PRESCRIBED BURNING IN CATALONIA: FIRE MANAGEMENT AND RESEARCH

E. Pastor[A], *Y. Pérez*[A], *M. Miralles*[B], *E. Nebot*[B] *and E. Planas*[A]
[A] Centre for Technological Risk Studies (CERTEC), Technical University of Catalonia, Barcelona, Spain.
[B] Forest Actions Support Group (GRAF), Generalitat de Catalunya (Catalan Government), Spain.

Abstract
Wildfires have been seriously affecting Catalonia (NE Spain) during the last decades. Before the large fires of 1994 and 1998, the Catalonian policy was mainly focused on extinction activities, underestimating prevention and forest management. Nevertheless, since the occurrence of those events, a new debate arose between politicians, scientific community and land managers in order to find solutions to the new large wildfire reality. Its first result was the implementation of a new policy based on fire management, basically focused on prescribed burning, as well as the increase of Catalan universities involvement in forest fire research topics. The most relevant achievements in prescribed burning during its six years of application will be presented in this paper, deserving special attention to the synergies found between forestry management and research in wildfires.

Introduction
Background to the problem of wildfires in Catalonia
Catalonia (NE Spain), as many other regions of the Mediterranean Basin, has been devastated by wildfires during the last decades. Some recent statistics in terms of number of fires and affected area show the magnitude of the current problem (Figure 1). Small and medium fires were the most frequent ones during seventies and early eighties. Nevertheless, the proportion of burned area by this type of fires has decreased to the detriment of large fires. This tendency could be fully studied in terms of the controversial paradox extinction theory (Minnich, 1983 and Minnich and Chou, 1997), as even Catalan fire fighters are very successful in the 96% of the arisen fires, letting them not to spread more than 10ha, they can not control the remaining 4% of them, which are the responsible of the 96% of the total area burned per year (Castellnou *et al*., 2005).

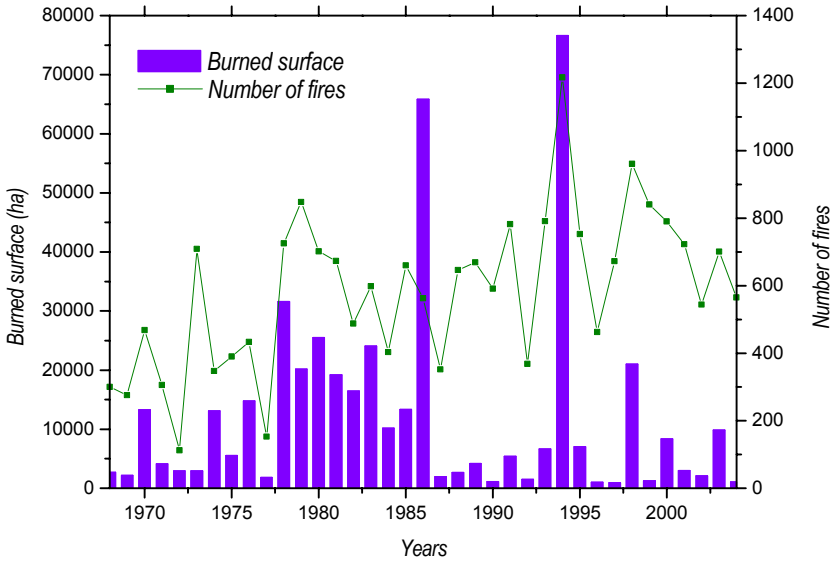

Figure 1. Number of fires and burned area in Catalonia (1968-2004). Source: Department of the Interior, Generalitat de Catalunya

The causal framework of this situation is obviously complex and involves many points of a very different nature, as political, ecological and social items. However, it can be summarized in two main evidences, which are basically the increase of both ignition and propagation risk. The former has its main origin not only in severe meteorological summer conditions but in the increasing social pressure within the forest-urban interface area, due to high demand of nature spaces for recreational uses and accommodation. The later is a direct consequence of biomass accumulation in Catalan forests, mainly due on the one hand to the failure of primary sector −hence rural areas abandonment and lack of forest exploitation− and on the other, to the forest policies historically focused on extinction instead of prevention,

by which small and medium fires acting as natural landscape breaks have practically disappeared. Many resources were allocated during the second half of the 20th century to extinction systems in order to increase suppression effectiveness and detection and so trying to completely remove fire from Mediterranean ecosystem. This policy was found to be hardly useful during the large fires of 1994 and 1998 so, after the occurrence of those dramatic events, a new debate about fire management, essentially in terms of prescribed burning and prevention, finally arose between politician, scientific community and land managers in order to find solutions to the new wildfire reality.

Fire management in Catalonia. First steps

The establishment of this new fire policy in Catalonia was done with the general aim of recovering and reintroducing fire in the country, as it has historically had an important role in Mediterranean ecosystem dynamics, especially relevant in our region of study. This new scope basically meant the introduction of prescribed burning in the ecosystem as well as in the Catalan society with the aim of dealing with the problem of large fires. An ambitious program was established considering three main milestones, i.e. burns design, execution and education. So, bearing in mind these points, prescribed fire has been gradually applied during the last six years, overcoming several difficulties such as bureaucracy, available funds and staff, and population suspicion.

Moreover, early steps in other fire management directions have already been done. At present, some fires are not just extinguished but managed: monitoring the fire to minimize the simultaneity or to stop it only in anchored sites, directing large fires to minimize potential or avoid vulnerable sites are examples of current fire management decisions in real emergencies situations. Finally, Catalan forest fire fighters are preparing themselves to start managing lighting fires, as this type of fire has traditionally played an important role in fuel discontinuity generation, providing natural sources of biodiversity (Castellnou, *et al.* 2005).

Prescribed burning as a fire management tool and a scientific research scenario

Current planning of prescribed burning. Types, objectives and methods

Following the mentioned background, prescribed burning planning in Catalonia is done by the Forest Actions Support Group of the Autonomous Government (GRAF, Generalitat de Catalunya) by considering several needs and aims of different nature and priority −such us extinction, forest management, training, education and research− in different types of forest structures. Hence, prescribed fires may be grouped into two big categories; the first is in the scope of extinction purposes and gathers treatments to transform a forest structure which can be safely used to anchor fire operations, to reduce fuel load in order to decrease fire intensity or to specially protect the rural-urban interface from wildfires. The later is in the field of forest management and gathers different purposes as pasture maintenance, thinning or habitat recovery. In that sense, GRAF defines and executes the next types of burns:

- *Strategic Plots (SP):* This category applies to plots where a specific forest structure is persuaded, so that fire fighters can plan secure and efficient manoeuvres in potential large fires. This is especially important when the use of technical fire during extinction is needed, i.e. when anchor safer points are required. Location, shape and dimensions of the plot are designed by studying the local fire pattern and regimes, considering historical fires and reproducing their behaviour by means of forest fire simulation tools such as Farsite® and Flammap® (Martínez, *et al.* 2004). The treatment of these critical spots aims to achieve the optimum value of the treated/protected forest surface ratio.

- *Low fuel load lines (LFL)*: This type of burns covers all the actions mainly done next to trails, roads and firebreaks, planned to reduce fuel load and therefore fire intensity, so that the security of the means of extinction can be better guaranteed during fire emergencies.

- *Interface areas (IA):* This group includes burns in all the different types of interface that can be found in Catalonia, i.e. the metropolitan perimeter, made of sites and fields close to industrial and urban areas where intentioned and negligent ignitions may often occur during fire season; the rural interface, where small mountain villages surrounded by abandoned lands must be protected, and the last type of interface area, which has been growing without any control during the last ten years, is the one located in new second-housing developments in the middle of the forest, especially in this areas where forest management has been absent.

- *Forest management (FM):* They cover different aims and objectives such as thinning, logging debris elimination, habitat recovery for protected fauna and flora species and, finally, grazing lands maintenance in

the mountains, invaded at present by shrub lands, where pasturage used to be done before the emigration of rural population to urban areas (Figure 2).

Figure 2. Recent prescribed burning in pasture lands (Prats de Molló, Pirineus, Catalonia). Source: Department of the Interior, Generalitat de Catalunya.

Prescribed burning as a fire scenario for research purposes

During this last years in Catalonia, many research teams from Catalan universities have focused their interests in forest fires research topics, joining efforts, sharing resources and working with a close interaction by means of a well defined thematic network funded by the Catalan Autonomous Government (Plana, 2004).

Is therefore in this framework where Catalan fire researchers have found in prescribed burning a hot topic for their research projects. They cover different ecology subjects such as fire effects on soil properties and on vegetation dynamics. As examples, Úbeda *et al.* (2005) have recently examined the immediate and one year effects in soil quality of a low intensity prescribed fire in grassland in terms of pH and nutrients, while Nebot (2005) has compiled in a shared database the information generated during prescribed fires in terms of execution, general fire spread patterns and fire meteorology, so that dynamics vegetation and fire regime have been properly modelled (Piñol *et al.*, 2005).

Moreover, fire behaviour topics are also studied in prescribed burns, since field fire data is much needed for models development and calibration. Hence Perez *et al.* (2005) have described the field methodology used for IR measurements during a prescribed burn mainly designed for extinction purposes and showed their primary results. Finally, other disciplines such as social sciences studies have found in prescribed burns a source of research information, particularly of population perception of this fire use. The study of Oliveras (2005) shows the advantages and drawbacks of prescribed burning perceived by two samples of population, the former in Catalonia and the latter in central western Victoria, comparing both areas in terms of knowledge, participation and acceptance.

Results and Discussion

During this six years of prescribed fires in Catalonia the main goals have been successfully achieved (Nebot, 2005). It has become a normalised tool for fire prevention as the area treated by prescribed fire has been increasing year after year, although the real the impact of any prescribed burning program on fire statistics (e.g. number of large fires) take many years to be assessed.

This empirical evidence has been endorsed by Piñol *et al.*(2005) by means of their model of vegetation dynamics and fire spread. Hence the authors found a clear relationship between the increase of prescribed burns intensity and the decrease of large fire occurrence in the regions of study (South Catalonia and Central Portugal). Nevertheless, despite the potential of this tool, prescribed burning is a big source of controversy in Catalonia regarding different topics. Thus, a great debate has currently ensued between politicians, land managers and population (Oliveras, 2005) being escape risk, public security, inconveniences caused by smoke, reduction in air quality, aesthetic issues associated and fiscal responsibilities the main concerns.

Not only in social terms but in ecological effects the discussion is still opened. Thus, wider studies are needed in order to better assess the whole repercussion of prescribed burning in Mediterranean ecosystems −particularly in Catalonia− as well as the specific efficiency of this tool in the achievement of all the different planned objectives. Practical and useful methodologies have to be designed in order to obtain this valuable information. Finally, the productivity and profitability of prescribed burning in front of other treatments has to be also discussed (Larrañaga et al. 2005).

Furthermore, more agreement and communication is still needed between researchers and fire managers in order to completely achieve both burn objectives, to complement methodologies and to optimize resources, though much effort has been already invested in this direction.

Conclusions

Prescribed fire has been presented as a valid tool in early application for fire management in Catalonia. Although more research is needed in order to better understand long-term ecological effects and efficiency in terms of forest management objectives, the Catalan research community is already working on these topics.

Prescribed burning represents a hot forest fire research topic in Catalonia. An emergent synergy between forestry management and researchers from multiple disciplines has been recently found. Prescribed burning with preventive objectives offers an inestimable opportunity to develop experimental scientific studies encouraging the interaction between both research and operational staff.

Prescribed burns can be optimized with other aims that cover not only fuel management and extinction purposes but research needs in several areas, promoting advances in both directions. Because of this great potential, an increment of the efforts necessary to normalize this practice is strongly demanded.

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