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Tree-Ring Analysis of Timbers from Number 8 Canon's Cloisters, Windsor Castle, Windsor, Berkshire

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Summary

A total of 10 samples was obtained from a series of oak joists and floorboards from an upstairs room in number 8 Canon's Cloisters. The analysis of these samples produced two site chronologies.

The first site chronology comprises two samples with a combined overall length of 119 rings. This site chronology can be dated as spanning the years AD 1165-1283. Neither of the samples in this site chronology retains the heartwood/sapwood boundary, and it is thus not possible to accurately calculate the felling date of the timbers represented, except to say that it is unlikely to be before AD 1298 and therefore may represent fourteenth-century material.

The second site chronology comprises four samples having a combined overall length of 86 rings. This site chronology cannot be dated though again it is likely that the two timbers represented were felled at the same time.

None of the four remaining ungrouped samples can be dated individually.

Keywords

Dendrochronology
Standing Building

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Introduction

Between AD 1352 and AD 1355 King Edward III erected lodgings for a community of canons and priest vicars serving his newly established college of St George at Windsor Castle (SU 973 768; Figs 1 and 2). These new buildings were squeezed around a courtyard between the twelfth-century great hall of Henry II's palace, now given over to the college for its own use, and the Dean's Cloisters. The lodgings were built in timber-frame and were arranged on two storeys, the upper jettied out over the lower, to create an internal cloister walk at ground level. There must originally have been about twenty-six sets of chambers within the cloisters. It has been suggested that those on the upper floor served to house the canons and the lower their juniors, the priest vicars.

Much of the medieval timber framing for these lodgings has survived to the present day, though it is now obscured in many places by later extensions and adaptations. The cloister is probably the earliest surviving example of timber-framed collegiate architecture in Britain and continues as the home of the canons to the present day.

Number 8 Canon's Cloisters comprises a range of four large and two small rooms, being two storeys above a basement, with an attic storey over. It abuts the south side of the curtain wall of the Lower Ward of the Castle and gives onto a courtyard which is possibly the site of Henry II and III's Great Hall, first built during the AD 1160s – 70s. The early-fifteenth century St George's Chapel forms its southern boundary. Number 8 is set also between the surviving remains of original buildings of Henry III's residence to the west, dated to the first half of the thirteenth century, and abuts the Canons' Chamber to the east, which documentary evidence dates to AD 1352 – 55. A plan showing the location of Number 8 within the Castle is given in Figure 3.

Recent work to rectify a sagging ceiling over the ground floor 'Oak Room' at Number 8, Canon's Cloisters, has exposed some oak joists and an almost intact floor of wooden boards. These had hitherto been hidden beneath a later, probably mid-nineteenth century, softwood covering in a first-floor bedroom above. It is believed that the oak joists and floor boards may be of two phases, one possibly of mid-thirteenth century date, the other of mid-fourteenth century date. A programme of tree-ring research was requested by English Heritage to establish the dates of these timbers in order to help further understand the significance of this find, and to inform repair strategy decisions.

The floors consist of a series of east – west joists, in some cases made up of two individual timbers, overlain by a series of thin oak boards. The boards are laid next to each other with slightly overlapping chamfered joints to their long edges and are firmly nailed to the joists. A drawing of the floor within these rooms is given in Figure 4.

Sampling

After discussions with Duncan Moth, supervising architect, and in conjunction with the English Heritage brief, a total of 10 samples was obtained. Each sample was given the code WIN-C (for Windsor Castle) and numbered 27 to 36 (samples WIN-B01 – B12 and WIN-C01 – C26 having been obtained during earlier programmes of tree ring research at Windsor Castle (Arnold *et al* 2004 and Arnold *et al* 2005)). Eight samples, WIN-C27 – C34,

were obtained as cores from each of the available joist timbers. Two samples WIN-C35 and C36, were obtained from small sections of the oak floorboards which had been removed during cleaning and inspection.

Unfortunately, it was not possible to obtain samples from any of the other oak floorboards. Being slightly bowed, a little split in several places, and somewhat rotted, particularly at the ends, they are fragile items and it was felt that they should not be removed from their fixed positions. Even if they had been, given the amount of decay at the ends where the growth rings might have been visible, it would have required extensive cutting and sanding to obtain a readable surface. However, should any pieces be removed from the boards in the future, they should be retained for assessment as to their potential for tree-ring analysis.

The positions of the 10 samples thus obtained are shown on a drawing, made by Howard Jones, reproduced here as Figure 5. Details of the samples are given in Table 1. In this report the timbers have been described and numbered from north to south, or from east to west, as appropriate.

The Laboratory would like to take this opportunity to thank a number of people who were involved, or in some way assisted, with this programme of tree-ring analysis. Firstly we would like to thank Tim Tatton-Brown, consulting archaeologist, for his considerable help and advice. We would also like to thank Duncan Moth, of Martin Ashley, Architects, for his help in accessing the site, and for his thoughts and comments on the timbers. The Laboratory must also pay particular thanks to Howard Jones of Roger Joyce Associates, Architects, who, as usual, produced an excellent series of drawings, and provided a full set of notes from which some of the introduction above has been taken. Finally, we would also like to thank Mr Ian Poole, Clerk of Works for his help in accessing the site.

Analysis

Each of the 10 samples obtained was prepared by sanding and polishing and its annual growth-ring widths measured, the data of these being given at the end of the report. The data of these 10 samples were then compared to each other by the Litton/Zainodin grouping procedure (see appendix). At a minimum value of t=6.0 two groups of cross-matching samples was formed.

The first group consists of two samples, WIN-C35 and C36, cross-matching with each other at relative positions as shown in the bar diagram, Figure 6. These two samples were combined at their indicated off-set positions to form site chronology WINCSQ02 with an overall length of 119 rings (site chronology WINCSQ01 having been formed during previous programmes of tree-ring research). Site chronology WINCSQ02 was then compared to an extensive range of oak reference chronologies, cross-matching consistently with a number of these when the date of its first ring is AD 1165 and the date of its last measured ring is AD 1283. Evidence for this dating is given in the t-values of Table 2.

The second group to form during this programme of analysis consists of four samples, WIN-C28, C29, C30, and C31, which cross-match with each other at the relative positions shown in the bar diagram, Figure 7. These four samples were combined at their indicated

off-set positions to form site chronology WINCSQ03, having an overall length of 86 rings. Site chronology WINCSQ03 was also compared to an extensive range of oak reference chronologies, but, despite the extensive comparison, there was no satisfactory cross-matching, and the four constituent samples must remain undated.

Each of the four remaining ungrouped samples was then compared individually to a full range of oak reference chronologies. There was, however, no satisfactory cross-matching, and these samples must also remain undated.

Interpretation and conclusion

Analysis by dendrochronology has produced two site chronologies, WINCSQ02, and WINCSQ03, consisting of two and four samples, of length 119 and 86 rings, respectively. Only one site chronology, WINCSQ02, can be dated, however, its rings spanning the years AD 1165 to AD 1283. Neither of the samples in this site chronology, WIN-C35 and C36, retains the heartwood/sapwood boundary and it is thus not possible to accurately calculate the likely felling date of the timbers represented. Using a 95% confidence limit of 15 as a minimum number of sapwood rings that the timber might have had would, however, make it unlikely that they were felled before AD 1298. It is possible, therefore, that these timbers do represent a fourteenth-century phase of felling. Given that the two samples cross-match with each other with a value of t=6.2, it is probable that they are from trees growing close to each other. It is also likely, though of course not certain, that the two timbers were felled at the same time.

Although undated, the cross-matching of the four samples in the second site chronology, WIN-C28, C29, C30, and C31, would suggest that the respective timbers, all ceiling joists, almost certainly represent a single phase of felling as well. Two of the samples, WIN-C28 and C29, have the same relative last complete sapwood ring position, and the heartwood/sapwood boundaries of the other two are at relative positions consistent with such an interpretation. Judging by the cross-matching between these four samples it is very likely that they represent trees that were growing close to each other in the same patch of woodland, values of t=6.4 and 6.0 being seen. Indeed, given that samples WIN-C28 and C29, cross-match with each other with a value of t=9.7, and have the same last complete sapwood ring position, it is likely that the timbers represented are derived from the same tree.

Four samples, WIN-C27, C32, C33, and C34, remain ungrouped and undated. None of these samples show particular problems such as compacted or distorted growth-rings that might make cross-matching and dating difficult. However, although they have sufficient rings for reliable analysis they are all short samples, the longest, WIN-C27, having only 56 rings. It is of course possible that these samples represent individual timbers with different felling dates, and are possibly from different sources. Such timbers are often more difficult to date.

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Table 1: Details of the samples from number 8 Canon's Cloisters, Windsor Castle, Berkshire

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
WIN-C27	Joist 4 (from east)	56	h/s	------	------	------
WIN-C28	Joist 5	71	19C	------	------	------
WIN-C29	Joist 6	70	18C	------	------	------
WIN-C30	Joist 7	66	h/s	------	------	------
WIN-C31	Joist 8 (south part)	73	11	------	------	------
WIN-C32	Joist 8 (north part)	55	h/s	------	------	------
WIN-C33	Joist 9 (south part)	55	h/s	------	------	------
WIN-C34	Joist 10	54	h/s	------	------	------
WIN-C35	Floorboard	73	no h/s	AD 1165	------	AD 1237
WIN-C36	Floorboard	118	no h/s	AD 1166	------	AD 1283

*h/s = the last ring on the sample is the heartwood/sapwood boundary
C = complete sapwood is retained is retained on the sample, the last measured ring date is the felling date of the timber

Table 2: Results of the cross-matching of site chronology WINCSQ02 and relevant reference chronologies when first ring date is AD 1165 and last ring date is AD 1283

Reference chronology	Span of chronology	*t*-value	
St Albans Cathedral, Herts	AD 1151 – 1263	8.0	(Howard *et al* 2002)
England London	AD 413 – 1728	7.4	(Tyers and Groves 1999 unpubl)
Ightham Mote, Kent	AD 1157 – 1327	7.4	(Howard 2002 unpubl)
Chichester Cathedral, West Sussex	AD 1173 – 1295	7.2	(Howard *et al* 1992)
Reading Waterfront, Berks	AD 1160 – 1407	7.2	(Groves *et al* 1997)
7 Buttermarket, Thame, Oxon	AD 1161 – 1289	7.0	(Howard *et al* 1993)
Southern England	AD 1083 – 1981	6.8	(Bridge 1988)
East Midlands	AD 882 – 1981	6.5	(Laxton and Litton 1988)

Figure 1: Map to show general location of Windsor

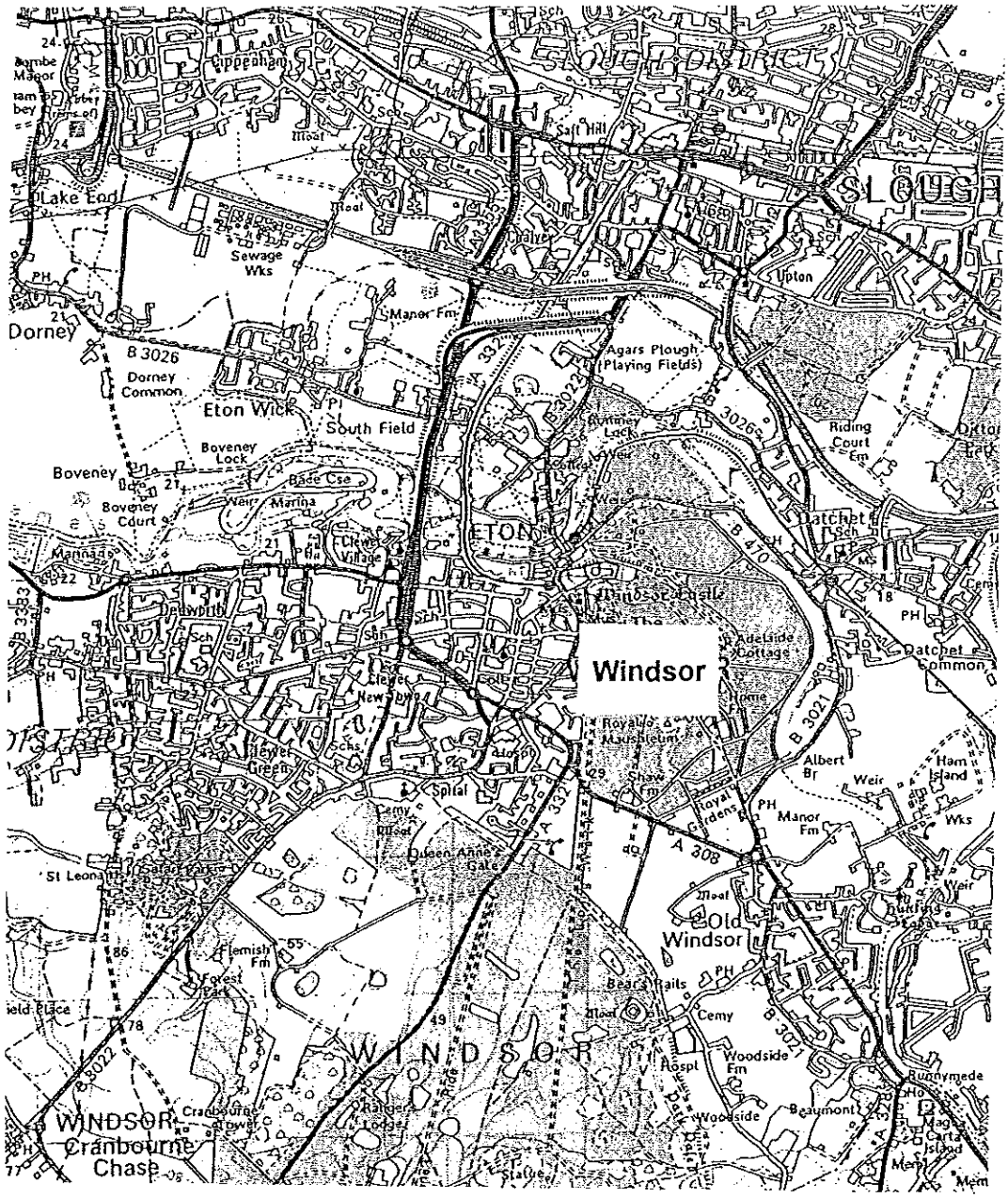


Figure 2: Map to show location of Windsor Castle

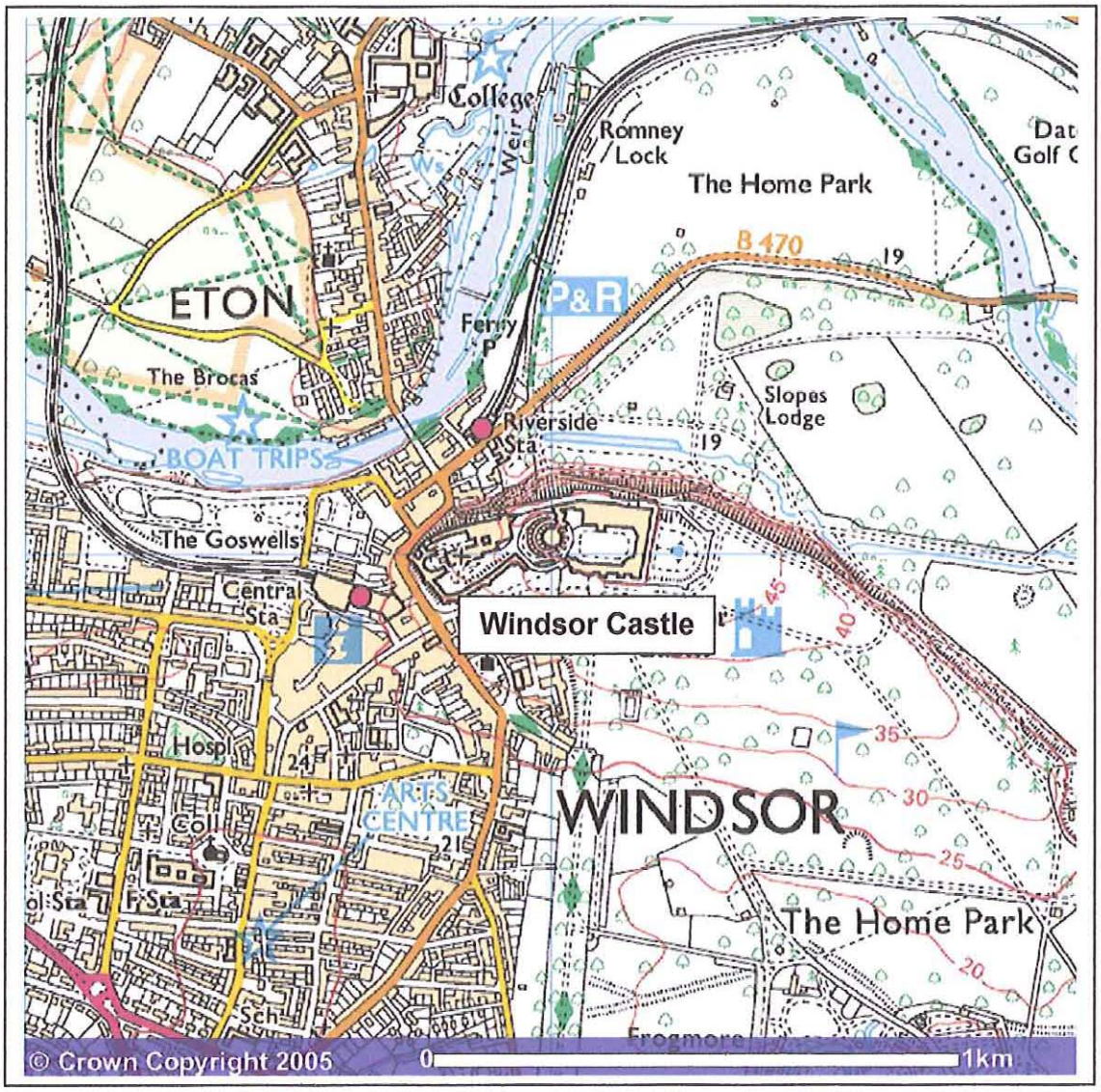


Figure 3: Plan to show the position of number 8 Canon's Cloisters
(after Hope 1913)

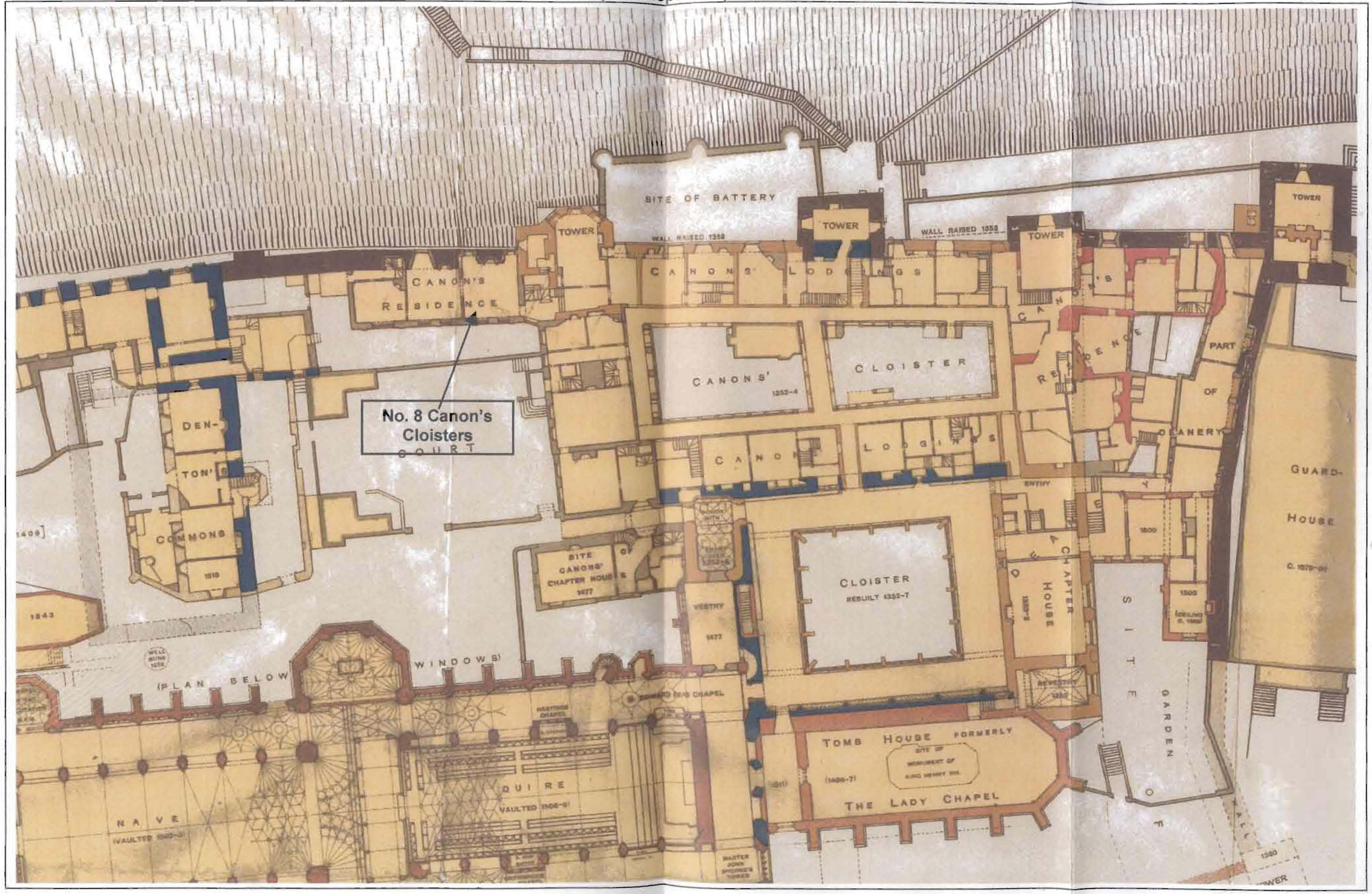


Figure 4: Drawing to show location of beams and floor within number 8 Canon's Cloisters (after Howard Jones)

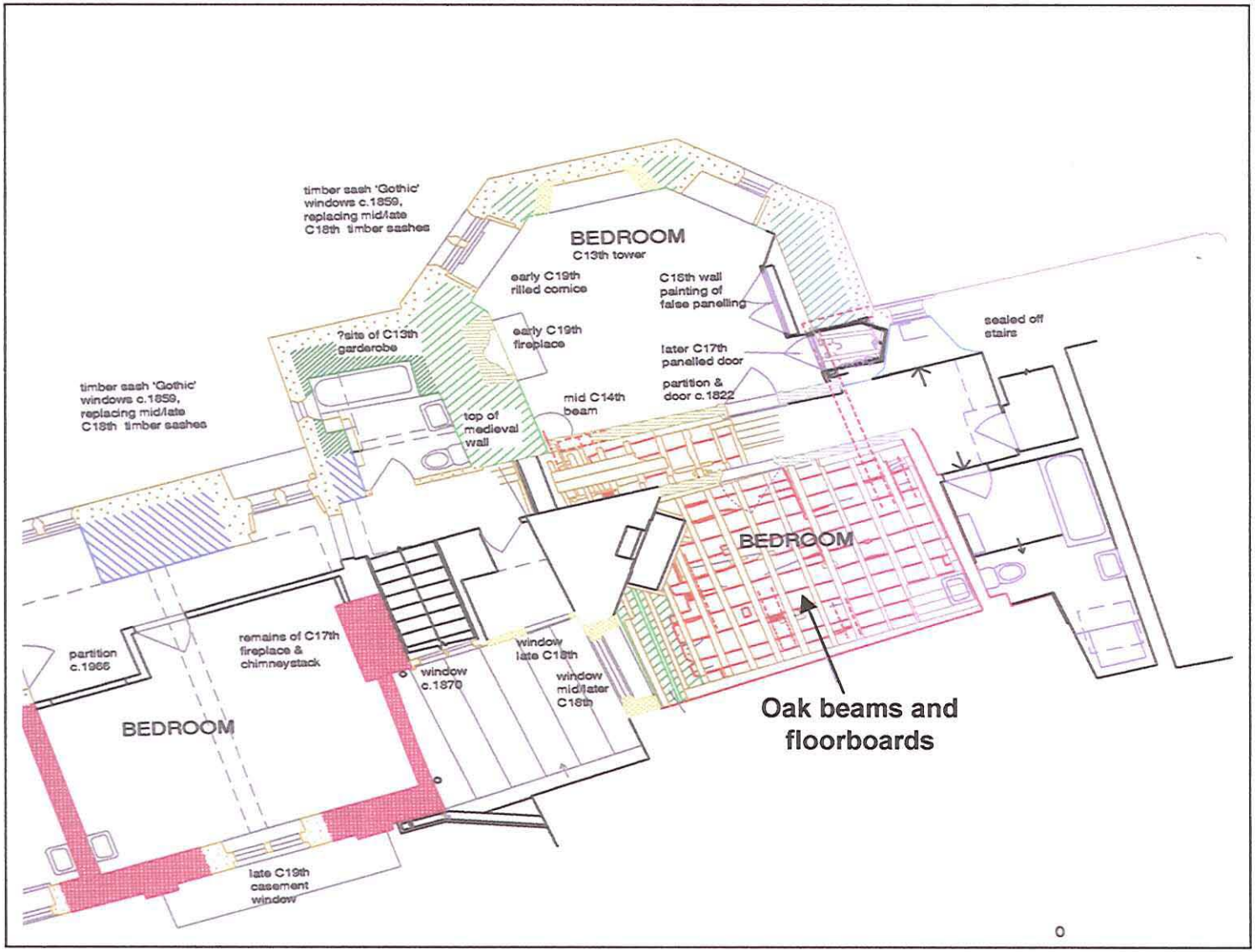


Figure 5: Floor plan of number 8 to show sampled joists (samples WIN-C35 – 36 not shown) (after Howard Jones)

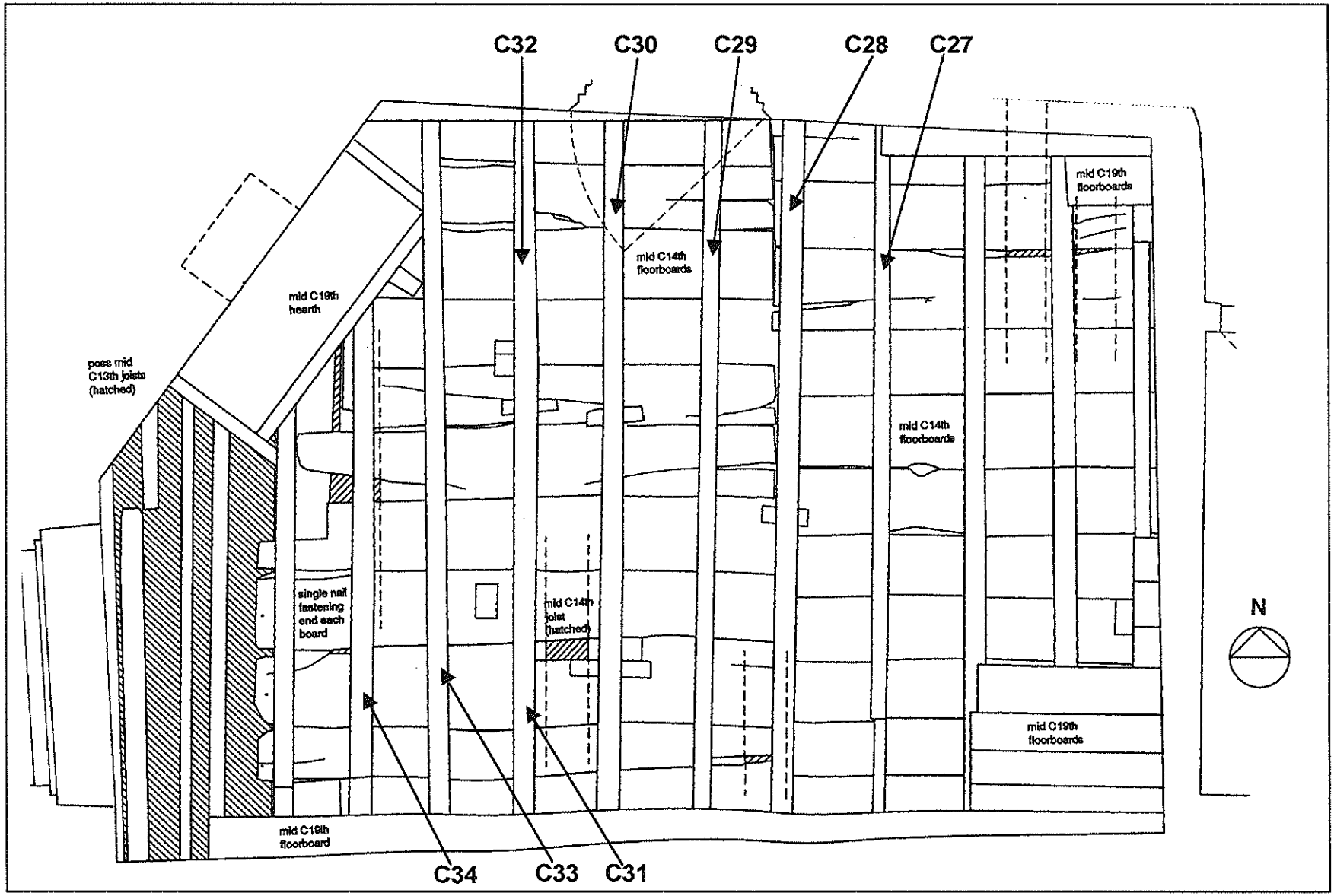


Figure 6: Bar diagram of the samples in site chronology WINCSQ02

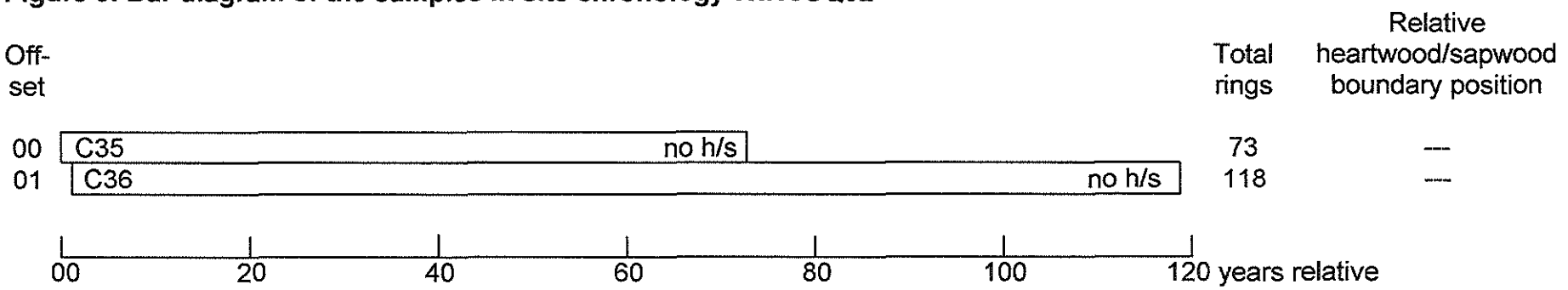
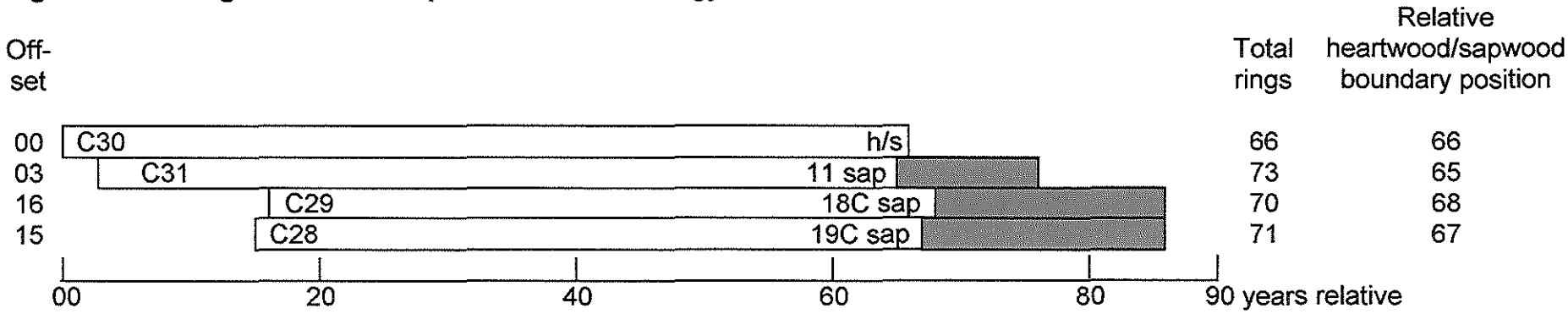


Figure 7: Bar diagram of the samples in site chronology WINCSQ03



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

WIN-C32A 55
315 458 178 250 334 396 311 468 352 448 580 521 395 217 171 161 302 363 220 93
160 135 73 78 120 152 176 199 162 179 214 244 352 374 294 227 296 249 205 104
53 49 64 69 98 89 101 110 120 160 153 121 112 108 125
WIN-C32B 55
313 459 184 239 339 365 321 463 354 450 568 519 384 222 163 170 312 356 198 94
170 140 66 80 133 151 187 197 155 170 209 249 321 375 289 234 289 248 199 114
56 41 54 83 98 95 87 119 110 155 143 113 125 106 127
WIN-C33A 55
610 444 562 655 663 770 753 717 668 622 425 398 538 402 316 328 434 443 373 387
401 358 382 394 391 330 295 193 212 213 228 276 244 294 246 156 228 188 191 156
129 185 162 217 210 168 150 150 271 190 115 171 174 181 162
WIN-C33B 55
592 445 561 644 644 775 793 745 600 614 454 411 487 410 306 330 442 434 363 392
390 360 398 402 398 349 274 222 183 188 224 278 250 318 230 181 241 195 172 151
177 166 176 185 219 182 147 144 239 186 113 163 180 177 151
WIN-C34A 54
269 304 267 234 359 282 320 284 347 187 228 127 159 121 151 125 219 205 184 226
233 251 215 151 130 158 215 245 214 190 253 191 190 187 242 314 199 221 160 192
330 222 272 205 154 185 213 201 207 189 201 123 220 267
WIN-C34B 54
249 302 251 206 359 282 320 284 347 192 228 130 167 128 155 121 221 203 193 224
226 255 221 154 128 156 216 244 194 203 254 174 186 191 254 300 223 226 150 193
323 205 279 232 153 180 221 200 215 177 212 142 199 277
WIN-C35A 73
534 433 467 484 346 283 237 276 239 265 225 199 140 192 220 186 222 257 236 113
133 112 129 88 107 176 140 125 260 191 173 155 159 102 89 143 156 135 164 126
133 111 100 180 138 164 126 106 141 127 130 163 138 152 164 153 136 85 117 190
97 116 80 115 125 93 76 91 120 117 96 73 77
WIN-C35B 73
561 455 491 455 370 270 256 320 246 271 235 218 167 170 215 182 202 233 201 122
124 112 135 71 103 153 111 104 242 192 162 161 154 104 87 144 169 116 164 135
126 117 100 189 144 179 121 94 134 127 139 159 140 151 161 154 136 89 119 186
86 110 81 112 130 87 81 79 130 110 76 77 79
WIN-C36A 118
539 510 551 433 314 386 280 354 348 236 355 290 316 293 209 238 287 278 177 204
174 256 187 208 225 207 189 268 248 243 285 201 100 140 167 193 146 193 108 161
117 101 144 101 127 126 84 113 123 93 127 105 88 110 102 89 54 42 69 79
100 65 80 117 63 45 48 91 108 89 88 120 81 199 157 137 136 191 225 188
246 178 154 162 247 169 148 181 168 292 158 158 113 168 147 173 161 102 100 112
148 81 110 246 304 217 175 167 151 161 118 146 95 135 179 179 171 173
WIN-C36B 118
559 505 547 443 321 333 264 346 369 323 338 269 252 323 208 301 284 260 208 201
186 273 200 180 219 260 204 283 261 232 277 220 97 135 164 225 142 207 109 165
114 93 132 120 134 121 93 100 127 99 130 105 105 105 102 98 63 30 76 71
101 65 79 102 64 51 53 92 95 99 80 124 92 180 177 148 125 198 208 179
240 181 154 163 250 176 129 175 172 260 171 178 102 163 149 181 161 114 93 130
140 68 109 260 257 280 163 151 170 140 147 118 97 136 179 170 181 167

Data of measured samples – measurements in 0.01 mm units

WIN-C27A 56
387 134 280 149 359 273 204 168 379 270 220 337 338 271 306 231 274 257 221 151
175 157 187 193 249 218 207 198 222 165 167 170 220 196 129 179 220 201 258 238
238 208 205 255 204 144 268 136 246 239 186 194 219 186 179 165
WIN-C27B 56
399 134 296 203 358 283 209 176 360 300 247 302 336 282 278 233 274 245 203 163
178 151 193 193 244 229 198 204 226 166 166 159 213 217 153 175 202 210 266 224
243 201 215 266 195 150 201 187 235 226 199 190 210 194 178 164
WIN-C28A 71
519 509 593 593 465 481 572 513 468 480 422 290 309 427 410 150 161 279 245 222
91 166 219 269 221 328 184 154 194 137 139 187 207 228 170 198 142 158 156 104
99 57 111 100 135 152 158 50 72 52 95 191 107 94 97 92 121 104 103 122
146 140 174 155 137 144 117 159 221 132 175
WIN-C28B 71
515 540 606 621 452 464 551 489 494 455 417 282 318 419 405 151 162 277 247 218
96 165 216 275 225 316 181 161 191 143 127 197 207 240 205 198 140 158 148 126
89 54 96 100 133 171 158 56 68 55 86 184 101 104 99 88 122 107 97 130
137 144 158 156 145 153 97 157 190 177 172
WIN-C29A 70
622 583 664 605 582 651 712 720 627 771 595 435 628 733 295 428 448 410 308 209
275 298 342 360 455 382 246 311 282 212 326 264 266 252 236 222 185 223 174 119
94 136 128 178 273 180 118 135 115 123 219 163 121 145 91 159 123 98 142 164
125 176 185 177 115 118 121 157 148 168
WIN-C29B 70
556 590 648 588 576 662 722 738 640 753 605 451 638 717 345 439 446 397 328 206
287 306 351 379 441 373 247 303 303 216 294 259 269 240 229 229 182 227 171 125
93 129 135 188 277 188 108 138 119 137 227 172 128 129 87 158 133 89 148 170
140 172 182 176 118 117 121 146 147 168
WIN-C30A 66
350 184 300 382 444 225 333 280 289 491 418 524 601 689 547 671 547 442 579 419
304 469 468 600 538 482 410 484 467 449 213 125 121 114 170 107 91 104 110 138
174 97 141 161 160 110 94 135 181 154 155 133 151 153 91 70 48 84 67 129
146 135 53 67 98 98
WIN-C30B 66
352 180 275 395 439 217 317 287 305 492 423 523 594 686 520 649 549 448 584 427
268 516 478 591 550 463 458 456 426 443 192 142 112 123 159 106 85 110 105 132
176 103 137 148 183 107 86 149 192 136 165 124 158 134 109 66 57 79 66 126
148 140 55 78 91 98
WIN-C31A 73
591 563 651 510 465 365 476 345 462 529 553 469 539 623 492 491 407 313 416 424
477 433 412 484 360 356 399 228 195 227 289 201 135 155 170 176 201 270 155 160
208 113 82 86 97 189 196 219 138 169 192 135 90 50 70 71 161 158 194 109
161 138 151 221 201 254 204 172 258 150 121 111 129
WIN-C31B 73
573 550 668 515 477 370 464 357 463 509 583 484 509 631 505 497 397 314 430 409
490 423 419 463 370 354 403 249 190 224 283 207 137 134 184 185 208 265 149 158
199 109 88 85 96 203 189 215 143 161 190 147 79 60 59 79 156 171 193 105
151 155 148 216 190 250 210 181 236 149 137 100 131