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**Tree-Ring Analysis of Timbers from the roof of
St Margaret's Chapel, St Nicholas' Cathedral,
Newcastle upon Tyne, Tyne and Wear**

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Tree-Ring Analysis of Timbers from the roof of St Margaret's Chapel, St Nicholas' Cathedral, Newcastle upon Tyne, Tyne and Wear

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Summary

Twelve samples from the roof timbers of St Margaret's Chapel in St Nicholas' Cathedral, Newcastle upon Tyne, were analysed by tree-ring dating. This analysis produced a single site chronology of 11 samples, having a combined overall length of 302 rings long. Neither this site chronology, or the remaining single ungrouped sample, could be dated against any available reference chronology.

It is possible that the climatic data of the site chronology is not represented in any reference material. This is possibly because the trees used in the roof are from an isolated source in Britain or, possibly, the timbers have been imported from an area abroad for which reference data is currently unavailable.

Keywords

Dendrochronology
Standing Building

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Introduction

St Nicholas' in Newcastle upon Tyne (NZ 249 641; Fig 1) was formerly a parish church, having been elevated to Cathedral status in AD 1882. Although it does have some pre-Conquest and Norman remains in the crossing and north arcade the bulk of the cathedral is of fourteenth- and fifteenth-century date. Further alterations were made in the eighteenth century and again in the nineteenth century.

A programme of grant aided repairs to the roof of St Margaret's Chapel, undertaken in the autumn of AD 2003, involved the stripping of the existing lead covering and its replacement with new material. As part of this process a scaffold platform was placed in the chapel providing a unique opportunity to safely access the roof timbers from below. There is no archival information for the date of this plain and simple roof, which consists of 12 common joists supported by a single axial bridging beam, but it is believed that it is possibly of late fourteenth- or early fifteenth- century date.

Sampling

Sampling and analysis by tree-ring dating of the roof timbers of St Margaret's Chapel were commissioned by English Heritage. This was requested as part of a research programme to better understand the structure of this part of the cathedral, and to inform a programme of grant-aided repairs, an earlier programme of tree-ring analysis having been undertaken on the roof timbers of the north transept (Howard *et al* 2002). It was hoped that analysis of the chapel roof timbers would provide a precise date for them and either confirm or refute the supposed late fourteenth- or early fifteenth-century date assigned to them.

Thus, from the modest number of timbers available a total of 12 core samples was obtained. Each of these samples was given the code NWC-C (for Newcastle, site "C"), and numbered 12 – 23 (samples NWC-C01 - 11 having been obtained previously from the north transept). Timbers were selected for sampling on the basis of their appearing to be original and having sufficient rings for satisfactory analysis by tree-ring dating. One of the major problems encountered at this site was the lack of sapwood, or indeed even the heartwood/sapwood boundary, all the beams having been severely trimmed by the original carpenters, with much of the sapwood being removed at that time.

A general plan of St Nicholas' is given in Figure 2, with the approximate positions of the 12 samples taken being marked on the plans provided by English Heritage, Figure 3. Details of the samples are given in Table 1. In this report the timbers have been numbered from east to west.

The Laboratory would like to take this opportunity to thank Mr James Adams and all the staff at St Nicholas' Cathedral. Everyone was most helpful and very obliging at all times and greatly assisted with access to the roof.

Analysis

Each of the 12 samples obtained was prepared by sanding and polishing and its annual

growth-ring widths measured. The data of these measurements are given at the end of the report. These data were then compared with each other by the Litton/Zainodin grouping procedure (see appendix). At a minimum t -value of 5.0 a single site chronology, NWCSQ01, consisting of 11 samples could be formed, the relative position of each sample being shown in the bar diagram, Figure 4. This site chronology has a combined overall length of 302 rings.

Site chronology NWCCSQ01 was compared with an extensive range of reference chronologies for oak, including the material previously obtained from the north transept, but unfortunately, despite its great length, there was no satisfactory cross-matching. The single remaining ungrouped sample, NWC-C23, from the axial bridging beam was also compared with an extensive range of reference chronologies for oak, but again there was no satisfactory cross-matching.

Interpretation and conclusion

Analysis by dendrochronology has produced a single site chronology, NWCCSQ01, consisting of 11 samples with a combined overall length of 302 rings. Site chronology NWCCSQ01, and the single remaining sample, was then compared to an extensive range of reference chronologies from the British Isles, and elsewhere in Europe, from Russia in the east to Ireland in the west, and from Norway to southern France, the reference material spanning the period AD 400 to the present date. However, despite this exhaustive attempt at cross-matching neither the site chronology or the single sample could be dated.

It is unusual for such a long and seemingly well-replicated site chronology to not date. Site chronologies commonly do not date because of insufficient data, ie, they have a low numbers of rings, which is clearly not the case with site chronology NWCCSQ01, or they contain only a small number of samples.

While some samples in site chronology NWCCSQ01 do show a few narrow growth rings, perhaps caused by stressful growing conditions, there does not appear to be any particular overall problem with any of them that might make cross-matching and dating difficult. Thus the lack of dating cannot be explained by this potential problem.

A possible alternative explanation is that the original woodland source for the timber, and its climatic signal, are not represented in any available reference chronologies. Judging by the strong degree of cross-match between many of the samples it is very likely that the great majority of the timbers used here come from trees growing in the same stand of woodland. Certainly, given that values in excess of $t=15$ and 14 are seen, it is quite possible that several timbers are from the same tree, and that overall perhaps only three, and possible as few as two, different trees are represented. Given that cross-sectional views of the timbers were not available, and that hardly any heartwood/sapwood existed, it was very difficult to determine how the beams had been converted from the wood. Had they been quartered the beams might represent three trees, had they been sixths, which is possible, then possibly as few as two trees may be represented.

It is thus possible that the relatively few timbers actually used in the roof of St Margaret's Chapel have come from some very isolated location, possibly in north-east England or

southern Scotland. However, it may be that the original source for the timber is abroad; the possibilities include mainland Europe, Ireland, Scandinavia, or even North America.

It is notable that the sample from the axial bridging beam, NWC-C23, is a singleton, being ungrouped with any of the other samples. It should be stressed, however, that this does not mean that the tree it represents was felled at a different date; it is possible that it was, but this cannot be determined through tree-ring dating. The lack of cross-matching with the other samples is possibly explained by it being from a different source to the other trees (although from a larger timber than all the others, sample NWC-C23 has the lowest number of rings), and the lack of dating could be explained by it being a singleton, which are almost always more difficult to date.

Bibliography

Howard, R E, Laxton, R R, and Litton, C D, 2002 *Tree-ring analysis of timbers from the north transept roof, St Nicholas' Cathedral, Newcastle upon Tyne, Tyne and Wear*, Centre for Archaeol Rep, **85/2002**

Table 1: Details of samples from the roof of St Margaret's Chapel, St Nicholas' Cathedral, Newcastle upon Tyne

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
NWC-C12	Joist 1 (from east)	169	9	-----	-----	-----
NWC-C13	Joist 2	158	12	-----	-----	-----
NWC-C14	Joist 3	187	h/s	-----	-----	-----
NWC-C15	Joist 4	195	no h/s	-----	-----	-----
NWC-C16	Joist 5	144	no h/s	-----	-----	-----
NWC-C17	Joist 6	158	no h/s	-----	-----	-----
NWC-C18	Joist 7	107	no h/s	-----	-----	-----
NWC-C19	Joist 8	101	no h/s	-----	-----	-----
NWC-C20	Joist 9	216	no h/s	-----	-----	-----
NWC-C21	Joist 10	154	no h/s	-----	-----	-----
NWC-C22	Joist 11	131	no h/s	-----	-----	-----
NWC-C23	Axial bridging beam	86	7	-----	-----	-----

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

Figure 1: Map to show general location of St Nicholas' Cathedral

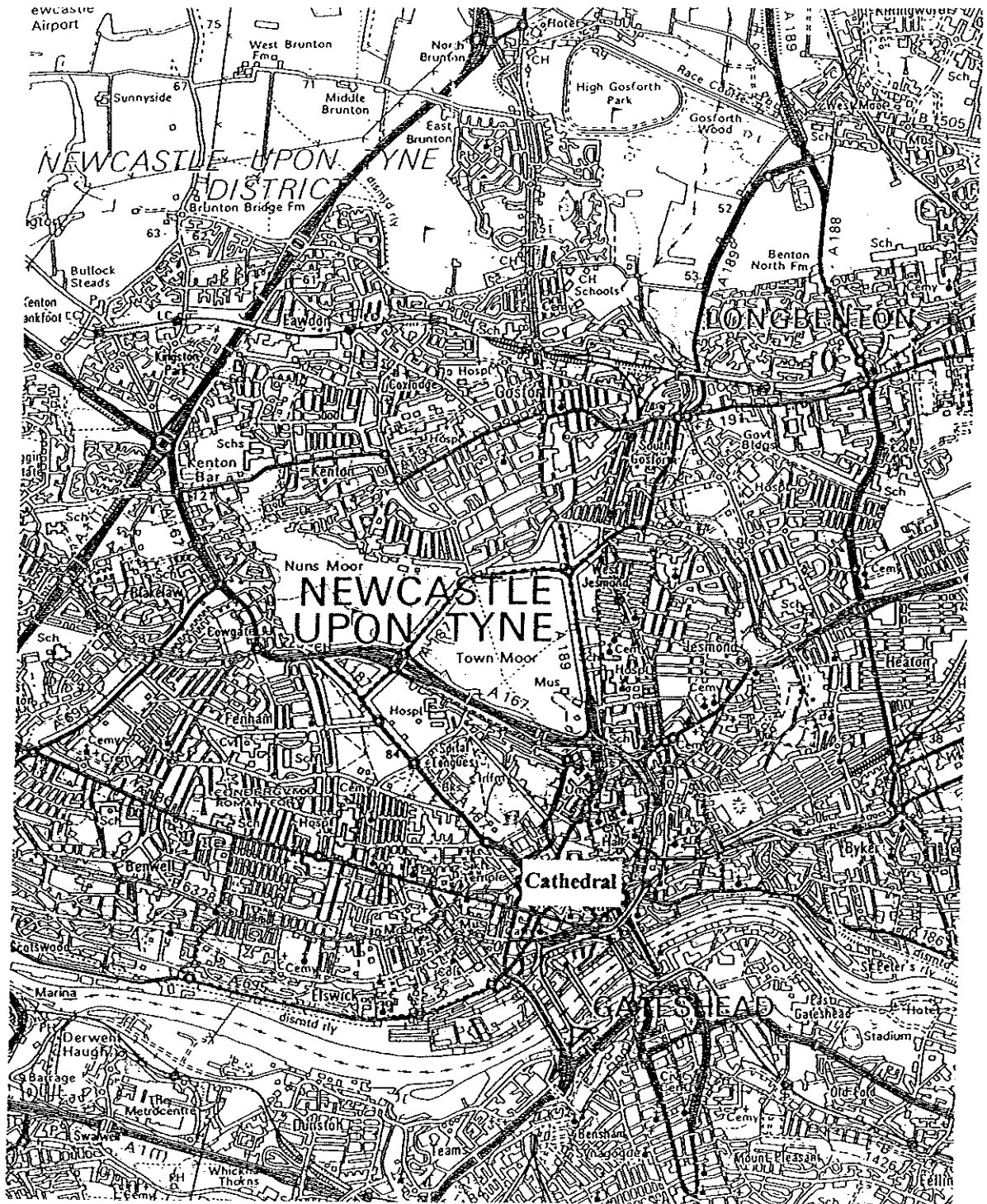


Figure 2: General plan of St Nicholas' Cathedral

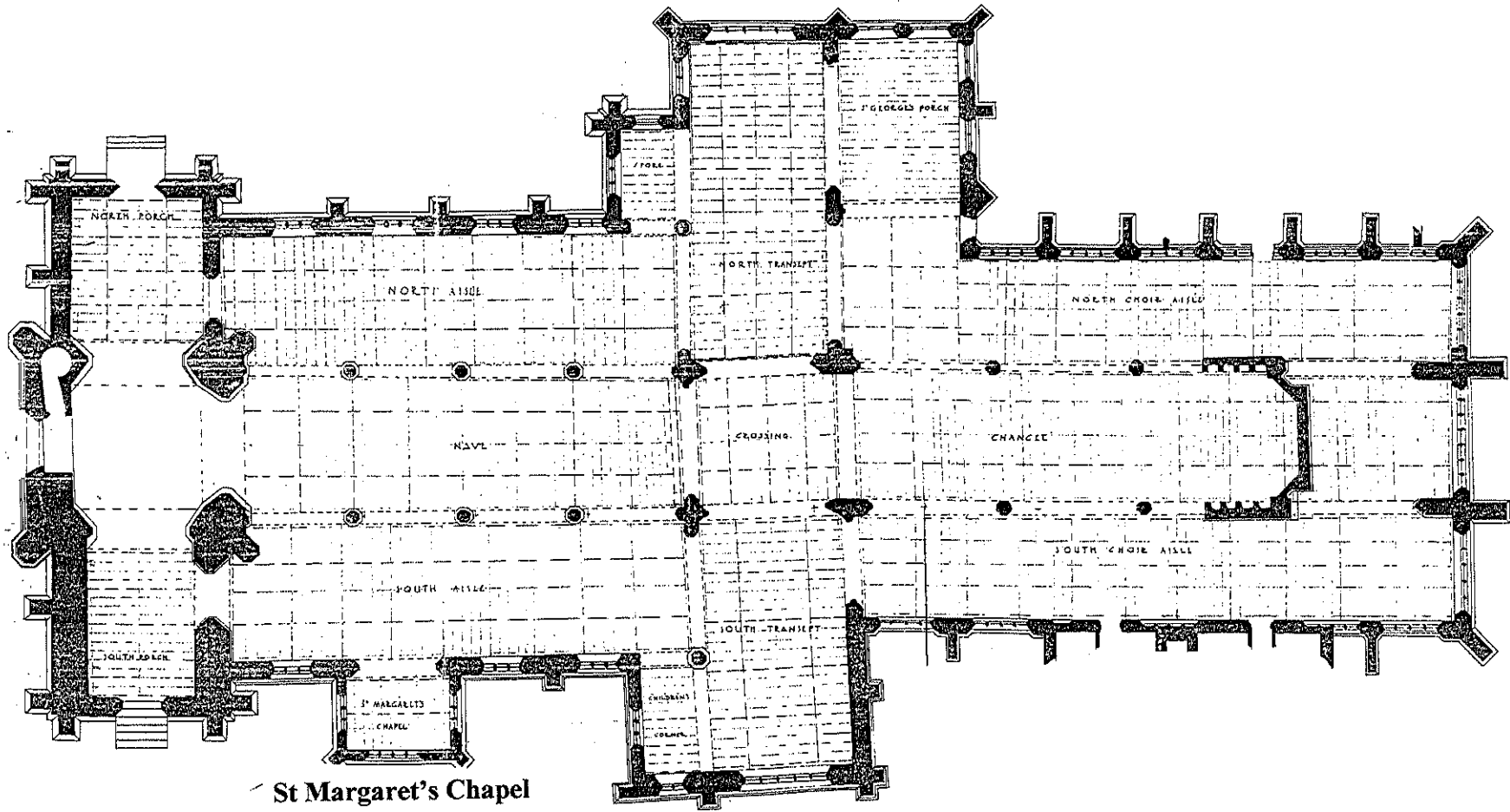


Figure 3: Plan to show sampled timbers of St Margaret's Chapel roof

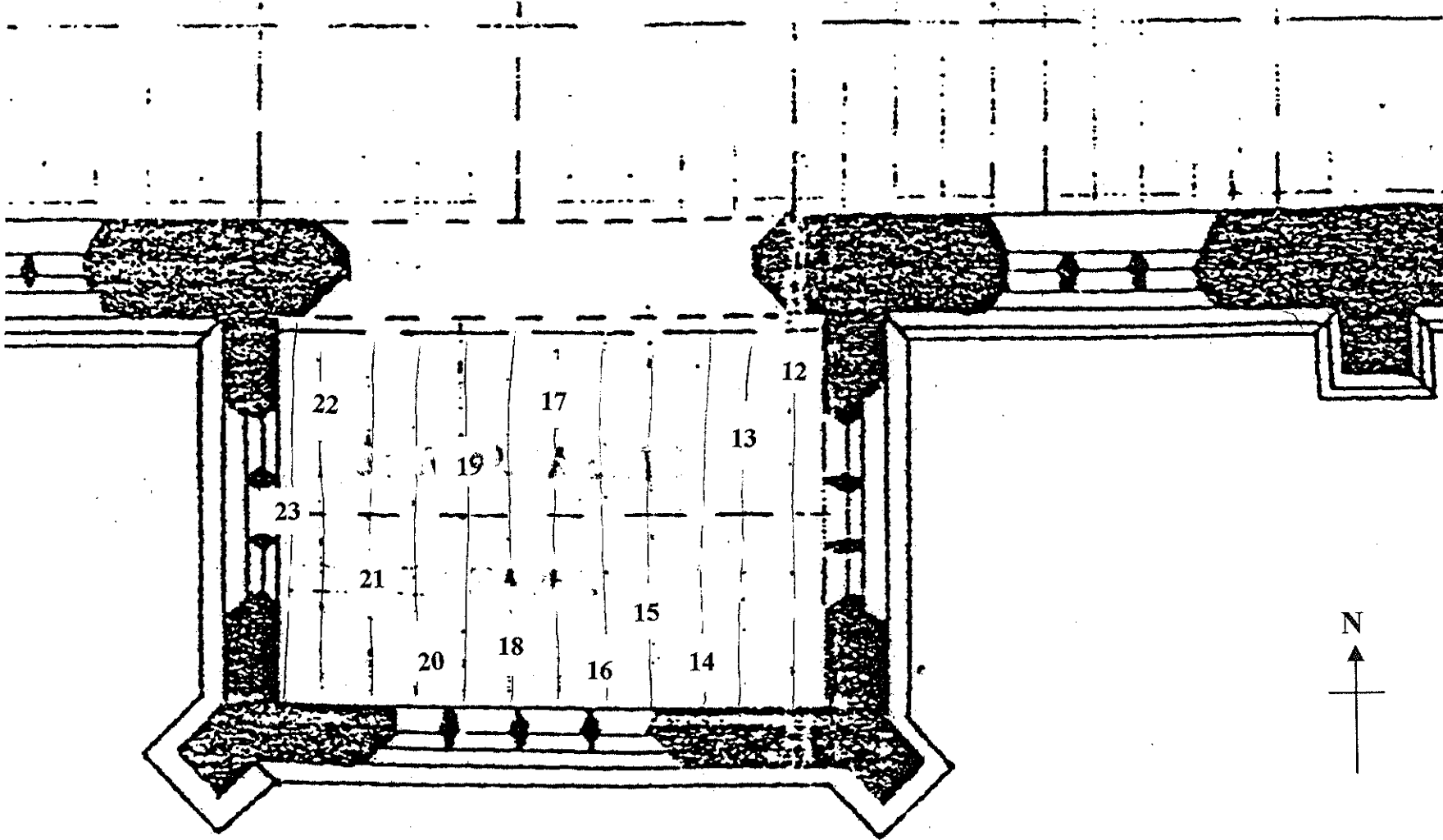
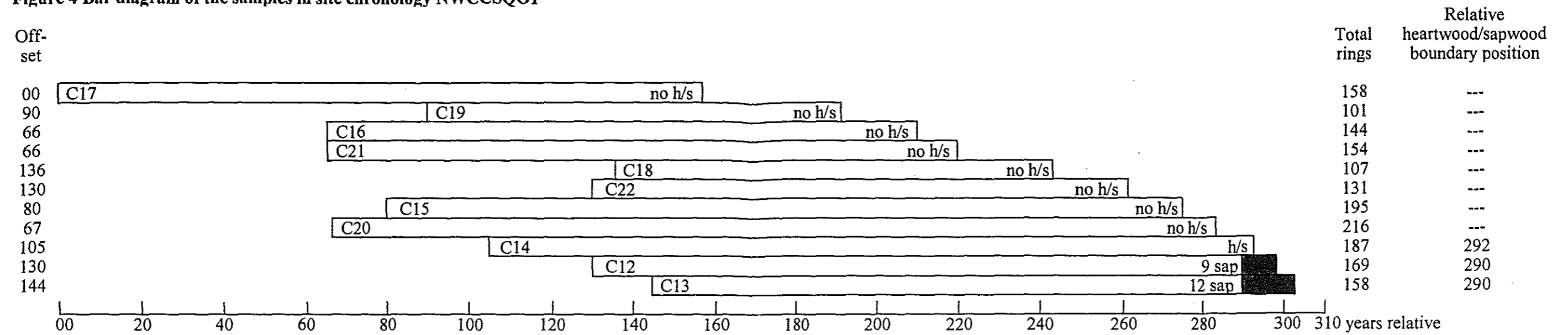


Figure 4 Bar diagram of the samples in site chronology NWCCSQ01



white bars = heartwood rings, shaded area = sapwood rings
h/s = heartwood/sapwood boundary is last ring on sample

Data of measured samples – measurements in 0.01 mm units

NWC-C12A 169

98 124 131 186 180 165 86 132 132 174 237 179 118 114 110 140 128 200 158 134
160 145 103 149 149 169 122 150 112 144 198 163 137 97 140 139 120 128 124 100
112 81 86 78 73 155 133 88 75 55 79 120 110 115 129 90 100 126 87 78
86 81 87 98 74 98 94 98 89 95 90 65 73 124 144 125 113 130 138 152
136 135 134 114 120 98 134 172 155 146 92 136 144 134 127 117 129 115 106 154
105 118 122 100 86 81 70 91 81 78 76 108 121 94 108 75 98 80 114 89
85 88 87 104 105 83 90 74 93 93 94 95 78 70 80 64 71 80 78 84
65 58 66 75 59 57 79 59 48 87 67 79 69 75 84 80 84 90 70 73
78 96 91 73 96 104 99 122 111

NWC-C12B 169

116 117 123 196 168 154 89 136 115 183 227 184 96 124 106 138 136 196 150 135
178 136 96 162 147 177 128 160 110 133 202 159 148 111 120 134 121 135 99 114
130 70 92 72 73 151 142 90 66 59 86 115 115 114 133 84 105 113 95 75
98 75 97 84 90 85 97 97 87 94 94 57 76 120 152 112 130 122 144 147
140 142 120 114 129 95 148 164 158 144 95 138 133 141 123 127 121 106 116 144
120 111 122 106 87 86 67 76 83 83 93 90 107 110 108 76 98 79 109 100
74 91 88 101 94 94 89 79 88 92 92 89 76 74 79 65 74 80 76 88
58 63 65 74 57 54 90 52 52 77 82 87 56 84 78 83 83 92 64 72
84 92 86 80 96 104 91 124 106

NWC-C13A 158

122 145 171 161 181 188 194 293 120 135 154 143 143 135 99 134 193 178 173 138
193 185 142 163 132 118 149 83 89 84 85 130 103 104 79 85 108 129 129 152
144 117 112 125 168 88 147 110 115 119 101 92 111 98 98 81 115 69 67 86
103 80 111 109 133 128 135 126 97 111 128 85 125 115 107 111 73 95 106 98
95 93 103 94 88 111 110 115 95 81 58 72 74 83 75 76 78 90 128 98
117 74 101 84 92 93 99 133 117 109 126 91 117 99 130 120 140 126 120 120
98 90 114 111 115 115 75 100 90 111 65 57 84 72 74 86 83 72 69 68
101 75 75 85 68 59 76 82 83 88 93 99 141 151 91 119 122 118

NWC-C13B 158

102 165 164 171 174 182 192 288 98 150 136 161 129 139 113 140 202 188 185 140
179 185 153 164 133 113 144 89 97 81 87 113 110 89 91 85 90 146 127 143
138 129 106 133 136 113 147 104 120 108 105 92 108 102 101 85 105 77 75 83
98 89 97 107 133 129 136 118 102 118 124 88 118 127 112 110 74 101 109 102
86 96 100 89 95 105 126 118 94 99 52 71 71 71 79 73 92 107 119 95
119 74 104 91 93 92 106 139 132 107 135 101 112 99 132 117 140 122 113 125
109 88 108 126 115 116 70 105 96 99 72 67 69 74 72 72 107 69 67 76
96 79 80 86 62 57 86 88 78 90 89 115 123 142 93 127 109 141

NWC-C14A 187

133 92 96 47 60 47 73 89 67 122 94 67 65 73 70 73 57 76 97 77
84 61 47 64 70 81 58 86 61 68 63 58 63 84 71 51 57 42 58 74
79 93 125 107 119 111 134 149 96 107 134 77 102 90 93 108 167 87 98 99
145 113 95 102 110 117 119 122 117 106 114 115 103 91 70 78 90 97 127 133
85 58 79 94 77 98 78 103 111 94 97 82 98 96 88 93 63 92 84 116
97 89 100 80 85 75 88 85 70 100 80 83 94 109 96 60 111 79 68 73
94 84 78 76 113 109 111 86 77 84 74 65 58 72 82 68 73 91 84 78
68 76 71 73 74 100 93 94 97 115 83 91 103 93 95 103 88 63 61 58
51 75 79 57 84 73 75 85 94 92 65 78 64 63 64 66 65 59 37 68
49 56 52 47 49 66 79

NWC-C14B 187

135 65 98 47 47 49 79 78 77 114 86 77 90 54 90 68 53 86 83 91
76 63 48 57 85 77 53 87 65 62 80 60 85 74 83 57 53 62 58 71
81 80 110 108 109 129 126 142 106 110 133 72 98 71 99 105 172 90 85 112
134 105 108 86 117 113 123 113 124 107 117 120 96 87 73 84 80 104 119 132
92 64 77 93 80 105 76 103 108 96 98 79 104 86 92 90 73 81 96 101
100 82 95 79 88 83 77 90 81 91 70 81 108 103 74 74 108 75 77 77
79 82 73 88 119 94 104 92 77 88 79 57 60 75 80 70 64 96 90 77
58 83 71 75 80 90 100 85 97 115 83 99 82 99 98 107 75 74 62 63
50 73 76 64 79 74 69 84 97 97 60 76 70 62 65 68 67 61 26 71
51 61 53 42 53 61 69

NWC-C15A 195

56 78 69 89 66 52 51 69 85 62 68 69 58 59 77 32 38 45 45 70
67 58 93 114 89 69 101 90 54 60 60 83 73 74 83 86 72 49 67 76
73 55 53 64 72 93 72 51 62 71 73 85 99 93 127 117 98 95 118 123
86 66 61 64 70 60 88 97 95 103 103 120 125 90 85 121 69 97 75 93
90 134 112 91 109 119 85 87 92 101 89 98 77 89 97 120 96 93 62 70
75 77 84 113 98 72 51 57 80 58 89 70 72 88 73 77 77 84 68 75
62 66 72 74 67 57 67 87 59 81 75 89 67 72 88 69 84 103 101 89
75 103 91 63 82 72 67 62 66 95 75 97 79 70 61 63 67 64 75 86
69 61 76 93 71 70 64 87 79 86 88 90 95 81 98 78 84 91 94 100
98 75 61 61 47 44 44 67 67 73 75 80 81 92 95

NWC-C15B 195

65 89 60 94 65 44 60 66 75 77 56 76 60 45 89 33 34 39 61 60
61 69 81 118 84 74 83 94 40 61 67 71 86 57 91 79 74 60 54 76
68 56 57 65 66 90 59 55 61 72 79 73 108 88 129 123 84 112 115 120
87 70 55 67 60 75 76 101 93 111 96 119 127 81 96 107 67 89 85 88
101 132 89 108 97 127 85 85 88 95 108 84 89 86 106 116 93 90 68 62
78 78 86 101 96 64 52 59 76 66 83 67 80 87 80 73 80 77 69 79
58 72 60 77 70 67 72 74 62 77 76 91 70 78 76 72 80 107 105 98
66 102 90 69 70 80 79 61 83 87 94 92 80 69 63 64 62 70 77 87
71 59 74 91 81 61 66 89 79 77 90 94 94 84 98 83 79 87 97 99
93 80 63 62 46 30 49 69 66 75 75 73 76 114 100

NWC-C16A 144

68 55 45 71 122 88 84 83 84 114 131 108 72 73 119 61 55 78 48 36
59 70 59 65 64 87 89 53 78 34 41 39 49 64 60 61 95 103 74 78
107 108 60 67 53 82 81 68 100 101 78 60 60 65 57 69 67 68 66 86
59 47 62 95 94 106 126 125 100 128 81 93 102 122 79 76 74 89 84 104
108 157 126 145 131 131 151 127 139 179 87 109 96 125 149 206 85 72 130 132
107 96 119 126 112 100 118 124 105 156 114 85 95 79 97 104 96 136 122 92
54 79 101 84 121 106 109 116 97 107 89 99 86 96 97 66 87 99 100 102
115 112 87 132

NWC-C16B 144

79 59 48 70 131 75 84 87 90 97 138 117 63 69 124 67 75 61 59 49
48 65 69 53 73 86 93 54 72 36 32 36 38 72 60 64 97 102 88 77
114 99 54 67 62 77 93 72 102 91 82 59 57 77 59 55 75 51 53 84
67 58 61 96 95 95 120 114 100 116 87 92 91 119 83 65 71 86 90 110
96 151 116 155 145 146 144 113 143 168 75 117 93 127 159 197 94 77 115 151
102 88 125 126 128 95 123 130 126 157 111 88 91 70 112 90 107 128 113 105
56 89 126 91 131 115 109 113 99 98 96 102 83 90 86 65 96 95 89 109
107 116 85 128

NWC-C17A 158

111 100 125 91 57 81 73 57 54 80 39 68 37 40 99 47 38 28 45 48
41 36 45 46 51 43 34 76 84 57 75 69 86 55 61 59 42 45 44 61
57 44 67 58 51 48 35 31 48 36 42 50 70 56 33 38 46 31 45 52
53 45 73 65 45 62 64 66 55 60 113 88 86 94 98 97 118 100 61 56
89 66 60 75 48 40 35 68 60 68 79 58 72 41 88 22 32 46 58 50
57 53 77 94 88 67 90 77 51 63 62 84 90 82 99 108 72 65 83 85
75 72 83 76 83 73 67 49 76 84 77 72 84 67 78 118 88 117 146 128
105 86 84 89 92 117 127 129 108 135 119 119 146 86 105 102 72 98

NWC-C17B 158

92 104 119 93 61 84 71 65 54 79 37 64 32 45 114 45 34 29 39 48
43 40 44 31 47 53 54 82 94 70 84 53 82 62 50 53 44 50 51 78
56 43 86 52 46 52 36 35 41 40 44 47 65 63 31 37 43 36 40 46
53 51 71 72 47 53 44 53 37 56 112 77 87 81 90 83 114 89 60 72
85 68 57 71 49 40 43 61 58 67 70 66 74 48 56 18 41 48 50 60
58 59 78 91 90 63 90 82 48 61 63 82 89 74 100 100 81 64 64 99
78 79 85 73 77 79 60 56 74 84 81 70 85 62 80 109 89 125 176 106
104 87 85 99 94 113 124 133 112 135 118 120 140 97 101 112 66 95

NWC-C18A 107

99 91 141 147 101 94 90 91 77 93 116 126 120 126 128 145 163 118 119 139
85 126 107 120 129 192 120 111 147 150 141 115 127 131 146 133 120 119 116 122
124 111 101 77 105 103 99 158 163 138 71 89 114 97 131 109 130 133 104 85
105 86 93 80 111 73 91 92 78 80 98 105 90 94 85 96 98 100 108 95
94 119 126 103 114 161 122 103 111 108 113 122 95 111 123 126 123 95 81 90
88 89 197 112 117 118 141

NWC-C18B 107

93 106 134 136 99 97 87 99 63 98 106 128 122 114 124 161 162 121 103 146
80 122 119 120 120 204 121 113 142 153 124 119 142 99 152 143 137 117 123 130
133 115 105 81 102 120 104 160 174 150 68 95 114 104 114 113 132 123 102 99
93 93 82 89 118 69 92 92 74 89 96 108 89 91 84 95 105 105 114 106
95 120 123 107 100 149 124 105 114 104 103 115 95 116 130 124 131 108 82 80
93 87 158 141 100 121 156

NWC-C19A 101

68 100 100 76 97 38 32 47 58 84 71 82 116 101 71 79 84 82 39 51
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99 111 119 100 101 118 91 113 101 131 73 63 68 84 77 92 89 131 99 110
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111 95 90 83 95 100 91 92 84 76 79 68 83 106 113 80 55 72 85 70
78

NWC-C19B 101

79 102 101 72 105 29 41 43 52 82 59 79 102 126 72 73 84 74 53 55
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105 115 107 114 103 109 88 107 109 132 79 62 64 81 72 92 89 132 99 107
95 105 115 86 116 105 70 102 75 94 95 156 80 84 98 119 98 81 102 107
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96

NWC-C20A 216

95 70 92 105 89 79 71 67 66 100 102 78 84 108 73 78 80 55 40 57
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NWC-C20B 216

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69 53 80 76 82 75 88 80 62 72 50 58 52 68 71 94

NWC-C21A 154

103 87 80 73 122 69 87 51 67 77 143 91 87 88 97 76 55 75 60 48
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NWC-C21B 154

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NWC-C22A 131

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NWC-C22B 131

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165 148 159 153 164 80 185 207 227 192 101 177 188 169 150 157 157 119 160 219
147 165 158 131 102 71 106 113 118 114 98 114 130 122 118 79 100 91 97 120
119 122 134 118 108 85 107 94 105 128 123

NWC-C23A 86

397 343 362 275 321 277 371 393 385 332 297 271 348 278 321 264 239 263 245 281
250 258 221 206 188 190 162 145 187 214 167 167 145 164 162 157 127 112 133 148
151 169 173 161 133 117 102 83 81 110 101 135 80 115 114 91 94 118 102 99
83 94 101 86 101 87 106 82 107 101 94 89 110 103 88 112 85 79 74 98
99 96 121 108 113 132

NWC-C23B 86

342 339 365 255 328 285 377 353 378 339 258 267 348 272 316 276 224 265 254 270
258 244 232 196 193 188 158 152 183 203 182 168 152 162 158 148 131 125 120 153
159 174 178 157 137 122 105 84 84 100 105 129 85 113 115 86 107 119 109 92
76 97 95 87 97 94 93 93 109 92 95 91 105 99 93 109 77 91 68 110
89 110 120 91 113 127