

Comparative water use of wattle thickets and indigenous plant communities at riparian sites in the Western Cape and KwaZulu-Natal

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Abstract

Large-scale funding by both the Government and the private sector continues in support of the Working-for-Water Programme, which is active in many regions of the country. One justification for this programme of alien tree removal is the streamflow enhancement that is believed to follow the replacement of dense stands of invasive trees by indigenous, largely herbaceous or shrub-dominated plant communities. Often the densest stands of invader trees occur within riparian zones, where removal of trees in close proximity to stream channels is believed to strongly enhance streamflow. Few data are available, however, to support this assumption. Results from a number of research catchments have consistently shown that afforestation significantly decreases streamflow where the pre-afforestation vegetation was seasonally dormant mountain grassland or fynbos (Versfeld, 1994). The net difference in evapotranspiration (ET) between riparian thickets of alien trees and riparian fynbos may be quite different, due to the yearlong availability of soil water and enhanced plant growth in riparian zones. The water use of alien invasive trees in South Africa remains largely unknown, adding further uncertainty to the effect of alien removal on streamflow. This paper describes the results of a comparative study of annual ET between indigenous riparian plant communities and riparian wattle thickets (*Acacia mearnsii*) at four sites in the Western Cape and KwaZulu-Natal.

The Bowen ratio energy balance (BREB) technique was used to record a 12-month record of 20 min evaporation rates from a fynbos riparian plant community in the Jonkershoek valley (Western Cape), and a grassland riparian community on the property Gilboa in the KwaZulu-Natal midlands. Closed-canopy, mature stands of self-established *A. mearnsii* in the Wellington and Groot Drakenstein areas of the Western Cape were selected to provide comparative transpiration data. The heat pulse velocity (HPV) technique was used to record hourly sap-flow rates in six sample trees representing the range of tree sizes at both wattle sites. Total daily sap flow in all sample trees experiencing adequate soil water availability was found to be very closely correlated to tree size and an index defined as the product of mean daily vapour pressure deficit (VPD) of the air and the number of daylight hours. These relationships were used to predict the water use of wattle thickets at Jonkershoek and Gilboa, using VPD and day-length data recorded at these sites. Published estimates of canopy rainfall interception were added to the sap flow (transpiration) component to yield a combined annual ET to compare to the BREB ET data. Table 1 summarises the annual evapotranspiration at each site.

Locality	Vegetation	Annual evapotranspiration estimate (mm)			
		Transpiration	Rainfall interception	ET	Difference
Jonkershoek	<i>A. mearnsii</i> Fynbos	1 318	185	1 503 1 332	171
Gilboa	<i>A. mearnsii</i> Grassland	1 077	183	1 260 836	424

We conclude that the removal of riparian wattle and its replacement by indigenous herbaceous plants may indeed result in significant reductions in annual ET, and could very likely lead to streamflow enhancement. However, this study has clearly shown that annual ET varies considerably in different riparian plant communities, and that one must consider the structural and physiological characteristics of both the pre-clearing and post-clearing vegetation in order to predict the net change in ET. This conclusion supports an earlier view (Versfeld et al., 1998) that an improved methodology of general applicability is required to enhance the accuracy of water use predictions for a wide range of alien and indigenous plant communities. Such predictions are important to prioritise clearing operations in areas invaded by alien trees.

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