

Chapter 19. Forests and forest sector in Catalonia

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1. Summary

More than half of the territory of Catalonia is covered by forests characterised by a great diversity of species and structures, which reflects the outstanding heterogeneity of the Catalan landscape. Most of the Catalan forests are privately owned, still young and often too dense. The heterogeneity, instability and low income that characterise the Mediterranean areas, together with the small extension of the forest ownerships (among other factors) lead to a lack of management in most of the forests, despite the improvements in recent years. In the following pages, the problems of Catalan forests are described more in depth, as well as the measures that are currently being applied or might be applied in the future in order to achieve an adequate development and conservation of our forest resources, which should be based on the sustainability and multifunctionality in their management.

2. General characteristics of the forests and the forest sector in Catalonia

Catalonia is clearly a forested region, with more than half of its territory corresponding to forests and other wildland areas (forests, scrublands, grasslands, etc.). The recent Third Spanish Forest National Forest Inventory (IFN3, finished in Catalonia in 2001) estimated 1,931,334 hectares of forests and other wildland areas in Catalonia, which amount to nearly 60% of the total territory, above the Spanish (52%) and European (47%) averages.

According to the Catalan Land Cover Map, which was obtained from aerial photographs in 1993 and has a very detailed scale (minimum mapping units of only 500 m²), 38% of Catalan

territory are forests (1,218,527 ha); 37% presenting a forest canopy cover above 20% (dense forest) and only the remaining 1% with a forest canopy cover between 5% and 20% (open forest). As for other important vegetation types, 16% of Catalonia is occupied by scrublands (527,392 ha) and 4% by meadows and grasslands (129,513 ha). Regarding the forest tree species, about 60% are conifer forests, 20% are sclerophyllous forests (*Quercus ilex* and *Quercus suber*), 13% are deciduous broadleaved forests and the remaining 7% are a mixture of several of these groups.

Catalonia is characterised by a great diversity of forest species and structures, ranging from typical Mediterranean forests to other characteristic of more humid conditions; this is related to the outstanding heterogeneity of the Catalan territory. In the Catalan Forest and Ecological Inventory (IEFC) 100 different species of trees were recorded, though the 13 most common species accounted for more than 90% of the total number of trees. The main tree species in Catalonia are: *Pinus halepensis*, *Pinus sylvestris*, *Quercus ilex*, *Pinus nigra*, *Quercus suber*, *Quercus humilis*, *Pinus uncinata*, *Pinus pinea* and *Fagus sylvatica*, ranked by their abundance in terms of area, as shown in Table 1.

The average volume of Catalan forests is 77 m³/ha, below the European average (110 m³/ha average of the 44 European countries) and above the Spanish average (44 m³/ha). Higher volumes (above 100 m³/ha) are reported in the forests present in the more humid zones of the North of Catalonia (Pyrenees and Pre-Pyrenees), such as *Abies alba*, *Fagus sylvatica*, *Pinus uncinata* or *Pinus sylvestris* forests (Table 1). On the other hand, typically Mediterranean areas and tree species present lower volumes mainly due to long summer draughts and limited water availability. Examples of such species are *Pinus halepensis*, *Quercus ilex*, *Quercus suber* or *Pinus pinea* (Table 1). *Quercus suber* and *Pinus pinea* forests are the least dense of all Catalan forests (Table 1), being their management aimed at the production of cork and

pine nut respectively. According to IEFEC, the Catalan forests accumulate 52 millions of tons should be added.

Comparing the results of IFN3 with the former Spanish National Forest Inventory (IFN2), it becomes apparent that the area occupied by the forests in Catalonia has increased considerably in recent years, 17% in the last 12 years, mostly due to the fact that many farmlands were abandoned and subsequently recolonised with trees, either naturally or through plantation. Likewise, we can speak of an important increase of the area occupied by forests (20%) between the 70s and the 90s, approximately when the First and Second Spanish National Forest Inventories took place in Catalonia (IFN1 and IFN2).

It is clear that the Catalan forests have undergone constant changes, mainly because former farmlands as well as other types of lands have been converted into forests. Forest fires have also had an important impact on the forests distribution and their characteristics. As a result of all this, it can be said that most of the forests in Catalonia are young (less than 50 years on average), except the forests located in the highest altitudes in the Pyrenees mountains, where we can find *Abies alba* and *Pinus uncinata* forests (Table 1). The Catalan forests are in general too dense, with small diameters and slow growth, slowed down by poor management during the last decades (Figures 1 and 2).

The total forest production in Catalonia accounts for less than 2% of the total agriculture production in terms of the gross domestic product. Wood and logs account for about 30% of the total economic value of the forest production, whereas the hunting and the fishing account for 40% approximately. The rest corresponds to other products such as mushrooms, cork, or pine nuts, among others. It has to be said, however, that in such figures there is no mention to elements as important as the preservation of the biodiversity, forest recreation, landscape, soil protection, etc.

An average of 621,600 m³/year of wood without bark is harvested in Catalonia (1994-1998), which is far from the growth of the Catalan forests. Quite the same is true for the whole Spain, with less than a third of the forest production (growth) being harvested.

Regarding the forested lands ownership, 20% of the forest surface in Catalonia is of public property, mostly located in mountainous areas, whereas about 80% is private property (above the 66% in the whole of Spain). This private property is distributed in considerably small parcels, with an average size of 30 ha; 80% of the parcels are not bigger than 25 ha (and do not represent more than 12% of the total forested area in Catalonia).

Forest fires constitute one of the biggest hazards for the forests in Catalonia, as well as in the rest of Spain and Mediterranean Europe, bringing about great ecologic and economic damages, and even casualties. Every year, about 8.000 ha of forested lands and a total of 13.500 ha (forested lands and other woodlands) are burnt on average in Catalonia (1970-2003), though it is also true that there are years when these figures increase dangerously, as it is the case of the fatal summer of 1994 (Figure 3), when more than 76.000 hectares were burnt. About 566 forest fires take place on average each year in Catalonia, especially in July and August. Most of them burn small areas, and only 0.4% of the fires destroy more than 500 ha; but are these fires which are responsible for most of the burnt surface (above 80% between 1992 and 2001). As for the origin of the fires in Catalonia (between 1986 and 2001) 9% are due to natural causes (lightning), 42% are the result of negligence (such as uncontrolled agricultural land burnings that end up as a forest fire), 9% are accidents (mainly caused by power lines), 22% are deliberate and for the remaining 18% the origin is unknown.

3. Silviculture and production of the main forest species in Catalonia

Most of the forests are not managed according to rigorous silvicultural criteria and it is still common to find negative selection cuts, in which the biggest trees are cut systematically. On the other hand, there is an increasing interest among managers and owners towards the ecology and the production of forest species, and the application of silvicultural methods that allow sustainability in the forest management. In the case of private forests, management depends on the owner's level of knowledge or the criteria of the companies that cut and sell the wood. However, in some areas with a higher potential for forest production, there is an important silvicultural tradition, where silviculture is more intensive and new forest species have been introduced in the last decades. In such cases, owners are better informed about silviculture, production and harvesting techniques in their forests. Silviculture in public forests has also a long tradition, especially in the Pyrenees, where the main species typical of the mountains can be found.

As it has already been mentioned, the Catalan forests are characterised by their diversity of species and sites quality, which is by far greater than the average in Europe. This fact, together with other socio-economic factors, results in a heterogeneous landscape, with lots of species of trees and plants (among them mixed forests), and a greater complexity for the application of silvicultural treatments. What follows is a list of the main tree species of Catalonia with some information about the characteristics of their silviculture.

Aleppo pine (*Pinus halepensis*)

This is a characteristic species of the Mediterranean areas that adapts to almost any type of treatment due to its capacity to regenerate, survive and grow in considerably severe conditions. It plays a very important ecological and protecting role, and in some areas of

Girona its growth and production are noteworthy. The typical rotation is 80 years and the production ranges between 1 and 4 m³/ha/year, in the best conditions.

Scots pine (*Pinus sylvestris*)

This is a typical species of mountainous zones but still has a great potential for production. It is managed, especially in public mountains, as even aged stands with rotations of 100-130 years. It is estimated that this pine can produce 2-4 m³/ha/year.

European black pine (*Pinus nigra ssp. salzmannii*)

This is one of the conifer species that achieves the greatest height and presents the greatest capacity of regeneration. It has been managed mostly through selective cuttings, negative most of the times, which has helped to bring about complex structures, with little economical value and with uneven aged distributions. Because of the quality of the wood, the material of this pine is mostly used to build posts. Timber production is about 2-3 m³/ha/year, though in the best sites it can reach higher values.

Black mountain pine (*Pinus uncinata*)

This is one of the species that can live at highest altitudes, being found as high as about 2500 m. As a result, it plays an important role as a protecting species, especially on top of the basins. It is usually managed through selective cuttings; although it is quite appropriate to be managed as even aged stands with three thinnings throughout the rotation. This happens normally between 100 and 140 years, with a period of regeneration of about 25-30 years. The timber production amounts to 2-4 m³/ha/year.

Stone pine (*Pinus pinea*)

This pine offers another alternative to the production of wood: the pine nut. The production of this fruit is one of the main sources of income, with an average of 500 kg/ha/year. However, the production of pine nut in Catalonia is below its possibilities because the forest management results in too dense forests and lack of growth. Timber production amounts to 1-3 m³/ha-year and rotation is between 80 and 100 years approximately.

European silver fir (*Abies alba*)

It is normally managed as uneven aged stands and through selective cuttings. This species is still recovering from the uncontrolled shepherding and felling in the past decades or centuries. It is currently spreading all over the Pyrenees under pines overstory, due to its shade-tolerant character. Its production is of 4-8 m³/ha/year.

Holm oak (*Quercus ilex*)

This is the main broadleaved species of Catalonia. There are two important subspecies, one in the coastal area (*ssp. ilex*), and the other in more continental areas (*ssp. ballota* = *Q. rotundifolia*). It is typically managed as a sprout-origin forest for the production of firewood, with rotations of 10-20 years and low average incomes, in general 1-2 m³/ha/year, and up to 4 m³/ha-year at the most. Especially in some areas of Girona it is managed in a particular way for this species: as uneven aged stands. The method consists of selective cuttings oriented to obtain better quality products. However, most of the hectares occupied by this species are not managed.

Cork oak (*Quercus suber*)

The interest of this tree, which spreads over the acid soil areas of Girona and Barcelona, relies in the production of cork. The cork oak forests need intensive care in order to be productive,

and it is necessary to remove competing vegetation. The first cork extraction takes place when it reaches a diameter (DBH) of 20 cm at least (around 40 years old). Afterwards, the process keeps going for 13-15 years. The management is based on selective cuttings in which the old trees with a low production of cork and the sprouts are removed, favouring the process of regeneration. The average rate of production is between 100 and 300 kg of cork/ha/year. The best quality cork comes from the adult trees of between 70 and 150 years.

Other Oaks (*Quercus humilis* = *Quercus puebeszens*, *Q. faginea*, *Q. canariensis*)

This species of oaks is quite commonly found in Catalonia, and in less proportion *Quercus petraea* and *Quercus robur*. In general, they are either managed as a sprout-origin forest or not managed at all. The main source of income is its wood. In recent years there has been an interest to develop new techniques to enable the production of a better quality wood and at the same time help to the transformation into a seed-origin forest.

Beech tree (*Fagus sylvatica*)

In Catalonia, it grows in the more humid areas of the medium mountains, between 400 and 2000 m. Most of the stands are sprout-originated for the production of wood and charcoal, although there are also areas with seed-origin forests that are truly productive and very beautiful. Besides, the selective cuttings are usual. Rotations are between 100-120 years and the common income amounts to 2-6 m³/ha/year.

Chestnut tree (*Castanea sativa*)

It can be mostly found in Girona, the northwest of Barcelona and the North of Tarragona. Forests are typically sprout-origin and traditionally the rotation used to be of about 20 years with the aim of producing small-sized pieces for the building of barrels. Recently, the

rotations have been increased to 25-40 years in order to obtain bigger sizes. The regeneration is done by means of clearcuts and the rate of production amounts to 4-8 m³/ha/year approximately.

Poplar (*Populus sp.*)

The techniques used in the plantations are pruning and fertilization. No thinnings are performed since the trees are planted at set distances (6x6 to 8x8 m). Rotations typically range from 10 to 15 years and production is high, reaching between 20-25 m³/ha/year.

Other species

There are other relevant species for their rapid growth and economic interest, especially in the regions of Girona. They are normally gathered in plantations, where intensive methods are used. Among them, we can find *Platanus hybrida*, *Eucalyptus sp.* or *Pinus radiata*. Other species with important rates of production, but with longer rotations are *Pseudotsuga menziesii*, *Pinus pinaster* or broadleaves such as *Prunus avium* and *Juglans sp.*.

Some of the main species of trees in Catalonia are illustrated in figure 4.

4. The problems and challenges of the forests and the forest sector in Catalonia

Low yield and poor management

In Spain, only about 5% of the total forest lands are managed. This figure increases to over 12% in the case of public forest spaces. Moreover, many of the current plans need revision since they are no longer valid. In Catalonia, the situation is somewhat more positive, especially after the boost given by the Forest Management and Improvement Technical Plans (*Planes Técnicos de Gestión y Mejora Forestal*) (PTGMF). Nowadays about 20% of the

forest surface owned privately is managed. In general, as it is pointed out in the Spanish Forest Plan (2002) “the management of most of the woodlands lacks an adequate and up-to-date planning, two factors that are the basis of a sustainable management”.

The reasons that explain this situation are mostly structural-type and are associated to the particular features of the forests in the Mediterranean regions. Such characteristics pose a series of restrictions to the management of the forests. In first place, the Mediterranean regions are characterised by the great heterogeneity and diversity of both the physical environment and the vegetation, which requires a more detailed and thorough management, with specific and distinct treatments in generally small areas. This implies a higher cost and little profit, which obviously hinders the management of the forests. Another feature of the Mediterranean regions is the marked instability, associated to the temporal variability of the climate, the forest fires, the different periods of dissemination and the strong human pressure. All these elements, among others, contribute to give uncertainty and make it difficult for the adequate stability and regeneration of the stands. Besides, the long periods of drought, among other features of the Mediterranean regions, together with the lack of management lead to low growths and low timber yields (Table 1). Last but not least, we have to bear in mind the great fragmentation of the private property in Catalonia, the smallholding, in which most of the properties aren't any bigger than 25 ha. Consequently, the owners can seldom afford the costs associated to planning and managing their properties, and even less their implementation without extra economic help.

All things considered, most of the Mediterranean woodlands have a low income, which contributes to a poor management. This lack of management highlights the gradual deterioration of the stands and makes the situation worse, especially in the forests of private ownership, which are the great majority. As for the public woodlands, the public investments reduce the importance of the problem.

In this context of lack of planning it is difficult to know the rate of production, dynamics and structure of the forest stands in Catalonia, both for conifers and broadleaves. Consequently, on a general basis, new tools for planning need to be developed in order to achieve a more sustainable management of the resources. However, it seems that the development of such feasible models (in terms of income and prevention of fires) is still a challenge.

It is important to mention the study about the rate of growth and production of the main species through the development of yield models. In this context it is important to emphasize the use of forest simulation models that, together with geographic information systems, enable us to approach the planning and management of our forests in a more flexible way, although their practical and ordinary application is still rather a challenge than a reality at the present time.

Sustainable management: tools and measures

The basis of any solution to this problem will be to encourage a sustainable planning and management of the woodlands. The main planning tools are the Forest Management Projects (*Proyectos de Ordenación Forestal*) (PO), which apply for all Spain, and the Forest Management and Improvement Technical Plans (*Planes Técnicos de Gestión y Mejora Forestal*) (PTGMF), which are specific only for Catalonia. The last ones are mostly aimed at the planning and management of private woodlands. More recently, the Forest Management Simple Plans (*Planes Simples de Gestión Forestal*) (PSGF) have been created in Catalonia as a simplified version of the PTGMF, only applicable to smaller ownerships than 25 ha. The main objective of all these tools that are currently being applied in Catalonia is the management of the forest resources under the premises of sustainability and multifunctionality. Sustainability means that the persistence of a resource in quantity and quality along the time is ensured. Given the current social context, the forest management has

to take into account several objectives. First, it has to ensure the ecologic stability of the ecosystems and their biodiversity. Second, it has to ensure the leisure and the enjoyment of the landscape. Third, it has to ensure a sustainability of those resources other than wood, such as the game, mushrooms, fruits and aromatic plants among others. To achieve these goals, the manager has to bear in mind the socio-economic context of the forest sector and the main problems it is facing. Moreover, there has to be an awareness of the fact that only with a thorough management of the resources and only by means of the most advanced tools, can the best results be achieved.

Therefore, the main challenges a forest manager in the 21st century in Catalonia are:

- To achieve an integral management that optimises the direct and indirect profits of the woodland, and incorporates criteria aimed at the preservation of the biodiversity.
- To tackle the demands of the different social sectors by means of a multifunctional management, that may use the possibilities of the woodland as a source of social, environmental and economic activity.
- To manage forests on the basis of an objective and technical feasibility to ensure success throughout time.
- To use flexible management methods that can be adapted to the real situation and the future evolution of the forest, as it may undergo unexpected changes due to natural causes, different management goals or changes in the social demands, among others.
- To use other tools that support the management of forest resources and large data bases such as: geographic information systems, systems to support the multiobjective decision and planning, simulation tools, etc.
- To optimise the process of forest inventory, one of the most expensive of those required for forest management, by means of inventories adapted to the situation of each forest.

Although most of the current management plans are still based on the 1970 Instructions on Forests Management (*Instrucciones de Ordenación de Montes Arbolados*) (IOMA), some autonomous regions have recently created their own instructions. In Catalonia, this step has not been taken yet, and it is expected that the new Forests Law (*Ley de Montes*) passed on 21st of November 2003 will shortly introduce changes in the instructions for the management and use of the woodlands.

In any case, a key factor in order to guarantee the success of the PO and PTGMF is the amount granted for the projects. In this sense, we have to make reference to the Rural Development Program in Catalonia (*Programa de Desarrollo Rural de Catalunya*) (PDR), which will contribute during the period 2000-2006 to give financial support to the management of the woodlands. This support has been decisive for the creation and implementation of PO and PTGMF (on 31st December 2003, there were 2,036 PTGMF approved, which entailed a surface of 312,508 ha, about 20% of the private forest surface). On the 14th of December 2001, the amounts granted for the sustainable management of the woodlands were approved for the year 2002, by the PDR. This support means direct grants up to 100% for the development of the forest management plans as well as for the revision of the existing plans, and gives priority for subsequent funding of silvicultural treatments when these are included in previously approved management plans.

Forest fires

An inherent feature of the Mediterranean ecosystems is the presence of fire as a natural factor that contributes to configure the forest landscape. However, the current frequency of the fires is far too high for us to speak of a natural factor; so much that fire has become a serious problem that threatens the forest sector and its resources. Especially, we have to mention the

devastating effects of the large-scale fires, which involve most of the burnt surface in Catalonia despite being relatively scarce; such was the case of the summer in 2004.

Fire is often associated with long summers, high temperatures and almost a total absence of rain. All these factors help in the rapid spread of fire. To all these elements, we have to add the strong winds, which also contribute to the fire spread. Finally, we have to make reference to the excessive density of the stands and the accumulation of forest biomass, which is the result of the set-aside of the rural socioeconomics and the lack of management; not to mention the increase in the number of homes, roads and other infrastructures beside or within the forest and also the use of the forest for leisure mostly by urban people.

The fight against fire generally entails the combination of both prevention and extinction measures. Some improvements needed in the extinction systems in Catalonia are the following: professionals specialised in forest fires (knowledge of both the forest and the fire), a better coordination of the infrastructures and the people involved in the extinction, and a continuous renewal of the techniques used in the extinction (geographic information systems, fire simulators, fire risk models, specific weather forecasts, etc.) However, the key challenge in this context is prevention, implemented by means of territory planning and an adequate forest management.

Especially, adequate silvicultural treatments should be applied to the stands in order to make them more fire resistant. Such results are achieved by reducing the excessive density of the Catalan forests, diversifying the stands and landscape, controlling the development of the undergrowth to avoid the vertical continuity of the vegetation (which can bring about the onset of crown fires), the creation and maintenance of the necessary infrastructure (firebreaks, accessibility, water availability, etc.), the establishment of strips wide enough to stop the fire from spreading next to roads and paths (by means of clearing, pruning, etc.), etc. All in all, it

is necessary to manage the fuel and to plan prevention infrastructures, always bearing in mind the typology and recurrence of the fire.

Besides, in the context of prevention, it is important to mention the introduction of prescribed fires. Such techniques are still rarely applied in Catalonia and Spain in general, probably because their positive effects are not known enough among the management teams, owners and the society in general.

Forest certification

Forest certification began over ten years ago and has rapidly developed since then. It is basically a process that verifies and proves that the forest management is done according to a set of sustainability criteria bearing in mind ecologic, economic and social aspects. The forest certification is voluntary and consists of the forest management certification and the transformation of the elaborated products (custody chain). Besides, by providing evidence of a sustainable management, such certification may increase the added value and social acclaim of the products, at the time it promotes forest products as ecologic ones, since they are renewable resources.

There are several levels within forest certification: the individual certification (when it is only an individual ownership who applies for it), the group certification and the regional certification. The criteria used to decide whether a forest is sustainable or not vary from one system to another. In Europe, Spain and Catalonia, for instance, the two systems that are being introduced are: FSC (Forest Stewardship Council), mostly promoted by conservationist and ecologist organisations, and PEFC (Programme for the Endorsement of Forest Certification Schemes), more connected with the industry and the forest property. Although there are some forests with FSC certification, in Catalonia the preferred option is mostly the regional certification following the model of PEFC. In this way, Catalonia is the first Spanish

autonomous region to follow a regional pattern, though other Spanish regions, mainly the Basque Country and Galicia, are also working in the same line.

One of the reasons that explains the choice of the PEFC system is that it makes possible the regional certification while the FSC system does not. This seems to be a factor to be taken into account given the features of the forest sector in Catalonia: small private ownerships with low income in general, whose owners would otherwise not be able to afford the cost of the certification process and would thus may be left aside from important markets.

For this reason, in April 2001, the Catalan Association for the Promotion of Forest Certification (*Asociación Catalana Promotora de la Certificación Forestal*) was created. At the end of 2002, the Catalan Applying Institution for the Regional Certification (ENSCAT) (*Ente Solicitante Catalán de la certificación regional*), was created, and it was acknowledged in the beginning of 2003 by PEFC-España as the only applicant for regional forest certification in Catalonia. Nowadays, the initial process by which the factories and forest areas subscribe voluntarily to the forest certification applied by ENSCAT, with an average cost of one euro/ ha of forest area for the next five years, has finished. The final cost entails a far smaller inversion than the one owners would have to face if they were to apply for the certificate individually.

In order to subscribe to such certification process (both on a regional or on an individual basis, both for the PEFC and the FSC), it is necessary to have a valid forest management plan (PO, PTGMF, PSF). As a result, the competitive advantage that following FSC or PEFC certificates can bring about in the markets can be considered as an indirect mechanism that would encourage the increase in the number of managed forest areas in Catalonia.

In any case, it has to be said that, nowadays, the number of woodlands and properties that follow forest certification processes is still quite low, even when it may increase in the

following years. Besides, it is necessary to evaluate their implementation, as well as to revise and adapt the so-called forest certification sustainability indicators.

Forest valuation: wood, secondary products and externalities

OJO es “Valuation”, no “Evaluation”

Nowadays, wood is the main product obtained from the forests together with cork or the pinecone. However, wood is sold at very low prices, which have been stagnant for many years and even have a tendency to decrease in the worst of cases. Therefore, the direct income from the woodland is nowadays insufficient to guarantee a sustainable management in most Catalan forests. At the same time, it is difficult to base a sustainable forest management only from the incentives and subsidies from the government.

In addition, the Mediterranean forests present an outstanding ecologic value (biodiversity), apart from the economic value that derives from the wood and other products such as mushrooms, fruits, aromatic and medicinal plants, which are becoming more and more relevant. However, it is still difficult to quantify the value of elements such as the landscape, biodiversity, carbon sequestration, leisure, etc. Therefore, ways of quantifying these benefits should be developed as a means to benefit the owner and the management of the woodlands.

Nowadays the externalities are hardly a source of income for forest owners, which eventually lead to the abandonment of forests. For this reason, as well as looking at the externalities, we should encourage the production of wood and other products from the forest, by finding new markets. For instance, there is a wide range of options still to explore in the production of small-sized wood, and also possibilities with mushrooms, fruits, etc.

Forest policy and aids for the sustainable management of forests

On 21st November 2003, a law was passed which emphasised the need of a improved management of the forests, and praising the current Spanish Forest Strategy (*Estrategia Forestal Española*) and the Spanish Forest Plan (*Plan Forestal Español*). Besides, the Spanish Forest Plan aims at 7% of the forest surface with a valid management plan in Spain by the year 2008 and at 20% by 2032. The law establishes that the incentives will only be applicable to those forests and activities that follow a management plan, which will have to include all the public woodlands within a maximum of fifteen years.

The law also introduces a new element in the forest management: Forest Resources Management Plans (*Planes de Ordenación de los Recursos Forestales*) (PORF), which have a wider perspective and scale planning. The PORF can be applied to regions with homogeneous socioeconomic, ecological or cultural features, bigger than the woodland and smaller than the province. Besides, the Law also establishes that the public Administrations will encourage the association of forest owners, either public or private, in order to facilitate the management of their forests.

In Catalonia, the Catalan Forest Law (*Ley Forestal de Catalunya*) was passed on 30th March 1988. This law refers to the Forest Development plans, which include the General Plan of Forest Policy and Forest Production Plans (*Plan General de Política Forestal y Planes de Producción Forestal*), which are in turn quite similar to the PORF. Nowadays, the General Plan of Forest Policy is being drawn up in Catalonia. It goes without saying that the creation and development of such plans constitute a major challenge for the forest sector in Catalonia.

Forest research and training

The training and specialization of the professionals in the sector is another major challenge. Despite the fact that there are a lot of professionals in the field of science, planning and management, there is still evidence of the lack of workers to put into practice such tasks in the

forests. In this way, although there has been some improvement, the number of specialised workers and their wages are still not satisfactory.

As for the research in the sector, there are some important institutions working in different subjects, such as the University of Lleida, the Catalan Forest Technology Centre, the Centre for Ecologic Research and Forest Applications and the Agri-food Research and Technology Institute. The research and management teams seem to increase in number and quality, which is indeed desirable.

5. Conclusions

- Catalunya is clearly a forested region, where a great diversity of species can be found. Besides, the forest is undergoing a period of expansion that started several decades ago. As a result, it can be said that the forests in Catalonia (80% of which are private) are relatively young, often highly dense and tend to present low production.
- The fire is a natural element in the Mediterranean ecosystems that has to be taken into account in the forest planning and management. In this sense, the problem with big fires has to be tackled mainly from the prevention and land management perspective.
- In general, it can be said that there is a lack of sustainable forest planning and management, which derives in a lack of forest growth and stability, as well as low income and increase of the risk of big fires.
- It is thus necessary to encourage a sustainable management by means of planning tools such as PO, PTGMF, PSGF and other models of management. The aim is to provide silvicultural guidelines and ways to improve the development and structure of the forests and to provide alternatives for both forest harvesting and forest conservation.

- However, to put into practice these initiatives, specific policies are needed and subsidies have to be given as a economic reward for the positive externalities that the forests generate.
- It is also necessary to encourage the association of both public and private owners to make the management of small properties easier, which is particularly important in the case of Catalonia.
- The training and specialization of the forest professionals, the managers and the owners is necessary to achieve the sustainability of the sector. It is likewise desirable further advances in the research and the cooperation among the experts.

6. Practical example

Now, we will look at some of the main socioeconomic characteristics in relation to the forests in Solsonès (Catalonia). A big forest fire hit the region in 1998. In less than two days, about 28,000 ha (20,000 ha of which were forested) were burnt. In the region of Solsonès, 18,500 ha were burnt, 11,000 ha of which were forests.

After considering both, technical and socioeconomic characteristics of the region of Solsonès, a restoration plan of the area has to be drawn up. The student has to identify the needs, priorities and actions that have to be carried out to restore the area, bearing in mind the current situation and the demands of the groups interested and the different groups that are involved in the sector. They also have to find out which are the necessary tools to put into practice the initiatives and to ensure the success of the plans.

STUDY AREA: AREA OF SOLSONÈS

1. Forest context

1.1. Distribution of the forest surface (before the fire)

| Type | Surface (ha) | % |
|-------------------------------|--------------|-----|
| Whole of Solsonès | 99,860 | 100 |
| Forest and other wooded lands | 78,123 | 78 |
| Forest | 61,483 | 62 |
| Other wooded lands | 16,679 | 16 |
| Public forest | 4,063 | 5 |
| Private forest | 74,099 | 95 |

The region of Solsonès is basically covered by forests, with 62% of **forest area** compared with the 40% of the rest of Catalonia. It is also relevant to mention that 95% of the surface is occupied by private forests, compared with the 80% of the rest of Catalonia. Besides, the average size of the ownerships is 25-75 ha. The 100% of the burnt surface is private.

1.2. Distribution of the surface according to the species (before the fire)

| Species | Surface (ha) | % |
|--|--------------|-------|
| European black pine (<i>Pinus nigra</i>) | 43,778 | 67.00 |
| Scots pine (<i>Pinus sylvestris</i>) | 13,299 | 20.35 |
| Aleppo pine (<i>Pinus halepensis</i>) | 3,047 | 4.66 |
| Holm oak (<i>Quercus ilex</i>) | 1,883 | 2.88 |
| Black pine (<i>Pinus uncinata</i>) | 1,830 | 2.80 |
| Oaks (<i>Quercus pubescens</i> , <i>Q. faginea</i> , <i>Q. cerrioides</i>) | 1,471 | 2.25 |
| Beech tree (<i>Fagus sylvatica</i>) | 30 | 0.05 |

Although conifers predominate in the region, a more detailed study of the vegetation shows that there is an important regeneration of broadleaves as well (oaks, service trees, maples, cherry trees, etc.). Most of the current forests are still young, since they origin from the colonisation of former agricultural fields. After the fire in 1998, the surface covered by the *Pinus nigra* has been reduced to 35,000 ha, that of *Pinus halepensis* to 1,800 ha, that of holm

oak to 1,078 ha and that of oak to 728 ha. The species that most suffered the effects of the fire was the *Pinus nigra*, which is in turn one of the most interesting species from the productive point of view, with a production of 4 m³/ha-year on average and also for its ecological value. *Pinus halepensis* regenerates easily after the fire. It is more difficult for *Pinus nigra* to regenerate and, as a result, it has been replaced by the *Quercus sp.* species in a natural way.

2. Socioeconomic context

2.1. Forest property and social perspectives

Most of the owners live in their property and combine the work of the land with both, forest and livestock-farming activities. Forest harvesting is common, every 10 years in 60% of the cases. However, the population are clearly ageing and it is unlikely that future generations may take charge of the properties and the forest management.

In general, the perspectives for the owners are negative. Most of them are not in a position to restore the burnt areas and eventually choose to let nature grow without interfering. The reasons that may explain this situation are the high cost of the forests restoration and management in relation with the low income they produce and the fear of new fires.

2.2. Economic activities of the region

Industry and the forest sector

The economic activity that derives both directly and indirectly from the forests and their exploitation accounts for a considerable percentage of the total activity. Besides, the percentage of population working in the forest sector is higher than the Catalan average.

The wood is mainly sent to several sawmills in the region and to the only company that produces boards in Catalonia. It is also sent to other sawmills and companies that produce

posts and RTI in the nearby regions. Apart from that, it can be said that there has been a reduction in the number of activities related to the forest sector in Catalonia.

Tourism

Tourism is an important sector in the region. In fact, rural tourism is gaining more importance and people are increasingly seeking quietness and leisure in Solsonès (hiking, mushroom gathering, riding bicycles and skiing are some of the main activities)

2.3. Forest management before and after the fires

Solsonès is a region where forests predominate, but with little tradition in silviculture. Management tools are not commonly used and management is often carried out by the person who buys the wood (diametric criteria). After the fires, the Administration has economically promoted the development of forest management plans.

Bibliography

- CPF, 2004. Información sector forestal y bosques privados en Catalunya. *En:* www.mediambient.gencat.net/cat/cpf
- CREAF, 2004. Inventari Ecològic i Forestal de Catalunya. *En:* www.creaf.uab.es/iefc
- CTFC, 2004. INFOCERT Forestal. Certificació Forestal Informació. *En:* <http://www.ctfc.es/webcast/infocert/>
- Generalitat de Catalunya, 2004. Información bosques y sector forestal en Catalunya. *En:* www.gencat.net
- ICONA, 1993. Segundo Inventario Forestal Nacional (1986-1995). Cataluña.
- Madrigal, A. 1994. Ordenación de montes arbolados. ICONA. Madrid. 375 pp.
- Ministerio de Medio Ambiente. 2005. Tercer Inventario Forestal Nacional. Dirección General para la Biodiversidad, Madrid.
- Piqué, M. 2004. La gestió forestal como a eina per a la prevenció del grans incendis forestals. In: Plana, E. (Ed.), Incendis forestals, dimensió socioambiental, gestió del risc i ecologia del foc. Zarza ALINFO, Solsona, DL: L-501/2004. pp 28-33.
- Vélez, R. 2000. La defensa contra incendios forestales: fundamentos y experiencias. McGraw-Hill. 1308 pp.

Table 1. Main species of trees in the Catalan forests and their characteristics according to the Ecologic and Forest Inventory of Catalonia (*Inventario Ecológico y Forestal de Catalunya*).

The figures for each species are the average of the inventory plots where such tree species are the most abundant (which amounts to at least 50% of the total basal area). Only the trees with diameter (DBH) above 5 cm are included. Values of the fraction of the canopy cover can be over 100% where canopies are overlapped.

| Species | Surface (ha) | Num trees /ha | Forest Canopy cover (%) | Basal area (m ² /ha) | DBH (cuadrático mean) (cm) | Dominant height (m) | Volume of the trunk with bark (m ³ /ha) | Wood Production (trunk only) (m ³ /ha/year) | Age (years) |
|-------------------------|--------------|---------------|-------------------------|---------------------------------|----------------------------|---------------------|--|--|-------------|
| <i>Pinus halepensis</i> | 225,889 | 717 | 49.0 | 13.3 | 16.3 | 11.2 | 55.9 | 1.7 | 42 |
| <i>Pinus sylvestris</i> | 208,414 | 903 | 68.2 | 21.6 | 18.3 | 13.1 | 108.7 | 2.7 | 49 |
| <i>Quercus ilex</i> | 176,546 | 1551 | 71.8 | 13.2 | 10.8 | 8.1 | 38.6 | 1.2 | 38 |
| <i>Pinus nigra</i> | 134,079 | 1024 | 53.8 | 17.0 | 15.7 | 12.3 | 77.4 | 2.0 | 53 |
| <i>Quercus suber</i> | 60,855 | 473 | 32.6 | 13.3 | 20.7 | 9.2 | 43.3 | 0.7 | 30 |
| <i>Quercus humilis</i> | 56,266 | 907 | 63.3 | 12.1 | 14.3 | 11.5 | 52.4 | 1.2 | 43 |
| <i>Pinus uncinata</i> | 50,141 | 1004 | 48.3 | 28.1 | 20.1 | 13.4 | 144.2 | 2.8 | 75 |
| <i>Pinus pinea</i> | 35,499 | 360 | 46.2 | 14.3 | 24.7 | 11.4 | 64.4 | 1.6 | 42 |
| <i>Fagus sylvatica</i> | 27,910 | 971 | 140.0 | 23.7 | 19.5 | 17.7 | 161.0 | 4.7 | 59 |
| <i>Pinus pinaster</i> | 13,345 | 696 | 37.3 | 15.5 | 18.1 | 12.8 | 74.6 | 3.2 | 23 |
| <i>Abies Alba</i> | 11,736 | 832 | 66.0 | 36.6 | 26.7 | 22.0 | 312.0 | 6.3 | 87 |
| <i>Castanea sativa</i> | 11,411 | 1339 | 99.7 | 17.4 | 13.9 | 12.3 | 94.0 | 5.4 | 16 |
| <i>Quercus petraea</i> | 8,878 | 957 | 87.2 | 17.8 | 17.3 | 15.1 | 96.6 | 2.8 | 46 |



Figure 1. Natural stand of *Pinus sylvestris* and *Pinus nigra* in former agricultural lands. The trees present low growths due to the excessive density of the stand.



Figure 2. Natural regeneration of *Pinus halepensis* after a fire. Thousands of hectares of this type of forests need to be thinned in order to achieve healthy and fire-resistant stands on the medium term.

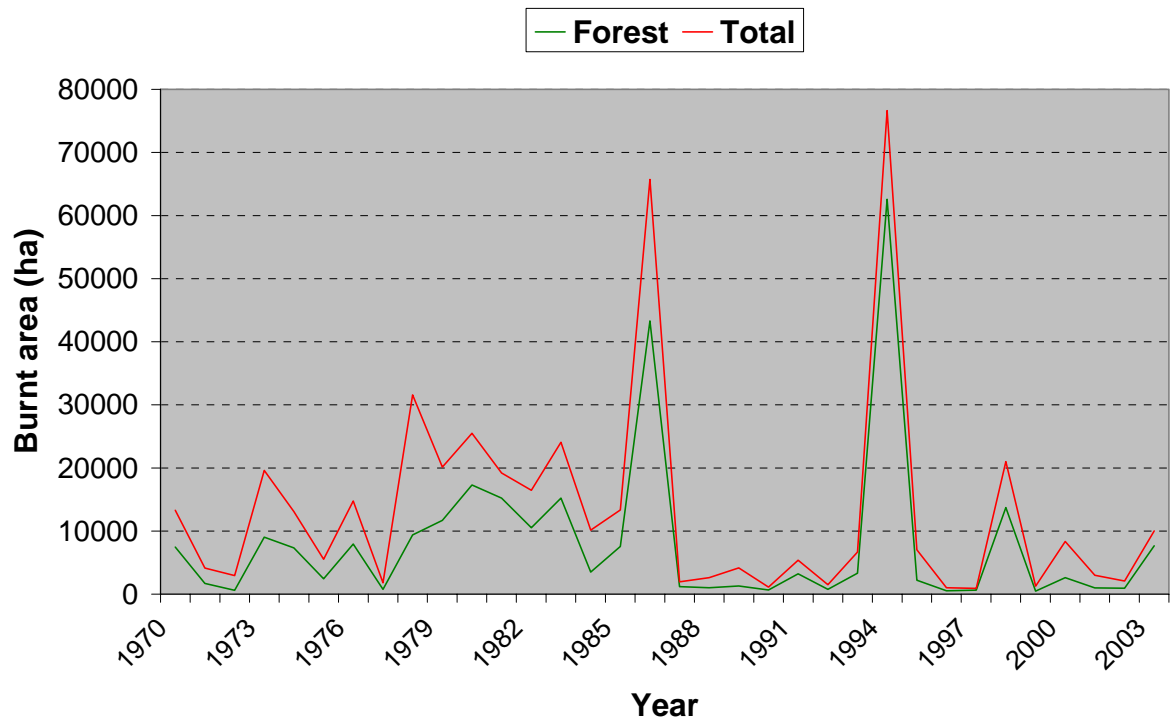
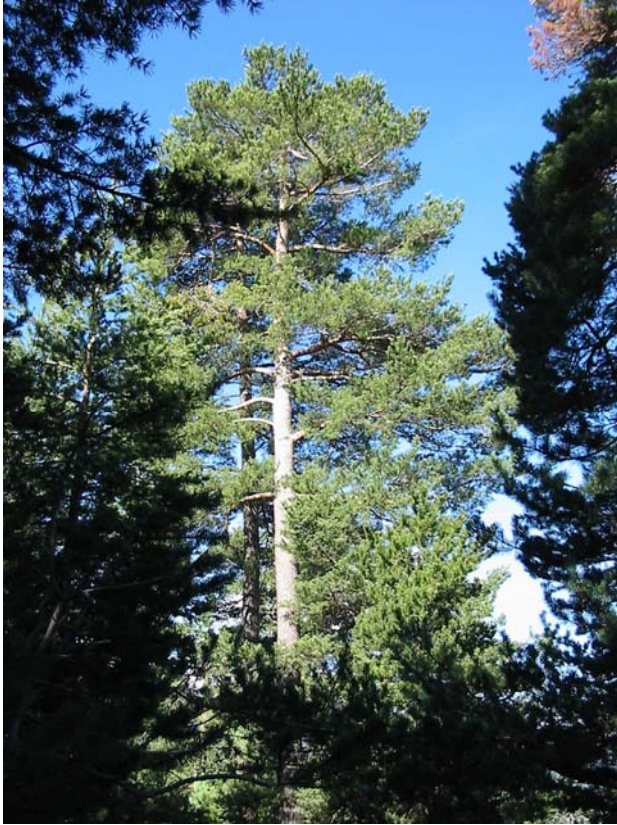


Figure 3. Evolution of the burnt surface yearly in Catalonia during the period 1970-2003. Source: Departament de Medi Ambient i Habitatge, Generalitat de Catalunya.

Figure 4. Main tree species:



Pinus halepensis (Photo: Asier Larrañaga)



Pinus sylvestris



Pinus nigra (Photo: Xavier Nosàs)



Pinus uncinata



Pinus pinea



Abies alba



Quercus suber



Quercus ilex (Photo: Judit Rodríguez)