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Wildfire impacts on soil characteristics in two *Pinus halepensis* Mill. stands within a Natura 2000 site (Southern Italy)

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Forest fires are a complex disturbance linked to several factors, such as climate conditions, vegetation types and human activities. Their frequency and intensity/severity have increased in recent decades and this trend is projected to continue because of climate change. Particularly critical are wildfires that frequently affect natural areas. In 2020 across Europe about 131474 hectares of surface within the Nature 2000 Network (N2K) were burnt. In addition to causing damage to vegetation, fire can affect soil characteristics influencing the functioning of the whole forest ecosystem. Understanding the influence of fire on the soil system provides information on its resilience and can be a useful tool for supporting forest management.

This research complements a larger multidisciplinary research project monitoring the conservation status, *sensu* Habitat Directive 92/43/EEC, of the Habitat of Priority Interest 2270*-Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*, within the Special Areas of Conservation (SAC) IT9130006-Pinewoods of the Ionian Arch. Here, we explore the relationships between soil and vegetation as a function of different fire conditions considered capable of triggering multiple successional pathways, potentially leading to habitat degradation. In this context, the specific objective of this work was to evaluate the long-term effects of wildfires on the soil properties in two Aleppo pine stands within the "Romanazzi" and "Marziotta" sections of the SAC that have been influenced by fires between 1997-2006 and 2000-2012, respectively. In both stands, three sites were identified: double-fire, single-fire and unburnt (control) sites. In March 2021, a synchronic sampling across sites, covering a period of 9-24 years post-fires, was performed. In each of them, the weight and organic carbon content of the organic layer (O-layer) were measured alongside the physicochemical and biological properties of the underlying topsoil (0-10 cm depth, n=5).

Our results show the absence of the O-layer in double-fire sites, indicating a loss of this organic carbon pool. On the contrary, in both single-fire sites, this layer had successfully recovered. Our data suggest that the recovery in the O-layer in single-fire plots might be independent of the time elapsed since the wildfire. Regarding soil properties, compared to control sites, both single and

double-fire sites for each stand exhibited significant alterations in specific soil chemical properties, *i.e.*, pH, electrical conductivity, content in total organic carbon (C_{org}), extractable organic carbon, nitric and ammoniacal nitrogen, as well as decreases in soil microbial biomass (C_{mic}), respiration, and C_{mic}/C_{org} ratio. Of particular interest was a significant alteration in the N-cycle with increased mineralization and nitrification rates in all burnt sites at both stands. Principal component analysis showed that the impact of multiple fires may not depend only on frequency or time since the last fire, but also on frequency-time interaction.

In conclusion, the burnt sites have not recovered to control levels for many soil characteristics, especially for N-cycle processes. The increase in N mineralization, nitrification and, consequently, in N availability could induce shifts in the plant, fungi, and pedofauna community structure, thus affecting the successional pathways with consequences on the resilience of the target forest ecosystem.