NOTES ON POLLARDS

BEST PRACTICES' GUIDE FOR POLLARDING

Gipuzkoako
Foru Aldundia

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CHAPTER 1.
WHAT ARE POLLARDS?

A. TYPOLOGY OF POLLARDED TREES

There is no classification or typology for pollarded trees. There is not even an agreed definition that covers all the possible types of pollarding. It should be noted that pollarding, as a special type of pruning, can be carried out in different ways and affects different types of trees according to their species, shape or age. Furthermore, trees of species without defined apical dominance, that have grown in isolation and without competition or where there has been damage to their apical branches, may also be similar in appearance to pollarded trees, despite their not having been modelled by human hands.

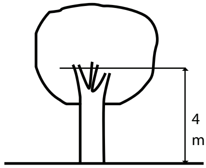
It is thus sometimes difficult to ascertain whether a tree has been pruned or pollard or if the shape of its branches are down to natural phenomena.

Even though the terms "pollarding" or "topping" are usually used interchangeably, some authors do distinguish between them. Thus, the historian Álvaro Aragón, usually speaks of the *ipinabarros [guided pollard]* oaks as pollard or topped trees "leaving *horca y pendón*" [*horca* where the branches are left at right angles and *pendón* where the branches are at an obtuse angle to the main trunk], so that the pruning did not prevent regrowth at the top of the tree or its future use as cambered beam usually for the Navy.

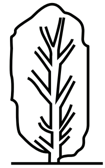
The typology followed in the *Instrucciones para el apeo de las parcelas de campo del Inventario Forestal Nacional [Instructions for the Shoring of Land Plots of the National Forestry Inventory]*, published for the Ministry for Agriculture, Food and the Environment, can be used.

Those instructions specify that all the trees on the inventory must be classified according to the "airspace form". The aim of this parameter is to separate the trees from a single species into more uniform groups based on estimating their volume and then applying different equations more in keeping with each profile.

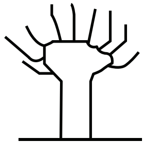
The three first types of this classification are applied to fusiform or free-growing trees, with the following types used to calculate the pollard-aspect trees given their high amount of branching:



- Form 4. Trees whose main trunk branches out before 4 m high and which belong to one of the following species, which are usually widespread in number and are shade bearing under normal conditions: Acacia or mimosa, wild apple, wild pear, stone pine, pedunculate or common oak, sessile or Durmast oak, Pyrenean oak, Algerian oak, Holm oak, Cork oak, American oak, common ash, black poplar, willow, wild olive tree, carob trees, beech tree, chestnut tree, Hazelnut tree, walnut tree, banana tree and bay tree.



- Form 5. Trees whose main trunk is twisted, damaged or has a lot of branches and they can therefore not be classified as fusiform or free-growing trees. Also bole stands of under 4 m if they are species different to those of codes 4 and 6.

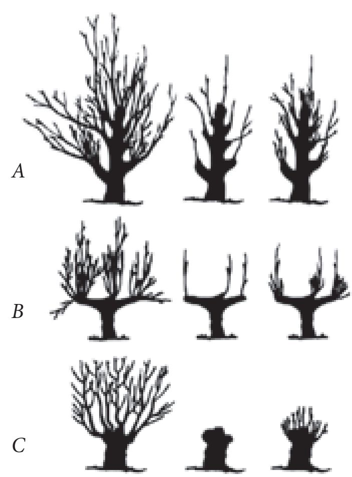


- Form 6. Topped or pollarded trees where the upper part of the trunk and the branches have been cut at points close to their insertion on the trunk and which belong to one of the following species: Common oak, sessile oak, Pyrenean oak, common ash, black poplar, beech and bay trees.

Form 4 seems to the most appropriate for trees with many branches, Form 5 for trees from repeated lateral pruning, cutting back or stump shoots united at the base and Form 6 for topped or pollarded trees. The rules of the inventory recommend that the pollard or “candelabra” trees may be in Form 6 when the branch shoots are young, in other words, they have been recently pollarded, and Form 4 when they are thick and of a certain age, or that the pollarding had been carried out rather earlier.

As they are subjective estimates, the differences between those types of pollarded trees are usually small and tend to be confused in many cases. One such example is the thick beech, usually over 60 cm in diameter and with a pollard aspect, included in the 2011 inventories of field plots in Gipuzkoa, as they have been classified on 123 occasions as Form 4, on 26 occasions as Form 5 and on 25 occasions as Form 6. If these data are extrapolated to the whole of Gipuzkoa, the total of pollarded thick beeches in the forests of the province can be estimated to total 260,000.

The following diagrams, taken from Pardo Navarro *et al.* (2003), show an appropriate typology to describe the pollarded trees of the Basque Country.



Form A shows giraffe pollarding. They are one-hundred year old trees, which are to be found on old estates in the eastern part of Llanada Alavesa, where secular pruning and coppicing have shaped pollarded oaks of spectacular dimensions.

Form B is typical of guided trees, pruned in the past to produce cambered timber. The decline of these practices has meant that some of these branches have grown to be large in size and usually threaten the very conservation of the pollarded tree due to their weight and their structural imbalances. This form is the one that is usually also seen in the holm and cork oaks pruned on the estates of mainland Spain and Portugal.

Form C is the most frequent among the pollarded beeches of the Basque Country and Navarra, the same as with other species such as oaks, alms and willows. The decline of the charcoal makers and pollarders in the middle of the 20th century has shown that the majority of the branches of those trees have not reached excessive dimensions.

B. PHYSIOLOGICAL ASPECTS ASSOCIATED TO PRUNING

1. Introduction

Pollarded trees are not differentiated from the biological or physiological point of view from the ones that are not. The general functioning is based, also logically, on the photosynthetic efficiency associated to a good root functioning.

Their specific nature is based on their special structure and (in the case that maintenance or recovery work was carried out) on how it is managed.

2. The physiology of the trees.

The correct physiology of the trees is based on the existence of a positive feedback circle, where:

- The foliage receives the essential elements to carry out the photosynthetic function (particularly the water) efficiently.
- The environmental conditioning factors (particularly the temperature) are the appropriate ones for that reaction to occur correctly.
- The root system receives carbohydrates synthesized by the leaves and which keep or increase its root absorption capacity.
- There is a flow of hormonal information between the two basic physiological elements (leaves and sap) and absorbent roots that feed back.
- The continuity and proportion of the live tissues between the energy generation, water uptake and distribution points between those two elements (fundamentally) are maintained and are sufficient for the correct interrelation between the parts.

2.1. Photosynthetic efficiency

Photosynthesis is the main reaction of plants and is what defines them. Glucose (as a main element) is synthesised by means of atmospheric CO_2 combining with the water taken up by the roots. The energy for this union is supplied by sunlight and requires a highly complex and efficient cellular environment.

Photosynthetic efficiency then occurs in those leaves that have good lighting, appropriate temperature conditions and, in particular, the necessary water contribution. Water contribution depends on the resources that the environment has at any given time and on the good root conditions.

The trees reactively position their active foliage at different heights to accommodate their active structure to the conditions of each circumstance. In the case of trees in natural environments, the conditions that modify the resource contributions mainly depend on the meteorological conditions associated to the soil behaviour and to the competitive relations.

Thus, photosynthetic efficiency is based on a high input level (glucose synthesis) combined with a low expenditure level (glucose consumption). For this relationship to be optimum, the tree structures must have a reduced structural cost (cells that consume little but do not produce): the structures associated to the cost are the branches, shafts, trunks, etc., and are fundamental to distribute the leaves in the air space.

2.2. The conditioning factors of the environment

The exact location of a tree determines a series of nutrient, water, temperature and soil characteristics that contribute a certain amount of resources. The reason that the majority of special trees have that status is more down to the special combination of the physical characteristics of the environment than their own genetics. It is the wealth of resources that defines the final dimension of the structure and, therefore, impacts decisively on the longevity of the trees.

In the case of all trees, including the pollarded ones, those environments with poorer physical conditions will produce weaker trees, with a less powerful structure and (in general) shorter longevities.

The trees in turn are able to adapt their structure to changes in the environment. However, this adaptation capacity is conditioned by the energy level prior to the changes that may occur.

2.3. The root system

The absorbent roots are that part of the tree that supplies the leaves with one of the 3 key elements of photosynthesis and as, in principle, there is an excess of CO_2 and light, it is usually the most limiting factor.

The trees size and position their absorbing root system to guarantee the most efficient possible supply rate. Abrupt changes in the supplies means that the air structure built on a specific amount of contributions is forced to generate quantity changes (regression, entrenchment, etc.).

Therefore, one of the determining factors in the conservation of a tree air structure is its root system functioning correctly, taken to be:

- High glucose reserves in the bearing roots
- Appropriate proportion of absorbing roots
- Reactive and adaptive distribution in an environment that allows all its resources to be used, including those that do so temporarily (and periodically).
- Efficient root substitution strategies and therefore a constant presence of connected roots and exploring roots that constantly increase and

fine-tune the connection with the environment.

- Lack of drastic changes in the environment (soil)

2.4. The hormonal relationship between the two elements making up terrestrial plants: leaves and roots

The efficiency of the photosynthesis generates a positive effect by means of synthesising glucose that enriches the whole organism.

Yet, furthermore, to boost those efficient structures, auxins (in the efficient elements) are synthesised and are distributed through the trees and are, preferably, sent through the connecting tissues to the root.

The root responds to this auxin presence by increasing the root ramification and with the synthesis of cytokinins that, due to a call effect of the auxins, move to the centres where the later is synthesised, thus promoting growth.

This positive feedback circle is the basis of the adaptive growth of the tree as it promotes those more efficient substructures by increasing their efficiency capacity by increasing resources and growth stimulators.

2.5. The continuity of the "living" tree: roots – sapwood - leaves

The complex structure of a veteran tree, and which we have summarised as efficient leaves and active absorbing roots, means the presence of a conductive element, that connects those two sets of structure and is adequate in terms of function and, above all, of dimension.

The two essential components of all root and air elements are phloem and sapwood.

Phloem is a tissue with a level of low rigidity and with a very high adaptation capacity to changes in the connection needs. The position where the phloematic vessels contract and expand is the same and therefore the rapidity in the response is high and efficient.

The sapwood is, however, a much more structured tissue. It is made up of vessels with cellulose walls that adapt more slowly. The sapwood vessel creation and elimination positions are different. The sapwood mass contracts at its limit with the heartwood, as new vessels are generated between the sapwood and cambium. Therefore, the continuity in the tissues of the sapwood (throughout the tree) is an element that intervenes in the response of the trees to the stress conditions:

The dramatic loss of foliage implies lower water transport needs (as the consumption is reduced), and therefore, the sapwood must reduce its strength (thickness) to adapt to those new needs. In the most extreme cases (in trees with low energy reserves), this reduction (death) of the sapwood is continuous throughout the tree and it therefore results in the (total or partial) death of the roots that were connected to it. Thus, the result of a dramatic pruning (in those weakened trees) means a loss of synthesis capacity and a massive root death. Apart from the anatomic changes, from the point of view of the absorbent roots-leaves feedback circle, the loss of leaves causes a reduction in the glucose synthesis, this reduction in the glucose contribution affects the absorption capacity of the roots that will mean a reduction in the contribution of water to leaves, with the tree entering into a negative feedback process.

For trees with high reserves, their inversion capacity implies that the loss of sapwood is not as high and may be reduced or even none far from the damaged zone. Furthermore, the capacity to generate new healthy and active shoots restores the energy levels in a moderate time.

3. Pollarded trees

Pollarded trees share their same physiological base with trees with a natural bearing. However, their specific structure (space colonisation strategy) provides them with a set of physiological characteristics and makes them evolve and respond to impacts in a different way to those with natural bearing.

3.1. The cycle of pollarded trees

Pollarded trees have a cycle defined by the periodic elimination of the photosynthetic structure. Topping can be carried out on branches and shoots of different size according to the targeted type of use.

The durability of the pollards is based on that the repetition topping cycle (years) always happens while the tree has high vitality levels, in other words, it is in the juvenile or adult phases.

3.2. Pollarded trees maintained without interruption

The pollards maintained without interruption are those where the topping work takes place with a specific frequency (those that have been carried out traditionally).

This periodic topping while the tree is in the adult or juvenile phase (in other words it has a high energy level associated) enables:

- Better compartmentalisation of the gashes
- Lower loss of strength of the sapwood.
- Less impact on the roots

Thus, the high energy levels are recovered more quickly and the longevity and durability of the trees is high. In fact, many of the species managed correctly by means of topping have longer longevities than those of trees left to develop by means of a natural structuring process.

How the pruning work is carried out (tools, cutting point, period, etc.), information that, in general, is part of the cultural legacy that accompanies those trees, plays a key role in the management of the pollarded trees during the period.

3.3. The "abandoned" pollarded trees

Abandoning the topping work of those trees usually results in an accelerated ageing of their physiology.

This intense reduction of the vitality is particularly related to the structure that the trees have after having been managed by means of periodic toppings and the main structural characteristics of the abandoned pollards are:

- Crown made up by shoots developed with high competition for the light
- Lack of hierarchy between the different shafts
- High presence of forced heartwood (generated by each pruning session) that is usually colonized totally or partially by xylophages.

3.3.1. The structure of the crown and the lack of hierarchy:

When a topping is carried out at the correct stage the tree generates shoots that have a high colonization capacity of the space. This capacity is due to high energy reserves. Therefore, the growth of the shoots is great.

The shoots that are generated after pruning have no type of regulation among them that allows them "to order", strengthen or stifle which shafts are developed and which parts of the structure are secondary and can be subordinate

to a global organisation (of the whole tree). Thus, these crowns are de facto tree forests (total reiterations) whose sole relationship is to compete for light and for root resources.

The abandonment, and, therefore, the lack of new toppings, means that the majority of the shoots (total independent reiterations) develop particularly at the top and are made up of a shaft (trunk-sides) with a reduced proportion of leaves (input).

As the shafts reach their maximum height, the lack of proportion between wood and leaves increases. Furthermore, the excess of independent individuals, which start from the intersection (cutting zone) means that the amount of light available for each is reduced. Thus, the abandonment of pollarded trees generates a structure with:

- Reduced input in each individual-shaft, due to the competition for light.
- Very high costs in terms of the amount of leaves due to their having large shafts and low associated foliage

Some species have a high capacity to renaturalise by means of the very competition process that eliminates the less energetic shafts and generates trees with fewer shafts, therefore with more light and with a large proportion of leaves. In other species, this capacity to purge is lower and they find it harder to return to "natural" structural growth. Apart from the species factor, the environment factor (with a specific amount of resources) facilitates or reduces this specific capacity according to their wealth.

The final result of this abandonment process is "trees" with very low energy values, due to:

- The net production of each shaft being null or near to zero. The tree overall therefore does not obtain the necessary amount of glucose
- The drop in energy in each shaft reduces their capacity to generate alternative crowns to adapt to the new situation
- The competition that all the shafts generate prevents light from reaching lower zones and reduces the capacity to strengthen the shafts
- The drop in glucose contributions weakens the root system and the tree thus enters into a negative circular process.

This is a generalisation and the trees can (mainly due to external circumstances) and in some cases exceed this critical period and produce a more efficient crown. Some of the circumstances that help to overcome this period are:

- Fewer dominant shafts. The fewer the shafts a tree produces, the more efficient each one is and the longer longevity and more adaptation mechanisms it has. This fact has to pitted against the fact that environment that is richer in resources and conditions allows the existence of more shafts and in better condition, or in other words, the ageing processing is slower and with greater opportunities to be partially reverted.
- Increased light due to the tree loosing branches. This fact generates spaces in the tree itself and can create juvenile zones that change the general structure of the tree.

- Increased light in the immediate proximity to the trees, normally caused by the loss of nearby trees. Even though this increased light can improve the vitality, it does not vary the space utilisation strategy (and capturing light) that the trees have and therefore it does not mean permanent improvement.

The natural process of many pollards is death from ageing and progressive reduction of vitality. However, many do not die old as the physiological weakening also implies a mechanical weakening and, therefore, a high risk of breaking.

3.3.2. Large amount of forced heartwood associated to the xylophage action:

The elimination of living parts of a tree is followed by a sudden reduction of the sapwood that becomes forced heartwood. The forced heartwood is in contact with the outside and is therefore quickly colonisable by xylphages.

While the pollarded trees are maintained as such, the sapwood is very strong and may cope with the mechanical needs of the trees. Furthermore, the crown is in an adult or juvenile state, which implies:

- Reducing the mechanical effort of the wind by means of deforming an elastic crown
- Less canopy
- High physiology and therefore capacity to generate reaction wood and adapt the structure to the different mechanical needs.

When the pollarded trees are abandoned, they start an ageing process that involves:

- A reduced physiology and therefore the adaptation capacity
- Thinning the thickness of the sapwood and therefore a lower mechanical support capacity

- Large canopies (crowns), with branches supporting increasingly greater weights
- Large cavities and rotting

The mechanical characteristics of those trees mean that the vast majority of abandoned pollarded trees end up breaking.

3.4. The recovery of old pollarded trees

The large amount of pollarded trees to be found in the Basque Country prevents their individual management. Therefore, it has to be accepted that this type of structure (particularly in the case beeches, alms, poplars and other soft wood trees) are going to disappear from our landscapes at great speed (from the woodland perspective)
. The hardwood species (particularly the *Quercus* genre) that also have a greater capacity to consolidate and reshape the crown, have rather better perspectives.

The only solution for the overall conservation of the pollarded trees would involve recovering the value of their derivatives.

Even though conserving pollarded trees is difficult in general, sporadic measures have to be carried out that allow trees or groups of trees of special interest to be conserved. As part of this cultural conservation strategy, we believe that it is important to generate new pollarded trees that enable this type of structures and the age-old culture of using nature that it seeks to maintain.

The conservation strategies of a specific tree require an assessment of its structural phase (juvenile, adult, mature or senescence). This first assessment will enable the response capacity to any measure that may be proposed to be determined.

The majority of pollarded trees are abandoned and therefore have a vitality between low and very low. These reduced vitality values mean that no dramatic measures (similar to the traditional topping work) should be carried out, before embarking again on this type of measures, the vitality of the tree must be improved. The most common solutions in these restoration processes are based on:

- Reducing the competition between shafts
- Increasing light in the surrounding area
- Improving the root conditions
- Moderate reduction (to a lesser extent the weaker the tree is) of the crown to foster epicormic growth.

These measures can be carried out together, but the intensity level of each of them must be based on a detailed study of each tree.

C. THE REASON FOR POLLARDING

Pollarding still continues to be a very specific type of pruning, where the aim is to create a crown of certain characteristics or as a way of using branches of different sizes. Therefore, the many reasons for pruning a tree or in woodland must be taken into account.

In a case of forestry pruning, the most traditional objectives when the lower branches are cut from a tree are usually to improve the quality of the wood of the trunk, avoiding the presence of knots in the timber, or reducing the risk of fire, therefore eliminating the lower branches that could turn a surface fire into the canopy being on fire.

In the case of pruning shapes linked to the arboriculture, the objectives are usually:

- to raise the height of the branches or the crown of the tree to a certain height, so that they are not obstacles to people or machinery.
- to balance the general structure of the tree, providing a shape that is

solid, balanced and well-distributed around the trunk.

- in some gardens or parks, the aim may be to give specific or artistic shapes in the trees: geometric shapes, trellising, hedges, etc; in this case, the pruning usually requires periodic maintenance pruning or cutting of the crown of the trees

In the case of urban arboriculture, other more specific objectives are usually added to the above ones, such as periodic pruning to prevent the trees getting near to the windows of the buildings, to increase the shadow of the trees or to reduce the biomass of the branches, by reducing the risk of woody material dropping on to the street. The drastic pruning of the shade banana trees and thorntrees in urban settings are usually the most extreme cases of this type of pruning.

The toppings linked to the silvopastural activities usually have the following objectives:

- to increase future production to improve the sun exposure inside the tree
- to allow livestock to get at the most tender branches
- wood production using the timber branches
- as they are zones with spring or winter waterlogging, which would make it impossible for the shoot leaves to breathe
- as they are zones with frequent ground and late frost, normally due to thermal inversion, which may hinder the budding.

Finally, forestry pollarding may be for some or several of these historical reasons:

- there was a need to make the presence of livestock, herbivores and frugivores compatible with the continued existence and regeneration of woodland and with the production of timber
- search for special curved shapes from the trunk and main branches of trees, generally linked to shipbuilding (*ipinabarros* [guided pollard] with "horca y pendón" [*horca* where the branches are left at right angles and *pendón* where the branches are at an obtuse angle to the main trunk], curved trees)
- there was a need to avoid the ancient marking by the Navy in the case of good boles in woodland near to the Bay of Biscay; some owners avoided this "seizure" by pollarding their trees and thus reduced their amount of wood of interest for shipbuilding.

The implementation of the Pollarding LIFE+ project has increased the list of reasons for pollarding:

- avoiding the accumulation of thick and heavy branches on a weak and hollow trunk, in order to reduce the structural imbalances in the tree and the consequent risk of breaking or falling down

- fostering the formation of dead or rotting woods in order to increase the population of saproxylic insects
- creating new pollarded trees in young beech plantations, so that they can take over in the future from the current old pollarded beeches when they are dying.
- slowing down the expansion of those trees whose growth may endanger the conservation of other trees of interest; it is the case of the pollarding of beeches to slow down their expansion in areas of oak trees, or the case of opening up small clearings in uniform and dense beech groves, clearings where the beeches are pollarded to foster the regeneration of other species whose development increases biodiversity in the adult beech groves.

CHAPTER 2.
POLLARDING IN THE PAST (UNTIL THE MID 20TH CENTURY)

Practically until the mid 20th century, the forest was the main source for supply human activities in the Basque Country and north-western Navarra. For a long time, it supplied wood for tools, farm equipment, weapons, furniture, buildings and ships; food for animals and even for people; fuel for kitchens, forges, *dorlas,* tileworks and lime kilns, and fertilizer for agriculture work. All the parts of the trees were used: the trunk and branches, as fuel or raw material for manufacturing and construction; the leaves, as fertilizer or food for livestock; fruit, as human or animal food; the bark, to produce dyes, using its tannins, and shoes.

In general, the oak was the most used tree until the 19th century, followed, by the chestnut, the beech, poplar, alders, etc. This species was considered the most useful, both for building and shipbuilding, and to obtain charcoal, due to the good qualities of their wood and to the proximity of oak groves to the iron and steel and shipbuilding production centres. Not surprisingly, the oak was mainly grown on hillsides at heights of up to 600-700 metres. This all contributed to its being, along with the chestnut, the most exploited and repopulated tree in the Basque Country and Navarra during the Modern Era.

However, the expansion of human activities in the 19th century, above all agriculture and livestock, led to a clear drop

in the number of chestnut and oak trees, and different manufacturing activities, mainly iron and steel, turned their sights on the extensive beech woodland, which had been less exploited due to its higher location and its further distance from

production centres. It continued to be used until the 1970s in the 20th century to cover a series of needs: to obtain fire wood for homes and bakeries, producie charcoal for iron and steel, obtain oars for shipbuilding and beams to be used down mines and for railway sleepers.

The incompatibility between the rate of exploiting the forest, due to the voracity of the production activities, and the very biological and growth rate of the broad-leaf species, was one of the greatest problems that humans had to face when using the forests until the beginning of the 20th century, when non-native species were introduced. The extent of the demand for raw materials was clearly greater than the growth of the different tree species and the deforestation and supply problems became gradually more serious. In order to guarantee the sustainability of forest management, between the 15th and 18th centuries, different forestry techniques were introduced that tried to guarantee the greatest possible productivity. These techniques evolved overtime according to the needs and priorities of the economic activities, along with the abundance of forestry resources and materials.

A. FROM THE UNDERGROWTH TO POLLARDED TREES

As can be seen from the different municipal ordinances, the forests of the Basque Country and of north-western Navarra were dominated by thickets and free-growing trees, at least until the 17th century. Thickets particularly predominated in those places closely linked to the iron industry. The combination of thickets, free-growing and pollarded trees was common in towns along the coast of Bizkaia and Gipuzkoa, or in the immediate vicinity. Traditionally, at least until the 17th century, the presence of pollarded trees was more common in Bizkaia than in Gipuzkoa, which meant that it was forced to import "corbatones" or pieces of curved timbered, right from the start.

The free-growing trees were not pruned. Once mature or *seasoned*, they were felled at the trunk. Thanks to them, the needs were met of different sectors, such as livestock farming, construction (beams and building frames), iron and steel (hammer handles for forges), ship building (oars, boards, curved dunnage, keels, masts, etc.) and, in some cases, to make charcoal.

As regards these free-growing trees, after being felled at the bottom of the trunk, branches would grow again from the stump and they would become thickets. The new branches were pruned once every 12 or 15 years to be used to make charcoal, weapons, poles, strips, barrels and houses, and their crops were used to feed the livestock. After the pruning, they had to be fenced off so that the animals did not eat the shoots, something that was impossible in the municipal forests, as livestock had right of way.

The damage caused by the livestock and a certain drop in the production of the thickets, as the cutting periods were not respected, precisely contributed to the iron and steel industry at a time when the sector was being reorganised, would drive the introduction of certain changes in the forestry management model halfway through the 17th century. Even

though there was previous abundant legislation in that sense, the thickets were guided in order to convert them into pollarded trees. This process was precisely more important in those places where iron and steel interests predominated and where the presence of thickets and free-growing trees had been notable up until them.

Proof of that change is the fact that, during the 18th century, the number of thickets ostensibly declined – even though they essentially continued to be used for the basket and cask making industries, and the majority of the woods and forests of the Basque Country and Navarra were already made up of free-growing and pollarded trees. Halfway through the 18th century, the forests of topped—pollarded trees had taken over from thickets and even over from free-growing trees. It is not known if the pollard-topped trees were correctly guided, even though according to contemporary accounts, the royal authorities were concerned as the iron industry interests prevailed in most of the cases and they paid little attention to that type of issues.

B. LEAVING "HORCA AND PENDÓN"

The demographic and economic expansion that occurred in the peninsula during the late Middle Ages culminated between the second half of the 15th century and the first half of the 16th century, which put a strain on the forestry wealth. In order to avoid this deforestation, during the time of the Catholic Monarchs, specifically in 1496, an order was issued that trees should not be cut "... *at the stump, but rather at the branch and leaving horca and pendon where it could grow again*" The technique consisted at leaving two or three main branches unpruned, one perpendicular [horca] and the other forming at an obtuse angle [pendon]

This requirement continued to be applied throughout the peninsula during the 16th and 17th centuries, as can be seen from the legislation at that time. However, it was particularly important

in the Basque Country and Navarra, where it even had its own name. The term *ipinabar* is a Basque word, which means to *prune or leave branch,* which refers to the Spanish term of "*leave horca and pendón*".

The technique used in those cases was similar to the one used for the thickets, but instead of beginning the felling from the base of the trunk, the pruning was carried out at 2.5 or 4 metres high, which prevented animals from reaching the shoots. The oaks were felled every 8 or 10 years and the beeches every 5 or 6, which meant faster and greater production than with the thickets.

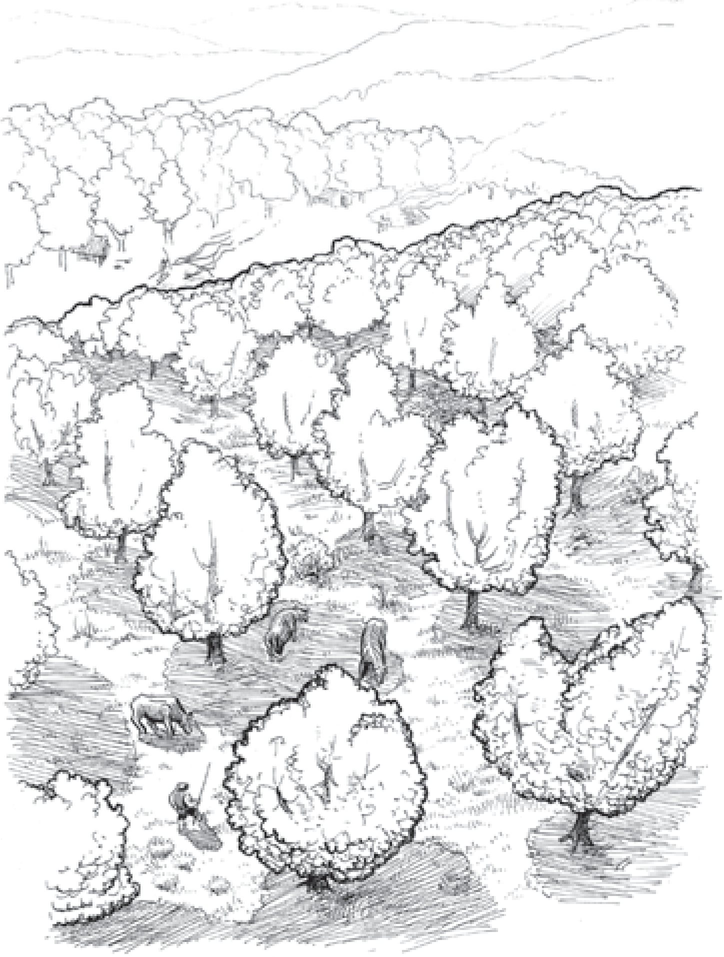
However, failure to comply with the legislation led to the appearance of a double pollard model: guided and non-guided. In the case of non-guided topped trees, all the branches were cut off – only half in the case of beeches to conserve the tree -, while the *horca* and *pendón* were left in the case of guided pollarded trees. The pollarded trees were particularly used for livestock and to produce charcoal, pulley blocks, gun grips and planks, and guided pollarded trees for livestock and to produce charcoal, planks and boats (producing curved timber).

The latter were called *guiones,* even though in Oiartzun they were known as *suariçes* or *suaritza,* which means oak for or from fire, used to manufacture charcoal. This word probably came from the current *suhaitza,* which is used for trees that can be used for timber, compared to *arbola* which is used in the case of fruit trees. The guided pollarded trees were also known as *corbos* or *ipinabarros.*

Halfway through the 16th century (1552-1563), the lack of materials, mainly for constructing buildings and ships, meant that certain measures had to be taken, including the obligation to leave a pollarded oak, at a certain distance, in the thicket forests. These measures were generally rejected in those charter towns where thickets prevailed and the forges were the main industry. The use of *ipinabarros* were already common in Bizkaia during the 16th century, while in Gipuzkoa and Navarra, except for some specific points where it was applied from the early 16th century onwards, its use was not widespread until the end of the 17th century.

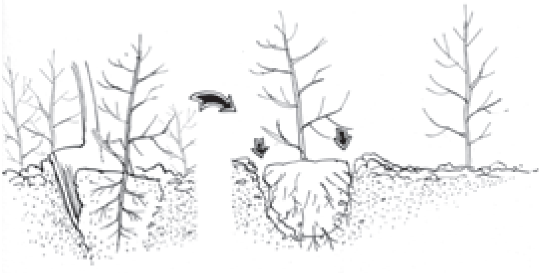
Pollarding fulfilled certain functions and offered certain advantages compared to the other models, particularly, as pollarded trees could complement the demand of a wide range of activities such as iron and steel, ship building or livestock:

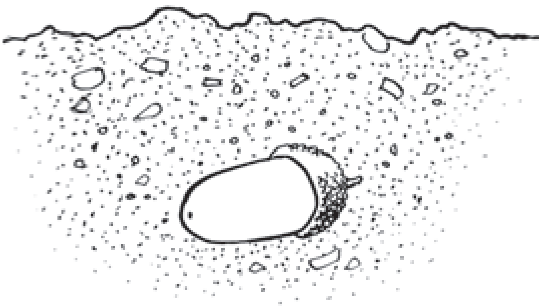
- it produced pasturing and feed for livestock in the form of leaves, fresh branches, acorns, beech nuts or chestnuts
- it allowed grass and undergrowth to grow to be grazed by livestock and prevented the latter from eating the offshoots, as the pruning was upwards



- had two or three main branches, that over time would be used to obtain curved timber, *tuertas* or *curvatones,* essential for ship buildings
- a series of branches would grow off those main branches and they could also be used for large planks, but, above all, for making charcoal. The added advantage was from the increase in productivity as the pruning system was brought forward by around four years – if the thickets were coppiced every 12 or 15 years, oak pollards could be cut every 10 years and every 5 or 6 years in the case of beech.
- the distance from one tree to another allowed the tree to expand, which meant that its branches could extend to a total area of 60 m^2

Between the 15th and 18th centuries, the method to obtain this type of trees was established and improved. In the 18th century, at a time when silviculture or forestry was at an emerging stage, the process was as follows:



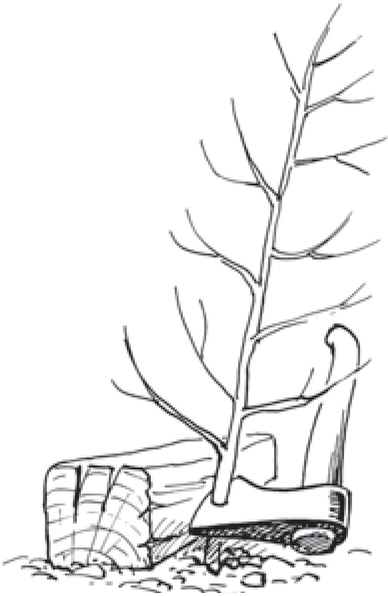


1. Planting seeds

The first step consisted of planting the acorn or seeds in good quality soil, either during November (in the case of oaks, holm oaks, beech and chestnut trees) or during the winter, until March (in the case of walnuts). The acorn, beech nut and chestnut were ideally placed on the side, to make it easier for the shoot to come out.

2. Nursery

Two or three years after the seeds were planted, the seedlings ready to be transplanted, known as *chirpías* were moved between November and March, always under a crescent moon to use the strength of the sap, to another plot or nursery that had been previously prepared, dug and fertilized during the months of May, June or July. In the nursery, which was fenced to avoid livestock getting in, the *chirpias* had to be planted out in rows with a distance of 70 cm between them, so there was room for weeding using a hoe and so that the trees did not get tangled up when growing. Weeding had to be carried out three or four times a year in March, June, September and December.



3. First pruning

Two or three years after being moved to the nursery, between the months of February and March, the oak or beech chirpia had to be pruned 7 or 9 cm from the surface of the soil - this operation was not necessary in the case of beeches and walnuts-. In June of that same period, the weakest chirpías were thinned out and only the straightest were kept.

Every year, between November and the end of January, the surplus twigs had to be cut off. Before moving on to the third step, the tip was cut off the small tree: instead of making a smooth cut, it had to be made at the aforementioned minimum height of 2.5 metres, when the branches divided, at the large shoots or where there was new growth, to avoid the tree drying out or the livestock eating the saplings.

4. Transfer to the plantation

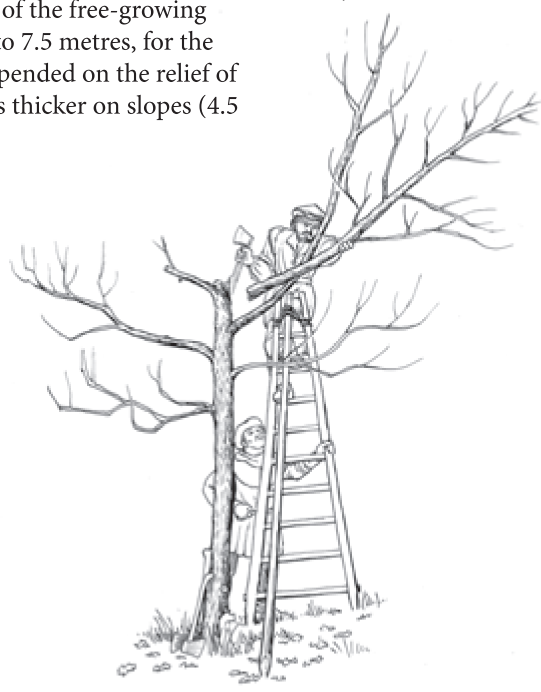
The second step would take place after the chirpía had been in the nursery for 6 or 7 years, in other words when the young trees were 9 or 10 years old. It was the time to move it to its final place in the woodland. The tree had to be approximately 2.5 metres high and a minimum thickness of 1 cm.

The trees were extracted selectively between November and half way through March. The strongest trees were taken out in the first year and another year was left between extraction and extraction, so that the trees that remained in the nursery could recover and could benefit from the shade of the others.

The transplants were carried out leaving a distance of 3 to 3.5 metres between trees, in the case of the free-growing ones, and of 5.5 to 7.5 metres, for the pollards. This depended on the relief of the land, and was thicker on slopes (4.5 metres) and more spaced out on flat land (7.5 to 8 metres). The trees had to be thorny – generally using hawthorn - and weeded once a year, when the soil was not very fertile.

5. Thinning out

Sixteen years after leaving the nursery and being in the planting out, in other words, when the trees were already 25 years old, the trees to be free grown had to begin to be thinned out, with a cadence of 10 year. The appropriate rage was that, for every 400 trees planted out, only 100 would remain at the end of 60 years. The pollarded trees did not have to be carried out as they had to be grown spread out so that their trunks were not excessively high and long, but rather stocky and filled out with branches.



6. First cut of the guiding branch

Seven years after being planted, the pollard guiding branch had to be cut to a distance of 3-5 metres from ground level, leaving all the branches whole and intact.

7. Successive pruning

Subsequently, 8 to 10 years after making this first cut, the smallest branches were pruned, leaving those that looked like they would be curved, in other words, the trunk, the *horca* and *pendón* were left. On land that had rich and humid sub-soil, an arm or *horca* 1.5 to 2 metres long located 2.8 metres from the *pendón* should be left on the tree. Ideally, the pruning had to be carried out furthest away from the trunk. Warts were thus avoided and it encouraged strong growth and in an appropriate away to obtain wood that could be used by the merchant and royal navy.

The best time to top trees for the first time was during the descending moon – and also for the free-growing trees to be used of ship building – from St. Michael's Day, 29 September until the Day of Our Lady of the Annunciation or Incarnation -, 25 March. In the case of the trees that had already been pollarded, the pruning was carried out between 20 February and 25 March. No branch had to be left lower than the others, as the shade from the higher offshoots affected the ones below.

C. CHARCOAL MAKING

Obtaining fuel was the main activity related to the non-guided pollard technique. The timber was for domestic uses or *suegurra* and to make the charcoal for the steel and metal industry. In the first of the cases, central heaths did not require large amounts of wood. But half way through the 18th century, the move to the side stove with chimney and draught resulted in a greater demand for firewood, which also led to a wave of illegal felling.

At that time, two wagons of wood, around a ton and a half, was delivered to each farmstead or house owner in the majority of municipalities. However, the increase in demand from the provincial capitals, such as Vitoria-Gasteiz, Donostia-San Sebastián, Bilbao or Pamplona, led to widespread imports of firewood and charcoal from other territories and to the exploitation of woodland and forest that up until then had had a temporary or isolated use, as was the case of the Andia, Urbasa or Altzania ranges.

The demographic expansion and the new ploughed areas caused the forests to shrink significantly. With the construction of new farmsteads and the conversion of timber huts into stone buildings, the demand for lime and tiles, a symbol linked to ownership, increased. When it came to manufacturing tiles, some accounts refer to around 415 loads of timber (26 tons) being used for each batch.

At the same time, the demand for charcoal remained steady or increased between the 18th and 19th centuries, due to the continuity of the traditional forges and making of iron billet and to the appearance of numerous puddling and cap furnaces and blast furnaces. Until the 1960s in the 20th century, this charcoal served the needs of the Araya, Bilbao, Luzuriaga and Orbegozo steelworks.

The method for making charcoal had barely changed from the Middle Ages. In reality, the operation was reduced to heating the wood, at a certain temperature, so that the main volatile elements burnt off and only the charcoal remained that was combined with oxygen.

1. Preparing the site

The first step consisted of looking for an appropriate spot to build the *txondarplaza* or the carbon kiln site, which have to be levelled and prepared before the wood and firewood was piled up.

2. Accumulating the firewood

The wood to be used was then coppiced from around the site. Generally, this was collected, in the case of council or communal woodlands, from trees previously marked by the warden or surveyor, as was the case until recently at Ataun, Elosu-Legutio, Leitza or Oiartzun.

In the centre of the carbon kiln, a straight pole was placed - which was taken out once all the wood had been filed up to make the kiln - or four boards that would leave inside a gap of around 25 cm^2 and which, built up in a cross-intersection pattern up to a height of 1.5 to 2 metres, acted as the stack. The lower part was surrounded by dry branches and, the pieces of wood, with the larger ones being placed nearer to the stack, were arranged radially. The wood was filled up in a pyramid shape, with the smaller pieces being placed towards the top to facilitate the elevation.

3. Covering the charcoal kiln to facilitate the charcoal process

Once the wood had been piled up, the carbon kiln was covered with damp soil, moss, sods, heather, gorse, damp leaf litter and fern to help the charcoal process. The usual charcoal kiln, as can be seen from the witness accounts gathered in Ataun or Ezkio-Itsaso, were usually 3-5 m high and used a volume of 100-200 sacks (nearly 20 tons) of firewood, which was turned into 4 or 5 tons of charcoal.

4. Lighting the charcoal kiln and combustion

The charcoal kiln was lit towards the upper opening of the stacks by means of lighting the upper branches or a handful of gorse. The carbonisation was thus triggered and it moved in a centrifugal direction from the top downwards. Once the covering was completed, a wooden pole was used to make a series of holes all the way round the base of the charcoal kiln to facilitate the air circulating between the stack and the aforementioned conducts.

The fire inside heated the fresh wood, which cause the humidity to be given off. In a second combustion phase, the flame turned white in colour. The wood started to shrink and the charcoal kiln cracked, which meant it had to be regularly supplied with more wood and the cracks covered with earth. The charcoal-making process of an average sized kiln was around 15 days to a month.

5. Final stage of the carbonisation and cooling of the charcoal kiln

In order to facilitate the carbonisation and to help the release of vapours, a stick was used to make vents in the upper and lower part, which were in addition to the aforementioned holes at the bottom. The heating process ended when smoke stopped coming out, when the covering was changed to start the cooling process. The openings and holes were covered with the same earth, which was flattened using the stick, which was carried out over several days. Once cold, the charcoal kiln was gradually opened up and a wooden hook was used to extract the fragments of charcoal, which were loaded into thick wool sacks and transported in wagons, mules and asses.

6. Traditional pollarding in the Basque Country and Navarra: end of the 19th century until the mid 20th century

The information provided here are the result of a survey conducted in 2011 in different places of Álava, Bizkaia, Gipuzkoa and Navarra
[1]. This involved interviewing around twenty people who at some time of their lives had worked in forestry, pollarding and making charcoal, using the traditional methods. The techniques they used, and which are described here, they had learnt from their parents and elders, the heirs of a long tradition whose roots in the Basque Country and Navarra can be traced back to the 19th century.

This work method was used until 50 or 60 years ago – and even, although only rarely, it continues to be used - to obtain the firewood for household or "suegurra" use, for the industrial production of bread and to produce charcoal to be used in the modern steel-metallurgy industry.

However, in this last stage, the forestry rates were very different to the last third of the 19th century, when the traditional forges, based on the direct system or shaft furnace, disappeared from the Basque Country and Navarra geography.

This disappearance influenced the coppicing system, which went from every 5 or 6 years, in the case of the beech trees, and every 9 or 10, for the oaks (19th century) to, from the 20th century onwards, 10 to 12 years, when obtaining household firewood and for bakeries (as was the case in Belauntza, which supplied Tolosa or Ubide, whose destination was Vitoria), and 40 to 60 years to obtain the charcoal used in the hardening of the cast steel in factories (such as Araya, Luzuriaga, Orbegozo) or to manufacture engines (such as Construcciones Juaristi).

The pollarding technique that is going to be described does not match what was applied to the *ipinabarros*, but rather to the *modorras* or unguided pollarded trees. Therefore, even though there are important similarities with the techniques described for the 18th century, it has some specific features. In any event, there is a great geographical variety when it comes to defining the pollarding technique in Basque: *kapetatu,* in Urdazubi (Navarra); *inausi,* in nearly all Gipuzkoa; *enborratu* or *lepotu,* in Oiartzun; *mogarratu,* in the eastern part of Gipuzkoa and the Narrava massif of Bortzirieta; *lepatu* or *lepotu,* in Oñati. The term *mochar* was also used in some areas of Bizkaia.

7. Transfer to the planting out

Generally, in winter and spring, the plants were taken from the nursery - belonging to the provincial institutions - to the place where they were going to be transplanted, which did not require any prior preparation. In the majority of cases, the moon was not taken into account, although it was said in some places that beeches should be planted under a new moon and the oaks under a waning moon. A hoe was used to dig the holes in a grid layout and the plant was placed in the hole and held in place with a *viurra* or three sticks, to that it grew to the right.

In the case of plants from the nursery, there were two options: As was the case of Ataun and Eskoriatza, they could come already pollarded, with the main guiding shaft cut, the intersection branches prepared and the lower twigs pruned, so that the trunk was smooth and whiter in colour than the standard – in Ataun they were called *aldapagoak* -. It could also be a plant that kept the main guiding branch to be subsequently treated.

Weeding was carried out once a year and when considered necessary, according to the land and to the production of weeds. In some cases, the planting out had to be carried out in areas of thicket, briar or thick fern to protect the plant and provide shade.

8. First cut of the guiding branch

When the plant did not come prepared from the nursery, when it reached 20 years and a height of between 2.5 and 3 metres, the main guiding branch was cut – by saw or by hand – leaving the side branches to achieve the pollarding and the lower branches were stripped. This was the practice in places such as Belauntza, Eibar, Eskoriatza, Oñati – where it was known as *pagolinderoa* - or Ubide.

9. Successive pruning

The pruning could be carried out once the leaves fell from the tree, as that was considered to be the time when the sap was in the roots and less damage was done. The pruning was therefore carried out between November and March, even though the most recommended period was January. The beech was preferably pollarded under a new moon – the first Friday of that moon in Azkoitia – and the oak and chestnut under a waning moon.

In reality, the belief was that respecting the phases of the moon improved the quality of the firewood or timber to be obtained. If the pruning was not carried out to obtain a certain type and quality of timber or firewood, it did not matter when it was carried out and the moon cycles did not come into play. In order to obtain beech firewood, it was better to prune under a new moon because it led to a more lasting flame and which gave off greater heat, while if it was pruned at another time, the wood could sweat and water given off in the fire. In the case of the oak, if it was cut under a waning moon it would hardly be affected by woodworm, as the ribs of the wood are much more compact.

When the pruning was carried out, not all the branches were coppiced, except in the case of the chestnut, where no guiding branches were left. In the other cases, only the thickest and most twisted were felled, and the thin and straight youngest branches left - known as *pagotxaraka*, *txara* o *txarakapa* in Eskoriatza and Aretxabaleta, as guiding branches, used by the tree to continue to grow.

In some places such as Azkoitia, Belauntza, Eibar or Urdazubi, not all the branches of the same tree were cut at the same time, but rather two branches were cut each year. If there were lower branches or at the intersection, they were coppiced from their base. Otherwise, a small margin or stump always had to be left, making sure that there was a branch under the cut make. It was sometimes recommended to cut or make a series of incisions in the bark of the stump for new shoots to appear.

The pruning frequency depended on the quality of the soil, as was the case in Elosu-Legutio. In places where the soil was not very deep, more time was left between pruning and pruning, while in the case of deeper soils, the time between prunings was shorter.

The pruning was mainly carried out using an axe, as it was convenient and because the saw dragged and left a smooth surface. That was not the case of the axe and it was more effective for new shoots to appear. The cut had to be chamfered, so that the water ran towards the ground and did not form pools, and it was performed for thinning out or clear cutting; in the case of thinning out, it only involved those tress that had branches that were sufficiently large to provide firewood or the required material.

Once the branch was felled, axes, saws and wedges were used. The branches cut to make charcoal or household firewood were left to try at the foot of the tree until summer or autumn, where they were taken to the site of the charcoal kiln. If the charcoal kiln was to be built in winter or when the firewood was for bakeries, it was transported immediately after pruning.

CHAPTER 3.
POLLARDING IN THE 21ST CENTURY

Pollarded trees emerged in Gipuzkoa in response to the need to maximise the goods obtained from them. The decline, first of all, of shipbuilding and then charcoal ceasing to be used as a fuel reduced their utility until, several decades ago, the trees ceased to be managed. The pruning of the existing pollarded trees stopped, along with the creation of new ones.

Yet is the production of firewood and timber the only use that can be obtained from the pollarded trees? For some time now, we have been aware that, apart from those material benefits, pollarded trees provide other important services to the communities.

This chapter focuses on two of them: their contribution to the mountain landscape, and therefore, to the local identity, and the maintenance and conservation of certain ways of life, which helps to maintain the biodiversity.

A. LANDSCAPE. ETHNOGRAPHIC AND CULTURAL VALUE.

The extension of land that is seen from a place is called landscape. This definition is very simple, but it introduces two essential aspects for its explanation. the observer, who must see, and the object, which must be seen.

Therefore, a landscape does not exist without the people who see it and interpret it. In other words, apart from the material aspects (shapes, textures, colours, etc.), the landscape has a clear social component. Delving further into this idea, the European Landscape Convention defines it as any part of the territory, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.

The current preoccupation with the landscape is based on the certainty that it plays a key role in the social, environmental, ecological and cultural fields. It is a beneficial resource for economic activity and contributes to the setting up of local cultures, to the well-being of human beings and to determining their identity.

Pollarded trees are much more frequent in Gipuzkoa than in other territories and have become characteristics of the region and as part of their identity. They form part of mountainous Gipuzkoa, that area located over 500 metres high and are present in some of the most characteristic spots of the province. They are sometimes found in small groups, while in others they form large forests covering hundreds of hectares.

The highlands of Gipuzkoa are noted for limestone, the green pastureland used by the herds of Latxa ewes, cows and mares, the folds used by shepherds and beech forests. The latter are sometimes

free growing and others are pollarded trees. Small pollarded trees are usually found close to the chapels scattered over the mountains of Gipuzkoa, traditional gathering places for the inhabitants of the neighbouring valleys.

The landscapes that are the result of the interaction between nature and man are known as cultural landscapes. They illustrate the evolution of society and of human settlements over the years, under the influence of the natural environment and the economic, cultural and social forces.

Pollarded trees are undeniably a cultural landscape. They are the result of several generations of people managing natural elements (trees of different species), to obtain timber (beams for buildings, keels for shipyards or mastheads for vessels) and firewood, making it compatible with the tree itself and with use by the livestock.

Economic and social changes have been reflected in the pollarded trees and in their presence in the landscape. The need for timber for shipbuilding was the driving force behind its origin and their existence spread from the coast inland. They were initially mainly guided pollards to obtained timber for ships or *ipinabarras*. Subsequently, this type of pollarded tree began to disappear from the mountains of Gipuzkoa once ships ceased to be made out of timber and it was replaced by non-guided pollards.

In recent ages, a new change has occurred once pruning stopped. In this way, the pollarded tree which is now characteristic, with thick branches on the intersection, must have previously been very scarce. The repeated pruning every 10-20 years prevented the main branches from growing to a large diameter and reached the heights to which we are now used.

Cultural landscapes are not unchanging and those of pollarded trees are no exception. Apart from the morphological change that the trees themselves usually adopt when developing and growing, the environment also adapts to the administrative, economic and social conditional factors that have developed jointly, and in response to the natural environment.

The landscapes of Gipuzkoa with the presence of pollarded trees reveals the naval past of the province, the first industrialisation of the valleys and the existence of different trades that have now disappeared (blacksmiths, axe men, woodsmen, charcoal makers, carpenters, shipbuilding carpenters or joiners, etc.)

There is currently a movement working to protect, manage and conserve the landscapes. This is driven by the conviction that it is an important aspect for social and individual quality of life and for economic activity. The fact that the landscape with pollarded trees is a cultural landscape means that the trees need to be managed again. If that does not happen, like any living being, they will enter senescence, death and disappear.

B. ECOLOGICAL FUNCTIONS AND ASSOCIATED BIODIVERSITY

Pollarded trees are usually to be found in groups, forming forests and coppices of different sizes. Individual trees are less frequent. In any event, pollarded trees are part of larger habitats and coexist with different characteristics and typical species. Some of those species are very specific and they exclusively used specific niches, with very few possibilities of being developed in other environmental conditions. Others, however, have broad vital spectra, which enable them to grow in different habitats and environments.

The majority of Basque forests are made up of young trees, even though some are large in size. This structure arises from the intense exploitation to which they were subject in past centuries. Therefore, this type of young forest is preferably mainly colonized by general species, that are adaptable and able to use many types of resources.

There are very few mature, age-old, senescent and dying trees, with many holes and wood in different stages of rotting... This diversity of environment means that old trees play an important role as reservoirs of forestry biodiversity, as they are many species that depend, to a greater or lesser extent, on those holes and rotting wood to complete their biological cycle.

Given the lack of old trees in Basque forests, some species find the environments they need in the pollarded trees. The presence of gashes and rotting woods, usually the result of the intensive pruning

to which they had been subjected, led to very unique environments that allowed a variety of life forms to thrive. In fact, they are many numerous life forms that live on the trunks of pollarded trees and examples can be found from the plant, animals and fungi kingdoms.

Numerous plant species settle on the trunk and branches of pollarded trees, including algae, lichens, mosses and ferns. Higher plants, or even other trees or shrubs, sometimes grow on some large pollarded trees. The presence of other organisms is important because they create different niches that are used by many species of insects that feed or seek refuge in them.

The rotting and mature wood of the pollarded trees are essential elements for certain fungi to develop. There is a very high diversity of fungus species living in them. Some create symbiotic associations, known as mycorrhizae, where the rootlets of the trees associate with the hyfas of the fungus, to the benefit of both organisms. Others are saprophyte fungi and feed off the remains of the tree, either when it is dead or decomposing, and off the organic remains that it produces (leaves, branches, etc.). There are specialised fungi in each of the stages that the wood passes through as it decomposes, creating a sequence of the species present from the wood beginning to rot until it finally disappears from the environment.

The relationship existing between the presence of age-old trees and those of saproxylic invertebrate has been known for a long time. The saproxylics are a broad group of invertebrates that are characterised because they depend during part of their life cycle – mainly larval stage and reproduction – on the senescent or dead wood of trees, on the fungi of the wood or on the presence of other saproxylics.

The best known include the saproxylic beetles or weevils, such as the stag beetle (*Lucanus cervus),* a species that develops in the bulky and dead parts underground of all the deciduous trees (stumps, roots, parts of live trees or remains of dead trees).

Rosalia alpina – Rosalia longicorn beetle - is a very eye-catching species that mainly depends on the presence of dry beech wood and it is found in great numbers in some pollarded forests. This species is of particular interest for conservation and the European Union considers it to be a priority species.

Another priority species, but less aesthetically attractive, is *Osmoderma eremite* (hermit beetle). This large black beetle lives in large hollows of deciduous trees and in Gipuzkoa, so far, has only been found on pollarded trees.

However, the list of saproxylic beetles and weevils to be found in the forests of Gipuzkoa is very long and easily exceeds a hundred species.

Pollarded trees are also important for birds. A least a third of forest birds are considered to depend on the presence

of trees with hollows and dead wood, as they use the hollows to nest or as a source of food.

The birds associated to those trees include woodpeckers, which peck their own nests in the thick trunks of the mature trees and make hollows that can be used by other species.

The majority of the nocturnal birds of prey need trees with suitable hollows to nest, such as the tawny owl, a species that is typical of forests. Yet some species adapted to the rural environment and the countryside, such as the Scops owls, the little owl and the screech owl, sometime breed in hollow trees.

Small birds, such as some passerines, also need small gaps and hollows in which to build their nests. This is the case of the blue nuthatch, short-toed creeper, great tit or coal tit, whose presence is frequent in the zones with pollarded trees.

Among the mammals, forest bats are one of the groups most linked to old trees. These small flying animals need cracks and hollows in the trees to rest during the day. The setting of those trees is usually an appropriate zone to feed given the insects to be found then.

Bats are considered to be one of the animal groups with the greatest number of threatened species, mainly due to the widespread use of insecticides to control pests. In the case of forest bats, this fact has been further aggravated by the lack of mature forests, habitats where those species were to be found in greatest density.

Many of those species therefore need the pollarded trees to survive. Without them, they would disappear from our forests and it would often be difficult for them to colonise again, given their lack of dispersion capacity.

The current emphasis on conserving biodiversity is clear. However, the latest data collected from successive forestry inventories allow us to be optimistic, as our forests are currently immersed in a slow process to increase their maturity, with a growing number of old trees to maintain broad and stable forestry communities. Until the current trees acquire that maturity, other type of trees will be needed that provide those micro-environments, where such important and unique species can survive and thrive.

This situation is common to the majority of European forests. In Scandinavian countries, such as Sweden, techniques are used to speed up the ageing of the trees in very young forests by means of creating different types of hollows and gashes in trunks and branches. The outcome is that the environments are created in those forests that are necessary to develop and conserve unique species until the natural dynamics themselves produce a mature forest with the presence of old trees.

In Gipuzkoa, the work of the charcoal makers and blacksmiths has left us a

great many trees that fulfil those functions. We will need them to conserve the forest biodiversity until our forests become sufficiently mature.

C. PROBLEM OF THE POLLARDED TREES. RISK OF DISAPPEARING

The socio-economic changes that occurred during the last half of the 20th century account for the nearly total disappearance of pollarding in Gipuzkoa. The rural depopulation, the need for greater productivity in the primary sector and the impact of fossil fuels brought the pruning of the pollarded trees to an end.

Previously, every 10-20 years old, those branches were coppiced and the cycle started again. But when the pruning stopped, the branches on the main branch continued to grow, they increased in thickness and more biomass continued to accumulate on the main trunk. This ongoing process has progressively increased the centre of gravity of the trees, which negatively impacts their stability and makes them increasingly more vulnerable.

A significant number of trees break every year, which is not only limited to the branches, as many trunks are hollow or rotten, the trees split to the bottom. A percentage of those are due to snowfalls. The large crowns that characterise the unpruned pollarded trees trap significant amounts of precipitation in the form of snow, and the trunks weakened by the repeated pruning and spreading rot are not capable of supporting the weight and snap.

Two examples illustrate the size of this problem. According to the resurveyed plots in the Forestry Inventory of the BAC, it is estimated that around 20,000 pollarded beech trees, approximately 8% of the total, disappeared from the forests of Gipuzkoa between 1996 and 2005, even though it is not known how many were due to the power saw or axe and how many for natural causes.

On the other hand, in Oieleku, where there are 200 hectares of pollarded beech, it is estimated that around 10 or 12 a year disappeared due to the snow storms and gales.

Therefore, it is a relatively quick process that is going to mean that the presence of pollards is going to become rarer in the woodlands of Gipuzkoa. This process is not expected to reverse, given that no new pollards are being created by means of new pruning of free-growing or planted trees, as was the case in the past.

D. POLLARDING AS PART OF THE MANAGEMENT OF FORESTRY PRACTICES

The reasons have already been described for conserving pollarded trees as functional elements of the forests that provide them with spatial heterogeneity and as characteristic features of a cultural landscape, the result of the customs and lifestyles from the not so distant past.

These reasons are also the ones that have driven Gipuzkoa Provincial Council over 25 years old to subsidise the individual owners of outstanding woodland to conserve the old and pollarded trees that they had on their land. It was the first step in the management of the forest systems from a more conservative approach.

The subsequent implementation of the Aiako Harria LIFE and Pollarded trees and Biodiversity LIFE+ projects highlighted the importance of pollarded woodland as habitats of numerous species, including some priority ones for the European Commission such as the *Rosalia alpine* and *Osmoderma eremite* beetles and weevils.

The results of the Aiako Harria LIFE directly pinpointed the important contribution of pollarded trees to conserve the forest biodiversity and the Pollarded trees and Biodiversity LIFE+ was fundamental to begin to act in the natural environment and work directly on the woodland to conserve this type of trees that are so unique.

However, there is a great uncertainty regarding what is going to happen once the current LIFE project ends and that will mean the end of the economic funds behind the key work to conserve and improve the forests of Gipuzkoa, by means of protecting the pollarded trees and creating new pollards in the future.

In order to overcome this uncertainty, conservation goals, in the broadest sense and in the long term, need to be incorporated in the forest eco-systems, so that balanced management is generated where there is room for conservation and productive measures.

Among the measures that are seen as necessary to achieve mature forestry systems, with the appropriate ecological functions and structure, some are easy to incorporate in the management and only the willingness of the managers is necessary to implement them. For example, it involves respecting the death wood once the life cycle has started of the saproxylic beetles and weevils that have been able to colonise that dead word by not marking mature or dying trees for thinning out or as firewood.

On the other hand, other type of activities such as the very pruning for the pollarding requires a great effort and it seems that it would only be effective if associated to an economic profit for those who decide to carry out period coppicing. The emerging forestry biomass market to provide fuel at local level, in small boilers or in traditional hearths, could be a strong demand for wood and the selecting pruning of rams (pollarding) could be a good alternative to felling the tree at its base.

CHAPTER 4.
CONSERVATION ENDEAVOURS

It is becoming increasingly clearer that pollarded trees have a great role to play regarding the conservation of the biodiversity, the genetic heritage and the historical and cultural heritage of the Basque people. However, this recognition does not usually go hand in hand with measures to foster their conservation. Indeed, they are a financial burden for many forest owners, as they usually involve significant investment for their active conservation, and a legal burden, due to the limitations raised occasionally by the authorities to carry out any forestry work. Against this background, many owners have chosen to opt out.

On the top of the lack of return on the pollarding work, there are also other practical problems for the owners of those trees, such as the structure of the property (many of those pollarded trees are located on small plots) or their geographical location (they are usually located on high land, with low productivity and far from the forest road network).

In recent years, there have been very few actions of this type driven by private owners and those few have been very limited in space. However, the list of conversation actions carried out in the Basque Country in recent years by the Authorities and related to pollarded trees has gradually been increasing. The following list of initiatives is broken down according to the public institution behind them, with a great variety seen within the initiatives implemented.

Yet beyond the specific measures listed here, special mention should be made of the change in attitude seen during recent years among many owners, forest wardens and technicians. It has gone from considering old pollarded trees as the one to mark and eliminate, to be converted into firewood or candidates to be felled in any forestry intervention due to their lack of commercial value, to being respected for their naturalistic and cultural values. The results achieved in recent years, as regards the increase in biodiversity associated to those trees and to conserving their genetic heritage, can be clearly seen.

The provincial councils, in their capacity of being responsible for forestry administration in terms of managing public woodland and overseeing private woodland, have been implementing different tasks related to conserving old and pollarded trees:

- awareness-raising with private owners and local councils and training forestry wardens and

technicians on the importance of conserving those structures and the dead wood.
- clearing around the adjacent stands to foster the pollarded trees and avoid their “drowning” in some cases
- experiments to bring back “interrupted” pollarded beeches (in other words, pollards whose pruning stopped being carried out decades earlier) and fostering dead wood
- experiments to mechanise the work to bring back interrupted pollarded beeches
- managing and monitoring the pollard word in cleaning and extending electricity lines
- response to the request of private owners and local councils that are asking for advice on possible measures to be developed in deciduous woodland.
- acquiring land with pollarded trees.

A. GIPUZKOA

Gipuzkoa is the Basque province with the greatest extension of pollarded beeches. Using the data of the Forestry Inventory of the Basque Country, it is calculated that out of the 15,000 hectares that beech trees cover in Gipuzkoa, the surface area with pollarded ones comes to 7,200, within which the more or less pure pol-

larded trees would not exceed the 3,000 hectares.

Gipuzkoa Provincial Council has been particularly active regarding the measures to conserve the old woodland, a fact due to its being the Basque province with the greatest surface area occupied by pollarded beech:

- Study on compensation for refusing felling permits (2007). This study listed all the plots of private woodland for which economic subsidies were granted in exchange for an undertaking to conserve those trees for at least 20 years. Since 1988, this has prevented the felling of around 16,600 trees distributed over 164 ha, 7,300 of which were beech trees and 7,000 oak, with 2,000 pollarded trees included in total.
- The "Special Trees in Gipuzkoa" study, commissioned to IKT (2009). This study was based on the information gathered by the forest wardens on nearly a hundred large and spectacular trees within the Province. Some of those trees are pollards and may be future candidates to be declared special trees by the Basque Government.
- Between 2005 and 2010, the Aiako Harria LIFE+ Project was implemented, also under the aegis of Gipuzkoa Provincial Council, which enabled contact with different European experts on the conservation of pollarded trees and facilitated the conducting of different biodiversity studies and specific measures in pollarded beech groves in the aforementioned Natural Park and Aiako Harria SCI, mainly in Oieleku (Oiartzun).

- The “Biodiversity and Pollarding” LIFE+ project, or to give its full time “Managing and conserving the habits of **Osmoderma eremita*, **Rosalia alpina* and other saproxylic beetles and weevils of community interest in Gipuzkoa” deserves special mention. This project, which was conducted between 2010 and 2013, was made up of different interrelated actions to be implemented in five SCI in the mountains of Gipuzkoa: Aiako Harria, Aizkorri-Aratz, Aralar, Pagoeta and Hernio-Gazume.

B. IN THE BAC

Even though the Basque Government barely has forestry competences, it has implemented different measures aimed at disseminating and increasing the degree of protection and knowledge of the pollarded trees, including:

- Special trees declaration

The legislation is based on the Conservation of the Nature of the Basque Country Act 16/1994, of 30 June, specifically its Article 16:

“Special trees are examples of trees that for their outstanding or extraordinary characteristics (size, age, history, beauty, situation, etc.) deserve special protection.”

Decree 265/1995, of 16 May, declared 14 special trees, while Decree 23/1997, of 11 February, declared the remaining 11, all of which were proposed by their respective Provincial Councils. No special tree has been declared since 1997.

Some of those 25 trees declared as Special in the Basque Country are pollards, as is the case of the Altzo Beach Tree (Gipuzkoa) or the Angosto Holm Oak under which oaths were taken (Álava).

- Publications

Different books on the trees declared as Special or candidates to be so in the Basque Country have been published.

- Days on arboriculture

The Itsasmendikoi institute held several of those days, where there was usually a special emphasis on pollard and monumental trees. In 2009, the Delegation in the Basque Country of the Professional Association of Forestry Engineers took over that role and organised a session on old and pollarded trees in Derio.

- ***Álava Provincial Council.***

Álava Provincial Council manages a large area of public woodland (around 150,000 ha) and a considerable surface areas of beech trees located in public woodlands (around 30,000 ha, 60% of the total of the total extension of beech groves in the Basque Country). Quantitatively, the pollarded woodland do not occupy a considerable surface area of that woodland, but they do have a great qualitative value, as they are concentrated in scattered spots of great natural interest due to their rarity and natural value within the Basque Country.

Some of the measures carried out in recent years regarding those pollarded woodlands have been:

- Work to research, disseminate and relevance of monumental pollarded oaks of the Arimotz zone (Munain and Okariz mountains)
- Creating forestry reserves in woodlands of great natural interest, pursuant to the Woodlands Provincial Law No. 11/2007
- Initiatives in Natural Parks: Gorbeia, Aizkorri-Aratz and Izki. In the first of them, Forestry Management Plans have been deployed in the public beech groves of Urkabustaiz, Zuya and Zigoitia and a dozen of old beeches have been re-pollarded in the vicinity of Mairulegorreta (Gopegi). In the second case, an inventory was conducted of the Zalduondo and Gordoa monumental pollarded oaks, with some one-off measures planned and started in the vicinity of those Zalduondo oaks. In the third case, a new LIFE+ project called Pro-Izki has just been approved, by means of which different actions to conserve oak groves and their associated biodiversity are planned to be implemented.

- ***Bizkaia Provincial Council.***

Bizkaia Provincial Council has implemented different actions aimed at increasing their pollarded surface area and to regenerate or conserve that woodland:

- Approval of Provincial Law 11/97 regarding the specific system for different native forestry species, which has enabled the natural deciduous coppices and trees to be protected, including protecting the pollarded trees from felling.
- Publication of the "El haya en Bizkaia" [The Beech in Bizkaia] book, where Antonio Buesa describes his experience with that species and his groundbreaking forestry regeneration actions in the Otxandio pollarded beech grove (MUP El Limitado).
- Acquisition of private pollarded beech land in Natural Parks. In 2002, Bizkaia Provincial Council tasked IKT with producing the management plan for different beech trees located in recently purchased heritage woodland in the part of Bizkaia of the Gorbeia Natural Park (around 165 ha).
- Measures to receive the pollarding activity in different Zeanuri beech groves (Gorbeia Natural Park) and in the vicinity of Urkiola, between 2009 and 2012, in order to conserve those forest and enable, in the cases where it is possible, the silvopastoral activity.

- ***Local Councils***

Local authorities, such as local councils or parish councils (in the case of Álava) are owners of a large part of Basque public woodlands and, also, of their pollarded woodland.

Mention should be made of the recent measures carried out by the Trepalari association and driven by Amurrio Council in the Goikomendi-Kuxkumendi pollarded beech grove, located in public woodland, where a charcoal kiln and different routes have already been established. Re-pollarding measures have also been undertaken involving a dozen gall oaks in the Armentia forest (Vitoria-Gasteiz)

Different local councils of Gipuzkoa and Navarra are being very active in the deployment and planning of measures in the pollarded beech groves in their local jurisdiction:

- it is the case of Oiartzun and their different measures to recover the pollards during the last decade in the Oieleku beech grove
- maintenance measures are being planned in Eibar in the Arrate and San Roman pollarded beech groves (from (de Usartza to Kalamua)
- Azpeitia has heritage plots with pollarded beech groves on Mount Izarraitz
- In the case of Navarra, special mention should be made of the different re-pollarding measures in Leitza and Jauntsaras beeches, with an important impact on the media.
- ***Other stakeholders***

Outside the public sphere, special mention should be made of the activities of the Association to conserve the mature trees and forests in Navarra www.arbolesviejos.org/), which periodically organises visits to the woodland in order to showcase the wealth of the old trees of Navarra.

The Asmoz Foundation, answering to Eusko Ikaskuntza, successfully organised an online course in 2011 on “Pollarded trees: Tradition, management and conservation”, with the involvement of different stakeholders and experts in the field. Likewise, in 2012, the Asmoz Foundation, in conjunction with HAZI, organised a shorter new online course, entitled “Past, Present and Future of Pollarded Trees”. The lectures of both courses are available online.

C. IN OTHER ZONES

New experiments with creating new pollards by means of forestry processors are currently being conducted in some woodlands of Castilla y León. The hike in the price of firewood is helping to drive the forestry work on these deciduous woodlands.

That is the case of a public woodland in the north of León (Dehesa de Corrales), which was formerly pastureland, and today occupied by a Pyrenean oak (*Quercus pyrenaica*) grove, with small diameters on average, and where the root and stump shoots grow profusely after the trees have been felled. As in this case the experiment is being self-funded by means of selling the wood generated, a similar activity is being carried out on further public woodland in Burgos, in the Sierra de la Demanda range, even though in this case it is being funded by the Improvement Fund and aimed at providing firework for the local residents.

The central idea of these measures is control the re-shooting of the felled oaks and avoid epichromic shoots in the future stands, by proceeding to cut the bole of the oaks without future at a height of 3-4 metres, so that there can be re-growth at that height in the form of pollard stands, without competing with the boles with future.

These innovative experiences seem to be showing initial success as they are not very expensive (the firework can usually be sold) and as woodland with trees with future is being created, with future value as quality wood, with a sub-level of leafy trees aimed at fostering biodiversity. The lower slopes of that woodland, that facilitate the mechanising of the work, mean that the experiment cannot be exported to woodland with more irregular relief.

In the proposal section, mention must be made of the researches carried out during the last 20 years in the Montejo de la Sierra beech grove by Luis Gil and his collaborators of the Politécnica University of Madrid. Their management recommendations include making clearings around the pollard and/or old trees and encouraging the survival by acting on those branches with mechanical problems.

The traditional Iberian landscape of the pasturelands in a huge set of pollarded trees, generally holm oaks, cork oaks and ashes. The management of those pastureland species varies between two extremes: The Salamanca pastureland, as an example of an area where the pollard is widespread and intense, and other more southerly zones, where the pollarding is less frequent and forestry authority intensely regulates those pruning practices.

Finally, different forestry, agriculture and traditional landscapes, generated by the repeated practice of pruning woods, should be mentioned: *Soutos* of chestnuts from the north-west of the peninsula, former cattle pastureland of gall oaks, elms and ashes, woodland of ashes used as pastureland in both Castillas, black popular landscapes in Teruel... In general, those landscapes are related to extensive livestock farming and their conservation, as has been the case in recent centuries, is under threat due to the gradual loss of pruning practices.

CHAPTER 5.
THE EXPERIENCE OF THE POLLARDING AND BIODIVERSITY LIFE+ PROJECT.

The Pollarding and Biodiversity LIFE+ project began in January 2010 under the aegis of the Environment and Woodland Directorate of the Department for Development of the Rural Environment of Gipuzkoa Provincial Council (DFG).

The full title of the project is *Managing and Conserving the habitats of Osmoderma eremita, Rosalia alpina and other saproxylic beetles and weevils of community interest in Gipuzkoa*, and its planned duration is three years. It has a budget over 3 million euros, half of which are provided by the European Commission.

The LIFE projects are designed to implement specific conservation actions in the natural environment, leaving long-term studies, research and monitoring to the background, as it is based on the premise that the knowledge is already known and it is time to implement all the acquired know-how from so many years of study.

When the DFG embarked on the adventure of this LIFE project, it already had the prior and positive experience of the Aiako Harria LIFE project, focused on management for the conservation of the natural values of this Site of Community Interest (SCI), with special emphasis on the beech tree and river bank ecosystems.

The results of the forestry policies implemented in Aiako Harria, along with those obtained from other natural parks in Gipuzkoa, which pointed towards a narrow relationship between the presence of beetles and weevils of community interest (according to the Habitat Directive) and the old pollarded woodland, was the final impetus to implement a nature conservation project that guarantees the long-term duration of the pollarded trees. This type of intensely pruned trees have currently become one of the few shelters that many organisms find in greatly managed and anthropized forests, where the pollarded trees are the best representation of the old woodland.

The most important threats to the biodiversity that are quoted over and over again include the loss of appropriate habits for the species and their fragmentation, which prevents the expansion of the populations and the genetic exchange between individuals.

This is precisely the ultimate purpose of the Pollarding and Biodiversity LIFE+ project: long-term conservation of the saproxylic beetles and weevils of community interest to be found in Gipuzkoa. In other words, keeping decaying or dead old trees and in different stages of decomposition, which in Gipuzkoa meant conserving the pollarded woodland.

There are many European specialists who are struck by the number of old pollarded trees to be found over the Gipuzkoa mountains forming real forests. It is not only the odd trees being kept on an isolated basis and which need specific management. They are small coppices covering up to 300 hectares, with a density of over 100 trees per hectare, which means that the managing of their conservation has to contemplate guidelines for managing the forest.

A. OBJECTIVES

The general objective of the project is the long-term conservation of the saproxylic beetles and weevils of community interest present in Gipuzkoa by means of maintaining the pollarded woodland.

In order to achieve this objective, other more specific ones have been established that involve:

- Increasing knowledge about the populations of *Osmoderma eremita*, *Rosalia alpina*, *Lucanus cervus* and *Cerambyx cerdo* to be found in the five SCI being studied (Aiako Harria, Aizkorri-Aratz, Aralar, Hernio-Gazume and Pagoeta)
- Guaranteeing the long-term availability of the pollarded woodland, as a habitat for the saproxylic community in the forests of Gipuzkoa.
- Characterising the coppices of pollarded trees, by relating forestry parameters and ecological parameters.
- Developing an appropriate methodology for the long-term conservation of the pollarded trees and their associated biodiversity
- Creating reserve zones of pollarded woodlands
- Documenting and recovering traditional pollarding techniques
- Contributing to European global awareness regarding the importance of the pollarded trees for biodiversity and as structural typical elements of mature forests.

Without forgetting the environmental awareness-raising of private individuals, local population and society in general about the importance of old woodland to maintain forest biodiversity.

B. STUDY AREA

Five SCI of Gipuzkoa that are forestry in nature, which are Aiako Harria (6,779 ha), Aizkorri-Aratz (14,947 ha), Aralar (10,962 ha), Hernio-Gazume (2,158 ha) and Pagoeta (1,336 ha), in order to implement the Pollarding and Biodiversity LIFE+ project. All of them, except for Hernio-Gazume, are also Natural Parks that are home to numerous habitats and species of high European and regional interest.

Figure 1. *Location of the SCI study areas*

C. METHODOLOGY

As has already been mentioned, the LIFE projects fundamentally seek to implement specific conservation actions in the territory. In order to guarantee the long-term permanency of the pollarded woodland, the plan was to apply two approaches: 1) re-pollarding trees that had already been pruned for them to last in time and 2) creating new pollarded trees using the young stands that will replace the current ones in the near future.

The task was not at all easy. The work sphere of the Pollarding and Biodiversity LIFE+ covers over 36,000 ha surface area, out of which, over 22% were occupied by natural forests.

First of all, the zones of action were selected according to the public ownership of the woodland and of their accessibility. It was then necessary to visit many plots, talk to the technical and institutional agents tasked with their management, discuss and return to visit the zones, until an agreement was reached regarding the work plots and the measures to be implemented in them. In short, to establish the Plan of Action.

During the project, it was noted that a great deal of the guidelines set in this Plan of Action are correct, while others have had to be corrected.

1. Re-pollarding pruned old stands

When it came to re-pollarding pruned neglected stands and where it was clear that the felling cycle had been abandoned over half a century ago, the risk of the tree being knocked down by wind or in

a blizzard, so that the first pruning criteria must be to eliminate those braches that may weaken and endanger the tree, branches that are usually large in size and it is therefore complex to coppice them. A second criterion that has proven to be important is to leave young branches under the intersection point, as they are going to help the tree to recover from the stress suffered.

Once the tree has been pruned, it is fundamental to provide the appropriate light so as not to limit its recovery. A clearing therefore has to be made around the tree to eliminate the stands that could create shade and compete for the nutrients.

However, the tree should therefore be left in isolation, unprotected from the wind or extreme temperatures.

It was therefore decided that it was appropriate to working on opening up small pollarded coppices, so that the light could reach the pruned stands and the trees could protect each other.

When it came to opening up clearings in the coppices, the decision was taken to eliminate some trees from their stumps, pollarding and ringing other stands, so that a group was created that would find it easier to resist any adverse weather. Furthermore in the case of the ringed individuals or others that may perish, standing dead wood (*snag*) would be generated, which is fundamental in the food networks of the forestry systems.

An example of this type of measure in the framework of the LIFE+ are the plots of the Artaso mountain (Aizkorri-Aratz SCI), where a notable number of pollarded trees could be pruned, distributed in 5 plots with each one being 1 ha.

Notwithstanding all these premises, in certain cases, the experience provided by English experts was taken into account. They recommended the progressive pruning of the crowns, lowering the height by between 5 and 10% and monitoring the reaction of the tree before proceeding to a second partial pruning. Presumably, this process is less aggressive and allows the pruning to be abandoned is a sup-optimum reaction of the tree is detected. In the framework of the Pollarding and Biodiversity LIFE+ project, it is unfeasible to apply this methodology, mainly due to the limited duration of the project (three years) and due to the high economic cost that this type of pruning involving. Therefore, in the case of some very large stands from the Txotxeta zones (Aralar SCI) and Guardetxe (Pagoeta SCI) has applied an intermediate methodology by lowering the crowns to 50% of their height, in order for those stands to last in time by making them more resistant to wind and snow.

2. Creating new pollarded trees

The type of plots selected to create new pollarded trees has enabled the different ways of forestry work to be addressed, above all, according to the size and the species.

In general, work has been carried out in zones with contemporary individuals from young plantations or stump growth, some with stands of no more than 20 cm normal diameter or DBH (diameter at breast height) and others with a DBH of around 30 cm.

In all cases, the pollarded trees were created by cutting the central guiding branch at a height of between 2 and 3 metres, according to the technical possibilities.

As the same way as is the case of the old standing trees, the largest number of young branches were also left under the intersection point in these cases to help the tree to recover.

for their progressive elimination. In a second stage, the pruned beech stands with the poorest future prospects must be weeded, which thus encourages light to come in and the availability of nutrients for future *pagomotzak (*pollarded beeches).

In other plots, such as Guardetxe (SCI Pagoeta), the creation of new pollards has been carried out on the basis of small coppices, where a young beech, with a DBH of at least 20 cm and with good branches, was selected as a central point and all the beech trees were pollarded in

Another circumstance that was different was the pollard species. Thus, in the majority of the plots, the dominant species is the beech (*Fagus sylvatica*) and where the work has been carried out to achieve future pollards, even though in other cases, plots dominated by sessile oaks (*Quercus petraea*) were selected and in others, plots with plantations of northern red oaks (*Quercus rubra).*

In Karalugarriko Hegia and Urmendi (LIC Aiako Harria), all the beeches present in the work plots were pruned and the stands of exotic species were ringed

radiuses of 10 metres or 5 metres. All the trees of non-native species were removed from the stump in those coppices and all the native species other than beeches have been respected.

Yet undeniably, the most striking experience in the creation of new pollarded beeches has been the one on Mount Iturrigorri (Aizkorri-Aratz SCI), a homogenous wooded area of 500 ha, with contemporary boles of an average thickness of around 30 cm DBH. In this zone, five small coppices, each measuring 0.25 ha, were opened up. The approach was initially to choose the most appropriate standing trees to prune and eliminate the surrounding competition, but it was subsequently decided to pollard all the beech trees, to carry out, subsequently, the selection of the future standing trees and remove the poorest performers from the clearings. Nobody has been left unmoved by the result of the coppicing. However, and even though it is still early, some of the pruned stands began to contradict the most pessimistic forecasts and produced shoots where it had previously seemed impossible.

On the Matia plots (SCI Aizkorri-Aratz) acquired in the Pollarding and Biodiveristy LIFE+, the sessile oak prevailed over the beech. In this zone, the future pollarded oaks have been selected and the competition of the nearby beeches has been eliminated by felling the youngest trees and ringing the thickest ones with the lowest possibilities of falling down. Some oaks within a radius of between 10 and 20 metres around the future pollards were also pruned and other native species other than beech were respected, with the exception of some birch groves that have been ringed when they were abundant.

Other oaks that have also been pruned in their central shaft were the *Quercus rubra* planted 40 years ago in the Basaunen Janlekua and Urmendi zones (SCI Aiako Harria). Those oaks were pruned at over 3 metres high, some of them thanks to the help of a boom truck, in the same way that the crown has been thinned and space was opened up to germinate beech saplings from the beeches located over the plantation.

3. Managing the generated dead wood

Forestry interventions such as those carried out in the Pollarding and Biodiversity LIFE+ generate a great quantity of sawn wood.

The general premise has been to keep this wood in the forest to increase the percentage of fallen dead wood (*log*) per hectare.

However, based on the recommendations of the entomologists that collaborate in the LIFE+ relating to the suitability of certain diameters and provisions of recent dead wood (recently coppiced) for *Rosalia alpina,* wood has been stacked up in all the work plots of the project.

They have been made in two different ways. The most wide-spread one was to leave the thinnest branches at the base and pile on the thickest branches, out of contact with the ground, that seem to be selected positively by the females of this longicorn beetle to lay eggs. These stacks have been left in small sunny clearings, which will allow an optimum prolonged drying out for the larvae development of this species.

In other plots such as those of Artaso (SCI Aizkorri-Aratz), apart from those stacks, support has been placed against the trunk of the trees, some recently cut branches, of around 20 cm in diameter, imitating the dried trees of live trees, which may also be selected by *Rosalia alpine.*

The other finer branches were pulled off and spread out or piled up on the work plots for their progressive decomposition in situ.

Only in a few cases, such as that of Iturrigorri (SCI Aizkorri-Aratz) part of the wood generated in the pruning work was cut up and stacked up at the bottom of track for Oñati local council (the owner of the woodland) to remove 13 batches of firewood to distribute among the local residents.

4. Forestry teams and forest machinery

Different professional teams were organised in order to carry out all the forestry works contemplated in the LIFE+. In to-

tal, the services of six forestry teams and two teams of specialists in climbing and pruning at heights were contracted. In all the cases, all the requirements regarding occupational health and safety were met.

Forestry machinery was used wherever possible. Thus, in the plots with adequate access routes, a boom truck would be used that allowed the pruning to be carried out very effectively, as the number of standing trees pruned per day was higher to the average when manually pruning. The boom truck has also allowed pruning to be carried out at a height of over 2 metres.

The forestry tractor was also used on other plots to facilitate the works to move and cut up the large trunks, even though the difficulties to access and move within the work zone were limiting when it came to being able to use this type of machine.

D. RESULTS

The first forestry measures of the Pollarding and Biodiversity LIFE+, both for re-pollarding old trees and to create new pollards, were carried out in December 2010. Some more years will have to pass before the response can be finally assess of the trees to the pruning carried out and test possible differences according to the methodology used and the species involved.

Nonetheless, some initial results can be assessed.

1. Re-pollarding pruned old stands

It is gradually being seen that, in the case of the beech trees, the youngest branches that had remained under the intersection point are re-shooting normally even in those old stands and with trunks that are

often hollow and semi-rotten, when in the cutting zone of the branch, the shoots are rarer even though not infrequent. It is supposed that the vigorous growth of the tree, the richness of the soil, the lighting and/or their orientation are determining factors in the response of each tree intervened.

In both cases, the response of the beeches to pruning may be later and the new shoots would then begin to be observed from the second year from the cutting. It is also possible that some of the pruned stands end up dying.

The answers will emerge over time.

In the case of the oaks, stands both of *Quercus petraea* and *Quercus rubra* have been pruned. In both cases, the appearance of new shoots in the trunk, in the cutting zone or at the base of the tree is very frequent, which further reinforces the idea of the better performance of the oaks in terms of intensive pruning.

Even though it is true that is possible that some of the newly pollarded trees end up dying at the end of over 50 years, it is also true that many will survive the work done and the result will be that many large pollarded trees remaining standing and, otherwise, they would have ended up felled. Furthermore, the recently pruned more vigorous individual trees will be forced to grow new branches, it is therefore very possible that they will be stronger and their life expectancy will thus be extended. Read, H. (2007) thus points out that an interesting effect of the pollarding is that, by means of regular pruning, the pollarded trees may live to be much longer than the non-pollard ones. The pruning also generates new hollows and other irregularities in the tress, thus creating different optimum ecological niches as shelter and food for numerous species.

2. Creating new pollarded trees

As regards the younger trees that have been cut at their central shaft, the response is generally very good, above all in those individuals with branches under the intersection point. Such is the response of those leafy young stands, that in many cases, it is hard to work out where the pruning was carried out. In fact, some of the lower branches can be eliminated on some plots and that facilitates the growth of other branches and, in general, of the tree.

In the case of the pruned trees with a diameter (DBH) of over 30 cm and without branches under the intersection point, the regrowth is more difficult, even though some new shoots can be seen on the surface of the cut branches.

The majority of the new pollarded trees have been created in contemporary stands from plantations or stump growth. Therefore, should some individual trees die, the gaps left will open up space in the woodland which, undoubtedly, will help to achieve a great spatial heterogeneity, associated to the presence of a greater number of environments and, therefore, greater biodiversity.

3. Improving the habitats of the saproxylic insects of community interest

The impact of the endeavours to increase habitat availability for the saproxylic beetles and weevils and reduce their fragmentation in Gipuzkoa has also been able to be assessed in the Aiako Harria SCI, while it is still too soon to know the effect of the measures at the Aralar SCI and at the Aizkorri-Aratz SCI.

This is because in the Oieleku beech grove (Aiako Harria SCI), work has been carried out on monitoring the *Rosalia alpine* populations for several years now. The methodology and the sampling zones have been standardised since 2007.

The data time series, even though it is still short, provides an idea of the evolution of the populations of this longicorn beetle in one of the best conserved pollarded beech groves of Gipuzkoa. The standardisation of the sampling allows the impact of the increased recently cut dead wood (in the first phases of decomposing) on the population dynamics of the species.

Thus, an overview of the 2010 and 2011 samplings (years when the Pollarding and Biodiversity LIFE+ was being run) shows the effect of the increase in recently dead wood in terms of an increase in the numbers of this insect. Furthermore,

the 2011 results place *Rosalia alpine* in the scenario of the repollarding of neglected trees that had been pollarded years earlier, specifically in the Karalugarriko Hegia zone, where the first pruning took place in autumn 2010.

Future follow-up campaigns in this beech grove (even beyond the LIFE project itself) may allow individual of future generations of *Rosalia alpine* to be seen emerging from the dead wood generated by pollarding.

As regards the endeavours to improve the habitat availability for the saproxylic insects and decrease their fragmentation both in Aralar and in Aizkorri-Aratz, it is still years away from when the impact can be assessed of the work carried out throughout the Pollarding and Biodiversity LIFE+ project. But data have been obtained that highlight the importance of standing dead trees located in large clearings and sheltered from the humid north-westerly wind, for the effective *Rosalia alpine* larva development.

As regards the *Osmoderma eremite*, it should be mentioned that the species is very scarce in Gipuzkoa and only the presence of one group of larvae is known in the Ezkalusoro zone (Aralar). During the intense sampling in 2011 as part of the LIFE+ project, only one adult female was found that is the first living imago of the species located in the Basque Country. However, the absence of a new generation of larva in the zone is very concerning and the fear is of a drop in the numbers of the already small population of *Osmoderma eremite* in Ezkalusoro.

The results of this project regarding saproxylic insects consolidates the hypothesis that the pollarded trees, in the absence of other representatives of old trees in the forest, provide the optimum ecological conditions to develop saproxylic populations.

The Pollarding and Biodiversity LIFE+ highlighted these species of insects and extols the importance of conserving all the elements that intervene in the ecological processes, that they support the goods and services of the ecosystems for society.

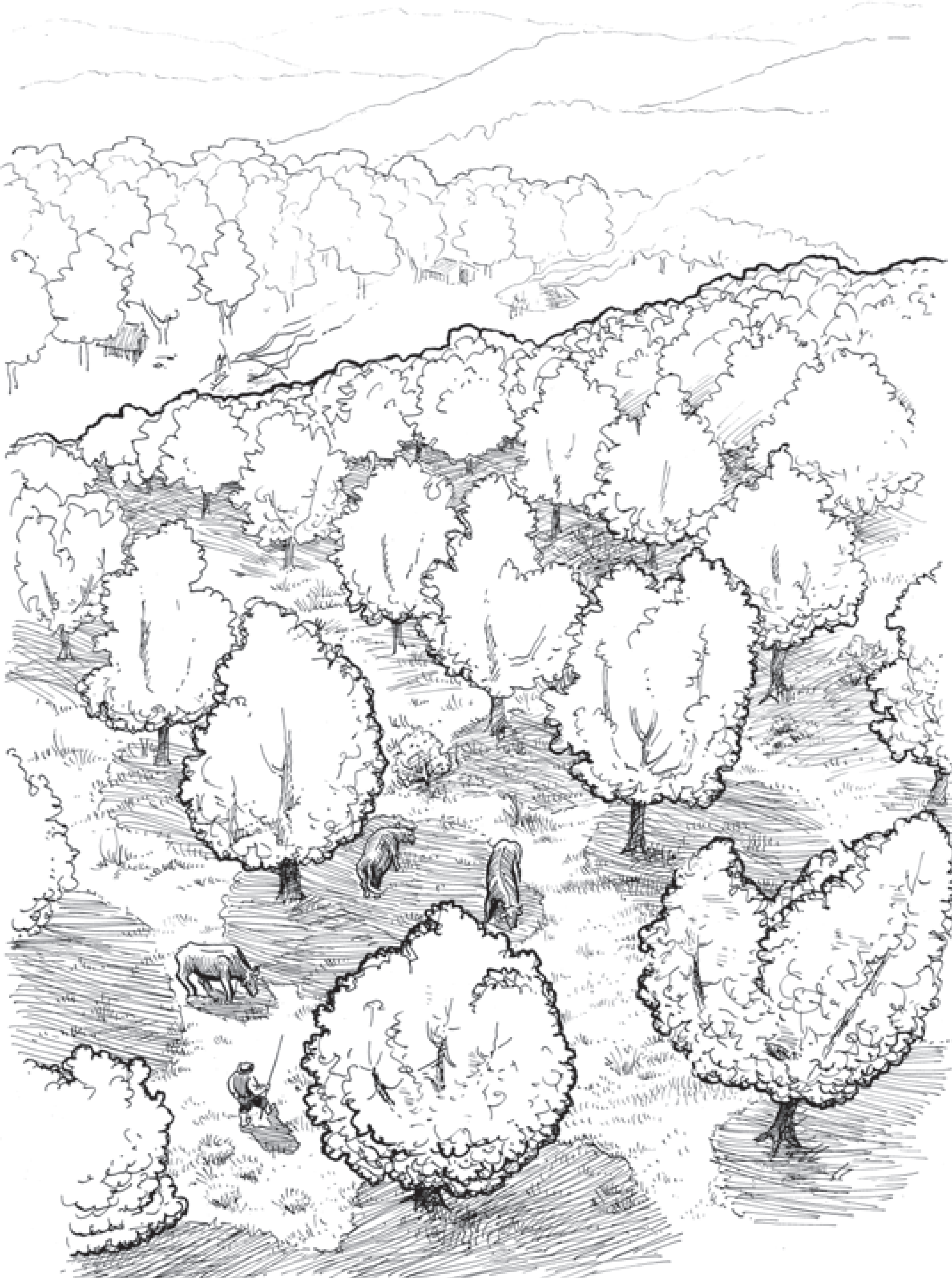
E. A FUTURE COMMITMENT

Even though it is difficult to understand the need for maintained neglected pruned trees and the creation of new pollarded trees, one only has to look at any coppice of pollarded trees that characterise the wooded landscape of Gipuzkoa to understand that they have previously been subjected to intense pruning. If information is also sought on the situation a few years ago, either by consulting old aerial photos or by talking to the elderly people living in the place, further proof could be surely found of the existence of more pollard stands that, in one way or another, have been disappearing from the forests.

It is therefore clear that intervention is required now so that future generations will be able to enjoy that forest legacy.

Even those people who opt for passive conservation (do not touch, leave them to evolve) will also find it easy to understand the role that pollarded trees play in today's forest. Not only are the trees older, but also their premature "ageing" allows them to meet their inherent functions, above all as the habitat of the saproxylic community and as a place of shelter and food of other species dependent on the presence of old trees.

While the non-intervened zones, the integral reserves, evolve naturally until it reaches a state of optimum maturity, the pollarded trees will help to keep a great part of the diversity of species typical of the better conserved forests.



CHAPTER 6.
BEST PRACTICES GUIDE FOR POLLARDING. A PROPOSAL FOR THE PRESENT

Implementing different forms of pollarding in public woodlands of Gipuzkoa in the framework of the LIFE+ Project has enabled the efficiency and cost of different pruning to be verified.

Thus, for example, it has been seen that the work to create pollarded beeches has cost less in general than the maintenance work of old pollards. Within the first, the cheapest and easiest work (just a few euros per standing tree) has been to create young pollarded trees, in the thicket stage and just a few centimetres in normal diameters. On the other hand, there is the work to create new pollards in adult beeches, where the need to deal with cutting thick branches at various metres of heights slow down and make the work more expensive, involving either the operator climbing up a ladder or a Skidder or using a forestry truck with a lifting basket (around 45 euros per standing tree).

As regards the aforementioned work to maintain the old pollarded trees that was undertaken in these recent years, the economic and technical effort depends on the layout of the branches, the location and the vitality of each pollard beach. The final unit costs were similar whether the operator climbed the tree or if a boom truck was used (between 60 and 140 euros per standing tree).

In any event, it should be stressed that all that pruning work, and even more so in the case of bulky branches and if the operator works hanging from ropes or up a tree or a platform, are very dangerous. The very environment in which pollarded beeches are usually located, damp, irregular relief and away from inhabited areas, adds further to that hazard. There is always a risk of a health and safety accident, both in the pruning operation using an axe or motor-saw and in the piling up and dragging work with a forest machine. Therefore, the operators must always have the appropriate safety equipment (PPE) and never work alone, out of contact or away from the forestry escape routes. Traditionally, the pollarding and climbing work was the cause of numerous serious accidents and they must be undertaken by experts.

The following general proposals have therefore been prepared, by adapting the bibliography available to the lessons learnt by means of the field experience with beeches in the aforementioned LIFE+ Project in Gipuzkoa.

- Decalogue / Criteria to select trees for (re)pollarding:

  - The beech is one of the deciduous trees in the Basque forest with the worst regrowth capacity after pruning. This low regrowth capacity in general increases with the age of the tree and the diameter of the pruned branch. However, in a beech grove, beech trees necessarily have to be selected for this operation and there is that risk.

  - It is preferable to pollard the trees with many branches or shafts sprouting from the "head" or thickening of the tree. In general, the smaller the diameter of those branches is (in the case of the beech, it is preferable not to cut branches with diameter over 20-25 cm), the greater the probability of gashes closing and regrowth. The time from the last pruning must be the least possible and/or have other small or younger branches (called "tirasavias", which are very useful for the trees in the years after the pruning).

  - The trees with great vitality are preferable: this can be appreciated by analysing the density of the crown, fruit production, among of epicormic growth or the growth response of the callus.

  - The preference is for trees without structural stability (with an uneven crown) or which can show possible natural tears.

  - The preference is for trees with actively growing epicormic shoots, particularly in the lower part of the crown and around the top of the tree.

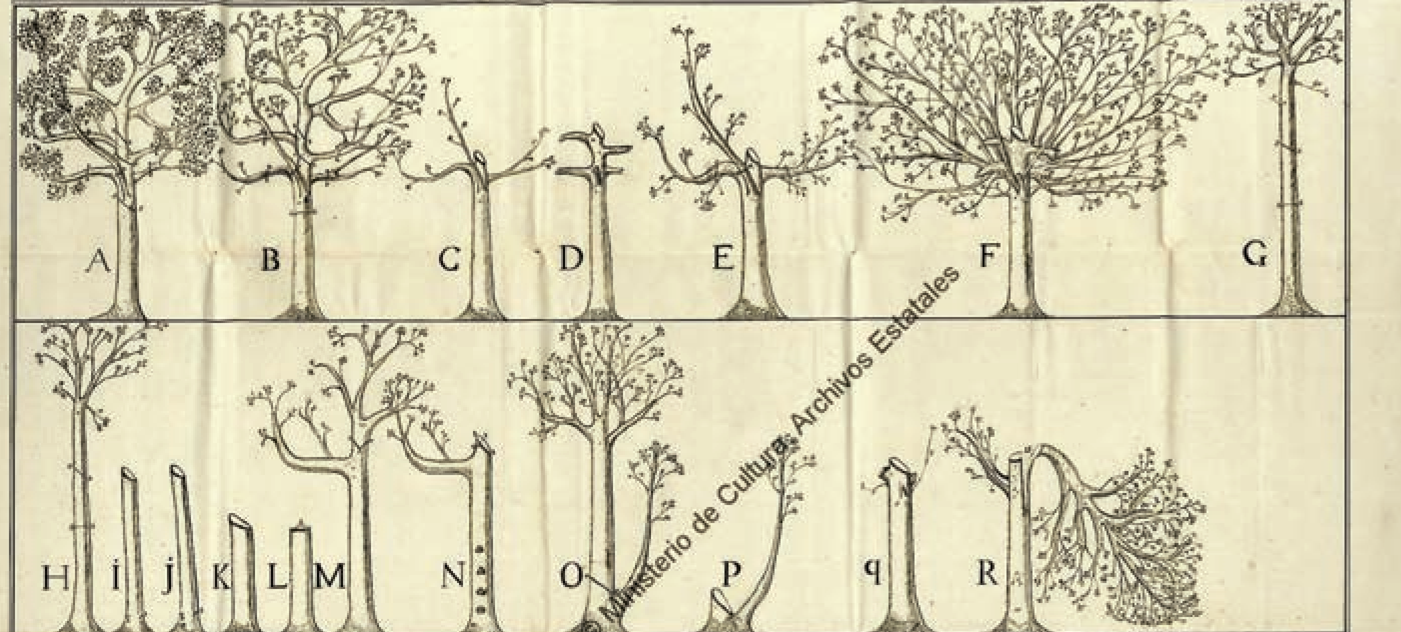
  - The preference is for trees of a more or less open location. The growth of callus after the pruning is usually greater in the trees with greater exposure to the light before the work is carried out.

  - The preference is for trees that support importance plant or animal populations (for example fungi, saproxylic insects, epiphytic moss), which require the tree to remain standing, particularly its trunk, head and low branches with the largest diameter.

  - Avoid compacting or changes to the roots, caused by trampling, continuous toing-and-froing or from traffic circulating. the greater the compacting around the tree, the poorer the response of the tree after the pruning.

  - Avoid necessarily choosing the largest or the oldest tree of the oak grove, except when there are other reasons for doing so, such as a special tree that requires to be conserved. In the case of exceptional or very old trees, it is usually more advisable to eliminate the competition from the adjacent trees prior to pruning the tree itself.

- Apparently, the cuts by axe are more certain than those caused by power saw in terms of encouraging the subsequent regrowth. Those cuts should be straight and help the rain water to run off, not be accumulated. Small amounts of ponding water can facilitate subsequent rotting and hinder regrowth.



Demostración del modo con que se podan los Árboles de Robre en el distrito de la Dirección de las Rs. Fábricas de Artillería de la Cavada y Liérganes [illegible]

Orden de podas [illegible]

A. El Árbol de Robre [illegible]

[illegible]

Abusos en las podas [illegible]

K. El Árbol A. [illegible]

[illegible]

La Cavada 28 de Mayo de 1775

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CHAPTER 7.
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The esteem that we feel for beech trees has, on occasions, caused us to consider them as the paradigm, the epitome of the forest, even more so in the case of a pollarded beech grove, a quintessential magical place, a sanctuary of pristine nature. Yet if you ever see a beech tree blown down by the wind, the impression will be weakness, helplessness. It is a fallen giant, supported by mud sandals, by surface roots that the wind can overcome after the rain.

The Woodlands of the Future: a Glimpse from their Past.
José Ramón Guzmán Álvarez

"Pollards, the ancient keepers of so many tales; source of life for a wide diversity of tiny brave-hearted beings"

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