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Species climatic niche explains post-fire regeneration of Pinus halepensis under compounded effects of fire and drought

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Abstract

Fire and drought are two major agents modeling Mediterranean ecosystems. Despite the wide knowledge accumulated on their individual effects, fire-drought interactions have not yet been enough studied. We use *Pinus halepensis* as species case study to assess the influence of compound fire-drought regimes on the success of post-fire regeneration. This obligate seeder species, that produces semi-serotinous cones that release abundant seeds after being heated by wildfires, is widely distributed over the Mediterranean Basin. We set forty-three sampling areas in *P. halepensis* forests that burned between 1994 and 2013 along the Spanish east coast. In each plot we measured the density of pine recruitment in several replicates (mean = 18893 tree/ha , sd = 56401 tree/ha), avoiding burned areas close to surviving adults that may have released seeds continuously after the fire. We characterized the environmental space occupied by *P. halepensis* within the study range (i.e. bioclimatic niche) based on historical series of precipitation and temperature for the warmest quarter (period 1979-2013) to compute the centroid or distribution optimum of the species. Then, we localized the climatic coordinates of our sampling areas within the species' environmental space to compute climatic deviations concerning species' optimum for the 5 years previous and posteriors to the respective fire event. Finally, we built GLMs where *P. halepensis* density was the response variable, and pre- and post-fire climatic deviations, as well as the severity of each fire event (as DNBR), were the explanatory variables. Contrary to what might be expected we found a significant positive relationship between fire intensity and the density of pine regeneration of *P. halepensis* populations. However, the interaction of fire severity with deviations in temperature, as a drought indicator, can have opposite effects on regeneration density depending on whether they occur before or after the fire event. Although *P. halepensis* can regenerate after high-intensity fires, the interaction of fire effects with drought conditions can alter the response of this species.

Keywords: post-fire regeneration, Pinus halepensis, climatic niche

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