

## Integrating science, policy and management of rivers: Peter Cullen's legacy

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### Introduction

The need for greater integration among scientists, policy makers and managers remains one of the key challenges for the intelligent management of catchments and rivers. The call for transparent, inclusive and adaptive decision-making processes that are flexible to changing circumstances, and embrace a diversity of stakeholders and perspectives, is a consistent theme in the recent international literature for management and monitoring (e.g. Macleod *et al.* 2008; Reed 2008; Lindenmayer and Likens 2009). The integration of concerned interests, such as the formation of partnerships, along with policy emphasising ecologically sensitive development, has been widely proposed to strengthen protection and management of natural resources (e.g. Reed *et al.* 2008). However, the effective translation of scientific-research findings into policy and on-ground practice is still limited. Obstacles to integration and partnerships among these disparate groups are well known and may result from the fundamentally different approaches that scientists and those engaged in the policy process take to scientific knowledge (Briggs 2006; Rogers 2006; Pielke 2007; Hart and Calhoun 2010). Effective catchment management incorporating lessons from the past could be progressively improved by the *a priori* establishment and maintenance of integrative research projects that provide the conduit for greater awareness, involvement, transparency and understanding among research, policy and management communities.

In Australia, the critical need for a comprehensive water-research and -policy development strategy to give better direction to freshwater science, improve science-policy communications and ultimately improve the sustainable management of water resources was a consistent message from the late Peter Cullen. Cullen (1990) described the fundamentally different approaches that scientists and those engaged in the policy and management process take to scientific knowledge, coining the phrase 'turbulent boundary' to describe the friction among these cultures, resulting from poor information exchange. The two key challenges posed to bridge the boundary were the development of scientific or knowledge brokers to foster effective communication and the development of integrative projects that were relevant to decision makers. This key paper by Cullen (1990) synthesised concepts explored earlier (e.g. Cullen 1977, 1989)

and these challenges remained dominant themes throughout his career.

The statement that 'individuals lie at the heart of successful collaborations' was a key component of the guiding framework for collaboration in freshwater ecology developed by Cullen *et al.* (1999) and tested in Cullen (1999). That collaboration among scientists and decision makers could break down traditional barriers brought to the fore the important role of the knowledge brokers (Cullen *et al.* 2000; Cullen 2003), and that collaboration could be achieved through the optimisation of intellectual expertise and funding, and advancing science along the lines of consensus through integrative projects were core steps in this framework. The critical need to manage water resources in the long term was highlighted by the development in Australia of the National Water Initiative (NWI) in 2004. Peter Cullen worked to inform the policy of the NWI so that the significant disconnect between water policy and aquatic science was recognised in the knowledge- and capacity-building clause of the NWI agreement (Cullen 2006a), and remains a key goal for the current policy (Likens *et al.* 2009). This Special Issue provides case studies focussed on the key challenges of fostering scientific communication and integration for the effective management of water resources, and challenges articulated and tackled by Peter Cullen during his career.

### Peter Cullen's life and legacy

Peter Cullen passed away in March 2008. His achievements and ability to communicate his thoughts effectively and persuasively have had a very strong influence on the development of freshwater ecology and natural-resource policy formation in both Australia and worldwide. He set a very clear agenda for water and catchment management in Australia. Measures, such as the necessity to audit resources and the need to provide ecologically worthwhile environmental flows, have been initiated, whereas others such as large-scale catchment and river restoration remain to be adequately addressed. Peter Cullen led the way in reforming natural-resource management as he effectively straddled the gap between the demanding strictures in seeking scientific truths and the difficult and diplomatic requirements in getting clear scientific messages to politicians, managers and the

public (Cullen 1999). His well-crafted messages raised an awareness of ecological issues, and spelt the need and clarified the paths for action. In dealing with the often-volatile issues of water-resource management and seeking long-term, ecological sustainability of freshwater ecosystems, Peter was a gifted and convincing communicator, and a knowledgeable and insightful advisor. There is no doubt that Peter was a driving force in moving governmental water reforms forward in Australia, such as the National Water Initiative, an initiative that recognised ecological imperatives and problems, along with social and economic concerns, in water-resource management. His advocacy over the years that the environment must be fully considered in water-resource planning and management has, after many setbacks, at last been recognised and even acted on. Undoubtedly, Peter left an unfilled gap in the advocacy for and the championing of ecologically sound land and water management.

With degrees in agricultural science from the University of Melbourne, Peter migrated to the University of Canberra where he became a lecturer in resource management at the Canberra College of Advanced Education and helped to develop a very active School in Applied Ecology and Resource Management. After an initial unsuccessful bid for a Cooperative Research Centre (CRC), the second bid was successful and the CRC for Freshwater Ecology (CRCFE) was started, with Peter as the Director. Quickly, the CRCFE took shape and under Peter's drive it evolved into a very effective research and educational hub for freshwater ecosystems in Australia. Not all the research was applied; basic ecology and 'blue sky' research were critical components as they were necessary to underpin the research on applied problems and in policy formulation.

As the 'Millennium drought' developed in southern Australia and managerial shortcomings became very evident, Peter became a central figure in the water debate, actively and fluently engaging in it, providing independent and wise advice and pointing out the dire ecological state of Australian rivers and wetlands (especially in the Murray–Darling system), and suggesting feasible solutions, such as the need to deliver environmental flows to maintain important riverine ecosystems.

Peter worked tirelessly for not just freshwater ecological research to be noticed by politicians, but for science in general to be built into the political agenda. He became President of the Federation of Australian Scientific and Technological Societies (FASTS) and was an enthusiastic promoter of the 'Science meets Parliament' annual event. His influence on government policy increased when he became a member of the Prime Minister's Science, Engineering and Innovation Council in 1998, and was elected a Fellow of the Australian Academy of Technological Sciences and Engineering. His success as a strong advocate of water issues was recognised when he was awarded the Prime Minister's Prize for Environmentalist of the Year in 2001, and the Order of Australia for his services to freshwater ecology in 2004.

Peter was a member of the International Society for Limnology and in 2004 he was awarded the highest international recognition in limnology, the Naumann–Thienemann medal for his leadership in communicating 'complex limnological and water resource issues to colleagues and especially to decision makers, which over the past three decades have led to improved understanding about, and wiser allocation of, critical

water resources in Australia'. In 2006, Peter gave an invited address (Cullen 2006b) at the annual conference of the North American Benthological Society in which he warned scientists that if they enter the public debate, they need 'to understand that they are leaving a world where finding the truth is the most important goal, for a world where winning is most important'. He also often stressed that 'committed and knowledgeable scientists can make a contribution to public policy if they are prepared to speak out', which was certainly true in his case.

In his retirement, Peter was very active in water reform. In 2002, he became a founding member of the Wentworth Group of Concerned Scientists and as Thinker in Residence in Adelaide, he produced some very forthright recommendations for water management in drought-stressed South Australia (Cullen 2007). In addition, he was a Director of Land & Water Australia (precipitately closed in 2009), a Commissioner of the National Water Commission, Chair of the Scientific Advisory Panel of the Lake Eyre Basin Ministerial Forum, Chair of the Victorian Water Trust Advisory Council, Member of the National Heritage Trust Advisory Committee and a lifetime member of the International Water Academy.

His ability to see the 'big picture' and to not only describe the problems, but to offer solutions made him a much-heeded and influential environmentalist. In environmental management, he saw the progressive necessities of understanding the science, auditing the state of the resources and of restoring ecosystems to a functioning, robust condition. Because Peter was such an open, generous and fair-minded person, people warmed to him even if they disagreed with his views. He will be missed as an energising and generous leader, in his dedication to the effective reform of water and catchment management, and in his capacity to successfully bridge the gaps between science and resource management and policy.

### Structure of this Special Issue

One of the challenges facing freshwater ecologists is to contribute the 'best available scientific knowledge' to the sound management of water resources. The papers in this Special Issue provide contemporary examples of effective collaborative projects, identify lessons learnt, and put forward solutions of how scientists can successfully engage in the policy and management arena. The issue begins with 'big picture' case studies from Europe where trans-boundary issues along the Danube River pose major challenges to the establishment of effective management plans (Sommerwerk *et al.* 2010), the Motueka River Integrated Catchment Management (ICM) research program from New Zealand that highlights six key lessons for engaging scientists, managers, local communities and indigenous cultures (Phillips *et al.* 2010), and an exploration of the conceptual basis and need for well-planned and integrative large-scale programs of river-condition assessment using the Sustainable Rivers Audit in Australia (Davies *et al.* 2010).

These 'big picture' issues are followed by more focussed case studies, with Robson and Mitchell (2010) grappling with models for communicating complex system dynamics to river managers. Watts *et al.* (2010) and Webb *et al.* (2010) examine the theme of building 'trust' in partnerships among multiple partners with differing priorities, expectations and responsibilities, by using an

Adaptive Environmental Management framework and stakeholder engagement models respectively. Progressing this theme, Tomlinson and Davis (2010) go beyond individual relationships to explore the role of science–policy integration across jurisdictional boundaries, by using the Australian NWI water reforms as an example, and Gawne *et al.* (2010) offer solutions to their four key impediments to integrative freshwater research.

The final paper of this Special Issue (Ryder *et al.* 2010) synthesises progress towards meeting the dual challenges of scientific communication and policy integration set by Cullen (1990, 1999), places them into an international context, and outlines a way forward for developing and integrating ‘best available science’ into sustainable land and water management. We hope that papers in this Special Issue help Peter’s vision to continue to prosper by promoting excellent science and well-planned management, and that the future for sustainable water resource management is less turbulent than the past.

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