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Soil prokaryote community structure and C and N related biological conditions following fires in Mediterranean native forest of central Chile

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Abstract

Fires are important drivers of ecological processes in forest ecosystems. However, these events also represent an important pressure that induce land degradation worldwide, especially in regions with Mediterranean climates with dry summers and elevated temperatures. In Chile, these events have drastically raised over the last decades, and while most of the fires registered in the country are of anthropogenic origins (accidental or intentional), changes in local climatic conditions are also related to the occurrence of these events. Under this scenario, fire behavior in Chile is expected to endanger the resilience of forest ecosystems. Thus, understanding how soil biological and physicochemical conditions behave after fires is of central importance to elucidate ecosystem restoration under conditions where natural recovery is hampered. This study aimed to evaluate prokaryotic community structure and C and N related biological soil conditions of soils from fire-affected sclerophyll forests in the Mediterranean climate zone of central Chile. Molecular analyses based on 16S rRNA coding genes revealed the presence of 22 classified bacterial phyla and 2 archaeal phyla. Out of these Actinobacteria and Firmicutes phyla abundance significantly decrease in burned soils, while Acidobacteria and Rokubacteria increased significantly in fire affected soils. Among Archaea, the phylum Thaumarchaeota evidenced an increase in burned soils. Molecular analyses and culture-based techniques focusing on diazotrophic microorganisms evidenced a decrease of N fixing microorganisms following fires, with differences in relative abundances of Clostridiales, Rhizobiales, Bacillales, Fibrobacterales and Nostocales orders. Multivariate analyses showed dissimilarity of prokaryote communities according to fire occurrence, which was associated mainly with changes in soil nitrate contents. Carbon source utilization patterns of soil microbial communities assessed using Biolog EcoPlates™ (Biolog Inc., Hayward, CA, USA) reflected a decrease of C substrate utilization for recalcitrant substrates and a high L-Asparagine consumption in all soils studied, particularly in burned soils. These findings will allow to better understand microbial states over ecological succession following fires and potential resilience of prokaryote communities and diazotrophic populations at fire-prone ecosystems of central Chile.

Keywords: community-level physiological profiles, illumine sequencing, N-fixing bacteria, sclerophyll forest, wildfires.

References

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