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Lifting our gaze: Improved environmental water management requires a landscape scale approach

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Key Points

- Environmental water management has traditionally focused on individual sites or waterways
- Future management directions should take a broader landscape view that considers regional priority objectives and ensures environmental watering actions are delivered in a co-ordinated way across multiple sites to better support ecological processes.
- Landscape scale management approaches need to be supported by research that aims to improve understanding of landscape scale processes.

Abstract

Environmental water management and the scientific monitoring and research projects that inform it have historically focused on individual river reaches and individual wetlands. This approach presents two problems:

1. There is no clear ecological basis for deciding which of the myriad of waterways with different permutations and combinations of environmental objectives have the most legitimate claim to environmental water in any given year.
2. Many of the environmental objectives that waterway managers want to achieve are underpinned by ecological processes that operate at a landscape scale. Applying the perfect water regime to an individual waterway will probably not achieve the intended outcome unless the waterways and floodplains to which it is connected also have suitable flow regimes and complementary management actions.

Rather than asking what we can achieve with environmental water at a favourite waterway, we should ask what are the fundamental ecological processes that underpin waterway health across our landscapes and which waterways need environmental water and other management interventions to support those processes. The task is not simple and involves all of us. Researchers need to shift their focus to landscape scale processes and use the results of site based studies to build landscape scale ecological models. NRM agencies and environmental water holders need to co-ordinate efforts to ensure environmental water and other management tools are delivered where, when and in ways that they are most needed across the landscape.

This presentation aims to trigger thought, discussion and debate about these issues to influence future research agendas and management frameworks.

Keywords

environmental water, environmental flows, landscape scale assessment, prioritisation

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Introduction

Environmental water management and the scientific monitoring and research projects that inform it have historically focussed on individual river reaches and individual wetlands. The approach has delivered good outcomes at individual sites, been instrumental in gaining community support for the environmental water program and fostered collaborative partnerships between Catchment Management Authorities and scientists who have worked on projects at particular waterways. The site based approach to environmental water management and research will continue to deliver incremental advancements, but more significant progress will require a broader landscape scale approach to environmental watering decisions and related science.

This paper briefly describes the current approach to environmental water management, highlights two specific limitations of the current approach and proposes potential actions to help the environmental water program evolve. The paper aims to trigger thought, discussion and debate with a view to influencing future research agendas and management frameworks.

The current situation

The environmental water program in Victoria has evolved through a ground up approach whereby Catchment Management Authorities (CMAs) identify priority waterways in regional waterway strategies (e.g. GBCMA 2014, GHCMA 2014, NCCMA 2014) and then commission technical studies for individual waterways to determine target environmental values and the water regimes required to support those values (e.g. SKM 2012, Alluvium 2013, Jacobs 2015, Jacobs 2015). CMAs review the water requirements for their selected waterways each year based on factors such as recent watering history, seasonal forecasts and likely water availability and submit proposals to the Victorian Environmental Water Holder (VEWH) requesting support for their proposed watering actions. The VEWH reviews the *Seasonal Watering Proposals* from across the State and applies the criteria outlined in ***Table 1*** and estimates of likely water availability to determine which of requested watering actions to authorise in the *Seasonal Watering Plan* (VEWH 2018).

Table 1: Criteria applied to individual waterways to determine where and how to use environmental water in Victoria each year. These criteria are generally applied to wetlands and river reaches individually and on a case by case basis

Criteria used to prioritise environmental watering decisions

• **Extent and significance of benefit expected from proposed watering**
  o Is the watering action targeting a threatened species?
  o Is the site recognised as high value under state, national or international legislation or agreements (e.g. Ramsar)
  o Is the watering event aiming to trigger a breeding event that hasn't already occurred?

• **Certainty of achieving environmental benefit**
  o Has the event been delivered before and shown to work?
  o Are measures in place to manage risks (e.g. pest control) and support the target outcome?

• **Ability to provide ongoing benefits**   o Can the outcomes of environmental watering be maintained over the long term?

• **Watering history of the site and implications of not watering**
  o Is the proposed watering action supporting outcomes from previous watering actions?
  o Will previous gains be at risk if the proposed watering action is not delivered?

Criteria used to prioritise environmental watering decisions

• **The feasibility of watering.**
  o Do we have enough water in the holdings to deliver the required volume?
  o Can the proposed watering action be delivered within constraints of infrastructure, capacity, resourcing and levels of risk?

• **Cost effectiveness of the watering action**
  o How much will the action cost?
  o Do we have sufficient funds to deliver the event?
  o Do the expected benefits represent good value?

The identification of priority waterways in regional waterway strategies, assessment of water requirements for those waterways and selection of which waterways will receive environmental water in any given year is all done at the scale of individual rivers or wetlands. Waterways that are initially considered for inclusion in the environmental water program are usually selected because they have significant environmental values (i.e. they support species of conservation significance or community interest), are valued by local communities and other stakeholders, and can readily receive environmental water via existing infrastructure. Environmental flow assessments at the selected waterways effectively put a fence around the waterway, ask what species we would like the waterway to support and then use known water requirements for those species to recommend a water regime for that waterway. Environmental flow studies rarely specify what other flows and conditions are needed in the wider landscape. The VEWH's annual evaluation and prioritisation of watering actions considers the likely success and cost of waterways individually. It is rare for any of these steps to consider how different waterways interact with each other, how actions at one site may affect outcomes at other sites and whether watering multiple sites in a co-ordinated way will achieve better outcomes than the sum of benefits achieved at individual sites.

Most of the scientific research and monitoring programs that inform environmental water management also focus on individual sites and have relatively short timeframes. This is mainly a function of small budgets for monitoring and incentives for scientists to focus on research projects that have a high chance of producing publishable results in a short time. Studies that are conducted at a small spatial or temporal scale may miss critical patterns that are operating at larger scales. There is also little incentive for scientists to develop landscape scale conceptual models because they are complex and have higher levels of uncertainty.

The collective focus of scientific studies and environmental water management at the individual site scale potentially produces a restrictive feedback loop, whereby new management actions are devised, implemented and evaluated at individual sites without considering what is happening or what is needed at the broader landscape scale. Some processes undoubtedly operate at the individual site scale and management actions applied at individual sites will have good outcomes. But we know that ecosystem processes operate at large spatial and temporal scales and therefore we need to understand how to apply management actions at a landscape scale to achieve better outcomes.

The problem

The site based approach to environmental water management presents two problems:

Problem 1 – there is no clear ecological basis for deciding which waterways have the most legitimate claim to environmental water in any given year.

The ground up approach to building the environmental water program has produced a myriad of waterways (i.e. river reaches and wetlands) with different permutations and combinations of environmental objectives that now call for environmental water (see Figure 1). The wide variety of sites and objectives makes it difficult to compare the merits of delivering environmental water to sites that have different objectives, especially when those waterways are in different systems. There is not enough environmental water to meet demand in all waterways that have modified flow regimes and therefore waterway managers and the VEWH need to decide which waterways will receive water and which ones won't.

A case can always be made to deliver water to an individual waterway. We therefore need a method that allows us to objectively decide which suite of environmental water objectives are most important in any given region (or even at a whole state or basin level) and which waterways should be given priority, especially in dry years when supply is low. Moreover, because waterways are highly connected, a framework that identifies which combination of waterways to apply co-ordinated management actions to will likely provide more benefit than the sum of benefits achieved at individual waterways.

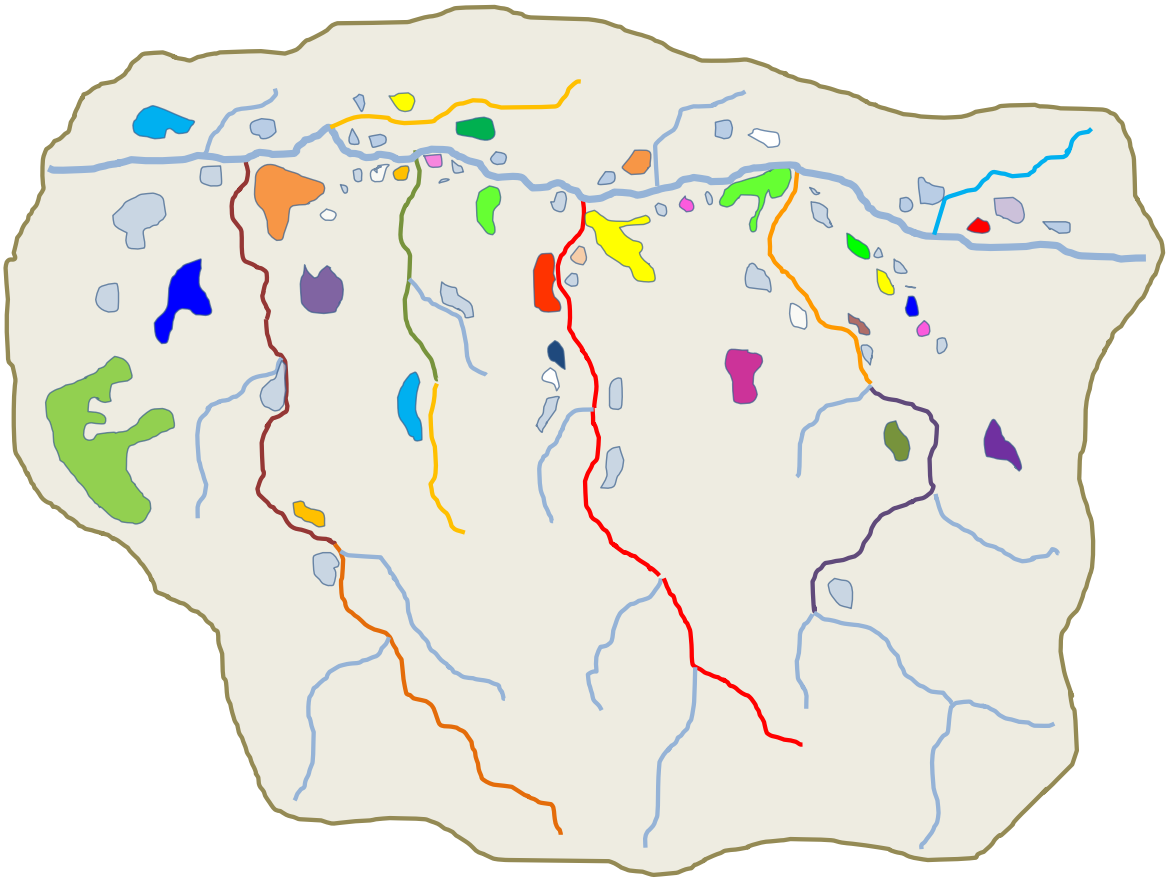

Figure 1: Schematic diagram of a region with multiple rivers and wetlands. Colours for each river reach and wetland indicate a different suite of environmental water objectives. This example is intended to represent the current situation where we have many river reaches and wetlands that have different suites of environmental objectives. Deciding which sites to water based on such a wide variety of site based objectives is difficult.

Problem 2 – many ecological processes that underpin waterway health require co-ordinated management at a landscape scale.

The current approach of setting environmental flow objectives and associated water regime recommendations for individual waterways does not adequately address the requirements of ecological processes that operate at a larger landscape scale. Many ecological processes are influenced by multiple factors that operate across a range of spatial and temporal scales. These scales often extend beyond individual river catchments and the jurisdictional boundaries of individual Catchment Management Authorities and States. An approach that focuses on delivering the recommended water regime at individual waterways will likely be ineffective if necessary flows and other required management actions are not delivered to other parts of the connected landscape.

Continuing to prioritise environmental water use based primarily on the value of individual sites and the specified environmental flow recommendations for those sites may not support critical landscape scale ecological processes and therefore limit the effectiveness of the environmental water program.

What is needed

Rather than asking what we can achieve with environmental water at a favourite waterway, we should ask what are the fundamental ecological processes that underpin waterway health across our landscapes and which waterways need environmental water and other management interventions to support those processes. The task is not simple and involves all of us.

We need to consider the landscape as a whole system that is made up of many inter-related parts, which need to be managed in a co-ordinated way rather than in isolation. Drawing a fence around a waterway and asking what environmental values we want it to support and what flow regime we want it to have will not lead to the best environmental outcomes. We should instead ask what environmental outcomes we want across the broader landscape, what role individual waterways play in supporting those outcomes, and what water regime and other management actions need to be applied at those waterways to achieve those outcomes.

Recent advances in science and management show that this approach is possible and worthwhile. For example, environmental water managers in Victoria, New South Wales and at the Commonwealth level have started to co-ordinate flows in tributaries of the River Murray to support the dispersal and recruitment of Golden Perch and Silver Perch. The trigger for the co-operative landscape scale approach was research by Zampatti *et al.* (2015) that showed most of the Golden Perch and Silver Perch in the southern part of the Murray Darling Basin recruited from spawning events that followed floods in the lower Darling River and Menindee Lakes. That finding explained discrepancies between smaller-scale studies that described relationships between fish recruitment and flow in individual tributaries in the 1990s and early 2000s (e.g. Mallen-Cooper and Stuart 2003, Ebner *et al.* 2009, King *et al.* 2009, Koster *et al.* 2012); and it generated widespread support for co-ordinated water deliveries between multiple management jurisdictions. Preliminary monitoring suggests the co-ordinated environmental water deliveries are having a benefit at the landscape scale and should provide the impetus for our industry to look for other ecological processes to co-operatively manage at a landscape scale rather than an individual site scale.

A challenge for environmental managers

Environmental managers need to collectively agree on priority environmental objectives at a regional scale and work with scientists to identify the fundamental ecological processes that underpin those objectives. They need to marry their on-ground understanding with current scientific knowledge to determine what

combination of waterways need to be managed in a co-ordinated way to support those objectives; and what water regimes and other management actions to apply at those sites.

The Murray Darling Basin Authority *Basin Wide Environmental Watering Strategy* (MDBA 2014) has made a first step in this direction. It describes regional objectives for river flows and connectivity, vegetation, waterbirds and native fish but the objectives are predominantly based on what water savings associated with the Basin Plan are likely to achieve rather than a fundamental assessment of what is needed to support underlying ecological processes. The waterbird section of the *Basin Wide Environmental Watering Strategy* (MDBA 2014) probably deals with these issues best because it draws on long-term survey data to identify critical refuge, breeding and feeding habitats for different guilds of waterbirds throughout the Murray-Darling Basin (see Bino *et al.* 2014) and therefore provides a clear direction for co-ordinated management. Similar directives for other objectives would be useful. It is instructive that the *Basin Wide Environmental Watering Strategy* (MDBA 2014) was written before the results of the Golden Perch recruitment research (described above) were well known. This highlights the extent to which clear management plans rely on clear scientific understanding.

Applying a landscape scale approach to environmental water management decisions will likely result in little change to the management of some sites, but may significantly change objectives and management actions at other sites. Some waterways may become a lower priority and receive less management intervention than they have historically, while other sites may receive greater management intervention because their position in the landscape or habitat type supports an ecological function that would otherwise be missing. Proposed changes to existing sites may challenge waterways managers and local communities that have a long-standing interest in affected waterways, and much work will be needed to navigate these challenges and retain broad support for the overall environmental watering program.

A challenge for scientists

Scientists need to design and implement studies that improve our understanding of landscape scale ecological processes and the tools that can be used to support them. Scientists need to target research at scales that are relevant to specific ecological processes. This may involve large scale field investigations, although these are often prohibitively expensive for small research teams and may require collaboration between multiple groups. Alternatively, scientists may design small-scale studies in ways that allow their results to be interpreted at a landscape scale.

A critical first step will be to build conceptual, and preferably quantitative, landscape scale ecological models that describe our current understanding. These models should be developed in partnership with waterway managers to ensure a shared understanding of fundamental ecology, the factors that may influence those processes, and the range of management tools that can potentially be used to achieve a desired outcome.

New research and monitoring projects should aim to test the model's assumptions and address key knowledge gaps. Project proposals should indicate what aspect of the landscape scale ecological model they are targeting, describe the potential results of the proposed research or monitoring program and indicate how each of those potential results will refine the current model and influence future management decisions.

Conclusion

State and federal governments have invested billions of dollars in environmental water recovery and use. Environmental water science and management is still a relatively new discipline. The ground up approach to environmental water management has provided a good starting point, but it needs to be complemented with

a more sophisticated landscape scale approach. That approach requires managers and scientists to work together to understand the scale at which critical ecological processes operate and the management actions that need to be applied across the landscape to support those processes.

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