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**Tree-Ring Analysis of Oak Timbers from Syningthwaite
Priory, Bilton in Ainsty, North Yorkshire**

Ian Tyers

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Tree-Ring Analysis of Oak Timbers from Syningthwaite Priory, Bilton in Ainsty, North Yorkshire

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Summary

A tree-ring dating programme was commissioned on timbers from the roof, two ceilings, some lintels and sills, and an internal partition in Syningthwaite Priory, Bilton in Ainsty, North Yorkshire, by English Heritage in AD 2003. The tree-ring analyses have produced later-sixteenth century dates for two tiebeams in the roof but no other dating evidence.

Keywords

Dendrochronology
Standing Building

Author's address

Sheffield Dendrochronology Laboratory, Archaeology & Archaeological Science Research School,
Department of Archaeology & Prehistory, University of Sheffield, West Court, 2 Mappin Street,
Sheffield S1 4DT. Telephone : 0114 2225107. Email : i.tyers@sheffield.ac.uk

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from Syningthwaite Priory, Bilton in Ainsty, North Yorkshire (NGR SE 462 487). It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. Elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication, or an archive deposition, on the building.

Syningthwaite Priory is c 15km west of York and c 5km east of Wetherby (Fig 1). The site stands in the Vale of York between the rivers Nidd and Wharfe (Fig 2). Historically Syningthwaite was extra-parochial and was in the area primarily south and west of York known as the wapentake of the Ainsty, which was not formally part of any of the Yorkshire Ridings, the Ainsty is usually treated with West Riding after c AD 1900 by which time the wapentakes were redundant. Syningthwaite along with the rest of the Ainsty is covered in the West Riding of Yorkshire volume of the Buildings of England series (Pevsner and Radcliffe 1967). In current administrative terms the site is in North Yorkshire and part of the parish of Bilton in Ainsty with Bickerton.

Syningthwaite Priory was founded c AD 1160 for Cistercian Nuns, and surrendered to the crown c AD 1534/5 just before the Dissolution. The surviving priory building that is the subject of this report now stands in the middle of a large potato farm. This complex structure includes elements probably dating from the 12th, 15th, 16th, and 19th centuries. It consists of a single east-west aligned block (Figs 3-5) with a 19th century range forming the western part. The north and south walls include earlier medieval arches and a doorway arch, along with Tudor windows, and there is a similar range of decorative details internally. The surviving building is of uncertain original function. Pevsner considers it to be part of the cloister, with a gateway to the refectory, while the list description suggests it may be the Prioress' Lodging or a refectory. The building is listed Grade 1, and is on the Buildings-at-Risk register Grade C. Tree-ring analysis of timbers throughout the structure was commissioned by Giles Proctor, the local English Heritage Historic Buildings Inspector to assist with a recording program being undertaken by English Heritage on this important structure.

Methodology

The general methodology and working practises used at the Sheffield Dendrochronology Laboratory are described in English Heritage (1998). The methodology used for this building was as follows.

The building was initially visited in company with Adam Menuge, Architectural Investigator from English Heritage (York), and an assessment of the

dendrochronological potential of timbers throughout the structure was undertaken. This assessment aimed to identify whether oak timbers with sufficient numbers of rings for analysis existed in any part of the structure. This assessment identified that several discreet groups of timbers contained suitable material. The timbers were sampled during a subsequent visit.

The timbers selected for analysis were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken as closely as possible along the radius of the timbers so that the maximum number of rings could be obtained for subsequent analysis. The core holes were filled with oak plugs. The ring sequences in the cores were revealed by sanding.

The complete sequences of growth rings in the usable cores were measured to an accuracy of 0.01mm using a micro-computer based travelling stage (Tyers 2004). The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition a cross-correlation algorithm (Baillie and Pilcher 1973) was employed to search for positions where the ring sequences were highly correlated. These positions were checked visually using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below 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 these positions are supported by satisfactory visual matching.

The sequences obtained from the suitable cores were compared with each other and any found to cross-match were combined to form site master curves. These, and any remaining unmatched ring sequences, were tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem* (*tpq*) for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which are missing. This *tpq* may be many decades prior to the felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have

been present. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 46 annual rings, where these figures indicate the 95% confidence limits of the range (Tyers 1998a). These figures are applicable to oaks from England and Wales. Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the re-use of timbers, seasoning, and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

Twenty-six timbers were selected for sampling from the structure. These samples were numbered 1-26 (Table 1; Figs 3-5). All of these timbers are oak (*Quercus* spp.).

Eight of the samples were found to be unsuitable for analysis either because of their fragmentation or because they contained series of irresolvable bands of narrow rings. The tree-ring series from the remaining 20 timbers were measured and the resultant series were then compared with each other. Two pairs of samples and a group of three samples were found to match together in each case to form a single group (Tables 2-4). A mean chronology was calculated from each of these groups. These chronologies and the unmatched series were then compared with dated reference chronologies from throughout the British Isles and northern Europe. A single well-correlated position was identified for one of the composite sequences. Table 5 shows example correlations at its identified dating position against independent reference chronologies. Table 1 provides the chronological dates identified for both component samples of this sequence by this process and their interpretation. Figure 6 shows the chronological position identified for each component sample. Appendix 1 lists the individual sample series. The other three composite groups and the remaining individual series failed to match reference data and remain undated by the analysis reported here.

Interpretation and discussion

The 77-year chronology SP5/6 is dated AD 1464 to AD 1540 inclusive. It was created from two of the sampled timbers. Neither of the datable samples are complete to the original bark surface and none retain sapwood, although both are complete to the heartwood/sapwood boundary. Adding the minimum and maximum expected number of sapwood rings to the date of the heartwood/sapwood boundary on these samples, and hence assuming that they are contemporaneous, suggests they were felled between AD 1552 and AD 1586 (Fig 6; Table 1). These dated timbers are both tiebeams in the roof.

No samples taken from the collars, purlins, and rafters of the roof are dated and it seems possible that there is material of a variety of dates within the present roof structure. The samples obtained from other elements of the structure have also failed to provide dating evidence. The sampled timbers in Syningthwaite are generally somewhat short lived and fairly fast grown, both characteristics which tend to produce highly localised sequences.

Conclusion

Assuming the timbers were felled for immediate usage, which was normal practice in this period (Charles and Charles 1995), then at least two of the tiebeams, though not necessarily any other component of the roof, dates from the second half of the sixteenth century.

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Giles Proctor and Peter Marshall from English Heritage put together the request documentation. Cathy Groves provided useful discussion of the results. Mr D and Mr M Rawlings kindly provided access to the building for the initial assessment, and during the sampling of the roof, Derek Hamilton kindly assisted with the scaffolding and generator. Adam Menuge kindly supplied the diagrams used as the basis for Figures 3, 4, and 5.

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Figure 1 Location of Syningthwaite Priory, North Yorkshire,



Figure 2 Location of Syningthwaite Priory, Bilton in Ainsty, North Yorkshire

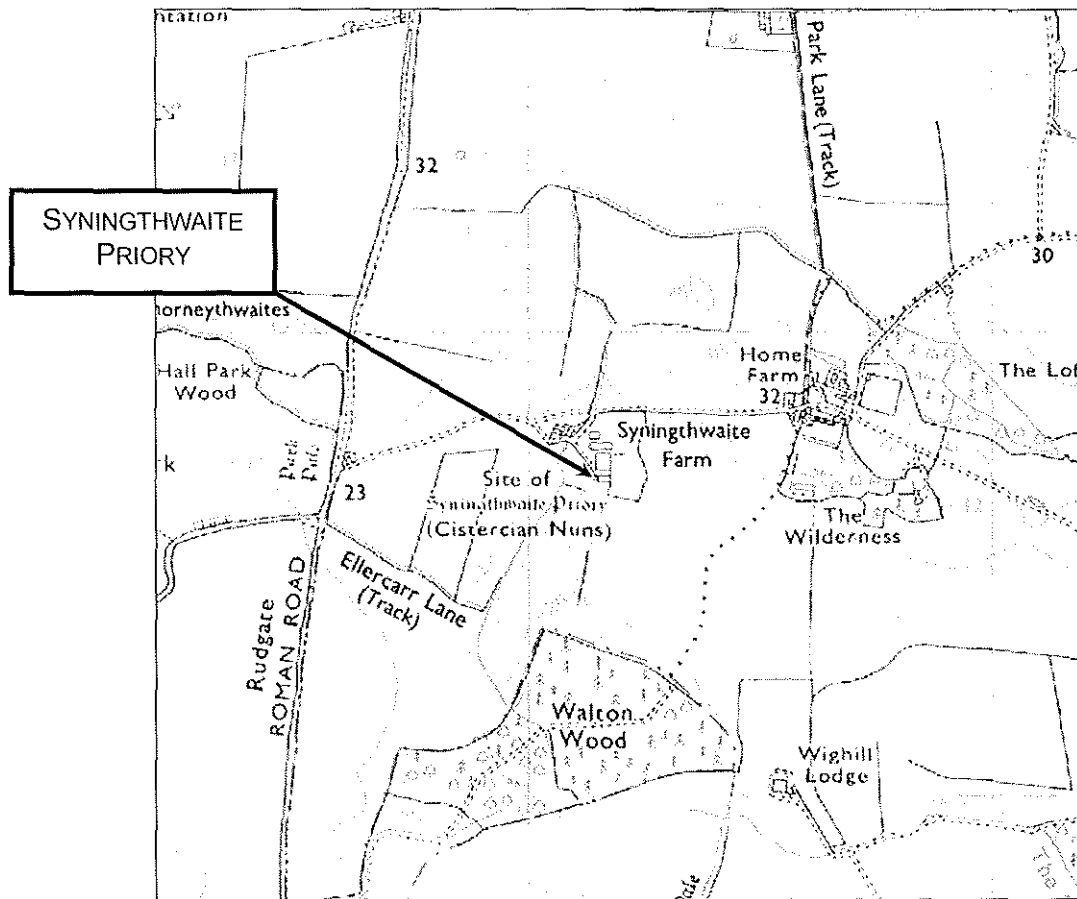


Figure 3 Roof plan of Syningthwaite Priory, Bilton in Ainsty, North Yorkshire showing the truss numbering scheme used in this report. The labelled arrows indicate the approximate locations of the sampled timbers and the direction of the cores (based on a plan by Adam Menuge supplied by English Heritage). The roof arrangement in the western block is not included on this figure.

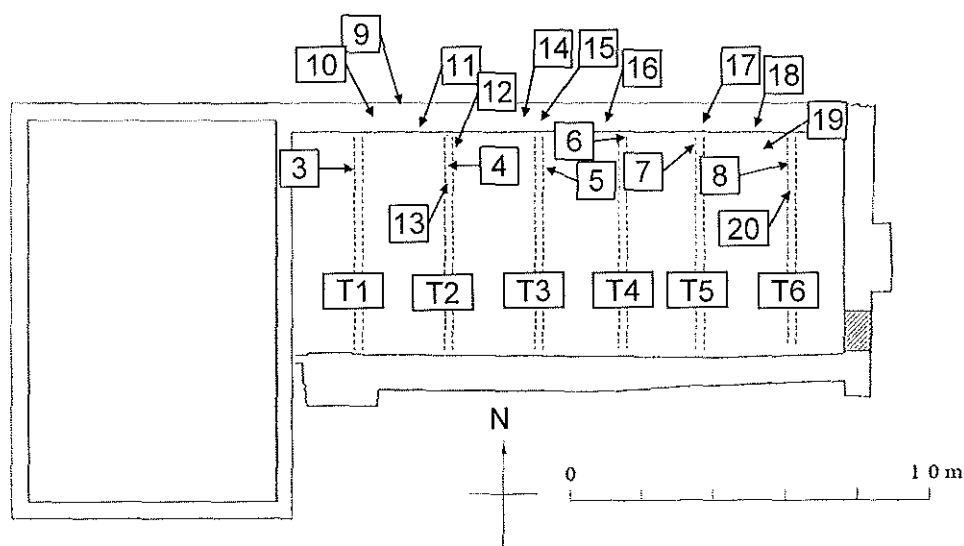


Figure 4 First floor plan of Syningthwaite Priory, Bilton in Ainsty, North Yorkshire showing the approximate locations of the sampled timbers and the direction of the cores (based on a plan by Adam Menuge supplied by English Heritage)

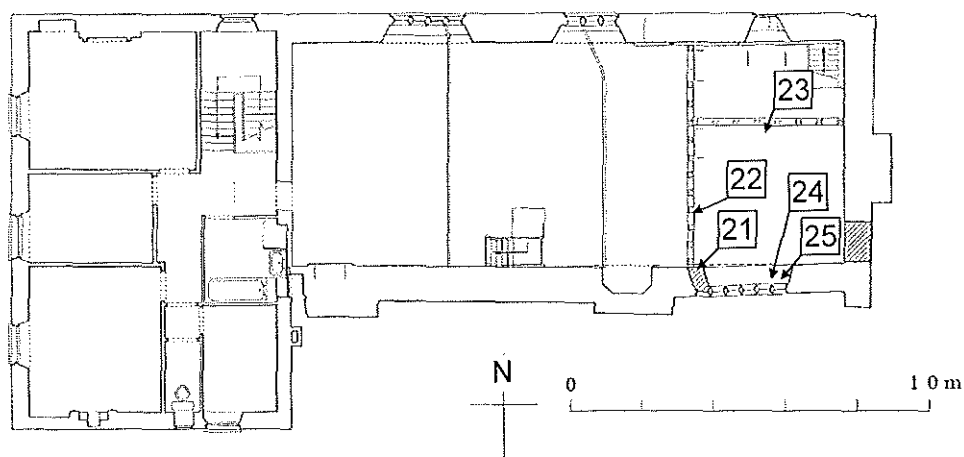


Figure 5 Ground floor plan of Syningthwaite Priory, Bilton in Ainsty, North Yorkshire showing the approximate locations of the sampled timbers and the direction of the cores (based on a plan by Adam Menuge supplied by English Heritage)

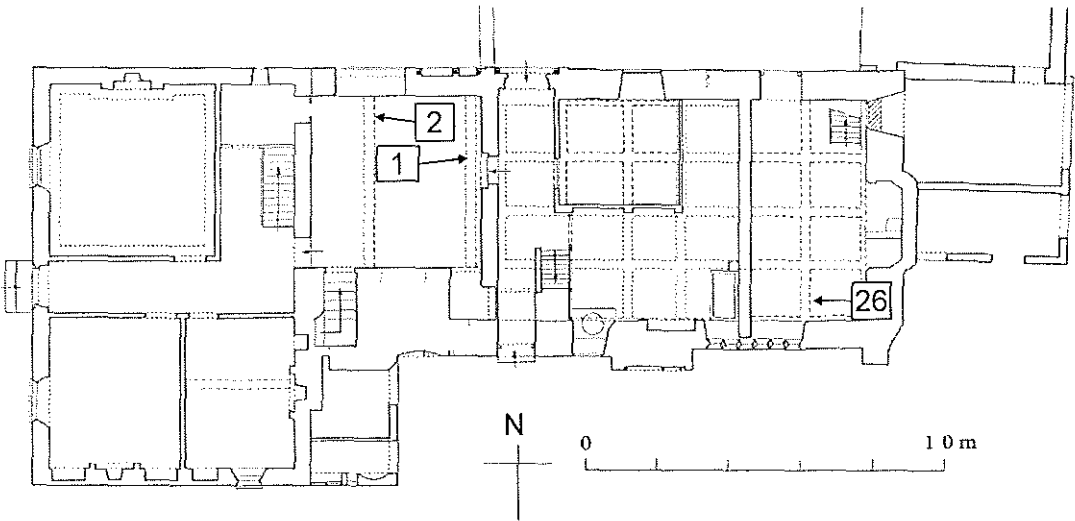
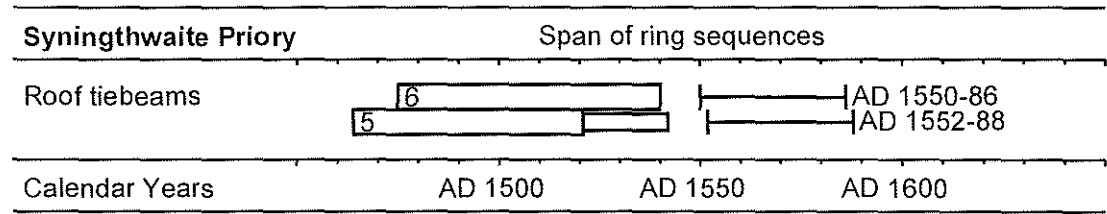


Figure 6 Bar diagram showing the chronological positions of the dated timbers from Syningthwaite Priory, Bilton in Ainsty, North Yorkshire. The narrow bar indicates unmeasured rings. The estimated felling period for each sequence is also shown



KEY for figure 6


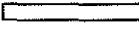
	heartwood
	unmeasured heartwood

Table 1a The samples from the roof of Syningthwaite Priory, Bilton in Ainsty, North Yorkshire

Ref	Origin of core	Cross-section size (mm)	Total rings	Sapwood rings	ARW (mm/year)	Date of sequence	Felling period
3	T1 tiebeam	350 x 220	67	9	2.88	undated	-
4	T2 tiebeam	320 x 220	-	-	-	unmeasured	-
5	T3 tiebeam	320 x 220	58+21	H/S	2.36	AD1464-AD1521	AD1552-88
6	T4 tiebeam	300 x 210	66	H/S	2.08	AD1475-AD1540	AD1550-86
7	T5 tiebeam	330 x 240	-	-	-	unmeasured	-
8	T6 tiebeam	300 x 230	-	-	-	unmeasured	-
9	N rafter T1-T2	125 x 90	-	-	-	unmeasured	-
10	N rafter T1-T2	130 x 80	-	-	-	unmeasured	-
11	N lower purlin T1-T2	160 x 135	119	11+15	1.09	undated	-
12	T2 N principal	310 x 110	51	H/S	3.84	undated	-
13	T2 collar	185 x 115	52	H/S	3.51	undated	-
14	N rafter T2-T3	120 x 110	101	H/S	1.08	undated	-
15	T3 N principal	310 x 100	-	-	-	unmeasured	-
16	N lower purlin T3-T4	175 x 125	74	H/S?	2.35	undated	-
17	T5 N principal	310 x 130	59	10	3.47	undated	-
18	N lower purlin T5-T6	130 x 130	108	8	1.18	undated	-
19	N upper purlin T5-T6	180 x 90	20+56	H/S	2.51	undated	-
20	T6 collar	350 x 110	62	H/S	3.71	undated	-

KEY for Table 1a See Figs 3 for truss numbers and sampling locations. N north, Total rings = measured rings, with values in italics indicating additional rings present in the samples that could not be measured. H/S heartwood/sapwood boundary, H/S? possible heartwood/sapwood boundary. ARW average ring width of the measured rings

Table 1b Samples from the ground floor kitchen ceiling, the first floor partitions and window, and the ceiling at the east end of the ground floor from Syningthwaite Priory, Bilton in Ainsty, North Yorkshire

Ref	Origin of core	Cross-section size (mm)	Total rings	Sapwood rings	ARW (mm/year)	Date of sequence	Felling period
1	Kitchen ceiling E beam	300 x 180	125	H/S	1.54	undated	-
2	Kitchen ceiling W beam	290 x 170	40+69	-	1.83	undated	-
21	N-S partition S end post	215 x 90	-	-	-	unmeasured	-
22	N-S partition mid rail	235 x 90	79	-	3.01	undated	-
23	E-W partition mid rail	235 x 95	85	-	2.78	undated	-
24	1st floor E S window sill	365 x 80	53	H/S?	1.92	undated	-
25	1st floor E S window lintel	embedded	-	-	-	unmeasured	-
26	G floor E central beam	250 x 200	81	-	1.84	undated	-

=

KEY for Table 1b See Figs 4 and 5 for sampling locations. S south, N north, E east, W west, Total rings = measured rings, with values in italics indicating additional rings present in the timbers that could not be accessed for measurement. H/S heartwood/sapwood boundary, H/S? possible heartwood/sapwood boundary. ARW average ring width of the measured rings

Table 2

t-value matrix for the timbers forming the chronology SP5/6

	6
5	5.54

Table 3

t-value matrix for the timbers forming the chronology SP11/14/18

	14	18
11	7.10	8.02
14		5.07

Table 4

t-value matrix for the timbers forming the chronology SP22/23

	23
22	5.13

Table 5

Dating the mean sequence SP5/6, AD 1464-1540 inclusive. Example *t*-values with independent reference chronologies

Reference chronology	<i>t</i>-value
Bedfordshire, Chicksands Priory (Howard <i>et al</i> 1998)	6.37
Cumbria, Sizergh Castle near Kendal (Tyers 1999)	4.56
Essex, Gosfield Hall nr Halstead (Bridge 1998)	5.60
Norfolk, Abbey Farm Barn Thetford (Groves and Hillam 1993)	5.25
Nottinghamshire etc, East Midlands region (Laxton and Litton 1988)	5.94
Staffordshire, Sinai Park nr Burton (Tyers 1997)	5.27
Yorkshire, Clumpcliff Farm Rothwell (Howard pers comm)	7.07
Yorkshire, Markenfield Hall Ripon (Howard <i>et al</i> 2002)	4.46
Yorkshire, Nostell Priory nr Wakefield (Tyers 1998b)	5.10
Yorkshire, Thorpe Prebend House Ripon (Boswijk 1998)	4.17