25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 9 to 14 July 2023
mssanz.org.au/modsim2023

Are terrestrial groundwater-dependent ecosystems dependent on groundwater from localised or regional aquifers?

J.L. Pritchard and E. Bunney

CSIRO, Australia
Email: mailto:jodie.pritchard@csiro.au

Abstract: Vegetation uses a variety of water sources (local rainfall, floodwaters, unsaturated soil water, groundwater) throughout the different stages of the life cycles (seed, germination, flowering, growth, reproduction, pollination and seed dispersion) to sustain healthy functioning ecosystems. Groundwater is a critical source of water for terrestrial groundwater-dependent ecosystems (GDEs). Ecosystems that have access to groundwater can often sustain vibrant flora and fauna communities within otherwise dry landscapes. The frequency and timing of groundwater use by GDEs is highly dependent on local site hydrogeological characteristics and climatic conditions. On floodplains, the sources of groundwater used by terrestrial GDEs may be derived from localised alluvial aquifers recharged via bank recharge or by over-bank flooding or from regional aquifers that may recharge remotely but discharge to the floodplain where riparian vegetation occur.

When assessing the impacts of water resource development on vegetation, it is essential to identify the sources of water used by vegetation, the timing of when the different sources of water are used (e.g. seasonally, during drought) and their connections to water resources with potential for future development (Doody et al. 2019). This study develops a conceptual model of the dynamics of water use by floodplain vegetation in the Victoria catchment, Northern Territory, and tests the utility of strontium isotopes for differentiating between the potential sources of water used by vegetation. Of particular interest in this study is differentiating between groundwater derived from localised versus regional aquifers.

The potential sources of water used by vegetation can have distinct oxygen and hydrogen isotope compositions that are observable in vegetation if they are recharged in different environments or by different processes. Previous studies have used the stable isotopes of water to differentiate between sources of water used by vegetation (e.g. Canham et al. 2021). However, the oxygen and/or hydrogen isotope composition cannot always distinguish between all the potential sources of water available to vegetation and further lines of evidence are often required to irrefutably establish regional groundwater use. Strontium isotopes provide a complementary line of evidence to oxygen and hydrogen isotopes because the composition in groundwater is derived from meteoric input as well as the dissolution of Sr-bearing minerals within the aquifer system (e.g. Bullen and Kendall 1998). Strontium isotopes are not fractionated as they are taken up by plants (Graustein 1989) therefore the strontium isotope composition in plants should be consistent with the sources of water used. This study will analyse strontium isotopes in vegetation, soils, surface water and groundwater to test its applicability for differentiating between sources of water used by vegetation adjacent to a groundwater-fed creek in Victoria catchment, NT.

REFERENCES

Bullen, T. D., Kendall, C, 1998. Tracing of weathering reactions and water flowpaths: a multi-isotope approach. In: Isotope Tracers in Catchment Hydrology (Eds C. Kendall & J.J. McDonnell), pp. 611–646. Elsevier, Amsterdam.

Canham, C. A., Duvert, C., Beesley, L. S., Douglas, M. M., Setterfield, S. A., Freestone, F. L., Clohessy, S., Loomes, R. C., 2021. The use of regional and alluvial groundwater by riparian trees in the wet-dry tropics of northern Australia. Hydrological Processes 35(5), e14180. https://doi.org/10.1002/hyp.14180.

Doody, T. M., Hancock, P. J., Pritchard, J. L., 2019. Assessing groundwater-dependent ecosystems: IESC Information Guidelines explanatory note. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2019.

Graustein W. C., 1989. 87Sr/86Sr ratios measure the sources and flow of strontium in terrestrial ecosystems. In Stable Isotopes in Ecological Research (editors Rundel P W, Ehleringer J R, Nagy K A). Springer-Verlag, New York, pp. 491-512.

Keywords: *Groundwater dependent ecosystem, water resource, strontium isotopes, vegetation*