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Scientific Dating

Farm Outbuilding Comprising Former Barn, and Stables to the South-West of Barlow Woodseats Hall, Johnnygate Lane, Barlow, Derbyshire

Tree-ring Dating of Oak Timbers

Martin Bridge and Robert Howard

Discovery, Innovation and Science in the Historic Environment

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Front cover: Former Barn and Stables at Barlow Woodseats Hall in Derbyshire.
Photograph by Martin Bridge

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FARM OUTBUILDING COMPRISING FORMER BARN, COWHOUSE, AND STABLES TO THE SOUTH-WEST OF BARLOW WOODSEATS HALL, JOHNNYGATE LANE, BARLOW, DERBYSHIRE

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SUMMARY
In total, 39 timbers have been sampled, 13 from each of the three sections of the outbuilding: a cowshed, stables, and a cruck-framed former threshing barn, the latter of which had been the subject of a previous dendrochronological programme in the 1990s. Samples from 18 timbers were successfully dated. The majority of the dated timbers in the cruck barn, comprising cruck blades, purlins, a collar, and a wall plate, were felled in, or around, AD 1535. However, the southernmost pair of cruck blades were felled in AD 1625. The cowshed and stables were found to have been most likely constructed at the same time as each other, in the period AD 1677–1704.

CONTRIBUTORS
Martin Bridge and Robert Howard

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DATE OF INVESTIGATION
1995 and 2013

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INTRODUCTION

The early seventeenth-century Barlow Woodseats Hall and its associated outbuildings, which have significant seventeenth-century phases but earlier origins, form an outstanding vernacular building group in the parish of Barlow, lying some 5km north-west of Chesterfield (Fig 1). The Hall and outbuilding range are both listed at Grade II* (List Entry Numbers 1087802 and 1186957).

The outbuildings comprise a former threshing barn, a cowshed, and a substantial stable building. These form an L-shaped range incorporating several constructional phases. The long arm of the 'L' runs broadly north-west to south-east but for the purposes of this report a site north has been assigned with this long arm deemed to be running north to south. The cruck-framed threshing barn section lies at the southern end of the long arm of the 'L' and is thought to be the earliest part of the range. It was the subject of an earlier dendrochronological investigation (Howard *et al* 1996; Laxton *et al* 1996 unpubl), which dated timbers from the roof, with the exception of the southernmost truss, to AD 1535. The southernmost truss was dated to AD 1625. It is thought that the barn was originally timber-framed, although the walls are now of stone. The sequence of construction of the remaining outbuildings cannot be dated with certainty on typological grounds, although the addition or remodelling of the stable range (forming the northern short arm of the 'L') appears to coincide with seventeenth-century works to the Hall. This interpretation is based on the stable front wall having been built parallel to the front elevation of Barlow Woodseats Hall, creating an acute angle with the cruck barn/cowshed range, which are thus presumed to have already been in existence.

Dendrochronological dating of the stable range and cowshed, along with elements of the cruck barn that were not previously accessible, was requested by Bob Hawkins (then EH Designation Advisor in the East Midlands) to provide independent dating evidence for the primary construction, and hence chronological development of this important group of outbuildings.

METHODOLOGY

An assessment of the potential for further dendrochronological work was carried out in the late summer of 2013, with the additional sampling taking place in October 2013. During this period, work was being undertaken on these outbuildings and the stalls in the stable range, seen *in situ* during the assessment, had been removed but stored on-site, along with some other timbers from the other buildings, at the time of sampling.

Those timbers judged to be potentially useful were cored using a 16mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis. The cores were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be clearly distinguished.

The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was attempted by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted on the computer monitor to allow visual comparisons to be made between sequences. This method provides a measure of

quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one sample or site master against other samples or chronologies, *t*-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual samples match together with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. Lower *t*-values however do not preclude same tree derivation.

The 1990s work is described in Laxton *et al* (1996 unpubl) and the results summarised in Howard *et al* (1996). This earlier analysis basically used similar methodology to the more recent study in the form of the Litton/Zainodin grouping procedure (Laxton *et al* 1988; Laxton and Litton 1988). However, cores were standardly measured twice, with the mean of the two series being used in subsequent analysis, hence two sets of data are presented in the Appendix for each core. The exception to this is where more than one core was obtained from a timber (BAR-A03, BAR-A05, BAR-A08, and BAR-A10), when each core was measured only once and hence a single data set is presented in the Appendix.

Ascribing felling dates and date ranges

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward. Depending on the completeness of the final ring, ie if it has only the spring vessels or early wood formed, or the latewood or summer growth, a precise felling date and season can be given, although this is sometimes not the case where the outermost rings are very narrow or degraded. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an estimated felling date range can be given for each sample. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* or felled-after date.

A review of the geographical distribution of dated sapwood data from historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area is 12–45 rings (Miles 1997). It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study.

RESULTS

Ten oak (*Quercus* spp) timbers had been sampled from the cruck barn in the 1990s as part of the previous investigation, with a further five oak samples obtained during this study, two of which were duplicates of those taken in the 1990s. Thirteen oak timbers were sampled from various elements of the cowshed, both from the floor and the roof. Ten oak timbers were sampled from the stable range, again from both the floor and the roof, and three *ex situ* oak timbers from the stalls in the stable range were also sampled.

Basic information for all samples and their locations are given in Table 1, with the data for all measured cores being presented in the Appendix. The locations of the roof and first-floor timbers sampled in the new study are illustrated in Figure 2, with those from the previous study being shown in Figure 3. No drawings are available to illustrate the locations of the samples taken from ground-floor timbers in the cowshed and stable range.

Cruck-framed (Threshing) Barn

Two specific areas of interest had been noted for further investigation within this new programme of dendrochronology. Firstly, a newly exposed timber in a window reveal (Fig 4) was of interest as it was thought to represent a surviving part of the original timber-framed wall, now covered in stone. As can be seen in the photograph (Fig 4), this timber has few rings, a very uneven grain pattern, no sapwood, and is very difficult to access for coring. Being assessed as unsuitable, it was not sampled. In addition, the wall plates, not sampled in the 1990s analysis, were identified as of interest as it was thought that they might give an indication of when the barn had been converted from an entirely timber-framed structure, to one with stone walls. Samples from three wall plates were therefore obtained (Table 1), along with two samples from cruck blades to give data for this study against which to compare the wall plate samples, as at the time, the earlier dataset was not available. Overall therefore there were 21 core samples representing 13 timbers. Subsequently the data from the 1990s analysis was made available. Whilst seven of the ten timbers sampled previously had been dated (Howard *et al* 1996; Laxton *et al* 1996 unpubl), bearing in mind the greater number of reference chronologies now available, the ring sequences from these ten timbers were reanalysed along with the ring sequences from the newly obtained samples. The trusses and bays are numbered from the northern end of the barn, the northernmost truss (truss 1) demarcating the junction between the barn and the cowshed.

Two of the new samples, bwsCB01 and bwsCB05, had fewer than 40 rings and were not analysed further. Where more than one core had been obtained and measured from a timber, the ring series were cross-matched, where possible, and combined to produce a single ring series for the timber. All of these were then compared with each other.

As previously, BAR-A01 and BAR-A07 cross-matched (Table 2a), with the combined series dating to AD 1454–1530 (Table 3a). However, bwsCB02, BAR-A05, and BAR-A06 produce low but consistent intra-site cross-matching with BAR-A01 and BAR-A07 and each other (Table 2a), this being supported by independent consistent cross-matching of the individual series with the reference database (Tables 3b–3d). Thus, all five series were combined to produce site chronology BARLOW1 which dates to AD 1405–1530 (Table 3e).

The mean ring-width series from the east cruck blade of truss 3, A02CB05, cross-matched BAR-A03 (t =12.1) and the ring-width series were thus combined to produce site chronology BARLOW2, which dates to AD 1417–1535 (Table 3f).

The third site chronology, BARLOW3, comprises the two series BAR-A09 and BAR-A10 which cross-match at t =12.9, as previously, and dates to AD 1463–1625 (Table 3g).

The remaining three measured series can neither be cross-matched nor dated.

Cowshed

Thirteen timbers were sampled in the cowshed (Table 1), including timbers from the roof, the walls, and the floor. The trusses and bays are numbered from the northern end of the cowshed, the northernmost truss (truss 1) being the junction between the cowshed and the stables. Two samples, bwsC02 and bwsC04 both from truss 1, were found to have fewer than 40 rings and were not analysed further. Of the remaining eleven samples, five were cross-matched (Table 2b) and successfully dated. These, along with four samples from the stable range (*see* below), were combined to produce site chronology BARLOW4 which dates to AD 1588–1676 (Table 3h).

The remaining six series neither cross-match or date.

Stable range

Ten samples were taken from structural elements of the stable range, and another three samples from *ex situ* stall posts that had been removed during the renovation programme. The trusses and bays are numbered from the eastern end of the stables. One sample, bwsS09, had too few rings to justify further analysis. Four samples from structural elements cross-matched (Table 2b) and were successfully dated. As indicated above, these were combined with five samples from the cowshed to produce site chronology BARLOW4.

None of the remaining six samples from structural elements, nor the three samples from stall posts, could be cross-matched or successfully dated.

INTERPRETATION AND DISCUSSION

In total, 18 timbers have been dated from this L-shaped outbuilding indicating three phases of felling (Fig 5).

Seven timbers, potentially representing the primary phase of construction of the cruck barn, appear coeval. These include three cruck blades, two purlins, a collar, and a wall plate, all from the central trusses and bays. One timber, BAR-A03, retained complete sapwood and was felled in AD 1535, the season of felling is indeterminate (Fig 5; Table 1). A second timber, BAR-A05, had retained a large number of sapwood rings but the ring series from one of the three cores taken from it, core BAR-A05c with 35 sapwood rings present, could not be securely cross-matched with the two other cores from this timber, these other two cores retaining only the heartwood/sapwood boundary and five sapwood rings respectively. The number of sapwood rings, and hence the date of the heartwood/sapwood boundary is variable around the circumference of a tree. If it is, however, assumed that the heartwood/sapwood boundary on BAR-C05c is at a similar, but not necessarily the same, date to those on BAR-C05a and BAR-C05b, both AD 1501, then it appears likely that the timber represented by these three cores was felled at some point during the AD 1530s to AD 1540s, a date compatible with the felling date of AD 1535 already identified. The remaining five dated timbers have felling date ranges that also incorporate this precise felling date (Fig 5; Table 1), and it should be noted that the east cruck blade of truss 3, A02CB05, may be derived from the same tree (see above) as the west cruck blade of truss 3 (felled AD 1535). It seems likely therefore that these timbers all represent a phase of construction shortly after felling in, or around, AD 1535. The newly dated wall plate is therefore part of this earliest phase of construction identified in the outbuilding.

The two remaining dated timbers from the cruck barn (Fig 5; Table 1), the cruck blades from the southernmost truss (truss 5), cross-match with a *t*-value high enough to indicate that they are potentially derived from the same tree. One timber,

BAR-A10, retained complete sapwood and was felled in AD 1625, the season of felling again being indeterminate. The felling date range for BAR-A09 incorporates this precise felling date and hence is also highly likely to have been felled at the same time. It seems therefore that the timbers forming the southernmost truss represent a phase of repair or modification shortly after felling in AD 1625.

The nine timbers dated from the cowshed and stables all appear coeval (Fig 5; Table 1). These comprise two principal rafters, a tiebeam, a wall plate, and a ceiling beam from the cowshed, and three ceiling beams and a purlin from the stables. All nine have some sapwood or the heartwood/sapwood boundary present, the date of which varies by only 16 years. The mean heartwood/sapwood boundary date is AD 1659, which gives a likely felling date range of AD 1671–1704, which may be modified to AD 1677–1704 in light of the surviving rings on sample bwsC10.

Overall therefore, the development of the L-shaped outbuilding has been shown to have started with the cruck barn, the earliest dated phase of which dates to AD 1535, including at least one wall plate, thus supporting the pre-seventeenth century origins indicated in the list entry. The cruck barn had its southernmost truss replaced in AD 1625, this coinciding with the mid-AD 1620s date for the construction of Barlow Woodseats Hall. The long cowshed adjoining the cruck barn to the north, and the stables at an acute angle to it at the north end of the cowshed appear to be coeval, and to date to AD 1677–1704, coinciding with works to the Hall in the late-seventeenth century.

All dated timbers appear most likely to be of relatively local origin, as indicated by the site reference chronologies with which they match most strongly which are generally from the surrounding counties. However, it is suggested that they may be derived from potentially disparate local sources as the level of cross-matching between the three earlier site chronologies from Barlow Woodseats outbuilding is relatively low at t = 3.0 (Barlow1 v Barlow 2), t = 3.3 (Barlow1 v Barlow3), and t = 3.3 (Barlow2 v Barlow3). This potential use of timbers derived from disparate local sources may, at least, partly explain the relatively low success rate with only 18 of the 39 timbers sampled being dated. It would therefore be of interest, should the opportunity arise, to extend sampling for dendrochronlogical study to the Hall itself.

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TABLES

Table 1: Details of samples taken from the outbuilding comprising the cruck barn, cowshed, and stables at Barlow Woodseats. All samples with the prefix 'BAR-A' were taken as part of the 1990s analysis, whilst those with the prefix 'bws' were taken in 2013

Sample number	Timber and position	No of rings	Dates spanning (AD)	h/s boundary (AD)	Sapwood rings	Mean ring width (mm)	Mean sensitivity	Felling date ranges (AD)
	Cruck barn							
BAR-A01	Lower collar, truss 2	59	1472–1530	1517	13	1.82	0.21	1530–62
BAR-A02	*Rear (east) blade, truss 3 (duplicate of bwsCB05)*	*96*	*1417–1512*	*1512*	*h/s*	*2.22*	*0.25*	*1524–57*
BAR-A03a	Front (west) blade, truss 3	*82*	*1429–1510*	*1510*	*h/s*	*2.22*	*0.20*	*1535*
BAR-A03b	*ditto*	*76*	*1450–1525*	*1507*	*18*	*1.98*	*0.23*	*1535*
BAR-A03c	*ditto*	*62*	*1474–1535*	*1507*	*28Cu*	*1.53*	*0.25*	*1535*
BAR-A03	ditto (mean of a, b, and c)	107	1429–1535	1507	28Cu	2.11	0.21	1535
BAR-A04	Front (west) blade, truss 4	51	-	-	h/s	2.87	0.24	-
BAR-A05a	*Rear (east) blade, truss 2*	*97*	*1405–1501*	*1501*	*h/s*	*1.85*	*0.18*	*1530s–40s*
BAR-A05b	*ditto*	*58*	*1449–1506*	*1501*	*5*	*1.48*	*0.22*	*1530s–40s*
BAR-A05c	*ditto*	*81*	*-*	*-*	*35*	*1.13*	*0.21*	-
BAR-A05	ditto (mean of a and b)	102	1405–1506	1501	5	1.75	0.19	1530s–40s
BAR-A06	Front (west) purlin, truss 2-3	54	1456–1509	1509	h/s	2.15	0.22	1521–54
BAR-A07	Rear (east) purlin truss 3-4	63	1454–1516	1514	2	2.22	0.18	1526–59
BAR-A08a	Front (west) blade, truss 1	*104*	*relative 1–104*		*20*	*1.57*	*0.21*	-
BAR-A08b	*ditto*	*77*	*relative 28–104*		*20*	*1.25*	*0.20*	-
BAR-A08	ditto (mean of a and b)	104	-	-	20	1.58	0.21	-
BAR-A09	Front (west) blade, truss 5	137	1465–1601	1598	3	1.47	0.14	1610–43
BAR-A10a	Rear (east) blade, truss 5	*156*	*1463–1618*	*1585*	*33*	*1.27*	*0.19*	*1625*
BAR-A10b	*ditto*	*94*	*1532–1625*	*1586*	*39Cu*	*0.94*	*0.15*	*1625*
BAR-A10	ditto (mean of a and b)	163	1463–1625	1586	40Cu	1.25	0.17	1625
bwsCB01	East wall plate, bay 2-3	<40	-	-	-	-	NM	-
bwsCB02	East wall plate, bay 3-4	54	1458–1511	1511	h/s	2.18	0.23	1523–56
bwsCB03	West wall plate, bay 3-4	69	-	-	h/s	1.88	0.20	-
bwsCB04	*West cruck blade, truss 4 (duplicate of BAR-A04)*	*<40*	-	-	-	-	*NM*	-
bwsCB05	*East cruck blade, truss 3 (duplicate of BAR-A02)*	*92*	*1421–1512*	*1512*	*h/s*	*2.23*	*0.21*	*1524–57*
A02CB05	ditto (mean of BAR-A02 and bwsCB05)	96	1417–1512	1512	h/s	2.24	0.20	1524–57

	Cowshed							
bwsC01	Tie, truss 1	51	-	-	13	2.29	0.18	-
bwsC02	East post, truss 1	<40	-	-	1	-	-	-
bwsC03	East wall plate, bay 1-2	44	1620–63	1659	4 + 10NM	3.67	0.21	1673–1704
bwsC04	East principal rafter, truss 1	<40	-	-	h/s	-	-	-
bwsC05	Ground floor ceiling beam 1	68	-	-	20C	2.21	0.28	-
bwsC06	Ground floor ceiling beam 2	69	-	-	7	2.68	0.26	-
bwsC07	Ground floor ceiling beam 3	109	-	-	27 + 2mm NM	1.76	0.20	-
bwsC08	Ground floor ceiling beam 4	56	1600–55	1654	1	1.83	0.14	1666–99
bwsC09	Tie, truss 2	48	-	-	15C	2.18	0.20	-
bwsC10	East principal rafter, truss 2	62	1615–76	1670	6	2.79	0.22	1682–1715
bwsC11	East principal rafter, truss 3	56	-	-	-	2.66	0.27	-
bwsC12	Tie, truss 3	54	1617–70	1654	16	2.38	0.22	1670–99
bwsC13	East principal rafter, truss 4	54	1621–74	1658	16	2.41	0.16	1674–1703
	Stables							
bwsS01	South principal rafter, truss 3	88	-	-	28¼C	2.30	0.25	-
bwsS02	Tie, truss 3	40	-	-	8 + 13NM	3.83	0.23	-
bwsS03	North principal rafter, truss 3	49	-	-	h/s	1.85	0.28	-
bwsS04	Collar, truss 1 (re-used)	70	-	-	h/s	2.32	0.22	-
bwsS05	North purlin, bay 1-2	58	1608–65	1665	h/s	3.27	0.30	1677–1710
bwsS06	First floor ceiling beam between trusses 1 and 2	55	1606–60	1654	6	2.28	0.21	1666–99
bwsS07	First floor ceiling beam between trusses 2 and 3	70	1588–1657	1657	h/s	2.26	0.23	1669–1702
bwsS08	Tie, truss 2	128	-	-	39C	1.41	0.20	-
bwsS09	Ground floor ceiling beam 4	<40	-	-	-	-	NM	-
bwsS10	Ground floor ceiling beam 3	57	1602–58	1657	1	2.40	0.25	1669–1702
	Stables - stalls (*ex situ*)							
bwsSS01	Stall post	77	-	-	h/s	1.65	0.19	-
bwsSS02	Stall post	60	-	-	5	2.01	0.17	-
bwsSS03	Stall post	48	-	-	h/s	1.32	0.32	-

Key: NM = not measured; h/s = heartwood-sapwood boundary; C = complete sapwood, tree felled in winter; ¼C = complete sapwood, tree felled in the following spring; Cu = complete sapwood, season of felling indeterminate. Sapwood estimate 12–45 rings used (Miles 1997)

Table 2a: Cross-matching between the ring-width series included in the site chronology BARLOW1, values of t = 3.5, and above, are significant

	t-values			
series	BAR-A07	bwsCB02	BAR-A05	BAR-A06
BAR-A01	7.2	3.9	3.5	2.3
BAR-A07		3.8	2.8	3.2
bwsCB02			3.4	2.1
BAR-A05				3.4

Table 2b: Cross-matching between the ring-width series included in the site chronology BARLOW4, values of t = 3.5, and above, are significant

	t-values							
series	bwsC08	bwsC10	bwsC12	bwsC13	bwsS05	bwsS06	bwsS07	bwsS10
bwsC03	2.6	5.8	7.2	4.8	4.0	5.9	3.1	4.7
bwsC08		5.1	3.8	2.5	3.8	4.9	6.7	4.5
bwsC10			9.5	3.2	4.8	5.3	3.8	3.6
bwsC12				4.7	5.7	6.8	4.3	5.1
bwsC13					4.5	5.1	2.2	4.7
bwsS05						7.8	4.5	5.7
bwsS06							6.1	8.4
bwsS07								3.6

Table 3a: Dating evidence for the combined series of BAR-A01 and BAR-A07, AD 1454–1530

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Derbyshire	Codnor Castle	Arnold and Howard 2015a	CODCSQ02	1381–1559	77	8.9
South Yorkshire	Bishops' House, Sheffield	Arnold and Howard 2017 unpubl	SHBHSQ01	1399–1579	77	7.6
Object	The Mermaid Door	Tyers 1992	OS0013	1468–1640	77	7.1
Warwickshire	Kingsbury Hall, Kingsbury	Arnold *et al* 2006a	KNGHSQ01	1391–1564	77	7.1
Warwickshire	Gorcott Hall, Redditch	Nayling 2006	GORCT17	1385–1531	77	7.0
Warwickshire	Town Hall, Alcester	Arnold and Howard 2014a unpubl	ALCASQ01	1374–1626	77	7.0
Derbyshire	Kent House, Ridgeway	Groves and Hillam 1990a	RIDGEWAY	1431–1646	77	6.8
West Midlands	Wednesbury Forge, Sandwell	Tyers 2007a	WEDNSBRY	1322–1616	77	6.6
West Yorkshire	Westgate End House, Wakefield	Arnold and Howard 2015b	WKFBSQ01	1377–1567	77	6.5
West Yorkshire	Elland Old Hall	Hillam 1984	ELLAND	1372–1574	77	6.4

Table 3b: Dating evidence for series bwsCB02, AD 1458–1511

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Wales	Kerry Church	Miles *et al* 2011	KERRY	1402–1567	54	5.3
West Yorkshire	Kirkgate, Wakefield	Morgan 1982	WKFLD	1360–1517	54	5.2
Wales	Lower Cill, Berriew	Miles *et al* 2006	BERRIEW	1428–1583	54	5.1
Wales	Caerfallen, Ruthin	Bridge *et al* 2015	CAERFLLN	1415–1559	54	5.1
Shropshire	St John the Baptist Church, Myndtown	Arnold *et al* 2022	MYNTSQ03	1420–1568	54	5.1
Shropshire	Bank Farm, Aston Piggot	Bridge 1996	ASTONPIG	1418–1581	54	4.9
Lancashire	Turton Tower, Blackburn	Arnold and Howard 2008	TRTASQ02	1439–1513	54	4.7
Oxfordshire	Kingsholme, East Hagbourne	Alcock *et al* 1989	DIDBSQ01	1355–1548	54	4.6
Wales	Old Market Hall, Llanidloes	Miles *et al* 2003	LNYDLOS1	1424–1589	54	4.6
Shropshire	Old Farm, Lydbury North	Miles *et al* 2007	LYDBURY5	1363–1658	54	4.6

Table 3c: Dating evidence for series BAR-A05, AD 1405–1506

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
South Yorkshire	Holly Farm, Greenhill, Sheffield	Tyers 1996 unpubl	HOLLYFRM	1416–1553	91	6.6
Shropshire	Roseleigh, All Stretton	Miles *et al* 2007	ALLSTRET	1386–1509	102	6.2
Greater Manchester	Ordsall Hall, Salford	Arnold *et al* 2004	ORDHSQ02	1366–1534	102	6.1
Greater Manchester	Taunton Hall, Ashton under Lyne	Bridge 2003	TAUNHALL	1401–1495	91	6.1
West Midlands	Wednesbury Forge, Sandwell	Tyers 2007a	WEDNSBRY	1322–1616	102	6.1
Lancashire	Pleasington Old Hall, Pleasington	Tyers 2000b unpubl	PLESNGTN	1373–1527	102	6.0
West Yorkshire	All Hallows Church, Kirkburton	Arnold and Howard 2007a	KRKCSQ02	1306–1633	102	5.8
Cornwall	The Gildhouse, Poundstock	Arnold and Howard 2007b	PDSASQ01	1405–1543	102	5.7
Staffordshire	Sinai Park, Burton upon Trent	Tyers 1997	SINAI22	1227–1750	102	5.6
Lancashire	Lathom House	Nayling 2000a	LATHOM1	1369–1465	61	5.5

Table 3d: Dating evidence for series BAR-A06, AD 1456–1509

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Object	The Mermaid Door	Tyers 1992	OS0013	1468–1640	42	7.5
Staffordshire	Sinai Park, Burton upon Trent	Tyers 1997	SINAI22	1227–1750	54	7.4
Derbyshire	Church Street, Dronfield	Tyers 2003	DRNFIELD	1344–1526	54	5.8
North Yorkshire	Markenfield Hall, Ripon	Howard *et al* 2002	MKFASQ01	1388–1589	54	5.7
North Yorkshire	Thorpe Prebend House, Ripon	Boswijk 1998	PREBEND	1356–1583	54	5.7
Shropshire	Old Farm, Lydbury North	Miles *et al* 2007	LYDBURY5	1363–1658	54	5.6
Shropshire	8-10 High Street, Bishop's Castle	Miles and Bridge 2011	BCSC	1422–1508	53	5.6
Shropshire	St Mary's Church, Neen Savage	Arnold and Howard 2014b	NSVASQ01	1227–1532	54	5.4
Shropshire	The Reader's House, Ludlow	Bridge and Miles 2011	READERS1	1406–1615	54	5.4
South Yorkshire	Sheffield Bishops' House	Arnold and Howard 2017 unpubl	SHBHSQ01	1399–1579	54	5.4
Worcestershire	31 High Street, Bewdley	Tyers 2015	BW31HST4	1445–1526	54	5.3

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Table 3e: Dating evidence for site chronology, BARLOW1, AD 1405–1530

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Object	The Mermaid Door	Tyers 1992	OS0013	1468–1640	63	8.7
West Yorkshire	Dewsbury Low Mill	Hillam 1993 unpubl	DEWSBRYX	1434–1528	95	8.1
Derbyshire	Codnor Castle	Arnold and Howard 2015a	CODCSQ02	1381–1559	126	8.1
Staffordshire	Sinai Park, Burton upon Trent	Tyers 1997	SINAI22	1227–1750	126	7.7
West Midlands	Wednesbury Forge, Sandwell	Tyers 2007a	WEDNSBRY	1322–1616	126	7.3
South Yorkshire	Holly Farm, Greenhill, Sheffield	Tyers 1996 unpubl	HOLLYFRM	1416–1553	115	7.3
South Yorkshire	Sheffield Bishops' House	Arnold and Howard 2017 unpubl	SHBHSQ01	1399–1579	126	7.2
Lancashire	Speke Hall	Howard *et al* 1992	SPKHSQ06	1387–1598	126	7.1
Shropshire	Ightfield Hall Farm Barn, Whitchurch	Groves 1997	IGHTFLD	1341–1566	126	7.0
South Yorkshire	Gunthwaite Barn, Upper Denby	Boswijk 1993 unpubl	GUNTHWTE	1392–1550	126	6.8

Table 3f: Dating evidence for site chronology, BARLOW2, AD 1417–1535

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
West Yorkshire	St Peter's Church, Addingham	Tyers 2007b	ASPCT6	1367–1513	97	7.6
South Yorkshire	Oughtibridge Hall, Bradfield	Arnold *et al* 2020	OTIBSQ01	1424–1624	112	6.4
Greater Manchester	Stayley Hall, Stalybridge	Nayling 2000b	STAYT20	1387–1565	119	5.9
Shropshire	Buildwas Abbey, Ironbridge	Miles 2002a	BUILDWS2	1374–1547	119	5.9
Tyne and Wear	White Hart Yard, Newcastle upon Tyne	Arnold *et al* 2005a	NWCDSQ01	1391–1529	113	5.9
Wales	Gwernfyda, Llanllugan, Powys	Miles *et al* 1996	GWRNFYDA	1410–1551	119	5.9
Derbyshire	Codnor Castle	Arnold and Howard 2015a	CODCSQ02	1381–1559	119	5.8
South Yorkshire	Sheffield Bishops' House	Arnold and Howard 2017 unpubl	SHBHSQ01	1399–1579	119	5.7
Devon	Sydenham House, Marystow	Arnold *et al* 2015	SYDHSQ01	1394–1654	119	5.6
South Yorkshire	Swaith Hall, Worsborough	Tyers 2000a	SWAITHE	1414–1597	119	5.3

Table 3g: Dating evidence for site chronology, BARLOW3, AD 1463–1625

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Shropshire	Brookgate Farm, Plealy	Miles and Haddon-Reece 1993	BROOKGTE	1362–1611	149	6.9
Shropshire	Stokesay Castle	Miles *et al* 1997	STOKESY4	1449–1640	163	6.4
Derbyshire	Unthank Hall, Holmesfield	Howard *et al* 1993	HLMASQ01	1359–1589	127	6.1
South Yorkshire	Grange Farm, Norton, Sheffield	Arnold and Howard 2007c	NRTASQ01	1436–1599	137	6.1
Nottinghamshire	Teversal Manor, Sutton in Ashfield	Arnold *et al* 2003	NTMASQ03	1487–1632	139	5.7
South Yorkshire	Lane Head Farm, Dodworth	Tyers 2006	DODWORTH	1385–1627	163	5.7
Worcestershire	Whispering Cott, Wribbenhall	Tyers 2007c	WWCT7	1402–1576	114	5.4
Oxfordshire	Upper House Farm House, Nuffield	Haddon-Reece *et al* 1989	NUFFIELD	1404–1627	163	5.3
Worcestershire	Upwich, Droitwich	Groves and Hillam 1990b	UPWICH3	1454–1651	163	5.2
Suffolk	Ballingdon Bridge, Sudbury	Tyers 2002	BCBT12	1484–1790	142	5.2

Table 3h: Dating evidence for site chronology, BARLOW4, AD 1588–1676

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Shropshire	Yews Cottage, Clunbury	Miles *et al* 2006	YEWSCOT	1540–1646	59	7.0
Shropshire	Clungunford	Miles 2002c unpubl	CLNGNFRD	1273–1653	66	6.9
Leicestershire	St Nicholas' Church, Bringhurst	Arnold *et al* 2005b	LBF-F03	1619–1677	58	6.6
Worcestershire	Allesborough, Pershore	Bridge *et al* 2021	ALSBRGHe	1540–1644	57	6.1
Bristol	Red Lodge, Bristol	Tyers 2008	REDLDGE2	1617–1703	60	6.1
West Midlands	Fox and Grapes, Birmingham	Bridge *et al* 2019	FOXGRAPE	1567–1719	89	5.7
Buckinghamshire	Bradenham Manor	Miles and Worthington 1998	BRADNM1	1553–1652	65	5.6
Warwickshire	Middleton Hall	Arnold *et al* 2006b	MIDHSQ01	1593–1718	84	5.4
Wiltshire	Salisbury Cathedral	Miles 2002b	SARUM6	1604–1668	65	5.3
Gloucestershire	100 Church St, Tewkesbury	Nayling 2000c	TEWKES2	1484–1664	77	5.1

FIGURES

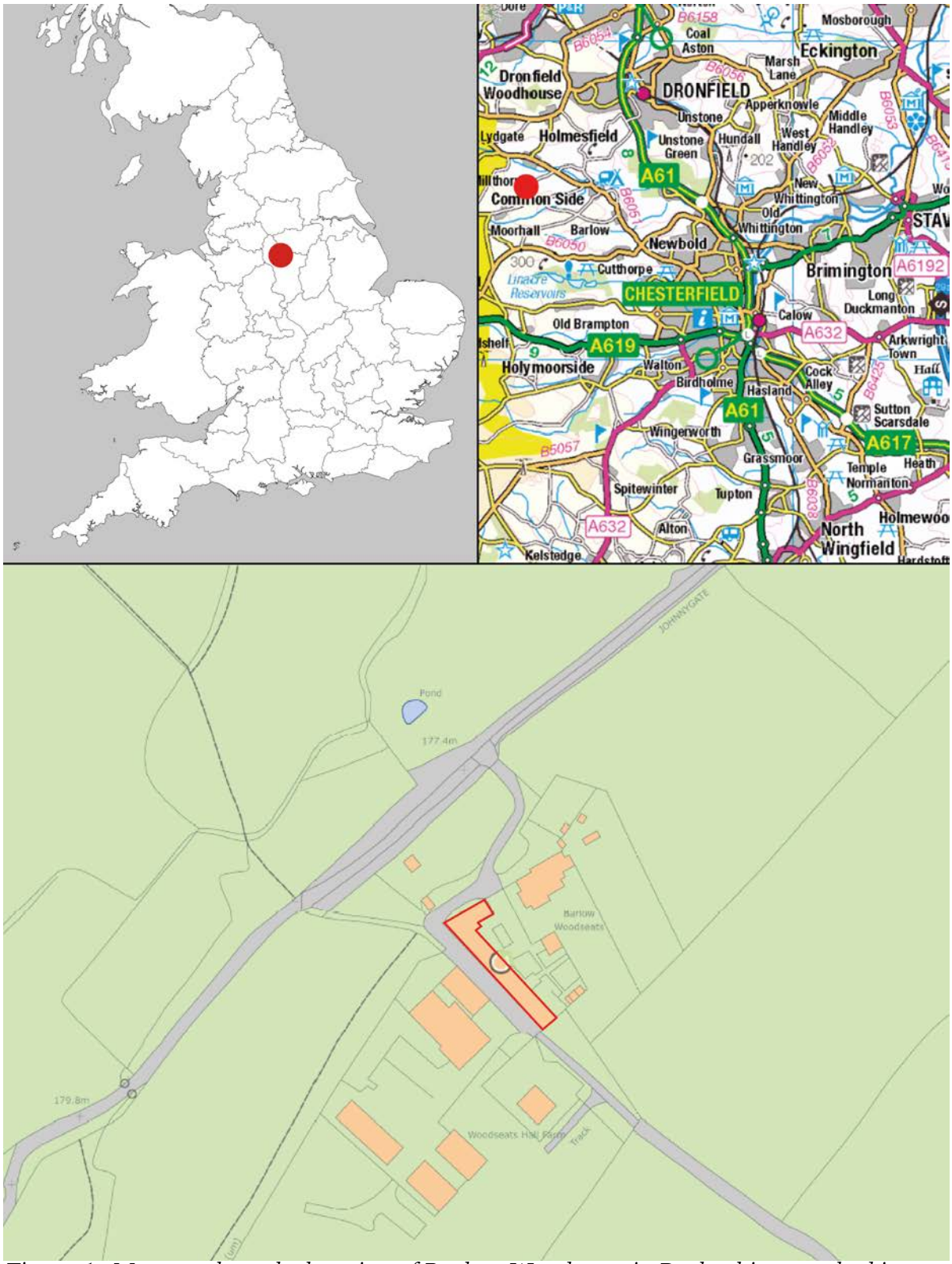

Figure 1: Maps to show the location of Barlow Woodseats in Derbyshire, marked in red. Scale: top right 1:125,000, bottom 1:700 © Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 100024900

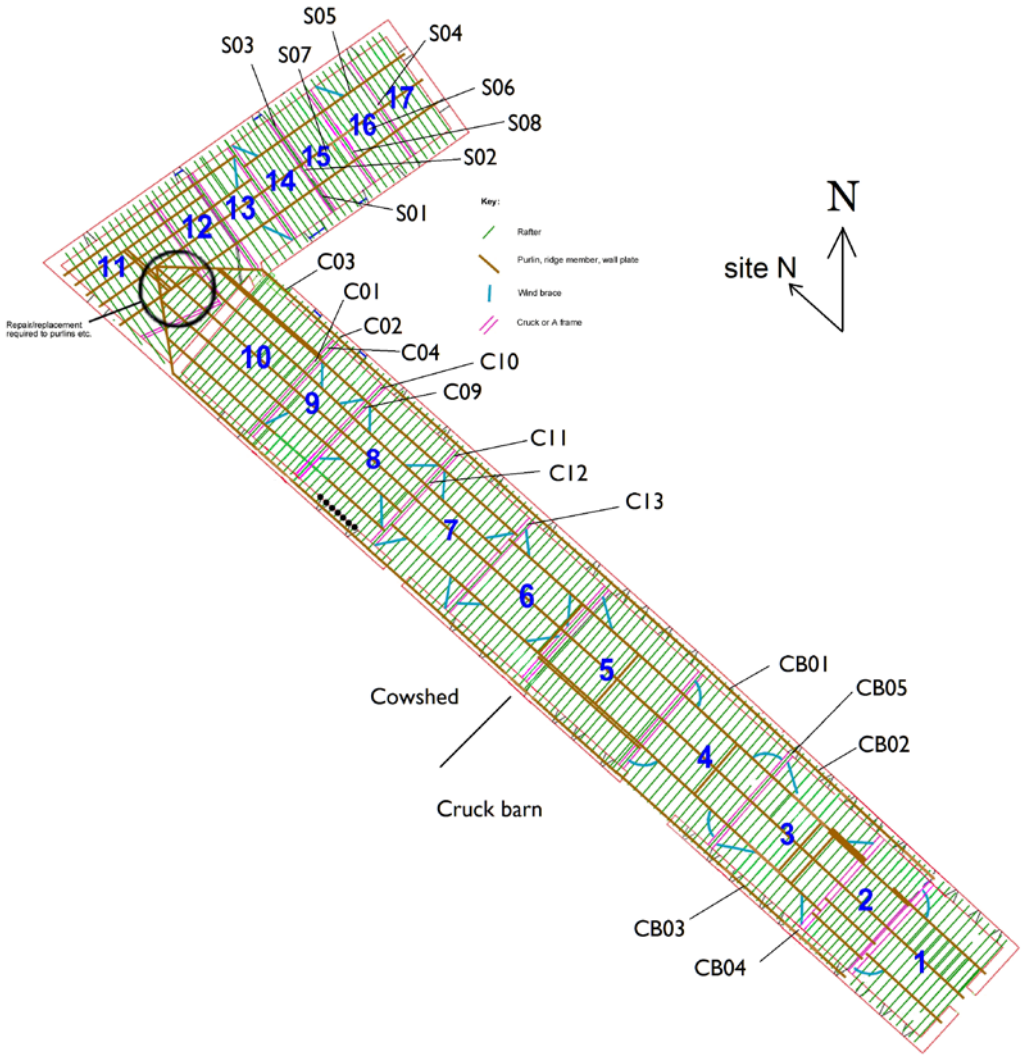

Figure 2: Roof survey drawing by Ellis Willis & Beckett, adapted to show the approximate positions of many of the timbers sampled in the present study (ground-floor timbers are not shown)

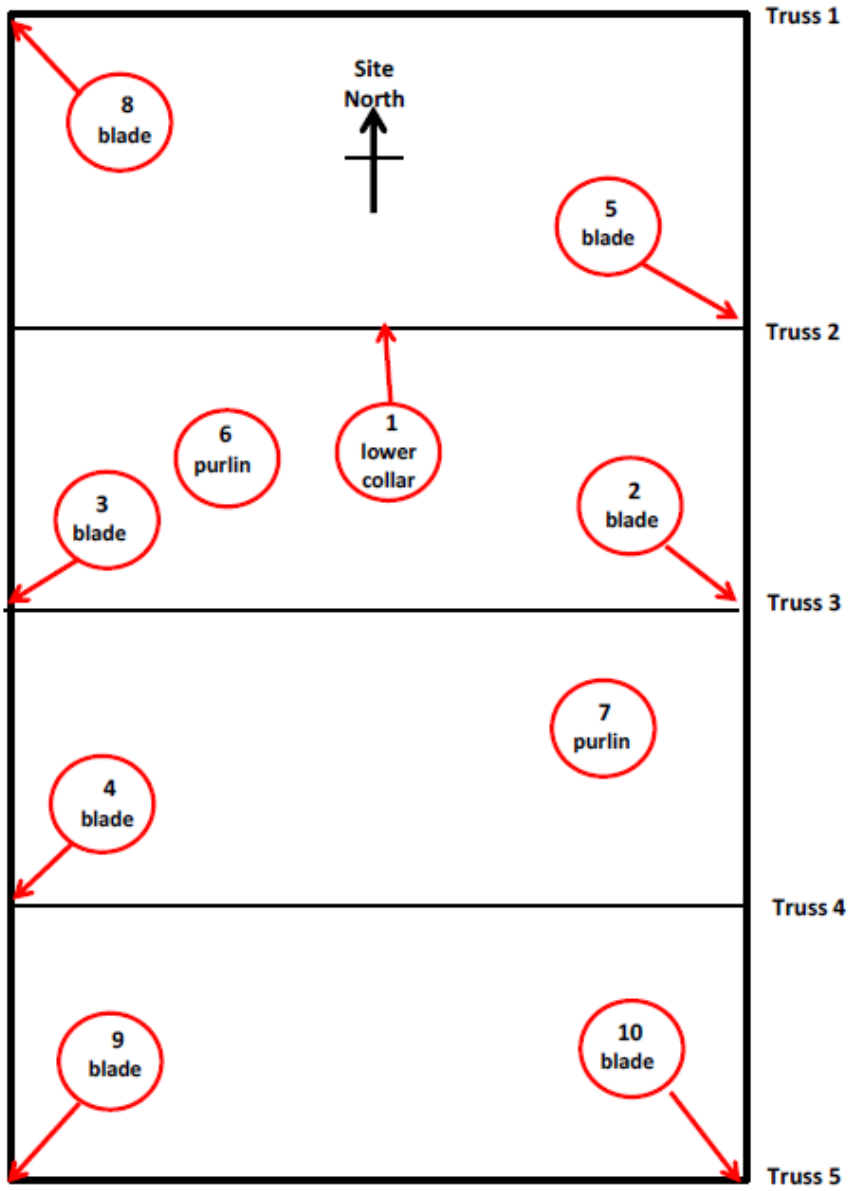

Figure 3: Timbers sampled in the cruck barn in the previous dendrochronological investigation (Laxton et al *1996 unpubl)*

Figure 4: Timber within a window reveal, thought to be part of the original framing of the cruck barn (photograph by Martin Bridge)

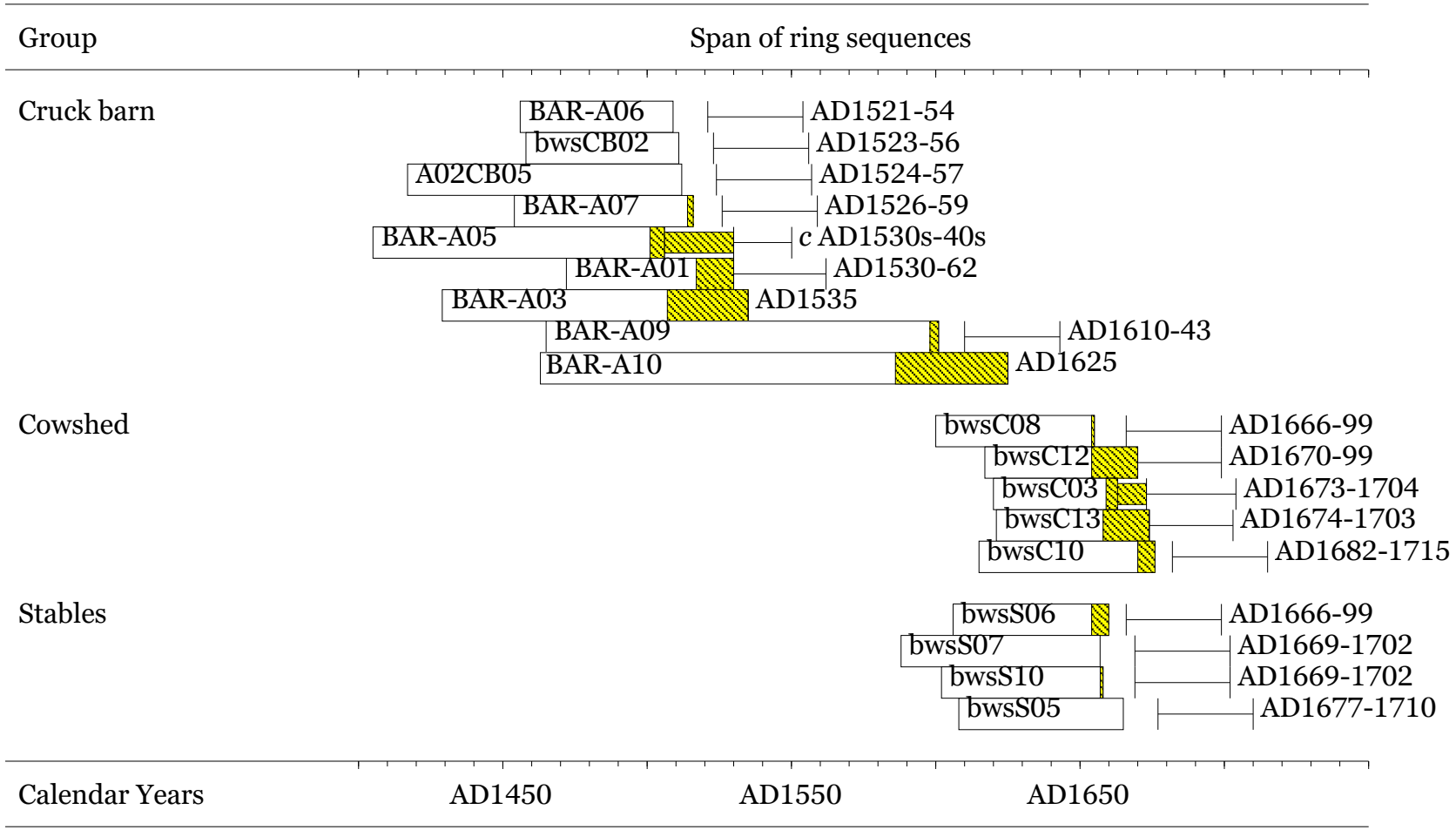

Figure 5: Bar diagram showing the relative positions of overlap and likely felling date ranges for the dated timbers from outbuildings at Barlow Woodseats Hall. White bars represent heartwood rings, yellow hatched sections represent sapwood rings, and narrow bars represent additional unmeasured rings)

APPENDIX

Ring width values (0.01mm) for the measured ring series

BAR-A01A

158	186	211	266	122	113	90	114	105	84
81	71	40	50	97	255	179	152	128	87
90	86	130	164	186	192	147	150	108	65
82	97	124	254	208	174	172	276	196	252
229	250	218	192	218	216	297	271	252	315
276	273	298	226	240	326	328	288	267	

BAR-A01B

163	181	220	265	128	113	89	110	111	92
82	73	50	49	97	250	181	134	127	91
87	90	122	175	210	184	152	160	102	57
85	84	135	241	215	174	176	272	192	263
221	245	221	196	213	216	292	270	254	314
274	268	295	240	230	325	352	287	311	

BAR-A02A

242	268	226	478	444	270	345	271	319	413
365	346	330	212	336	334	239	266	342	264
258	326	243	279	240	194	239	272	239	192
194	148	156	172	200	199	213	281	239	308
276	271	222	174	111	69	62	71	100	124
109	144	154	178	213	258	229	299	319	227
129	213	394	123	115	143	129	111	141	149
218	96	171	286	223	273	186	215	360	448
344	260	436	403	73	58	119	89	96	77
85	110	96	155	117	116				

BAR-A02B

240	278	246	501	440	292	337	275	328	410
393	368	314	233	323	371	242	266	338	277
269	312	250	282	243	195	237	284	242	208
185	153	147	174	194	208	196	283	246	315
277	265	229	166	108	75	60	69	100	120
118	138	145	169	201	239	245	299	316	235
125	222	398	120	123	137	113	111	151	149
222	96	191	282	229	270	194	208	360	434
331	259	431	402	67	64	131	89	99	70
84	120	101	149	121	101				

BAR-A03a

578	396	540	572	397	324	444	406	383	396
297	405	321	273	400	424	356	248	257	326
301	231	289	328	310	346	314	343	320	307
340	262	243	165	114	110	178	183	189	202
191	153	149	119	138	160	238	213	184	149
191	127	110	88	88	105	139	131	180	106
114	176	147	133	87	95	162	181	122	123
151	138	72	61	66	119	87	74	82	99
76	71								

BAR-A03b

572	528	478	318	386	358	426	363	364	373
344	271	113	68	72	115	114	168	215	209
188	196	195	204	233	365	245	191	213	246
94	155	199	167	179	226	204	270	158	181
229	212	217	162	231	243	329	181	182	250

249 80 98 95 121 97 90 107 139 153
111 191 127 150 158 148 42 41 43 38
54 65 109 106 123 142

BAR-A03c
225 349 239 188 251 260 93 155 190 165
176 215 203 274 169 196 243 227 239 170
221 251 332 211 197 274 256 75 105 118
145 108 108 104 149 157 126 183 139 144
165 172 67 45 48 88 85 70 112 126
130 107 110 133 75 46 35 48 51 54
49 45

BAR-A04A
115 206 186 224 176 252 177 159 131 154
279 272 375 464 292 334 237 341 357 349
270 322 293 367 286 340 344 260 257 250
154 164 198 216 360 397 214 435 210 158
249 274 250 458 341 374 328 469 448 480
350

BAR-A04B
120 236 246 202 146 228 187 157 124 145
276 284 399 461 314 357 240 312 359 351
258 319 313 412 258 334 355 281 277 258
153 156 210 220 363 398 192 434 215 152
248 266 263 430 344 377 341 446 443 480
370

BAR-A05a
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187 249 178 182 136 297 269 209 232 238
226 221 279 314 255 229 294 274 182 202
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158 147 198 189 209 136 94 91 136 127
96 117 89 114 147 183 210 212 225 175
155 242 315 231 210 213 190 195 209 166
203 176 173 146 170 198 203 171 189 152
165 144 222 229 160 146 130 159 158 157
164 195 177 160 214 210 177

BAR-A05b
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176 208 232 233 229 234 95 161 214 183
193 209 156 167 239 254 328 251 208 211
151 185 223 226 275 115 74 75 111 114
98 110 103 117 88 86 97 117 80 92
105 138 88 111 129 121 96 109

BAR-A05c
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172 202 301 225 185 146 141 156 128 132
159 218 153 158 109 110 142 161 145 160
145 129 152 203 157 112 99 81 80 61
70 86 101 108 80 96 72 81 59 81
97 78 83 76 82 93 91 117 82 70
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86 79 120 96 93 51 41 21 51 36
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BAR-A06A
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179 106 143 212

BAR-A06B
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188 268 211 183 264 139 281 259 211 251
336 202 141 196 187 116 170 183 180 158
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138 180 256 417 262 287 267 204 208 210
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164 218 204 174 173 233 228 222 177 190
185 149 139

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138 182 254 423 257 291 297 188 186 222
263 283 379 245 197 227 142 128 118 153
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165 167 165

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190 177 174 193 245 209 256 205 173 135
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77 71 71 92 110 49 51 42 62 48
52 56 57 66 98 102 104 112 112 125
102 110 82 79 88 121 126 193 182 143
173 93 82 84 68 56 66 69 61 85
114 126 120 166

BAR-A08b
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88 86 76 80 95 140 123

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156 149 131 138 168 181 192 149 171 125
133 127 103 97 116 133 119 112 126 108
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94 74 74 68 67 86

BAR-A10b
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61 83 65 89 68 69 80 82 84 78
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163 163 139 147 189 214

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303 370 371 329 398 193 262 276 276 154
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184 173

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255 268 282 351 262 205 204 266 238 216
224 171 211 191

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bwsS02
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425 364 285 125 158 199 196 271

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116 172 91 102 41 29 35 49 33 72
168 113 132 117 88 113 124 131 142 87
54 63 142 227 94 217 293 279 223 254
186 207 163 134 153 147 144 75

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