Dendrochronology, timber analysis, and historic building consultants

TREE-RING ANALYSIS OF TIMBERS FROM
THE OLD RECTORY,
BLAKENEY,
WIVETON ROAD,
NORFOLK

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SUMMARY

Dendrochronological analysis was undertaken on samples taken from timbers of the main and cross-wing roofs and from two timber ceilings, resulting in the dating of a single site sequence.

This site sequence contains 15 samples (from the two roofs and the entrance hall ceiling) and spans the period 1339–1518. One of the samples is known to have been felled in 1518 with interpretation of the sapwood on the rest of the dated samples suggesting they were also felled at this time.

Tree-ring dating has shown that both the main and cross-wing roofs and the entrance hall ceiling all contain timber felled in 1518, suggesting construction of these three elements was contemporary and occurred soon after felling of the timbers utilised.

Two further site sequences are undated.

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INTRODUCTION

The Old Rectory is located at the end of a private drive off Wiveton Road in the village of Blakeney, 34km north-west of Norwich on the North Norfolk coast (TG0315643435; Figs 1–3). The main, and apparently oldest surviving part of the building, is aligned north-north-west to south-south-east (for the purpose of this report north-south) and contains the entrance hall and dining room at ground floor level. At the south end of this range is a cross-wing, aligned east-west (Figs 4 and 5). These early remains are thought to date to the sixteenth or seventeenth century. There have been later extensions and modifications (www.britishlistedbuilding.co.uk).

Main range

The main range roof consists of five trusses (numbered from north to south). Each truss consists of principal rafters, collars, and tiebeams; windbraces run from the principal rafter to the purlin. Additionally, trusses 1 and 5 are studded above and below the collar, suggesting these two trusses were originally 'closed' (Fig 6). Truss 3 has a cranked collar and is archbraced Fig 7).

Within this range, at ground-floor level, are the entrance hall and dining room. Both of these rooms have exposed timber ceilings (Figs 8 and 9). That of the entrance hall is more heavily moulded and with painted main joists. This ceiling is interrupted by an inserted panelled screen.

Cross-wing roof

This roof does not appear to be so complete with more signs of modification and later repairs. There are three trusses (including the hip truss). Truss 6 is studded above and below the collar and resembles truss 1; the timbers are painted a red colour (Fig 10). This suggests a 'closed' truss and that either the roof space was utilised (perhaps for accommodation or storage) or the timbers were visible from the room below. Truss 7 is a rather cobbled together truss of collar and studs and truss 8 is the hip truss. There is a single, surviving windbrace from the south principal rafter of truss 6 to the purlin.

Principles of Tree-ring Dating

Tree-ring dating relies on a few simple, but fundamental, principles. Firstly, as is commonly known, trees (particularly oak 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 to 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 determined pattern. Furthermore, and importantly, all trees growing in the same area at a 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 pattern of the tree. The pattern of a short period of growth, 20 or 30 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 60 years or so. In essence, a short period of growth, anything less than 50 rings, is not reliable, and the longer the period of time under comparison the better.

The third principal 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 millimetre. 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 a sample "cross-matches" repeatedly at the same date 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 the 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 phases 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 satisfactory analysis.

SAMPLING

A total of 36 timbers was sampled with each sample being given the code BLK-A and numbered 01–36; samples BLK-A01–10 being taken from the main range roof, BLK-A11–20 from the cross-wing roof, BLK-A21–8 from the entrance hall ceiling beams, and BLK-A29–36 from the dining room ceiling beams. The location of samples was noted at the time of sampling and has been marked on Figures 11–16. Further details can be found in Table 1.

ANALYSIS & RESULTS

At this stage, seven of the samples were found to have too few rings for secure dating to be a possibility and so were discarded prior to measurement. The remaining 29 samples were prepared by sanding and polishing and their growth-ring widths measured. These growth-ring widths were then compared with each other, resulting in the formation of three groups.

Firstly, 15 samples (seven from the main range roof, three from the cross-wing roof, and five from the entrance hall ceiling) matched each other and were combined at the relevant offset positions to form BLKASQ01, a site sequence of 180 rings (Fig 17). This site sequence was compared against a series of relevant reference chronologies for oak where it was found to match consistently and securely at a first-measured ring date of 1339 and a last-measured ring date of 1518. The evidence for this dating is given by the *t*-values in Table 2.

Four further samples, three common rafters from the hip truss of the cross-wing roof, and a common rafter from the main range roof, matched each other and were again combined at the relevant offset position to for BLKASQ02, a site sequence of 67 rings (Fig 18). Attempts to date this site sequence by comparing it against the reference chronologies were unsuccessful and it remains undated.

Finally, four of the dining room ceiling samples matched each other and were combined to form BLKASQ03, a site sequence of 74 rings (Fig 19). Again, this site sequence could not be matched against the reference chronologies and is undated.

Attempts to date the remaining, ungrouped samples by comparing them individually against the reference material were unsuccessful and these remain undated.

INTERPRETATION

Tree-ring analysis of timbers at this building has resulted in the successful dating of 15 samples. One of these samples (BLK-A02) has complete sapwood and the last-measured ring date of 1518, the felling date of the timber represented. Another 13 of the dated samples have the heartwood/sapwood boundary, which in all cases is broadly contemporary and suggestive of a single felling. The average of these heartwood/sapwood boundary ring dates is 1496, allowing an estimated felling date range to be calculated for the timbers represented of 1517–36. This allows for sample BLK-A04 to have the last-measured ring date of 1516 with incomplete sapwood. The felling date range of 1517–36 is consistent with these timbers having also been felled in 1518.

One sample, BLK-A24, does not have the heartwood/sapwood boundary, but with a last-measured heartwood ring date off 1494 it is possible that this timber was also felled in 1518 with the rest of the timber.

Felling date ranges have been calculated using the estimate that mature oak trees from this region have between 15 and 40 sapwood rings.

DISCUSSION

Prior to tree-ring analysis being undertaken the main and cross-wing ranges were thought to be the oldest surviving elements to this building and to date to the sixteenth or seventeenth century. It is now known that the roofs over these two ranges were constructed with timber felled in 1518. Furthermore, the timbers of the exposed ceiling of the entrance hall (located within the main range) are also thought likely to date to 1518. These results suggest that the two ranges are contemporary and that the southern part of the main range always had a floor at first-floor level.

The intra site matching (ie, how well each sample matches the other samples) seen within the components of site sequence BLKASQ01 is very good, showing significant similarities between the growth pattern of timbers used within the two roofs and the ceiling. An example is BLK-A13 from the cross-wing roof matching BLK-A26 from the entrance hall ceiling at a value of t=11.6 and BLK-A25 from the ceiling matching BLK-A02 from the main range roof at a value of t=8.1. This suggests that the timber utilised in the construction of these elements was sourced from the same woodland or adjacent woodlands. Although it cannot be said with complete certainty where this woodland might be, it is interesting to note the highest match with the reference chronologies is with a site in nearby Kings Lynn, suggesting that the woodland was probably local.

It is unfortunate that neither of the other two site sequences could be securely dated. When a site sequence is undated it is usually due to poor replication or shortness of the sequence. Both site sequences contain four samples and are of 67 (BLKASQ02) and 74 rings (BLKASQ03). These sequences are not especially short or poorly replicated and one would certainly be hopeful of a secure date for at least one of them. However, clearly the longer and better replicated a site sequence is, the more chance there is of success and in a region such as Norfolk where successful tree-ring dating is notoriously difficult it may be that they are simply not robust enough. The reason for the difficulties in Norfolk is unclear. It may be due to a localised woodland management regime unduly influencing the growth pattern and masking the climatic signal. Alternatively, it may be that due to the benign climate in Norfolk one does not see great variations in growth within the trees. This might mean that although a site sequence of 74 rings might produce a distinctive growth pattern in other parts of the country with more changeable weather (and therefore growth) within Norfolk it does not.

In light of the above, the construction and dating of the well replicated site sequence BLKASQ01 is particularly encouraging and it is hoped may assist in the successful dating of further Norfolk timbers in the future. The undated site sequences from this building will be retained and as more reference chronologies from this area are produced it may one day be possible to find a match and therefore a secure date for them.

Acknowledgements

This work was commissioned by Antony Major of The Whitworth Co-Partnership on behalf of Mr & Mrs Smedley, owners of the property. The Laboratory would like to thank Mr Major for all his assistance during this research and for providing some of the drawings used to locate samples. Hugh Richmond, architectural historian, kindly discussed the building during the initial site visit. Thanks are also given to Martin Jackson of R & J Hogg Limited and other site staff for their assistance and co-operation during the initial site assessment and whilst sampling was undertaken.

Table 1: Details of samples from The Old Rectory, Blakeney, Norfolk

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
Main range – roof						
BLK-A01	Collar, truss 1	64	01	1435	1497	1498
BLK-A02	Stud 2, truss 1	98	30C	1419	1488	1518
BLK-A03	Stud 3, truss 1	102	h/s	1391	1492	1492
BLK-A04	Stud 6, truss 1	124	28	1393	1488	1516
BLK-A05	Stud 8, truss 1	80	h/s	1418	1497	1497
BLK-A06	Collar, truss 2	133	h/s	----	----	----
BLK-A07	West windbrace, bay 2	89	h/s	----	----	----
BLK-A08	West common rafter 1, bay 1	62	h/s	1431	1492	1492
BLK-A09	East common rafter 3, bay 1	50	h/s	----	----	----
BLK-A10	East common rafter 2, bay 2	68	h/s	1421	1488	1488
Cross-wing – roof						
BLK-A11	Collar, truss 6	90	h/s	1406	1495	1495
BLK-A12	Stud 1, truss 6	NM	--	----	----	----
BLK-A13	Stud 2, truss 6	62	h/s	1441	1502	1502
BLK-A14	Stud 6, truss 6	50	h/s	1451	1500	1500
BLK-A15	Stud 2 (upper), truss 6	NM	--	----	----	----
BLK-A16	South principal rafter, hip bay	52	14	----	----	----
BLK-A17	West principal rafter, hip bay	NM	--	----	----	----
BLK-A18	West common rafter 8, hip bay	50	--	----	----	----
BLK-A19	South common rafter 1, hip bay	66	--	----	----	----
BLK-A20	North common rafter 2,hip bay	44	--	----	----	----
Main range – entrance hall ceiling						
BLK-A21	East 6	NM	--	----	----	---
BLK-A22	East 10	103	02	1402	1502	1504
BLK-A23	East 13	94	h/s	1408	1501	1501
BLK-A24	East 14	49	--	1446	----	1494
BLK-A25	West 6	158	09	1339	1487	1496

BLK-A26	West 7	55	h/s	1449	1503	1503
BLK-A27	West 10	45	--	----	----	----
BLK-A28	West 15	NM	--	----	----	----
Main range – dining room ceiling						
BLK-A29	Main east-west beam	65	h/s	----	----	----
BLK-A30	Joist 2	NM	--	----	----	----
BLK-A31	Joist 4	44		----	----	----
BLK-A32	Joist 5	58	--	----	----	----
BLK-A33	Joist 6	NM	--	----	----	----
BLK-A34	Joist 7	41	06	----	----	----
BLK-A35	Joist 10	69	01	----	----	----
BLK-A36	Joist 12	66	h/s	----	----	----

*NM = not measured

**h/s = the heartwood/sapwood boundary ring is the last-measured ring on the sample

c = complete sapwood on timber, 1 or 2 rings lost during the sampling process

C = complete sapwood retained on sample, last ring is the felling date.

Table 2: Results of the cross-matching of site sequence BLKASQ01 and relevant reference chronologies when the first-ring date is 1339 and the last-measured ring date is 1518

Reference chronology	*t*-value	Span of chronology
Marriot's Warehouse, Kings Lynn, Norfolk	8.1	1309–1583
Chalgrove Manor, Chalgrove, Oxfordshire	5.7	1355–1503
49/50 Quarry Street, Guiildford, Surrey	5.5	1341–1583
Chicksands Priory, Bedfordshire	5.2	1200–1541
White Tower, Tower of London, London	4.8	1260–1489
Langhord by Holme, Nottinghamshire	4.7	1451–1608
Barbican/Gatehouse, Warwick Castle, Warwickshire	4.7	1310–1503

Figure 1: Map to show the general location of Blakeney, arrowed (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)

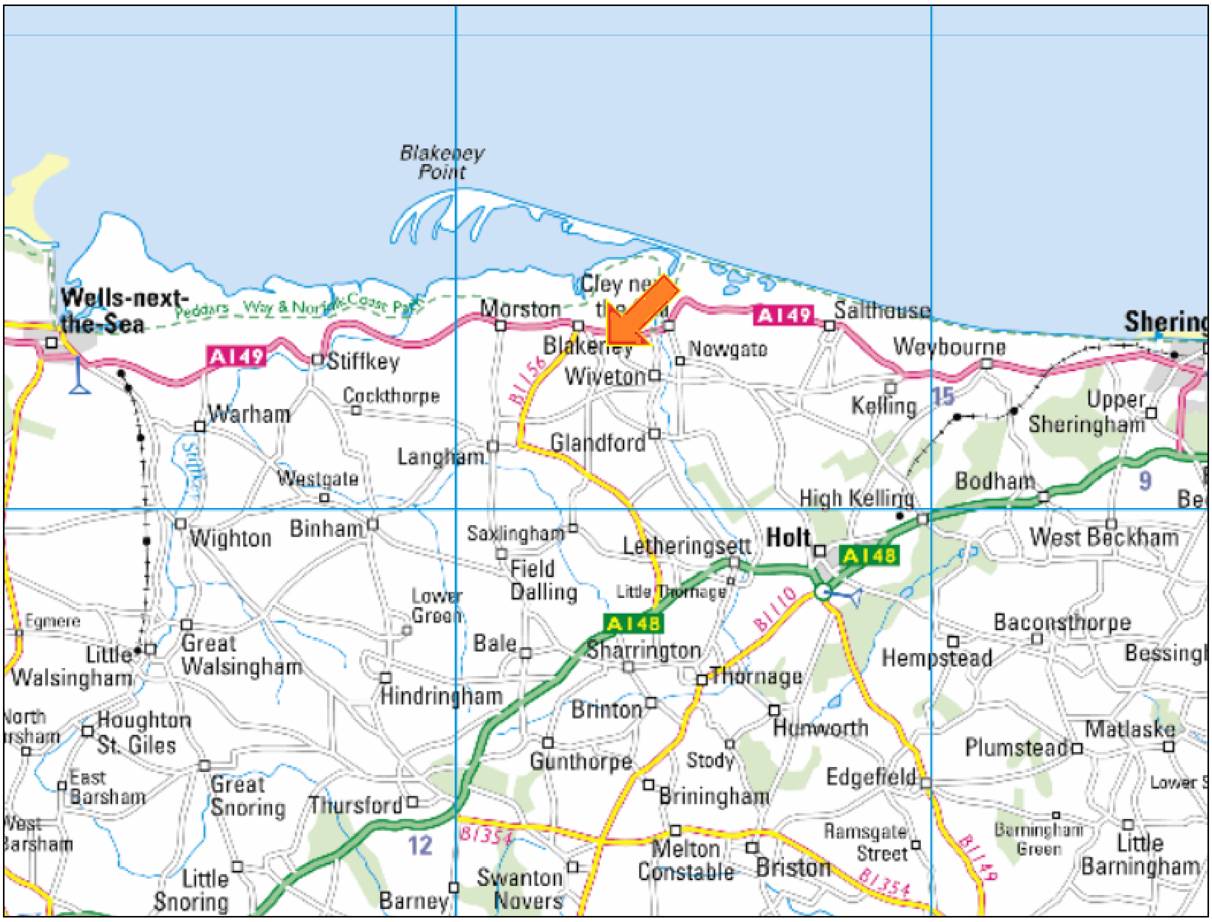

Figure 2: Map to show the general location of Blakeney,arrowed (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)

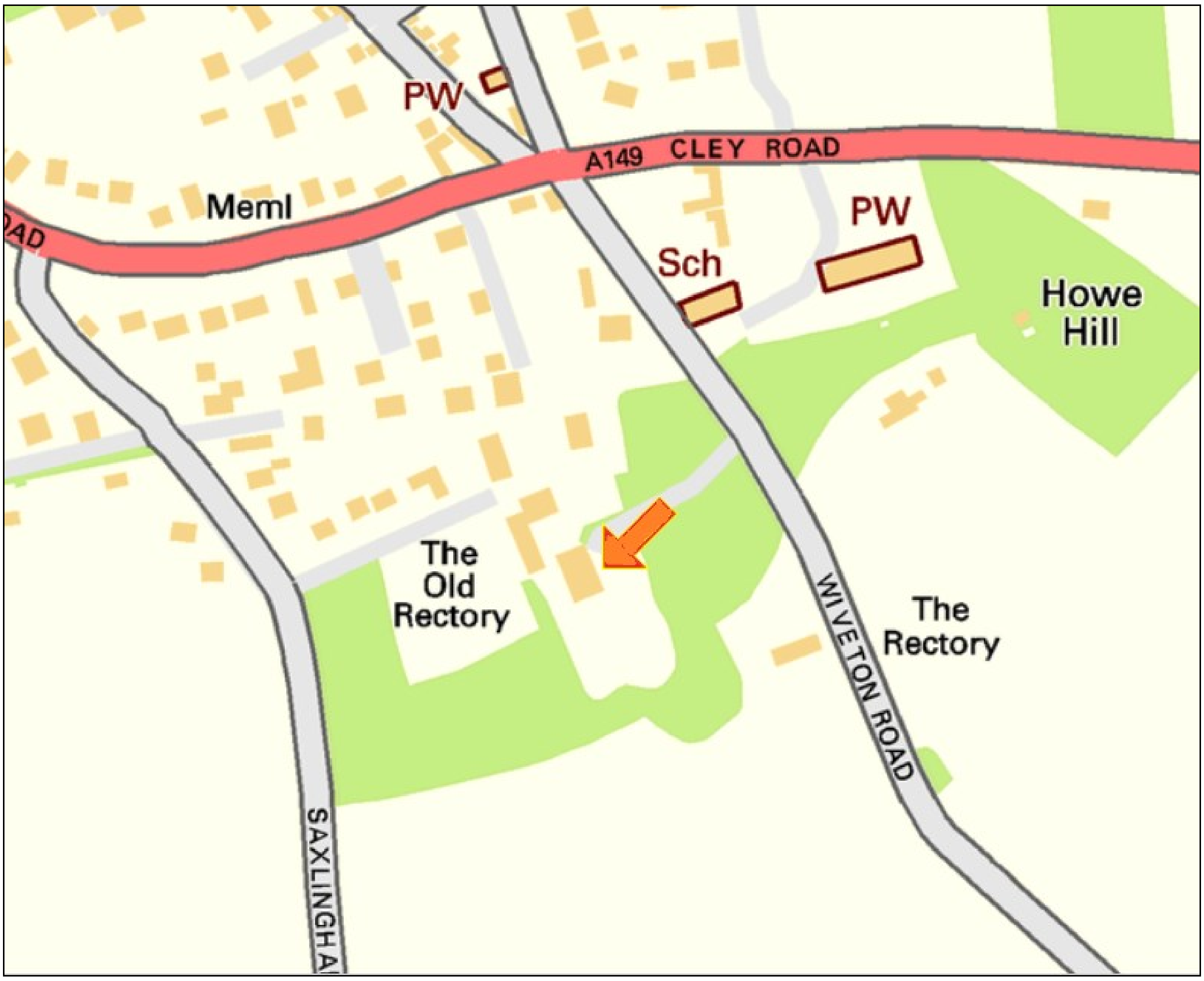

Figure 3: Location of The Old Rectory,Blakeney, arrowed (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)

Figure 4: Ground-floor plan, showing the entrance hall (orange) and dining room (blue), (plan supplied by The Whitworth Co-Partnership)

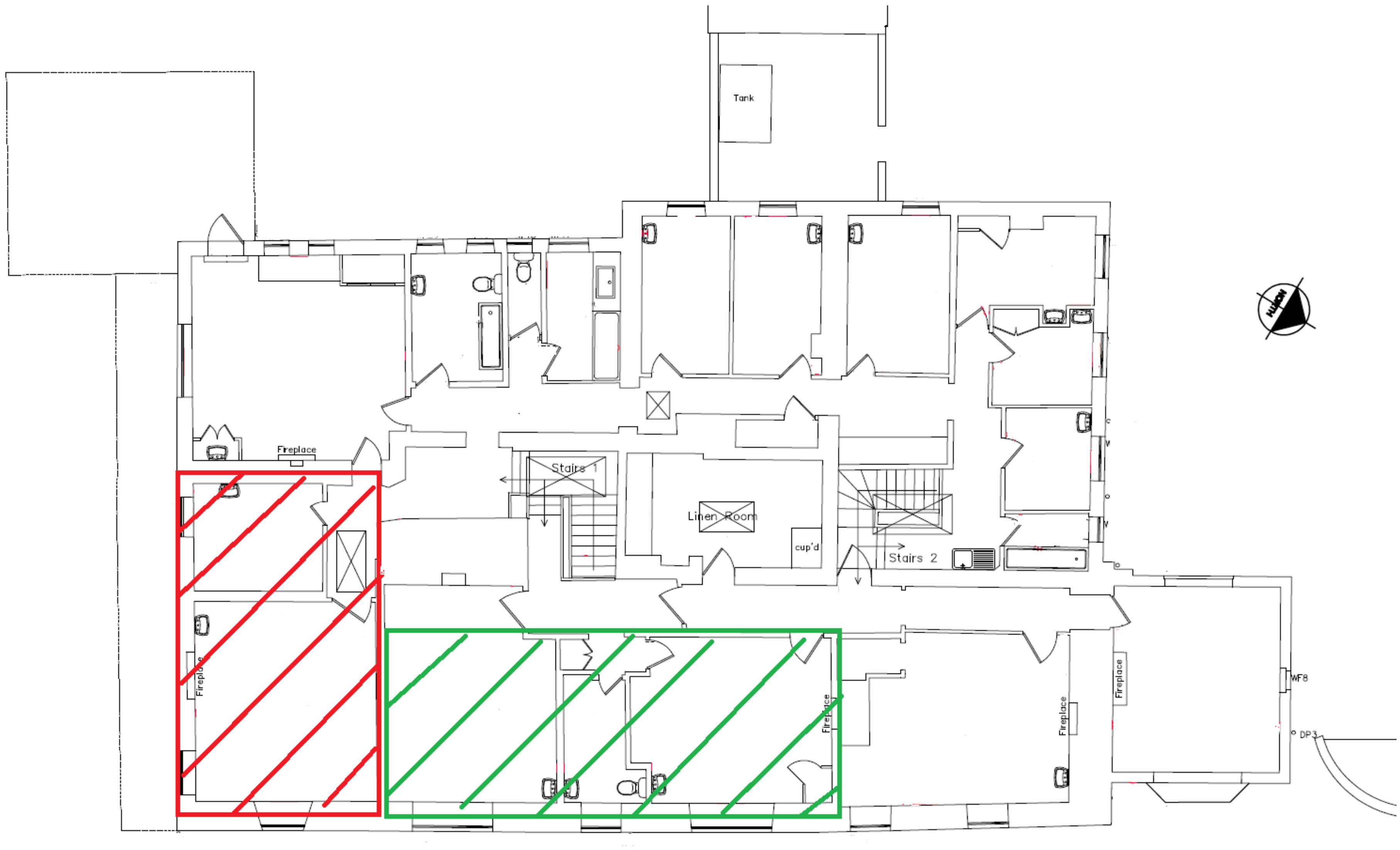

Figure 5: First-floor plan, showing the main range roof (green) and cross-wing roof (red), (plan supplied by The Whitworth Co-Partnership)

Figure 6: Main range roof; truss 1 (photograph taken from the north)

Figure 7: Main range roof; truss 3 (photograph taken from the south)

Figure 8: Main range; entrance hall, ceiling, photograph taken from the south-west

Figure 9: Dining room, ceiling, photograph taken from the south-east

Figure 10: Cross-wing; truss 6 in the background (photograph taken from the west)

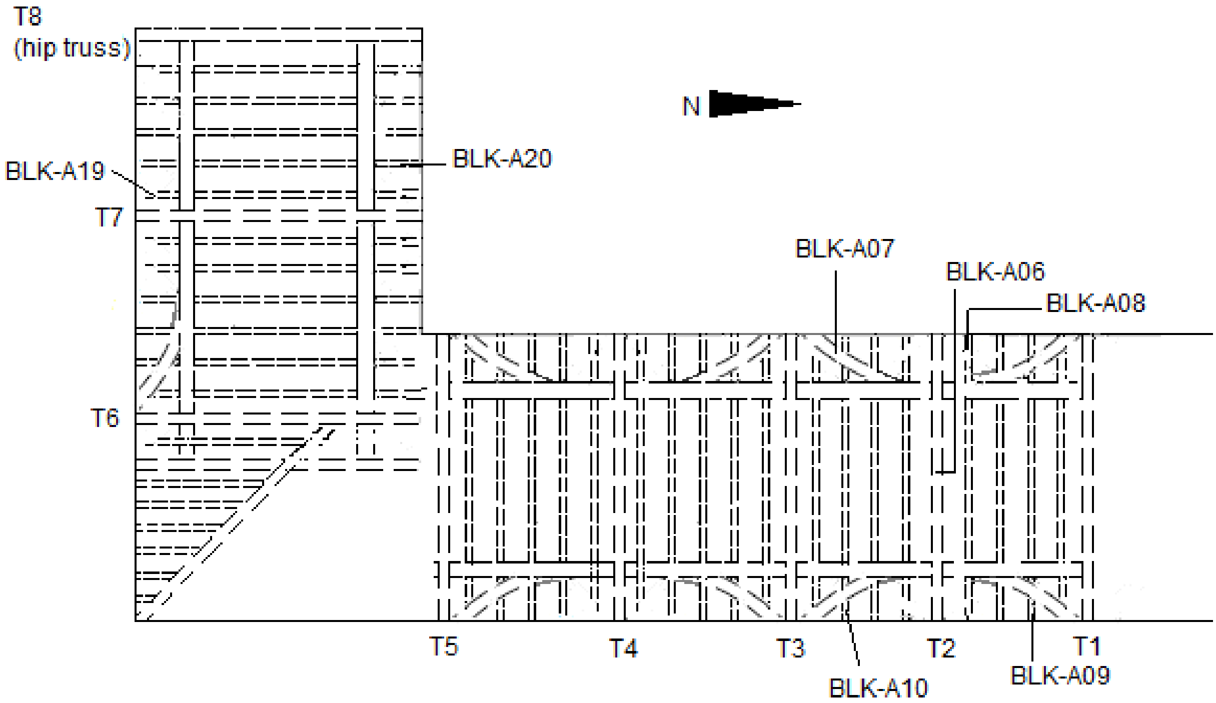

Figure 11: Sketch plan of the main range and cross-wing roofs, showing the location of samples BLK-A06–10 and BLK-A19–20

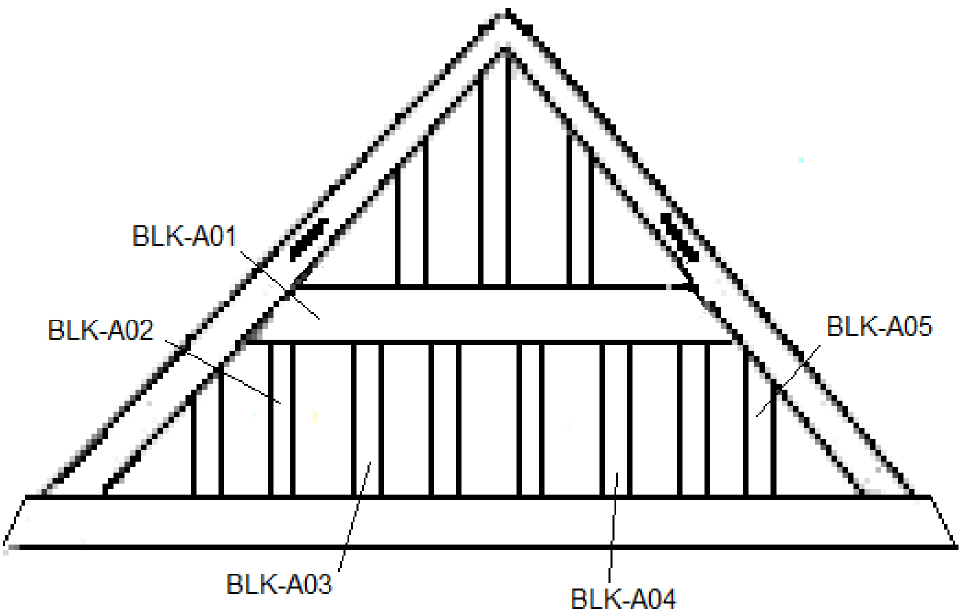

Figure 12: Sketch of truss 1, showing the location of samples BLK-A01–05

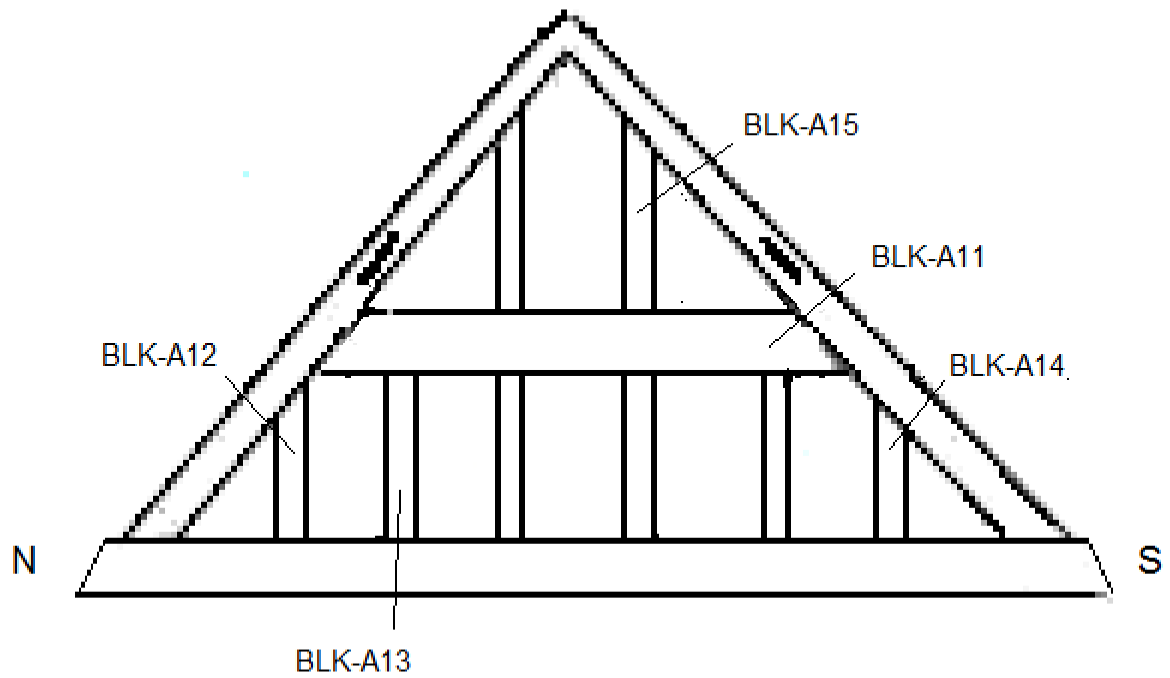

Figure 13: Sketch of truss 6, showing the location of samples BLK-A12–15

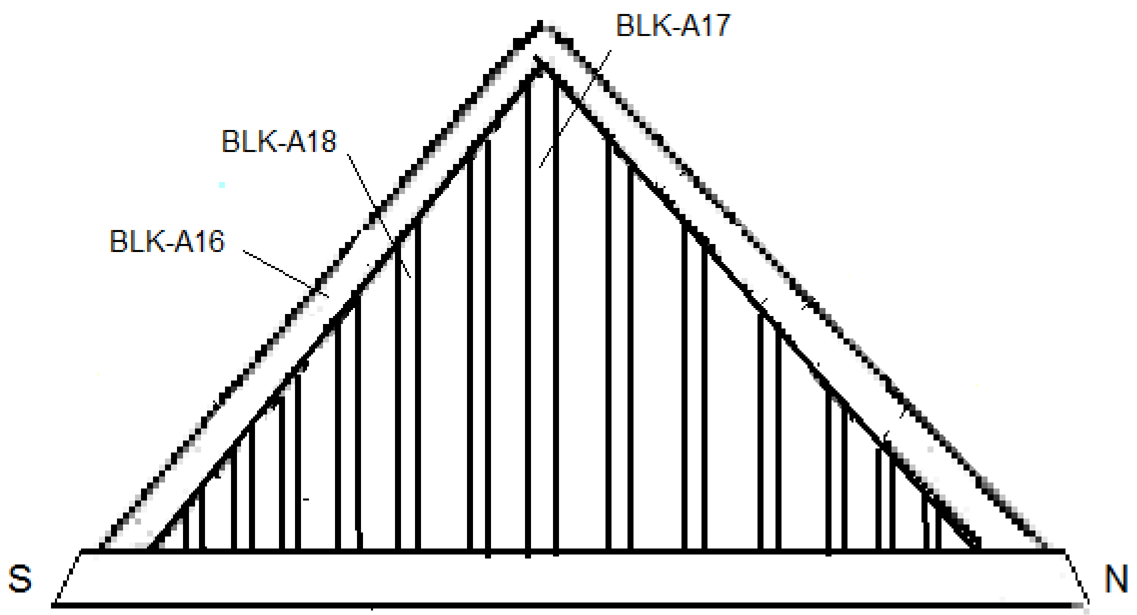

Figure 14: Sketch of truss 8 (hip truss), showing the location of samples BLK-A16–18

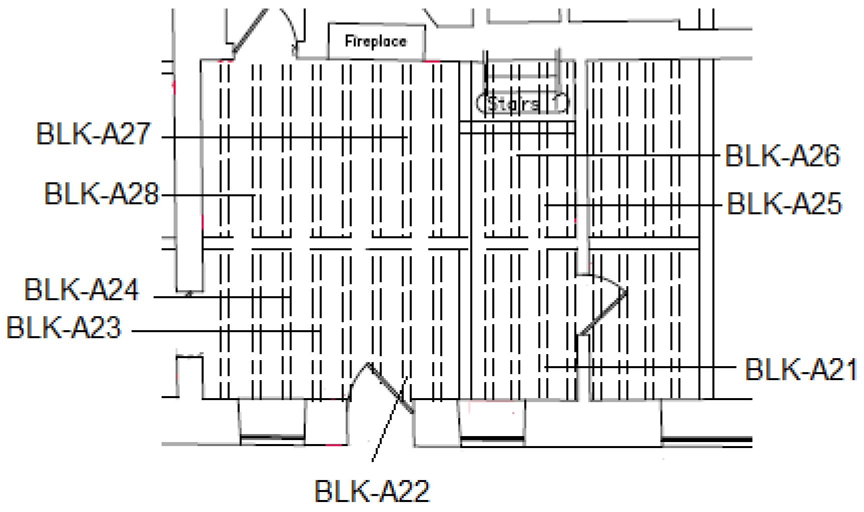

Figure 15: Plan of Hall ceiling, showing the location of samples BLK-A21–8

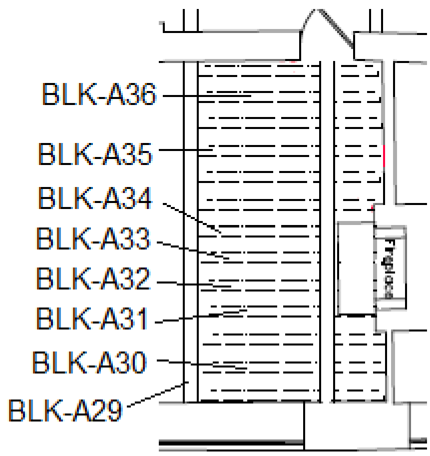

Figure 16: Plan of dining room ceiling, showing the location of samples BLK-A29–36

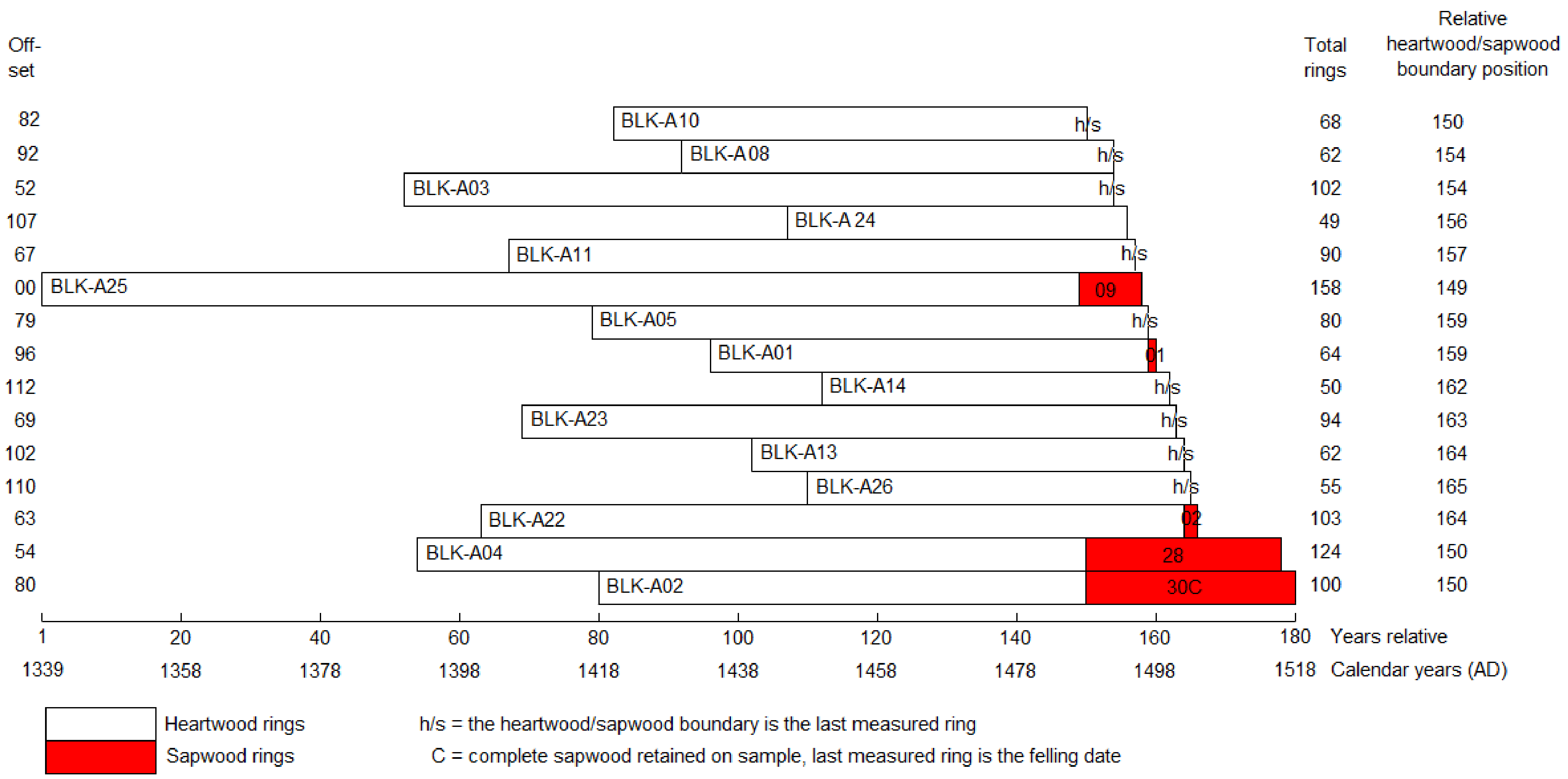

Figure 17: Bar diagram of samples in site sequence BLKASQ01

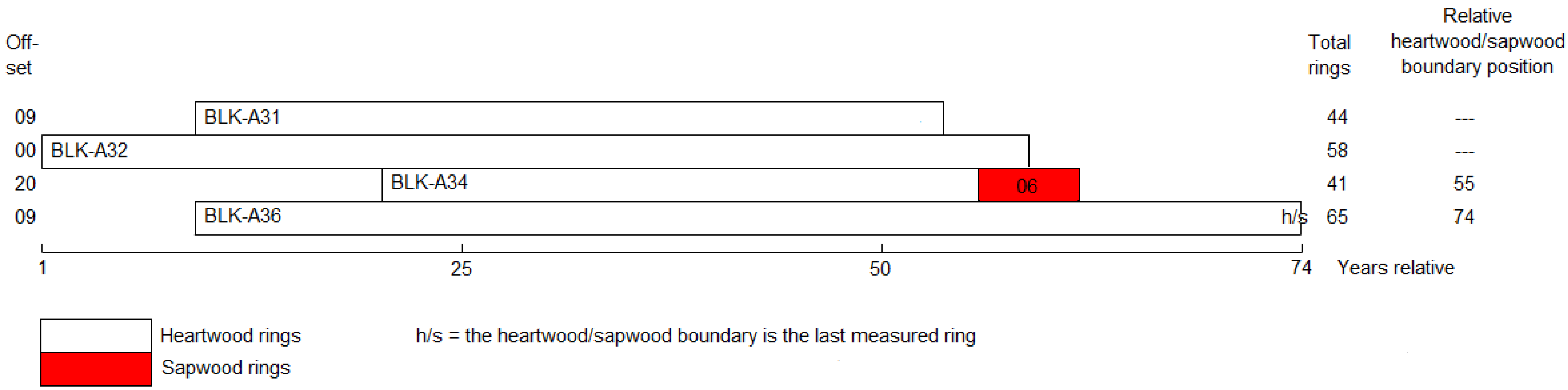

Figure 18: Bar diagram of samples in undated site sequence BLKASQ02

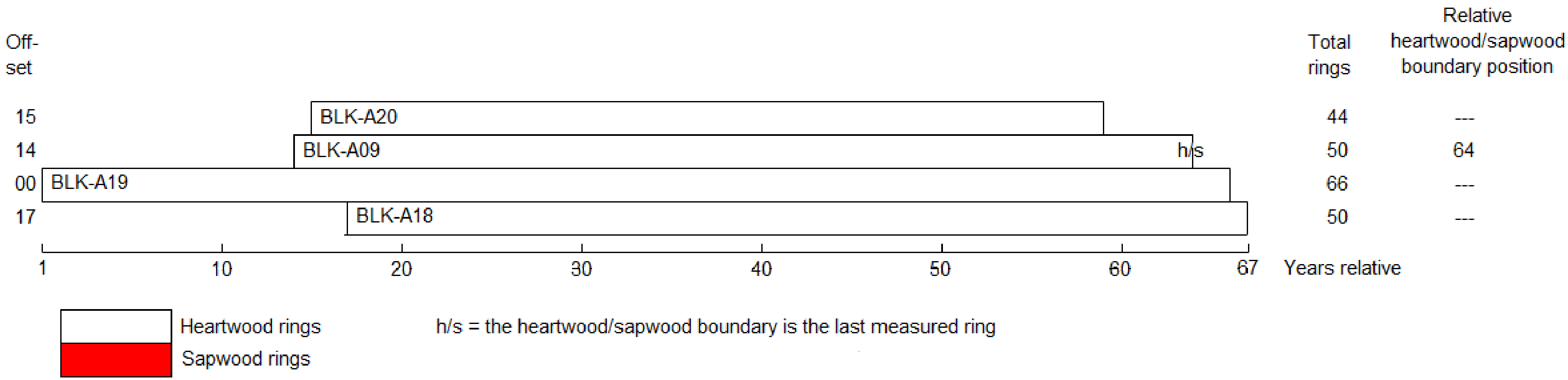

Figure 19: Bar diagram of samples in undated site sequence BLKASQ03