Tree Ring Dating

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Oxford Dendrochronology Laboratory
Report 2018/30

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM TY CANOL, LLANTYSILIO, DENBIGHSHIRE

(SJ 142 443)

Summary

A number of the timbers from this site showed abrupt growth changes making them undatable. Two cruck blades from the same hall truss were found to have been derived from the same tree, felled in the winter of **1533/34**. Another hall cruck blade had a likely felling date range incorporating this date, making it likely that they are contemporaneous. The parlour cruck was from a tree felled later, in winter **1550/51**.

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The Dendrochronological Dating of Timbers from Ty Canol, Llantysilio, Denbighshire (SJ 142 443)

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.

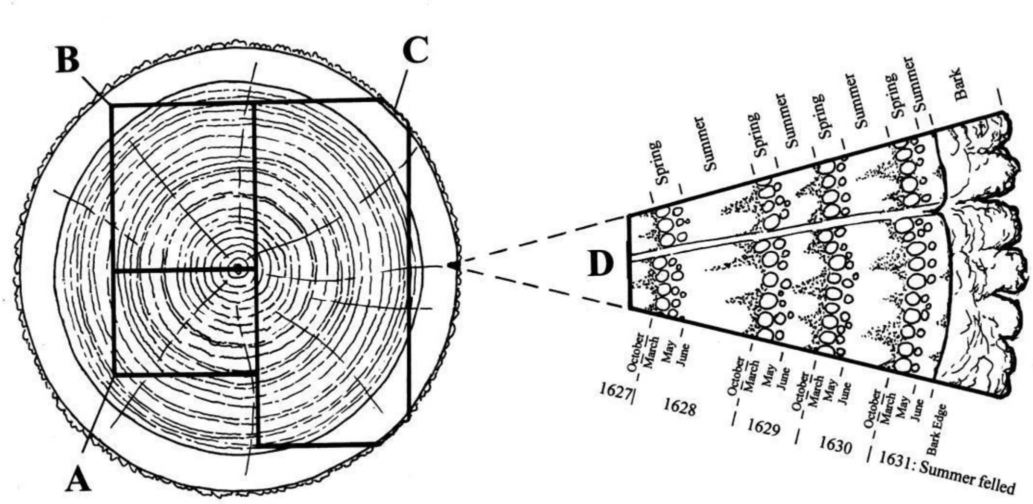
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

Ty Canol

A cruck hall house on a classic downhill site, with a barn parallel to the house. The hall has an inserted chimney. Timbers in the lower end of the hall range are all reset, possibly in the nineteenth century. The parlour has well-finished chamfered joists and beams, the floor is inserted.

<u>SAMPLING</u>

Nine samples were taken from timbers in the roof during August 2018 (Fig 1). Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **canl**, 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 purposebuilt 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).

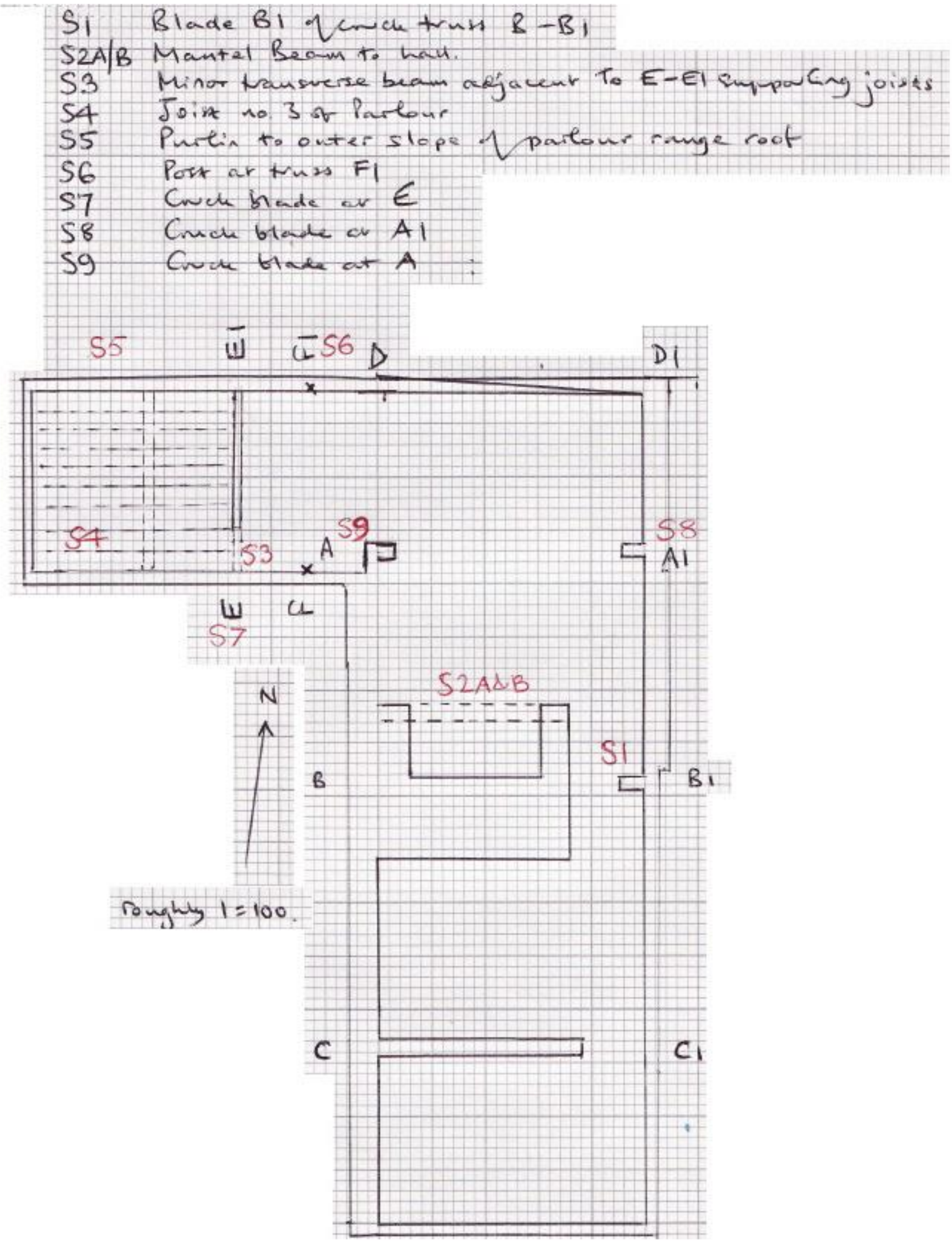


Figure 1: Field sketch-plan by Martin Cherry showing the layout of the property and approximate position of the cores

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1. Cross-matching between the samples revealed few good matches (Table 2), however samples **08** and **09** did give a strong match (*t* = 7.9), and closer inspection of the plots (Fig 2) suggests that these two series derived from the two blades of the same cruck, are almost certainly derived from the same tree. The series were combined for further analysis (and it was later found that using the combined series gave a better matching site master).

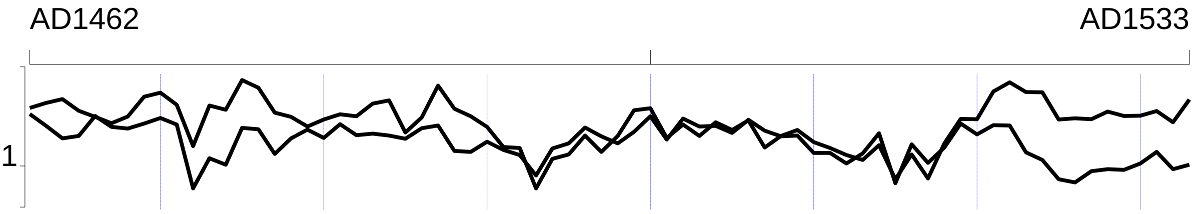


Figure 2: Plots of **08** and **09**, showing the strong similarity of these two cruck blades, probably derived from the same tree. *y*-axis is ring width in mm on a log scale.

A number of samples had long ring width series, but showed growth anomalies which prevented dating. For example, **03** (Fig 3) showed at least two sudden growth declines, followed by slow recoveries, the kind of pattern seen when branches are removed, either by accident or through management.

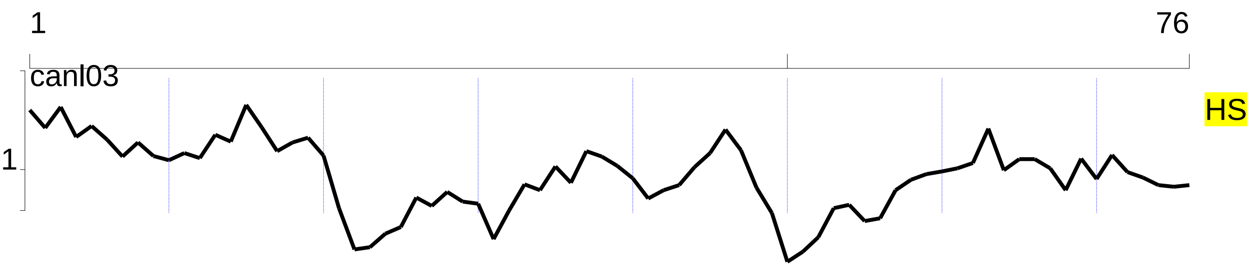


Figure 3: Plot of series **03**, showing a number of growth declines. *y*-axis is ring width in mm on a log scale.

Series **05** and **06** showed remarkably similar growth patterns (Fig 4), suggesting that these too were derived from the same tree. The very narrow rings present mean that one or other of these series may not be totally representative, as the two series are not completely synchronous in places, but either way, the sudden growth declines, probably resulting from some form of management or mechanical damage to the tree, render these series undatable.

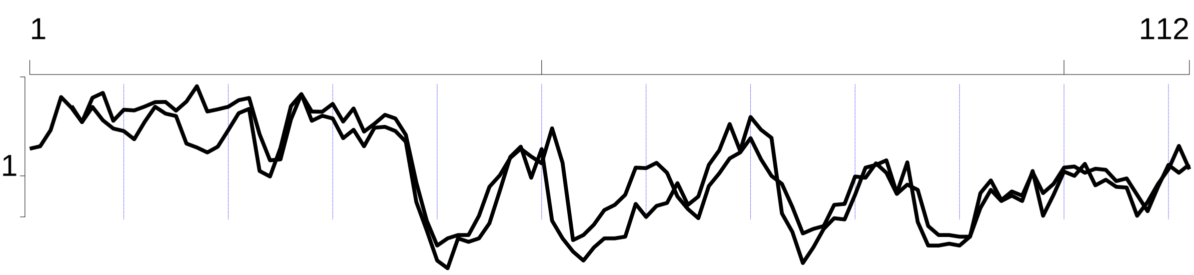


Figure 4: Plots of series **05** and **06**, showing them to be from the same parent tree. *y*-axis is ring width in mm on a log scale.

The short 50-year long sequence from **04** failed to give consistently strong matches either to the remaining samples, or to the database, and remains undated.

The remaining series dated well independently, and show various degrees of matching between themselves (Table 2). They were combined into a single site chronology, **TYCANOL**, of 123 years. This was subsequently dated to the period 1428–1550, the strongest matches being shown in Table 3.

Sample **01** had some detached sapwood and a few rings may have been lost, hence a likely felling date range of 1530–40 is given for this cruck. The other two cruck blades (derived from the same tree) have a felling date of **Winter 1533/34**, and it seems highly likely that these two cruck trusses in the hall are contemporaneous. The cruck blade from the parlour however was from a tree felled in **Winter 1550/51**, showing a later phase of work at this site. The relative positions of overlap of the dated samples are shown, along with the derived felling dates (or likely felling date ranges) in Figure 5.

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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.

Bridge, M. C., Miles, D., Suggett, R., Cook, R., Dunn, M. and Thompson, P. (2016) Tree-Ring Dating Lists, **Vernacular Architecture**, 47, 96-101.

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

Howard, R. E., Laxton, R. R. and Litton, C. D. (2003) *Tree-ring analysis of timbers from Combermere Abbey, Whitchurch, Cheshire*, **Centre for Archaeology Rep**, 83/2003.

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

Miles, D. H. and Haddon-Reece, D. (1994) List 56 - Tree-ring dates, **Vernacular Architecture**, 25, 28-36.

Miles, D. H. and Haddon-Reece, D. (1995) List 64 - Tree-ring dates, **Vernacular Architecture**, 26, 60-74.

Miles, D. H. and Worthington, M. J. (1997) Tree-ring dates, **Vernacular Architecture**, 28, 159-181.

Miles, D. H. and Worthington, M. J. (2000) Tree-ring dates, **Vernacular Architecture**, 31, 90-113.

Miles, D. H. and Worthington, M. J. (2002) Tree-ring dates, **Vernacular Architecture**, 33, 81-102.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2005) Tree-ring dates, **Vernacular Architecture**, 36, 87-101.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2006) Tree-ring dates, **Vernacular Architecture**, 37, 118-132.

Miles, D. H., Worthington, M. J., Bridge, M. C., Suggett, R. and Dunn, M. (2010) Tree-ring dates, **Vernacular Architecture**, 41, 110-118.

Miles, D. H., Bridge, M. C., Suggett, R. and Dunn, M. (2011) Tree-ring dates, **Vernacular Architecture**, 42, 109-116.

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

Table 1: Details of samples taken from the barn at Ty Canol, Llantysilio.

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
Hall Range									
*** canl01**	Cruck blade truss B	1428–1518	1499	19 +12NM	91	2.05	0.91	0.28	1530-40
canl02a	Bressumer	-	-	-	67	2.08	0.70	0.19	-
canl02b	*ditto*	-	-	-	132	1.27	0.75	0.20	-
canl02	Mean of **02a** and **02b**	-	-	-	132	1.38	0.84	0.21	-
canl03	Transverse beam	-	-	H/S	76	1.05	0.56	0.26	-
canl08	East cruck blade truss A	1462–1533	1510	23C	72	1.50	0.40	0.20	-
canl09	West cruck blade, truss A	1462–1533	1517	16C	72	2.10	0.71	0.22	-
*** canl98m**	Mean of **08** and **09**	1462–1533	1510	23C	72	1.80	0.47	0.20	Winter 1533/34
Parlour Range									
canl04	Joist 3 in parlour	-	-	H/S	50	2.01	0.52	0.18	-
canl05a	North purlin in parlour	-	-	H/S + 29	99	1.32	0.92	0.23	-
canl05b	*ditto*	-	-	4	107	1.45	1.01	0.23	-
canl05	Mean of **05a** and **05b**	-	-	4 (+25)	108	1.45	1.00	0.22	-
canl06	Post to truss in parlour	-	-	H/S	112	1.26	0.85	0.28	-
canl07a	Cruck blade in parlour	*1455–1524*	*1524*	H/S	70	2.05	0.64	0.17	-
canl07b	*ditto*	*1436–1550*	*1520*	30C	115	1.30	0.43	0.15	-
*** canl07**	Mean of **07a** and **07b**	1436–1550	1520	30C	115	1.50	0.55	0.14	Winter 1550/51
***** = included in site master **TYCANOL**		**1428–1550**			**123**	**1.76**	**0.69**	**0.18**	

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

Table 2: Cross-matching between the dated samples in site master **TYCANOL**
Values over 3.5 are statistically significant, orange highlight indicates probably same tree origin

	t-values		
Sample	**canl07**	**canl08**	**canl09**
canl01	2.1	3.4	3.4
canl07		5.6	6.4
canl08			7.9

Table 3: Dating evidence for the site chronology **TYCANOL AD 1428–1550** against dated reference chronologies

County or region:	***Chronology name:***	***Reference***	***File name:***	***Spanning***	***Overlap: (yrs)***	***t-value:***
Site Chronologies						
Caernarvonshire	Dylasau Isaf	(Miles *et al* 2011)	DYLASAU1	1412–1592	123	8.0
Breconshire	The Elms, Talgarth	(Bridge *et al* 2016)	TLGRTELM	1442–1622	109	7.6
Shropshire	Habberley Hall	(Miles and Haddon-Reece 1995)	HABBERLY	1386–1554	123	7.6
Shropshire	High Grosvenor	(Miles and Haddon-Reece 1994)	HGROVNR9	1442–1590	109	7.4
Denbighshire	Branas-Uchaf, Llandrillo	(Miles *et al* 2010)	DENBY6	1388–1763	123	7.2
Cheshire	Combermere Abbey, Whitchurch	(Howard *et al* 2003)	CBMASQ01	1371–1564	123	7.0
Shropshire	Cherrington Manor	(Miles and Worthington 2000)	CHERGTN	1386–1635	123	6.9
Denbighshire	Hendre Isaf barn, Gwyddelwern	(ODL 2018 unpubl)	HENISAF	1433–1534	102	6.7
Shropshire	14 Callaughton, Much Wenlock	(Miles and Worthington 1997)	CALLGHTN	1335–1569	123	6.7
Shropshire	Cotton's House, Market Drayton	(Miles *et al* 2005)	COTTONHS	1416–1584	123	6.6
Herefordshire	Pikes Farm, Michaelchurch, Escley	(Miles *et al* 2006)	MLCHRCH2	1342–1590	123	6.6
Shropshire	Abcott Manor, Clungunford	(Miles and Worthington 2002)	CGFA	1422–1545	118	6.6

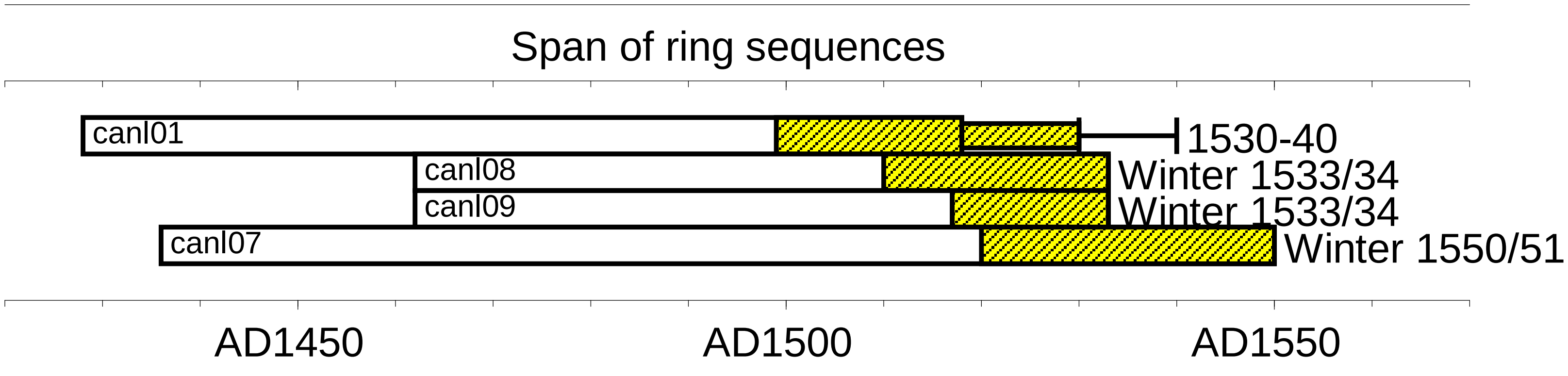

Figure 5: Bar diagram showing the relative positions of overlap of the dated samples, with their likely felling date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.