Contrasting water relations are associated with species distribution and crown decline in four common sympatric eucalypt species in south-western Australia

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Background/question/methods: Drought-associated vegetation declines are increasingly observed around the world including Mediterranean south-west Australia which has experienced a 15% rainfall reduction over 40 years. We investigated whether differences in water relations can potentially explain species distribution and vulnerability to drought-induced decline in four co-occurring tree species. We compared seasonal and daily water relations of four common south-west Australian eucalypt species (i.e. *C. calophylla, E. accedens*, *E. marginata, E. wandoo)* on a site where they all co-occurred as well as on nearby typical sites for each species.

Results/conclusions: Species with their centre of distribution in drier regions (i.e. *E. accedens*, *E. wandoo*), were characterised by substantially lower leaf water potentials (predawn and midday), lower osmotic potentials, higher stomatal conductances, higher relative sapflow velocities and a much lower vulnerability to cavitation. On sites where they are dominant, *C. calophylla* and *E. marginata* showed greatly improved leaf water status indicating better soil water access. Our results suggest that the regional distribution of these species is consistent with their water relation characteristics and the implications that these have for growth and survival along a rainfall gradient. However, local distribution is also strongly dependent on soil profiles and root system architecture, with shallow-rooted *E. wandoo* only occurring on eroded soil profiles with clay layers close to the surface where it can make optimal use of its superior water extracting ability. In contrast, the wetter-zone species *C. calophylla* and *E. marginata* are deep-rooted and rely on accessing weakly held water in a large soil volume, explaining their dominance on deeper well-draining soils. Our work demonstrates that combining plant water relations with detailed local knowledge on soil profiles, species habitat preferences and root system architecture can greatly improve our understanding of local species distribution patterns. This is essential to improve our capacity to understand and predict drought-induced declines.

Dr Pieter Poot is a plant ecophysiologist from the Netherlands who arrived in WA 14 years ago. He is interested in the ecophysiological and evolutionary drivers of plant species distribution patterns. Currently Pieter has a shared position between UWA and the Department of Environment and Conservation.

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