

# Prescribed fire plus grazing horses: A sustainable model to decrease fire hazard in a mountain landscape

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## Abstract

The mountain landscapes of northern Portugal have been modified through rural depopulation and the absence of rangeland management. As such, increased above-ground biomass and higher fire hazard resulted, as well as decreased ecosystem biodiversity. The objectives of the OpentoPreserve Interreg SUDOE project are to evaluate the effects of the combined use of prescribed fire with grazing horses, and also to develop strategies of socio-economic valorization of this model. Concerning the evaluation of prescribed fire and grazing effects, the experimental design consisted of three plots in the Natura 2000 Alvão/Marão Site, respectively Control, Fire x Grazing, and Fire. The Fire plots were burned in early spring and vegetation percent cover and height were measured in all plots in late spring. We have implemented four transects in the three different plots, used the line intercept method and subsequently estimated vegetation volume. This methodology is also applied on Forestation of Agricultural Land with More Silviculture, Silvopasture, Innovation and Value project. Concerning socio-economic valorization, the stakeholders related to the native horse breed, were interviewed and a focus-group was held. The study intends to identify both the benefits resulting from the adoption of a management system that includes the native horse breed, named Garrano, and the main weaknesses related to environmental, economic and social sustainability. Initial results for total vegetation in each plot show a high reduction in vegetation percent cover and its volume in the burned plots (33.5% and 268.3 m<sup>3</sup> ha<sup>-1</sup>) in comparison to the control plot (183.7% and 12862.5 m<sup>3</sup> ha<sup>-1</sup>). Furthermore, a fast recovery was observed in July, mainly of the *Pterospartum tridentatum* shrub species. Interviews and focus-group results shows the important role of these grazing animals in vegetation control as well as in other ecosystems services, involving an environmental and a socio-economic dimension. A strategy to value contribution to the economy of agricultural holdings has been proposed.

**Key-words:** Fire effects, horses, vegetation cover, volume, valorization.

## Introduction

The mountain landscapes of Portugal have been modified through rural depopulation and the absence of rangeland management. A number of asymmetries that reflect development inequalities can be observed in Portugal, particularly between the coast and inland regions, with devastating consequences for the economy of the latter territories. These consequences mainly result from the migratory phenomenon, which is increasingly contributing to depopulating inland regions, demographic imbalances, population aging, and landscape abandonment. In addition, agriculture becomes impracticable for older people nowadays. This phenomenon has implied an increase of high and dense shrublands, promoting the accumulation of biomass fuel, which is associated with high fire hazard. Several authors (Almeida and Moura 1992, Mather and Pereira 2006, Ruiz-Mirazo and Robles 2012, Mancilla-Leytón et al. 2013) have shown the existence of larger burned areas in the municipalities with the highest emigration. According to Bengtsson et al. (2000) it is important to understand natural disturbance dynamics and also their relationship with human disturbance. These authors refer how management practices are

important to preserve biodiversity in human-influenced landscapes and ecosystems. In fact, European forests evolved and adapted under both natural and human disturbance regimes and in this context, a good management of fire and grazing are important for the ecosystems conservation.

The objectives of the OpentoPreserve Interreg SUDOE project are to evaluate the effects of the combined use of prescribed fire with grazing by horses, and also to develop strategies of socio-economic valorization of this model. This article aims to demonstrate how Garrano horses can have a potential role to the sustainable landscape management, preventing wildfires.

## Methods and Study Site

One of the pilot experiences from the OpentoPreserve project is placed in the north of Portugal, specifically at the Natura 2000 Network Alvão/Marão site (lat: 41°17'47'' N, 7°53'53'' W) in a commonland area of 11 ha. The average elevation is 850 m, in a 15-20% slope with a S-SW aspect. The soil is from schists-grauvaquic origin, local mean annual rainfall ranges from 1400 to 1600 mm and mean annual temperature from 10° to 12°C.

The experimental design consists of a delimited area where 4 ha were burned using prescribed fire in the early spring of 2019. There, two plots (3 ha and 1 ha) were established, respectively for combined and monitored practices of prescribed burning and grazing. The experimental design comprises a fire and grazing plot (3ha) (F\*G), a fire plot (1ha) (F), and a control plot (0, 2 ha) (C). The first two plots were fenced and in the F\*G there are 3 Garrano breed horses in permanent grazing, which have been introduced in March 2020. The animals are supplemented with hay and their body condition is measured weekly.

At the end of spring 2019, after prescribed fire and before grazing, 4 permanent transects were established and georeferenced in the three different plots and vegetation monitoring was started using the line transect method (Canfield 1941) for estimating vegetation cover, height, and phytovolume. The same method was applied in the spring of 2020.

Concerning socio-economic valorization, the stakeholders, including breeders, companies, and associations related to the Garrano horses were interviewed and a focus-group with several agents and companies was held. There were listed some ideas for the implementation of valorization strategies for this breed.

## Results

### Spring 2019

Mean structural characteristics for the vegetation in each plot are presented in Table 1, highlighting the high reduction from C to F\*G and F treatments in cover, height, and volume. In Spring 2019, F\*G and F can be considered similar treatments because F\*G had not yet been grazed.

The dominant species in the control plot were the legume shrubs *Pterospartum tridentatum* (78%) and *Ulex minor* (38%) and there were also *Ericacea* shrubs as *Erica umbelata* (32%) and *E. cinerea* (30%). *Pterospartum tridentatum* (25%) and *Ulex minor* (10%) were the main species found in the fire plots.

Table 1 – Vegetation structure per treatment in the 2019 inventory

July 2019	Cover (%)	Height (cm)	Vol.(m <sup>3</sup> /ha)
Control	183.75	70.03	12862.50
Fire&Grazing	40.00	8.99	359.47
Fire	32.50	10.18	330.89

*Spring 2020*

What it can be highlighted concerning vegetation cover and volume is the persisting great difference between the control plots and the other plots (Fig. 1 and Fig. 2). In the Spring of 2020, the difference in total vegetation cover and volume between F and F\*G is mainly explained by the consumption of grass by the horses. In species or groups of species, there are no significant differences between treatments.

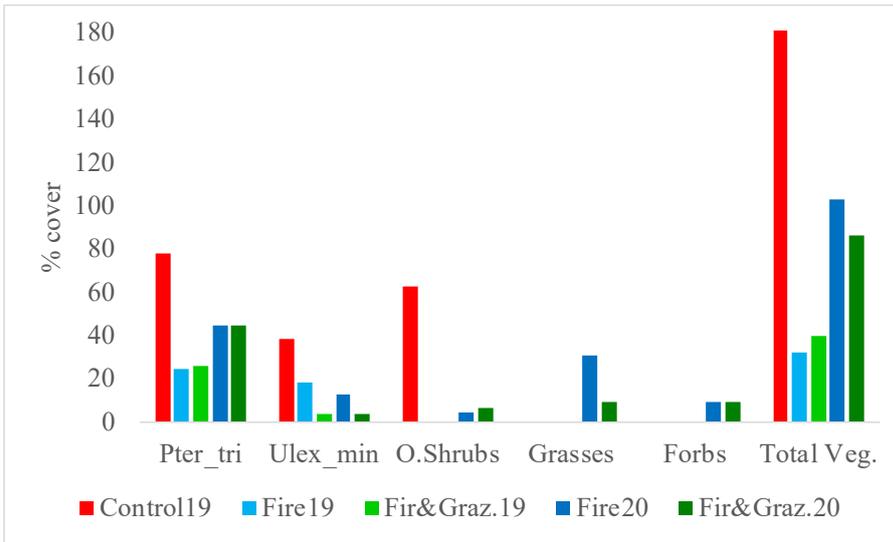


Figure 1 - Dynamics of vegetation cover with fire and grazing (2019-2020)

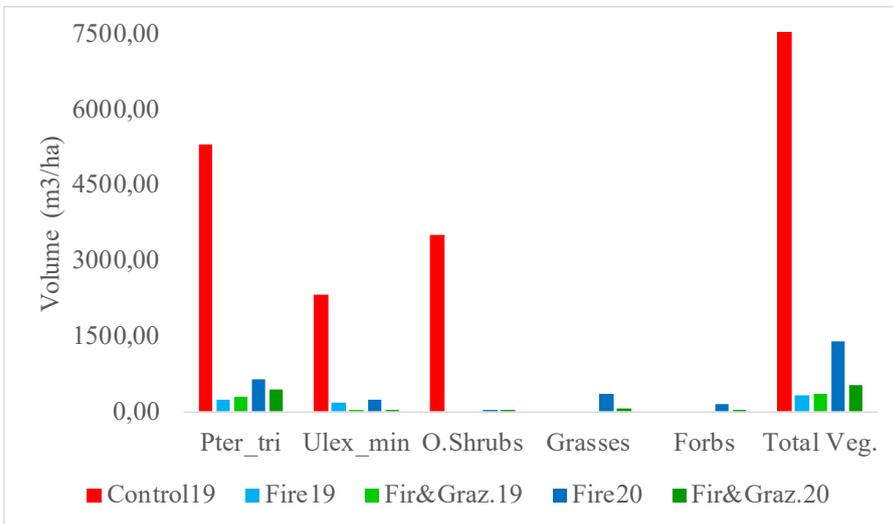


Figure 2 - Dynamics of phytovolume with fire and grazing (2019 -2020)

### *Socio-economic valorization*

The results of the interviews and the focus-group shows the abilities of the breed as well as its constraints and potentialities were identified. The most socially valued proposals involve the payment of services to farmers whom, in addition to recognising these horses as historical heritage, develop activities which contribute to the maintenance of the Garrano population and to its environmental externalities. Concerning the environmental dimension, the participants understand that the training and awareness of breeders on the multifunctional potential of the breed is relevant. They should be aware of the importance these horses may have in fire prevention. Finally, the evaluation of the economic dimension brings out three potentialities that could have a greater impact: the valorization of the Garrano as an endogenous resource in the area of tourism; the recognition of the breed as historical and cultural heritage and the payment of services to breeders who develop activities with the Garranos.

### **Discussion**

It is important to stress the effect of fire on the cleaning of dense and ageing shrubby vegetation. This intervention allowed the regrowth of grasses as well as new shoots of shrubs, providing grazing by horses. The quick recovery of *Pterospartum tridentatum* in burned plots was already expected. Similar results were found in previous studies remarking also the good nutritive value of crude protein and digestibility of new *Pterospartum tridentatum* shoots (Rego 1986, Torres-Manso 2005).

However, in regards to the reduction in cover and phytovolume by grazing it is early to have consistent results at this stage. One of the reasons is possibly the low livestock density, and the other is that more time is needed to reach conclusive findings in this type of study.

The valorization of the Garrano as an endogenous resource in the ecotourism allow to a strategy concerning the wild horse watching. This strategy involves the dimensions of sustainability.

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