Tree-ring Analysis of Timbers at Old Baptist Chapel, Tewkesbury, Gloucestershire

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Summary

This report provides results from tree-ring dating of twelve cores obtained from oak timbers from Old Baptist Chapel, Tewkesbury. Nine of the twelve samples provide absolute dates, and two timbers that retain bark edge were felled in AD1458. The other seven dated timbers all have felling date ranges coeval with the two that were felled in AD1458, suggesting a single phase of construction for the timber framed building.

Introduction

As part of the Gloucestershire Dendrochronology Project, the Old Baptist Chapel, Tewkesbury (SO 8902832562) was selected for dendrochronological sampling and analysis. Suitable oak timbers (those containing >50 rings and thought to be original timber framing) were sampled for tree ring dating.

Methods

Dendrochronological sampling was undertaken on the 23rd July 2020. Twelve core-samples were taken using a power drill corer with each core sample being assigned a unique identifier with the prefix OB. Notes and photographs were used to record sample locations and the condition of each core obtained.

Dendrochronological analysis was undertaken on all samples. The samples were surfaced in the laboratory using a sander with progressively finer grit sandpaper (60 through to 400 grit) so that the ring sequence could be clearly discerned and measured. Broken cores were glued together where there was a good join. In the case of broken cores where no clear join could be established, individual core fragments were measured separately.

Methods employed at the Lampeter Dendrochronology Laboratory in general follow those described in English Heritage guidance (English Heritage, 2004). The complete sequence of growth rings in each sample was measured to an accuracy of 0.01mm using a micro-computer based travelling stage(Tyers, 2004). Cross-correlation algorithms (Baillie and Pilcher, 1973; Munro, 1984) are employed to search for positions where the ring sequences are highly correlated against each other. The ring sequences were also tested against a range of oak reference chronologies from Britain. The *t*-values reported are derived from the original CROS algorithm (Baillie and Pilcher, 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position must be obtained from a range of independent sequences, and that satisfactory visual matching supports these positions and that there is good overlap. Correlated positions are checked visually using computerised ring-width plots.

Interpretation of any tree ring date is limited by whether sapwood or bark edge is present in a sample. Sapwood is distinguishable as lighter coloured band around the outer annual rings of a tree and represents the part of the tree that is alive. At a microscopic level, sapwood in *Quercus* spp. is recognisable by the open earlywood vessels used for water and mineral transport. Heartwood earlywood vessels appear filled when viewed microscopically as the cell walls have collapsed (tyloses) and no longer form the living part of the tree. Should a sample contain sapwood and bark edge, the year and even season of felling can be inferred from a dated sample. Should partial sapwood be present an estimate of between nine and forty-one rings is used to infer a date range for a southern British oak sample (Miles, 1997). In samples where there is no sapwood or microscopic sign of the heartwood/sapwood boundary a date will represent a *terminus post quem* (date after which) the parent timber must have been felled. The date in this case will refer to the

date of the last complete annual ring and at least nine years after the date of that final ring to account for a minimum amount of missing sapwood.

Results

Details of the samples recovered are given in Table 1. All core samples contained sufficient rings to warrant analysis and were sanded and their ring sequences measured. Three of the samples clearly exhibited complete sapwood, with two (**OB06** and **OB12**) containing both earlywood and partial latewood for their final measured ring, and one (**OB09**) where the terminus of latewood growth was observable as the final measured ring, indicating winter felling. One retained partial sapwood (**OB04**) whilst five samples (**OB01**, **OB02**, **OB07**, **OB08** and **OB10**) final measured ring was on the heartwood sapwood boundary. With the remaining three samples (**OB03**, **OB05** and **OB11**), no definite heartwood/sapwood boundary was observed.

When attempting to cross-match the ring-width sequences produced from the samples taken, significant correlations were noted between nine samples (Table 2). A mean calculated from these samples (**TWKES-OB**), cross-matched against a range of previously dated British site master sequences indicating a date for this mean sequence of AD1218 to AD1458. Two of the samples (**OB06** and **OB12**) retained complete sapwood with a felling date of AD1458. The felling date ranges of samples with heartwood sapwood boundary or partial sapwood are consistent with this date. The results indicate that the Old Baptist Chapel was constructed in, or soon after, AD1458.

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References

Arnold, A.J., Howard, R.E., Litton, C.D., 2004. Tree-ring analysis of timbers from New Inn House, 7 Wotton Road, Kingswood, Gloucestershire. Centre for Archaeol Rep, 62/2004.

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

Boswijk, G., Tyers, I., 1997. Tree-ring analysis of Booth Hall and 16-18 High Town, Hereford. Anc Mon Lab Rep 101/97.

English Heritage, 2004. Dendrochronology: guidelines on producing and interpreting dendrochronological dates. English Heritage London.

Groves, C., 2002. Dendrochronological analysis of Bowhill, Exeter, Devon. Centre for Archaeology Report 23/2002.

Groves, C., Hillam, J., 1997. Tree-ring analysis and dating of timbers, in: Hurst, J.D. (Ed.), A Multi-Period Salt Production Site at Droitwich: Excavations at Upwich, CBA Res Rep 107. London, pp.

121–126.

Howard, R.E., Laxton, R.R., Litton, C.D., 1996. Tree-ring analysis of timbers from Mercer's Hall, Mercer's Lane, Gloucester. Anc Mon Lab Rep 13/96.

Miles, D., Haddon-Reece, D., 1995. List 64 (III) - Tree-ring dates. Shropshire Dendrochronology Project - Phase 3. Vernac. Archit. 26, 68–72.

Miles, D.M., 1997. The interpretation, presentation and use of tree-ring dates. Vernac. Archit. 28, 40–56.

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

Nayling, N., 2000. Tree-ring analysis of timbers from the Old Hat Shop, 100 Church Street, Tewkesbury, Gloucestershire. Ancient Monuments Laboratory Report 68/2000.

Nayling, N., Bale, R., 2020. Tree-ring Analysis of the Berkeley Arms and Outbuilding, 8 Church Street, Tewkesbury, Newent, Gloucestershire. DendroArch Report GDP GLBA/5/20.

Tyers, I., 2004. Dendro for Windows programme guide, 3rd edn.

Tyers, I., Wilson, R., 2000. Tree-ring Analysis of Oak Timbers from 66 and 68 Westgate Street, Gloucester. Ancient Monuments Laboratory Report 19/2000.

Table 1. Details of samples taken and results of analysis

Sample Code	Description	Conversion	Dimensions (mm)	Total Rings	Sapwood	Average Ring Width (mm)	Date range	Felling date
OB01	Tiebeam south end	Whole	280 x 140	130	+15s	1.15	AD1298-AD1427	AD1442-68
OB02	Post west wall	Whole	250 x 140	197	+HS	0.99	AD1227-AD1423	AD1432-64
OB03	Post east wall inner	Whole	270 x 170	194	-	0.90	AD1218-AD1411	After AD1420
OB04	Wall plate west wall could not measure consistently	Whole	150 x 80	117	31	0.75	Undated	-
OB05	Post east wall	Whole	290 x 100	112	-	0.82	AD1303-AD1414	After AD1423
OB06	Tiebeam north gable	Whole	270 x 30	170	21+B	0.97	AD1289-AD1458	AD1458
OB07	Transverse beam ground floor south gable	Whole	290 x 130	126	+HS	1.03	AD1308-AD1433	AD1442-74
OB08	Post west wall	Whole	310 x 210	110	+HS	1.26	AD1308-AD1417	AD1426-58
OB09	Joist ground floor ceiling	Whole	230 x 140	59	12+Bw	1.98	Undated	-
OB10	Knee brace east wall	Whole	125 x 60	101	+HS	0.89	AD1327-AD1427	AD1436-68
OB11	Post south-west corner	Quartered	195 x 165	150	+?HS	0.98	Undated	-
OB12	Joist	Whole	210 x 120	142	25+B	0.77	AD1317-AD1458	AD1458

All samples were oak (*Quercus* spp.). +*n*s number of detached sapwood rings, +HS heartwood / sapwood boundary, +?HS possible heartwood / sapwood boundary, +B Bark edge, +Bw bark edge winter felled

Table 2. Correlations between cross-matched individual tree-ring series used to calculate the 241-year mean TWKES-OB

- = t-values less than 3.00. * = empty triangle

Filenames	OB02	OB03	OB05	OB06	OB07	OB08	OB10	OB12
OB01	4.40	3.76	-	-	3.73	4.39	3.33	3.74
OB02	*	4.68	-	4.14	5.69	4.97	3.05	3.38
OB03	*	*	5.64	-	3.89	6.65	4.69	4.67
OB05	*	*	*	-	-	3.12	3.65	-
OB06	*	*	*	*	4.24	3.85	-	3.97
OB07	*	*	*	*	*	8.01	3.94	3.93
OB08	*	*	*	*	*	*	5.51	6.02
OB10	*	*	*	*	*	*	*	-

Table 3. Correlations (CROS73 *t*-values) between 9-timber 241-year site master TWKES-OB dated to AD1218 to AD1458 inclusive and previously dated British site masters.

Tree -ring Site Master	-	-	**TWKES-OB**
	start	dates	AD1218
	dates	end	AD1458
66/68 Westgate St, Gloucester (Tyers and Wilson, 2000)	AD1209	AD1518	12.37
Hereford Cathedral Barn (Tyers pers. comm.)	AD1359	AD1491	8.92
TWKES-B1 Berkeley Arms Rear Range (Nayling and Bale, 2020)	AD1234	AD1438	8.89
New Inn House, Kingswood, Gloucestershire(Arnold et al., 2004)	AD1191	AD1519	8.22
Hightown 16-18/Booth Hall, Hereford (Boswijk and Tyers, 1997)	AD1302	AD1489	8.04
Bedstone Manor Farm, Hall and Solar, Shropshire (Miles and Haddon-Reece, 1995)	AD1341	AD1560	7.67
Mercers Hall, Gloucester (Howard et al., 1996)	AD1289	AD1541	7.34
Farmers Club, Widemarsh St, Hereford (Tyers pers. comm.)	AD1313	AD1617	7.21
Droitwich Upwich2, Herefordshire (Groves and Hillam, 1997)	AD946	AD1415	7.21
Old Hat Shop, Tewkesbury, Gloucestershire(Nayling, 2000)	AD1325	AD1458	7.11
Bowhill, Exeter, Devon (Groves, 2002)	AD1292	AD1468	7.11

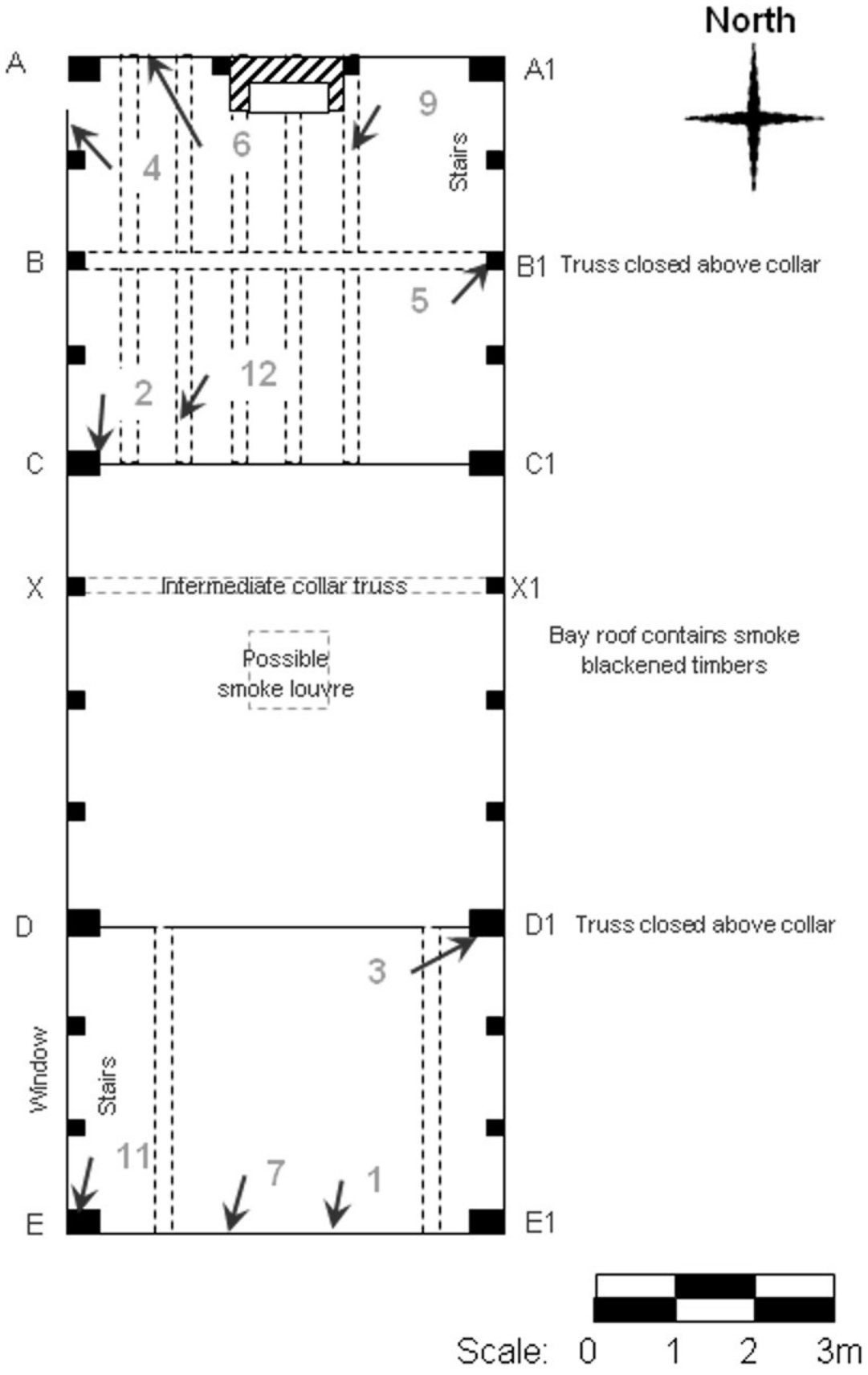

Figure 1. Plan of roof space at Old Baptist Chapel, Tewkesbury indicating location of dendrochronology samples

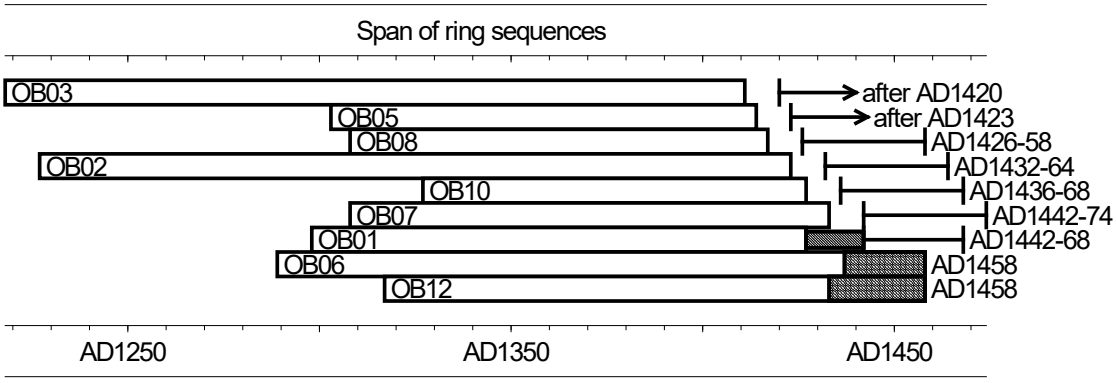

Figure 2. Bar diagram of dated samples

Figure 3. Photograph of sample location for OB01 (tiebeam in the south gable end) View towards the south.

Figure 4 Sample location of OB02 Post in west wall. View to the west.

Figure 5 Sample location of OB03. Post in east wall. View south.

Figure 6 Sample location of OB04. Post west wall. View north west.

Figure 7 Sample location of OB05. Post east wall. View north east.

Figure 8 Sample location for OB06. Tiebeam south gable end. View south.

Figure 9 Sample location of OB07. Transverse beam in north gable. View north.

Figure 10 Sample location of OB08. Post in west wall. View west.

Figure 11 Sample location of OB09. Joist. View west.

Figure 12 Sample location of OB10. Knee brace east wall. View east.

Figure 13 Sample location of OB11. Post SW corner gable. View south

Figure 14 Sample location of OB12. Joist. View north.

Appendix

Dated ring width data (0.01mm) in decadal format

Title : Old Baptist Chapel Tewkesbury 9 timber mean **TWKES-OB**

Timber mean Ring-width QUSP data of 241 years length

Dated AD1218 to AD1458

9 timbers raw data mean

Average ring width 95.80 Sensitivity 0.15

191	155	173	154	79	112	86	86	105	86	1	1	1	1	1	1	1	1	2
114	103	62	38	35	43	52	87	73	142	2	2	2	2	2	2	2	2	2
110	152	188	117	148	197	137	108	113	111	2	2	2	2	2	2	2	2	2
96	141	89	143	88	104	79	97	53	46	2	2	2	2	2	2	2	2	2
57	74	82	96	93	113	126	123	115	76	2	2	2	2	2	2	2	2	2
93	93	80	95	109	136	132	99	104	100	2	2	2	2	2	2	2	2	2
73	61	74	87	93	121	87	98	107	84	2	2	2	2	2	2	2	2	2
82	83	94	86	82	88	88	96	83	88	2	3	3	3	3	3	3	3	3
78	78	71	92	70	78	76	68	68	86	4	4	4	4	4	5	5	5	5
88	85	91	87	99	102	125	134	139	144	7	7	7	7	7	7	7	7	8
115	140	128	154	138	130	123	89	85	107	8	8	8	8	8	8	8	8	9
95	96	88	75	83	72	69	95	86	88	9	9	9	9	9	9	9	9	9
93	105	88	96	85	87	90	101	100	108	9	9	9	9	9	9	9	9	9
124	115	112	123	107	111	100	104	84	101	9	9	9	9	9	9	9	9	9
97	92	75	81	86	98	101	80	103	97	9	9	9	9	9	9	9	9	9
75	120	109	106	102	95	111	100	95	106	9	9	9	9	9	9	9	9	9
85	116	105	83	97	93	107	92	105	87	9	9	9	9	9	9	9	9	9

84	87	85	102	82	78	83	76	94	92	9	9	9	9	9	9	9	9	9
90	110	118	109	86	116	101	95	88	84	9	9	9	9	9	9	9	9	9
93	123	102	94	98	78	92	95	92	84	9	9	9	9	8	8	8	7	7	7
80	65	92	101	88	101	94	92	78	88	6	6	6	6	6	6	5	5	5	5
130	93	83	85	80	69	63	88	63	64	3	3	3	3	3	3	2	2	2	2
53	48	73	63	62	88	76	95	90	76	2	2	2	2	2	2	2	2	2	2
79	70	83	86	86	90	98	80	98	91	2	2	2	2	2	2	2	2	2	2
104										2									