DYDDIO HEN DAI CYMREIG DATING OLD WELSH HOUSES

PROSIECT DENDROCRONOLEG GOGLEDD ORLLEWIN CYMRU

NORTH WEST WALES DENDROCHRONOLOGY PROJECT

Oxford Dendrochronology Laboratory
Report 2011/**

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

Draft as at 13/10/11

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.

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The Dendrochronological Investigation of Clogwyn Bach, Pwllehi, Gwynedd (NGR SH 377 360)

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.

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. 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

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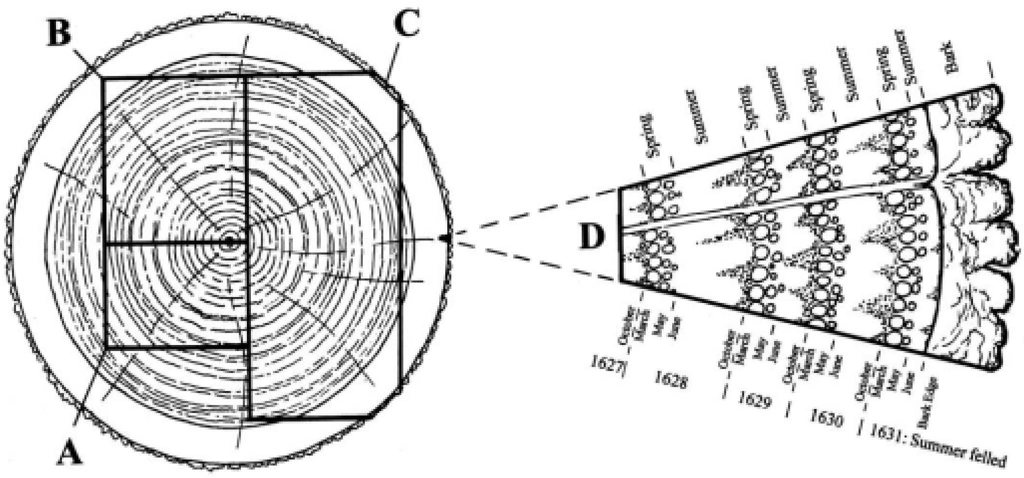
resulting from widespread influences such as the weather. However, a single sequence can be successfully dated, particularly if it has a long ring sequence.

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 1997a, 42)

<u>CLOGWYN BACH</u>

To be inserted

<u>SAMPLING</u>

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.

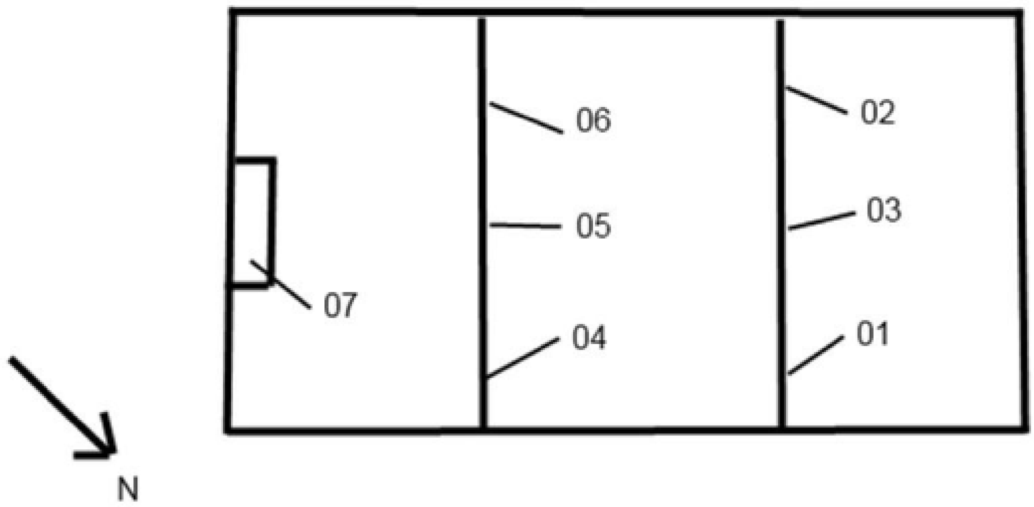


Figure 1: Sketch-plan of Clogwyn Bach showing the approximate positions of timbers sampled

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, and illustrated in Figure 1. Although sapwood was present on all of the roof timbers sampled, this became detached on several of them during coring. The ring-width series measured from the roof timbers matched each other (Table 2) and a 91-year long site chronology was produced. This however failed to give replicated acceptable matches when compared with the dated reference material, and it remains undated at this stage. This is unusual for a series that does not show any obvious signs of atypical growth (i.e. no sudden abrupt growth rate changes or unusually wide or narrow rings) in an area where many other sites have been successfully dated. The data will be kept on record and may be dated in the future when new data become available. The relative positions of overlap are shown in Fig 2. Although no absolute dating was achieved, it can be seen that those timbers that retained complete sapwood were felled in different years.

A fireplace lintel at the southern end of the building was cored. The core broke into many fragments, reflecting internal fissures in the timber. One long segment was measured, but this too failed to date.

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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

		t-values			
Sample	**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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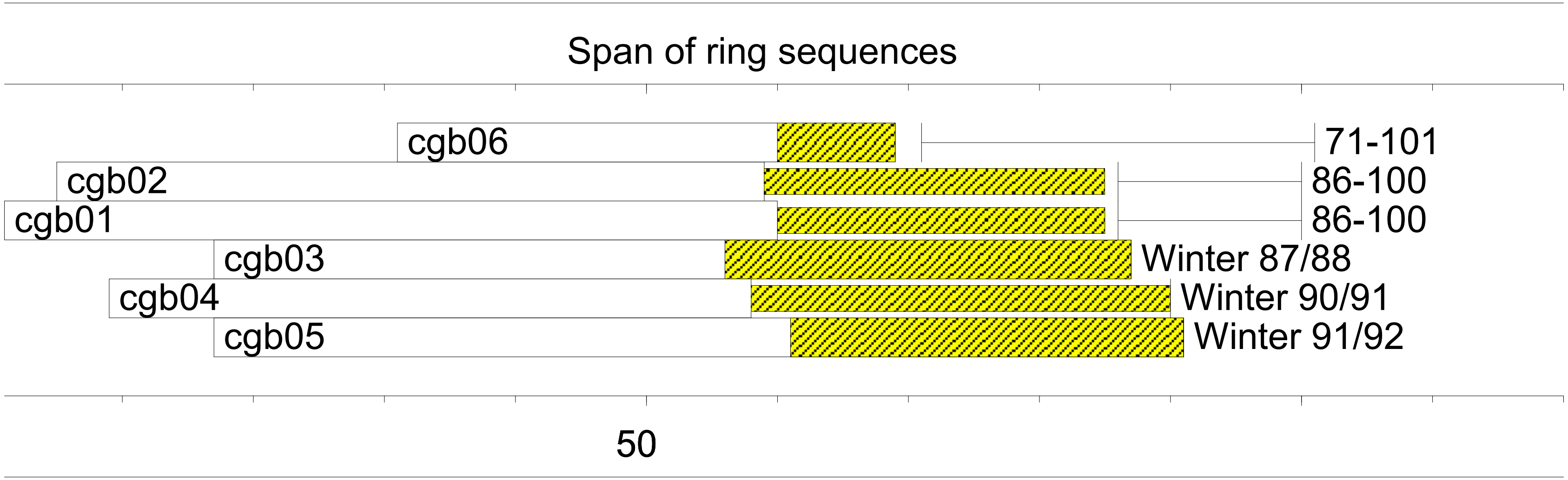

Figure 2: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

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REFERENCES

Baillie, M.G.L. and Pilcher, J.R. (1973) *A simple cross-dating program for tree-ring research*. **Tree Ring Bulletin**, 33, 7-14.

Bridge, M. C. (1988) The dendrochronological dating of buildings in southern England, **Medieval Archaeology**, 32, 166-174.

English Heritage (1998) *Guidelines on producing and interpreting dendrochronological dates,* **English Heritage, London.**

Miles, D. (1997a) The interpretation, presentation, and use of tree-ring dates, **Vernacular Architecture**, 28, 40-56.

Tyers, I. (2004) *Dendro for Windows Program Guide 3rd edn*, **ARCUS Report,** 500b**.**