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TREE-RING ANALYSIS OF TIMBERS FROM THE GROVE, RUYTON XI TOWNS, SHREWSBURY, SHROPSHIRE

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SUMMARY

Tree-ring analysis of samples from nine oak timbers at The Grove, Ruyton XI Towns, indicates that the earliest phase of felling is represented by the two southern purlins to the roof of what is now the rear, or northern, range of this double pile house. These timbers were felled between early March and early May 1684.

A later phase of felling is represented in the ceilings of the first and ground floors to this rear range. The timbers used for these elements are estimated to have been felled between 1787 and 1812, and are almost certainly related to the development and 'Georginisation' of the building stylistically dated to the late-eighteenth century.

From the samples analysed three site chronologies were created. The first, RYTASQ01, comprises two samples, both from the front or south purlins of the roof to the rear, or north, range. This site chronology has an overall length of 122 rings which can be dated as spanning the years 1562–1683. The second site chronology, RYTASQ02, comprises five samples, all from the ceilings. This second site chronology has an overall length of 110 rings which are dated as spanning the years 1673–1782.

The third site chronology, RYTASQ03, comprises the two samples from the rear or north purlins of the rear range roof. This site chronology is 75 rings long but it cannot be dated.

NTRDL, 20 Hillcrest Grove, Sherwood, Nottingham, NG5 1FT
Telephone 0115 960 3833 (laboratory);
07980 305583 / 07913 427987 (Mobiles)
roberthoward@tree-ringdating.co.uk
alisonarnold@tree-ringdating.co.uk

Introduction

The Grove, a brick-built, double-pile, house stands on the north side of Church Street, face on to the street, close to the centre of Ruyton XI Towns. (SJ 391 222, Fig 1). The front (Fig 2a), or south, range of the double pile (Fig 2b) is a later addition to what appears to have been an already existing two-bay structure with a central chimney stack. This earlier, north range, structure was probably a two-floor (ground and first) with low attics building of 'baffle-entry' type, in which the main front door opened to face the side or flank of the central chimney. By turning right one would, as now, enter the kitchen or service end, whilst turning left would take one to the higher status living room. It is quite probable that there was a rear door opposite the front door, on the far side of the chimney. Apart from hearths to both ground floor rooms, it is likely that both rooms to the first floor were heated; the attic rooms were almost certainly not. The location of the original stairs is uncertain.

The later, south range, addition follows the format of the earlier building in having a two-cell plan, with a single room either side of the central porched entrance, and ranged over ground and first floors. The rooms of this later addition are higher than those of the earlier building, those to the first floor rooms being reached by a stylish central staircase. Stylistically, the new addition may be described as 'Georgian', its features suggesting a date in the later-eighteenth century. In this later addition the chimney stacks are at each gable end.

The timbers

The timbers within what appears to be the earlier phase of the building, the rear or north range, comprise a single truss on the line of the central stack (only clearly visible at attic level), plus single purlins to each slope of the roof in the east and west bays (Fig 3a/b). It is clear that some alteration of the central truss and movement of the purlins has taken place. While the principal rafters of the truss have lap mortices to house the purlins, these are now empty, and the purlins themselves are set higher up. It would appear that this alteration was possibly undertaken relatively recently to increase the height of the attic rooms when dormer windows were inserted into the roof.

To the ceiling of the west bay at first floor level may be found a single main, north–south, bridging beam from which run a series of smaller common joists (Fig 4a). The ceiling of the east bay to the first floor is probably similar. It too has a single north–south bridging beam, but any common joists which may exist are ceiled-in. The ceilings of both the east and west bays to the ground floor, now the kitchen and living room respectively, comprises two parallel east–west bridging beams (those to the living room now supported by Samson posts) from which run smaller common joists (Fig 4b). The main bridging beams are chamfered and stopped. There are no extant timbers in the lower portions of the more recent front, or south, range of the present building, and this part of the site was not included in this programme of analysis.

Sampling

Sampling and analysis by tree-ring dating of the timbers of within The Grove were commissioned and generously funded by the owners, Mr and Mrs White. This was undertaken out of personal interest and concern for the building, and as part of a general programme of research in to its history and development, and of its possible relationship with a number of other interesting houses in the locality. It was hoped that tree-ring analysis would establish the date of a number of timbers in what appears to be the earlier, and probably primary, extant building on the site with greater reliability, thus providing some further indication of its possible original date and of its possible sequential development.

Thus, from the timbers available a total of nine core samples was obtained from timbers located in the roof and from the first and ground-floor ceilings, each sample from a different timber. Each sample was given the code RYT-A (for 'Ruyton', site 'A') and numbered 01–09. Of these nine samples, four were obtained from the purlins of the roof structure, two from the principal bridging beams to the first floor ceiling, with the final three being taken from common joists of the ground floor ceiling structure. The positions of these samples were marked on a simple schematic sketch plans made at the time of sampling, these being later worked-up to those reproduced here as Figures

5a-c. Details of the samples are given in Table 1. In this Table, and on the plan, all trusses and the individual timbers have been numbered and/or identified on a north–south, or east–west basis, as appropriate.

Although in theory other timbers might be available for sampling, it was seen that a number of these are derived from fast-grown trees. As such, they are unlikely to provide samples with the minimum number of rings, 54, required for reliable dating. Other timbers are buried deeply in the wall and are inaccessible.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank the owners of The Grove, Mr and Mrs White for their generous funding of this programme of analysis, and for their discussions and help about the possible phasing of the building whilst sampling.

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 most frequently used building timber in England) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added 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.

Secondly, because the weather over any number of consecutive years is unique, so too is the growth-ring pattern of the tree. The pattern of a short 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. 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 54 years or so. In essence, a short period of growth, anything less than 54 rings, is not reliable, and the longer the period of time under comparison the better.

The third principle of tree-ring dating is that, until the early- to mid-nineteenth century, builders of timber-framed houses usually obtained all the wood needed for a given structure by felling the necessary trees in a single operation from one patch of woodland, or from closely adjacent woods. Furthermore, and contrary to popular belief, the timber was used "green" and without seasoning, and there was very little long-term storage as in timber-yards of today. This fact has been well established from a number of studies where tree-ring dating has been undertaken in conjunction with documentary studies. Thus, establishing the felling date for a group of timbers gives a very precise indication of the date of their use in a building.

Tree-ring dating relies on obtaining the growth pattern of trees from sample timbers of unknown date by measuring the width of the 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 relevant 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 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, 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)).

Given that in a timber-framed building the trees required for each phase are almost certainly to have been cut in a single felling operation especially for that building, it is usual to calculate the average date of the heartwood/sapwood boundary of *all* the dated samples from each phase of a building and add 15 to 40 rings to get the overall likely felling date of the group.

Analysis

In the case of the nine samples obtained The Grove, each was prepared by sanding and polishing to clearly show the individual annual growth rings (Fig 6a). The widths of these growth-rings were measured, the resultant data then being compared with each other as described in the notes above. Although a statistical method is used to determine cross-matching, a visual representation, in the form of a graph, is given in Figure 6b showing how, when cross-matched at the correct position, the widths of the annual growth rings of different samples rise and fall in unison.

At a minimum value of t=4.5 three groups of cross-matching samples could be formed. The first group comprises two samples, both of them from the south purlins of the rear range roof. These two samples, cross-matching with each other at the positions indicated in the bar diagram Figure 7, were combined at the off-set indicated to form RYTASQ01, a site chronology of 122 rings. These rings were then satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1562 to 1683. The evidence for this dating is given in the *t*-values of Table 2.

The second group comprises five samples, all of them from the timbers of the ground and first-floor ceilings. These five samples, cross-matching with each other at the positions indicated in the bar diagram Figure 8, were combined at the off-set positions shown to form RYTASQ02, a site chronology of 110 rings. These rings were also satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1673 to 1782. The evidence for this dating is given in the *t*-values of Table 3.

The third and final group comprises two samples, both of them from the rear or north purlins of the rear range roof. These two samples, cross-matching with each other at the positions indicated in the bar diagram Figure 9, were combined at these off-set positions to form RYTASQ03, a site chronology of 75 rings. Although these rings were compared to a large number of reference chronologies for oak there was no satisfactory cross-matching, and the two samples must, therefore, remain undated

Interpretation

Analysis by dendrochronology of nine samples obtained from The Grove has resulted in all of them being combined to form one of three site chronologies. The first site chronology, RYTASQ01, comprises two samples from the south purlins of the rear or north range roof, whilst the second site chronology, RYTASQ02, comprises five samples from first and ground-floor ceilings. The third site chronology comprises samples from the two northern or rear purlins of the rear range roof.

Roof

The earliest episode of felling is represented by the two samples (RYT-A02 and A04) in site chronology RYTASQ01, both samples from the two front, or south, purlins of the roof. One of these samples, RYT-A02, is from a timber which has complete sapwood on it, meaning that it has the last ring produced by the tree from which it was derived before it was felled. This complete sapwood ring is retained on the sample. In this case it is possible to see that, although the last full ring on the sample is dated to 1683, the spring-cell growth for the following year has just commenced indicating that the tree was in fact felled between about early March to early May 1684 (depending on how early or late spring arrived that year).

The timber from which sample RYT-A04 was taken also has complete sapwood on it meaning that it too has the last ring produced by the tree from which it was derived before it was felled. Unfortunately, due to the soft and fragile nature of this part of the wood, a very small amount of sapwood was lost from the sample during coring. It is estimated that such a loss represents no more than 2–3 sapwood rings which, given that the last extant sapwood ring on this sample dates to 1681, would give the timber represented a felling date of 1684 as well.

Ceilings

A later episode of felling is represented by the five samples (RYT-A05, A06, A07, A08, and A09) in site chronology RYTASQ02. None of these samples retains complete sapwood and it is thus not possible to indicate a precise felling date for any of the trees represented. All the samples, however, do retain either some sapwood or at least the heartwood/sapwood boundary. It may be seen from Table 1 and the bar diagram, Figure 8, that this boundary lies within a narrow relative position or date range on all five samples. It will be seen, for example, that the earliest heartwood/sapwood boundary is at relative position 96 (1768) on sample RYT-A07, whilst the latest is at relative position 101 (1773) on samples RYT-A06, A08, and A09, a variation of only five years. Such a limited range of the heartwood/sapwood boundary, and its identical coincidence amongst samples, is highly indicative of a group of trees being felled at the same time as each other.

Although the exact felling date of the timbers cannot be known, the presence of the heartwood/sapwood boundary also means that a likely felling date range can be estimated. This is done by taking the average date of the sapwood boundary, which in this case is 1772, and adding a likely minimum and maximum number of sapwood rings to it, the usual 95% confidence limit for oak trees being 15–40 sapwood rings. Using this figure would give these timbers an estimated felling date in the range 1787 to 1812.

Conclusion

Tree-ring dating has thus determined that, as suspected from the structural evidence within the building, there are at least two phases of timber felling represented. The earliest, and probably primary phase of the present buildings, that is the rear range, uses timber felled in 1684. In the later-eighteenth, or possibly very early-nineteenth century, when a new, 'Georgian' range was added to the front of this late-seventeenth century building, the opportunity was taken to replace the existing floors of the primary range with new ones. The timber used for this phase of alteration was felled in the period 1787–1812.

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Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
RYT-A01	North-east purlin (roof)	60	15	------	------	------
RYT-A02	South-east purlin (roof)	122	18C	1562	1665	1683
RYT-A03	North-west purlin (roof)	60	4	------	------	------
RYT-A04	South-west purlin (roof)	119	15	1563	1666	1681
RYT-A05	Main east bridging beam (first-floor ceiling)	81	5	1697	1772	1777
RYT-A06	Main west bridging beam (first-floor ceiling)	101	h/s	1673	1773	1773
RYT-A07	Common joist (ground floor ceiling)	67	6	1708	1768	1774
RYT-A08	Common joist (ground floor ceiling)	62	9	1721	1773	1782
RYT-A09	Common joist (ground floor ceiling)	60	2	1716	1773	1775

h/s = the last ring on the sample is at the heartwood/sapwood boundary
C = complete sapwood is retained on the sample; the last measured ring date on the sample is the felling date of the tree represented

Reference chronology	Span of chronology	*t*-value	
Church Farm House, Ockbrook, Derbys	1560 – 1672	5.8	(Arnold and Howard 2008)
37/39 Kirkgate, Newark, Notts	1603 – 1694	5.1	(Arnold *et al* 2002)
1 Soar Lane, Sutton Bonnigton, Notts	1552 – 1651	4.9	(Howard *et al* 1993)
Hempshill Hall, Nottm	1566 – 1702	4.8	(Arnold and Howard 2007)
Worcester Cathedral, composite working mean	1484 – 1772	4.8	(Arnold *et al*)
Sinai Park, Burton on Trent, Staffs	1227 – 1750	4.7	(Tyers 1997)
Sharpcliffe Hall, Sharpcliffe, Staffs	1466 – 1647	4.7	(Arnold *et al* 2008)
Lodge Farm, Staunton Harold, Leics	1533 – 1647	4.7	(Arnold *et al* 2008)

Reference chronology	Span of chronology	*t*-value	
Trentham's Barn, Purley, Berks	1640 – 1751	5.3	(Howard *et al* 1996)
Worcester Cathedral, composite working mean	1484 – 1772	5.3	(Arnold *et al*)
Avoncroft museum	1675 – 1754	5.3	(Howard *et al* 1994)
Catholme, Staffs	1649 – 1750	5.3	(Howard *et al* 1992 unpubl)
Bradgate Trees, Leics	1595 – 1975	5.0	(Laxton and Litton 1988)
Stoneleigh Abbey, Stoneleigh, Warwicks	1646 – 1813	4.7	(Howard *et al* 2000)
Coates' Barn, Main Street, Cosby, Leics	1642 – 1734	4.6	(Alcock *et al* 1991 unpubl)
Croome Court, Worcestershire	1639 – 1753	4.5	(Arnold *et al* 2004)

Figure 1: Map to show general location of Ruyton XI Towns

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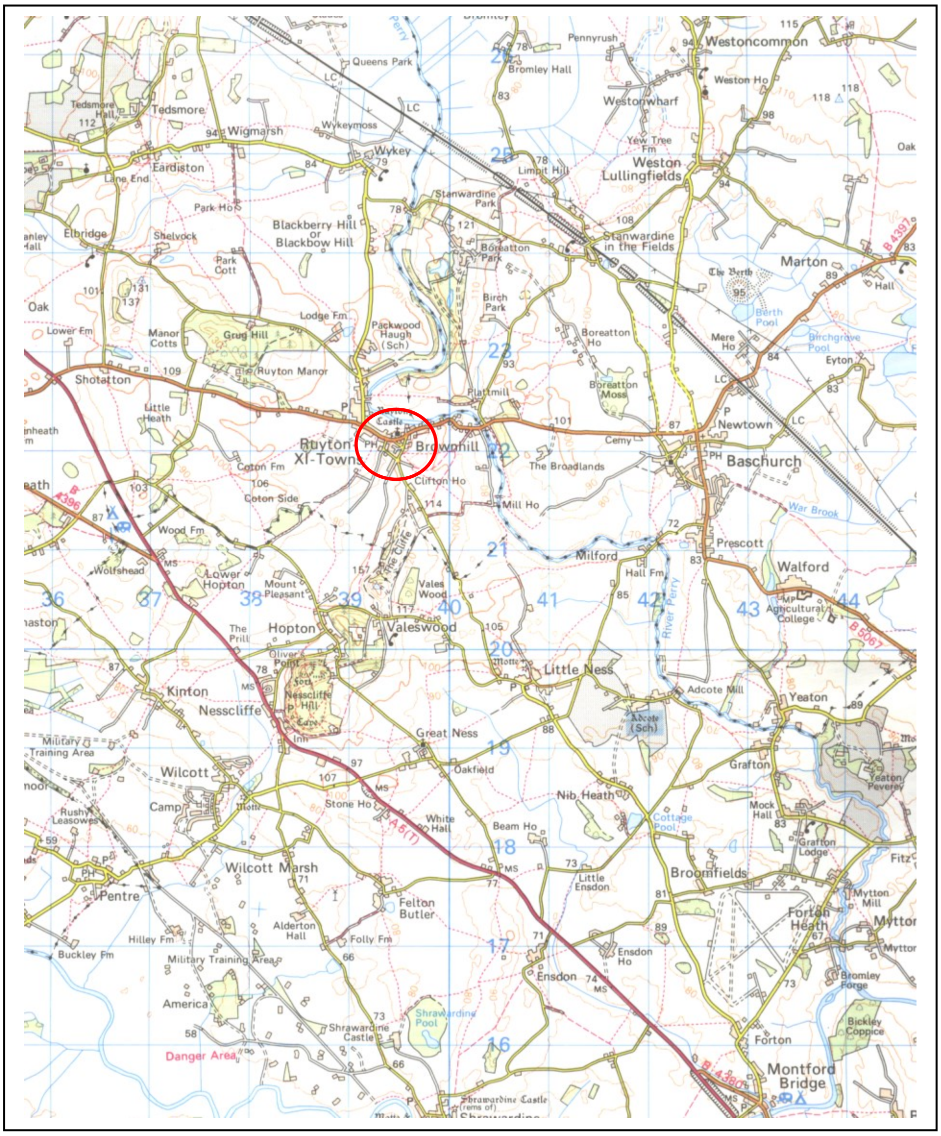

Figure 2a: View of The Grove from the front or south-east

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Figure 2b: View from the west showing double pile construction

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Figure 3b: The pulins of the west bay, looking east to west

Figure 4b: Ground floor ceiling of the west bay

Figure 5a: Simple sketch plan at attic level to show sampled timbers

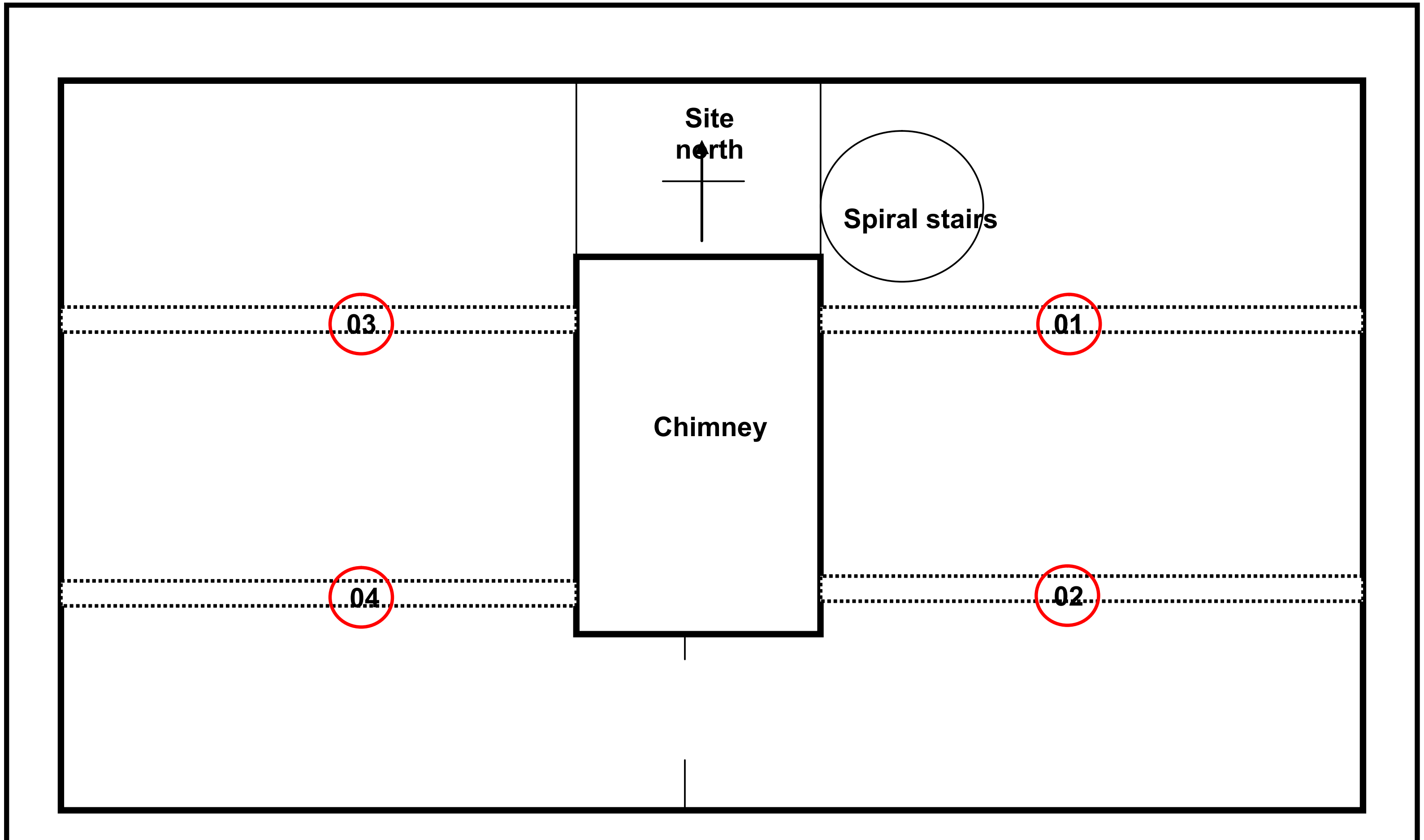

Figure 5b: Simple sketch plan of first floor ceiling to show sampled timbers

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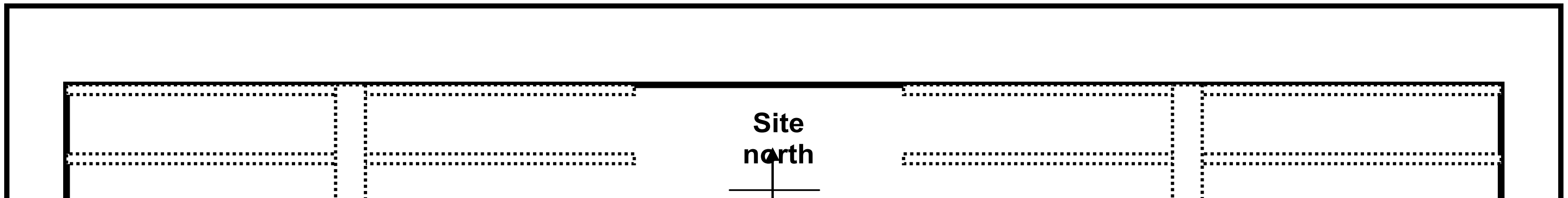

Figure 5c: Simple sketch plan of ground floor ceiling to show sampled timbers

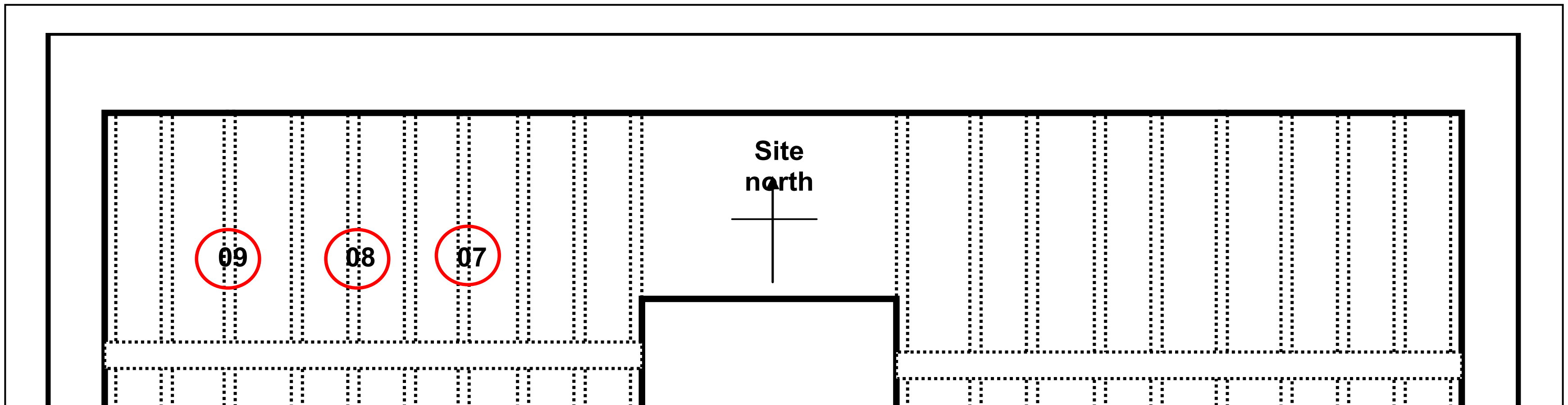

Figure 6a (top): Samples RYT-A02 (upper) and A04 (lower) showing the annual growth rings
Figure 6b (bottom): Graphic representation of the annual growth rings of samples RYT-A02 and A04 at cross-matching positions

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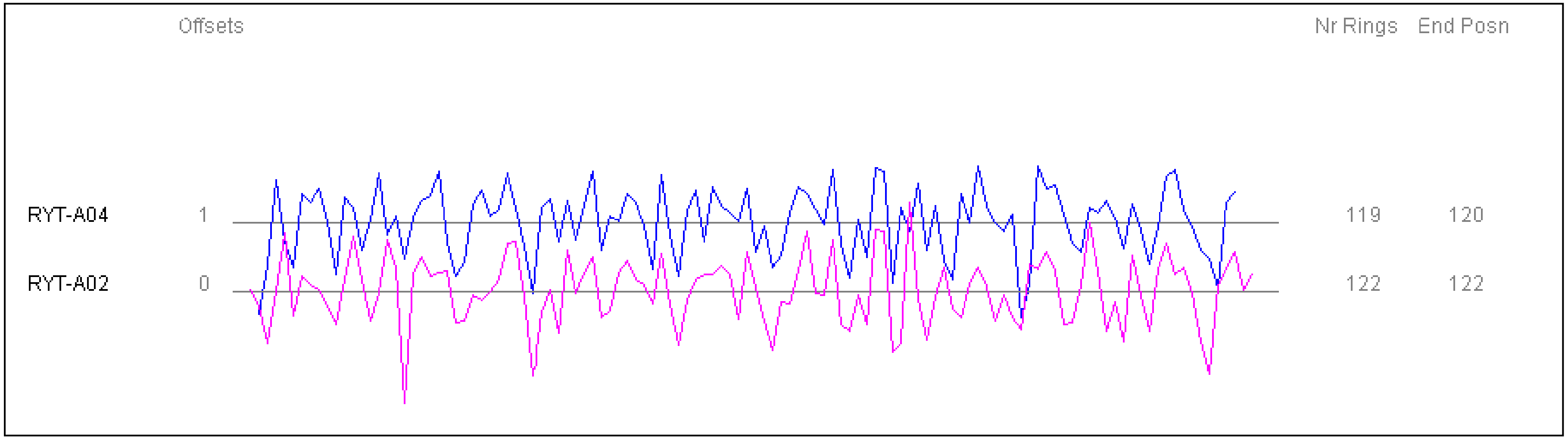

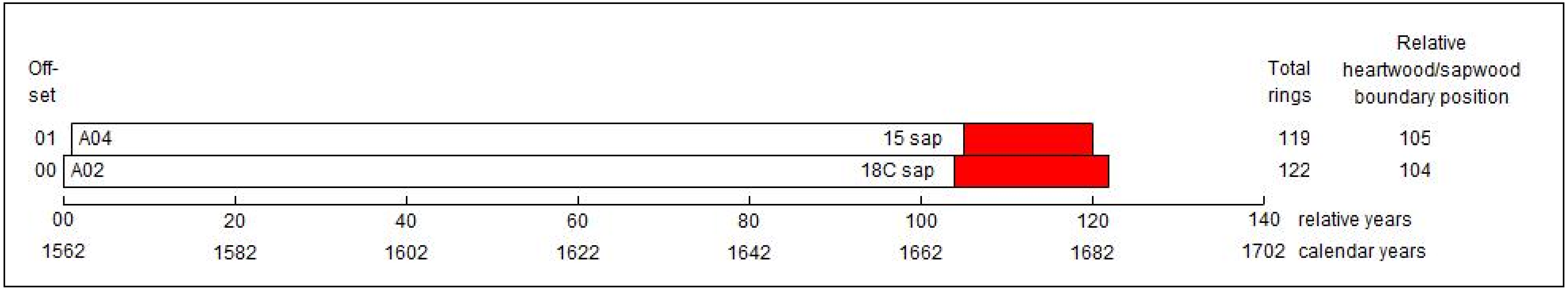

White bars = heartwood rings, shaded areas = sapwood rings
C = complete sapwood is retained on the sample. Where dated the last measured ring date is the felling date of the tree represented

Figures 8 & 9: Bar diagrams of the samples in site chronology RYTASQ02 (top) and RYTASQ03 (bottom)

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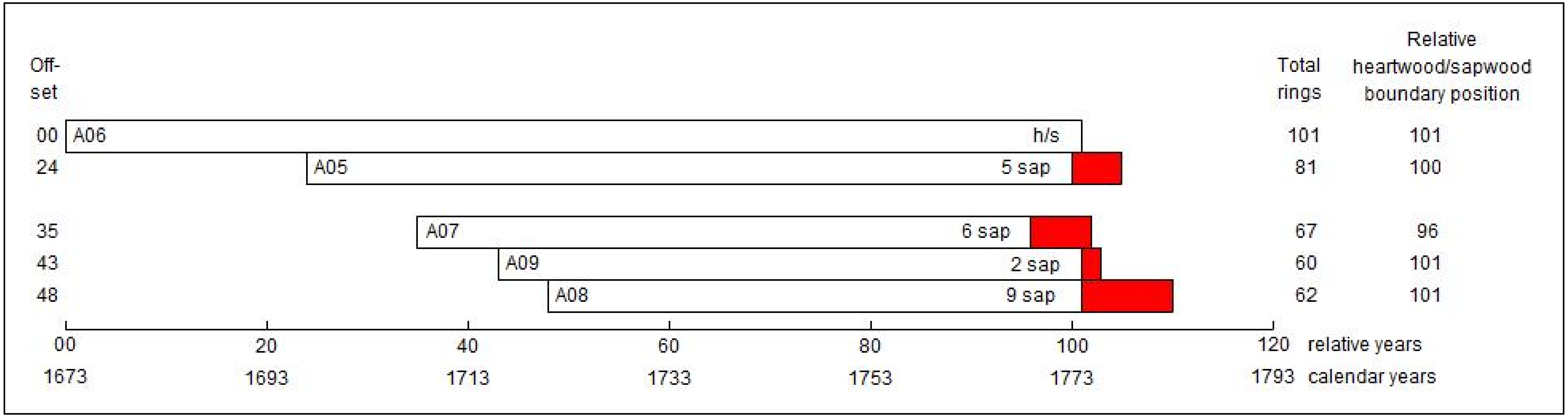

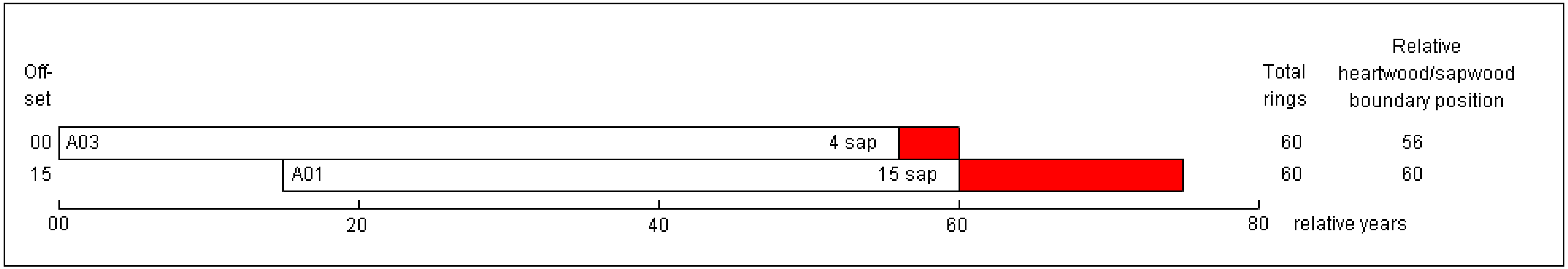

White bars = heartwood rings, shaded areas = sapwood rings
h/s = heartwood/sapwood boundary