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# Effects of an experimental fire and post-fire stabilization treatments on soil microbial communities

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ABSTRACT

Wildfire is the major type of disturbance in forest and shrubland ecosystems in Galicia (NW Spain). Soil stabilization and rehabilitation techniques are frequently used to minimize the impact of fire on the ecosystems affected. However, information concerning the specific effects of these post-fire practices on soil microbiota is particularly scarce. In the present study we assessed the effect of an experimental fire of low severity, alone and combined with one of two post-fire stabilization treatments (seeding and mulching), on soil microbial communities in a shrubland area in the region. Measurements of soil microorganism biomass (microbial C determined by both the fumigation-extraction and the substrate induced respiration techniques), activity (respiration, β-glucosidase, urease and phosphatase) and diversity (community level physiological profiles by Biolog Ecoplates) were made at different times (1, 90, 180 and 365 days) after the fire and application of the stabilization treatments, and compared with the same measurements made in the respective unburned control soil. Microbial biomass and activity were generally reduced by fire, whereas the microbial diversity was increased by fire. However, the fire-induced changes in microbial communities were relatively small compared with the marked temporal variations in the microbial parameters analyzed, suggesting that this type of fire does not substantially change the soil functioning. This response can be partly explained by the relatively low temperature that the soil reached during the experimental fire. Mulching and seeding treatments did not have any effect on biomass, activity and diversity of soil microorganisms. The implications of these results for management practices are discussed.



## 1. Introduction

Wildfire is the major type of disturbance in forest and shrubland ecosystems in Galicia (NW Spain). In fact, Galicia and the North of Portugal are the areas of Europe most affected by forest wildfires, and worldwide they are amongst the areas with the greatest number of fires per hectare and inhabitant (Carballas et al., 2009; Catry et al., 2010). Approximately half of the wildfires in Spain occur in the temperate humid zone; the number of fires is around 9000 per year on average, and the area burned was on average about 40,000 ha in each of the last ten years (Ministerio de Medio Ambiente, Medio Rural y Marino, 2010). Most of the wildfires occur in shrubland areas (Xunta de Galicia, 2011), which are often located on sloping terrain, in soils with moderate erodibility due to rainfall. All of these factors and post-fire meteorological conditions (abundant high-intensity rainfall events in the autumn period immediately after wildfires) tend to increase runoff and erosion processes in the surface soil horizon (Díaz-Fierros et al., 1982, 1990; Fernández et al., 2008; Vega et al., 2005).

Soil microorganisms are the main agents responsible for the long-term sustainability of soil ecosystems because they control the breakdown of organic matter and the net fluxes and amounts of soil carbon and nutrients via decomposition, mineralization, and immobilization processes (Nannipieri et al., 2003). Furthermore, as microorganisms reflect environmental conditions, they can be used as early indicators of changes in soil quality due to soil perturbation, land use or soil management, before such changes can be easily detected in other soil properties. Hence, analysis of microorganisms is important to elucidate the role of fire in forest ecosystems and to determine the contribution of microbes to ecosystem recovery after fire. Previous studies have shown that several aspects of microbial presence, including number, biomass, activity and composition may be affected by wildfire and that these effects may vary widely depending on fire severity, changes in some soil properties and post-fire environmental conditions (see reviews by Certini, 2005; DeBano et al., 1998; Mataix-Solera et al., 2009; Neary et al., 2005). In general, these studies have shown that fire directly alters the composition of the soil microbial community and activity (in the short-term)

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