Chapter

The Management of Trees in the Wood Pasture Systems of South East England

Helen Read and Vikki Bengtsson

Abstract

This chapter outlines the history and past management of trees within the wood pasture systems of South East England. Changes over time are discussed, and the challenges that the trees now face are outlined along with some potential solutions. Wood pasture was a common and traditional form of management in South East England although the conservation significance of it has only recently been realised. The types of wood pasture included wooded commons, Forests and parks, all of which have quite precise historical meanings. Many trees in wood pastures were managed as pollards, probably mainly for fuel wood, but some were open-grown. The number of trees has declined, and the area of wood pasture has diminished due to development pressure and agricultural intensification. Despite this, the area remains important in a European context for the number of old trees. In addition, lack of traditional management is a threat to tree and wood pasture survival. Restoration of grazing using traditional livestock is an important first step. New skills are required to work on trees that have been left many years out of a regular pollarding cycle, and new uses for the products will be important to help these trees become relevant again.

Keywords: wood pasture, pollards, England

1. Introduction

In conservation terms wood pasture is only a relatively recently recognised habitat in the UK, in contrast to countries like Spain where the *dehesa* is well known and still actively managed. Following the 1992 Rio Convention on Biodiversity, the UK focused on conservation action through the development of biodiversity action plans (BAPs) for species and habitats. Wood pasture was included in the form of 'wood pasture and parkland'. One of the first problems for the steering group setup to oversee the BAP was defining the habitat.

At the time that the UK joined the EU, wood pastures were not listed as a CORINE habitat type, so that Special Areas of Conservation under the Habitats and Species Directive could only be granted to wood pasture sites in the UK under other, usually woodland, habitats. Later, at the time of the accession of several Scandinavian countries, like Sweden, to the EU, two extra habitats were proposed and accepted, Fennoscandian wooded meadows (6530*) and Fennoscandian wooded pastures (9070). Some of these are very similar to areas in the UK, but

designation under these categories was not permitted to countries that accessed before these countries. This remains the case today (see [1] for more details and a list of the wood pasture sites designated as Special Areas of Conservation SAC).

Despite the current situation with SAC sites, the English agri-environment schemes fund both the maintenance and restoration of wood pastures. The former BAP steering group has morphed into a technical advisory group and has produced guidance in the form of videos [2] including one for advisers, to help them recognise and value wood pastures and increase their knowledge of the appropriate management. Other management films and training materials focusing on the management of the habitats and, in particular the trees, have been developed through the Ancient Tree Forum [3, 4] and an EU project [5].

The irony is that wood pasture is probably one of the oldest forms of land management in Southern England and it was probably extremely widespread and common in the past. It is also most likely that wood pasture mimicked the appearance of at least parts of the English landscape in times before humans altered it so substantially [6].

Wood pasture and parkland are mosaic habitats valued for their trees, especially veteran and ancient trees, and the plants and animals that they support. Grazing animals (either domestic livestock or deer) are fundamental to the existence of this habitat along with flowers providing nectar sources and open grassland or heathland ground vegetation [7]. In this chapter we outline the different origins of the wood pasture systems in South East England and look at the historical management of the trees. Some of the changes are then discussed as well as the problems that the trees now face. Finally, we look to the future and suggest some potential solutions. Where possible we have given details of some case studies which present some key sites and trees in a little more detail.

2. Historical background

Trees started colonising the UK following the end of the last ice age in around 8200 BC. The density of the tree cover that developed has recently become a matter of conjecture, with the traditional view that this was dense and continuous [8] being challenged in recent years due to the work in other parts of Europe (for example, see [6]). Kirby and Watkins [9] consider that, prior to the Neolithic period, tree cover in England probably ranged between 60 and 90% but with some parts being much more open. Although undoubtedly early man had some impact on local areas, around 3100 BC more extensive evidence of human impact on the English landscape starts to be found. This includes more widespread tree felling, and finds of ancient trackways from Neolithic and Bronze Ages indicate that wood was being used and quite probably was grown for use [10]. Between the birth of Christ and 1200 AD, the English countryside changed into a 'modern' landscape with villages, fenced areas and orderly management of woodland. During this period the Romans and then Anglo-Saxons had large impacts on the land, including periods when the tree cover increased [11]. They were followed by the Normans who also had a major influence on the land. In 1086, just 20 years after the Norman Conquest, the first inventory was taken from the English landscape on a huge scale which included descriptions of the size and location of woodland, as well as other features, for each parish (the smallest administrative unit in England). These are still accessible today in the *Domesday Book*. Unfortunately, it is not always easy to interpret every entry in the *Domesday Book*, and there are regional variations in the way different land management is described; however, it is evident that both coppiced woods (*silva minuta*) and pasture wood (*silva pastilis*), which has been described [12] as

being 'park-like with plenty of grass', existed. Probably, *silva pastilis* constituted the greater part of woodland at this time [11]. By the thirteenth century, it is considered [12] that these two types of woodland were clearly differentiated and it was relatively rare for woods to be converted from one to the other (although this clearly did happen in places [13]), and most woods were now managed as coppice [14].

The management of woodlands in the medieval landscape was considered to be intensive and relatively stable, with replacement trees grown in place of any cut down. Woods were enclosed by banks and ditches combined with a fence or hedge. Wood pastures were rather less stable than the woodlands, and many had been lost by the thirteenth century.

In other parts of the UK, particularly in upland areas, the land use history and patterns were a little different, and the trees and wood pastures were subject to different pressures [1, 10, 14] which is why in this chapter, we confine our discussion to South East England, especially the area around London, which still has some particularly notable places for trees and wood pasture to this day.

2.1 Types of wood pasture and where they were found

There are many different types of wood pasture in South East England, but the most frequent were those associated with the historic land uses of wooded commons, Royal Forests and parks. In addition, fields with trees can be considered a form of wood pasture. These different types are outlined below and some case studies of typical examples.

2.1.1 Wooded commons

Common land was abundant in the English countryside in the twelfth and thirteenth centuries, and probably every parish had some, even today there is over 1.3 million acres [15] (526,000 hectares) of common land remaining in England and Wales. Commons were owned by a person, often the Lord of the Manor or the owner of a large estate. Although it was usually a wealthy person who owned the common, villagers could use the land, subject to certain rules and regulations. Typically, commons provided fuel, small-scale wood and grazing for the poor of the village [16] with cattle, sheep, horses, geese and pigs, all turned out on them. Thus, they were areas where there was a high intensity of management, and they were crucial to the survival of many people.

Case study: Ashtead Common. At 200 ha in size and on heavy clay soils, Ashtead Common has over 2300 *Quercus* sp. pollards [17] (of which about half are still alive) (**Figure 1**). As part of the Manor of Ashtead, it was probably used for providing wood and grazing land for the local people. Earthworks in the wood indicate Iron Age working, and there are also a Roman villa and tile works. Pollarding probably ceased around 150 years ago, and recently a work programme to reduce the crowns of the trees has started to try to stop them falling apart from the heavy weight of the branches. Ashtead Common is owned and managed by the City of London Corporation.

2.1.2 Parks

The word park has conjured up images of very different landscapes in England over the years. In Anglo-Saxon times, it was an area of land with a fence around it. From 1066 until the eighteenth-century parks were places where wild animals like deer (of various species) or semi-wild animals such as feral cattle were kept for the main purpose of hunting. These proliferated from the thirteenth century, and it has been calculated that in lowland England there may have been roughly one park to every four parishes or every 38 square kilometres [12]. The animals were kept

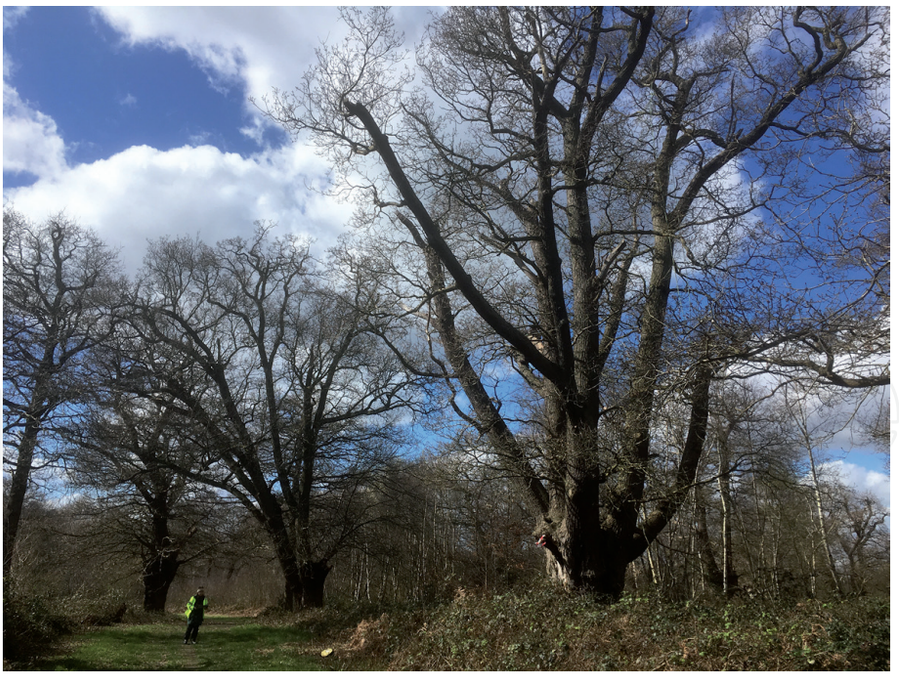

Figure 1.
Lapsed Quercus *sp. pollards at Ashtead common.*

in the parks by a deer-proof boundary, the most characteristic being a 'park pale' or palisade fence of cleft oak, very expensive to build and maintain. The park pale could also be a wall, but this was less likely in South East England. Parks varied in size and, because of their cost, were the preserve of rich people and those that could afford such a status symbol. Inside the park pale, the land was grazed, but it could range between dense woodland and completely open areas. Typically, much of the area was grassland with scattered trees, sometimes pollarded, but this was not universal.

In the seventeenth and eighteenth centuries a new type of park evolved, that of a formally designed landscape park. Famous designers included Lancelot (Capability) Brown and Humphry Repton, amongst others, who were employed by wealthy landowners to make their estates attractive. In many cases they imposed these on an older park, frequently retaining features such as the older trees [12]. Most of the landscaping involved physically moving soil to create lakes and mounds and the planting of trees in specific patterns such as clumps or avenues [12]. Parts of these parks continued to be grazed by livestock or deer.

Case study: Windsor Great Park was the largest deer park in England in medieval times and today contains just under 2000 ha [18]. The modern boundary of the park follows the old park pale in many places although today it is part of a large area adjacent to Windsor Castle, much of which is open to the public and also comprises areas of working farmland and forestry. More than 7000 significant trees have been identified across the whole of the estate [19], but the *Quercus* spp. are the most abundant and impressive with many exceeding 6 m in girth (**Figure 2**). The land under the trees is mostly acid grassland and is grazed by deer. Several avenues form part of the overall complex which also includes ponds and streams. The park is partly owned by the state and managed as part of the Crown Estate.

2.1.3 Royal Forests

The word Forest has a very specific meaning in England, as an area of land where specific laws operated [12]. Thus, it was not usually enclosed, like a park,

Figure 2.
Old Quercus *sp. tree at Windsor Great Park.*

but included a wide range of different land uses and sometimes even towns. Later in time the term Forest was used more to describe that part of the land that was not woodland, farmland or built upon [12]. This could be open grassland or heathland, but much was also probably wood pasture. A Royal Forest was an area where the king had rights, including the right to hunt. There was often a great deal of administration associated with the Forest, and many people were employed to supervise the interest of the Crown (royalty) in the land. These administrators gained rights through their positions, and these included rights to pasture animals, take wood and timber, etc. The land was not necessarily owned by the Crown, but the owners were prohibited from doing certain things with their own land, and this frequently included cutting down their own trees [12]. Chases are equivalent to Forests but were privately owned not part of the Crown land. At one time Forests and chases covered approximately one fifth of England [12].

Case study: Hatfield Forest is considered to be the most intact example of a medieval hunting Forest remaining in the UK today. It was a compartmentalised Forest, meaning that there were different areas within the Forest that were clearly marked out and the tree management was rigidly defined. About 220 hectares of the total 400 hectares was coppice cut on an 18-year cycle. The cut areas were fenced to keep all browsing animals out for the first six years, after which deer were admitted, and then after further three years all animals were admitted. The remaining area of the Forest was open 'plain' of grassland with pollarded trees and scrub (see [20] for more details). Today, some 800 pollards remain (**Figure 3**), including more tree species as pollards than any other site in England and *Carpinus betulus* as the most frequent. Today, Hatfield Forest is owned and managed by the National Trust.

2.1.4 Fields with infield trees

Field systems present in England today do not have a single origin. The oldest systems (sometimes called ancient countryside) are Bronze Age or earlier and difficult to date. Others were created post the Norman conquest of 1066 and were based on a mosaic of strips or parcels of land within a parish's, or manor's, common-field system. These initially had few or no hedges. Another field origin was the "inclosure" of the commoners' grazing lands called 'commons', mostly rough pasture but also some

Figure 3.
Carpinus betulus *pollards at Hatfield Forest.*

woodland. This affected over 20% of all parishes in England [12]. Some enclosure was piecemeal and illegal, but Acts of Parliament made the process legal from 1700 onwards. Whenever and wherever strip fields or common grazing land was enclosed, the land was divided up into fields, bounded by hedges, in an *ad hoc* manner in old field systems, more rigidly planned and planted under legal inclosure.

Today, relatively few English fields contain trees, but old maps and documents indicate that this was not always the case and most fields had trees in them, more in pasture than arable. In the Ancient Countryside "clayland" region of Suffolk, Norfolk and part of Essex and elsewhere in South East England, trees were managed as pollards or shreds in several systems; scattered infield trees line 3–4 trees deep, around the margins of fields, forming a type of linear wood pasture system [13], and trees within the hedge line around the fields, sometimes in very high numbers (up to a pollard every 10/15 m), a pattern throughout much of this region, up to about the mid-nineteenth century. Old maps and farm sale documents indicate that almost all fields historically had trees within them, but these mostly disappeared as tractors arrived throughout the agricultural intensification of the twentieth century.

Case study: Pollarded trees in the hedges of Goswold Hall, Suffolk. Goswold Hall is a 150 ha arable farm with mixed species hedges around the small Bronze Age fields (a nearby Roman road cuts diagonally across them) and several green lanes or ancient trackways pass through the farm. Prior to the 1970s, there were over 100 *Ulmus* sp. pollards within the hedges, but these all died from Dutch elm disease. *Quercus* sp. and *Fraxinus excelsior* pollards were also abundant, and many of these still survive; most pollarding had lapsed by the mid-nineteenth century (due to the availability of coal for fuel brought by canals or railway), but a few were cut until the late twentieth century (**Figure 4**). Pollards were cut on a 12–15-year cycle (still mostly for firewood); the farm workers were given the wood from a tree and could sell the wood if they did not need it themselves, but they had to cut the trees in their own time [3].

2.1.5 Summary

The density of trees across the historic landscape of Southern England must have varied widely, with some fields containing many infield trees, while other areas of commons, Forests or parks included everything from dense woodland to areas with

Figure 4.
Pollarded Quercus *sp. trees in an ancient hedge at Goswold hall.*

almost no trees. Thus, 'wood pasture' has not acquired a separate identity in the UK but was characteristic of several different forms of land management. It was also potentially difficult to delineate because it blended seamlessly into open habitats like pasture or places with dense tree cover like woodlands within the same park or Forest. Even on a common, there could be very open areas with almost no trees and contrasting places where the density of trees or pollards was so great that they were in effect like woodlands.

There was probably also a high degree of convergence between the different landscapes so that some places with hedges and infield trees could be potentially quite similar to areas within commons, Forests and parks.

2.2 Management of trees in wood pasture systems

2.2.1 How and why were the trees managed?

The management, and therefore the appearance of the tree, varied within the different wood pasture systems depending on the needs of the people owning and managing the land around the tree. Below, the main traditional tree management methods are outlined, those of pollarding, coppicing and shredding, and are contrasted with open-grown trees.

2.2.2 Pollards

On common land in peaty areas, fuel could be cut from the ground as turves or peat, but in many places, it was the trees that provided it as wood [12]. Wood could be collected from the ground (sometimes leaf litter was collected too) or cut from the trees. Tree felling or coppicing was not generally permitted, but the cutting of branches from the trees as pollarding often was. It seems likely that in most cases the cutting of pollards was not as regular or organised as coppicing, but as records describing the management practice in detail are scarce, it is difficult to know.

Wood cut from the trees was probably largely used as domestic fuel, but other uses dependent on the area might have been charcoal, small-scale building materials, fence posts, etc., and sometimes the wood was sold rather than used by the

villagers themselves, for example, at Epping Forest where bundles of wood cut from *Carpinus betulus* pollards were sold for use in London's bread ovens.

The cutting of trees for leaves to feed to livestock as fodder or leaf hay is poorly documented in the UK. Hooke [11] indicates that *Quercus* spp., *Fraxinus excelsior* and *Ulmus* spp. were lopped (cut) in summer for winter fodder, and Barnes and Williamson [13] infer that leaves may well have been used for this purpose, but, while it was a known practice in upland areas such as the Lake District [21], its prevalence in South East England is unknown. Guidance from the sixteenth-century sources such as Tusser [22] and Fitzherbert (quoted in [25]) supports the traditional view that tree and hedge cutting was done in the winter. Fitzherbert specifies that pollarding was not carried out in 'sappe time', and Tusser [22] lists work according to the calendar stating that 'lopping of pollengers' [pollards] is a January task. However, it seems highly likely that, especially in dry years, branches would have been cut from the trees so that livestock could eat the leaves. While most villages probably had hay meadows which may have been grazed by livestock after the hay was cut, the grazing pressure, particularly on those areas with poor or thin soils, must have meant that leaf hay was needed, at least in some years.

The trees on common land were important also for their fruit. Some was no doubt consumed by humans, but the autumn pannage season, when the pigs were turned out into the woods, was an important period in the farming year, and some areas were referred to as swine pastures [12]. The acorns, beech nuts and other fruits and berries were crucial to the fattening up of the pigs and survival of poor people during the winter months although with *Quercus* sp. and *Fagus sylvatica* trees producing intermittently fruit, mast was not necessarily abundant every year.

Outside areas of common land, trees in hedges were also pollarded; for example, in parts of East Anglia, it is thought that at one time 60% of the *Quercus* sp. trees were pollards [13]. In some places the density must have been quite high, and it has been speculated that, because there were also coppice trees to provide fuel wood, the pollards must have either been cut on a longer rotation to provide larger-diameter wood for fencing and building or possibly on a shorter rotation to provide leaves [13].

In some Forests, trees were also pollarded because, although the King or another wealthy person had the rights to hunt deer, these places remained extremely important for the livelihoods of the local people. Hence in, for example, Hatfield and Epping Forests, large numbers of trees were pollarded [12, 23]. Epping Forest is so large that it extended into several parishes, and the Forest was divided up so that the people from a particular parish had specific areas where they could cut their wood.

Working trees (see [24]), i.e. those that were pollarded or otherwise cut to produce a product, were an essential component of the landscape for the majority of the people living in South East England. They were perhaps the typical tree of the poor man.

Case study: Historical pollarding of beech in Burnham Beeches [25]. Burnham Beeches is a wooded common that today has just under 400 ancient pollarded trees, mostly *Fagus sylvatica*, but around 20% *Quercus* spp. (**Figure 5**). In the 1930s there were 1795 pollards on 81 hectares with densities up to 88 per hectare, but the number has declined, and some 300 trees were estimated to have been lost in the last 50 years. Tree rings were examined in the 1930s, and it was determined that, at that time, the trees were 270 to 360 years old. They were first cut at the age of 25–35 years old and subsequently cut on an irregular cycle of 11–12 years, extending up to 15 in some older trees. Cutting began to decline in the eighteenth century but continued until about 1820 with the last trees cut being those that were smaller and more easily accessible. Today, Burnham Beeches is owned and managed by the City of London Corporation.

Figure 5.
Lapsed Fagus sylvatica *pollards at Burnham Beeches.*

2.2.3 Open-grown trees

Within hunting Forests, in deer parks or in designed landscapes associated with large country houses, the trees often fulfilled a different function. There was less need for them to be productive because fuel wood could be produced from specifically designated areas such as coppices (see below). So here the trees were more important as a part of the landscape. They either provided cover to ensure an exciting hunt for deer or they could simply look attractive. Many of the designed landscapes incorporated older trees, but many more planted trees in specific blocks, avenues or locations to frame views or to draw the eye to specific features. Many of these trees developed in very open and light conditions (**Figure 6**). In contrast to the pollards with their repeatedly cut, short stubby branches, these 'open-grown' trees spread their branches widely, also in contrast to trees grown in dense woodland [24]. The trees developed large, full crowns and branches spreading out horizontally which sometimes came right down to touch the ground where grazing by livestock or deer was at low density or absent.

2.2.4 Coppice

Perhaps the most well-known woodland management in Southern England, and that which there has been much written about, is coppice with standards. These were areas of woodland managed specifically for wood production in a variety of forms. Trees such as *Corylus avellana*, *Fraxinus* spp. and *Ulmus* spp. were coppiced, i.e. cut close to the ground on a regular cycle (often 8–10 years), and in many places were formalised and regulated. Wood from coppice was used for the walls of houses (as wattle and daub), hurdles, small-scale fencing, thatching spars (for holding the thatch onto roofs) and bean/pea poles, and the bark could be used for tanning leather. Often coppice plots contained 'standards' which were trees managed as maidens (i.e. not cut as coppice) and which were harvested on a longer cycle of 80–100 years for their timber (for planks) (**Figure 7**). These woods were securely enclosed by banks, ditches or fences to keep livestock and deer out

Figure 6.
Open-grown trees in a formal landscape at Burghley Park.

Figure 7.
Tilia and Corylus coppice *in a wood with standards in a Lincolnshire wood.*

of them and allow the coppice to grow, but sometimes they were let in towards the end of the cutting cycle, and at Hatfield Forest this was part of the organisation of the whole Forest [20].

2.2.5 Shredding

It is relatively unknown to what extent shredded trees were of importance in South East England although it is mentioned in documents up to 1600 [10]. Repeated cutting of the side branches up the trunk of the tree was a technique used widely in other countries such as Spain, Romania and Nepal, and it is said that this technique generates more leaves for use as fodder than pollarding. Whereas pollards can still be quite easily identified some 200 years after they were last actively

managed, this is not so true of shredded trees. There is documented evidence in the form of photographs that these were certainly present [4, 13], but their extent and frequency are unknown.

3. Changes between then and now

3.1 Losses of trees/decline in management

England is now one of the least wooded countries in Europe. In the late nineteenth century, there was just 4% woodland although this has now increased to 13% tree cover [14] and continues to rise due to large-scale tree planting by organisations like the Woodland Trust. Trees outside woodlands, those in farmland and wood pastures, were not immune from this decline although in many cases it is less easy to document. Grubbing up of hedges was extremely widespread with the aim of increasing the size of fields for modern and large agricultural machinery, and it is thought that just 1–2% of the hedges once in the UK are still remaining [26–28]. Hedgerow loss also resulted in the loss of the trees within them. In one county the loss of trees between the 1880s (as recorded on a series of maps that showed individual trees) and aerial photographs taken in 1946 varies between 25 and 70% with the average loss being 50%. Parishes may have had up to 400 trees per square kilometre with a girth over 2′ (60 cm) in their hedges or fields (these figures do not include the woodland trees) [13]. From the late nineteenth century onwards, large-scale felling of pollards was probably quite common as they were viewed as 'unnatural' and perhaps seen as relics of a backward peasant farming system [13]. In Epping Forest the abundant but small *Carpinus betulus* pollards (**Figure 8**) in particular were considered ugly, and for this reason, they were very heavily thinned, an operation that involved the felling of tens of thousands of pollards over most of the Forest [23, 29]. The density of trees is still very high today, so it is incredible to think what it must have been like in the past.

Reasons for the extensive losses include agricultural intensification, urbanisation and conversion to commercial forestry but also abandonment. Once the tree products were no longer valued, they stopped becoming relevant to the local people.

Figure 8.
Example of a group of small pollarded trees at Epping Forest, where pollarding may have been on an industrial scale.

This may not have resulted in them being felled but in the long term led to their demise through shading out by younger trees or falling apart once regular pollarding ceased. In addition, human values have changed over time, and today we appreciate lapsed pollards as indicators of a previous culture and farming system even if we do not necessarily consider them beautiful.

3.2 Why do we have trees left today?

Despite the massive decline in trees and woodland in England, it is surprisingly one of the best places in Europe to see ancient and other veteran trees. Farjon [29] considers that the only other place in Europe with substantial numbers of *Quercus robur* or *Quercus petraea* 6 m or more in diameter at breast height is Southern Sweden (although he may have underestimated those in Spain) and that for *Quercus* spp. over 9m there are more in England than in the rest of Europe combined. Being an island, Britain tends to have an impoverished fauna and flora in comparison with other mainland European countries at the same latitude, but the saproxylic fauna can be comparatively rich [30]. Farjon [29] has noted that there seems to be no consistent environmental factors that could be responsible, so why are there so many old trees remaining today? The reasons for this and for the current distribution of veteran trees in the UK have been speculated and may include the following.

3.2.1 Places with poor soils

Commons were usually established on the poorer quality land in any parish. The richer soils were cultivated, but the areas with thin or wet or heavy clay-dominated soils were less easy to till and therefore became the rough grazing for the community. Trees grew on many of these areas and were managed for example, by pollarding, but during periods of agricultural intensification, they were less attractive for conversion. There are examples of open commons being ploughed during the World War II in order to boost food production but abandoned after 1 or 2 years because they were so hard to work and unproductive.

3.2.2 Stable (rich) landownership

The landownership structure in the UK and the inheritance system, where the eldest (usually son) inherits the entire estate, tended to keep large estates intact. Deer parks and chases therefore were less likely to be broken up, and commons also frequently remained in the same family for generations. Fashions may have changed over the years, and former 'wild' deer parks became more formally landscaped, but individual trees within them were often retained. The landscaping movement also planted trees in open conditions, either singly or in small groups, which boosted the number of open-grown trees for the future.

3.2.3 Green lungs for London

The farsightedness seen by wealthy landowners in designing their estates with the long-term future in mind also extended to others in more urban situations. London was growing rapidly in the mid-nineteenth century, and this was of concern to a small group of people who actively sought to improve the conditions for the workers and poor of the city. The countryside was then relatively close, so the idea of protecting areas as 'green lungs' for London that were accessible at weekends for those living in the city was born. From this idea, the policy of having a green belt around major cities in England has grown. Around London there are some

important places for veteran trees and wood pasture such as Epping Forest and Burnham Beeches, which were preserved at the very beginning of this policy in 1878 by the City of London Corporation who took through Acts of Parliament to allow them to acquire these areas in perpetuity for the people of London [23] and has since been added to over the intervening years.

3.2.4 Conservation organisations

Amongst those responsible for drawing up the City of London Acts were some who had aspirations for something similar that had a more nationwide remit. Out of this the National Trust was born, an NGO that acquires land, as well as buildings, to protect them in perpetuity for the nation. The National Trust now owns some very special wood pastures in South East England like Hatfield Forest. Since then a variety of NGOs have arisen in the conservation sector, coupled with an increasing awareness of the importance of conservation generally which gained traction in the 1970s and 1980s in the UK, and this has helped protect wood pastures and their trees. The conservation sector in the UK is particularly complex with nature reserves owned and managed by a variety of governmental and non-governmental organisations as well as private landowners. Several important wood pastures in South East England are designated as SAC sites (such as Windsor Great Park, Epping Forest and Burnham Beeches), and others are protected in the National Law as Sites of Special Scientific Interest (the basic nature reserve designation in England) and sometimes also the National Nature Reserves, with examples being Ashtead Common and Hatfield Forest.

3.3 Problems that the trees face now

3.3.1 Lack of management and abandonment of grazing

The most common problem facing our old trees today is the abandonment of grazing and/or lack of management. With the abandonment of grazing, the older trees become heavily shaded by younger trees which have grown up as a consequence of lack of grazing [3]. Sometimes, the younger trees may overtop the older ones or grow through the canopy resulting in significant shade, which in the end may lead to an early death of the old trees. In places, once open wood pastures have also been planted with conifers which results in even faster losses.

Another common problem is the abandonment of management of the trees themselves, primarily a lack of regular pollarding. The majority of wood pasture sites in the South of England contain old pollards that may not have been cut for at least 100 years. This has led to large, heavy branches growing on often hollow stems, which have a high tendency to fall apart [3, 4].

3.3.2 Agricultural intensification

Many of the wood pastures in South East England were lost as a consequence of agricultural intensification. Sometimes, the trees remain (**Figure 9**), but the grasslands in between have been ploughed up, resulting in significant root damage. Sometimes, the grassland in parklands (see above) is ploughed, fertilised and reseeded, which as well as being detrimental for the trees also removes the bushes and other nectar sources, which are a natural part of the mosaic in a wood pasture system. Agricultural intensification also resulted in grubbing out of hedgerows to enlarge fields. The hedgerows often contained old trees, which may once have been part of an old wood pasture or common.

According to Rackham [10], the Georgian and Victorian eras saw the greatest destruction of wood pasture systems, as they were seen to have no further use. In the twentieth century, less was lost, but coniferisation of wood pasture sites was common, destroying the essential elements of the habitat. Britain is still thought to have a large proportion of wood pasture; however, there are no reliable statistics on the extent of the overall cover nor on its loss or fragmentation.

3.3.3 Urbanisation/planning

Increased pressure on the landscape for development has also had an impact on wood pastures. There are many examples of housing developments which have been built on old wood pastures. Sometimes, the trees are retained (**Figure 10**), but often this leads to conflicts of interest between the homeowners and the trees, due to concerns about safety or problems with roots. Often the space retained is not enough for the long-term good health of the trees.

3.3.4 Fragmentation

As a consequence of the above problems, wood pastures and parklands often now exist as isolated fragments in an otherwise intensively farmed or urbanised landscape. As the fragments become smaller and further apart, species dependent on the trees and their surrounding environment are less able to move between them, and their populations eventually become unviable. This is a particular problem in South East England as huge amounts of development and house building take place in the area around London.

3.3.5 Loss of traditional knowledge and skills

People are nowadays much less connected to the land, and many of the skills that were previously passed down through the generations have been lost. Farming methods have changed to be more mechanised, and the manual skills are no longer needed. There is really no first-hand knowledge of how the trees were pollarded, and most were last cut over 100 years ago, so there is no older

Figure 9.
Old Quercus *sp. tree that has been ploughed close to it in order to cultivate for arable crops.*

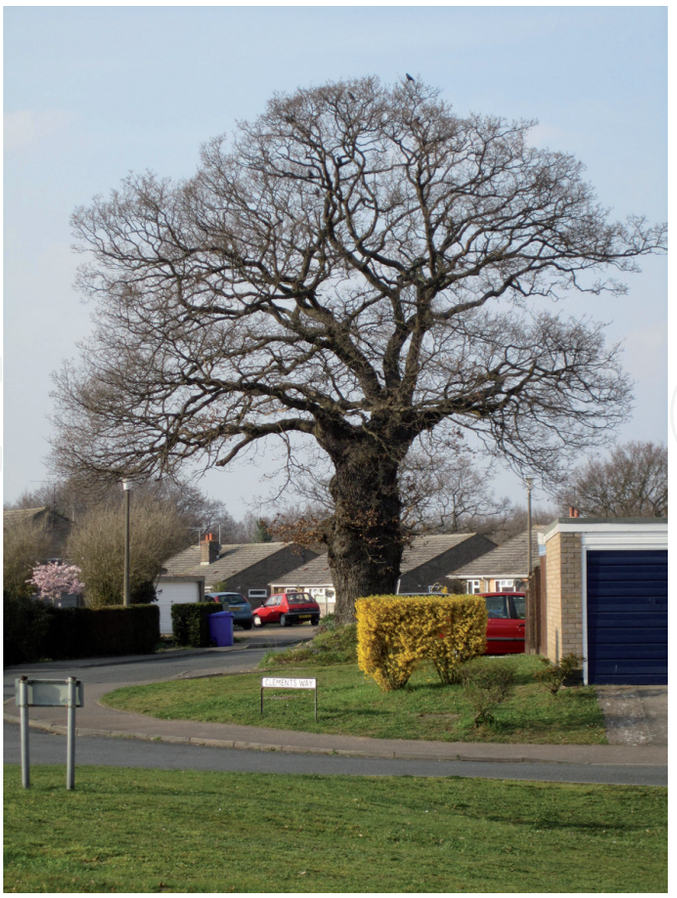

Figure 10.
Old Quercus *sp. tree that was part of a wood pasture on a wooded common but is now within a housing estate. Aspal close, Suffolk.*

generation of workers to talk to. As the work was once considered to be so commonplace, details were not generally written down, so it is necessary to (re)learn from other places, try to interpret from the structure of the trees or discover again from the beginning. In addition, the lapse in cutting of the trees means that they are now out of a regular pollarding cycle, something that our ancestors did not have to deal with, so we have to learn new skills to manage these trees. The consequences of our actions may take many years to become evident, so this is not a process that should be hurried.

Loss of skills also applies to animal husbandry. In the past domestic livestock were herded, and thus their grazing and browsing were directed. Today animals are put into fields unattended for most of the day. Some of the older traditional livestock breeds that developed in these systems are no longer available for use or are difficult to obtain, and the specialist knowledge for managing them is known by a small number of, often amateur, breeders. The lack of connection with the land also means that people are not used to coming into contact with grazing animals and may also see fencing as a restriction on their rights to walk where they like. This is especially true for the wood pastures in South East England, where visitor pressure is high and concentrated. Conflicts between visitors and livestock are common, such as with dogs.

3.3.6 Pests and diseases

Many of our old trees in wood pasture landscapes are suffering from new pests and diseases. The number of pests and diseases on trees has increased tenfold over the last 2 decades [31]. Some examples which are having an impact on the

wood pasture landscape of South East England include oak processionary moth (Richmond Park, Ashtead Common), acute oak decline (Ashtead Common, Aspal Close) and ash dieback (Hatfield Forest) to name but a few.

4. Solutions

4.1 Learning to recognise the importance of the trees/landscapes

Much work is being done to raise the profile of wood pasture, which until the last couple of decades has had very little attention, particularly in nature conservation. The Ancient Tree Forum, Natural England and other partners through the Habitat Action Plan Group and the Ancient Tree Hunt have helped raise the profile of the ancient trees in wood pasture landscapes. In addition, these organisations have also worked hard to help share the knowledge regarding the management of these important sites and their old trees [3, 4].

4.2 Reinstate traditional management

For many wood pastures, the restoration and reintroduction of grazing animals is the most important management option for conserving these valuable habitats. This is potentially more important than any work which may be required on the individual trees. Restoring wood pastures needs to be carried out in stages, to make sure that the old trees are not suddenly shocked by fast changes to their environment [3, 4]. Removing competing trees should first involve removing the young

Figure 11.
View looking up from a tree that has been halo cleared to show the gap between its foliage and that of the surrounding trees—The first step in giving an old tree more light (Ashtead common).

Figure 12.
Traditional English longhorn cattle grazing a wood pasture at Cranborne chase, Windsor. These cattle are good at browsing and thriving on poor quality vegetation.

trees that grow under and through the canopy of the old trees, ensuring there is also a ring of a few metres around the canopy that is open (**Figure 11**). A few years later, the next phase can create a larger ring around the old tree, ensuring that the tree is not too exposed to the sun and wind. Doing this work by focusing on trees in groups is more effective and leads to better results [32] than only on individual trees.

Grazing may then be reintroduced in stages [33]. In the South of England, hardy sheep breeds have been used as an interim restoration phase for several years to help restore a grassland with greater proportion of herbs rather than woody, unpalatable species. This has then been followed up by the introduction of cattle. The use of traditional breeds of livestock (**Figure 12**) that are better at browsing and thriving in areas with poor quality fodder has been promoted by organisations like the Rare Breeds Survival Trust and the Grazing Animals Project. As a result, they are more commonplace in wood pastures now, and there is increasing experience in how to manage them.

It is unlikely that in most wood pastures, the clock will be turned back so that they will be managed as they were at a particular period in the past, nor is this probably desirable, but traditional methods are being used to inform future management.

4.3 Learn new skills

The management of lapsed pollards, well out of a regular cycle of cutting, is something that our ancestors did not have to deal with. Probably any particularly difficult trees were left uncut, and any that died would not have been a major concern as new ones could be planted and subsequently cut. Nowadays our lapsed pollards are precious because they are remnants of a landscape and culture that are no longer active and the numbers of trees are substantially lower than in the past and declining. We are aware of the value of these trees for biodiversity and aim to keep them alive as long as possible. This has required honing new skills in dealing with these trees, and early experiences in the 1980s and 1990s were not always positive.

From our experience of managing the lapsed pollards in wood pastures in South East England we have identified some actions which quickly result in the death or long-term decline of these trees, and others that currently appear to be more successful in keeping them alive; thus, the following recommendations can be made (see also [34, 35]):

1. Do the trees have sufficient light? Many older trees have lower canopies and are perhaps growing less vigorously than younger trees. Alternatively, the branches may have been drawn up because of the lack of light so that all the foliage is at the tips of the branches. The solution is to clear round the trees so that there is firstly a small gap between the tree and any neighbouring branches (see also Section 4.2) by removing young regrowth growing through the canopy.

2. Are the tree roots OK? Avoiding damage to the roots and the soil that they grow in from agricultural activities, building or other development or visitor pressure is very important. Although trees can be fenced, other solutions that are less visually intrusive include: re-siting agricultural activities (water trough, etc.), using a dead hedge, encouraging rough vegetation to grow around the tree or mulching (using a shallow layer of partially composted wood chip to protect the roots). For feature trees or those with lots of visitors, a boardwalk can be a solution.

3. Does the tree need pruning to stop it falling apart or falling over? We suggest that cutting a tree is the last resort, but for some top-heavy and fragile lapsed pollards, it may be the only option. Pruning should aim to remove as little leaf area and branch material as possible and to make wounds that are as small as possible (**Figure 13**). Cutting lapsed pollards as if they were still in a regular cycle of cutting is not generally successful although sometimes it can appear so initially. The growth that arises on the sides of large wounds close to the bolling eventually becomes very vulnerable as the branches get heavier and the decay resulting from the cut gets more extensive. Eventually, when this fails, it has the potential to tear away parts of the trunk of the tree as well as destroying the bolling.

4.4 New markets for products

As functioning wood pasture systems with managed trees and grazing livestock start to become a part of the landscape again, they need to become relevant and cost-effective to survive. Many are being restored because they are nature reserves, but in times of austerity and agricultural uncertainty (e.g. Brexit), the more sustainable they are, the more likely they are to survive. Wood products like firewood, bean poles, wood chip and charcoal can be produced from the trees along with meat from the grazing livestock (**Figure 14**). In recent years there has been a resurgence in interest in local and artisan products as well as improvements in marketing so that people are aware of the importance of buying locally. Local/regional festivals, farmers' markets, meat box schemes and site-based events, for example, the wood fest at Hatfield Forest, are methods by which it is possible to sell products at premium prices, and this can be achievable with the relative wealth in this part of England.

4.5 Agri-environment and other direct funding

It is possible to obtain financial support for wood pasture restoration and management in England at the moment. Many nature reserves are owned and managed by charities that gain funding from their members and grants via a variety of sources. In recent years this has included grants from lottery income and from taxes taken from companies that carry out, for example, landfill or quarrying activities as well as private funds. Agri-environment funding, i.e. from CAP, has been possible for wood pastures for many years. Currently there are area-based payments for both the restoration and the ongoing management of wood pasture as well as payments for working on veteran trees and the creation of decaying wood habitats on trees (amongst other potential payments that might be relevant to wood pastures), but some of these are

Figure 13.
Gradual reduction on a lapsed Fagus sylvatica *pollard at Burnham Beeches.*

Figure 14.
Tamworth pig and deer at Knepp Castle estate. Pork, ham and venison contribute income for the estate.

only accessible on high conservation value and/or large sites, and thus smaller areas may be less well supported. In addition, the administrative burden and obligatory requirements of the scheme mean that it is not attractive to all landowners.

4.6 Landscape-scale approach

In 2010 a report was published [36], commissioned by the Government, which was the result of a review of how England's wildlife and ecological network could

be improved to help nature thrive in the face of climate change and other pressures (The Lawton Review). This concluded that England's wildlife sites, despite their diversity, did not currently comprise a coherent and resilient ecological network and therefore were not capable of coping with the challenge.

The report highlighted that the fragmented nature of the landscape, caused by human activity like development and intensive agriculture, when subject to rapid change like climate change, is unable to adapt quickly enough as species are unable to move through it. It thus proposed that a landscape-scale approach is needed to reverse fragmentation and environmental degradation. Wood pastures have the potential to play a key role in this due to their mix of trees and open areas. They are also potentially productive areas for both livestock (food production) and wood as well as being good for nature conservation.

The Lawton Review sets out a clear vision with a change of direction from the current emphasis on wildlife in isolated reserves and towards whole landscapes that are vibrant, wildlife-rich and ecologically functioning. To do this, Lawton says that we need to make our network of sites bigger, better and more joined up. This call for action has been supported through various funding opportunities and will hopefully benefit wood pasture and promote low-intensity management of larger areas.

4.7 Rewilding

Rewilding is a concept that varies in terms of what it means across Europe. In some places however, it is proving to be an interesting and viable management regime for wood pasture. Areas where rewilding has been tried are not necessarily those that have a long history as wood pasture nor those where there are particularly important tree populations, but this does not stop them from contributing to a landscape-scale approach.

Case study: The Knepp Estate in Sussex took the decision in 2001 to stop traditional farming and remove all the internal fences and boundaries. Several different species of livestock (*Dama dama*, longhorn cattle, Tamworth pigs and Exmoor ponies, **Figure 15**) were introduced and allowed to roam freely. This allows the animals to decide where they want to feed, wallow, calve and sleep. The idea builds on the concepts and ideas of Frans Vera and his book *Grazing Ecology and Forest History* in 2000 [6]. The animals are allowed to drive the system, and the result so far after some 20 years is a dynamic wood pasture system, where biodiversity is thriving [37].

Figure 15.
Exmoor ponies used as part of the rewilding project at Knepp Castle estate.

In addition, the Knepp Estate has been able to sustain itself financially by selling the meat from the animals and developing agro-tourism, along with receiving agri-environmental subsidies and carrying out other farm diversification activities [38].

4.8 Create decaying wood habitats including new pollards

The key elements in wood pasture that are so important for biodiversity are the old trees and the decaying wood they contain and produce. Decaying wood provides conditions that are suitable for a wide range of species (especially fungi and insects); many of these species are very rare, and some have very precise requirements in terms of decay type and moisture level. Some species may also have difficulty colonising new sites if they are too far apart. As described above, many wood pasture sites are fragmented with few old trees remaining, and there may be a large generation gap between the old trees and their successors.

Sometimes it is desirable to attempt to create some decaying wood habitats to help close up this generation gap or provide habitats where there are none currently. Pollarding is one reliable technique, whereby through regular cutting, the trees develop hollows at a younger age than trees that have not been pollarded [39]. Other techniques, to create decaying wood habitats in younger trees, known as veteranisation [40], involves damaging younger trees in a variety of ways by mimicking nature. The principle is never to do this to the old trees but to those that need to be felled or cut for other management reasons. A variety of different techniques have been attempted such as the creation of woodpecker-like holes using a chainsaw (**Figure 16**), making bird nesting boxes within the trunks of sound trees and mimicking bark damage by horses or sheep at the base of the trees using chainsaws or axes; there is plenty of scope for experimentation.

4.9 Protection/reinstatement of hedges

In agricultural systems where scattered trees in the hedges are acting as a different form of wood pasture, a big problem in the past has been the removal of hedges to make larger fields allowing easier cultivation with larger machinery. Any trees in the hedges were generally lost too and were rarely incorporated into the fields. Hedges are now protected in England, and there are grants for replanting and managing them. In highly productive areas, this has been an important way to increase the density of trees in the landscape along with the scrub species in the hedges.

Figure 16.
(A) Woodpecker hole created with a chainsaw at the bottom and holes created by a woodpecker above it, a few years after the work was done. (B) Newly created Quercus *pollard.*

5. Conclusion

The wood pastures of the South East England contain some of the highest biodiversity remaining in an otherwise heavily exploited landscape. There are however significant challenges including conserving the existing protected sites, identifying other valuable sites that are not protected, creating new sites for the future and linking and buffering these areas. New uses for the trees in combination with grazing, to make wood pastures both attractive and sustainable, are perhaps the way forwards if we are to ensure that there are wood pastures with old trees into the future.

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Author details

Helen Read[1*] and Vikki Bengtsson[2]

1 City of London Corporation, Burnham Beeches, UK

2 Pro Natura, Alingsås, Sweden

*Address all correspondence to: helen.read@cityoflondon.gov.uk

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