RESEARCH DEPARTMENT REPORT SERIES no. 15-2008 ISSN 1749-8775

CHURCH OF ST ANDREW, SOHAM, CAMBRIDGESHIRE
TREE-RING DATING OF TIMBERS FROM THE NAVE ROOF

SCIENTIFIC DATING REPORT

Dr Martin Bridge

ARCHAEOLOGICAL SCIENCE

ENGLISH HERITAGE

Research Department Report Series 15-2008

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TREE-RING ANALYSIS OF TIMBERS FROM THE NAVE ROOF

Dr Martin Bridge

NGR TL 593 732

ISSN 1749-8775

SUMMARY

Ten timbers from the nave roof, including one replacement jackpost supporting the westernmost truss of the nave roof, were sampled. Most nave roof timbers were assessed as having too few rings to sample, and three of the samples taken were rejected from further analysis because they also had too few rings. Five of the fifteenth-century roof timbers were dated and if it is assumed they form a single group of timbers felled at the same time, their most likely felling date range is AD 1477–1509. The replacement jackpost was fashioned from a tree felled in winter AD 1626/7.

ACKNOWLEDGEMENTS

This work was commissioned by Dr. John Meadows of the Scientific Dating Service, English Heritage. Staff of Purcell Miller Tritton made arrangements for my visit to the site, and the contractors C.E.L. provided access to the roof. I thank Cathy Tyers (Sheffield University) and Jane Sidell (English Heritage) for useful comments on an earlier draft of this report.

DATE OF FIELDWORK

July 2007

CONTACT DETAILS

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INTRODUCTION

The original church on this site (NGR TL 593 732; Fig 1) was a Minster church built *c* AD 1180–90. The nave roof of the grade-I listed church of St Andrew, Soham, is stylistically dated to the fifteenth century, although it is believed that elements of the original twelfth-century roof may survive within the late medieval structure. The nave roof has tiebeams supported by carved jackposts with moulded braces, and with angels and other figures carved to the soffits of the intermediate principal rafters. Tree-ring dating of the nave roof was requested by the English Heritage Historic Buildings Architect Malcolm Starr to inform ongoing grant-aided repairs to this historic roof, the major part of which is expected to take place in 2008.

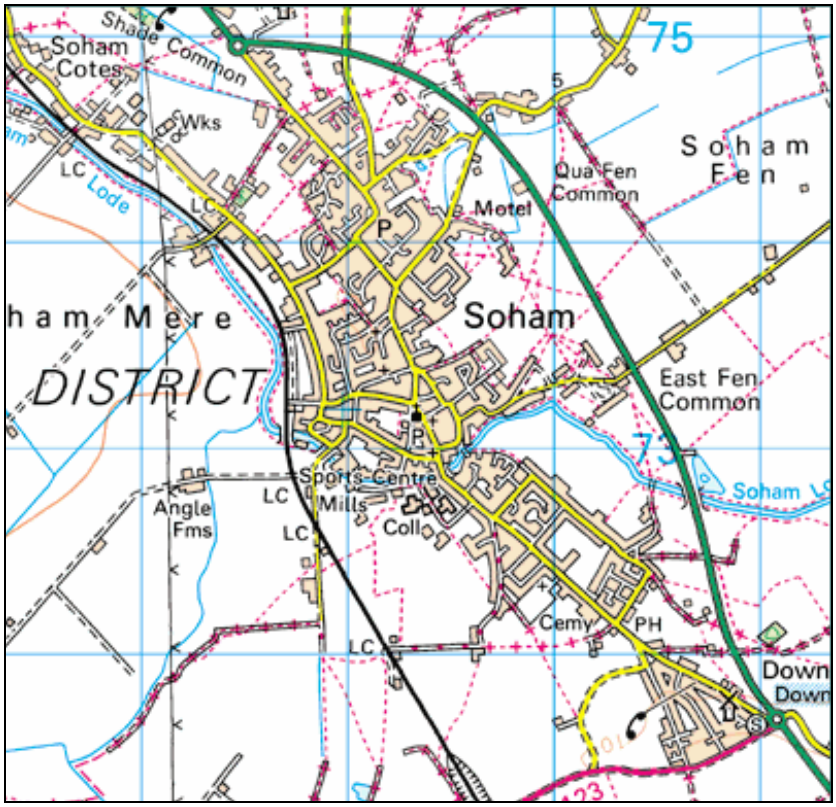

Figure 1: Map showing the location (centre) of St Andrew's Church, Soham, Cambridgeshire.

METHODOLOGY

The site was assessed in July 2007. In the initial assessment, accessible oak timbers with more than 50 rings and traces of sapwood were sought, although slightly shorter sequences are sometimes sampled if little other material is available. Those building timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labeled, and stored for subsequent analysis.

The cores were prepared for measuring by sanding, using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done manually. Suitable 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 and dating was accomplished 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 to allow visual comparisons to be made between sequences on a light table. This method provides a measure of quality control in identifying any errors in the measurements when the samples cross-match.

In comparing one sequence or site sequence against another, *t*-values over 3.5 are considered significant, although in reality it is common to find *t*-values of 4 and 5 which are demonstrably spurious because more than one matching position is indicated. For this reason, it is necessary to obtain some *t*-values of 5, 6, and higher, and for these to be well replicated from different, independent chronologies and with local and regional chronologies well represented, unless the timber is imported. Where two individual sequences match with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they most likely came from the same parent tree.

When cross-matching between samples is found, their ring-width sequences are averaged to form an internal 'working' site mean sequence. Other samples may then be incorporated after comparison with this 'working' master until a final site sequence is established. This is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the measured rings in each sample. These dates require interpretation for the date of felling of each timber and subsequent construction date of the phase under investigation to be determined. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. The sapwood estimates used here are based on those proposed for this area by Miles (1997), in which 95% of oaks contain 9–41 rings. Where complete sapwood or bark is present, the exact date of tree felling may be determined.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the reuse of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965; Miles 2005).

RESULTS

The nave roof is thought to extend over the ceiling of the crossing tower and it is here that it was thought that some of the original twelfth-century roof timbers may be present. This part of the roof was not accessible in July 2007 when the sampling for this analysis was undertaken, though a brief look from the small access to the ceiling of the tower suggested that no ancient timbers remain in the roof high above. This area may be more accessible when the lead is removed from the exterior, scheduled for 2008.

The main nave roof was accessible from scaffolding. A report of 2006 from the Bedford Timber Preservation Company suggested extensive damage to many of the timbers, largely resulting from deathwatch beetle attack, and therefore it was not expected that many timbers would prove to be suitable for dendrochronological dating. The levels of damage were found to be far less than had been suggested. All timbers assessed and those later sampled were of oak (*Quercus* spp.). Details of the samples are given in Table 1, and the positions of the samples are illustrated in Figure 2. Figure 3 shows a section view of truss I looking east, showing the general form of the roof. Trusses are numbered from the east end, following the assembly marks visible on the timbers.

One jack post, that on the south side supporting the first full truss from the west end (VI marked on the tie) was clearly a replacement timber, carved in a Jacobean style. The decision was taken to sample this as it clearly contained a large number of rings and retained complete sapwood. Single timbers are rarely

thought suitable for dendrochronological analysis as they are less likely to date and do not necessarily accurately date a phase, however in this instance the number of rings visible, the presence of complete sapwood, and the additional historical evidence for the development of the roof in this part of the roof justified sampling. The timbers throughout the rest of the nave roof however were generally quite fast-grown. The nine most promising timbers were sampled, although three were subsequently rejected as they had sequences too short to warrant further analysis.

Sample (SHM01), from the replacement jackpost, contained 143 rings and was dated to the period AD 1484–1626 (Table 3a). Cross-matching was found between four of the remaining series (Table 2). Sample SHM05 gave only a single significant cross-match, but its proposed date was confirmed by matching with reference material, and the visual plot with the other three timbers was found to be acceptable. These series were combined into a working site master SHM2359, which was dated to the period AD 1358–1477 by comparison with dated reference chronologies (Table 3b). A further sequence, SHM04, was dated independently (Table 3c) to the period AD 1306–1380.

The series SHM01, SHM2359 and SHM04 are presented in Table 4, and the relative positions of overlap of the dated timbers are illustrated, along with their actual felling date or interpreted likely felling date ranges in Figure 4.

Sample SHM06 did not match the other series, nor did it date independently.

INTERPRETATION AND DISCUSSION

The replacement jack post on the south side of the west end truss was fashioned from a tree felled in the winter of AD 1626/7. Assuming that it was carved and positioned soon after felling, this gives evidence of a repair phase to the nave roof in AD 1627 or one or two years after this date.

Of the five dated timbers from the fifteenth-century nave roof, one timber retained no sapwood, and appears to have lost many rings in its conversion. It was however sampled as a source of datable rings from a roof generally lacking in good samples. The other four timbers have heartwood-sapwood boundaries with quite a wide range of dates (22 years). If it is assumed that these four timbers were all felled at the same time, the mean heartwood-sapwood boundary date of AD 1468, gives a most likely felling date range of AD 1477–1509, relating well to the date proposed on stylistic evidence. It is possible that more than one group of timbers was used in this construction. Three samples (SHM02, 03, and 05) have heartwood-sapwood boundary dates within a ten year period and are likely to form a single group with a mean boundary date of AD 1472, but it is possible that the other two dated samples come from a different phase with a slightly earlier felling date range. This hypothesis could only be tested if more samples from the roof were taken and dated, preferably from a greater range of structural elements, but unfortunately too few timbers were found to have sufficient numbers of rings to make this possible.

The dated series match best against reference data from the East Anglian region, and are most likely to be of relatively local origin.

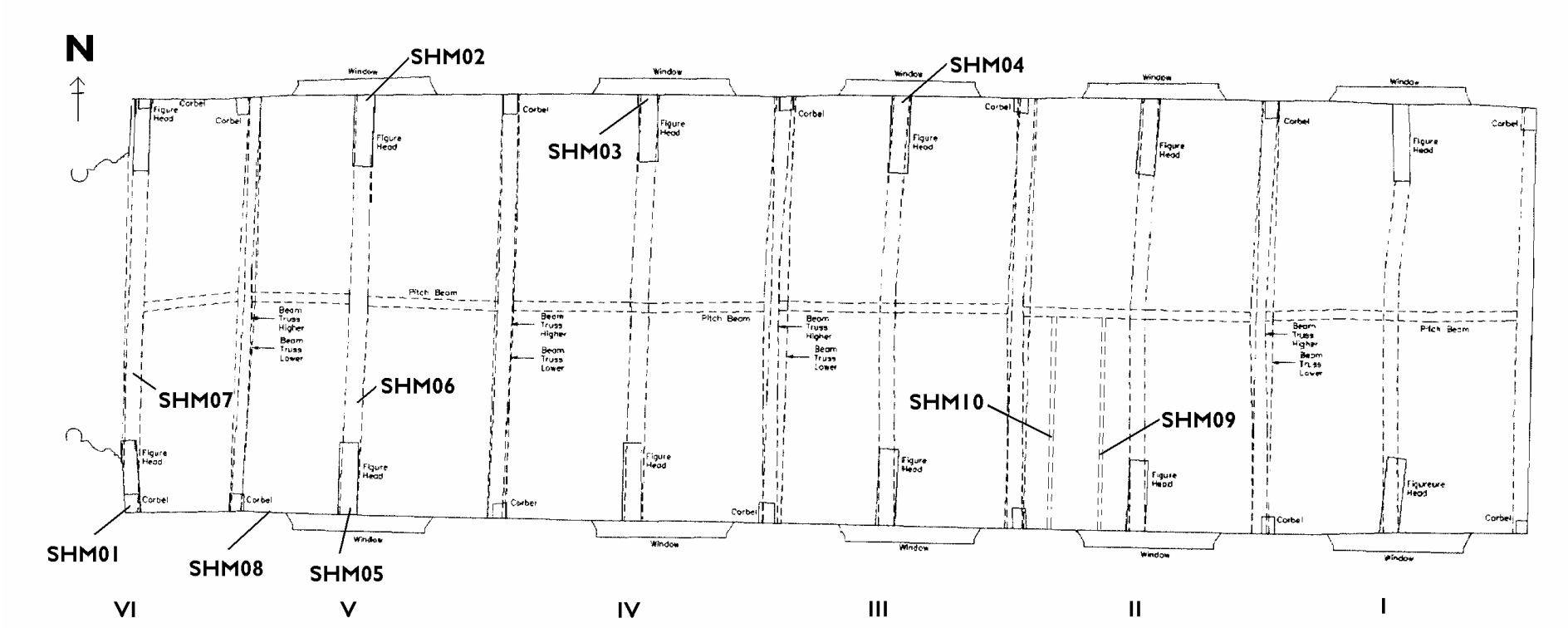

Figure 2: Plan of the nave showing the approximate positions of the samples taken for dendrochronology, adapted from an original supplied by Purcell Miller and Tritton, architects

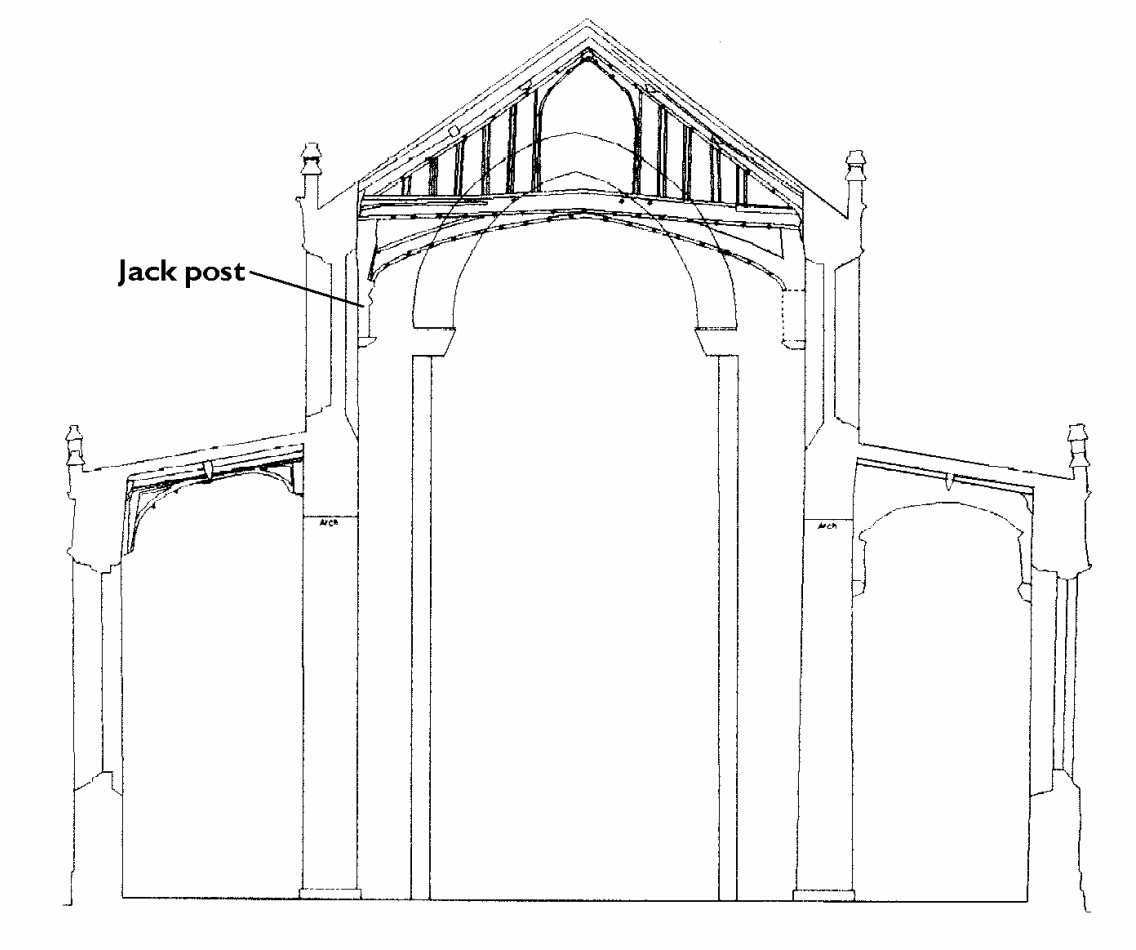

Figure 3: Section through the nave, showing truss I, looking east, and giving the general form of the roof trusses. Adapted from an original drawing supplied by Purcell, Miller, Tritton architects

*Table 1: Details of oak (*Quercus *spp.) timbers sampled from the nave roof of St Andrew's Church, Soham, Cambridgeshire. Trusses are numbered from the east end reflecting the assembly marks on the trusses themselves*

Sample number	Timber and position	No of rings	Mean Width (mm)	Mean sens (mm)	Dates AD Spanning	H/S bdry AD	Sapwood complement	Likely felling date ranges (AD)
SHM01	Jack post south side, truss VI	143	1.57	0.27	1484–1626	1606	20C	winter 1626/27
SHM02	Jack post north side, truss V	103	1.99	0.20	1366–1468	1468	H/S	1477–1509
SHM03	North post, truss IV	84	1.35	0.23	1388–1471	1471	H/S	1480–1512
SHM04	North post, truss III	75	1.39	0.29	1306–1380	-	-	after 1389
SHM05	South post, truss V	57	2.59	0.18	1421–1477	1477	H/S	1486–1518
SHM06	Tie V	60	1.78	0.17	undated	-	H/S	unknown
SHM07	Tie VI	<45	NM	-	undated	-	-	unknown
SHM08	Wallplate cover, south bay V-VI	<45	NM	-	undated	-	-	unknown
SHM09	Common rafter 2, bay II-III south	110	1.38	0.25	1358–1467	1454	13	1468–95
SHM10	Common rafter 4, bay II-III south	<45	NM	-	undated	-	-	unknown

Key: NM = not measured; H/S = heartwood/sapwood boundary

*Table 2: Cross-matching between the four samples making up series **SHM2359**; t-values over 3.5 are considered significant*

	t-values		
Sample No	SHM03	SHM05	SHM09
SHM02	4.9	4.6	5.1
SHM03		2.9	4.2
SHM05			1.9

*Table 3a: Dating evidence for the series **SHM01**, AD 1484–1626 (regional multi-site chronologies have the file name in **bold**)*

County/ region	Chronology	Reference	File name	Spanning (yrs AD)	Overlap (yrs)	t-value
East Anglia	East Anglia Master Chronology	Bridge 2003	**ANGLIA03**	944–1789	143	7.8
Hertfordshire *	Priory Barn, Lt Wymondley	Bridge 2001a	LWYMON2	1450–1540	57	6.7
Shropshire	Old Hall Farm, All Stretton	Miles and Haddon-Reece 1996	OLDHLLFM	1379–1630	143	6.6
Oxfordshire	Bodleian Library	Miles and Worthington 1999	BDLEIAN3	1395–1610	127	6.1
Shropshire	Milk Street, Shrewsbury	Miles 1996	ms19	1529–1654	98	6.0
Northern England	Northern England Master	Hillam and Groves 1994	**NORTH**	440–1742	143	5.9
London	London Master Chronology	Tyers pers comm.	**LONDON**	413–1728	143	5.8
East Midlands	East Midlands Master	Laxton and Litton 1988	**EASTMID**	882–1981	143	5.7
Cambridgeshire *	St Andrew's Church, Wimpole	Bridge 1998a	WIMPOLE1	1469–1615	132	5.7
Suffolk	Crow's Hall	Miles *et al* 2007	CROWSHL2	1404–1551	68	5.7

* = component of **ANGLIA03**

*Table 3b: Dating evidence for the series **SHM2359**, AD 1358–1477 (regional multi-site chronologies have the file name in **bold**)*

County/ region	Chronology	Reference	File name	Spanning (yrs AD)	Overlap (yrs)	t-value
England	Ref3 Master Chronology	Fletcher 1977	**REF3**	1399–1687	79	6.6
East Anglia	East Anglia Master Chronology	Bridge 2003	**ANGLIA03**	944–1789	120	6.0
Norfolk	Abbey Farm, Thetford	Howard *et al* 2000	THTASQ01	1332–1536	120	5.9
Oxfordshire	Manor Farm, Stanton St John	Miles and Worthington 1998	STNSTJN2	1379–1474	96	5.9
Suffolk	Bedfield Hall	Miles *et al* 2007	BEDFLD1	1274–1419	62	5.8
Suffolk *	Hengrave Hall, Hengrave	Bridge 2001b	HENGRAVE	1367–1512	111	5.5
Oxfordshire	Priory Cottages, Steventon	Miles and Worthington 2002	pcs12	1337–1443	86	5.3
Essex *	St Mary's, Saffron Walden	Bridge 2001c	SAFFRON1	1305–1475	118	5.1
London	London Master Chronology	Tyers pers comm.	**LONDON**	413–1728	120	5.0
Yorkshire	Nostell Priory	Tyers 1998	NOSTELL1	1263–1536	120	5.0

* = component of **ANGLIA03**

*Table 3c: Dating evidence for the series **SHM04**, AD 1306–80 (regional multi-site chronologies have the file name in **bold**)*

County/ region	Chronology	Reference	File name	Spanning (yrs AD)	Overlap (yrs)	t-value
Hertfordshire	Wymondleybury	Groves *et al* 2005	WYMNDBRY	1184–1379	74	6.8
Essex *	Fyfield Hall	Bridge 1998b	FYFIELD2	1293–1388	75	5.8
Suffolk *	Debenham Church	Bridge 2001d	DEBENHAM	1256–1388	75	5.6
Gloucestershire	Chest, Kempley Church	Miles *et al* 1999	KEMPLEY4	1329–1468	52	5.6
Essex	Cann Hall	Tyers 1998	CANNHALL	1301–1511	75	5.5
Gloucestershire	Twyning bell towerr	Tyers 1996	TWYNING	1251–1452	75	5.5
East Anglia	East Anglia Master Chronology	Bridge 2003	**ANGLIA03**	944–1789	75	5.4
Bedfordshire *	St George's Church	Bridge 2001e	TODDNGTN	1226–1392	75	5.3
Hertfordshire	Clothall Bury Barn	Arnold *et al* 2003	CLBASQ01	1253–1367	62	5.3
Berkshire	Reading Waterfront	Groves *et al* 1999	READING	1160–1407	75	5.3

* = component of **ANGLIA03**

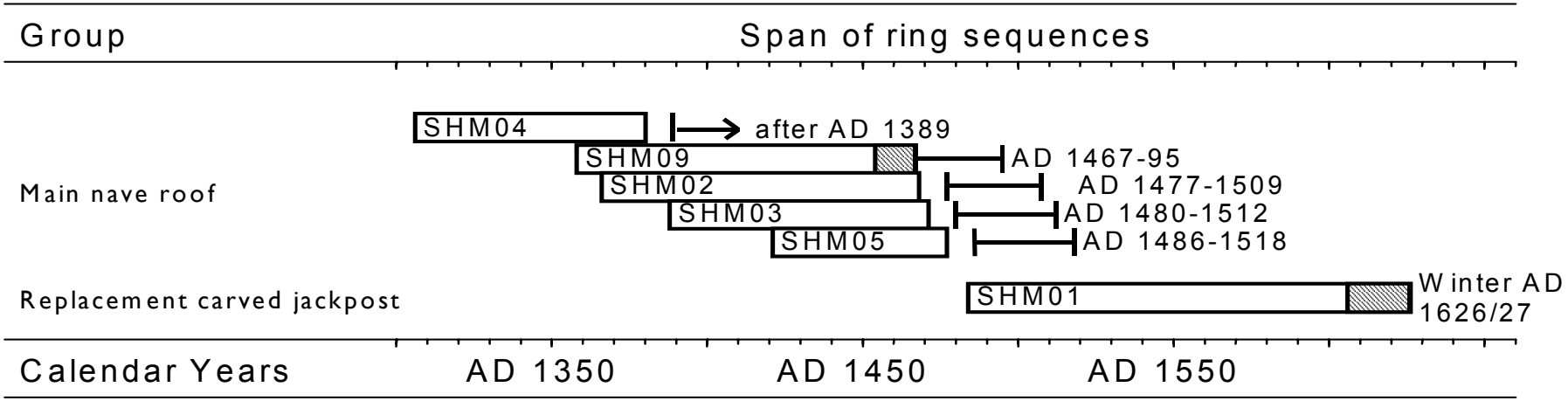

Figure 4: Bar diagram showing the relative positions of overlap of the dated timbers, along with actual or interpreted likely felling dates

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*Table 4: Ring width data for the site series **SHM01** (AD 1484–1626), **SHM2359** (AD 1358–1477), and **SHM04** (AD 1306–80)*

Ring widths (0.01mm)	no. of trees
SHM01	
126 117 158 301 200 222 169 161 107 152	
147 141 216 222 149 141 182 153 176 131	
124 130 146 106 128 108 148 127 179 139	
83 117 131 97 128 174 145 139 317 198	
248 215 259 167 142 157 143 253 139 139	
142 252 200 175 142 201 168 105 104 95	
119 184 126 116 148 90 232 184 129 279	
190 230 157 108 162 104 221 145 173 130	
91 131 101 98 144 162 175 180 153 148	
188 129 98 109 105 108 298 193 165 140	
154 142 158 104 127 154 124 146 115 162	
239 151 279 135 170 157 123 101 98 120	
166 90 211 213 265 171 134 122 179 232	
149 134 168 177 121 116 190 146 136 150	
99 129 117	
SHM2359	
123 272 303 266 168 86 84 93 141 153	1 1 1 1 1 1 1 1 1 1
122 81 64 84 87 127 145 84 85 131	1 1 1 1 1 1 1 1 1 1
96 105 222 263 215 141 106 87 115 132	1 1 1 1 1 1 1 1 1 1
97 116 106 322 351 314 300 178 150 150	1 1 1 1 1 1 1 1 1 1
134 255 191 115 102 105 59 65 88 51	1 1 1 1 1 1 1 1 1 1
81 138 103 110 140 121 235 214 228 126	1 1 2 2 2 2 2 2 2 2
136 145 206 259 265 249 194 117 139 160	3 3 3 3 3 3 3 3 3 3
188 154 229 219 225 289 217 186 209 278	3 3 3 3 3 2 2 2 2 2
247 173 200 141 160 103 87 149 211 198	2 2 3 3 3 3 3 3 3 3
239 192 145 120 119 120 96 167 248 173	3 3 3 3 3 3 3 3 3 3
169 117 128 117 104 125 179 223 186 172	3 3 3 3 3 3 3 3 3 3
131 79 138 144 157 241 191 211 214 163	3 3 3 3 3 4 4 4 4 4
153 141 222 234 224 215 236 179 126 138	4 4 4 4 4 4 4 4 4 4
214 237 198 171 166 146 162 175 149 136	4 4 4 4 4 4 4 4 4 4
190 180 155 183 160 184 166 159 211 185	4 4 4 4 4 4 4 4 4 4
188 157 118 103 123 135 131 126 116 130	4 4 4 4 4 4 4 4 4 4
153 129 181 190 220 200 149 199 185 242	4 4 3 2 2 2 1 1 1 1
145 180	1 1
SHM04	
123 272 303 266 168 86 84 93 141 153	
122 81 64 84 87 127 145 84 85 131	
96 105 222 263 215 141 106 87 115 132	
97 116 106 322 351 314 300 178 150 150	
134 255 191 115 102 105 59 65 88 51	
81 138 124 89 104 70 135 162 132 92	
50 46 71 114 134 163 223 174 170 212	
113 60 101 129 134	