Tree Ring Dating

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Oxford Dendrochronology Laboratory
Report 2019/09

THE DENDROCHRONOLOGICAL INVESTIGATION OF TIMBERS FROM PLAS YNGHOED DRWG, CORWEN, DENBIGHSHIRE

(SJ 1407 4422)

Photo: Ross Cook

Summary

Samples were taken from seven timbers in the rear range of this building. Cross-matching between the samples revealed on group of two timbers and a second group of three timbers that matched each other. Some timbers exhibited several abrupt growth changes, and none of the individual, or grouped series could be dated against the extensive database. The site therefore remains undated.

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February 2019

A report commissioned by the Discovering Old Welsh Houses Group in collaboration with the Royal Commission on the Ancient and Historic Monuments Wales (RCAHMW)

The Dendrochronological Investigation of Timbers from Plas Ynghoed Drwg, Corwen, Denbighshire (SJ 1407 4422)

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.

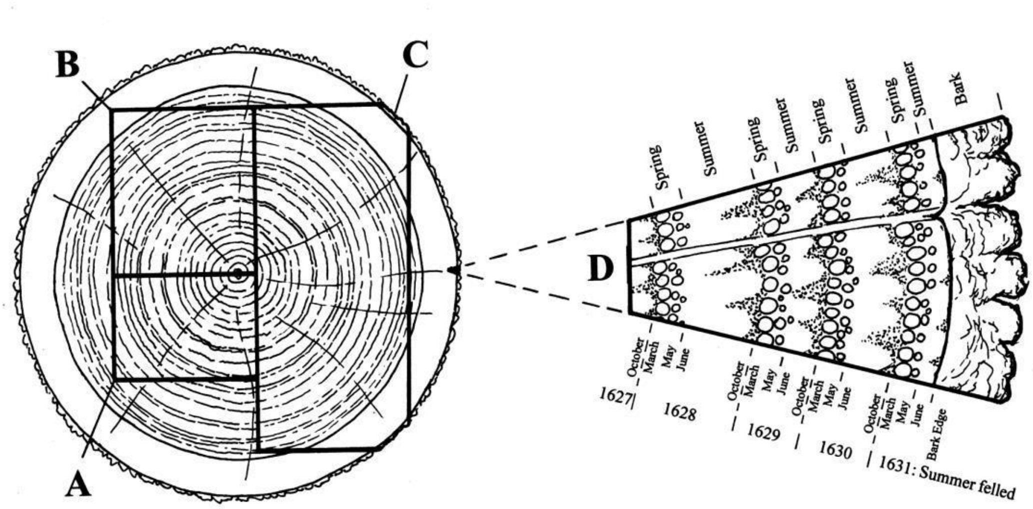
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation 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 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)

Plas Ynghoed Drwg

A late 16th-early 17th century sub-medieval house of three units and two storeys with lateral chimney to floored hall; later 19th century addition to downhill end across lower bay and forming the new frontage. Possibly box-framed at first and latterly built up in stone, now sitting under a slate roof. Plank and muntin partition surviving at lower end between kitchen and living room. Previously believed to be a possible cruck house, though no evidence was found for this during course of sampling. Probably a rebuild on an earlier site.
NPRN 27804

SAMPLING

Samples were taken from timbers in the roof structure during February 2019. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **drwg**, and taken away for subsequent analysis, where they were glued to laths.

The samples 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 programs by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1. Cross-matching between the samples revealed possible matches between series **02** and **07** (t = 4.3 with 70 years overlap), and between series **06** and **04** (t = 4.2 with 88 years overlap) and the combined series **64m** with **05** (t = 4.2 with 51 years overlap). These potential matches are shown in Figs 1 & 2 where the sudden growth rate changes in the series can also be seen. All individual series, and the newly formed combined series based on potential matches were compared with dated reference material, but none of the series gave consistent acceptable matches, and all remain undated.

ACKNOWLEDGEMENTS

This report was commissioned by The Discovering Old Welsh Houses Group. We thank the members of DOWHG who made arrangements for our visits, and assisted during the fieldwork. We thank the owners, Mr and Mrs Jones, for their support and our fellow dendrochronologists for permission to use their data.

DOWHG wishes to acknowledge the assistance of the Woodtiger Fund, Clwydian Range and Dee Valley AONB, and the Marc Fitch Fund, towards this work.

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Table 1: Details of samples taken from Plas Ynghoed Drwg. Trusses numbered from north (uphill) to south.

Sample number	Timber and position	Sapwood complement	No of rings	Mean width (mm)	Std devn (mm)	Mean sens
drwg01	West principal rafter, truss 1	7	86	1.21	0.84	0.14
drwg02	East principal rafter, truss 1	21¼C	118	0.94	0.69	0.14
drwg03	Upper rafter, bay 1, east	h/s +6NM	83	1.41	0.61	0.14
drwg04	Upper purlin, bay 2	h/s	88	1.34	0.81	0.20
drwg05	Cut tie, truss 1	h/s	67	1.70	0.80	0.24
drwg06	East queen post, truss 1	h/s	120	1.34	0.81	0.11
drwg07	Longitudinal beam in kitchen	h/s	74	1.51	0.50	0.19
drwg27m	Mean of **02** an **07**		118	1.21	0.59	0.15
drwg654m	Mean of **06**, **05** and **04**		136	1.55	0.74	0.17

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

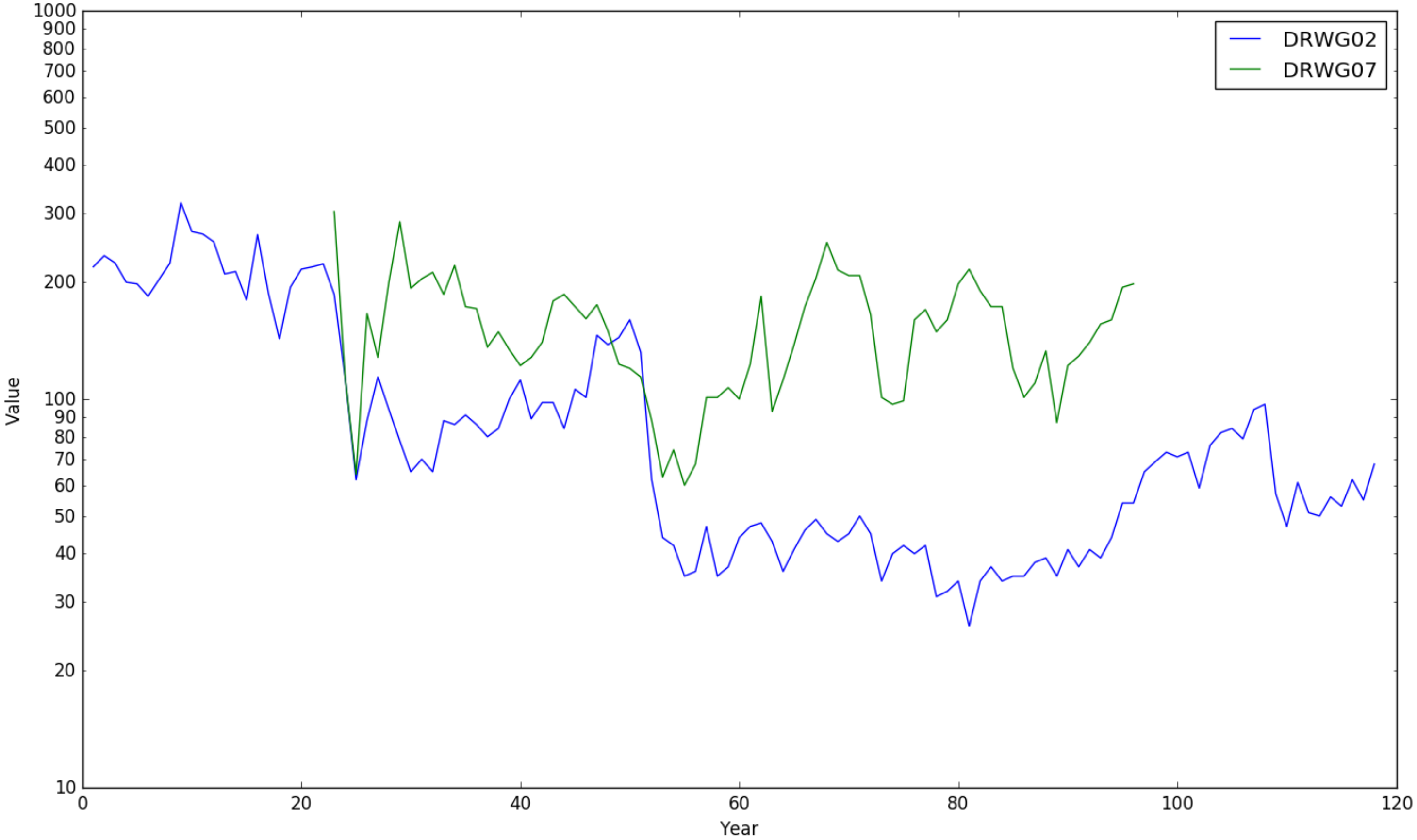

Figure 1: Plots of **02** and **07** showing the position at which they match, and the sudden growth rate changes exhibited. The *y* axis is ring-width in mm on a logarithmic scale.

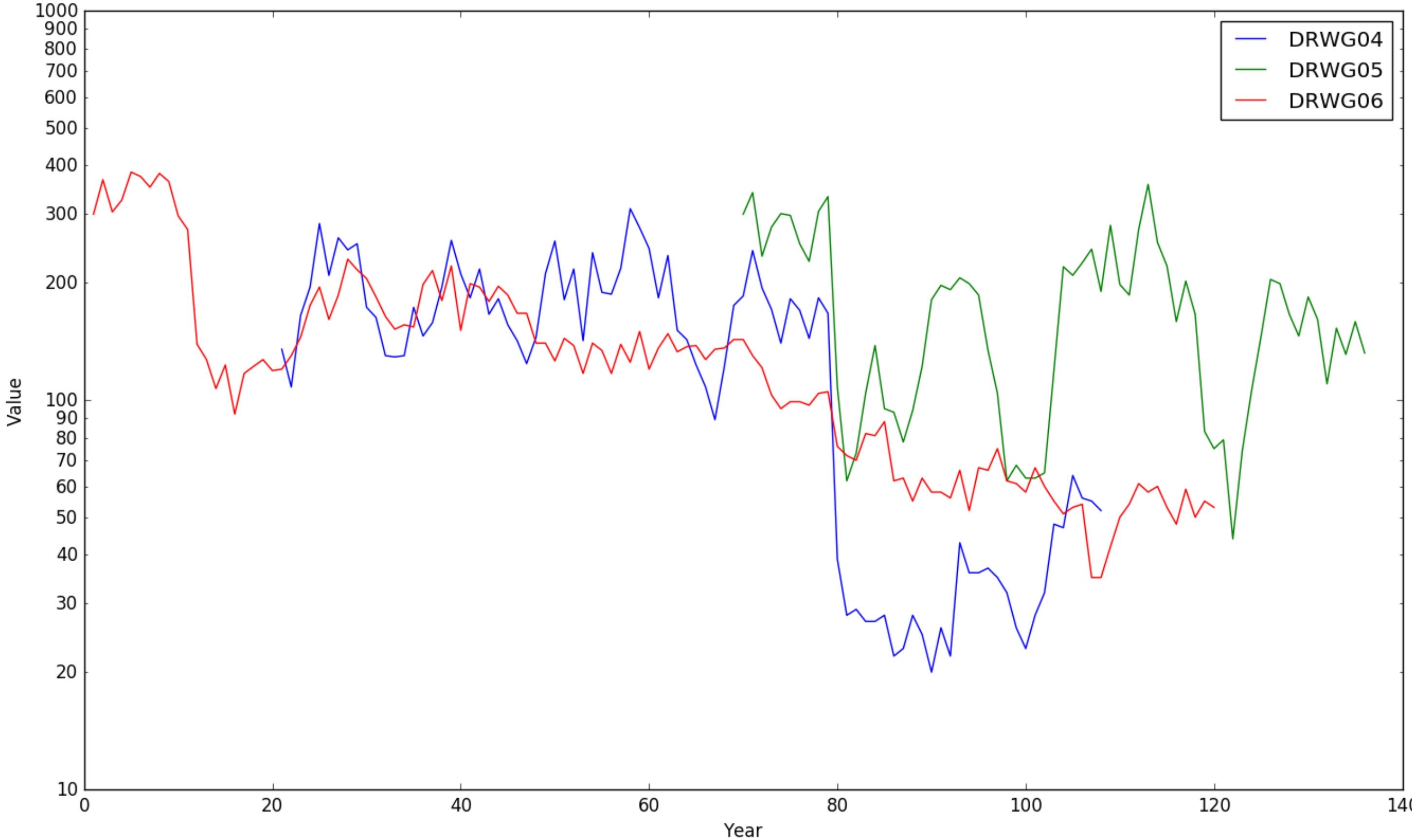

Figure 2: Plots of **06**, **05** and **04** showing the possible position at which they match, and the sudden growth rate changes exhibited. The *y* axis is ring-width in mm on a logarithmic scale.