Oxford Dendrochronology Laboratory
Report 2017/53

THE DENDROCHRONOLOGICAL DATING OF THE CLIMPING (CLYMPING) AND CHICHESTER CHESTS IN CHICHESTER CATHEDRAL, WEST SUSSEX

(SU 859 047 Cathedral)
(TQ 002 025 Climping)

Summary

Climping Chest

Samples from the front and rear boards matched each other and were combined into a 153-year long sequence which dated to the period 1133–1285. Although it was thought the heartwood-sapwood boundary was present on the rear board, this was several decades earlier than the last measured ring on the front board, which had no indication of sapwood (discussed in the text). It is most likely that the trees used were felled **after 1294**, and experience suggests little heartwood is likely to have been lost, suggesting an early fourteenth-century date for the chest. The wood appears to be of relatively local origin

Chichester Chest

A core from the rear left stile retained a clear heartwood-sapwood boundary, and was from a tree most likely felled in the period **1256–88**, giving a date range for the manufacture of the chest. Photographic series from the two side boards (found to be too thin to core) and the till lid, failed to date. The timber used was probably of local origin, although the best matches are with sites slightly to the north in Oxfordshire and Berkshire.

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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.

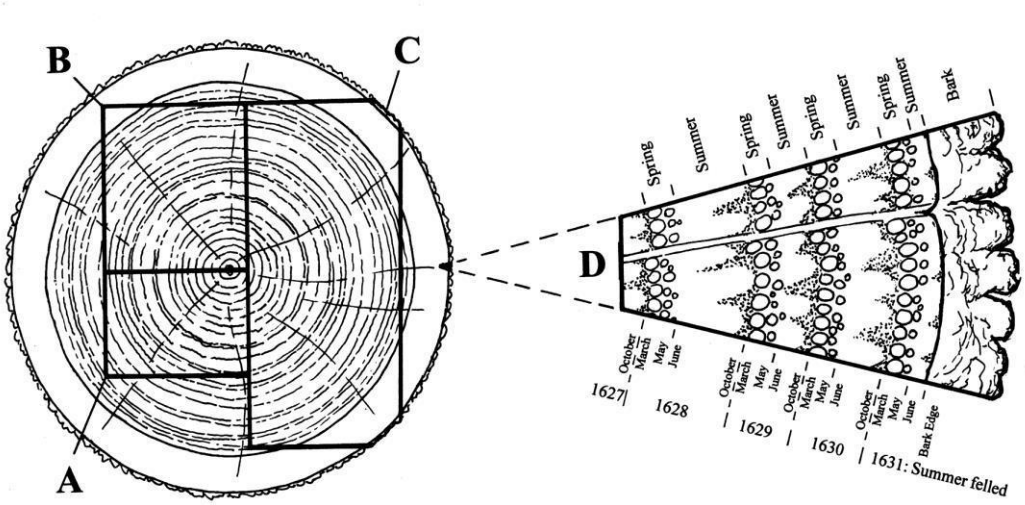
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation 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 south-east England the estimate used is that 95% of oaks will have a sapwood ring number in the range 9 – 41 (Miles 1997.



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 1997, 42)

Climping Chest (based on notes by Chris Pickvance)

This chest is 196 cm wide x 49 cm deep, measured at the lid and is of clamped construction. The original height is hard to estimate as the stiles have been cut off – perhaps 67 cm. There are iron caps on the pegs holding the front board to the stiles. The lid is made of a single board and has its original pin hinges, in which battens fixed under the sides of the lid rotate on iron rods held in the rear stiles. The remains of iron strap hinges can be seen on the lid and there are wooden inserts where previous locks were fixed on the front. The side joints are strengthened with an applied grid of battens. There are losses to the lower parts of this and the original bottom boards are missing. There is a till box on the left inside. Money slots of unknown date can be seen in the lid and in the till box lid.
The facade is elaborately carved. Two whorls are carved on the stiles and the central board has low relief gothic arcading with columns, above which are two smaller roundels with star designs. A C19th drawing shows that the feet of the stiles had a rectangular honeycomb carved design. The lid battens have stop chamfering with bosses.

Chichester Chest (based on notes by Chris Pickvance)

This chest is 78 cm high x 129 cm wide x 67 cm deep, measured at the lid, and is of clamped construction. The front stiles have lost very little in height. There are iron caps on the pegs holding the front board to the stiles. The front part of the lid has been replaced but the original pin hinges, in which battens under the sides of the lid rotate on iron rods held in the rear stiles, are extant. The side joints are not strengthened with an applied grid of battens. The original bottom boards are missing but the grooves into which they fitted can be seen. There is a till box on the right inside, the edge of whose lid is stop chamfered. The chest has a later single central lock plate.
The facade has a triple incised frame all the way round the edge, three 'star' roundels, with iron discs at the centre, and one remaining spandrel by the left foot. A very unusual feature is the remains of polychrome in the roundels. The front feet have surface-carved lunettes with bosses and column; the rear feet are shaped to form a lunette with boss.

SAMPLING

Samples were taken in November 2017. The locations of the samples are described in Tables CL1 and CH1. Core samples were extracted using an 8mm diameter borer attached to an electric drill. They were labelled (prefix **clmp** and **chich** respectively), mounted on a grooved mount, and 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). In addition, a number of overlapping digital photographs were taken of the left and right side boards, and the till lid of the Chichester chest. These were examined in CooRecorder 9.1 and CDendro 9.1 from Cybis Elektronic and Data AB.

RESULTS AND DISCUSSION

Details of the samples are given in Tables CL1 and CH1.

CLIMPING CHEST

This chest had only two timbers with good long ring sequences: the front and rear boards. The top board was in very poor condition, and the four stiles were relatively fast grown. Thus only the rear board (**clmp01**) and the front board (**clmp02**) were sampled. The rear board exhibited a heartwood/sapwood boundary for half the length of the top edge of the board whilst the front board had no evidence of heartwood/sapwood boundary.

Sample **01** matched sample **02** (t = 6.2 with 87 years overlap) and were combined to form a mean chronology **CLMPING**. This was dated to the period 1133–1285 by comparison with the dated reference material, the strongest matches being shown in Table CL2. The relative positions of overlap of the samples are shown in Fig CL2.

A problem with this dating is in the interpretation of what this means in terms of dating the manufacture of the chest. When sampled, the rear board was thought to exhibit heartwood-sapwood boundary (h/s), which would suggest a likely felling date range for this board of 1246–78. The front board however matches well with the rear, and is likely to have come from a tree felled at the same time, but it has no evidence for the h/s boundary, and has a last measured ring formed in 1285, suggesting felling after 1294 at the earliest. There are a few possible explanations: firstly it is just

possible that the rear board came from a tree with an abnormally large number of sapwood rings, but being from a relatively fast-grown timber, however, this seems unlikely. It is possible that the heartwood-sapwood boundary was mis-identified, and maybe represented degradation of the timber for some other reason, although both authors have very extensive experience in identifying such features. Another possibility is the presence of 'included sapwood' – a rare phenomenon, usually following trauma to the tree, where growth ceases in one part of the tree following some unusual experience, such as a lightning strike, killing the active growing area in part of the tree, which subsequently becomes engulfed in new growth around it, leaving the sapwood unconverted to heartwood in part of the tree. An example can be seen in Fig. CL1, but it should be noted this is very rarely seen.

Fig: CL1: An example of the rare occurrence of 'included sapwood'

We are left then with the interpretation from the second board, from which we conclude that the tree used was most likely felled after 1294, but there is no way of knowing how soon after 1294, other than through experience with other work on prepared boards, where generally it has been found that little wood beyond the sapwood is lost. This suggests then an early fourteenth-century date for the chest.

CHICHESTER CHEST

This chest was assessed, and the side boards exhibited good ring sequences and clear heartwood/sapwood boundary on the right hand side board. However, the boards were found to be approximately 12mm – 15mm thick, and too thin to core. Of the four stiles, the rear left-hand and front right-hand stiles had clear heartwood/sapwood boundaries. Unfortunately these stiles were found to be fast growing, with less than 50 rings visible on the top edge. However, the grain was compressed on the lower part of the rear left stile, and this was therefore sampled (**chich01**).

As the side boards were too thin, they were photographed with a scale. In addition, the lid to the till had become detached and the rings were very visible on the end. However, the photographic series from the two side boards and the till lid failed to date, but resolution of the rings was difficult, and it only takes one ring boundary to be mis-identified to upset any cross-matching. The till lid did yield a

clear sequence, but this failed to give acceptable consistent matches with the dated reference material (including Baltic timber chronologies). The 71-year sequence from the core from the rear left stile, which retained the heartwood-sapwood boundary, dated very well (Table CH2) and gives a likely felling date range of **1256–88**.

Overall

The relative positions of overlap of the dated series from the two chests are shown in Fig 1. The dated series from the Climping Chest matched the dated series from the Chichester Chest (t = 3.6 with 71 years overlap), but not strongly, suggesting different sources for the timber used. Both chests appear to have used timber from central southern England, as indicated by the matches with dated reference material shown in Figs CH2 and CL2. The lack of matches in Sussex reflects the lack of data from this area in the relevant period, not the possibility that the timber may have come from this area. Neither chest matched significantly against the only other Sussex chest so far dated (Buxted).

ACKNOWLEDGEMENTS

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REFERENCES

Baillie, M.G.L. and Pilcher, J.R. (1973) *A simple cross-dating program for tree-ring research*. **Tree Ring Bulletin**, 33, 7-14.

Bridge, M. C. (1988) *The dendrochronological dating of buildings in southern England*, **Medieval Archaeology**, 32, 166-174.

Bridge, M.C., Roberts, E., Fergie, B., Crook, J. and Miles, D. (2010) Tree Ring Dating Lists, **Vernacular Architecture**, 41, 105-108.

English Heritage (1998) *Guidelines on producing and interpreting dendrochronological dates,* **English Heritage, London.**

Groves, C., Hillam, J. and Pelling-Fulford, F. (1999) *Dendrochronology, in Excavations on Reading Waterfront sites 1979-1988* (eds J W Hawkes and P J Fasham), **Wessex Archaeology Reps**, 5, 65-68.

Hillam, J. and Groves, C. (1993) *Tree-ring analysis of oak timbers from the south range roof of the Blackfriars Priory, Gloucester, Gloucestershire*, **Anc Mon Lab Rep**, 26/93.

Hurford, M., Tyers, C. M. and Howard, R. (2010) *Apshill House, Lower Chicksgrove, Wilstshire: Tree-Ring Analysis of Timbers*, **English Heritage Res Dept Rep Series**, 102-2010.

Hurford, M., Bridge, M. and Tyers, C. (forthcoming), *Dauntsey House, Dauntsey, Wiltshire: tree-ring analysis of timbers,* **English Heritage Res Dept Rep Series**, 62-2014.

Miles, D. (1997) *The interpretation, presentation, and use of tree-ring dates*, **Vernacular Architecture**, 28, 40-56.

Miles, D. (2003) Dating Buildings and Dendrochronology in Hampshire, in *Hampshire Houses 1250 - 1700: Their Dating and Development* (ed E Roberts), 220-226, Southampton (Hampshire County Council).

Miles, D.H. (2004) Working compilation of reference chronologies centred around Somerset by various researchers, unpublished computer file SOMRST04, Oxford Dendrochronology Laboratory.

Miles, D. H. and Haddon-Reece, D. (1996) List 72 - Tree-ring dates, **Vernacular Architecture**, 27, 97-102.

Miles, D. H. and Worthington, M. J. (1997) Tree-ring dates, **Vernacular Architecture**, 28, 159-181.

Miles, D. H. and Worthington, M. J. (1998) Tree-ring dates, **Vernacular Architecture**, 29, 111-129.

Miles, D. H. and Worthington, M. J. (2001) Tree-ring dates, **Vernacular Architecture**, 32, 74-86.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2008) Tree-ring dates, **Vernacular Architecture**, 39, 135-146.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2009) Tree-ring dates, **Vernacular Architecture**, 40, 122-128.

Miles, D. H. and Bridge, M. C. (2014) Tree Ring Dating Lists, **Vernacular Architecture**, 45, 115-119.

Tyers, I. (2004) *Dendro for Windows Program Guide 3rd edn*, **ARCUS Report,** 500b**.**

Wilson, R., Miles, D., Loader, N. J., Melvin, T., Cunningham, L., Cooper, R. and Briffa, K. (2012) *A millennial long March-July precipitation reconstruction for southern-central England*, **Climate Dynamics**, 40, 997-1017.

Worthington, M. J. and Miles, D. W. H. (2003) *The Tree-Ring Dating of the Chapter House Roof, Christ Church, Oxford*, **Centre for Archaeology Rep**, 3/2003.

Table CL1: Details of samples taken from elements of the Climping chest.

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
* **clmp01**	Rear board	1133–1237	?1237	?h/s	105	3.18	1.77	0.28	?
* **clmp02**	Front board	1151–1285	-	-	135	2.81	1.10	0.28	After 1294
* = component of site mater **CLMPING**		**1133–1285**			**153**	**2.99**	**1.35**	**0.26**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table CL2: Dating evidence for the site sequence **CLMPING AD 1151–1285** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
England	Southern Central England	(Wilson *et al* 2012)	**SCENG**	663–2009	153	10.1
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	153	9.3
Somerset	Somerset Master Chronology	(Miles 2004)	**SOMRST04**	770–1979	153	8.9
Site Chronologies						
Hampshire	Pilgrims Hall, Winchester	(Miles and Worthington 2001)	PILGRIMS	1148–1310	138	9.7
Hampshire	Stables at Bishops Waltham Palace	(Miles *et al* 2009)	BISHWTHM	1133–1291	153	9.4
Hampshire	42 Chesil Street, Winchester	(Bridge *et al* 2010)	CHESIL1	1153–1291	133	8.9
Hampshire	Winchester Cathedral	(Miles and Worthington 1998)	WINCATH2	1098–1317	153	8.7
Gloucestershire	Gloucester Blackfriars	(Hillam and Groves 1993)	GLOUCBLF	1076–1219	87	8.4
Hampshire	15 High Street, Fareham	(Miles and Worthington 1998)	CHIVES	1167–1271	105	8.3
Shropshire	Stokesay Castle	(Miles and Worthington 1997)	STOKE2	1046–1289	153	7.8
Devon	St Brannock Church, Braunton	(Miles and Worthington 2001)	BRAUNTN1	1051–1259	127	7.6
Oxfordshire	Christ Church Chapter House, Oxford	(Worthington and Miles 2003)	CHCHCH	1142–1260	119	7.6

Table CH1: Details of samples taken from elements of the Chichester chest.

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
chich01	Rear left stile core	1177–1247	1247	h/s	71	3.15	1.12	0.17	1256–88
CHtill	Edge of till lid (photographic)	-	-	-	60	1.53	0.45	0.16	-
CHlhb	Left side board (photographic)	-	-	-	*c118*	-	-	-	-
CHrhb	Right side board (photographic)	-	-	-	*c66*	-	-	-	-

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table CH2: Dating evidence for the site sequence **chich01 AD 1177–1247** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
London	London Master Chronology	(Tyers pers comm)	**LONDON**	413–1728	71	6.2
England	Southern Central England	(Wilson *et al* 2012)	**SCENG**	663–2009	71	6.0
Site Chronologies						
Oxfordshire	Manor Farm, Stanton St John	(Miles and Worthington 1998)	STNSTJN1	1131–1304	71	7.0
Berkshire	Reading Waterfront	(Groves *et al* 1999)	READING	1160–1407	71	6.8
Oxfordshire	New Inn, Oxford	(Miles and Haddon-Reece 1996)	ZACHS	1164–1381	71	6.1
Oxfordshire	Christ Church Chapter House, Oxford	(Worthington and Miles 2003)	CHCHCH	1142–1260	71	6.1
Wiltshire	Dauntsey House, Dauntsey	(Hurford *et al* forthcoming)	DSDPSQ02	1122–1355	71	6.1
Dorset	Font le Roi, Alweston	(Miles and Bridge 2014)	FNTLEROI	1140–1390	71	6.0
Wiltshire	Apshill House, Lower Chicksgrove	(Hurford *et al* 2010)	LCAHSQ01	1080–1332	71	5.8

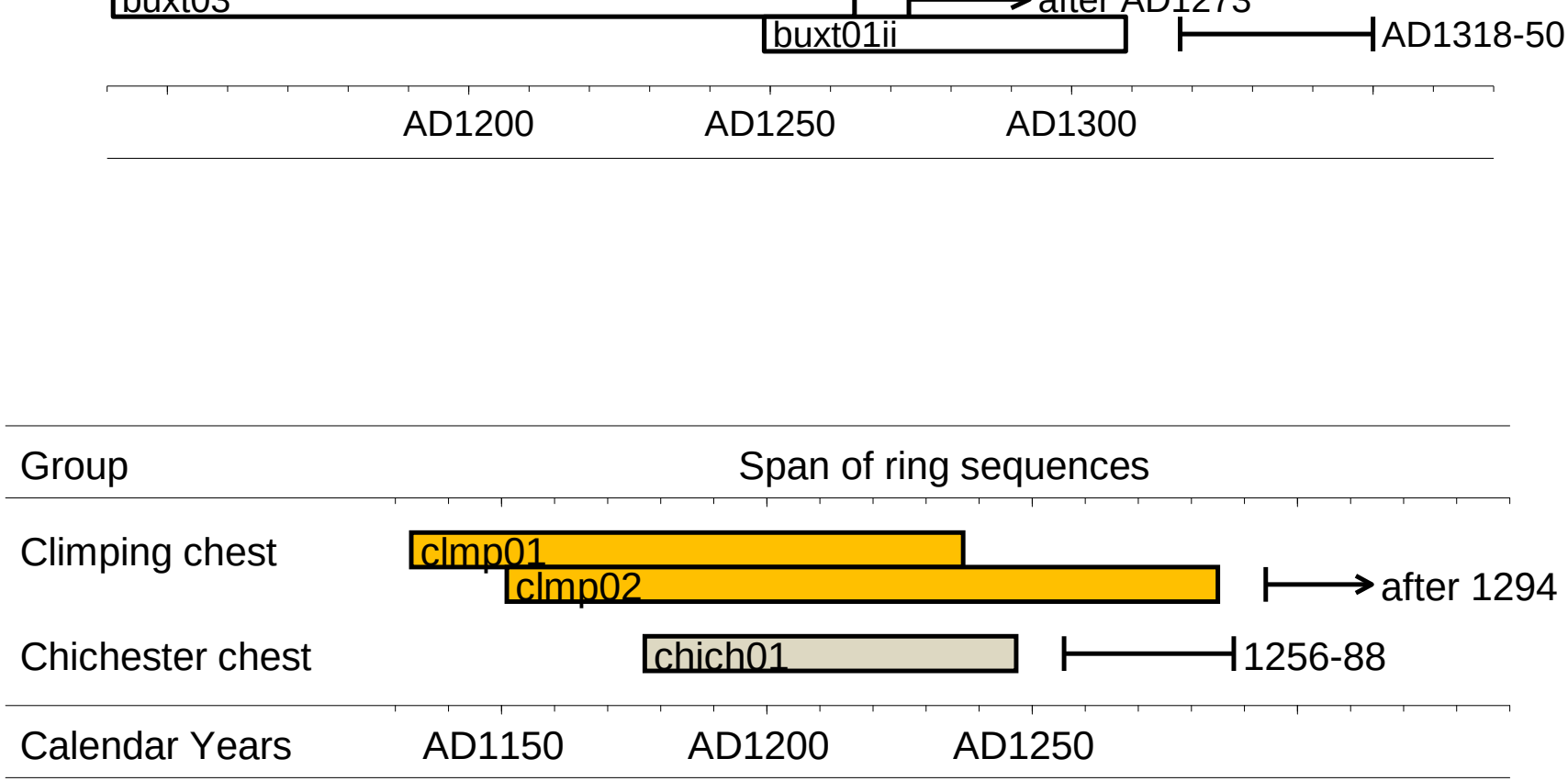

Figure 1: Bar diagram showing the relative positions of overlap of the two dated series.

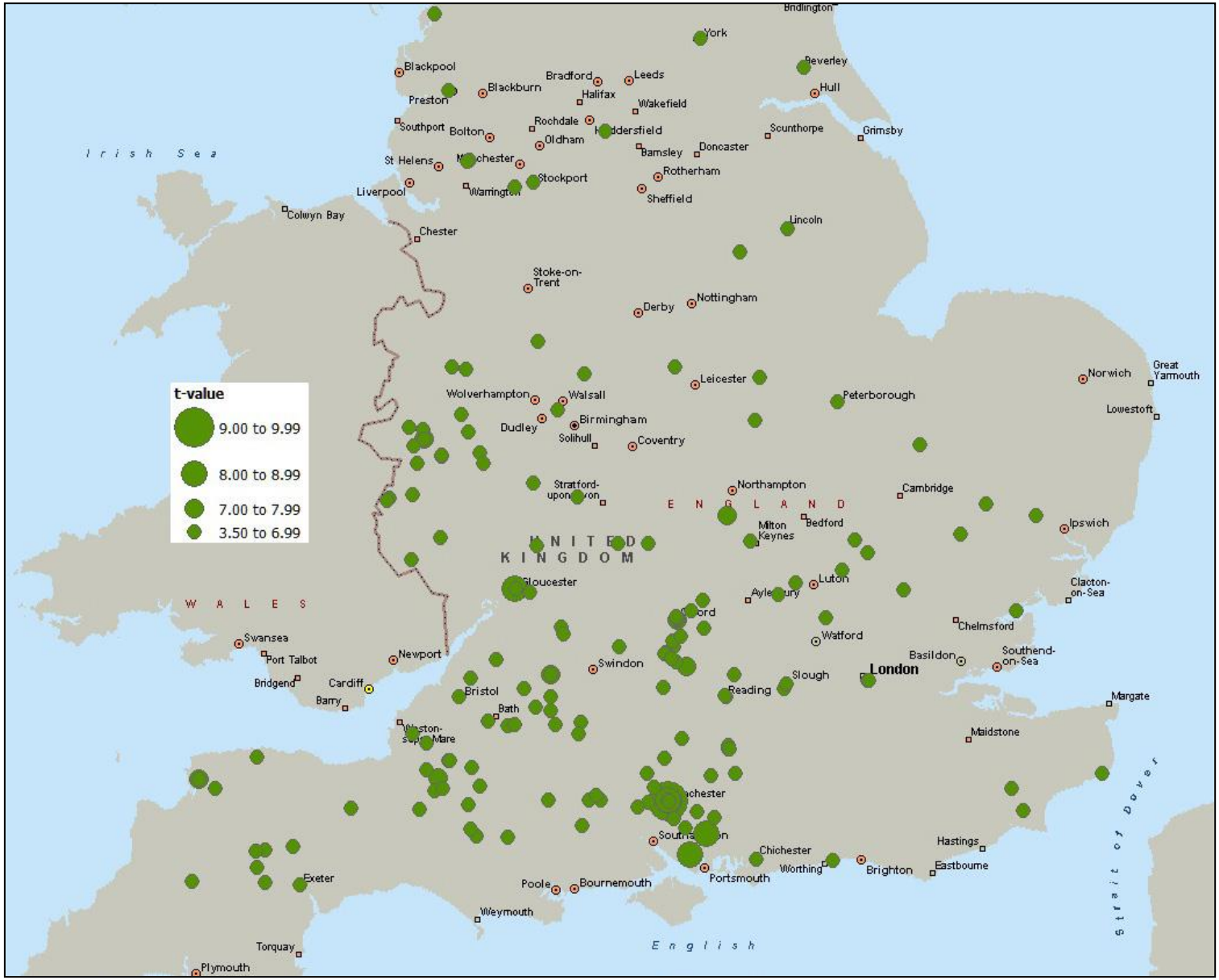

Figure CL2: : Map showing the geographical spread of matches of the sequence **CLMPING**, representing the Climping Chest, suggesting the timber was of relatively local origin (prepared in Microsoft MapPoint ®)

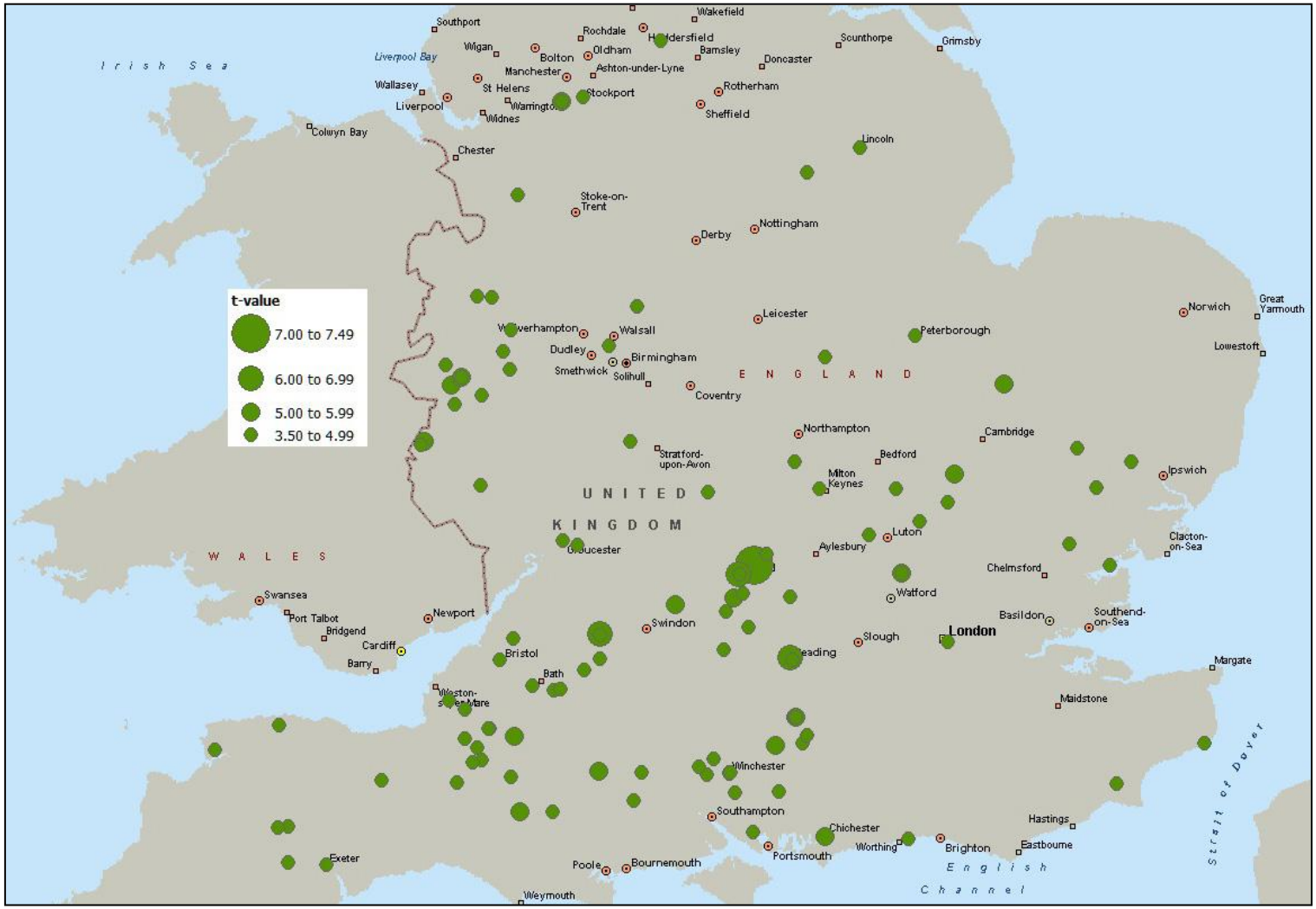

Figure CH2: Map showing the geographical spread of matches of the sequence **chich01**, representing the Chichester Chest, suggesting the timber was of relatively local origin (prepared in Microsoft MapPoint ®)