DYDDIO HEN DAI CYMREIG | DATING OLD WELSH HOUSES
PROSIECT DENDROCRONOLEG GOGLEDD ORLLEWIN CYMRU | NORTH WEST WALES DENDROCHRONOLOGY PROJECT

Oxford Dendrochronology Laboratory
Report 2011/37

THE DENDROCHRONOLOGICAL INVESTIGATION OF THE PENLAN FAWR INN, PWLLHELI, GWYNEDD (NGR SH 375 351)

Summary
Timbers were sampled from the ground floor ceiling, fireplace and door lintels, the main range roof and the porch floor and roof. All samples were found to have unusual growth rate changes with sudden declines in growth in most samples, whilst a few showed some unusually wide rings as well. These were not apparent until after preparation of the samples, which often had in excess of 100 rings. None of the timbers could be dated, although samples from the roof and the porch floor were found to match each other, suggesting that the roof and porch could be contemporaneous. An assessment of the roof to the rear outbuilding concluded that too few rings were present to warrant sampling.

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

October 2011

A report commissioned by The North West Wales Dendrochronology Project in partnership with The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

The Tree-Ring Dating of the Penlan Fawr Inn, Pwllheli, Gwynedd.
(NGR SH 375 351)

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.

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.

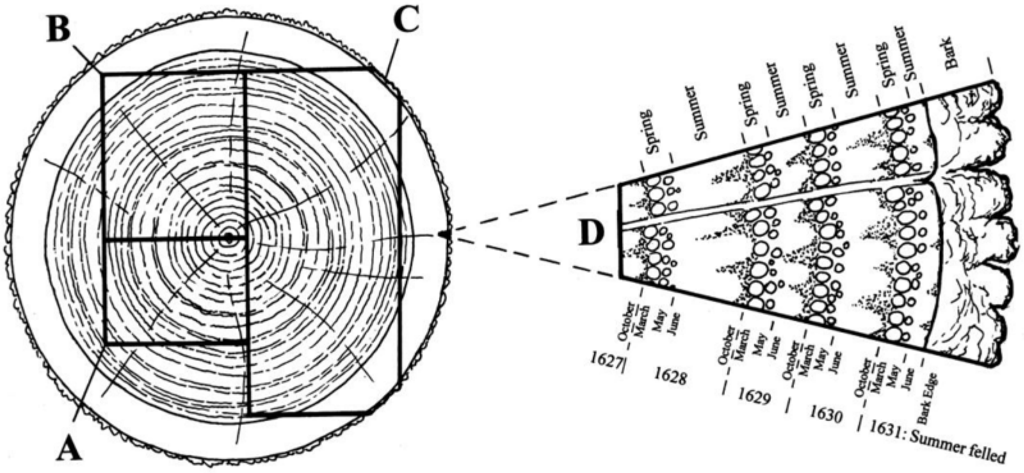
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation 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. 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 11 – 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 1997a, 42)

<u>**PENLAN FAWR INN** (Description from RCAHMW Caernarfonshire, Vol III, 1964)</u>

This building stands on the south side of Penlan Street, near to the former shore line. It is a single block of two storeys with an attic, thought to have been built in the first part of the 17th century. Each gable end has a square, capped chimney. The windows in the north façade (street-front) have been enlarged, but some of the openings to the rear, e.g. the doorway at the north-east corner, are original. The porch, of two storeys with a square stack that is probably original, is open to the north, where its flat lintel is carried on two engaged, rough, octagonal pillars with battered plinths. The interior ground floor has a large fireplace in the west gable with a cambered bressummer, chamfered and scroll-stopped. The beams and wallplates have similar stops. The chamfered joists are mostly reset original timbers. The modern roof has three original trusses lacking their collars.; the principals are stop-chamfered on either side of the mortices and peg holes. An outbuilding to the south has a stepped gable on the west, and is probably not earlier than *c*1750.

SAMPLING

Sampling took place in July 2011. All the samples were of oak (*Quercus* spp.). Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were numbered using the prefix **pfi**. The samples were removed for further preparation and analysis. Cores were mounted on wooden laths and then these were polished using progressively finer grits down to 400. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer allowing the measurement of ring-widths to the nearest 0.01 mm using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004), which was also used for subsequent analysis, along with other programs written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

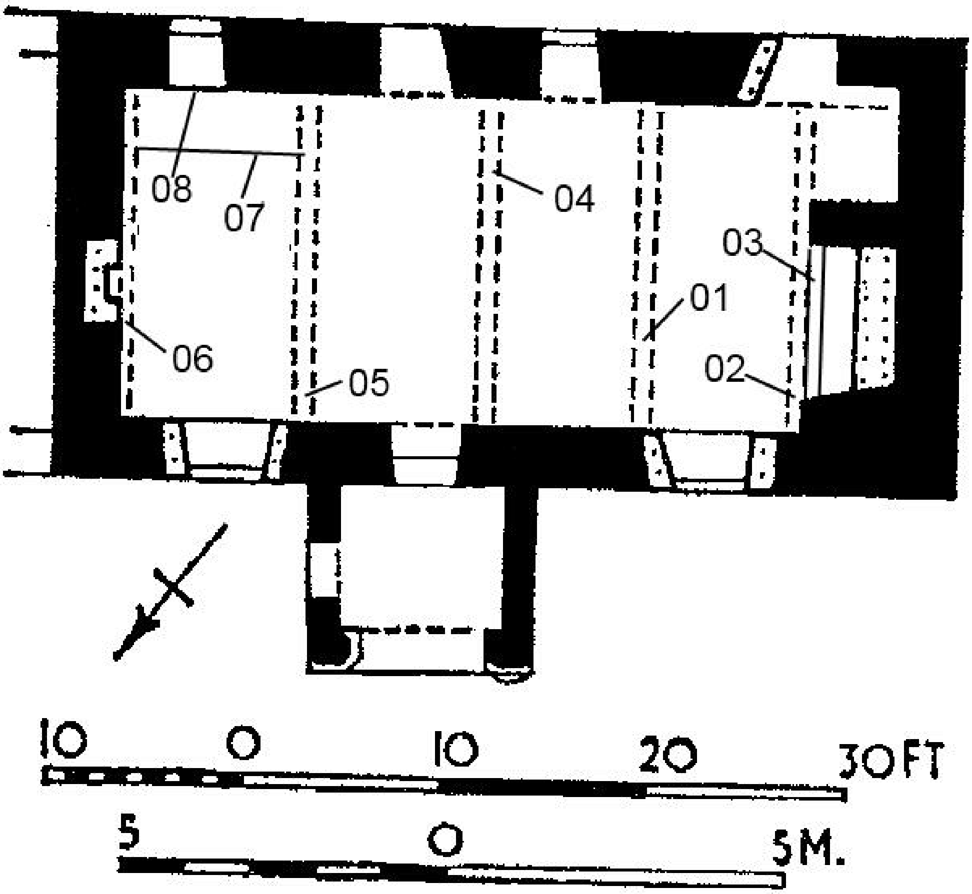


Figure 1: Ground-floor plan showing some of the timbers sampled

A report commissioned by The North West Wales Dendrochronology Project in partnership with The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

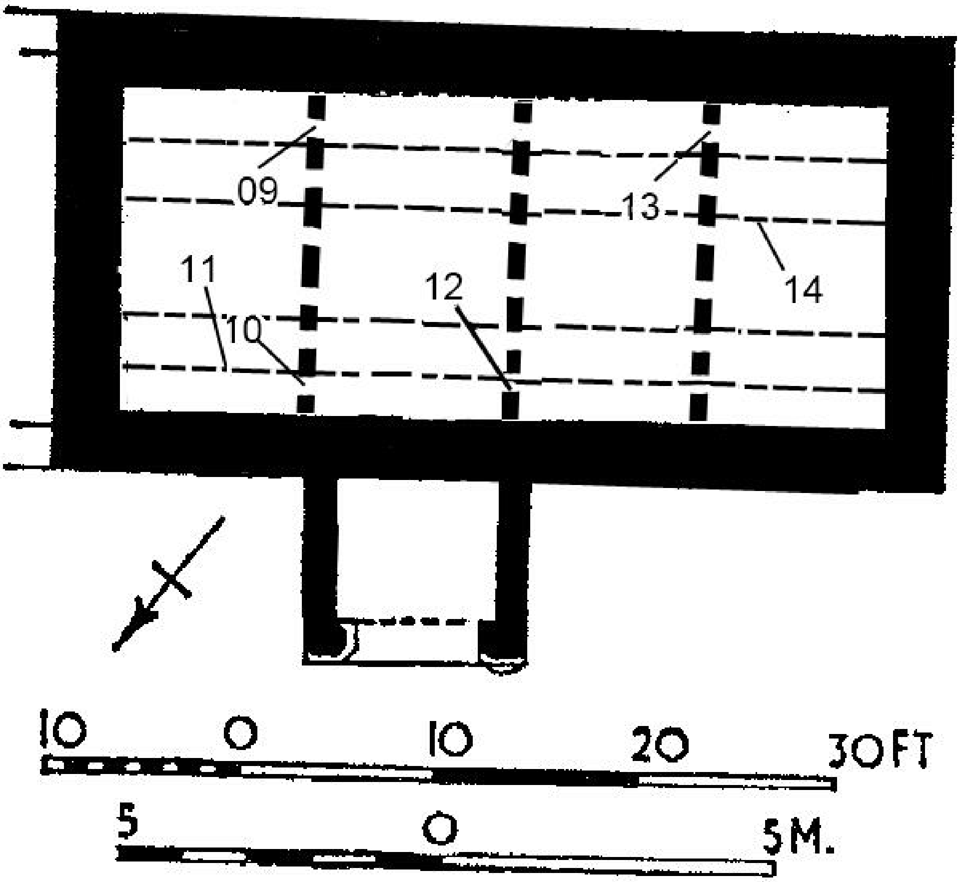


Figure 2: Attic plan showing some of the timbers sampled

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, with many being illustrated in Figs 1 and 2. The opportunity was taken to assess roof timbers of the step-gabled outbuilding at the rear of the property, but this was deemed to contain too few rings in the timbers to be likely to be datable. Samples were taken from the ground floor ceiling beams and a single joist that retained complete sapwood, as well as a fireplace lintel and a door lintel. In the roof, four principal rafters and two purlins were sampled, and in the porch, a number of floor and ceiling joists, as well as one small principal rafter and two lintels were sampled.

A number of samples were found to have distortions from knots and abnormal growth, and were not measured. Those from the porch mostly contained far too rings to warrant measuring, and only two samples were measured from this section. Of the remaining timbers, many had long tree-ring series, often in excess of 100 rings, and looked promising at the time of sampling. However, when polished to reveal the ring width sequences in detail, they were found to contain bands of very narrow rings, (Fig 3) many of which were difficult to resolve, whilst some also exhibited abnormally wide rings in mid-sequence (Fig 3a). Cross-matching was attempted, and samples **09**, **12**, **13** and **15** were all found to have a common growth feature mid-way through their sequences, a sudden decline in growth, followed by

A report commissioned by The North West Wales Dendrochronology Project in partnership with
The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

several very narrow rings (Fig 3d), as well as several smaller declines previously. These features are unlikely to be the result of external weather conditions. They could results from a common external factor such as disease or some other form of site disturbance, such as management of the trees.

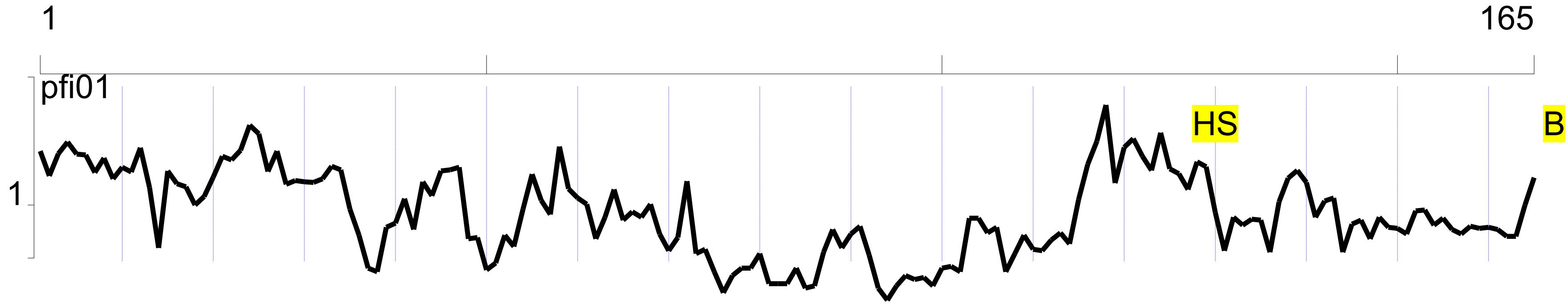
All the sequences with more than 50 rings were compared individually with the dated reference material, but none were dated. One other site in the Pwllheli area, Plas ym Mhenrhos, exhibited bands of very narrow rings, but surprisingly, that dated quite well against a number of local chronologies. Two other Pwllheli sites, Mathan House in the same street as the Penlan Fawr Inn, and Clogwyn Bach, just to the north of the town, both produced site chronologies that could not be dated. The success rate in North West Wales is generally high now that a number of sites have been successfully dated, but the buildings of the Pwllheli area seem to present a difficult problem. It is possible they were importing wood from another area, although the database of dated reference chronologies covers most of the British Isles.

Table 1: Details of samples taken from the Penlan Fawr Inn, Pwllheli. (Roof trusses are numbered from the SW end)

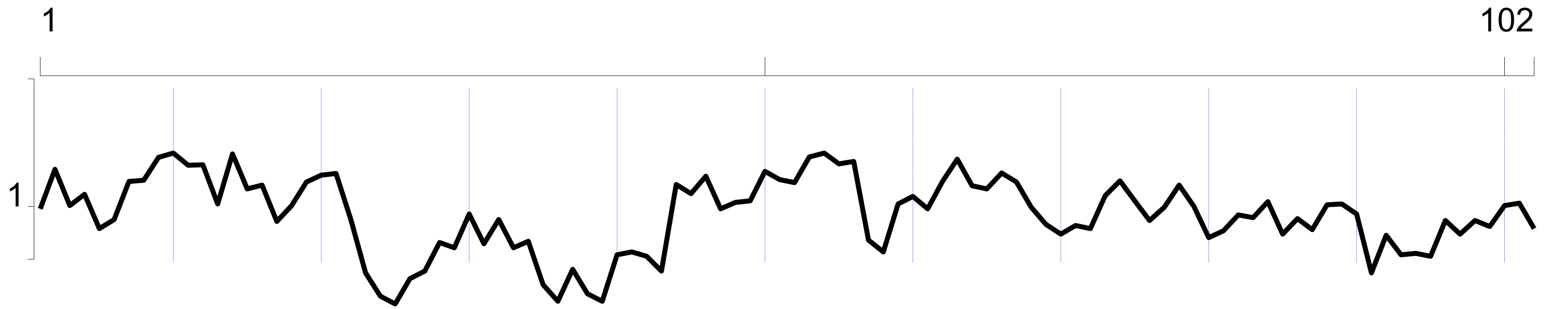
Sample number	Timber and position	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens
Ground floor						
pfi01	Second ceiling beam from SW end	35C	165	1.03	0.55	0.24
pfi02	Ceiling beam at SW end	*c*21C	106	0.84	0.55	0.39
pfi03	Fireplace lintel at SW end	?H/S	102	0.99	0.42	0.25
pfi04	Third ceiling beam from SW end	22	128	0.78	0.33	0.25
pfi05	Fourth ceiling beam from SW end		distorted	NM	-	-
pfi06	Fifth ceiling beam from SW end	28¼C	90	1.08	0.64	0.35
pfi07	Joist in NE-most bay, 11th from front	17	48	1.57	0.65	0.29
pfi08	Lintel over rear door, NE end	H/S	152	100	0.66	0.25
Roof						
pfi09	SE principal rafter, truss 3	H/S	145	0.82	0.45	0.23
pfi10	NW principal rafter, truss 3	-	distorted	NM	-	-
pfi11	Front lower purlin, NE end bay	-	distorted	NM	-	-
pfi12	NW principal rafter, truss 2	H/S	95	1.22	0.57	0.31
pfi13	SE principal rafter, truss 1	44C	108	0.84	0.59	0.29
pfi14	NE upper purlin, SW end bay	28C	71	1.46	0.68	0.26
Porch						
pfi15	1st floor ceiling joist	3 +30NM	84	1.06	0.59	0.26
pfi16	1st floor ceiling joist	-	<25	NM	-	-
pfi17	1st floor ceiling joist	-	<25	NM	-	-
pfi18	NE principal rafter	32C	51	1.62	1.09	0.27
pfi19	2nd floor joist from door	-	<35	NM	-	-
pfi20	3rd floor joist from door	-	<25	NM	-	-
pfi21	Rear lintel of two at front of porch	-	fractured	NM	-	-
pfi22	Front lintel of two at front of porch	-	<25	NM	-	-

Key: H/S bdry = heartwood/sapwood boundary – last heartwood ring date; C = complete sapwood, winter felled; ¼C = complete sapwood, felled the following spring; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured;

a)

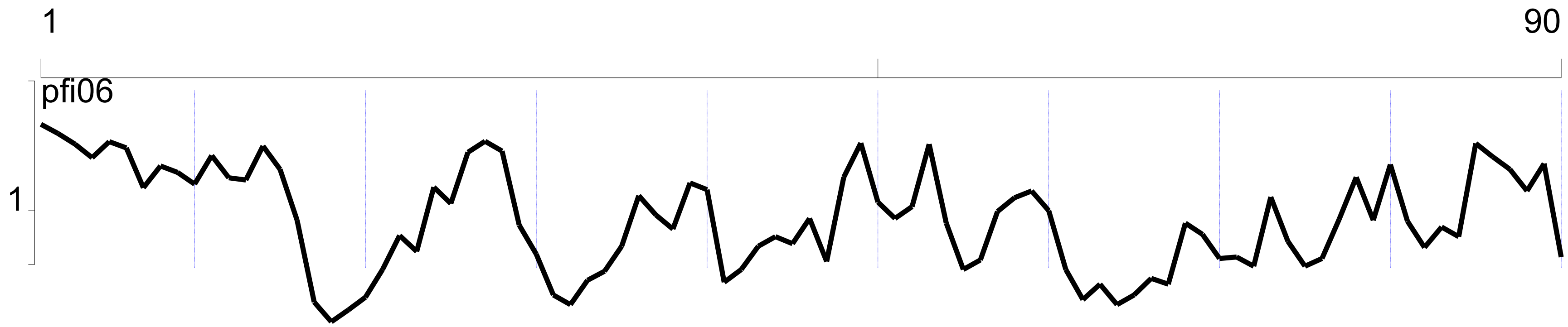


b)



A report commissioned by The North West Wales Dendrochronology Project in partnership with
The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

c)



d)

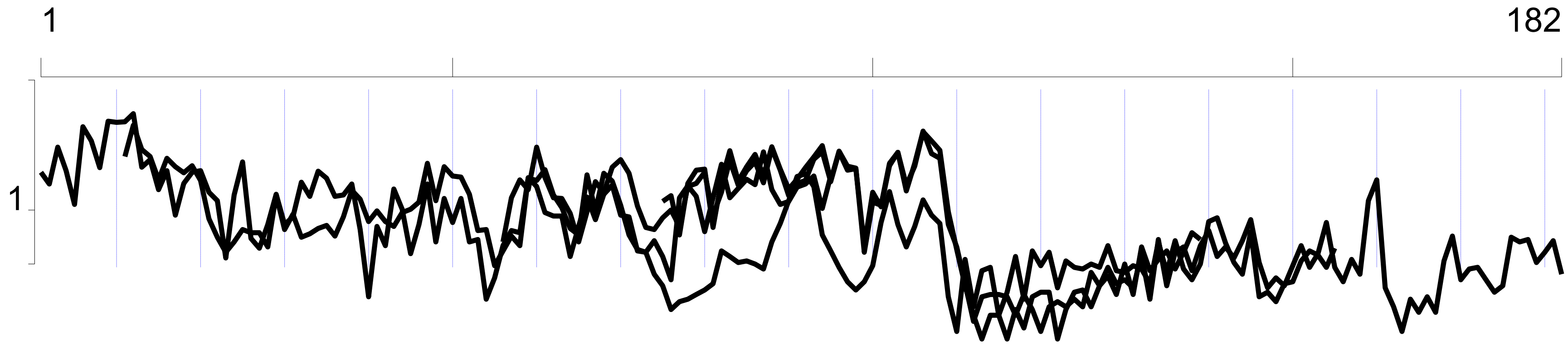


Figure 4: Ring width plots of series a) **pfi01**, b) **pfi03**, c) **pfi06** and d) combined plot for **pfi09**, **pfi12**, **pfi13** and **pfi15**. The *y*-axis is ring width (mm) plotted on a logarithmic scale.

ACKNOWLEDGEMENTS

This study was commissioned by Margaret Dunn of the North-West Wales Dendrochronology Project. I am grateful to the owner, Mr Iwan Edgar, for allowing access to his building and his generous hospitality, and to Richard Suggett of the Royal Commission on Ancient and Historic Monuments of Wales who assisted in the interpretation on site, and provided useful background information.

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.

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

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

RCAHMW, (1964), *Caernarvonshire Inventory, Volume III:*

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