Tree Ring Dating

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Oxford Dendrochronology Laboratory
Report 2018/03

THE DENDROCHRONOLOGICAL INVESTIGATION OF TIMBERS FROM BRYN-BOWLIO, LLANFERRES, DENBIGHSHIRE

(SJ 1880 6152)

Summary

Sampling was cut-short at this site as the timbers failed to yield series as good as was hoped for. The large axial ceiling beam at ground floor level had bands of narrow rings, a distortion from a knot on one core, and the worm-eaten nature of the sapwood prevented the measurement of the complete sapwood on a second core from the same timber. Whilst the cores from the roof timbers did have good numbers of rings, again the growth patterns showed sudden changes in growth rate throughout their length, meaning that they could not be cross-matched or dated.

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The Dendrochronological Investigation of Timbers from Bryn-bowlio, Llanferres, Denbighshire (SJ 1880 6152)

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.

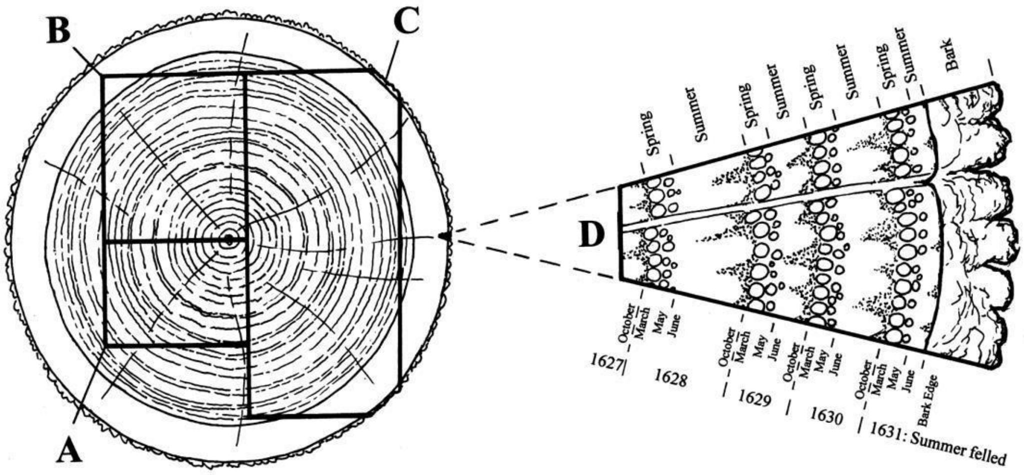
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student’s *t*-test. The *t*-test compares the actual difference between two means in relation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

Bryn-bowlio (with notes by Richard Suggett recently added to Coflein)

There was previously nothing on Bryn-bowlio in Coflein, other than a drawing of the ground floor and first floor plans by Ffrangcon Lloyd under the NPRN 26840, listing it as a post-medieval domestic house.

Brynbowlio is a three-unit stone-built farmhouse of regional type with several entries in *Houses of the Welsh Countryside* (Maps 29, 33, 37). Ffrangcon Lloyd's plan (?1960s) in the NMRW indicates than an outer parlour was added in the later C17th to the original two-unit house of *c*.1600 of end-chimney lobby-entry plan with large hall and paired inner-rooms. This is a not uncommon development (cf. the tree-ring dated example at Tu-hwnt-i-Gain, VA 33.102). Surviving architectural detail includes a stone fireplace stair, a central spine-beam in the hall, and a post-and-panel partition with one surviving pointed doorhead.

SAMPLING

Samples were taken in November 2017. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **bbwl** with samples 1- 6 from the cruck hall, samples 11 - 19 from the western down-slope range of both later phases, and sample 20 from the fireplace lintel between the stack at the west end of the cruck hall. 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 DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1, with the ground floor samples shown in Fig 1. The first sample from the axial ceiling beam had a knot distorting much of its ring series, so a second core was taken. The second core had a more reliable series, but the sapwood was highly degraded and the outer rings could not be distinguished. It was not possible to match the two series with certainty, although plots of each showed great similarities. The individual series failed to match with series from the roof timbers, and could not be dated against the dated reference material.

Two samples were taken from the north upper purlin near the east truss in an attempt to get the complete sapwood. The two series were combined to form a single series representing this timber for subsequent analysis. This series showed 'normal' looking variation and had 70 rings, but could not be dated. The other series (Fig 2) showed sudden changes in growth rate, possibly resulting from management of the timbers, and these could not be matched against each other, nor could they be dated.

Sampling was discontinued as the cores showed poor ring series for dating, and on closer inspection, the timbers in the screen were unsuitable for sampling.

ACKNOWLEDGEMENTS

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I also thank my fellow dendrochronologists for permission to use their data.

Table 1: Details of samples taken from Bryn-bowlio, Llanferres.

Sample number	Timber and position	Sapwood complement	No of rings	Mean width (mm)	Mean sens
Ground floor					
bbwl01a	Axial ceiling beam	18 (+9NM)	56	1.95	0.23
bbwl01b	*ditto*	25¼C	58	2.32	0.26
First floor					
bbwl02	Collar to west truss	-	38	3.41	0.23
bbwl03	North principal rafter to west truss	24½C	50	2.36	0.25
bbwl04a	North upper purlin by east truss	*h/s*	*30*	*1.22*	*0.23*
bbwl04b	*ditto*	*h/s*	*70*	*1.19*	*0.19*
bbwl04	Mean of **04a** and **04b**	h/s	70	1.18	0.20
bbwl05	North principal rafter to east truss	h/s	81	1.66	0.31

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; ¼ C = complete sapwood, felled the following spring; ½C = the following summer; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

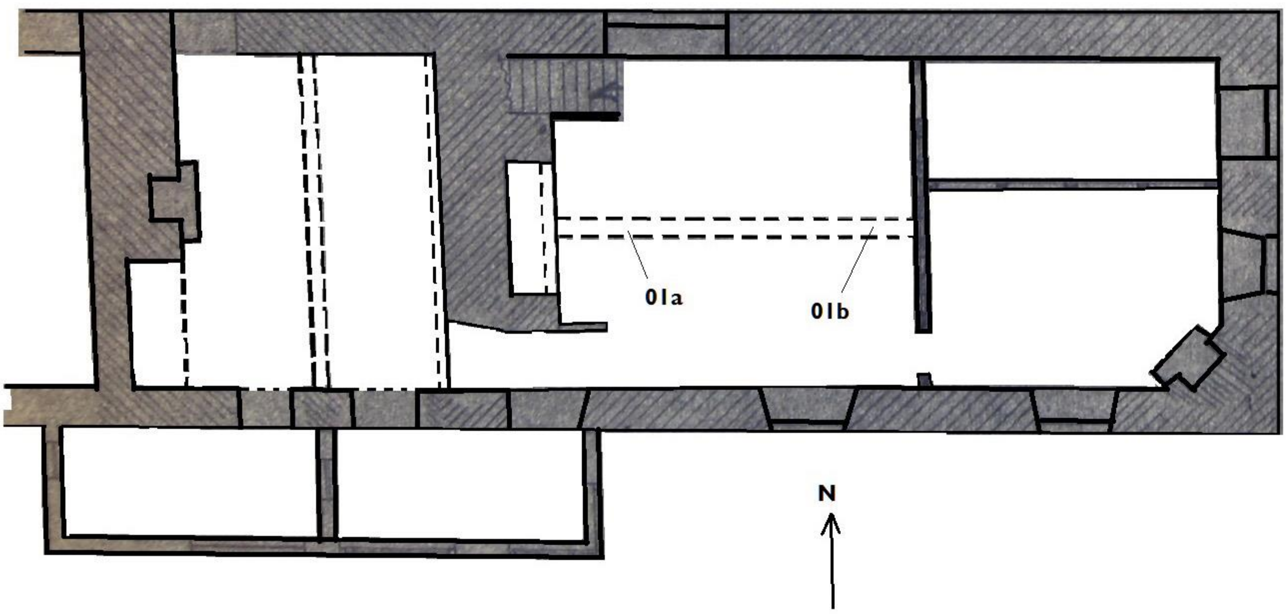

Figure 1: Ground floor plan showing the axial beam sampled in two places, adapted from an original drawing by Ffrangcon Lloyd

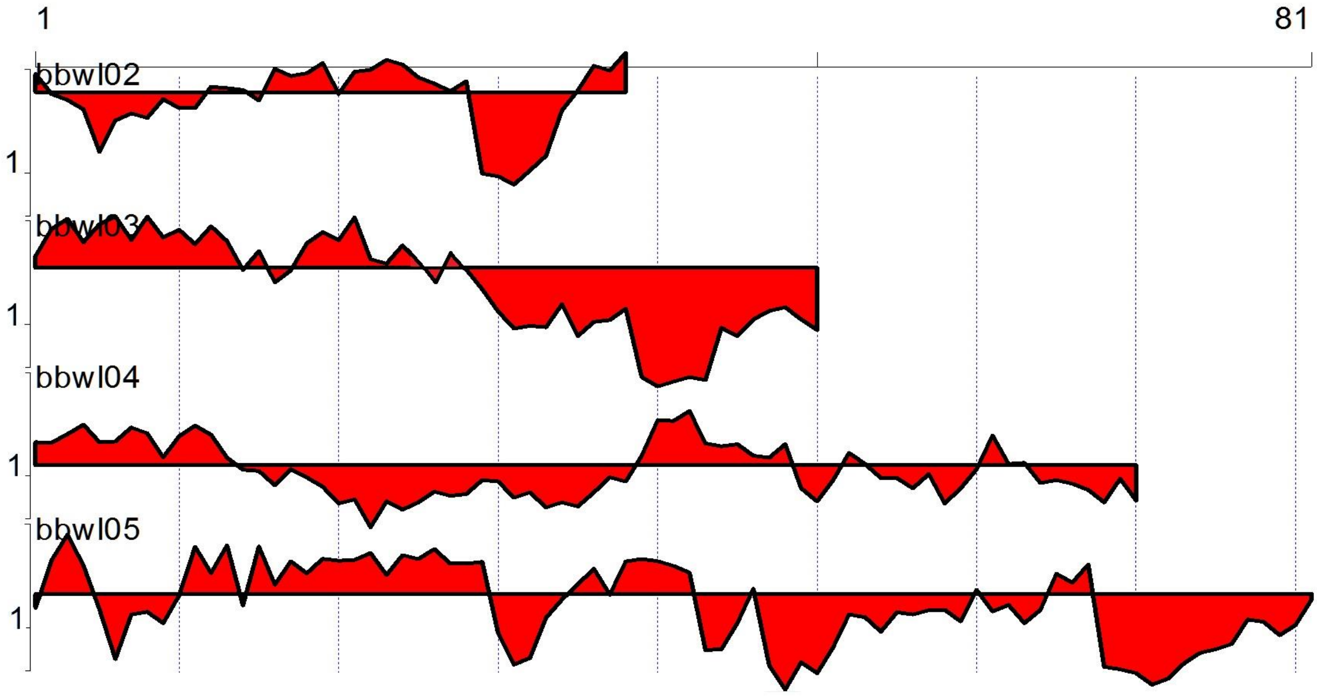

Figure 2: Plots of the roof samples showing the sudden growth rate changes in all but sample **04**. The *y*-axis is ring width (mm) on a logarithmic scale. The horizontal line through each plot denotes the mean ring width of the individual series.

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**.**