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EDITORS' HIGHLIGHT

When fire acts like an irrigation: competition release after burning enhances growth

Víctor Resco de Dios[1]

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The Earth is greening up. The encroachment of woody plants into former grasslands, and the thickening and regrowth of woodlands and forests are a global phenomenon. Rural exodus and land abandonment, feedbacks from grazing and herbivory over the fire cycle and increases in CO_2 concentrations, to name but a few, have been claimed as contributing factors across different areas of the globe. The extent of woody plant encroachment and forest regrowth is such that they are currently thought of as major drivers of the land C sink (Field et al. 2007).

Paradoxically, as the Earth is becoming greener, the forests are getting drier. There is substantial debate as to whether this is the direct result of climate change, and on the potential feedbacks to an acceleration or a deceleration of the hydrological cycle (Roderick et al. 2015). However, there is consensus that, as tree size and density increase, the available water will need to be shared by increasingly higher leaf area and number of plants. As a result, tree competition after woody thickening increases and exerts a negative feedback on tree growth and survival (Ruiz-Benito et al. 2013).

How to maintain the strength of the land C sink while preserving healthy forest ecosystems far from collapse thus remains an important global challenge. The article by Alfaro-Sánchez et al. (2016) in this issue presents a novel approach to tackle this problem and indicates how fires could, at least in some areas, be part of the solution. The authors inferred basal area increment from tree rings in different stands of the Mediterranean Aleppo pine (*Pinus halepensis* L.) across a productivity gradient subjected to low or medium severity fires, as well as in unburned controls. They observed how low and medium severity fires had a positive effect on the growth of the surviving trees, and how that effect was predictable from, and dependent upon, the interaction between site productivity and fire severity (Fig. 1).

The study of Alfaro-Sánchez et al. (2016) is important and novel for different reasons. First, because it links applied forestry with classical ecological theory and ecophysiology, and also shows the way forward for merging theory with practice. There are long-term standing debates in the ecological literature on how the intensity and the importance of competition vary across productivity gradients (Grace 1991), and this work indicates how the importance of competition is positively related to site productivity. The positive effect of fire on growth was driven by decreases in tree density, and the effect size increased with site productivity (Fig. 1). Moreover, the study of Alfaro-Sánchez et al. (2016) goes one step further. By examining the stable isotope composition of C and N in wood, they were able to link the positive effect of fire to post-fire increases in water and N availability. Although the study was conducted after unplanned fires, it has immediate implications for guiding forest thinning and prescribed burning as tools to diminish water stress in forest stands.

Another important aspect of this study is that the authors were able to quantify fire severity. It is an unfortunate but common practice to consider fire as a binary ("on/off") variable, whereas in reality fires are spatially heterogeneous and their effects vary markedly depending upon local variation in intensity and severity. The approach presented in this study presents an elegant solution to the problem of documenting the severity of unplanned fires,

✉ Víctor Resco de Dios
v.rescodedios@gmail.com

[1] Department of Crop and Forest Sciences, AGROTECNIO Center, Universitat de Lleida, Rovira Roure 191, 25198 Lleida, Spain

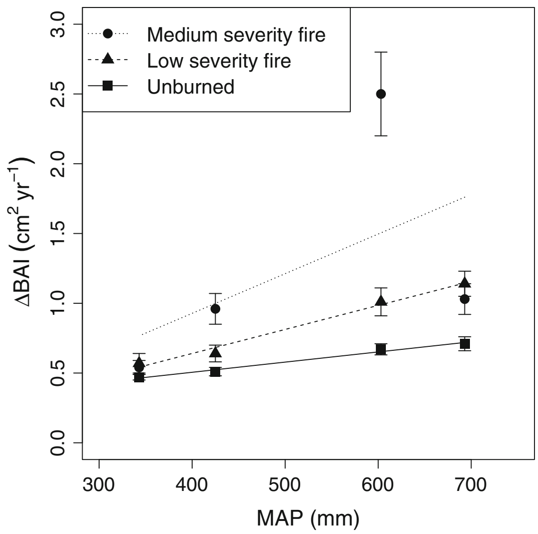

Fig. 1 Fire has a positive effect on the growth of surviving trees, but dependent upon site productivity and fire severity. Mean annual basal area increment during four post-fire years, relative to that in the four pre-fire years (ΔBAI), is plotted for four different sites scattered across a gradient in mean annual precipitation (MAP). *Each point* (and *error bar*) indicates the average (and standard error) of 15–21 trees per site and fire severity class. The *lines* are the result of least squares fitting. Data comes from combining Tables 1 and 2 in Alfaro-Sánchez et al. (2016)

where no in vivo measurements are available, by combining forest inventory with remote sensing data.

Forest management and ecological theory require a robust understanding of the underlying mechanisms and, as Alfaro-Sánchez et al. (2016) show, physiological ecology could act as the bridge between these disciplines. These integrated approaches are required to solve pressing issues, such as the maintenance of a healthy land C sink under increasing woody cover and drought stress.

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