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SCOTTISH WOODLAND HISTORY DISCUSSION GROUP

NOTES VI

SIXTH MEETING – WEDNESDAY 28TH NOVEMBER 2001

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Fiona Anderson, Editor of *Tree News* (the journal of the Tree Council) would be glad to add any members of SWHDG who wish it to the mailing list to receive future issues. It is a lively publication, full of items of interest to members. Write to her at The Tree Council, 51 Catherine Place, London, SW1E 6DY.

Front cover photograph: semi-natural oakwoods, Sleat peninsula, Skye.

C O N T E N T S

C O N T R I B U T O R S

Wednesday 28th November 2001

ALEXANDRA AND BRIAN COPPINS
(Lichen Consultants)

PROFESSOR JIM DICKSON*
(Environmental and Evolutionary Biology, Glasgow University)

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DR JAMES FENTON
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JIM KIRBY
(Sunart Oakwoods Research Group)

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(Consultant Forester and Forest Ecologist)

JOHN MITCHELL
(Independent Researcher)

***Unfortunately Professor Dickson was unable to provide a synopsis of his talk.**

INTRODUCTION

FIONA WATSON AND CHRIS SMOUT

For the first time in the six years of the Scottish Woodland History Discussion Group, we did not focus on a single theme, but instead sought to highlight areas of interest which we have not hitherto tackled, and also to hear about ongoing woodland projects. The morning's sessions covered a range of ecological topics, all of which help us to understand better the truly magnificent complexity of a forest ecosystem. The afternoon's sessions were devoted to reports on current woodlands from across the country, a feature that we would like to see continue. If obvious themes suggest themselves (or are suggested to us!) we will revert to giving a definite focus to our meetings. Otherwise, it seems sensible to highlight the range of work going on within the extremely broad church of Scottish woodland history.

The first paper, by **Sandy** and **Brian Coppins**, was ostensibly about lichens associated with the Atlantic hazelwoods. However, as the tale progressed, it became clear that this was a much bigger story, in that to understand the lichens, it was necessary to understand the ecosystem as a whole. And in doing so, it became clear to the Coppinses that one common assumption about hazel was not substantiated by their investigations: the high quality lichens to be found in the best Atlantic hazelwoods would not have survived if their hosts had been systematically coppiced. They therefore concluded that hazel effectively coppices itself naturally. This is only the bare bones of a most fascinating and complex story, beautifully illustrated and convincingly argued.

The second paper, by **James Fenton**, asked us to consider the current understanding of the dynamics of woodland cover over the past 800 years or so. We are now well aware of the essential mythology relating to the Great Wood of Caledon but this paper also asked us to consider that we may not have truly understood the problems of regeneration over more recent centuries. A number of factors were considered, some anthropogenic and others natural, which led the author to conclude ultimately that cause and effect were a difficult business but one should not automatically presume that human activity was the prime mover of deforestation in this period at least.

Scott Wilson then tackled the equally daunting task of relating the species composition of Scotland's forests to ecological site factors, considering also how we might make best use of the current ecological situation for future forestry. The essence of this controversial paper involved taking a sufficiently broad view of the subject to at least debate the possibility that some introduced species – particularly spruce, fir, beech and sycamore – are better adapted to grow in some more marginal parts of Scotland than native species. It could be argued that this would permit more 'natural' growth, since less intervention would be required over the longer-term.

The morning's final paper introduced another aspect of woodland ecology which is perhaps as underexplored as lichens: fungi. The essential point of the talk by **Ernest & Valerie Emmett** was to illustrate how fundamentally important these often invisible inhabitants of the forest floor are to the trees and plants surrounding them. The Mycorrhizal Fungi in particular plays an essential role in the health of the whole ecosystem by promoting the transference of nutrients to the flora. It was also pointed out that, though fungi are a fundamental part of forest biodiversity, they are notoriously difficult to catalogue because they do not fruit very regularly. However, none of the audience will be able to ignore them in future.

The afternoon's papers began with a fascinating illustrated talk by **Christopher Dingwall** on his recent work on Callendar Wood, Falkirk. As a remnant of an ancient woodland which has managed to survive within the same boundaries since the middle ages, Callendar Wood should be better-known, and appreciated as a comparative rarity in the lowland landscape. Anyone interested in woodland history would find it well worth a visit, not least in order to see what the many multi-faceted layers of its history, as described by Christopher, now look like on the ground.

Like Callendar Wood, the Sunart woodlands, again beautifully illustrated and described by **Jim Kirby**, make it perfectly clear that semi-natural woodlands, as a matter of course, have always undergone considerable change over time, however ancient they might look today. Jim also made it clear that a good understanding of their history enables us to appreciate their current condition far more and to make management decisions from a more informed standpoint. Again like Callendar, the Sunart woodland history is an extremely long and complex one and underlines the close relationship between the trees and the people who lived in the area.

Finally, **John Mitchell** treated us to a comprehensive trip round the Loch Lomondside woods, making the obvious – but underrated – point that there is far more to them than just oak. However, the concentration on oak, as well as the continuation of practices, such as intensive grazing in the uplands, does mean that some of these other types of woodland are not in as good a shape as they might be. Once again we are reminded of the need to view our wooded landscape holistically and to value more than just oak and pine.

SCOTTISH ATLANTIC HAZELWOODS:

SOME OBSERVATIONS ON THE ECOLOGY OF THIS NEGLECTED HABITAT FROM A LICHENOLOGICAL PERSPECTIVE

ALEXANDRA (SANDY) & BRIAN COPPINS

This paper concerns a neglected British plant, and a neglected habitat type that is almost unique to Scotland and of comparable, international importance to the much acclaimed machair. The plant is *Corylus avellana* - the Hazel. The habitat type is the Atlantic Hazelwood - found mainly along the coast of Western Scotland, from Knapdale in the South, to southern Sutherland in the North, but with a few examples in Western Ireland. Although they have been with us for 9000 years, the Atlantic Hazelwoods do not fit comfortably into any NVC community type, nor do they figure in the EU Habitats Directive.

Our interest and recognition of this habitat evolved from the study of the lichen flora of western Scotland. The story begins in the late 1970s, early 1980s when Brian began to look carefully at hazel as a host for lichens. He soon became aware that among his collections were many unidentifiable yet distinctive species. Subsequent study revealed that some of these species were new to Britain or Europe, and others were new to science. However, even in the Western Highlands and Islands, these species were not found everywhere on hazel - they were virtually absent from hazels under the canopy of oak and always absent from hazel stands that have developed from clear-cutting or had invaded open ground during the last 50-100 years or so.

The best hazels for lichens are found in woodlands where hazel forms the dominant canopy, on ridges and knolls or slopes close to the sea, or in steep ravines, also near the sea. Prime examples are found at Ballachuan (on Seil), south of Drimnin (Morvern), Struidh Wood (east coast of Eigg), and the Resipole ravine (Sunart).

A striking feature on entering a hazelwood is that thin, apparently ‘bare’ stems are white in colour - not hazel-brown. Closer inspection (especially with a hand lens), reveals that the white coloration is in fact a mosaic of small crustose lichens, some silvery white, some almost pure white, and others creamy-white. Some have black dots scattered on the surface, and others small lines like scribbles. It is this last group (the ‘script’ lichens) that lends the name to this group of crustose lichens - the *Graphidion scriptae* community (or *Graphidion* for short). This community occurs world-wide, but in the British Isles comprises about 65 species overall, of which about 20 can be considered ‘specialist’ species in that they are confined to Atlantic woodlands, especially hazelwoods. Some of these species are apparently endemic to the British Isles, and one of them, *Graphis alboscripta*, has so far not been found outside of Scotland. Several of these lichens are BAP (Biodiversity Action Plan) species, which means they are undergoing special study to understand their present status. Some species of the *Graphidion* also have their own host specific fungal parasites, which are even more restricted in distribution; e.g. *Arthonia cohabitans* on *Arthothelium macounii*, and *Opegrapha brevis* on *Thelotrema petractoides*.

A feature of these thin stems with their cover of smooth, crustose lichens is that rain-water drains fairly rapidly down the stems. When it stops raining, the stems dry very rapidly, and *Graphidion* lichens appear well-adapted to these alternating wet and dry conditions. On walking further into the hazelwood, where conditions are more shaded and humid, the hazel stems (or at least the older ones), appear darker and much more ‘mossy’. These stems have become colonized by bryophytes, such as *Frullania*, allowing larger, leafy-lobed lichens to get a hold. It is these lichens that are more familiar to the casual observer. They include species of the genera *Lobaria*, *Nephroma*, *Pseudocyphellaria*, *Sticta*, *Degelia*, *Pannaria* and *Leptogium*.

All these lichens have blue-green algae (more correctly, cyanobacteria) as their photosynthetic partner. A physiological feature of the cyanobacteria is that they not only fix carbon from the air, but also nitrogen. Thus, when in abundance the lichens containing them play an important role in the nitrogen-cycle of the ecosystem.

What is also striking in the Atlantic Hazelwoods is the dearth of many larger lichens that have green algae as their photosynthetic partner and which are common and abundant in nearby woods dominated by oak or birch. These include the grey, leafy Parmelias, e.g. *Parmelia laevigata*, and the shrubby, coralloid *Sphaerophorus globosus.*

Without a detailed knowledge of lichens, how do you know if you are in a "good" Atlantic hazelwood? One way is to attend one of the regular lichen courses run under the auspices of the NWDG (Native Woodlands Discussion Group) and AGWA (Argyll Green Woodworkers Association) and get to recognize a few key species. Another way is to keep an eye out for the orange fungus, *Hypocreopsis rhododendri* ('Hazel gloves') (but absolutely nothing to do with *Rhododendron ponticum*!). This fungus somewhat resembles a lichen in that it forms thick, rubbery-orange rosettes, with fingers or radiating lobes that clasp round hazel stems (sometimes also nearby stems of blackthorn, rose and willow). It is also a BAP species, and in Western Scotland is an excellent indicator of a "good" hazelwood, although it has so far not been recorded north of Eigg.

In a global context, it is interesting to note that the "good" Atlantic hazelwoods have an abundance of crustose lichens belonging to the *Graphidaceae* and *Thelotremataceae* families found on smooth bark, and a preponderance of larger lichens with cyanobacterial partners on the older, mossy stems and branches. Where else in the World can the same combination (if not necessarily the same species) be found? - the Lowland Tropical Rain Forests!

Indeed, there is one species, *Parmentaria chilensis*, found in Resipole Ravine at Sunart, and in a small ravine on Mull, that has sub-tropical distribution in Central and South America, with outliers in Macaronesia, a couple of ravines in the western Pyrenees and a few woods in SW Ireland.

Why are the Atlantic Hazelwoods so good for their lichens?:

1. mild oceanic climate - benefits of the Gulf Stream
2. inherent characteristics of hazel bark
3. geographical location - still largely unaffected by atmospheric pollution
4. ideal levels of illumination and ventilation within the woodland
5. the peculiar characteristics regarding the dynamics of hazel stools
6. the management history of the woods

The last two aspects are further discussed below.

Part of the remit when preparing species dossiers of some of Scotland's rare lichens on hazel for the Biodiversity Action Plan process was to make comments on the habitat and ecology of the species under scrutiny, and to recommend the appropriate management for the habitat. To understand the dynamics of the lichen, we first needed to know about the dynamics of the habitat, and more specifically - the dynamics of hazel itself. Because of difficulties in locating literature on the way hazel behaves, we have attempted to formulate possible hypotheses based on casual observations we (and Peter Quelch) have made over the years.

Pollen evidence

We know from the pollen evidence that hazel was one of the first woody species to invade western Scotland in the early Holocene (Birks 1989). The pollen evidence also suggests that pure hazel scrub covered significant areas for a substantial period, perhaps 1,000 years (Birks 1989, McVean 1964). Today, remnant stands of pure hazel (exclusive of a tall tree presence) are still a feature in some places, especially in coastal areas of the western Scottish Highlands, suggesting the continual presence of an ancient relict habitat of nearly some 10,000 years (Birks 1989).

Are all of today's significant stands of hazel former coppice?

Literature searches on the ecology of hazel revealed that there was very little written about hazel *per se*. If hazel is noticed, or mentioned, it is dismissed at best as “scrub”, or “understorey”, or (the universal favourite) “hazel coppice”, and at worst as “neglected hazel coppice”. There does appear to be a mind-set in describing *Corylus avellana* as “hazel coppice”. It is true that hazel lends itself admirably to coppicing, and the uses to which hazel has been utilized over the centuries are many and varied. The classic coppice-with-standards practice in lowland southern England is recognized as a form of management that gives rise to herb-rich ground floras, supports high diversity of insects and birds, and as such is elaborately described in glowing terms in all handbooks of ecology and woodland management. Hence, students and woodland managers are swayed into thinking that this is the way in which hazel always has been - and should be - managed, so that all stands of hazel, wherever they occur, are automatically regarded as “hazel coppice”. Indeed, there are still some ecologists who believe that hazel will die out if it is not regularly coppiced. Well, this is patently not the case.

The coppice question did present us with some problems: on the one hand, Atlantic Hazelwoods represent an ancient, relict habitat but if, as we are led to believe, all hazel present today was formerly coppiced in the past, then we are left with a dilemma. We know from the work of Francis Rose (Rose 1976, 1992) and others, that certain critical species of lichens require long periods of ecological continuity. When a hazel stool is coppiced, all the lichens which occur on the hazel go with the cut stems. The stool will regenerate, the ground flora will recover, the woodland birds and insects will return as the hazel matures, but not the “old woodland” lichens. True, some lichens will colonize the stems, but these will be the common and widespread species, the “weeds”.

Hazel dynamics - a proposed scenario based on lichen evidence

A typical hazel stool has a cluster of thin, medium and thick stems. The smooth-barked young stems are colonized by a distinctive community of crustose lichens (the *Graphidion*). As these stems become older and thicker, the bark roughens, and crustose lichens give way to bryophytes and foliose lichens of the *Lobarion* community. The ageing stems tend to gradually lean outwards, probably from the weight of the canopy they support. This creates a gap in the overall canopy, which enables new, young stems to arise and fill the space. Damage to the canopy from winter storms will break off canopy twigs, and abrasion from stems rubbing together in windy weather allows fungal pathogens to attack, and gradually kill off individual stems. This all leads to a considerable turn-over of stems within a stool.

New stems (whips) appear to be produced every year. Initiation of new stem production may be triggered by short periods in the spring, when light conditions are favourable, but if the canopy above is closed, then these stems will abort by late summer, due to heavy shade created once the existing canopy is in full leaf. But, if a gap is present, then they are ready to grow rapidly and fill it. The new stems appear to act as a sort of “fail-safe” strategy to ensure the viability and perpetuation of the stool. Therefore, it is clear, that each stool is a self-perpetuating ecological unit, with always some young, smooth-barked stems (supporting crustose lichen communities), and generally always some older stems, supporting the leafy-lobed lichen communities. Hence, the value of a hazel stool for lichens. There is always this continual cycle of replenishment, which is so critical for retaining the ecological continuity required by the more specialized “old woodland” lichens, and why old Atlantic Hazelwoods in western Scotland support endemic species.

However, the plot thickens, as hazel stools in different situations tend to behave slightly differently**;** on deep soils in sheltered conditions, the stools tend to be large, well-grown and widely spaced, often with the canopies of adjacent stools meeting, giving rise to widespreading canopies (e.g. 6.5 m diameter). In these situations, the canopy can be up to 6.0 m high. Stools in these situations tend to support mostly shade-tolerant “old woodland” lichens of the *Lobarion,* with the more light-demanding species of the *Graphidion* only poorly represented. There are a large number of stems per stool, ranging from thin, spindly ones, to very thick, woody ones, the latter often becoming almost horizontal. The canopy twigs of these old stems gradually adjust to vertical as the main stem assumes a horizontal position. Hence, when the old stems eventually collapse, the canopy twigs are often well above browsing height. In some cases, layering of the collapsed stem takes place, and new stools are formed, but this is only successful if there is a “space”, as competition for light is the prime factor controlling successful hazel establishment. Within a closed stand of hazel, the shade created by summer canopies in full leaf is extremely dark, which maybe explains why tree seedlings are unable to establish and are rarely encountered.

In more exposed situations on thin soils (the typical slope hazelwoods), stools tend to be closer together, much smaller, and composed of a few thin to medium-sized stems, with rarely the thick woody stems present. In these situations, the *Lobarion* is often species-poor, with the *Graphidion* dominant on the smooth-barked young stems. Depending on exposure, the height of the canopy is 1–3 m. There is a rigidity within the stand, with a tight, interlaced network of small twigs, which means internally it is very sheltered, although the outer twigs are often wind clipped and distorted. Turn-over of stems appears to be far more frequent, with the oldest stems being only 12–15 years old (we have found - as a very rough rule of thumb - that 1 cm girth approximately corresponds to 1 year of growth).

Do hazels eventually die, or do the stools get bigger?

We know that where oak has been coppiced over many centuries, the resulting stool enlarges, with individual coppiced trunks forming a sizeable ring around an open central space (Quelch 2001). From observations particularly at Ballacuan Hazelwood, but also on Mull, we have seen what we believe are hazel "rings" - a bit like the fairy rings formed by fungi in old meadows. These are best developed on gentle slopes or flat ground in the intermediate zones, between the exposed slopes and the sheltered, deep soils on damp ground. Are these evidence of ancient hazel coppice?

At Ballachuan and on Mull, there are examples of circles of "satellite" stools around an empty space, which can measure from 1.10 m in diameter to 2.30 m. (Coppins & Coppins 2000a,b). Intermediate stages of this open circle formation were also detected. About the same time that we were pondering over the implications of this, Peter Quelch was photographing similar hazel stool rings in Scandinavia, and tentatively coming to the same conclusion**:** that these satellite stools may have evolved through a gradual outward expansion of new stems at the edge of a "mother" stool until a point is reached whereby the centre of the stool becomes too shaded, and central stems are not able to replenish this space, due to canopy shade from the outer, more vigorous stems. The root stock at the centre of the stool may also become exhausted.

The potential extrapolation of this method of vegetative reproduction has interesting implications if taken to logical conclusions**;** whole series of rings of satellite stools could perhaps be plotted, many overlapping with adjacent rings, and satellite stools themselves could in turn, eventually become "mother" stools, and form further rings. Genetically-related groupings could be traced and plotted, which could lead to conclusions about the ecological history of the stand. Where hazel reproduces by seed, there will be genetic variability, but where it reproduces vegetatively (by spread of stool area or by layering), then is it possible that some hazel stands may represent genetic relics that originated thousands of years ago? In an extensive hazelwood such as Ballachuan (27 ha), the implications of such long-term stand integrity go some way to explaining why this site today is of international importance for its lichen flora.

Other questions then followed, such as "how old are the stools". Again, Peter Quelch came up with a paper from an ecologist in Finland (Hæggström 2000), who had attempted to date hazel stools by applying systematic calculations relating to ages of stems and basal girths. He arrived at an amazing age of 990 years for his oldest stool. Hæggström also noted the tendency of hazel stools to form open rings.

But where does all this fit in with coppicing?

Of course hazel has been extensively utilized by man over the centuries, as is demonstrated from the archaeological Wetlands Project carried out on the Somerset Levels (Coles & Coles 2001). Several wooden trackways were laid across marshy ground in prehistoric times between the Polden Hills north to high ground at Westhay and Meare. One of these trackways is dated to 2,900 BC (around 5,000 years ago) and is late Neolithic. It is constructed of hurdles woven from hazel. Approximately 1,000 hurdles were used, and later repairs were added with further hurdles (Brunning 2001). Careful analysis of the stems that were used to construct the hurdles revealed that although they are all of a similar diameter, they are not of a similar age, and it was proposed that the individual hazel stems were cut on a selective basis (by drawing), from stools, rather than as a result of complete coppicing (Morgan 1982).

This practice has several advantages**:**

(1) it reduces the effort of cutting a complete stool simply to obtain the few stems of the required size. Conceivably, though, the unused cut wood could be used as fire-wood.
(2) leaving the stool more-or-less intact would stimulate new stems to grow quickly, and straight up to the light to the gaps in the canopy left by the selective cut. This would mean that the stool could be selectively cut again at an earlier time, even the next year, when stems too small for the first year would have thickened up. In comparison, complete coppicing requires a gap of at least seven years before the complete new growth is sufficiently developed into straight-grown stems, suitable for hurdle making. The stems remaining in the stool would afford some protection from browsing animals.

(3) Selective cutting (or Drawing) would reduce the distance involved in walking to new locations to find suitable stools for the next round of hurdles.

(4) Selective cutting would ensure that the older stems were still present, and these are the nut-bearing stems, providing an important additional food source for late autumn.

(5) Selective cutting would ensure that nearby stands of hazel were retained as shelter for flocks in the winter (not relevant perhaps in Neolithic times, but certainly an important feature and requirement for later farming communities).

(6) Complete coppicing requires some substantial, labour-intensive method of protecting the coppiced stools from browsing animals to ensure continuing viability of the stool.

The recent experimental coppice plot at Abriachan Wood near Drumnadrochit, on the west side of Loch Ness demonstrates an example of modern-day conservation in action, following the belief that hazel needs to be coppiced (Coppins & Coppins 2001). Several stools have been completely coppiced and the site enclosed against grazing by erecting a palisade made from hazel stems. A great deal of effort has gone into making the protective palisade, and used an awful lot of the cut product to build it. On the evidence of this experiment, this method seems to be counterproductive, as the net result in numbers of useful stems obtained for other purposes would surely be too few to justify.

Evidence for selective cutting
The evidence of the lichen flora in many of the stands of western Scottish hazelwoods strongly suggests that they were not coppiced in the past, but have retained integrity over a very long period. These stands, where they are not over-topped by trees, retain a closed canopy, and appear to have a self-regulating system of continual replenishment, and support unique lichen assemblages found only in western Scottish and Irish coastal hazelwoods.

The selective cutting method is, we believe, the method that was widely used where extensive stands of pure hazel occur in western Scottish Atlantic Hazelwoods. This method retains the majority of stems within a stool, and as such it inadvertently retains the necessary ecological continuity that the associated lichen flora requires, which may be why these western Scottish hazelwoods are so important today.

It may not be the whole story, as there is documentary evidence (e.g. for the Portalloch Estate in Argyll) that large areas of hazelwood were intensively harvested to provide hoops for barrels: “February, 1836, 51 men did 700 man-days cutting wands and hoops” (Gordon Gray-Stephens, pers. com., quoting from Estate Papers GD43.80.96). But even here, “cutting wands” could imply selective cutting of stems suitable for splitting to make barrel hoops. Certainly, the value of hazel as shelter for flocks, as well as the needs of local people for this useful commodity of everyday life, would probably have precluded all hazel being intensively managed in this way in a given area.

Another factor in the life of hazel is the effect of long-term grazing on the stool. This is a fascinating field of study, but will have to be the subject of another talk at another time. Suffice it to say that hazel deserves to be more widely appreciated and recognized. Apart from the lichen evidence, the comments and conclusions discussed in this paper are purely theoretical and untested, but are set out to provoke discussion and hopefully to promote more detailed research.

- Hazel should not be used with the epithet "coppice" unless there is strong evidence to support the fact that stools or stands have been managed as coppice in the past, or are currently being so managed.
- Hazel should be recognized as a valuable component in its own right where it occurs within a woodland.
- Where hazel stands occur at the edge of a woodland, or form stands in what is termed "scrub" development, they should be recognized as having high ecological potential for a variety of associated wildlife, particularly lichens and bryophytes.
- Stands of hazel without trees should not necessarily be regarded as areas of degraded woodland, or dismissed as secondary scrub development. There is the possibility (especially in coastal areas of Western Scotland and Ireland), that stands of pure hazel form an ancient relict habitat that dates back to post-glacial times, with important implications for genetic integrity and associated epiphytes.
- Where stands of hazel occur without a significant presence of trees, it is not desirable to introduce trees within the stand, as this will lead to a degradation of the established hazel habitat, and an overall loss of diversity.
- Precautionary advice is that hazel should not be coppiced as a general management practice, especially in the Scottish Highlands. We are currently working towards providing guidance for assessing the potential ecological importance of existing hazel stands, using one or two "indicator" species, but until this is ready, we would advise that selective cropping of desirable stems from individual stools should be carried out rather than wholesale coppicing.

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[Our attention has been drawn to a forthcoming paper (Tallantire, P.A. (2002) The early-Holocene spread of hazel (*Corylus avellana* L.) in Europe north and west of the Alps: an ecological hypothesis. *The Holocene* **12**(1): 91–106), as perhaps throwing more light on our own hypotheses. However, having obtained a proof copy, we find there is extremely useful data on how hazel spreads under various climatic regimes, etc., but again, no consideration given as to long-term behaviour of individual hazel stools.]

JAMES FENTON

Introduction

Often it is true that what we hold in our imagination has more sway than the evidence presented by our eyes. For example, I have seen examples in the Pennines where muirburn is obviously causing heather loss, but the gamekeepers still burn because "that is what you do promote heather"; the mantra that "burning is good for heather" is so ingrained in their minds that it can override evidence to the opposite. Might the same not apply to our image of what the Highlands "should be like"? The image of the Great Wood of Caledon is so powerful that it can blind us to the possibility of considering other models. But maybe it is an image that is outdated.

Indeed, Chris Smout starts chapter two of his book *Nature Contested* with the comment "Let us begin with the Great Wood of Caledon. It is, in every sense of the word, a myth" (Smout 2000). Also, in relation to montane scrub, Duncan Poore states "there is little evidence that there was extensive scrub on the mountains within the current climatic period" (Poore 1997).

If you look, for example, at John Farquharson's 1703 map of the 'Forrest of Mar', covering a large area of the eastern Cairngorms, this presents no evidence that the extent of native woodland was any greater then than now. However, if there had been major anthropogenic loss of this woodland over the past 300 years, you would have expected more woodland relicts to have been present in 1703. The fact that they are not present must mean that conditions have been unsuitable for regeneration of woodland for at least the age of a tree, say 300-500 years for pine. This takes you back to the period 1200-1400, and indicates the area has been largely unwooded for many centuries.

Why is this? Let's not forget that it includes a period when wolves were present, and it is likely that wolves would have prevented major congregations of herbivores, and so would have benefited woodland regeneration. The reasons for woodland loss of much of upland Scotland are not clear-cut, and this paper looks at the some of the doubts and the certainties surrounding long-term woodland dynamics in upland Scotland.

Doubts and certainties of woodland dynamics.

The table below lists some of these doubts and certainties. The certainties are based on direct observation as well as research, and the fact that some are contradictory indicates the complexity of ecology. In what follows, an attempt is made to resolve some of these contradictions.

DOUBTS	CERTAINTIES
What was the main cause of woodland decline prior to 200 years ago? Is woodland or moorland/peatland the climatic climax? Indeed, is the concept 'climax' valid? Are non-woodland communities able to outcompete woodland for long periods of time (eg. Calluna, bracken, peatland) Is it possible to elucidate a logical rationale to explain the complexity of nature? Or is there an inherent unpredictability? What have been the grazing levels prior to 1800? & what species? What would have been the role of wolves (& lynx) & other now extinct species? Would beech by now be a natural component of Scottish woods? Is Norway a relevant model?	*c.*200 years ago Scotland had *c.5%* woodland cover Native birchwoods *can* regenerate with heavy grazing Native birchwoods *cannot* regenerate with heavy grazing Native oakwoods *can* regenerate with deer grazing Native oakwoods *cannot* regenerate with deer grazing Native pinewoods *cannot* regenerate with no grazing Native pinewoods *can* regenerate with no grazing Regeneration following a relaxation of grazing *generally* comes initially from growth of suppressed trees rather than new seedlings Many species of trees will survive in many different habitats if planted Persistence of a population depends on ability to regenerate, and on ability of offspring to survive to maturity Norway has lots of trees!

Like any species, trees can only survive in an area if they can successfully regenerate, and again the factors controlling this are complex. The fact that a tree can grow in a given area if planted is no guide as to whether a given tree population can sustain itself in an area.

For trees to survive, there needs to be:
1. Seeds produced
2. Seedling germination
3. Seedling survival
4. Sapling survival to maturity

Factors affecting the above, either singly or in combination are:

Light	Mycorrhiza
Moisture	Pathogens/disease
pH	Seed viability
Soil nutrient status	Genetic make-up
Temperature	Grazing (from insects to mammals)
Competition with other plants	

Grazing is obviously a major factor, and either heavy grazing or light grazing can mitigate against tree regeneration. Particularly on organic soils, low grazing can result in a dense litter layer in which seedlings cannot establish. This is illustrated in Fig.1, which shows that once the mineral soil is covered by organic layers, then regeneration becomes more sensitive to grazing pressure, and it is possible that, during the lifetime of a tree, the optimal grazing level for the woodland is not achieved; over a long timescale it can be seen that this can cause woodland decline. Fig.1 also shows that peatlands are buffered against grazing, being able to sustain themselves whatever the herbivore numbers (although their low palatability means that herbivore numbers are rarely high; additionally, very high grazing levels can also instigate peat erosion).

In upland Scotland, after the large release of available nutrients brought about by glaciation and periglacial activity, the climate tends to result in soil leaching and increased acidification, especially as the parent material tends to be nutrient-poor. Increased acidification results in less decomposition, perhaps largely brought about by the soils becoming too acid for earthworms. Unmixed soils (podsolisation) tend towards peat formation (accumulation of undecomposed organic litter), and there is also a feedback loop as the organic litter tends to hold moisture, resulting in even less decomposition and waterlogging.

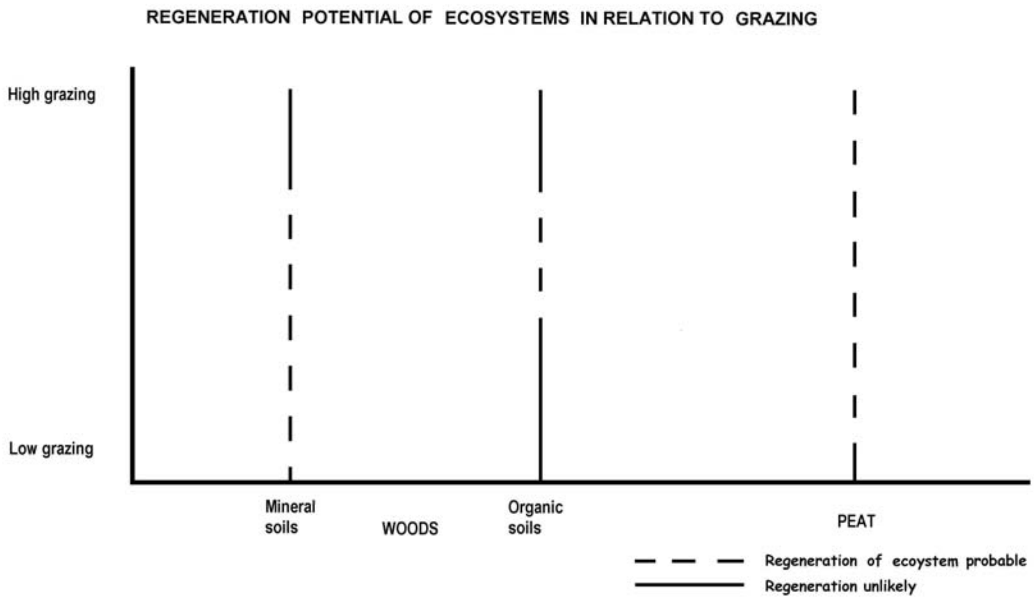
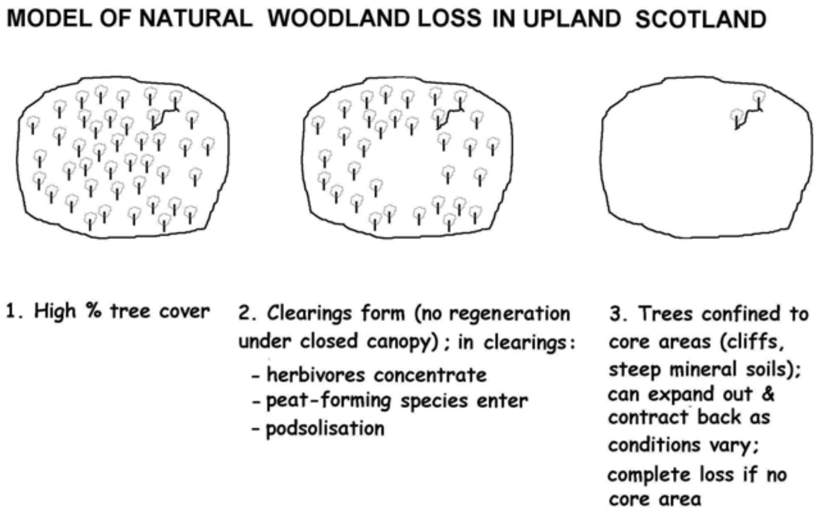


Fig.1

Fig.2 illustrates how these factors can lead to woodland loss. It also shows that many relict woods have 'core areas' where regeneration can continue whatever the overall grazing level; these areas can be very small, only supporting a few trees, consisting of areas where mineral soils can sustain themselves and/or grazing is low or absent (Fenton 1985). If trees have retreated to the core area, they can expand out again if conditions change – for example, if a period of high grazing (exposing mineral soil for seedling establishment) is followed by a period of low grazing. However, where there is no suitable core area, trees can vanish from the landscape.

Fig. 2



Models of woodland loss

Fig.3 shows two possible models of woodland dynamics in upland Scotland. The "climax model" is one where, once trees cover the landscape, then, without human intervention, the woodland sustains itself in perpetuity. The other possible model is one where, after peaking, there is long-term woodland decline, for some of the reasons discussed above. Climate change has also, of course, played a part, either encouraging or discouraging woodland, increased oceanicity particularly discouraging woody species (Crawford 1998). However, it is possible that the ecological trend is towards the vegetation community that is most buffered against environmental change, eg. peatland (Klinger 1994), so that once this 'climax' is reached, further climate change, unless extreme, will have little impact.

Hence, it would appear that the natural decline model would fit the facts best. However, there is no doubt that there has been anthropogenic loss of woodland in parts of Scotland, but, as Fig.3 shows, this may in many cases have only accelerated a natural trend, and not made any ultimate difference to the open nature of the Highland landscape.

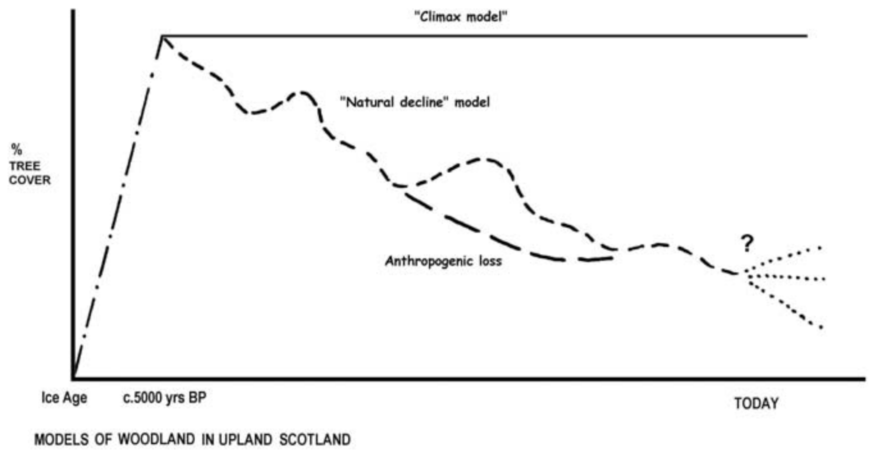


Fig. 3

Fig.4 attempts to summarise the distribution and dynamics of woodland at the landscape scale, particularly for north and west Scotland. Many of these issues are discussed in more detail in my paper in *Scottish Forestry* (Fenton 1997).

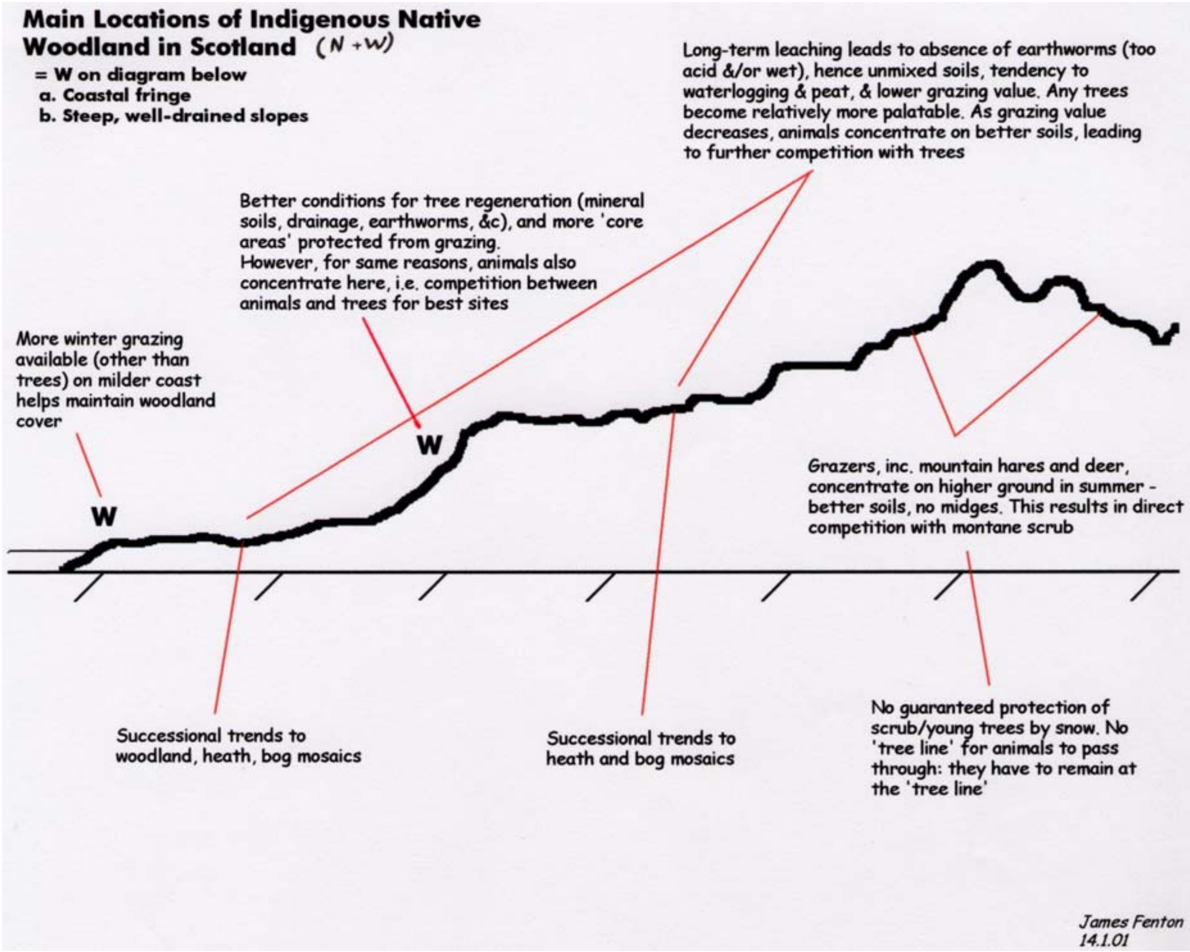


Fig. 4

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RELATING THE SPECIES COMPOSITION OF SCOTLAND'S FORESTS TO ECOLOGICAL SITE FACTORS: PAST, PRESENT AND FUTURE

SCOTT McG. WILSON

Introduction

Much effort in Scottish forestry is currently being devoted to the restoration of "new native woodlands" on sites that have not carried native trees for centuries or millenia. It is widely assumed that the species composition of natural forests that existed in Scotland at the mid-Holocene climatic optimum (~ 6,000 years B.P.) provides an appropriate ecological template for such projects. The establishment of new forests consisting of tree species that have not been native to Scotland during the Holocene is usually now regarded as less ecologically appropriate. Consequently, attempts to remove "exotic species plantations" are also being pursued in many parts of Scotland. This paper seeks to make an ecological case for maintaining a wider perspective on the selection of tree species for establishment in Scotland, drawing on those many tree genera that have been present in Europe during the Tertiary and Quaternary eras. It is argued that such a pluralistic approach to species selection would offer greater future opportunities to use the range of Scotland's forest sites to their full ecological potential and to meet society's diverse requirements in terms of the economic, environmental and social benefits of forestry. In advancing this case, the development of understanding as regards the matching of tree species to ecological site types in Scotland is reviewed.

Natural forest species composition before the Holocene

The species composition of forests in Scotland before the end of the last glacial period (~10,000 years B.P.) has been little studied. This is primarily because the physical action of the glaciers removed the unconsolidated Tertiary and Quaternary deposits capable of preserving fossil plant remains. However it is known that, during the Tertiary era (65 million to ~ 2 million years B.P.), Europe had extensive and species diverse "Arcto-Tertiary" forest assemblages (Tallis, 1991). In the early part of the Tertiary (Eocene) these forests had a moist sub-tropical character and persisted to high latitudes. As long-term trends of global cooling and drier climates prevailed, their species composition converged on that of the seasonal temperate deciduous forest, with some areas possibly becoming natural wood-pasture savannahs. Based on evidence from the nearest unglaciated areas preserving fossil remains (East Anglia, the West Midlands and Southern Ireland) the late Tertiary British flora is thought have contained the following tree genera: *Abies*, *Picea*, *Pinus*, *Sequoia*, *Taxodium*, *Tsuga*, *Carpinus*, *Corylus*, *Fagus*, *Carya*, *Pterocarya*, *Quercus*, *Tilia*, *Ulmus*, *Rhododendron* and *Larix*. This list contains most of those tree genera that have recently been introduced to Scotland as plantation species, with the apparent exceptions of *Thuja* and *Pseudotsuga*.

With the onset of severe climatic oscillations in the Quaternary this list of genera began to shorten progressively with successive glacial episodes (Godwin, 1975). Subject to the available evidence, it appears that each inter-glacial episode saw a further reduced tree flora in Europe. This effect was much more severe than in North America, due to the presence of longitudinal mountain barriers along the southern edge of Eurasia (Pyrenees, Alps, Carpathians, Taurus, Caucasus, Hindu Kush, Karakoram and Himalaya). These prevented cold-sensitive tree genera from finding suitable refugia where they could survive the glacial periods. Eurasian temperate montane forests (effectively Arcto-Tertiary remnants) persist in a belt eastwards from northern Turkey through the Caucasus ranges to the Caspian coast of Iran and then resume from Kashmir eastwards to Bhutan and into China proper (Li, 1952). More extensive areas of analogous forest types persist in eastern North America, where stands with several deciduous genera present in the canopy can similarly be found.

Based on R.G. West's detailed work for the East Anglian Quaternary sediments (West, 1980), *Taxodium* and *Tsuga* were removed by the first glaciation. *Pterocarya* and *Abies* survived until the mid-Quaternary, as did *Rhododendron* in Ireland (Coxon *et al*, 1997) and *Larix* in the West Midlands (Field *et al*, 1997). *Picea* was naturally present in England in all inter-glacials except the present one (the Holocene) (Holyoak, 1983). Of particular relevance to the theme of native woodland restoration is the regular pattern of sub-stages of forest development that West (1980) observed in the four previous Quaternary inter-glacials of the East Anglian record:-

1. Pre-temperate substage
   Emergence of open forests of light demanding tree genera such as *Betula*, *Pinus* and *Populus* with associated ground flora. Soils skeletal with little organic matter.

2. Early-temperate substage
   Establishment and expansion of mixed oak forest vegetation typically with *Ulmus*, *Quercus*, *Fraxinus* and *Corylus*. Soils have achieved optimum fertility status.

3. Late-temperate substage
   Expansion of more shade tolerant late successional genera such as *Carpinus*, *Abies*, *Picea* and *Fagus*. Possibility of soil and climate deterioration beginning.

4. Post-temperate substage
   Return of boreal forest conditions with *Pinus*, *Betula* and *Picea* recovering dominance. Expansion of damp ericaceous heathland. Clear evidence for climatic and soil deterioration as the next glacial onset is approached.

Within the present (Holocene) interglacial it is probable that the climatic optimum has now been passed, probably at around 3,900 years B.P. (Anderson *et al*, 1998). Hence it would be expected that present natural forest vegetation would correspond to substage 3 above. The current climax forest vegetation of Central Europe does conform to substage 3, with that of lowland England resembling it where beech and hornbeam occur. The situation for the British uplands is more enigmatic as none of the late successional tree genera of substage 3 (fir, spruce, beech and hornbeam) have yet colonised naturally and there has been much human influence on the species composition of woodland. The semi-natural woodlands present in Scotland today appear as residuals of substage 1 (pine and birch woodlands) and substage 2 (oak and ash woodlands). However it could be argued that the better establishment and greater vigour of introduced spruce, fir, beech and sycamore in Scotland indicates that underlying site ecology has progressed to that expected for substage 3 (or even substage 4 on the poorer upland sites) during the deforested period. Hence, although current native woodland restoration projects adopt West’s substages 1 and 2 as their template, it is valid to suggest that the stand types created by afforestation with spruce, fir, beech and sycamore also make a valuable contribution to restoration of the “potential-natural” woodland vegetation for many site types.

Natural forest species composition during the Holocene

Our understanding of the species composition of Scottish forests since the last glaciation has been greatly aided by the survival of fossil plant remains in peat and lake-bed sediments. This, together with the known ecological tolerances of the major native tree species, has allowed maps to be drawn “reconstructing” natural forest types at the Holocene climatic optimum. The earliest of these were produced by McVean and Ratcliffe (1962) and their impression has been updated more recently by the valuable work of Tipping (1994) and others, as better pollen evidence has become available. Four major forest types are usually mapped:-

1. Caledonian pine-birch woodland in the Highland zone.
2. Birch-rowan-hazel woodland in the far north and west and for the Hebrides.
3. Oligotropic oak-birch woodland for the margins of the Highland zone.
4. Mesotrophic oak-ash-elm woodland for the Lowland zone.

The stand types envisaged usually reflect those observed in existing semi-natural woodlands, although it is recognised that most or all of these have been heavily influenced by human activities, including selective felling, burning and pastoralism. Some authors have expressed the view that the semi-natural woodlands existing today reflect “stereotyped” residuals of former natural forest communities (e.g. the Caledonian pine forest from which holly, juniper and bird cherry have been removed, or the Atlantic oakwood from which birch, hazel and aspen have been removed). As such they may not form a reliable basis from which to plan new forests in Scotland.

A more serious concern in this regard is that we lack a detailed knowledge of the changes in ecological site factors that have taken place since the mid-Holocene. Deterioration in climate may well have rendered some areas ecologically unsuitable for woodland composed of the suite of tree species dominant at that earlier time. This applies equally to areas at high elevation and to those in exposed hyper-oceanic areas. It is also thought that soil conditions have deteriorated in many parts of Scotland, both in terms of increased soil wetness/ poorer aeration and in terms of available nutrition. The most obvious evidence for this is that many Highland sites show a development of peat from the mid-Holocene onwards, forming over the fossil remains of a forest. Decisions as to the choice of tree species for planting and the methods of ground preparation when restoring woodland to such sites must take due account of these changes. Pollen evidence for the earlier forest composition is sadly not enough on its own to conclude that a forest of that type can be re-established on the same ground.

Ecological planning of new plantation forests in Scotland from 1650 to 1960

As soon as the "planting dukes" of Breadalbane and Atholl began to create new forests in Perthshire from the mid 17th century onward, a body of Scottish forestry experience began to develop as to the matching of tree species to site (Anderson, 1967). It rapidly became apparent that certain tree species introduced initially from mainland Europe (beech, sycamore, larch, silver fir and Norway spruce), offered distinct advantages to the Scottish estate forester in three respects:-

1. Easier establishment, particularly on the wet, infertile upland sites.
2. Faster growth and greater timber yield on most, but not all, site types.
3. Diversification of the forest in terms of structure, products and visual amenity.

These benefits were greatly extended when a wider range of coniferous tree species became available from the Pacific North West of North America and from the Far East of Asia in the mid 19th century. The discovery that Sitka spuce (*Picea sitchensis*) would establish readily on many wet upland sites in Highland Scotland with infertile organic soils brought these into effective forestry use. The native Scots pine is not well adapted to these oceanic site conditions and does not produce vigorous stands on them with adequate natural regeneration. However in the more continental eastern Highlands it proved that native Scots pine, supplemented by European larch, continued to offer the better prospects. Similarly the introduction of beech and sycamore from England and mainland Europe allowed broadleaved woodland to be established in many eastern lowland agricultural areas which were too exposed for oak and ash.

The accumulated knowledge of the Scottish estate foresters, combined with the tree species introduced by the Scottish plant hunters during the 19th century, became available to the Forestry Commission when it was established in 1919. The fundamental approach of matching the tree species to the ecological site conditions was continued and provided the basis for the diverse pattern of species planted in some of the older FC forests in the Central and Eastern Highlands and in the Borders. Experimentation continued to "test the limits" of individual introduced tree species. This body of experience was formalised in Mark Loudon Anderson's book "The Selection of Tree Species" (Anderson, 1961) published while he was Professor of Forestry at the University of Edinburgh. Anderson was a forward-thinking and innovative ecological forester whose ideas are very much in keeping with today's aspirations to create diverse and sustainable forests which can be managed on a "continuous-cover" basis. His tables of species groups suited to particular ecological site types (Figure 1) often included a combination of introduced and Scottish native tree species, which he thought would form an attractive and valuable stand type. This paper aims to encourage Scottish foresters in the 21st century to have the professional courage and ambition to sustain this approach.

Making the site fit the species – the intensive afforestation period 1960-1988

From approximately 1960 onwards the quality of afforestation site becoming available in the uplands was often so poor that intensive site amelioration works were required to render them ecologically suitable even for Sitka spruce and Lodgepole pine. These works included deep cultivation, drainage and fertiliser applications. In some cases these measures were successful in improving the site to the point where a crop of trees could be grown productively. In other places this was not so, and on reflection, many sites were afforested during this period which were really not suitable for woodland of any species. Without amelioration, they are certainly not ecologically suited to any of the native species woodland communities, having deteriorated very significantly in the long period since they last supported such vegetation. One disadvantageous consequence of this period was that it distracted attention from the fundamental need to match the choice of tree species to the ecological site type. This became apparent when the range of site types to be afforested became more diverse from the late-1980s onwards and the range of tree species to be used expanded to include many more of the natives. However this period did demonstrate that the ecological potential for woodland on many upland site types in Scotland could only be fully realised by appropriate site amelioration at the time of establishment.

The development of the Ecological Site Classification – the 1990s

In the early 1990s, three major trends in Scottish forestry led to a return to the previous approach of matching the tree species to the planting site. These were:-

1. The end of the first rotation in the older upland conifer forests and a wish to re-stock with a more diverse range of stand types and species.
2. The afforestion of more fertile ex-agricultural site types.
3. The campaign to expand the area of native woodland by planting.

These developments led the Forestry Commission to initiate the development of the Ecological Site Classification (ESC) as a decision-support tool to aid species selection and other aspects of forest site management (Pyatt *et al*, 2001). The ESC embodies most of the fundamentals of Anderson's approach, but provides for greater quantification of site conditions. It also brings practice in Britain into line with that adopted in other territories in Europe and North America where temperate forests are well managed.

The ESC describes ecological site conditions in terms of climate (warmth and wetness), soil moisture regime (SMR) and soil nutrient regime (SNR). Climate is assessed from spatial meteorological datasets, SMR from examination of the soil profile and SNR from combined consideration of the soil profile, lithology and the species composition of the ground vegetation. The last method extends and develops the original methodology set out by Anderson, using a more quantitative approach, based on species indicator values for soil base status and nitrogen availability. The ESC method is best applied in practice with the aid of a computer Decision-Support System published by the Forestry Commission (Ray, 2001).

A well-developed understanding exists of the ecological tolerances of many individual tree species (native and introduced) when used in single species plantation conditions. This allows for robust advice on species selection and performance predictions for a site once the above ESC analysis has been completed. This advice is largely consistent with the body of practical experience in Scotland referred to above, but provides the forest manager with a more explicit underpinning to justify tree species choices.

A rather less well refined understanding is available for the ecological tolerances of native woodland communities as described by the National Vegetation Classification (NVC) (Rodwell, 1991). Observation of the site conditions under which existing examples occur in the field is one source of evidence, although these may not express their full ecological range. Another approach is to use ground vegetation indicator value analysis of the NVC woodland sub-communities to estimate their preferences in terms of SMR and SNR (Pyatt, *pers comm*., 2002). Evidence from these sources is used to make suggestions as to the most appropriate NVC woodland communities for restoration on particular ESC site types. A comparable approach to native woodland suitability assessment is embodied within the Native Woodland Model developed for upland Scotland by the Macaulay Institute, and is intended for application in larger-scale regional planning contexts (Towers et al, 1998).

Current forest establishment practice – priorities and problems

At the present time the creation of new forests in Scotland is dominated by the establishment of "new native woodlands" as indicated at the outset. This process began in the Native Pinewood Grant Scheme

(W18), but has expanded to include other woodland communities covered by the UK Biodiversity Habitat Action Plans, such as upland ashwoods (W9), upland birchwoods (W11/17), Atlantic oakwoods (W11/17) and wet *Alnus/ Salix* woodland communities (W1-W7). Although many of the schemes are intended to create only small areas of such woodland, there are a few larger projects on a comparable scale to the former upland conifer forest plantings (e.g. Glen Finglas, Carrifran Valley and Cashel Farm). In most cases it is too early in the life of these woodlands (< 15 years) to make any reliable comment on their long-term prospects and ecological development, but there are some worrying signs.

Although these efforts justifiably command widespread support in their own right, there is concern that they should form such a dominant component of overall forest creation in Scotland. The current level of new plantings with a predominance of introduced conifer species appears to be artificially and disadvantageously low for the following reasons:-

1. There is a distinct category of exposed, wet and infertile upland site types that are best suited ecologically to introduced conifer species. However, these sites are currently being planted with native tree species (sometimes not well chosen) with inadequate advance ground preparation. In some instances establishment and stocking are unsatisfactory as a result and there is no easy way to recover these schemes.

2. On a much wider range of site types, introduced coniferous species represent a valid long–term ecological species choice for the reasons discussed above. These species offer better prospects for reliably meeting the economic and recreational demands on the forest estate than do most native species, certainly in the short to medium terms. They also offer a more robust and flexible framework within which to pursue arising rural development forestry objectives.

3. With the present level of uncertainty about possible future environmental change, it is necessary to maintain as many forestry options as possible. While some native species woodland communities may see an expansion in their territory, others may be in retreat. In particular the more boreal biomes within Scotland, such as the Caledonian pinewoods and some upland birch/ aspen woodlands, may unavoidably contract. On the other hand the extent of site types suitable for some of the more demanding introduced coniferous species such as Douglas fir may well expand. This surely argues in favour of maintaining viable stocks of a wide range of forest types.

Thoughts for the future – quality and diversity

I would like to draw the arguments presented in this paper together by suggesting what I would see as the important themes that should be followed in future species choice for woodland creation (and indeed restocking) in Scotland.

1. <u>Native species woodland restoration</u>

There remains a valid case for expanding each of the main Habitat Action Plan woodland communities on the right site type as defined by the ESC. However, in the case of the wet, infertile upland site types it will be necessary to define a category of site which is simply too poor to plant with natives. It will also be necessary to define a category of somewhat better sites where natives should only be established after a return to the more intensive site preparation methods that were formerly employed for their afforestation with coniferous species. Much more attention should be paid to selection of the right genetic origins of each native tree species for the site type in question – the emphasis should be on ecological adaptation (and in some cases inherent timber potential) rather than an arbitrarily defined "localness" of the origin.

2. <u>Afforestation with those introduced tree species already in use in Scotland</u>

There is also a case for resuming the expansion of the forest area composed of introduced tree species on the correct site types as defined by the ESC. These species should be favoured over natives on site types where they are the better adapted and may thus require less intervenionist site preparation. On site types where either introduced species or natives are a valid choice, a balance should be struck, taking into account the manager's objectives. The creation of stand types (possibly combining both categories of species) that are amenable to irregular silvicultural systems should be emphasised, along the lines proposed previously by Anderson (e.g. spruce – silver fir – beech; spruce – Grand fir – alder; Douglas fir – larch – sycamore). Schemes aimed at restoring native woodland to conifer plantation sites by premature stand replacement fellings should be reconsidered and probably avoided – a more sophisticated and ecologically consistent approach should often be adopted.

3. Afforestation with newly introduced species

There is a possible case for introducing some additional tree species to Scotland, and certainly for introducing some on a wider basis. These species would be selected to fill ecological gaps in the current species portfolio (e.g. Pacific silver fir *Abies amabilis,* Yellow cedar *Chamaecyparis nootkatensis* and Japanese cedar *Cryptomeria japonica*) or to cope with and even take advantage of future climatic changes (e.g. Walnut *Juglans regia,* Swamp cypress *Taxodium distichum* and Coast redwood *Sequoia sempervirens*).

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Figure 1
Anderson's scheme for the selection of tree species
Taken from Anderson (1961)

Table of Future Stand Units or Groups of Species

Fertility-class	Dry – Hardy	Dry – Tender	Moist – Hardy	Moist – Tender	Wet (a) – Hardy	Wet (a) – Tender	Wet (b) – Hardy	Wet (b) – Tender
A	Wych elm, Lime, Whitebeam, Cordate Alder, Austrian pine, Corsican pine	Beech, Horse chestnut	Elms, Grey poplar, Aspen, Grey alder, Willows, Lime	Sycamore, Ash, Beech, Walnuts, Nordmann's silver fir	Grey poplar, Alders, Aspen, Scots pine	Ash	Alders, Willows, Poplars, Scots pine	Norway spruce
B	Elms, Lime, Birch, Turkey oak, Japanese larch, Corsican pine, European larch	Ash, Beech, Sycamore, Horse chestnut	Aspen, Hornbeam, European larch, Japanese larch, Scots pine, Weymouth pine, Thuia, Lawson's cypress	Oak, Sweet chestnut, Beech, Cherry, Douglas fir, Silver firs, Spruces, Tsuga	Alders, Willows, Thuia	Norway spruce	Alders, Poplars	Norway spruce

Fertility-class	Dry – Hardy	Dry – Tender	Moist – Hardy	Moist – Tender	Wet (a+b) – Hardy	Wet (a+b) – Tender
C	Birch, Japanese larch, European larch, Scots pine, Corsican pine, Monterey pine	Sessile oak, Sweet chestnut, Beech	Birch, Aspen, Alders, Scots pine, Thuia, Lawson's cypress	Oak, Spruces, Tsuga, Silver firs	Aspen, Alders, Willows	Spruces
D	Birch, Scots pine, European larch, Japanese larch	Sessile oak, Douglas fir	Aspen, Scots pine	Spruces, Tsuga, *Abies procera*	Pubescent birch, Alders	Sitka spruce
E	Birch, Scots pine	Red oak	Birch, Rowan, Scots pine, European larch	Red oak, Douglas fir, Norway spruce, Sitka spruce	Pubescent birch, Black alder	Sitka spruce
F	Scots pine, Shore pine, Mountain pine		Pubescent birch, Shore pine, Mountain pine		Mountain pine, Shore pine	

Table of Waste Land Communities

Fertility-class	Dry 1	Moist 2	Wet 3a	Wet with peat 3b
A	Dry Grass-herb	Moist Grass-herb	Grass-rush (Hard Rush)	Willow-Reed
B	Dry Grass	Fern	Sedge	Soft Rush
C	Grass-heath	Rush-grass (Jointed Rush)	—	*Molinia*
D	*Erica cinerea*	*Nardus-Molinia*	—	Cottongrass
E	*Calluna*-heath	*Vaccinium*	—	*Myrica*
F	Lichen	*Erica tetralix*	—	*Sphagnum*-moor

FORESTS NEED FUNGI

ERNEST AND VALERIE EMMETT

Although fungi are present in forests all year round, they are not always visible to the casual observer because of the diversity in the nature and timing of their fruiting. Some fungi may produce fleshy fruit bodies above the forest floor only rarely, and others like the truffles never produce fruit bodies above ground. Yet an intimate relationship exists between fungi, trees and other plants in a woodland and one cannot thrive without the other.

Forest fungi fall into three groups: the pathogens; the decomposers or detrivores; and the helpers: the mycorrhizal fungi.

The Pathogens adversely affect the growth of the trees and may ultimately kill them. They are associated with disease of trees and considerable amounts of money are invested in finding ways of killing these fungi before they can harm the tree. Some adversely affect the growth of twigs, leaves and seed production. Others, such as the Polypores or Bracket fungi and less conspicuous fungi, such as the Ascomycetes, feed on living wood. In their way they contribute to a woodland's biodiversity and such fungi play an important role in natural thinning of the trees and in creating food sources for some insects, such as beetles and flies. The bracket fungi are the initial agents for nutrient recycling and the residues make up the main component of forest soils.

Forest litter, such as fallen wood, leaves and bark is recycled by the second group of fungi - the Detrivores. Some produce the familiar toadstools that one sees during a woodland stroll in the autumn; others look more like paint splashes on fallen timber.

The secret friends are the third group: the Mycorrhizal Fungi and they are of great significance to the health of the forest. They, too, may produce familiar colourful toadstools; others belong to the truffles fruiting underground. Mycorrhizal fungi live symbiotically with trees in a relationship that has evolved over millions of years, and both benefit from it. Much work in the last 30 years has shown that mycorrhizal fungi are the chief organs for nutrient uptake by nearly all land plants, not just trees. Scientific studies have revealed that the hyphal threads of the fungal mycelium, link trees and plants together below ground, and that nutrients can be transferred from one plant to another in a forest community by this means.

The presence of a fungus in a forest is largely only realised when it produces fruiting structures above ground in order to spread spores. Some fungi fruit annually, others only rarely and this is problematic for the mycologist and ecologist in evaluating forest biodiversity. New species are still being found in study areas at Abernethy Forest, for example, even after 25 years of recording fungi there. A similar but more rigorous study in Switzerland for 21 years has produced similar results; new fungi were still being identified at the end of the study period because they had not fruited before.

More recently, mycologists are making use of DNA techniques to begin to identify species from hyphal fragments taken from soils. However, the DNA pattern still needs to be matched to a fungal fruit body to be certain of its identity. A rigorous study now in its eighth year at Dawyck Botanic Garden has indicated the presence of a species of Russula in the soil, but since it has not fruited yet, its identity remains as yet unknown. The fungal mycelium can live for a long time; in a forest in Michigan it has been estimated that the mycelium of a member of the honey fungus family has been genetically stable for 1500 years; it extends over 15 ha and weighs in excess of 10,000 kg.

Several factors can influence the species richness of the fungi in a forest. One factor depends on the previous history of the land on which the trees grow. Where new forests are established on former agricultural land or in pioneer areas, the fungal diversity is likely to be limited in the early years to those whose mycelia can easily colonise the roots of the tree seedlings. If all the fallen wood is removed from a forest, then the fungi that rely on such a habitat are likely to be absent and part of the nutrient recycling system will be missing.

In forests where the collection of edible species is a long standing cultural tradition there is concern that the number of fruit bodies is declining in recent years. Atmospheric pollution has been implicated. Some DNA work in Switzerland has shown that increase in the soil nitrogen does not actually kill the mycorrhizal fungi, but there is a change in the balance of the species, from those that produce fleshy fruit bodies to those that are much less conspicuous. More work remains to be done to discover if this change will ultimately affect the health of the trees.

There is some evidence, too, that compaction of forest soils through human interference may be detrimental to the mycorrhizal fungi, particularly where heavy machinery is used to harvest timber and where there is a lot trampling where forests are used extensively for recreational purposes. In one study it was found that heavy trampling resulted in the number of fruit bodies going down to zero and recovery to former levels took some years once the trampling ceased.

Mycologists and ecologists are increasing their knowledge of the role of fungi in forest health from the results of both long term recording and from DNA studies, and thereby in understanding what might pose threats to forest biodiversity. Mycology in its own right is still young – essentially less than 150 years old in Britain and new fungi are still being described both from the UK and worldwide. Red data lists are useful in highlighting fungi and hence the habitats they depend upon that should to be conserved. There is still a lot of exciting work to be done.

THE HISTORY OF CALLENDAR WOOD, FALKIRK
"THE FINEST TREES THAT CAN BE GOT"

CHRISTOPHER DINGWALL

The subject of this paper is Callendar Wood in Stirlingshire, which lies on sloping ground just to the north of Callendar House, on the eastern outskirts of the town of Falkirk, (not to be confused with the Callander in Perthshire, known to many as the gateway to the Trossachs). In my talk, I presented cartographic and other evidence which points to this wood having existed within precisely the same boundaries, and as having been continuously productive since medieval times. I would suggest that its survival within what is a well-settled and highly industrialised part of the Central Valley of Scotland is worthy of note.

There is good reason to believe that Callendar Wood may have had its origins in the natural forest which covered much of lowland Scotland in the post-glacial period. In this form it would surely have been exploited by Bronze Age and Iron Age peoples who settled across the length and breadth of the Central Valley in pre-Roman times. This same wood must also have been used by the Romans in the construction of forts, buildings, roadways, and not least in the palisades and breastwork on the Antonine Wall which runs along the northern edge of the estate, within a few hundred yards of Callendar House.

The earliest documentary evidence of the exploitation of the wood so far found is a record, noted by M.L. Anderson in his book ***A History of Scottish Forestry*** (1967), that the monks of Newbattle Abbey, just to the south of Edinburgh, were granted the right to pasture cattle and to gather fuel in the Wood of Callendar by King David I in the 12th century. Reference is also made to the wood being a source of fuel at this time for salt-pans in the nearby Carse of Forth. Callendar is also known to have provided 'three great oak trees' for use in building work, and *'six dozen great birch trees'* for use in scaffolding at nearby Linlithgow Palace in 1534. By that time, the property was in the ownership of the Livingstone family, having been granted to one William de Livingstone in 1458. The family remained there until their involvement in the Jacobite unrest of the early 18th century resulted in the estate being confiscated by the Government and put under the management of the York Buildings Company - but more of that in just a moment.

The boundary of the medieval wood, clearly seen on ***Timothy Pont's Map*** of the East Central Lowlands (c.1595), coincides exactly with the outline of the wood seen on the ground today, as marked by the present estate wall. Pont gives us a view of the old tower house of 'Calendar Castle' surrounded by a barmkin wall and a moat or canal. To the west, south and east of the castle is shown a woodland or wooded hunting park, contained within a double line (which is generally taken to be Pont's symbol for a wall). To the west of this is written 'The Parck', though it is not clear if this notation refers to the wooded area itself or to the (apparently) unenclosed land immediately to the west - I would suggest the former. Pont's manuscript map evidently provided the basis for the engraved map of 'Stirlinshyre' published in Johannes Blaeu's ***Atlas Novus*** (1654), though the engraver of this map appears to have misinterpreted the outer lines on Pont's draft as representing another watercourse, producing a very strange drainage pattern. Incidentally, the dedication of this map to James, Earl of Callendar is significant, and may give us a clue as to why the estate was so carefully drawn.

Robert Sibbald's ***History and Description of Stirlingshire*** (1707) describes 'Calander' as *'a noble seat with fine buildings added to the castle …[which] has a large wood adjacent to it, with walks cut through it, and fish-ponds near the house, and gardens, and large inclosures to the east and west'*. Another description of the parish of Falkirk, written by a Mr. Johnstoun of Kirkland in 1723, and published in Walter Macfarlane's ***Geographical Collections Relating to Scotland*** (Ed. Mitchell 1906) talks of *'the Wood of Callender about a quarter of a mile's distance from [Falkirk]'*, the size of which he gives as *'a long mile in length and half in breadth'*. The same author also notes that *'in this wood are very good coal-pits which serves the village and country about at very reasonable prices'*. ***The Military Survey of Scotland*** (c.1750) is drawn at too small a scale to allow much detail, but shows the wood cut through by a broad north-south avenue or vista aligned on the mansion house.

As I mentioned earlier, the estate was annexed by the Crown in the 18th century and spent some time under the management of the York Buildings Company - events described in David Murray's history of ***The York Buildings Company*** (1885). ***A Plan of the Third Lot of the Callendar Estate*** by John Horne (1781) - presumably drawn up prior to the auctioning of the estate, following the bankruptcy of the York Buildings Company, shows the 'Wood of Calender' within the same boundary as on Pont's and other early maps, but with few internal details save for a few paths or tracks within the western part of the wood, and a small area of open ground around 'Hendry's Hill'. It is noteworthy, incidentally, that Hendry's Hill can be shown to have remained unplanted from the time of the ***Military Survey*** (c.1750.) onwards - i.e. for at least 250 years - appearing on all subsequent maps as an open space.

The auctioning of the estate in 1783 brought a change of ownership when the then Earl of Errol, a member of the Livingstone family, was unexpectedly outbid by the wealthy Aberdeenshire-born coppersmith William Forbes, who later boasted that he had succeeded in acquiring the estate for little more than half the value of the timber planted on it. In the decades which followed William Forbes and his successors invested a great deal in the improvement of the estate, and in the aggrandisement of the mansion house. Papers now in the National Archives of Scotland (Ref. GD.171), which I have been unable to explore in detail, would appear to contain a good deal of material relating to Forbes' improvements. These refer, among other things, to some of the people involved in the planning and replanting of the grounds - for example to a John Dingwall who gave advice on tree-planting and fencing, to a Mr. Sutherland who was involved in the draining and laying out of the grounds, and to a William Driver on the development of the gardens. One letter of 1786 spoke of *'100 workmen … improving and ornamenting the grounds … making fine walks, avenues, lawns, greens [and] planting the finest trees that can be got'*. *The Statistical Account of Scotland* (c.1792) for the Parish of Falkirk also refers to Forbes' improvements and comments on *'the numerous fine trees which are in Callendar Park, together with the wood belonging to the same place [which] add much to the pleasantness of the town of Falkirk'*.

The nature and extent of Forbes' landscaping activities are evident from the ***Plan of Callendar Park in the County of Stirling*** (1818) which shows a number of new landscape features, including a large walled garden, new lodges, approaches and carriage circuits, together with a Mausoleum built to designs by Archibald Elliott in 1816. On this plan a long circuit drive is seen to run through the wood, with other drives running to it, and past features such as the 'Piece of Water', the 'Mausoleum', the 'Cascade' and 'Bridge', and 'Henry's Hill', presumably intended as points of interest along the way. Landscaping on this scale was clearly intended to impress the visitor, as well as providing for the family's own recreation and enjoyment. Incidentally, this estate plan also shows a projected deviation of the Edinburgh and Glasgow Union Canal through the Middle of Callendar Wood, the likely effect of which was represented in a drawing by the contemporary landscape painter, Alexander Nasmyth. In the event, this scheme was never executed, and the canal was diverted around the park.

Evidence points to Callendar Wood containing a high proportion of oak which was being managed as coppice throughout much of the 18th century and during the early decades of the 19th century. ***The New Statistical Account of Scotland*** (1841) describes *'250 acres of coppice, mostly oak, upon ground rising gently to the south [of Callendar House]'* and talks of Mr. Forbes having planted oak, elm and beech. There is also Charles Roger's slightly later account published in his book ***A Week at Bridge of Allan*** (1853) which talks of *'the park, which gently slopes from the south, contain[ing]400 Scottish acres, of which 250 are covered with coppice wood, chiefly of oak, singularly luxuriant and beautiful [while] the lawn is decorated with very large trees which were planted by the Earl of Callendar on returning from the exile into which he had passed with Charles II'*.

The arrival of the railways in the mid 19th century saw lines built to both north and south of Callendar Park and Wood, though these had a very limited impact on the designed landscape, with the Edinburgh & Glasgow Railway passing beneath the south-western corner of the wood in a tunnel, and the Stirlingshire Midland Junction Railway cutting off a small section in the north-eastern corner of the park, necessitating the partial realignment of the east drive and the building of a new lodge-house a little to the west of the original one. The building of the latter line also had the effect of cutting off access to the estate from the public road via the Lochbank Gate, which was subsequently blocked off.

These changes are easily seen on the ***First Edition Ordnance Survey*** (1859-60) which includes one or two features not seen on the 1818 plan, notably the 'Observatory' viewpoint on the hill-top and 'Kennels' near the Shielhill Lodge, together with a so-far unidentified building just inside the gate in the south wall. Other changes evident on this map include the enlargement of the loch, and the creation of a new woodland garden or arboretum within an enclosure immediately to the south of the mansion house, flanked on either side by an area of parkland studded with standard trees. Interestingly, the notes kept by the surveyors in the ***Ordnance Survey Name Book*** for the Town of Falkirk describe the wood in 1860 as '*a large mixed wood, principally fir [presumably Scots Pine] , covering an area of nearly 300 acres*'. This suggests that a significant change was taking place in the species composition of the wood during the latter half of the 19th century, perhaps as the management of the oak coppice became unprofitable.

The regularly-spaced more-or-less circular **yew clumps** in the lower part of the wood seem likely to date from about this time - evergreens which may have been planted, together with rhododendron laurel, in order to provide interest and winter colour in views from the house and/or from the various drives and walks. While the planting of yew within 18th and 19th century mixed policy woodland is by no means uncommon, its arrangement in clumps like those at Callendar is certainly unusual, if not unique in the Garden History Society's experience. It is not clear whether the clumps were intended to fulfil some other function as well - e.g. to provide cover for game. They may merit closer study.

The ***Second Edition Ordnance Survey*** (1896) shows that comparatively little change occurred during the latter half of the 19th century, apart from the development of a more complex network of paths and drives within the wood. Management of the wood by the Callendar Estate continued through the rest of the 19th and on into the 20th century. Though some mature, mostly broadleaved trees and a few old Scots Pine up to 200 years old still survive here and there (survivors of the 19th century planting, perhaps), it is clear that large areas of the wood were felled and replanted by Callendar Estate with a commercial conifer crop in the course of the 20th century. However, a lower level of management in the latter half of the 20th century led to the infestation of much of the wood with rhododendron, and to self-seeding of invasive species such as birch and sycamore in some places. The removal of much of the rhododendron during the last couple of years, with the help of Millennium Forest grant, has transformed the wood for the better, and has revealed some traces of earlier planting which had become lost. Callendar Wood is now in the ownership of the Forestry Commission, and is now being managed as a Community Woodland in partnership with Falkirk Council and others.

In conclusion, and having reviewed this evidence, and additional information which time does not allow me to refer to, I have reached the view which I expressed at the start of my talk that Callendar Wood can be seen to have existed for at least 400 years, and possibly for much longer as a productive wood. This it has achieved by adapting to meet changing socio-economic circumstances - evolving from wood-pasture through hunting park, coppice wood and commercial conifer plantation to its most recent manifestation as a community woodland. Its very success as a productive wood has a down-side to it, however, from the historian's point of view - that is that continuous and fairly intensive exploitation of the timber means that very few old trees have survived. That said, there are some very old sycamores and sweet chestnuts in the parkland to the north and north east of the house which bear the signs of pollarding, and which must be at least 300 years old.

THE SUNART OAKWOODS
EIGHT THOUSAND YEARS OF EXPLOITATION AND CHANGE

JIM KIRBY

The Sunart Oakwoods Research Group was established in 1999 to access funding from the Millennium Forest for Scotland and carry out an archaeological and historical survey of the semi-natural woodlands which occur on the north side of Loch Sunart, in North Argyll. It became apparent from the very outset, that the woodlands could not be treated in isolation, but formed an integral part of the whole historical and archaeological landscape, and the survey expanded to include agriculture, the use of the sea, mining, trade, transport and the lives and culture of the people of the area, as well as the woodland history.

The woodlands today look, to the casual observer, as though they have not changed significantly over the centuries, but this is not the case. Closer examination shows that many trees have been planted, some areas have been extensively coppiced, and occasionally there are veteran trees which have clearly been pollarded, and all within ring-dykes enclosing the whole woodland area. In order to understand how the woodlands arrived at the state we now find them in, we must turn the clock back 14,000 years, and look at the origins of the woodland, and the factors affecting them.

Fourteen thousand years ago, the area was covered by a vast ice-sheet, many hundreds of feet thick, and it is unlikely that any tree species survived the glaciation locally. During the next two thousand years, the climate warmed up very rapidly, the ice melted, and arctic-alpine plants spread up from the south. The dwarf willows would probably have been the first ‘tree’ species, followed by birch, a very successful pioneer species, by about 7,500 BC. Scots Pine and Juniper arrived about 7,000 BC, and Elm, Oak and Hazel some 500 years later.

The first settlers in the area arrived about this time, coming in by sea, and occupying favourable areas along the coast, for the sea provided an inexhaustible supply of food. We failed to find any evidence for these settlers of the Mesolithic period, but they could well have occupied some of the caves and rock-shelters which occur in the 10 m raised beach. The well documented settlement on the Island of Risga is only 9 km to the SSW of the survey area. There was no trace of the Neolithic people who introduced farming to the area about 4,000 BC, although there are two chambered cairns of this period 13 km to the west. The impact of these early settlers is not known, but they would have felled trees to make houses and shelters – and learned by observation, that felled broadleaved trees coppice, and that small coppiced poles are more useful for construction work than forest giants. Examination of soil profiles also show that these early peoples were setting fire to the woodland edges, to control the expansion of the woodland, and create grassland on which both wild and domesticated animals could graze.

The Bronze Age people who followed arrived about 2500 BC, and buried their dead in round cairns. Five round cairns were recorded in the survey area; the largest is 14 m in diameter, and still standing to a height of 2 m. At first glance, this appears to indicate quite intensive settlement during the Bronze Age, but five cairns over a 2,000 year period suggests otherwise. Corduroy roads excavated on the Somerset Levels in England and dated to this period were formed of coppicewood, and there is no reason to suggest that parts of the Sunart oakwoods were not being managed on a coppice rotation at this time. A number of pine stumps found buried in the peat may be of this period, as may be several pieces of bog oak. Samples of each of the bog oak found have been submitted to a dendrochronologist for analysis, so dating evidence will eventually be forthcoming.

The three fortified sites within the survey area may belong to the Iron Age, c 600 BC-400AD; one was so fragmentary that it could have been a timber structure, and possibly from a previous era. The most exciting discovery was of several roundhouses, probably of Iron Age, although they could have been of the Early Christian Period, or even Mediaeval. No finds of the Early Christian Period have been positively identified in Sunart; even the ancient parish church on Eilean Fhionain is in the next county. The Norsemen were here, but the only evidence we have for their presence is onomastic. Resipole is one of the few Norse settlement names in Argyll, and appears to have originally been ‘Hrisbolsta[illegible]r’, Brushwood settlement. The valley to the north of Strontian was called Eggadale, Oak Valley, until 200 years ago, and was probably a prime source of boatbuilding timber. The oakwoods of Sunart would have been essential to the very existence of the Norsemen on the western seaboard, and well worth fighting over.

The Norsemen were not the first people to use the sea, nor the last. On Glas Eilean there is a group of bait mortars, which were used for preparing ground bait, and are usually found where the fishing is most favourable. There is also a rock-cut basin in Sailean nan Cuileag, which may have been used as a cold store where seafoods could be kept fresh. A fish trap in Ceann Traigh Breige may be quite recent, but many of the places where the beach has been cleared for boat landing could be very ancient. Fishing was never of great importance in Sunart. A attempt to establish a commercial 'fishing' on the loch in the 1730s using labour from elsewhere, met with little success, although barrels were made locally in the early 1800s for the herring fishing, when several hundred boats could be seen in Loch Sunart, at times when the herring were running.

Nothing of the Mediaeval Period was recorded, apart from a number of ancient pollarded oak, which probably had their origins in the pasture woodlands of about 500 years ago. Over 400 recessed platforms were recorded in the study area. These have generally been regarded as charcoal-burners platforms in the past, and dated to the late 18th and early 19th centuries, but recent excavation proved that they were originally constructed much earlier, as the foundations for timber-framed roundhouses, and may be Mediaeval, or earlier. Further excavation work is required to give more information on their date and function, as they are widely distributed throughout the Western Highlands. The results will shed new light on the settlement pattern for this period, and on the history of the ancient woodlands, where most of them are to be found.

The lead mines in Sunart commenced operations in 1723, and there are a number of prospecting pits in the Ariundle woodlands, and one burn apparently eroded by 'hushing'. This is where the miners accumulated a head of water behind a temporary dam, then suddenly released it, causing erosion down to bedrock, exposing lead-bearing strata beneath. A single mine adit in the side of one of the burns extended for 30 m, but was clearly not worth developing further. Felspar was mined at Sron na Saobhaidh during the Great War, and shipped out from a specially constructed jetty nearby. Evidence of mica prospecting was found at Resipole, but it was never developed.

The woodland industry was developed on a commercial scale from about 1700 onwards, when bark was being exported to Ireland. There may have been some form of temporary enclosure following clear felling, using timber cut from the wood, but permanent enclosure appears to have been a gradual process, which took about 100 years to complete. Attempts were made to enclose large areas, which sometimes included wet peatlands quite unsuited to tree growth, but in Ariundle, there were eleven woodland enclosures, with the smallest only 0.4 acres in extent, indicating the value of woodlands 200 years ago. Much of the area was open wood pasture during the Mediaeval Period, and livestock was dependant on the shelter of the woodlands, especially during the winter months. Once the woodlands were enclosed and managed on a commercial basis, this shelter was denied the stock, which must have suffered considerably during the four to seven years they were excluded, and there was constant friction between the proprietor and his tenants because of it. There was very little evidence of stock rearing within the woodlands, although several shielings were located in outlying parts of the area. Ground suitable for cultivation was at a premium throughout Sunart, from Neolithic times on, and a number of small fields were recorded within the woodlands. Once these areas were exhausted for agriculture, they were used as hayfields. Small areas of lazybeds and ploughed rig were also found within the woodlands, as well as some cultivation terraces, which could not be dated.

The woodlands provided a significant cash crop to the proprietor from the early 1700s through until about 1850, when the bottom dropped out of the coppicewood market. Originally the woodlands consisted of mixed broadleaves, with oak, birch, ash, elm, rowan, holly, aspen and hazel, but oak was the preferred species for both tanbark and charcoal. Suitable ground was managed on an oak monoculture system, with birch occupying the wetter peatlands, and alder along the flushed burn-sides. Oak was widely planted, using standards raised from seed from outwith the area, and other species were ruthlessly weeded out. The oldest 'non veteran' oak are about 280 years old and appear to have formed the canopy in a 'coppice with standards' regime. The woodlands were cut on a 20-30 year coppice rotation, with the purchaser generally deciding when the coupes were ready for cutting. The bark was harvested in the spring, when the sap was rising, and the trees were then felled, cross-cut to length, and stacked in ‘cords’ to dry. Each cord was of a known size, so it was possible to estimate how many ‘dozens’ of charcoal were likely from the felled area. In Cumbria, the twigs and bracken were kiln dried, and the resulting potash was used in the glass and soap industries, or for bleaching linen, and some of the pits found in the woodlands may have been potash kilns. The charcoal was exported to the Lorne Furnace Company’s charcoal-fired blast furnace at Bonawe, near Taynuilt, on Loch Etiveside, which was run by the‘ Newlands Furnace Company’, based at Ulverston, in Furness. The bark was sent to tanneries in Oban, Glasgow, Paisley and Kendal.

Many of those employed in the woodlands were itinerant workers, who lived on site in temporary dwellings, most of which have vanished without leaving any visible trace, but occasionally, more permanent buildings were recorded, although these too were generally of a fragmentary nature. Until the middle years of the 18th century, even many of the Lairds and their principal tenants lived in ‘creel’ or ‘basket’ houses. These were in effect, cruck-framed houses with the walls and roof constructed of wattle, with a slate cladding. A small house required about 2,000 poles, and barns, byres and fences required additional small poles, suggesting that the woodlands were being managed on a coppice rotation right through this period, and probably much earlier. Stone built houses did not become the norm for most of the populace until the early years of the 19th century

The woodlands that we see today are the result of eight thousand years of exploitation and change, and require careful management if they are to be of value in the future. They have recently been designated a candidate Special Area for Conservation for nature conservation, and management plans are now being drawn up by Forest Enterprise and Scottish Natural Heritage, in conjunction with local land owners and other interested parties, so their future is assured for some time at least.

NATIVE WOODLAND ON LOCH LOMONDSIDE - THERE IS MORE THAN JUST OAKS

JOHN MITCHELL

Introduction

With Loch Lomondside well within day-visit reach of half-a-dozen universities and other learned institutions in Central Scotland, the region's oak woodlands are amongst the most studied in the country. But the emphasis placed on Lomondside's oaks have tended to overshadow other woodlands present in the area. An attempt to draw more attention to the differing types of woodland represented - all of which add considerably to the local biodiversity - was made by the present author in Loch Lomondside (2001) New Naturalist Series No.88 Harper Collins, the presentation to the SWHDG meeting at Battleby providing an opportunity of showing additional illustrative material to that included in the book.

Upland Pasture Birch Woodland

Loch Lomondside has the longest history of hill sheep management of anywhere in the Scottish Highlands, and in consequence what little upland woodland remains is usually found on northern slopes least favoured for grazing rather than on well-lit southern slopes best suited for tree growth.

Less than a century ago the highest birch woodland on Loch Lomondside occurred up to the 500m contour around the headwaters of the River Falloch on the north flank of Beinn a' Chroin, but this presumed ancient woodland has now completely disappeared. Today, the highest birch wood (as distinct from the occasional individual tree scattered here and there) extends up to 450m OD alongside the Stuckindroin Burn on the north-east face of Ben Vorlich. Due to grazing pressure, there is next to no successful regeneration, so that its continuation as a sizeable upland woodland must be in doubt.

Mixed species woodland of ravines and steep-sided glens

Difficulties in access and management ensured that ravine and steep-sided glen woodlands were less likely to have been drawn into Loch Lomondside's intensive oak planting and coppicing regime. In these neglected pockets of woodland, a variety of trees - such as ash, wych elm and gean - are still present, having not been removed as less marketable species.

Shaded from direct sunlight by the topography and permanent tree cover, these confined woodlands are characterised by high humidity and luxurient plant growth, particularly bryophytes and ferns. In appearance at least, they would seem to be remnants of a long-lost temperate rain forest on Europe's Atlantic edge. Representative examples of this woodland type have been designated as Sites of Special Scientific Interest in both the Highland and Lowland zones.

Flood Plain Alder and Willow Woodland

Low-lying riverside woodlands are undoubtedly one of the most precarious wildlife habitats in Britain today, their underlying rich alluvial soils having proved an irresistible temptation to arable farming despite the very real risk of annual flooding.

Valued more in past times as wet wood pasture (the spring growth of sedges providing a much needed early bite for stock) and for cultivating basket willows, Loch Lomondside's largest surviving example occurs beside the lower reaches of the River Endrick. Several nationally rare or scarce flowering plant species are particularly well represented. The nature conservation importance of these alder and willow woodlands was recognised by being incorporated into the Loch Lomond National Nature Reserve.

The Inchlonaig Yews

Making the assumption that the yew is truly indigenous to Scotland, it is the only native conifer species which is still found in one place on Loch Lomondside in sufficient abundance to be considered a wood.

Said to contain several thousand yews before numbers were reduced by a major fell and a destructive fire in the early 19th century, the former deer park of Inchlonaig - a 75 ha island in the central basin of the loch - currently supports approximately 800 well grown yews, some apparently several hundred years old. The proportion of male to female trees has been shown to be roughly equal, but the lack of young trees coming up appears to be due to the resident fallow deer, one of just a few animals able to browse on the yew's poisonous foliage without ill effect. In the heyday of the deer park, individual young trees were protected by encircling them with iron railings.

Two unusual cases of tree damage

The presentation on Loch Lomondside’s woodlands concluded with illustrations of tree damage caused by farmed wild boar and escaped North American beaver.