

Post-fire effects of ungulates on the structure, abundance and diversity of vegetation in a Mediterranean Ecosystem

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Aims and Introduction

Fire, herbivory and their interactions constitute very important processes shaping plant communities in many Mediterranean ecosystems. Wildfires in southern European Mediterranean countries are especially noted in Portugal, where burned area significantly increased in the last two decades (EC, 2005), and the lack of information about these processes, stimulated research on this topic.

Aiming to contribute to this knowledge, we assessed the post-fire effects of ungulate herbivory on the recovery of plant communities in a Portuguese region with a Mediterranean climate, after a wildfire that affected about 3,000 hectares of Mafra municipality. The main goal of the study presented here, was to evaluate the post-fire regeneration capacity of different woody species in relation to the presence/absence of ungulate herbivory.

Materials and Methods

The study area is located in central west Portugal (38°58'30" N, 9°15'52" W), 8 km far from the sea, in a public protected area that was severely affected by a wildfire in September 2003. The altitude ranges between 100 and 350 m and the soils are humic cambisols derived from sandstone. The mean annual precipitation is 798 mm and the mean annual temperature is 14.6 °C. The vegetation is mainly dominated by forests, composed by broadleaved and coniferous species, and by shrublands, dominated by genus *Erica* spp. and *Ulex* spp. In the study area there is also a population of wild ungulates, constituted by *Dama dama* (fallow deer), *Cervus elaphus* (red deer), and *Sus scrofa* (wild boar), with densities of about 0.4 deer/ha, and 0.2 wild boar/ha.

One year and half after the wildfire, we established 10 paired plots of 50 x 4 m, 5 of which were fenced to avoid ungulate access to the vegetation. Between spring 2005 (immediately after fencing) and autumn 2006 the plots were regularly monitored for diversity, abundance and growth (including plants height and diameter). The results presented here concerns observations made on the 10 study plots, totalizing 1,000 m² where ungulates had full access during the whole period and 1,000 m² that were fenced in early 2005. All the woody species present in the area, including trees and shrubs, were monitored. To access the effects of ungulates on plant diversity, we opted to use the Shannon diversity index (Legendre and Legendre, 1998).

Results

In total we found 24 woody species in the study plots (11 broadleaved and coniferous trees, and 13 shrubs), belonging to 19 genus and 15 distinct families. Fenced and unfenced plots had a similar number of species, with only two more species in fenced ones (one tree and one shrub), both in 2005 and 2006. Concerning the tree species, in 2005 the number of individuals in fenced plots was much lower, representing only 37% of all trees, but one year and half later, the situation completely inverted and those plots had already 61% of the total individual numbers (Figure 1). Number of individual shrubs increased between 2005 and 2006, both in fenced and unfenced plots, and although total numbers were very similar in 2006, the increase was much higher in fenced plots (Figure 2).

The Shannon diversity index considerably varied among plots. Considering all trees and shrubs together, we verified that in 2005 the Shannon diversity index in fenced plots varied between 0.70 and 1.62 in 2005, and between 1.34 and 1.96 in 2006, while in unfenced plots it varied between 0.22 and 1.62 in 2005 and between 0.42 and 1.96 in 2006. Considering for each year the five fenced plots together and doing the same for unfenced plots, we verified that there were no significant differences between them with the Shannon index varying between 1.86 and 1.90 in fenced plots and between 1.88 and 1.96 in unfenced plots.

Height and diameter of woody species did not differ significantly for the fencing treatment however the variability of these parameters increased between 2005 and 2006 and the plants growth tended to be larger in the fenced plots.

Discussion

Considering the total number of individuals among all plots, the most common woody species observed in 2006 were shrubs, namely *Cistus salvifolius* and *Erica scoparia* representing respectively 35% and 29%, followed by *Ulex jussiaei* (7%), *Euphorbia characias* (5%), *Myrtus communis* (4%) and *Rubus ulmifolius* (4%). Among trees the most common species were *Pinus pinaster* (3.1%), *Fraxinus angustifolia* (2.4%), *Pistacia lentiscus* (1.8%), *Crataegus monogyna* (1.3%) and *Quercus coccifera* (0.6%).

The majority of these plant individuals were from seed provenience. However we were not able to distinguish the herbivory effects between ungulate species present in the area we believe, based on their

ecology, that *Dama dama* and *Cervus elaphus* are likely to be the main consumers of woody species, however *Sus scrofa* can also have an important role as a seed consumer, mainly from some tree species like oaks and pines.

Results suggest that post-fire ungulate herbivory at these densities and in this type of habitat will not affect the woody species diversity in the early stages. However they appear to negatively affect the trees natural regeneration, both in reducing the number of individuals and their growth. One of the main problems in these kinds of studies is that they require medium or long term monitoring, which is often difficult to accomplish. However we are going to keep monitoring these plots some more time, expecting to obtain more clear results. The lack of information about the interactions between plants, fire and herbivores, difficult the post-fire planning and the decision making about management actions to be taken.

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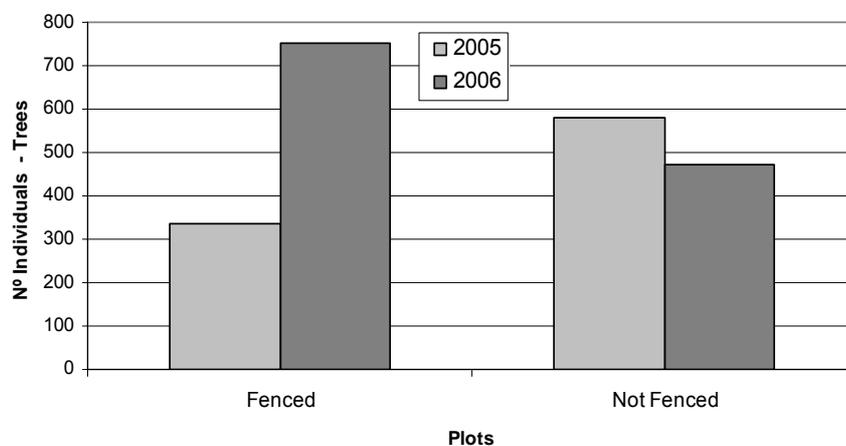


Figure 1 – Total number of individuals of tree species in fenced and unfenced plots, observed in spring 2005 and autumn 2006

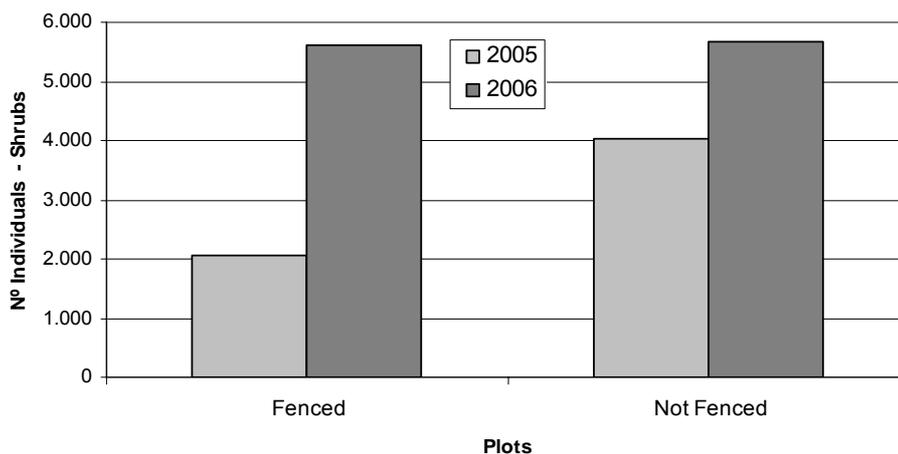


Figure 2 – Total number of individuals of shrub species in fenced and unfenced plots, observed in spring 2005 and autumn 2006