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Oxford Dendrochronology Laboratory
Report 2017/02

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM LLANERCH, CYNWYD, MERIONETH (SJ 044 386)

Summary

Timbers were sampled from the primary cruck phase of the house, the inserted floor and the fireplace, and one timber from a cruck in the associated barn. Many of the timbers had been sand-blasted, and it was not clear in all cases if the outside ring was the final sapwood ring, though the results suggest that the timbers of the primary phase were all felled in the winters of 1501/02 and 1502/03. A sample from the screen did not give significant matches to the other dated primary features, although it dated well on its own, suggesting a different source area for this timber. Two timbers from the inserted floor dated, one retaining complete sapwood, from a tree felled in the winter of 1614/15. The cruck sampled in the barn failed to date.

Authors: Dr D. Miles FSA and Dr M. C. Bridge FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

January 2017

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 Dating of Timbers from Llanerch, Cynwyd, Merioneth (SJ 044 386)

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.

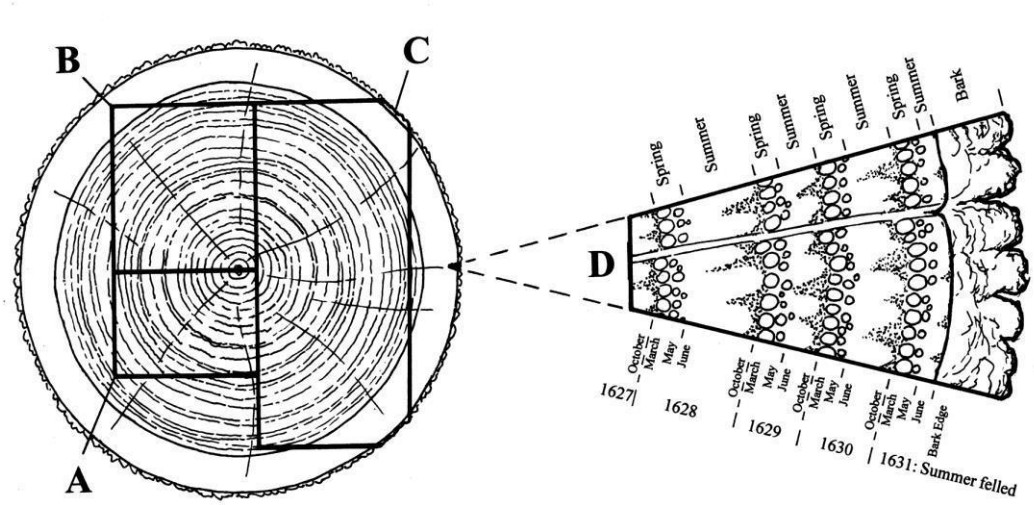
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

Llanerch

C17th farmhouse; cruck-framed hall-house in origin with three cruck-trusses surviving. 1661 graffiti date alongside inserted chimney possibly dates replacement of timber walls. Site associated with cruck-framed barn of four bays (NPRN 421848). Not listed. RFS/RCAHMW/ Dec. 2016

SAMPLING

Samples were taken in December 2016. The locations of the samples are described in Table 1. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **lll**) and were polished with progressively finer grits down to 800 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 were written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker, and in DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

Details of the samples are given in Table 1. Cross-matching between the timbers (Table 2) resulted in six timbers from the primary phase being combined into a 133-year long site chronology (**LLANRCH1**), which was subsequently dated to the period 1370–1502, the strongest matches being shown in Table 3a. The matching suggests the timber grew locally. The timbers had been sand-blasted, making it difficult to determine whether or not the outer rings present actually represented the last ring of growth of the tree. Whilst two timbers were thought to have complete sapwood and were felled in the winter of 1501/02, another may have been felled the following winter (1502/03). The apex of the crucks was cusped on the inside.

One timber (**LLL07**), from the screen, did not give any significant matches with the other primary timbers (Table 2), but did date on its own (Table 3b) – the results suggesting that this timber may have come from elsewhere, possibly even England – perhaps the boards and muntins were specialist material imported to the area. The screen head beam was a separate timber set immediately below the cruck tiebeam, which is unusual; normally the planks and muntins would be let into the underside of the tiebeam. This may suggest a slight change of plan during construction.

Two timbers from the inserted floor matched each other (t = 5.6 with 58 years overlap), and these were combined to form a second site chronology (**LLANRCH2**), subsequently dated to the period 1492–1614 (Table 3c). One retained complete sapwood, and was found to be from a tree felled in winter 1614/15. Whilst probably of local origin, these timbers match well with material from further east. The inserted floor joists were tenoned into the tiebeam of the closed cruck truss, and the joists had stop chamfers that respected the mantle beam, suggesting that the fireplace and stack were inserted at the same time, although since there was no smoke-blackening, there may have been an earlier stack.

The relative positions of overlap of the dated samples, along with their actual or interpreted likely felling date ranges, are shown in Fig 1.

The samples from the mantelbeam and the cruck in the barn on the site both showed dramatic abrupt growth changes (the plot for LLL11 being shown in Fig 2) and these could not be dated.

ACKNOWLEDGEMENTS

The Discovering Old Welsh Houses - North East Wales Project - acknowledges that this project would not have been possible without the grants gratefully received from the Woodtiger Fund, the Marc Fitch Fund, the Vernacular Architecture Group and the Clwydian Range & Dee Valley Area of Outstanding Natural Beauty Fund

We thank the many members of DOWHG who made arrangements for our visits, and assisted during the fieldwork, and to the owners, Mr and Mrs Mollison-White for allowing the work to be carried out. Margaret Dunn provided transport, and we are particularly grateful to the owner's father, who came out to transport DM to site after Margaret had trouble with her car just short of the destination. Richard Suggett was on site, and suggested the speculative sample from the barn be taken.

We also thank our fellow dendrochronologists for permission to use their data.

REFERENCES

Arnold, A. and Howard, R. (2009) *The Manor House, Hall Green Road, West Bromwich, West Midlands, Tree-ring analysis of the timbers*, **EH Res Dept Rep Ser**, 49-2009.

Arnold, A. J. and Howard, R. E. (2014) *Walmer Castle, Kingsdown Road, Deal, Kent: tree-ring analysis of oak and pine timbers*, **HE Res Rep Ser**, 40-2014.

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. (2002) *Tree-ring analysis of timbers from Muchelney Abbey, Muchelney, near Langport, Somerset*, **Centre for Archaeology Rep**, 114/2002.

Bridge, M. C., Miles, D., Suggett, R. and Dunn, M. (2013) Tree-Ring Dating Lists, **Vernacular Architecture**, 44, 105-111.

Bridge, M. C., Miles, D., Suggett, R. and Dunn, M. (2014) Tree-Ring Dating Lists, **Vernacular Architecture**, 45, 125-126.

Bridge, M. C., Miles, D., Suggett, R., and Dunn, M. (2015) Tree-Ring Dating Lists, **Vernacular Architecture**, 46, 112-116.

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., Litton, C. D. and Arnold, A. J. (2006) *Tree-ring analysis of timbers from Lord Leicester's Stables, Kenilworth Castle, Warwickshire*, **EH Research Dept Rep Ser**, 21/2006.

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

Miles, D.H. (2004) Working compilation of reference chronologies centred around Somerset by various researchers, unpublished computer file SOMRST04, Oxford Dendrochronology Laboratory.

Miles, D. H. and Haddon-Reece, D. (1996) List 72 - Tree-ring dates, **Vernacular Architecture**, 27, 97-102.

Miles, D. H. and Worthington, M. J. (1999) Tree-ring dates, **Vernacular Architecture**, 30, 98-113.

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. (2003) Tree-ring dates, **Vernacular Architecture**, 34, 109-113.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2004) Tree-ring dates, **Vernacular Architecture**, 35, 95-113.

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.

Tyers, I. (1996) *The tree-ring analysis of six secular buildings from the city of Hereford*, **Anc Mon Lab Rep**, 17/96.

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

Tyers, I. and Boswijk, G. (1998) *Tree-ring analysis of oak timbers from Dore Abbey, Abbey Dore, Herefordshire*, **Anc Mon Lab Rep**, 18/98.

Table 1: Details of samples taken from Llanerch, 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
LLL01	Rear cruck to closed truss	1425-1502	1491	11?C	78	2.19	0.64	0.25	?winter 1502/03
LLL02	Rear stud tie/collar, closed truss	1419-1501	1474	27?C	83	1.26	0.61	0.20	?winter 1501/02
LLL03	Front stud tie/collar, closed truss	1405-1501	1473	28?C	97	1.19	0.52	0.19	?winter 1501/02
LLL04	King strut over collar, closed truss	1433-1501	1478	23C	69	2.09	1.68	0.24	Winter 1501/02
LLL05a	Front lower purlin, hall bay	*1425-1501*		*22C*	*77*	*1.85*	*1.47*	*0.22*	
LLL05b	*ditto*	*1433-1501*		*19C*	*69*	*2.22*	*1.06*	*0.25*	
LLL05	Mean of **05a** and **05b**	1425-1501	1479	22C	77	2.15	1.30	0.22	Winter 1501/02
LLL06ai	Rear cruck, open truss	*1370-1407*		-	*38*	*1.72*	*0.58*	*0.24*	
LLL06aii	*ditto*	*1419-1479*		-	*61*	*1.21*	*0.36*	*0.25*	
LLL06b	*ditto*	*1376-1482*		*1*	*107*	*1.30*	*0.52*	*0.26*	
LLL06	Mean of **06ai**, **06aii** and **06b**	1370-1482	1481	1	113	1.36	0.52	0.25	1492–1522
LLL07	Muntin nearest door	1375-1458	1458	H/S	84	1.77	0.55	0.21	1469–99
LLL08	Transverse beam in hall ceiling	1492-1572	1572	H/S	81	2.01	1.21	0.29	1583–1613
LLL09	7th joist from front, by fireplace	1515-1614	1573	41C	100	1.06	0.73	0.27	Winter 1614/15
LLL10a	Mantelbeam	-	-	*44?C*	*112*	*1.61*	*1.83*	*0.25*	
LLL10b	*ditto*	-	-	*43*	*43*	*0.73*	*0.33*	*0.22*	
LLL11	Cruck in barn	-		26¼C	157	1.20	0.73	0.25	
* = included in site master **LLANRCH1**		**1370–1502**			**133**	**1.67**	**0.57**	**0.18**	
Ω = included in site master **LLANRCH2**		**1492–1614**			**123**	**1.49**	**1.20**	**0.27**	

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

Table 2: Cross-matching between the dated samples (*t*-values above 3.5 are significant)

Sample	LLL02	LLL03	LLL04	LLL05	LLL06	LLL07
LLL01	3.8	3.4	5.5	6.2	4.0	*
LLL02		5.5	3.7	3.2	2.9	2.3
LLL03			2.4	1.7	2.3	1.8
LLL04				8.4	2.2	2.0
LLL05					2.0	1.1
LLL06						1.7

* = overlap less than 40 year, not calculated

Table 3a: Dating evidence for the site chronology **LLANRCH1** **AD 1370–1502** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440–1742	133	7.7
North Wales	North Wales Master	(ODL 2016)	**NWALES**	1306–1758	133	7.7
East Midlands	East Midlands Master	(Laxton and Litton 1988)	**EASTMID**	882–1981	133	7.2
Site Chronologies						
Denbighshire	Rose and Crown, Gwyddelwern	(Miles and Worthington 2000)	GWYDWN	1411–1571	92	8.8
Montgomeryshire	Neuadd Cynhinfa Pontrobert	(Miles and Haddon-Reece 1996)	neu1	1438–1506	65	8.5
Wales	Cotehele tester	(Miles unpublished)	COTEHELE	1327–1509	133	8.2
Denbighshire	Glas Hirfryn,	(Bridge *et al* 2014)	GHN	1404–1557	99	7.9
Merioneth	Gwernbraichdwr, Llandderfel	(Bridge *et al* 2016)	GWRNBRDW	1404–1585	99	7.8
Merioneth	Cwrt Plas yn Dre	(Bridge *et al* 2013)	CWRTPLAS	1397–1508	106	7.6
Denbighshire	Bryngwylan, Abergele, Conwy	(Bridge *et al* 2013)	BRYNGWYL	1430–1586	73	7.6
Merioneth	Ty Cerrig, Llandower	(Bridge *et al* 2015)	TYCERRIG	1373–1633	130	7.6
Montgomeryshire	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384–1593	119	7.5

Table 3b: Dating evidence for the site sequence **LLL07** **AD 1375–1458** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
Somerset	Somerset Master Chronology	(Miles 2004)	**SOMRST04**	770–1979	84	5.4
Site Chronologies						
Montgomeryshire	Parliament House	(Miles *et al* 2004)	PARLMNT1	1306–1451	77	6.1
Hampshire	Army & Navy Store, Alton	(Miles and Worthington 1999)	ARMYNAVY	1350–1500	84	6.1
Somerset	Muchelney Abbey	(Bridge 2002)	MUCHNEY	1148–1498	84	6.0
Hampshire	Place House Cottage	(Miles and Worthington 1999)	PLACEHS	1311–1447	73	5.7
Herefordshire	Farmer's Club, Hereford	(Tyers 1996)	HEREFC	1313–1617	84	5.6
Somerset	Old Post Office, Luccombe	(Miles *et al* 2003)	LUCCOMBE	1380–1436	57	5.5
Radnorshire	Great House, Newchurch	(Miles and Haddon-Reece 1996)	GRTHOUSE	1359–1449	75	5.5
Herefordshire	Dore Abbey	(Tyers and Boswijk 1998)	DORE2	1363–1612	84	5.4
Kent	Walmer Castle, Deal	(Arnold and Howard 2014)	WLMCSQ01	1396–1523	63	5.2

Table 3c: Dating evidence for the site chronology **LLANRCH2 AD 1492–1614** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Site Chronologies						
Denbighshire	Ty Mawr, Druid, Corwen	(Miles *et al* 2010)	DENBY1	1440–1583	92	6.9
Denbighshire	Berain, Llannefydd	(Bridge *et al* 2014)	BERAIN	1469–1553	62	6.8
Shropshire	Church Farm, Ditton Priors	(Miles *et al* 2004)	DITTON5	1437–1578	87	6.2
Warwickshire	Baddesley Clinton	(Miles and Worthington 2002)	BADESLY3	1423–1577	86	6.1
Warwickshire	Kenilworth Castle	(Howard *et al* 2006)	KNWESQ02	1482–1599	108	6.0
W Midlands	Manor House, West Bromwich	(Arnold and Howard 2009)	WBRASQ01	1318–1590	99	5.8
Montgomeryshire	Blaen-y-cwm, Pennant Melangell	(Miles *et al* 2005)	BLNYCWM3	1457–1646	123	5.7
Shropshire	Dutch Cottage, Clunbury	(Miles *et al* 2006)	DUTCHCOT	1424–1549	58	5.6
Shropshire	Abcott Manor, Clungunford	(Miles and Worthington 2002)	CGFA	1422–1545	54	5.5
Oxfordshire	Harwell Church	(Fletcher unpubl)	HARCHRCH	1467–1557	66	5.4
Montgomeryshire	Rhos-fawr-isaf, Meifod	(Miles *et al* 2005)	RHOSFAWR	1430–1576	85	5.4

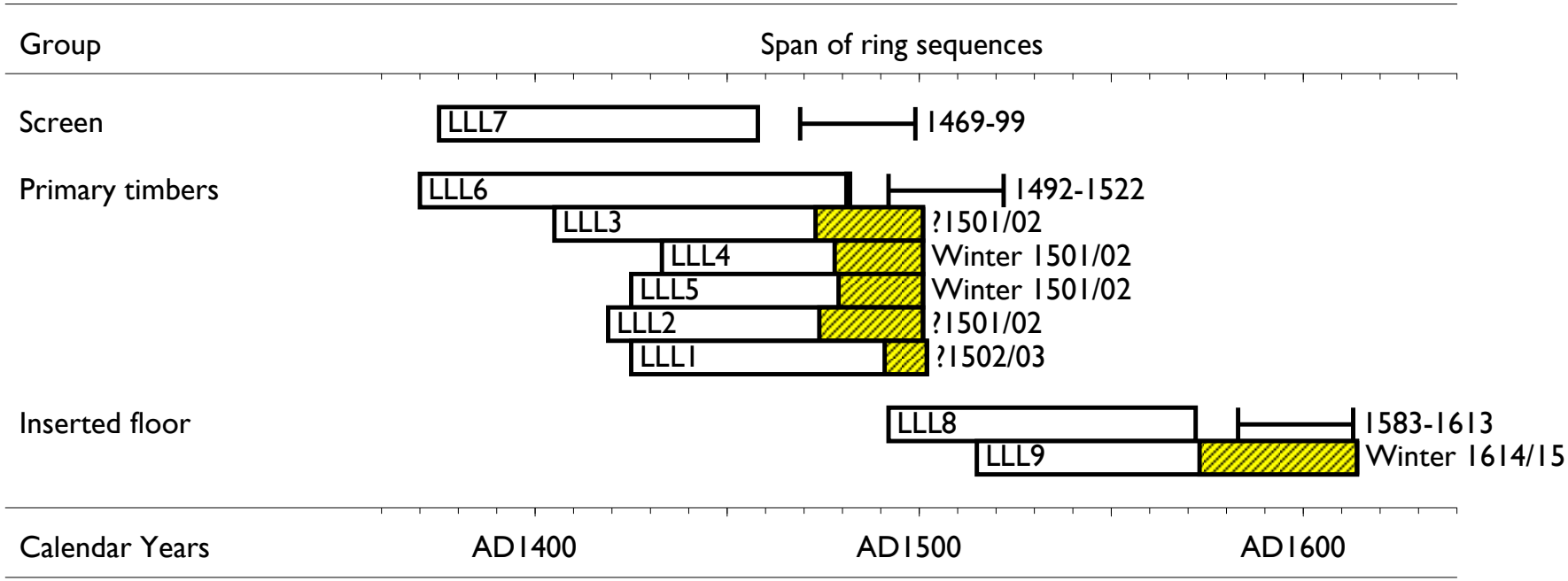


Figure 1: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.

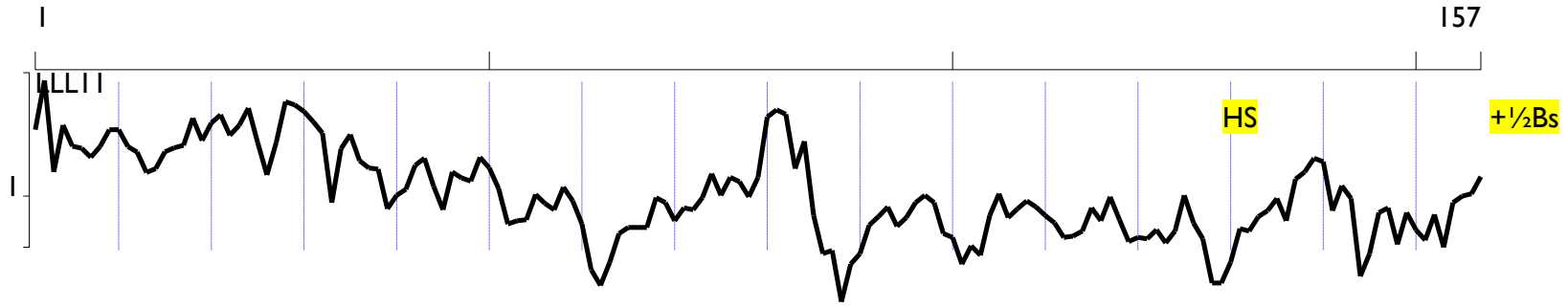


Figure 2: Plot of the ring width series for sample lll11 showing the abrupt growth changes along its length (y axis, width in mm on a log scale)