Water SA
Vol. 40(2)

Riparian trees as common denominators across the river flow spectrum: are ecophysiological methods useful tools in environmental flow assessments?

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Abstract

Riparian tree species, growing under different conditions of water availability, can adapt their physiology to maximise their survival chances. Rivers in South Africa may flow perennially, seasonally or ephemerally (episodically). Different riparian species are adapted to survive under each of these different flow regimes by making use of surface, ground, soil, rainwater, or some combination of these. These water sources are available to varying degrees, depending on local climatic, hydrological, geohydrological and geomorphological conditions. This paper tests physiological differences among trees along rivers with varying flow regimes. In this study 3 parameters were selected and tested, namely wood density, specific leaf area and water use efficiency through stable carbon isotope measurements. All three parameters are quick, simple and cheap to determine and as such their value for standard-procedure river monitoring programmes or environmental flow requirement procedures was tested. *Acacia erioloba* is an arid-adapted riparian tree along the ephemeral Kuiseb (Namibia) and Kuruman (South Africa) Rivers that shows decreasing specific leaf area and increasing wood density correlating with deeper groundwater levels. Intraspecific changes for specific leaf area and carbon isotope values were demonstrated for *Acacia mellifera* and *Croton gratissimus* at varying distances from the active channel of the seasonal Mokolo River (South Africa). No significant differences in physiology were noted for *Salix mucronata*, *Brabejum stellatifolium* and *Metrosideros angustifolia*, growing along the perennial Molenaars and Sanddrifskloof Rivers (South Africa) under reduced flow conditions. Only the measurement of specific leaf area recurrently showed that significant physiological differences for trees occurred along rivers of the drier flow regime spectrum (seasonal and ephemeral). As such, this physiological measurement may be a valuable indicator for water stress, while the other measurements might provide more conclusive results if a larger sampling size were used. Specific leaf area, in conjunction with other carefully picked water stress measurement methods, could be considered for monitoring programmes during environmental flow assessments, river health monitoring exercises and restoration projects. This would be particularly valuable in rivers without permanent flow, where there is little species-specific knowledge and where current monitoring methods are unsuited.