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Impacts of artificial inundation of ephemeral creek beds on mature riparian eucalypts in semi-arid northwest Australia

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The resilience of riparian ecosystems of intermittent rivers to changes in their hydrological regimes is not well understood. In the Pilbara region of northwest Australia, streams flow only occasionally, reflecting a highly dynamic and extremely variable cycle of prolonged droughts punctuated by occasional floods. However, discharge of ground water pumped from mining activities over recent years has resulted in localised areas with constant surface water. Here we sought to assess impacts of prolonged saturation on the health and functioning of two co-occurring eucalypts (*Eucalyptus camaldulensis* and *Eucalyptus victrix*). While riparian vegetation is clearly adapted to partial root-zone hypoxia, we hypothesised that trees in inundated areas experience reduced root function due to an energy crisis, which will be reflected by symptoms in the foliage. We expected that complete saturation of the entire root system for an extended time period reduces physiological function through lower stomatal conductance and more negative water potential, results in canopy sparseness and reduces accumulation of foliar nitrogen and phosphorus.

Trees (n=26) were assessed at two sites with artificially permanent surface water (discharge sites) and compared to trees (n=21) at a site with a naturally occurring permanent groundwater fed pool ('reference site'). Trees were sampled from a range of positions including the stream bed, the lower bank and the upper bank, in order to determine the extent of influence of the discharge water. No eucalypts grew in the stream bed at the reference site, indicating either the stream bed conditions were unsuitable for seedling survival or eucalypts were outcompeted by the flood tolerant tree *Melaleuca argentea* (which was absent from the impact sites). Soil redox potential, an indicator of oxygen availability and other soil chemical conditions, was measured with platinum redox probes at 25 cm depth. Trees were assessed for canopy cover, foliage water potential and gas exchange. Leaves from each tree were also analysed for stable isotope composition (δ^{13}C, δ^{15}N and δ^{18}O) and nutrients (N and P). Bank trees did not differ between the discharge and reference sites by any measure. However, trees positioned in the stream bed at discharge sites were exposed to severely reduced soil redox potential (median = -189 mV) compared to trees growing on the lower (90 mV) or upper bank (188 mV). Trees in the stream bed were clearly separated from upper or lower bank trees using principle components analysis (PCA) for all measured attributes. Canopy cover, δ^{13}C and δ^{18}O contributed most to separating the groups. Canopy cover in stream bed trees was 41% and 52% sparser compared to bank trees at discharge and reference sites, respectively. Stream bed tree leaves had more enriched δ^{13}C values but more depleted δ^{18}O values, indicating leaf gas exchange with the atmosphere was more restricted than for the trees on the bank. Overall, we conclude that artificially constant surface water expression significantly changed environmental conditions in the stream bed and the effect on riparian eucalypt trees was highly localised.