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Tree-Ring Analysis of Timbers from the Church of St Nicholas, Wilsford, Wiltshire

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Summary

Nine roof timbers from the reconstructed chancel roof were sampled, along with two moulded cornices attached to the lower side of the inner wallplate of this roof. The cornices contained too few rings and could not be dated. Some of the wallplates were reused moulded timbers, probably from the same roof, of which one dated. The likely felling date range of the moulded timber reused as a wallplate is AD 1553–85, whilst that for the remaining dated timbers, three principal rafters and an inner wallplate, is AD 1593–1608. No timbers from a thirteenth-century roof were identified or dated.

Keywords
Dendrochronology
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Introduction

This medieval parish church (NGR SU 102 572; Fig 1) was undergoing grant-aided repairs to its chancel roof. This roof is thought to contain remnants of the original thirteenth-century roof *in situ*, perhaps including a moulded cornice at wallplate level and other moulded timbers reused within the present roof. At some point in the nineteenth century, the roof was dismantled and reconstructed lower down, as evidenced by the scar on the gable end at the eastern end of the nave. The roof was also lowered in pitch at this time, with the principal rafters being truncated just above the upper purlin mortice. The poor quality of this work is evidenced in the use of [ash?] twigs, complete with bark, as replacement pegs.

Dendrochronological dating of the roof timbers was requested by Sarah Ball of the English Heritage South-west Regional office, in an attempt to establish the number and dates of phases of work on the chancel roof prior to repairs commencing. The chancel walls and windows are of thirteenth-century style, and the oldest timbers could therefore be of this age.

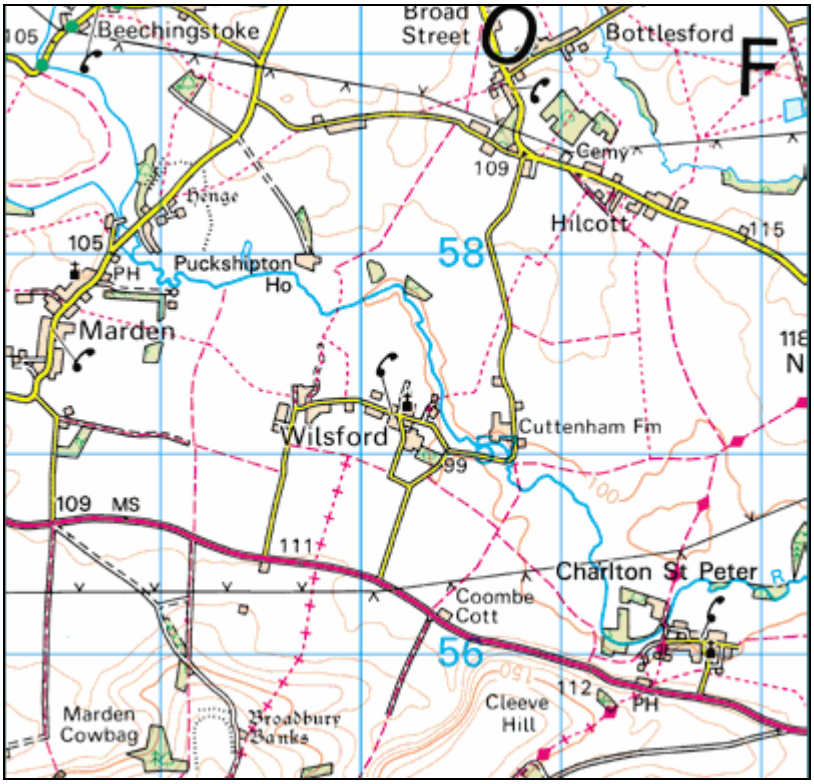

Figure 1: Map showing the location of the Church of St Nicholas, Wilsford, Wiltshire.

Methodology

The site was visited in November 2005. In the initial assessment, accessible oak timbers with more than 50 rings and traces of sapwood were sought. 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, labelled, and stored for subsequent analysis. The two cornices were too thin to be cored, and after on-site consultation with the local English Heritage inspector, thin V-cuts were made on the rear of them at joins, allowing a thin section to be removed from each.

The cores and slices 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, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (1999a). 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 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 empirical sapwood estimates used here are based on those proposed for this area by Miles (1997a), 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). The question of reuse of at least some

elements of this roof, either from the same building, or from elsewhere, needs to be addressed to properly interpret these dates.

Results and Discussion

All timbers sampled were of oak (*Quercus* spp.). Details of the locations of the samples are given in Table 1, along with other information about the tree-ring sequences, and illustrated in Figure 2. Many timbers contained too few rings to be good candidates for dendrochronological dating, and only eleven timbers were sampled. Where more than one core was taken from a timber, in order to get the maximum ring sequence possible, the individual sample sequences were first cross-matched to each other and then combined into a single composite sequence, eg for timbers WLF07 and 11. Cross-matching between timbers was then sought, and four timbers were found to match each other (WLF01, 03, 07, and 10) to form an intermediate working site master. Remaining individual series were then compared first with this intermediate site master, and then with dated reference material. It was found that a fifth sample, WLF11 gave good consistent matches; t = 4.6 against the working site master at a position equivalent to the outside ring having been formed in AD 1571, a position conformed by independent matches to the database. The cross-matching between the individual series is shown in Table 2, and the independent dating of sample WLF11 is shown in Table 3. None of the remaining unmatched series were dated.

The five matched series were combined into a single 99-year site series, WLSFRDCH, which was dated to the period AD 1477–1575, the best matches being given in Table 4. The positions of overlap of the dated series are illustrated in Figure 3. The data for this site master series are presented in Table 5.

One of the five timbers, WLF07, appears to have been felled earlier than the other timbers, although it matched well with the other sequences. This timber was the only example of the moulded timbers reused as wallplates that dated. Its likely felling date range of AD 1553–85 overlaps with the likely felling date ranges of the remaining samples, which can be calculated from a mean heartwood-sapwood boundary date of AD 1567, to be AD 1576–1608. The detached sapwood section of timber WLF11 retained the outermost ring, and its 22 rings suggest an actual felling date of AD 1593. This cannot be confirmed, however, as it is possible that a few rings were lost between the core and the detached sapwood section. However, due to the similarity of the moulding profiles, it appears likely that all of the sampled timbers originated from the same roof structure. Thus it seems more likely that WLF07 may have simply been derived from a tree with an unusually large number of sapwood rings, and that it is in fact contemporaneous with the other samples. The two sections of moulded timbers reused as short sections of outer wallplates probably originated from sections of tiebeams or collars removed when the roof was lowered. It is interesting that the tree-ring series from this timber appears to have a greater affinity with three of the other dated timbers than does the independently dated WLF11, which perhaps came from a different source.

A more detailed understanding of the roof structure may be necessary in order to fully comprehend the dendrochronological results. It is clear however that there are no proven thirteenth-century elements to the present roof, as were expected. The primary elements of the present roof, along with some evidently reused timbers, all appear to come from a single group of sixteenth century date, although this roof was lowered at some later date.

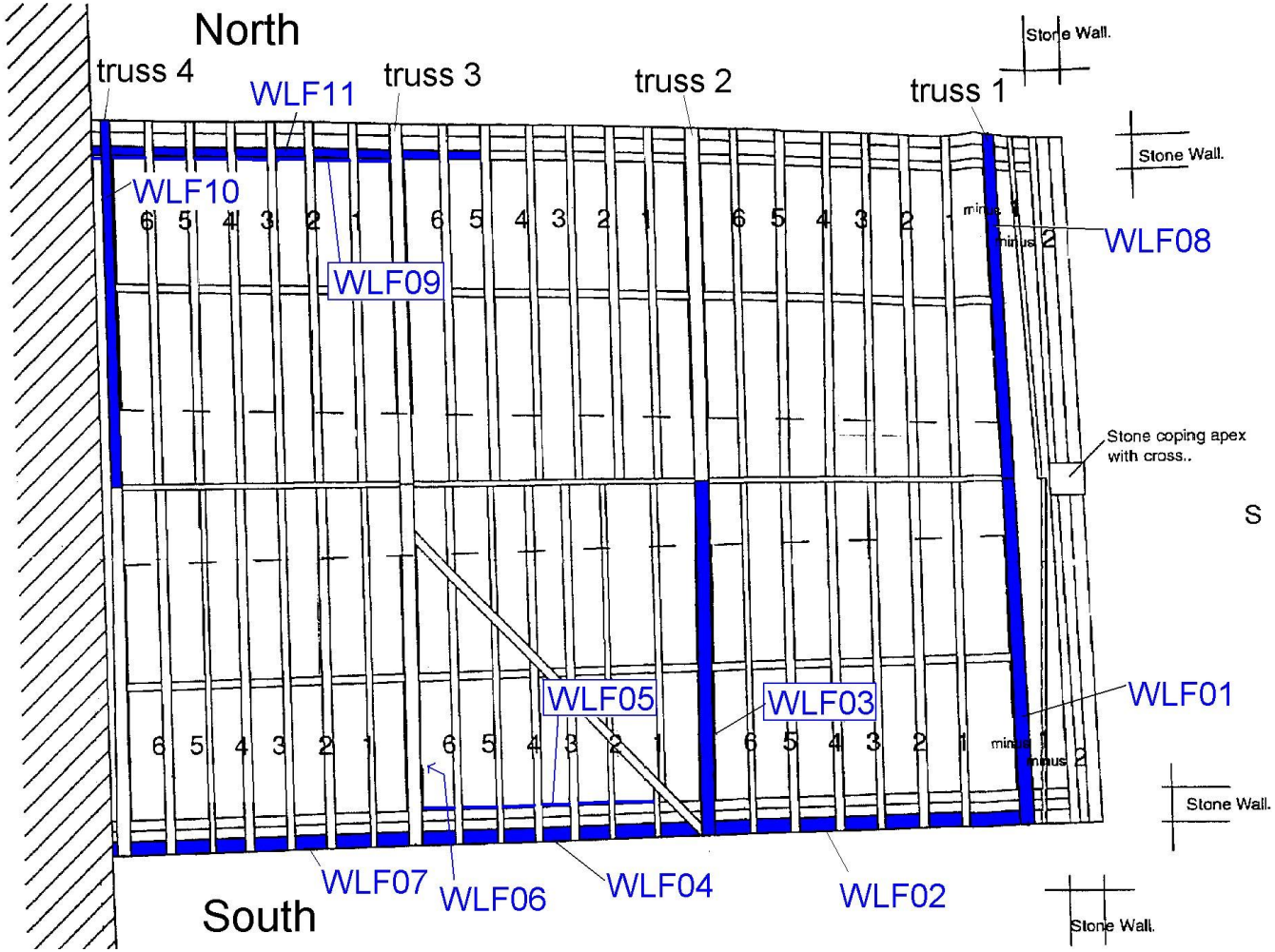

Figure 2: the chancel roof, based on a plan by Slade Smith and Winrow, Architects, showing the timbers investigated dendrochronologically

Table 1: Details of oak (*Quercus* spp.) timbers sampled from the Church of St Nicholas, Wilsford, Wiltshire

Sample Number	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Dates AD Spanning	H/S bdry AD	Sapwood complement	Felling seasons and dates/date ranges (AD)
WLF01	Principal rafter 1 south	87	1.46	0.26	1489–1575	1575	H/S	1584–1616
WLF02	South wallplate, bay 1, reused moulded timber	53	2.09	0.19	undated	-	H/S	unknown
WLF03	Principal rafter 2 south	79	2.64	0.27	1482–1560	1560	H/S	1569–1601
WLF04	South wallplate, bay 2	<40	NM	-	undated	-	H/S	unknown
WLF05	South cornice, bay 2	<40	NM	-	undated	-	H/S	unknown
WLF06	Tiebeam 3 at south end	64	2.07	0.19	undated	-	H/S	unknown
wlf07a	South wallplate, bay 3, reused moulded timber	63	1.92	0.16	1478-1540			
wlf07b1	ditto	40	1.30	0.18	1478-1517			
wlf07b2	ditto	30	1.95	0.175	1519-48	1544	4	
WLF07	South wallplate, bay 3, reused moulded timber	71	1.74	0.16	1478–1548	1544	4	1553–85
WLF08	Principal rafter 1 north	46	2.98	0.25	undated	-	H/S	unknown
WLF09i	North cornice, bay 3	40	2.53	0.25	undated	-	-	unknown
WLF09ii	*ditto*	26	2.26	0.16	undated	-	-	unknown
WLF10	Principal rafter 4 north	84	1.77	0.24	1477–1560	1560	H/S	1569–1601
wlf11a	Inner wallplate, bay 3 – bay 2	34	1.47	0.14	1530-63			
wlf11b	ditto – bay 3	47	1.98	0.14	1525-71	1571	+22C NM	
WLF11	Inner wallplate, bay 3	55	1.80	0.14	1517–71	1571	+22C NM	*c*1593–1612
WLSFRDCH	**Site master of 01 03 07 10 11**	99	1.88	0.19	1477–1575			1593–1608

Table 2: Cross-matching between the dated elements of site master WLSFRDCH

Sample	WLF03	WLF07	WLF10	WLF11
WLF01	3.8	4.6	8.0	3.7
WLF03		4.5	5.1	2.6
WLF07			5.3	5.1
WLF10				2.1

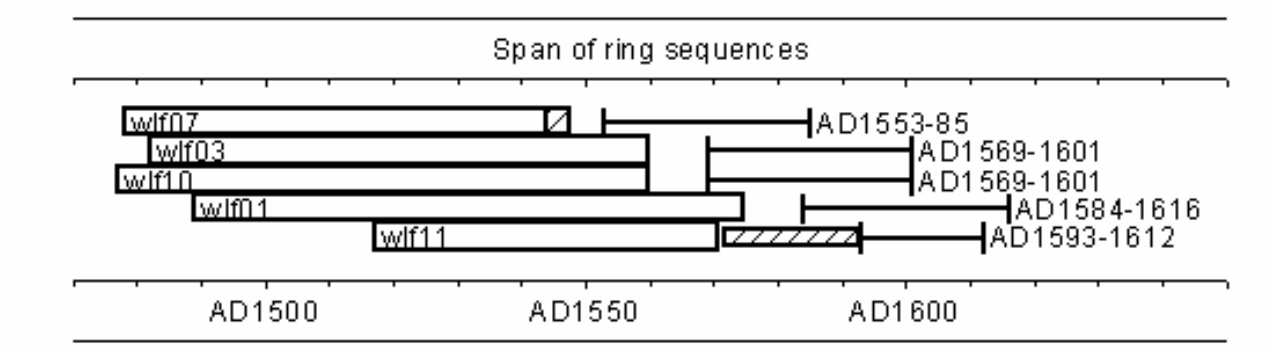

Figure 3: Bar chart showing the relative positions of overlap of the dated timbers in the site series WLSFRDCH, along with their interpreted likely felling dates. Hatched portions of the bars represent sapwood rings and narrow bar sections represent additional unmeasured rings

Table 3: Dating evidence for the sequence **WLF11,** AD 1517–71 (regional multi-site chronologies have the file name in **bold**)

County/ region:	***Chronology name:***	***Short publication reference:***	***File name:***	***Spanning: (yrs AD)***	***Overlap (yrs)***	***t-value***
Surrey	Gaterounds, Newdigate	(Miles and Worthington 2002)	GATERNDS	1501–79	55	5.8
Warwickshire	Halls Croft, Stratford-upon-Avon	(Miles and Worthington 1999)	HLSCRFT3	1438–1630	55	5.7
Hampshire	St Margaret's Priory, Titchfield	(Miles and Worthington 2000)	STMRGRTS	1451–1622	55	5.5
Oxfordshire	Kings Arms Barn, Henley	(Miles and Worthington 2000)	KNGSARMS	1488–1601	55	5.5
Oxfordshire	Greys Court, Rotherfield Greys	(Miles *et al* 2004)	GREYSCT2	1417–1587	55	5.4
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440–1742	55	5.4
Norfolk	Paston Great Barn	(Tyers 1999b)	PASTON	1356–1568	52	5.2
Hampshire	Chawton House	(Miles and Worthington 1998)	CHAWTON3	1446–1582	55	5.1
Hampshire	Black House Fm, Hinton Ampner	(Miles and Worthington 2001)	BLCKHSFM	1497–1619	55	5.1
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	55	5.0

Table 4: Dating evidence for the site chronology **WLSFRDCH,** AD 1477–1575 (regional multi-site chronologies have the file name in **bold**)

County/ region:	***Chronology name:***	***Short publication reference:***	***File name:***	***Spanning: (yrs AD)***	***Overlap (yrs)***	***t-value***
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	99	7.0
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	99	7.0
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	99	6.9
Wiltshire	Dog Kennel Farm, Clarendon	(Miles *et al* 2004)	CLRENDN7	1351–1603	99	6.8
Somerset	Market Place, Shepton Mallet	(Miles and Worthington 2002)	SHPTNMLT	1518–1677	58	6.6
Herefordshire	Penrhos Court, nr Kington	(Tyers 1998)	PENRHOS2	1420–1558	82	6.6
Hampshire	St Margaret's Priory, Titchfield	(Miles and Worthington 2000)	STMRGRTS	1451–1622	99	6.5
Yorkshire	Yorkshire Buildings Chronology	(Hillam pers comm)	**YORKMED**	1320–1696	99	6.5
Warwickshire	Baddesley Clinton	(Miles and Worthington 2002)	BADESLY3	1423–1577	99	6.4
Berkshire	Shaw House, Newbury	(Miles *et al* 2004)	SHAW1	1391–1579	99	6.1

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References

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

Haddon-Reece, D, Miles, D H, Munby, J T, and the late Fletcher, J M , 1993 Oxfordshire Mean Curve - a compilation of master chronologies from Oxfordshire, unpubl computer file OXON93, Oxford Dendrochronology Laboratory

Hillam, J, and Groves, C, 1994 Compilation of master chronologies from the North, unpubl computer file NORTH, Sheffield Dendrochronology Laboratory

Hollstein, E, 1965 Jahrringchronologische von Eichenholzern ohne Walkande, *Bonner Jahrbuecher,* **165,** 12–27

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

Miles, D H, 1997b Working compilation of 58 reference chronologies centred around Wales by various researchers, unpubl computer file WALES97, Oxford Dendrochronology Laboratory

Miles, D, 2003 Dating Buildings and Dendrochronology in Hampshire, in *Hampshire Houses 1250 - 1700: Their Dating and Development* (ed E Roberts), 220-6, Southampton (Hampshire County Council)

Miles, D H, and Worthington, M J, 1998 Tree-ring dates, *Vernacular Architect*, **29**, 111–29

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, 2001 Tree-ring dates, *Vernacular Architect*, **32**, 74–86

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

Miles, D H, Worthington, M J, and Bridge, M C, 2004 Tree-ring dates, *Vernacular Architect*, **35**, 95–113

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

Tyers, I, 1998 *Tree-ring analysis of oak timbers from Penrhos Court, Near Kington, Herefordshire,* Anc Mon Lab Rep, **31/98**

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

Tyers I, 1999b *Tree-ring analysis of timbers from Paston Great Barn Norfolk,* Anc Mon Lab Rep, **54/1999**

Table 5: Data for the site master chronology, WLSFRDCH, AD 1477–1575

Ring widths (0.01mm)										no of trees									
324	293	296	323	297	276	274	276	339	248	1	2	2	2	2	3	3	3	3	3
334	202	238	254	258	256	238	216	236	249	3	3	4	4	4	4	4	4	4	4
202	115	121	130	125	163	147	149	87	120	4	4	4	4	4	4	4	4	4	4
75	147	178	125	186	192	153	213	172	165	4	4	4	4	4	4	4	4	4	4
158	217	210	174	225	251	169	158	148	174	5	5	5	5	5	5	5	5	5	5
171	180	149	113	169	151	156	204	289	255	5	5	5	5	5	5	5	5	5	5
212	189	217	193	174	133	137	172	178	154	5	5	5	5	5	5	5	5	5	5
146	182	260	242	248	196	166	194	154	143	5	5	4	4	4	4	4	4	4	4
134	171	278	243	135	173	130	145	117	107	4	4	4	4	2	2	2	2	2	2
94	138	184	136	185	134	121	70	77		2	2	2	2	2	1	1	1	1	