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TREE-RING ANALYSIS OF OAK TIMBERS FROM FURNESS ABBEY PARK COTTAGE, BARROW-IN-FURNESS, CUMBRIA.

Cathy Groves

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Summary

Samples of ten oak timbers from Furness Abbey Park Cottage, near Barrow-in-Furness, were taken for tree-ring analysis. The ring sequence of one timber was dated to AD1355-1436. This timber was felled after circa 1450 but probably before 1495.

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Introduction

A survey of a cottage in the grounds of Furness Abbey was undertaken by the Cumbria and Lancashire Archaeological Unit for English Heritage. The style of architecture suggested a fifteenth/sixteenth century date for the construction of the cottage. In May 1989 samples were taken from ten oak (*Quercus* spp) timbers in the cottage (Table 1) for tree-ring analysis at the Sheffield Dendrochronology Laboratory. It was hoped that the analysis would provide a more precise date for the construction of the cottage.

Method

Seven timbers were sampled by the removal of a core. Cores are extracted using a corer (a hollow steel tube with one end serrated) attached to a Bosch power drill. This produces cores of approximately 9mm diameter. The remaining three timbers were sampled by the removal of a complete cross-sectional slice using a chain saw. The samples were prepared and measured following the method given by Hillam (1985).

The ring width data were transferred to an Atari 1040ST-F microcomputer via the Sheffield University Prime mainframe. The ring width data were plotted, using a graphing program on the mainframe (Okasha 1987), to facilitate visual comparison of the patterns. This process of crossmatching and dating is aided by the use of tree-ring software written for the Atari by Ian Tyers of the Museum of London. The crossmatching routines are based on two programs, CROS73 (Baillie & Pilcher 1973) and a revised version of CROS73 known as CROSS84 (Munro 1984). Both routines measure the amount of correlation between

two ring sequences at each position of overlap. The Student's t test is then used as a significance test on the correlation coefficient. The t values given in this report are identical to those produced by the original CROS73 program (Baillie & Pilcher 1973). Generally a t value of 3.5 or over represents a match provided that the visual match is acceptable (Baillie 1982: 82-85).

It is usual for curves from a single structure/site to be compared against each other, and a site master produced from any matching curves by taking an average of their ring widths. A master curve is more likely to produce a date than the ring sequence of a single sample when compared with dated reference chronologies. This is because the master curve enhances the common climatic signal but reduces the "background noise" resulting from the local growth conditions of individual trees. However if it is not possible to produce a master curve, ring sequences of over 49 years are compared directly with reference chronologies. Short ring sequences (ie less than 50 years) are unlikely to provide reliable absolute dates when compared directly to reference chronologies as their ring patterns may not be unique (Hillam *et al* 1987).

The tree-ring results only date the rings present in the timber and therefore do not necessarily represent the felling date. If the bark or bark edge is present on a sample, the exact felling year can be determined. A study of oak sapwood data indicated that 19 out of every 20 British oak trees had from 10 to 55 sapwood rings (Hillam *et al* 1987). These 95% confidence limits are used to estimate felling dates in the absence of complete sapwood. In the total absence of sapwood the addition of the minimum sapwood allowance (10 rings) to the date of the last measured heartwood ring produces a *terminus post quem* for felling.

Results

Samples 4 and 5, both cores, were rejected before measurement as they had broken whilst being extracted. The remaining eight samples contained 34 to 145 annual rings (Table 2). Sample 2, a slice from a rafter, had retained its full complement of sapwood and was felled during late spring or early summer. With the exception of 9, all timbers from which cores were removed had some sapwood. However this was lost during the extraction of the cores and is a common problem. The outermost heartwood ring on each core was therefore known to be either the sapwood boundary itself or within a few rings of this boundary.

No reliable crossmatching was obtained between the ring patterns of the eight timbers. Three samples (1, 2, 6) were then compared with reference chronologies from Britain and Europe. The remaining five samples (3, 7, 8, 9, 10) were rejected as their ring sequences are less than 50 years (see above). High t values were found for 6 (Table 3) when its ring sequence spanned the period AD1355-1436 (Table 4). Sample 6 matches particularly well with reference chronologies from southern England (Bridge 1988), Dublin (Baillie 1977) and western England/Wales (Siebenlist-Kerner 1978) when it spans the period AD1355-1436. No consistent dating was produced by 1 but a tentative mid/late fifteenth century date was indicated for 2, although this cannot yet be confirmed.

The sapwood and possibly a small number of the outermost heartwood rings on timber 6, an upper purlin, were lost during coring. The outermost measured ring dates to AD1436 and, using the 10-55 sapwood estimate and allowing for a small number of heartwood rings to be missing, a felling date range of *circa* AD1450-1495 is obtained. The tentative date obtained for 2 would give a

felling date consistent with this. Seasoning of timber is thought to be a relatively modern phenomena (Rackham 1976) so timbers would probably be used shortly after felling. Assuming that timber 6 is primary, the probable construction date for this section of the cottage roof is also *circa* AD1450-95.

Conclusion

Only one (6) of the ten timbers sampled from the Furness Abbey Park Cottage was dated. This is probably due to the shortness of the ring patterns, the lack of internal crossmatching and the few reference chronologies available for this area. Dendrochronological analysis indicates a probable construction date for the roof during the latter half of the fifteenth century. This is compatible with the date suggested by the architectural style.

This date is based on a single timber and therefore may be refined if additional timbers could be obtained for tree-ring analysis. The analysis of further timbers may also allow the construction of a site master chronology. There are few reference chronologies available for this region and therefore a site master curve from the cottage may greatly aid the dating by tree-ring analysis of further standing buildings from this area of the country.

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References

Baillie MGL 1977a The Belfast oak chronology to AD1001, *Tree Ring Bulletin* 37, 1-12.

Baillie MGL 1977b Dublin Medieval Dendrochronology, *Tree Ring Bulletin* 37, 13-20.

Baillie MGL 1977c An oak chronology for south central Scotland, *Tree Ring Bulletin* 37, 33-44.

Baillie MGL 1982 *Tree-Ring Dating and Archaeology*, London: Croom Helm.

Baillie MGL & Pilcher JR 1973 A simple crossdating program for tree-ring research, *Tree Ring Bulletin* 33, 7-14.

Bridge MC 1988 The dendrochronological dating of buildings in southern England, *Medieval Archaeology* 32, 166-74.

Hillam J 1985 Theoretical and applied dendrochronology - how to make a date with a tree. In P Phillips (ed), *The Archaeologist and the Laboratory*, CBA Research Report number 58, 17-23.

Hillam J, Morgan RA & Tyers I 1987 Sapwood estimates and the dating of short ring sequences. In RGW Ward (ed), *Applications of tree-ring studies: current research in dendrochronology and related areas*, BAR S333, 165-85.

Laxton RR & Litton CD 1988 *An East Midlands master tree-ring chronology and its use for dating vernacular buildings*. University of Nottingham, Dept of Classical & Archaeological Studies, Monograph Series III.

Munro MAR 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin* 44, 17-27.

Okasha MKM 1987 *Statistical methods in dendrochronology*. PhD thesis, Sheffield University.

Rackham O 1976 *Trees and woodland in the British Landscape*. Dent: London.

Siebenlist-Kerner V 1978 The chronology, 1341-1636, for certain hillside oaks from Western England and Wales. In JM Fletcher (ed), *Dendrochronology in Europe*, BAR S51, 157-61.

Table 1: Function and location of timbers sampled according to plans available during extraction of samples.

sample number	function/location
1	west truss-tie-beam, north side
2	bay two-common rafter, south side (west)
3	bay two-common rafter, south side (east)
4	west truss-principal rafter, south side
5	west truss-principal rafter, north side
6	bay two-upper purlin, north side
7	bay one-lower purlin, south side
8	east truss-principal rafter, north side
9	bay one-upper purlin, south side
10	bay one-upper purlin, north side

Table 2: Details of the samples. All timbers except 9 had sapwood but this was lost on the cores during extraction.

sample number	total number of rings	sapwood rings	mean ring width (mm)	type of sample	comments
1	145	-	0.76	core	close sapwood boundary
2	68	22	1.40	slice	felled summer
3	34	-	1.84	slice	close sapwood boundary
4	-	-	-	core	badly broken
5	-	-	-	core	badly broken
6	82	-	1.58	core	close sapwood boundary
7	49	12	2.65	slice	-
8	49	-	2.11	core	sapwood boundary
9	44	-	2.99	core	knotty
10	41	-	2.87	core	close sapwood boundary

Table 3: Ring width data, in units of 0.02mm, of sample 6.

year	ring widths									
AD1355					139	67	99	172	135	94
	92	82	121	118	115	111	103	70	96	84
	114	166	101	92	81	64	36	35	49	60
	65	58	56	84	75	117	104	65	52	63
	101	64	86	67	75	69	58	62	59	92
AD1401	56	48	84	82	86	130	83	94	87	86
	89	91	81	114	90	73	107	103	63	75
	102	71	114	87	47	33	27	27	27	28
	32	40	40	51	51	61				

Table 4: Results of comparisons between sample 6 (AD1355-1436) and reference chronologies; * indicates non-independent chronology.

reference chronology	t value
Belfast (Baillie 1977a)	4.0
*Britain (Baillie & Pilcher pers comm)	5.3
Dublin (Baillie 1977b)	4.4
East Midlands (Laxton & Litton 1988)	3.5
*England (Baillie & Pilcher pers comm)	4.7
Minehead (Hillam pers comm)	3.0
Oxford (Haddon-Reece pers comm)	3.3
Scotland (Baillie 1977c)	3.9
Southern England (Bridge 1988)	5.3
Welsh border (Siebenlist-Kerner 1978)	4.4
Yorkshire buildings (Hillam pers comm)	3.7