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Summary

Research is currently underway to determine the viability of the dendrochronological analysis of conifer timbers imported into England during the medieval and post-medieval periods. The eighteenth and nineteenth century coffin assemblage excavated from the former burial ground of the Infirmary, Newcastle upon Tyne, dominated by softwood boards, was therefore considered a potentially valuable data resource. Timbers from 19 coffins were analysed. The majority of the timbers were found to be one of three coniferous wood types, whilst two were beech. The ring sequences from individual components of various coffins were found to crossmatch, but no crossmatching was obtained between coffins, and none of the ring sequences could be assigned calendar dates.

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Introduction

This document is a technical archive report on the tree-ring analysis of timbers from the former burial ground of the Infirmary, Newcastle upon Tyne. It is beyond the dendrochronological brief to describe the site in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the site, elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition.

The excavations at the former burial ground of the Infirmary, Newcastle upon Tyne, during 1996/97 revealed the remains of over 40 coffins in varying states of completeness. Although burials are frequently excavated, the recovery of the timber boards from coffins is unusual. Many less well preserved fragments of single boards or other coffin artefacts have been discovered in medieval or post-medieval contexts but the Newcastle Infirmary coffins are probably only the sixth group of well-preserved waterlogged coffin boards to have been archaeologically excavated and recovered in the past 25 or so years in England (Table 1). The burial ground was in use during the period AD 1753-1845 so this group of coffins are the most recent to have been recovered during archaeological excavation. In contrast to the previously excavated coffin assemblages it was clear that the majority of these boards were made of coniferous wood.

Analysis was undertaken with the following aims:

- to determine the wood type and, where possible, the actual species
- to provide additional dating evidence
- to examine the temporal pattern of dates in order to facilitate comparison with the burial pattern, any technological changes, and any changes in timber utilisation
- to determine the source of the timbers

These aims would be considered fairly routine if the wood was oak but, as will become clear from the following section, the latter three were accepted to be very ambitious when dealing with an historic coniferous assemblage in England.

Dendrochronology, Conifers, and Importation

Tree-ring or dendrochronological analysis relies upon a number of basic concepts (Baillie 1982; Hillam forthcoming). Trees in temperate zones of the world have a single growing season and a single resting season each year. The anatomical result of this is an identifiable tree-ring within the trunk of the tree that has a distinct boundary marking the end of one growing season and the start of the next. The amount of growth, or the width of the ring, varies from year to year and is influenced by a combination of general climatic conditions, local environmental factors, anthropogenic effects, and the genetic make up of the individual tree. Since the growing point of the trunk is the cambium layer directly under the bark, it follows that each years growth appears on the outside of the previous years growth. The oldest rings of a trunk are thus in the middle and the most recent rings are directly under the bark. Counting the rings provides an easy method of determining the age of trees but not their date.

Dendrochronology attempts to provide absolute dates for the rings present in individual timbers. This is achieved by accurately measuring the widths of each successive ring within a sample and comparing the pattern of narrow and wide rings with reference chronologies built up from previous work. The technique can be successful and reliable only when a number of conditions are met. Firstly, there have to be contemporary chronologies of a relevant species, genus, or type of timber from the relevant geographical area in order that some degree of cross-correlation is possible. Secondly, the timbers have to have a long enough sequence of tree-rings that they match other chronologies in only one position.

The vast majority of structural timbers excavated over the last 25 or so years in the British Isles have been oak (*Quercus* spp). Consequently our broad chronological coverage is confined to this genus, and the technique has been mainly restricted to the provision of dates for oak timbers. Oak reference chronologies in the British Isles cover the last 7000 years, although the geographical spread and strength of replication vary through time with many more chronologies available for the historic period than the prehistoric.

Over the past few years interest in the possibility of working with other species has steadily increased as various excavated features have yielded large quantities of structural timber of types other than oak, such as ash (*Fraxinus excelsior* L.), beech (*Fagus silvatica* L.), elm (*Ulmus* spp), and various conifers. Chronologies have been produced for ash from the neolithic Sweet Track (Hillam *et al* 1990), beech from medieval Wales and London (eg Tyers 1997a), and elm from post-medieval Droitwich (Groves and Hillam 1998). However, the relative scarcity of non-oak timbers makes the production of long composite reference chronologies extremely difficult. Instead, precise dates for these sequences have been obtained from comparisons with contemporary oak chronologies, often from the same archaeological site. Similar success has been achieved with prehistoric bog pines (*Pinus sylvestris* L.) which have been dated by comparison with contemporary bog oak chronologies in both England and Ireland (Boswijk forthcoming; Pilcher *et al* 1995).

There has also been increased interest in the use of imported timbers at least partly fuelled by the development and exchange of the large network of oak chronologies covering northern Europe that has occurred over the last decade. These data have allowed quantities of imported oak timbers to be dated and have had the added bonus of identifying the geographical region from which the timbers were derived (eg Baillie *et al* 1985; Bonde and Crumlin-Pedersen 1990; Bonde *et al* 1997). This new sub-field of dendrochronology, described as 'dendro-provenancing' (Bonde and Jensen 1995), reveals information concerning the origin of timbers and therefore provides information which enhances our understanding of past economies with respect to the trading of timber.

There is little doubt from the documentary evidence that the import of timber into England has occurred on an increasingly regular basis throughout much of the last millennium. Up to and including the eighteenth century the regions exploited for their timber resources covered a large part of northern Europe, though the key supply area and types of timber changed through the centuries. However, during the latter part of the eighteenth century, North America steadily increased its timber exports to Britain. By the early nineteenth century it had become the major supplier, though the Baltic and Scandinavian region were still of importance, particularly for quality or specialist timber (eg Dollinger 1970; Lower 1973; Fedorowicz 1980).

Imported oak has already been identified dendrochronologically but it was only one of a number of timber types imported. Large quantities of conifers such as Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* Karsten), and various North American pine species were also imported. Conifer timbers have previously been identified in various buildings and on a number of archaeological sites but these have been largely ignored by British dendrochronologists. This is due, at least in part, to species such as pine, spruce, and larch not being native to England. Pine was present in England up to the Bronze Age, but apart from some possible isolated relict forests, it was not growing within this country until reintroduced as a timber tree by early modern forestry (eg Clapham *et al* 1989). Norway spruce and European larch (*Larix decidua* Mill.) were introduced in the early to mid sixteenth century and early seventeenth century respectively. Their commercial value had been recognised by the end of the seventeenth century. North American timber trees such as Weymouth pine (*Pinus strobus* L.) and Douglas fir (*Pseudotsuga menziesii* Franco) were introduced during the early eighteenth and nineteenth centuries (Evelyn 1729; James 1990; 164, 184). It is therefore possible that some local conifer timber was produced as early as the seventeenth century and may well have become more abundant following the increase in plantations during the latter part of the eighteenth century. However, documentary evidence indicates that England remained heavily dependent on imported timber throughout the medieval and post-medieval periods. Consequently, although the presence of locally grown conifer timbers is not impossible, the majority of conifer timbers recovered from archaeological excavations or standing buildings are probably imported.

Following the successful dating of imported oak timbers by comparison with reference data from other European countries, the logical progression was to apply the same techniques to assemblages of conifers. A research project 'The dating and provenancing of imported conifer timbers in England' was recently commissioned by English Heritage. The primary aim is to extend the scope of British dendrochronology so as to enable precise dating evidence to be obtained from a wider range of timber species and hence provide a more comprehensive dating system for timber structures and artefacts. An important secondary aim is that the 'dendro-provenancing' of timber will enhance our knowledge of timber trading during the medieval and post-medieval/early modern periods. In addition the project may reveal information concerning the production and utilisation of timber from non-native species grown in England thereby enhancing our understanding of the history of forestry.

Prior to the analysis of the Newcastle coffins the research project had taken in 231 samples from eight sites. The three major sites analysed, all with over 30 samples from large single phase structures, have produced dated chronologies which, as they show most similarity with Norwegian and Swedish reference data, indicate that the timbers were derived from Scandinavia (Groves 1997a, Groves 1997b, Groves forthcoming a, Groves forthcoming b, Groves forthcoming c). The Newcastle coffin assemblage contrasts with these large single phase structures in that it is in effect a series of small structures of variable dates with only a handful of timbers available from each 'structure'. In addition, the expected usage date of the coffin boards spans a transitional period with respect to the potential source of timber, as supplies from North America were increasing and those from northern Europe were decreasing. Consequently, although the coffin boards were viewed as a potentially valuable data set, they were also considered to be an extremely difficult assemblage to work with at this early stage of the conifer research project and that initially there would be relatively little, if any, dating evidence provided.

Methodology

The timbers from all coffins were assessed for their dendrochronological potential prior to sampling. Oak timbers with less than 50 annual growth rings are generally considered unsuitable for analysis as their ring patterns may not be unique (Hillam *et al* 1987). At present this is also the minimum being applied to conifers, although as the analysis of conifers in Britain extends, this lower limit may be altered. The condition of some of the timbers made accurate assessment impossible, so if there was any doubt concerning suitability the timber was sampled.

The selected timbers were sampled by the removal of cross-sectional slices, the only exceptions being those which were associated with coffins *049* and *237*. These two coffins are virtually complete and are required for display purposes so minimal intervention analysis was to be attempted on the individual component boards.

The samples and intact boards were air dried over a period of several weeks. The ring sequence of each sample or board was revealed by sanding the cross-sectional surfaces using progressively finer grits until the annual growth rings were clearly defined. The wood type of each sample was determined through reference material in the form of permanent slides, an identification key (Schweingruber 1990), and a computer database (GUESS - see Wheeler *et al* 1986). A note was also made of the cross-sectional dimensions.

Any samples which did not contain at least 50 rings or had unclear ring sequences were rejected. The sequence of ring widths in the samples selected for further analysis were measured to an accuracy of 0.01mm using a purpose built travelling stage attached to a microcomputer based measuring system (Tyers 1997b). On oak, it is usual to measure a single radius as this is considered a reliable representation of the growth pattern of the tree. However, various species are less reliable as they may have locally absent rings, where some sections of the trunk show no growth, or under particularly severe conditions some trees may simply not produce a growth ring. With such species several radii per sample are measured in order to allow these problems to be resolved. If this is successful the radii are averaged to produce a single sequence. If inconsistencies between radii cannot be resolved, the individual radii are used throughout the rest of the analysis.

The ring sequences were plotted onto semi-logarithmic graph paper to enable visual comparisons to be made between them. In addition, cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where the ring sequences were highly correlated. The Student's t test is then used as a significance test on the correlation coefficient and those quoted below are derived from the original CROS algorithm (Baillie and Pilcher 1973). With oak ring sequences a t value of 3.5 or over is usually indicative of a good match, provided that high t values are obtained at the same relative or absolute position with a range of independent sequences and that the visual match is satisfactory (Baillie 1982, 82-5). These statistical tests were designed for use with oak but some species, such as pine or beech, tend to exhibit much greater differences between successive rings than is normal for oak which results in a noticeable increase in the t values calculated. Discussions with various Scandinavian colleagues show that the equivalent to the 'oak 3.5' varies between laboratories, with CROS t values ranging from 4.0 to 6.0 suggested. No information is available for the equivalent value for North American timbers as CROS is not standardly used in America.

Dating is usually achieved by crossmatching ring sequences within a structure or artefact and combining the matching patterns to form a structure or artefact master curve. This master curve and any remaining unmatched ring sequences are then tested against a range of reference chronologies, using the same matching criteria as above. The position at which all the criteria are met provides the calendar dates for the ring sequence. 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.

An additional important element of tree-ring analysis is the identification of 'same-tree' timber groups. The identification of 'same-tree' groups is based on very high levels of similarity in both year to year variation and longer term growth trends, and anatomical anomalies. Such information should ideally be used to support possible 'same-tree' groups identified from similarities in the patterns of knots/branches during detailed recording of timbers for technological and woodland characterisation studies. High *t* values are not necessarily indicative of two ring sequences being derived from a single tree. Conversely low *t* values do not necessarily exclude the possibility. It is a balance of the range of information available that provides the 'same-tree' link. Previous work on sub-fossil pines in the British Isles suggests that *t* values in the order of 10-15 or over probably indicate that the samples/timbers were derived from the same tree. As the conifer research project develops and further detailed information is obtained from previous European and American work concerning post-medieval conifers this value may be revised.

The crossdating process provides precise calendar dates only for the rings present in the timber. The nature of the final (youngest) rings in the sequence determines whether the date of the last ring also represents the year the timber was felled. Species such as oak consist of inner inert heartwood and an outer band of active sapwood. If the sample ends in the heartwood of the original tree, a *terminus post quem* for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which may be missing. This is the date after which the timber was felled but the actual felling date may be many decades later depending on the number of outer rings removed during timber conversion. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. If the bark-edge survives, then a felling date can be directly obtained from the date of the last surviving ring. However with species with no obvious sapwood if the bark edge is absent it is only possible to give a *terminus post quem* for the felling of the tree. This is equivalent to the date of the outermost ring of the sample which indicates the date after which the timber must have been felled.

Evidence concerning the reuse of timbers, stockpiling, or seasoning have to be routinely considered before the dendrochronological dates given can be reliably interpreted as reflecting the construction date of a structure or artefact. In addition, with imported timbers, it is also necessary to take into account factors such as transport and manufacturing processes. Consequently the date of felling of a tree is not necessarily the date of use of the timber.

If in the future dates are derived from this or similar assemblages it will be necessary to develop a method of reliably relating the date of the outermost ring of the coffin boards to the likely usage date. Work on oak panel paintings on which sapwood is rarely present has used evidence derived from a series of comparative studies on panels of known date to employ a combined allowance for missing heartwood rings, missing sapwood rings, seasoning, and the transport and manufacture. This statistic is usually known as the *LEHR-usage* value, meaning the difference in date between the last heartwood ring present in the oak board and the panel's use. Clearly a variant on this value will have to be developed for use with coniferous boards as sufficient data becomes available.

Results

Sixty nine samples were removed from timbers associated with 18 coffins, including one sample (01) from coffin *237* (Table 2). A further 18 intact timbers from coffins *049* and *237* were also included in the analysis (Table 2) . Several samples were known to be duplicates taken from the same board (Table 2). These were taken in order to obtain information concerning the level of *t* values produced between known 'same tree' or 'same timber' sequences. Fifty timbers were considered suitable for measurement. Several of the intact boards from coffins *049* and *237* had to be rejected even though they contained sufficient rings. These boards could not be attached to the measuring equipment and due to the presence of very narrow rings it was felt that hand lens measurements would not have a sufficiently high resolution to be of use.

1. Identification

Microscopic identification of the timbers indicated the presence of four wood types. It has not been possible to determine the wood type down to species level for any of these types as various groups of species have very similar anatomical features. This is exacerbated by the problem of unknown geographical origin. It was hoped that the difficulties caused by the unknown geographical origin may be resolved if dendrochronological dates, and hence an indication of provenance, could be provided by the next stage of analysis. Unfortunately this was to prove unsuccessful. The four types are as follows:

Type A is either *Pinus sylvestris* L. (Scots pine), *P. mugo* Turra (Mountain pine), *P. nigra* Arnold (Black pine) or *P. resinosa* (Red pine). *P. sylvestris* and *P. mugo* cannot be distinguished on the basis of their wood anatomy. *P. sylvestris* occurs throughout Europe; *P. mugo* and *P. nigra* are native to central/southern Europe; and *P. resinosa* is a native of North America. *P. nigra* can sometimes be distinguished from *P. mugo* and *P. sylvestris* as the early/latewood transition may be more abrupt than in the other two species (Schweingruber 1990, 131). *P. resinosa* cannot normally be distinguished from these three European species on the basis of its wood anatomy. Seven of the coffin timbers proved to be wood type A (Table 2).

Type B is either *Pinus cembra* L. (Stone pine), *P. peuce* Griseb (Macedonian pine) or *P. strobus* L. (Eastern white/Weymouth pine). *P. cembra* and *P. peuce* are central/southern European species, where as *P. strobus* is a native North American species which was widely introduced into Europe in the eighteenth and nineteenth centuries. These three species cannot be distinguished on the basis of their wood anatomy (Schweingruber 1990, 119). This was the dominant wood type in the coffin assemblage with 63 timbers (Table 2).

Type C is either *Larix* spp (Larch) or *Picea* spp (Spruce). The various species in the genus *Picea* cannot be distinguished from one another on the basis of their wood anatomy and it is not always possible to distinguish between the genus *Picea* and *Larix*. The transition between the earlywood and latewood is normally quite abrupt in *Larix* spp where as it is more gradual in *Picea* spp. The transition on the coffin boards of type C tended to be quite abrupt and for this reason it is thought that they are more likely to be *Larix* spp. Various species of the genus *Larix* and *Picea* occur in both Europe and North America. This was the second commonest wood type with 15 boards (Table 2).

Type D is probably European beech (*Fagus silvatica* L.). However bearing in mind that most of the boards are likely to be made from imported timber the possibility that it could be American beech (*F. grandifolia* Ehrh.) cannot be completely discounted. Only two of the boards proved to be made from beech (Table 2).

2. Tree-ring results

coffin 045: Samples 21 and 22, both side boards, matched with a *t* value of 11.84 and were probably derived from the same tree. Their ring sequences were combined to produce a master curve of 357 years (Fig 1).

coffin 159: Samples 67 and 68, both possibly base boards, matched with a *t* value of 13.66 and were probably from the same tree. Their ring sequences were combined to produce a master curve of 101 years (Fig 1).

coffin 201: Five samples from the side boards (05, 06, 07, 08, 09) and three probably from the lid (44, 46, 47) matched and were all probably derived from the same tree (Fig 1; Table 3).

Their ring sequences were combined to form a master curve of 86 years. Samples **11** and **12** from the base boards matched with a *t* value of 7.17 and were combined to produce an 85-year master sequence (Fig 1).

coffin 237: Samples **01** and **70** matched with a *t* value of 19.32 and were probably actually from the same brace (Fig 1). Their ring sequences were combined to produce an 81-year master curve. Samples **71** and **74**, both side boards, matched with a *t* value of 5.89 and were combined to produce a 70-year master curve (Fig 1).

coffin 248: Samples **51**, **54**, **55**, all fragments, and **52**, a board, matched and were combined to produce a 147-year master sequence (Figs 1 and 2; Table 4). All four samples were probably derived from the same tree.

coffin 259: Samples **14** and **15**, from side boards, matched with a *t* value of 8.04 and were combined to form a 62-year master sequence (Fig 1).

coffin 298: Samples **30** and **31**, possibly from the lid, and **32**, a brace, crossmatched and were combined to form a 98-year master sequence (Fig 1; Table 5). Samples **30** and **32** were probably derived from the same tree.

coffin 307: Samples **57** and **58**, from fragments, matched with a *t* value of 7.01 and were combined to produce a master curve of 68 years (Fig 1).

coffin 434: Samples **33** and **35** matched with a *t* value of 10.67 and were probably derived from the same tree. Their ring sequences were combined to form a master curve of 63 years.

Work by the author on modern chronologies has shown that interspecies crossmatching between various *Pinus* spp, *Larix* spp, and *Picea* spp is viable. Consequently all the coffin master curves and unmatched individual ring sequences were compared with each other but no reliable matches indicating contemporaneity were identified. The provision of calendar dates was then attempted by comparing these master sequences and unmatched individuals with an extensive set of European and North American reference chronologies from the three relevant genus. The European reference chronologies commonly span the fifteenth century to present day and range from Russia to Spain on an east-west axis and Norway to Greece on a north-south axis. The North American chronologies are derived from Canada and north-east USA and commonly span the sixteenth century to present day. Despite these exhaustive checks no consistent results were obtained for any of the coffin sequences and thus the dendrochronological analysis has been unable to provide precise calendar dates for any of the timbers.

Discussion

The immediate obvious difference between the coffin assemblage and the large single phase structures analysed at this early stage in the research project is the identification of three different coniferous wood types as opposed to a single species found at Danson House (Groves forthcoming a), Millers House (Groves 1997b; forthcoming b) and Tilbury Fort (Groves forthcoming c). This variation emphasises the point made earlier that the coffins must be viewed as a series of unrelated small 'structures' from which only a few timbers are available for sampling. It is also notable that the dominant wood type in the coffin assemblage is type B, the *Pinus cembra* group, which may be a reflection of the date of the timbers and hence their source. At Millers House and Danson House, which date to the AD 1760s and AD 1770s respectively, the timbers were *Pinus sylvestris* L.. The timbers at Tilbury Fort associated with an AD 1670s structure were *Picea abies* Karsten. Dendrochronological dating at these three sites indicated that the timbers were derived from Norway and Sweden and also allowed the identification of the wood type to be taken down to species level which has not been possible with the coffin boards, with the probable exception of the beech timbers.

One of the immediate objectives of the conifer research project was to determine whether it was possible to produce replicated chronologies from individual sites or whether substantial mixing had occurred at the point of export or import. This could severely hamper the successful production of chronologies if the timbers present in a single structure were from multiple diverse sources. The evidence from the large single phase structures suggests that this is less of a problem than anticipated. Prior to the analysis of the coffin boards it was thought that mixing was far more likely to have occurred in this assemblage. The fact that five (*049*, *201*, *257*, *258*, *298*) of the 16 coffins which provided more than one sample were constructed of timber of more than one species provides some support for this hypothesis. However, several of the multi-sampled coffins appear likely to have several boards derived from trees from the same source area if not the same tree. The level of *t* values obtained between known 'same tree' sequences is in the order of that currently proposed (see above).

The failure to obtain calendar dates for any of the boards is disappointing though perhaps not surprising for such a complex assemblage at this early stage of the conifer research project. It is likely that a combination of factors have adversely affected the dating potential of the coffin boards. Firstly if the boards suffer from problems such as partially missing rings it is less likely that these can be resolved than when a complete cross-sectional disk is available on which several different radii can be measured. Secondly, the vast majority of samples contained relatively short ring sequences, the exception being coffin *045*, and the resultant master curves were therefore short. Thirdly, these master curves often appeared likely to represent only one tree. Poorly replicated, short master sequences and individual board sequences are far less likely to produce a reliable date than a well replicated site master curve. Finally, there is evidence that some of the boards were made from reused material. This could result in the timbers spanning a much wider time period than that indicated by the dates during which the cemetery was in use. It could also result in the timbers from any one coffin potentially being derived from disparate sources.

Conclusion

The analysis of the coffin assemblage has provided information concerning wood type but has not provided additional dating evidence indicating contemporaneity or actual calendar dates for any coffins. The ring sequences will remain in the database and will be retested as the conifer research project progresses. The reference database has also been expanded to include more Canadian and American data of the relevant period.

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Figure 1: Bar diagram showing the relative positions of the matched ring sequences within each coffin. Note there is no matching between coffin groups.
The bars represent the ring sequence from each sample.
Shading indicates duplicate samples from single timbers.

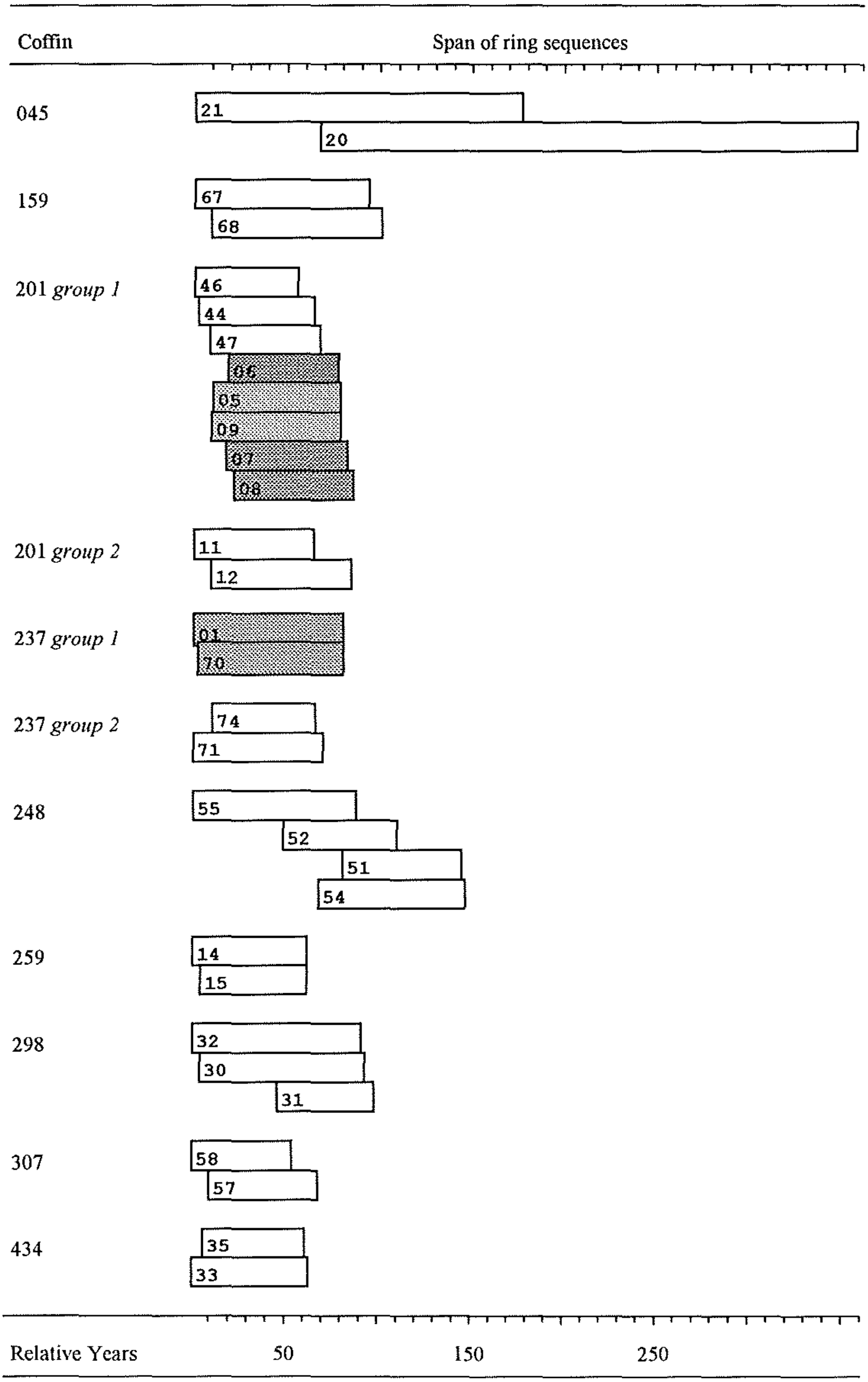

Figure 2: Diagram showing the ring sequences from the probable 'same-tree' group of four matching samples from coffin *248*.

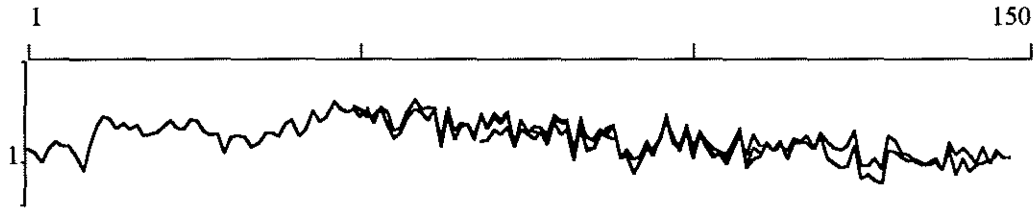

Table 1: Summary of sites with well preserved coffin assemblages that are known to have been sampled for dendrochronological analysis.

Site	Number of coffins	Number of samples	Date (century AD)
Barton on Humber (Rodwell 1982)	34 (oak and 1 pine)	*c*110 samples to be obtained	11th and 12th
Hull Magistrates Court (Tyers pers comm)	44 (oak)	306 samples currently under analysis	14th
London Guildhall (Tyers 1994)	20 (oak and beech)	38 samples analysed	11th and 12th
London Merton (Boswijk and Tyers 1997)	10 (oak)	35 samples analysed	12th
York Swinegate (Tyers pers comm)	?	49 samples to be analysed	medieval

Table 2: Details of the samples sorted by coffin number.

Wood Number - number allocated to each coffin timber or timber fragment
Wood Type - given according to the groups indicated in the text
Rings - total number of rings measured
ARW - average ring width in millimetres
Dimensions - cross-sectional dimensions of the sample or board, at the point of measurement, in millimetres

Coffin	Function	Wood Number	Wood Type	Rings	ARW	Dimensions	Comment
045	left side board	20	B	290	0.47	255x13	-
045	right side board	21	B	177	1.04	265x15	-
045	head board	22	B	75	1.73	310x27	-
045	left base board	23	B	99	1.43	283x30	-
045	right base board	24	B	71	1.59	190x27	-
045	middle brace	25	B	*c*15	-	130x28	rejected
045	head end brace	26	B	*c*30	-	116x27	rejected
045	fragment	66	B	141	1.13	165x23	-
049	head board	78	B	117	0.87	260x28	-
049	right side board	79	B	76	1.38	282x15	-
049	base board	80	B	*c*55	-	290x22	rejected; intact long board
049	foot board	81	B	*c*40	-	220x22	rejected
049	left side board	82	B	*c*45	-	280x14	rejected
049	left lid	83	B	*c*85	-	160x10	rejected; intact long board
049	right lid	84	B	*c*80	-	168x12	rejected; intact long board
049	middle brace	85	B	*c*25	-	94x23	rejected
049	head end brace	86	B	*c*25	-	94x20	rejected
049	foot end brace	87	B	*c*45	-	90x22	rejected
129	base fragment	48	A	*c*30	-	80x8	rejected
129	base fragment	49	A	*c*20	-	150x13	rejected
159	base? board	67	B	94	1.70	181x24	-
159	base? board	68	B	92	2.17	200x21	-

Table 2: (cont).

Coffin	Function	Wood Number	Wood Type	Rings	ARW	Dimensions	Comment
160	base? fragment	42	C?	?	-	110x23	rejected; too decayed to distinguish rings
160	base? fragment	43	C	*c*40	-	113x19	rejected
190	fragment	37	C	*c*45	-	110x13	rejected
190	fragment	38	C	*c*40	-	70x19	rejected
201	right side board - foot end	5	B	69	1.23	280x12	duplicate of 9
201	left side board - centre	6	B	60	1.18	280x12	duplicate of 7 and 8
201	left side board - foot end	7	B	66	1.19	280x13	duplicate of 6 and 8
201	left side board - head end	8	B	65	1.16	300x12	duplicate of 6 and 7
201	right side board - head end	9	B	70	1.26	315x13	duplicate of 5
201	head board	10	A	78	1.52	284x27	-
201	right base board	11	B	65	1.42	221x29	-
201	left base board	12	B	76	1.51	227x26	-
201	lid	44	B	63	1.43	224x8	-
201	lid	45	B	54	1.86	160x10	-
201	lid? fragment	46	B	56	1.45	134x7	-
201	lid? fragment	47	B	60	1.52	125x11	-
237	head end brace	1	B	81	1.31	115x14	duplicate of 70
237	brace	70	B	79	1.33	115x13	duplicate of 1
237	left side board	71	B	70	1.83	272x15	-
237	foot board	72	A?	*c*25	-	255x20	rejected
237	head board	73	A	*c*30	-	250x20	rejected
237	right side board	74	B	56	1.68	270x16	-
237	right lid	75	B	*c*75	-	180x12	rejected; intact long board
237	left lid	76	B	*c*65	-	152x13	rejected; intact long board
237	base board	77	B	*c*5	-	260x20	rejected

Table 2: (cont).

Coffin	Function	Wood Number	Wood Type	Rings	ARW	Dimensions	Comment
248	head or foot board	50	B	105	1.39	245x22	-
248	fragment	51	B	65	1.19	125x11	-
248	board	52	B	62	1.63	215x12	-
248	board	53	B	*c*35	-	245x15	rejected
248	fragment	54	B	80	1.33	114x24	-
248	fragment	55	B	88	1.70	165x27	-
248	fragment	56	B	*c*40	-	172x13	rejected
257	base board	59	D	*c*30	-	240x20	rejected
257	brace?	60	C	95	1.21	120x17	-
258	board fragment	63	D	*c*35	-	170x12	rejected
258	lid?	64	C	71	1.26	162x12	-
258	lid?	65	C	62	1.72	170x12	-
259	left side board - head end	13	B	*c*50	-	?x17	rejected; fragmented; duplicate of 14
259	left side board - foot end	14	B	62	1.68	221x16	duplicate of 13
259	right side board	15	B	58	1.51	230x19	-
259	right base board	16	B	75	1.56	167x20	-
259	left base board	17	B	53	1.72	162x60	-
259	middle brace	18	B	52	1.64	100x20	-
259	head end brace	19	B	*c*45	-	97x19	rejected
259	lid fragment	39	B?	?	-	80x20	rejected; too decayed to distinguish rings
259	lid fragment	40	B	55	1.48	96x11	-
259	lid fragment	41	B	*c*35	-	110x24	rejected

Table 2: (cont).

Coffin	Function	Wood Number	Wood Type	Rings	ARW	Dimensions	Comment
298	left? base board	28	B	83	2.04	288x25	-
298	right? base board	29	B	63	1.88	288x25	-
298	lid?	30	C	89	1.38	237x19	-
298	lid?	31	C	53	1.95	240x20	-
298	brace	32	C	91	1.26	140x19	-
304	brace?	27	C?	*c*20	-	60x15	rejected
307	fragment	57	C	59	1.48	114x12	-
307	fragment	58	C	54	1.51	108x14	-
316	unknown	2	B?	*c*35	-	90x21	rejected
316	unknown	3	B?	*c*45	-	120x25	rejected; too decayed to distinguish rings
316	unknown	4	B	*c*70	-	95x25	rejected; too decayed to distinguish rings
316	board	69	B	*c*70	-	437x34	rejected; too decayed to distinguish rings
332	board fragment	62	C?	*c*50	-	225x13	sample fragmented
434	right base board	33	A	63	1.85	170x19	-
434	foot? end brace	34	A	*c*45	-	92x23	rejected
434	middle brace	35	A	55	1.73	103x26	-
434	left base board	36	A	*c*45	-	230x18	rejected
436	board fragment	61	C	57	0.96	155x12	-

Table 3: *t* values obtained between the eight matching samples from coffin *201*.

Sample → ↓	start dates	dates end	06	07	08	09	44	46	47
			19	18	22	10	3	1	9
			78	83	86	79	65	56	68
05	11	79	12.27	15.17	11.43	13.25	9.63	7.31	11.62
06	19	78		15.92	11.21	12.38	11.86	7.23	12.54
07	18	83			15.65	14.35	10.16	6.83	12.65
08	22	86				11.12	7.06	7.89	8.71
09	10	79					11.31	8.63	11.45
44	3	65						10.50	17.81
46	1	56							8.73

Table 4: *t* values obtained between the four matching samples from coffin *248*. \ = overlap < 15 years.

Sample → ↓	start dates	dates end	52	54	55
			49	68	1
			110	147	88
51	81	145	12.94	11.51	\
52	49	110		16.55	13.14
54	68	147			12.46

Table 5: *t* values obtained between the three matching samples from coffin *298*.

Sample → ↓	start dates	dates end	31	32
			46	1
			98	91
30	5	93	9.71	12.42
31	46	98	*	8.14