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7 Market Street
Chipping Norton
Oxfordshire

Tree-ring Analysis of Oak Timbers

Martin Bridge and Cathy Tyers

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SUMMARY
Ten samples were taken from timbers in the attic rooms, and two samples were taken from the first-floor ceiling beams. Three timbers contained fewer than 30 rings and were not analysed. The remaining timbers showed abrupt growth changes, but at least two pairs appear likely to have each been derived from the same parent tree. The erratic growth patterns are potentially the result of management of the trees. None of the samples dated.

CONTRIBUTORS
Martin Bridge and Cathy Tyers

ACKNOWLEDGEMENTS
We are grateful to the owners for allowing this work to be carried out. The site was one of several examined as part of the Historic Fabric in Historic Towns: Chipping Norton project, and we thank Rebecca Lane for managing the project on behalf of Historic England. We are indebted to members of the Oxfordshire Buildings Record and Chipping Norton Buildings Record, especially Victoria Hubbard for her extensive input on coordinating the project, and her friendly encouragement, and Jan Cliffe for permission to reproduce her drawings in Figures 2 and 3. We'd also like to thank Shahina Farid for commissioning the work, and her input into preparing this report.

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DATE OF INVESTIGATION
2015

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CONTENTS

INTRODUCTION

The Early Fabric in Historic Towns: Voluntary Group Projects, funded by Historic England, have been developed in the recognition and acknowledgement of the excellent work being undertaken by local vernacular groups in the study of local architectural trends and fabrics. The intention of these projects is to encourage this type of study through the provision of support and facilitate training of more people in building analysis and recording. The local projects were coordinated by Rebecca Lane (Historic England South West Region: Architectural Investigation).

Early Fabric in Chipping Norton Project

Whilst Chipping Norton features in a study on historic towns in Oxfordshire (Rodwell 1975), and some buildings have been recorded and published in detail (eg Simons and Phimester 2005), no systematic research had been undertaken on the buildings of the town before this project.

The project examined vernacular historic buildings in the centre of Chipping Norton, aiming to improve understanding of the morphology and development of the historic town plan and to understand this within the framework of economic and social change. It aimed to identify early plan forms and to understand the dates of the introduction of vernacular architectural details (eg in materials, carpentry, fenestration, and decorative features), thus mapping the survival of early (pre-1900) fabric and revealing the architectural evolution of the town's buildings.

Initially, 21 properties were identified that were thought to be key to understanding the town's architectural development for a programme of comprehensive investigation. These properties were assessed for their suitability for dendrochronology and 12 that contained oak timber considered suitable for analysis were initially sampled and analysed. Oak timbers from seven of these buildings could be dated by ring-width dendrochronology, whilst radiocarbon wiggle-matching was undertaken for one of the buildings where the ring-width dendrochronology had produced an undated site master chronology.

The results of the project are presented by Rosen and Cliffe (2017). The reports produced on the historic buildings recorded as part of this project by the Chipping Norton Buildings Record/Oxfordshire Buildings Record (OBR) will be deposited in the Oxfordshire Historic Environment Record.

7 Market Street

The property sits on the western side of the old market square (Fig 1) in the centre of Chipping Norton. It is a Grade II listed building (List Entry Number 1052627). As an important early building in the town (listed as seventeenth-century), it was a natural candidate for dendrochronological investigation as part of the *Early Fabric in Historic Towns: Chipping Norton* project. It was hoped that any results obtained might provide additional evidence on the development of the building itself, and the formation of the old market square, this being one of several buildings around the square investigated by the OBR.

The property is aligned north to south and has two storeys, and attic rooms, with brick stacks at either end. The roof has three bays, with butt purlins and through tenons. The northern truss has a cambered, lapped collar. Oak roof timbers were accessible in the attic rooms, and it is these that were investigated, along with two ceiling beams at first-floor level.

METHODOLOGY

Fieldwork for the present study was carried out in October 2015, following an initial assessment of the potential for dating a few weeks beforehand, and consultation with those involved in the project. In the initial assessment, accessible oak timbers with more than 50 rings and where possible traces of sapwood were sought, although slightly shorter sequences are sometimes sampled if little other material is available. Those timbers judged to be potentially useful were cored using a 16mm auger attached to an electric drill. The cores were labelled, and stored for subsequent analysis.

The cores were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be clearly distinguished. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was attempted by a process of qualified statistical comparison by computer, supported by visual checks. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted on the computer monitor to allow visual comparisons to be made between sequences. This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one sample or site master against other samples or chronologies, *t*-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value in the range of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual samples match together with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. Lower *t*-values however do not preclude same tree derivation.

Ascribing felling dates and date ranges

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward.

Depending on the completeness of the final ring (ie if it has only the spring vessels or early wood formed, or the latewood or summer growth) a precise felling date and season can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an estimated felling date range can be given for each sample. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or felled-after date.

A review of the geographical distribution of dated sapwood data from historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area is 9–41 rings (Miles 1997). It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study.

RESULTS AND DISCUSSION

Samples were taken from ten timbers in the attic rooms, including principal rafters, purlins, a collar, and a knee attaching a purlin to the north end truss, thought to be part of the building to the north. The two ceiling beams on the first floor were also sampled. Details of the samples are given in Table 1, with the ring-width measurements for each sample being given in the Appendix. The location of the timbers sampled are shown in Figures 2 and 3.

Three samples had less than 30 rings, and so were not measured or analysed further. Cross-matching was found between two pairs of samples: cn7mkt07 matched cn7mkt08 (t = 8.3 with 75 years overlap; Fig 4) and cn7mkt04 matched cn7mkt09 (t = 6.6 with 52 years overlap; Fig 5). The ring-width series were combined from each of these pairs to produce two new mean series (cn7mkt78 and cn7mkt49) of 115-years and 64-years respectively for further analysis, but neither these, nor any of the remaining series, could be dated against the extensive oak reference material.

It would appear that each of these pairs of samples potentially represent two timbers derived from the same parent tree. Potential cross-matching between the two pairs is poor (t = 3.7 with 64 years overlap) and hence inconclusive. However, given the distortions in the rings, it is possible but unproven that all four timbers are coeval and potentially from two trees growing in relatively close proximity that had been managed in the same way. The abrupt growth changes evident in Figures 4 and 5 could potentially represent human interference in the growth of the trees through woodland management practices. Given these abrupt growth changes found, it is not surprising that none of the ring-width series were securely dated.

The 'knee' (cn7mkt10), attached to the west purlin in the north attic room, is thought to be a later addition (Fig 6) and showed a more typical growth pattern (Fig 7). It also failed to date but individual 60-year series are relatively rarely securely dated.

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TABLES

Table 1: Details of the samples taken from 7 Market Street, Chipping Norton

Sample number	Timber and location	Total number of rings	Mean ring width (mm)	Sapwood rings	Mean sensitivity	Relative date span
Roof timbers in attic rooms						
cn7mkt01	East principal rafter, south truss	61	1.81	-	0.20	-
cn7mkt02	South-east purlin, south room	87	1.25	27	0.29	-
cn7mkt03	Collar, south truss	<30	NM	h/s	-	-
cn7mkt04	South-west purlin, south room	52	1.43	1	0.25	13-64[49]
cn7mkt05	West principal rafter, south truss	<30	NM	h/s	-	-
cn7mkt06	North-west purlin, south room	<30	NM	-	-	-
cn7mkt07	West principal rafter, north truss	75+	1.15	15+3NM	0.23	38-112[78]
cn7mkt08	East principal rafter, north truss	115	1.16	23C	0.21	1-115[78]
cn7mkt09	West purlin, north room	64	1.37	4	0.26	1-64[49]
cn7mkt10	'Knee' added to west purlin, north room	60	1.85	17C	0.25	-
First floor ceiling beams						
cn7mkt11	South ceiling beam	60	2.78	24C	0.19	-
cn7mkt12	North ceiling beam	33	3.18	11	0.27	-

Key: NM=not measured, h/s=heartwood/sapwood boundary, C=complete sapwood, winter felled; [49]=relative date span within mean series cn7mkt49; [78]=relative date span within mean series cn7mkt78

FIGURES

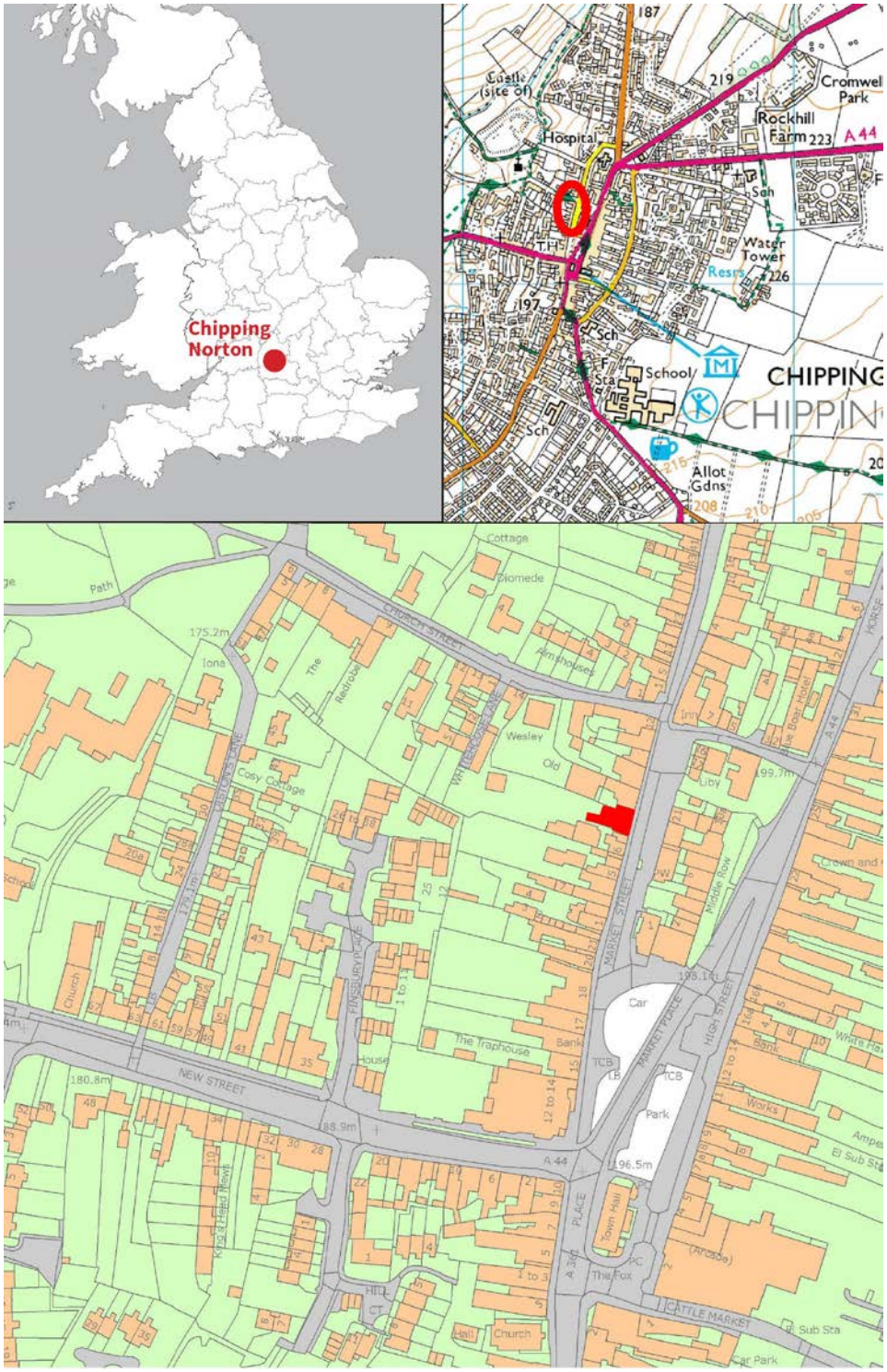

Figure 1: Maps to show the location of 7 Market Street in Chipping Norton, marked in red. Scale: top right 1:15000; bottom 1:2000. © Crown Copyright and database right 2020. All rights reserved. Ordnance Survey Licence number 100024900. © British Crown and SeaZone Solutions Ltd 2020. All rights reserved. Licence number 102006.006. © Historic England

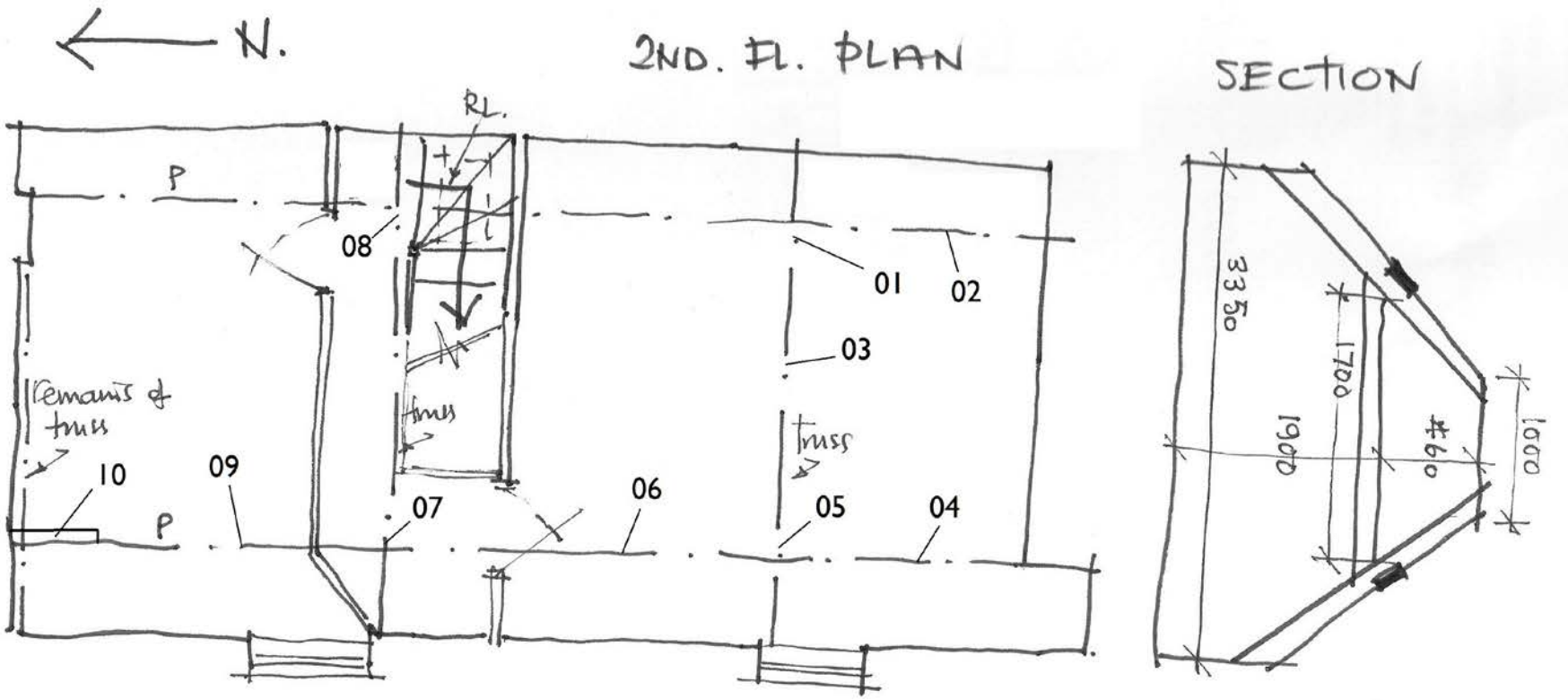

Figure 2: Sketch plan of the second floor, showing the positions of timbers sampled for dendrochronology (adapted from an original by Jan Cliffe, Chipping Norton Buildings Record working with the Oxfordshire Buildings Record)

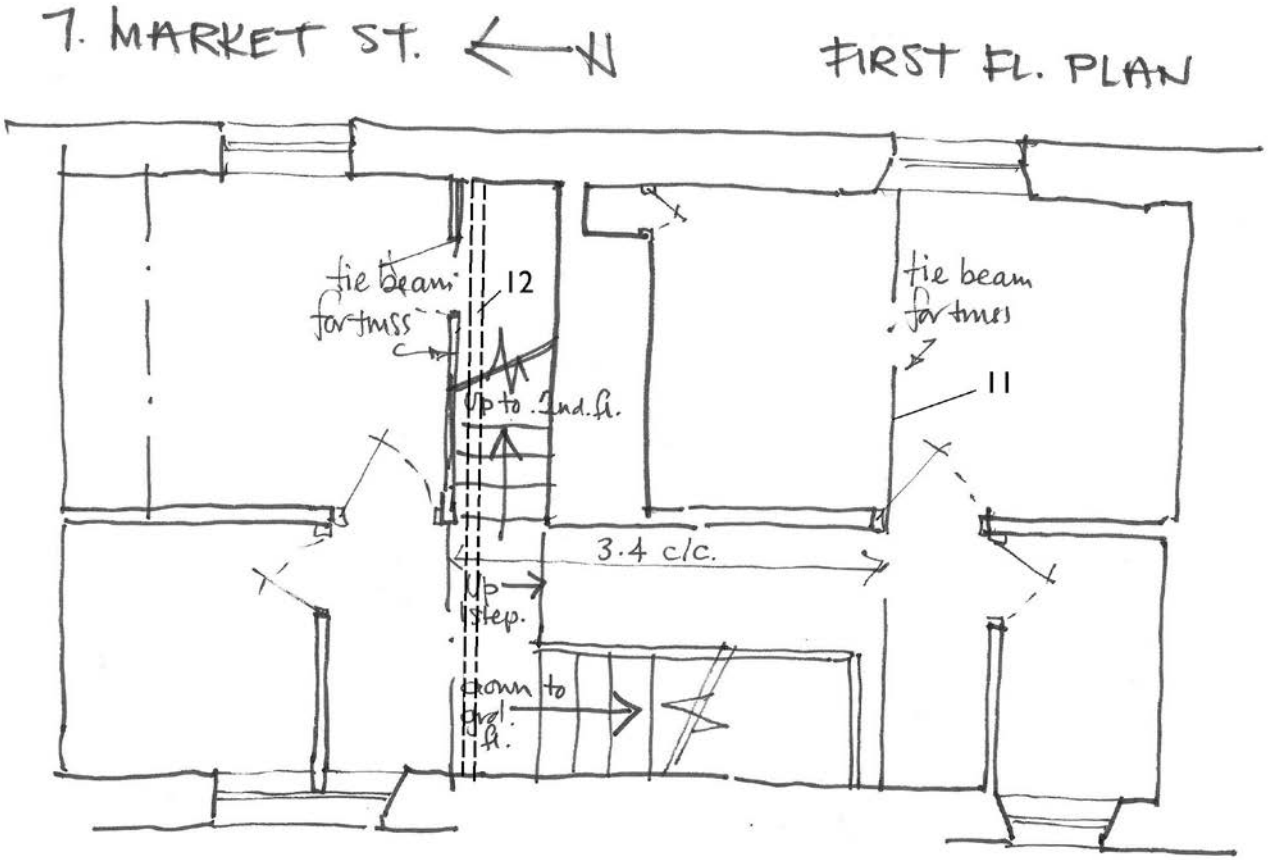

Figure 3: Sketch plan of the first floor, showing the positions of timbers sampled for dendrochronology (adapted from an original by Jan Cliffe, Chipping Norton Buildings Record working with the Oxfordshire Buildings Record)

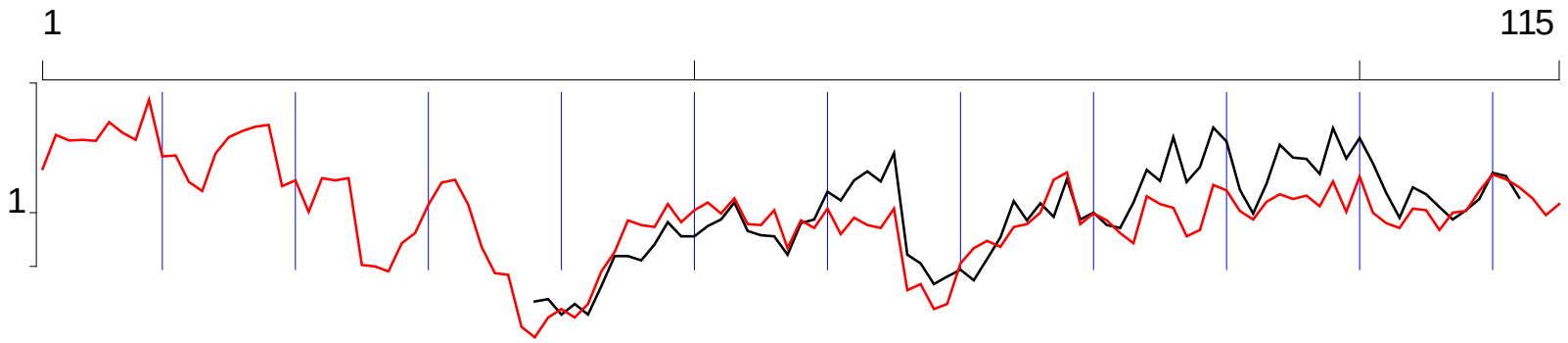

Figure 4: Plots showing the relative positions of overlap for samples cn7mkt07 (black) and cn7mkt08 (red), showing their similarity in growth. The y-axis is ring width (mm) on a logarithmic scale

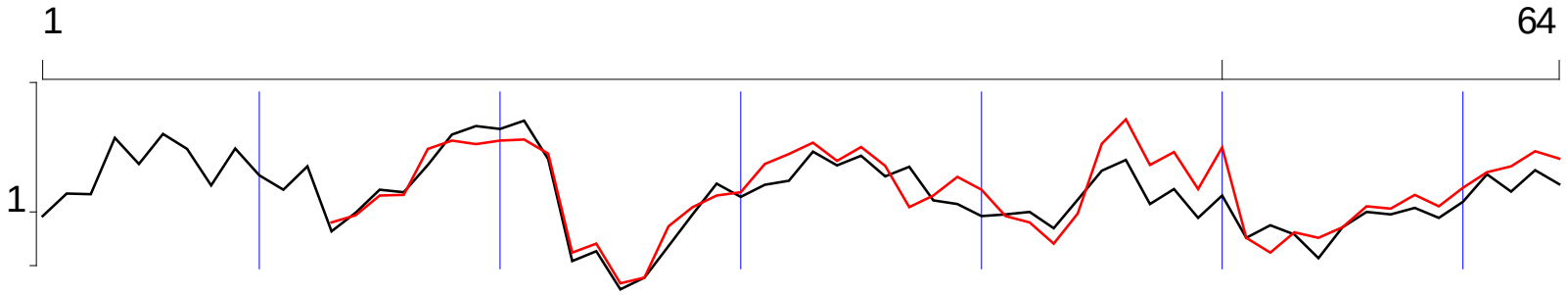

Figure 5: Plots showing the relative positions of overlap for samples cn7mkt04 (black) and cn7mkt09 (red), showing their similarity in growth. The y-axis is ring width (mm) on a logarithmic scale

Figure 6: The attached 'knee' added to the west purlin in the north attic room (photograph Martin Bridge)

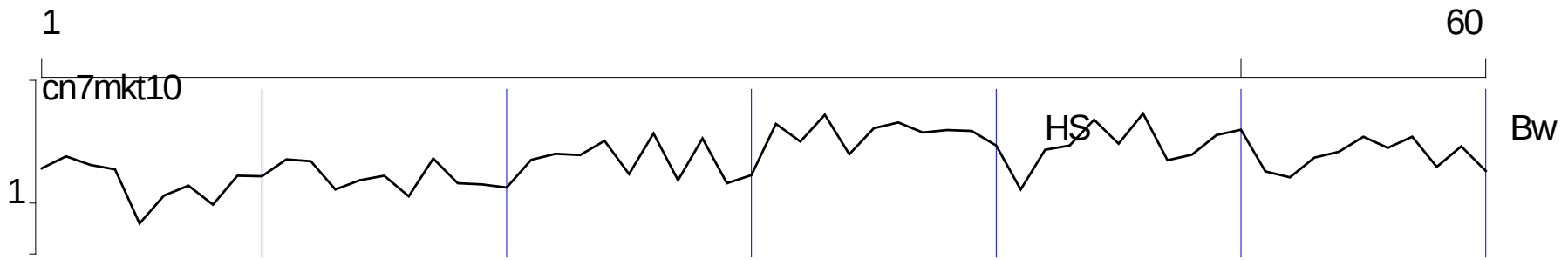

Figure 7: Plot showing the growth characteristics of sample cn7mkt10. The y-axis is ring width (mm) on a logarithmic scale

APPENDIX

Ring width values (0.01mm) for the sequences measured

cn7mkt01

254	220	193	201	159	200	350	274	303	303
290	266	339	338	253	183	195	177	170	192
218	269	196	260	236	231	224	270	223	220
121	180	158	86	63	75	86	100	141	181
175	131	162	120	187	145	59	62	84	109
109	102	130	107	144	154	185	183	139	91
95									

cn7mkt02

131	121	92	121	218	266	205	219	152	190
237	172	149	181	165	199	213	88	35	33
47	38	87	77	103	112	102	74	53	89
168	134	163	161	129	193	88	123	102	84
99	161	140	111	145	213	210	168	202	166
31	42	39	44	54	41	92	83	99	154
191	117	144	101	64	64	67	84	92	67
55	131	203	189	154	222	152	243	108	99
74	69	117	113	96	110	111			

cn7mkt04

88	96	122	123	215	238	228	238	241	203
61	68	42	45	84	106	122	127	179	202
232	186	220	175	106	122	153	131	95	88
68	98	229	308	177	207	132	219	73	61
78	73	83	107	104	123	107	134	162	174
209	191								

cn7mkt07

34	35	29	33	29	41	59	59	56	68
89	75	75	85	92	113	80	76	75	60
88	92	129	116	148	165	146	206	60	54
42	46	50	44	57	74	115	91	112	95
150	92	100	86	83	113	168	147	250	145
174	281	237	132	99	142	228	195	192	160
279	193	247	182	127	94	136	125	107	92
103	118	162	156	120					

cn7mkt08

170	257	240	242	239	300	264	242	394	198
200	145	130	205	250	269	284	290	138	148
101	152	148	152	53	52	49	69	78	110
144	149	110	66	48	47	25	22	28	31
28	33	49	62	91	86	84	111	89	103
113	99	119	87	86	103	65	91	83	105
77	94	86	83	105	39	42	31	33	54
65	71	66	84	87	100	149	163	87	99
91	78	69	122	111	106	75	81	140	131

102 92 114 125 118 123 108 146 101 155
100 88 83 105 103 81 100 102 130 159
150 136 119 97 111

cn7mkt09
95 125 124 246 179 258 215 138 216 156
131 174 79 99 131 127 177 256 284 274
303 190 55 62 39 45 66 97 141 120
139 146 208 176 198 154 173 115 110 95
97 100 82 116 165 188 110 132 93 122
73 85 76 57 83 100 97 105 93 113
158 128 166 140

cn7mkt10
156 182 163 154 77 110 125 98 142 141
175 171 119 134 142 109 177 129 127 122
174 188 185 222 145 244 134 229 129 143
276 220 310 187 261 281 247 255 252 209
119 198 209 291 214 315 173 186 239 256
150 139 179 193 234 203 234 159 207 151

cn7mkt11
400 431 358 473 409 514 554 612 704 402
305 565 390 391 391 355 358 419 366 442
378 360 395 339 326 258 340 301 322 355
369 346 272 316 268 260 288 302 90 63
78 69 48 50 53 47 59 52 85 66
63 73 70 109 194 172 140 116 149 200

cn7mkt12
411 501 484 359 362 431 290 439 331 306
354 254 406 494 449 434 394 412 398 210
400 229 94 231 187 136 164 153 168 244
330 235 202

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