Water points

Where pastoralism and biodiversity meet

Bryony Bennett

Free-flowing artesian bores provide essential water in the outback, but at what cost?

Samuel McCaughley owned the world's largest sheep flock in 1900, thanks in no small way to his invention of a revolving earth scoop called Tumbling Tommy. With this labour-saving device, McCaughley fashioned 15 000 cubic metres of soil into a huge private dam to catch the floodwaters of the semi-permanent Warrego River in western New South Wales.

The key to McCaughley's success was water. He and other pastoralists like him not only endured droughts, but added cheaply to their holdings as bankruptcy befell their neighbours.

Looking back it seems surprising devices such as Tumbling Tommy weren't invented 50 years earlier. Settlers in Australia's 'back country', far from permanent waterways, took decades to learn that good seasons were followed, sooner or later, by bad. It wasn't until the 1880s that bores drilled to artesian basins heralded pastoralism's advance on the arid interior, where feed appeared abundant, but natural surface water sources were few and far between.

Unfortunately for today's ecologists and conservation managers, the ensuing march of sheep and cattle across Australia's inland was monitored by neither satellite nor science. One third of the mammal species that used to inhabit the arid and semi-arid rangelands are now extinct and many more plant and animal species are in trouble. Domestic livestock have been linked with this decline, almost since setting hoof in the region, but evidence to support and characterise this link has been sketchy.

In 1993, a team of ecologists from CSIRO's Division of Wildlife and Ecology set out to clarify the impact of domestic and other grazing animals on rangelands biodiversity. After considering several investigative approaches, including grazing trials, the team adopted the focus of Samuel McCaughley. Artificial sources of water were the lifeblood of Australia's pastoral industry, so would be the best places to survey its impact.

The study, carried out for Environment Australia, found that bores and troughs are a potential threat to biological diversity of native plants, animals and birds in arid and semi-arid regions. Study leader, Dr Jill Landsberg, says water is the underlying cause of this threat, but is also the potential solution.'We just need people to think about the provision of water in the arid zone in a different way,' she says.

Just add water

Before the arrival of Europeans, water was rare in inland Australia. It was plentiful after rain, but as the country dried out animals had to rely on widely-spaced natural waterholes along drainage lines.

'Once I was shown a little corner, a long way from the nearest water, which had managed to survive in something like its virgin state. It was a sight for sore eyes, and a very useful indication of the extent of the changes which had taken place since the white man settled the land. There was actually grass about, and the foliage of the shrubs grew down to the very ground; and I saw little bushes here which had practically vanished from the general landscape.'

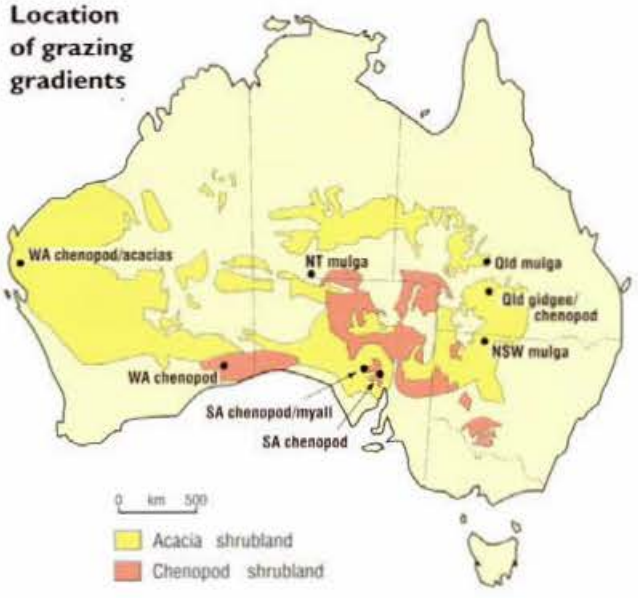
From Francis Ratcliffe, *Flying Fox and Drifting Sand*, published in Australia by Halstead Press, Sydney. First published in England in 1938.

Artificial water points now exist at high densities over much of the rangelands. In most pastoral areas there is at least one water source within 10 km of most places and in many areas there are more. Only the desert regions (Simpson, Tanami, Gibson, Great Sandy and Great Victorian deserts) have substantial areas that are water-free.

A result of these changes is that most droughts no longer cause a shortage of drinking water. Grazing animals can remain in naturally-waterless land, drinking bore water and eating perennial vegetation that would normally survive long, dry periods. Because this vegetation does not grow much except after rain, palatable grasses and shrubs can be removed over large areas if stock continue to graze well into a drought.

A historical example of this occurred more than a century ago in South Australia, where artificial water points became the focus of enormous sheep flocks (up to 10 000 animals) during dry periods. A severe drought from 1864 to 1869, combined with heavy grazing pressure, killed much of the state's perennial saltbush and eroded topsoil to a depth of 7-15 centimetres.

'Most wild grazing animals used to spread out after rains, when the flush of feed was on, and contract back to the few permanent waters as the country dried out, but now there are so many sources of water that we no longer see that expansion and contraction of populations,' Landsberg says. 'Instead there is sustained grazing pressure across large areas, because animals can remain on country where once they couldn't have survived.'



The first stage of the CSIRO project involved selecting appropriate sites to survey. The surveys were to be conducted along gradients – each extending from a water point – representing a broad spectrum of grazing intensity. Each gradient had to start with a site close to a water point, where grazing intensity was high, and continue to a 'reference site' where grazing intensity was minimal, because it was outside the normal range of the livestock using the water (15 km for cattle and 9 km for sheep). All the sites on each gradient had to be in the same paddock and in the same type of country.

The idea was that distance from water substituted for the cumulative impact of grazing, but everything else along a gradient should be similar. Finding reference sites was a problem, because there were very few pastoral areas far enough from water to qualify.

Eventually, aided by a Geographical Information System (GIS) analysis of mapped water points, aerial photography, property maps and discussions with local experts, the team selected eight study gradients across the chenopod and acacia shrublands of central and southern Australia. 'I hadn't expected there would be so few options,' Landsberg says. 'Seven of the eight gradients we chose were on sheep stations. We could only find one gradient on a cattle property in the regions we searched, because cattle can travel so much further away from water.'

For each gradient, five sites were chosen in addition to the reference site, each progressively closer to water, at progressively closer spacings. The sites were arrayed in this way because most

changes were expected to occur within 2-3 km of water. At each of the six sites along the gradients, the team surveyed understorey plants, plants in the soil seedbank, birds, reptiles small mammals, ants, beetles, springtails, grasshoppers and crickets.

The field work was undertaken by two teams made up of CSIRO researchers, plus a cast of enthusiastic volunteers from universities and other organisations. Four gradients were surveyed in the spring of 1994, and the next four a year later. 'We had to do the surveys in spring to see as many reptiles, birds and plants as possible,' Landsberg says.

Win some, lose some

The gradients were particularly rich in plant species. A quarter to half of these, found only in the soil seed bank, were ephemeral species which grow and reproduce after adequate rainfall and survive dry periods as resistant seeds. Ants and birds were the most species-rich animal groups.

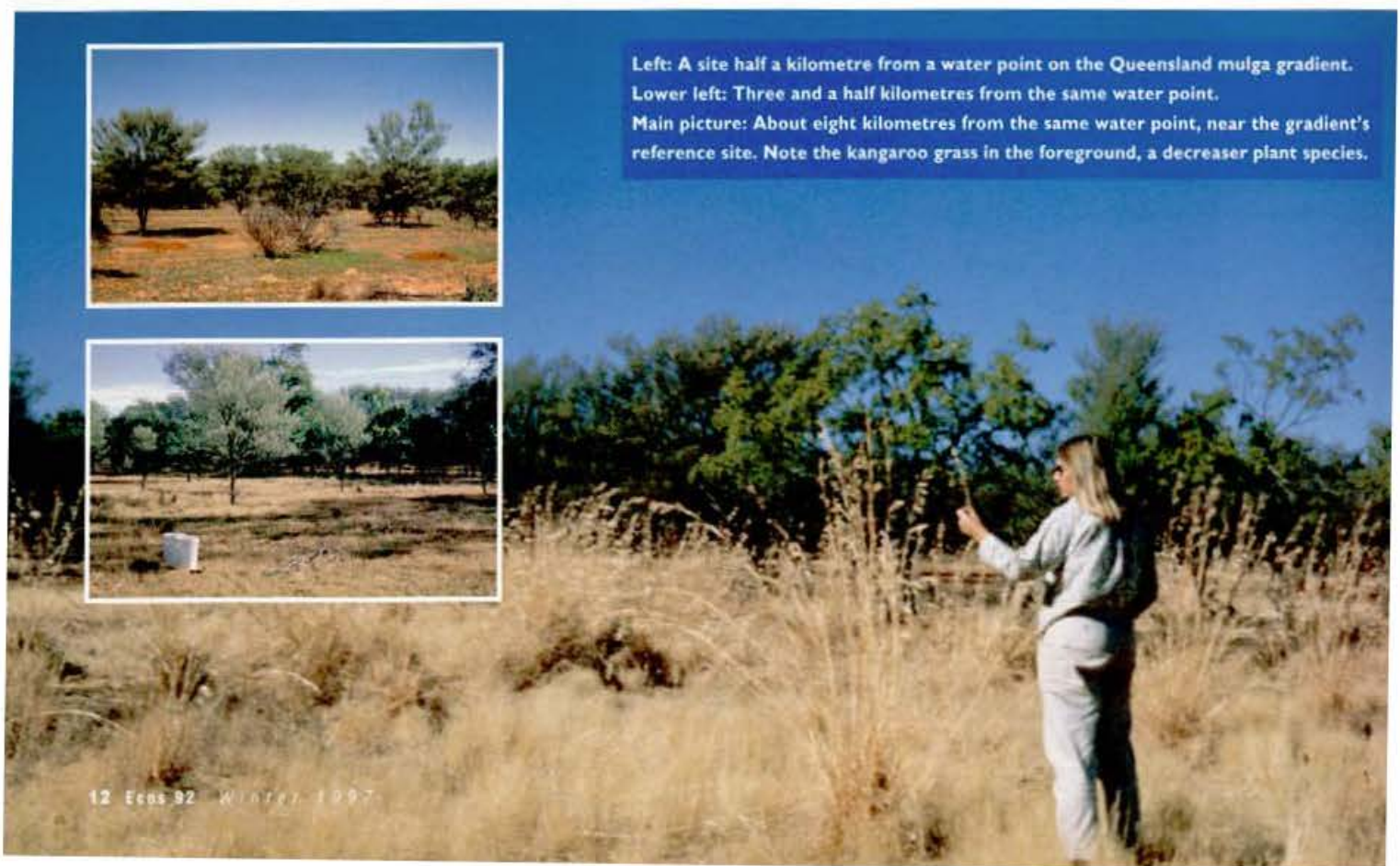
'Most of the invertebrate species and a few of the plants were new to science,' Landsberg says. 'It shows how little we know of the biodiversity of much of the rangelands.

'We sort through all the specimens then lodge voucher specimens of the invertebrates with the Australian National Insect Collection and plants with appropriate herbaria. In time they will be formally described by taxonomists and kept as a reference for future surveys.'

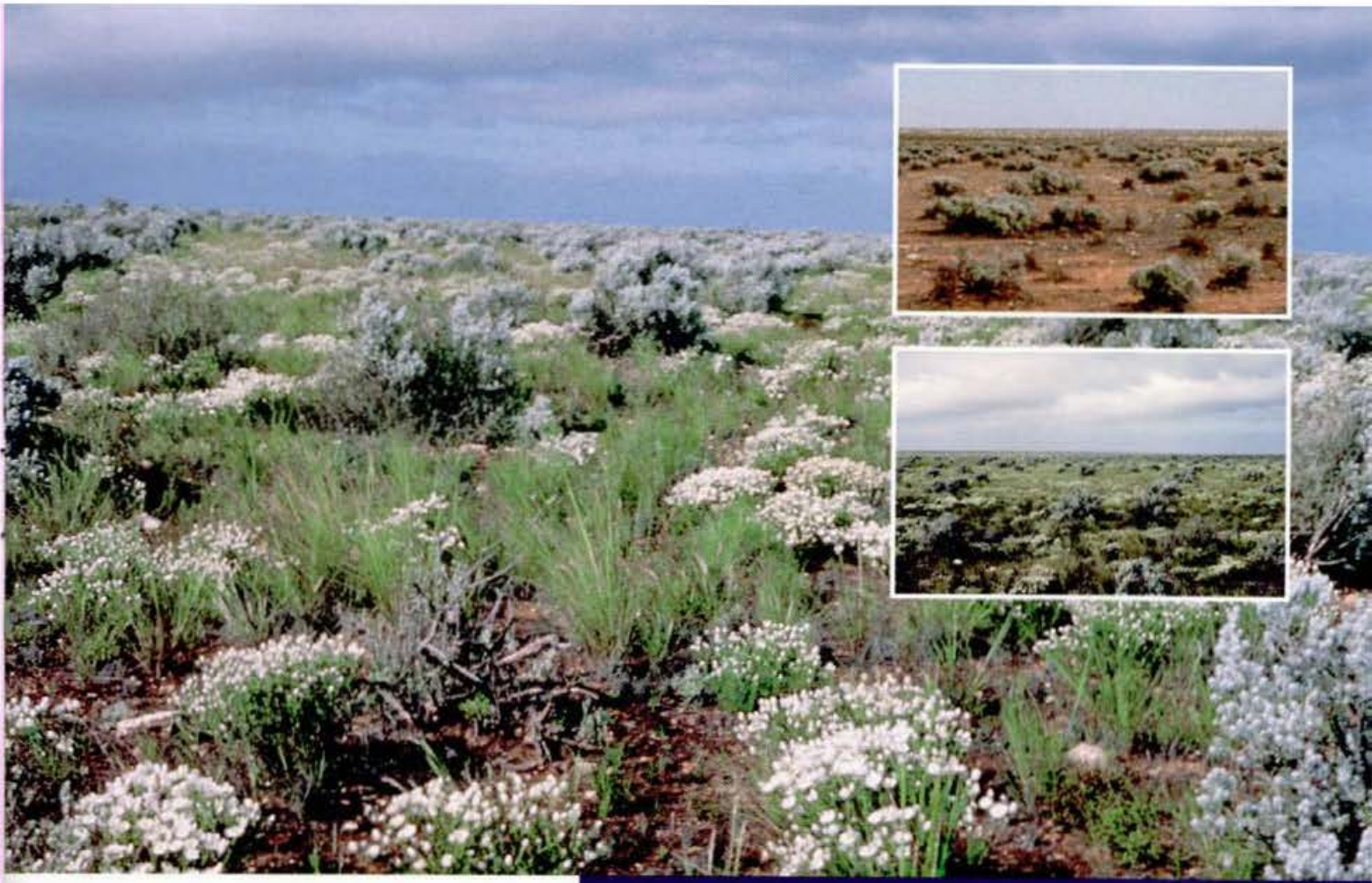
Reptiles and small mammals were sampled in pit traps consisting of pairs of buckets dug into place well before the surveys, so that the soil could settle. During the survey the lids were removed from each pair of buckets and a drift fence put in place to guide animals in. Captured animals were recorded and released at least twice daily. Insects were collected in much smaller pit traps and understorey plants in the vicinity were surveyed.

The surveys found little evidence of severe degradation, but a pilot study of landscape function at two of the gradients revealed early warning signs. Landscape patches close to water showed more evidence of tree die-back and may have lost some of their ability to capture, store and use water and nutrients.

In contrast, species composition at different distances from water changed dramatically. Some species of plants and animals increased in abundance closer to



**Left: A site half a kilometre from a water point on the Queensland mulga gradient.
Lower left: Three and a half kilometres from the same water point.
Main picture: About eight kilometres from the same water point, near the gradient's reference site. Note the kangaroo grass in the foreground, a decreaser plant species.**



Top right: A site half a kilometre from a water point on the Western Australian chenopod gradient.
Above right: Nearly four kilometres from the artificial water point on the same gradient.
Main picture: The gradient's reference site, nearly nine kilometres from water.

water (increasers), while others decreased (decreasers). On average, 15-38% of species in different taxonomic groups appeared to be decreasers, 10-33% appeared to be increasers and the remaining species did not exhibit any demonstrable response to the artificial water.

Nearly all the decreaser species were natives. A small but significant number of the decreaser plant species at each gradient was found only at the gradient's reference site, where grazing intensity was minimal. 'This is of particular concern because so little of the rangelands is now this far from water,' Landsberg says.

Increaser species included natives and exotics, with buffel grass, *Cenchrus ciliaris*, a prominent exotic increaser at one gradient. No exotic bird species were detected, but many of the increasers were species whose ranges have expanded since the provision of water.

'Given how widespread artificial waters have become throughout the chenopod and acacia rangelands, the results suggest that some 15-38% of species are at risk of declining substantially throughout these lands,' Landsberg says. 'The challenge is to develop strategies that will provide for the persistence of these vulnerable decreaser species.'

Where to from here?

MANY native plants and animals may not be coping well with present levels of water provision and grazing in the rangelands. Before closing water sources, however, more information must be gathered about the appropriateness of such a strategy.

To meet this need, Dr Jill Landsberg's research team has combined with the Department of Environment and Natural Resources in South Australia, and the Parks and Wildlife Commission of the Northern Territory in a new project called Biograze: Waterpoints and Wildlife. The project is funded by the Land and Water Resources Research and Development Corporation and Environment Australia.

Three research themes will be explored during the project. The first involves finding out whether grazing gradient results from the artificial water points study are representative of whole regions. Some species identified as decreasers on the gradients may be more abundant or secure in other parts of the landscape, or other paddocks with different histories. The Biograze team will see if this is the case in regions of SA and NT. Consultation with pastoralists will be an important part of these surveys.

The second theme involves determining which types of species should be monitored as indicators of biodiversity in different pastoral regions. Which are the most informative and cost-effective plant and animal groups to survey? Which *kinds* of species are in most trouble and what characteristics do they have in common?

The third theme involves using computer models to compare potential regional conservation plans. Selective reduction of water sources is one strategy, but how many should be closed and which ones? What would it cost? Would it be any cheaper or more effective than more traditional methods, such as fencing, or managing stocking rates? What would the different options cost in terms of pastoral production?

Answers to these questions are likely to be different for different regions. In some regions it is likely that some sort of special action will be needed to ensure vulnerable decreaser species are not lost.

Dams closed in 'Sunset' country

AN extensive network of catchment dams built during the late 1920s and early 1930s opened up to pastoralism the semi-arid woodlands and shrublands of Victoria's 'Sunset' country.

Seventy years on, more than half of these dams are being closed in an attempt to reduce grazing and pest animal impacts in the 633 000-hectare Murray-Sunset National Park, located in the state's far north-west.

Stock grazing ceased after the park was proclaimed in 1991, but many of the dams continue to provide herbivores (both feral and native) with a reliable source of water throughout summer. In fact, most of the eastern end of the park is less than 10 km from an artificial source of surface water.

A project officer with Parks Victoria, Peter Sandell, says groundcover and palatable plants have declined as a result of continuing higher grazing pressure generated in the vicinity of water points. Goats and western grey kangaroos, which use a wider range of food sources in the presence of water, have increased in abundance. Some water-reliant birds such as the galah and yellow-throated miner have increased at the expense of other bird species which are less abundant close to water.

Work on closing catchment dams in the Murray-Sunset began this year. To date, 32 dams have been closed in the eastern half of the park. Another 24 dams are yet to be closed. Sandell says every effort is being made to retain the historic fabric of the dams. For example, drains will be filled in with soil while maintaining the profile of dam walls.

Where water may be required for fire suppression, or visitor use, concrete tanks will be installed.

The dam closure is not considered a threat to other native species, since these species survived independent of artificial waters prior to European settlement. The most likely outcome is an overall decline in the populations of western grey kangaroos and goats in the park, reducing total grazing pressure.

Managing with less

In a report on the study for Environment Australia, Landsberg and her colleagues made recommendations in relation to conserving rangelands biodiversity. Heading the list was the suggested strategic closure of artificial water points in conservation reserves and the testing of selective water-closure to balance production and conservation goals outside conservation areas.

This could well be done in collaboration with land managers, to determine what approaches might be most successful and what costs might be involved. There may be a role for public support and compensation if conservation goals contribute to the public good, but compromise pastoral production.

Other recommendations voiced the need for future research to adopt a regional perspective, and for more cost-effective survey and monitoring techniques. 'Detailed assessments of the distribution of existing artificial waters are needed to identify regions for priority attention,' Landsberg says.

'Surveys should aim to determine what proportion of regional biodiversity can be identified as decreaser species, what makes particular species increasers or decreasers, and to what extent this is influenced by variation in landscapes. Groups of species with particular characteristics could then be identified as indicators to monitor for signs of change.'

Landsberg says the main message flowing from the study is that we need to reconsider our approach to the provision of water. 'Most of arid Australia was naturally waterless, and its native plants and animals are adapted to such conditions,' she says. 'Access to drinking water is essential for humans and livestock, but many native species do not need to drink. These and other species, including plants, are often disadvantaged by the ready availability of water and the grazing it supports.

'We're suggesting it might be time to pull back a bit. Pastoralists have long been encouraged to provide many closely-spaced water points, to avoid the localised degradation that occurs when animals are concentrated on too few waters. But this strategy has been almost too successful.

'The huge areas of devastation that occurred at the turn of the century, when stock numbers were high and waters were few, are largely a thing of the past. But so many water points have been provided since then, that now nearly everywhere is close to a water point and there is hardly anywhere in the rangelands not grazed.

'There's nothing in our results that suggests you can't have a good, viable pastoral industry in the outback. It's more a question of striking a balance, between the needs of the pastoral industry, and the needs of the native plants and animals that are not coping very well.'

More about biodiversity and water

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