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PORCH HOUSE,
1 WATERSIDE,
CASTLE COMBE,
CHIPPENHAM,
WILTSHIRE

TREE-RING ANALYSIS OF TIMBERS

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SUMMARY

Analysis by dendrochronology of samples from two suitable timbers in this cottage has resulted in the production of a single dated site chronology comprising both the samples obtained, this having an overall length of 69 rings. These rings were dated as spanning the years 1368–1436. Interpretation of the sapwood on the samples would indicate that the timbers were probably all cut as part of a single programme of felling at some point between 1455 at the earliest and 1465 at the latest.

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Introduction

Porch House (number 1 Waterside, close to the river Bybrook) in Castle Combe, Wiltshire (ST 841 766, Figs 1a/b) (popularly believed to be the prettiest village in England), presents itself as a very fine, two-storey with attic-floor cottage built of Cotswold stone beneath a stone tile roof. The attic floor rooms are lit by a gabled dormer window. Number 1 forms part of a terrace of other cottages to Waterside, notably numbers 2 and 3, a pair of cottages with rough rendered stone, and a similar stone tiled roof, and listed as being of later-eighteenth century date. The left hand, gabled, door of number 2 is now part of 1 Waterside over which, at first floor level and above, there is a flying freehold (Fig 2).There is a substantial chimney between numbers 1 and 2, with some interesting stonework at ground floor level.

Sampling

Sampling and analysis by tree-ring dating of the timbers within Porch House were commissioned by Shirley Ungemuth. This was undertaken as part of a long-standing personal interest in the building and its history, and as part of a general programme of research into its origins and development. It was hoped that tree-ring dating would provide dates for the trusses of the roof, and thus possibly provide some information about the origins of the building.

Although there are some smaller timbers to the lower floors, the most substantial beams, and those which appear most likely to be integral and primary to the structure, are found at attic room level. These comprise a substantial principal-rafter-with-collar truss which originally probably had double purlins to each slope of the roof. Only one original purlin now appears to remain, and the collar has either been re-set or, more likely, removed and replaced by a more recent slightly cambered collar set at a slightly higher level. The original ridge beam has also been replaced (Fig 3). It seems likely, given that the purlins appear to have run on to both north and south from this truss, that there were other trusses to either of the truss that now remains in this roof.

The carpentry of the timbers appears to be of some quality, the mortices, for example, being marked-out with scribe lines (Fig 4a), and the joints being numbered for ease of assembly (Fig 4b). It would appear that many of the baulk timbers have been carefully half-sawn from whole trees using a quality saw, this action having left very fine, evenly spaced, saw-marks on the one face of such timbers (Fig 4c). The other, apparently outer, faces of the trees have been cut reduced or trimmed using an adze or axe (Fig 4d). One feature of note is the compass-scribed circle seen to the north face of the east, or rear, principal rafter, just below the mortice for the purlin (Fig 4e). It is possible that this was the first stage in the marking out of a never completed ‘floret’ or rosette, patterns which are quite often seen on medieval timbers. The meaning of these marks is unknown, and indeed, it is probable that they are of no significance other than being something of a ‘doodle’, or a marking-out exercise undertaken by a carpenter during a possibly moment of relaxation or idleness.

Thus, core samples were obtained from each of the two principal rafters, these being the only timbers which appeared to be primary to the structure and which had sufficient rings (ie, more than about 50) for reliable dating. Although there were other timbers, these appeared either to be later insertion or alteration pieces, or to be too small or derived from fast grown trees, and had insufficient numbers of rings. Such timbers were not sampled.

Each sample was given the code CCM-A (for Castle Combe, site – site 'A'), and numbered 01 and 02. The sampled timbers are located on the photograph, Figure 3. Details of the samples are given in Table 1, including the timber sampled and its location, the total number of rings each sample has, and how many of these, if any, are sapwood rings. The individual date span of each dated sample is also given. In this Table, the front of the cottage is deemed to face west, while the rear of the cottage faces east.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank Shirley Ungemuth for her enthusiastic support for this programme of research, and for allowing unlimited access to the building. We would also like to acknowledge the generous funding provided for this programme of work.

Tree-ring dating

Tree-ring dating relies on a few simple, but quite fundamental, principles. Firstly, as is commonly known, trees (particularly oak trees, the timber most commonly used in building construction until the introduction of pine from the late eighteenth century onwards) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added, as a sapwood ring, to the outside of the previous year's growth just below the bark. The width of this annual growth-ring is largely, though not exclusively, determined by the weather conditions during the growth period (roughly March–September). In general, good conditions produce wider rings and poor conditions produce narrower rings. Thus, over the lifetime of a tree, the annual growth-rings display a climatically influenced pattern. Furthermore, and importantly, all trees growing in the same area at the same time will be influenced by the same growing conditions and the annual growth-rings of all of them will respond in a similar, though not identical, way (Fig 5).

Secondly, because the weather over a certain number of consecutive years (the statistically reliable minimum calculated as being 54 years) is unique, so too is the growth-ring pattern of the tree. The pattern of a shorter period of growth, 20, 30**,** or even 40 consecutive years, might conceivably be repeated two or even three times in the last one thousand years, and is considered less reliable. A short pattern might also be repeated at different time periods in different parts of the country because of differences in regional micro-climates. It is less likely, however, that such problems would occur with the pattern of a longer period of growth, that is, anything in excess of 45 years or so. In essence, a short period of growth, anything less than 45 rings, is not reliable, and the longer the period of time under comparison the better.

Tree-ring dating relies on obtaining the pattern of the annual growth of trees from sample timbers of unknown date by measuring the width of these annual growth-rings. This is done to a tolerance of 1/100 of a millimeter. The growth patterns of these samples of unknown date are then compared with a series of reference patterns or chronologies, the date of each ring of which is known. When the growth-ring sequence of a sample 'cross-matches' repeatedly at the same date span against a series of different reference chronologies the sample can be said to be dated. The degree of cross-matching, that is the measure of similarity between sample and reference, is denoted by a '*t*-value'; the higher the value the greater the similarity. The greater the similarity the greater is the probability that the patterns of samples and references have been produced by growing under the same conditions *at the same time*. The statistically accepted fully reliable minimum *t*-value is 3.5.

However, rather than attempt to date each sample individually it is usual to first compare all the samples from a single building, or phase of a building, with one another, and attempt to cross-match each one with all the others from the same phase or building. When samples from the same phase do cross-match with each other they are combined at their matching positions to form what is known as a 'site chronology'. As with any set of data, this has the effect of reducing the anomalies of any one individual (brought about in the case of tree-rings by some non-climatic influence) and enhances the overall climatic signal. As stated above, it is the climate that gives the growth pattern its distinctive pattern. The greater the number of samples in a site chronology the greater is the climatic signal of the group and the weaker is the non-climatic input of any one individual.

Furthermore, combining samples in this way to make a site chronology usually has the effect of increasing the time-span that is under comparison. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any site chronology with less than about 55 rings is generally too short for reliable dating.

Having obtained a date for the site chronology as a whole, the date spans of the constituent individual samples can then be found, and from this the felling date of the trees represented may be calculated. Where a sample retains complete sapwood, that is, it has the last or outermost ring produced immediately below the bark by the tree before it was cut, the last measured ring date is the felling date of the tree.

Where the sapwood is not complete it is necessary to estimate the likely felling date of the tree. Such an estimate can be made with a high degree of reliability because oak trees generally have between 15 to 40 sapwood rings. For example, if a sample with, say, 12 sapwood rings has a last sapwood ring date of 1400 (and therefore a heartwood/sapwood boundary ring date of 1388), it is 95% certain that the tree represented was felled sometime between 1403 (1400+3 sapwood rings (12+3=15)) and 1428 (1400+28 sapwood rings (12+28=40)).

Analysis

Each of the two samples obtained from the roof timbers of Porch House was prepared by sanding and polishing, and the widths of their annual growth rings were measured. The data of these measurements were then compared with each other as described in the notes above. By this process it was seen that the growth patterns of both samples cross-matched with each other at positions as shown in the bar diagram, Figure 6.

The two cross-matching samples were combined at their indicated off-set to form CCMASQ01, a site chronology with an overall length of 69 rings. This site chronology was then satisfactorily dated by repeated and consistent comparison with a large number of relevant reference chronologies for oak as spanning the years 1368 to 1436. The evidence for this dating is given in the *t*-values of Table 2.

Interpretation

Although both of the sampled roof timbers appeared to have complete sapwood on them (the last growth ring produced by the trees immediately before they were cut down), this could not be retained on the core sample; due to the soft and fragile nature of this part of the wood it was churned up and lost from the samples in coring. It is thus not possible to say with absolute precision when either of the trees was felled. Both samples do, though, retain the heartwood/sapwood boundary (h/s), meaning that *only* the sapwood rings are missing. Having noted the length of core (in millimetres) lost from the samples, it is possible to estimate approximately how many sapwood rings the lost portion might have contained. In this case the cores samples lost approximately 25–30 mm, which, it is estimated, account for about 19–29 sapwood rings. Given that the latest ring on either sample is dated to 1436, this would suggest that the trees are likely to have been cut at some point between, 1455 at the earliest and 1465 at the latest.

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Table 1: Details of tree-ring samples from Porch House, 1 Waterside, Castle Combe, Chippenham, Wiltshire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Heart/sap boundary (AD)	Last measured ring date (AD)
CCM-A01	West (front) principal rafter	57	h/sc	1380	1436	1436
CCM-A02	East (rear) principal rafter	66	h/sc	1368	1433	1433

h/s = heartwood/sapwood boundary, i.e., only the sapwood rings are missing

c = complete sapwood is found on the timber, but all or part has been lost from the sample in coring

Table 2: Results of the cross-matching of site chronology CCMASQ01 and the reference chronologies when the first ring date is 1368 and the last ring date is 1436		
Reference chronology	*t*-value	
Avebury Manor, Avebury, Wilts	8.8	(Arnold and Howard 2011 unpubl)
Ashpools, Northall, Bucks	6.8	(Howard *et al* 1990 unpubl)
Kingswood Abbey Gatehouse, Kingswood, Glos	6.5	(Arnold *et al* 2003)
April Cottage, Rothley, Leics	6.4	(Alcock *et al* 1990)
Bremhill Farm, Calne, Wilts	6.3	(Alcock *et al* 1991)
Gainsborough Old Hall, Gainsborough, Lincs	5.9	(Howard *et al* 1988)
England, London	5.9	(Tyers and Groves 1999 unpubl)
Trerice, Kestle Mill, Cornwall	5.4	(Hurford *et al* 2009)

Site chronology CCMASQ01 is a composite of the data of the relevant cross-matching samples as seen in the bar diagram Figure 6. This composite data produces an 'average' tree-ring pattern, where the overall climatic signal of the growth is enhanced, and the possible erratic variations of either individual sample are reduced. This 'average' site chronology is then compared with several hundred reference patterns covering every part of Britain for all time periods, cross-matching with a number of these only at the time span indicated, the table giving only a small selection of the very best matches as represented by '*t*-values' (ie, degrees of similarity). It may be noticed from this Table that the resultant *t*-values are well in excess of the *t*=3.5 value usually taken as the minimum acceptable level for satisfactory dating. These values, along with the many other slightly lower, unlisted, cross-matches, indicate a very firm and reliable date for the Porch House.

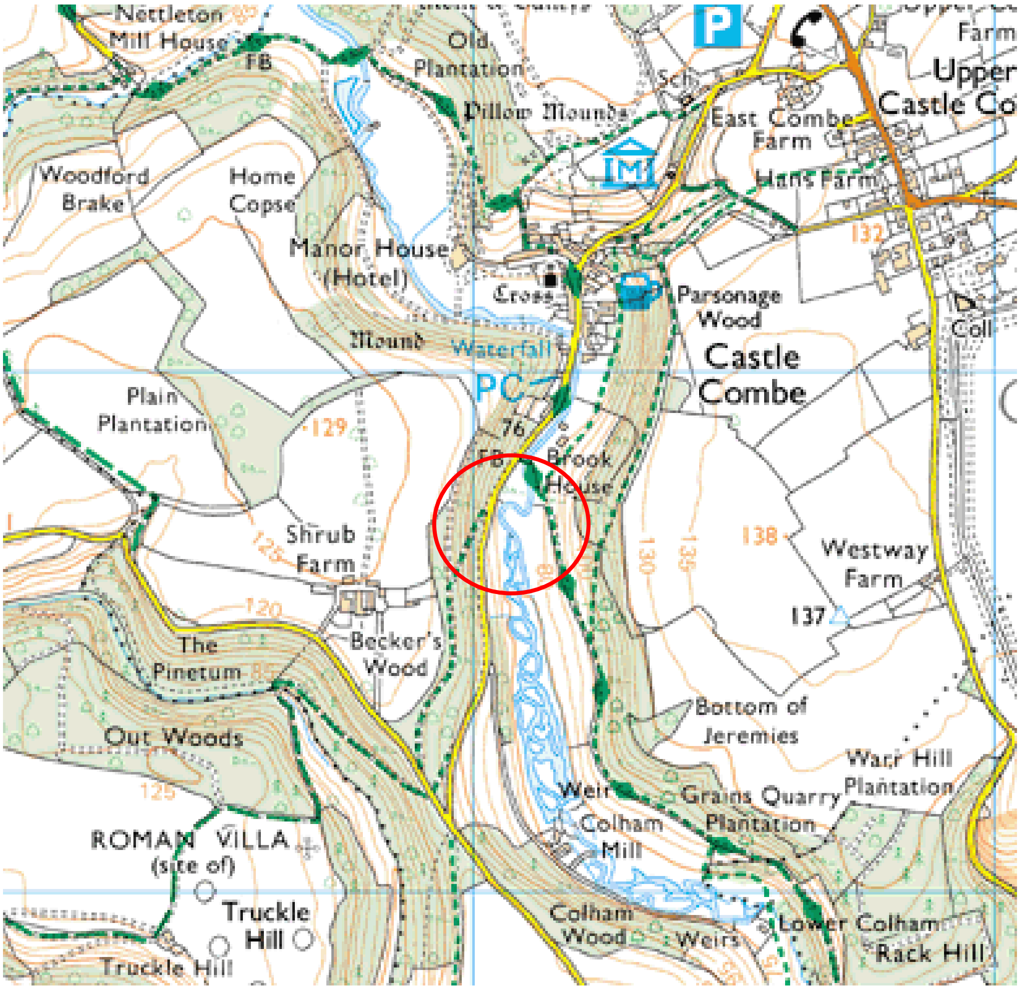


Figure 1a/b: Maps to approximate location of Castle Combe (top) and Porch House (bottom)

Figure 2: Porch House, 1 Waterside, Castle Combe, outlined, showing the entry from number 2

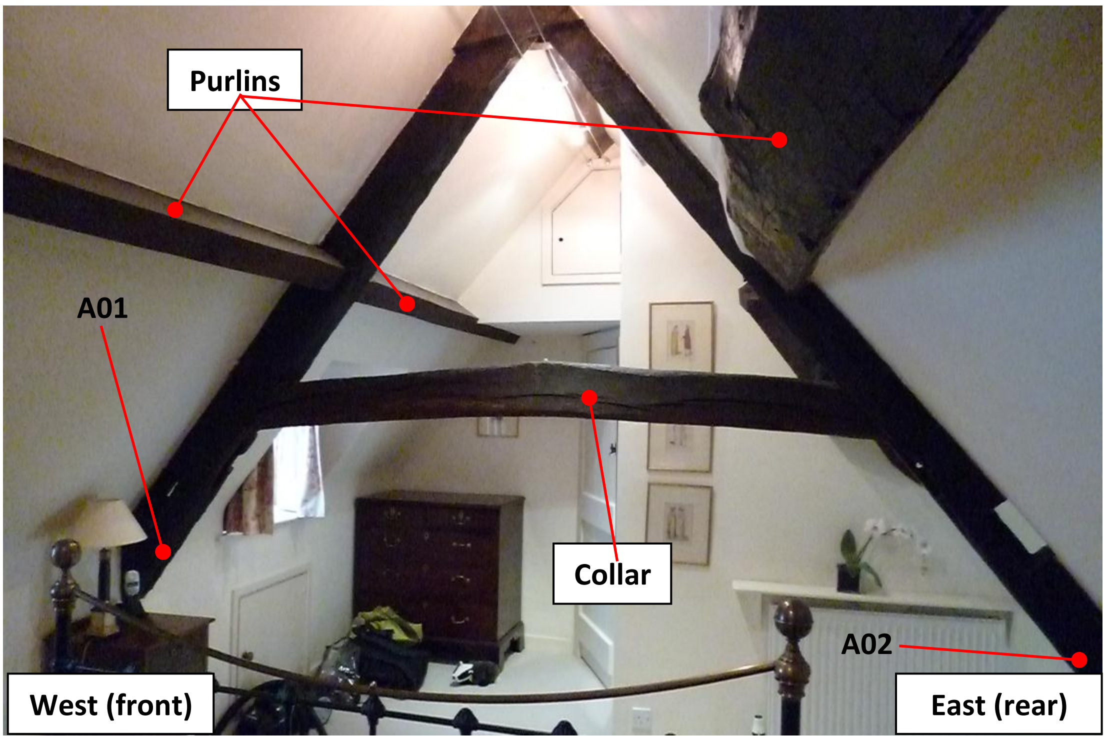


Figure 3: View of the principal rafter truss at attic floor level

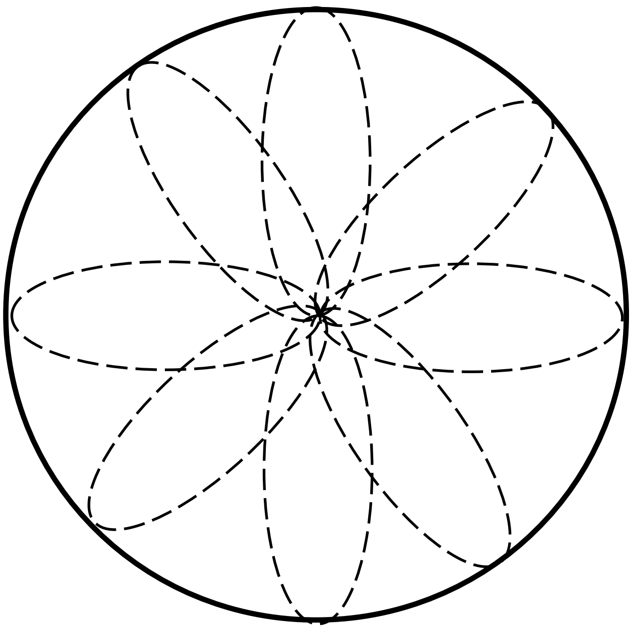
Figure 4a: Scribed marking-out lines for the cutting of the mortice joint in the front principal rafter

Figure 4b: Assembly mark for a mortice and tennon joint between collar and rafter

Figure 4c: Saw marks to the face of one timber forming parallel lines

Figure 4d: Adze marks to the face of timber forming characteristic 'scallops'

Figure 4e: Circular ‘compass’ mark to timber, possibly the beginnings of a decorative ‘florets’ inscription, and as it might have looked, completed, below



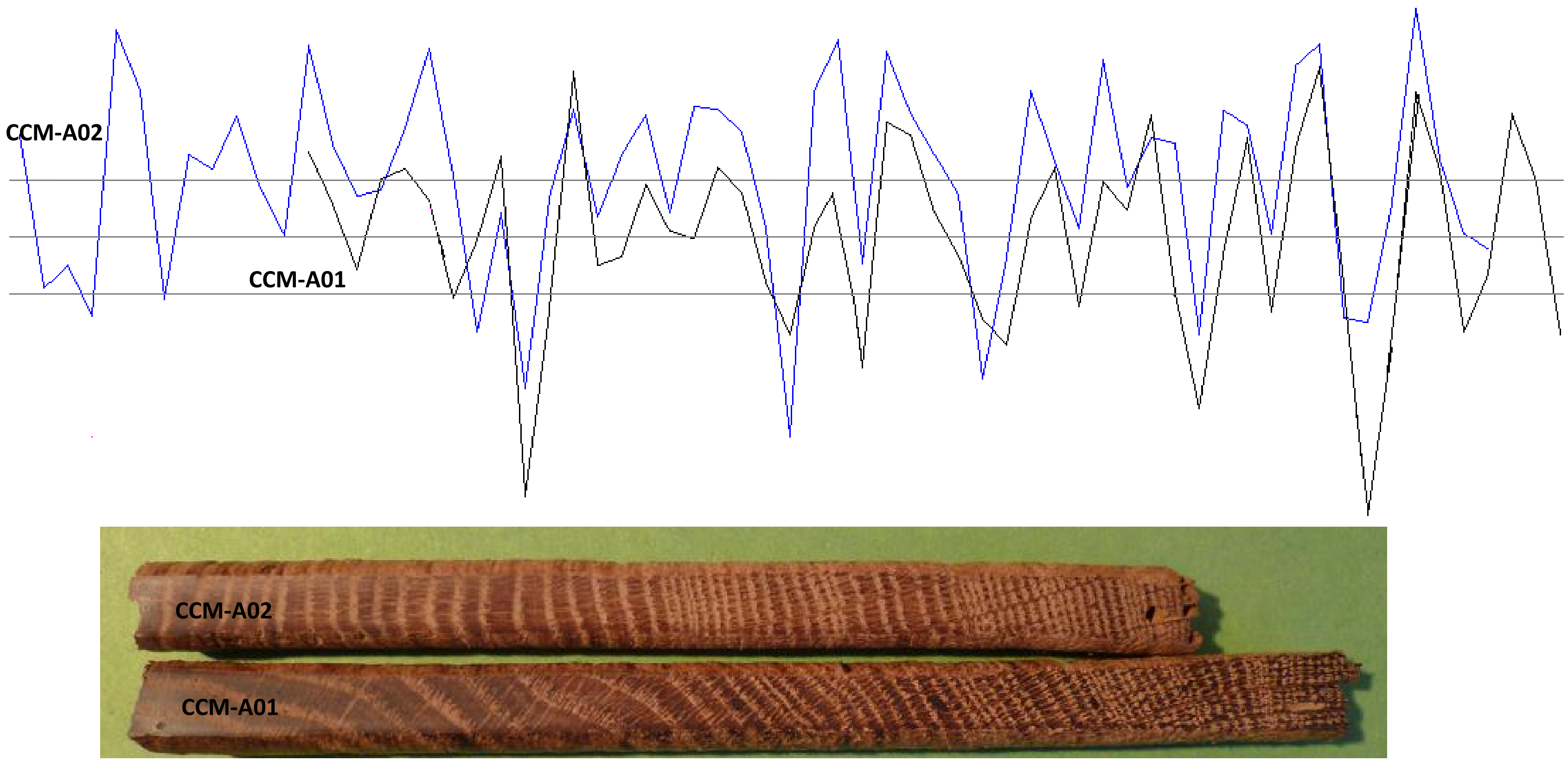
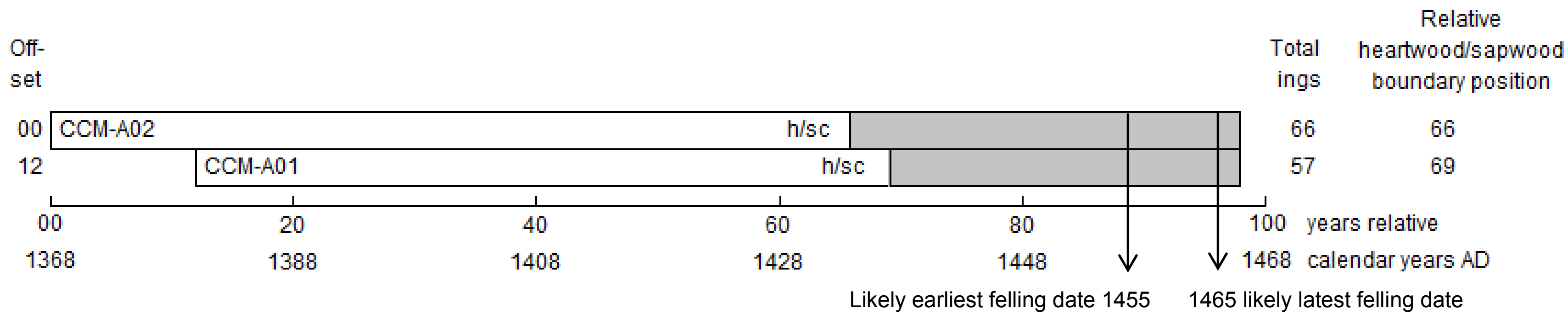


Figure 5: Graphic representation of the cross-matching of samples CCM-A01 and A02

When cross-matched at the correct positions, as here, the variations in the rings of the two samples correspond with a high degree of similarity. As the ring widths of one sample increase (represented by peaks in the graph), or decrease (represented by troughs), so too do the annual ring widths of the second sample. This similarity in growth pattern is a result of the two trees represented having grown in the same area *at the same time.* The growth ring pattern of two samples from trees grown at different times would never correspond so well.



h/s = heartwood/sapwood boundary, i.e., only the sapwood rings are missing
blank bars = heartwood rings
shaded bars = possible sapwood lost from sample in coring, based on the length of core lost

Figure 6: Bar diagram of the samples in site chronology CCMASQ01

The two samples of site chronology CCMASQ01 are shown here in the form of a bar diagram at positions where the ring variations of each sample cross-match with each other. This similarity is produced by the trees represented sharing periods of growth in common (i.e., where the bars overlap). The samples are combined at these offsets to form a 'site chronology' which is compared with a large database of reference chronologies for all time periods for all parts of England. The site chronology cross-matches only with a date span of 1368 (the date of the earliest ring on either sample, CCM-A02) to 1436 (the date of the latest ring on either sample, CCM-A01) (see Table 2).

Both of the sampled roof timbers appear to have complete sapwood on them (the last growth ring produced by the tree immediately before it was cut down). However, due to the soft and fragile nature of this part of the wood it was lost from the samples in coring and it is thus not possible to say with absolute precision when either of the trees was felled. Both samples do, though, retain the heartwood/sapwood boundary (h/s), meaning that *only* the sapwood rings are missing. Having noted the length core (in millimetres) lost from the timbers during sampling, it is possible to estimate approximately how many sapwood rings the lost portion might have contained. In this case, while it is *possible* that both trees went on growing till as late as 1468, it is most likely that both trees were felled, at one and the same time, at some pointy between, say, 1455 and 1465.