

The Cantabrian-Atlantic oak and beech forests: Human influence throughout history

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Abstract

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A brief description of the history of human influence on the Cantabrian forests is outlined in this paper. Three main periods are distinguished: The first includes the ancient Neolithic time and the Roman period till the Middle Ages, in which a traditional exploitation model developed under an agricultural and livestock breeding economy of low technology and high sustainability. The second period is the modern age, from the discovery and colonisation of the New World till the industrial revolution, with the demographic increase, the introduction of new plants and the growth of the demand of food for people but also with some industrial activities such as shipbuilding and ironworks. A description of the various forests products for the human society of that time as well as the main social groups with contradicting interests involved in the forest exploitation is given. Finally the last period is the 20th Century with the huge demographic increase and the technological advances creating a very artificial landscape. A general view of the present situation of the natural forests in the area is also presented, with the artificial timber cultivations of Monterey pine and eucalypts and the release of the ancient exploitation systems on the natural forests. This model has led to a dramatic reduction in the extent of natural forests together with an obvious naturalisation due to the abandonment of traditional extraction of wood for fuel or charcoal, timber for ship or house building and other uses. The ecological problems of this modern intensive exploitation system are presented and some perspectives for the future are also outlined.

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Introduction

General features and evolution of climate and vegetation through the Quaternary Period

The Cantabrian Fringe is an area under extreme Atlantic conditions at the present time, i.e. very oceanic climate with mild winters and not very warm summers (annual temperature range is about 8-13°C) and high rainfall in all seasons with a low in summer which does not provoke a severe drought stress. The influence of the continuous series of Atlantic lows and the approach of the warm Gulf Stream waters to the shoreline, governs the general stress-free climatic conditions of the region, particularly of the coastal areas. This results in a vegetation dominated by oak and beech forests and some typical seral stages such as heathlands and hay meadows.

Nevertheless, in glacial times the situation was different: the climate was colder and forests were dominated mostly by pines. Broad-leaved trees were restricted to the coastal strip refuges where conditions were locally milder (sea level was ca. 120 m lower than today). Man was in a primitive stage and his influence on the ecosystem was very low. Human population concentrated in coastal areas under milder climatic conditions. With the rapid change of the climate after the last glaciation, conifer forests retreated and broad-leaved forests occupied most of the area in a span of about 4000-5000 years.

Historical review

The first period: The Neolithic to the early 15th Century

The first severe impact of man on the forests in this area was caused by the early development of agriculture and ranching during the Neolithic Revolution about 6000 years BP or even earlier (ZAPATA 2002). At that time, new arable land was needed for crop fields and more areas had to be used for livestock breeding. This led to a first reduction of the forested area. This retreat of the natural ecosystems was slight at the beginning and more intense later, but in any case it first affected the coastal areas, where other food resources were available (seafood, fishing) and somewhat later also the midlands or mountain areas of intermediate altitude where soils were shallower and easier to plough. The prehistoric Neolithic and iron age cultures reached a certain degree of development but, nevertheless, large areas of natural forest were preserved and kept out of the human destruction. Huge oak and beech forests were lightly used mostly to extract fuel wood and for fruit gathering. Another growing demand of wood started to be the production of charcoal, as primitive forges began to develop with the entrance of the Celtic people from central Europe. This period lasted several millennia and the transformation of the land was slow but finally led to a partial occupation of the territory in a balance of sustainability between the products extracted from the environment and the regeneration capacity of the ecosystems. Some characteristic vegetation types linked to anthropogenic conditions such as the heathlands, very typical for the Atlantic area of Europe, probably expanded in this period. They are related to a particular type of management, fire, grazing, etc., which developed in the early agrarian system established in the Neolithic and Iron Age.

The Roman period meant an enormous jump for most of the southern European countries concerning the cultural, economic and demographic aspects, and this caused a severe decrease of the forested areas in most of them. In the Cantabrian Fringe this effect was lower as Romans had less interest in settling mountainous areas than the lowlands. Only some small coastal cities for navigation and trade and some mining areas really show a relevant activity in this long period. Some important tree cultures such as chestnuts seem to start at this time as well as some fruit trees such as peach, apricot and walnut trees. In fertile valleys of the central and southern peninsula a developed agriculture, based on olive and vineyards together with cereals (mostly wheat), was established according to the Roman trilogy: wheat, wine and oil. The rest of the territory was left to the natives who continued living in a primitive way, devoted more to ranching than to farming. Thus the retreat of the forest was small there.

The Middle Ages can be divided into two halves: the upper and the lower Middle Age. In the former this region basically continued in primitive conditions, with only the central area of Asturias knowing a certain degree of development from the 8th Century onwards due to the appearance of a little kingdom which later originated the kingdoms of León and Castile. The last part of the Middle Ages knew, as in most of Europe, a growth of the population and an intense social and political development. This resulted in an increase of the intensity of land use and a larger demand for forest products. In this period new land was demanded for farming and the forested area retreated as demographic pressure increased together with a more intense exploitation of the remaining forests. The forest is progressively exploited in a more intensive way, particularly with the increase of demand for wood for domestic fuel, charcoal, house building and shipbuilding. The naval industry developed in this period as commercial routes with northern European countries (England, The Netherlands) started to be important for the trade of wool, iron and other goods.

At the end of this period, forests were exploited more or less intensively all over western Europe in a coppice regime as this was the best system to obtain a maximal amount of wood for the different uses. Wood became scarce and demand grew steadily and the interests of the different social groups crushed in the competition for a sufficient supply.

The second period: The 16th Century to the Industrial Revolution

Human population reached a state of demographic saturation at the end of the 14th Century in relation with the capacity of the territory to produce food. This provoked constant social riots that became chronic till the end of 15th Century. At that moment came the discovery of America and the population excess emigrated to the New World. At that time, the exploitation model for the forests was a combination of coppicing and tree pollarding depending on the particular demand of the sites.

The period between the beginning of 16th and the end of the 18th Centuries is known as the Modern Age and in it an "American Revolution" took place in Europe (mostly in the 16th and 17th Centuries), particularly in those countries where their relationships with the new territories were intense. Northern Spain had really intense relations with America in many aspects: migratory flow, trade, shipbuilding for commercial and military purposes (Spanish galleons were built in the dockyards of this coast), introduction of new crops which adapted to the local climate such as beans, corn, potatoes, tomatoes, pepper, and so on. At this time a new model of land exploitation was established, which served a more developed society in which relations with America and with some countries of Europe played an important role in the local economy.

The forests provided timber for tools, weapons, furniture, houses and ships, fuel for kitchens, heating, ironworks, lime kilns and for brick and pottery manufacture, but also provided fodder for the animals (leaves, young branches, twigs and herbs and grasses in the understorey) and organic matter for fertilising the fields. Almost all the components of the trees were used: the trunk and the branches for wood or timber, the leaves for fodder or as fertilizer, the fruit as food for animals (or sometimes also for people), the bark as dye or tanning material or to elaborate clothes and shoes, etc. The forests were very important resources at that time as they supplied essential elements for human life.

More specifically, the constant increase of the demand for the following forest products during these three centuries has been recorded:

- Wood for domestic fuel: cooking and heating,
- Sticks and other wooden pieces used in rural life as ordinary instruments,
- Wood for lime kilns. Lime was used in construction and as a fertiliser in crop fields,
- Wood for furnaces of brick, tiles and other ceramic products,
- Wood for charcoal for iron furnaces (ironworks) and forges,
- Timber in pieces of different sizes, including large beams, for house building,
- Timber of different sizes, including big poles and keels, for shipbuilding,
- Litter for fertilisation. The increase of human population demanded more food and this required improving crop fertilisation,
- Fresh leaves as fodder for livestock, particularly in periods of drought,
- Edible fruits and seeds, mostly acorns, for livestock (pigs) and eventually for humans,
- Dyes, medicine and tanning plants,
- Edible mushrooms.

Dense human population demanded a particular model of forest exploitation in which a high quantity of wood for fuel had to be extracted. That meant that small pieces of wood were needed more than big ones. This led to a model of coppice forest called *monte bajo* or *jaral* (Fig. 1), widespread throughout Europe, where the trees were cut a little above ground level and the branches left to grow from the stump. The cutting of the branches was done every 12-15 years and the wood was, to a large extent, for charcoal making. This was convenient to supply wood for domestic uses and also the growing demand of the iron industry (ironworks or *ferrerías*). On the other hand, big timber pieces were necessary for house and shipbuilding, and they were possible to obtain only in forests managed in a way in which the trees could grow high and reach the appropriate size (*monte alto* or *monte bravo*). This needed at least 60-100 years growth until the trees were suitable for cutting and providing large timber pieces. The competition between the two forest exploitation models increased during this period as the demand for both forest product types grew. The regional administrations (*Diputaciones*) tried to encourage tree plantations in public dominions using autochthonous tree species, mostly *Fagus sylvatica* and *Quercus robur*, but also *Castanea sativa*. In this period the scarcity of wood became more and more severe as forests occupied smaller and smaller areas in spite of the efforts of the *Diputaciones*, and were more intensely exploited. Most of the woods near human living places were progressively destroyed and only in the most remote and least accessible mountainous areas did considerable forest masses remain; even they also suffered the invasion of livestock. So many depredations severely impoverished the forest patrimony of the public dominions and substantially transformed the aspect and dynamics of the natural forests.

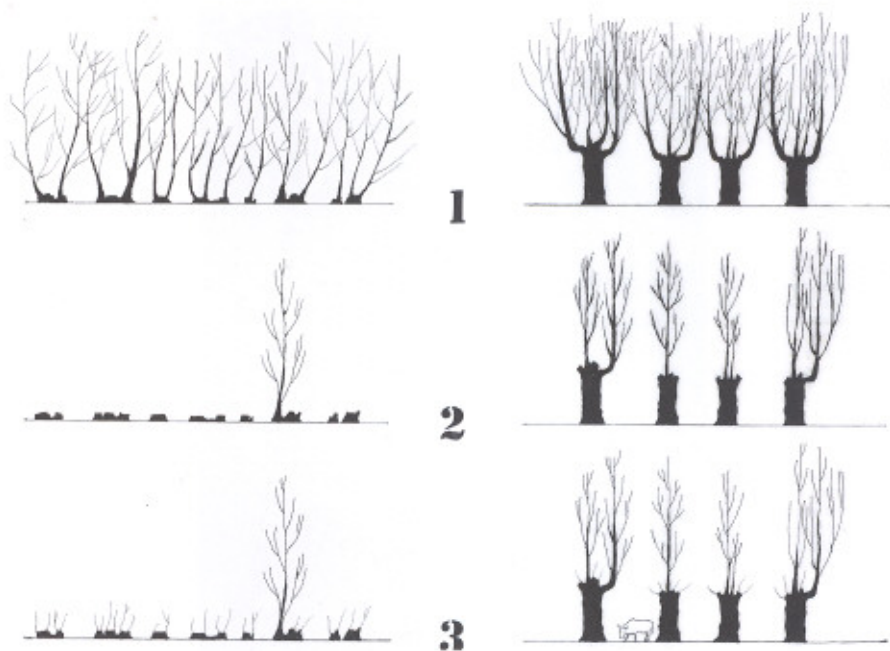


Fig. 1. Scheme of the two main ways of managing wood-producing forests. The coppice system (left) and the pollard trees system (right). 1: one year before cutting, 2: just after cutting, 3: one year after cutting.



Fig. 2. Pollarding beeches in the Basque Country.

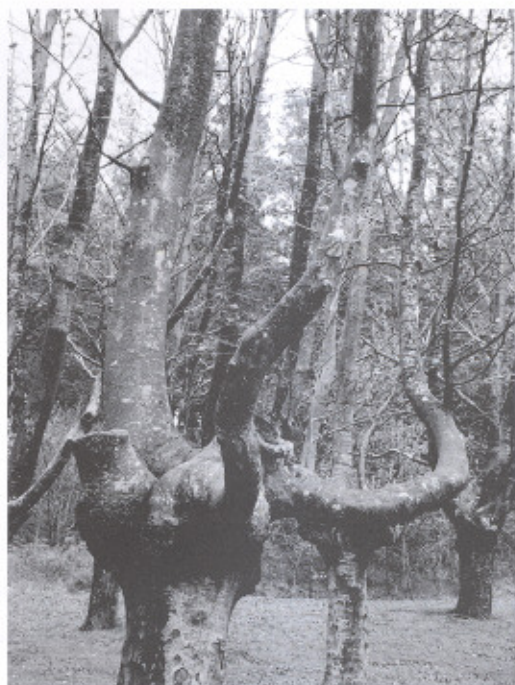


Fig. 3. Pollarded beech trees with a curved branch.



Fig. 4. Pollarded forest.

One of the results of this historical development was the appearance of an exploitation model that satisfied most of the requirements of forest products of that period, although the rate of wood production was lower than in the coppices. This is

the wood of pollard trees. In this model, trees are pollarded at a height of about 3 m above ground level, the time span is 8-10 years, and only half of the branches are cut from each tree in one cutting episode (Fig. 2). In this exploitation model, several different demands of that society were satisfied: wood in small pieces for fuel and charcoal together with the possibility that livestock could move through the forest. The last condition was an important demand for many rural people at that time. However, still another very specific demand was fulfilled in that period and that was the supply of large pieces of curved timber that were necessary to build the "corbatones" ships. The banded branches originated in the pollard beeches, *horca y pendón* (Fig. 3). After 40 years they reached sufficient size to obtain such pieces that were essential for the shipbuilding industry (ARAGÓN 2001). So, the model of pollard forest seemed to harmonize the main demands of the society of that time.

Table 1. Advantages and disadvantages of the three main forest exploitation models of the Cantabrian fringe from 16th-18th Centuries.

Forest exploitation model	Coppice forest [monte bajo]	Tall trees forest [monte alto]	Pollard trees forest [árboles trasmochos]
Advantages	<ul style="list-style-type: none"> - High production rate - Production of small wood pieces for domestic fuel or charcoal making 	<ul style="list-style-type: none"> - Large pieces of timber for house or shipbuilding - Livestock can also exploit the forest 	<ul style="list-style-type: none"> - Production of small wood pieces for domestic fuel or charcoal making - Production of curved timber pieces "corbatones" for shipbuilding - Livestock can also exploit the forest
Disadvantages	<ul style="list-style-type: none"> - Cattle has to be kept away - No large pieces of timber 	<ul style="list-style-type: none"> - Low production rate 	<ul style="list-style-type: none"> - Low production rate

The coppices were predominant at the beginning of this period as they were the most extensive system used in the Middle Ages. After the 16th Century, pollards became more and more abundant (Fig. 4) as they adapted better to the demands of the developing society. The tall forests retreated and were almost only defended by navy administrators and house builders. To improve pollard forests and tall tree forests, local administrators stimulated tree plantations (oaks, chestnut trees and beeches) by private owners who provided their own land for nurseries.

The land ownership regime of the forested areas in this period was prevalingly public or belonged to the Catholic Church. Private forested land also existed in the hands of large owners but most of the private ownership was devoted to more intense exploitation such as agriculture or intensive cattle breeding. This public land belonged mostly to towns and villages and their inhabitants had the right to extract the forest products following strict regulations ordered by the town councils. Other areas were

property of the Crown or belonged to the local *Diputaciones*. This regime permitted the survival of the lowest stratum of the society, formed by people without land, who were allowed to exploit royal, church and other public areas. Cattle or sheep breeding, wood and timber extraction, and charcoal making were their main activities.

Nonetheless, different political and economic forces pushed in different directions in order to favour their respective interests:

- Common people. This sector was mostly interested in obtaining small wood pieces for domestic uses. In this sector we can also include the people who made charcoal in winter for the ironworks (charcoal burners or *carboneros*), the shepherds who introduced their animals into the wood, or the lime makers, who also needed important quantities of wood.
- The ironworks that demanded huge quantities of charcoal. Their demand was at a maximum through all three centuries but declined in the 19th due to technical innovations in the iron industry.
- The Crown and the navy who were interested not only in curved pieces but also in large pieces of timber which could only be provided by large trees. Their interests coincided with those of the house building profession that also needed large timber pieces. The Royal Navy, alarmed by the growing scarcity of large trees, established a complete protection program for those *monte bravo* forests in the north to reserve large trees for the shipyards. Houses were built completely of timber until the end of the 14th Century. Later on, wood started to be replaced by stone or brick, and quite soon, most of the houses used timber pieces only for the structure.

All the above inform us about the decrease of this forest type due to the strong pressure of the growing demand of wood for other local activities. The iron demand increased constantly and became very important throughout this period. The owners of the ironworks were also important and influential people in the towns and villages and they formed a powerful lobby that pushed in the direction of managing the forests in order to obtain more small wood. Navy officers tried to stop the tendency of transforming the tall-tree forests into coppices or pollard trees but they usually failed in this struggle.

Political and economic revolution: 19th and 20th Centuries

The relatively stable period of the previous three centuries was abruptly broken by the events that happened in the shift between the 18th and 19th Centuries. The French Revolution brought a period of political instability to most of Europe and a lack of peace. Northern Spain was invaded twice by the French armies during a twenty-year period: The Convention war (1793-1795) and Peninsular War during Napoleon's rule (1808-1814). In those invasions the occupying armies exacted enormous resources from towns, villages and *Diputaciones* for their maintenance. To afford the exactions, many of the villages and towns had to sell part of their land patrimony. This necessitated, at least in the Basque Country, a substantial change in the structure of land ownership as the proportion of public land strongly decreased. War events continued affecting the area during the rest of the 19th Century with two civil wars, the so-called Carlist Wars (1833-1839 and 1873-1876). All these episodes

severely impoverished the country and caused profound changes in the economy, society and land ownership structure.

Together with these military affairs, a long debate took place at that time over many years between those defending common property and those who supported private land ownership. This debate started in the middle of the 18th Century and reached a peak at this time. This was also a confrontation between the defenders of the traditional land uses and those who considered intense exploitation of the land, mostly by transforming the woodland (*monte*) into arable land to be more productive. This dramatic debate was won by the latter with the establishment of the Liberal regime in Spain from 1833 onwards. This meant the dismantling of the "*Ancien Régime*" and included the confiscation of all the rural properties of the Church, together with the suppression of the nobility domains and other measures (laws passed by Álvarez de Mendizabal in 1835, and Madoz in 1855). These operations were called "*desamortizaciones*" and all the land in the so-called "*manos muertas*" (dead hands) was transferred to private owners, including the properties of the Church. This huge extent of land was auctioned and bought by private people, who immediately started intense exploitation.

In summary, a major part of the land owned by towns, villages and the Church was transferred to private hands in ca. 30-40 years. This land was immediately submitted to intensive exploitation, abandoning the traditional non-intensive and sustainable system, which included the forest management models described above. This led to an increase in the production of agricultural goods and more food was available for a growing population but a high price was paid in terms of a decrease of biological diversity, diminution of forested areas, less regulation of hydrological resources, and also less and less available wood and timber.

In the second half of the 19th Century an important technical innovation happened in the iron industry: the blast furnace. This furnace used mineral coal, not charcoal. As a result, old ironworks started to disappear as the new iron industry developed. Charcoal was no longer in such demand by the declining *ferrerías* and the use of coal for domestic fuel also reduced the demand for wood in towns: the *carboneros* and woodcutters became scarcer in this changing society. All these changes in land ownership and the demands of forest products resulted in a dramatic decrease of the forested areas. Land, supporting a continuously increasing population, was being almost entirely devoted to food production and the forests were being reduced to small patches or confined to the most inaccessible areas in the mountains. This process culminated at the end of 19th and beginning of the 20th Century. Most of the mountains and hills of the territory were bald, covered by intensely grazed grasslands and every piece of land whose slope was not too steep, was ploughed for crops. However, the remaining forested areas were still being exploited using the same ancient models.

The third period: The 20th Century

The 20th Century experienced a new tendency in the history of the forests in this region. There was a change in the mentality of the forest administration of both the regional governments and the Spanish forest service. Until that epoch the criterion was to repopulate cut down areas with indigenous tree species, usually trying to plant species that had previously grown in the area. This sort of imitation of nature profited the adaptations of these species to the local conditions and reduced the risk of

unpredictable events of undesired consequences. On the contrary, the new forestry sought the most timber productive species among all the tree species of the world that could adapt to local conditions (ADÁN DE YARZA 1913). As a result, fast growing exotic species started to be used to plant naked areas. Very often these species were conifers and if not, eucalypts, *Robinia* or *Acacia* species. Throughout the last 70-80 years afforestation has been almost exclusively carried out with pines or eucalypts in that region (as in many others in Europe). The importance of the process has been enormous, as it has completely changed the landscape. Human demographic structure has also changed dramatically with severe rural abandonment. This extremely mountainous territory is not suitable for highly productive agriculture able to compete in a global market and has thus been devoted to this modern forestry using exotic pines or eucalypts.

Present situation of the natural forests

The situation of the natural forests, i.e. oak, holm oak, alder, and beech, has strongly changed throughout this story. Today, the remnant forests exhibit a quite natural and diverse state in the area. This can be explained by the present situation combined with historical events. In earlier times, their surface was severely reduced by the process of continuous expansion of agriculture and ranching due to the growing demands of the ever-increasing population, combined with heavy exploitation to obtain the different forest products for the traditional society. This exploitation was very intense but ensured forest survival as these products were indispensable for humans at that time and there was always someone interested in preserving the forest trying to regulate its exploitation in a sustainable way or planting it again if cut down. The new situation is completely different; tree cultures of pine and eucalypt occupy huge areas, reducing the surface occupied by the natural forests to tiny patches. Only few and dispersed patches of oak woods survive in the lowlands, together with some regular sized bushes of holm oak, and some good areas of beech forests in the montane belt. Nevertheless, as the previous traditional exploitation pressure has been released in these remaining patches, their situation has become much more natural than in earlier days. A naturalisation has happened in these remaining patches although their surfaces are continuously diminishing. In the lowlands, the reduction of the area is more dramatic than at montane level. This is because the lower altitude territories offer better perspectives for timber production than the colder highlands. Thus, *Quercus robur* forests have become quite a rarity in the Cantabrian fringe. Other types such as riverine alder forests have also been severely reduced by intensive forestry. Only holm oak (*Quercus ilex*) forests have partially escaped massive destruction. In the montane belt beech masses have survived better and some good examples can still be found today.

Some comments on timber cultures

Modern forestry uses techniques and methods similar to modern agriculture and thus it can be considered as such. The ancient techniques and methods, based on a much more ecological mentality seeking sustainable exploitation, has given way to an intense exploitation system using heavy machinery, chemical products and exotic

fast-growing species. By analysing the consequences of those tree plantations in the Basque Cantabrian area, we can indicate the following items in which negative effects are to be expected:

- **Biodiversity.** Timber cultures show a dramatic reduction in diversity of plant species in the planted areas in comparison with the natural forests (AMEZAGA & ONAINDIA 1997, ONAINDIA & AMEZAGA 2000). This relates to alpha diversity but beta diversity is also affected due to the homogenisation of the different habitat types present in the area. It is particularly severe in the case of alder forests in rivulets and small streams which disappear under the homogeneous massive pine plantation.
- **Soil conditions.** Pine and eucalypt litter is acidic and aggressive. This means that there is the tendency to form iron and aluminium oxide complexes that eluviate to lower horizons in siliceous soils. This podzolisation happens in the Cantabrian area and was formerly pointed out by KUBIENA, not only under pines but particularly under heaths. Nevertheless, those plantations are suspected of having the same effect, although perhaps not enough time has elapsed to provoke a massive and clear podzolisation process.
- **Erosion.** Modern cultivation methods for trees cause severe erosion in comparison with the traditional ones (EDES0 & al. 1997, 1999, MERINO & al. 1995, 1998, 1999, MEAZA & al. 1994). This erosion is enhanced by the steep slopes of many areas and the high precipitation regime.
- **Risk of fires and plagues.** Uniformity of tree cultures implies fragility in terms of sensitivity to plagues or attacks from insects, fungi or other diseases. *Thaumatopea pitocampa* is a good example of this. In addition, fire finds huge quantities of fuel in those plantations of trees which are themselves adapted to fire in their homeland, particularly *Pinus radiata* and *Eucalyptus globulus*. Severe wildfire episodes can occur in spite of the humid climate during periods of southerly winds. These are frequent throughout the year, particularly in autumn.
- **Introduction of alien species.** During the last decades, several alien plants have established in forested areas. This is the case of *Robinia pseudoacacia*, *Cortaderia selloana*, *Lonicera japonica*, *Buddleja davidii*, etc., including *Pinus radiata* and *Eucalyptus globulus* spontaneous stands (CAMPOS & HERRERA 1997).
- **Landscape quality impoverishment.** Diverse reticulate landscape, created through the centuries under a traditional exploitation regime, is replaced by homogeneous pine plantations that cover almost the whole land surface.

Perspectives for the future

In the near future, the socio-economic situation is not going to change. For that reason we will have to tolerate with the timber plantations occupying a majority of the area. Our conservation efforts can be concentrated on the remnant natural forests in order to stop their reduction and improve their naturalness. Some general regulations could also be introduced in the timber cultures in order to improve their biodiversity and make them more sustainable.

The policy concerning forests should be directed towards those targets:

- Strict conservation of the remaining natural forests,
- Conservative management of those remaining natural forests in order to improve their naturalness and biodiversity (dead wood, etc.),
- Policy of land purchase and restoration of natural forests,
- Strict protection and restoration of river bank forests,
- Regulations for timber cultures:
 - Limit timber cultures to less than 600 m of altitude,
 - Limit timber cultures to slopes of less than 30% of inclination,
 - Improve strips of natural woods on the limits of ways and paths in order to build a network of connections of natural tree lines connecting the separate patches of natural forests (ecological paths),
 - Create a model of artificial forest in which some natural trees are also present in a regular way, at least in some areas or spots.

In the country, severe rural abandonment has taken place in most of the territory. The rural population has almost entirely moved to cities and towns and the traditional way of managing the forest (and the land) is almost lost. The population, traditionally disperse, has almost entirely abandoned the countryside and has moved to the urban areas attracted by better salaries and more comfortable standard of living. This is not unique in Europe but here a kind of new timber agriculture has occupied the area almost completely. There is almost no place for nature or biodiversity conservation now that we have released the pressure of the formerly intense traditional forest exploitation.

Human society in the northern Iberian Peninsula (Galicia, Asturias, Cantabria and the Basque Country) is still keeping in the collective memory the myths and traditions in which trees such as oaks and yews have been venerated in the past. But now we are essentially avid for material richness and progress, which leads to a practical elimination of the worshiped trees. What can we expect from a society that so easily sacrifices their sacred trees to the Golden Calf?

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