Oxford Dendrochronology Laboratory
Report 2014/33

THE DENDROCHRONOLOGICAL INVESTIGATION OF THE GROES INN TY'N-Y-GROES, CAERNARVONSHIRE (NGR SH 776 740)

Summary
Six samples were taken from floor and roof timbers at the north end of this building. Five matched each other and were combined into a 117-year site chronology, but this failed to date. The building is thought to be quite late, probably eighteenth or nineteenth century, and it is possible that it may date at a future time, when more local material from this period becomes available.

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September 2014

A report commissioned by Dating Old Welsh Houses Project in partnership with
The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

The Dendrochronological Investigation of the Groes Inn, Ty'n-y-Groes, Caernarvonshire (NGR SH 776 740)

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.

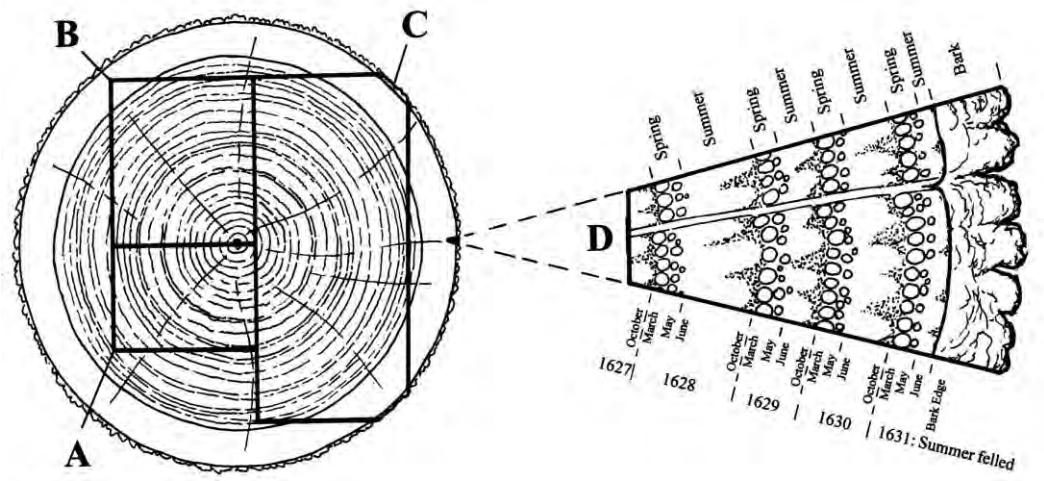
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence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

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 1997).



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)

GROES INN (notes by Richard Suggett)

Groes Inn was originally a storeyed house of Snowdonian plan-type and possibly the 'Taverne-y-groes' named in late-Elizabethan documents. The house retains a large end chimney and substantial beamed ceiling but has been extended and modernized in several phases. The roof and stair may date from the eighteenth century.

Coflein entry: NPRN 26356. Description in RCAHMW, *Caernarvonshire, Vol. I: East* (London, 1956), pp. 129-30. R.F. Suggett/RCAHMW/November 2014.

SAMPLING

Sampling took place in June 2014. 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 **gsi**. 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 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. The ring-width series were compared on an IBM compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973). A version of this and other programmes were written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker. Subsequent analyses were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

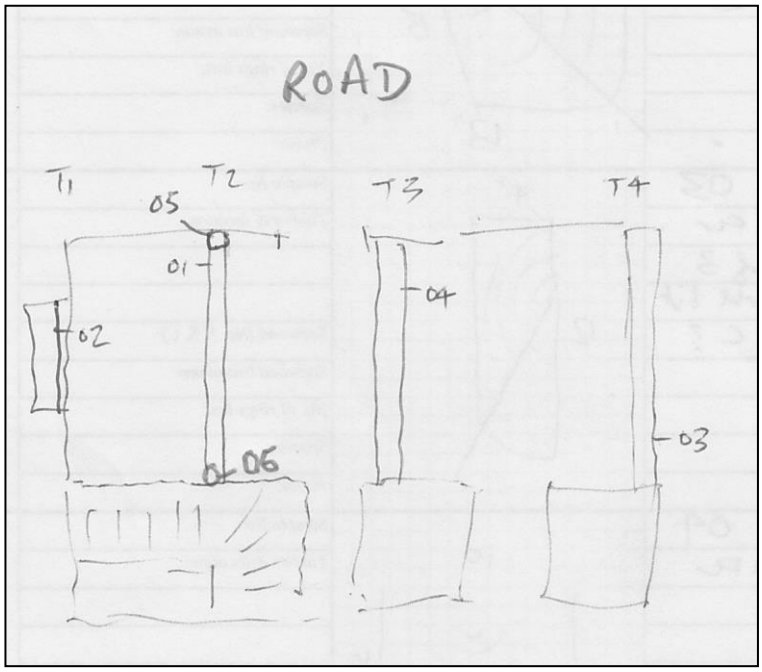


Figure 1. Field sketch, showing the approximate locations of samples taken for dendrochronology

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, with an indication of the locations of the samples being shown in Fig 1. Although later in style than most of the buildings looked at in this project over several years, the number of rings in the timbers made this a potentially useful site for establishing later chronologies in the region. Five of the timbers cross-matched (Table 2) and were combined into a single 117-year long chronology, at the positions indicated in Figure 2.

It is relatively unusual now to have such a long well-replicated site master that does not date, but earlier buildings in the Conwy valley have proved difficult to date, and if the timber is local, it is perhaps less surprising that this late building, for which there are few other local sites with which to compare the ring series, did not date. It is hoped that at some stage in the future the site chronology will become dated, if more late-style buildings are investigated in the region.

ACKNOWLEDGEMENTS

This study was commissioned by Margaret Dunn of the charity Dating Old Welsh Houses (who provided the cover photo), in collaboration with Richard Suggett of the Royal Commission on Ancient and Historic Monuments of Wales who provided useful background information. We thank the staff at The Groes Inn, for their co-operation in allowing the work to take place, and especially the owner, Justin Humphries. We thank our fellow dendrochronologists for permission to use their data.

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. (1997) 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**.**

Table 1: Details of samples taken from the Groes Inn

Sample number	Timber and position	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens	Felling date range
* gsi01	W-E ceiling beam at N end (grd flr)	26½C	101	1.67	0.78	0.22	-
* gsi02	Fireplace lintel at N end	21¼C	117	1.75	0.88	0.25	-
gsi03	S. end beam (grd flr)	? C	86	1.31	0.81	0.31	-
* gsi04	S. intermediate ceiling beam	22¼C	75	1.42	0.81	0.24	
* gsi05	E. principal rafter, truss 2	19 (+21NM)	65	1.89	0.82	0.22	
* gsi06	W. principal rafter, truss 2	17 (+14NM)	87	1.32	0.73	0.22	
* = included in site master **GROES**			**117**	**1.75**	**0.78**	**0.19**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, felled the following winter; ¼C = complete sapwood, felled the following spring; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured;

Table 2: Cross-matching between the samples (values over 3.5 are significant)

	***t*-values**			
Sample	**gsi02**	**gsi04**	**gsi05**	**gsi06**
gsi01	3.2	4.5	5.0	7.7
gsi02		6.8	4.2	3.5
gsi04			4.3	3.8
gsi05				6.2

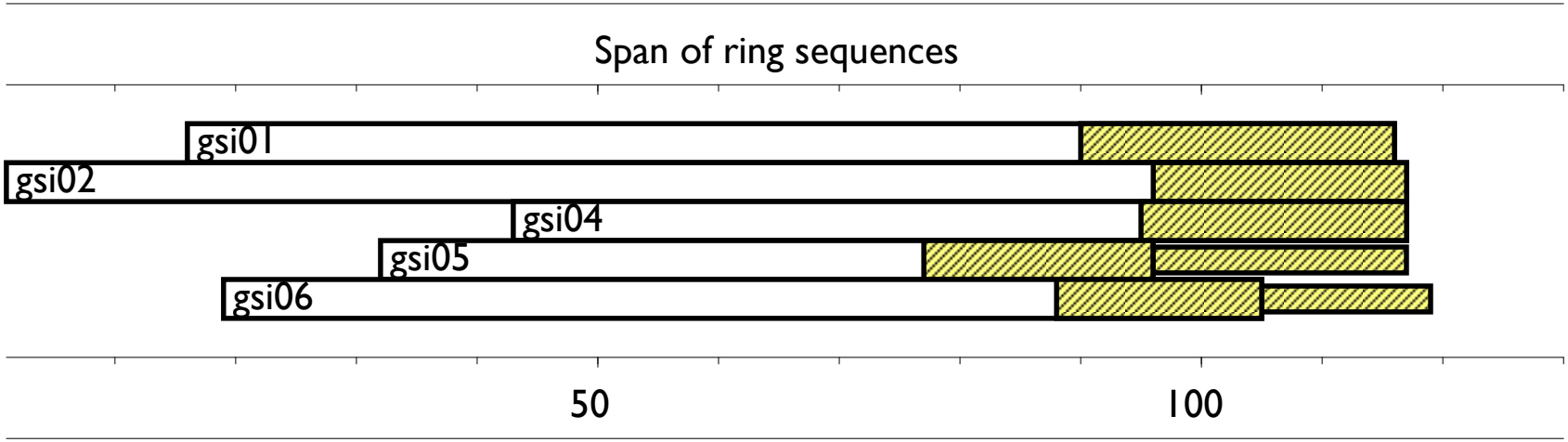


Figure 2: Bar diagram showing the relative positions of overlap of the cross-matched series. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings