

Assessing water use by *Prosopis* invasions and *Vachellia* karroo trees: Implications for groundwater recovery following alien plant removal in an arid catchment in South Africa

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ABSTRACT:

Prosopis spp., (or Mesquite), is a desert adapted woody weed which has invaded large parts of arid and semi-arid regions. It has a characteristic deep tap root, and forms dense impenetrable thickets along river banks, flood plains, and seasonal water courses. Several studies have quantified the water use by *Prosopis*, but there is limited information on how this compares with that of co-occurring groundwater dependent indigenous tree species in the arid and semi-arid tropics. Consequently the effects of removing *Prosopis* on groundwater, where they co-occur with indigenous trees, are not known. This study quantified the incremental water use by *Prosopis* invasions compared with the indigenous deep rooted *Vachellia* karroo (*V. karroo*) trees that normally replace *Prosopis* once it has been cleared. The study was done in an arid catchment in the Northern Cape Province of South Africa. Stem sap flow dynamics, groundwater levels, and weather data were collected hourly over 15 months in the invaded catchment. Data collection continued for a further 11 months after *Prosopis* had been cleared to monitor the recovery of the ecosystem from the invasions. There was no significant difference ($P = 0.116$) in the sap flux density of the two species although *Prosopis* had a much thinner sapwood depth than *V. karroo* due to its ring porous wood anatomy. However, at the stand scale *Prosopis* transpired more than five times more water ($\sim 544 \text{ mm y}^{-1}$) than *V. karroo* ($\sim 91 \text{ mm y}^{-1}$) since there were six times more *Prosopis* than the indigenous species. The removal of *Prosopis* slowed down the rate of decline of the water table from a pre-clearing peak of $\sim 8.9\text{--}5.0 \text{ mm d}^{-1}$ after alien plant removal. Tree transpiration was accurately

predicted by a simple model that used aquifer properties and hourly changes in water table depths with a RMSE of $\pm 0.22 \text{ mm d}^{-1}$ before and $\pm 0.32 \text{ mm d}^{-1}$ after clearing *Prosopis*.