# Biodiversity impacts of ground tank closure in southeast Australian rangelands

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## Abstract

Literature suggests that provision of artificial water through bores, dams and ground tanks has negative environmental effects through increased grazing pressure, prevention of native species regeneration and promotion of exotic species. Though some native species may benefit from increased water, other species may decline. In arid environments worldwide, few areas remain distant from water. In Australia, much water provision is though ground tanks storing diverted run-off following rainfall events. Whilst closure of tanks is a recognized means of reducing negative impacts there is reluctance to utilize this strategy. Consequently, there are few opportunities to study responses of plant and animal populations to such closures. Where tank closure has occurred in areas reserved for conservation there is a lack of data on the effects on flora and fauna. Past studies have been limited in: the range of biota incorporated; lack of landscape-scale experimental manipulation; failure to replicate treatments. Research on the University of Ballarat's 40, 000 hectare arid-zone research property, Nanya, is investigating impacts of four alternative tank treatments: fencing to exclude mammalian grazers; partial tank closure by blocking of drains; complete closure with landscaping to original profile; no action. Responses of plants, mammals, birds, reptiles and ants to these treatments are being studied. Findings will help illuminate the potential for water point closure to restore balance to the surrounding landscape, an important consideration in biodiversity conservation in arid landscapes in Australia and other parts of the world

## Introduction

Water is a key limiting factor in arid environments and, prior to European settlement Australian arid zones had few permanent water points (James *et al.* 1995). Abundant literature suggests that provision of artificial water through bores, dams and ground tanks in pastoral areas has had negative environmental effects (e.g. Landsberg *et al*. 1997; Hilty *et al.* 2006, Todd 2006). Currently there are few areas left in the Australian rangelands that are distant from water, and this problem exists in arid and semi-arid environments worldwide (e.g. Noy-Meir 1996, Thrash 1998).

Some of the potential impacts of watering points on the surrounding environment include:

- Contributing to elevated native and exotic grazer populations (James *et al*. 1995)
- Redistribution of nutrients through deposition of dung (Lange & Willcocks 1978)
- Allowing establishment and spread of exotic plant species (Westbrooke 1990) and unpalatable native plant species.
- Prevention of regeneration of native perennial plant species (Westbrooke 2005), in particular palatable chenopods (Montague-Drake & Croft 2004)
- Increased numbers of opportunistic water-dependent species (Draper *et al*. 2004).
- Providing a focus for activity of exotic predators
- Potential flow on effects for tree health through changes in trophic interactions (Landsberg *et al*. 1990, Grey *et al*. 1997).

Fensham and Fairfax (2008) in reviewing this issue highlighted the lack of sound data on benefits of closing water-points and the need to address the problem at a landscape scale. In western NSW and adjacent areas of South Australia, a major means of water provision is through ground tanks storing diverted run-off following major rainfall events. There is widespread agreement that, for better control of feral grazers and improved grazing management in areas where biodiversity is a primary or secondary objective, closure of tanks or greater control of water distribution is management strategy. Despite incentives available for improving biodiversity outcomes on pastoral lands, there is reluctance among landholders to utilise these strategies and as a result, there are few opportunities to study in detail the responses of plant and animal populations to such closure. Past studies have not

carried out experimental manipulation at the landscape scale to demonstrate the long-term impacts on arid-zone biodiversity.

Research is investigating the impacts of four alternative tank treatments on a range of plant and animal groups.

## Methods

The research is centered on Nanya Station (40,000 ha.) 150 km northwest of Wentworth in southwestern NSW (Fig. 1), where the dominant vegetation comprises eucalypt open-scrub (mallee) (Westbrooke *et al*. 1998). Until 2004, Nanya Station was under pastoral management but its purchase by the University of Ballarat for teaching, research and conservation provides a unique opportunity to test the conservation benefits of manipulating water availability across the landscape.

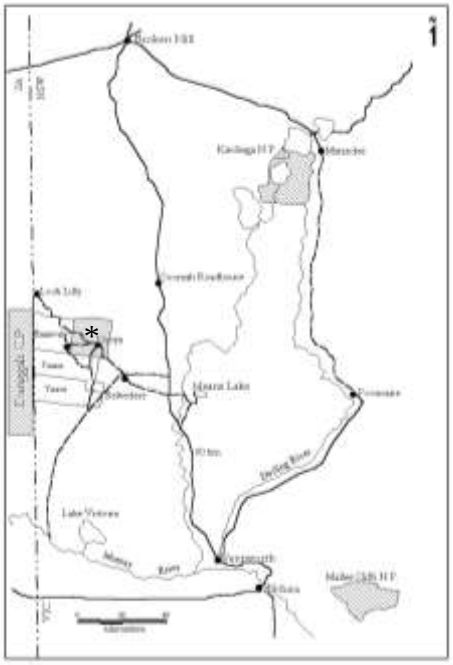


*Fig. 1. Location of study area * indicates Nanya Station*

Twelve tanks ground tanks were selected for maximum distance between treatments, similarity in size of tank and surrounding vegetation type. Assessments are undertaken at sites adjacent and at 500m and 1500m from the tank, replicated on dunes and in swales (Fig. 2).

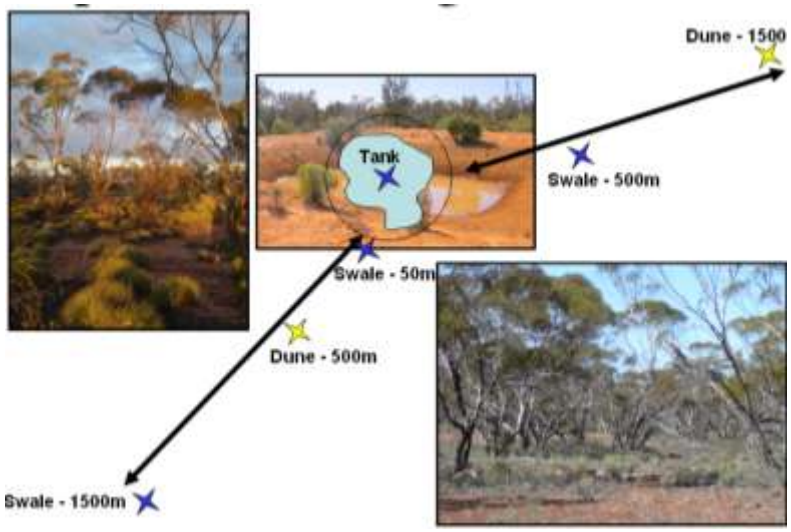


*Fig. 2. Simplified diagram indicating experimental design and location of assessment sites at each of 12 ground tanks*

At all sites, a range of taxa was surveyed prior the application of treatments (fencing to exclude mammalian grazers; partial tank closure by blocking of drains; complete closure with landscaping to original profile; no action – each with three replicate tanks) and at intervals following treatment. These surveys include:

*Large grazing mammals:* Assessed annually through faecal accumulation plots. Plots are checked for faeces accumulated during each assessment, and the number of faecal groups for each species identified, following the technique of Neff (1968).

*Reptiles and small mammals:* Abundance and richness assessed in spring, summer and autumn via 20-meter pitfall lines. Pitfall lines are run for five nights during each assessment.

*Predators:* Fox scats are collected and analysed for hair and bone content and level of fox activity is assessed based on uptake of baits which are set on a 1km. grid at six monthly intervals.

*Birds*: Species abundance and richness assessed in spring and autumn through morning 20min. point survey counts.

*Ants:* Surveyed via pitfall trapping in summer to assess changes in species composition of the community.

*Vegetation:* The line intercept of all ground species along with litter, cryptogamic crust and bare ground is sampled along transect lines within each quadrant. The point-centred quarter

technique is used to determine the occurrence and density of tree and shrub species. Structural attributes are assessed for a 50 x 20m area around the pitfall line.
*Climate*: Since rainfall in the area is highly variable both temporarily and spatially rainfall and soil moisture are being assessed by automatic weather stations established at each water point.

## Results

For the vegetation, preliminary results indicate a positive relationship (cover and richness) between native species and distance from water and a negative relationship for exotic species. These trends were more marked for dunes than swales.

There is higher large mammal activity at water points but whilst goats are more abundant in swales, Grey Kangaroos prefer dunes whereas Red Kangaroos show no habitat effect.

A total of 93 bird species have been recorded during surveys. Two of these were EPBC listed species and a further four listed under state legislation. Greater species richness was detected within 20m of water however there were significant compositional differences with more parrots and honeyeaters but less small insectivores. Additionally, there was a significant increase in the total abundance of ground nesting birds (Southern Scrub Robin, Malleefowl, Chestnut Quail Thrush and Striated Grass Wren) recorded with increasing distance from water.

Forty-seven species of reptile and six species of small mammals were collected via pitfalls. Water points have less reptile species than other sites. Dunes have greater abundance than swales and tanks but all three habitats have a distinct complement of species. Sites 500m< from water had a greater abundance of small mammals than sites adjacent to watering points. Preliminary analysis indicates that ant diversity may be greater in close proximity to tanks than at other sites.

## Discussion

Limited time since treatment and variability of rainfall make it too early to draw conclusions on the relative impact of the treatments. However 18 months post treatment) and based on pre treatment surveys, taxa have shown highly variable responses to distance from water. Ground nesting bird species are likely to be exposed to risks from predation, particularly in more open landscapes such as those which exist in close proximity to watering points. This pattern was reflected in our data and is closely related to a reduction in structural complexity of vegetation and habit closer to watering points as demonstrated through vegetation surveys and habitat assessments. Preliminary vegetation data support the view that, in conservation reserves created in areas previously used for pastoralism, an essential measure for vegetation recovery is closure of watering points.

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