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THE BELLFRAME
CHURCH OF ST CATHERINE
COSSALL
NOTTINGHAMSHIRE

SURVEY, RECORDING, AND TREE-RING ANALYSIS OF TIMBERS

Alison Arnold, Robert Howard, and George Dawson

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SURVEY, RECORDING, AND TREE-RING ANALYSIS OF TIMBERS FROM THE BELLFRAME OF THE CHURCH OF ST CATHERINE, COSSALL, NOTTINGHAMSHIRE

ALISON ARNOLD
ROBERT HOWARD
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SUMMARY

Dendrochronological analysis undertaken on samples taken from timbers of the bellframe at this church resulted in the construction and dating of two site sequences.
Site sequence NBFISQ01contains two samples and spans the period AD 1388–1492 and site sequence NBFISQ02 contains eight samples and spans the period AD 1461–1619.
Interpretation of sapwood demonstrates felling of timbers in AD 1619 with others having *terminus post quem* felling dates of AD 1474, AD 1507, AD 1539, and AD 1594.

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INTRODUCTION

The Grade II* Church of St Catherine, located in the village of Cossall (Figs 1 and 2) dates from the thirteenth and fourteenth centuries but was heavily restored and partially rebuilt in AD 1842 with the exception of the tower. It consists of chancel, clerestoried nave of two bays, aisles, vestry, south porch, and west tower with spire (http://southwellchurches.nottingham.ac.uk/cossall/main/hindex.php).

The bellframe

The bells are hung for full circle ringing in an oak frame, Pickford Group 5.P with variant E Group 2 braces, for two bells, with wooden headstocks, wheels and plain bearings. The frame itself is of slight construction, but is somewhat unusual in having queen-posts, rather than the more common king-posts; the braces are curved (Figs 3 and 4). The installation is in poor condition and the bells are only swing chimed. The fittings would appear to be of early nineteenth-century date.

The bells

The bells are inscribed:

1. Blank.

2. T. TVRVY P. SYSON C.W. 1733

Physical data:

	Diameter	Weight (Cwt.Qr.Lbs)
Treble	20.75"	*c* 1.5 cwt
Tenor	22.5"	*c* 2 cwt

The treble has five moulding lines at the shoulder. It is probably a mid to late-fourteenth century production by an unknown founder. It was originally supposed to have come from Cossall Hall, at one time a residence of the Willoughby family, but in the light of the evidence of the Archdeaconry Books doubt must be cast on that statement.

The larger bell is the work of Daniel Hedderly and Cossall appears in the Hedderly hand-list. The previous bell had been cracked for many years as evidenced by two entries in the Archdeaconry Court Act Book:

25 May 1722 The second bell must be new cast and hung

19 Sept. 1728 Memorand there is a broken bell ther which was broak in 1713

1552: ij belles in the stipull

Phillimore visited on 10 October 1873.

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 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 STRATEGY

A total of ten samples were taken from the timbers of this bellframe. Each sample was given the code NBF-I and numbered 01–10. The location of all samples was noted at the

time of sampling and have been marked on Figures 5–9. Further details relating to these samples can be found in Table 1.

ANALYSIS & RESULTS

All samples were prepared by sanding and polishing and their growth ring widths measured. These measurements were compared against each other where it was found the ten samples formed two groups,

Firstly, two samples matched each other and were combined at the relevant offset positions to form NBFISQ01, a site sequence of 105 rings (Fig 10). This site sequence was then compared against a series of relevant reference chronologies for oak where it was found to match consistently and securely at a first-ring date of AD 1388 and a last-measured ring date of AD 1492. The evidence for this dating is given by the *t*-values in Table 2.

The remaining eight samples matched each other and were again combined at the relevant offset positions to form NBFISQ02, a site sequence of 159 rings (Fig 11). This site was found to span the period AD 1461–1619 when compared against the reference material. The evidence for this dating is given by the *t*-values in Table 3.

INTERPRETATION

Tree-ring dating has successfully dated all ten samples (Fig 12). One of these (NBF-I10) has complete sapwood and the last-measured ring date of AD 1619, the felling date of the timber represented. Five further samples have the heartwood/sapwood boundary ring which in all cases is broadly contemporary and suggestive of a single felling. The average heartwood/sapwood boundary ring date is AD 1591, allowing an estimated felling date to be calculated for the five timbers represented to within the range AD 1606–31, consistent with a felling of AD 1619. The remaining four dated samples do not have the heartwood/sapwood boundary and so an estimated felling date cannot be calculated for the timbers represented. With last measured ring dates of AD 1459 (NBF-I03), AD 1492 (NBF-I02), AD 1524 (NBF-I05), and AD 1579 (NBF-I06) these samples have *terminus post quem* felling dates of AD 1474, AD 1507, AD 1539, and AD 1594, respectively.

The felling date range has been calculated using the estimate that 95% of the mature trees in this region have 15–40 sapwood rings.

DISCUSSION

The dendrochronology has demonstrated that the bellframe at Cossal church utilises timber felled in AD 1619, with construction likely to have followed shortly after.

Other samples have *terminus post quem* felling dates ranging from AD 1474 to AD 1594. The intra-site matching of samples would suggest that at least two of the timbers with *terminus post quem* felling dates were also felled in AD 1619. Samples NBF-I05 and NBF-I06 can be seen to match a number of the AD 1619 samples extremely well (Table 4). However, it is unclear as to whether the other two samples (NBF-I02 and NBF-I03) denote the use of reused or stockpiled timber within the frame or simply represent the inner portions of long lived trees. Given that neither of these beams show any obvious signs of reuse (such as empty mortices) have empty mortices (which would suggest a previous use for the timbers) it would seem more likely that they are the inner portion of long lived trees or o empty mortices were noted

BIBLIOGRAPHY

Arnold, A J, and Howard, R E, 2013 unpubl Tree-ring analysis of timbers from Preston Manor House, Cross Lane, Preston, Rutland, unpubl computer file *PSTASQ01*, NTRDL

Arnold, A J and Howard, R E, 2007 Nottingham Tree-ring Dating Laboratory, *Vernacular Architect*, 38, 106–14

Arnold, A J, Howard, R E, Litton, C D, and Dawson, G 2005 *The Tree-ring Dating of a Number of Bellframes in Leicestershire*, Centre for Archaeol Rep 5/2005

Arnold, A J, Howard, R E, and Litton, C D, 2008 Nottingham Tree-ring Dating Laboratory, *Vernacular Architect*, 39, 129

Arnold, A J, and Howard, R E, 2014 *Groby Old Hall, Markfield Road, Groby, Leicestershire, Tree-Ring Analysis of Timbers*, Res Dep Rep Ser 23/2014

Cossall, http://southwellchurches.nottingham.ac.uk/cossall/hintro.php

Howard, R E, Laxton, R R, Litton, C D, and Simpson, W G, 1991 Nottingham University Tree-Ring Dating Laboratory: results, *Vernacular Architect*, 22, 40 – 3

Howard, R E, 1995 unpubl Barbican and Gatehouse, Warwick Castle, Warwickshire, unpubl computer file *WRKCSQ01*, NUTRDL

Howard, R E, Laxton, R R, Litton, C D, and Simpson, W G, 1995 Nottingham University Tree-Ring Dating Laboratory: results, *Vernacular Architect*, **26**, 47–53

Howard, R E, Laxton, R R, and Litton, C D, 1996 *Tree-ring analysis of timbers from the north aisle of St Nicholas' Church, Stanford upon Avon, Northamptonshire*, Anc Mon Lab Rep, **27/96**

Howard, R E, Laxton, R R, Litton, C D, and Simpson, W G, 1986 Nottingham University Tree-Ring Dating Laboratory results, *Vernacular Architect*, **17**, 52–3

Howard, R E, Laxton, R R, and Litton, C D, 2000 *Tree-ring analysis of timbers from the buildings and living trees at Stoneleigh Abbey, Stoneleigh, Warwickshire*, Anc Mon Lab Rep, **80/2000**

Howard, R E, Laxton, R R, and Litton, C D, 2002 *Tree-ring analysis of timbers from the staircase of the West Lodge, Hardwick Old Hall, Doe Lea, Near Chesterfield, Derbyshire,* Anc Mon Lab Rep, **57/2002**

Hurford, M, Arnold, A J, Howard, R E, and Tyers, C 2008 *Tree-ring analysis of timbers from Flore's House, High Street, Oakham, Rutland*, EH Res Dep Res Rep, **94/2008**

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The Laboratory and George Dawson would like to thank Gillian Thornhill for facilitating access and Professor John Beckett and Dr Chris Brooke for the information on the Southwell and Nottingham Church History website. Thanks are also given to Dr Chris Brooke for his comments on early drafts of this report. The research was undertaken as part of the Southwell and Nottingham Church History Project and this element was joint funded by The Heritage Lottery Fund and Nottinghamshire County Council.

Table 1: Details of samples taken from the bellframe at the Church of St Catherine, Cossall, Nottinghamshire

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
NBF-I01	Top cill, truss C	123	h/s	1474	1596	1596
NBF-I02	East brace, truss C	89	--	1404	----	1492
NBF-I03	East brace, truss B	72	--	1388	----	1459
NBF-I04	Top cill, truss A	114	h/s	1475	1588	1588
NBF-I05	West post, truss A	64	--	1461	----	1524
NBF-I06	Top cill, east end frame E	110	--	1470	----	1579
NBF-I07	North post, east end frame E	100	01	1491	1589	1590
NBF-I08	Top cill, west end frame D	93	h/s	1501	1593	1593
NBF-I09	South post, west end frame D	93	h/s	1496	1588	1588
NBF-I10	South brace, west end frame D	92	25C	1528	1594	1619

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

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

Table 2: Results of the cross-matching of site sequence NBFISQ01 and relevant reference chronologies when the first-measured ring date is AD 1388 and the last-measured ring date is AD 1492

Reference chronology	*t*-value	Span of chronology	Reference
Hempshill Hall, Nottinghamshire	9.1	AD 1315–1500	Arnold and Howard 2007
Barbican/Gatehouse, Warwick Castle, Warwickshire	6.5	AD 1310–1503	Howard 1995 unpubl
Stoneleigh Abbey, Stoneleigh, Warwickshire	6.4	AD 1398–1658	Howard *et al* 2000
Gotham Manor, Nottinghamshire	6.4	AD 1391–1590	Howard *et al* 1991
The Gables, Little Carlton, Nottinghamshire	6.4	AD 1389–1516	Howard *et al* 1986
St Nicholas' Church, Stanford upon Avon, Northamptonshire	6.2	AD 1349–1479	Howard *et al* 1996
Groby Old Hall, Groby, Leicestershire	6.0	AD 1321–1516	Arnold and Howard 2014

Table 3: Results of the cross-matching of site sequence NBFISQ02 and relevant reference chronologies when the first-measured ring date is AD 1461 and the last-measured ring date is AD 1619

Reference chronology	t-value	Span of chronology	Reference
Manor House, Preston, Rutland	8.9	AD 1471–1631	Arnold and Howard 2013 unpubl
St Stephen's Church (bellframe), Sneinton, Nottinghamshire	8.0	AD 1484–1654	Arnold and Howard 2007
Coach Road Cottage, Staunton Harold, Leicestershire	7.5	AD 1456–1605	Arnold *et al* 2008
Hardwick Hall (West Lodge staircase), Derbyshire	7.3	AD 1397–1625	Howard *et al* 2002
Hodsock Priory Gatehouse, Nottinghamshire	7.3	AD 1397–1567	Howard *et al* 1995
Church of St Andrew, Welham, Leicestershire	7.3	AD 1443–1633	Arnold *et al* 2005
Flore's House, Oakham, Rutland	7.2	AD 1408–1591	Hurford *et al* 2008

Table 4: Matrix of intra-site matching of all dated samples; the higher the level, the greater the similarity between samples

		1	2	3	4	5	6	7	8	9	10
NBF-I01	1	***	-44	10	-1	-67	4	-17	-27	-22	-54
NBF-I02	2	3.6	***	16	65	-44	53	36	-14	-4	-36
NBF-I03	3	3.2	**6.6**	***	-15	-1	41	20	10	15	37
NBF-I04	4	**11.5**	2.8	3.1	***	14	5	-16	-26	-21	-53
NBF-I05	5	3.9	3.0	2.7	**7.1**	***	-9	50	40	40	3
NBF-I06	6	**9.9**	3.8	3.0	**10.0**	**5.7**	***	-21	-31	-26	-58
NBF-I07	7	**6.9**	**4.0**	**4.2**	**6.2**	**4.3**	**6.0**	***	-10	-5	-37
NBF-I08	8	**9.7**	3.3	3.2	**7.3**	3.8	**9.3**	**6.5**	***	5	-27
NBF-I09	9	**5.0**	3.2	2.5	**5.3**	2.9	**4.6**	**5.0**	3.6	***	-32
NBF-I10	10	**6.6**	**4.3**	2.3	**6.6**	**4.3**	**4.1**	**4.5**	**6.3**	**4.5**	***

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

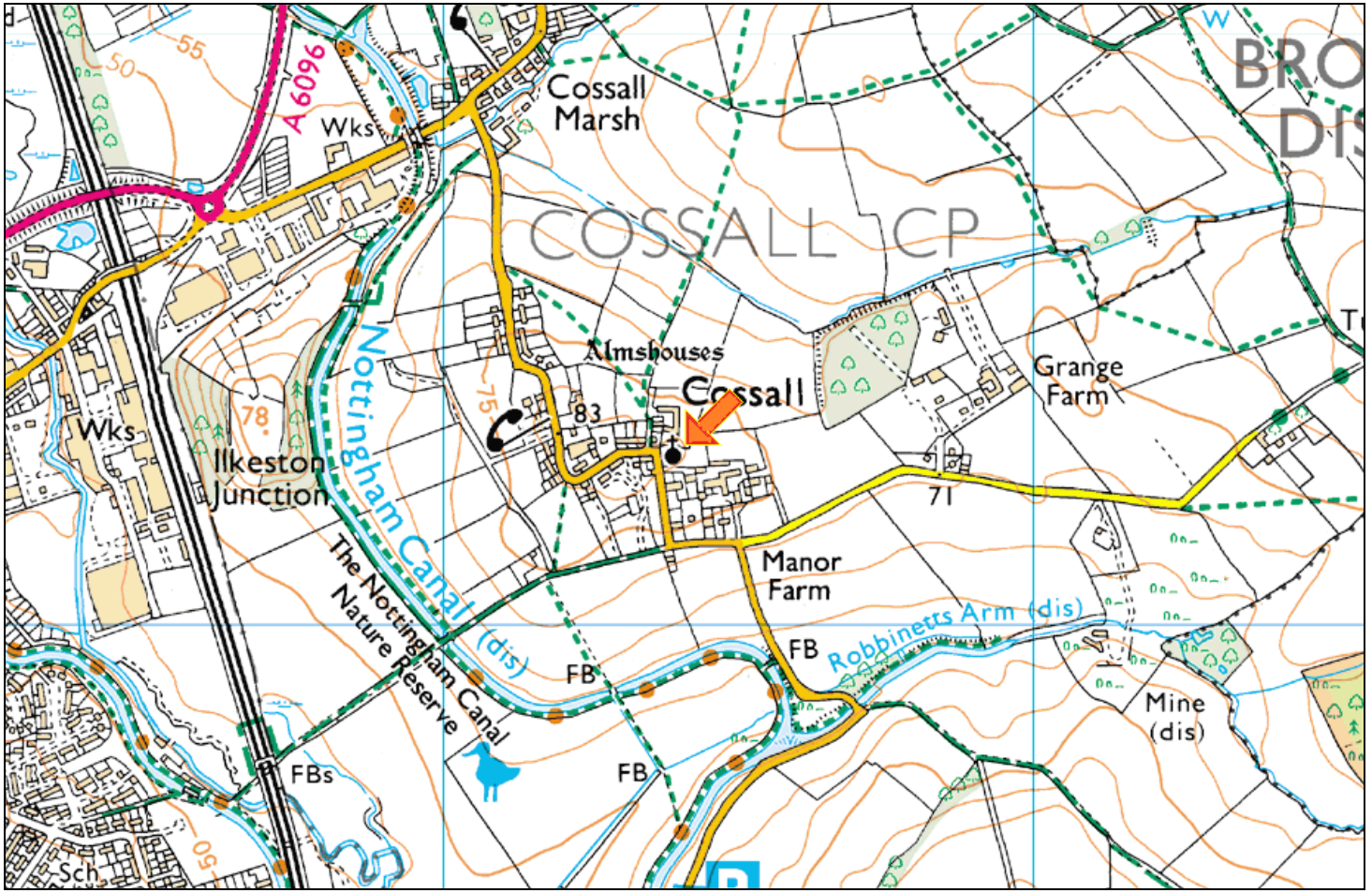

Figure 2: Map to show the location of Church of St Catherine, arrowed (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)

Figure 3: Bellframe, photograph taken from the north-west

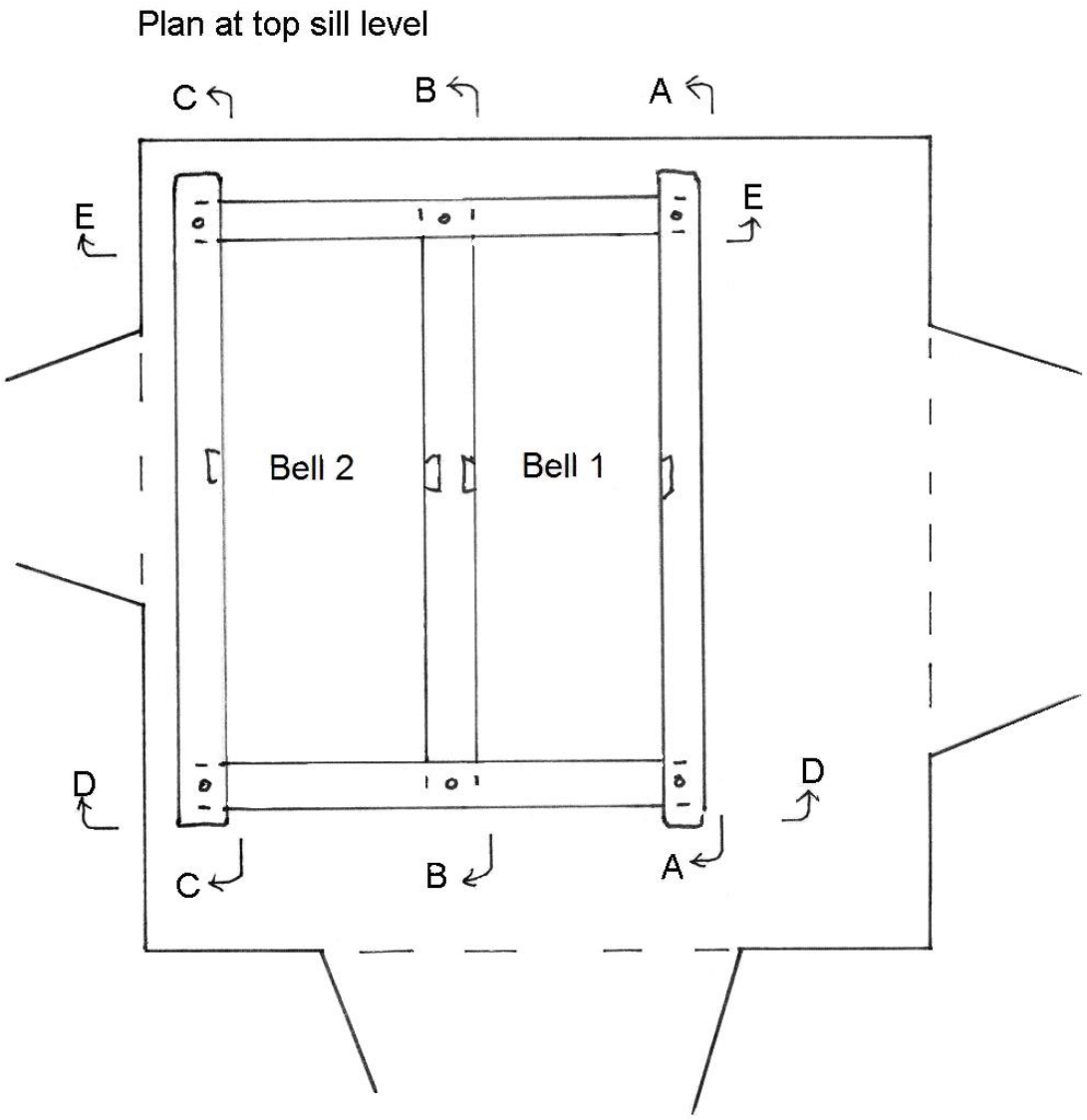

Figure 4: Plan of bellframe, showing truss labelling (George Dawson)

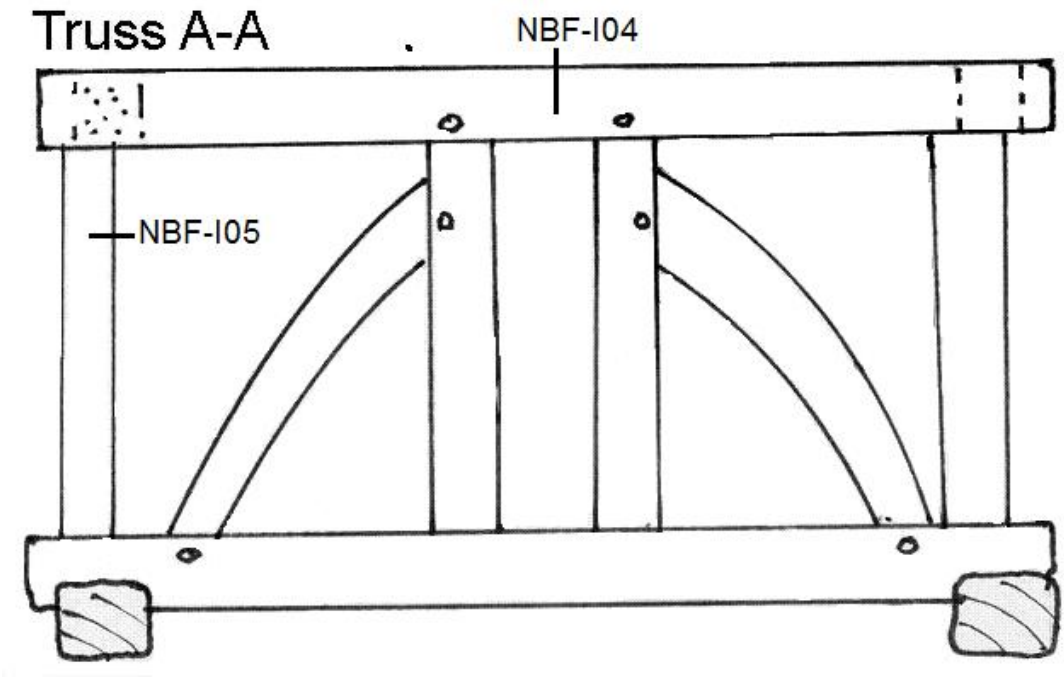

Figure 5: Truss A, showing the location of samples NBF-I04 and NBF-I05 (George Dawson)

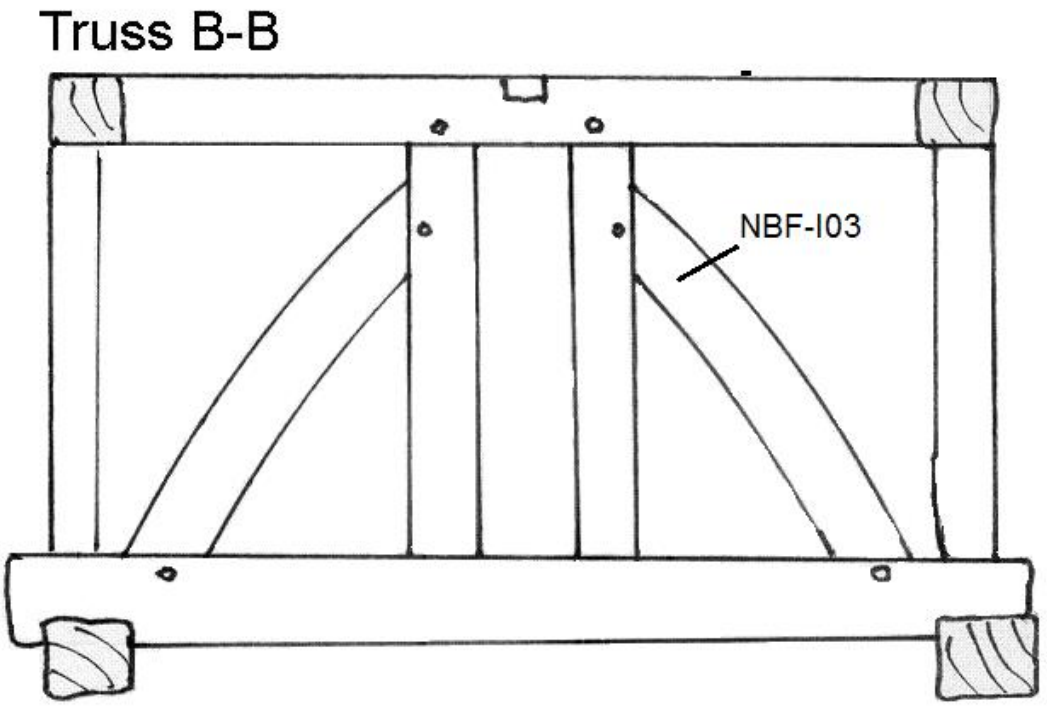

Figure 6: Truss B, showing the location of sample NBF-I03 (George Dawson)

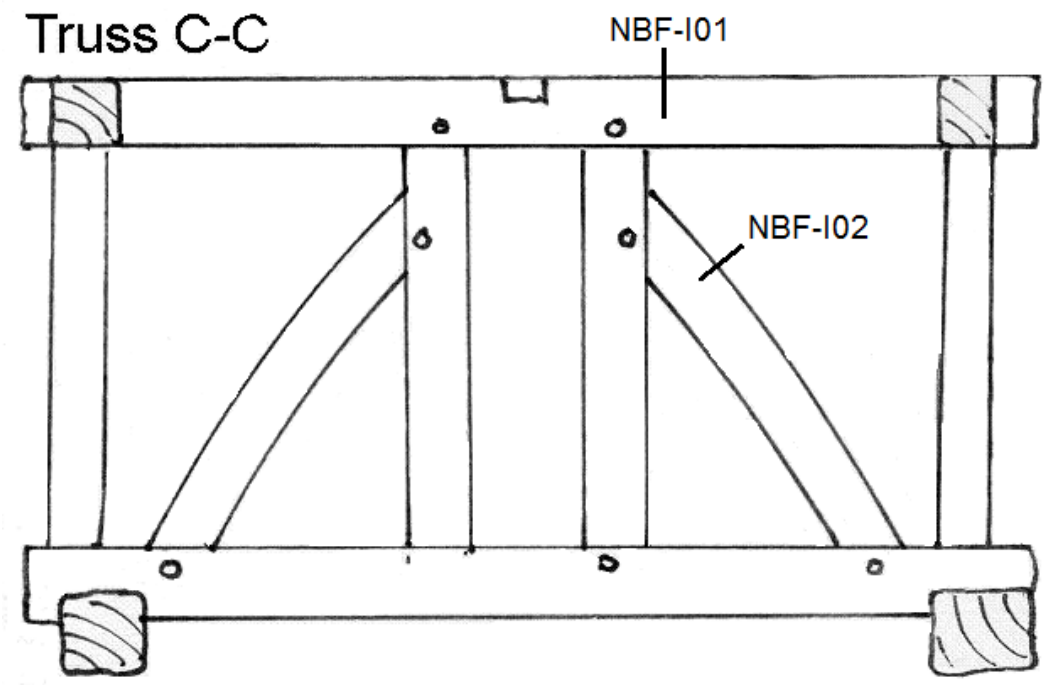

Figure 7: Truss C. showing the location of samples NBF-I01 and NBF-I02 (George Dawson)

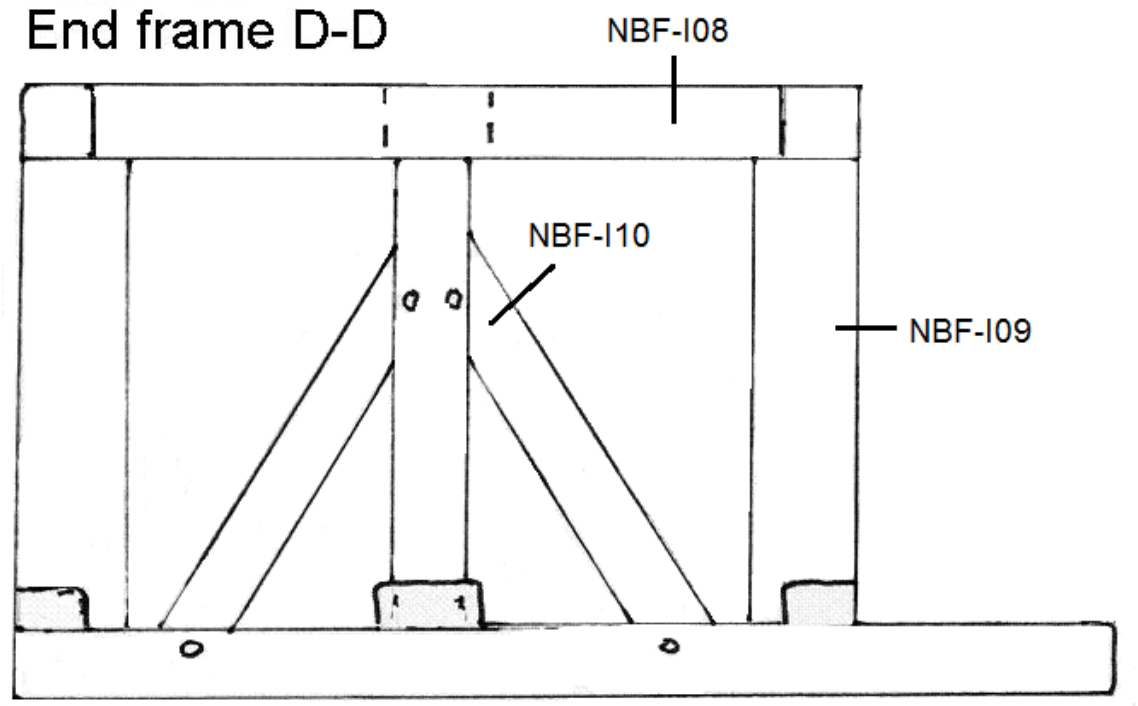

Figure 8: End frame D, showing the location of samples NBF-I09 and NBF-I10 (George Dawson)

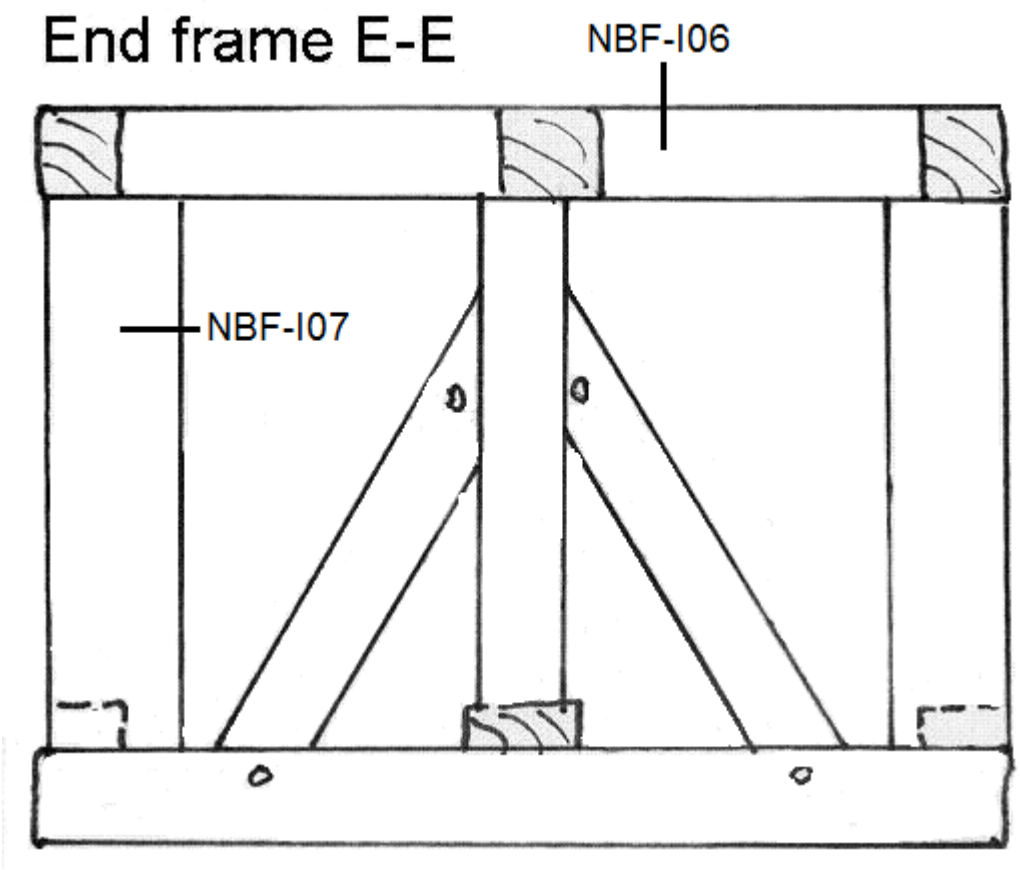

Figure 9: End frame E, showing the location of samples NBF-I06 and NBF-I07 (George Dawson)

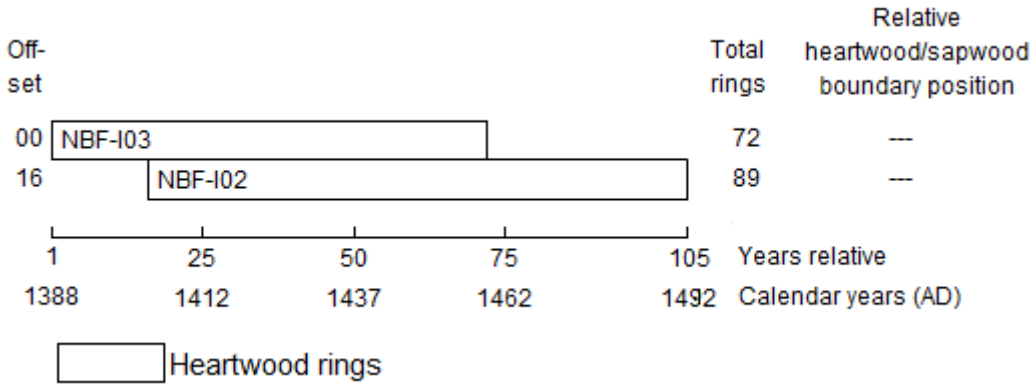

Figure 10: Bar diagram of samples in site sequence NBFISQ01

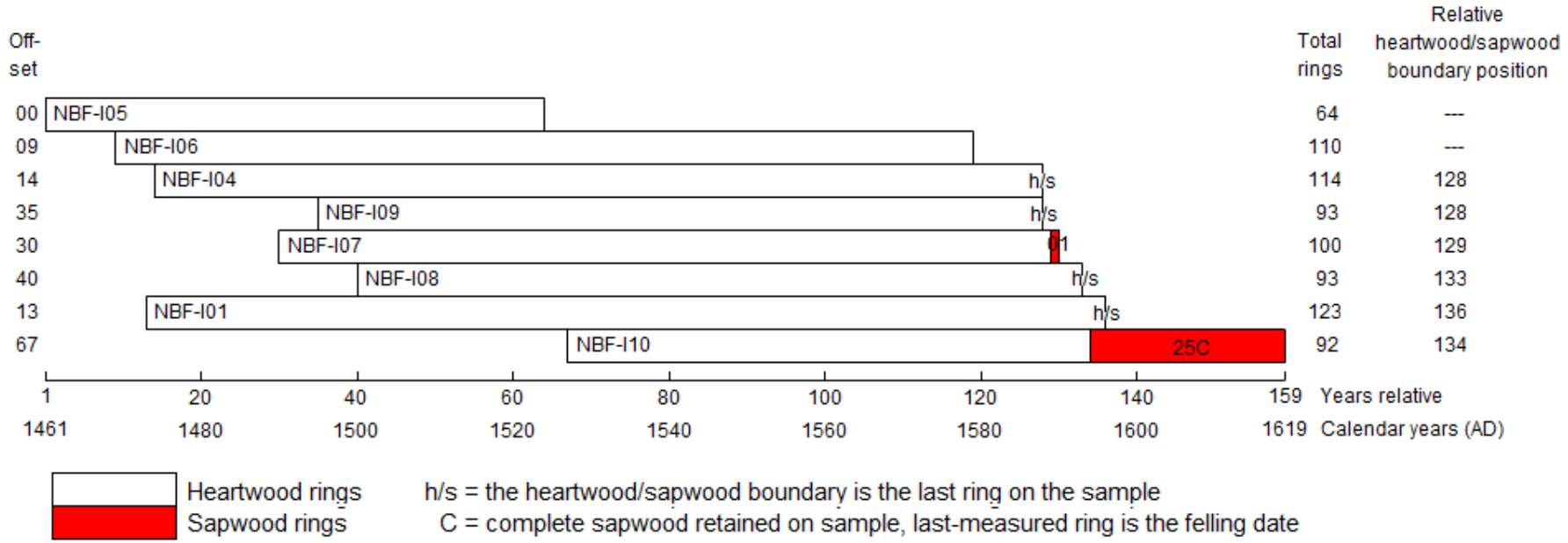

Figure 11: Bar diagram of samples in site sequence NBFISQ02

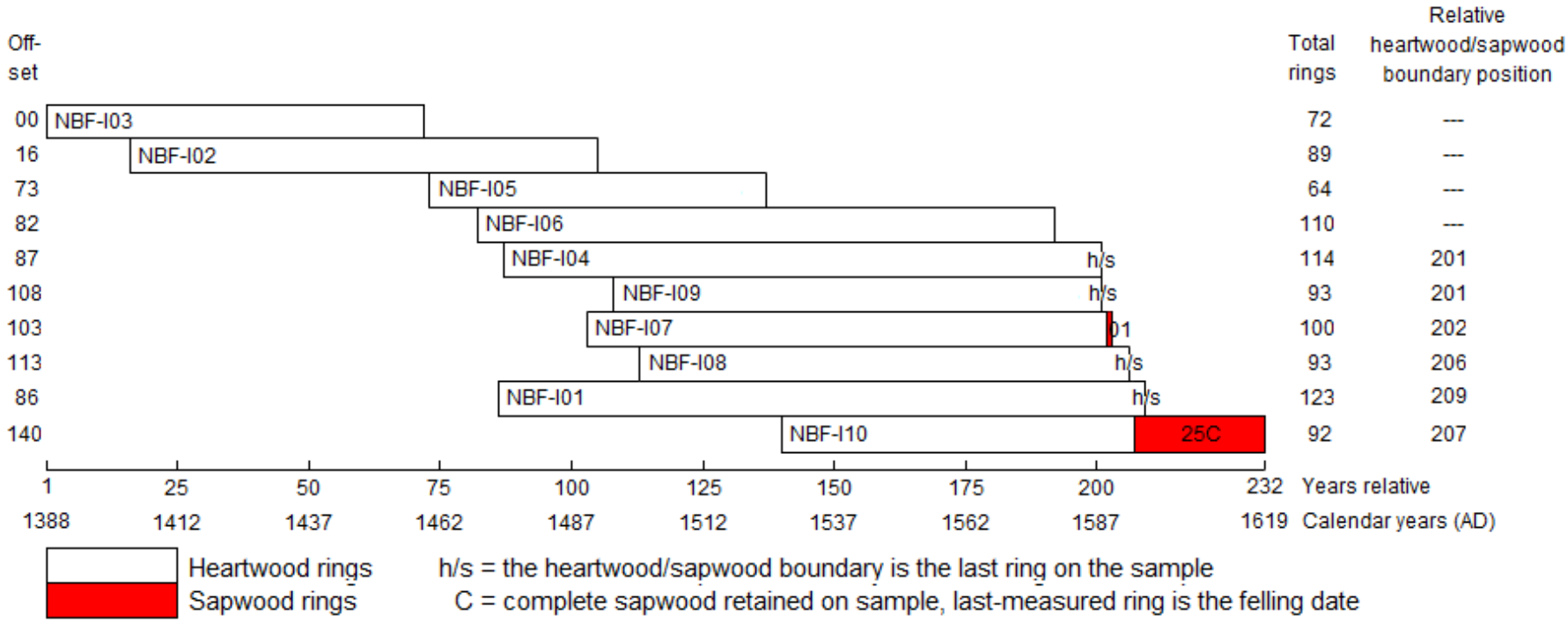

Figure 12: Bar diagram of all dated samples

DATA OF MEASURED SAMPLES

Measurements in 0.01mm units

NBF-I01A 123
296 315 241 150 200 258 288 251 250 286 241 234 216 237 183 147 147 116 126 136
159 140 261 167 108 172 127 102 134 137 121 125 117 122 124 174 123 148 210 141
90 103 120 96 135 156 183 158 160 160 125 85 168 253 280 213 127 189 199 202
146 116 102 111 145 154 139 78 73 77 74 109 86 59 88 109 114 123 94 94
63 108 63 57 73 103 115 97 89 91 80 71 72 84 76 60 65 60 52 51
61 38 56 52 52 91 132 124 123 129 165 153 157 116 108 146 129 131 117 273
297 230 208
NBF-I01B 123
305 323 239 152 207 256 287 248 232 270 227 224 200 230 184 149 149 119 119 143
154 147 261 163 115 165 122 114 138 135 111 134 120 121 118 176 122 148 204 141
92 91 131 96 137 149 171 163 164 162 122 89 158 252 279 217 124 189 203 201
148 111 98 126 142 163 137 76 66 84 77 105 76 55 90 101 118 124 97 93
66 112 56 56 79 111 108 102 90 89 76 75 76 76 74 55 71 58 59 34
66 42 53 51 54 87 134 128 120 133 153 167 149 128 106 150 111 135 117 262
314 221 173
NBF-I02A 89
245 246 157 164 233 346 271 114 143 114 79 64 47 56 73 73 115 145 110 104
127 99 82 64 123 148 117 191 197 113 91 135 170 228 176 190 210 242 214 272
264 195 157 121 104 143 176 193 210 177 135 151 201 181 107 93 164 148 232 191
141 181 215 212 233 123 160 136 218 193 176 312 231 112 107 126 132 155 112 116
70 40 60 48 31 40 30 42 49
NBF-I02B 89
246 250 162 168 229 342 281 110 151 121 66 65 55 49 71 80 106 146 114 102
123 118 82 80 124 141 117 188 180 146 111 147 199 248 183 176 213 258 208 266
241 176 136 119 104 142 175 198 210 175 136 158 189 176 109 93 160 157 231 197
146 171 219 205 234 124 161 144 225 189 181 335 249 116 102 128 134 151 112 113
79 41 54 44 42 38 24 50 44
NBF-I03A 72
83 54 68 56 53 56 70 88 139 152 101 69 82 43 68 109 137 174 107 113
129 161 105 146 136 103 73 80 58 66 79 81 129 150 134 126 136 90 77 76
111 151 126 191 201 112 101 112 135 187 137 160 203 259 203 283 294 182 176 167
118 170 228 258 298 233 184 198 230 189 167 108
NBF-I03B 72
67 53 66 61 56 47 71 93 138 111 82 75 85 42 75 115 121 142 109 112
132 156 107 151 136 100 78 80 58 63 93 85 147 158 133 137 134 109 108 90
127 138 124 192 204 112 103 114 138 185 133 167 201 262 207 282 297 192 175 166
126 163 227 254 306 233 192 204 230 186 162 141
NBF-I04A 114
269 248 205 264 280 339 276 300 334 356 348 335 321 249 187 169 124 140 168 131
129 222 102 91 108 86 87 79 89 98 90 76 72 83 181 128 130 129 112 75
87 103 68 86 105 112 131 103 106 111 58 134 166 227 188 120 118 104 131 112

119 102 103 100 119 104 68 66 78 67 100 72 46 81 88 84 93 59 70 61
82 42 72 75 110 138 95 75 60 83 54 60 65 63 55 53 44 44 49 51
35 45 36 56 76 113 64 63 56 98 71 78 53 52
NBF-I04B 114
274 235 216 270 276 340 280 279 340 365 346 332 330 224 193 176 124 144 166 135
128 216 119 68 113 87 76 69 91 100 88 79 73 82 177 147 125 123 116 76
88 102 67 86 125 103 123 102 105 93 84 128 171 223 186 120 128 103 128 111
139 101 113 108 113 100 74 63 77 69 101 76 46 76 81 89 104 67 74 60
75 54 64 69 111 135 88 75 65 84 52 62 67 61 53 59 42 44 48 50
33 43 45 53 72 115 69 55 59 98 69 76 56 51
NBF-I05A 64
175 218 216 200 267 195 138 207 253 291 196 276 223 350 428 272 176 206 322 397
282 225 310 369 341 252 228 188 243 254 260 344 362 300 297 287 148 100 115 95
130 117 231 312 257 182 147 119 322 266 237 145 210 99 103 144 101 147 139 129
165 145 106 115
NBF-I05B 64
171 222 214 193 274 211 151 195 259 285 194 234 214 355 421 286 176 216 331 396
281 236 338 372 337 253 228 203 226 264 257 344 357 300 277 282 148 96 108 99
120 134 244 306 263 179 159 124 309 259 250 144 208 103 101 143 95 123 142 133
160 135 110 133
NBF-I06A 110
164 227 199 162 183 197 223 133 136 202 241 216 239 240 249 254 164 181 151 164
206 151 175 171 114 132 172 117 111 173 123 105 110 151 154 127 109 74 93 155
116 118 94 82 77 91 97 66 106 112 122 154 112 116 103 117 228 303 360 225
105 138 149 121 111 91 63 72 70 76 104 52 66 78 68 68 69 43 83 67
98 71 81 69 57 98 49 47 59 84 88 74 60 70 76 64 69 60 44 48
55 36 41 34 41 41 33 35 45 53
NBF-I06B 110
191 212 204 168 183 181 224 130 137 198 251 212 250 256 243 251 166 178 151 161
222 150 178 166 120 128 178 113 103 178 124 93 111 172 160 114 101 78 94 164
102 119 75 64 74 85 104 63 102 110 122 167 103 113 106 110 238 306 357 229
106 148 164 119 119 86 69 68 74 89 94 61 75 75 69 71 62 48 81 66
97 81 72 75 55 97 52 55 59 91 91 73 74 80 81 75 67 61 59 47
55 44 44 41 42 33 38 30 37 55
NBF-I07A 100
70 158 165 134 138 176 119 74 93 131 96 107 125 119 95 142 181 193 188 138
175 174 180 158 146 167 103 107 131 149 162 104 128 93 90 148 219 148 126 103
146 106 110 84 105 91 94 97 90 83 70 76 76 83 71 62 53 80 72 84
91 88 82 74 97 52 50 68 86 74 44 56 69 73 63 74 73 59 56 64
49 43 58 40 38 46 49 57 61 70 58 47 55 71 74 70 41 43 72 62
NBF-I07B 100
113 161 156 124 143 169 107 71 88 130 94 99 116 116 98 128 193 190 192 130
175 181 178 158 147 171 110 97 136 151 161 101 124 100 83 153 218 173 122 103
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