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Fire history modulate soil biogeochemistry and microbial community in Pinus pinaster forests of central Spain

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Abstract

Mediterranean ecosystems are considered to be resilient to fire. However, changes in the fire regime (frequency, severity, etc.) may compromise the stability of these ecosystems. It is expected that, in the future, as a consequence of changes in land use and climate, fire frequency might increase. Fire is an important regulator of soil C and N accumulation and losses. However, very few studies have evaluated the effect of fire in the long term under increased fire frequency. Here, we determined the effect of the fire history (fire frequency, time since the last fire and fire return interval) on soil C and N dynamics and the main microbial groups in *Pinus pinaster* forest in central Spain. The study area is located in the southern face of the Sierra de Gredos, in central Iberian Peninsula. 28 stands were chosen differing in the number of fires (0, 1, 2 and 3) occurred between 1976 and 2018, in the time elapsed since the last fire and the interval undergone between the last two consecutive fires. Soil C and N fractions (total, organic, microbial and easily extractable) as well as their mineralization rates (i.e. heterotrophic respiration, nitrification and N mineralization rates) were analyzed. Additionally, the microbial community of these soils was characterized by analysis of fatty acid profiles (esther linked fatty acids, ELFAs). We found that, in general, most of the studied biogeochemical and microbial variables showed clear differences between unburned and burned stands. Increased wildfire frequency only modified total C and nitrification rate. The time interval between the two most recent consecutive fires was generally not a significant variable. The time elapsed since the last fire was the most important fire history variable and governed the main soil dynamics. Recovery of pre-fire values of the studied variables took about 30-40 years after fire. The fact that some stands burnt up to thrice in a period of 43 years, and that palaeoecological records hint at fire return intervals of more than a century for native *Pinus pinaster* forests, support the strong resilience of these soils to increased fire frequency. Our work supports arguing that the management of this ecosystem should concentrate on prioritizing areas based on the time

since the last fire, focusing on preventing fires in stands below 40 years since the last time, to ensure the stability of this system.

Keywords: Fire recurrence, fire return interval, soil C, soil N, microbial community structure

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