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Understanding patterns of water use in a subtropical woodland using stable isotopes

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Vegetation structure in the arid subtropics is often highly variable across the landscape, reflecting at least in part the high spatial and temporal heterogeneity of rainfall, groundwater and soil moisture. Here, we investigated how patterns of water uptake by trees and shrubs differed across landscape positions in the Pilbara region of northwest Australia and assessed the responsiveness of trees and shrubs to large (cyclonic) rainfall events. We sampled water stable isotope compositions of xylem, soil, rain and groundwater as well as soil water content and root distributions of eucalypt and mulga woodlands in the Pilbara region over three years. Based on the 18O results, we found that the sampled plant taxa (mulga, Eucalyptus victrix) were using water originally derived from a large rainfall event (Cyclone Heidi), both at lowland and upland sites. Trees and shrubs such as mulga were accessing shallow soil water of meteoric origin. Eucalyptus victrix accessed water deeper in the profile (8-10 m) as surface soils dried out. Mulga appeared to store water for many months after the recharge event. This ability to take up and likely store a large proportion of shallow soil water after rainfall is a key feature enabling mulga to survive through the period of greatest water demand and to acclimate to the spatiotemporal changes to water conditions in the soil profile. Alternatively, episodic cyclonic recharge maintains deep soil and groundwater resources that maintain deeper-rooted species such as E. victrix throughout the prolonged drought periods.