How old are my trees?

A tree's rings open a window into history, says professional dendrochronologist and wood owner Andy Moir.

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Britain's outstanding veteran and ancient trees are an important but often little understood part of our heritage. The ageing of trees is largely based on girth measurements and comparison with other trees of the same species which leads to problems in accuracy. Larger trees are generally associated with being older, but where a tree receives a lot of light it can grow very large very quickly. Far from ancient woodland many 'traditional' woods today are comprised of privately-owned plantations that were abandoned in the 19th century due to economic upheaval and cheap timber imports.

I have worked with trees since the early 1990s, but it was only in 2013 that I finally got to manage a small wood in the Forest of Dean. This wood contained a number of large veteran oak trees which had girths ranging from 3.47 to 5.35m. No one knew exactly how old the trees were and estimates varied widely from 200 to 500 years. This article briefly describes how these trees can be accurately dated by dendrochronology (tree-ring analysis) and gives a number of other examples of how the technique can produce accurate information on many of Britain's trees.

What is dendrochronology?

Many people at some time have counted the number of rings in a felled tree to see how old the tree was. Assuming the year the tree was felled is known, you can count back from the outermost ring to the centre and establish exactly the year the tree was planted or germinated. This laying down of annual growth rings is the fundamental basis of the science of dendrochronology.

In dendrochronology though, annual rings are not just counted, the width of each and every tree-ring is accurately measured in sequence. Ring width is determined partly by the weather in the year it grew; in a good year a wide ring will tend to develop, and conversely in a bad year a narrow ring will develop. A consecutive series of 70+ rings forms a unique 'bar code' or 'tree-ring chronology' of wide and narrow rings. Using dendrochronology, a 70+ series of tree-rings of unknown date can be matched and dated against a series of tree-rings of known date (called a tree-ring reference chronology).

In the UK we have a remarkable reference chronology for oak extending back to 7700 BC. Therefore, it makes little difference if the technique is called to analyse trees growing today, those used in medieval timber-framed buildings, or those from the Iron Age, sometimes preserved in a peat bog. In this country, dendrochronology is most commonly used to identify the precise year of construction of medieval buildings. Archaeological timbers are also routinely dated, such as those used in the construction of the Seahenge at Holme-next-the-Sea in Norfolk, which is dated to 2050 BC and reveals evidence for coppicing in the Bronze Age. To date though this technique has only been used in a few studies on woodland.

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How do we get tree-ring samples?

When a tree is felled or falls it presents a good opportunity to saw a 2-3-inch-wide section which is ideal for tree-ring analysis. In the event of the clear felling of a site it is often possible to gather off-cut sections. Thinning provides another a useful opportunity to obtain samples for analysis. Old tree stumps or dead standing trees can survive for years and similarly provide useful samples.

Cutting full sections from very large trees and stumps is not always practical and in these instances the cutting of a V-section across a diameter of a tree by a circular saw or chainsaw can provide a useful alternative. Another often overlooked opportunity to collect samples for tree-ring analysis is during tree surgery on main branches or when branches simply fall off.

Obviously, the felling of trees for many woodland owners is not a desirable option, and in these instances small cores can be taken from the trees to examine the ring growth. Small cores are taken from live trees by use of an increment borer, which is a specialised device designed to extract a small pencil like core of wood with minimal injury.

Core samples collected from live trees are typically either 5mm or 12mm in diameter and if the corer is long enough, a sample can be obtained from the bark right through to the pith. However, increment corers are not cheap, ranging from around £200 for a 30cm-long version to £800 for a metre-long corer. As well as the cost there is also a technique to using an increment corer and a degree of hard physical effort, which probably explains why it is not so commonly used.

What tree-rings can tell us?

Once a series of tree-rings has been dated, each ring of known date can be examined in more detail to provide information about the life of the tree. Where the outermost ring lies under bark it is possible to identify the season when a particular tree was felled or died (i.e. in the spring, summer or winter of a particular year). Where the pith (or near pith) is also sampled it's normally possible to identify accurately how old a tree is, when a tree germinated (or was planted) and when a tree died.

A year in which coppicing or pollarding occurs produces a much narrower ring and so cycles of past management can be identified. In our oldest trees, cycles of medieval management for poles, fence posts or building timbers may be shown. Measured ring widths provides information useful for marketing and managing trees and can provide an indication of the current state of health of a tree. The effects of haloing around veteran trees (the cutting back of competing trees to increasing light levels) is another recent management practice, the effects of which can be shown by tree-ring analysis.

The study of the veteran oak in the woodland that I manage in the Forest of Dean revealed that:

- Despite the wide differences in girth between eight trees (ranging from 3.47 to 5.35m) all the trees sampled appeared to have been planted c.1776.
- The trees had a mean formative growth rate of 3.85 mm/yr for the first 90 years of their growth and a mean mature growth rate of 1.64 mm/yr lasting for around 200 years.
- Onset of senescent growth had occurred in four oaks in the last two decades.
- No patterns of past management were indentified.
- Additionally it was found that the positions of these oak correspond exactly with individual trees shown on the Ordnance Survey Map of 1881.

Analysis on a large 5.5m girth windblown oak in Leigh Woods near Bristol identified the tree as likely to be around 600 years old. While at Lullingstone Country Park in Kent, a rule of thumb was identified for the larger oak where every metre of girth equated to 100 years of age. One of the largest oaks at the site (with an 11m girth) was calculated to have germinated around 1000 AD.

Which other tree species have been studied?

In the UK, tree-ring research has tended to concentrate on our three longest-lived native tree species: oak, Scots pine and yew. Oak is by far the staple of tree-ring analysis in this country, but some research on other species has been conducted. We are exceptionally fortunate in this country in our survival of large yew trees, a tree species which is extinct or rare in many parts of Europe. One study using increment cores from yew trees at Wakehurst Place in West Sussex identified that trees with girths of 1.80m, 1.88m and 2.70m germinated in 1914, 1851 and 1733, respectively. Two much larger hollow yew trees with girths of 4.52m and 6.04m were established as likely to have been growing since 1650 and 1400, respectively.

Sawn sections from long-dead (up to 60 years) veteran sweet chestnut trees and stumps has recently proved a reliable method for dating these trees back to 1640. This study also highlighted the possible inaccuracies of estimating tree age from girth measurements. A study on avenues of lime trees at Hampton Court Palace identified four cohorts of trees planted around 1898, 1922, 1931 and 1955. It was concluded that many of these lime trees were planted to replace trees which had perished.

In conclusion, dendrochronology can provide a precise method for dating many different species of trees found in the British landscape. The use of increment cores currently offers the least destructive means of accurately dating living trees and tree-ring analysis can be used to dispel the uncertainty about the age of many of our largest trees. As well as identifying tree age this technique can provide valuable information on growth, health and past management, all of which is useful in informing conservation management plans for small woods.

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More information

Dr Andy Moir is director of Tree-Ring Services and a Post-Doctoral Research Fellow with the Institute for the Environment at Brunel University. He has worked on the tree-ring analysis of trees and timber-framed buildings for over 25 years.

The book 'A Slice through Time, by Mike Baillie (published in 1995) provides very interesting fuller explanation on the science of dendrochronology.

Some reports on the tree-ring dating of trees and buildings are freely available for download from: http://www.tree-ring.co.uk