

Fire or water: which limits tree biomass in Australian savannas?*

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Summary

The processes that allow the coexistence of trees and grasses in tropical savannas have long intrigued ecologists. Early theories had a strong focus on climatic controls, but over the last two decades a conceptual model has emerged suggesting that savanna trees are subject to a fire-mediated recruitment bottleneck. Under this model, frequent savanna fires prevent recruitment of saplings into the tree layer, and this bottleneck maintains tree biomass below a climate-determined carrying capacity. We propose that the relevance of this conceptual model, which is based largely on African savanna research, has been substantially overemphasised in the northern Australian context. In this region, the overall abundance of trees in savannas is very strongly controlled by water availability, not fire. There is considerable evidence that the dominant trees of Australian savannas – eucalypts – are one of the most fire-tolerant tree lineages on Earth, and have a remarkable capacity to grow rapidly through the ‘fire trap’ and reach fire-resistant sizes. The extreme fire tolerance of savanna eucalypts makes them relatively unresponsive to reductions in fire frequency and intensity. In contrast, other groups of trees in Australian savannas typically have a much lower capacity to escape the fire trap, and therefore respond positively in abundance to reductions in fire frequency and intensity. From an applied perspective, there have been suggestions that managers could sequester substantial quantities of carbon (thereby offsetting anthropogenic greenhouse gas emissions) by reducing the frequency and intensity of savanna fires and, hence, increasing tree biomass. We contend that if tree biomass in Australian savannas is strongly limited by water availability, then the potential for fire management to increase tree biomass is relatively limited, at least in relation to the dominant eucalypt component. There may be potential to increase the abundance of the more fire-sensitive non-eucalypt tree component, but the biomass carrying capacity of non-eucalypts in this eucalypt-dominated system remains poorly understood, including whether there is a trade-off between eucalypt and non-eucalypt biomass.

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