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WYSDOM HALL, 115 HIGH STREET, BURFORD, OXFORDSHIRE
TREE-RING ANALYSIS OF TIMBERS

SCIENTIFIC DATING REPORT

Martin Bridge and Dan Miles

INTERVENTION AND ANALYSIS

ENGLISH HERITAGE

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SUMMARY
Three areas of this complex property were investigated. The front range was found to contain several reused timbers, but original principal rafters were sampled. These were found to have been made from oaks showing abrupt growth changes and remain undated. The south range was found to incorporate timbers whose empirically-derived likely felling date range is AD 1544–66 (*95% confidence*), whilst their *combined felling date range* derived through OxCal is *AD 1543–58* (*95% probability*). Timbers from the north range were also dated, one of which was felled in the period *c* AD 1387–90 (*95% confidence*), the others having likely felling date ranges incorporating this date.

CONTRIBUTORS
Dr M C Bridge and Dr D W Miles

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INTRODUCTION

Wysdom Hall, formerly known as Wisdom House, stands on the east side of Burford High Street (Figs 1 and 2). It fronts one of the medieval burgage plots of the town. It is thought to have been built in the sixteenth century, but has successive additions, including an early eighteenth-century front. The building was the subject of an investigation by the Oxfordshire Buildings Record (2003). Three parts of the house were of interest, the front range (section A in the background material supplied for this site), the south range (section B), and the north range (section C). Dating was requested by Kathryn Davies of the English Heritage South East Regional Office in order to better understand the development of the building.

METHODOLOGY

The initial assessment of the structure (by Dan Miles) aimed to locate accessible oak timbers with more than 50 rings and possible traces of sapwood. This identified that there were sufficient numbers of suitable timbers in the north (C) and south (B) ranges. In addition it was noted that the principal rafters of the front range (A) might be worth investigating further, although these had a limited chance of dating because of the low numbers of rings and lack of suitable timbers in the phase, which also contained a large number of apparently reused timbers. Fieldwork for the present study was carried out in March 2011(by Martin Bridge) when those timbers judged to be potentially useful were cored from *in situ* timbers 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 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.

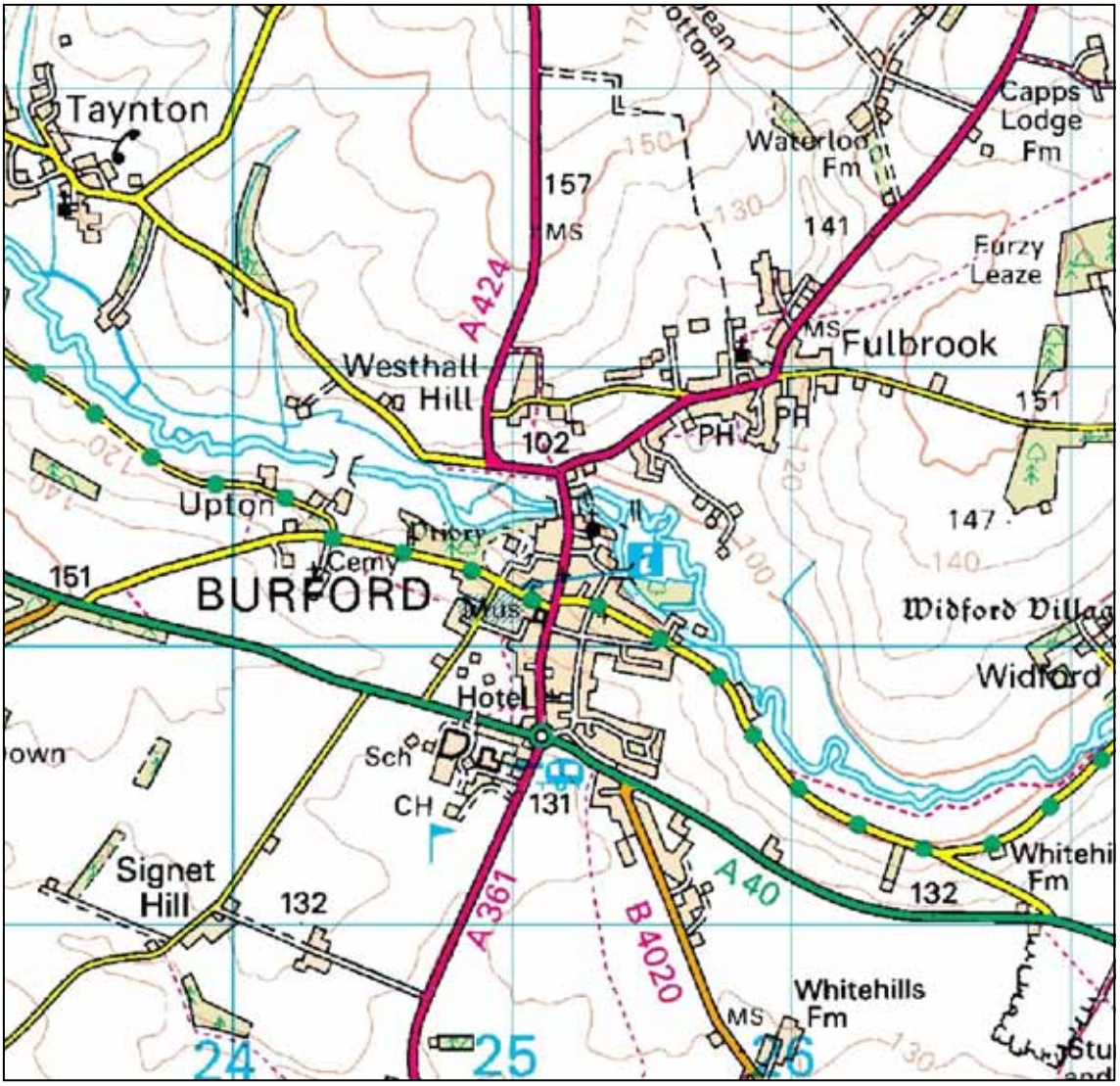

Figure 1: Map to show the location of Burford. © Crown Copyright 2011. All rights reserved. Ordnance Survey Licence number 100019088

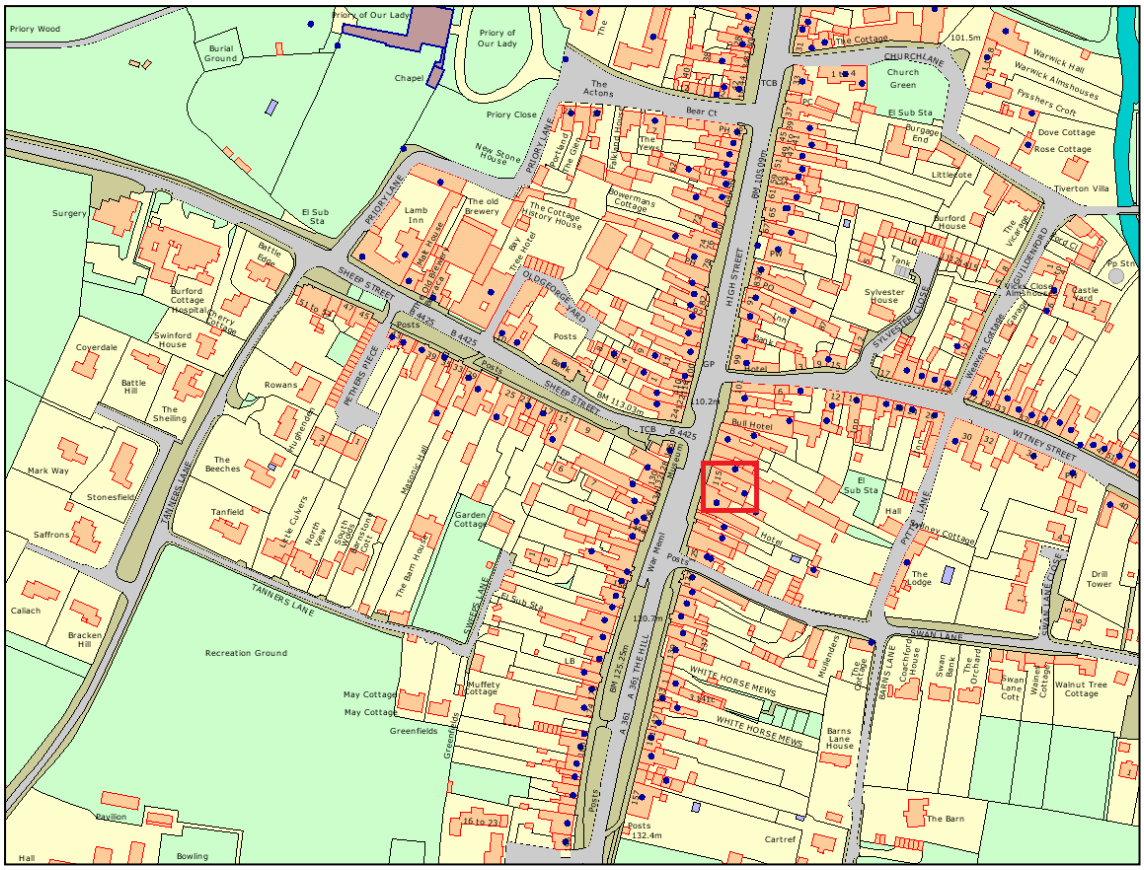

Figure 2: Map showing the location of Wysdom Hall (outlined with a red rectangle) within its immediate environs. © Crown Copyright 2011. All rights reserved. Ordnance Survey Licence number 100019088

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. 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* (*tpq*) or felled-after date.

A review of the geographical distribution of sapwood data from dated historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area Miles (1997) gives as 9–41 rings (95% confidence level).

However an alternative method of estimating felling date ranges has recently been developed (Miles 2005) which runs as a function under OxCal (Bronk Ramsey 2009; Miles 2006). Following the methodology set out by Millard (2002), Bayesian statistical models are used to produce individual sapwood estimates for samples using the variables of number of heartwood rings present, the mean ring width of those heartwood rings, the heartwood/sapwood boundary date, and the number of any surviving sapwood rings or a count of those lost in sampling. These individual probability distributions for the felling dates (expressed at the 95% probability level), may then be combined to produce a highest probability density estimate for the *combined felling date range*. When carried out within OxCal, this uses a sapwood model that has to be defined. Miles (2005) suggested several such models, of which the one that has been deemed appropriate to apply to the timbers in this case is that for 'England and Wales AD'. This model used is based on timbers from throughout England and Wales, with a bias to those in the most densely-dated counties of Shropshire, Somerset, Hampshire, Oxfordshire, and Kent, and is thus considered appropriate for these timbers.

It has been found that some samples do not fit this particular model well (Tyers 2008). These include samples which have exceptional or sudden variation in mean ring width, such as might be found in pollarded or managed timber. Sometimes a tree will exhibit a sudden drop in mean ring width toward the end of its life, resulting in more sapwood rings being present then might be suggested in the faster-grown heartwood. Additionally, samples which have come from small timbers converted from larger, slow-grown trees would have had a much larger number of heartwood rings then were actually present in the sample. Some examples of heartwood ring counts of 25 years or less with a narrow mean ring width are good indicators of this situation, as were observations made during sampling. Thus it is necessary to very carefully consider whether or not samples are potentially suitable for such analysis.

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. Thus 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 AND INTERPRETATION

Three phases of the property were investigated; the front range (A), the south range (B), and the north range (C). Basic information about the samples taken is presented in Table 1, with the locations of sampling being shown in Figures 3–9. The results are summarised below area by area. All but one sample, WYSc04, had sufficient numbers of rings for analysis. The ring-width data of the measured samples are presented in the Appendix.

Front Range (A)

All four samples showed several distinct abrupt growth changes (Fig 10), possibly reflecting management of the trees used. The principal rafters of the north truss appear to have been made from the same tree, as judged on-site by the coincidence of knots on either timber, although the *t*-value between the series was only 7.4, but none of the samples could be dated.

South Range (B)

Four of the seven samples taken were dated, including samples from two collars and two studs in the north wall of the gallery. Sample WYSb03 had a split in it with the possible loss of a very small number of rings. The inner part of the sequence, being designated WYSb03i, could not be dated as it contains an abrupt growth change, but the outer part (WYSb03ii) was dated. Cross-matching between the samples is poor (Table 2a) and therefore the evidence for the dating of each individual timber is summarised in Tables 3 a-d. The relative cross-matching positions of these timbers, all thought to be coeval, is shown in Figure 11. The mean heartwood-sapwood boundary date is AD 1525 and thus, using the empirical 9–41 sapwood ring estimate (*95% confidence*, Miles 1997), a likely felling date range of AD 1534–66 (*95% confidence*) is obtained, which can be modified in light of the surviving sapwood to AD 1544–66 (*95% confidence*).

OxCal v4.2.3 (Bronk Ramsey 2014) was used to produce sapwood estimates for each of the three dated tree series from this range with traces of sapwood (Table 1; Fig 12). In the case of WYSb03ii, the total known number of heartwood rings (131 years) was used, and the mean ring width of both 03i and 03ii combined was used as the closest approximation possible, despite it not being known exactly how many rings might be missing between the two sections. As the group had similar individual sapwood ranges a Bayesian approach to combining individual sapwood estimates following the methodology of Millard (2002), was used to derive the likely *combined felling date range* (Fig 12). The combined index agreement for this group (A_{comb}102.0%, An= 40.8%, n=3) shows this to be a coherent group. This methodology derives a *posterior density estimate* for the *combined felling date range* of *AD 1543–58* (*95% probability*), and construction is assumed to have taken place within months of the trees being felled. It should be noted that this *posterior density estimate* may vary if a different combination of samples was used, but there is no reason in this case to reject any of the samples.

North Range (C)

Three of the four samples taken were dated. These include a wallplate, a floor joist, and two braces in the south wall. One timber retained complete sapwood, but degradation around the heartwood-sapwood boundary meant that it was not possible to measure the

entire ring sequence. However a narrow estimated felling date range of *c* AD 1387–90 can be obtained for this timber, based on the 17 detached sapwood rings to the bark edge counted, and allowing for a few rings that may have been present between the heartwood-sapwood boundary and this detached section. The other two samples have likely felling date ranges that incorporate this range (Fig 11). With this narrow felling date range available, obtaining sapwood estimates and a *combined felling date range* through OxCal was not deemed necessary. The matching between these series was good (Table 2b) and they were combined into a site chronology, BURFRD9, the dating evidence for which is shown in Table 3f.

DISCUSSION

The late fourteenth-century date obtained for the North range (C) was earlier than expected from previous descriptions of the building, which attributed the earliest parts to the sixteenth century. Both the empirically- and Bayesian-derived combined felling date ranges for this group of four dated timbers encompass the date of AD 1555 inlaid in the panelling on the ground floor that may, therefore, relate to the building of this wing.

Despite the poor matching between the individually dated timbers from the South range (B), the timbers formed a coherent assemblage within the building. Previous work has shown how trees growing in the same woodland can vary in the way they match each other quite substantially (eg Bridge 1983), and yet these are often combined by dendrochronologists to form a site chronology which reflects the various tree reactions to the same external growth factors. It was therefore decided to combine these dated timbers from the same phase into a site chronology, BURFRD8, which gave much stronger matches to the available data than the individual series (Table 3e). This unusual approach may be justified in this case by the improved matching and coherency of the structural elements, but is not necessarily normal practice in historical dendrochronology.

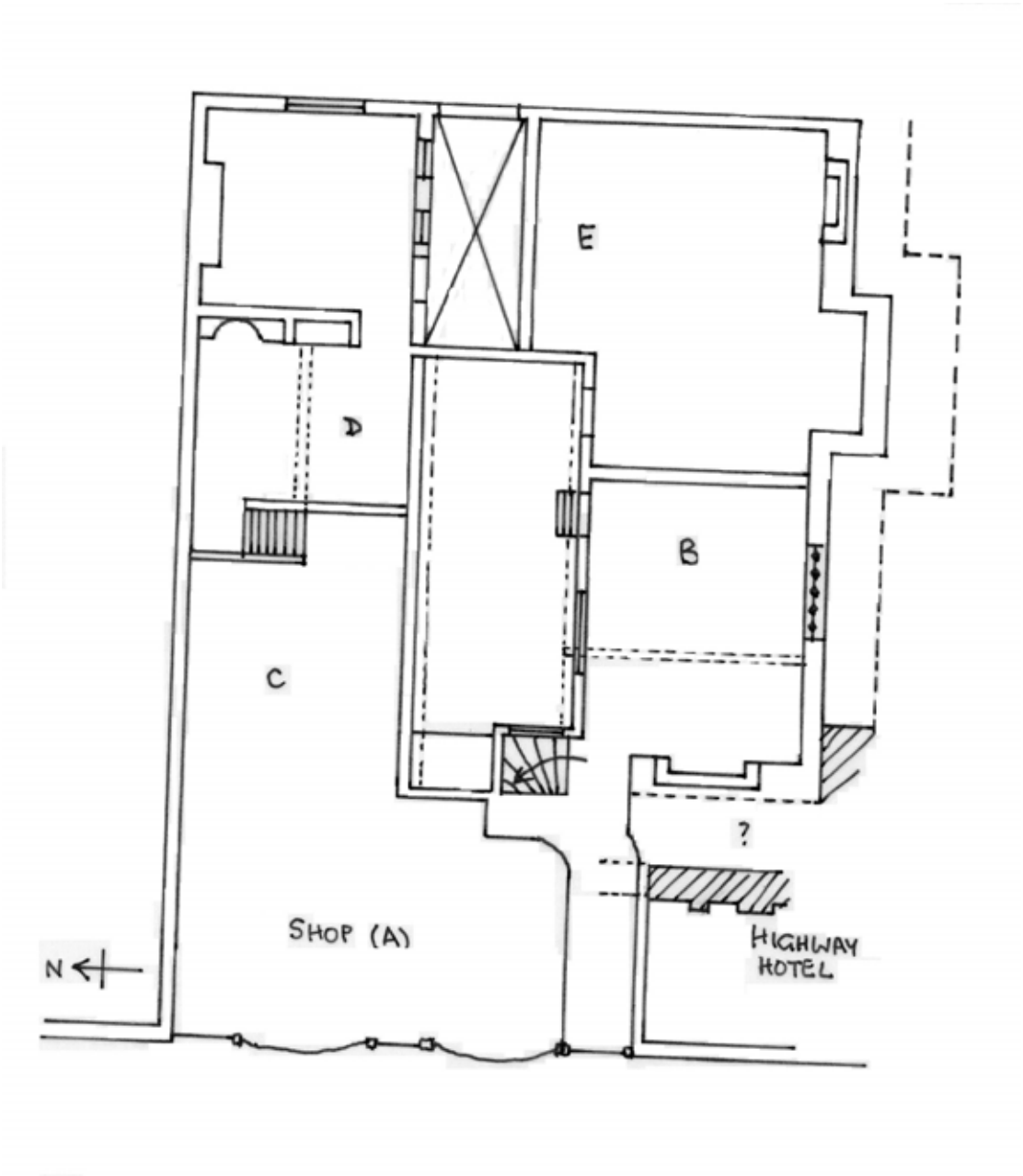

Figure 3: Plan of the property showing the areas discussed in the text, drawn by David Clark

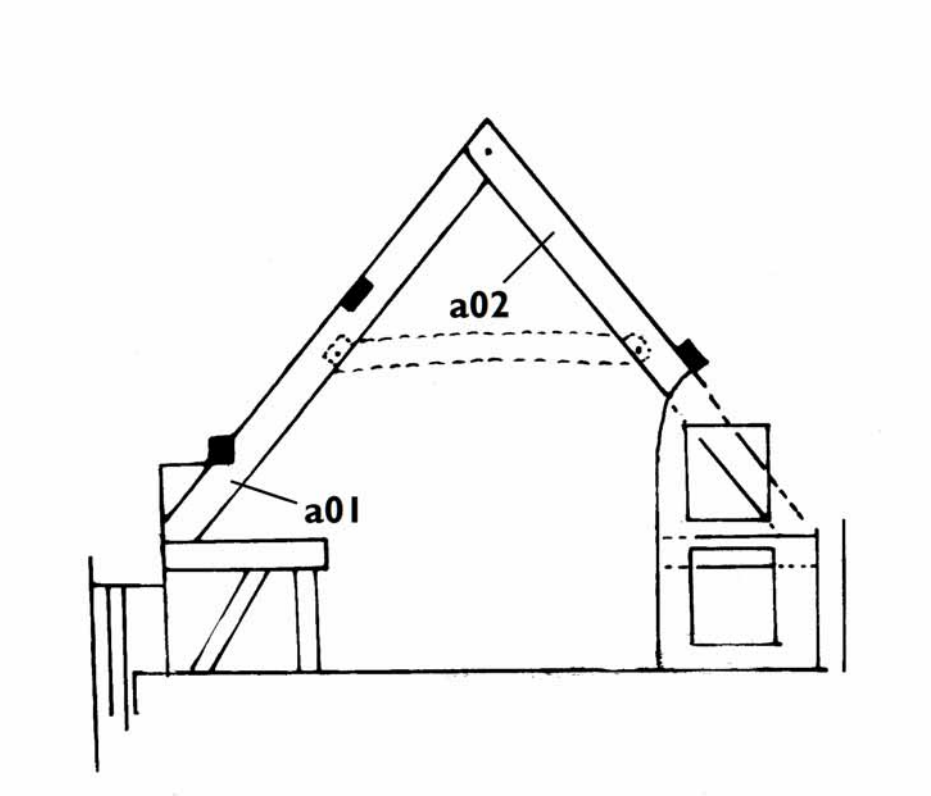

Figure 4: North truss in the front range (A) showing the approximate positions of sampling, adapted from an original drawing supplied by David Clark

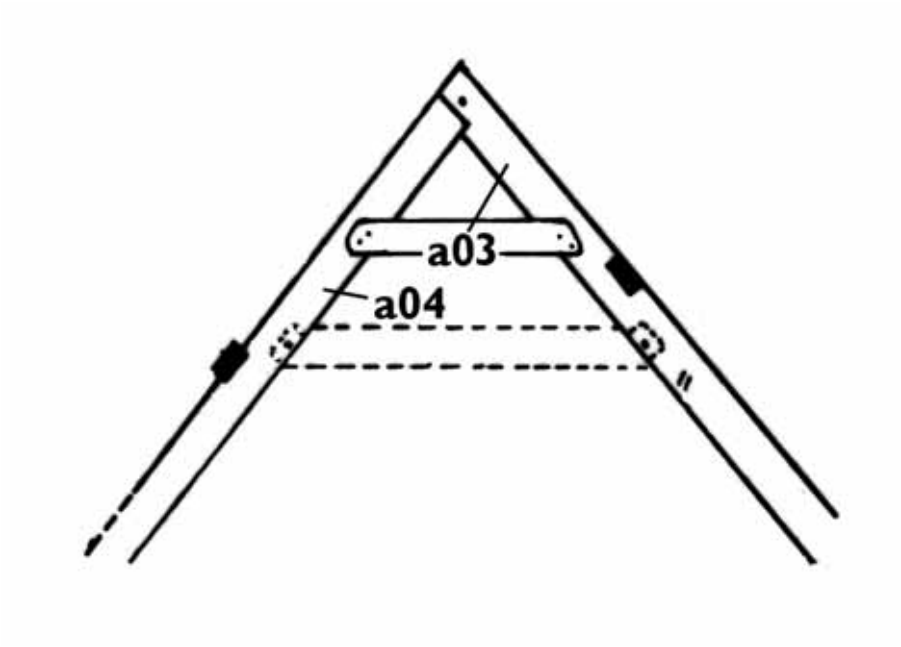

Figure 5: South truss in the front range (A) showing the approximate positions of sampling, adapted from an original drawing supplied by David Clark

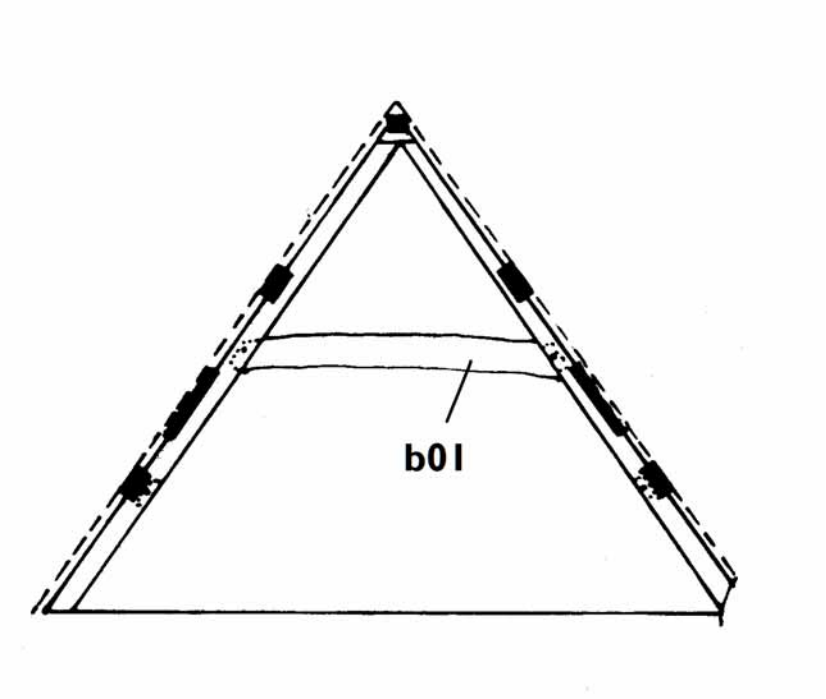

Figure 6: Truss 3 in the south range (B) showing the approximate positions of sampling, adapted from an original drawing supplied by David Clark

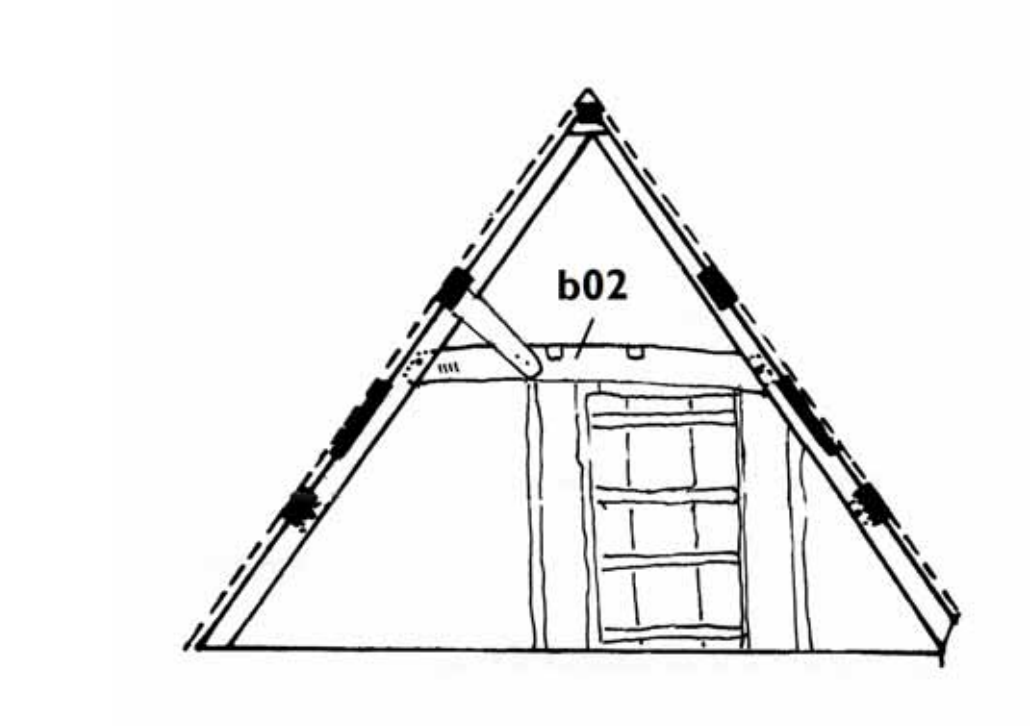

Figure 7: Truss 4 in the south range (B) showing the approximate positions of sampling, adapted from an original drawing supplied by David Clark

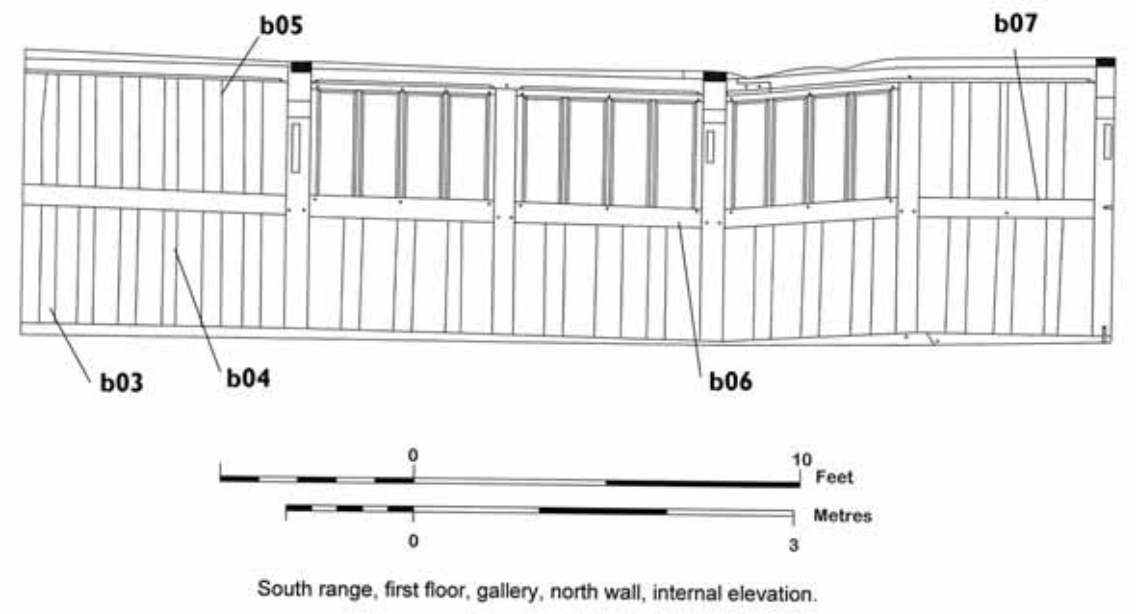

Figure 8: South range (B) north wall, showing the approximate positions of sampling, adapted from an original drawing supplied by Paul Clark

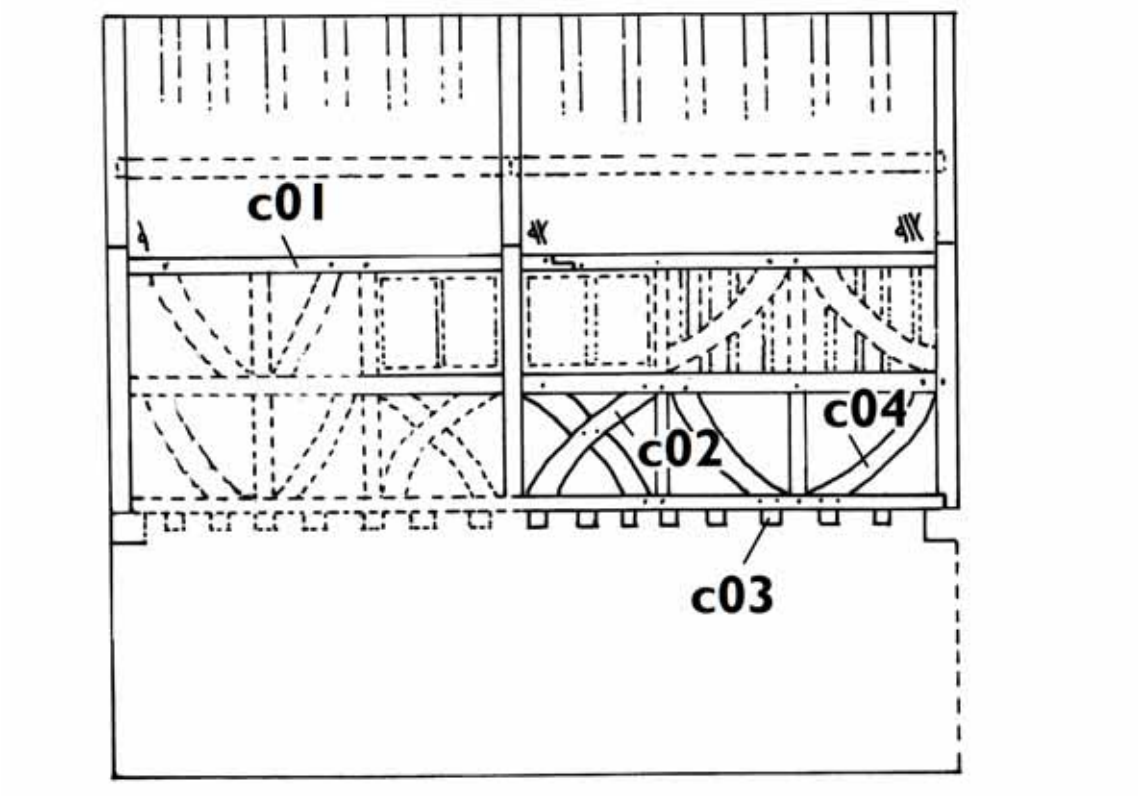

Figure 9: North range (C), showing the approximate positions of sampling, adapted from an original drawing supplied by David Clark.

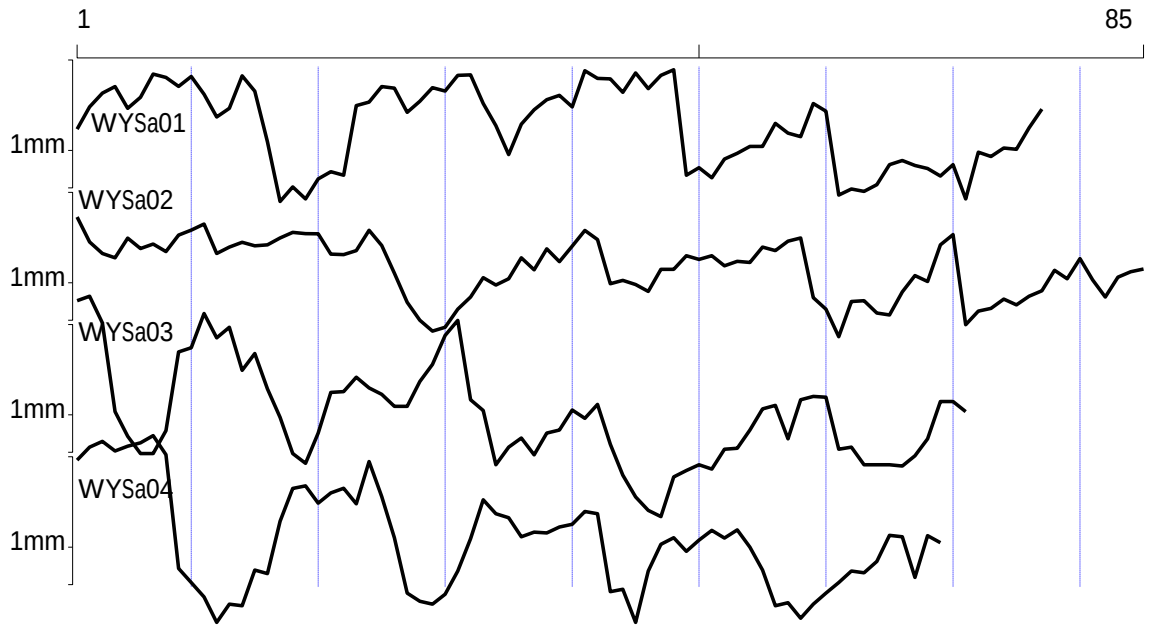

Figure 10: Plots of the four undated series in Front range (A), showing the abrupt growth changes discussed in the text. The x-axis is arbitrary years, and the y-axis is ring width on a logarithmic scale

Table 1: Details of oak (Quercus spp) timbers sampled from Wysdom Hall, Burford, Oxfordshire

Sample	Timber and position	Spanning dates (AD)	No of heartwood rings	MHRW (mm)	H/S boundary (AD)	Sapwood	Mean sens (mm)	Empirical felling date ranges (AD, *95% confidence*)	OxCal-derived felling date range (AD, *95 probability*)
Front Range (A)									
WYSa01	West principal rafter, north truss	undated	49	2.40	-	28 + 9NM	0.28	unknown	-
WYSa02	East principal rafter, north truss	undated	77	1.45	-	8	0.23	unknown	-
WYSa03	West principal rafter, south truss	undated	32	2.45	-	39C	0.33	unknown	-
WYSa04	East principal rafter, south truss	undated	52	1.98	-	17 + 8NM	0.31	unknown	-
South Range (B)									
WYSb01	Collar to truss 3	1437–1520	84	1.45	1520	h/s	0.22	1529–61	1530–59
WYSb02	Collar to truss 4	1421–84	64	2.22	-	-	0.29	after 1493	-
WYSb03i	North wall, west-most lower stud (inner section)	undated	71	0.94	-	-	0.16		-
WYSb03ii	*ditto* (outer section)	1467–1541	60	0.66	1526	15 + 3NM	0.18	1544–67	1543–74
WYSb04	North wall, 4th bottom stud from west end	undated	83	1.59	-	-	0.24	unknown	-
WYSb05	North wall, 5th upper stud from west end	1419–1528	110	0.96	1528	h/s	0.16	1537–69	1540–74
WYSb06	North wall, sill to central window	undated	99	0.92	-	h/s	0.23	unknown	-
WYSb07	North wall, middle rail to east bay	undated	128	1.12	-	19C	0.20	unknown	-
North Range (C)									
WYSc01	South wallplate at west end	1327–70	44	2.42	1370	h/s +17CNM	0.19	1387–90	-
WYSc02	East bay, brace	1322–76	51	2.35	1372	4	0.18	1381–1413	-
WYSc03	East bay, west curved brace	1318–72	48	3.46	1365	7	0.25	1374–1406	-
WYSc04	East bay, east curved brace	undated	NM	NM	-	-	-	unknown	-

Key: MHRW= mean heartwood ring width; NM = not measured; h/s = heartwood-sapwood boundary; C = complete sapwood, winter felled; Mean sens = mean sensitivity

Table 2a: Cross-matching between the dated series from South range (B), values above t = *3.5 are significant*

	t-values		
Sample	WYSb02	WYSb03ii	WYSb05
WYSb01	4.2	2.7	2.0
WYSb02		-	0.8
WYSb03ii			4.6

- = overlap less than 30 years, no *t*-value calculated

Table 2b: Cross-matching between the dated series from North range (C), values above t = *3.5 are significant*

	t-values	
Sample	WYSc02	WYSc03
WYSc01	6.3	3.6
WYSc02		3.6

Table 3a: Dating evidence for the site sequence WYSb01, AD 1437–1520

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	*t*-value
Suffolk	37 High Street, Debenham	(Miles *et al* 2009)	DEBNHM6	1437–1524	84	6.5
Shropshire	Park Farm, Alkington	(Miles and Haddon-Reece 1996)	PARKFARM	1456–1555	65	5.1
Oxfordshire	Dower House, West Hanney	(Miles *et al* 2005)	WHANNEY	1390–1517	81	4.7
Hampshire	Corner Cottage, Baughurst	(Miles *et al* 2009)	BAUGHRST	1424–1580	84	4.6
Hampshire	Tudor Cottage, Romsey	(Bridge *et al* 2010)	TCROMSEY	1426–1523	84	4.5
Shropshire	Shootrough Farm, Cardington	(Miles and Haddon-Reece 1996)	shu6	1433–1538	84	4.5

Table 3b: Dating evidence for the site sequence WYSb02, AD 1421–84

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	*t*-value
Hampshire	Tudor Cottage, Romsey	(Bridge *et al* 2010)	TCROMSEY	1426–1523	59	6.0
Berkshire	Shaw House, Newbury	(Miles *et al* 2004)	SHAW1	1391–1579	64	5.6
Oxfordshire	Harpsden Court, Harpsden	(Miles *et al* 2009)	HARPSDN1	1413–1571	64	5.4
England	Ref3 Master Chronology	(Fletcher 1977)	REF3	1399–1687	64	5.4
Hampshire	St Mary and St Ethelflaeda, Romsey	(Hillam and Groves 1994)	ROMSEY	1362–1496	64	5.2
Oxfordshire	Manor Farm, Stanton St John	(Miles and Worthington 1998)	STNSTJN2	1379–1474	54	5.2

Table 3c: Dating evidence for the site sequence WYSb03ii, AD 1467–1541

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	*t*-value
Warwickshire	Kenilworth Castle	(Howard *et al* 2006)	KNWESQ01	1354–1532	66	5.1
Wiltshire	Bishop's Palace, Salisbury	(Miles and Worthington 2000)	SARUMBP6	1450–1569	75	5.1
Warwickshire	Halls Croft, Stratford-upon-Avon	(Miles and Worthington 1999)	HLSCROFT	1429–1648	75	4.7
Warwickshire	Baddesley Clinton moated manor house	(Miles and Worthington 2002)	BADESLY3	1423–1577	75	4.7
Gloucestershire	Algars Manor, Iron Acton	(Miles *et al* 2009)	ALGARS	1381–1559	75	4.6
Warwickshire	Palmer's Farm, Wilmcote	(Miles and Worthington 2000)	ARDEN3	1454–1580	75	4.6

Table 3d: Dating evidence for the site sequence WYSb05, AD 1419–1528

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	*t*-value
Cornwall	Old Duchy Palace, Lostwithiel	(Tyers 2010)	LSTWTHEL	1464–1620	65	5.4
Shropshire	10–11 Lydbury North	(Miles *et al* 2007)	lydC3	1475–1573	54	5.3
Wales	Plas Mawr House, Conwy	(Miles and Haddon-Reece 1996)	PLASMWR2	1360–1578	110	5.0
Bedfordshire	Dovecote, Willington	(Miles and Worthington 1998)	WILNGTN1	1394–1542	110	5.0
Shropshire	Church Farm, Ditton Priors	(Miles *et al* 2004)	DITTON5	1437–1578	92	4.8
Hampshire	Chawton House, Chawton	(Miles and Haddon-Reece 1996)	CHAWTON2	1377–1563	110	4.8

Table 3e: Dating evidence for the site master chronology BURFRD8, AD 1419–1541

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	*t*-value
Gloucestershire	Algars Manor, Iron Acton	(Miles *et al* 2009)	ALGARS	1381–1559	123	7.5
Hampshire	St Michael's Cottage, Chilbolton	(Miles *et al* 2007)	CHLBLTN1	1421–1554	121	6.5
Oxfordshire	39 The Causeway, Steventon	(Miles and Bridge 2010)	CAUSEWY2	1396–1518	100	6.5
Hampshire	Tudor Cottage, Romsey	(Bridge *et al* 2010)	TCROMSEY	1426–1523	98	6.2
Wales	George and Dragon, Beaumaris	(Miles *et al* 2010)	ANGLSY1	1437–1540	104	6.1
Hampshire	Mottisfont Abbey	(Miles 1996)	MOTISFNT	1388–1538	120	5.9
Hampshire	Sydmonton Court, Kingsclere	(Miles *et al* 2005)	SYDMNTN1	1383–1529	111	5.6
Berkshire	Greenham Mill, Newbury	(Miles and Worthington 2002)	GREENHAM	1373–1589	123	5.6
Oxfordshire	Harpsden Court, Harpsden	(Miles *et al* 2009)	HARPSDN1	1413–1571	123	5.6
Worcestershire	Plowstall Farmhouse, Bayton	(Miles *et al* 2008)	BAYTONPF	1410–1570	123	5.6
Berkshire	Shaw House, Newbury	(Miles *et al* 2004)	SHAW1	1391–1579	123	5.5

*Table 3f: Dating evidence for the site master chronology BURFRD9 , AD 1318–76. File names in **bold** represent regional chronologies*

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	*t*-value
Kent	St Margaret's Church, High Halstow	(Bridge 1988)	HALSTOW	1311–1424	59	6.6
Oxfordshire	82–84 High Street, Burford	(Miles *et al* 2006)	BURFRD4	1307–1472	59	5.9
West Sussex	Charlton Court Barn, Steyning	(Miles 1995)	CHARLTON	1230–1405	59	5.9
Kent	Church of St Mary Magdalene, Cowden	(Howard *et al* 1999)	CWDASQ03	1254–1439	59	5.2
Somerset	Somerset Master Chronology	(Miles 2004)	**SOMRST04**	770–1979	59	5.1
Buckinghamshire	Castle House, Buckingham	(Miles *et al* 2007)	CASTLEHO	1272–1406	59	5.0
Surrey	91–3 Church Road, Croydon	(Bridge 1998)	CROYDON	1266–1377	59	5.0
Suffolk	23 High Street, Debenham	(Miles *et al* 2009)	DEBNHM4	1273–1417	59	4.8
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	59	4.8
London	London Master Chronology	(Tyers pers comm)	**LONDON**	413–1728	59	4.8
Somerset	Upper Row Farm, Hemington	(Miles and Worthington 2002)	HEMINGTN	1300–1490	59	4.7

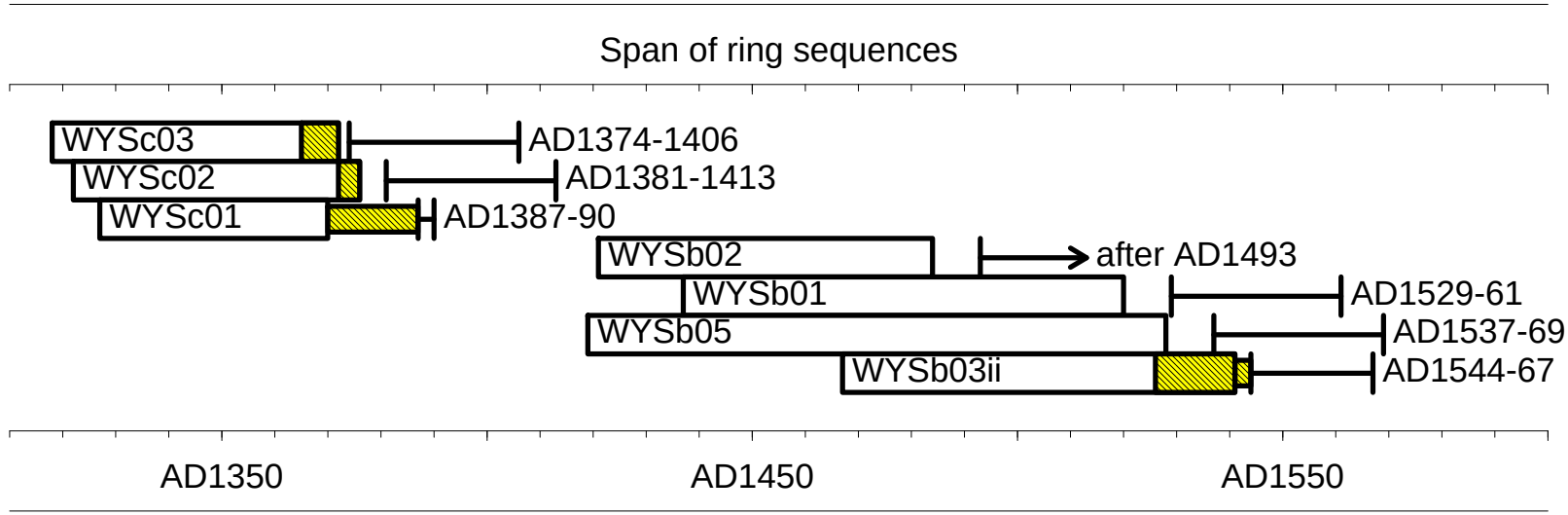

Figure 11: Bar diagram showing the relative positions of overlap between the dated series, along with their likely interpreted empirical felling dates, sorted by area. Yellow hatched sections represent sapwood, and narrow sections are additional unmeasured rings

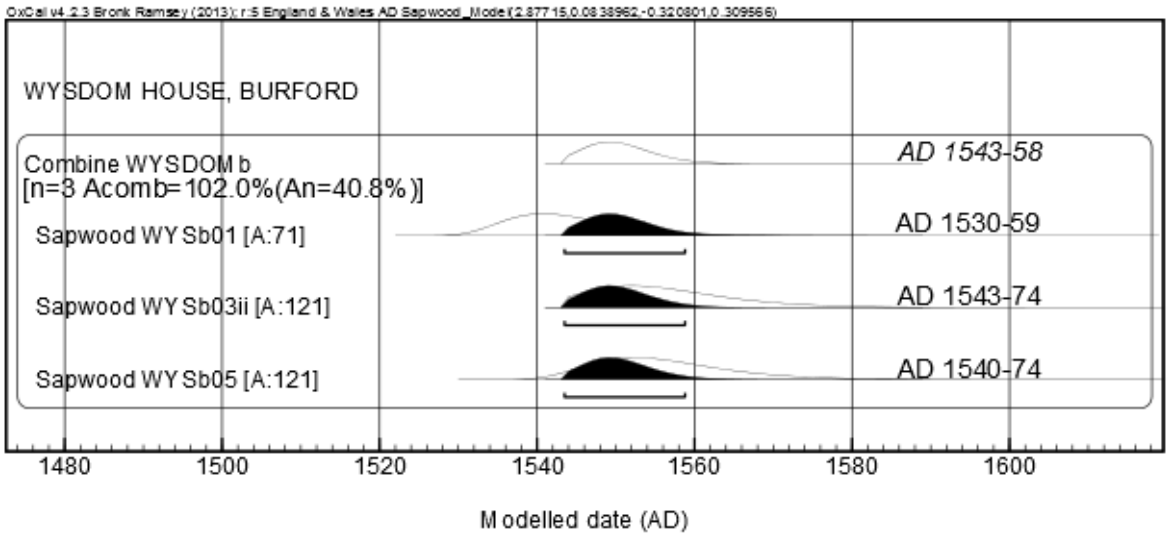

Figure 12: Wysdom House, Burford, combined felling date range and individual felling date distributions for timbers from the South range (B). Individual felling date distributions are shown in outline and the 95% probability individual felling dates ranges are listed. The 95% probability combined felling date range is shown in black and in italic text

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APPENDIX

Ring width values (0.01mm) for the sequences measured

WYSa01

145	213	271	304	208	252	377	356	305	363
266	179	208	366	280	116	41	53	43	61
69	65	218	232	304	296	194	235	298	281
369	372	226	154	93	158	203	242	261	213
400	351	348	275	385	293	370	407	65	74
62	86	95	107	107	160	135	127	226	198
46	51	49	55	78	84	77	73	64	78
43	97	90	104	102	148	205			

WYSa02

314	203	166	154	217	181	196	172	229	250
277	166	186	202	190	193	218	240	235	234
164	163	175	249	191	118	71	52	43	46
63	78	109	96	107	154	125	180	144	189
248	212	98	104	97	86	126	126	160	150
160	134	145	142	186	175	206	218	77	63
39	72	73	59	57	85	113	102	193	231
48	61	64	75	68	79	87	124	107	152
105	78	110	121	127					

WYSa03

729	789	496	106	69	51	51	76	299	322
585	383	460	217	291	157	96	51	43	73
148	150	193	160	143	116	116	179	241	399
518	130	108	42	57	67	50	73	77	109
94	120	60	35	24	19	17	34	38	42
39	55	56	77	111	118	66	130	138	136
55	57	42	42	42	41	49	66	126	126
106									

WYSa04

455	570	631	533	579	615	697	501	69	54
42	27	37	36	67	63	157	278	291	215
257	279	213	444	241	118	45	39	37	44
66	116	228	179	167	120	130	128	142	149
186	179	46	48	27	66	105	118	93	113
134	117	135	100	67	36	38	29	37	45
54	66	64	78	123	120	59	122	108	

WYSb01

247	99	108	126	158	167	233	208	203	209
192	142	185	126	145	142	136	115	50	64
69	78	133	103	120	121	247	165	250	242
165	146	139	204	203	268	237	362	294	219
199	261	243	226	237	225	275	255	190	225
287	197	148	100	53	68	58	84	106	160
114	93	83	55	56	53	79	85	60	55
47	65	73	72	66	96	98	96	70	80
70	68	52	70						

WYSb02

189	268	186	166	166	57	83	170	218	199
369	246	155	102	155	294	156	126	110	210
188	190	207	181	146	121	134	99	127	72
138	98	86	88	59	69	71	105	188	263
211	262	442	304	458	418	363	430	548	578
370	305	260	331	376	408	240	283	259	192
264	195	274	213						

WYSb03i

142	96	129	125	104	109	151	175	170	158
196	166	184	172	187	156	145	163	205	158
225	178	140	124	119	115	153	137	104	113
106	91	37	46	45	51	36	43	52	49
50	60	55	63	50	54	40	45	48	40
40	36	33	44	48	54	62	52	43	41
38	59	51	53	63	53	47	54	68	75
74									

WYSb03ii

79	52	45	40	40	54	43	61	64	60
47	48	64	73	78	68	66	70	61	68
88	60	67	63	87	84	70	42	61	59
59	63	82	65	73	69	100	104	110	75
62	75	102	81	96	89	77	71	58	52
60	43	56	36	39	72	57	40	56	49
49	49	47	44	64	86	69	71	84	86
64	88	87	118	114					

WYSb04

537	447	518	397	406	408	330	181	153	159
174	148	89	95	108	76	95	153	282	356
307	313	224	168	260	189	196	204	104	99
75	68	116	101	111	71	58	100	111	90
113	81	123	115	107	118	109	94	110	67
56	60	49	91	133	175	183	135	113	153
96	102	63	46	78	77	86	59	85	150
190	205	246	201	143	141	188	156	113	113
96	112	190							

WYSb05

188	252	269	260	286	282	256	214	243	231
256	226	294	199	164	162	126	102	118	107
93	103	89	74	56	61	60	46	54	46
62	58	57	58	69	66	64	63	58	60
55	55	52	37	43	46	37	39	48	35
33	79	47	60	52	77	62	67	59	49
54	66	91	64	72	73	61	91	88	88
85	86	109	100	72	78	88	111	87	75
86	70	79	71	81	99	109	98	69	72
91	87	102	112	96	96	72	90	70	80
79	66	76	97	62	49	53	55	67	68

WYSb06

172	211	208	138	146	154	130	149	123	103
150	125	87	42	49	56	63	57	61	62
66	56	67	66	47	64	58	67	57	49
77	72	70	53	59	73	76	111	71	92
36	61	56	62	44	44	54	30	72	48
34	87	107	71	61	64	79	86	80	107
98	99	89	107	85	61	52	64	97	84
114	74	98	140	118	119	123	146	53	52
74	130	153	137	141	159	136	113	94	108
107	142	135	100	109	184	90	90	91	

WYSb07

333	273	222	230	278	277	197	182	204	228
194	213	247	236	323	250	179	191	190	183
214	270	275	235	319	265	231	229	154	193
224	66	34	53	39	28	41	61	68	63
82	117	130	122	99	119	112	155	115	81
141	129	174	148	89	126	144	80	53	65
45	42	45	63	71	61	96	86	114	99
120	90	95	105	72	33	31	40	34	42
39	50	61	53	39	52	53	57	69	68
84	85	85	83	80	96	106	110	77	83
72	90	87	101	41	28	30	26	24	25
36	30	35	40	52	42	55	60	58	47
50	59	66	63	68	76	115	104	120	126
92	120	82	106	89	101	92	96	118	145
111	120	97	111	124	107	114			

WYSc01

334	312	281	262	212	253	220	332	307	307
293	296	365	309	233	186	194	200	272	253
177	222	376	295	321	144	186	215	236	283
253	176	247	222	210	194	259	288	198	142
122	165	143	133						

WYSc02

190	241	214	178	157	257	261	343	323	220
251	258	231	223	197	213	251	235	222	162
173	144	197	343	317	253	276	281	242	245
118	174	280	242	290	230	171	236	252	215
247	319	283	256	206	222	233	187	249	202
257	210	232	192	202					

WYSc03

323	365	423	454	385	457	270	326	320	434
503	375	219	126	227	378	474	347	375	304
362	470	427	286	265	307	361	515	400	293
360	292	370	461	212	185	233	346	318	283
211	175	259	319	369	486	544	390	374	483
447	253	176	127	224					

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