DOI: 10.53478/TUBA.2018.002

Chapter 1
Ancient Woodland in Concept and Practice

George Peterken

Abstract

During the 1970s, British ecologists adopted what they thought was a new concept, ancient woodland, which broadly meant medieval and pre-medieval woodland that still existed in the modern landscape. The concept developed out of an expanding interest by ecologists in the history of the habitats they studied, epitomised by influential works on the *Pinus sylvestris* woodland in Scotland (Steven and Carlisle, 1959) and the woods of the New Forest (Tubbs 1968). At the same time, ecologists were realising that some rare woodland plant species were found in woods that had existed for centuries, but not in woods of recent origin (Pigott, 1969; Ratcliffe, 1968). Ancient woodland quickly became a key concept in nature conservation, partly because the species associated with such woodland were clearly vulnerable to changes in the pattern of woodland. Indeed, these associated species acquired an identity of their own as 'ancient woodland indicators' and were used to evaluate woodlands for nature conservation purposes (Peterken, 1974).

The concept, however, was easily misunderstood. In particular, many people thought 'ancient woodland' meant woodland with ancient trees, whereas ecologists meant 'land that has been continuously wooded since the Middle Ages', i.e., the concept referred to habitat continuity and not the age of the trees, though of course some ancient woodland was in fact dominated by large, old trees. The other misunderstanding was to assume that the term 'ancient woodland indicator' could be taken literally, i.e., that, if any of the species known to be associated with ancient woodland were found in a wood, then that wood must have enjoyed a continuous existence back to at least the Middle Ages.

Despite the confusions, the concept of ancient woodland has since become important in British ecology and conservation. It helps explain the distribution of wildlife species; links ecology with cultural and landscape history; and forms a key element in forestry policy. Allied to this, the concept of ancient woodland indicators has also lodged in the public imagination. Such species tend to be rare and local; they implicitly require land to have remained wooded for several centuries; and for both these reasons they tend to be a priority for nature conservation.

This chapter describes how the concept developed in Britain and its strengths and limitations for ecologists and conservationists. It also considers its use and limitations in mainland Europe and eastern North America.

Defining Ancient Woodland

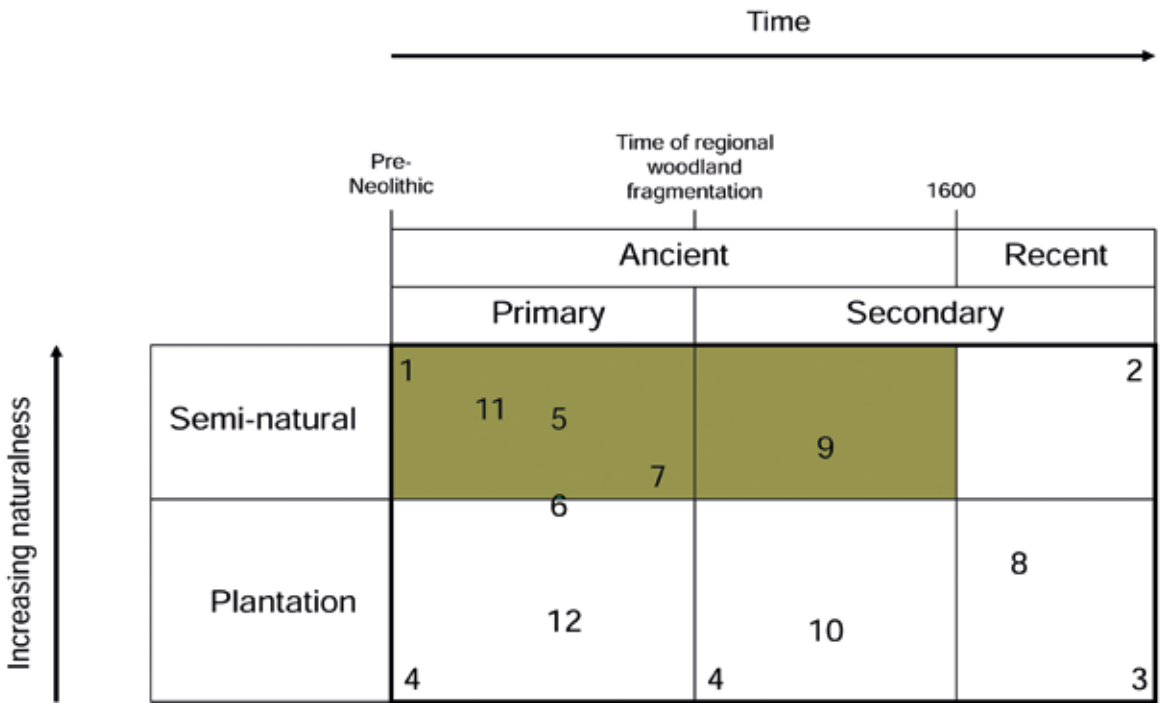
In the late 1960s, we usually used the term "primary woodland" to describe remnants of the original, pre-Neolithic woodland cover and contrasted these with "secondary woodland", which had developed on former agricultural land, i.e., land that has formerly been cleared. However, it is difficult and time-consuming to prove that a wood has always been there, so about 1970 we developed a corresponding pair of terms, "ancient woodland" and 'recent woodland', the former being woodland that existed before 1600, the latter being woodland that originated since 1600. On this basis:

- Any primary woodland would fall within ancient woodland.
- All recent woodland is 'secondary'.
- Any woodland originating on farmland before 1600 would be both 'ancient' and 'secondary'.
- 'Recent woodland' potentially covers a very wide range of ages, from woodland started 400 years ago to new woodland planted last year.

The relationship between these terms is shown in Figure 1.1. The somewhat arbitrary threshold between ancient and recent woodland was set at 1600 because (i) tree planting and the deliberate creation of new woodland only became commonplace after that date, (ii) advances in map-making during the late 16th century enabled accurate maps to be made showing individual woods, so

Summary of terms describing woodland origin (horizontal axis) and naturalness (vertical axis).

Figure 1.1



Both axes are regarded as continuous variables. The green zone represents 'ancient, semi-natural woodland'. The place of several woodland types is indicated by way of example: 1) The original-natural woodland. 2) Naturally-regenerated woodland on former pasture, arable, etc. 3) Plantations of non-native conifers on former pasture, arable, etc. 4) Ancient woodland replanted with non-native conifers. 5) Traditional mixed coppice in woodland of medieval origin or older. 6) As 5, but replanted with locally-native broadleaves and now grown to maturity. 7) Traditional coppice improved by planting locally-native species. 8) 18th-century amenity plantation of native and non-native tree species. 9) Former coppice in woodland on land formerly cultivated by pre-medieval farmers. 10) As 9, but replanted with non-native conifers and some native broadleaves. 11) Wood-pasture of medieval or earlier origin. 12) As 4, but replanted with locally native tree species.

it is relatively easy to identify which woods originated after that date and to define their boundaries, and, (iii) for broadly explanatory purposes, it was reasonable to equate 'ancient woods' with 'medieval woods'.

This distinction between ancient and recent was also useful because the distribution of many wild species could be explained. In particular, we found that some species grew only or mainly in ancient woodland, and we tended to think of these as survivors from the pre-Neolithic 'wildwood' that had rarely been able to colonise new woodland developing on formerly unwooded land at some distance from any ancient wood. These quickly came to be known as "ancient woodland indicators". Some were widespread and fairly common species, but many were rare and uncommon. In contrast, most of the species found in recent woodland were common and widespread, and many were not even confined to woodland. Once we recognised that most of the species of conservation concern were found mainly in ancient woodland, the priority for nature conservation in Britain became the protection and proper management of ancient woods. If we wanted to maintain the full variety of woodland species in Britain, these were the woods that required the greatest care and attention.

The development of the ancient woodland concept in the 1970s refreshed both woodland ecology and studies of landscape history, but it was not a new idea. The early ecologists were broadly aware of the distinction between ancient and recent woodland, though they did not use the terms, until Boycott (1930) used them in more-or-less their modern sense in an important review of the distribution of Mollusca. Much earlier, agricultural and forestry writers in the late 18th and early 19th centuries had distinguished between "woods" and "plantations", and this was tantamount to distinguishing ancient from recent woodland (Watkins, 1988). The beech-oak wood-pastures of the New Forest, one of the most important collections of woods – historically and biologically – in Britain, were actually protected by a statute of 1877 as 'Ancient and Ornamental Woods'. 'Ancient woodland', therefore, was a concept that lapsed in the late 19th century and was revived in the 1970s.

Ancient Woodland Indicators

The idea of ancient woodland indicator species caught the public and professional imagination every bit as much as the idea of ancient woodland itself. Taken literally, these were wildlife species whose presence in a wood confirmed that the wood in question was ancient. Their significance for ecologists and conservationists was that such species must be reluctant to colonise new woodland and so had to be protected where they were found. For landscape historians, they offered a new method for identifying old features in the landscape, which would be useful in the absence of other evidence. To the general public, they were species with an aura around which conservation activities could identify.

Ancient woodland indicators, however, cannot be treated literally. The perfect indicator would be present in all ancient woods, absent from all recent woods and absent from all other habitats. In Central Lincolnshire (Peterken and Game, 1984), *Anemone nemorosa* (Photograph 1) came nearest to this form of perfection. It was present in 75 ex 89 ancient woods, 20 ex 273 secondary woods and scarcely occurred in other habitats. A few species were absolutely confined to ancient woodland, the least-rare of which was *Paris quadrifolia* (Photograph 2) which was present in 9 ex 89 ancient woods, i.e., absent from 81 ancient woods. Nevertheless, even though both species were closely associated with ancient woods, even *Anemone* would have misclassified 34 of the 362 woods in the study area and *Paris* was useless as an identifier of 81 ex 89 ancient woods.

The general points to emerge were (i) that few, if any, species are absolutely confined to ancient woodland, and (ii) any that are so confined prove to be so rare that they cannot be used on their own as indicators. Another flaw in the idea that ancient woodland indicators could be used to identify ancient woodland becomes apparent when one recognises that, by the time we could identify which species were indicators, we had already determined which woods were ancient by using historical and archaeological evidence. More significantly, *Anemone*, Paris and the many other 'indicators' were evidently very slow to colonise recent woodland in Central Lincolnshire and thus vulnerable to change in the distribution of woodland.

Similar studies matching independent evidence of woodland history against plant distributions confirmed that both the range of habitats occupied by species and their ability to colonise vary across their ranges. In Britain, for example, *Anemone nemorosa* also occurs sparingly in meadow grasslands and heaths, but in Central Europe it can be widespread in meadows. *Primula elatior*, which in Britain is abundant mainly in ancient woods, and only occasionally occurred in grassland and fens, is a grassland species in Continental Europe. *Hyacinthoides nonscripta*, which is an abundant and characteristic woodland herb in eastern and Midland England with a limited colonising ability, spreads out over unwooded hillsides, upland meadows and coastal grassland in Wales and western England. The implication was that the list of ancient woodland indicators identified in Lincolnshire could not be used elsewhere: one must identify the slow colonists region-by region.

Photograph 1: *Anemone nemorosa* (G. Peterken).

Photograph 2: *Paris quadrifolia* (G. Peterken).

The detailed historical and archaeological studies needed to identify ancient woods are time-consuming, but a quick approach to identifying slow colonist species is possible by looking on the other side of the coin. In any region, one can easily identify a sample of woods that originated in the last 200 years, find out which species have colonised them, and then the remaining woodland species in the region, i.e., those that were not or rarely seen in the recent woods, would be likely to be slow colonisers.

Photograph 3: *Lamiastrum galeobdolon* (G. Peterken).

Using such informal means, we were able to recognise that many of the slow-colonising species in any region were those on the margins of their ranges and/or on the limits of their ecological tolerance, where they have a narrower habitat amplitude. In both circumstances, growth and reproductive vigour decline and a species is more vulnerable to extreme episodes. This implied that the Lincolnshire list would apply in neighbouring districts, but would become increasingly unreliable with increasing distance from Lincolnshire. One test of this was in nearby East Anglia, where Rackham (1980) reckoned that thirty-five of the fifty ancient woodland indicators identified in Lincolnshire also had a reasonably strong affinity with ancient woodland in East Anglia, but fifteen did not, including *Chrysosplenium oppositifolium, Ranunculus auricomus, Allium ursinum, Veronica montana* and *Primula vulgaris*.

Not all slow colonists were species reaching their ecological limits. Some appeared to be slow colonisers throughout their ranges, e.g., *Lamiastrum galeobdolon* (Photograph 3), *Paris quadifolia* (Wolf, 1997). Ancient forest species tend to be associated with intermediate pH and nitrogen availability; to be more tolerant of shade than most forest species; to be low-growing (geophytes and hemicryptophytes); to use short-distance dispersal mechanisms, e.g., by ant; and to have limited seed and fruit production (Hermy et al., 1999).

In addition to dispersal mechanisms and ecological tolerances, we also needed to take landscape history and woodland management into account when explaining the occurrence of species in recent woods and inferring from that their colonising ability. For example:

- Habitat amplitude of individual species and the habitat history of individual recent woods must also be taken into account when interpreting the distribution of a species in terms of habitat continuity. For example, *Conopodium majus* grows in woods, meadows and heathy pasture, so, if a new wood develops on an abandoned meadow or heathy pasture, this species will be present. It may or may not be a slow colonist, but in this instance the woodland colonised the *Conopodium* population.
- Likewise, both *Anemone* and *Hyacinthoides* grow well and survive indefinitely in hedges, so they can thrive in farmland on field boundaries, even if there is no woodland. If this farmland is planted as new woodland, they may already be present and waiting to expand. Hedges are just one example of semi-woodland habitat (i.e., habitats outside woodland that offer refuge for some woodland species), other examples being stream sides, screes and rocky ground.
- The absence of slow colonisers does not necessarily mean that a wood is recent. Slow coloniser ground flora species are usually absent from ancient woods that were once wood-pastures; and conversely saproxylic indicators are infrequent in ancient woods with a coppice history.

We also needed to remember that some soil types are extreme enough to limit the variety of plant species capable of growing on them. Thus, for example, even ancient woods on strongly acid, sandy soils have a very limited range of plant species, and many of these survive in the grassy heathland that historically was the alternative land type on such ground. Recent woodland on former heaths has few woodland species, but because of the soil, not the inability of species to colonise.

Against this background, we concluded that ecologists and historians should not use species to identify which woods are ancient. Rather, ecologists should use knowledge of woodland history (and the history of non-woodland habitats) to learn about species' capacity to respond to habitat change. In doing this, they should look carefully at the distribution of species within woods, as well as between woods, for this may alert them to small refuges (e.g., ancient hedges, small remnants of ancient woodland in a matrix of recent woodland) from which slow-colonising woodland species have been able to spread. The soil pattern should also be considered when interpreting species distributions. Also, bearing in mind the differences between coppice and wood-pasture, ecologists should recognise that trees, underwood and ground vegetation (and the species that depend on them) may have different histories, i.e., that a wood could be

ancient for old trees and recent for ground flora (wood-pasture) or recent for old trees but ancient for ground flora (coppice).

Species can exceptionally be used to identify ancient woods in the early stages of woodland survey. If an unknown wood is found to include many species that have been demonstrated to be slow colonists in the same region, or nearby on similar soils, one can safely assume that the wood is ancient. Equally, if several acknowledged slow colonists are concentrated in certain parts of a wood that will probably be the ancient portion. This informal 'ecological wisdom' should be verified from historical sources if the historical status of the wood is an important factor in research or forest management.

Listing Ancient Woods

The importance of ancient woodland for nature conservation was quickly recognised by ecologists, but the pace of recognition amongst foresters was slower. Nevertheless, many foresters and woodland owners were sufficiently interested to say they would make special efforts to protect species in ancient woodland if they knew which woods were ancient. Thus encouraged the Nature Conservancy Council experimented with a simple approach to identifying ancient woods (Goodfellow and Peterken, 1981) and then, from 1981, to list and map all the ancient woods in Britain, using maps of different ages. By the late 1980s a complete, but provisional, Inventory of Ancient Woodland had been developed for the whole of England, Scotland and Wales.

The key objective was to make it possible to develop a site-specific forestry policy that recognised the importance of ancient woodland and provided incentives and advice to facilitate its conservation. Conversely, and just as important, other woodland could be 'released' from special obligations for nature conservation to give priority to timber production, recreation and other objectives. The inventory also made ecological surveys more efficient by directing effort at the most rewarding sites, and provided a basis for monitoring and judging changes in forest cover. The site-specific forestry policy was introduced in 1985 as the UK Government's Broadleaves Policy.

The methodology and outcomes were recently reviewed by Goldsmith et al. (2011). Briefly, we used Ordnance Survey maps to filter out secondary woods originating after about 1800. Then, secondary woods originating before 1800, but after 1600, were filtered out using older maps – if available – and other indications, such as wood name, shape and location in the landscape pattern. The outcome was the 'provisional' inventory.

We also attempted to determine how much of each ancient wood was semi-natural and how much had been converted to plantations, using air photographs and any recent field surveys. Inevitably, there were gaps in the information and many stands on the borderline, so the result was approximate. Decision rules were needed. For example, plantations of native trees were recorded as 'plantations' when they were young, but 'semi-natural' when they had matured and developed a more natural stratification.

The inventories were thus provisional and approximate, but they were accurate enough to show the amount and condition of ancient woodland, and to use as a basis for dialogue with owners and foresters when making decisions about what should be done on the ground. The initial inventories have been continuously updated as new information has become available. Their strength is that they are always provisional, in the sense that users agree that they can be changed if new information becomes available. So, if an owner knows more about the history and condition of his/her wood than the inventory shows, the inventory will be modified. In general, when management plans are being developed, they alert all involved to the need for careful consideration of the nature conservation needs, but they do not dictate any particular form of management.

Ancient Woodland Concept in Practice

The revival and development of the concept in the 1970s, was largely due to Rackham and myself, who were both based in eastern England. There, ancient woods were sharply defined and the sources of historical information were relatively good, but elsewhere a variety or problems became apparent in both the concept of ancient woodland and the ability to define its boundaries.

The least troublesome was the choice of 1600 as a threshold date for defining ancient woodland. The main need was to separate younger from older woods and to define a category, within which all primary woods must fall, that was as limited as possible. By doing this we had the option of economising on survey and historical searches. We could not have chosen an earlier threshold because estate maps only started to become reasonably frequent in the late 16th century, so there was little cartographic evidence of woodland distribution before 1570. Fortunately, this also pre-dated enclosure of commons and extensive pastures and the habit of tree-planting which gave rise to numerous small woods from the 18th century onwards. In practice, 1600 was a notional date, and what this really meant was 'in the 17th century'. When we listed ancient woods for the Inventory, we actually used the first comprehensive maps, the Ordnance Survey 1st edition, dating from the early 19th century. In Scotland, we had the earlier Roy maps, so we used those. Similar dates-of-convenience were adopted elsewhere.

One commonly-asked question was easy to resolve. If a wood was clear-felled, did that break the continuity of woodland? Our answer was that for both ecologists and foresters, clear-felling and natural stand destruction (e.g. by wind or fire) was part of the forest cycle and that it did not break continuity if the stand was replanted or regenerated naturally. This was particularly true of coppice, which simply regenerated from the stumps of

the previous stand – new trees, but the same individuals and patterns. The only problem was that some maps of the mid-twentieth century mapped recently-felled woodland as not-wooded.

Another issue related to small clearances. If a clearing or a forest road within an ancient wood filled with trees, should the ground be classified as new woodland? If it were, small patches or strips within ancient woodland would be classified as recent. Technically, such woodland is indeed recent, but in practice such small inclusions have no ecological isolation from ancient woodland and were counted as part of the ancient woodland for conservation purposes. In fact, most ancient woods have small recent inclusions which are quickly colonised by woodland species and eventually merge into the surrounding ancient woodland. They differ only if the soil or hydrology was altered when the patch or strip was open.

Similar issues arise with new woodland that develops next to ancient woodland. Small adjacent ancient woods were notionally 'adsorbed' into ancient woodland, but larger adjacent new woods were recognised as recent. Many species colonise from ancient woodland at less than 1m per annum, so large, new woods next to ancient woods take much longer to occupy than small additions (Bossuyt et al., 1999).

More difficult was the treatment of wood pasture. Should it count as woodland and do woods that originate from pre-1600 wood-pasture count as ancient? This was important, because much of the western uplands and many lowland medieval forests and commons were wood-pasture for centuries. Moreover, many saproxylic species were strongly associated with pre-1600 wood-pastures, so such places were exceptionally important for conservation.

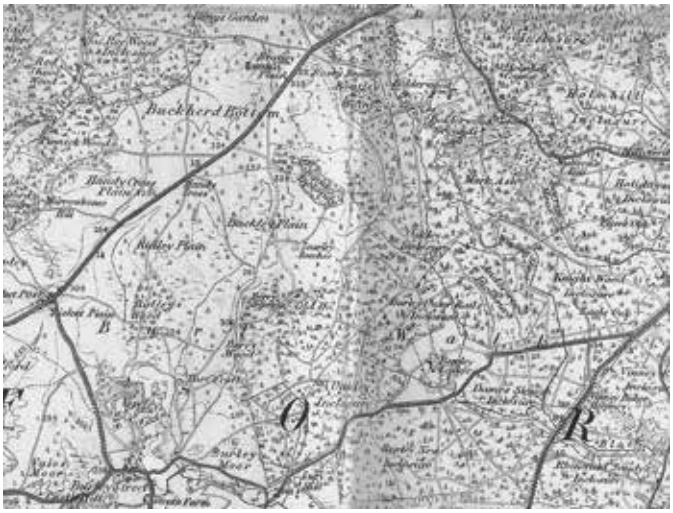
Wood-pastures are grazed woodlands in which grazing so limited regeneration that the woodland become open and often thinned to parkland, i.e., pasture with scattered trees. The trees were often large and old, but the underwood and woodland ground vegetation was replaced by pasture species and scattered shrubs, often thorny, such as *Crataegus monogyna* and *Prunus spinosa*. In many cases, wood-pastures became so open that they were not mapped as woodland. If such parkland later fills with trees and become closed woodland, should that woodland be 'secondary' because the land was previously open, or 'ancient' because trees have always been present on the ground?

The problem is illustrated by two maps (Map 1 and 2). One shows a wood-pasture landscape (Photograph 4) where, as is often the case, the trees in wood-pastures stand in a diffuse mosaic with unwooded ground. Here woodland boundaries are difficult to define and map. In contrast, the second map shows a landscape of scattered, sharply-defined woods, in which the ancient woods were coppices (Photograph 4). Here, woods are easily delimited and changes can be quickly identified.

In practice, GB usage has been inconsistent and needs to be rationalised. Wood-pastures that have filled with younger trees have generally been regarded as ancient, but sometimes not. This is obviously unsatisfactory, but it can be resolved with a more discriminating analysis that recognised different histories for different components of the stand. In most wood pastures, large trees and dead wood habitats have been continuously present, so for these components the wood is ancient. The underwood, on the other hand, has usually not been continuously present and the ground vegetation has passed through a pasture phase, so for these components the wood is recent secondary. In woods which have had a coppice history, the woodland ground flora and the underwood have been continuously present, but the mature timber habitats usually have not. The two management regimes are thus complimentary: an inventory of ancient woods should aim to distinguish between those with a wood-pasture history and those that have been coppices.

Summarising, the ancient woodland concept works best in the UK when:

- Woodland covers well below 30% of the landscape, preferably 5-10%. Without this, there will be little ecological isolation in the landscape and good colonists will not be favoured. The 30% threshold is not sharp and depends on the predominant shapes of woodland, but in 30% wooded landscapes where woodland is well-distributed, almost any new woodland will be adjacent or close to an existing woodland.
- There is in fact some woodland in the landscape dating from before 1600, as well as some dating from later. Obviously, there is no point in separating ancient from recent woods if only one class is present. If all woods are pre-1600 or post 1600, age as woodland is unlikely to differentiate their characteristics.
- The reduction to well below 30% woodland cover happened several centuries ago. In such landscapes, isolation has been long-lasting, but, more to the point, enough time has elapsed for new woodland to have developed.
- Woodland boundaries are sharply defined. Without this, woodland itself is hard to delimit and discrete patches that might be ancient or recent are hard to define.
- The ancient woodland has been managed as coppice or high forest, rather than wood-pasture. Partly this is because pasture woodlands are often diffuse and hard to delimit (see above). Also, coppice and high forest stands tend not to be grazed, so the woodland ground flora has not been transformed into a pasture. The logic is reversed for pasture woods where saproxylic species are being considered.
- The matrix (intervening land) has been used for arable cultivation, which is hostile to almost all woodland plants and animals. Where the matrix is pasture, heath or meadow, some woodland species thrive in these habitats. If a two-habitat species is found in a wood then at most is indicates continuity of woodland + the other habitat.
- Semi-woodland habitats are uncommon in the



Map 1 and Photograph 4 (above): A portion of the New Forest, which is a wood-pasture. Here, the woodland is generally diffuse and boundaries are difficult to define.

Map 2 and Photograph 5 (below): A predominantly agricultural landscape in which woods are sharply defined. The two ancient woods, Calpher and West Woods, were treated as coppices.

intervening landscape. These are habitats that are not classified or mapped as woodland, but nevertheless support a range of woodland species. Hedges form a widespread semi-woodland habitat in farmland. Others include river and stream banks, cliffs and railway embankments.

These conditions are fulfilled in much of lowland Britain, which is primarily agricultural, but not in the wood-pasture enclaves, such as the New Forest, nor in the few places with a long history of woodland cover above 30%, such as the Lower Wye Valley and the Chiltern Hills. These are districts which have always been well-wooded and have a long history of both wood-pasture and coppice. In upland and northern Britain, the conditions are rarely fulfilled, because (i) boundaries not sharply defined; (ii) the long and widespread history of pasturage and wood-pasturage; and (iii) the higher frequency of semi-woodland habitats in the landscape. Nevertheless, even in the districts where the conditions are poorly fulfilled, it has been possible to recognise woodland species with only limited abilities to colonise new woodland isolated from old woodland, e.g., the Atlantic bryophytes (Ratcliffe, 1968).

Primary Woodland

One reason why ancient woodland is important is that it will include any primary woodland that survives. Primary woodlands are – or would be, if they exist - remnants of the original, pre-Neolithic forests, and these would obviously be of interest to ecologists if they could be identified. The general problem is that, to prove a wood is primary, one must demonstrate that it has existed continuously throughout 5,000 years, which is really only possible with localised pollen records, and then these apply only to the immediate vicinity of the sample.

Archaeologists have usually taken the view that primary woodland could not have survived. The scale, intensity and duration of prehistoric land use is considered to have been such that woodland must have been removed from every patch of ground at some

time. This view is supported by examples of woodland that undoubtedly go back 1,000 years or more in the historical record, but which nevertheless occupy land that was once a prehistoric field system or a fortified settlement. It has also been reinforced by pollen studies that have demonstrated pre-1600 open phases in ancient woods, and by recent LiDAR images, that enable even faint earthworks to be seen under vegetation. The latter in particular have opened everyone's eyes to hitherto unsuspected activity in ancient woods.

Nevertheless, there is good reason to entertain the possibility that some ancient woods are indeed primary, even if they have passed through relatively open phases. Not all ancient woods are found to overlie earthworks, even in LIDAR images, and woods with a pollen record showing a continuous trace of woodland are known. In any case, there has always been a need for timber, and it is far easier to keep the woods one has already than clear them away and create new ones elsewhere.

Whilst only a minority of ancient woodland may be primary and it is rare to find evidence of continuity of a particular wood back to the pre-Neolithic, there is a sense in which the question of continuity back beyond the Neolithic is not crucial for an ecologist. Consider a district where forest was much reduced in the early Neolithic, but tree-cover remained as an open patchwork of wood-pasture, scrub and marginal woodland amongst which there were cultivated fields and habitations. If, in the later Neolithic, this reverted to closed woodland, together with its characteristic species, any fragments of that late-Neolithic woodland that remained today would technically be secondary and might contain the remains of houses and field systems, but habitats for all components of the original woodland would still have been present continuously. In any case, a few thousand years have elapsed in which something like the original woodland could have been reconstituted. It is only when the woodland of a district has been so reduced, that the development of any restored woodland is limited by isolation from remnant woodland that it matters for ecologists.

In any case, pre-Neolithic forests were not wall-to-wall trees. They certainly had substantial openings in wetland and locally elsewhere, and there is the unresolved issue of whether large herbivores maintained wood-pasture on ordinary ground, as maintained by Frans Vera (2000). Accepting that Vera-type glades and scrub were present on some site types implies that we do not have to be too literal about the question of whether a particular patch of current woodland is, or is not, primary. If it has existed continuously since the Bronze Age, that's old, and it is highly likely to incorporate a direct habitat link to pre-Neolithic woodland.

Mainland Europe and North America

The concept of ancient woodland has proved to be useful in several countries in mainland Europe. A particularly strong research interest developed in Belgium around Martin Hermy and others working with him. He and other ecologists in Netherlands, Germany, northern France, Denmark, southern Sweden, Czechoslovakia and Poland have all used the concept in the British sense, although they have frequently used other labels, such as 'older woodland', etc. In each case, the threshold date has been dictated by local historical sources, usually the first systematic maps of the regions being studied, so 'ancient woodland' has tended to be woodland that existed in the mid – late 18th century and has survived ever since. This, in practice, is how we used the term in Britain when developing the ancient woodland inventory, where threshold dates were determined largely by the first comprehensive Ordnance Survey maps.

The common factors in all these countries and regions is that woodland has been reduced to a small proportion of the landscape and much of the matrix land has been used for intensive agriculture, i.e., they match the woodland and landscape history over much of lowland England, where the concept was developed. Elsewhere in Europe, (to the best of my knowledge) the concept has not been used, even by Oliver Rackham, who was as closely associated as anyone with the concept in Britain, and it is easy to understand why not:

- In the Mediterranean region, much of the arboreal vegetation is open woodland and scrub on irregular ground subject to grazing and fires. Being open and subject to a long history of use and modification, woods themselves are difficult to delimit. Sheltered, humid conditions are found only in specialised locations in ravines and on north-facing slopes (Rackham and Moody, 1996; Grove and Rackham, 2001).
- In boreal districts, trees cover a great deal of the landscape. Naturally and historically, they were subjected to fire and extensive grazing, leaving them open and constantly changing in their patterns. The non-forested habitats are forms of heath and mire, not unlike the ground vegetation of the open woodland. Today, with fire-suppression and intensive forestry, the forest stands are dense and landscape patterns are more sharply defined (Many examples in Sweden).
- In montane districts, wooded ground is disturbed by rock falls and avalanches, and most is grazed by stock with freedom to range into all habitats. In many regions, the forested ground occupies much of the land below the tree line. Elsewhere, the forested patches are often open and difficult to delimit.
- In some other kinds of lowland landscape, woodland is also poorly delimited and has fluctuated in distribution. For example, extensive lowland deciduous woodland in regions around the Baltic Sea have long been used as wood-meadow, which will be ancient, but the precise boundaries of woodland are hard to define, even when one is walking in them. In the now well-wooded Landes region of SW France, woodland was reduced to small remnants amongst heath, yet some well-defined ancient woods survived, e.g., Biscarrosse.

In north-eastern USA there has also been some interest in how forest history has influenced the distribution of plant species, and this has involved identifying those patches of forest that were never cleared by European settlers. In 1860, Henry David Thoreau knew such patches as 'primitive woodland' or 'second growth' (Torrey and Allen, 1962) and modern authors refer to them as 'primary' or 'old growth' in contrast with 'secondary' or 'old field' woods (Marks, 1995; Whitney and Foster, 1988; Whitney, 1994). In the modern landscape, where settlements and houses are mostly islands in a matrix of forest, these remnants can be identified from maps, by the presence of pit-and-mound micro-topography and by how they relate to the walls and other remnants of abandoned farms.

Rather than recognise ancient woodland in the British sense, ecologists and conservationists in most of Europe and North America recognise 'old-growth' stands, 'Urwald' or its equivalent, and in each case the terms refer to stands of mature trees that have not recently been managed, and which now usually possess a high volume of dead wood and a diverse vertical and horizontal structure. Such stands are 'ancient' in the British sense, but most British ancient woods are neither 'old-growth' nor Urwald. Many of these Urwälder survive in densely-forested regions, where there would be little meaning in recognising ancient woodland in the British sense.

The British have often translated 'Urwald' and 'old-growth' as 'virgin forest', implying that they are natural forests that have never been influenced by people, but this is rarely, if ever, justified. Most old growth boreal forests have changed in the 20th century with fire-suppression and restrictions on grazing. Many sub-montane Urwälder in central Europe were are least used and modified in the past, some as wood-pasture or wood-meadows. And, in the USA, the old-growth stands have changed since they were abandoned by indigenous Americans at the time of settlement by Europeans.

Conclusions

The British concept of ancient woodland has limited application. Ancient woods are easiest to define and delimit in temperate lowland landscapes where forests have at some time been reduced to much less than 30% of the landscape and the cleared land has been used for agriculture, leaving the remaining woods sharply defined in space and time. In such regions the concept has proved to be most useful when defining nature conservation priorities, based on protecting sites with (i) a direct link to the primitive landscape (ii) links to local history and culture, and (iii) biodiversity values connected to species that are least resilient in the face of radical and rapid habitat change. In montane, Mediterranean and Boreal landscapes, as well as in those landscapes where forests have always remained abundant and/or have been used for extensive pasturage, the concept has proved to be less useful, though, with modifications, it can be applied where old habitats and a long, uninterrupted continuity of habitat is significant, e.g., old-growth remnants in Boreal forests.

One can turn this conclusion back onto British conditions. In the wider context, one can appreciate that the difficulties in applying the concept of ancient woodland to sub-montane and boreal regions and districts with a history of extensive wood-pasturage are similar to the difficulties that would apply in many parts of mainland Europe.

The German concept of Urwald has frequently been translated into English as 'virgin forest', implying that such woodland has never been altered by people. Perhaps this expressed an unconscious hope that such woodland really does survive, but archaeological and palynological studies have repeatedly confirmed what common sense dictates, that no present-day woodland can have escaped some direct or indirect modification by people in the last 5000 years. But, taking a less black-and-white view, we recognise land that has always been reasonably well-wooded, bearing stands whose composition is little altered the late Mesolithic (and then only in a way one might have expected with post-Mesolithic species movements and soil maturation)> Such woodland is 'primary', 'ancient' and 'semi-natural'. If it is left untouched until its structure and processes show little sign of earlier human influence, it would become as much Urwald as most, perhaps all, Urwälder in mainland Europe.

References

Bossuyt, B., Hermy, M. and Deckers, J., 1999. Migration of herbaceous plant species across ancient-recent forest ecotones in central Belgium. *Journal of Ecology* 87: 628-638.

Boycott, A.E., 1934. The habitats of land Mollusca in Britain. *Journal of Ecology* 22: 1-38.

Goldberg, E., Peterken, G., & Kirby, K., 2011. Origin and evolution of the Ancient Woodland Inventory. *British Wildlife* 23: 90-96.

Goodfellow, S. and Peterken, G.F., 1981. A method for survey and assessment of woodlands for nature conservation using maps and species lists: the example of Norfolk woodlands. *Biological Conservation* 21: 177-195.

Grove, A.T. and Rackham, O., 2001. *The nature of Mediterranean Europe. An ecological history*. Yale University Press, New Haven and London.

Hermy, M., Honnay, O., Firbank, L., Grasof-Bokdam, C. and Lawesson, J.E., 1999. An ecological comparison between ancient and other forest plant species of Europe, and the implications for forest conservation. *Biological Conservation* 91: 9-22.

Marks, P.L., 1995. Reading the landscape: primary vs. secondary forests. *Arnoldia* 55: 2-10.

Peterken, G.F., 1974. A method for assessing woodland flora for conservation using indicator species. *Biological Conservation* 6: 239-245.

Peterken, G.F. and Game, M., 1984. Historical factors affecting the number and distribution of vascular plant species in the woodlands of central Lincolnshire. *Journal of Ecology* 72: 155-182.

Pigott, C.D., 1969. The status of *Tilia cordata* and *T. platyphyllos* on the Derbyshire limestone. *Journal of Ecology* 57: 491-504.

Rackham, O., 1980. *Ancient woodland*. Arnold, London.

Rackham, O. and Moody, J.A., 1996. *The making of the Cretan landscape*. Manchester University Press, Manchester.

Ratcliffe, D.A., 1968. An ecological account of Atlantic bryophytes in the British Isles. *New Phytologist* 67: 365-439.

Steven, H.M. and Carlisle, A., 1959. *The native pinewoods of Scotland*. Oliver and Boyd, Edinburgh and London.

Torrey, B. and Allen, R.H. (eds.), 1962. *The journal of Henry D. Thoreau*. Dover, New York.

Tubbs, C.R., 1968. *The New Forest: an ecological history*. David and Charles, Newton Abbot.

Vera, F.W.M., 2000. *Grazing ecology and forest history*. CABI Publishing, Wallingford.

Watkins, C., 1988. *The idea of ancient woodland in Britain from 1800*. In: Salbitano, F., (ed.) Human influence on forest ecosystems development in Europe. Pitagora Editrice, Bologna, 237-246.

Whitney, G.G., 1994. *From coastal wilderness to fruited plain. A history of environmental change in temperate North America 1500 to the present*. Cambridge University Press, Cambridge.

Whitney, G.G. and Foster, D.R., 1988. Overstorey composition and age as determinants of the understorey flora of woods of central New England. *Journal of Ecology* 76: 867-876.

Wolf, M., 1997. Plant species as indicators of ancient woodland in northwest Germany. *Journal of Vegetation Science* 8: 635-642.