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ST MARY'S CHURCH, SHRAWLEY, WORCESTERSHIRE
TREE-RING ANALYSIS OF TIMBERS FROM THE NAVE AND CHANCEL ROOFS

SCIENTIFIC DATING REPORT

Dr Martin Bridge

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Summary

Limited access and lack of suitable timbers meant that no samples were obtained from the chancel roof and only six timbers were sampled from the nave roof. Of these, four were successfully dated, though only one timber retained any sapwood. This had a likely felling date range in the early sixteenth century, whilst the others may have been felled at the same time or within a few decades of this period. With so few dated timbers and a lack of surviving sapwood it is not possible to determine whether these timbers all represent the original roof construction or repair phases, but none looked to be reused. One pair of matching timbers was from the west end of the roof, the other pair from the centre. This suggests that the roof may be later than the fifteenth-century date that had been ascribed to it, but does not establish the exact construction date.

Keywords

Dendrochronology
Standing Building

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Introduction

St Mary's Church, Shrawley (NGR SO 806 648; Fig 1) is a Grade-I listed parish church. Access to the exterior of the nave roof was possible during grant-aided repairs to the nave roof, and dendrochronological study of this and the chancel roof was requested by the Historic Buildings Architect, Chris Miners (English Heritage Birmingham office). Both the nave and chancel roofs are reputed to be fifteenth-century in origin, although some sources say that they are seventeenth-century. Dendrochronological dating was requested to try to establish the construction date of the roofs.

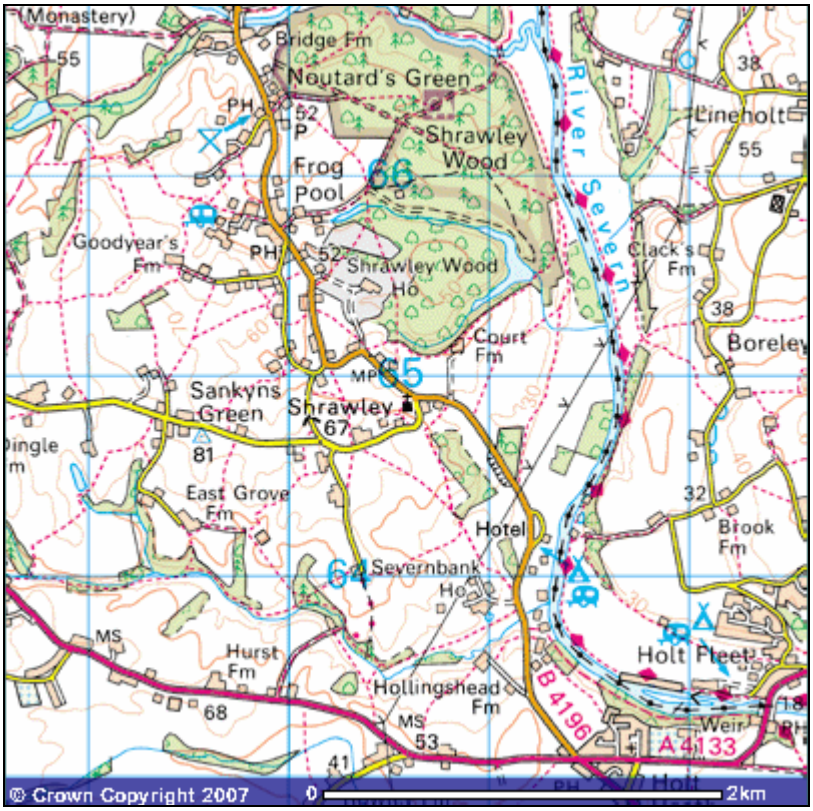

Figure 1: Map showing the location of St Mary's Church, Shrawley, Worcestershire.

Methodology

The site was visited in September 2006. 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, 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, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (1999). 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 sapwood estimates used here are based on those proposed for this area by Miles (1997a), in which 95% of oaks contain 11–41 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).

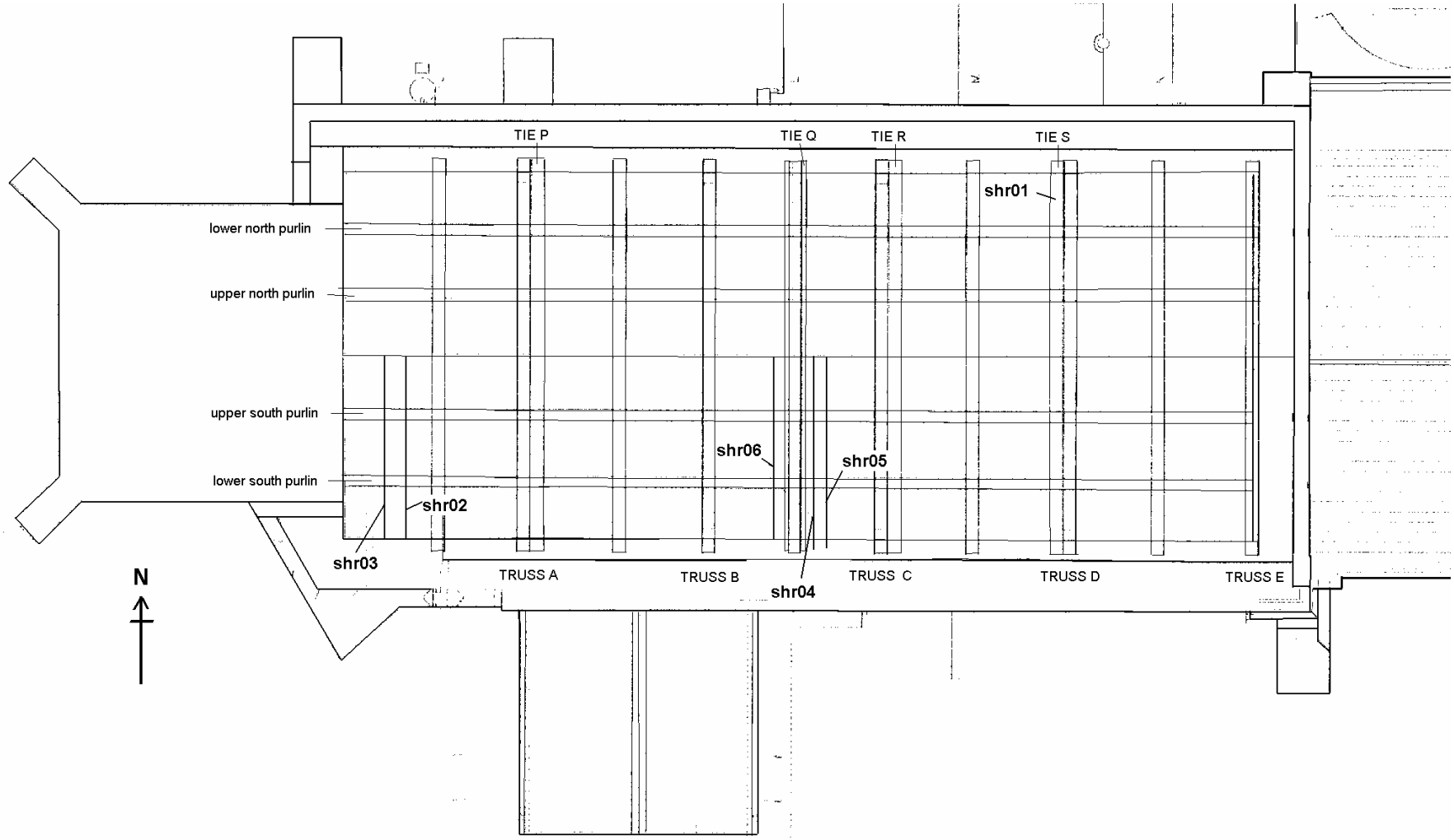

Figure 2: Plan of the roof of St Mary's Church, Shrawley, showing the approximate position of samples taken for dendrochronology, based on a drawing supplied by Stainburn Taylor & Michael Reardon, Architects

Results

Access was restricted to the exterior of the nave roof. It was not possible to gain access to the chancel timbers during this phase of repairs. Timing of the dendrochronological sampling was extremely difficult, due to severe weather conditions seriously affecting the contractor's schedule. Access to timbers was therefore seriously hampered, resulting in a highly restricted programme of sampling. The assessment indicated that the roof timbers generally had too few rings and that there was also very little extant sapwood. However, it was decided to proceed with sampling of the most promising timbers, in the hope that these borderline samples would be suitable for analysis, bearing in mind the location of the church in an area with good reference data availability, and hence it would at least be possible to distinguish whether the roof was of fifteenth- or seventeenth-century origin.

Most of the nave roof rafters had rebates to take boards on their upper surfaces. The east end of the south side of the roof exhibited much smaller, squarer rafters that appeared to be machine-sawn, and had no rebates for boards. These were clearly of later origin and therefore not of interest in this specific investigation, although tie S was sampled as one of the few good sequences available. The purlins and collars were not accessible.

All timbers sampled were of oak (*Quercus* spp.). Details of the samples are given in Table 1. Cross-matching was attempted between all samples. Samples **shr02** and **shr03** matched with the high *t*-value of 7.2, but with only 25 years of overlap, far too short to be acceptable evidence on its own. Although both sequences were quite short (55 and 51 rings respectively), they were each compared with dated reference material, both actually giving firm cross-matches that confirmed the suggested short overlap (Tables 2a and 2b).

Similarly, **shr04** and **shr06** cross-matched (t = 6.4 with 39 years overlap) and this suggested match was confirmed when the two relatively short sequences gave strong consistent matches against the dated reference material (Tables 2c and 2d).

No other individual series gave acceptable consistent matches individually or against other site series, and so two site series were formed, **shr23m** and **shr46m**. The dating evidence for the two new series is presented in Tables 3a and 3b, and the relative positions of overlap of all four dated timbers are shown in Figure 3. The data for these two series are given in Table 4.

Series **shr23m** is confirmed as covering the period AD 1380–1460, and series **shr46m** the period AD 1445–97.

Interpretation and Discussion

It is unusual for such short series to give reliable dates, although there are several dated sites within this part of Worcestershire, which makes dating of such sequences less of a problem. The interpretation of the felling dates produced is not simple. The two pairs of timbers have quite different matching characteristics: that from the west end of the south side, shr02 and shr03, giving the strongest matches against Welsh sites, but also sites further afield (Table 3a); whilst that from the centre of the south side, shr04 and shr06, gives strongest matches with sites from Hereford and Worcestershire (Table 3b), possibly indicating a more local origin, although it may just be that the two pairs of timbers come from sites with different microclimates or ecological conditions.

In terms of interpreting the date of the nave roof, with only one timber retaining any sapwood, it is difficult to draw any strong conclusions. It seems likely that the timbers sampled represent timbers from two distinct sources, which may or may not be of similar age. The pair shr03 and shr02 did not

retain any sapwood, so only produce *terminus post quem* dates, and this does not help to distinguish whether the two pairs are of the same felling period.

The one felling date range of AD 1507–37 suggests an early sixteenth-century date for at least one phase of work on the extant roof, near the centre of the south side, but this could itself be a repair rather than the original roof. What is apparent is that the roof contains at least some timbers that predate the seventeenth-century proposed construction date, but post-date the fifteenth-century proposed construction date.

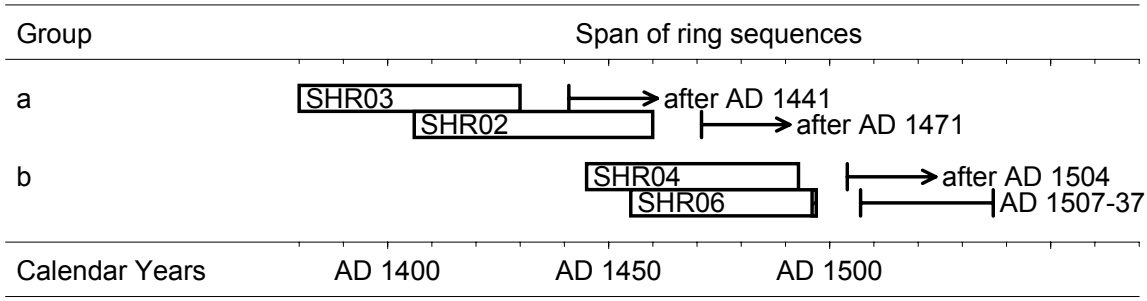

Figure 3: Bar diagram showing the relative positions of overlap of the dated timbers, along with their interpreted felling dates. Hatched sections of the bars represent sapwood

Table 1: Details of oak (*Quercus* spp.) timbers sampled from the nave roof of St Mary's Church, Shrawley, Worcestershire. Truss names follow those used by Stainburn Taylor & Michael Reardon, Architects

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)
shr01	Tie S, by truss D	62	2.05	0.20	undated	-	h/s?	unknown
shr02	Common rafter, south side, 3 from west end	55	1.36	0.31	1406–60	-	-	after 1471
shr03	Common rafter, south side, 2 from west end	51	1.81	0.29	1380–1430	-	-	after 1441
shr04	Common rafter, south side, 1 east of tie Q	49	2.06	0.16	1445–93	-	-	after 1504
shr05	Common rafter, south side, 2 east of tie Q	<40	NM	-	undated	-	-	unknown
shr06	Common rafter, south side, 3 west of tie Q	43	2.13	0.19	1455–97	1496	1	1507–37

Table 2a: Dating evidence for the series **shr02**, AD 1406–60 (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
Wales	Rose and Crown, Gwydwn	(Miles and Worthington 2000)	GWYDWN	1411–1571	50	7.0
Wales	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384–1593	55	6.4
Cornwall	St Martin's Church, East Looe	(Arnold *et al* 2006)	LOOASQ01	1363–1518	55	6.3
Herefordshire	Hergest Court, Kington	(Miles and Worthington 1997)	hc3	1406–1474	55	6.2
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	55	6.2
Devon	Broomham, King's Nympton	(Tyers *et al* 1997)	BROOMHAM	1370–1464	55	6.0
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	55	5.9
Gloucestershire	66 Church Street, Tewkesbury	(Nayling 2005)	66CHT4	1371–1474	55	5.8
Herefordshire	Church Ale House, Colwall	(Hillam 1991)	COLWALL5	1401–1509	51	5.8
Lancashire	Lathom House	(Nayling 2000)	LATHOMT5	1369–1465	55	5.8

Table 2b: Dating evidence for the series **shr03**, AD 1380–1430 (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
Wales	Ty Mawr, Castell Caereinion	(Miles and Haddon-Reece 1996)	TYMAWR1	1346–1459	51	8.9
Anglesey	Hafoty Llansadwen	(Hillam and Groves 1991)	HAFOTY1	1372–1499	51	7.8
Wales	Tyddyn Cynnar Llansilin	(Miles *et al* 2003)	TYDDYNC1	1348–1471	51	7.2
Wales	Nantclwyd House, Ruthin	(Miles *et al* 2005)	NHRA	1336–1434	51	6.9
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	51	6.7
Herefordshire	Pound Farm, Kington	(Nayling 2002)	POUNDT7	1316–1441	51	6.5
Wales	Royal House, Machynlleth	(Miles *et al* 2004)	ROYALHS1	1363–1560	51	6.4
Wales	Hafod Llansilin Denby	(Miles *et al* 2003)	HAFOD	1337–1431	51	6.1
West Yorkshire	Barns at Headley Hall Farm	(Tyers 2001)	HEADLEY1	1381–1604	50	5.8
Wales	Old Burfa, Evenjobb, Radnorshire	(Miles and Worthington 1998)	OLDBRFA1	1347–1500	51	5.8

Table 2c: Dating evidence for the series **shr04**, AD 1445–93 (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
Herefordshire	Cathedral Barn, Hereford	(Tyers 1996a)	HERECB2	1359–1491	47	7.3
Wales/borders	Hillside oaks	(Siebenlist-Kerner 1978)	**GIERTZ**	1341–1636	49	6.2
Herefordshire	Dinmore Manor	(Miles and Worthington 2000)	DINMORE1	1371–1603	49	6.1
Herefordshire	Church House, Allensmore	(Miles *et al* 2006)	CHAM	1357–1551	49	6.1
Worcestershire	Old School House, Bayton	(Bridge 1996)	BAYTON	1348–1525	49	5.7
Herefordshire	Dore Abbey	(Tyers and Boswijk 1998)	DORE2	1363–1612	49	5.6
Worcestershire	Crowle Abbey	(Hillam 1997)	CROWLE2	1412–1496	49	5.5
Shropshire	Buildwas Abbey	(Miles 2002)	BUILDWS2	1374–1547	49	5.3
Herefordshire	Forbury Chapel, Leominster	(Arnold *et al* 2003)	HFCASQ01	1432–1520	49	5.2
Yorkshire	Elland Old Hall	(Hillam 1983)	ELLAND	1372–1574	49	5.1

Table 2d: Dating evidence for the series **shr06**, AD 1455–97 (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
Wales/borders	Hillside oaks	(Siebenlist-Kerner 1978)	**GIERTZ**	1341–1636	43	7.7
Herefordshire	Hergest Court, Kington	(Miles and Worthington 1997)	HERGEST3	1434–1598	43	6.8
Herefordshire	Church House, Allensmore	(Miles *et al* 2006)	CHAM	1357–1551	43	6.5
Herefordshire	Broad Street, Leominster	(Miles 2001)	LEOMSTR2	1349–1499	43	6.1
Worcestershire	Mamble	(Tyers 1996b)	MAMBLE_B	1348–1582	43	6.1
Worcestershire	Church House, Areley Kings	(Miles *et al* 2003)	ARELEY	1365–1535	43	6.1
Shropshire	St Swithin's Church, Clunby	(Tyers 2000)	CLUNBY	1239–1494	40	5.9
Herefordshire	Dore Abbey	(Tyers and Boswijk 1998)	DORE2	1363–1612	43	5.8
Somerset	Broomfield Church	(Miles *et al* 2005)	BROMFLD1	1414–1520	43	5.8
Herefordshire	Dinmore Manor	(Miles and Worthington 2000)	DINMORE1	1371–1603	43	5.7

Table 3a: Dating evidence for the series **shr23m**, AD 1380–1460 (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
Wales	Ty Mawr, Castell Caereinion	(Miles and Haddon-Reece 1996)	TYMAWR1	1346–1459	80	7.7
Wales	Tyddyn Cynnar Llansilin	(Miles *et al* 2003)	TYDDYNC1	1348–1471	81	7.6
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	81	7.6
West Yorkshire	Barns at Headley Hall Farm	(Tyers 2001)	HEADLEY1	1381–1604	80	7.3
Wales	Rose and Crown, Gwydwn	(Miles and Worthington 2000)	GWYDWN	1411–1571	50	7.0
Wales	Nantclwyd House, Ruthin	(Miles *et al* 2005)	NHRA	1336–1434	55	7.0
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	81	6.7
Devon	Broomham, King's Nympton	(Tyers *et al* 1997)	BROOMHAM	1370–1464	81	6.6
Herefordshire	Church Ale House, Colwall	(Hillam 1991)	COLWALL5	1401–1509	51	6.4
Lancashire	Lathom House	(Nayling 2000)	LATHOMT5	1369–1465	81	6.4

Table 3b: Dating evidence for the series **shr46m**, AD 1445–97 (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
Wales/borders	Hillside oaks	(Siebenlist-Kerner 1978)	**GIERTZ**	1341–1636	53	7.7
Herefordshire	Dinmore Manor	(Miles and Worthington 2000)	DINMORE1	1371–1603	53	7.1
Herefordshire	Church House, Allensmore	(Miles *et al* 2006)	CHAM	1357–1551	53	7.1
Herefordshire	Cathedral Barn, Hereford	(Tyers 1996a)	HERECB2	1359–1491	47	7.0
Herefordshire	Dore Abbey	(Tyers and Boswijk 1998)	DORE2	1363–1612	53	6.7
Worcestershire	Old School House, Bayton	(Bridge 1996)	BAYTON	1348–1525	53	6.5
Herefordshire	Hergest Court, Kington	(Miles and Worthington 1997)	HERGEST3	1434–1598	53	6.1
Worcestershire	Crowle Abbey	(Hillam 1997)	CROWLE2	1412–1496	52	6.0
Worcestershire	Church House, Areley Kings	(Miles *et al* 2003)	ARELEY	1365–1535	53	5.9
Worcestershire	Bailiff's House, Bewdley	(Fletcher 1980)	BEWDLEY2	1430-1600	53	5.9

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Table 4: Ring width data for the site chronologies, **shr23m** AD 1380–1460 and **shr46m** AD 1445–97

Ring widths (0.01mm)										no of trees									
shr23m																			
106	95	83	91	121	103	183	156	138	150	1	1	1	1	1	1	1	1	1	1
97	134	118	168	132	159	174	129	280	354	1	1	1	1	1	1	1	1	1	1
271	294	160	231	227	227	188	148	186	251	1	1	1	1	1	1	2	2	2	2
193	141	165	83	155	144	109	138	173	83	2	2	2	2	2	2	2	2	2	2
188	153	106	194	128	207	190	143	185	171	2	2	2	2	2	2	2	2	2	2
210	192	215	153	112	193	128	184	200	116	2	1	1	1	1	1	1	1	1	1
113	120	81	145	153	85	134	123	164	137	1	1	1	1	1	1	1	1	1	1
102	149	142	80	219	115	138	130	105	145	1	1	1	1	1	1	1	1	1	1
199										1									
shr46m																			
216	268	291	261	257	204	229	230	212	272	1	1	1	1	1	1	1	1	1	1
275	274	240	254	177	278	221	200	205	142	2	2	2	2	2	2	2	2	2	2
130	149	187	186	248	253	163	175	166	170	2	2	2	2	2	2	2	2	2	2
273	223	225	196	205	222	226	200	217	262	2	2	2	2	2	2	2	2	2	2
208	216	230	144	148	184	136	162	185	191	2	2	2	2	2	2	2	2	2	1
158	309	229								1	1	1							