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October 2024

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Prepared for	Borders Forest Trust
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Project No.	Dendrochronicle: 0317
Date of Report	V1 October 2024

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Figure 1 Deadwood sampling, Hawthorn DW01. Photo: C Mills

Summary

This tree-ring study of selected living and dead trees at Dairy Wood (known as Braefoot Wood on OS mapping) aims to inform the understanding of this wooded landscape's history, alongside other strands of evidence being gathered by BFT and Dendrochronicle, including our recent historic map research (Quelch 2024). Dendrochronology samples from a total of 14 trees across five species have been analysed, including a range of single and multi-stemmed forms.

The oldest trees identified are oak and ash originating in the mid-18th century, clustered in a particular part of the wood (Figure 2). These species do not occur in the gullies. As the most economically valuable species present, with a discrete distribution, it is postulated that in the 18th century oak and ash were planted into some of the boundaries between small pre-improvement fields (see Quelch 2024, Part 2), an aspect which further documentary research may elucidate.

The strongest evidence for subsequent woodland management is an old multi-stem oak with a large footprint and a characterful form. Its stem origin date indicates it was last coppiced in the early 1830s and it could have gone through several coppice cycles before then. However, it is the only example of a coppiced oak in Dairy Wood, and it is unknown whether others have been lost over time. It is also possible that this tree is an outlier and that other similar coppiced oaks were being managed elsewhere on 'Erickstane' farm's lands, in areas we have not surveyed.

A number of ash stem origin dates cluster in the early 19th century, around AD1812-1816, so the possibility of a planted origin needs to be considered but, on balance, a regeneration phase seems more likely, self-seeded from the older ash trees present, perhaps in a period of abandonment or reduced grazing pressure.

The other species studied, alder, hawthorn and birch, returned a range of 19th century and early 20th century dates and are all likely to represent natural establishment, albeit as the consequences of changes in land-use in this old agricultural landscape. A future phase of synthesis of available evidence will consider how the woodland history meshes with the land-use history. It appears likely that a major shift occurred at the study site somewhere in the later 18th or early 19th century, from a pre-improvement field system, under multiple occupancy, to an improvement-era single farm unit. More evidence about that may come to light in future studies, but the working interpretation of the tree-ring evidence is that this change has left a legacy of some 18th century planted oak and ash trees on former field margins with some later semi-natural establishment of younger trees, including alder and hawthorn, into the old fields in the 19th and 20th centuries. There has probably been an accompanying shift in land-use from intensive mixed farming, with some arable in the small fields, to predominantly pastoral use within larger field bounded by stone dykes. A big question remains, of exactly when that change occurred, which any future historic documentary research may reveal.

The studied trees were largely on the open braes but the gullies in between them, although of a different character with no obviously ancient trees in them, have probably remained the most wooded parts of Dairy Wood throughout, being least accessible for grazing.

Perhaps the most important point to emerge from this study is that, over the last few centuries, the results indicate an evolution from fields to wood, and not the other way round as one might usually expect from something which has been previously labelled an 'ancient wood pasture'. The results therefore indicate that farming and woodland establishment can co-exist here under a relatively benign grazing regime. They also point to the appropriateness of continuing suitable grazing at Dairy Wood to sustain its open character and biodiversity.

Introduction

This dendrochronological study forms a key part of the work being undertaken by Dendrochronicle on the history of Dairy Wood to inform Borders Forest Trust's conservation management and interpretation of the site. This woodland is known as Braefoot Wood on the OS mapping, and this tree-ring study is complemented by prior research into the historic map evidence by my Dendrochronicle colleague Peter Quelch (Quelch 2024). Dairy Wood is the name in local oral tradition but has not so far been identified in any written records.

The dendrochronological work is aimed at obtaining tree-ages for a range of species and tree-forms of the older trees that grow at Dairy Wood, as part of a wider set of investigations arranged by BFT to inform their conservation management and interpretation of the site. Five species have been included in the tree-ring study: oak, ash, alder, hawthorn and birch, but the majority of the samples are from oak and ash. Of the various tree species present at Dairy Wood, oak and ash are most suited to tree-ring studies, due to their clear ring structure. Furthermore, they are likely to be the longest-living species present and the most economically valuable, so their study might provide the longest records and also shed most light on the past use of the wood. The inclusion of a range of other species allows a comparison with the oak and ash ages and allows a wider consideration of the evolution of Dairy Wood over recent centuries.

Methods

The selection of samples was informed by a reconnaissance walkover with Peter Quelch on 24th April 2024. This allowed suitable deadwood and living tree candidates to be located, with the author returning to site to sample them with the assistance of Hamish Darrah on the 13th to 14th June 2024. We sought to sample a range of species and both single-stemmed and multi-stemmed trees. Living tree samples were taken using a Swedish Increment Corer which extracts a narrow core of wood, 6mm in diameter. Deadwood samples were taken as disks by chainsaw. National Grid Reference locations of each sampled tree were recorded using a handheld GPS.

Records were made for each sampled tree of location, stem girth, sampling height, tree form, whether single-stem (SS) or multiple-stem (MS), and whether living or dead when sampled. The single stem samples reveal the tree's age. Multiple-stem trees, depending on the species, can be the result of past coppice management, with the stem age information capable of revealing when the coppice was last cut. This is most relevant for oak and other commercially coppiced species. However, some of the tree species present at Dairy Wood can form multi-stems naturally or under grazing pressure so not all multi-stems are necessarily coppiced trees.

Standard dendrochronological techniques (English Heritage 1998) were employed in the analytical work. The cores were bound with string onto baton mounts, to allow them to dry without warping, then glued into the mounts. The surfaces of the core samples were prepared for tree-ring width sequence measurement by sanding with a series of ever-finer sandpaper grades. The disk samples were retained in a field moist condition and a measuring track pared with a razor. The tree-ring width sequences were measured on a Heidenhain measuring table, under a low-power microscope, linked to a laptop computer for data capture.

Where more than one tree of a certain species was sampled, then further dendrochronological analysis was undertaken to compare the tree-ring sequences between trees for that same species, and in the case of the oak and the ash to combine them into site chronologies. Analysis and plotting were undertaken using the 'Dendro' suite of programs (Tyers 1999) which produces t-values as a measure of the degree of correlation between sequences; as a general rule of thumb t-values above 3.5 are worthy of consideration, although higher values are expected for strong

matches, and the length of overlap is also taken into account. Visual comparison of ring-width graphs is also undertaken to verify statistical positions of match. The date of core-sampling living trees means we know that the last (partial) ring formed under the bark on the core samples dates to 2024, a useful anchor in time.

The measured date spans of the samples do not, on their own, reveal the origin date for a tree or a stem. An allowance, known as the 'pith offset', has to be made for any rings missing at the centre of the sample (which can happen because coring rarely hits the exact central ring of the stem or because deadwood samples may have a rotted centre), and an allowance also has to be made for the sampling height up the stem. The pith offset estimate (Table 1, Column 6) is made using a transparent overlay sheet with sets of concentric rings drawn at a range of ring width intervals, so that the arc and interval of rings present towards the centre of the sample can be used to interpret how many rings are missing to the centre of the stem. The sampling height up the stem has to be allowed for because it takes several years of growth for the young tree or re-growing coppice stem to reach the height at which a sample is usually taken. We avoid taking samples too near the roots because this disrupts the ring pattern, and also because clear access is needed to turn the corer handle, so we usually take a living tree sample somewhere between waist height and chest height. On deadwood we try to take the slice near the base, but for felled stems where the stump cannot be located, we have to make an estimate of the sample height up the stem.

In previous studies, an allowance has been used of ten years for a sapling to reach 1m height (Bishop et al 2022; Mills *et al* 2009; Mills 2011; Mills & Quelch 2019a & 2019b; Mills 2022; Mills et al 2023). This is very much an estimate which will vary in reality depending on the growing conditions at the site. Thus, despite the precision with which a date span can be applied to the measured rings in a sample through dendrochronology, there is a degree of estimation involved in deducing a stem origin date from those data. A further complication is to consider whether any of the trees were planted, and if so whether they were planted as seed or as saplings. Historically, in the 18th and 19th centuries, nursery-grown saplings were generally planted out at about three to five years of age (Bishop *et al* 2022).

Some of the tree species sampled at Dairy Wood, such as oak and ash, have clear reliable 'ring porous' tree-ring anatomy and are well suited to cross-matching, chronology building and precision dendrochronological ageing. Others such as birch and hawthorn have indistinct diffuse porous ring anatomy, and it is possible that the ring counts are out by a few years either way.

The data from the tree-ring analysis will be archived alongside all other Dendrochronicle tree-ring data (NRHE intended). Most of the samples will also be archived (NMS intended), but the Dairy Wood hawthorn and birch disk samples have not been retained. They were well rotted, falling apart and teeming with invertebrate and other life-forms, so they have been returned to site where they are valuable as deadwood habitat. Of the disk samples, only the two ash disks (DW06A and DW06B) have been retained. These were already dry and stable when collected.

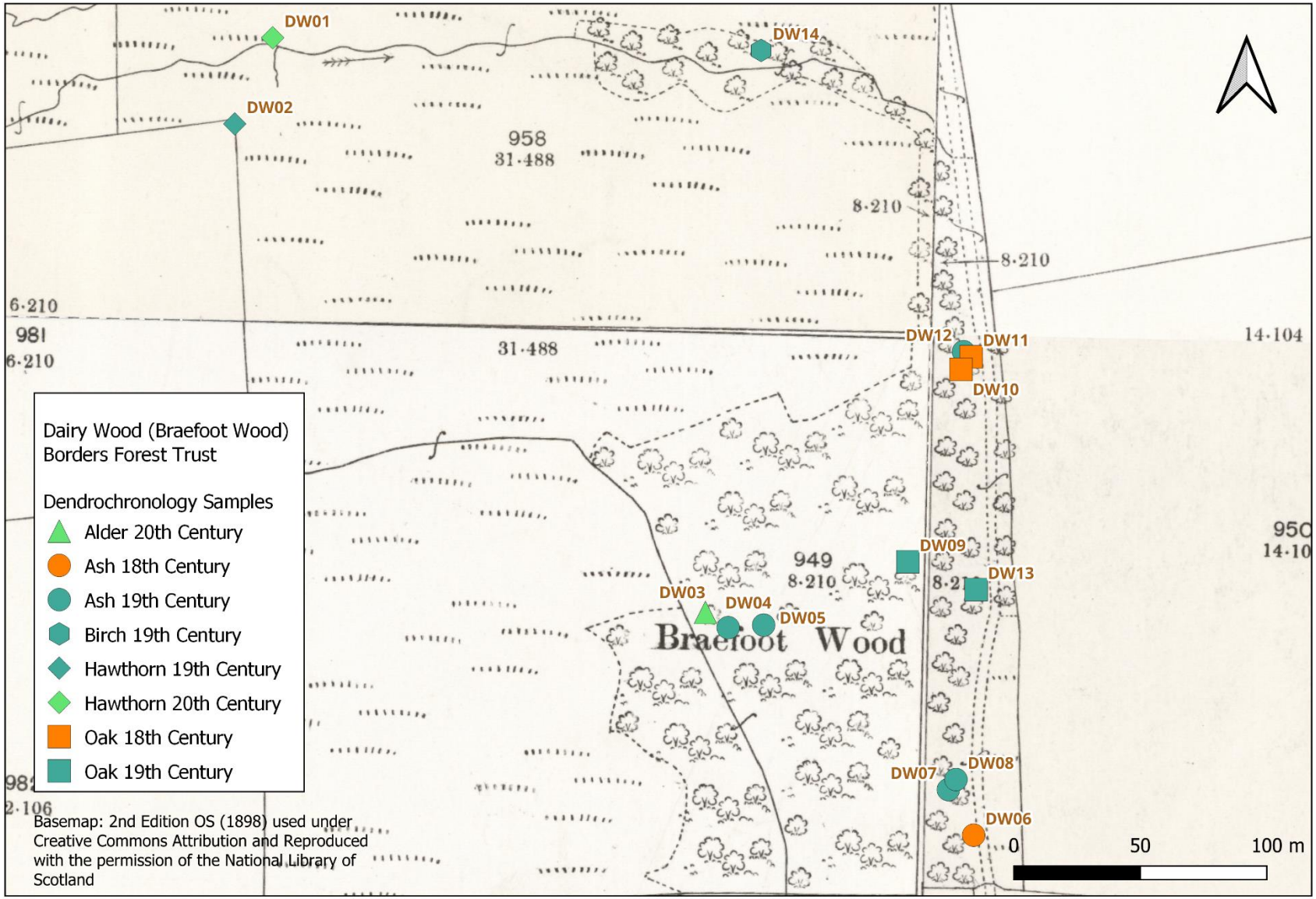

Figure 2

Locations of Dairy Wood dendro-chronology samples DW01 to DW14.

Illustrator: C Patience, BFT.

Results

The locations of the samples are shown in Figure 2. The field records and analytical results are presented in Table 1, grouped by species and ordered by the numeric tree codes DW01 to DW14.

Table 1 Key attributes of the Dairy Wood dendrochronology samples (sampled on 13-14 June 2024). Deadwood disk sample results are shaded grey. The unshaded rows are living tree cores.

Tree code (suffix R - remeasured) / **SS or MS** (single- or multi-stem)	**GPS** reading **NGR: NT**	**Sample height (m) up stem,** above ground surface	**Girth m -** sh = at sample ht, or at stated ht. Disk girths in rotted state	**Number of measured rings** (sapwood count in brackets)	**Central ring present & measured** =Centre, or **Pith Offset – PO** est rings missing to centre	**Measured to bark edge** (B)? B+½ - final part ring for 2024 not measured	**Date span of measured ring sequence** (NB all living trees also had a partial 2024 ring not measured)	**Estimated stem origin date** (allowing for any PO and for sample height – est takes 10 yrs to reach 1m ht)
HAWTHORN SAMPLES								
DW01 SS	06841 11508	0.5	0.87 at 1m ht	84	PO-12	B	Undated. Died before 2024	**Before 1923**
DW02 MS	06826 11474	0.3	0.61 sh	123	Centre	B	Undated. Died before 2024	**Before 1898**
ALDER SAMPLE								
DW03 SS (2 cores)	07012 11281	0.7	1.5 sh	104	PO-7	B+½	1920-2023	**1906**
ASH SAMPLES								
DW04 MS	07021 11275	0.8	2.25 at 1.2m ht	198	PO-5	B+½	1826-2023	**1813**
DW05 SS (2 cores)	07035 11276	0.9	3.30 sh	194	PO-5	B+½	1830-2023	**1816**
DW06AR MS Stem A (upslope side)	07118 11193	2 m approx	2.57 sh	223	Centre *Stem A has double centre*	B (felled winter 2023-24)	1801-2023	**1781**
DW06B MS Stem B (down-slope side)	Ditto	3 m approx	2.45 sh	243	Centre	B (felled winter 2023-24)	1781-2023	**1751**
DW07 SS rot - part core outer 87mm of radius	07108 11211	0.5	2.45 sh	76 (part core)	PO>>20	B+½	1948-2023	**Long before 1923**
DW08 SS rot – 2 cores. Core a outer 110mm; Core b outer 75mm of radius	07111 11215	0.8	2.80 sh	78 (part cores)	PO>>30	B+½	1946-2023	**Long before 1908**
DW12 SS	07114 11384	0.85	2.95	188	PO-15	B+½	1836-2023	**1812**
Ash site chronology (comprising DW04, DW05, DW06AB, DW07, DW08) (DW12 no match, but does match other ash ref chrons)								
DWASHMx5							1781-2023	
OAK SAMPLES								
DW09 MS (2 of 3 stems are hollow)	07092 11301	1.1	3.36	165	PO-15	B+½	1859-2023	**1833**
DW10 SS	07113 11377	1.25	4.05	264	PO-5	B+½	1760-2023	**1742**
DW11 SS rot Part core – lost inner 22cm	07117 11382	0.9	2.60	167	PO>50	B+½	1857-2023	**Before 1798**
DW13 SS	07119 11290	1.0	3.24	134	PO-10	B+½	1890-2023	**1870**
Oak site chronology (comprising DW09. DW10, DW11 & DW13)								
DWOAKMx4							1760-2023	
BIRCH SAMPLE								
DW14B SS (2 slices, Slice A too rotten to measure rings)	07034 11503	Est 2m	1.15	109	PO-5	B	Undated. Died some years before 2024 – decayed state	**Before 1890**

The results are considered further here in same-species groups, starting with the groups which include the oldest trees, the oak and the ash.

Dairy Wood oak results

All four old oak trees present at Dairy Wood were sampled for this project. They are all located quite close to each other within a small area towards the southern end of Dairy Wood (Figure 2).

Figure 3 Dairy Wood oaks: DW09 (left) and (DW10) right. Photos: Coralie Mills

Single-stemmed oak DW10 (Figure 3) has a massive girth of 4.05m and is demonstrably the oldest tree sampled at Dairy Wood. Its measured ring-span begins at AD1760, but its stem origin date is calculated to be AD1742 when allowances are made for the number of rings missing to the centre of the tree in the core (pith offset) and for the number of years it would have taken for the oak sapling to reach sampling height (Table 1).

The massive multi-stem oak DW09 (Figure 3) has all the character of a truly ancient oak. However, two of the three stems are hollow and the only stem which was intact enough to sample returned a stem origin date of AD1833 (Table 1). The multi-stem form indicates that this oak has probably been coppiced, and therefore the 1833 date identifies when the tree was last cut over, not when it originally germinated. The stool has a substantial 'footprint', about 4m across and about 10m in circumference, which is another indicator of antiquity. Oak DW09 could easily be as old as DW10 or even older. It has probably been coppiced more than once before AD1833 for it to develop such a large stool.

Figure 4 Dairy Wood oaks: DW11 (left) and DW13 (right) with BFT staff Adrian and Catriona for scale. Photos: Coralie Mills.

Single-stemmed oak DW11 (Figure 4) is probably an 18th century oak, but rot in the centre prevented a complete core being obtained. The measured ring span begins in AD1857 but there is a large pith offset estimate to be made together with the sampling height factor which, when factored in, indicate a stem origin date before AD1798 (Table 1).

Nearby, single-stemmed oak DW13 (Figure 4) is not so old as the other oaks; its measured ring span starts at AD 1890 and its stem origin date is calculated to be AD1870 (Table 1). It is difficult to say whether or not it is planted, given no other oaks share this date, but this tree could be self-seeded from the adjacent older oaks.

Dairy Wood ash results

Six ash trees at Dairy Wood have been sampled for dendrochronology (Table 1), including disks taken from the recently felled large multi-stem DW06 (Figure 5) and cores from two other roadside ash trees, DW07 and DW08 (Figure 6), which are to be felled. It is understood this is for safety reasons and is related to chalara (ash dieback) in these trees. Before turning to the individual ash tree-ring results, it is worth noting that our coring work encountered rot in the interior of DW07 and DW08 but that the other four ash trees, including felled DW06, showed no sign of rot in the samples.

Figure 5 (Left) DW06 multi-stem ash stump, with the sloping surface of stem DW06A facing the camera and the higher stem DW06B overhanging the road – with Peter Quelch for scale. (Right) Ash DW08 (foreground) with DW07 behind. Photos: Coralie Mills.

The oldest ash tree proved to be the recently felled DW06 (Figure 5). It has a semi-fused multi-stem form with three main stems, two of which were disk-sampled. The third could not be reached safely. Peter Quelch observed in the field that the stem nearest the road (Stem DW06B) appeared to be the oldest stem, and this was backed up by the dendrochronological results. Stem DW06B has a measured ring span which starts with the central ring at AD1781 and, allowing for its height above ground surface (an estimate given it is growing on a steep slope), a stem origin date of around AD1751 is indicated (Table 1). Stem DW06A is a little younger. It has a measured ring span which starts with the central ring at AD1801 and, allowing for the sampling height, a stem origin of around AD1781 is indicated. Stem A actually has two centres which indicates that it represents two fused stems. The difference in age between Stems A and B suggests this is not a formally coppiced tree and that the form is more probably the result of secondary shoots emerging from the base over time alongside the original leading stem.

It is difficult to say how old single-stemmed ash trees DW07 and DW08 (Figure 5) are because rot in their heartwood meant that only partial cores could be obtained, extending back only to the 1940s, but they are clearly much older than that (Table 1). In girth and form they are similar to other single-stemmed ash trees which have been dated to the early 19th century (see below).

Figure 6 (Left) Ash DW12. (Right) Ash DW04 upslope from DW05. Note dead second stem of DW04 lying on the ground and the curved form of the surviving stem. Photos: Coralie Mills.

Single stemmed ash trees DW05 and DW12 (Figure 6) returned early 19th century stem origin dates of AD1816 and AD1812 respectively (Table 1). They are effectively from the same cohort or generation. Double-stemmed ash DW04 returned a similar stem origin date of AD1813 (Table 1) for the surviving living stem (Figure 6).

Dairy Wood hawthorn results

Disks were taken from two fallen hawthorn trees, DW01 and DW02 (Figure 7). DW01 had a single main stem and is around 100 years old, originating before AD1923. A dead stem sampled on multi-stem hawthorn DW02 was a little older, with 123 measured rings present and originating before AD1898 (Table 1). Hawthorn has a difficult ring structure to discern, and the two samples' ring-width sequences did not match each other or the other very limited living hawthorn reference data from elsewhere in Scotland. Therefore, an absolute date span cannot be attributed because we do not know how many years ago these stems died. The 'before' dates in Table 1 are the minimum age they can be. However, their condition suggests that they probably died within the last few years and so they are not likely to be much older than their calculated 'before' dates. It seems likely that both sampled hawthorns represent naturally self-seeded trees rather than remnants of old hedges. Other adjacent hawthorns would be expected to be present if they were from old hedges.

Figure 7 (Left) Dead single-stem hawthorn DW01. (Right) Multi-stem hawthorn DW02, the dead stem coming towards the camera is the sampled stem. Photos: Coralie Mills.

Dairy Wood alder results

There are many old alders at Dairy Wood, but the majority have hollow, stilted or complex fused forms which are not suited to tree-ring analysis. One rare single-stemmed mature alder (DW03), growing on the bank which runs along the downstream side of the mill-lade (Figure 8), was sampled. Its measured ring sequence starts at AD1920, and its stem origin date is calculated to be AD1906. Today, we see young alders germinating all along this mill-lade and this particular alder probably arrived through natural means to germinate on the upcast bank of the artificial mill-lade channel. The historic map evidence shows that the mill-lade was already present when the first edition Ordnance Survey six-inch map was surveyed in 1857 (Quelch 2024, Part 2). Some of the alders along it may therefore be older than this example.

Figure 8 Alder DW03, beside the mill-lade. Photo: Coralie Mills

Dairy Wood birch results

Figure 9 (Left) Long-dead fallen birch DW14 about to be sampled. (Right) Hamish Darrah holds a disk sample from DW14. Photos: Coralie Mills.

It had been decided in the April 2024 sampling candidate selection visit that one of the several recently wind-blown birch trees along the northern-most gully at Dairy Wood should be sampled, but on closer inspection in June they were all still showing some signs of life, and it was thought they should be left intact as they might survive as phoenix trees. Instead, a more decayed and long-

dead birch stem (DW14) was sampled from the gully slope (Figure 2; Figure 9). It appears to have been a single-stemmed tree and showed quite advanced decay so has probably been down a while. A total of 109 measured rings were present and a stem origin before AD1890 is indicated (Table 1). This is likely to be a tree of natural origin, self-seeded into the steep slope of the gully which would be less accessible for grazing than the open braes between the gullies.

Discussion

A longer woodland history?

This tree-ring study can only consider the history of this wooded landscape over the lifespan of its oldest surviving trees. There is certainly potential for a longer history to be uncovered in other avenues of research. It is known that Upper Annandale formed part of the baronial Annandale Forest (ie a hunting reserve, not necessarily a woodland) in medieval times. Annandale Forest was granted to Robert de Bruce by King David I in AD1147 x 1153, as identified in the earliest surviving forest grant in Scotland, one of only two such charters to survive from David's reign (Gilbert 1979, 21, 183 and Table 28). Other methods including pollen analysis and historic documentary research are required to look into deeper time at Dairy Wood. Without them, it is difficult to say how wooded this landscape was in the medieval and early post-medieval periods, and difficult to identify how what survives today relates to any earlier woodland cover. Maps prior to the 19th century do not show any woodland at the study site, but that does not necessarily mean that there were no trees or wood pasture present (Quelch 2024).

Interpretation of dendrochronology results

The oldest trees identified by dendrochronology at Dairy Wood originate in the mid-18th century, as evidenced by the single-stem oak DW10 (Table 1: stem origin date calculated as AD1742) and multi-stem ash DW06 (Table 1: stem origin dates calculated as AD1751 and AD1781). Single stem oak DW11 (stem origin date calculated as before AD1798) is also likely to be 18th century in origin but the inner part of the core was lost due to rot in the heart of the tree. It is also possible that the magnificent multi-stem oak DW09 is at least as old as DW10, because its stem origin date of AD1833 is dating regrowth, presumably after it was coppiced, and is not giving us the original sprouting date of the tree which must be rather earlier. Including all three stems, the stool of massive oak DW09 is over 10m in circumference, indicating some antiquity. In form, it is similar to some of the Lochwood Oaks near Beattock where dendrochronology has revealed some tree ages extending back into the 16th century (Baillie 1977; 1982, 104). However, it seems more likely that DW09 is around the same age as DW10 and has undergone several coppice cycles between the mid-18th century and the early 1830s, contributing to its massive footprint.

In Scotland in the late 18th and early 19th centuries there was widespread coppicing of oak, principally for commercial charcoal and tan-bark production (Stewart 2003; Smout at al 2005; Mills et al 2009; Mills 2011; Mills et al 2012), usually involving cutting oak coppices on a 20 to 24-year cycle (Gilchrist 1874). If DW09 shares a similar origin date to single-stemmed oak DW10, then it could have been coppiced around three times before its AD1833 stem origin date. Unusually, though, DW09 is the only old oak multi-stem in Dairy Wood, whereas other oak coppice sites we have studied (eg Mills et al 2012; Mills & Quelch 2019a) have numerous old, coppiced oaks, managed within fenced enclosures or 'haggs' to protect the emerging coppice shoots from grazing damage. The archaeological remains of the enclosure banks are often visible in the old coppice woods. This raises the question as to whether DW09 was always the only oak coppice tree at Dairy Wood or whether other examples could have been lost over time. Alternatively, it is possible it was a one-off, perhaps managed to supply immediate farm needs only. Or perhaps it was managed with other oaks elsewhere on the same landholding, there being other historic woodland more

immediately around 'Erickstane' Farm shown on the first and second edition OS mapping (Quelch 2024, Part 1). We have not surveyed that area.

Recently felled ash DW06 is by far the oldest of the sampled ash trees at Dairy Wood, of 18th century origin, with the other ash dates falling into the early 19th century or later (Table 1). DW06 is a semi-fused multi-stem ash with Stem B on the downslope side rather older (c.AD1751) than Stem A (c.AD1781) which itself has a double centre. One would expect the stems to be more even aged if the multi-stem form was the result of coppicing. It seems more likely that some secondary basal shoots have fused into the original oldest main stem. The form of DW06 may also be influenced by its location on a steep slope.

Single stemmed ash trees DW05 and DW12 and double-stemmed ash DW04 all returned similar early 19th century stem origin dates, between AD1812 and AD1816. It is difficult to say whether this represents an early 19th century planting phase or simply a phase of natural recruitment. If it was not for the fact that DW04 is double stemmed, one would be tempted to identify this cluster of dates as an early 19th century planting phase. However, if DW04 is double-stemmed because it was coppiced then it would have an earlier origin by at least 20 years or so and could not have been planted in the early 19th century. Alternatively, DW04 could be interpreted as two seeds germinating next to each other in the same phase as DW05 and DW12 rather than necessarily having been on older tree which was coppiced around AD1813. All of these early 19th century ash trees could have self-seeded from local older ash trees like DW06, perhaps in a period of abandonment or reduced grazing pressure.

A key question for future historic documentary research is to identify the timings of any major changes of land-tenure and land-use at Ericstane. This early 19th century phase of ash establishment might be indicating such a change. The oldest ash trees around a pre-improvement farm at South Loch Katrine became established in the AD1690s (Mills et al 2009; Mills et al 2012), which period dendro-climatology has identified as the coldest decade in Scotland in the last 800 years (D'Arrigo et al 2020). This climatic downturn followed an eruption of Hekla on Iceland in AD1693 and is known historically in Scotland as the 'Seven Ill Years' when sequential harvests failed, and many Scots died of starvation. Our interpretation at Katrine was that the 1690s generation of ash trees became established at a time of reduced grazing pressure on the land (Mills et al 2009; Mills et al 2012). Perhaps something similar occurred at Dairy Wood in the second decade of the 19th century. Further historical research may reveal more.

Single-stemmed ash trees DW07 and DW08, near the road, proved to have rotten hearts providing incomplete core samples and this precluded obtaining precise ages for them. They were the only sampled ash trees to show signs of rot, and it is understood that they are going to be felled for safety reasons.

The oak and ash would be the most valuable trees present, in historic economic terms, and it is noticeable that they largely cluster in the south-eastern part of the wood. The historic map evidence (Quelch 2024, Part 2) suggests that much of Dairy Wood is located on a former pre-improvement rig field system, intersected by gullies, and that it surrounds the site of a now lost pre-improvement farm settlement a little north of the extant Ericstane farm. The 18th century estate plans indicate a complex land ownership pattern within what is now Dairy Wood, with adjacent farms, and even adjacent rigs, under different ownerships. This aspect will be considered further in a later stage of work, in the planned synthesis of the various strands of evidence regarding the history of Dairy Wood. However, the initial interpretation is that the oldest oak and ash trees identified in this study were in existence when the old rig fields were still in use in the mid to late 18th century and that they had probably been planted on some boundaries between the small fields. The identification of the oak present as *Quercus robur* (rather than *Q. petraea*) in the recent

botanical survey (Averis & Averis 2024) perhaps lends a little more weight to a planted origin. Historic enclosure banks with planted oaks on are known elsewhere, for example at Caerlaverock Castle Wood, where ancient oaks occur in maiden, pollard and coppiced forms (Mills *et al* 2020) and this may have been a more widespread phenomenon in pre-improvement landscapes of south west Scotland.

The other species studied dendrochronologically at Dairy Wood, namely hawthorn, alder and birch, proved to be rather younger than the oldest oak and ash, with either 19th or early 20th century stem origin dates indicated (Table 1). Starting with the hawthorns, the two sampled trees have different forms from each other. Single-stemmed fallen hawthorn DW01 sprouted before 1923, although probably not long before given the fallen tree appears not to have been dead for many years. The multi-stem hawthorn DW02 which has fallen against a stone dyke is a little older, with the sampled dead stem having originated before 1898. These hawthorn trees may have self-seeded here at Dairy Wood and could have spread from planted hawthorn hedges elsewhere in the locality. Hawthorn or 'quickthorn' hedges were a popular improvement era phenomenon. They established quickly and their thorny nature would make them relatively graze resistant. There do not seem to be enough hawthorn trees at Dairy Wood to identify these two trees as elements of lost old hedges.

Most of the old alders at Dairy Wood have hollow, stilted or complex fused forms which are not amenable to tree-ring ageing. The sampled alder DW03 was a rare solid single-stemmed tree, close to the line of the mill-lade, and returned a stem origin date of 1906 (Table 1). One might speculate that this is one of the younger mature alders present with the more complex forms likely to evolve with age. Most of the alders occur on the open slopes, between the gullies, which area would largely have been part of the old pre-improvement field system shown on the 18th century estate plans (Quelch 2024, Part 2). The old alders have probably become established after the pre-improvement small fields system became redundant, representing a likely shift in land-use from intensive mixed farming, including some arable, to a predominantly pastoral land-use, with larger fields bounded by stone dykes, all to be researched further. One can see many tiny alder saplings becoming established on those slopes now, even though the woodland is being grazed by cattle, so it seems likely (although cannot be proved) that the bulk of the old alder trees in Dairy Wood are younger than the oldest oak and ash trees present and are more likely 19th century in origin.

It is worth noting that most of the dendrochronology samples were taken from trees on the open slopes between the deep gullies, and not from trees growing in the gullies. Only the fallen dead birch stem DW14 originated from the slopes of a gully and appears to be a 19th century single-stemmed tree. Few of the individual trees within the gullies appear to be much older than that, but the continuity of woodland cover in those gullies is thought to stretch back far longer.

Thus, the oldest individual trees now present are the most economically valuable oak and ash which largely cluster in the south-eastern portion of Dairy Wood, where they are thought to have been planted in the mid-18th century and managed as 'wood banks' on field boundaries around parts of the old pre-improvement field system. The sketch-like nature of the 18th century estate plans unfortunately means we cannot identify which specific field boundaries or ownerships they are located on, but it is possible that the oak and the ash are on one particular 18th century owner's or tenant's land. The 1830s stem origin date for one stem of the massive multi-stem oak DW09 is interpreted as a last coppice cut of that tree which could have also been planted in the mid-18th century.

In contrast, the more widespread hawthorn, alder and birch are likely to have become established naturally within those old fields after a change of land-use which must have occurred either in the late 18th or the early 19th century. Other research avenues into the history of Ericstane Farm and the Corehead area in that period need to be explored, not least to find out when that changed

happened. That is key to interpreting the dendrochronology results fully. For example, the cluster of three ash stem dates between AD1812-1816 might reflect tree establishment after such a land-use change, although it appears the old oak DW09 was still being coppiced after that time, into the 1830s. Oak coppice materials would be valuable for local use at any date of course.

It seems likely that these lands were unified under Ericstane Farm somewhere within the late 18th or early 19th century period, with a probable shift of emphasis from mixed farming to stock grazing, at which point the old small pre-improvement field divisions would have become defunct and no longer maintained. It would appear that the grazing levels after that change allowed pulses of natural tree establishment to occur into the old field system during the 19th and early 20th centuries. That is quite promising in terms of informing future woodland expansion potential and designing appropriate grazing regimes to maintain the open character and biodiversity of this small but complex historic wooded landscape.

The studied trees were largely on the braes between the gullies, but the gullies, although of a different character with no obviously ancient trees in them, have probably remained the most bio-diverse and wooded parts of Dairy Wood throughout, being least accessible for grazing.

Dairy Wood in context

As Peter Norman's excellent booklet on wood pastures in Dumfries & Galloway shows, the history of any one historic wood pasture is unique and there are many possible trajectories (Norman 2005). In considering Peter Norman's wood pasture types listed under his heading 'Why has some wood pasture survived?' we can see that Dairy Wood does not fit neatly into any one classification but that it shows aspects of the following selected types (quoted from Norman 2005, 8-10), which are labelled A to E here for ease of reference.

A 'Wood pastures of old working farms: Large trees in the middle of fields were not tolerated during 18th century and especially 19th century farming and estate improvements, but some trees escaped this process. Such trees were usually located on the poorer agricultural land where the limited benefits of clearance may have reduced the incentive for removal. Those trees that remain are often on small banks that would have been difficult to cultivate, and sometimes they are associated with clearance cairns … Such trees are therefore probably the remnants of a partial clearance of wood pasture.'

B 'Upland wood pastures: Most upland woods were unenclosed and grazed by sheep, cattle or deer, and may sometimes have been pollarded. Some degraded remnants of these native woods still remain at high elevation as wood pasture, having escaped agricultural improvement, and, more recently, conversion to forestry. They consist of widely spaced trees that are often linked to, or merge into, broadleaved woodland or include patches of natural woodland, particularly in refugia such as cleughs, ravines, crags and islands.' See also Quelch (2010) for more information on upland wood pasture character, history and formation processes.

C 'Medieval Hunting Forests: Hunting was the main recreation of medieval kings and nobles, and a number of hunting forests were established in Scotland, held directly by the Crown or local barons and churchmen. They are often bounded by natural features such as rivers, and are often close to a castle. The trees may have been of natural origin, but there would have been deliberate selection and possibly planting of favoured species.'

D 'Landscaped pastures: During the 18th and 19th centuries some landowners in Dumfries and Galloway planted trees, not only to create parkland around the big house, but also to enhance their wider estates.'

E 'Scrub pastures: There are many examples of scrub pasture across Dumfries and Galloway, and unlike all of the other types of wood pasture listed above, the distribution and extent of scrub pastures may have actually expanded in recent years. In its simplest and perhaps most widespread form the scrub consists entirely of gorse, but other types are dominated by hawthorn, blackthorn, or in rare examples, juniper.'

Thus, we can see various aspects of the above five categories represented in Dairy Wood. Like (A) some old pre-improvement farm trees have survived, possibly on now indiscernible pre-improvement field banks. Like (B) Dairy Wood has escaped forestry plantation and is used rather like an unenclosed upland wood for grazing now, with fairly free movement of cattle through it but, significantly, it lacks any obvious pollards which perhaps indicates that it did not originate as an unenclosed upland wood pasture. Regarding (C), we know that Upper Annadale was indeed part of a baronial medieval hunting forest, but what we cannot yet discern is the connection between any earlier woodland cover and the oldest trees now present. Could the oldest surviving oak and ash be descendants of an even older lost generation of medieval trees? Category D could be relevant to the origins of the apparently planted older trees at Dairy Wood, with Corehead and Ericstane being rather higher status places in the past than is evident now, and there may have been an enhancement objective as well as economics behind the planting of oak and ash in certain locations. It is even possible that tenant farmers were required to plant trees as part of their farm lease. The spread of species like hawthorn and alder over the 19th and 20th centuries into the old field system at Dairy Wood fits very much into the definition of 'Scrub pastures' at Category E.

The more such sites we study, we see that there is rarely one simple answer to explain a historic wooded landscape, and that small old woods can be amongst the most complex and interesting of all. We can see this complexity and diversity at other old woods we know in the region. For example, at Lochwood near Beattock, which originated as a hunting reserve around a castle, there has been continual woodland presence since at least late medieval times (Baillie 1977; Baillie 1982; Norman 2005, 9) and some of the old oak tree forms do look deliberately managed. Similarly, at Caerlaverock Castle Wood there has been some tree cover since at least the 13th century, as recorded in the pollen record, with historic coppicing and pollarding in evidence in the surviving oak forms (of as yet undetermined age), mostly growing on early enclosure banks. However, Caerlaverock Castle Wood has probably never been so wooded in the past as it is now and would have been a far more open series of enclosures and fields with wooded banks between them in late medieval and post-medieval times (Mills et al 2020).

Elsewhere in Dumfriesshire, our study at Barhill Wood, beside Kirkcudbright, revealed that the landscape was pretty devoid of tree cover by the mid-18th century, and that Barhill Wood originated as a late 18thcentury plantation with a very wide range of species planted then and subsequently coppiced into the early 20th century (Mills & Quelch 2019b; Mills et al 2022). However, agricultural needs were incorporated from the start. Only the rocky knolls were planted leaving small, sheltered grazing paddocks on the better land in between in a more distinct separation of woodland and farming than is indicated at Dairy Wood. A theme emerging from a number of case studies in south west Scotland is the co-existence of woodland and farming over a very long time.

Concluding remarks

If we were to travel back in time to the mid-18th century, it is unlikely that we would recognise Dairy Wood as a wood. More probably we would see it as the lands of a busy farming township, divided into rigs and small fields, with some useful trees growing on the field boundaries and the most densely wooded areas being in the gullies, as they are today. The character of a wood pasture has been acquired in the spread of trees into the old small pre-improvement fields after their abandonment, as the land-tenure changed from multi-occupancy to a single farm unit, and as

it shifted to a more predominantly pastoral use. Further research into the timing of that change and the history of the owners, tenants, farms and land-use is desirable to allow a fuller interpretation of the tree-ring evidence and a better understanding of the history of this special place. Research into the woodland cover in deeper time here is also warranted, to be able to visualise the landscape before the oldest trees now surviving, and especially to research any connections to Upper Annandale's medieval hunting forest history.

Nonetheless, the tree-ring study has allowed a precise chronological framework to be established for the old trees in Dairy Wood over the last three centuries and it has allowed different phases of this cultural wooded landscape's evolution to be teased out. Perhaps the most important point to emerge from this tree-ring study of Dairy Wood is that, over the last few centuries, the results indicate an evolution from fields to wood, and not the other way round as one might usually expect from something labelled an 'ancient wood pasture'. The results therefore indicate that farming and woodland establishment can, and probably should, co-exist here under a relatively benign grazing regime.

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