Written in Wood – What Trees Can Tell Us about Rainfall and Hydrology of the Cave Systems in the SWWA

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The significance of recent shifts in the amount and seasonal distribution of rainfall across Australia remain uncertain owing to a lack of long-term climate records. We have used *Callitris columellaris* (native cypress pine) from southern and northern WA to develop the only two multi-century tree-ring records of rainfall for continental Australia. These reconstructions reveal synchronous periods of drought and wet conditions between northwest and southwest Australia as well as a generally anti-phase relationship with hydroclimate in southeast Australia over the last two centuries. However, reconstruction skill for coastal WA remains poor; this lack of knowledge of past regional variation in rainfall change, particularly at catchment scales, in turn limits capacity to predict impacts on hydrology and the resilience of ecosystems to future climate change. We have thus recently commenced investigations of the "dendroclimatic" potential of karri (*Eucalyptus diversicolor* F. Muell).

At Boranup (SWWA), karri grows in close association with caves used for speleothem reconstructions, allowing direct comparison and possible verification of these proxies. Karri may be long-lived (> 500 years) and our analyses to date indicate ring formation is primarily annual and that growth is sensitive to environmental change. For example, trees from the same stands exhibit similar narrow rings, implying reduced growth in particularly dry years. However, it remains unknown if karri are under stress from recent declines in winter rainfall. Karri on the karstic systems of SWWA may grow roots to >60 m depth. The ecohydrological significance of deep-rooted trees in these seasonally dry environments has not been quantified. We are coupling our tree-ring studies with an assessment of the hydraulic structure and function of deep roots and their contribution to water use of karri (e.g. Do they access cave water? What is the volume of water transpired?). We compared deep roots (>40 m depth) accessed via Moondyne Cave, near Augusta, with shallow roots (<0.5 m depth) and tree stems. We hypothesised that deep roots significantly increase tree water use, contribute relatively more water during drought, and show more consistent seasonal patterns of water transport than shallow roots in soil layers subject to regular wetting and drying cycles. However, preliminary results to date have revealed that trees were primarily dependent on stored soil water (1-4 m depth). Over the next few years, we hope that outcomes from this research inform questions around groundwater recharge and water cycling in these forested karstic systems.

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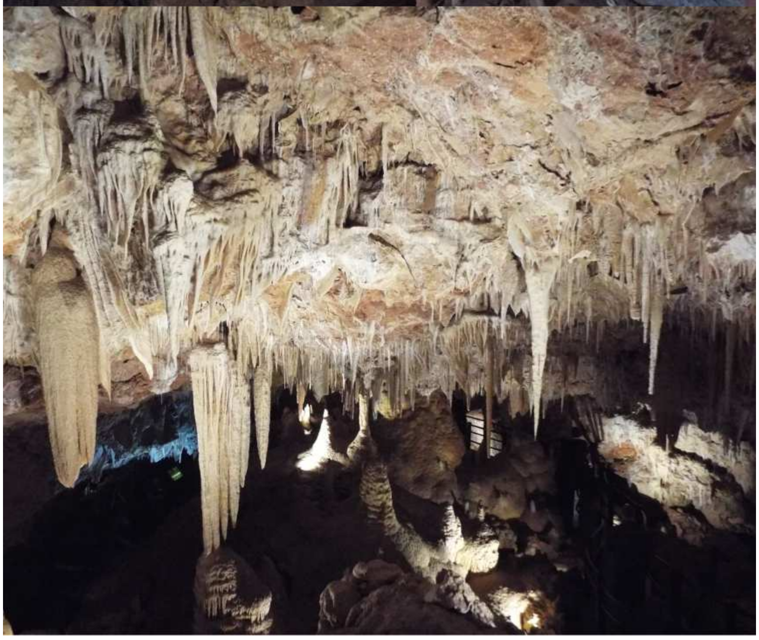

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