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Research Brief for Resource Managers

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Live Fuel Moisture Varies among Chaparral Species

Pivovaroff, A.P., M.R. Sharifi, M. Witter, J.E. Keeley, and P.W. Rundel. 2019. The effect of ecophysiological traits on live fuel moisture content. Fire 2: 12pp. doi:10.3390/fire2020028

A low percentage of live fuel moisture content (LFMC) is an important metric for predicting fire danger in chaparral. However, the physiological traits that control LFMC among highly diverse chaparral species is poorly understood. To remedy this, the authors measured chaparral ecophysiological traits to understand how LFMC varied among chaparral functional groups.

Researchers cut and processed branches to get wet/dry weights and measured several important ecophysiological functions for 11 woody chaparral species growing at UCLA Stunt Ranch Reserve, Santa Monica Mountains, CA. These included photosynthetic CO_2 assimilation rate, transpiration rate, stomatal conductance rate, intrinsic water efficiency, water potential at saturation point and turgor loss point, relative water content at turgor loss point, osmotic potential, elasticity modulus, capacitance at full turgor and turgor loss point, and leaf dry matter content. Using these measures, the researchers were able to calculate and compare several different plant traits among these species, including LFMC (%), plant water potential, gas exchange, and pressure/volume curves.
The results showed that all of the measured functional traits including access to water (root depth), water regulation (transpiration rate), drought adaptation (stomatal opening), and photosynthesis (CO_2 assimilation) worked together to control both LFMC and water potential. Further, the traits differed enough between species to cause variable LFMCs and water potentials during different seasons (Fig.1, 2). During the rainy season (Jan-May) there were variable LFMCs with wide divergence between species. As the dry season progressed (Aug-Dec), most species converged on approximately the same LFMC. Water potentials also varied by species and season.

Management Implications

- Chamise, *Adenostoma fasciculatum,* is indeed a good choice as a fire risk indicator species. It is abundant, geographically widespread, and of the 11 species that were assessed, it was the first to reach the critical 78% LFMC threshold during the fire season (Fig. 1).
- In contrast, some other species such as *Malosma laurina and Heteromeles arbutifolia* are not good fire danger indicator species because they maintain higher dry season LFMCs that does not represent the condition of most of the vegetation.
- Revising the critical threshold from 60% to 80% chamise LFMC would provide a more conservative estimate of the risk of extreme fire behavior in southern California chaparral.

Finally, these researchers found that there was a common tipping point, or "inflection point," for most species, after which winter LFMCs dispersed (80% LFMC; -2$MP_{a\ water}$ potential; Fig.2). This point coincides with critical fire thresholds identified in other studies (Dennison and Moritz, 2009).

Overall, the study demonstrates that a whole suite of physiological traits controls both LFMC and water potential. It also supports raising the critical LFMC from 60% to 80% LFMC as the threshold for high flammability used by fire departments to measure ignition potential. The authors conclude by emphasizing the importance of understanding basic ecophysiological plant traits with impending drought and extreme fire.

Further Reading:

Dennison, Philip E and Max A Moritz. "Critical Live Fuel Moisture in Chaparral Ecosystems: A Threshold for Fire Activity and Its Relationship to Antecedent Precipitation." International Journal of Wildland Fire 18, no. 8 (2009): 1021-27.

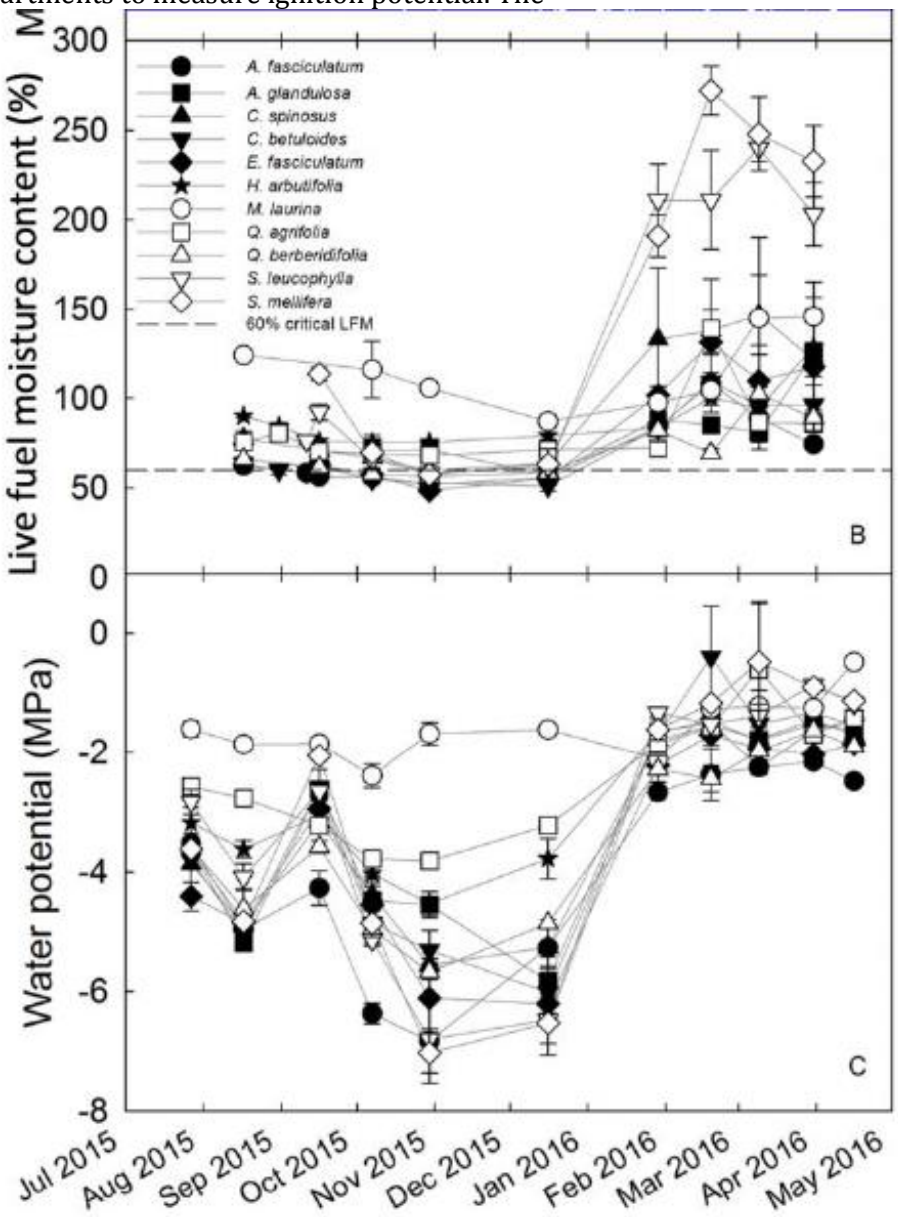

Figure 1. (B) Live fuel moisture content including the 60% critical threshold used by Los Angeles County Fire Department and (C) midday water potential measured for 11 species at Stunt Ranch.

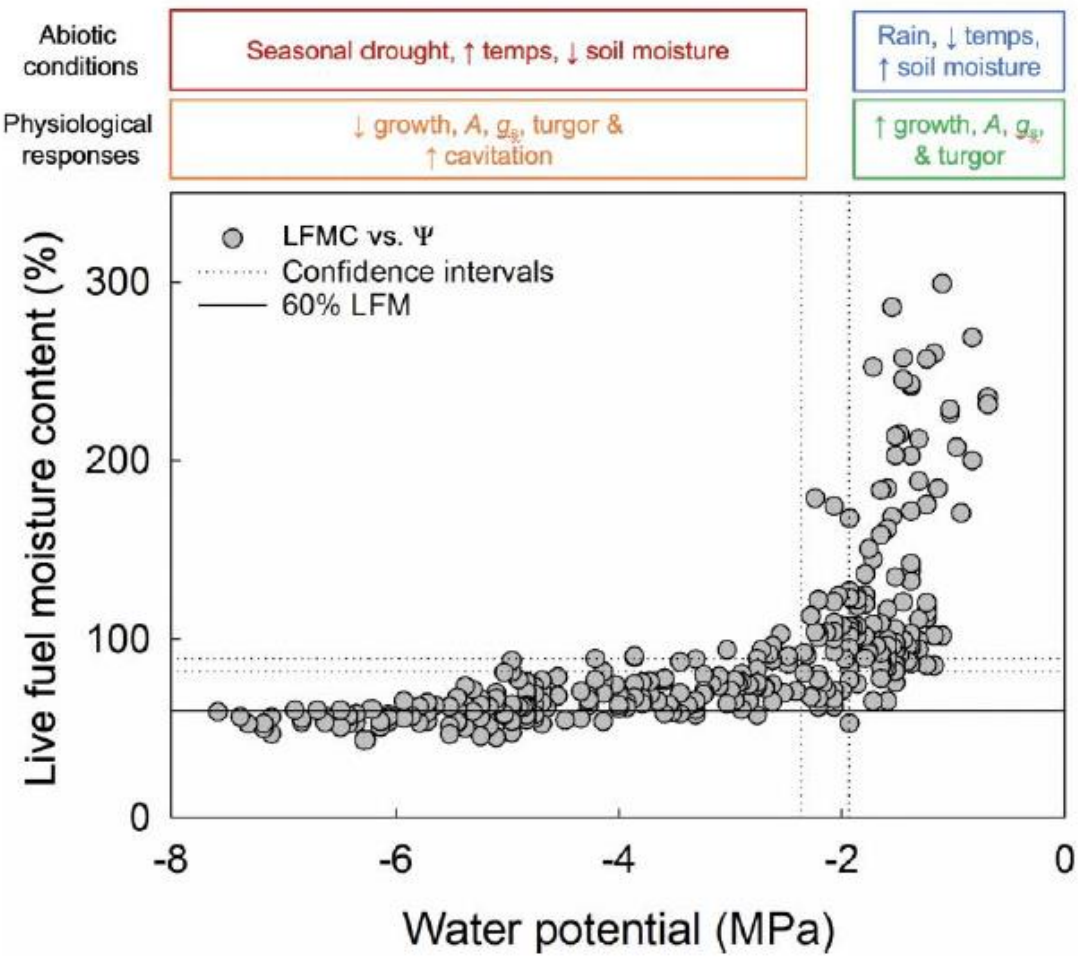

Figure 2. Live fuel moisture content (LMFC) versus water potential (Ψ) for 11 species measured at the Stunt Ranch Santa Monica Mountains Research Reserve from July 2015–May 2016 (grey symbols). Each grey symbol represents a data point. The solid black line represents the 60% critical LFMC threshold used by fire departments in southern California. Dotted lines represent the 95% confidence intervals for Ψ and LFMC; the intersection of the confidence intervals represents the LFMC versus Ψ inflection point (LFMCIP). At the top of the figure, there is a conceptual explanation of abiotic conditions and physiological responses associated with LFMC and Ψ changes.