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DENDROCHRONOLOGICAL ANALYSIS OF OAK TIMBERS FROM KINSLEY MOAT, CARR FARM, NEAR WAKEFIELD, WEST YORKSHIRE, 1996

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Summary

Ten oak samples from nine timbers were submitted for tree-ring analysis from Kinsley Moat, Carr Farm, near Wakefield. The ring sequences of six of the samples were considered suitable for dating purposes but no calendar dates were obtained.

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Introduction

This analysis was commissioned at the request of John Ettè, the local English Heritage Ancient Monuments Inspector, following the dredging up of a number of timbers from the centre of the north-west arm of Kinsley Moat, Carr Farm, near Wakefield (SE 4089 1436). The dendrochronological study was to form part of the detailed archaeological recording of the timbers being undertaken by West Yorkshire Archaeology Service. The timbers were thought to be associated with a former bridge structure, probably of medieval date (Wrathmell forthcoming). This analysis was undertaken with the aim of providing precise dates for the timbers and hence providing more precise dating evidence for aspects of the past history of the site.

Method

The timbers were initially assessed for their dendrochronological potential during a site visit. The condition of the timbers prevented accurate assessment of all timbers at this time but a handful, including the only coniferous timber, were rejected prior to sampling as they clearly contained too few rings for dating purposes. Unsuitable timbers are usually those with less than 50 rings or unclear ring sequences. Samples with fewer than 50 rings are generally unsuitable for dating purposes as the ring sequence may not be unique (Hillam *et al* 1987). When the suitability of a timber was in doubt, it was sampled so that a more accurate assessment could be carried out in the laboratory. Ten samples in the form of cross-sectional slices were cut by chainsaw from nine timbers.

The samples were prepared and analysed using standard dendrochronological techniques (see eg Baillie 1982; Hillam 1985). Any samples unsuitable for dating purposes were rejected before measurement but, where possible, a note was made of the number of rings and the average ring width estimated.

The growth rings of the samples selected for dating purposes were measured to an accuracy of 0.01mm on a travelling stage connected to a microcomputer which uses a suite of dendrochronology programs written by Ian Tyers (pers comm 1996). The ring sequences were plotted as graphs using an HI-Epson plotter attached to a microcomputer. The graphs were then compared with each other to check for any similarities between the ring patterns which might indicate contemporaneity. This process is aided by the use of computerised statistical routines. The crossmatching routines are based on the Belfast CROS program (Baillie & Pilcher 1973; Munro 1984) and measure the amount of correlation between two ring sequences. The Student's *t* test is then used as a significance test on the correlation coefficient. All *t* values quoted in this report are identical to those produced by the original CROS program (Baillie & Pilcher 1973). Generally a *t* value of 3.5 or over represents a match (Baillie 1982, 82-85), provided that

the visual match between tree-ring graphs is acceptable and that high *t* values are obtained at the same relative or absolute position with a range of independent chronologies.

Dating is usually achieved by crossmatching ring sequences within a phase or building and combining the matching patterns to produce a site master curve. This master curve and any unmatched ring sequences are then tested against a range of reference chronologies to obtain calendar dates. A master curve is used for absolute dating purposes whenever possible as it enhances the common climatic signal and reduces the background noise resulting from the local growth conditions of individual trees.

The results only date the rings present in the timber and therefore do not necessarily represent the felling date. If the bark or bark edge is present on a sample, the exact felling year can be determined. In the absence of bark surface, the felling date is calculated using the sapwood estimate of 10-55 rings. This is the range of the 95% confidence limits for the number of sapwood rings on British oak trees over 30 years old (Hillam *et al* 1987). Where sapwood is absent, the addition of 10 rings (the minimum number of sapwood rings expected) to the date of the last measured heartwood ring produces a probable *terminus post quem* for felling. This is the date after which the timber was felled. The actual felling date may be much later because during timber conversion a large number of outer rings could be removed.

At this stage it is necessary to incorporate other specialist evidence concerning re-use of timbers and possible later repairs or modifications, as well as factors such as stockpiling or seasoning, in order to determine whether the dendrochronological dates obtained reflect the construction date of the structure. Seasoning of timber is thought to have been a fairly rare occurrence until relatively recent times. Evidence indicates that it was normal practice to fell timber as required and use it whilst green (eg Rackham 1990, 69). Construction which utilises primary, rather than re-used, timber is therefore likely to have occurred shortly after felling. Thus, whilst the date obtained for the measured tree-ring sequence is precise and has been achieved by a completely independent process, the interpretation of the dendrochronological dates may be refined by studying other archaeological and documentary evidence.

Results

Details of the ten samples are presented in Table 1. All ten samples were oak (*Quercus* spp) and none had any trace of sapwood surviving. Oak is relatively easy to recognise as it is a ring porous species with wide medullary rays running from pith to bark (Schweingruber 1990). A range of conversion techniques were represented by the timbers: sample 05, for instance, appeared to be from a lightly trimmed whole trunk; sample 04 was from a trimmed halved trunk; sample 09 was from a quartered trunk; whilst sample 07 was a radial plank. It seems likely, when an allowance is made for the rings lost during the conversion of the trunks into beams or planks, that the majority trees used were probably around 100 years old when felled, although a few of the heavily trimmed timbers may have been derived

from trees up to 150 years old. The average ring width of the samples ranges from 2.0mm to 5.0mm which suggests that the timbers were likely to have been obtained from trees found in a relatively open environment rather than dense woodland where competition would have been more severe, resulting in a slower growth rate (ie narrower rings).

Samples 03, 04, 07, and 08 were unsuitable for further analysis as they contained fewer than 50 growth rings. None of six measured ring sequences were found to crossmatch reliably with each other. Consequently each individual sequence was compared with an extensive range of reference chronologies spanning the last two millennia from the British Isles and elsewhere in Europe. The Kinsley Moat ring patterns were also tested against various undated ring sequences from Yorkshire and Humberside. No conclusive results were obtained so the timbers associated with the medieval bridge structure remain undated by dendrochronology.

Discussion

It is not possible to determine precisely why the timbers from Kinsley Moat do not date. The absence of intra-site crossmatching and the relative shortness of the ring sequences must be major contributory reasons. The extensive medieval data sets available for Yorkshire suggest that the lack of suitable local reference data is unlikely to be part of the problem. The failure to obtain any matching between individual timbers meant that dating had to be attempted for each individual ring sequence. This procedure is far less likely to give a reliable date than the use of a well replicated site master curve. The production of a site master curve from a number of individual timbers maximises the dating potential as discussed in the methodology section above. A master sequence of only 60 rings may be datable, assuming there are appropriate reference chronologies available, whereas a single sequence with for example, 100 rings may not (see Hillam *et al* 1987).

Such problems are by no means rare during the analysis of small, potentially multiphase, assemblages of timber. For example similar problems have been encountered with the fifteenth- and sixteenth-century bridge timbers from Wood Hall Moated Manor site (SE 536 206), approximately 14 kilometres north-east of Kinsley Moat (eg Boswijk 1993). Extensive sampling of various phases of the Wood Hall bridge timbers have produced some dendrochronological dates for timbers but a high proportion of the *c*35 samples submitted for analysis were unsuitable or undatable. The timbers were of a similar nature to those from Kinsley Moat in that they were also derived from relatively fast grown (ie wide ringed) young trees.

Conclusion

Dendrochronology has not been able to provide dates for the timbers dredged up from Kinsley Moat. Neither has it been able to establish any relative dating which would have at least indicated whether the timbers were contemporaneous or represented different substructures or phases of construction within

the bridge structure. It is important to note that the absence of intra-site crossmatching cannot be taken as positive evidence for the timbers being associated with different substructures or different construction or repair phases.

The Kinsley Moat ring sequences will remain in the database and will therefore be tested against new reference chronologies from the region as they become available. If additional timbers are uncovered at any point in the future on this site, it is strongly recommended that dendrochronological analysis is undertaken as this will improve the chances of obtaining a date.

Acknowledgements

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References

Baillie, M G L, 1982 *Tree-Ring Dating and Archaeology*, London

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

Boswijk, G, 1993 *Tree-ring analysis of oak timbers from Wood Hall Moated Manor, Womersley, North Yorkshire - Interim report*, unpubl report prepared for the Wood Hall Moated Manor Project

Hillam, J, 1985 Theoretical and applied dendrochronology - how to make a date with a tree, in *The Archaeologist and the Laboratory* (ed P Phillips), CBA Res Rep, **58**, 17-23

Hillam, J, Morgan, R A, and Tyers, I, 1987 Sapwood estimates and the dating of short ring sequences, in *Applications of tree-ring studies: current research in dendrochronology and related areas* (ed R G W Ward), BAR Int Ser, **333**, 165-85

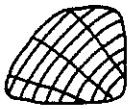
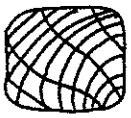
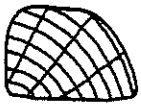
Munro, M A R, 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin*, **44**, 17-27

Rackham, O, 1990 *Trees and woodland in the British Landscape*, 2nd edn, London

Schweingruber, F H, 1990 *Anatomy of European woods*, Berne and Stuttgart

Wrathmell, S, forthcoming A note on bridge timbers from the medieval maoted site of Kinsley, near Wakefield, *Yorks Archaeol J*

Table 1: Details of the tree-ring samples from Kinsley Moat, Carr Farm, near Wakefield. Sample letter in brackets refers to the label assigned to each timber in Wrathmell (forthcoming); ARW - average ring width (mm/year); sketches are not to scale; dimensions are approximate.

Sample	Function	Total no of rings	ARW	Sketch	Dimensions (mm)	Comments
01 (C)	shore	79	2.3		170x155	measured
02 (D)	shore	59	2.9		180x180	measured; rings distorted
03 (F)	plank	31	2.9		190x85	rejected
04	-	27	3.9		160x100	rejected
05 (A)	soleplate	57	2.3		230x205	measured; rings distorted by knots; duplicate of 10
06 (E)	shore	71	3.0		325x135	measured
07	plank	27	5.0		135x20	rejected
08	-	47	2.6		120x50	measured
09 (B)	shore	85	2.0		235x200	measured
10 (A)	soleplate	73	2.7		295x195	measured; duplicate of 05