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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 2012/17

THE TREE-RING DATING OF COEDYFFYNNON, PENMACHNO, BETWS-Y-COED CONWY (NGR SH 804 530)

Summary
Previous studies of the building have suggested that that the primary phase was built as a Hall, but that it was quickly floored over. One timber from the roof retained complete sapwood, and was from a tree felled in **Spring 1537**, a second roof timber having a likely felling date range incorporating this date. Two timbers from the floor dated, but unfortunately neither retained complete sapwood on the core, although only 2-3mm was lost from the bark edge of one, suggesting that it was felled earlier than the roof timbers, in the 1520s. This evidence is contradictory, but it could mean that the floor timber was stock-piled before use. The other floor timber to date, a nail-head decorated beam has a felling date range which suggests it could be the same date as the roof timbers, or indeed slightly later. Other elements of the house did not date.

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The Tree-Ring Dating of Coedyffynnon, Penmachno, Betws-y-Coed, Conwy (NGR SH 804 530)

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.

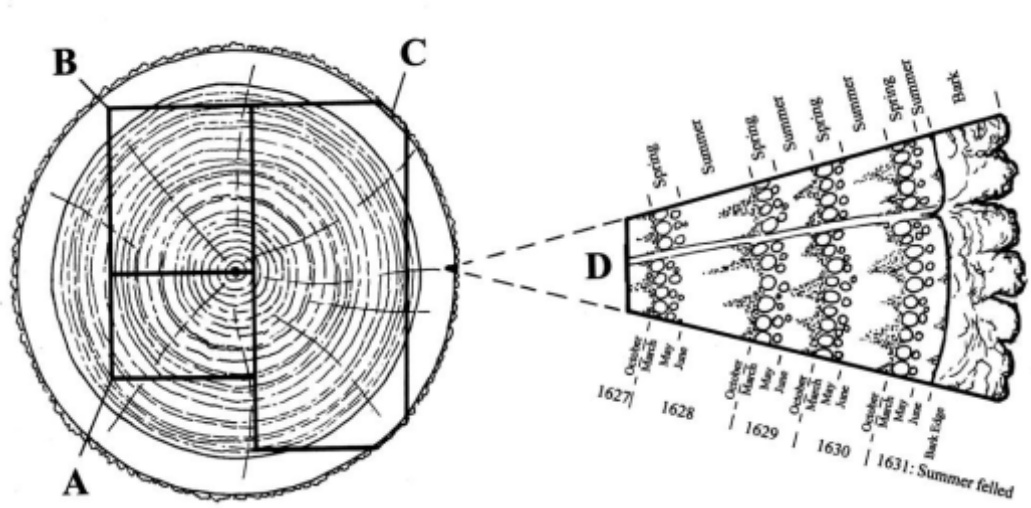
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence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

COEDYFFYNNON

Coedyffynnon is a classic early storeyed house of Snowdonian type, though somewhat disguised by the addition of a porch and back kitchen and C19th windows. When first built, Coedyffynnon had a cross-passage between outer rooms and hall with projecting end chimney. The outer parlour fireplace has a later plaster armorial shield. The trusses are of collar-beam type mostly with large, fast-grown timber. Early features include cusped windbraces and the nailhead decoration on the chamfer of the hall beams (*cf*. Cwm Farm, 1523). The beams are relatively narrow chamfered with diagonally-cut stops and the

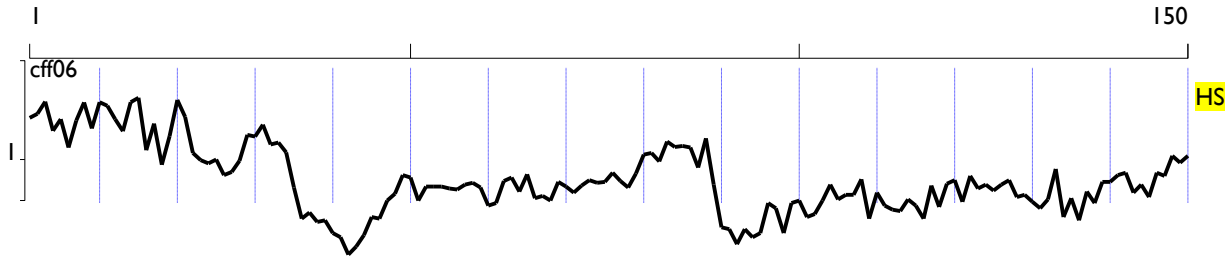
nailhead decoration occurs only on the chamfer facing the fireplace. There is no evidence for a fireplace stair, as in other early Snowdonian houses (e.g. Cae-glas 1547/48). The Caernarvonshire *Inventory* suggested that Coedyffynnon may have been a hall-house with inserted floor because it has cusped windbraces in the principal chamber. However, cusped windbraces/trusses are a feature of several early storeyed houses - Coedyffynnon is an early storeyed house and the tree-ring dates are consistent with the plan and detail. Plan and description in RCAHMW, *An Inventory of . . . Caernarvonshire, Volume I: East* (1956), pp. 172, fig. 164. NPRN 26304.

SAMPLING

Sampling took place in January 2012. 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 **cff**. 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. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer allowing the measurement of ring-widths to the nearest 0.01 mm using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004), which was also used for subsequent analysis, along with other programs written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, with Figures 1 and 2 giving more information on the position of the samples. A number of series were quite long, but contained abrupt growth changes, for example cff06, the semi-logarithmic plot for which is shown below.



Only four samples dated. These did not match each other particularly well (Table 2) and therefore independent dating for each is shown in Table 3a, but when combined into a 91-year site master sequence, **COEDYFNN,** this matches well with dated reference material. Interestingly, most of the matches are with sites to the east, rather than local material, perhaps indicating the wood was brought in from elsewhere.

Interpretation of the dates within the context of the building is a little complicated. The accepted wisdom (Smith 1988) suggests that the primary phase was built as a Hall, with a floor being inserted within a few decades. Only one timber retained complete sapwood, and this was a roof timber from a tree felled in Spring 1537. However, a floor timber only lost 2-3mm from the bark edge on coring, and is interpreted as coming from a tree felled in the 1520s – earlier than the roof. It could of course

represent a stock-piled timber, the other dated floor timber coming from a tree most likely felled in the period 1527-57.

ACKNOWLEDGEMENTS

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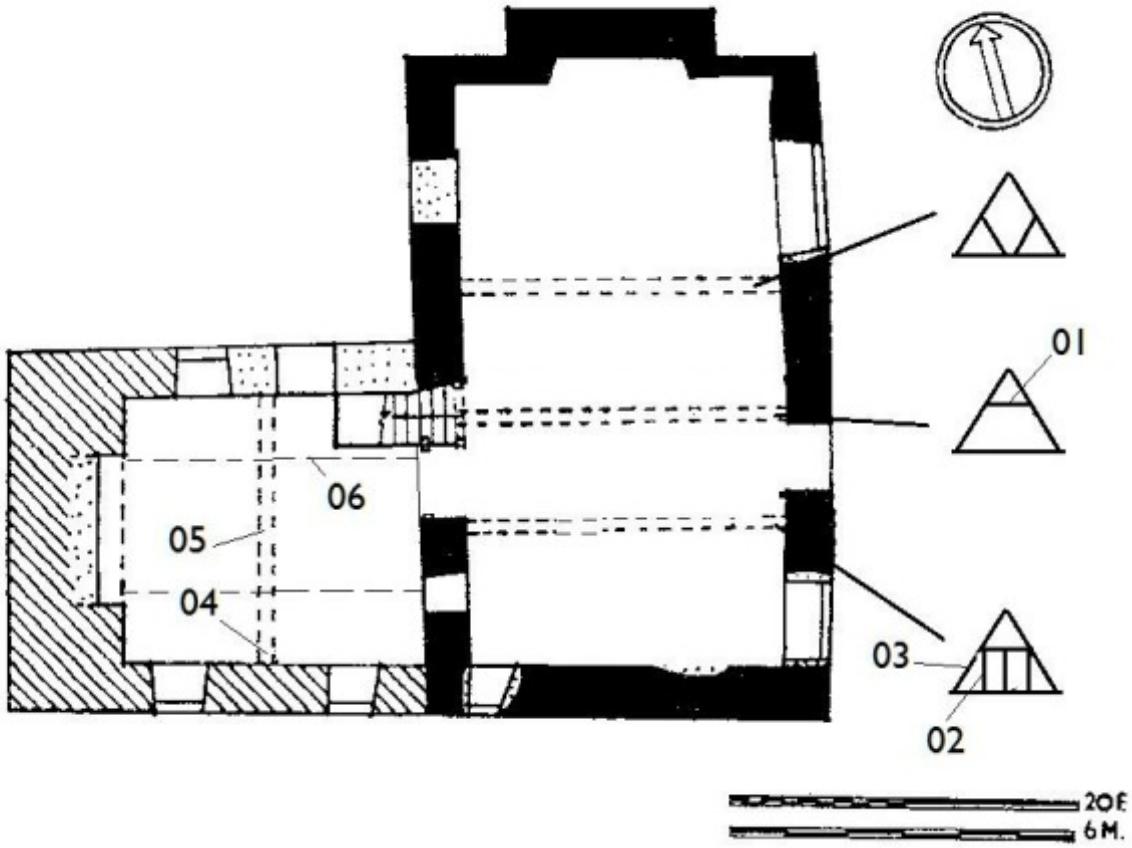

Figure 1: Plan of the roof areas showing the various parts of the building and the areas from which samples were taken for dendrochronology. Adapted from an original in RCAHMW, *An Inventory of . . . Caernarvonshire, Volume I: East* (1956).

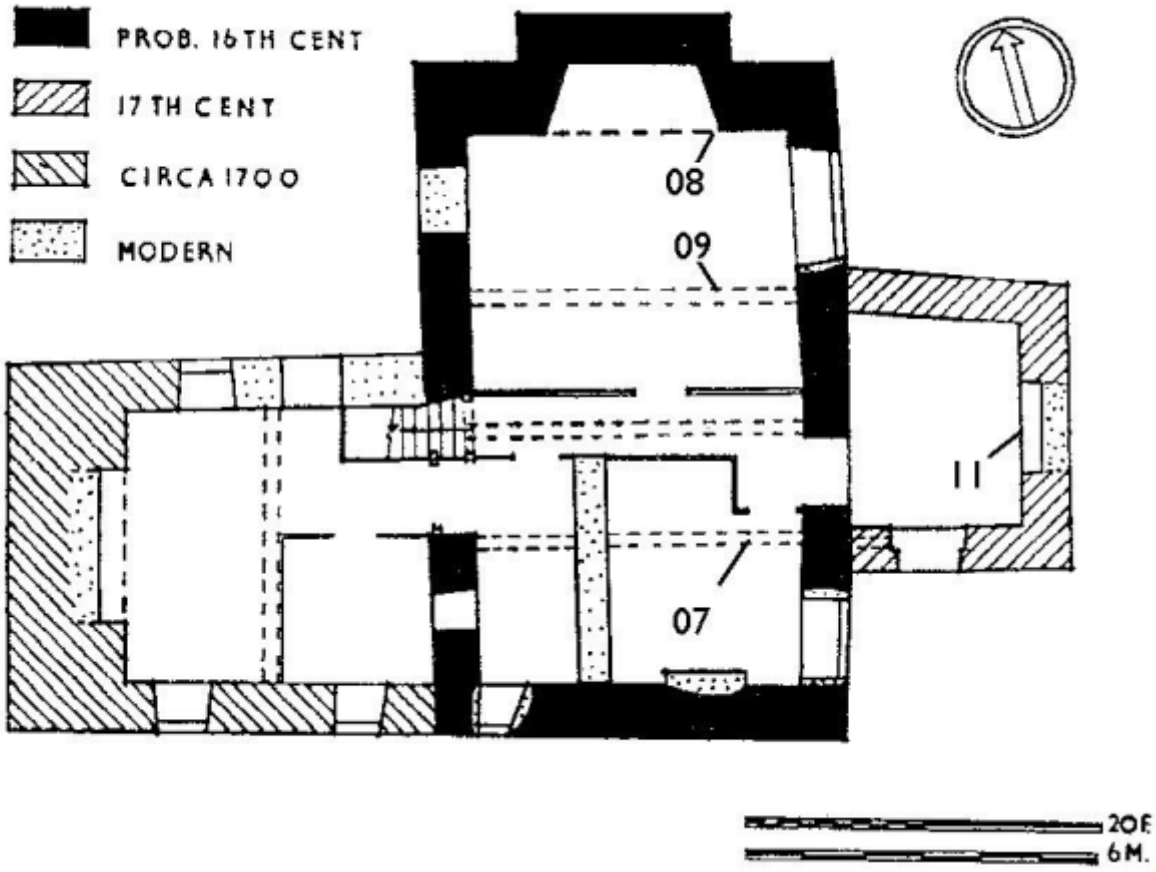

Figure 2: Plan of the ground floor, showing the various parts of the building and the areas from which samples were taken for dendrochronology. Adapted from an original in RCAHMW, *An Inventory of . . . Caernarvonshire, Volume I: East* (1956).

Table 1: Details of samples taken from Coedyffynnon, Penmachno, Betws-y-Coed Conwy.

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
Roof over Primary Phase									
* **cff01**	Collar to central truss	1446–1507	1507	h/s	62	2.94	0.92	0.18	1518–48
cff02	West vertical strut, south truss	undated	-	20½C	61	2.53	0.87	0.19	-
* **cff03**	West principal rafter, south truss	1450–1536	1517	19¼C	87	2.37	0.88	0.17	Spring 1537
Roof over West extension									
cff04	South principal rafter to west truss	undated	-	?h/s	111	0.86	0.42	0.18	-
cff05	Collar to west truss	undated	-	h/s	71	1.95	1.10	0.26	-
cff06	North purlin	undated	-	h/s	150	0.85	0.54	0.22	-
Floor to Primary Phase									
* **cff07**	Main axial beam, south room	1450–1515	1500	15+4NM∫	66	2.69	1.66	0.17	1520–25
* **cff08**	Decorated beam, north room	1446–1519	1516	3	74	2.75	0.82	0.19	1527–57
cff09	Main axial beam, north room	undated	-	18	67	1.64	0.56	0.19	-
Porch									
cff10	Axial beam	undated	-	11½C	126	1.83	1.12	0.20	-
cff11	Window lintel	undated	-	9	42	1.71	1.05	0.29	-
*** =** included in Site Master **COEDYFNN**		**1446–1536**	**-**	**-**	**91**	**2.42**	**1.05**	**0.13**	**-**

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, winter felled; ¼C = complete sapwood, felled the following spring; ½C = complete sapwood, felled the following summer; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured; ∫ = only 2-3mm lost to bark edge.

Table 2: Cross-matching between the dated samples

	***t*-values**		
Sample	**cff03**	**cff07**	**cff08**
cff01	3.5	2.3	6.5
cff03		1.2	3.8
cff07			2.7

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Table 3a: Dating evidence for the individual dated samples

Sample	*County or region:*	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
cff01	Wales	Neuadd Cynhinfa Pontrobert	(Miles and Haddon-Reece 1996)	neu1	1438-1506	61	6.7
	Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404-1981	62	6.5
	Herefordshire	Cradley Village Hall	(Miles *et al* 2004)	CRADLEY	1347-1530	62	6.3
cff03	Wales	Dulasau-uchaf, Penmachno	(Miles *et al* 2011)	dluc02	1450-1551	87	6.1
	Shropshire	Whittington Castle	(Miles *et al* 2004)	WHITNGTN	1351-1628	87	5.3
	Leicestershire	Ulverscroft Priory	(Arnold *et al* 2008)	ULVASQ03	1388-1533	84	5.3
cff07	Gr Manchester	Lightshaw Hall, Golborne	(Groves 1998)	LGHTSHW2	1414-1552	66	6.1
	Herefordshire	Cradley Village Hall	(Miles *et al* 2004)	CRADLEY	1347-1530	66	4.9
	Nottinghamshire	Askham	(Howard *et al* 2003)	ASKASQ01	1439-1539	66	4.7
cff08	Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404-1981	74	9.6
	Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881-1745	74	9.4
	Gloucestershire	Swan House, Blakeney	(Miles *et al* 2009)	SWANHS	1386-1628	74	8.4

Table 3b: Dating evidence for the site master **COEDYFNN AD 1446–1536** against dated reference chronologies.
Regional multi-site chronologies are shown in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404-1981	91	8.6
Herefordshire	Cradley Village Hall	(Miles *et al* 2004)	CRADLEY	1347-1530	85	8.3
Herefordshire	Forbury Chapel, Leominster	(Arnold *et al* 2003)	HFCASQ01	1432-1520	75	8.1
Gloucestershire	Swan House, Blakeney	(Miles *et al* 2009)	SWANHS	1386-1628	91	7.8
Herefordshire	Little Brockhampton Gatehouse	(Nayling 2001)	LBG-T10	1368-1543	91	7.7
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881-1745	91	7.4
Shropshire	8-10 High Street, Bishop's Castle	(Miles *et al* 2011)	BCSC	1422-1508	63	7.3
Wales	Ty Mawr, Wybrnant	(Miles *et al* 2011)	WYB	1437-1564	91	7.2
Wales	Cotehele tester	(Miles unpublished)	COTEHELE	1327-1509	64	7.0
Wales	Royal House, Machynlleth	(Miles *et al* 2004)	ROYALHS1	1363-1560	91	6.9
Wales	Llansantfraidd	(Miles and Worthington 2002)	TUHWNT	1400-1647	91	6.8
Wales	Neuadd Cynhinfa Pontrobert	(Miles and Haddon-Reece 1996)	neu1	1438-1506	61	6.8
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440-1742	91	6.6
Shropshire	Whittington Castle	(Miles *et al* 2004)	WHITNGTN	1351-1628	91	6.6
Lancashire	Worden Old Hall, Chorley	(Bridge 2003)	OLDWORD2	1415-1531	86	6.4

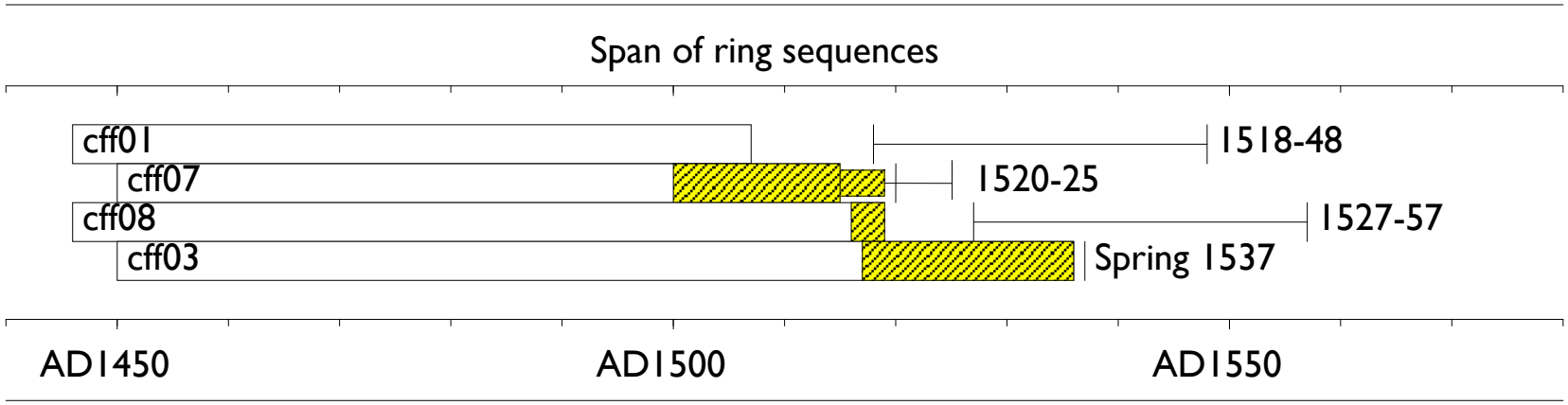

Figure 3: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings