Centre for Archaeology Report 17/2004

Tree-Ring Analysis of Timbers from the Nave Roof, Church of St Laurence, The Borough, Holwell, Dorset

Dr Martin Bridge

ISSN 1473-9224

The Centre for Archaeology Report Series incorporates the former Ancient Monuments Laboratory Report Series. Copies of Ancient Monuments Laboratory Reports will continue to be available from the Centre for Archaeology (see back cover for details).

Centre for Archaeology Report 17/2004

Tree-Ring Analysis of Timbers from the Nave Roof, Church of St Laurence, The Borough, Holwell, Dorset

Dr Martin Bridge

Summary

Timbers from the nave roof were sampled. Three collars were thought likely to have been derived from the same tree. The site chronology, containing series from collars, a rafter, and two arch-braces dated to the period AD 1195-1427. Combining the likely felling date ranges for each of these timbers gives a likely date range of AD 1436-64 for the primary roof timbers. This suggests a mid-fifteenth century date for the wagon roof, rather than the late-fifteenth century indicated by stylistic information.

Keywords

Dendrochronology
Standing Building

Author's address

Institute of Archaeology, University College London, 31-34 Gordon Square, London, WC1H 0PY.
Telephone: 020 7679 1540. Email: martin.bridge@ucl.ac.uk

Introduction

The Church of St Laurence (NGR ST 699 119; Fig 1) is a grade I listed building, thought to be of late-fifteenth century origin. The nave has a wagon roof rising above treble hollow-chamfered cornices at wallplate level. It comprises 32 paired rafter trusses, with arch braces and collars (Figures 2 and 4). Dendrochronological investigation of the nave and north aisle roofs was requested by Nicola Sterry, English Heritage Historic Building Surveyor, and commissioned by English Heritage, in order to provide precise dates for their construction and inform a programme of grant-aided repairs.

Methodology

The site was visited in October AD 2003. Oak timbers with more than 50 rings, traces of sapwood, and accessibility were the main considerations in the initial assessment. Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, 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 0.01 mm 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. The software used in measuring and subsequent analysis was written by Ian Tyers (1999).

Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This activity also acts as a measure of quality control in identifying any errors in the measurements when the samples crossmatch. Statistical comparisons were made using Student's *t*-test (Baillie and Pilcher 1973; Munro 1984). The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973). Those *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches, and give consistent matching positions.

When crossmatching between samples is found, their ring-width sequences are meaned 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, which 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.

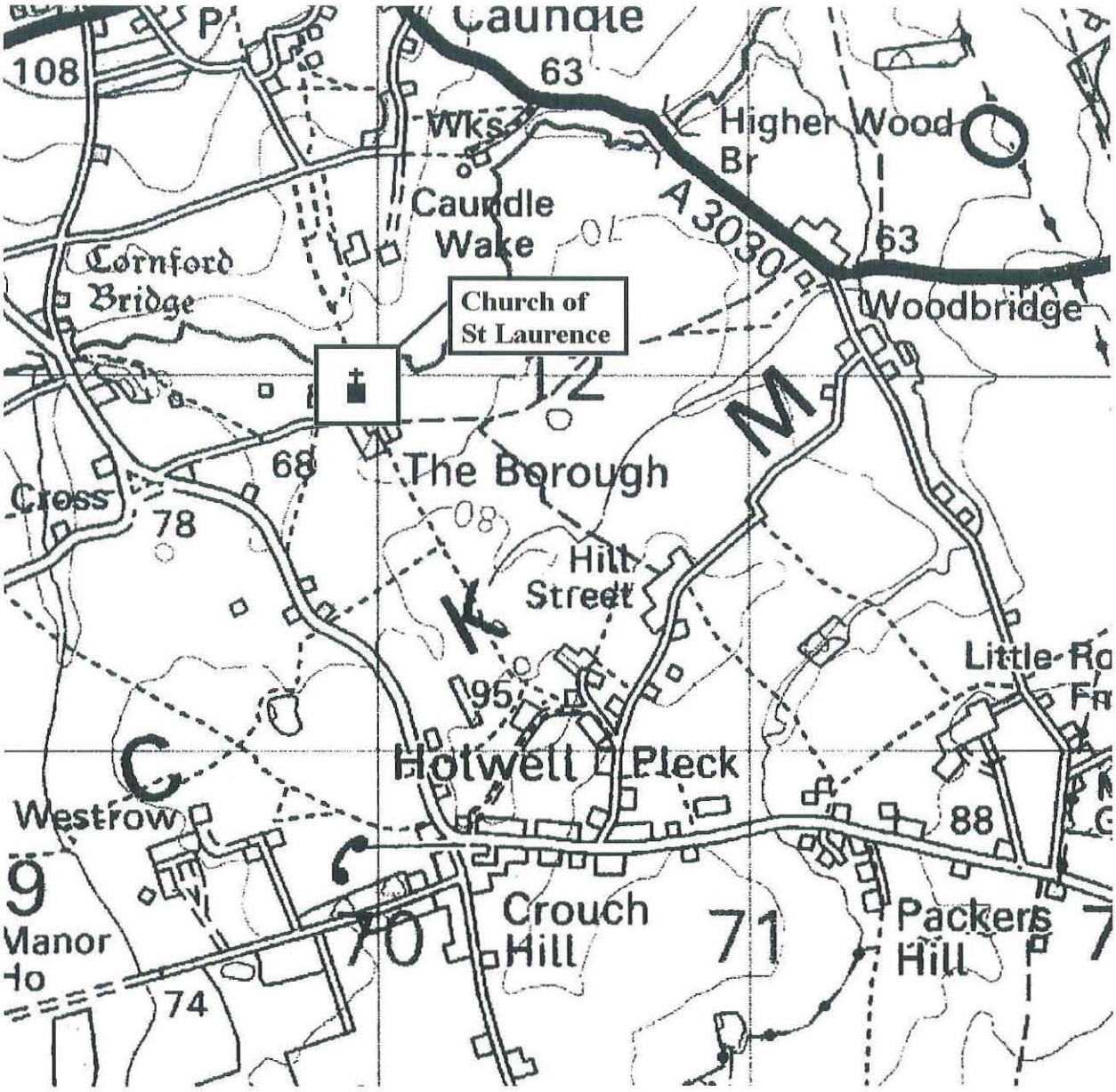

Figure 1: Map showing the location of the Church of St Laurence, Holwell,

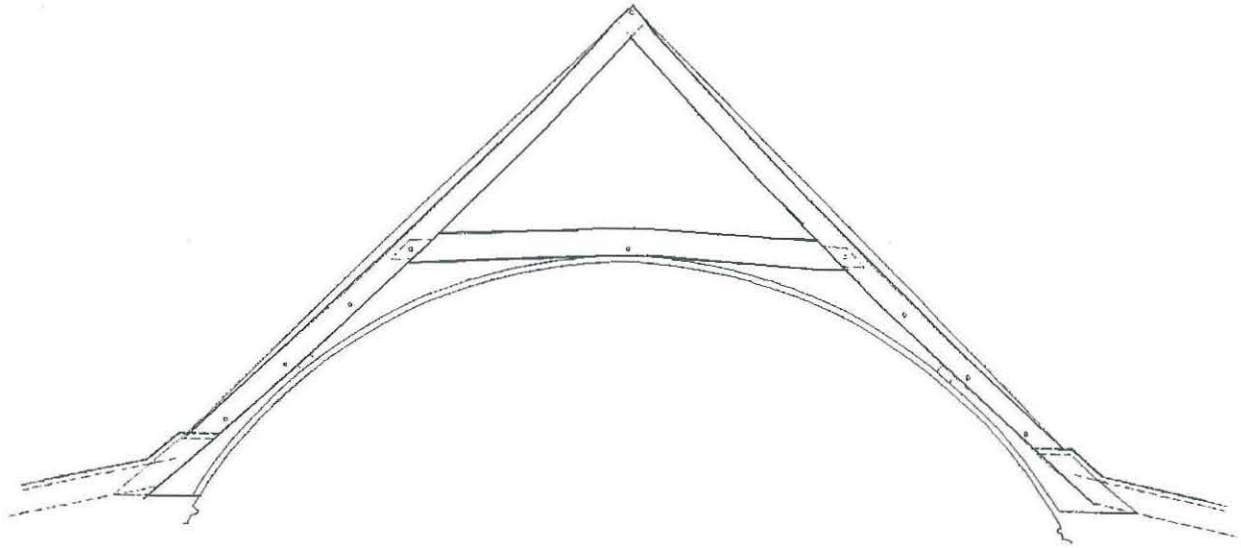

Figure 2: Drawing of a typical truss from the roof of the nave, Church of St Laurence, Holwell, based on an original drawing by P. James, John Stark & Crickmay Partnership

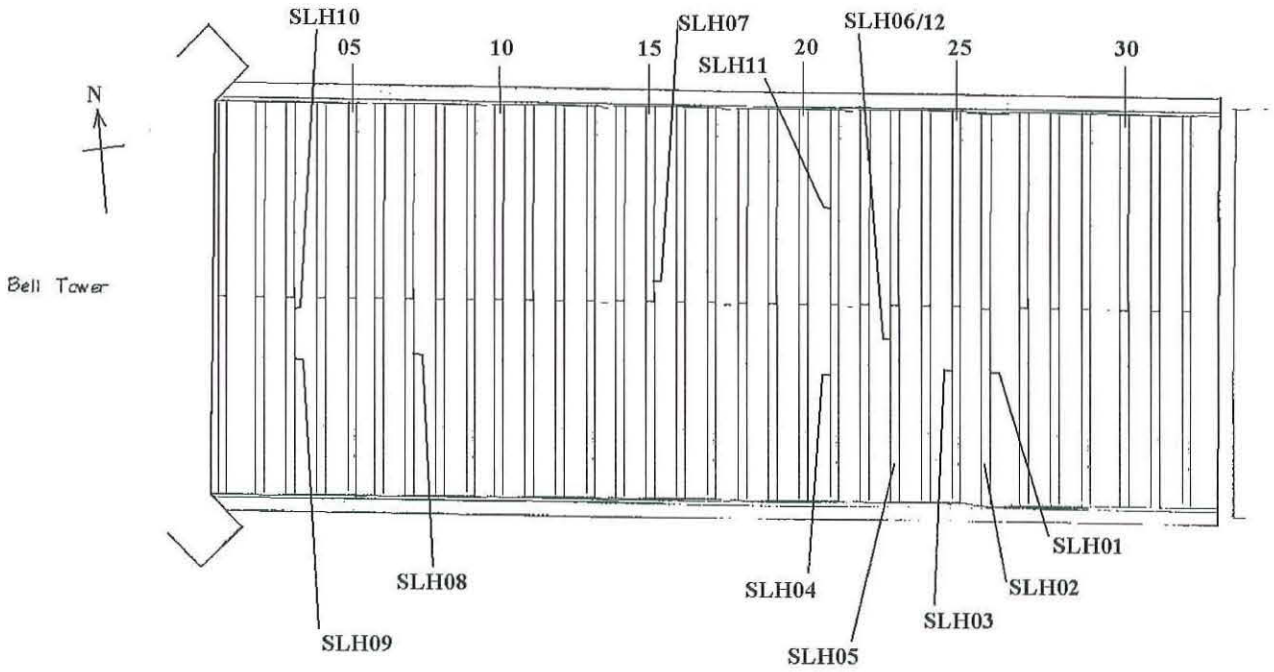

Figure 3: Plan of the nave roof, Church of St Laurence, Holwell, showing the position of timbers sampled for dendrochronology, based on an original drawing by P. James, John Stark & Crickmay Partnership

Figure 4: View of the nave roof of the Church of St Laurence, Holwell, Dorset, looking east, from an original taken by Amanda Grieve, English Heritage

The dates thus obtained represent the time of formation of the rings available on each sample. Interpretation of these dates then has to be undertaken to relate these findings to the construction date of the phase under investigation. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. In this instance, the sapwood estimates are based on those proposed for this area by Miles (1997), in which 95% of samples are likely to have from 9 to 41 sapwood rings. Where bark is present on the sample the exact date of felling of the tree used 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 re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

Results

Access to the nave roof was easiest from scaffolding on the south side, although some timbers on the north were also investigated. The north aisle roof still had its lead roof in place, and was not accessible from inside the church. After some discussion of the work schedule and following talks with English Heritage the decision was made not to investigate this roof. All the timbers investigated were of oak (*Quercus* spp.). Many of the timbers were badly degraded as a result of insect damage, limiting the number of timbers available for sampling. The trusses were numbered from the west end, following the numbering used in recording drawings of the roof. Rafter couples 3, 30, 31, and 32 were all replacements, possibly from the last re-roofing.

Details of the samples and their locations are given in Table 1 and illustrated in Figure 3. Three samples were not studied any further, SLH02 having too few rings, with SLH08 and SLH11 having fragmented. Samples SLH06 and SLH12 were taken from either side of the same collar, SLH12 retaining the heartwood-sapwood boundary was taken from the north side of the collar in the hope of extending the good series already obtained from SLH06. The two series matched each other well (t = 13.7 with 119 years of overlap) and were combined into a single 224-year sequence, SLH0612m. Whilst comparing the sequences from the other samples, SLH0612m was found to match exceptionally well with two other series, SLH03 (t = 13.1 with 162 years overlap) and SLH10 (t = 10.8 with 216 years overlap). Comparison of the plots of these series (Figure 5) led to the conclusion that these were likely all derived from the same parent tree, and they were therefore combined into a single sequence, SLH361012m.

Crossmatching between this and other series is shown in Table 2. These series were combined to make a single 233-year long site chronology, HOLWELL. This was subsequently dated to the period AD 1195 – 1427 by comparison with dated reference material, the best results being presented in Table 3. The relative positions of overlap of the dated samples are shown, along with their interpreted felling dates in Figure 6. The data for this site chronology are given in Table 4.

Table 1: Dated oak (*Quercus* spp.) timbers sampled from the nave roof of the Church of St Laurence, Holwell, Dorset

Sample number	Origin of core	Total no of years	Average growth rate (mm yr^{-1})	Sapwood details	Heartwood-sapwood boundary date (AD)	Date of sequence AD	Felling date of timber AD
SLH01	Arch-brace 26 south	167	0.64	h/s	1427	1261-1427	1436 - 68
SLH02	Rafter 26 south	*c*38	unmeasured	-	-	undated	unknown
SLH03§	Collar 25	162	1.03	h/s	1423	1262-1423	1432 - 64
SLH04	Arch-brace 21 south	122	0.83	-	-	1267-1388	after 1397
SLH05	Rafter 23 south	97	0.90	h/s	1424	1328-1424	1433 - 65
SLH06§	Collar 23 (same timber as 12)	195	0.99	-	-	1200-1394	after 1403
SLH07	Collar 15	167	0.83	-	-	1240-1406	after 1415
SLH08	Arch-brace 7 south	*c*47*	unmeasured	-	-	undated	unknown
SLH09	Arch-brace 3 south	35	unmeasured	-	-	undated	unknown
SLH10§	Collar 3	221	0.73	-	-	1195-1415	after 1424
SLH11	Arch-brace 21	*c*50*	unmeasured			undated	unknown
SLH12§	Collar 23 (same timber as 06)	148	1.07	h/s	1423	1276-1423	1432 - 64

* these cores were fragmented and were therefore not measured

§ subsequent analysis suggests that all four of these samples came from the same tree

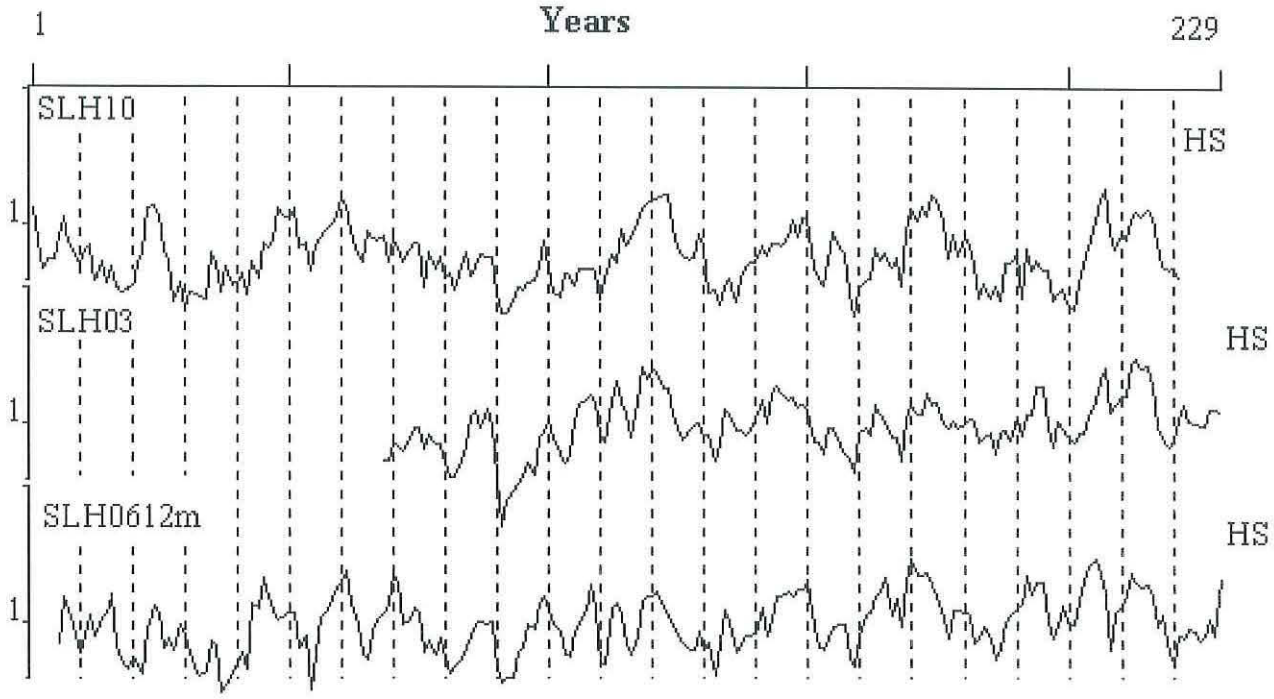

Figure 5: Plots of the series suspected of having been derived from the same tree. The *y*-axis is a logarithmic scale (ring width in mm), HS = heartwood-sapwood boundary

	***t* - values**			
Sample no	**SLH361012m**	**SLH04**	**SLH05**	**SLH07**
SLH01	7.8	5.3	4.9	5.9
SLH361012m		7.4	4.8	7.2
SLH04			4.2	4.2
SLH05				4.9

Table 2: Crossmatching between the dated individual tree series from the Church of St Laurence, Holwell, Dorset

Table 3: Dating of the oak site chronology HOLWELL, the upper section contains multi-site regional chronologies, the lower section contains individual site chronologies

		HOLWELL AD 1195-1427	
Dated reference or site master chronology	**Dates spanned (AD)**	***t*-value**	**Overlap (yrs)**
Southern England (Bridge 1988)	1083-1589	6.8	233
Hants02 (Miles pers comm)	443-1972	6.2	233
Wales97 (Miles pers comm)	404-1981	6.1	233
Salop95 (Miles pers comm)	881-1745	5.7	233
Wigmore Abbey, Herefordshire (Tyers 2002)	1055-1729	6.6	233
Kingswood Abbey, Gloucestershire (Arnold *et al* 2003)	1307-1428	6.4	121
Muchelney Abbey, Somerset (Bridge 2002a)	1148-1498	6.1	233
Butleigh, Somerset (Miles and Worthington 1997)	1136-1304	5.9	110
Rudgwick, Sussex (Miles and Worthington 2002)	1284-1337	5.6	54
Titchfield, Hampshire (Miles and Worthington 1999)	1355-1486	5.5	73
Crawley, Hampshire (Tyers and Barefoot unpubl)	1170-1338	5.5	144
Winterbourne, Gloucestershire (Miles and Worthington 2000)	1177-1341	5.4	147
Wraxell, Somerset (Miles and Worthington 1999)	1276-1441	5.4	152
Alton, Hampshire (Miles and Worthington 1999)	1350-1500	5.4	78
Newland, Dorset (Bridge 1993)	1190-1292	5.3	98
Borden, Kent (Litton *et al* 2000)	1218-1333	5.2	116
Somborne, Hampshire (Miles and Worthington 1997)	1154-1387	5.2	193
Kingsbury, Hertfordshire (Bridge 2002b)	1324-1418	5.2	95
Glastonbury, Somerset (Bridge 2001)	1095-1334	5.1	140

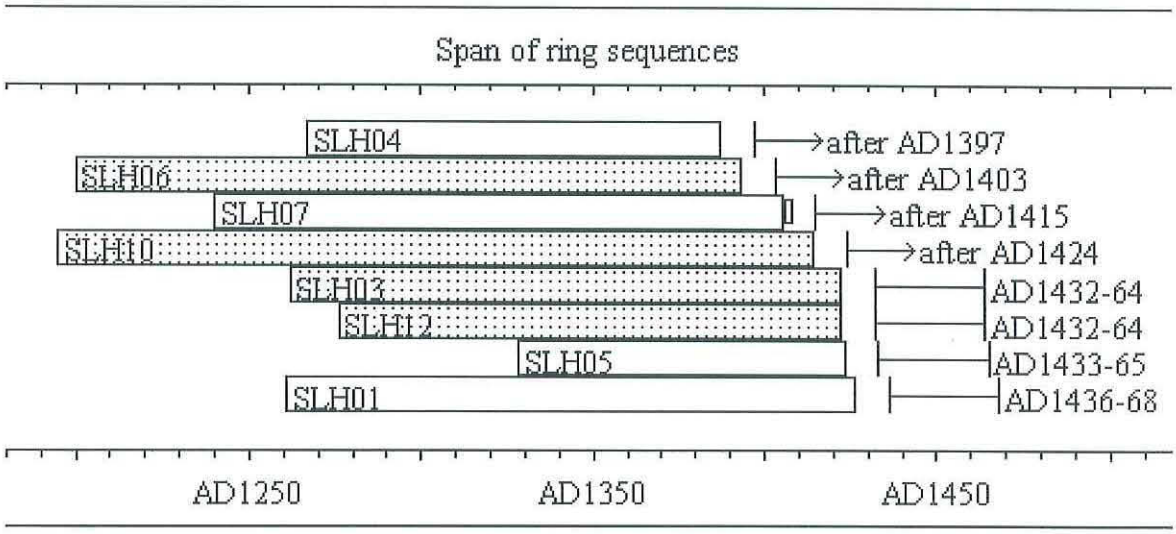

Figure 6: Bar diagram showing the relative positions of overlap of the dated samples from the nave roof of the Church of St Laurence, Holwell, Dorset, along with their interpreted likely felling dates. Shaded bars represent samples which probably all come from the same tree

Interpretation and Discussion

Sample SLH09 from the arch-brace to the third truss was rather different in character from the dated series, being from a much faster-grown tree. Given that the rafters on this truss had been replaced, it is likely that the arch-brace was also a replacement, though interestingly the collar on this truss was found to be original.

The tree-ring series from three individual collars was sufficiently similar for them to be considered as having been derived from the same tree.

Taking the combined data, the most likely felling date range for the primary timbers of the nave roof is AD 1436 – 64. The roof is generally described as being of the late-fifteenth century, but this result suggests that the description mid-fifteenth century might be more applicable. It seems likely that the timbers were of relatively local origin, the site chronology matching well against sites from all directions around, within 100 km or so.

Acknowledgements

This work was commissioned by English Heritage, and I would like to thank Alex Bayliss and Peter Marshall for their work in support of my activities. Peter James and Ron Jones of the John Stark and Crickmay Partnership assisted me on-site and the keyholder, Mrs Sibley, allowed access. Amanda Grieve took the photograph of the roof used in this report. Cathy Groves (University of Sheffield) made valuable comments on the data derived from this study and an earlier draft of this report.

References

Arnold, A J, Howard, R E, and Litton, C D, 2003 *Tree-ring analysis of timbers from Kingswood Abbey Gatehouse, Kingswood, Gloucestershire*, Centre for Archaeol Rep, **21/2003**

Baillie, M G L, and Pilcher, J R, 1973 A simple cross-dating program for tree-ring research, *Tree Ring Bulletin,* **33**, 7-14

Bridge, M C, 1988 The dendrochronological dating of buildings in southern England, *Medieval Archaeol*, **32**, 166-74

Bridge, M C, 1993 List 52 - Tree-ring dates, *Vernacular Architect*, **24**, 48-50

Bridge, M C, 2001 *Tree-ring analysis of timbers from the Abbey Barn, Glastonbury, Somerset,* Centre for Archaeol Rep, **39/2001**

Bridge, M C, 2002a *Tree-ring analysis of timbers from Muchelney Abbey, Muchelney, near Langport, Somerset*, Centre for Archaeol Rep, **114/2002**

Bridge, M C, 2002b Tree-Ring Dates, *Vernacular Architect* **33**, 74-8

Hollstein, E, 1965 Jahrringchronologische von Eichenholzern ohne Walkande, *Bonner Jahrb,* **165,** 12-27

Litton, C D, Howard, R E, and Laxton, R R, 2000 *Tree-ring analysis of timbers from the Church of St Peter and St Paul, Borden, Kent,* Anc Mon Lab Rep, **45/2000**

Miles, D, 1997 The interpretation, presentation, and use of tree-ring dates, *Vernacular Architect,* **28,** 40-56

Miles, D H, and Worthington, M J, 1997 Tree-ring dates, *Vernacular Architect* **28**, 159-81

Miles, D H, and Worthington, M J, 1999 Tree-ring dates, *Vernacular Architect* **30**, 98-113

Miles, D H, and Worthington, M J, 2000 Tree-ring dates, *Vernacular Architect* **31**, 90-113

Miles, D H, and Worthington, M J, 2002 Tree-ring dates, *Vernacular Architect* **33**, 81-102

Munro, M A R, 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin,* **44**, 17-27

Salzman, L F, 1952 *Building in England down to 1540,* Oxford

Tyers, I, 1999 *Dendro for Windows Program Guide 2nd edn*, ARCUS Rep, **500**

Tyers, I, 2002 *Tree-ring analysis of oak timbers from the Abbot's Hall and Parlour at Wigmore Abbey, near Adforton, Herefordshire,* Centre for Archaeol Rep, **112/2002**

Tyers, I, and Barefoot, A C, unpubl chronology for Crawley, Hampshire

Table 2: Ring width data for the site chronology, HOLWELL, dated AD1195 to AD1427

ring widths (0.01mm)										no of trees
119	83	60	67	67	82	119	97	85	66	1 1 1 1 1 1 1 1 1 1
79	93	67	84	80	99	62	55	52	56	1 1 1 1 1 1 1 1 1 1
62	63	106	121	110	73	72	56	73	61	1 1 1 1 1 1 1 1 1 1
58	51	48	49	76	70	44	54	52	55	1 1 1 1 1 1 1 1 1 1
63	50	93	84	123	106	99	113	113	111	1 1 1 1 1 2 2 2 2 2
113	86	95	83	118	128	115	99	101	113	2 2 2 2 2 2 2 2 2 2
123	88	79	67	83	92	84	96	74	87	2 2 2 2 2 2 3 3 3 3
67	59	86	119	107	81	99	80	94	80	3 3 4 4 4 4 4 4 4 4
82	88	95	88	96	103	105	111	98	72	4 4 4 4 4 4 4 4 4 4
54	59	59	76	79	95	82	102	116	100	4 4 4 4 4 4 4 4 4 4
74	69	56	62	62	73	85	103	83	69	4 4 4 4 4 4 4 4 4 4
70	90	85	74	66	62	80	108	97	94	4 4 4 4 4 4 4 4 4 4
102	104	97	83	70	56	61	70	87	79	4 4 4 4 4 4 4 4 4 4
67	60	84	99	91	57	60	63	77	82	4 4 4 5 5 5 5 5 5 5
98	86	96	107	105	102	95	92	81	87	5 5 5 5 5 5 5 5 5 5
60	48	55	64	80	74	73	55	53	69	5 5 5 5 5 5 5 5 5 5
70	77	93	92	98	72	72	60	108	115	5 5 5 5 5 5 5 5 5 5
98	103	111	100	101	72	60	72	84	90	5 5 5 5 5 5 5 5 5 5
78	72	66	66	65	56	64	71	82	70	5 5 5 5 5 5 5 5 5 5
80	104	94	87	78	63	53	63	70	70	5 5 5 5 4 4 4 4 4 4
65	83	92	103	115	106	90	68	77	87	4 4 4 4 4 4 4 4 4 4
90	104	114	108	109	83	67	54	58	51	4 4 3 3 3 3 3 3 3 3
59	73	75	71	66	75	80	72	94	64	3 3 3 3 3 3 3 3 3 2
67	62	39								1 1 1