Australia's Coorong Ramsar site as an example of climate change challenges

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Australia

Over-allocation of water and climate change wreck ecological havoc: big issues for Ramsar COP10?

Australia’s Coorong Ramsar site provides an example of the growing challenges facing many countries in conserving wetlands.

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Introduction

All of us concerned for conservation of wetlands are likely to have been aware of the threats posed by climate change. Yet our theoretical understanding has not prepared even a well-resourced country like Australia to respond in a timely way to minimize the damage, nor for some of the surprises climate change is inflicting on our wetlands. This note to the Ramsar community highlights:

1. How the impacts of climate change are exacerbated by the cumulative impacts of non-climate change degradation;
2. That many policies of governments in response to climate variability and for development of primary industries may actually increase the impacts of climate change on wetlands; and
3. There are nasty ecological surprises and unpredicted thresholds with climate change.

Lessons

There are a number of lessons that can be taken from the degradation of Ramsar wetlands along Australia’s Murray River:

1. Reducing non-climate impacts, like excessive diversion of water, is critical to increasing resilience and buying time to deal with the additional impacts of climate change;
2. Transboundary wetlands need effective inter-jurisdictional agreements for cooperative, equitable and sustainable management of climate change if their ecological character is to be maintained;
3. Adequate water allocation and provision of environmental flows is critical to sustaining the chosen ecological character of wetlands;
4. Do not wait for better data to commence climate adaptation measures – begin to address the obvious threats to ecological character and likely impacts now;
5. Avoid “maladaptations”, measures in climate change and other sectoral policies that exacerbate the impacts on wetlands (e.g., thoughtlessly storing more water or increasing groundwater use).

The impacts seen in Australia raise questions for the Convention: Can parties respond in time to maintain the ecological character of wetlands? How can Convention tools like the Montreux Record best be applied? If impacts on ecological character are unavoidable, how should Ramsar respond? The Ramsar Conference of Parties in October is due to consider a number of draft resolutions on these issues. Hopefully this note may inspire productive debate among contracting parties on the ways forward for wetlands conservation.

Background to the Murray Ramsar sites

Southern Australia is particularly vulnerable to climate change as global warming draws rain-bearing cold pressure...
systems south of the mainland and into the Southern Ocean in winter. Since the 1980s it has been predicted that southern Australia may suffer reduced precipitation due to climate change. In the clearest example of climate change, from 1975, inflows into the reservoirs of the west coast city of Perth fell in two ‘step changes’ from an average 338 Gigalitres (Gl) per year to 114 Gl from 1997 (see figure below).

**Figure: Stepwise reductions to dam inflows, Perth, Western Australia. Source: WA Water Corporation.**

The Murray–Darling basin covers a seventh of the continent’s landmass in Australia’s southeast. Wetland protected areas in the basin, including 16 Ramsar sites, encompass extensive freshwater ecosystems. A 2006 status report by government research agency CSIRO on river inflows says that on average there was ~25,000 Gigalitres (Gl) per year of inflows in the basin and, if none were diverted, 48% would have been discharged into the estuary. However, water diversions (95% of which are for irrigated agriculture) are severely degrading wetland habitats through desiccation, including those within major protected areas. Of the inflows, ~44% was diverted for human uses, ~44% was lost to evaporation and transpiration, and only ~12% was reaching the Coorong estuary.

The low levels of rainfall in the current “drought” in southern Australia are not unprecedented. In May, Murray-Darling Basin Commission (MDBC) Chief Executive, Dr Wendy Craik AM, announced the Australian Government’s conclusion that: “There is growing evidence that lower rainfall and reduced runoff in southeast Australia is linked to climate change.” Inflows into the river systems are at an historical low (see graph below) that many climatologists fear represents the type of inflow reduction experienced in Western Australia. For instance, CSIRO researchers Cai and Cowan conclude in 2008 from observational data that increased evapotranspiration reduces inflows in the Murray-Darling basin by 15% for every increase in temperature by 1°C. It is likely that the combination of greater evapotranspiration with higher temperatures and inflow intercepting land uses has dramatically reduced runoff.

**Figure: River Murray system inflows. Source: Murray Darling Basin Commission.**

Impacts on the Coorong
As a result the Coorong and Lakes Alexandrina and Albert Ramsar site (140,500 hectares) and many other wetlands are increasingly desiccated. The Ramsar site is divided by a barrage system between the Coorong estuary and Lake Alexandrina to prevent upstream sea water intrusion. Lake Albert is a terminal lake connected to Lake Alexandrina by a narrow channel. The Coorong and Lakes Alexandrina and Albert site has undergone significant change in ecological character over the past decade (documented in an ecological character description prepared for the South Australian Government in 2006: [http://www.environment.sa.gov.au/biodiversity/wetlands.html#ramsar](http://www.environment.sa.gov.au/biodiversity/wetlands.html#ramsar)) and the Australian Government has fulfilled its obligations under Article 3.2 of the Convention and communicated the findings to the Ramsar Secretariat.

The upstream portion of the Ramsar site (upstream of the barrages) is now below sea level.

This has produced some nasty surprises. High salinity was expected but not an invasion of marine bristle worms, which have colonized the shells of eastern long-necked tortoises with massive encrustations, leading eventually to their deaths. This has occurred in the lower reaches of Lake Alexandrina due mostly to saltwater intrusion through the barrages. There has also been an increase in salinity in the Lower Lakes due to reduced freshwater inflows.

The most significant impact from reduced inflows into the Coorong and Lakes Alexandrina and Albert Ramsar Site is the exposure of sediments high in sulfates which have the potential to oxidize and produce sulphuric acid upon re-wetting. In an attempt to maintain water levels and prevent further exposure of acid sulfate soils, a program of emergency pumping from Lake Alexandrina to Lake Albert was directed by the Murray-Darling Basin Ministerial Council earlier this year (2008). It began on 2 May and will continue at least until September this year. Around 3,000 hectares of the Coorong lake bed is affected, and the damage is spreading up the Murray River valley. A CSIRO survey (published in 2006) of 81 wetlands of the Murray-Darling Basin to determine the extent of sulfidic sediments in inland wetlands found that 17 (21%) wetlands contained concentrations of reduced sulfur at levels that could pose an ecological risk if mismanaged. Most of these wetlands were adjacent to the Murray River. At Bottle Bend lagoon near Mildura, for example, the water is now ph 1.6.
Dead red gum floodplain forests and salinized and acidified creek, Bottle Bend NSW, April 2007. Copyright Murray Wetlands Working Group.
Climate change impacts

A 2006 risk assessment by government research agency CSIRO on river inflows to 2030 concluded that climate change could potentially reduce stream flow by 5% and that reductions from climate change, over-allocation of groundwater, bushfire-induced forest regrowth, more on-farm dams, afforestation, and re-use of irrigation tail waters could result in a total reduction of between 10 and 23% of annual inflows. A 2008 CSIRO assessment suggests that farm dams and forestry expansion may only reduce inflows by 2%.

The 2006 assessment highlights a number of effects:

1. Direct impacts of climate change and bushfires, which increase regrowth of thirsty young trees, reduce inflows;
2. Indirect impacts of poor government management of groundwater separately to surface water, and of policies for establishing forests, that did not consider the resulting reduction of inflows into streams;
3. Drought mitigation and water use efficiency policies to expand on-farm dams and re-use irrigation tail water that did not consider the implications for reduced inflows.

The combined environmental impact of these risks to water resources is secondary compared to the diversion of nearly half the water for agriculture. Yet it is notable in this 2006 assessment that poor management – maladaptation – is forecast to reduce wetland inflows more than the direct impacts of climate change.

A 2008 CSIRO ‘sustainable yield’ assessment for the River Murray River notes that current water resources development has reduced average annual flow at the Murray mouth (Coorong) by 61% with the river failing to flow into the sea 40% of the time. The CSIRO 2008 report offers three forecasts to inform management decisions:

CSIRO forecast for River Murray waters
Average annual surface water availability
End of system flows
The great range of potential outcomes, and change in forecasts from 2006 to 2008, highlights one challenge in adapting to climate change. It would be dangerous to wait for more precise forecasts despite the great range of potential outcomes. Consequently there is a need to begin ‘no regrets’ adaptation measures now, such as reducing demand for water.

Under the median reduction in runoff scenarios, if measures promised by governments are implemented, including reducing water diversions and increasing environmental flows, then some parts of the Murray-Darling’s wetlands biota may be conserved. In the past year, for example, the Murray Darling Basin Commission and state conservation agencies have provided modest environmental flows to wetland Ramsar sites (including Banrock Station (Ramsar site no. 1221,1,375 ha), Narran Lakes (no. 995, 5,531 ha), Macquarie Marshes (no. 337, 18,700 ha) and the Gwydir wetlands (no. 993, 823 ha)). However a Murray Darling Basin Commission ‘icon site condition report’ in 2007, covering all or part of six Ramsar sites (Coorong, Riverland (‘Chowilla’; no. 377, 30,600 ha), Hattah-Kulkyne (no. 264, 955 ha), Gunbower (no. 263, 19,939 ha), Barmah (no. 262, 28,515 ha), and NSW Central Murray State Forests (no. 1291, 84,028 ha)) describes less than 21% of the floodplain forests as being in a healthy condition, with the rest declining or dead, as detailed below:

<table>
<thead>
<tr>
<th>Icon site (red gum forest Ramsar wetland)</th>
<th>Ramsar site #</th>
<th>Interim red gum forest objectives (Nov 2003)</th>
<th>Floodplain red gum forest condition (MDBC October 2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chowilla</td>
<td>377</td>
<td>100%</td>
<td>“Typically 20-60% of all trees are dead or nearly dead, while approximately 90% of live trees are stressed or severely stressed”</td>
</tr>
<tr>
<td>Lindsay &amp; Wallpolla Islands (part Chowilla icon site)</td>
<td>n/a</td>
<td>100%</td>
<td>21% 45% 21% 12%</td>
</tr>
<tr>
<td>Hattah Lakes</td>
<td>264</td>
<td>263 &amp; part 1291</td>
<td>5% 19% 31% 45%</td>
</tr>
<tr>
<td>Gunbower - Koondrook - Perricoota Forest</td>
<td>30%</td>
<td>“Virtually all”</td>
<td>19% 59% “unhealthy” 22%</td>
</tr>
<tr>
<td>Barmah-Millewa Forest</td>
<td>262 &amp; part 1291</td>
<td></td>
<td>20% 75% 5% 0%</td>
</tr>
</tbody>
</table>

Other Murray-Darling models based on observational studies suggest that wetlands are at much greater risk. For instance, CSIRO scientists Cai and Cowan in 2008 (in Geophysical Research Letters 35) concluded from observations that every 1°C rise in average temperature increased evapotranspiration and reduced inflows by 15%. They model a 55% reduction in inflows from reduced precipitation and increased evaporation with a 2°C temperature rise by 2060. Critics contend that government plans to manage climate change focus on median forecasts when current observational data suggests that the ‘extremely dry’ scenarios are being experienced. This greater magnitude of runoff reduction would exceed the likely thresholds for the survival of substantial elements of the wetland biota, including many Ramsar sites.

The Victorian state government has been considering what parts of its Murray basin wetlands biota can be conserved and which may have to be abandoned. For example, it has drafted an ‘emergency watering plan’ to try to save critical freshwater biodiversity in the current ‘drought’. Setting priorities for environmental water will become increasingly more important in a water scarce future, where natural flooding events are likely to become less frequent and be of reduced magnitude. In 2007, the Victorian River Health Program modeled a similar, ‘extremely dry’ (continuation of the current ‘drought’) scenario for the Barmah Ramsar site (no. 262, 28,515 ha) on the Murray River, where flood return intervals would become too infrequent for many species and flood plain forest vegetation communities to persist. Biota that may be conserved in the face of moderate climate change with better adaptation policies are unlikely to survive in the longer term with more severe impacts.
How are Australian governments responding to changes in wetland ecological character?

Australia’s state and national governments have squabbled over management of the Murray Darling basin throughout the nation’s history (a story well told by Dr Daniel Connell in his 2007 book: *Water politics in the Murray-Darling Basin*, Federation Press) and state governments have over-allocated water rights.

Australia’s national and relevant state governments identified six Murray-Darling ‘icon sites’ – major wetlands (includes all or part of six Ramsar sites) that are the focus of conservation efforts to avoid desiccation of a range of freshwater ecosystems (see map below). In 2002 an expert panel recommended options to ‘deliver a healthy working river’, including increasing environmental flows above the historic volume then reserved from diversion with up to 4,000 Gigalitres per year (GL pa) more water that would provide a ‘high’ chance of restoring ecological health. Governments made a ‘first step decision’ in 2003 to reallocate a mere 500 Gl pa to achieve specific environmental objectives and outcomes at each of the icon sites, objectives which did not include maintaining the ecological character of the entire area of each site (for example, only 30% of the of the total red gum floodplain forest area. of the Gunbower – Koondrook – Perricoota icon site was proposed to be maintained).


The Australian Government is revising this decision from 2008 with significantly higher reallocation to the environment to increase functionality, partly to compensate for the reductions in inflows forecast from climate change. $12.9 billion has been allocated under the Australian Government’s *Water for the Future* to take action on climate change, use water wisely, secure water supplies and support healthy rivers. The Council of Australian (state and national) Governments has agreed to reform Murray Darling Basin management, but these reforms are unlikely to be fully implemented for years. Under *Water for the Future*, the Australian Government has started a welcome AUD$3.7 billion (~USD$3.5 billion) program to repurchase water rights. However, at the time of writing, it is not known what new wetland conservation targets will be chosen, or the level of reallocation of water to the environment (speculation of 1,500 Gl), or the timeframe in which these measures will be implemented. In one part of the agreement, existing state tributary ‘catchment management plans’ remain in force until 2014 despite the urgency of enhanced action now.

Professor Mike Young at the University of Adelaide has criticized recent basin management, noting that the inflow reduction activities identified by CSIRO in 2006 will remove nearly twice as much water (2,570 GL by 2023) from the rivers as the government plans to buy back. Professor Young points to MDBC modeling of the different types of water rights in the basin that concludes that in dry periods water users may access 83% of their allocations while the environment may receive just 17% of its share, a concern reinforced by the suspension of rules for sharing water with the environment in many states in the current drought. He proposes an alternative basin management model (weblink below).

The key question is: despite the impressive government funding allocations and decisions, will the ecological health of the Ramsar sites along the lowland Murray survive long enough to recover should the government plans eventually
Suggestions for the way forward

In my view there are a range of actions that could improve the situation in the short to medium term:

1) Providing emergency environmental flows to the Coorong. The Australian Conservation Foundation is asking the government to purchase ~2,000 GL held in state and private storages in the northern part (Darling River portion) of the basin. Governments say there is not enough water left in the river system to do this and argue that transmission losses of 70-80% of water from the northern basin would preclude provision of the 1,050 - 1,250 Gl needed to fill and maintain the lakes at sea level to July 2009;

2) Regulating to prevent diversion of "overland" (non-channel floodplain) flows and dismantling the thousands of kilometres of diversion banks built in the northern basin, many in apparent breach of government guidelines (e.g.: [http://www.connectedwaters.unsw.edu.au/news/floodplain.html](http://www.connectedwaters.unsw.edu.au/news/floodplain.html)). This practice immediately impacts on the Gwydir Wetlands (site no. 993, 5,531 ha), Macquarie Marshes (no. 337, 18,726 ha), and Narran Lakes (no. 995, 5,531 ha) Ramsar sites, as well as reducing flows to more sites downstream. Governments have promised to better manage overland flows but action is not yet apparent;

3) Requiring developers of inflow diverting activities (e.g., on farm dams, forestry plantation establishment) to offset their water use by purchasing water rights. Governments are assessing what action to take but have announced no decisions yet;

4) Accelerating emergency pumping of seawater into the Coorong estuary and other urgent remediation measures;

5) Institute periodic re-licensing of water infrastructure to enable old dams and levees to be either renovated to reduce their environmental impacts (e.g., by installing fish passages) or removed if they are unsafe or redundant. Some impressive work has made good progress in reinstalling fish passage on the Murray River, but this is a one-off program that does not extend to the rest of the basin;

6) Replacing state catchment management plans soon where they fail to adequately provide for the environment;

7) Reinstating previous state government agreements for the allocation of water between the environment and users, which were set aside in some tributary valleys as the ‘drought’ began to impact;

8) Montreux Record listing the key Ramsar sites whose ecological character has changed, to maintain pressure on future state and national governments to restore and maintain the ecological character of wetlands. In my view this is also important to communicate the lessons learnt to the global Ramsar community on how to deal with the impacts of climate change. The Australian Government has said its position is that Montreux listing is considered on a case-by-case basis under the guiding principle that Australia only lists sites on the Record when all locally generated remedial actions have been exhausted and where there is a high probability that such a listing would assist in achieving improvements in the on-ground condition of the Ramsar site. (Senate Hansard 24 June, 2008).

Conclusion:

Climate change is upon us and is impacting on wetlands in many parts of the world. This Australian case shows that:
1) You should not wait for better data to start taking action now to reduce the most obvious non-climate and climate threats; 
2) The cumulative impact of past non-climate threats, and the indirect impacts of adaptation to climate variability (e.g., storing more water on farms and using more groundwater), can have as large an impact as the direct effects of climate change on hydrology; 
3) Good governance of natural resources like water is critical to avoiding wetland loss; 
4) Climate change brings many challenges to the implementation of the Ramsar Convention.

More information:

CSIRO Murray Darling Basin Sustainable Yields Project reports 2007-08:
http://www.csiro.au/partnerships/MDBSY.html

Murray Darling Basin Commission reports:
Including MDBC 2006 reports on “risks to shared water resources”:


Fact sheet on environmental flows to the lower lakes:

Council of Australian Governments decisions on management of the Murray Darling basin:

Professor Mike Young at the University of Adelaide:
http://www.myoung.net.au/water/

Australian Conservation Foundation:

* The views expressed in this article reflect those of the author and not necessarily those of the Australian National University, any government, or the Ramsar Convention. Australia's Department of the Environment, Water, Heritage and the Arts provided helpful comments to an earlier version of this paper. Any errors that may remain are my own.