Nottingham Tree-ring Dating Laboratory
Dendrochronology, timber analysis, and historic building consultants

TREE-RING ANALYSIS OF TIMBERS FROM MUCKNELL FARM, STOULTON. WORCESTERSHIRE

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Core sample MUK-A01 from the south blade of the cruck truss. Although felled in 1439, the tree from which this sample is derived probably began growing as early as 1170.

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SUMMARY

Tree-ring analysis of samples from the three timbers available at the core of Mucknell Farm shows that the (probably) two trees represented were felled in the late spring or very early summer of 1439.

The samples from the three timbers were combined to make a single site chronology, MUKASQ01, having an overall length of 247 rings. These rings were dated as spanning the years 1193 to 1439, indicating that, although the trees used were felled in the early-fifteenth century, one of them at least actually began growing in the late twelfth century.

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Introduction

It would appear that the earliest record of the site (SO 906 513, map Fig 1) is as an outlying farm, or 'berewick', held by Urso D'Abitot, Sheriff of Worcester at the time of Domesday, the farm being the pre-Conquest property of the Cathedral of St Mary, Worcester. At the time of Domesday Stoulton, along with Mucknell and Wolverton, were berewicks of the Manor of Kempsey, together containing 7 hides of land. The overlordship of these lands belonged to the Bishops of Worcester until it lapsed in the fifteenth century, at which time Stoulton, including Mucknell, was incorporated with the Manor of Wadborough.

In 1625 the Manor of Stoulton was sold to Samuel Sandys of Ombersley. Due to his involvement in the Civil War, Sandys mortgaged the property to the Somers family of Worcester, who subsequently acquired the freehold before 1716. It was bequeathed in that year to by John Somers to his two sisters, one of whom, Mary Cocks, inherited the whole. It was in the hands of her grandson, Sir Charles Cocks by 1781, at which time the estate covered about two thirds of the parish and was worth about £1050 per annum.

The earliest document relating directly to the present property is a valuation of 1683-7 which identifies the then farmer as George Brewer. It is possible that a dramatic increase in value at this time may reflect improvements to the farm buildings. There is little available eighteenth or early-nineteenth century information about the farm, and it is not until the later nineteenth and twentieth centuries that documentary evidence, including maps, illustrate the later history of the site.

The Mucknell Farm site comprises a series of nineteenth century, brick-built farm buildings, mostly large barns and stores, set in three ranges, north, east and west, around a central courtyard, with a farmhouse and associated 'dairy' set to the fourth or south side. The dairy, which is in poor structural condition and appears to be much altered, is timber-framed and probably dates to the late-seventeenth century or early-eighteenth century.

The farmhouse itself (Fig 2), the subject of this particular programme of analysis, appears to have a complicated structural history. The shell of the present farmhouse is of eighteenth century date with large-scale nineteenth and twentieth century additions and alterations. Many of the interior walls have been moved or replaced by studwork partitions, plasterboard, and concrete block-work. The most recent alterations were undertaken in the 1980s.

Buried beneath these later changes, however, are the fragmentary remains of what is probably the original timber-framing. This is formed by a single, probably, upper-cruck with collar truss, or possibly 'eaves blades' (Fig 3a/b), between the second and third bays at the western end of the house (Fig 4a/b). Both blades are badly damaged, having been truncated at attic level and having had various openings cut through them. Being fragmentary, partially hidden, and having no decorative features, it is not possible to determine a likely date for these timbers on stylistic grounds.

Sampling

Sampling and analysis by dendrochronology of timbers from the farmhouse at Mucknell Farm were commissioned by Mike Napthan Archaeology on behalf of the owners of the site. This was undertaken as part of the planning application process prior to the redevelopment of

the site at which time the farmhouse is due to be demolished. It was hoped that dendrochronological analysis would establish the felling date of the timbers used in this portion of the building and thus give an n accurate and reliable indication of its construction date.

Thus cores samples were obtained from the three timbers available. Each sample was given the code MUK-A (for Mucknell, site "A") and numbered 01 – 03. In each of the three cases the timbers sampled appeared to be primary and integral to each other and to be representative of this part of the present building.

The positions of these samples were marked at the time of sampling on plans made by Mike Napthan, these being reproduced here as Figure 4a/b. Details of the samples are given in Table 1. In this Table, all trusses and the individual timbers have been numbered and/or identified following the form of the plan provided.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank Mike Napthan, for his help with sampling at Mucknell Farm, and for the abbreviated use of parts of his report in the introduction above (Napthan 2007), and his plans and drawings elsewhere in this report.

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 from *all* the dated samples from each phase of a building and add 15 to 40 rings to this average to get the likely overall felling date of all the timbers used. In this calculation, wide variations in the position/date of the

heartwood/sapwood boundary (possibly suggesting different felling dates) must be noted and taken into consideration.

Analysis

In the case of the three samples obtained from Mucknell Farm, each was prepared by sanding and polishing, and their annual growth-ring widths were measured. The data of these measurements were then compared with each other and found to cross-match with each other with an unusually high degree of correlation (values in excess of t=10.0 being obtained), at the relative positions shown in the bar diagram, Figure 5.

The three cross-matching samples were combined at these indicated off-set positions to form a site chronology, MUKAQ01, with an overall length of 247 rings. Site chronology MUKAQ01 was then satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1193 to 1438. The evidence for this dating is given in the t-values of Table 2.

Given the high degree or correlation between the annual growth rings on the three samples it is almost certain that the timbers they represent come from trees growing very close to each other in the same copse or stand of woodland. Indeed, given the degree of cross-matching between the samples from the two cruck blades, where t=10.3, and that the timbers appear to be approximately 'half-trees' it is probable that they are both derived from one tree split in two. The timber used for the collar is from a second individual tree.

It is not possible to demonstrate exactly where the source woodland for the timbers used at Mucknell Farm might have been, except that it is likely to have been relatively local. As will be seen from Table 2, which shows the reference chronologies with which site chronology MUKASQ01 has cross-matched and dated, many of the best matches are with material from other sites in the west of England (site chronology MUKASQ01 having been compared with reference material from all parts of England). Some of the best values are found in comparison to other Worcestershire and Gloucestershire sites.

Interpretation and conclusion

Analysis by dendrochronology of three timbers at the core of the farmhouse at Mucknell Farm has resulted in the three samples obtained being combined to form a single site chronology, MUKASQ01. This site chronology is 247 rings long, these rings being satisfactorily dated as spanning the years 1193 – 1439.

Two of the samples obtained, MUK-A02 and A03, retain complete sapwood. This means that they have the last ring produced by the trees they represent before they were felled, ie, they indicate the felling date of the tree. In both cases, the last sapwood ring, and thus the felling date, is the same at 1439. On both samples, MUK-A02 and 03, it is possible to see that the spring cells for the final year are complete and that the growth of the summer cells is just about to commence. This clearly indicates that felling took place in the late spring or early summer of 1439.

As such, a date of 1439 may place the original construction of the present farmhouse at Mucknell a little earlier than might have been expected; prior to tree-ring analysis, there

being no stylistic or other dating evidence available, it might have been assumed that the building accounted for the late-seventeenth century rise in value of the site. It may instead, therefore, be possible to connect the construction of the cruck-framed building with the transfer of ownership of the site from the Bishops of Worcester in the fifteenth century and the incorporation of Mucknell with the Manor of Wadborough. It may be that the late seventeenth century rise in value is connected with the subsequent construction of the 'dairy' and that it too is slightly earlier than expected.

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Table 1: Details of tree-ring samples from Mucknell Farm, Stoulton, Worcestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
MUK-A01	South cruck blade	183	none	1193	------	1375
MUK-A02	Collar cruck blade	146	22C	1294	1417	1439
MUK-A03	North cruck blade	118	19C	1322	1420	1439

* C = complete sapwood is retained on the sample; the last measured ring date is the felling date of the tree

Table 2: Results of the cross-matching of site chronology MUKASQ01 and relevant reference chronologies when the first-ring date is 1193 and the last-ring date is 1439

Reference chronology	*t*-value	Reference
England, London Master Chronology	11.9	(Tyers and Groves 1999 unpubl)
The Commandery, Worcester	10.4	(Arnold and Howard 2006)
Brockworth Court, Brockworth, Glos	10.0	(Howard 2000 unpubl)
Kingswood Abbey Gatehouse, Kingswood, Glos	9.7	(Arnold *et al* 2003)
Worcester Cathedral; composite chronology	9.5	(Arnold *et al* 2003)
The Post Office, Oxhill, Warwicks	8.5	(Alcock *et al* 1989)
Mercer's Hall, Mercer's Lane, Gloucester	8.4	(Howard *et al* 1996)
East Midlands Master Chronology	7.9	(Laxton and Litton 1988)

Figure 1: Map to show general location of Mucknell Farm

Figure 2: View of Mucknell Farmhouse from the front or south.
The timber-framed building at the east, or right-hand, end is the 'dairy'

Figure 3a/b: View of the single remaining cruck truss;
top, from the east, below, from the north-west

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Figure 4a: General plan of the Farmhouse at Mucknell Farm (at first-floor level) showing phasing interpretation and position of sampled timbers (after Mike Napthan)

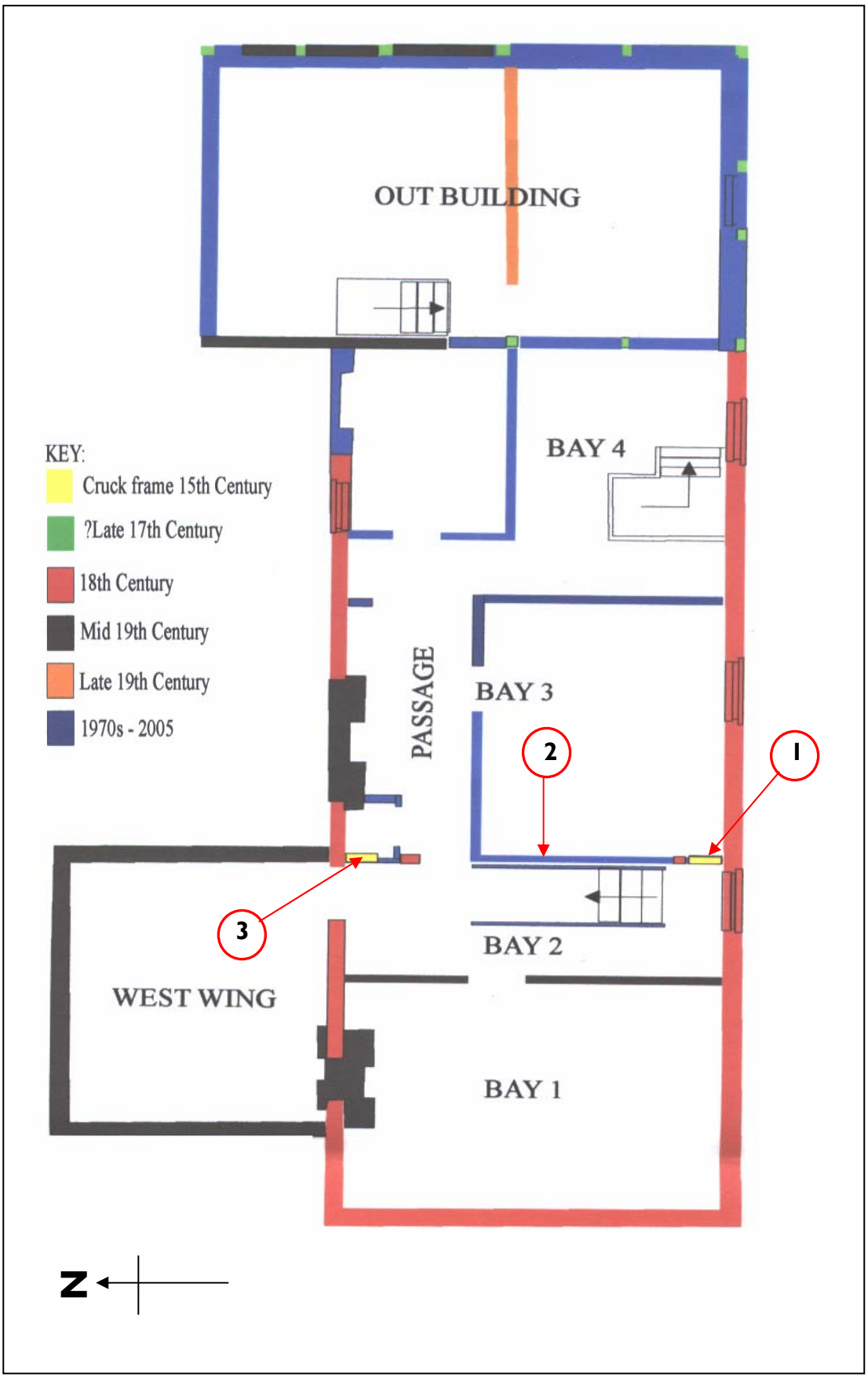


Figure 4b: View of the east face of the central truss showing upper-cruck framing (grey tone) and secondary framing (dark grey tone), with the position of the tree-ring samples. Late 18th – early 19th century timbers shown unshaded (after Mike Napthan)

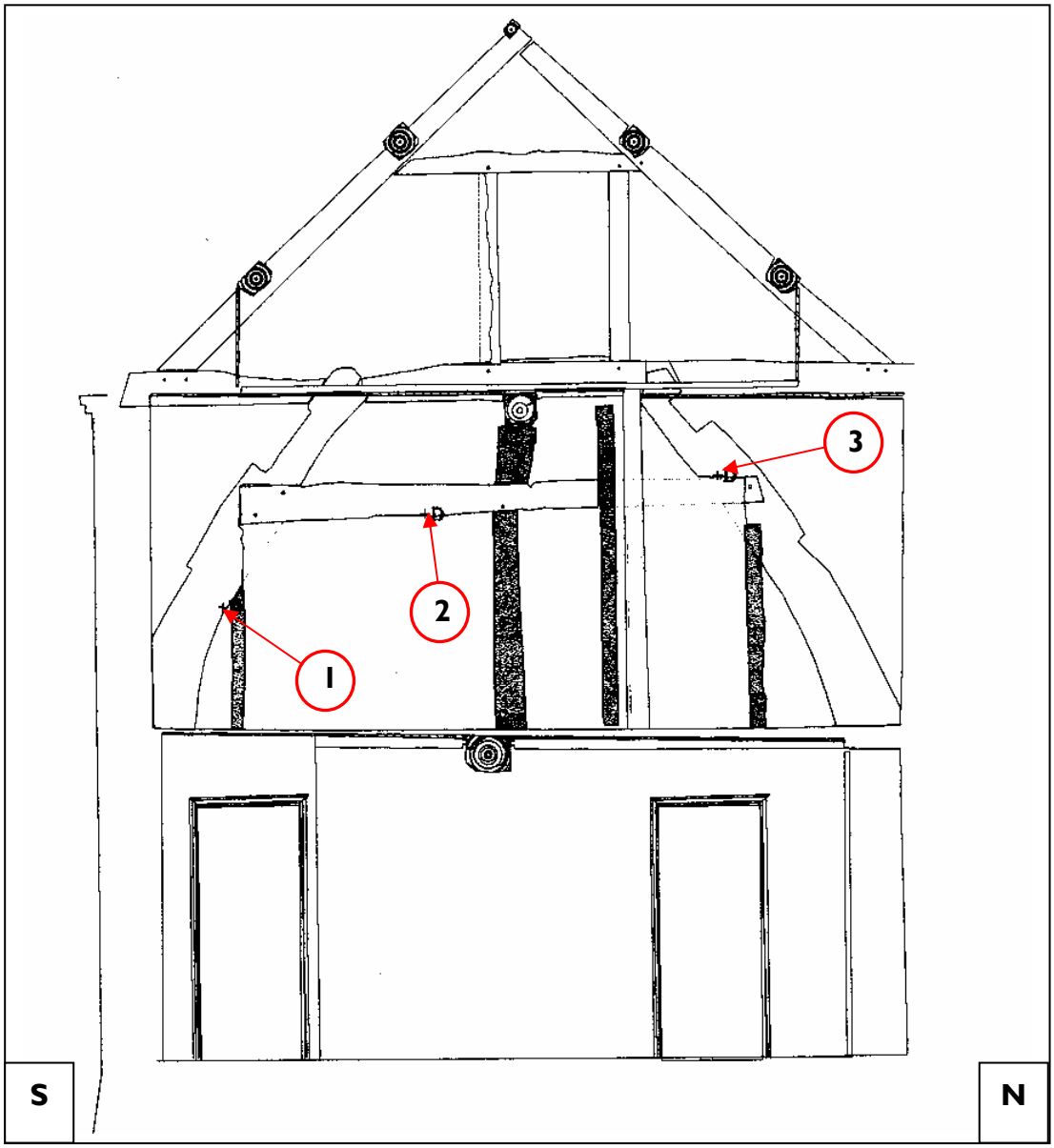
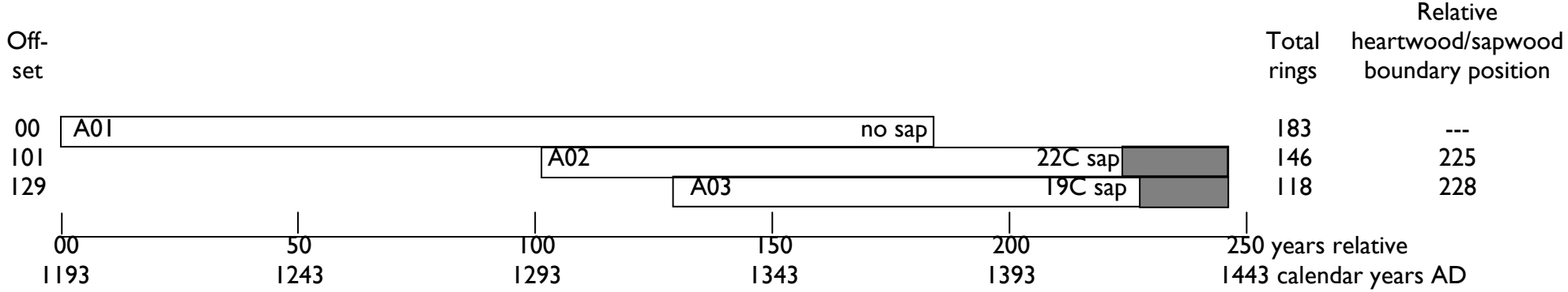


Figure 5: Bar diagram of the samples in site chronology MUKASQ01



C = Complete sapwood is retained on the sample; the last measured ring date is the felling date of the timber