

Fire severity overwhelms climate, soil moisture and topography in shaping vegetation recovery trajectories at short-term after fire in Mediterranean communities

¹Calvo, L., ¹Marcos, E. and ²Fernández-Guisuraga, J.M.

¹*Universidad de León*

²*Universidade de Trás-os-Montes e Alto Douro*

Abstract

Extreme wildfires may cause unpredictable shifts in the composition and structure of Mediterranean plant communities, and, ultimately, may hinder vegetation recovery trajectories and ecosystem resilience. Most research in fire ecology and remote sensing fields has primarily concentrated on assessing vegetation greenness as an indicator of post-fire vegetation dynamics (e.g. Helman et al., 2015; Prodon and Diaz-Delgado, 2021), rather than focusing on the recovery of biophysical properties using robust physical-based models. The latter approach would allow to disentangle vegetation recovery drivers, considering the variability of biophysical properties intrinsic to the species assemblage of each vegetation community (Fernández-Guisuraga et al., 2021). Moreover, the development of comprehensive models that integrate a wide range of fire regime and geophysical variables is still lacking in the current literature. Here, we investigated the role of fire severity and a comprehensive set of geophysical drivers in the post-fire vegetation recovery of Mediterranean landscapes. The fractional vegetation cover (FCOVER) recovery was selected as a resilience indicator retrieved from Sentinel-2 imagery by the inversion of the PROSAIL-D radiative transfer model (Verhoef et al., 2007; Féret et al., 2017) in *Pinus sylvestris* (Scots pine) forests and *Cytisus oromediterraneus* (black broom) shrublands. We selected 18 variables pertaining to fire severity, climate, post-fire soil moisture and topography as predictors of FCOVER recovery, calculated as the ratio of post-fire to pre-fire FCOVER. Random Forest regression (RFR) was used to disentangle the influences of fire severity and geophysical drivers on community-specific FCOVER recovery. The estimated FCOVER showed a good agreement with field validation data ($R^2 = 0.91$), without significant under or overestimation. Fire severity was the most important variable in driving FCOVER recovery in black broom shrublands and Scots pine forests at short-term after fire. Pre-fire climate, soil moisture and topography variables were not meaningful predictors at this time scale. Our findings offer novel insights into the processes that underlie resilience after extreme wildfire events in the western Mediterranean Basin. Pre-fire management efforts should be

undertaken to avoid the fuel conditions most susceptible to high wildfire severity.

Keywords: *Pinus sylvestris*; radiative transfer model; resilience; shrubland

References

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