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Oxford Dendrochronology Laboratory
Report 2011/**

**THE DENDROCHRONOLOGICAL
INVESTIGATION OF
CLOGWYN BACH,
PWLLELI
GWYNEDD
(NGR SH 377 360)**



Summary

Seven samples were taken from this building. Six samples all from the two main trusses all matched each other and produced a 91-year long site chronology. This however failed to match against a range of dated reference material, and for the present remains undated. A fireplace lintel was found to have many internal fractures, and a 79-year long sequence recovered also failed to date.

Author: Dr M. C. Bridge FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

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A report commissioned by The North West Wales Dendrochronology Project in partnership with The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

The Dendrochronological Investigation Of Clogwyn Bach, Pwllheli Gwynedd

(NGR SH 377 360)

SUMMARY

Seven samples were taken from this building. Six samples all from the two main trusses all matched each other and produced a 91-year long site chronology. This however failed to match against a range of dated reference material, and for the present remains undated. A fireplace lintel was found to have many internal fractures, and a 79-year long sequence recovered also failed to date.

CLOGWYN BACH

SAMPLING

Sampling took place in July 2011. All the samples were of oak (*Quercus* spp.). Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were numbered using the prefix cgb. The samples were removed for further preparation and analysis. Cores were mounted on wooden laths and then these were polished using progressively finer grits down to 400. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer allowing the measurement of ring widths to the nearest 0.01 mm using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004), which was also used for subsequent analysis, along with other programs written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker

Figure 1: Sketch-plan of Clogwyn Bach showing the approximate positions of timbers sampled

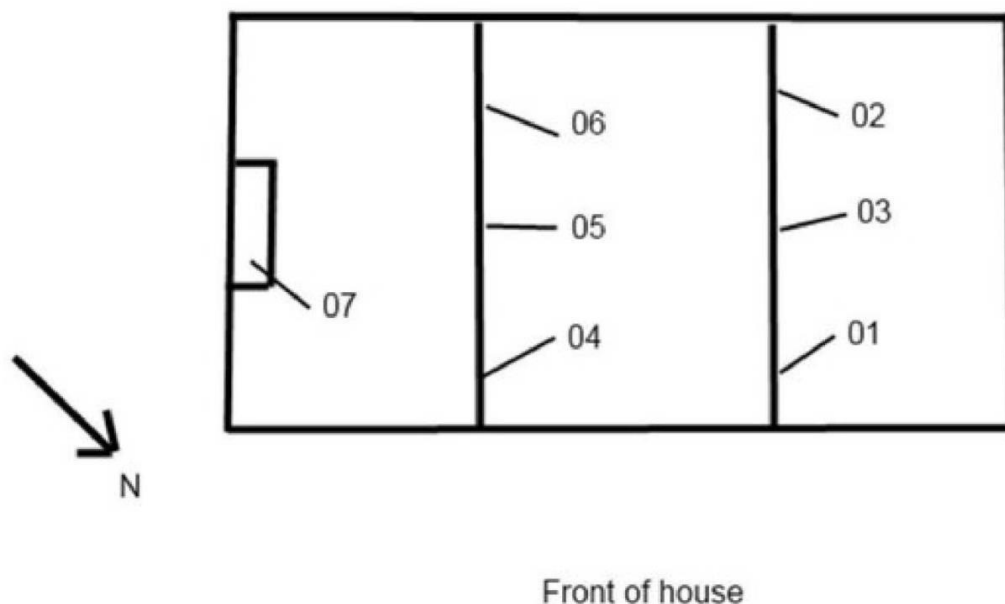


Table 1: Details of samples taken from Clogwyn Bach.

Sample number	Timber and position	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens	Felling date range (relative years)
* cgb01	East principal rafter, north truss	H/S +25NM	60	1.29	0.58	0.27	86-100
* cgb02	West principal rafter, north truss	H/S +26NM	55	1.84	0.61	0.24	86-100
* cgb03	Collar, north truss	31C	71	0.95	0.55	0.23	Winter 87/88
* cgb04	East principal rafter, south truss	H/S +32C NM	50	1.94	0.63	0.21	Winter 90/91
* cgb05	Collar, south truss	30C	75	1.21	0.62	0.19	Winter 91/92
* cgb06	West principal rafter, south truss	9	39	1.44	0.34	0.16	71-101
cgb07	Fireplace lintel, south end	-	79	0.87	0.46	0.21	-
* = included in Site Master CLOGWYN			91	1.32	0.71	0.18	-

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 roof samples

Sample	<i>t</i> -values				
	cgb02	cgb03	cgb04	cgb05	cgb06
cgb01	6.8	2.1	3.6	5.4	1.7
cgb02		2.2	2.7	5.4	2.4
cgb03			7.6	6.0	2.8
cgb04				6.0	4.2
cgb05					6.2



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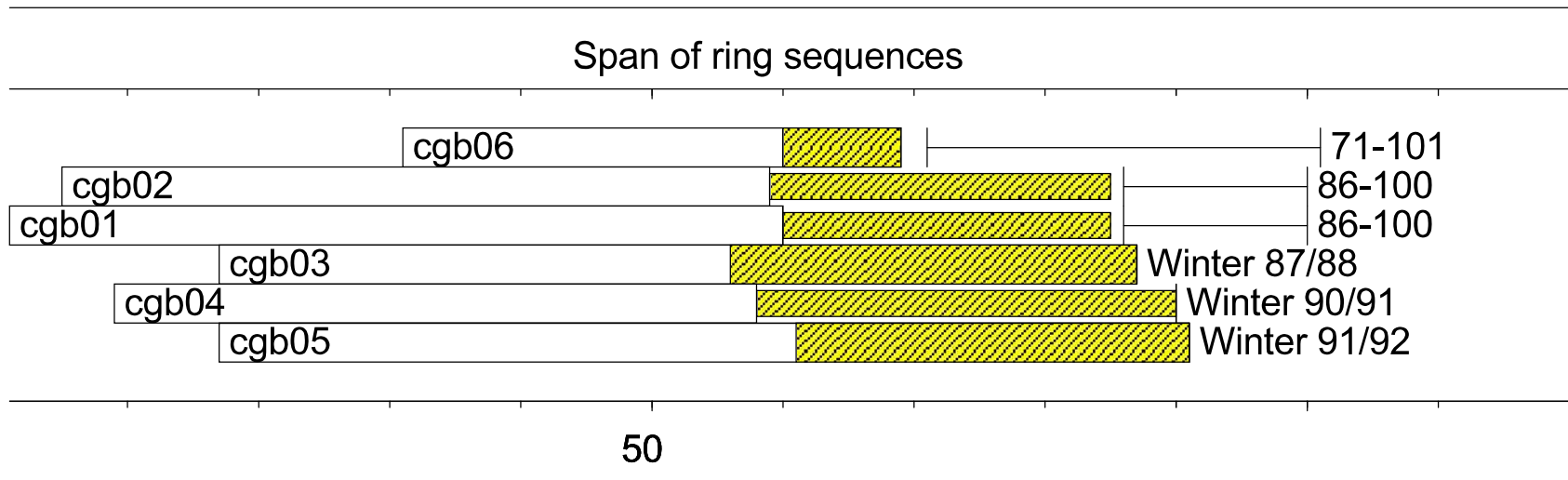


Figure 2: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

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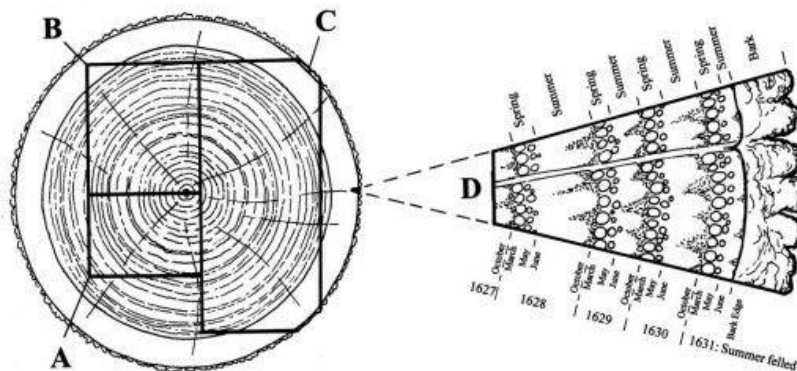
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BACKGROUND TO DENDROCHRONOLOGY

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 these sequences, maximise the common signal between trees. The resulting 'site Chronology' may then be compared with existing 'master' or 'reference' chronologies. 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 data sets 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. 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)



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