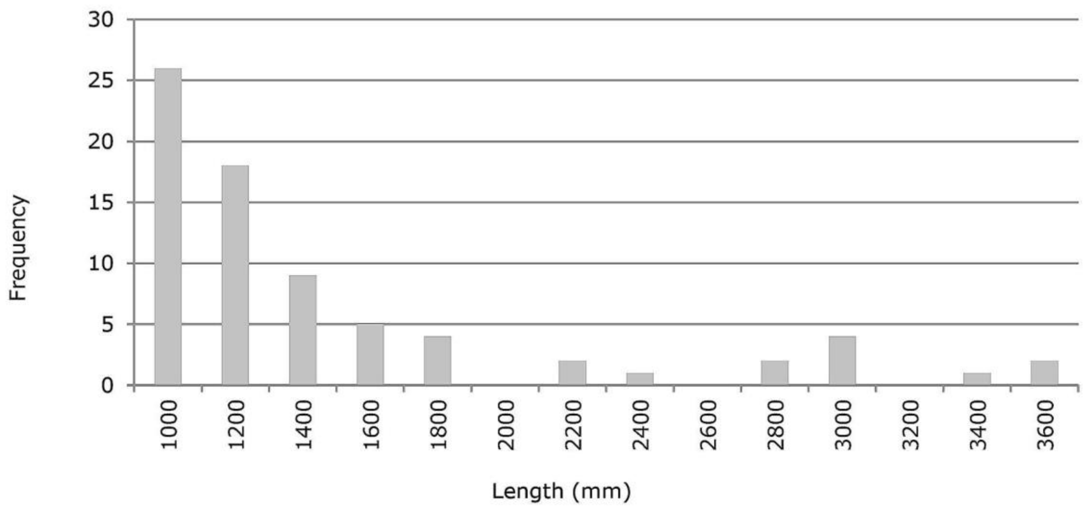

Figure 4.14 Lengths of split items greater than 1000 mm (n=74) (Bamforth et al. in press, a: Figure 28.8, © SCP).

There are several woodworking features that stand out amongst the Star Carr assemblage as being unique or very unusual. These include the high prevalence of tangential outer splits, the high prevalence of parallel-sided split items, the high prevalence of split timbers with the split fading or feathering out at one or both ends, the presence of longitudinal grooves on split faces, the presence of long, thin strips of woodworking debris and the presence of diagonal groove/gouge marks on split faces. The presence of these traces has led to the formulation of various hypotheses to explain the techniques that may have produced them, some of which have been tested through experimentation.

Star Carr's assemblage of split material appears in a variety of conversions. Tangential material dominates (73%), with moderate quantities of radially cleft material (21.3%) and occasional cross-grained items (1%) also present (Table 4.5). Interestingly, this closely matches the alignments of the recorded woodchip assemblage (Table 4.6). During the recording of the wood assemblage, it was noted that many of the split surfaces appeared rougher than would be expected, or perhaps torn. The cause of this is unknown.

Conversion	Frequency	%
radial	151	11.6
radial 1/2	79	6.1
radial 1/3	20	1.5
radial 1/4	20	1.5
radial 1/6	1	0.1
radial 1/8	5	0.4
tangential	729	56.2
tangential, outer surface split away	6	0.5
tangential outer	194	14.9
tangential and radial	15	1.2
cross grain	8	0.6
unknown	70	5.4
total	1298	100.0

Table 4.5 Conversions recorded from the Star Carr wood assemblage (excluding woodchips) (Bamforth et al. in press, a: Table 28.5).

Conversion	Frequency	%
Off-roundwood	9	4.9
radial	40	22.0
tangential	113	62.1
cross grain	2	1.1
unknown	18	9.9
total	182	100.0

Table 4.6 Conversions of the Star Carr woodchip assemblage (Bamforth et al. in press, a: Table 28.6).

4.3.4.1 Tangential outer splits

A striking feature of the worked wood assemblage recorded from Star Carr is the strong bias towards tangential outer splits, with bark edge still present (Figure 4.15). The split tends to fade out at either end of these timbers, which can range in length from 1-3.6 m. The presence of so many tangential outer split timbers within this assemblage is extremely unusual. In a later assemblage, such material would often be generated as waste material from squaring-up timbers into boxed heart or half splits. However, there is no evidence from the wood assemblage at Star Carr of such boxed-up material as a finished product to suggest that this is the case here. There are several items which have had a single outer surface tangentially cleft away, producing an offcut that was a tangential outer cleft. However, there are only six of these items (Table 4.5) which cannot account for the large number of tangential outer splits. Instead, the tangential outer splits seem to be for the most part finished products rather than waste material. This leads to the possibility that some of these timbers were being harvested from living, standing trees. This practice is known ethnographically. Indigenous peoples of the Pacific North-West Coast split huge structural timbers from living cedar trees (Stewart 1984: 42), and the Bindibu people of Central Western Australia cut parallel-sided planks from standing Mulga trees from which to produce spear throwers (Thompson 1964) using a technique similar to the 'groove and split' technique discussed below.

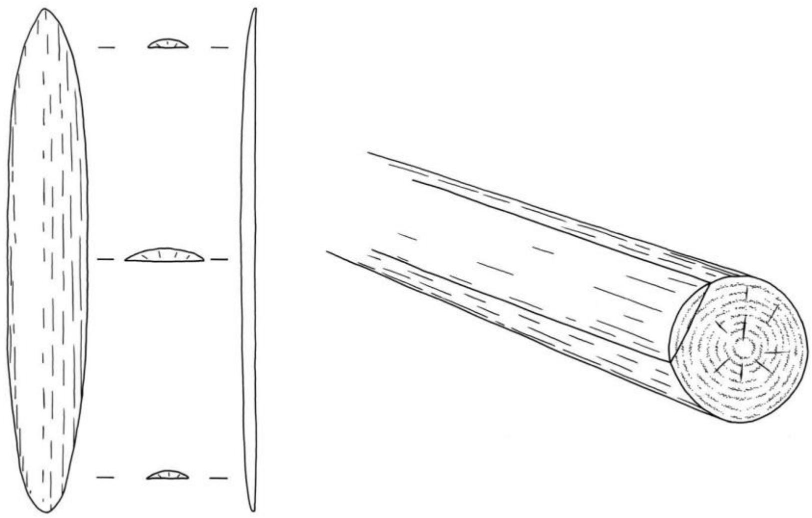

Figure 4.15 Tangential outer splits, often fading / feathering out at both ends (Bamforth et al. in press, a: Figure 28.16, © Chloe Watson).

Experimental work carried out during October 2014 showed it to be surprisingly easy to cleave planks from a standing tree. A notch was cut out at the top of the desired split to allow the insertion of splitting wedges. Wood, bone and antler wedges were used to chase the split down the trunk (Figure 4.16). This resulted in a stepped, almost cross cut distal/top end to the timber and a feathered out lower/proximal end. The tree had a diameter of 165 mm. It took 20 minutes to make the top cut and a further 30 minutes to split away a 1.6 m long timber. The author and Diederik Pomstra, who carried out the work, felt that this could be achieved in perhaps half the time with practice. It was noted that to split a longer timber from a standing tree, one would need to be at height having either climbed the tree or used a ladder or similar. However, it was not possible to replicate the feature noted on several split archaeological timbers where the split fades or feathers out at both ends. It is still unclear which technique produced this result.

Figure 4.16 Michael Bamforth splitting a tangential outer timber from a standing tree using wood and antler wedges (Bamforth et al. in press, a: Figure 28.17, © Don Henson).

4.3.4.2 Groove and split

Previous investigations at Star Carr identified the presence of longitudinal parallel grooves on the faces of timbers and a tendency for both parallel-sided timbers and long, thin, parallel-sided woodworking debris (Mellars et al. 1998).

Category	Type of evidence	Brushwood area	DWS	Central platform	Eastern platform	Western platform	CDA	*total*
timber	grooves on face	3						*3*
timber	parallel sided		54					*54*
timber	parallel grooves on face		20	8				*28*
timber	scars from cleaving or hewing away other pieces		7					*7*
debris / timber debris	parallel grooves on face	1	59	3				*63*
debris / timber debris	parallel sided	16	201	17			7	*241*
debris / timber debris	scars from cleaving or hewing away other pieces		4					*4*
total		*20*	*345*	*28*	*0*	*0*	*7*	***400***

Table 4.7 Frequency for possible evidence of groove and split woodworking, by area.

There are 400 items from the Star Carr assemblage which show evidence for possible groove and split woodworking, including both large timbers and smaller debris and offcuts (Table 4.7). Material showing woodworking traces that may be indicative of groove and split were predominantly located within the DWS. The complete lack of these traces from both the eastern and western platforms is likely to be a result of the relatively poor preservation conditions seen in these areas.

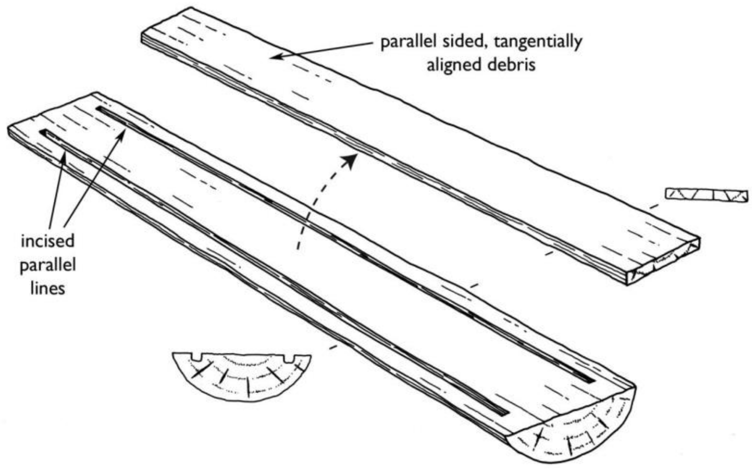

Figure 4.17 Schematic representation of groove and split (Bamforth et al. in press, a: Figure 28.18, © Chloe Watson).

Similar traces have been recorded at Etton Neolithic causewayed enclosure (Taylor 1998a), the Raunds Neolithic Long barrow (Taylor and Bradley 2007) and the Late Mesolithic Carlisle Northern Development Route (Taylor and Bamforth 2013). These traces, distinct to stone-tool woodworking assemblages, may have been produced by a previously unrecognised woodworking technique – 'groove and split' – whereby parallel grooves were used to control the edges of splits and the debris was split or gouged from between the parallel grooves (Figure 4.17 and Figure 4.18). This hypothesised technique is somewhat similar to the 'groove and splinter' technique applied to antler (Elliot et al. in press) or to the ‘notch and split’ technique used for tree felling and boat building discussed above.

This technique was tested on a small scale during experimental work. Parallel grooves were incised into the surfaces of split birch timbers with both flint flakes and bone chisels. The section of wood between the grooves was then split away using antler tines and a bone chisel. Although the experimental work did produce the woodworking traces recorded from Star Carr in the form of parallel grooves and long, parallel-sided pieces of woodworking debris, it was noted as being quite a slow technique and it was unclear why it would have been necessary to split thin pieces away from the surfaces of timbers.

Figure 4.18 Groove and split debris <103676> (top) and debris produced during experimental work (bottom) (Bamforth et al. in press, a: Figure 28.19, © Michael Bamforth).

4.3.4.3 Diagonal groove/gouge mark

A small group of split timbers also had an unusual diagonal groove or gouge mark present on the split surface (Figure 4.19). Previous experimental work carried out at Flag Fen had shown that using seasoned oak wedges to split wood does not leave any traces on the split timber. Furthermore, traces of splitting wedges on the split surfaces of timbers are not seen from prehistoric woodworking assemblages. Therefore, it was hypothesised that the diagonal features may have been produced using antler tines as splitting wedges. However, experimental work using antler tines to split birch timbers showed this not to be the case and the cause of these groove features is still not understood.

Figure 4.19 Diagonal groove feature on <99211> (Bamforth et al. in press, a: Figure 28.20, © Michael Bamforth).

4.4 Star Carr's woodworking technology

The detailed analysis of the traces of woodworking present in the Star Carr wood assemblage has provided an important and unique insight into the type of woodworking being undertaken at the site around eleven thousand years ago. The presence of large timbers and trees as well as the thorough recording of debris has enabled a reconstruction of some of the methods that the inhabitants of Star Carr were using to work wood. Trees of varying sizes were felled away from the lake, using hafted axes. The side branches were trimmed and larger baulks were broken down into the required shape using both tangential and radial splitting. Timbers were faced and shaped by hewing and trimming and may also have been shaped by using a 'groove and split' technique. Some material was also harvested: long, straight re-growth rods and stems were collected, and the growth of these materials was potentially encouraged via woodland management techniques not dissimilar to the historic practice of coppicing. In some cases, tangential outer split planks were probably harvested from standing trees. The low prevalence of stakes and other vertical elements is unusual but not unheard of. Several other early structures considered in the previous chapter share this trait, being formed solely of horizontal elements (see section 3.6: Belmarsh platform, Hatfield trackway and the Stirlingshire platform). These techniques and the tools used to carry them out do not seem to change over the 800 years of occupation; the woodworking practices seem to represent a single, distinct, temporally-consistent tradition.

As well as documenting the woodworking methods that were used at Star Carr, it has also been possible to identify a suite of tools that formed part of what might be called a Mesolithic woodworking toolkit. This has been drawn together from a combined consideration of traces on the wood, items in the finds assemblage and the use of microwear analysis and experimental archaeology. This toolkit appears to have consisted of flint axes/adzes, blades, burins, denticulates/notched pieces, scrapers, flakes, fragments, chunks, nodules and coarse stone burnishing tools. In addition, results from experimental research suggests the use of splitting wedges made of wood, bone and antler, and the probable use of antler mattocks and bone chisels, which proved to be highly functional tools for working wood.

There is currently little to compare Star Carr's woodworking assemblage to. In the UK, investigations at the submerged landscape of Bouldnor Cliff (Isle of Wight) provided evidence for Late Mesolithic woodworking in terms of tangentially split timber and a possible log boat fragment (Rich et al. 2016; Taylor 2011). The Bouldnor Cliff assemblage is relatively small (although large in terms of Mesolithic worked wood in the UK) and, coupled with taphonomic issues resulting from the burial environment, this has led to some difficulties differentiating anthropogenic from natural material. To this end, the team at Boudnor Cliff undertook a programme of experimental work to better understand Mesolithic woodworking practices, focusing particularly on the use of non-stone tools, including bone chisels and wooden wedges (Rich et al. 2016). As with the experimental work undertaken in support of this investigation, non-stone tools proved to be effective woodworking tools.

Star Carr currently sits alone in the UK as the only large assemblage of Early Mesolithic worked wood. However, there are comparable assemblages in Europe. Investigations at the submerged Danish site of Tybrind Vig have provided evidence for Mesolithic carpentry and woodworking practices relating to the Ertbølle period (Andersen 2013) including radial and tangential splitting, trimming of roundwood stems and the remains of felling scars, carried out with both core (generally larger items) and flake (generally smaller roundwood poles) flint axes. Dowel technology and species selection is also well represented in a series of hafts, digging sticks and bows. These tended to be extremely well finished, obliterating any evidence of initial production. A small number of charred woodchips (n=13) were also present that provide evidence for possible 'char and scrape' woodworking at the site. Like at Star Carr, the propensity for straight hazel rods has also led to the suggestion of coppicing at Tybrind Vig, in this case to produce stems for the construction of fish weirs. Nevertheless, the small volume of Early Mesolithic wood – both in the UK and Europe – means that the Star Carr assemblage makes a highly significant contribution to our understanding of very early woodworking and highlights the importance and relevance of a thorough documentation of this Early Mesolithic technology at Star Carr.

5 Discussion

The data presented in the previous pages have sought to explore past and current interpretations of the formation of the wood assemblage at Star Carr, and to reconstruct the woodworking technology in evidence at the site. This chapter provides an overview of the key points that the most recent campaign has identified from the wood assemblage, before placing those findings in a broader context.

5.1 The Star Carr woodworking: key insights

There has been a suggestion that much of the worked wood assemblage, and the structures encountered prior to the current campaign, is not anthropogenic, but was instead predominantly formed by beaver action (Coles 2006: 78). Although this research has demonstrated that there is indeed evidence for beaver activity, both predating the human activity at Star Carr and continuing throughout the phases of deposition, the volume of beaver-modified wood (n=24) are small in comparison to the quantity of split (1298), trimmed (138) and hewn (33) items produced by Mesolithic woodworkers. The presence of woodchips (182) is another key indicator of the anthropogenic origin of much of the assemblage. This research has thus clearly shown that the role of beavers in the formation of the wooden structures, though distinct, was minimal. Beaver activity appears to pre-date human activity at Star Carr, though diminishes during human presence at the site.

Instead, the relationship between the inhabitants of Star Carr and their forested environment can increasingly be intimated to be sophisticated and skilful. The presence of many roundwood stems within the examined wood assemblage makes the tantalising suggestion that they may be derived from coppice. This is represented by a spike in growth rings of 2-3 years seen amongst the roundwood with morphological indicators of coppicing, and also a slightly elevated diameter to age ratio for the roundwood possibly derived from coppicing compared to the control group. This may demonstrate woodland management in the form of intentional coppicing, alternatively, it might simply be a result of natural re-growth of material from trees felled either by humans or beavers.

There is certainly much evidence from the wood assemblage that the woodworkers at Star Carr showed a high level of competence, with strong evidence for a single, distinct, temporally-consistent woodworking tradition spanning the entire 800 year occupation of the site. Although complex carpentry in the form of joints or fixings does not seem to have been used, the woodworkers had an excellent understanding of both splitting and dowel technology (for dowel technology, see Taylor et al. in press). There is also evidence for the use of multiple twisted stems of willow plied together to produce an early form of rope (Taylor et al. in press). Entire trees were felled and then utilised whole or split down into large timbers, several of which were impressively long in a prehistoric context. It also seems likely that as well as harvesting regrowth 'coppice' stems, the woodworkers at Star Carr were harvesting planks from living trees, demonstrating a husbandry of available woodland resources. Together, this evidence points to a much more sophisticated package of technology than had previously been imagined for early carpentry.

As there are very few assemblages which could be used to compare the Star Carr material to, the experimental work was particularly useful in providing an analytical framework for understanding past woodworking technology. As is often the case when carrying out experiments which rely on skill, knowledge and crafts that are no longer commonplace, a real difference was observed in the speed and quality of work that could be achieved by skilled versus unskilled labour. It was also interesting to note that during the initial manufacture phase, which in these experiments was generally carried out with a flint tranchet axe, the more experienced woodworker produced larger woodchips and debris than the less experienced woodworker; the former working more efficiently to detach larger pieces of debitage for each strike of the tool.

Although the wood assemblage and experimental work have provided a wealth of evidence for woodworking and basic carpentry practices at Star Carr, many questions remain. For instance, the efficacy of 'groove and split', the performance of flint axes when working across the grain, and the creation of split timbers that fade out at both ends are still poorly understood. It is through further experimental work, alongside the analysis of excavated remains, that we will further our understanding of Mesolithic woodworking practices.

Overall, it should not be surprising that Mesolithic woodworkers had a firm understanding of the use and selection of available resources and had perfected many basic carpentry techniques, particularly when considered in conjunction with the fine and precise microlith technology in use at the time, and in light of the extreme antiquity of the utilisation of wood for artefacts (Taylor et al. in press). When excavating and analysing worked Mesolithic wood, it seems prudent to start from a perspective that expects relatively advanced woodworking technology, carried out with great sympathy to the naturally available resources, to fully understand what would have been a critical and versatile technology of the period.

5.2 The Star Carr woodworkers: their relationship with the wood

To fully understand the communities of people who made Star Carr their home, we need to consider both how the inhabitants influenced their environment and how they were influenced by it. The location of the site on a peninsula optimises the wet / dry boundary readily accessible from the site (Mellars 1998: Fig 19.12a) and provides opportunities to exploit lake and dryland resources. Given that the wood and timber discussed herein is a dryland resource, it is somewhat ironic that it only survives in the adjacent wetland environment of the lake. The effect of the occupants on their landscape were many and diverse and include reed clearance and burning along the edge of the lake (Mellars and Dark 1998; Milner et al. in press, a), the felling of trees from the surrounding woodland, the construction of lake-edge platforms and small dwellings as well as the gathering and predation of flora and fauna from both the lake and the surrounding woodlands. It is now widely accepted that Mesolithic peoples did not sit outside ecology but formed an integral part of the environment, their actions helping to shape the living world around them (Warren et al. 2014). The debate is now focused on the extent to which different groups' activities influenced the ecology of their region, from opportunistic use which had limited impact to systematic promotional strategies which enhanced the availability of desired plant and animal resources (Zvelebil 1994).

The temporal continuity of the technological traditions including flint (Conneller et al. in press, b), bone and antler working (Elliot et al. in press) and, as discussed herein, woodworking, may point to some continuity of culture of the people making use of this space in the landscape. Having considered the woodworking technology, it is also important to consider the possible human–forest–tree relationship within which raw material would be acquired. The trees that filled the landscape around Star Carr are the largest living thing that people would have encountered (Taylor 2010) and this, considered alongside their often-lengthy life cycle, may have led to an association with the rhythm of human ancestral cycles of transgenerational life and death (Evans et al. 1999: 251).

However, trees, particularly in the wooded landscape surrounding Star Carr, do not sit in isolation. Together they formed an extensive landscape of woodland or forest. The experience of being in a wood is one many of us are familiar with. The wind rustling the leaves, the sounds of bird song and the noise of a passing animal. A stick cracking underfoot, the smell of leaf mulch or the beauty of a ray of sun streaking down through the canopy. It's an experience that constantly changes in temporal cyclical cycles on a daily and yearly scale that is spatially differentiated as we move through the environment and emotionally shifting as our life changes within it: a never-repeating endlessly-varying cycle. Different people all bring a unique experience to their equally unique environment and it is hard to imagine how different, perhaps enhanced, a Mesolithic person's experience of their 'home' forest must have been to mine as a modern-day interloper, outside of my natural urban environment. The level of resource exploitation at Star Carr certainly indicates a relatively high level of knowledge of, and interaction with, woodland resources to procure specific types of tree required for various artefacts.

Due to the limited evidence for woodworking and woodland utilisation in the UK from such an early date, there is very little to draw on when trying to understand more about the relationship between the Star Carr inhabitants and their woodland environments. As Evans et al. (1999) propose, the immersive experience of living within a forested landscape may have led to the forest itself – and the omnipresent trees that form its constituent parts – having a central role in the "concerns, myths, classifications and value of these communities" (Evans et al. 1999: 241). The denizens of Mesolithic forests could be expected to have a rich language for, a directional understanding of, and deep resource-based knowledge of their seemingly limitless wooded landscape. However, the same wooded landscape with its limited horizons and near constant canopy is also likely to have contained sources of real and perceived physical and spiritual danger (Davies et al. 2005). To navigate around and through this environment would be through a deep knowledge of animal paths, distinctive trees, woodland clearings and unique remembered places within the forest. Paths used by humans focus activity along their route, provide nodal points at junctions and may contribute to the development of clearings at such junctions (Davies et al. 2005: 284). Trees could also be a valuable source of shelter, not only on a temporary basis beneath their canopy, but also within the protective setting of the bole of an uprooted tree. An example dating to c. 4350 BC has been excavated at Blick Mead, Wiltshire, complete with hearth, central post holes and stones, perhaps forming the base of walls or weighing down a hide canopy. Three Early Neolithic examples of tree bowl shelters are cited by Evans et al. (1999) in Cambridgeshire at Hinxton (one) and Barleycroft Paddocks (two). Brown (1997) also points out that fallen trees would have caused gaps in the canopy that may have provided focus for human and animal activity.

Davies et al. (2005) attempt to address the issue of Mesolithic people's relationship with the woodland they lived in, focusing the discussion around paths through the landscape and clearings within it. It is generally accepted that forest clearings were used by Mesolithic populations for food procurement, with some researchers arguing that clearings may have been anthropogenically-created or expanded by techniques including felling, burning, girdling or coppicing (see Davies et al. 2005: 280 for an overview).

Davies et al. (2005: 283) reject the current social paradigm placing Mesolithic hunter-gatherers in harmony with their environment, instead arguing that anthropological data can be used to support a model where at least parts of the landscape were viewed as wilderness and associated with fear. This concept is a direct inversion of the model presented by Warren (2003) who puts forward an argument whereby the ancient forests of Ireland might not have been regarded in the Mesolithic as the 'fearful wildscapes' they are suggested to be in the prevailing literature. An argument for a social space, as central to life as the hearths and clearings of 'home' is made.

Despite the relevance of these observations, the author does not agree with Davies et al. (2005) invoking a wilderness/fear model to explain the inception of such landscape routes, as it relies on cherry-picked anthropological observations to support this viewpoint. Although it is a viable model, there is no more or less supporting evidence for it than the materialist, reciprocal human/environment paradigm Davies et al. (2005) rejects. The wilderness/fear model is particularly at odds with Evans et al.'s (1999) immersive woodland model which describes a much more gentle relationship between people and the woodland they lived in.

What these models have in common is their description of woodland as spaces with tree cover, paths and clearings. The same mechanisms of fire, lightning strikes and anthropogenic influence are suggested and a model of perception and interaction laid over them. Perhaps as well as invoking the forest, theoretical models also need to include the diversity and agency of human experience. It is possible that some members of a group may have seen the forest as a dangerous wilderness, home to threat and danger, whilst others may have seen them as parkland, there to be travelled though and exploited or harvested of resources. Perhaps there were even prescribed mechanisms within a society to manage human-forest interactions and different group members' relationships to the woodland.

Furthermore, humans are far from the only species living within, moving through and indeed altering the woodland environment. As well as browsing vegetation, creating paths and leaving the remains of kill and defecation, there are several species present in the faunal record at Star Carr that would alter the woodland environment in other relatively distinct ways – red deer stags will debark trees whilst rubbing the velvet from their antlers and roe deer will mark the bark of trees to define their territory. It seems likely that these and other natural phenomena may well have been used to identify specific points within the landscape, sitting alongside anthropological markers, such as carvings made in trees (Warren 2003: 22, Evans et al. 1999: 249).

Indeed, humans are not even the only *woodworkers* present in the forest environment. Beavers not only fell trees and create clearings, they can also dig canals for movement and build substantial timber structures including dams and lodges (Coles 2006). Perhaps these structures even provided the inspiration for the first human trackways and platforms constructed in wetlands.

Human interactions with the world around us are generally layered in complexity and contingency, potentially providing cognisant space for these models to operate together. Whilst taking into account the immersive nature of woodlands presented by Evans (1999), within this space there is room for the classic parkland/resource procurement model and Davies et al.'s (2005) spaces of wilderness and fear. What is clear is that the woodworkers at Star Carr were travelling through a tree-covered landscape they would have been intensely familiar with to collect, move and transform a resource they had a deep knowledge of, and subsequently use it to transform and modify the lake-edge environment they inhabited.

6 Conclusion

Evidence of wooden structures or indeed woodworking from the Mesolithic is extremely rare, and not only do the remains encountered at Star Carr represent the earliest known wood-built structures and evidence of carpentry from the UK and possibly Europe, they also represent the most substantial. Evidence on this scale is not encountered elsewhere in the UK until the Neolithic, and as such Star Carr is an exceptional site by which to consider early woodworking technology and woodland utilisation.

This thesis has aimed to further our understanding of woodworking techniques in the Early Mesolithic by using fine-grained recording and analysis of the individual pieces of worked and unworked wood recovered from the lake-edge deposits at Star Carr, and to use this data to consider how the inhabitants of the site utilised and exploited woodland resources. This study has clearly demonstrated the efficacy and robustness of such a method, showing that the time invested in detailed recording greatly enhances the analytical potential of the material. Through this approach, it has been possible to address the research goals outlined in Chapter 1, each of which is discussed in turn below.

6.1 Woodworking technology

This research has identified a single, distinct woodworking tradition utilising the relatively small species of pioneer trees present within the heavily wooded, preboreal landscape. The woodworkers at Star Carr were splitting long, substantial timbers in the radial and tangential plane, most probably with antler and wooden wedges. They were trimming and hewing larger timbers into shape with hafted tranchet axes and most probably used bone chisels, smaller flint tools and antler mattocks for further trimming and shaping and stone tools for finishing. Although no evidence for jointing was encountered, the woodworking tradition is relatively advanced and would have been a key element of everyday life.

The scale of the woodworking is impressive. A surprisingly large percentage of the excavated waterlogged area contained worked wood, extending in places outside the investigated area to the west and south. This is not a fleeting glimpse of an occasional activity but a window into a world that featured many wooden structures, in both the wet and the dry areas of the site.

Although a skilled task, most of the woodworking techniques in evidence are not complex, and it is likely that such skills would have been relatively widely practiced by the population.

Although not considered herein, it seems likely that some of the artefacts, particularly those utilising dowel technologies (such as possible hafts and bows, Taylor et al. in press) are likely to have required a higher level of specialist knowledge. It is possible that such specialist knowledge might only have been possessed by limited members of the population, individuals we might today describe as carpenters or specialised woodworkers.

The people living at Star Carr used their carpentry skills to construct at least three platforms (including that first encountered in 1985 and reported in Mellars and Dark 1998) along the edge of the lake, to provide access to the wetland margins. The three platforms are strikingly similar to one another, the primary axis of each being defined by entire tree trunks and large split timbers (up to 3.5m in length) lying parallel to the shore. The dating model (Figure 2.8 and Table 2.3) and the formation of the platforms both suggest that although the platforms were constructed over a period of some 200 years, each was built as a single event. The similar construction and setting suggests that all may have performed similar function(s), although the broad temporal frame perhaps warns against such a simplistic interpretation. The interpretation of the lake-edge platforms is in broad agreement with Mellars and Dark (1998), although the activity is more widespread than was previously known.

I have interpreted the extensive DWS encountered further into the lake as an ad-hoc trackway to access deeper water. Although this feature also contained large trees and split timbers, a much higher proportion of woodworking debris and off-cuts were present than from the lake-edge platforms and the feature was formed over a longer time frame of several centuries, perhaps describing episodic use and deposition.

A reinterpretation of Clark's (1954) 'brushwood habitation platform' via detailed recording of the individual wooden elements of the accumulation has shown two distinct deposits. To the east of Clark's Cutting II is a natural accumulation of small-diameter roundwood brash with occasional anthropogenically-modified items probably representing casual discard related to lake-edge woodworking activities. To the west and south of Cutting II is a deposit made up predominantly of straight-stemmed small-diameter roundwood and small pieces of woodworking debris, including woodchips, that represents a mixture of casual discard and midden-like deposits with the presence of a high frequency of finished wooden artefacts and other find types hinting at more formalised, structured deposition.

As much as we have learnt about early woodworking practices, there are still questions that remain unanswered. It has not been possible to positively identify the technique that left distinctive longitudinal working traces on many larger timbers. Further investigation of the processes (such as groove and split) that might have resulted in these marks, via experimental archaeology, may further enhance our understanding of woodworking practices at Star Carr. Although the study of the wood itself and the woodworking was carried out almost entirely by the author, relying on nothing more than rulers and tapes, the identification of a possible Early Mesolithic woodworking toolkit necessitated an interdisciplinary approach working closely with animal bone, antler, flint and use wear specialists in conjunction with a programme of experimental archaeology and the input of an ancient technology specialist. This holistic approach is essential to furthering our understanding of Mesolithic woodworking technology and clearly demonstrates that, in modern field archaeology, the team stands above all else.

6.2 Utilisation of woodland resources

The relationship the inhabitants had with the woodland around them is open to debate. It was certainly an immersive experience, but whether the forest – and the trees it was formed of – represented a safe space, one full of danger or perhaps both is hard to discern. What is clear is that the woodland would have been imbued with meaning. Focal points such as clearings, human and non-human pathways, marks left on trees by people and animals and a sense of personal and communal history and narrative would all have formed part of the rich engagement with the landscape to produce deep sense of both space and place.

What is also clear is that the occupants of Star Carr had a detailed knowledge of the forest around them and widely exploited the woodland resources available in the area. Aspen was the preferred wood for larger, cleft timbers and willow for smaller rods and poles with some birch present throughout the assemblage. These findings concur with those reported from the 1985 investigations (Taylor 1998b), but contradict Clark's reporting of the wooden remains being comprised entirely of birch. The woodworkers eschewed the knottier trees growing along the margins of the lake in favour of straighter-grained, more easily-worked material growing in a denser wooded environment. The inhabitants of Star Carr sought out long, straight roundwood rods and poles and may have worked to encourage this resource, perhaps using methods similar to historic and modern coppicing. A further glimpse of possible woodland management practices is provided by the presence of many long, tangentially-split timbers that may well have been cleft from standing trees.

Unfortunately, the relatively poor condition of the wood at a cellular level has impinged on our ability to interrogate seasonality via analysis of the final growth ring. Debates around coppicing are notoriously difficult with many possible harvesting practices being difficult to control for. However, active research is currently being carried out in this area (Out et al. 2013, 2017) based on both archaeological and modern assemblages and as this moves forward, it may be fruitful to revisit the branch age/diameter analysis in light of future findings.

Above all, this study has shown that wood and trees, timber and technology should not be considered separately from the woodworkers and carpenters who work the material. Woodworking is not only an intensely personal pursuit, it is one in which the worker forms a relationship with the tree. Many a woodworker has been heard to say that they do not make anything from wood, they simply 'bring out' the form of the timber or the artefact that was already present within the tree (personal experience). The woodworking tradition evidenced at Star Carr stands apart from later assemblages, and there is much further work to be done in attempting to quantify the extent to which technological capability or species availability produced the distinct character of this assemblage. It is perhaps only through extensive comparison between UK assemblages of Later Mesolithic and Neolithic stone-tool woodworking which rely on boreal taxa (such as ash and oak), and ethnographic examples of technologies which utilise similar species to those recorded at Star Carr, that will elucidate this question. This would see research into woodworking technology moving forward into a social understanding of woodworkers' roles in society, and the rich lifeways of past peoples. Further insights might also be gleaned by seeking comparison with Early Mesolithic structures from further afield – in mainland Europe and beyond. Further research into the relationship between the inhabitants of the site and the woodland environment they lived within could thus help to establish the nature of the engagement between humans, technology and trees.

6.3 Final thoughts

The investment in terms of time, resources and labour involved in building the lake-edge wooden structures in the wetland at Star Carr alongside the presence of stake-built, bender-like structures on the dryland hints that group sizes may be larger than we traditionally expect and that occupation of the site was perhaps less fleeting than has been suggested, hinting at a greater degree of sedentism than is usually associated with Early Mesolithic groups.

Wider debates around the treatment of waterlogged heritage and discourses of preservation in-situ against destruction in-situ have swung back and forth, with Star Carr often at the heart of this debate (Last et al. 2009). The question around whether there are 'more Star Carrs' either in the Palaeolake Flixton or elsewhere has been much discussed (Last et al. 2009). What is the likelihood of having the opportunity to investigate another waterlogged Early Mesolithic site in the UK or elsewhere? I suggest that as building techniques improve and practices such as deep piling decrease in cost, development will push into ever more liminal zones, often those associated with deeply-layered alluvial deposits and the waterlogged organic remains they can contain. I therefore posit that we are likely to see more organic-rich Mesolithic archaeology in the UK.

In the case of the East Anglian fens, the focus of archaeological investigations has pushed out from the traditional gravel uplands and fen edge and into the deeper alluvium of the open fen. This is providing incredible glimpses not only of Bronze Age Fenland occupation (e.g. Must Farm), but also earlier prehistoric landscape divisions at relatively low elevations. As previously dryland ancient surfaces at ever greater depths are encountered, often in association with clay extraction, the chances of finding another 'Star Carr' in the waterlogged deposits of the fens or elsewhere can only be increased. As Clark originally believed, waterlogged sites such as Star Carr rich in both organic artefacts and environmental data, provide excellent opportunities to develop and expand our understanding of life in Early Mesolithic Britain. This study has clearly demonstrated the potential for the interrogation of woodworking practices and woodland utilisation to inform this debate.

7 Appendix A. Condition of the Star Carr wood

Descriptions of wood from the original excavations suggest that it was soft because roots had grown through the artefacts. However, visual records show that it retained the macroscopic appearance of wood (Clark 1954). Images of the excavations in 1985 and 1989 also show the wood to be macroscopically identifiable as wood, although in some instances it was difficult differentiating between the timbers and the surrounding peat matrix (Taylor 1998b). The surface data recorded from these timbers is the clearest fine grained evidence of woodworking recorded from Star Carr. Wood has never been retrieved from the dryland parts of the site; however, this is not surprising as archaeological wood only usually survives when biological activity has been suppressed, for example by waterlogging (Blanchette et al. 1990; Florian 1990).

Wood excavated in 2006 and 2007 was visually observed to be well-preserved but on handling was found to be extremely delicate (Milner et al. 2011) meaning great care had to be taken at all stages of excavation, cleaning and storage to ensure that vital surface data were protected. The peat-wood interface was often very difficult to define and as a result wood was difficult to analyse. Where possible, the condition of the wood was further assessed by York Archaeological Trust using scanning electron microscopy (SEM) imaging and standard decay tests such as density and maximum water content (µmax) (Milner et al. 2011). This analysis showed that little or no cellulose was remaining in much of the wood, leaving only a lignin-rich skeleton. Again, preservation appeared to vary across the site, although the major damage was concluded to be due to compression, rather than chemical or biological deterioration.

During the 2013-2015 excavations, all individually recorded pieces of wood were scored for condition, using the condition scale developed by the Humber Wetlands Project (Table 7.1). This condition scale is based primarily on the clarity of surface data. Material is allocated a score dependent on the types of analyses that can be carried out, given the state of preservation. The condition score reflects the possibility of a given type of analysis but does not take into account the suitability of the item for a given process. If preservation varies within a discrete item, the section that is best preserved is considered when assigning the item a score. In addition to the condition score assigned to each item, further information regarding condition, taphonomy and damage was noted on the individual wood sheets as appropriate.

Condition Score	Museum Conservation	Technology Analysis	Woodland Management	Dendro-Chronology	Taxonomic Identification
5 excellent	+	+	+	+	+
4 good	-	+	+	+	+
3 moderate	-	+/-	+	+	+
2 poor	-	+/-	+/-	+/-	+
1 very poor	-	-	-	-	+/-
0 non-viable	-	-	-	-	-

Table 7.1 Condition scale, after Van de Noort et al. (1995): Table 15.1 (Milner et al. in press, b: Table 22.3).

	BRUSH WOOD AREA	**DETRITAL WOOD SCATTER**	**CENTRAL PLATFORM**	**EASTERN PLATFORM**	**WESTERN PLATFORM**	**CLARK'S AREA**	**OTHER**	**ALL**	**ALL**
CONDITION SCORE	FREQUENCY	FREQUENCY	FREQUENCY	FREQUENCY	FREQUENCY	FREQUENCY	FREQUENCY	**FREQUENCY**	**%**
5 excellent	5	21	0	0	1	4	1	**32**	**0.7**
4 good	1042	388	51	4	23	197	60	**1765**	**39.1**
3 moderate	926	651	91	11	66	235	109	**2089**	**46.3**
2 poor	95	129	73	30	51	14	20	**412**	**9.1**
1 very poor	2	5	12	5	0	0	10	**34**	**0.8**
0 non-viable	0	0	0	0	0	0	0	**0**	**0.0**
unrecorded	0	135	49	0	0	0	0	**184**	**4.1**
total	*2070*	*1329*	*276*	*50*	*141*	*450*	*200*	***4516***	***100.0***

Table 7.2 Condition score of wood assemblage - including full records and rapid recording records (Milner et al. in press, b: Table 22.4).

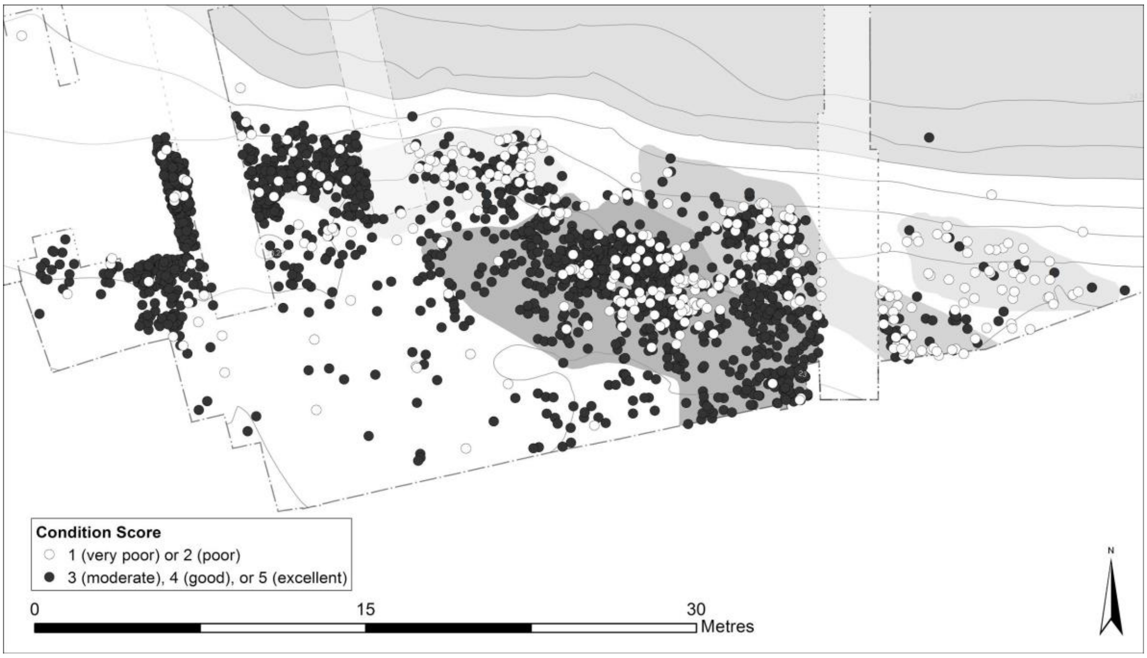

Figure 7.1 Plot of condition score of wood assemblage of pieces rated 3 or greater (moderate, good or excellent) against pieces rated <3 (poor or very poor) for wood with survey data (n = 2179) (Milner et al. in press, b: Figure 22.9, © SCP).

An overview of the assemblage is given in Table 7.2. The most common condition score is 3/moderate, describing material where the primary conversion is visible, identification to taxa is possible and growth ring data is visible. Fine grained surface data such as tool facets may be visible. Fine grained surface data is very unlikely to be visible for material that scores less than 3, whereas it generally will be visible for material that scores more than 3. Although preservation was highly variable at an extremely localised level, condition generally improved both as depth and distance from the lake edge increased. This is particularly evident in the areas around the eastern and western platforms; however, condition was again much better in Clark's Area even closer to the lake edge (Figure 7.1).

The wood assemblage has been damaged by compression as the site has dewatered and the waterlogged deposits have shrunk in the vertical plane. By measuring the vertical and horizontal diameter of wood that originally had a circular cross section, the degree of vertical compression can be mapped (Figure 7.2). In the most extreme cases, wood has been compressed by 97%. The mean average of compression is 39% (N = 937) (Figure 7.3).

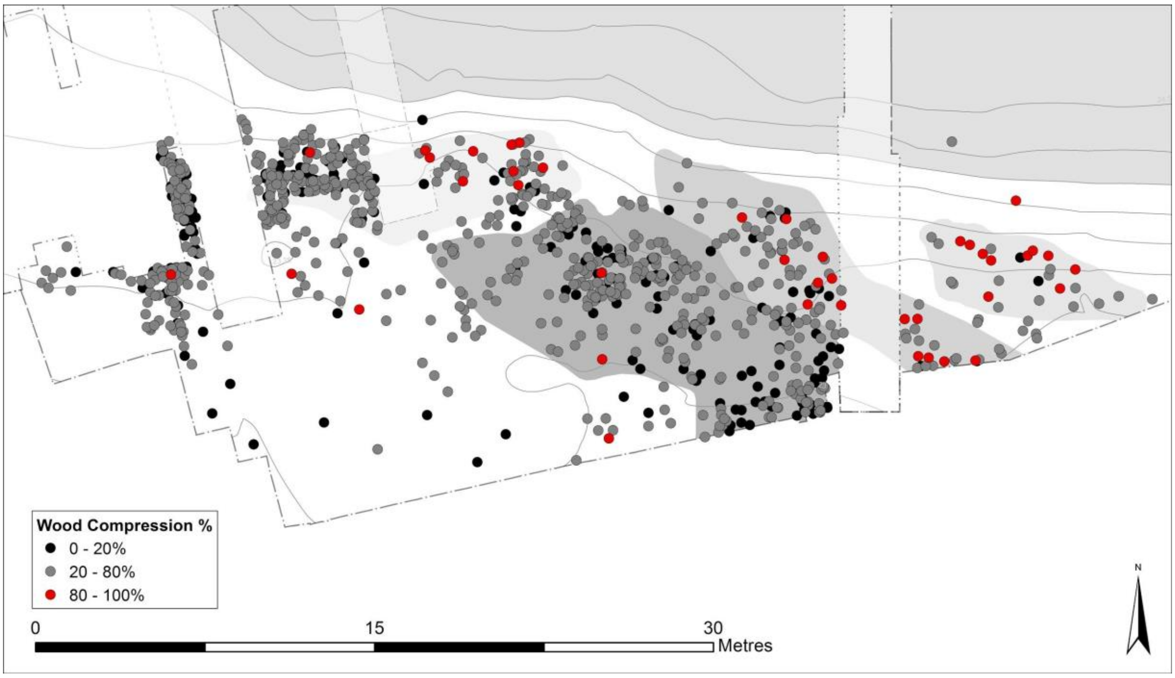

Figure 7.2 Vertical compression of wood assemblage - full records only (Milner et al. in press, b: Figure 22.10, © SCP).

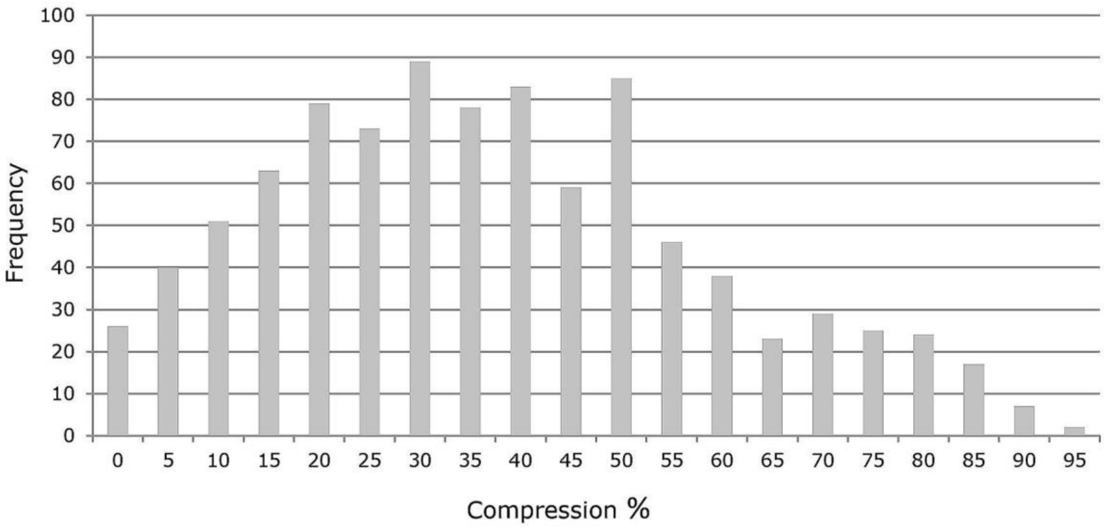

Figure 7.3 Histogram of vertical compression of wood assemblage – full records only (N = 937) (Milner et al. in press, b: Figure 22.11, © SCP).

Based on the assumption that the majority of worked items will have been trimmed to length with an edged tool (such as a flint adze or axe), the distribution of the presence of surviving tool marks and tool facets can be considered as a proxy indicator of condition (Figure 7.4). Survival of tool faceting is much lower than would normally be expected and is thought to be a result of the extreme age of the material. Most of the ends of items, where tool faceting is most likely to be present, are degraded and can be seen to 'feather' away.

Figure 7.4 Map of tool marks and facets as proxy for information potential (Milner et al. in press, b: Figure 22.12, © SCP).

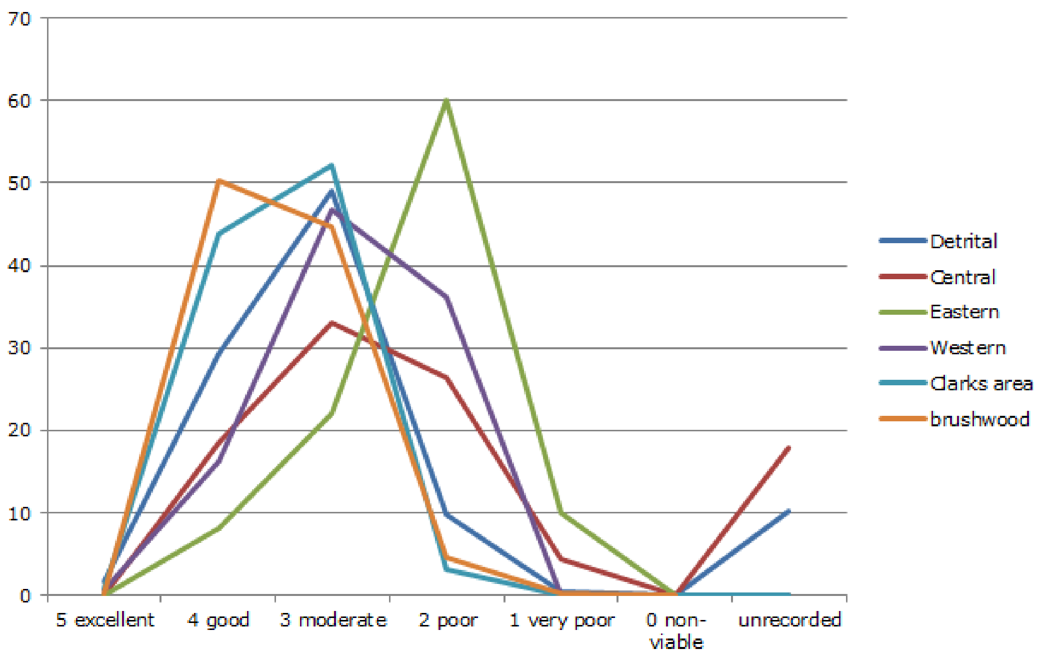

Figure 7.5 Results of the condition survey. The results are calculated as percentages for each area, i.e. in the brushwood 50% of items (1042 out of 2070) scored 4 (good) (Bamforth et al. in press, b: Figure 6.4, © SCP).

Unfortunately, the deterioration of the deposits has had a serious effect on the condition of the wood. Within the assemblage as a whole, a high degree of compression was noted throughout. Overall, the results of the condition survey show that wood is best preserved in Clark's area and the brushwood (Figure 7.5). The borderline for meaningful woodworking analysis sits with material that scores 3/moderate or above. The material from Clark's area has the highest percentage of material within this bracket (97%), on a par with the material from the brushwood area (95%) and somewhat better than the detrital wood scatter (80%) (Figure 7.5). However, it should also be noted that material in the west of the area of investigation tended to be in somewhat better condition than material towards the east, although the reasons for this are not clear.

The eastern platform appears to have the worst condition scores (30% scores 3/moderate or above) (Figure 7.5). Given the location of the material relatively high in the peat sequence and close to the edge of the lake, it is unsurprising that the majority of the material is in poor condition. In cross section, many of the timbers showed the upper half to be severely degraded with the wood's internal structure almost completely collapsed, whilst the lower half of the timber was in relatively better condition. The degradation of the material has obscured almost all surface evidence, with only a single example of tool faceting noted, and in several cases it was not possible to identify the primary conversion (split) of the material with any degree of confidence.

For the central platform, 52% of the wood scores 3/moderate or above. The material at the top of the upper layer was the least well preserved with condition generally improving with depth. The top timbers had badly degraded upper surfaces, the cross sections were highly compressed and intrusive roots were often visible. In addition, the platform lies on a slight slope which also led to variable preservation, sometimes noted within single timbers: the higher material, closer to the lake edge, had little or no surviving surface data such as tool facets or secondary tooling, limiting detailed analysis of this material. Overall, 64% of wood from the western platform scores 3/moderate or above. Here there are only three examples of tool facets. Again, in many cases, it is not possible to identify the primary conversion (split) of the material with any degree of confidence.

For all three timber platforms, where the end grain was exposed the wood was mottled yellow and black indicating oxidation and the subsequent associated bacterial action spreading through the wood via root holes and radially aligned voids generated by drying. When coupled with the high degree of compression, this material sits on the borderline for meaningful woodworking analysis. Due to the relatively poor condition of the material, it is only possible to achieve a 'broad brush' view of these platforms.

8 Appendix B. Species selection in the Star Carr wood assemblage

A total of 180 taxonomic identifications were carried out on the non-artefactual and non-root wood recovered from the 2013-2015 excavations and the various taxonomic identifications have been interpreted as aspen, aspen/willow, willow, birch/alder/hazel and birch (Table 8.1).

Interpretation	Identification	Notes
aspen, based on the presence of aspen catkin scales	*populus* sp.	based on presence of securely homogenous ray cells
aspen/willow	*salix/populus*	non-distinguishable Salicaceae
willow	*salix* sp.	based on presence of securely heterogeneous ray cells
birch, based on absence of other taxa in environmental records	*betula/alnus/corylus*	not distinguishable to taxa
birch	*betula* sp.	distinguishable to taxa

Table 8.1 Interpretation of taxonomic identifications (based on information given in 'wood identification' section of Milner et al. in press, b).

Aspen (*Populus tremula*) is tolerant of poor soils but tends to grow on rich alluvial soils, particularly wetter / open areas such as flood plains and meadowland. Aspen does not coppice well, but the timber, which is resistant to splitting and rot (if it is kept dry) has a wide range of uses, including timber framed buildings in the historic period (Gale and Cutler 2000).

Birch (*Betula* sp.) is generally found on light, non-calcareous soils and is tolerant of wet conditions (Gale and Cutler 2000). This generally short-lived tree produces quite strong timber and can be coppiced when young, although often produces low quality stems (Edlin 1944). Birch bark was an important resource to many hunter gatherer societies, having a wide range of uses including to produce vessels or containers and even canoes. Birch bark (*Betula pubescens*) appears extensively at Star Carr both as birch bark rolls (perhaps used for tar production or as torches) and as matting (Fletcher et al. in press).

Willow (*Salix* sp.) grows in a broad range of conditions, but is particularly common on damper ground. Readily coppiced, the resultant supple stems are often used in wattle and basketry and the bast for finer threads or twines (Gale and Cutler 2000). Although willow can rot in damp conditions, it is very durable when permanently wet (Edlin 1949).

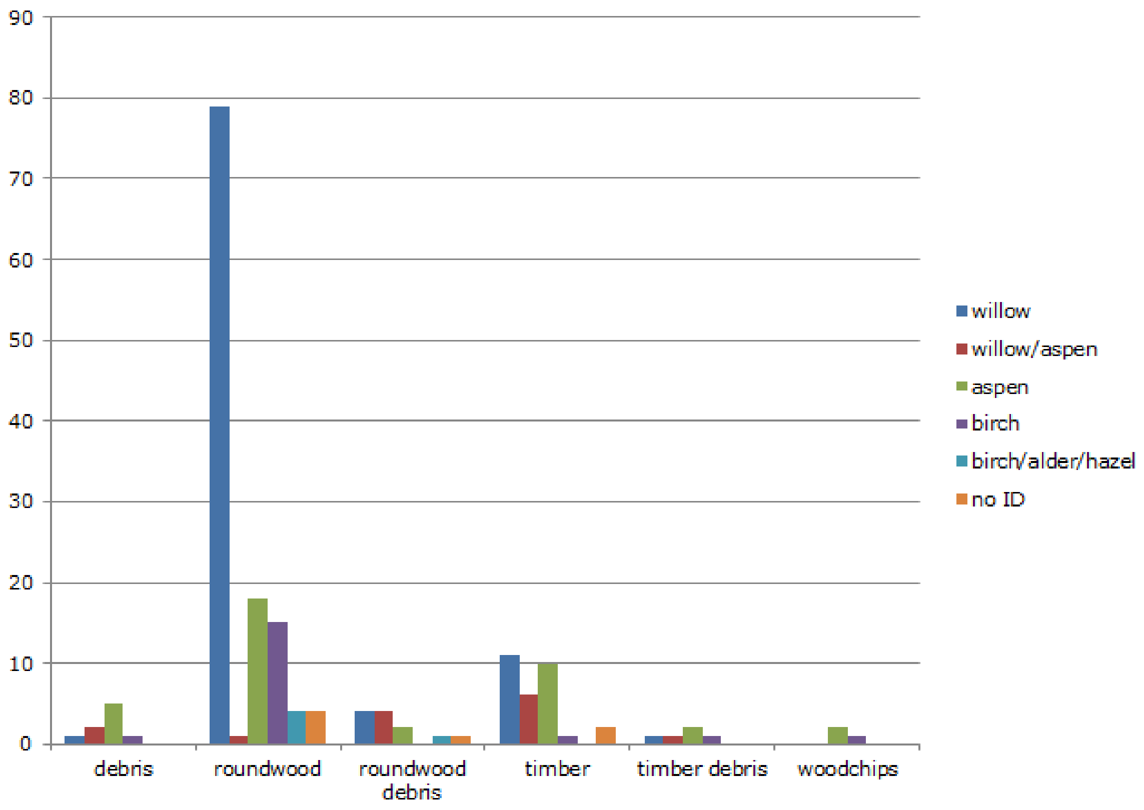

Figure 8.1 Frequency of taxonomic identifications by wood category (2013-2015 excavations only) (Bamforth et al. in press, b: Figure 6.5, © SCP).

Amongst the non-artefactual assemblage as a whole, willow is the most frequent taxon identified, with moderate quantities of aspen, willow/aspen and birch and occasional birch/alder/hazel (Figure 8.1). In comparison to other wood categories, there is a strong tendency towards willow within the identified roundwood assemblage (Figure 8.1) with moderate quantities of aspen and birch, as well as occasional birch/alder/hazel present. Interestingly, if only roundwood with possible morphological evidence of coppicing is considered (see section 4.2 Raw material selection) then the incidence of willow rises to 80%, with birch, birch/alder/hazel and aspen still all present. The higher prevalence of willow is not repeated amongst the roundwood debris. Of the 30 identified items categorised as timber, willow and aspen are prevalent. There is a single item identified as birch (recovered from the detrital wood scatter). The taxonomic identifications carried out as part of the VP85A excavations of the central platform and a subsequent 2010 re-investigation suggested a strong tendency for timbers to be aspen, a finding that has been partially supported during this study (central platform timber identifications: aspen = 3, willow = 2, not identifiable = 2). However, there is a strong prevalence of aspen amongst the timbers of the western platform. These have been identified exclusively as aspen both during the current campaign and the 2007/2010 trial trenching (a total of 20 timbers across the two studies).

In summary, it seems that willow was preferred for roundwood, perhaps due to its propensity to regenerate as coppice stems with aspen and birch also used. In terms of timber, aspen dominates with moderate use of willow and occasional use of birch. It should be noted that throughout Clark's reporting (Clark 1949; 1950; 1954) the wooden remains are identified exclusively as birch in terms of the artefacts, the recumbent trees and the birch brushwood platform, although no explanation is given as to how this was achieved. Given the relatively low prevalence of birch or birch/alder/hazel (13%) within the recently identified material, it seems likely that Clark's findings were to some extent based on assumption. This may well be linked to the propensity for the bark of waterlogged wood to turn a silver-grey colour as it dries, appearing to look like birch to the naked eye. However, it should be noted that the birch tree uncovered again in 2007 (Figure 3.9) was examined and identified as birch by AH.

9 Appendix C. Catalogue of charred material

Number	Type	Split	Charred?	Notes
114862	RW	N/A	Heavily	All over
114884	DEB	N/A	Heavily	All over
114895	RWDEB	Tan	Moderate	Outer face
115758	RW	N/A	Charred through	One end
115761	DEB	Tan	Moderate	One face
115762	RW	N/A	Charred through	One end
115773	RWDEB	Rad 1/2	Moderate	Outer face
115815	RW	N/A	Moderate	One face and one end
115817	RW	N/A	Lightly	One end
115818	DEB	N/A	Heavily	One face
115821	RW	N/A	Moderate	One face and one end
115825	DEB	Tan	Heavily	One face
115829	RW	Rad	Lightly	One end
115830	RW	N/A	Heavily	One end
115833	RWDEB	Rad 1/2	Moderate	Outer face
115836	DEB	Tan	Moderate	One edge
115841	RW	N/A	Moderate	One edge
115842	RW	N/A	Moderate	One end
115951	RW	N/A	Lightly	One end
115952	ART	N/A	Lightly	Proximal / worked end
115960	DEB	Tan	Moderate	One face
115961	RW	N/A	Heavily	All over
115962	RW	Tan faced	Lightly	One end
115971	DEB	Rad	Heavily	One end
115981	TIM	N/A	Heavily	One end
116080	TIM	Rad	Moderate	One end / underside
116081	RWDEB	Rad 1/3	Moderate	Outer face
116091	RW	N/A	Lightly	Upper face
116534	RW	N/A	Charred through	One end
116542	RW	N/A	Charred through	One end

116656	RW	N/A	Moderate	All over
116660	RWDEB	Rad 1/2	Lightly	Split face
116663	DEB	Tan outer	Moderate	Inner face
116674	DEB	Tan outer	Moderate	Inner face
116697	RW	N/A	Charred through	One end
116912	RW	N/A	Moderate	One end and one face
116914	RWDEB	Rad 1/2	Moderate	Outer face
116915	DEB	Rad	Lightly	One edge
116917	RWDEB	Rad 1/2	Moderate	One end
116921	DEB	Tan	Heavily	One face and all edges
116932	DEB	Rad	Moderate	One face
117153	TIM	Rad 1/2	Charred through	One end
117155	TIM	Tan?	Moderate	Underside
117157	TIM	Rad 1/2	Charred through	One end
117159	RWDEB	Rad 1/2	Heavily	One end
117162	RWDEB	Rad 1/2	Heavily	One face
117163	RW	N/A	Moderate	All over
117167	DEB	Tan	Moderate	One face
117195	DEB	Rad	Moderate	One edge and one face
117197	RW	N/A	Lightly	One end
117225	DEB	Tan	Heavily	All over

Table 9.1 Evidence of charring in Clark's area (Bamforth et al. in press, b: Table 6.2).

Number	Type	Split	Charred?	Notes
93556	RW	N/A	Lightly	c. 1 mm on underside of proximal / N end
94006	RW	N/A	Heavily	All over
94009	RW	N/A	Heavily	One end
94010	RW	N/A	Heavily	All over, both ends charred through
94011	DEB	Rad?	Heavily	All over
94015	WC	tan	Heavily	On one end and underside
94020	DEB	N/A	Heavily	All over, tan aligned amorphous lump
94022	DEB	N/A	Heavily	All over, charred into amorphous lump
94024	RW	N/A	Moderately	One end, 4 mm deep
94045	RW	N/A	Moderately	Underside
94047	TIM	Tan outer	Heavily	To at least 10 mm depth over whole of upper / split face
98001	RW	N/A	Moderately	One end of one face
98041	DEB	Rad	Heavily	One face
98042	ART	Tan	Heavily	One face
98043	DEB	Tan	Heavily	One face and one end
98768	RW	N/A	Heavily	All over
98773	RW	N/A	Heavily	One end
98775	RW	N/A	Lightly	All over
99227	RWDEB	Rad 1/4 (mod)	Moderately	Outer face charred away
99912	WC	Rad	Lightly	One edge
99917	RW	N/A	Lightly	One face
99927	RW	N/A	Lightly	One end. Probably charred post beaver gnawing

Table 9.2 Evidence of charring in the brushwood (Bamforth et al. in press, b: Table 6.5).

Number	Type	Split	Charred?	Notes
99808	RWDEB	Rad 1/2	Moderate	Proximal end, underside
99811	DEB	Rad (mod)	Moderate	One face and one end
99814	DEB	Tan	100%	-
99815	RW	N/A	Heavily	All over
99817	RW	N/A	Moderate	Underside, c. 10 mm deep
99890	TIM	Rad 1/3	Lightly	Upper face at one end
99903	RW	N/A	Moderate	-
99904	RW	N/A	Moderate	One end
103175	RW	N/A	Heavily	All over
103182	TIMDEB	Tan	Moderate	One part of face, max 4 mm
103194	DEB	Tan	Lightly	One side
103430	DEB	U/K	Moderate	-
103437	RW	N/A	Heavily	One end and one surface
103749	DEB	Tan	Moderate	One end
103780	DEB	Tan	Lightly	One end. One face
103800	TIMDEB	Tan	Lightly	One face
103812	DEB	Rad	Moderate	One face and one edge
107784	RW / STAKE	N/A	Moderate	Distal / top end is charred
109127	RW	N/A	Lightly	Upper face
109576	DEB	U/K	Heavily	One edge
109583	DEB	Tan	Heavily	One edge
109588	TIM	Tan	Lightly	Part of one face
109988	RW	N/A	Lightly	Underside
110173	TIM	Tan	Moderate	One edge
110357	RW	N/A	Moderate	One end
110360	TIM	Tan outer	Lightly	Outer, lower face. At one end
110472	TIMDEB	Tan	Moderate	Lower face

110509	RW	N/A	Moderate	Underside
110581	TIM	Tan outer	Moderate	Underside

Table 9.3 Evidence of charring from the DWS (Bamforth et al. in press, b: Table 6.10).

Number	**Type**	**Split**	**Charred?**	**Notes**
99080	TIM	Tan	Moderate	One end
99082	DEB	U/K	Heavily	All over. Charred into amorphous lump
109582	DEB	Tan	Lightly	One end
110103	TIM	N/A	Moderate	One end
113791	TIM	Tan outer	Moderate	Outer / lower face

Table 9.4 Charring from the western platform (Bamforth et al. in press, b: Table 6.14).

Type	**Find no**	**Layer**	**Charring**	Notes
Tree	99893	top	lightly	underside for 1 m at the proximal end
Timber (tan)	99960	top	moderate	at one end on outer / sapwood surface
Timber (rad)	99888	top	lightly	both faces at one end
Debris	99240	top	heavily	all over
Debris	99813	top	100%	all over

Table 9.5 Charring evidence from the upper layer of the central platform (Bamforth et al. in press, b: Table 6.18).

10 Appendix D. Evidence for beaver activity

European beavers (*Castor fiber*) are present in the faunal assemblage at Star Carr, with some evidence that the mandibles may have been utilised as tools (Knight et al. in press). There is also evidence for their activity within the wood assemblage, in terms of distinct and unique gnawing marks. These gnaw marks have been identified on the basis of modern reference material, published literature (Coles 2006) and previous experience of the author.

The beaver is a large rodent (c. 20-25 kg) that generally lives near water including rivers, streams and lakes (Coles 2006). The lake edge setting at Star Carr combined with the wooded landscape would have provided an ideal habitat. Beavers will generally build a burrow dug into banks at the edge of the water, with ingress from a sub-aqua entrance. In environments where it is not possible to dig a burrow, beavers will construct a lodge from a heap of wood and gnaw out a burrow within it (Coles 2006). Beavers are vegetarians with a broad diet that can include leaves, twigs and bark. In the search for food or material for a lodge, beavers are capable of felling saplings and even substantial trees (Coles 2006).

Following the identification of beaver-gnawed wood from the brushwood 'platform', Coles (2006: 78) suggested that the accumulation of wood recorded by Clark may have been partially, or wholly, the result of beaver activity. However, although there is some beaver-modified material present within this area, only two items displaying these traces were recovered from Clark's area during the 2013-15 excavations, suggesting the role of beavers in the accumulation of this material is minimal at best.

Overall, 24 items show evidence of beaver modification: 22 pieces of roundwood, one piece of roundwood debris and a timber classed as a tree (a side branch has been beaver gnawed). These were recovered from the brushwood (n=6), detrital wood scatter (n=11), central platform (n=1), Clark's area (n=2) and the western platform (n=4). The majority of the material has been gnawed through at one or both ends or a small side branch. A single item showed the classic 'melon slice' that can be caused by a beaver gnawing through one face (Figure 10.1). These types of modification, i.e. gnawing along the shaft to consume bark for food and gnawing of ends to acquire building material or for food, are all within the range of normal beaver behaviour.

Figure 10.1 Roundwood <99927>. Both ends are beaver-gnawed and there is a distinct ‘melon slice’ beaver gnaw along the stem (Bamforth et al. in press, a: Figure 28.1, © Michael Bamforth).

Although much of this material was recovered towards the base of the sequence, often below culturally-modified material, some of the items have also been anthropogenically modified. Of key interest to this study are three items which show possible evidence of both human and beaver modification: <116509> is half split roundwood debris that may represent cultural or natural modification and that has also been beaver-gnawed at one end; <109099> appears to have been trimmed with an axe or adze and beaver-gnawed at the same end; <103190> has been beaver gnawed at the proximal end and one side branch whilst the distal end has been trimmed with an axe or adze and torn in a ‘chop and tear’ (see below). Coles (2010) has suggested that during later prehistory, people may have been drawn to beaver modified landscapes, either to hunt the beavers or to take advantage of areas cleared of tree cover by the animals, an assertion that may also be of relevance at Star Carr.

Number	Context	Spit	Type	Notes
98036	312	2	RW	1 side branch (D: 10 x 12 mm) beaver gnawed
99220	320	8	RW	1 end / beaver gnawed
99921	317	8	RW	Proximal end beaver gnawed
99927	317	8	RW	Both ends beaver gnawed. One edge gnawed. One end lightly charred, probably post beaver gnawing
99992	317	8	RW	Distal end and two side branches gnawed by beaver. Gnaw marks on shaft from bark removal
103190	317	8	RW	Proximal end and one side branch beaver gnawed. Distal end is a stepped chop and tear

Table 10.1 Evidence of beaver modification in the brushwood area (Bamforth et al. in press, b: Table 6.6).

Number	Context	Type	Notes
99822	312	RW	Distal end possibly beaver gnawed
99946	312	RW	1 end possibly beaver gnawed
99979	312	RW	1 end beaver gnawed
103104	312	RW	1 end possibly beaver gnawed
103123	312	RW	1 end beaver gnawed
103503	317	RW	3 x SB and proximal end beaver gnawed
109021	319	RW	1 end beaver gnawed
109361	319	RW	1 end possibly beaver gnawed
109574	317	RW	Both ends beaver gnawed
110573	320	RW	1 end beaver gnawed
113220	317	RW	1 end possibly beaver gnawed

Table 10.2 Evidence of beaver modification from the DWS (Bamforth et al. in press, b: Table 6.11).

Number	Context	Position	Type	Notes
99246	317	platform	RW	both ends beaver gnawed
109909	312	brushwood beneath platform	RW	1 end beaver gnawed and possibly trimmed
113449	308	underneath platform	RW	1 end beaver gnawed
113772	308	underneath platform	RW	1 end beaver gnawed

Table 10.3 Evidence for beaver activity, western platform (Bamforth et al. in press, b: Table 6.15).

11 Appendix E. Catalogue of timbers classed as trees

Find no	Length (mm)	Horizontal diameter (mm)	Vertical diameter (mm)	Compression %
99801	5013	85	30	35.3
99894	2810	95	40	42.1
99932	3385	130	70	53.8
99949	3570	172	79	45.9
103148	1943	277	85	30.7
103785	1570	170	72	42.4
109030	3835	210	40	19.0
109557	2370	130	60	46.2
109903	3610	270	64	23.7
109905	5050	125	95	76.0
110192	1690	160	61	38.1
110365	3665	235	100	42.6
110390	1030	180	75	41.7
110401	1930	85	60	70.6
110528	3530	155	56	36.1
112992	4200	160	75	46.9
112996	1780	160	30	18.8
113239	1820	100	40	40.0
115699	1845	80	41	51.3
110377b	1975	160	60	37.5

Table 11.1 Trees from the DWS (Bamforth et al. in press, b: Table 6.12).

Find no	Length (mm)	Horizontal diameter (mm)	Vertical diameter (mm)	Compression %
99212	4430	230	56	24.3
109556	1910	105	24	22.9
109924	3535	270	30	11.1
109938	2010	160	40	25.0
109949	1180	270	168	62.2
109952	2410	115	35	30.4
109953	4030	100	40	40.0
109964	2504	140	70	50.0
109965	4485	180	70	38.9
110003	3880	110	45	40.9
110042	1940	175	38	21.7
110043	3950	215	39	18.1
110101	1745	50	25	50.0
110107	2405	130	38	29.2
110110	1785	165	35	21.2
110123	1905	110	45	40.9
110125	1100	128	41	32.0
110126	1810	122	22	18.0
110132	2115	175	30	17.1
110134	1680	210	56	26.7
110141	1610	140	40	28.6
110149	2225	165	22	13.3
110150	2980	170	33	19.4

Table 11.2 Trees from the western platform (Bamforth et al. in press, b: Table 6.16).

Find do	Length (mm)	Horizontal diameter (mm)	Vertical diameter (mm)	Compression %
99726	2910	150	22	14.7
99737	1950	135	19	14.1
99738	1400	205	30	14.6
99739	4200	130	32	24.6
99745	3590	224	40	17.9
99746	1560	156	40	25.6
99803	3890	150	30	20.0
99804	5180	138	40	29.0
99893	3220	170	80	47.1
99963	2425	80	52	65.0
103117	1542	217	32	14.7
103147	3400	160	67	41.9
103263	3901	150	60	40.0
103277	2390	230	55	23.9
103293	2445	160	80	50.0
103294	3750	180	95	52.8
115307	1230	200	20	10.0
115318	1111	185	72	38.9
115322	1715	180	62	34.4
115324	2222	140	19	13.6
115658	1385	155	42	27.1
115660	2330	110	32	29.1
115662	3460	160	20	12.5
115680	3660	100	20	20.0
116054	1775	143	75	52.4
116061	895	165	63	38.2

Table 11.3 Trees from the central platform (Bamforth et al. in press, b: Table 6.19).

Find no	Length (mm)	Horizontal diameter (mm)	Vertical diameter (mm)	Compression %
113252	3988	226	45	19.9
114252	4010	195	28	14.4
114854	3295	148	43	29.1
114856	3350	180	40	22.2
114860	4180	190	90	47.4
114861	3930	156	39	25.0
114874	3900	120	12	10.0
114879	4450	160	32	20.0
114881	3610	145	56	38.6
114883	4010	154	50	32.5
114885	4735	180	40	22.2
114888	4370	130	60	46.2
114890	4450	90	25	27.8
114897	3020	150	15	10.0
114898	1650	280	45	16.1
114899	4130	150	36	24.0
114900	1510	149	34	22.8

Table 11.4 Trees from the eastern platform (Bamforth et al. in press, b: Table 6.21).

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