



The Fraternal Four

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Recent studies have shown that the four famous, ancient Yews of Borrowdale may be older, and more closely related to one another, than previously thought.

Just south of Keswick lies the Borrowdale Valley, one of the most wooded, oak-dominated valleys in the Lake District. The Borrowdale Oakwoods, or Atlantic Oakwoods, are the remnants of a once vast oak forest that cloaked much of the north-western seaboard of Europe, from Scotland south to northern Spain. Today only fragments remain, the finest of which are on the west coast of Scotland.

Within these Borrowdale woodlands, Yew *Taxus baccata* is relatively rare. If you visit the southern end of Borrowdale, however, you will find three quite remarkable ancient Yew trees. The 12.5km trip from Keswick to see them takes about half an hour, but in the early 1800s it would have taken a traveller by coach and horses over a rough-hewn track considerably longer. This did not deter the poet William Wordsworth, who was so impressed

Section of tree 2, still visible after 1860s storm damage.
Maurice Pankhurst

by these ancient Yews that in 1803 he penned the poem *Yew-Trees*, in which he described the Borrowdale Yews as the 'fraternal Four'. A few decades later, the four became three when one was uprooted during a violent storm. Wordsworth was impressed not only by the size of these Yews but also by the surrounding landscape, with its wild nature and steep, forbidding, craggy mountainsides, and over the next two centuries scores of visitors have sketched, painted, photographed and written at length about the Borrowdale Yews and this ancient landscape.

Even after all these years, visitors to the Borrowdale Yews are full of questions. Were the trees planted? Are they related? And, perhaps the most asked question of all, how old are they? Recent attempts to answer those questions have shed further light on these famous Yews.

First, a little history is of interest. As already mentioned, in Wordsworth's day there were four Yews – which we shall call trees 1, 2, 3 and 4 – but storms have played a major role in their

lives. The first was in 1866, and it uprooted tree 4, causing the latter's subsequent death, something rarely recorded for Yew. The remains of this tree, however, are still present today. A few years later, although the precise date is unknown, tree 2 was severely damaged, some 50% of it being destroyed. Again, the remains of this section of the tree are still to be seen today. There are no reliable reports of any further limb losses or storms until 1998, when a major limb from tree 1 was torn from its canopy, an unfortunate occurrence which nonetheless provided the opportunity for an accurate ring count. Following on from that 1998 storm, there was much discussion within the National Trust in conjunction with specialists from the wider arboricultural industry about possible tree surgery to reduce the risk of further storm damage to tree 1, but, the consensus was that this was unnecessary. The last major storm to cause serious damage occurred during the night of 12th January 2005 and was powerful enough to remove the entire canopy of tree 1. Despite such catastrophic damage, tree 1 has slowly shown signs of recovery and by 2014 it had developed the beginnings of a new, albeit lower, canopy. Its future survival depends upon ensuring that the tree remains unmolested by farmstock and free from human intervention.

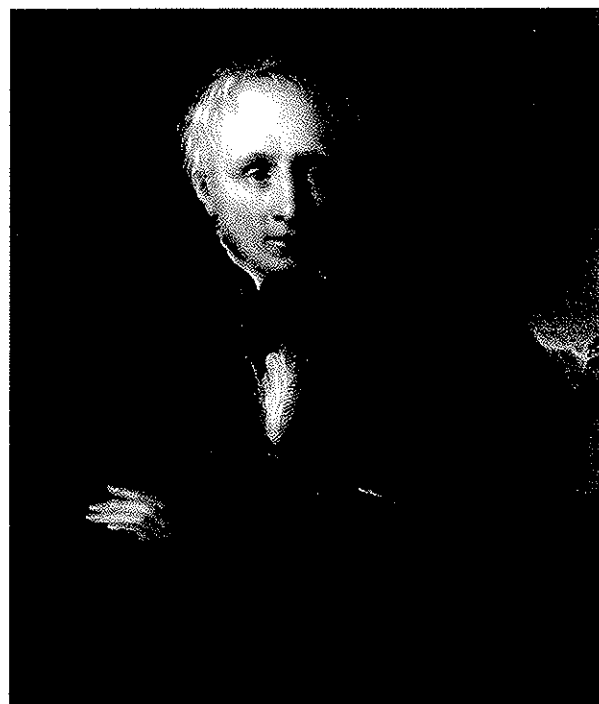
One estimate of the age of tree 1 was by Andy Moir, quoted by Greenwood (2004). On the basis of field measurements and growth rates of trees measured in other regions, Moir estimated tree 1 to be in the region of 1,000 years old. The loss of that limb in 1998, however, presented a new opportunity for dendrochronological investigations, and a sample of it was selected, removed and sent to Newcastle University for analysis. A cross section was prepared by lathe and then scanned by an electron microscope to assess the number of rings. This analysis revealed a ring count of 1,500 years. This was an impressive result, but, given the caveats regarding ageing of Yew, it is possible that the tree could be even older, particularly as this was a ring count from a single upper limb and not from the main trunk.

DNA studies

Advances in DNA technology now make it possible to produce a unique DNA 'fingerprint' for identifying genetically different individuals.

Yew-Trees by William Wordsworth

There is a Yew-tree, pride of Lorton Vale,
Which to this day stands single, in the midst
Of its own darkness, as it stood of yore;
Not loth to furnish weapons for the Bands
Of Umfraville or Percy ere they marched
To Scotland's heaths; or those that crossed the sea
And drew their sounding bows at Azincour,
Perhaps at earlier Crecy, or Poitiers.
Of vast circumference and gloom profound
This solitary Tree! – a living thing
Produced too slowly ever to decay;
Of form and aspect too magnificent
To be destroyed. But worthier still of note
Are those fraternal Four of Borrowdale,
Joined in one solemn and capacious grove;
Huge trunks! and each particular trunk a growth
Of intertwined fibres serpentine
Up-coiling, and inveterately convolved;
Nor uninformed with Phantasy, and looks
That threaten the profane; – a pillared shade,
Upon whose grassless floor of red-brown hue,
By sheddings from the pining umbrage tinged
Perennially – beneath whose sable roof
Of boughs, as if for festal purpose decked
With unrejoicing berries – ghostly Shapes
May meet at noontide; Fear and trembling Hope,
Silence and Foresight, Death the Skeleton
And Time the Shadow; – there to celebrate,
As in a natural temple scattered o'er
With altars undisturbed of mossy stone,
United worship; or in mute repose
To lie, and listen to the mountain flood
Murmuring from Glaramara's inmost caves.



William Wordsworth, engraved by J. Cochran after W. Boxall. Rex/Design Pics Inc



Remains of tree 4 uprooted in 1866. Maurice Pankhurst

In contrast, individuals which originate from basal shoots or branches that have layered produce the same DNA fingerprint (genetic clones). It is this technology that has been used to examine the three remaining Yew trees at Seathwaite. Two approaches, which have been used extensively for clonal analysis of a large number of tree species, have now been applied to the DNA extracted from Yew foliage samples.

The first of these was a DNA analysis of foliage from the three Yew trees by means of a RAPD (Random Amplified Polymorphic DNA) methodology, while the second approach involved four microsatellite markers. Microsatellite regions are generally highly variable among individuals and therefore provide suitable markers for use in DNA-fingerprinting studies. Foliage samples were taken from the three Yews at Seathwaite, along with a further 17 individual Yew trees from nearby fell land and hamlets.

The results of both methods suggested something fascinating. The RAPD analysis produced banding patterns that were identical for trees 1 and 2, while the banding pattern for tree 3 was distinctly different. From these results there is no evidence that trees 1 and 2 are actually different individuals at all.

Meanwhile, the microsatellite analysis from all the sampled trees indicated that there was high diversity in this population, with a total of 37 alleles recorded across the four loci, and between eight and eleven alleles per locus. This demonstrates that sufficient diversity exists in these markers to make them appropriate for use in clonal identification.

The 17 samples from various locations in the valley all had unique DNA fingerprints, indicating that they were all distinct individuals. Tree 3 at Seathwaite also produced a unique DNA fingerprint. Trees 1 and 2, however, produced identical DNA fingerprints, indicating, just as with the RAPD analysis, that both samples are most likely to be derived from the same tree, and this is in agreement with the findings of the RAPD analysis. Trees 1 and 2 are less than four metres apart, and the architecture of the above-ground roots is highly suggestive of linkage.

Conclusions

From the results of the dendrochronology, we now know that tree 1 is at least 1,500 years old (given that this ring count is from a limb in the upper canopy, the ring count from the main trunk

Management through the years

During 1944, The National Trust acquired much of the land at Seathwaite, including the lower slopes of Lowbank Crag, which support extremely ancient wood pasture dominated by Ash *Fraxinus excelsior*, oak *Quercus* and Hazel *Corylus avellana*; within this wood pasture close to the hamlet of Seathwaite stand the three remaining Yews.

From Table 1, which lists ancient trees that have been pollarded many times, it is clear that these ancient woodlands have been managed for centuries. Further supporting evidence of man's activities close to Seathwaite is revealed from research carried out in the 1990s (Wild *et al.* 2001), when a number of wooden

artefacts were recovered from peat layers along the banks of Seathwaite Beck south of Seathwaite farm. Radio carbon-dating for both peat and wooden artefacts suggests considerable human activity from the year 1400 onwards.

Analysis of pollen data from nearby Johnny's Wood, at Seatoller, suggests considerable change in woodland-canopy species around the time of the early Viking period (H. J. B. Birks *pers. com.* 1991). The pollen diagram picks out the increase in oak, along with grass species, as management of the woodland intensified and oak was deliberately favoured by these early communities.

Table 1 Pollarded ancient trees within Seathwaite Woodland

Species	Occurrence	Pollarding ongoing
<i>Fraxinus excelsior</i>	Common	Yes
<i>Quercus petraea</i>	Rare	Yes
<i>Ulmus glabra</i>	Very rare	No
<i>Betula</i> sp.	Rare	No
<i>Crataegus monogyna</i>	Rare	No
<i>Ilex aquifolium</i>	Rare	No
<i>Sorbus aucuparia</i>	Rare	No
<i>Corylus avellana</i>	Rare	Yes
<i>Taxus baccata</i> *	Rare	No

* It is possible that the Borrowdale Yews have in the distant past been subjected to pollarding, though any physical evidence is no longer visible today.

lower in the tree would be likely to yield a higher number of annual rings), while the recent DNA research shows that tree 1 and tree 2 generate the same DNA fingerprint and can now be regarded as a single tree which has undergone remarkable changes over a very long period of time.

How those changes have taken place is still a matter of speculation. In other examples, Yews are often recorded with multiple stems. For example, Hartzell (1991) mentions that the Fortingall Yew in Perthshire, Scotland, consisted of a single trunk in 1870 and measured 56 feet in girth. Today, the centre has decayed and a pathway divides the remaining halves.

Tree 1 in 2008. Maurice Pankhurst





Tree 1 in November 2014. Maurice Pankhurst

Alternative explanations may well involve branch-collapse and layering, whereby the partially broken limb produces roots and the secondary stem is formed. A fine example of this can be found in Ormiston, East Lothian, Scotland. Therefore, if the original trunk fails, the tree is not always lost and may be replaced by younger outlying branches. The root systems of Yews have been shown to exhibit extremely high vitality (Hageneder 2011) and may often give rise to vigorous regrowth; so long as part of the root system remains intact and in contact with the soil, the tree can survive. In the case of the Borrowdale Yews, the fellside above them was extensively mined for graphite over many centuries and falling rock must have been a fairly frequent occurrence and may have resulted in root damage. Further examples of this process can be found in England at Kingley Vale, Sussex, at Bennington, Hertfordshire, and at Coften Hackett, Worcestershire (Peters 2012).

These results may be of interest to historians, who will often question whether such ancient specimens are present through natural processes

or have in fact been planted. In his article on the Fraternal Four, Hindson (2012) observed that the trees exist on what appears to be some form of stone-built terrace. Other authors mention the arrangement of stones on the fellside that may suggest places of ritual or worship. During the period of George III, a guardhouse was built in the vicinity of the Yews, its purpose being to prevent theft of graphite from the mines above. Below the Yews is a medieval saw pit, which provides more evidence of the ongoing disturbance in this area that could so easily contribute to terracing or the moving of large boulders for building purposes.

The Borrowdale Yews are secure, with their future tempered only by natural processes. Enclosed, they are free from grazing stock, and will be further protected from browsing deer in the near future. Young seedlings from the three Yews have been successfully grown on and are now planted close to their parents and at two other locations in the Borrowdale and Langstrath valleys.

Undoubtedly, conjecture regarding their past will continue, and perhaps we shall never have all the answers. Nevertheless, these remarkable ancient trees will fascinate and enchant visitors to Borrowdale for many generations to come.

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