How do drought and fire influence the patterns of resprouting in Australian deserts?

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Globally, rainfall is the key driver of tree and shrub cover in arid grassy biomes where fire disturbance is usually rare and of low intensity. However, relatively little is known about the factors determining plant community composition in arid systems that are subject to periodic intense fire disturbance. In arid and semi-arid parts of central Australia, landscape-scale fire can occur following above average rainfall, but woody species regeneration patterns (resprouting vs. reseeding) are poorly understood for this region. As managers of this extensive and highly flammable landscape, we need to have a good understanding of what factors determine the distribution of species, and hence their tolerance of, or vulnerability to fire effects. This in turn helps us distinguish between areas where we need to put in a lot of management effort (i.e. in habitat where fire has long-lasting negative effects) from those where management effort is largely redundant (where species are tolerant of a range of fire regimes). Studies of other flammable systems in more mesic regions have shown that species, and hence plant communities, are not randomly distributed in the landscape – rather there is a high degree of predictability according mainly to rainfall gradients. In the most general terms, the pattern that has emerged across the globe (outside of arid regions), is that resprouters dominate the high end of rainfall/resource gradients because they cope best with frequent disturbance and intense competition from other plants.

In this study, we looked at whether or not species fire responses changed in a predictable way from north to south in central Australia, and therefore according to the close-to-linear relationship between annual rainfall amount and fire frequency (both highest in the north). We also considered which had the greatest effect: habitat type (namely hummock grassland vs. Acacia shrubland) or latitudinal location in the landscape. We found that there was a strong effect both of habitat type and of latitude: specifically, there were proportionately more species capable of resprouting after fire in grassland than in shrubland habitat, and in the north compared with the drier south. This fitted with the results found in other regions of the world and we attributed this pattern to the combined negative effects of frequent fire and rapid gap closure on seedlings of slow-growing, fire-killed woody species in higher rainfall grasslands. Importantly, we also found that the group of plants with basically the opposite life history to the group of strong resprouters – these being fast-growing and short-lived fire recruiting species – were similarly favoured by high fire disturbance. We showed therefore, that differing from tropical savannas, grassland in arid/semi-arid central Australia supports a mixture of resprouting and fire-recruiting functional types, and habitat- and regional-scale floristic composition cannot be predicted by resprouting capacity alone. We argued that this greater functional complexity is most likely a product of the longer intervals between grassland fires in this region compared to mesic biomes. Looking more broadly at the entire woody flora, we found

evidence for a subset of fire specialists in the grassland habitats, and at the other extreme, for a subset of slow growing fire-killed species that was strongly associated with less frequently burned Acacia shrublands and with the driest and least productive sites. Overall, our work emphasised that regions such as central Australia, that are characterised by grassland-shrubland mosaics of high and low fuel biomass respectively, pose specific challenges that are possibly best addressed by focussing modelling and management at the habitat rather than the landscape scale.