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Immediate changes in topsoil chemical properties after controlled shrubland burning in the Central Pyrenees

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Prescribed fire has recently been adopted as an encroachment-fighting strategy in the Central Pyrenees. Despite relatively large information on wildfire impacts on soil, there is little information on prescribed fire effects, especially in mountain ecosystems (Shakesby et al, 2015).
Fire effects are noticeable in the topsoil, particularly in relation to soil organic matter and nutrient contents and quality (Alexis et al, 2012). These components change with time after fire and at the scale of the upper few centimetres of mineral soil (Badía et al, 2014). The aim of this study is to evaluate the immediate effects of prescribed shrubland burning on soil's nutrients and organic matter content to detect changes at cm-scale, trying to differentiate the heat shock from the subsequent incorporation of ash and charcoal. The study area, densely covered with spiny broom (Echinospartum horridum), is located in Tella (Central Pyrenees, NE Spain) at 1900 meters above sea level. Three sites were sampled before burning and immediately after burning just in its adjacent side. The soils belong to the WRB unit Leptic Eutric Cambisol,
Soil samples were collected separating carefully the organic layers (litter in unburned soils and ashes and fire-altered organic residues in burned soils) and the mineral horizon at 0-1, 1-2 and 2-3 cm depths. Soil samples were air-dried and sieved to 2 mm. Soil organic C (by the wet oxidation method), total N (Kjeldahl method), water-soluble ions (Ca2+, Mg2+, Na+, K+, SO4=, NO_3- and NH4+), exchangeable ions (Ca2+, Mg2+, K+, Na+, Fe3+ and Mn2+), total and available P, pH (1:5) and the electrical conductivity (in a 1:10 soil-to-water ratio) were measured.
Immediately after the controlled fire, soil organic carbon content on burned topsoil decreases significantly within 0-3 cm of soil depth studied while total N decrease was not significant. Moreover, only a slight increase of the electrical conductivity, water-soluble ions and exchangeable ions was observed on burned topsoil. These changes detected immediately after fire (SOC decrease and slight nutrients increase) are related to the heat released during the severe intensity of prescribed burning. Few changes in nutrients are yet observed due to the negligible incorporation of ashes into the soil, still remaining on the surface. In the medium term, it can be expected its partial incorporation into the soil and, also, ash and soil losses depending on the rain intensity and the amount of time in which the soil is kept bare.

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