Darganfod Hen Dai Cymreig
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DYDDIO HEN DAI CYMREIG | DATING OLD WELSH HOUSES

PROSIECT DENDROCRONOLEG GOGLEDD ORLLEWIN CYMRU | NORTH WEST WALES DENDROCHRONOLOGY PROJECT

Oxford Dendrochronology Laboratory
Report 2011/**

THE TREE-RING DATING OF BRYN BERLLAN CYNWYD, CORWEN, DENBIGHSHIRE (NGR SJ 054 413)

Summary

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The Tree-Ring Dating of Bryn Berllan, Cynwyd, Corwen, Denbighshire (NGR SJ 054 413)

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.

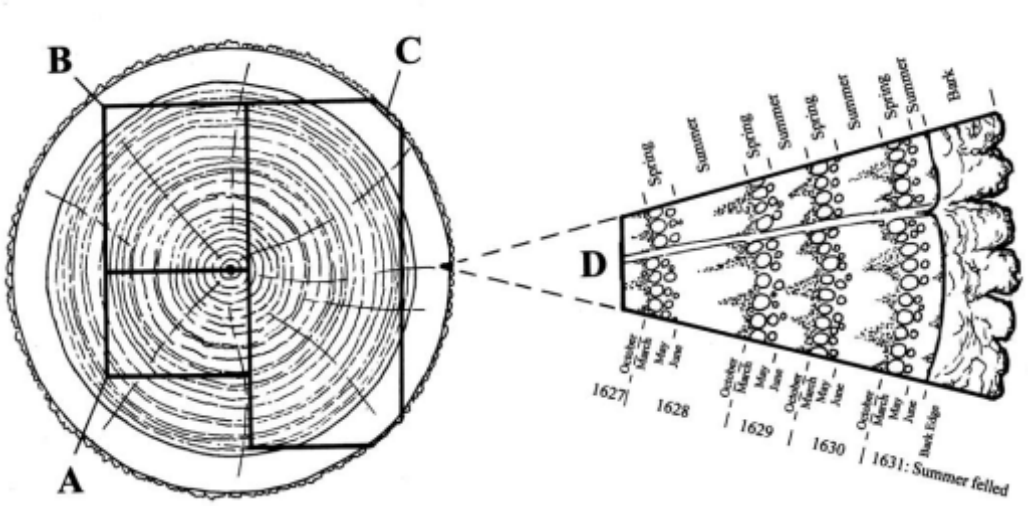
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

BRYN BERLLAN, CYNWYD

SAMPLING

Sampling took place in November 2010. 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 **deng**. 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.

Measurements and subsequent analysis were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

Table 1: Details of samples taken from Bryn Berllan, Cynwyd.

Sample number	Timber and position	Date of series	H/S boundary date	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens	Felling date range
* **deng01**	East principal rafter, truss 1	1376-1552	1518	34C	177	0.99	0.54	0.19	Winter 1552/53
* **deng02**	Collar, truss 1	1397-1525	1480	45C	129	1.29	0.80	0.26	Winter 1525/26
* **deng03**	West principal rafter, truss 1	1452-1514	1512	2	63	1.29	0.47	0.23	1523-53
* **deng04**	East purlin, bay 1 - 2	1400-1540	1514	26	141	0.83	0.2	0.22	1541-55
deng05a	East principal rafter, truss 2	*1415-1523*	*1523*	*H/S*	*109*	*0.83*	*0.34*	*0.29*	-
deng05b	*ditto*	*1463-1522*	*1522*	*H/S+27NM*	*60*	*0.98*	*0.38*	*0.28*	-
deng05	Mean of **05a** and **05b**	1415-1523	1523	H/S+27NM	109	0.84	0.34	0.28	1550-64
deng06a	West arch brace, truss 2	*1429-1512*	*1511*	*1*	*84*	*0.86*	*0.33*	*0.23*	-
deng06b	*ditto*	*1468-1522*	*1522*	*H/S+12NM*	*55*	*1.06*	*0.48*	*0.22*	-
deng06	Mean of **06a** and **06b**	1429-1522	1522	H/S12NM	94	0.91	0.35	0.21	1550-64
* **deng56m**	Mean of **05** and **06**	1415-1523	1522		109	0.85	0.33	0.24	1550-64
* **deng07**	West queen strut, truss 3	1378-1511	1511	H/S	134	1.35	0.71	0.30	
deng08	East principal rafter, truss 3	undated	-	-	<30	NM	-	-	unknown
* **deng09i**	Collar, truss 3	1406-1456	-	-	51	1.95	0.92	0.29	-
* **deng09ii**	*ditto*	1460-1527	1526	1	68	1.41	0.81	0.30	
deng10	3rd muntin from East, screen	undated	-	?C	138	1.04	0.64	0.25	unknown
*** = included in Site Master DENG**		**1376–1552**			**177**	**1.14**	**0.53**	**0.19**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table 2: Cross-matching between dated samples

	t - values							
Sample	**deng02**	**deng03**	**deng04**	**deng05**	**deng06**	**deng07**	**deng09i**	**deng09ii**
deng01	3.6	4.4	9.9	4.5	5.2	4.9	4.5	4.7
deng02		3.9	3.7	6.0	4.5	5.8	5.6	3.5
deng03			5.0	5.8	6.9	5.8	-	3.5
deng04				6.3	6.8	6.3	4.3	4.3
deng05					11.2	5.9	3.3	4.8
deng06						5.1	-	3.6
deng07							5.1	3.9

- = no value calculated (less than 20 rings overlap)

Table 3: Dating evidence for the site master **DENG AD 1376–1552** against dated reference chronologies, regional chronologies in **bold**

County or region:	***Chronology name:***	***Short publication reference:***	***File name:***	***Spanning:***	***Overlap (yrs):***	***t-value:***
Wales	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353-1521	146	11.4
Wales	Bryn yr Odyn, Gwynedd	(Miles and Bridge 2010)	BRYNRDYN	1388-1586	165	11.2
Wales	Gelli, Llanfrothen	(Miles *et al* 2006)	BDGLRT8	1391-1662	162	10.2
Wales	Bodwrda, Aberdaron	(Miles and Bridge 2010)	LYNA	1384-1527	144	9.1
Wales	Cae'nycoed-uchaf, Maentwrog	(Miles *et al* 2006)	BDGLRT17	1407-1592	146	8.5
Wales	Derwyn-bach, Dobenmaen	(Miles *et al* 2006)	BDGLRT15	1385-1548	164	8.5
Wales	Bwthyn Cae-glas, Llanfrothen	(Miles *et al* 2006)	BDGLRT7	1386-1547	162	8.5
Wales	Parc Llanfrothen	(Miles *et al* 2006)	BDGLRT22	1386-1669	167	8.3
Wales	Y Gesail Gyfarch, Dolbenmaen	(Miles *et al* 2006)	BDGLRT6	1384-1609	169	8.0
Surrey	Apple Tree Cottage, Elstead	(Tyers 2000)	ELSTEAD	1396-1591	157	7.6
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404-1981	177	7.5
Wales	Pant-glas-uchaf, Clynnog	(Miles *et al* 2006)	BDGLRT14	1413-1573	140	7.4
Wales	Clenennau, Dolbenmaen	(Miles *et al* 2006)	BDGLRT10	1406-1570	147	7.1
Wales	Ty-mawr, Nantmor	(Miles *et al* 2006)	BDGLRT3	1425-1528	104	6.9

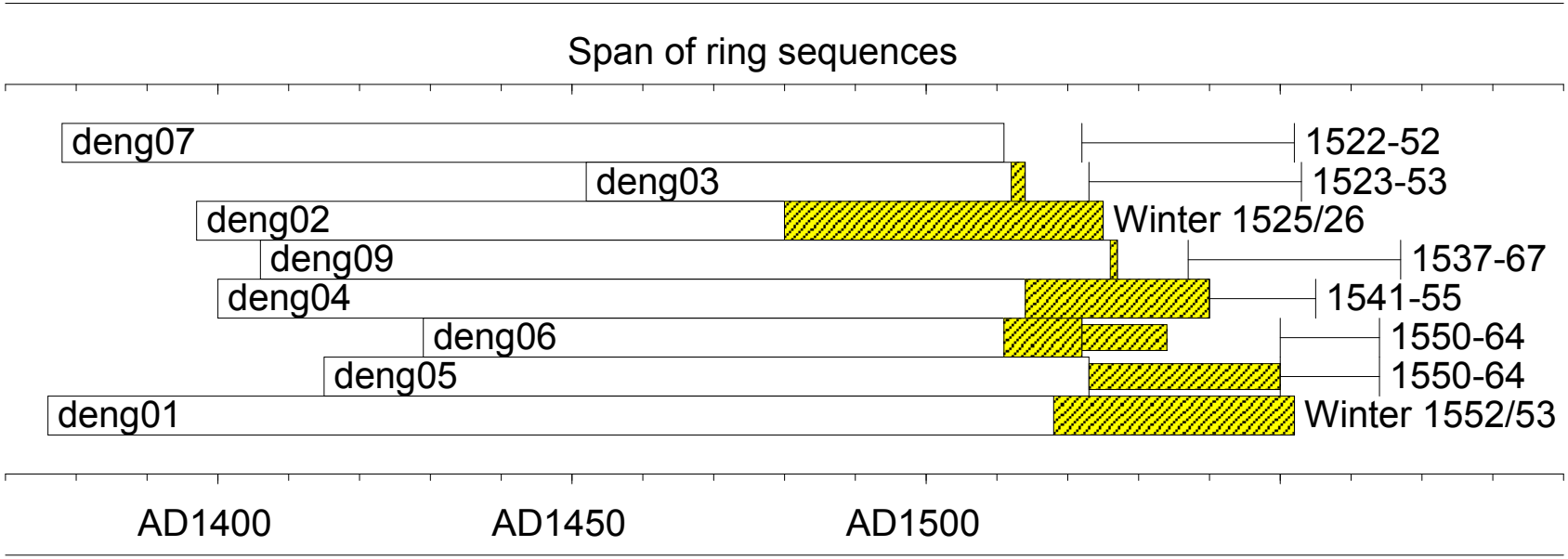


Figure 2: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

ACKNOWLEDGEMENTS

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