Oxford Dendrochronology Laboratory
Report 2017/01

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM HENDY GROES, LLANASA, HOLYWELL, FLINTSHIRE (SJ 109 816)

Summary

Timbers from the ground floor internal framing date to 1674, confirming the date found on a date-stone in the porch wall. The framing includes original ogee-headed doorways. Roof timbers were found to be too fast-grown, and were not sampled.

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BACKGROUND TO DENDROCHRONOLOGY

The basis of dendrochronological dating is that trees of the same species, growing at the same time, in similar habitats, produce similar ring-width patterns. These patterns of varying ring-widths are unique to the period of growth. Each tree naturally has its own pattern superimposed on the basic 'signal', resulting from genetic variations in the response to external stimuli, the changing competitive regime between trees, damage, disease, management etc.

In much of Britain the major influence on the growth of a species like oak is, however, the weather conditions experienced from season to season. By taking several contemporaneous samples from a building or other timber structure, it is often possible to cross-match the ring-width patterns, and by averaging the values for the sequences, maximise the common signal between trees. The resulting 'site chronology' may then be compared with existing 'master' or 'reference' chronologies. These include chronologies made by colleagues in other countries, most notably areas such as modern Poland, which have proved to be the source of many boards used in the construction of doors and chests, and for oil paintings before the widespread use of canvas.

This process can be done by a trained dendrochronologist using plots of the ring-widths and comparing them visually, which also serves as a check on measuring procedures. It is essentially a statistical process, and therefore requires sufficiently long sequences for one to be confident in the results. There is no defined minimum length of a tree-ring series that can be confidently cross-matched, but as a working hypothesis most dendrochronologists use series longer than at least fifty years.

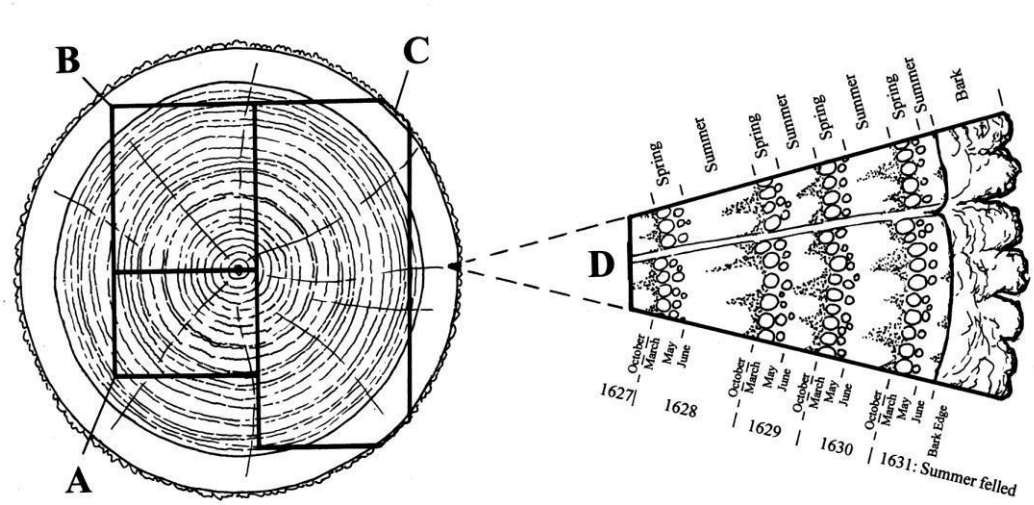
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation to the variation in the data, and is an established statistical technique for looking at the significance of matching between two datasets that has been adopted by dendrochronologists. The values of '*t*' which give an acceptable match have been the subject of some debate; originally values above 3.5 being regarded as acceptable (given at least 100 years of overlapping rings) but now 4.0 is often taken as the base value in oak studies. Higher values are usually found with matching pine sequences. It is possible for a random set of numbers to give an apparently acceptable statistical match against a single reference curve – although the visual analysis of plots of the two series usually shows the trained eye the reality of this match. When a series of ring-widths gives strong statistical matches in the same position against a number of independent chronologies the series becomes dated with an extremely high level of confidence.

One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence of unknown date to this reference material.

It follows from what has been stated above that the chances of matching a single sequence are not as great as for matching a tree-ring series derived from many individuals, since the process of aggregating individual series will remove variation unique to an individual tree, and reinforce the common signal resulting from widespread influences such as the weather. However, a single sequence can be successfully dated, particularly if it has a long ring sequence.

Growth characteristics vary over space and time, trees in south-eastern England generally growing comparatively quickly and with less year-to-year variation than in many other regions (Bridge, 1988). This means that even comparatively large timbers in this region often exhibit few annual rings and are less useful for dating by this technique.

When interpreting the information derived from the dating exercise it is important to take into account such factors as the presence or absence of sapwood on the sample(s), which indicates the outer margins of the tree. Where no sapwood is present it may not be possible to determine how much wood has been removed, and one can therefore only give a date after which the original tree must have been felled. Where the bark is still present on the timber, the year, and even the time of year of felling can be determined. In the case of incomplete sapwood, one can estimate the number of rings likely to have been on the timber by relating it to populations of living and historical timbers to give a statistically valid range of years within which the tree was felled. For this region the estimate used is that 95% of oaks will have a sapwood ring number in the range 11 – 41 (Miles 1997a).



Section of tree with conversion methods showing three types of sapwood retention resulting in **A** *terminus post quem*, **B** a felling date range, and **C** a precise felling date. Enlarged area **D** shows the outermost rings of the sapwood with growing seasons (Miles 1997, 42)

Hendy Groes

The two-storey rubble stone building consists of hall, pantry, cross-passage and parlour, with a rear wing that is thought to have been added soon after. A date-stone suggests a date of 1674. The framing at ground floor exhibits ogee headed doorways into the axial passage.

SAMPLING

Samples were taken in November 2016. The locations of the samples are described in Table 1, and shown in Fig 1. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **hgl**) and were polished with progressively finer grits down to 400 to allow the measurement of ring-widths to the nearest 0.01 mm. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer. Measurements and subsequent analysis were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

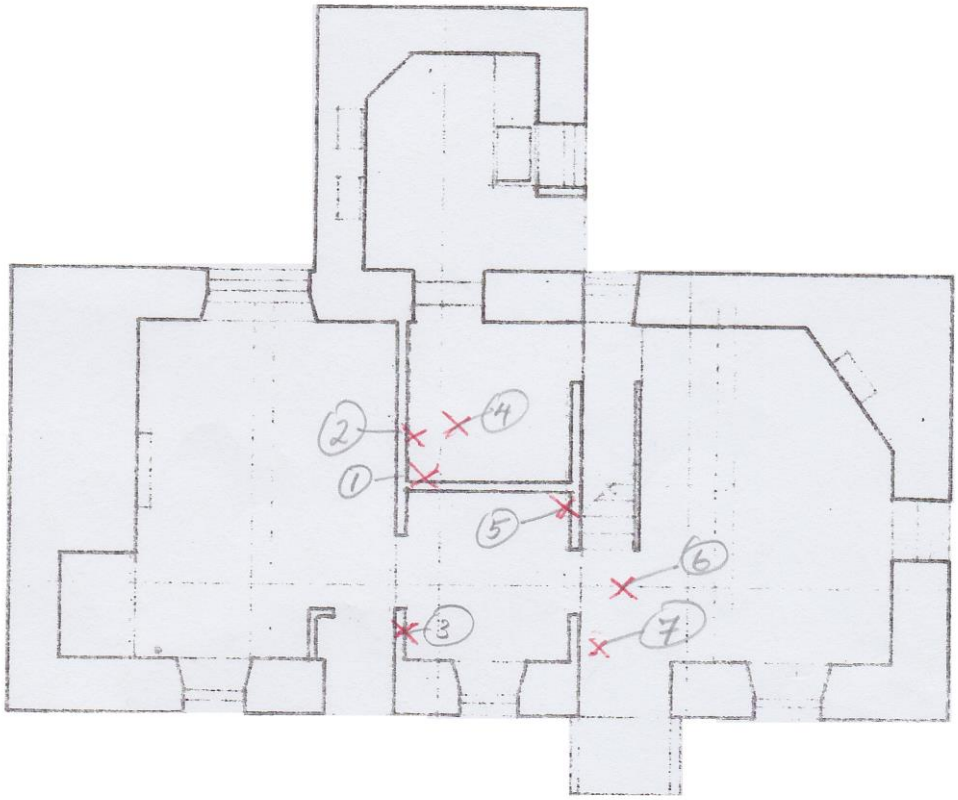


Figure 1: Ground floor plan of Hendy Groes, showing the approximate locations of the samples taken.

RESULTS AND DISCUSSION

Details of the samples are given in Table 1. Five of the timbers sampled were dated, the other two showing abrupt growth changes which do not look natural in origin (i.e. the trees had probably been managed in some way). Cross-matching between the series was highly variable (Table 2), reflecting the high frequency variation within the samples themselves. The mean series derived from the five dated timbers matches well with reference chronologies, mostly from English sites to the east and south, and less well with North Welsh sites, perhaps suggesting that the timber may have been brought in from elsewhere. The relative matching positions and interpreted/actual felling dates are shown in Fig 2. Two trees felled in 1674 agree well with the date-stone in the porch.

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Table 1: Details of samples taken from Hendy Groes, Llanasa.

Sample number	Timber and position	Date of series	H/S boundary date	Sapwood complement	No of rings	Mean width (mm)	Std devn (mm)	Mean sens	Felling date range
* **hgl01**	East door jamb in south partition	1581-1667	1644	23	87	1.37	0.82	0.19	1667–85
* **hgl02**	3rd stud from east, south partition	1584–1671	1641	30	88	1.18	0.66	0.17	1671–82
* **hgl03**	S transverse beam over partition	1590-1655	1639	16	66	1.74	0.59	0.22	1655–80
* **hgl04**	3rd joist from east, middle bay	1584–1673	1646	27¼C	90	1.11	0.50	0.18	Spring 1674
* **hgl05**	Middle transverse beam, S of stairs	1588–1673	1660	13½C	86	1.92	0.83	0.22	Summer 1674
hgl06	2nd joist from W, stair bay	-	-	7 (+9NM)	59	2.02	0.69	0.21	-
hgl07	1st joist from W, stair bay	-	-	10	84	1.58	1.20	0.25	-
* = included in site master **GROESFM**		**1581–1673**			**93**	**1.51**	**0.69**	**0.16**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, winter felled; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table 2: Cross-matching between the dated samples (*t*-values above 3.5 are significant)

Sample	hgl02	hgl03	hgl04	hgl05
hgl01	4.3	2.5	8.7	2.3
hgl02		2.4	5.7	0.8
hgl03			2.8	9.4
hgl04				2.5

Table 3: Dating evidence for the site chronology **GROESFM** **AD 1581–1673** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
England	Southern Central England	(Wilson *et al* 2012)	**SCENG**	663–2009	93	6.0
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	93	5.8
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	93	5.7
Site Chronologies						
Denbighshire	Nantclwyd House, Ruthin	(Miles *et al* 2005)	NHRE	1563–1662	82	6.5
Derbyshire	Bolsover Castle	(Arnold *et al* 2003)	BLSBSQ01	1532–1749	93	5.5
London	Breakspear House, Harefield	(Arnold and Howard 2010)	HFDBSQ01	1574–1694	93	5.5
Oxfordshire	Manor Farm, Stanton St John	(Miles and Worthington 1998)	STNSTJN3	1533–1637	57	5.5
Rutland	Oakham Castle	(Arnold and Howard 2013)	OKMCSQ03	1598–1737	76	5.3
Lincolnshire	Vicar's Close, Lincoln	(Hillam & Groves 1996)	LINCVC2	1578–1663	83	5.2
Oxfordshire	Old Clarendon Building, Oxford	(Worthington and Miles 2006)	CLRNDNOX	1539–1711	93	5.1
Gloucestershire	100 Church St, Tewkesbury	(Nayling 2000)	TEWKES2	1484–1664	84	5.0

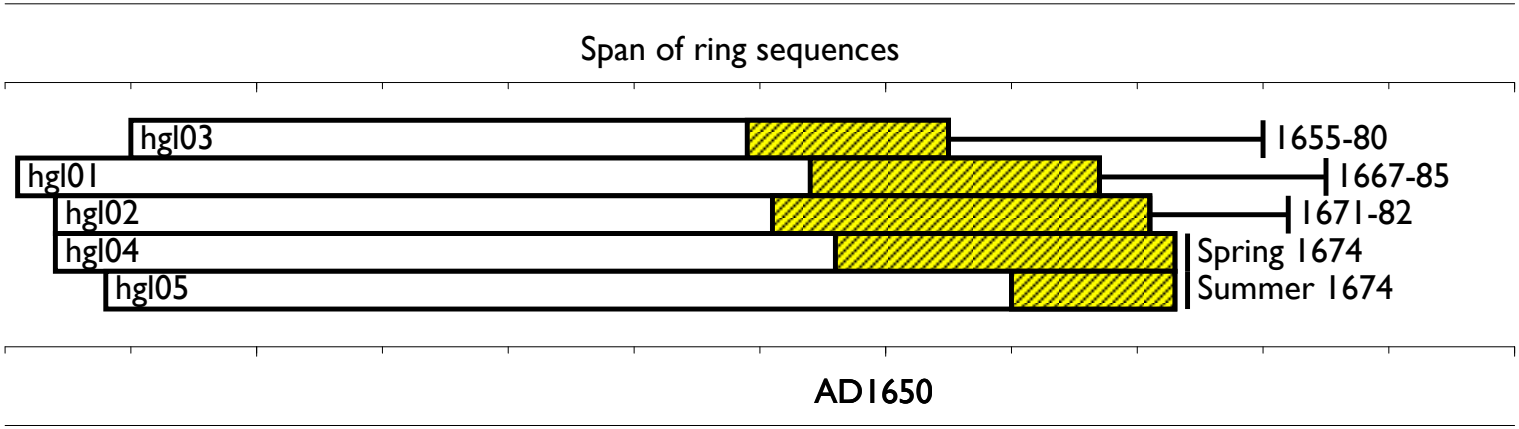

Figure 2: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.