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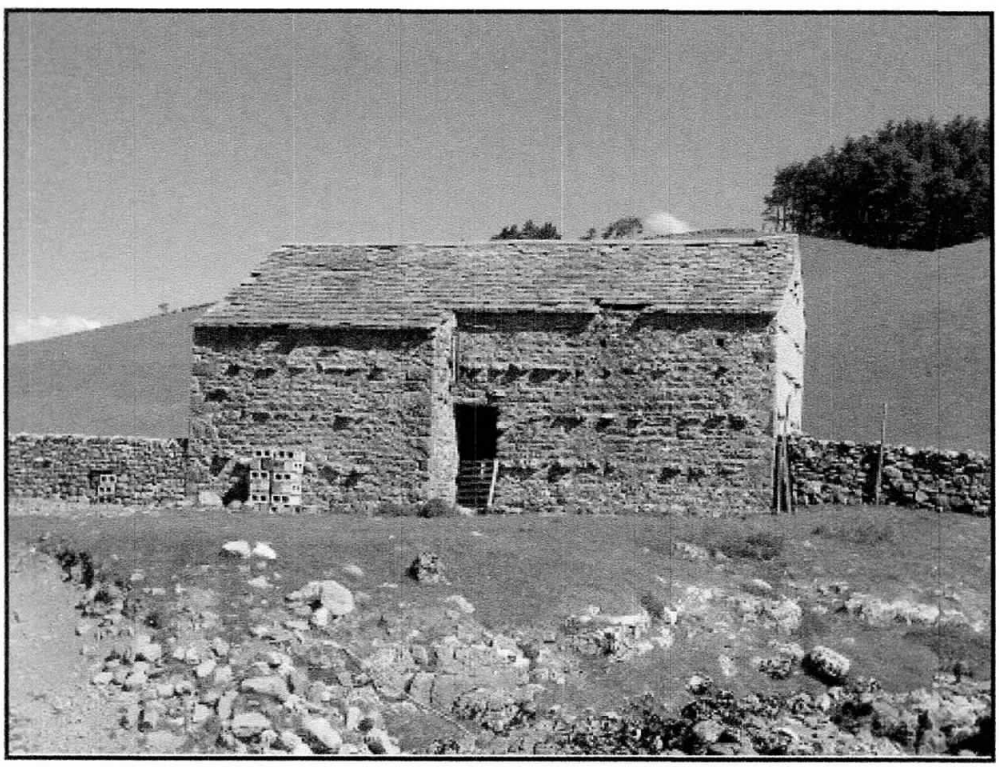
STUBBING BARN
LOW BIRKWITH
HORTON IN RIBBLESDALE
NEAR SETTLE
NORTH YORKSHIRE
TREE-RING ANALYSIS OF TIMBERS



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STUBBING BARN, LOW BIRKWITH, HORTON IN RIBBLESDALE, NEAR SETTLE, NORTH YORKSHIRE; TREE-RING ANALYSIS OF TIMBERS

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SUMMARY

Analysis by dendrochronology was undertaken five of the six core samples obtained from Stubbing Barn (one sample having too few rings for reliable dating) in conjunction with those from a number of other buildings in the Ingleborough area.

The analysis of these five has dated only two samples, this indicating that both timbers are almost certainly felled at the same time as each other at some point between 1596 at the earliest and 1621 at the latest.

Three measured samples remain ungrouped and undated.

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Introduction

Stubbing Barn (SD 7982 7684, map Fig 1) is an L-shaped barn with double-gable entry to the shippon and a single door in the front elevation to the hay mew. It has three trusses and a wealth of reused cruck timbers Fig 2a/b).

Sampling

Sampling and analysis by dendrochronology of timbers to Stubbing Barn were commissioned by the Yorkshire Dales Millennium Trust (YDMT) as part of the Ingleborough Dales Landscape Partnership *'Stories in Stone'* project H8, and fully funded by the National Lottery Heritage Fund, this being undertaken as an adjunct to a wider study of vernacular agricultural buildings in the Ingleborough area. In total, 15 individual buildings were sampled for tree-ring dating, Stubbing Barn being one of them. It was hoped that tree-ring analysis might establish the date of the timbers here, and provide some information on the history of this particular building. A full overall report on the wider survey, with more detailed descriptions of this and the other buildings sampled, will be published separately by the Yorkshire Dales Millennium Trust.

Thus, from the timbers available at Stubbing Barn, a total of six samples was obtained by coring. Each sample was given the tree-ring code HIR-C (for Horton in Ribblesdale, site 'C'), and numbered 01–06. Details of the nine samples are given in Table 1, including the timber sampled, 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. The locations of the sampled timbers are identified on a plan shown here as Figure 3.

The Nottingham Tree-ring Dating Laboratory would firstly like to thank the Yorkshire Dales Millennium Trust for promoting this programme of tree-ring analysis, and particularly Alison Armstrong and David Johnson, managers for the Stories in Stone team, for their help in arranging access to the sites, and for the provision of plans, background information, and additional help besides. We would also like to thank the owner of Stubbing Barn, Mr David White, for permitting access to the building for sampling. Finally we would like to thank the National Lottery Heritage Fund for their generous support for this analysis.

Tree-ring dating

Tree-ring dating relies on a few simple, but quite fundamental, principles. Firstly, as is commonly known, trees 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. Trees growing in widely different areas (Kent–v–Cumbria for example), even if growing at the same time, might experience a slightly different climate and thus produce different tree-ring patterns, but the difference is usually reduced the nearer trees are to each other.

Secondly, because the weather over a certain number of consecutive years is unique, so too is the growth-ring pattern of the tree. The pattern of a shorter period of growth, 40, 50, or even 60 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. In essence, a short period of growth, anything less than, say 50 rings for oak, is not fully reliable, and the longer the period of time under comparison the better.

The application of tree-ring dating relies on obtaining core samples from beams of unknown date in the building under investigation (these beams having been derived from oak trees). Where possible, it is usual to obtain samples from a number of different timbers within a single building, particularly where it is thought that timbers of different date may be present, ie where some timbers are possibly reused older beams, or are replacement beams which have been inserted more recently. In addition, as in the case of this project, the prospect of dating is enhanced if groups of samples can be obtained from timbers in a number of different buildings in a particular distinct locality, the different samples from different local buildings providing a more representative regional pattern of tree growth. As part of this project, from the 11 individual buildings that were cored, an overall total of 73 samples was obtained.

The ring-width measurements of the growth patterns of all the samples obtained are then compared with one another in the hope that they will 'cross-match' with each other (ie, that they will have the same growth patterns). When the growth patterns 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 of the group (in effect making an 'average' of the cross-matching sample's growth pattern). 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 because of the way that samples often

overlap with each other, with 'extensions' at either end where the rings on some samples are might be earlier or later than on other samples. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any oak site chronology with less than about 50 rings is generally too short for reliable dating.

This (average) site chronology is then compared with thousands of different reference chronologies (each made up of many samples from different buildings) covering every part of England for all time periods, the calendar dates of these reference being known. When the site chronology cross-matches with the reference chronologies (ie, where the growth patterns of site and reference chronology match each other because the constituent trees were growing at the same time as each other), the samples of the site chronology 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.

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 (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

Thus, each of the six core samples obtained from the various timbers to Stubbing Barn, along with all those obtained from all the other buildings included in this project, was prepared by sanding and polishing. It was seen at this time that one sample, HIR-C05 from the North lower purlin between trusses 2–3, had too few rings for reliable dating (ie, fewer than 45 rings), and it was rejected from this programme of analysis. The annual growth ring widths of the remaining five samples were, however, measured.

These measured data, along with that of the measured samples from all the other sampled sites (ie, the growth patterns) were then compared with each other as described in the notes above. This comparative process indicated that only two measured Stubbing Barn

samples, HIR-C03 and C04 could be combined with other samples from other buildings sampled as part of this project to make a series of 'site chronologies'. These site chronologies were then dated by comparison with the 'reference chronologies', this indicating a date for each individual sample from Stubbing Barn (Fig 4).

Interpretation

Neither of the two dated samples from Stubbing Barn retains sapwood complete to the bark, and it is thus not possible to reliably say precisely when either timber was felled. The two samples do, though, retain some sapwood and the heartwood/sapwood boundary (this denoted by 'h/s' in Table 1). This means that although sapwood has been lost from the samples, it is *only* the sapwood that is missing. As may be seen from Table 1 and the bar diagram, the two timbers have very similar date spans, and they have identical heartwood/sapwood boundary rings, these being dated to 1581 on both samples.

Given that most oak trees have between a minimum of 15 sapwood rings and the maximum of 40 sapwood rings (the 95% confidence interval), this would suggest that the trees represented were felled at some point between 1596 at the earliest and 1621 at the latest.

Conclusion

Analysis by dendrochronology has, therefore, dated only two of the five measured samples. Interpretation of the sapwood on these two samples would indicate that both timbers were almost certainly felled at the same time as each other at some point between 1596 at the earliest and 1621 at the latest.

Three measured sample, HIR-C01, C02, and C06, remain ungrouped and undated, and while one of these samples (HIR-C01) does have low ring numbers, the other two have sufficient number of rings for dating. The samples do not show any problems such as distortion or compression, which might make cross-matching difficult, and the reason for these timbers not dating is unknown. It is possible that these samples each represent a timber of a different date, this in effect making them 'singletons'. While such samples can on occasion be dated (especially if a large amount of local data has been amassed) it is often much more difficult than with well replicated groups of samples. It is, however, a frequent feature of most programmes of tree-ring analysis to find that some samples will not group or date, often for no apparent reason.

Table 1: Details of tree-ring samples from Stubbing barn, Low Birkwith, Horton in Ribblesdale, near Settle, North Yorkshire

Sample number	Sample location	Total rings	Sapwood Rings	First measured ring date (AD)	Heart/sap boundary (AD)	Last measured ring date (AD)
HIR-C01	North lower purlin, truss 1–west gable	51	2	------	------	------
HIR-C02	King block, truss 1	72	2	------	------	------
HIR-C03	North lower purlin, truss 1–2	65	10	1527	1581	1591
HIR-C04	North upper purlin, truss 2–3	63	4	1523	1581	1585
HIR-C05	North lower purlin, truss 2–3	nm	---	------	------	------
HIR-C06	North upper purlin, truss 3–east gable	69	12	------	------	------

nm = sample not measured

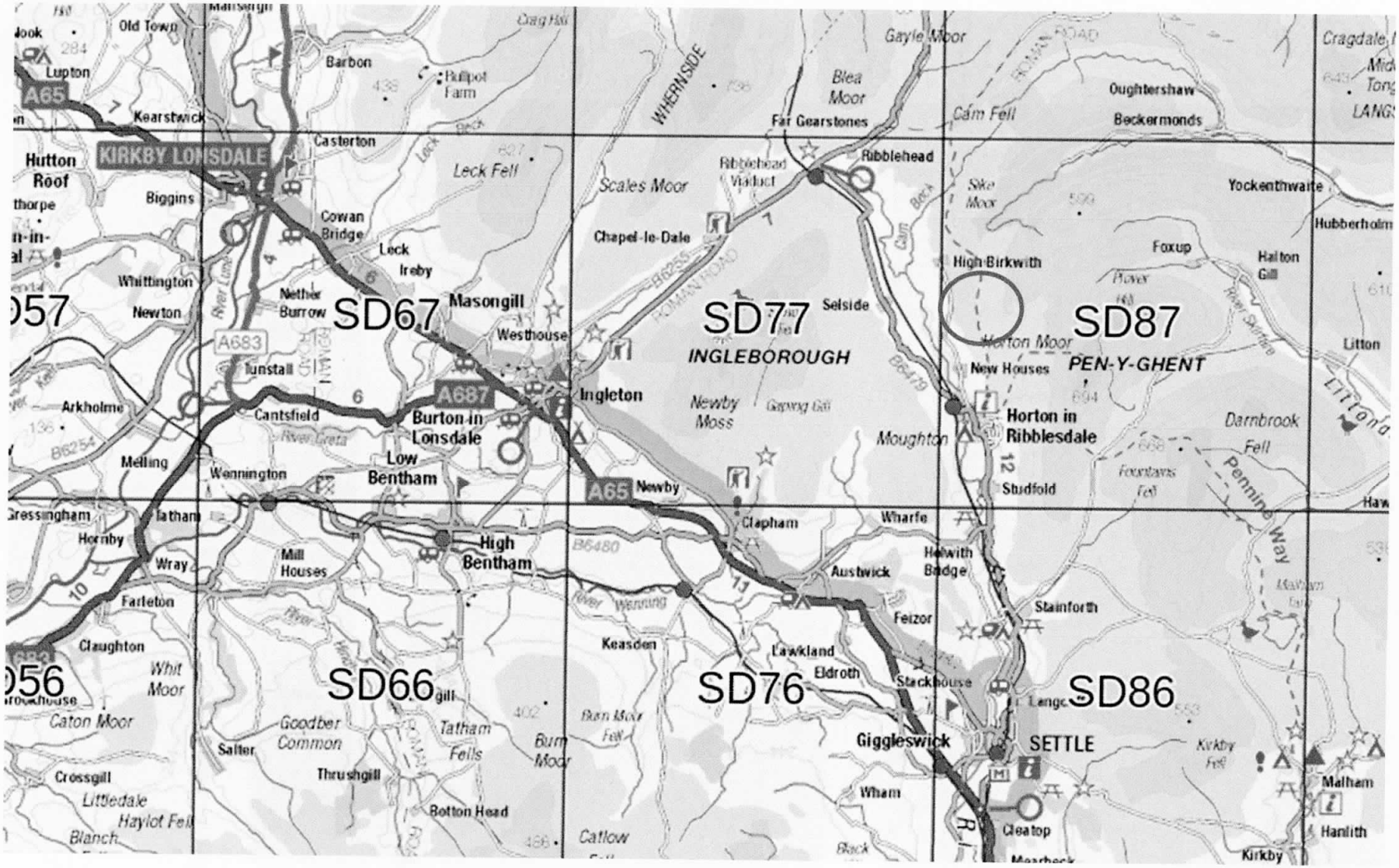

Figure 1: Map to show approximate location of Stubbing Barn

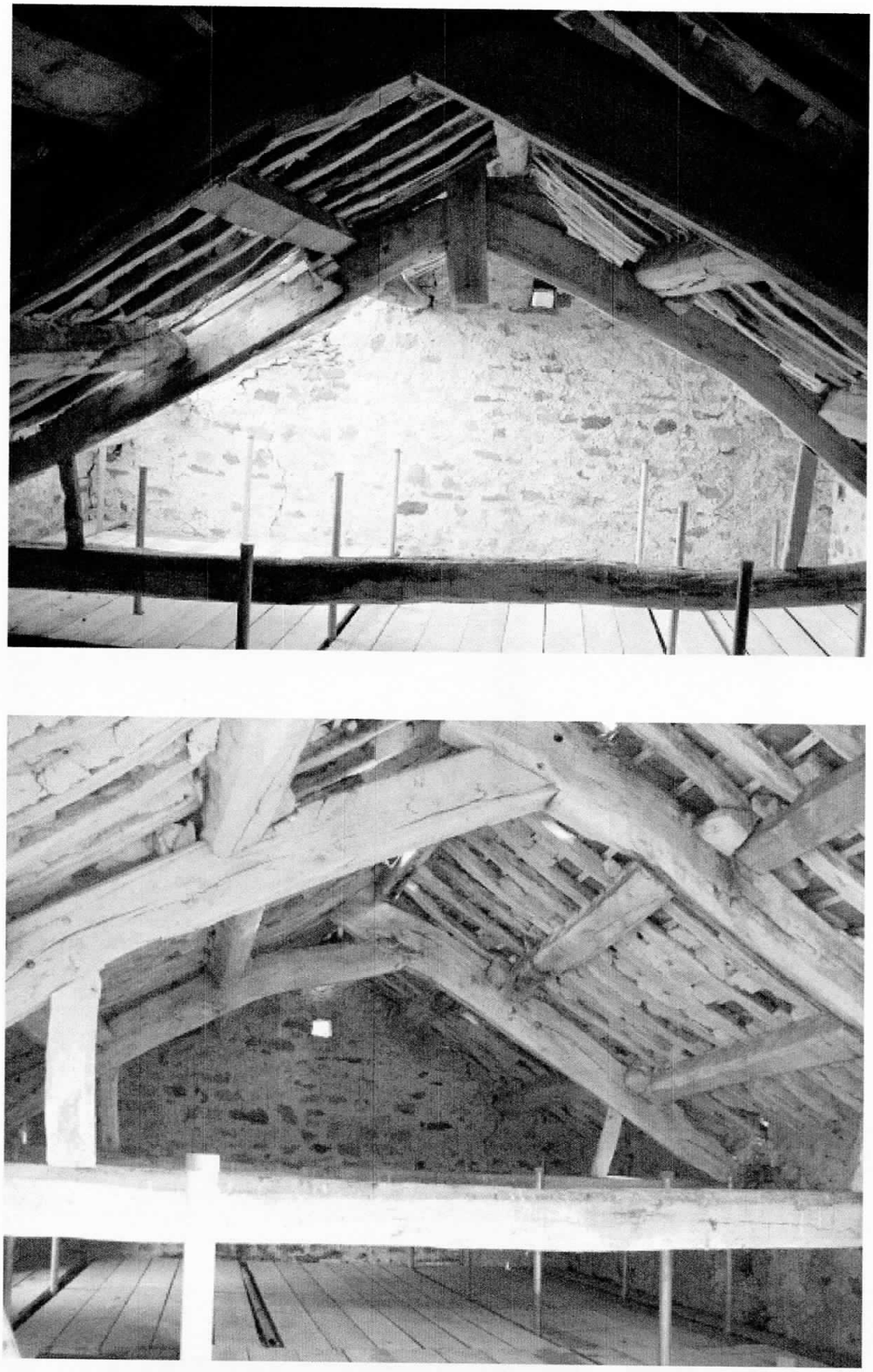

Figure 2a/b: View of truss 1 (top) and trusses 2 and 3 (bottom) (photos Alison Armstrong & David Johnson)

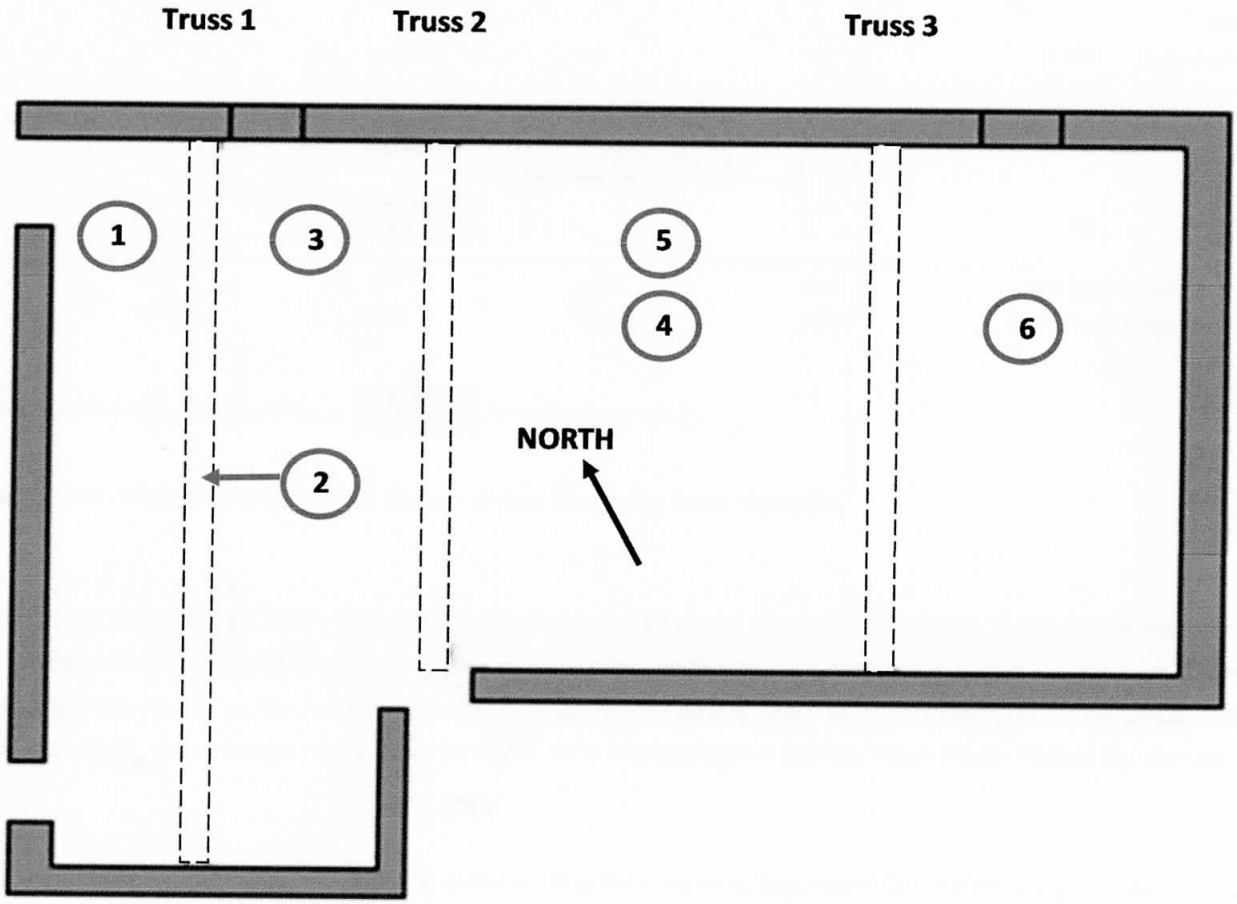

Figure 3: Plan to help locate the sampled timbers (see Table 1) (after Alison Armstrong and David Johnson YDMT)

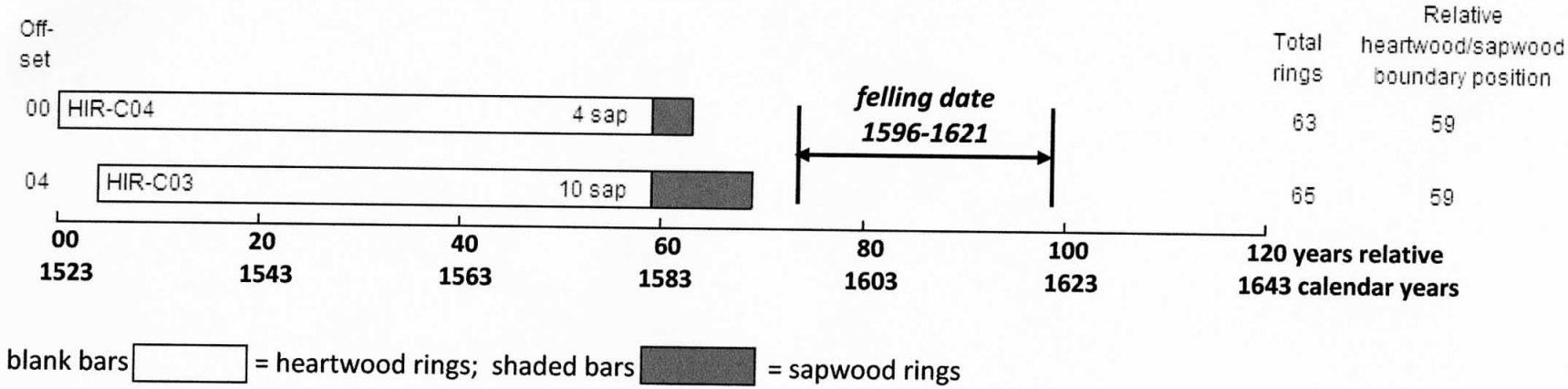

Figure 4: Bar diagram showing the relative position and dates of the Stubbing Barn samples

The two dated samples are shown here in the form of 'bars' at positions relative to each other where the growth rings of the timbers cross-match with all the other samples obtained as part of this programme of tree-ring analysis, the similarity being caused by the trees used for the beams growing at the same time and general area as each other. These two samples, along with all the other cross-matching samples from timbers in the other buildings which were sampled, have been combined to form site chronologies which have been dated by comparison with the 'reference chronologies'.

The likely felling dates of the timbers are shown, taking the date of the heartwood/sapwood boundary ring on the samples, and allowing for the minimum and maximum number of sapwood rings the trees are originally likely to have had (15–40). Given the cross-matching between these two samples, and that they have identical heartwood/sapwood boundary dates, it is very likely that the two timbers were felled at the same time as each other.