Using stable isotopes to identify soil moisture sources of key species in riparian woodlands

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Project background

Riparian woodland remnants on the upper Condamine River floodplain, southern Queensland (Fig. 1a), are in poor condition, with significant dieback and limited recruitment of the dominant canopy species, Eucalyptus camaldulensis (river red gum), as well as invasion by the introduced herb Phyla canescens (Lippia) (Fig. 1b). Mature trees facilitate the persistence of lippia under drought conditions in this landscape. However, the high density ‘halo’ of lippia under tree canopies (Fig. 1c) may have adverse impacts on tree condition, exacerbating dieback, as a result of increased competition for scarce soil moisture resources.

Clarification of water relations contributes to better understanding of environmental constraints on species, particularly under stressful conditions. It also highlights the potential risk associated with future climate change which may contribute to increased incidence of prolonged drought and intense flooding, increased dispersal of invasive weed species, accelerated groundwater decline, and increased vulnerability of important keystone species such as dominant eucalypts.

Natural abundance stable isotopes offer a means by which the water sources of these two ecologically-important species can be identified and better understood (e.g. Ludwig et al., 2004).

Key research objective

To use natural abundance stable isotopes to identify important water sources of key functional species (E. camaldulensis and P. canescens) in riparian woodland ecosystems on the Upper Condamine floodplain of the northern Murray-Darling Basin

Proposed research approach

Samples will be collected from three large mature trees with >60% lippia cover at each of three sites representing the range of groundwater depths (<12 m, 12-16 m & >16 m) associated with river red gum condition (good, variable and poor, respectively) in this landscape (Reardon-Smith, 2011).

Hydrogen (deuterium) isotope ratios (δD) (e.g., Phillips and Gregg, 2003) and/or variation in the natural abundance stable isotope ratio of water (δ18O) (e.g., Cramer et al., 1999) will be assessed (Isotope Ratio Mass Spectrometry or IRMS) in E. camaldulensis twig and P. canescens stem xylem water following extraction using cryogenic vacuum distillation procedures. Three potentially important water sources - surface soil (10–30 cm), subsurface soil (60–80 cm) and groundwater – will also be analysed.

Significance

The study will clarify the extent of variation in isotopic signatures of source waters in riparian woodlands of the Upper Condamine floodplain. It will also assist in the identification of critical water sources of two key structurally and functionally dominant species and the role of shallow groundwater resources in woodland ecosystems which are subject to seasonal and long-term drought, and potentially at risk from high levels of groundwater extraction and/or predicted climate change.

References:


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