CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

## *Research Brief for Resource Managers*


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# Hot Fire, Cool Soils in a Mediterranean Shrubland

*Stoof, C.R., D. Moore, P.M. Fernandes, J.J. Stoorvogel, R.E.S. Fernandes, A.J.D. Ferreira, and C.J. Ritsema. 2012. Hot fire, cool soil. Geophysical Research Letters 40:1-6.*

In areas where litter and duff are shallow, discontinuous, or absent, as in Mediterranean shrublands, soil heating and potential soil damage is expected to increase as fuel load increases. Stoof et al. found that in a prescribed fire experiment in Portugal, soils were unexpectedly cool where fuel loads were high and fire was hot. Conversely, soils were hot where expected to be cooler (Figure 2).

Prior to conducting the experimental burn, data on soil depth, vegetation cover and height, and fuel load were collected in the nine hectare Portuguese Valtorto study site. The catchment was burned using "backfire and headfire techniques to maximize convection and reach the maximum fire intensity possible". During the fire, flame temperatures, soil surface temperatures, and flame height (fire intensity) were measured. Spread rate was calculated from the timing of maximum temperatures.

While fire intensity (flame length) increased with fuel load as expected, soil temperatures decreased with increased fire intensity.

## Management Implications

- In shrubland vegetation with little litter and duff, soils with high fuel loads may be at less "risk for fire-induced soil degradation, while more sparsely vegetated areas may be at higher risk".
- In Mediterranean-climate shrublands Caution should be exercised in inferring the degree of soil damage from fire intensity measurements until there are more data relating fire behavior processes to soil heating in shrubland ecosystems.

This counter-intuitive result was attributed to three factors: 1) higher fire intensity increased upward heat transfer, 2) areas of high fire intensity and rapid spread had lower residence times and less time for soil exposure to heat, and 3) shrubland fires move primarily through the canopy and soils under taller vegetation have less exposure to heat release because vertical fuel continuity decreases with shrub height.

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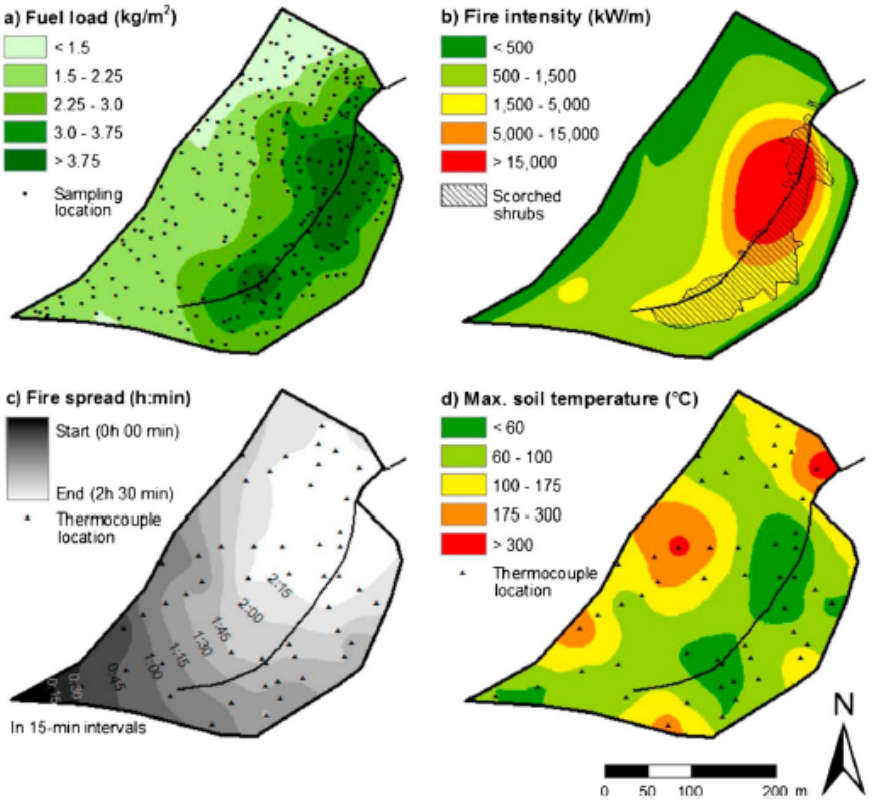


**Figure 2.** Fire and fuel characteristics in the Valtorto catchment. (a) High fuel load and (b) fire intensity were associated with rapid fire spread (wide color bands in (c)) and (d) cool soils. In contrast, hotter soils were associated with low fuel load and fire intensity and slower fire spread.