

**THE TREE-RING DATING OF
TIMBERS FROM
No 45 & No39 CHURCH STREET,
TEWKESBURY,
GLOUCESTERSHIRE,
(S0 890 325)**



Summary

A total of 8 timbers, 6 from No 45 and 2 from No 39 Church Street were dated. They appear to form a coherent group of timbers with good internal cross-matching, although two felling dates were found, summer 1405 and summer 1408. It is possible that such a large complex was constructed over the period of a few years. This is an important result as it is a little earlier than had been expected on stylistic grounds. There is a suggestion that the timber may have been transported down the Severn from somewhere close to Shrewsbury.

Author: Dr M. C. Bridge FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

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BACKGROUND TO DENDROCHRONOLOGY

The basis of dendrochronological dating is that trees of the same species, growing at the same time, in similar habitats, produce similar ring-width patterns. These patterns of varying ring-widths are unique to the period of growth. Each tree naturally has its own pattern superimposed on the basic 'signal', resulting from genetic variations in the response to external stimuli, the changing competitive regime between trees, damage, disease, management etc.

In much of Britain the major influence on the growth of a species like oak is, however, the weather conditions experienced from season to season. By taking several contemporaneous samples from a building or other timber structure, it is often possible to cross-match the ring-width patterns, and by averaging the values for the sequences, maximise the common signal between trees. The resulting 'site chronology' may then be compared with existing 'master' or 'reference' chronologies. These include chronologies made by colleagues in other countries, most notably areas such as modern Poland, which have proved to be the source of many boards used in the construction of doors and chests, and for oil paintings before the widespread use of canvas.

This process can be done by a trained dendrochronologist using plots of the ring-widths and comparing them visually, which also serves as a check on measuring procedures. It is essentially a statistical process, and therefore requires sufficiently long sequences for one to be confident in the results. There is no defined minimum length of a tree-ring series that can be confidently cross-matched, but as a working hypothesis most dendrochronologists use series longer than at least fifty years.

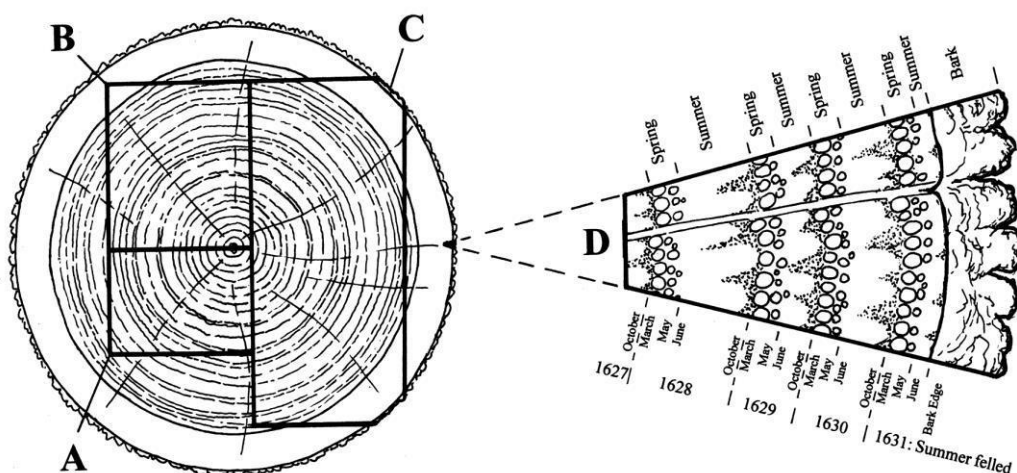
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation to the variation in the data, and is an established statistical technique for looking at the significance of matching between two datasets that has been adopted by dendrochronologists. The values of '*t*' which give an acceptable match have been the subject of some debate; originally values above 3.5 being regarded as acceptable (given at least 100 years of overlapping rings) but now 4.0 is often taken as the base value in oak studies. Higher values are usually found with matching pine sequences. It is possible for a random set of numbers to give an apparently acceptable statistical match against a single reference curve – although the visual analysis of plots of the two series usually shows the trained eye the reality of this match. When a series of ring-widths gives strong statistical matches in the same position against a number of independent chronologies the series becomes dated with an extremely high level of confidence.

One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence of unknown date to this reference material.

It follows from what has been stated above that the chances of matching a single sequence are not as great as for matching a tree-ring series derived from many individuals, since the process of aggregating individual series will remove variation unique to an individual tree, and reinforce the common signal resulting from widespread influences such as the weather. However, a single sequence can be successfully dated, particularly if it has a long ring sequence.

Growth characteristics vary over space and time, trees in south-eastern England generally growing comparatively quickly and with less year-to-year variation than in many other regions (Bridge, 1988). This means that even comparatively large timbers in this region often exhibit few annual rings and are less useful for dating by this technique.

When interpreting the information derived from the dating exercise it is important to take into account such factors as the presence or absence of sapwood on the sample(s), which indicates the outer margins of the tree. Where no sapwood is present it may not be possible to determine how much wood has been removed, and one can therefore only give a date after which the original tree must have been felled. Where the bark is still present on the timber, the year, and even the time of year of felling can be determined. In the case of incomplete sapwood, one can estimate the number of rings likely to have been on the timber by relating it to populations of living and historical timbers to give a statistically valid range of years within which the tree was felled. For this region the estimate used is that 95% of oaks will have a sapwood ring number in the range 9 – 41 (Miles 1997a).



Section of tree with conversion methods showing three types of sapwood retention resulting in **A** *terminus post quem*, **B** a felling date range, and **C** a precise felling date. Enlarged area **D** shows the outermost rings of the sapwood with growing seasons (Miles 1997a, 42)

Nos 45 and 38 CHURCH STREET, TEWKESBURY (Notes by Bob Meeson)

Nos 34 - 50 Church Street might be the longest surviving row of 'renters' in England. Built adjacent to the street along the north side of the abbey precinct, this long terrace of timber-framed mainly single-bay units was attributed in the VCH to the 15th or early 16th century.

Starting from the east, there were seven two-storey units (Nos. 34-39a and 39b), jettied to the front, and with the upper floors having down-braces below and up-braces above a mid-rail. The next three bays (40a, 40b and 41) are three storeys high, both upper floors were jettied, but the first and second floor front walls had only curved down-braces within the panels on each side of a central mullioned window; each of these bays was gabled to the street. Next in line to the west come numbers 42-50c, making up not less than fourteen more two-storey single-bay units with a continuous front jetty. Here, there is no mid-rail to the first floor, but elegant curved braces swing down from storey post to jetty bressumer on each side of a central panel which once contained a mullioned window. The most westerly unit ends

with a flanking panel that might indicate the counterpart of a surviving passage through the range between numbers 39b and 40a and, if so, the terrace might once have continued even further to the west.

The great majority of the units are confidently interpreted as single-bay ‘renters’, with a shop on the ground floor at the front and an open hall at the back. The floor area of each ‘solar’ on the first floor was considerably larger than the shop as it was jettied out both over the street and internally into the space over the hall. Most units can be shown to have had a cross-entry, first passing along the side of the shop and then forming part of the space within the hall. An enclosed solid-tread staircase flanked the opposite wall of each bay. In the ‘Merchant’s House’ (No. 45) extensive smoke-blackening remains from the former open hearth, but apparently there was never a louvre. On the first floor the smoke was kept out of the parlour by a screen or ‘smoke apron’ which slopes from the top of the jettied partition up towards the back side purlin. One mullioned window in the back wall lit the stairs, and another, at first-floor level within the smoke bay, doubled as supplementary lighting for the hall and as a smoke vent.

The transverse frames between each bay are of large rectangular panels. In the ‘Merchants’ House’ a long straight brace passes up from the sill beam to a main post in the back wall, and in the solar a curved brace extends up from the storey post to the tiebeam soffit. A crown strut extends up to the collar and two raked struts rise directly to the principals, which are reduced above clasped purlins. No. 41 Church Street, currently housing the main part of the John Moore Museum, and one of the three-storeyed gabled bays, employed largely similar carpentry, although the side purlins are tenoned into the front principals. The un-jettied rear wall is devoid of fenestration, supporting the internal evidence that a smoke void originally extended up through all floors.

SAMPLING

Samples were taken in May 2015. The locations of the samples in No 45 are described in Table 1, and illustrated in Fig 1. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **twkm** for No45, and **twkn** for No39) and were polished with progressively finer grits down to 400 to allow the measurement of ring-widths to the nearest 0.01 mm. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer. Measurements and subsequent analysis were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

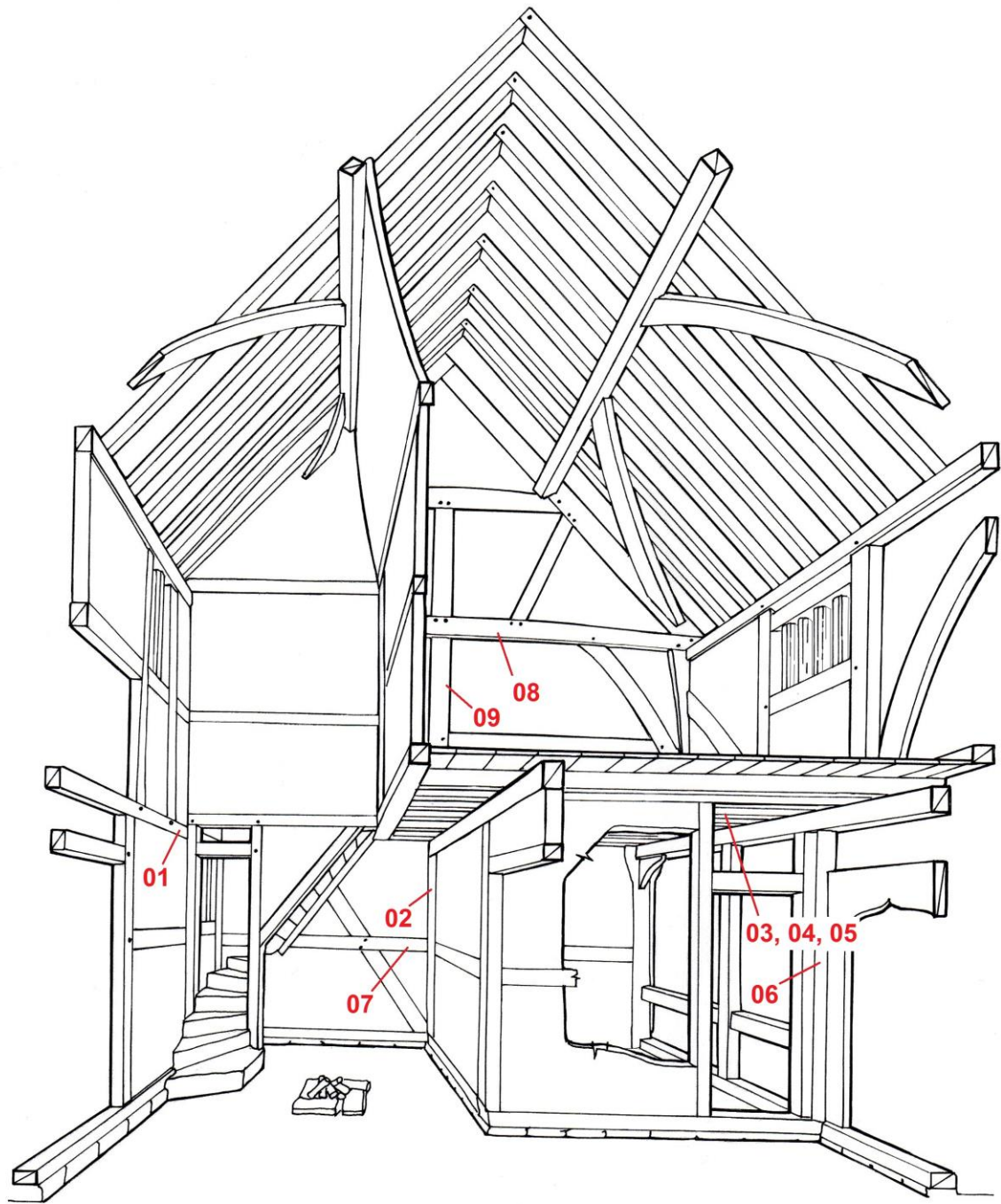


Figure 1: Drawing showing the timbers sampled in No 45 Church Street, Tewkesbury. This drawing by Bob Meeson is adapted with the consent of the John Moore Museum from an original made by Benson and Benson, Chartered Architects, in consultation with Stanley Jones and J T Smith

RESULTS AND DISCUSSION

Details of the samples are given in Table 1. Two samples were taken from the collar in No39 in order to obtain both the full sapwood and the inner rings of the timber. These series were matched visually (see Fig 2) as the overlap was too short to have meaningful statistical values. The two series were combined to form a single sequence used in subsequent analysis.

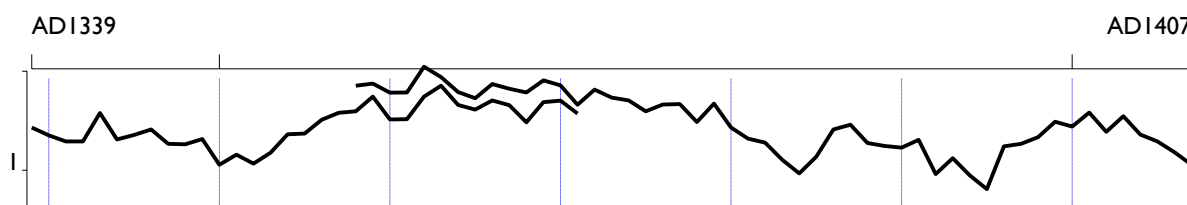


Figure 2: Plots of the inner and outer rings of the collar from No39 Church Street showing the relative position of overlap

The series from the joists in the north (front) room at No45 were too short to measure and analyse, but the other ring width sequences did match each other (Table 2) and were combined into a site master sequence of 69 years, **TEWKM**. This was subsequently dated to the period 1339–1407, the strongest matches being shown in Table 3. The timbers appear to form a coherent group, with good internal matching, although there is a spread of felling dates, two timbers (one from each building) having been from trees felled in summer 1405, and one timber having come from a tree felled in summer 1408. It is perhaps not surprising that on such an extensive group of buildings, trees were gathered over a period of a few years. Construction itself may have spanned a few years during the first decade of the fifteenth century. This is an important piece of information, as building historians had thought of this set of buildings as likely being a little later in date.

The results in Table 3 suggested that matches were better with material from Shropshire rather than more local sites. To investigate this further, the t -values of matching sites were mapped, and are displayed in Figure 3. The larger the circle, the stronger the match. This indeed supports the idea that the timbers may have come from somewhere very close to Shrewsbury – also on the River Severn. The sites it matches best are all in, or very close to Shrewsbury, and do not themselves contain many timbers, an important point, as well replicated site masters tend to give stronger matches to other sites. It is interesting that another Tewkesbury site of similar age (100 Church Street) only gives a match of $t = 3.3$ with 69 years of overlap. At this stage, dendroprovenancing at these relatively short distances is still rather crude (Bridge 2012), but this does at least suggest river transport of timber down the Severn in the early fifteenth century. Now that the building has been dated, it may be possible to focus on documentary evidence from the narrow date range provided to see if there is any support for this hypothesis.

The relative positions of overlap of the dated timbers are shown, along with their likely or actual felling dates, in Figure 4.

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Table 1: Details of samples taken from Nos 45 and 39 Church Street, Tewkesbury.

Sample number	Timber and position	Date of series	H/S boundary date	Sapwood complement	No of rings	Mean width (mm)	Std devn (mm)	Mean sens	Felling date range
No 45 – Merchant’s House									
* twkm01	Mid-rail on rear internal wall	1350-1404	1386	18½C	55	1.82	0.76	0.25	Summer 1405
twkm02	Post in centre of W wall, supporting jetty beam	1346-1390	-	1	45	2.75	1.14	0.26	1398–1430
twkm03	4 th joist from W, front room	-	-	detached	NM	-	-	-	-
twkm04	5 th joist from W, front room	-	-	-	NM	-	-	-	-
twkm05	1 st joist from W, front room	-	-	-	NM	-	-	-	-
* twkm06	W post of door, front (N) wall	1350-1393	1393	H/S	44	2.22	0.43	0.12	1402–34
* twkm07	Mid-rail to ground floor W wall	1355-1401	1387	14	47	1.91	0.68	0.17	1401–28
* twkm08	Tiebeam, W wall	1343-1405	1395	10	63	2.40	1.08	0.25	1405–36
* twkm09	Central post, W first floor wall	1353-1390	1385	5	38	1.75	0.48	0.24	1394–1426
No 39									
twkm01a	Collar to truss in W wall	1358-1407	1390	17½C	50	2.39	1.08	0.20	
twkm01b	ditto	1339-1371	-	-	33	2.17	0.68	0.18	
* twkm01	Mean of 01a and 01b	1339-1407	1390	17½C	69	2.10	0.83	0.19	Summer 1408
* twkm02	6 th common rafter (N) from west end	1347-1404	1384	20½C	58	1.36	0.55	0.28	Summer 1405
* = included in site master TEWKM		1339-1407			69	1.96	0.44	0.19	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; ¼ C = complete sapwood present, including spring vessels of the following year; ½C = complete sapwood, felled the following summer; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table 2: Cross-matching between the dated samples from the main building (*t*-values above 3.5 are significant)

	<i>t</i>-values						
Sample	twkm02	twkm06	twkm07	twkm08	twkm09	twkn01	twkn02
twkm01	2.4	3.2	4.7	3.4	4.1	4.5	5.4
twkm02		1.4	5.1	2.2	5.2	3.1	2.1
twkm06			4.0	3.5	-	3.2	-
twkm07				3.9	6.0	6.2	6.1
twkm08					4.7	5.0	5.2
twkm09						4.1	3.6
twkn01							6.1

- = overlap less than 30 rings, no calculation made

Table 3: Dating evidence for the site chronology **TEWKM AD 1339–1407** against dated reference chronologies

<i>County or region:</i>	<i>Chronology name:</i>	<i>Reference</i>	<i>File name:</i>	<i>Spanning</i>	<i>Overlap: (yrs)</i>	<i>t-value:</i>
Regional Chronologies						
Shropshire	Shropshire Master Chronology	(Miles 1995)	SALOP95	881–1745	69	7.5
Site Chronologies						
Shropshire	Riggs Hall	(Miles and Worthington 2001)	RIGGSHAL	1325–1407	69	10.2
Shropshire	King's Head, Shrewsbury	(Miles and Haddon-Reece 1995)	KINGSHD	1353–1403	51	9.3
Shropshire	Attingham	(Miles and Worthington 1998)	ATTNGHM1	1311–1385	47	8.7
Worcestershire	St Nicholas' Church, Warndon	(Tyers 1998)	WARNDON1	1348–1424	60	7.8
W Midlands	Manor House, West Bromwich	(Arnold and Howard 2009)	WBRASQ01	1318–1590	69	7.5
Shropshire	Upper Millichope	(Miles and Haddon-Reece 1995)	FORESTR1	1352–1450	56	7.2
Herefordshire	Cathedral Barn, Hereford	(Tyers 1996)	HERECB2	1359–1491	49	7.2
Gloucestershire	Mercer's Hall, Gloucester	(Howard <i>et al</i> 1996)	GLOUCMH	1289–1541	69	7.0
Shropshire	Abbot's House, Shrewsbury	(Miles and Haddon-Reece 1994)	ABBOTSHS	1348–1457	60	6.9
Shropshire	Bodenhams, Ludlow	(Miles <i>et al</i> 2003)	LUDLOW9	1358–1459	50	6.9

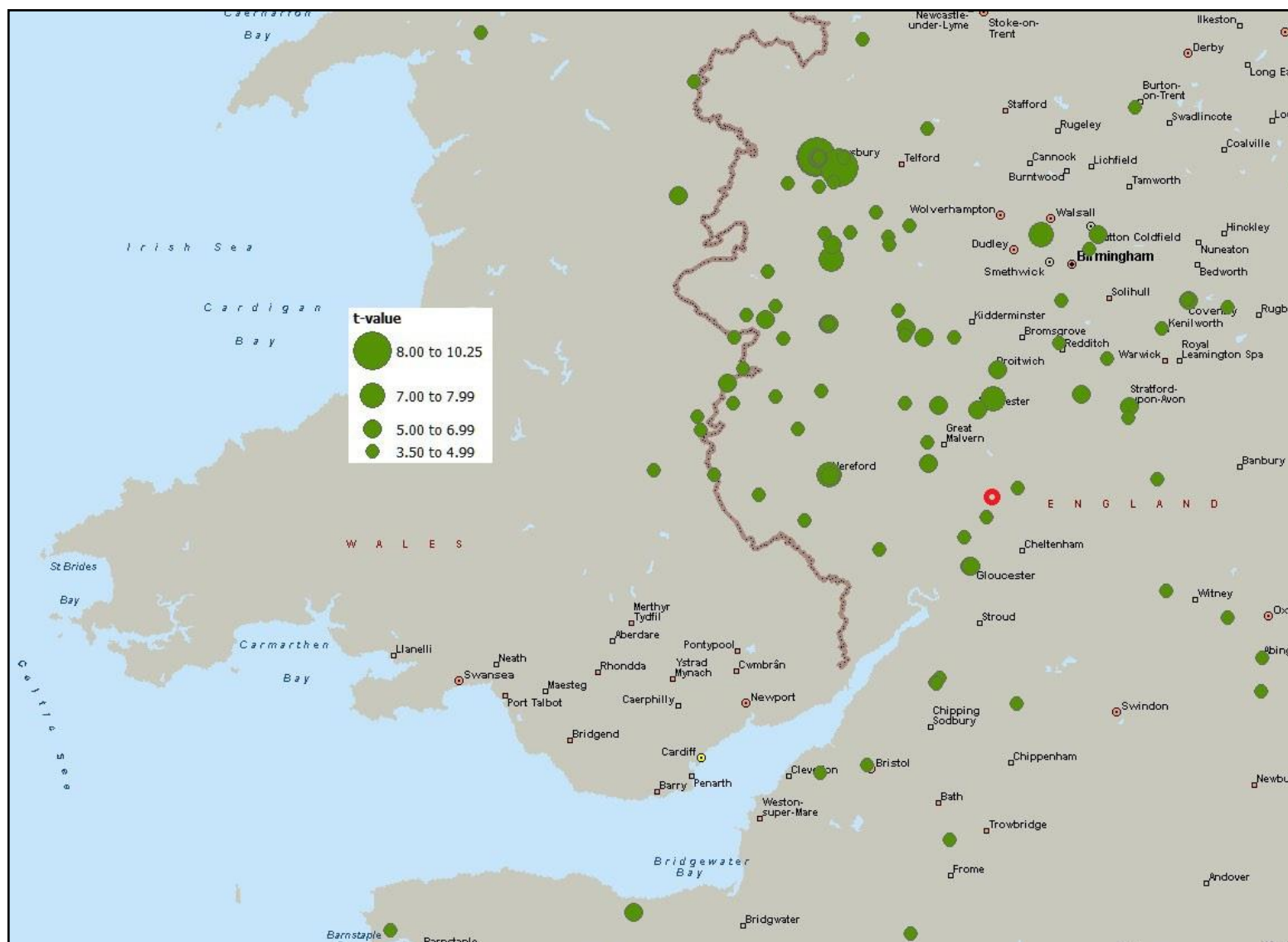


Figure 3: Map showing the locations of sites giving a t -value of 3.50 or over with the site chronology TEWKM (location denoted by red circle). Map produced in Microsoft® MapPoint™ 2000.

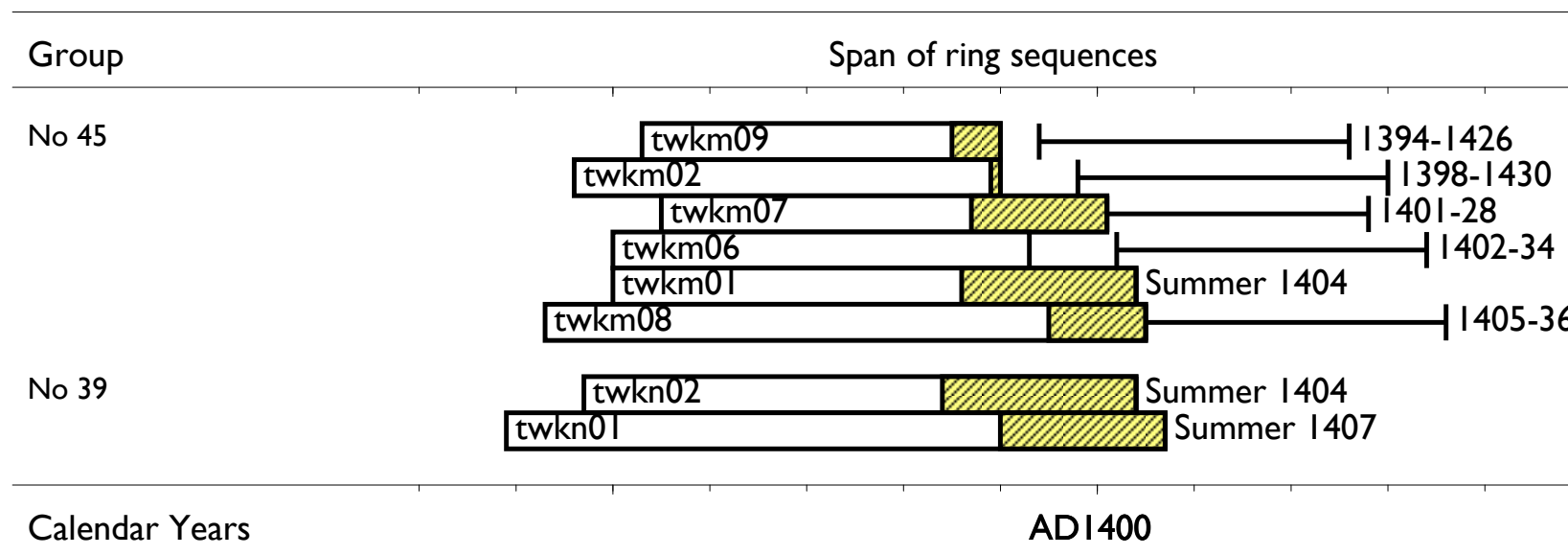


Figure 4: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.