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ALL SAINTS' CHURCH, GAZELEY, SUFFOLK TREE-RING ANALYSIS OF TIMBERS FROM THE ROOF OF THE SOUTH AISLE

SCIENTIFIC DATING REPORT

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Tree-Ring Analysis of Timbers from the Roof of the South Aisle, All Saints' Church, Gazeley, Suffolk

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Summary

Sampling was curtailed at this site after only six timbers had been cored, as the remaining timbers were judged to be from faster-grown trees than those sampled, and the cores taken had yielded relatively short sequences. Nevertheless, three sequences, all from the west end of the roof, did cross-match, and a 92-year long site sequence was dated to the period AD 1312–1403. Only one timber retained sapwood, giving a likely felling date of AD 1371–1403, whilst a second timber retained the heartwood-sapwood boundary, giving a likely felling date range of AD 1412–44. Clearly, these two timbers give two non-overlapping felling date ranges, but with the third timber sequence also ending in the late fourteenth century, an early fifteenth-century date for the roof is suggested, but cannot be conclusively proven due to the lack of dating evidence from the centre and eastern end of the roof.

Keywords

Dendrochronology
Standing Building

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Introduction

This building (NGR TL 71932 64164; Fig 1) is a grade I-listed parish church, substantially dating from the early fourteenth century, but apparently re-roofed in the fifteenth century.

The date of construction of the south aisle roof is uncertain, and it is likely to date either to the original construction, or to the possible raising/rebuilding of the aisle walls in the late fifteenth century. At the time of this investigation this roof was undergoing grant-aided repairs, and dendrochronological study of this roof was requested by the Historic Building Architect, Trudi Hughes, to inform these repairs.

Figure 1: Map showing the location of All Saints' Church, Gazeley (central).

Methodology

The site was visited in April 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 (1999a). 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 with 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 may have been derived 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 (1997), in which 95% of oaks contain 9–41 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).

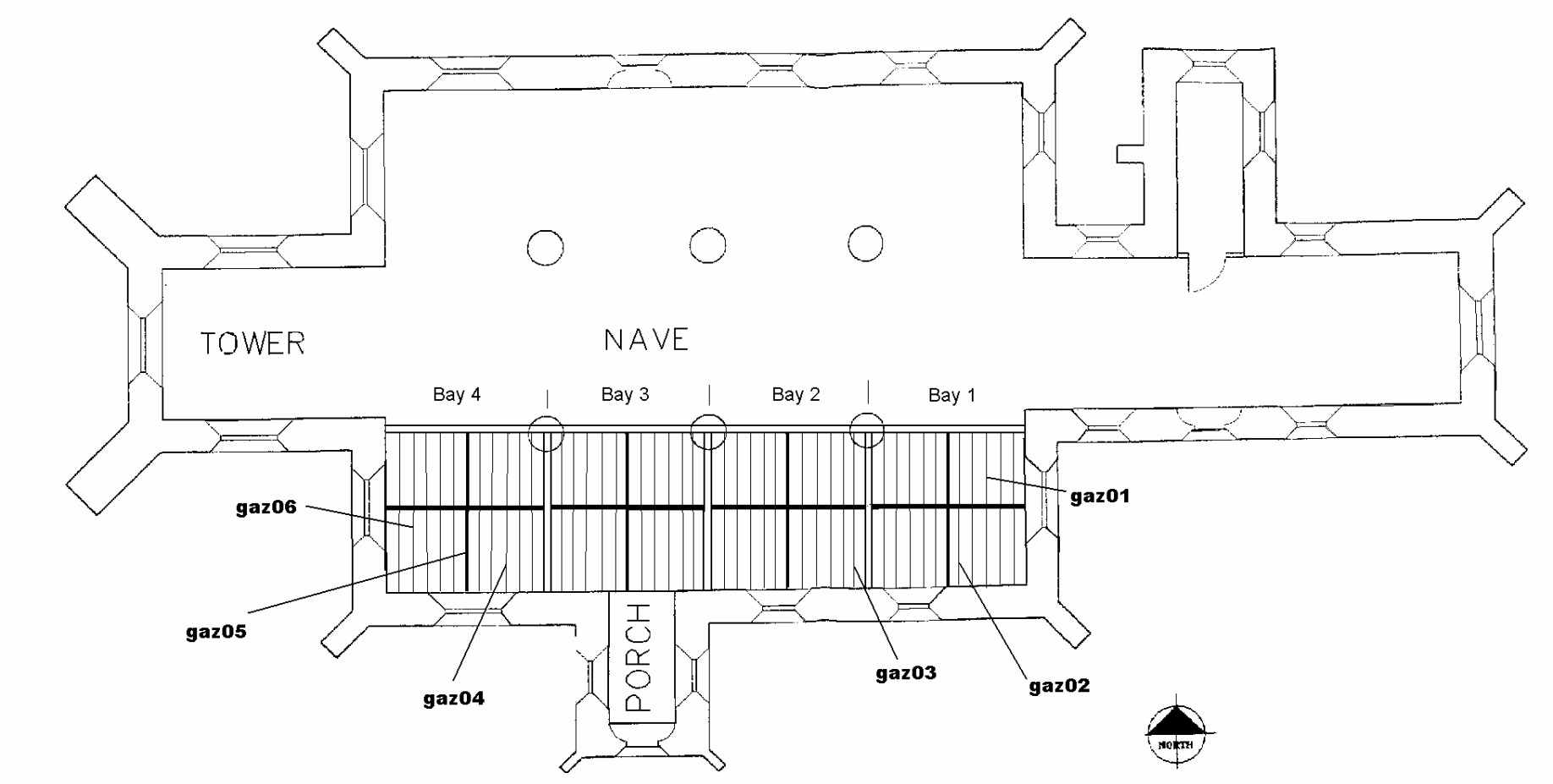

Figure 2: Plan of All Saints' Church, Gazeley, with added sketch of the roof of the south aisle, showing the approximate positions of timbers sampled for dendrochronology (based on a plan by The Whitworth Co-partnership)

Results

Most of the timbers inspected were judged to contain too few rings to sample, and it was noted that those timbers with sapwood remaining seemed to contain the fewest rings. Six timbers were sampled, however, five common rafters and an intermediate principal rafter; these timbers being judged as likely to contain the greatest number of rings. After finding the relatively disappointing sequences of fast-grown oak in these samples, the decision was made not to sample further.

Details of the positions of the timbers sampled are given in Table 1 and illustrated in Figure 2. Three series were found to cross-match (Table 2) and were combined into a 92-year site sequence, GAZELEY, which was dated to the period AD 1312–1403, the best results being shown in Table 3. The overlaps for gaz06 are rather short, and this sequence was also dated independently to confirm its date. The tree-ring data are given in Table 4. The relative positions of overlap of the dated timbers are shown, along with their likely felling date ranges, in Figure 3.

In addition, series gaz02 and gaz03 cross-matched (t = 6.8 with 60 years overlap). These series were therefore combined to make a new 95-year series, gaz0203m. This failed to match the site master, nor did it give any consistent matches against dated reference material, and it remains undated.

Interpretation and Discussion

The sample with the greatest number of rings (gaz03) was taken at an angle that resulted in the core crossing several medullary rays, and it is possible that one or more rings has been missed in the sequence, possibly explaining its failure to date. However, the good match with gaz02 suggests that the series was measured correctly, at least in the latter two thirds of the sequence.

Of the timbers sampled, gaz05 had eight rings of sapwood, and a likely felling date range of AD 1371–1403, whilst gaz06 retained the heartwood-sapwood boundary, and has a likely felling date range of AD 1412–44. These two timbers suggest that either there may be more than one phase of work represented in the roof that could not be distinguished at the time of sampling, or that some timbers used in construction had been stockpiled for some years. It is possible that some timbers were reused from an earlier roof, but no evidence for this was noted at the time of sampling. The third dated timber, with a sequence ending in AD 1380, though without positive identification of the heartwood-sapwood boundary, could belong to either potential felling phase.

The presence of sapwood on only the fastest-grown timbers may suggest a lack of suitably-sized trees needed for the construction of this roof. Despite the lack of suitable samples, and the different likely felling date ranges of the dated timbers, it is possible to suggest that the roof was most likely constructed in the early-fifteenth century, somewhat earlier than had been expected. It should be noted, however, that the few dated timbers all came from one end of the roof, and that different felling dates were found, which may suggest repairs, alterations etc, making it difficult to draw firm conclusions about the date of the whole roof. The dendrochronological evidence is inconsistent with the lack of evidence of reused timbers and the stylistic dating, but in situations where the tree-ring dating is more conclusive than it is at Gazeley, it may contradict other forms of evidence, disproving previous interpretations.

In retrospect, it may have been valuable to have sampled more timbers, even though the more promising ones had no sapwood, as this may have been able to show the range of dated timbers of the roof, though the chances of success were rather low. Further sampling of this roof and the other roofs, ie the nave and north aisle, may help to resolve the dating problem at this site.

Table 1: Details of oak (*Quercus* spp.) timbers sampled from the south aisle roof, All Saints' Church, Gazeley, Suffolk

Sample Number	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Dates AD Spanning	Sapwood complement	Felling seasons and dates/date ranges (AD)
gaz01	Bay 1, 3rd rafter from east end	48	1.92	0.22	undated	-	unknown
gaz02	Bay 1, 5th rafter from east end	60	1.07	0.20	undated	?h/s	unknown
gaz03	Bay 2, 1st rafter from east end	95	1.33	0.21	undated	-	unknown
gaz04	Bay 4, 3rd rafter from east end	60	1.71	0.20	1321–1380	-	after 1389
gaz05	Bay 4, intermediate principal rafter	59	2.10	0.24	1312–1370	8	1371–1403
gaz06	Bay 4, 9th rafter from east end	63	2.37	0.25	1341–1403	h/s	1412–44

?h/s = possible heartwood/sapwood boundary

Table 2: Cross-matching between the dated samples from Gazeley

	t- values	
Sample	gaz05	gaz06
gaz04	5.2	4.9
gaz05		4.1

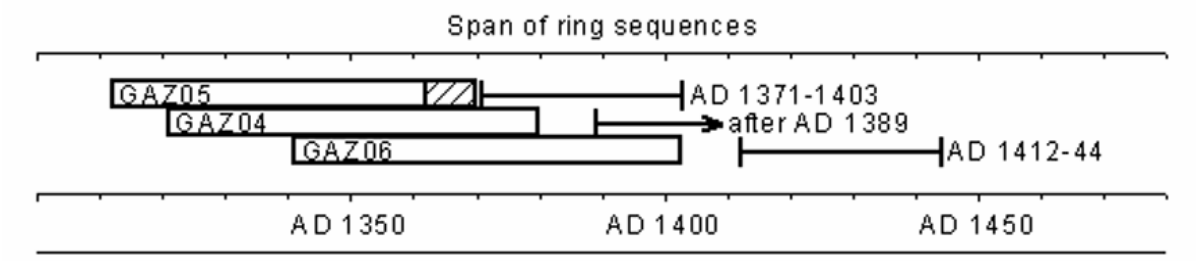

Figure 3: Bar diagram showing the relative positions of overlap of the dated timbers, along with their interpreted felling dates.

Table 3: Dating evidence for the site chronology **GAZELEY,** AD 1312–1403 (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*
Suffolk	Debenham Church *	(Bridge 2001)	DEBENHAM	1256–1388	77	7.8
Norfolk	Abbey Farm, Thetford	(Howard *et al* 2000)	THTASQ02	1237–1428	92	6.7
East Anglia	East Anglia Master Chronology	(Bridge 2003)	**ANGLIA03**	944–1789	92	6.1
Norfolk	Marriots Warehouse	(Tyers 1999b)	MARRIOTS	1310–1583	92	5.9
Southern England	Southern England Master	(Bridge 1998a)	**SENG98**	944–1790	92	5.5
Essex	Cressing Temple Barns	(Tyers and Hibberd 1993)	CRBCR3	1323–1410	81	5.0
Suffolk	Wingfield College *	(Bridge 1999a)	WNG0205M	1311–78	67	4.9
Hertfordshire	Clothall Bury Barn	(Arnold *et al* 2003)	CLBASQ01	1253–1367	56	4.9
Kent	Kent Master Chronology	(Laxton and Litton 1989)	**KENT88**	1158–1540	92	4.8
Essex	Kitchen, Little Braxted *	(Bridge 1999b)	BRAXTED	1314–93	80	4.7

* = component of ANGLIA03

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Table 4: Ring width data for the site chronology **GAZELEY**, AD 1312–1403

Ring widths (0.01mm)										no of trees									
257	319	322	310	230	139	125	231	283	246	1	1	1	1	1	1	1	1	1	2
180	136	86	98	76	141	215	235	174	148	2	2	2	2	2	2	2	2	2	2
108	122	193	257	232	253	204	209	185	285	2	2	2	2	2	2	2	2	2	3
330	269	195	271	274	249	166	132	172	232	3	3	3	3	3	3	3	3	3	3
201	210	185	235	251	257	137	152	172	149	3	3	3	3	3	3	3	3	3	3
224	287	233	225	191	149	185	212	207	183	3	3	3	3	3	3	3	3	3	2
243	173	194	191	226	204	225	207	226	338	2	2	2	2	2	2	2	2	2	1
378	207	133	241	245	350	321	279	165	152	1	1	1	1	1	1	1	1	1	1
120	85	172	222	193	141	167	217	202	243	1	1	1	1	1	1	1	1	1	1
142	177									1	1								