Watering private property wetlands in the Murray Valley, New South Wales

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Re-wetting trials of floodplains on private farmland produces some surprises and support from landholders.

Introduction

Few would disagree that the irrigation industry has brought huge benefits to rural and regional communities within Australia, and that the wider community has also reaped the rewards of productive agriculture. Equally, it is also widely accepted that such benefits have come at a price, such as the loss of biodiversity due to the reduction in native vegetation and habitats. Wetland habitats, in particular, have suffered enormous decline since the advent of intensive agriculture and this can be seen in some large irrigation regions where levee banks and river regulation have prevented flood waters reaching floodplain wetland habitats.

How then, can wetlands continue to survive in an agricultural landscape? How do you convince an irrigation community that water should be provided for these areas? Attracting frogs and birds might be nice, but increasing water costs means there is now far less inclination on the landholders’ part to deliberately provide and manage wetland areas at their own expense. Indeed, do we even know whether agricultural lands might recover habitat values just by reintroducing hydrological flows?

In recognition of this problem, a unique

Figure 1. Wetland fauna and a wide range of wetland plants flourished on 11 (previously ‘droughted’) floodplain wetland sites after receiving a total of 600 ML of additional water through irrigation infrastructure. The trial, coordinated by the NSW Murray Wetlands Working Group (MWWG), involved extensive cooperation between the irrigation corporation, State agency groups and volunteer landholders. (Photo courtesy of Peter Merritt.)
trial project began in November 2001 by the New South Wales Murray Wetlands Working Group Inc. (MWWG), an independent community-based wetland rehabilitation group (Box 1). The idea, first raised by one of the MWWG members, was to make water available to landholders within a large irrigation area for use on remnant wetland areas. The water to be provided was part of the water savings which the MWWG manages on behalf of the NSW government. Under the terms of the privatization of Murray Irrigation Ltd (MIL), this company was required to achieve a program of water conservation measures through infrastructure improvements to reduce seepage losses and increase the efficiency of supply. The NSW Department of Land and Water Conservation (DLWC) funded these works and a portion of the water savings (30 000 Megalitres (ML)) resulting from these improvements was removed from the MIL bulk entitlement on 30 June 1999 and returned to the NSW Water Administration Ministerial Corporation (WAMC). This volume is available for environmental purposes in the Murray Valley. In May 2001, the NSW Minister for Land and Water Conservation announced that the 30 000 ML of water savings was to be entrusted to the MWWG for a 3-year trial to support environmental improvements of wetlands. The flooding of wetlands on private land is one of a number of projects undertaken by the MWWG which has used the water for wetland restoration and enhancement.

**The Murray Wetlands Working Group’s on-ground trial**

The trial project involved extensive co-operation between MIL, the MWWG, DLWC and volunteer landholders, to deliver water via irrigation infrastructure to 11 sites on 10 different private properties (Figs 1,2). Landholders then controlled and managed the water entering their sites via Detheridge wheels. These sites had

**Figure 2.** The Murray Irrigation Limited (MIL) area of operation with stars showing the location of wetlands involved in the rewetting program. The 600 ML water provided in this project was part of the 30 000 ML of the water saved through infrastructure improvements under the terms of the privatization agreement between MIL and the NSW government. This was entrusted to the NSW Murray Wetlands Working Group (MWWG) for a 3-year trial to support environmental improvements of wetlands.

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**Box 1. The NSW Murray Wetlands Working Group**

The NSW Murray Wetlands Working Group was established in 1992 as an initiative of the Murray and Lower Murray-Darling Catchment Management Committees to acknowledge the continuing loss and degradation of wetlands along the River Murray and to develop and implement well-researched, technically sound and community-endorsed management programs for wetlands.

Since its inception, the Wetlands Working Group has developed into a very successful community-based wetland rehabilitation group in the Murray-Darling Basin, achieving a good record of wetland investigation, community education and participation, development of management plans for priority wetlands, and liaison with government agencies, research groups and Aboriginal communities.

The Group has also overseen the construction of works leading to the rehabilitation of priority wetlands on the River Murray floodplain.

The Group’s objectives are to develop a strategic approach to the management and rehabilitation of wetlands throughout the Murray and Lower Darling catchments within NSW, and implement wetland management programs at selected wetlands.
previously been screened by MIL to determine any potential to contribute to groundwater problems, with the final selection being made by the MWWG based on (i) the likelihood of an improved biodiversity outcome and (ii) landholder attitude and motivation.

In total, 232 ha received water. The sites included Black Box (Eucalyptus largiflorens) depressions, prior streams, and Tangled Lignum (Muehlenbeckia floru lentae) swamps. Most had not received substantial flooding for a decade or more, had been continuously grazed, and were in varying states of condition. Most of the sites contained Black Box trees that showed signs of stress, such as a thin leaf canopy and loss of limbs; while other trees appeared dead. The understorey was usually minimal, with perhaps a scattering of Tangled Lignum bushes, very little box tree regeneration, and many weeds. Would adding water to these sites result in any recovery of biodiversity or habitat values? How long might we need to wait for results? How persistent might be the effects, if any?

The trial, which was designed as an adaptive management project rather than a controlled experiment, included monitoring of the vegetation and bird communities both before treatment and for 6 months afterwards. We saw the project as an opportunity to not only improve biodiversity on private properties, but also to gauge landholder and community attitudes and commitment to improving wetland habitats.

**Emergence of the program**

**Some uncertainties**

When we approached MIL, there was a mixture of reactions for this untested idea that useful recovery of habitats may occur from reinstating water flows on the sites. While, on the one hand, there was an instant recognition that this project could improve the landscape and give something back to the environment, there was an equal reaction of uncertainty that any real ecological benefits would result. The landholders involved in the project simply wanted to see some water go to their valued remnant Black Box trees and generally did not expect to see wider improvements on their land. There is scant scientific information available on responses by Black Box to manipulated flooding regimes (Roberts & Marston 2000). This lack of information also made us uncertain as to whether putting water onto degraded former wetland sites would have any lasting ecological benefit, apart from perhaps providing a temporary reprieve for dying Black Box trees.

Apart from the uncertainty about what might happen ecologically, there were many other questions to which we could not provide immediate answers. How much water was needed and for what purpose? How long would (and should) the wetland remain inundated with the quantity of water supplied? What happens if we discover endangered birds breeding? How do we deal with landholders that might wish to divert the water for productive purposes? How do we provide support to those landholders subject to criticism from their peers? Who should pay for associated costs?

**Site selection and landholder discussions**

Landholders were initially attracted to the project by an advertisement in MIL’s weekly newsletter. Interested landholders were then asked to complete a questionnaire that aimed to gather some basic information on the site and test the level of commitment from the landholder. For instance, landholders were asked a series of questions relating to the ecology of the site: what sort of vegetation and birds had they seen, was the site grazed, could water be easily distributed to the area without affecting neighbouring properties, and were landholders willing to keep stock out of the site and not use the water for productive purposes (i.e. recycling onto adjacent crops). Reasons given for their interest in the project included comments such as ‘for regeneration of native vegetation’, ‘to maintain the biodiversity that remains and improve it’ and ‘we just love healthy native trees and this area has been preserved by three generations – it is an asset’.

After the potential sites were assessed by MIL for groundwater suitability (i.e. ensuring the sites were unlikely to impact groundwater via leaking or draining) visits were made to the selected shortlist of sites to briefly assess the vegetation and hold discussions with landholders to try and more clearly define their vision for the site. This was a particularly essential and revealing part of the process because it gave us the opportunity to develop a relationship of trust with the landholder. Some landholders admitted they were nervous at the idea of working with ‘greenies’ and were concerned that we may start dictating how they should manage their properties. After discussion with the landholders we determined management aims and a monitoring program for each successful application. This process identified 11 sites (232 ha) on 10 properties with ~600 ML needed to collectively fill wetlands and allow for keeping water levels maintained in case birds started breeding (Table 1). The amount of water used at each site was estimated by the landholder, or by using the formula of 3 ML per hectare (based on MIL advice). All sites were dry prior to water delivery (except one semipermanent site).

**Work starts**

The landholders began filling their wetlands towards the end of October 2001. While not ideal for a spring watering, the late start for the project was unavoidable as it took nearly 6 months of negotiation, site assessment and administration before water could begin flowing. This was further compounded by timing issues for the landholders who were delivering water for rice crops and lacked channel capacity to carry the wetland water. Some landholders held off watering their wetlands until they had erected fences around the sites and were able to exclude stock more effectively.

Monitoring the vegetation, birds and surface water salinity began before the first watering and every 3 weeks thereafter for 6 months until April 2002 (Fig. 3). We felt confident that at the very least, some remnant vegetation would benefit from the water, and the presence of some dead aquatic plants such as Common Nardoo (Marsilea drummondii) hinted at the potential of a wetland vegetation community developing in some sites.
Nevertheless, this optimism was tempered by a nervous ‘wait and see’ attitude, as we knew of no other similar project in Australia with which to compare our work.

How we monitored

The monitoring program used vegetation and birds as response attributes to monitor the success of the trial and we specifically aimed to (i) establish a prewatering benchmark; (ii) detect rates and directions of changes of vegetation community and bird composition; and (iii) detect change in the vigour of trees within the wetlands.

Three areas at each wetland were chosen and within each of these areas the cover abundance of all plant species in each of five random quadrats was recorded. The same three areas were monitored every 3 weeks for 6 months. Photopoints were set up at each monitoring site. Conductivity (µS/cm) was randomly measured below surface level in six areas within each wetland for each monitoring time point.

Birds were surveyed using standard 20-min and 1-hour area searches, which incorporated all available habitats at each site (e.g. mudflats at edges, deep water in centre, tree canopies, emergent vegetation). The minimum number of individuals detected for each species was recorded, together with any breeding activity.

What changes occurred on the sites?

Vegetation

Figure 4 shows examples (from established photopoints) of two of the wetlands prior to treatment and the changes that occurred afterwards. Prior to watering, the plant species present included wetland species such as reeds and rushes (*Eleocharis, Carex and Juncus* spp.); sedges (*Cyperus* spp.); Common Nardoo (*Marsilea drummondii*); Buttercup (*Ranunculus* sp.); Water-milfoils (*Myriophyllum* spp.); Southern Swamp Wallaby Grass (*Amphibromus neesii*); Tangled Lignum (*Muehlenbeckia florulenta*) and Cane Grass (*Eragrostis australasica*). Increased growth, and new growth of rushes and sedges (*Eleocharis* sp., *Juncus* sp., *Carex* sp., *Cyperus* sp.) was also recorded. Other changes we observed after inundation included new growth on Black Box and Tangled Lignum, with both species starting to flower. Although non-watered sites were not monitored, we didn’t

![Table 1. Details (size, wetland type and Megalitres delivered) of the 11 wetlands in the Murray Wetlands Working Group Inc. (MWWG) rewetting trial](image)

<table>
<thead>
<tr>
<th>MWWG Property Identification Number</th>
<th>Wetland area (ha)</th>
<th>Wetland type and dominant vegetation</th>
<th>Water used (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>Black Box depression</td>
<td>37</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>Riparian Black Box</td>
<td>58</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>Black Box depression</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>Red Gum swamp</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>8.1</td>
<td>Black Box depression</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>43</td>
<td>Black Box/Tangled Lignum swamp</td>
<td>34</td>
</tr>
<tr>
<td>7.1</td>
<td>30</td>
<td>Black Box floodrunner</td>
<td>26</td>
</tr>
<tr>
<td>7.2</td>
<td>30</td>
<td>Black Box floodrunner</td>
<td>77</td>
</tr>
<tr>
<td>8</td>
<td>34</td>
<td>Cumbungi swamp</td>
<td>114</td>
</tr>
<tr>
<td>9</td>
<td>13.6</td>
<td>Black Box depression</td>
<td>40</td>
</tr>
<tr>
<td>10</td>
<td>36</td>
<td>Red Gum/Tangled Lignum swamp</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>231.7</td>
<td></td>
<td>569</td>
</tr>
</tbody>
</table>
observe similar changes in dry adjacent areas. Roly Poly (probably *Sclerolaena muricata*), Bluebush (*Maireana* sp.), Wallaby-grass (*Austrodanthonia* sp.), and other native terrestrial plants showed an increased growth at those wetlands that are now in their drying phase. Weeds such as Rye-grass (*Lolium perenne*) and Barley Grass (*Critesion murinum*) were flooded, leaving native terrestrial plants to colonize during the dry phase. In some areas, these plants reached 100% cover of the area, making it more difficult for weeds to re-invade.

Prior to watering there were 57 plant taxa. After watering, a total of 83 taxa were recorded from the quadrats in all 11 wetland sites for the 6-month monitoring period (Table 2). Wetland plants were 23% of this total, native plants were 37% and introduced plants contributed 39%. The disappearance and reappearance of some taxa are likely to reflect the random sampling method.

As Table 2 indicates, as the duration of inundation increased, there was a marked decrease in introduced species and an increase in percentage (not absolute number) of wetland species. There was little change in the number of native terrestrial species. Figure 5 shows another example of photopoints at one of the wetlands depicting substantial aquatic plant growth.

**Birds**

The average hourly counts of bird species increased at most sites after inundation (Fig. 6, Table 3). However, because the monitoring program was not a controlled experiment, it cannot be stated with any certainty that the presence of the birds was a direct result of the watering or was due to increased monitoring period or a seasonal effect. It is likely that the water attracted birds from neighbouring dams or rice fields, resulting in very large numbers of some species. For instance, Black-tailed Native Hens (*Gallinula ventralis*) were recorded at 82% (9/11) of sites, with up to 320 individuals at one site. Nankeen Night Herons (*Nycticorax caledonicus*) probably responded to inundation at two sites by selecting day roost sites in trees in newly flooded areas.

In addition to the threatened woodland birds listed in Table 3, many species considered to be in decline were also recorded, such as Red-capped Robin (*Petroica goodenovii*), Chestnut-rumped Thornbill (*Acanthiza uropygialis*) and Jacky Winter (*Microeca fascinans*). Although no explicit responses were detectable for woodland birds, it is expected that they will benefit in the long-term if the health of these systems improves. Nine bird species were recorded that are listed under the NSW Threatened Species Conservation Act (Table 3), and of these, four are also considered threatened species under federal legislation (*Endangered Species Protection Act 1992*). Eight migratory shorebird species were recorded.

**Salinity**

Salinity of the delivered water was low, ranging from 120 to 300 µS/cm. Salinity after wetting was below 400 µS/cm on all occasions, indicating the wetlands stayed relatively fresh while inundated.

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**Table 2.** Percentage of introduced, native terrestrial and native wetland plant species prior to watering (week 0) and 6–24 weeks after inundation

<table>
<thead>
<tr>
<th>Plant type</th>
<th>Week 0</th>
<th>Week 6</th>
<th>Week 9</th>
<th>Week 12</th>
<th>Week 18</th>
<th>Week 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced terrestrial</td>
<td>42%</td>
<td>27%</td>
<td>19%</td>
<td>16%</td>
<td>22%</td>
<td>21%</td>
</tr>
<tr>
<td>Native terrestrial</td>
<td>39%</td>
<td>36%</td>
<td>41%</td>
<td>36%</td>
<td>31%</td>
<td>38%</td>
</tr>
<tr>
<td>Native wetland</td>
<td>19%</td>
<td>36%</td>
<td>41%</td>
<td>48%</td>
<td>47%</td>
<td>41%</td>
</tr>
<tr>
<td>Total no. of taxa</td>
<td>59</td>
<td>33</td>
<td>27</td>
<td>25</td>
<td>32</td>
<td>34</td>
</tr>
</tbody>
</table>

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![Figure 4](image-url)  
*Figure 4.* Changes to vegetation quality and quantity at Site 2. (a) The condition prior to water delivery (Week 0, 7 November 2001) and (b) the changes 15 weeks after delivery (Week 15, 11 March 2002). Note the new growth on trees and increased abundance of wetland plants after watering. (Photos: P. Alexander.)
Response of the landholders

The participating landholders (Fig. 7) were generally greatly surprised by the extent of the response by their land, as were we. As one landholder said:

We should have done this years ago … Our small wetland now has hundreds of birds, representing a wide variety of species, where in the adjacent creek you might have seen between two and six ducks at the very least.

The diversity and sheer mass of aquatic plants that developed in the wetlands surprised everyone, and it was not long before frogs were evident.
we monitored provide quantitative evidence that these isolated wetland areas can be rejuvenated and potentially provide drought refuge for many mobile species.

Costs

Apart from costs associated with employing project officers, the initial costs of the project included some minor earthworks on one property and the MIL water delivery service charge to each property. These costs were shared between MIL, the MWWG and the landholders, although later responses from most of the landholders indicated they were willing to pay these costs themselves (which averaged around $500 each) as they recognized the amenity value they gained from the project. Interestingly, when landholders were subsequently offered a rebate from MWWG, few chose to take up the offer and of those who did, they were still somewhat reluctant.

What we have learned

By the end of the project, many of the uncertainties noted at the beginning of the project were largely resolved, while answers to others still elude us. For instance, some wetlands retained water for far longer periods than others, and this probably remains the most difficult aspect to predict. Ideally, we prefer water to be present for at least 3 months to provide the best opportunity for seedbanks to be restored and for invertebrates to complete life-cycles (e.g. Briggs 1988; Nielsen & Chick 1997; Nias 1999). Three to four months may also be the preferred length of inundation for Black Box and Tangled Lignum (Roberts & Marston 2000). Each site was different in terms of, for example, its size and topography, past and present management and extent and health of the existing vegetation, so we were not always able to predict the ‘right’ amount of water needed. In some sites where there was little ground cover, water disappeared within 2 weeks, yet would still be present on a different site which also lacked ground cover. In general, however, the more degraded and droughted the site appeared, the less likely the water would be retained beyond 2–3 weeks. The most marked responses were usually associated with sites that had a relatively healthy vegetation cover and conservative stock management. With regards to the concern over the potential for this water to initiate a waterbird breeding event, we made an a priori decision to allow for extra water as needed until fledging was completed. However, our monitoring did not detect water-bird breeding events.

Where to from here?

Following a presentation of the monitoring results to the MIL Environment Committee and Board, a second trial has now begun. Awareness and interest has been high and the number of wetland sites increased substantially to 43, involving 27 landholders and covering some 572 ha, more than double the size of this first trial. Due to limited resources, only nine of these sites will be monitored for plant and bird responses. However, Land and Water Management Officers from MIL will be visiting the remaining sites to take regular photos and ensure that the landholder has appropriate support. By utilizing MIL staff and the landholders themselves, we hope to build a substantial knowledge base within the region and provide wider opportunities for the community to become actively involved in water resource management for biodiversity outcomes.
This project is also the beginning of a more strategic approach being developed by the MWWG to using environmental flows within the Murray Region of NSW. Our strategy will incorporate the rehabilitation of a diversity of wetland types within a specific timeframe. A ‘bank’ of wetlands can be identified which cover a variety of vegetation and hydrology types (i.e. wetlands dominated by Redgum (*Eucalyptus camaldulensis*) as well as Black Box or Cane Grass (*Eragrostis australasica*) dominated wetlands, Spike-sedge (*Eleocharis* sp.) dominated wetlands, etc.). The strategy will identify which wetlands should receive water over a 10-year time-scale or longer. For instance, some would receive water relatively often (every few years), while others would be inundated less frequently (e.g. every 5–10 years). Monitoring of the wetlands would still be required, but at a lower intensity than this trial project and will be targeted to achieve a particular management objective.

**Wider implications for biodiversity strategies within agricultural landscapes**

This trial was a landmark project in the overall context of managing environmental flows. Using irrigation infrastructure, it delivered water to former wetland sites on private property and brought together a conservation group, private landholders, a major irrigation company and a government agency. It has demonstrated that positive change can happen, even in the face of initial uncertainty.

The project also has wider implications for the biodiversity protection strategies of both government and private irrigation companies. For instance, the principles behind this project have been incorporated into the draft Biodiversity Strategy of the Rice Growers Association. Furthermore, information from the monitoring of this project is adding to the general knowledge bank for natural resource managers and landholders within the region, and this knowledge can be applied in future using adaptive management principles. With the increasing cost of water, it could emerge that delivering state-owned environmental water via irrigation structures will be an integral part of strategies designed to ensure wetland diversity and biodiversity does not continue to disappear from agricultural landscapes.

**Acknowledgements**

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**References**