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Quantifying potential water savings from clearing invasive alien Eucalyptus camaldulensis using in situ and high resolution remote sensing data in the Berg River Catchment, Western Cape, South Africa

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Abstract

Eucalyptus camaldulensis (Red River Gum) is an aggressive alien invasive species in South Africa where it forms dense self-established stands mainly along river channels and on flood plains throughout the country. The actual water use by invasive E. camaldulensis has not yet been compared with that of regenerating native vegetation after the invasions have been cleared. This study addresses this knowledge gap by determining how much more water E. camaldulensis invasions use relative to native vegetation, to provide an indication of the impacts of clearing on streamflow under Mediterranean climatic conditions. The study was conducted at two adjacent sites in the Berg River catchment, Western Cape Province in South Africa. One site was densely invaded by E. camaldulensis while the other was cleared of the invasions in 2010. Scattered shrubby Kiggelaria Africana (Wild Peach), grasses and herbaceous shrubs were the dominant native species at the cleared site. E. camaldulensis transpiration was quantified using heat pulse velocity sap flow gauges while evapotranspiration (ET) at the cleared site was measured using an energy balance system comprising a boundary layer scintillometer, weather station and additional energy balance sensors. Daily peak transpiration by a large E. camaldulensis tree ~50 cm diameter at breast height was up to 260 l in hot and dry weather. Despite the fact that the trees grew next to the river channel and had access to river water, substantial transpiration reduction occurred with increasing soil water deficit in the upper soil horizons under conditions of high atmospheric evaporative demand. This suggests that rain or floodwater stored in the shallow soil layers is an important source of water for the invasive eucalypts in this catchment, but water availability may be limited. Stand level transpiration (~833 mm/y) by E. camaldulensis was similar to the annual ET (~865 mm/y) at the cleared site. Additional ET estimates from two remote sensing models of ET, one using the Surface Energy Balance Algorithm for Land (SEBAL) and the other using a dual source Penman–Monteith model, showed that up to 2.0 ± 0.3 ML of water can potentially be saved per year for each hectare of the eucalypt invasions cleared.