Arboricultural notes on some of the practices seen

From notes compiled during a discussion with Neville Fay. See also Mattheck & Breloer (2003) and Lonsdale (1999).

Longevity of pollards and shreds

Pollards regularly appear to live to a great age whereas old shreds were not seen during the study tour and do not appear to live on in the landscape as relicts of former management in the way that pollards do.

It is readily accepted that pollards have the capability to live longer than standard trees of the same species. This may be due to various reasons, for example:

- Reducing the size of the crown at intervals delays the onset of the ancient stage of the tree's life when the demand for water and nutrients exceeds its ability to increase the root area to absorb them (Read 2000).
- Because the crown is reduced regularly the tree is much lower than a standard tree. This means that the 'sail area' is smaller so the tree is less vulnerable to winds, the centre of gravity is lower so the tree is more stable and the branches are shorter so the 'lever arm' is reduced and the branches are less likely to fail.
- Multiple branches from the bolling also produce a larger number of vascular connections into the trunk than on a normal tree. These act as separate compartments and it is less easy for pathogenic agents to spread through the entire tree.

Repeatedly shredded trees seem not to live as long, which may be for the following reasons:

- The develop decay that is confined within a relatively narrow trunk. As the areas of decay coalesce the tree becomes more vulnerable to collapse. This is the reason also that trees shredded several times are not suitable as timber trees.
- If the shredded tree is very tall the transportation distances within the tree become very high and the root system is unable to support it.
- All trees have a 'hot spot' which is a vulnerable area for breakage between 1m from the ground and the lowest branches (Lonsdale 1999). Because the lower branches are removed on a shred this makes the 'hot spot' much larger than on a normal tree.
- In normal tree growth the tree develops an axiom of uniform strength by tapering at each branch going upwards. If the branches are removed there is no build up of wood at the branch junctions and the tree becomes cylindrical rather than cone shaped. The cylindrical shape is less stable than a cone.
- Shreds where the top of the tree is left intact are a very tall 'lollipop' shape. This acts a a pendulum and there is a high risk of failure associated with it. A normal shaped crown acts as a dampener, absorbing energy, and is therefore more stable.

As in any tree the longevity of a pollard or shred depends on:

- The ratio of sound wood to the total radius of the tree
- The size of any cavities and the amount of incomplete trunk

- The load (i.e. the amount of weight in the tree)
- The shape or design of the tree
- The condition of the wood

'Pollarding works with the tree's biological system – shredding works against it' (N. Fay pers com.)

Rejuvenation and different lengths of pollarding cycle
It is often said that a tree is rejuvenated by the act of pollarding. When many (or all) branches are removed the tree has lost a major part of the leaf area that produces food. It responds by putting energy into two main activities, callusing to heal the cut surfaces and producing leaves. The leaves are juvenile foliage resulting from the activation of embryonic tissue and are produced instead of flowers, seeds and wood (just like a young tree). The tree rings after cutting are smaller because growing a thick coating of wood over the trunk is a lower priority than healing the wound and growing leaves. As the pollarding cycle (i.e. the gap between cuts) progresses the tree stops producing so much foliage and starts putting energy into wood production and seeds. Rejuvenation is the activation of embryonic tissue and in this way a pollarded tree can be considered rejuvenated. It also responds by growth rather than reproduction and this is also true of a juvenile state.

This growth response after pollarding also explains the cutting cycles for the different tree products. If foliage is required the optimum time to cut the tree is just at the point when it stops putting so much energy into leaf production and starts diverting it to wood. If the wood is the required product then the cycle needs to be long enough that wood is laid down on the new branches.

Trees pollarded at repeatedly short intervals also suffer from reduced nutrients, as the leaves from the tree are unable to go into the ground underneath to be broken down for use. Such trees continually produce small rings but are able to survive in the long term, as verified for example by the work of H. Slotte.

Impacts of restoration pollarding – large wounds
Creating a wound by removing branches (as when pollarding) causes a zone of desiccation that the tree tries to heal up by covering with a callous. The size of wound that the tree can callous over successfully depends on the vitality of the tree. Even *Fagus* can callous over large branch wounds but the larger the wound the more energy is required to heal it. Even if the tree is stressed in other ways it will still put energy into callusing wounds. Thus the impact of wounding a tree is lessened if the wounds are small and the tree has a high vitality.

Restoration pollarding is particularly traumatic to a tree as the wounds tend to be large and the tree may not have such a high vitality due to other factors. Large areas of dysfunctional tissue often result and it becomes more difficult for the tree to support the crown.

Fagus does not have true heart wood but is a ripe wood tree. The live sap wood has a life span of approximately 30 years, after this it is unable to respond to cuts by producing callous wood. Thus branches over 30 years of age are unable to heal completely and a potentially large desiccation zone develops.

Time of year of cuts

The product required of the pollards determined if they were traditionally cut in the summer (for the leaves) of the winter (for the wood). It is probably possible to find some traditional method for cutting in just about any season (especially in Norway). Cutting was also clearly carried out in drought years and long winters. Traditionally in Britain most tree work is considered a winter job but what are the consequences of cutting in different seasons?

A tree cut in winter is wounded during the dormant season. It is unable to respond until the start of the growing season, but is less likely to suffer from drying out, thus the wood near the wound will not become desiccated so quickly. In contrast, a tree wounded in the growing season can potentially respond immediately and can grow quickly to heal the wound. However, during the summer the wood near the wound is in a period of moisture deficit and cannot respond.

It has been suggested that April (i.e. early spring) is when the tree can most quickly respond to a wound but this is not recommended for trees in the family Rosacea as they suffer from silver leaf after spring cutting.

Whilst cutting in spring/summer seems to be very successful if is probably a higher risk strategy than winter cutting. Droughts in a previous growing season or immediately after cutting may result in moisture deficits and may be a problem to trees that cannot always be predicted. Looking at individual trees to ascertain their responses to dry periods may be beneficial but is not always easy to do. Some may suffer in a drought year whereas others may be more resilient and able to cope with cutting. For trees in a regular cycle it may not be too important when they are cut but the problem of drying out after summer cutting is particularly acute after restoration pollarding as the wounds tend to be larger in area.

Perhaps it is no accident that cutting trees for their wood has traditionally been a winter activity as this produces larger wounds than cutting for fodder. Fodder trees tend to be cut in high latitudes and altitudes where perhaps the risk of drought is lessened.

Changes in climatic factors may be as problematic to trees as exceptional years. For example several dry years followed by a wet one could lead to problems of anaerobic root conditions. The reverse situation is also likely to cause problems. The best solution to this is to do any work gradually if possible.

The use of phases of the moon to determine suitable times to cut trees is not confined to the Spanish. It was mentioned by Pliny that this method was used in Roman Italy and is also a technique used by Steiner in his biodynamic agriculture. Cutting when the moon is

waning was generally done so that there was less water in the wood and not particularly for any reasons associated with the health of the tree.

How to cut a pollard that lives for ever!
Pollards clearly do have the ability to live for a very long time. It seems that the most beneficial cutting regime is one that balances the frequency of cuts such that the tree is able to recover from each pollarding occasion but not so long that the branches removed create large wounds. Cutting should ideally take place in continual wet summers or in the winter and the most important point is to keep pollarding and not let the practice lapse.

Tools used to make the cuts and the type of cut
Bladed tools do seem to have been the favoured method of cutting in the past. Use of a chain saw encourages the cutting of larger branches, thus creating larger wounds, thus it is perhaps difficult on the strength of anecdotal evidence to separate the real effects of different tools. The surface area of cambium resulting from the cut is crucial to the amount of regrowth. A larger cut has a smaller area of cambium exposed relative to the area of the cut. On larger cuts, desiccation will be greater too. Work by Phillips (1971) on *Castanea* coppice showed that although growth after a chain saw cut was initially less than using a hand saw, over the growing season there was no difference. More work might reveal differences between cutting tools.

Producing a slanting cut may also be easier with an edged tool. This produces more cambium per surface area and is thought to heal quicker than a flat surface. Discussion concerning the best direction of the slant probably depends largely on the situation of the tree, balancing amount of light stimulating growth with that likely to cause drying out.

Creating new pollards
While most new pollards have been created by a single cut it was suggested that the trees benefit by being cut twice in rapid succession before being left for the normal cycle.

For trees that callous easily this may indeed be worth trying. After a cut the tree tries to heal the wound with callous tissue, which then becomes wound wood as it starts to lignify. Repeated cutting produces a complex of callous tissue because the tree heals successive wounds. Callous has a very strong woody structure and is also very vigorous in growth so this complex is stronger than normal wood.

Fagus generally callouses less easily and the growth resulting from pollarding is generally from existing dormant buds rather than being regenerative and resulting from the wound. Cutting at short time intervals initially might still be worth trying on these trees but the growth may be different in type than from a species such as *Fraxinus*.

Species specific differences, sap risers and suckers
High vigour species (such as *Salix*) have lots of energy and this is probably the reason why a sap riser results in less even growth. *Quercus* is a more complex species and less vigorous so a sap riser is a successful strategy when cutting. By the same reasoning a

sucker has a higher vitality than the pollard it arises from so the sucker will succeed and not the pollard. Leaving a sap riser may also have a beneficial effect in shading a tree like *Quercus* that might have become accustomed to a more shaded environment for the trunk before pollarding.

Different responses of *Fagus* to cutting

The few *Fagus* pollards in Romania and Hungary that had branches removed recently showed better regeneration (as new shoots from around the cut surface) than trees cut in Burnham Beeches. Bergendoff & Emanuelsson (1996) also discussed the fact that *Fagus* in central Europe appeared to respond better to cutting than in Sweden and thought that the trees might be genetically different. N. Fay (pers comm.) has noted that *Fagus* responds better in the Mendip area and south Wales on the wetter west side of Britain than trees in the drier south east. While genetic difference might be one reason for such differences, climatic factors might be an important factor too. In view of the possible impacts of climate change on this species it would be interesting to explore these issues further.

Final discussion and conclusions

Pollarding as a technique has clearly been widespread across Europe in the past wherever a crop from trees has been required as well as a crop from the ground flora. However, in all areas visited, remnants of systems that in some cases much have been very intense management regime, are all that are left. Even in Romania where the most traditional landuse system was observed the trees had clearly been more intensively managed in the past. From talking to others that have carried out similar reviews across Europe (e.g. Hæggström *pers com*) it is clear that this decline has resulted in almost extinction during the last 20 years. Areas where, in the 1980's pollarding was still an everyday part of the agriculture, it has now almost died out.

Pollarding has been carried out for various different reasons but in the region studied traditional cutting (excluding *Salix*) can be divided into two basic types with an almost infinite number of variations.

- Pollarding for fodder was generally carried out during the summer months, on a relatively short rotation length. In a few systems this was every year or every other year but 4-6 year intervals were more usual. Tree species where the leaves (or buds) were considered palatable and nutritious to the animals were cut although these varied from one place to another. Often the leaves were dried after cutting and stored for winter use, however sometimes the animals ate them from the branches left on the ground under the trees immediately after cutting. The twigs remaining after the animals had eaten the leaves were normally used and often burnt but this was not the principle reason for cutting the trees. Cutting for fodder was occasionally done during the winter when there were no leaves and the animals ate the buds or twigs. The cutting aimed to produce the maximum amount of leaves so sometimes subsequent cuts effectively shredded the branches to obtain more leaves. Variation in tree shape was generally as a consequence species specific responses to the removal of foliage. Cutting was traditionally done with a tool resembling a billhook.

- Pollarding for the wood was generally carried out in the winter months on a relatively longer rotation (generally up to 15 years but occasionally even longer) than fodder cutting. The wood was used directly as firewood, made into charcoal or used for building use (including ship building). Sometimes the trees were encouraged to grow into special shapes so the wood could be used for specific purposes. *Quercus* and *Fagus* were the most usual species but in the UK a wide range of others such as *Carpinus* and *Fraxinus* were used too. Cutting was traditionally still carried out with a bladed tool rather than a saw, most likely an axe.

Pollards are interesting for a variety of reasons. One of the most notable is that, as a consequence of human management trees with a high nature conservation value are produced at a potentially higher density that would probably develop in natural woodland. One off storm type events can be considered an exception but it is unlikely that these would occur repeatedly on the same stand of trees. In the over developed and

intensive agricultural landscape of most of Europe these trees have an immense value, providing habitats that are equivalent to old growth woodland regarding their continuity of dead wood habitat for saproxylic species and this is why aggregations of these trees are more valuable than individual trees. In addition they have a high cultural value demonstrating traditional agricultural practices and reminding us what it was like for our ancestors when trees were necessary for their survival. For these reasons alone pollards are worthy of preserving but pollards should not be seen as just features in a museum of traditional rural life. The long term survival of wooded meadows, wood pastures and associated pollards will depend on their continued management. Management principally for nature conservation is happening in, for example, Scandinavia and the UK. Management to maintain a traditional landscape is also carried out in, for example Austria and parts of France. The ideal situation is ultimately to find ways in which to incorporate traditional techniques into modern farming and land management systems. In this way the products have a use and the reasons for managing are increased. This is being attempted on a small scale in various places but the farmers in Norway are perhaps the furthest ahead, with scientific evidence backing up their activities to demonstrate its worth to the policy makers.

The value of pollards in traditional farming systems has been recognised by others. Austad (1993) pointed out that 'the traditional agrarian landscape contained an ecological diversity which is lacking in the modern cultural landscape' and is dissimilar to modern landscapes. She points out that the traditional landscape is characterised by 'small scale pattern of variation resulting in a great diversity of plant communities and ecological processes'. Lopping, hay making and grazing are considered by her to be the most important elements in such a landscape.

The value of pollards and pollard systems are clearly recognised in some countries, notably the more northern European ones. However awareness raising is urgently required in others, such as Spain, southern France, Romania and Hungary. Two factors seem to have hindered the realisation of the high value of these trees and associated landscapes. The first is familiarity – in areas such as northern Spain or Romania where pollards are abundant and common-place it is difficult for local people to see them in a European context and be aware that what they have is exceptional and of European importance. The second is realisation that a man made and relatively intensely managed system has a conservation value that is as high as, if not higher, than non intervention woodland. The view that a wilderness is not necessarily the ultimate nature conservation aim is a challenging one! This does not imply that pollarding all trees, or whole nature reserves, is always the solution, it is of course necessary to apply appropriate techniques in different situations. However, it is necessary to overcome the prejudice that nature conservation is always best when nature is left to her own devices. This option might be possible if we had not interfered with anything, but since humans have destroyed such huge areas we are no longer dealing with a natural situation. Pollarding is a rare example of human intervention improving on the natural system and we ought to make the best of it! I am not proposing that active intervention is the way to manage all nature reserves, non intervention has a definite place for many however, it is certainly necessary to manage some very actively. Of course the disadvantage of such a decision is that active

management is actually much more difficult and expensive than non intervention and must be continued once started. For this reason alone it is unlikely to be adopted universally.

The concept that active management is 'bad for tree'd ecosystems' is reinforced by the Natura 2000 network. An issue of the Natura 2000 newsletter in May 2003 about natural and semi-natural forests stresses that they are among the richest ecosystems in Europe and states guidance for selecting sites for the network where focus should be on:

- Forests of native species
- Forests with a high degree of naturalness
- Forests of tall trees
- Presence of old and dead trees
- Forests with a substantial area
- Forests having benefited from continuous sustainable management over a significant period.

It summarises these with the statement that ' These principles indicate that preference should be given to autochthonous forest with little human interference and/or those already subject to sustainable management practices favouring biodiversity.'

I argue that this has reinforced the bias of those designating areas away from sites that have large numbers of old pollarded trees because they have been heavily managed by man despite the fact that they have often been managed quite positively for nature conservation (although that might not have been the primary reason for management). Too much emphasis has been placed on naturalness to the extent that young regenerating trees may be preferred to old pollarded trees in designated sites despite the fact that the latter have a higher biodiversity value. The EU and the Natura 2000 network must start taking these arguments on board otherwise significant loss of biodiversity will occur in the future, and along with it part of Europe's heritage. Scandinavia has already achieved this by insisting that wooded meadows be a habitat type, Britain has attempted this by squeezing sites into other woodland categories but this does not help or encourage the rest of Europe that is struggling to realise the value of such places.

There is an additional problem where pollarded trees occur as part of a wider landscape, for example as hedgerow trees, rather than being in discrete areas. The recognition and preservation of landscapes is a more difficult task than the preservation of specific individual sites.

In the UK the realisation of the value of pollards, old trees and associated systems is slowly being taken for granted and becoming main-stream. As a result policies and procedures are generally in place, or being put in place to conserve and protect them (although clearly there is still opportunity for improvement!). In some other European countries this acceptance is not necessarily universal and substantial work needs to be done. It is hoped that experiences in the UK can help some of these countries recognise what they have and start to act to both manage and protect them. The following check list is intended to stimulate discussion and activity to promote awareness, management and protection of agricultural systems with pollarded trees across Europe.

Ideas for helping other countries

- Better interpretation of pollards and cultural landscapes
- Raising awareness of the value of traditional agricultural systems in the 'cultural consciousness'.
- Learning lessons from other countries and situations
- Designation of suitable areas with pollards as nature reserves
- Getting wood pastures sites recognised by the EU habitats directive.
- Helping accession countries and those recently joining the EU with designation of appropriate areas
- How will Romanian agricultural systems cope with EU'isation?
- There are a small number of people with considerable knowledge of pollard systems in their countries and others – How is this knowledge passed to those doing the practical work?
- How is this knowledge shared with other experts and interested people
- Locating important sites in each country – the formation of site directories
- A small number of active people can have a huge effect within a country or region - how do we find and assist such 'champions'

Ideas for work in Britain

Lessons learnt from other European countries can still provide ideas and opportunities for improvement of the British situation, some of these are:

- Protection of individual trees as nature reserves such as the Natur Minne system in Sweden
- Designation of cultural reserves as well as nature reserves and National monuments. These can help promote traditional farming systems and could help preserve interesting buildings along with the land management that surrounds them as one unit rather than as separate entities.
- Consider identifying traditional farming systems and setting up an inventory of particularly good examples
- Recognition of the importance of sap risers even in regularly pollarded *Quercus* trees
- In the past pollarded trees did die and this was not considered a complete disaster as long as other trees were able to take its place, either new younger trees or suckers or some other remnant of the same tree. Are we sometimes too precious about the importance of individual trees? Is continuous, consistent management of the site as important in the long term?
- For further information on pollarding, try talking to ethnographers.
- We have become so mechanised that we have forgotten that it is possible to do things by hand and at a slower pace. Are there more opportunities to take the pace a little slower and try using some traditional methods, such as pollarding with blades rather than a chain saw or cutting hay by hand? If it is an excuse to have a party afterwards like the traditional hay making parties in Scandinavia all the better!

- Increased awareness of the work of Ingvild Austad in Norway demonstrating that trees increase the productivity of meadows and that the nutritional value of tree leaves of some species are equivalent to hay or silage.
- Could we encourage more of a pollard culture again in Britain? The creation of new pollards is regularly discouraged because of the need for ongoing regular management that is labour intensive and expensive. Perhaps there is a use for pollards both as shade bearing trees where interesting tree shapes could be a feature and in other situations such tree plantings along motorways where non sensitive cutting using a tractor mounted hedge trimming flail would be an acceptable method of ensuring the trees do not grow too tall. There are definite opportunities for the creative use of pollards.

Potential projects to explore

- Cutting of new pollards with a slanting top
    - Is it better than a flat top?
    - Should the slant face north or south? Or does this depend on whether the tree is more likely to suffer from drying out or benefit from increased light levels?
- The benefit of using sap risers i.e. retaining one or two stems on trees that are in a regular cycle for a year or two after removing the rest of the branches. Do all tree species respond to sap risers in the same way – i.e. is the response in an 'easy' species such as *Salix* less beneficial than in *Quercus*?
- Is there a different response to cutting *Fagus* trees in Eastern Europe to those in northern Europe and if so does this have a genetic basis?
- Further exploration of the time of year of cutting. Is it actually better for the tree to be cut in the growing season when it can respond quicker? Does this depend on the weather conditions? Does it depend on the age of the tree and/or the regularity of cutting?
- Are pollards 'more forgiving' of hard cutting when they are in a regular cutting cycle rather than being cut at infrequent intervals?
- Is there any merit in taking lunar cycles into account when cutting trees?
- Do pollards respond differently to cuts made from a sharp blade, a hand saw and a chain saw?
- How important is the length of the cycle to tree survival. Is there an optimum length for the tree? Has the development of a longer cycle encouraged through the use of saws and chainsaws been detrimental to tree health and survival?

As a result of the tour various questions have been raised about historical pollarding in Britain and in particular about the *Fagus* pollards at Burnham Beeches. Answers to the following questions would help with our understanding of past management of pollards in the U.K:

- How big were the branches cut from *Fagus* and *Quercus* for fuel wood? Perhaps they were smaller than we might think.
- Did the trees grow slower in the U.K. than in some other countries? I.e. was a branch of 10 years here equivalent to one of 5 years in southern Sweden.

- What was the death rate of pollarded trees in regular management? Did death become progressively more frequent on older trees even in an active cycle? Presumably death of a few trees was not a problem, since there were so many, as long as new pollards were being created.
- Were sap-risers common-place on *Quercus*, like in northern France?
- What did the animals in Burnham Beeches eat in the winter months? Was it really hay and if so, where was it grown? (Why are there so few hay meadows locally marked on older maps?). If animals grazed in the Beeches all year round what did they eat in the winter? (heather?)
- Were trees cut for fodder at any time? What happened in drought years or hard winters?
- Was pollarding of *Fagus* (and other trees) in Britain like the Romanian examples (roughly 'hacked' branches) or Norwegian ones (cut tidily and with pride)?

How many old trees are there in the U.K.?

The question of how many old trees are in the UK relative to the rest of Europe is a much discussed issue currently. This tour has not answered this question but it has provided additional information. Pollards of course are not necessarily particularly old although many old trees are pollards. In three months I was limited by those places where people could tell me or show me trees and many interesting sites were discovered. However, I also realised how easy it would be to miss crucial places due to the intensely clumped nature of such places on a European scale. With the probable exception of Romania, where pollards are perhaps more widespread but at lower densities it would have been possible to overlook aggregations of trees very easily with no prior knowledge. Any system for estimating numbers must take this into consideration and the most accurate information would surely be gained by talking to the relevant experts in each country or region. The difficult part of this of course is finding the right person to ask!

It is clear that Britain is not the only European country to have old pollarded trees. A remarkable number of countries can boast at least some. The Spanish/French Basque country must have substantially more beech pollards than the U.K. and Romania may also have more too. Very old oaks were discovered in small numbers in a variety of countries; again the Basque country has many but these are probably, in general smaller than those in Britain.