

# Adaptive management of Temperate Highland Peat Swamps on Sandstone in the Blue Mountains: Is it occurring?

Nicole Ashby<sup>1</sup>, Kirstie Fryirs<sup>1</sup>, Richie Howitt<sup>1</sup>

1. Department of Environment and Geography, Macquarie University, North Ryde, NSW, 2109. Email: [kirstie.fryirs@mq.edu.au](mailto:kirstie.fryirs@mq.edu.au)

## Key Points

- The management of THPSS spans a number of scales from the Commonwealth to the micro-local.
- Despite being contained within four distinct regions of NSW, there is little congruence between management and rehabilitation efforts across individual swamp systems.
- An analysis of adaptive management practices revealed that beyond the micro-local scale, there is little evidence of cyclical planning, implementing, monitoring and evaluation.
- Environmental factors are the drivers of rehabilitation and management from the local to the Commonwealth scale, whilst social values, connections and a “sense of place” guide on-the-ground rehabilitation at the micro-local scale.
- There is a need for consistent classification of THPSS across the state and Commonwealth scales.
- An adaptive management framework is required which is applicable across scales, incorporates both social and environmental measures and values, and which reinforces the need for planning, implementing, monitoring and assessment to occur, so information can feed back into the process, and adjustments to practice made.

## Abstract

Adaptive management is a prominent concept in natural resource management in Australia, heralded for its attention to the prioritization and implementation of rehabilitation actions, and its acknowledgement of uncertainty and focus on “learning by doing”. There is significant focus on environmental science and condition. Little attention has been paid to monitoring and incorporating other forms of information (e.g. social science) into adaptive management frameworks. Temperate Highland Peat Swamps on Sandstone (THPSS), listed as endangered ecological communities (EEC) at the Commonwealth scale, are a form of upland swamp, positioned in the landscape above the headwaters of streams. The majority of THPSS are located within the Blue Mountains’ region. These swamps have been studied to varying degrees in the past with regards to their formation, vegetation assemblages and geomorphic condition. Whilst the physical condition of these important EEC provides insights for prioritization and rehabilitation, there is little understanding of the current approaches to management, particularly the within and cross scalar influences from the Commonwealth to the micro-local scale. This paper will explore how factors, at a variety of scales, influence management decisions of these EEC. Social factors are particularly influential at the micro-local and local scales, with much rehabilitation undertaken by Bushcare, Landcare and Swampcare groups and there seems to be a significant disconnect between activities happening at this scale and decisions made at coarser scales (e.g. associated with funding and prioritization). There is little adaptive management evident beyond the micro-local scale.

## Keywords

Adaptive management, upland swamps, rehabilitation, scale, context

## Introduction

Temperate Highland Peat Swamps on Sandstone (THPSS) have gained increasing attention and recognition since achieving their status as vulnerable/threatened ecological communities under State and Commonwealth legislation, the *NSW Threatened Species Conservation Act* (Office of Environment and Heritage, 2011) and the *Commonwealth Environment and Biodiversity Conservation Act* (Department of Environment and Heritage, 2005), respectively. This has resulted in a number of management and legislative initiatives which are embedded within certain scales, and in isolated instances, transcend scales.

Through understanding inputs to management systems, particularly information, monitoring and success evaluation, and the manner through which adjustments are made to practices, rehabilitation efforts can be understood in terms of contextual factors. This study is based on the premise that the context in which rehabilitation of THPSS occurs influences the methods used, and the actors involved. Context is a complex entity which encompasses the vast array of

components of social-environmental systems, and influenced by the notion of “sense of place” (Davenport & Anderson, 2005; Larson et al. 2013). For instance, community initiated rehabilitation and management has different goals, motivations and management strategies than programs of rehabilitation driven by state and Commonwealth grants, and thus priorities.

Scale and context are particularly pertinent concepts for this study. The differing constructions of scale were explored, including the hierarchically bounded scales comprised of time and space in environmental science arenas and the fixed entity ecological definition (Sayre, 2005). In contrast, socially based perspectives perceive scale to operate “simultaneously rather than hierarchically” (Howitt, 2001, p132), positioning it as a social and/or political construct which is inherently centred on power (Sayre, 2005) and used to explain social organization (Brown and Purcell, 2005). Whilst scale is recognised as a complex and changing entity, the current context surrounding the management of THPSS has set the scales of analysis for this study.

The principles of adaptive management are focused on managing uncertainty and process-based learning, through experimentation (Holling, 1978). The adaptive management of rivers (and thus wetlands and swamps) is ideally based on reflection and constant learning, through which approaches to management are adjusted, in light of changes to biophysical and social systems, the relationships between them, and continuing uncertainty (Haney & Power, 1996). The conceptual framework of this study (presented in Figure 1), is premised on a continual cycle of learning, where rehabilitation occurs according to processes which incorporate planning, implementation, monitoring and assessment. Further, information flows from one scale to the next, and thus a sharing of information, knowledge and techniques from the Commonwealth to the micro-local scale.

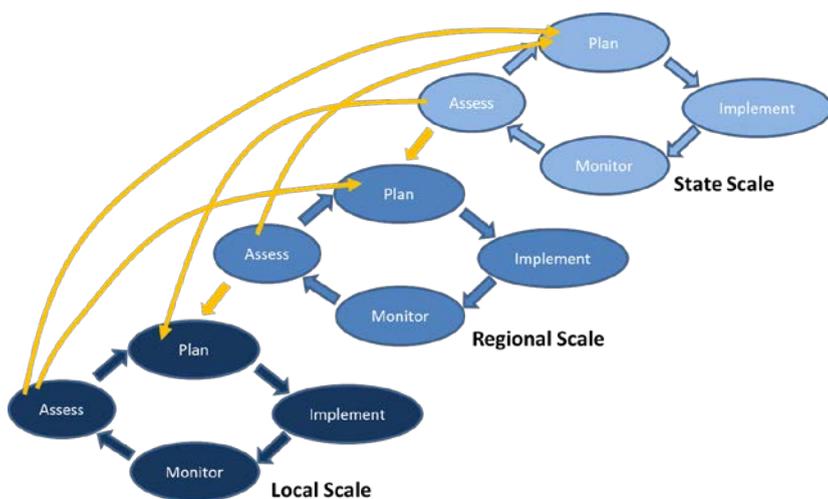


Figure 1: A conceptual framework for adaptive management within and across scales

## Methods

Scale selection was based on the current scales used in natural resource management and river management in Australia. This included the Commonwealth, state, regional, local and micro-local scales, with a cross scalar initiative also included in analysis. Institutions incorporated into the study (from the national to the micro-local scale included: the Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) and Caring for our Country (CfoC) at the Commonwealth scale, the Office of Environment and Heritage (OEH), the NSW Environmental Trust (NSW ET) and the Natural Resources Commission (NRC) at the state scale, the Hawkesbury Nepean Catchment Management Authority (HNCMA) and Save our Swamps (SOS) at the regional scale, the Blue Mountains City Council (BMCC) at the local scale, Popes Glen Bushcare Group (PGBG), Garguree Swampcare (GS) and Penrose Swamp Landcare Group (PSLG) at the micro-local scale.

In total 867 documents were analysed, including personal and official documents, to understand the inputs for management of THPSS at each scale (see Figure 3). Unstructured interviews were conducted with 25 participants from SEWPaC, OEH, HNCMA, BMCC, PGBG, GS and PSLG. Interviews were transcribed and presented as narratives which are

focused on providing rich descriptions of people's lives, reinforcing their own language and values (Grant, 2007; Pepper & Wildy, 2009). Through the use of NVivo, documents and interviews were coded according to themes, with frequency counts determined, enabling comparison across scales (see Figure 2).

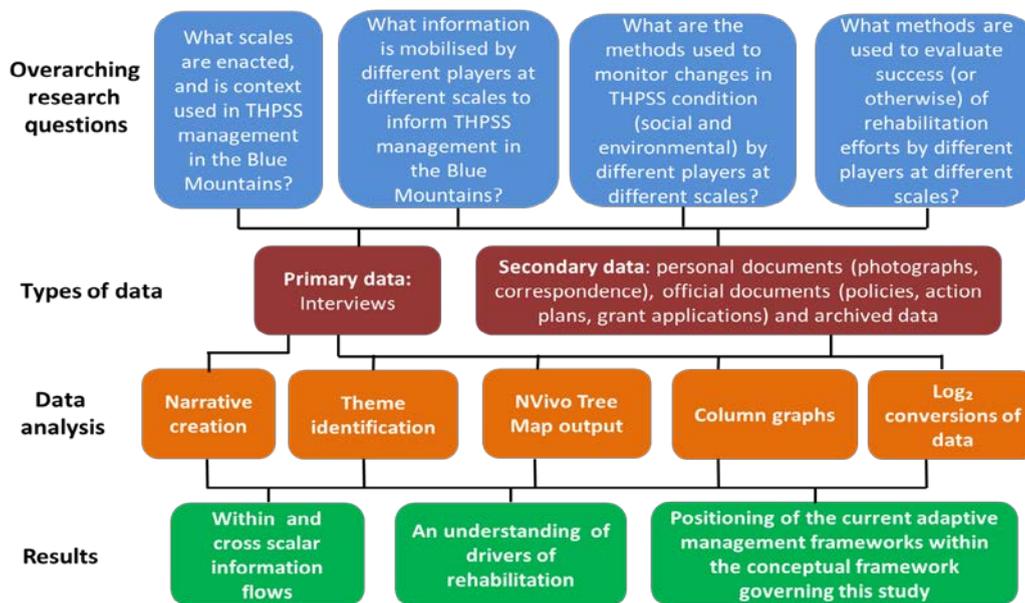


Figure 2: Summary of data collection and analysis methods

## Results

Overall, the motivations and guiding forces of management of THPSS differ from one scale to the next. At the Commonwealth scale, the dominant theme for SEWPaC is management. In contrast, at the regional scale of HNCMA, rehabilitation is the most prolific theme, closely followed by economics. At the local scale, the dominant theme for BMCC is threatened species and communities, whilst for the micro-local scale of PGBG it is Landcare-Bushcare, followed by temporal scale. Institutional scale is a dominant feature of regional and local scales, whilst less prevalent at the Commonwealth and micro-local scale. The theme of threatened species and communities dominates the local scale, is prevalent at the regional and Commonwealth scales, yet is largely absent from the micro-local scale. This is likely a reflection of funding opportunities and motivations for action.

Flora was the most commonly coded environmental theme, with community engagement and community education the most prolific social themes across documents and interviews. The micro-local scale displayed significant differences in the motivations for management, with sense of place, sense of achievement and personal education featuring in interview discussions. Adaptive management displayed no consistent pattern for documents, with the highest values recorded for PGBG and NSW ET. For interviews, percentages for this theme increase from the Commonwealth (0%) to the micro-local scale (2.3%). This is expected due to adaptive management being essentially comprised of trial and error, with the importance of context and place vital components.

Cross scalar analysis was also conducted through the development of diagrams similar to those depicting the “web of science” (Leydesdorff et al. 2013). Line thickness has been used to represent the strength of connections in Figures 3a and 3b. Figure 3a indicates that the strongest cross scalar connections for documents are from PGBG to BMCC, followed by PGBG to NSW ET, PGBG to OEH, SOS to BMCC, and OEH to HNCMA. For the interview data (Figure 3b), the strongest connection is again from PGBG to BMCC, followed by OEH to SEWPaC, HNCMA to BMCC, and BMCC to NSW ET. Overall, Figures 3a and 3b indicate that there seems to be stronger written connections (as reflected in documents) between scales than there is for interviews (or practical, on-the-ground). There are also a greater number of connections from lower to higher scales. This reflects a divide between theory and practice, whereby, on-the-ground management is influenced by social factors not considered in documents, thus resulting in particular outcomes and actions. Further, the stronger connections from lower to higher scales are reflective of compliance and reporting requirements, with this information seemingly lost beyond this specific purpose.

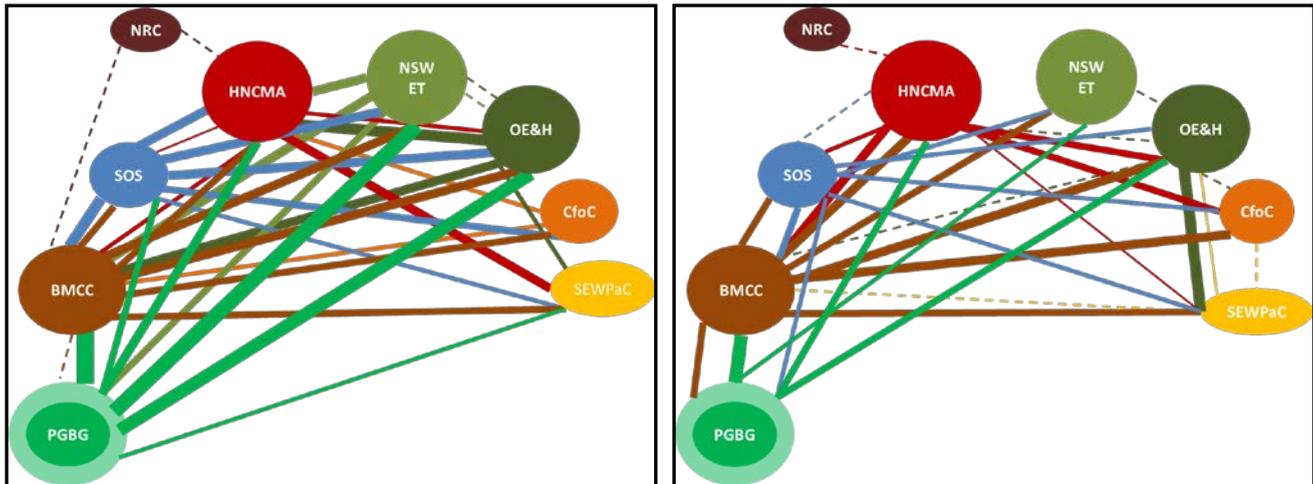


Figure 3a: Cross scalar connections for documents. Figure 3b: Cross scalar connections for interviews

## Discussion

The management of Temperate Highland Peat Swamps on Sandstone (THPSS) is subject to numerous, often conflicting influences from the Commonwealth through to the micro-local scale. Drivers of rehabilitation differ greatly, with a focus on legislation pertaining to endangered ecological communities (EEC) at the Commonwealth and state scale, and socially motivated reasons for action, such as sense of place and cultural connections at the micro-local scale. Further, analysis of documents and interviews illustrates the invisibility of factors within the process of swamp management. Overall, there is a tendency for funding and legislation to be filtered from higher to lower levels, with rehabilitation seen as a local or micro-local scale practice. This leads to priorities and actions being site specific, rather than motivated by a desire to protect and restore the suite of THPSS which occur throughout New South Wales (NSW).

The results of this study have highlighted a number of divergent priorities for rehabilitation of THPSS from the Commonwealth through to the micro-local scale. Of particular interest are the cross scalar connections and disconnections, reflecting an overall absence of the use of adaptive management beyond the micro-local scale. Figure 4 illustrates the components of adaptive management which are included in management of THPSS at the micro-local (PGBG), local (BMCC) and regional (HNCMA) scales. In general, monitoring and evaluation of success (or otherwise) are not conducted beyond the micro-local scale. Further, there is a lack of recognition and inclusion of social motivations for action which guide participation and rehabilitation at the micro-local scale. Four key challenges have been highlighted in this study:

### 1. Reconnecting with context at multiple scales

At present, the policy context created by the state and Commonwealth scales is focused solely on THPSS as EEC. As such, the contextual components of place are absent from decision making frameworks, with environmental determinants of condition guiding actions. In order for connections to exist between the micro-local and Commonwealth scales (and those in between), policy needs to be framed in such a way that it is context specific or context sensitive. Through the implementation of an adaptive management framework which is applicable across scales, and includes both social and biophysical determinants of condition, monitoring and success evaluation (see Figure 5), context becomes a central component of management.

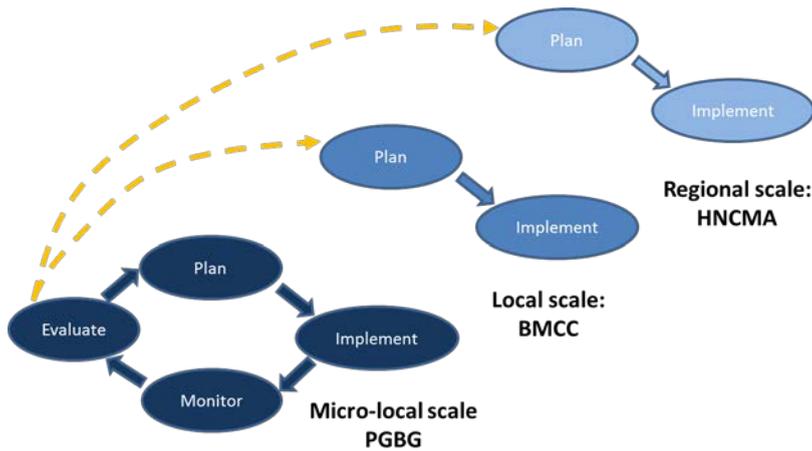


Figure 4: The current management cycle for THPSS from the regional to the micro-local scale

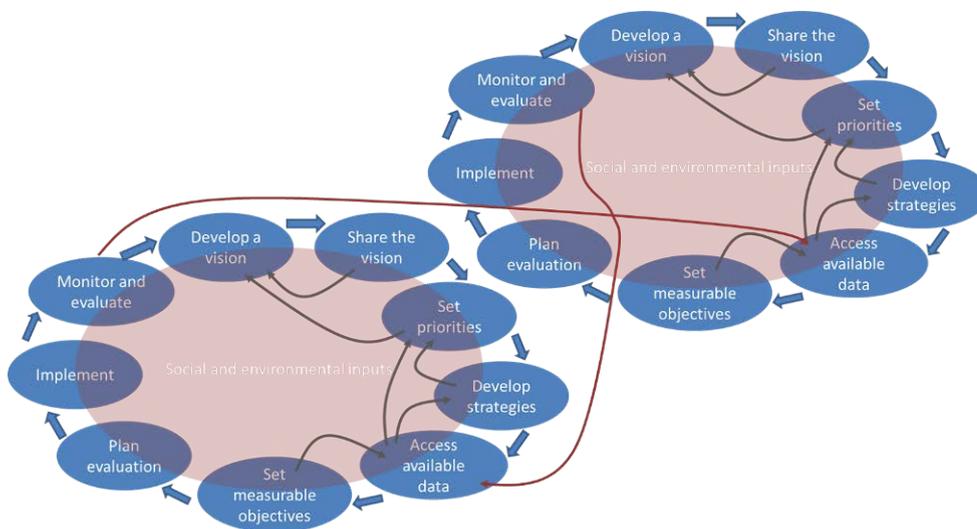


Figure 5: Cross-scalar framework for adaptive management of THPSS (based on Rutherford et al. 2000)

## 2. Making the invisible visible

The funding bodies of Commonwealth and state governments, through their priorities, render some THPSS invisible. The result is that some places receive funding for rehabilitation, with others left unmanaged. The invisibility of some THPSS, coupled with a lack of monitoring and subsequent prioritisation for rehabilitation, results in an ad-hoc approach to management. One way to approach the issue of invisibility is to understand the condition of all THPSS and thus their likely response to intervention and rehabilitation. The Geomorphic Condition Assessment for Blue Mountains Upland Swamps, through determining the geomorphic condition of each BMS and understanding its trajectory of change over time, allows the determination of four priority categories for rehabilitation: conservation, 1st priority, 2nd priority and 3rd priority (Kohlhagen et al., 2013). Such priorities can then be combined with social, cultural and economic values in order to determine the places in which social and environmental values and goals allow positive rehabilitation outcomes.

## 3. Breaking down barriers and creating or recreating connections

Management approaches to THPSS are divergent on a spatial scale, with fragmentation particularly evident across scales. This is highlighted by the lack of alignment between policy and practice, and the scientific-political divide. Further, the absence of consistent listing of THPSS from the Commonwealth to the state level further highlights the often conflicting and contradictory approaches to assessment of THPSS across scales. In order to address these disconnects,

there is a need for clear guiding frameworks which emphasise the importance of THPSS through multiple lenses, such as that presented in Figure 6. This requires a rethinking of the way in which we see and interpret landscapes (Howitt, 2001), and integrate the views of scientists, agencies and communities (Rogers, 2006; Brierley et al. 2011). Ultimately, the guiding framework which is employed needs to incorporate scientific understandings of THPSS in specific landscapes, coupled with values placed on these systems which reflect the human-ecological system and thus emphasise not only the needs and rights of the environment, but also the values and aspirations of the groups engaged in rehabilitation (see Figure 6).

#### **4. Making adaptive management real within and between scales**

Figure 5 illustrates the current situation with regards to adaptive management of THPSS, within and across scales. In order for it to become an embedded component of rehabilitation, it needs to be incorporated into all levels of management, from the micro-local scale to the Commonwealth. Adaptive management frameworks indicate the need for priorities to be set and all available data to be incorporated into a cyclical model of planning, evaluation and adaptation. To date, there is no evidence to suggest that information included in funding reporting requirements is used to inform prioritisation and rehabilitation beyond the site scale. This results in a disconnect between management approaches to THPSS, and thus a barrier to cross scalar learning's and adaptive management. The monitoring and evaluation framework enacted at the Commonwealth scale through CfoC provides some scope for development of a cross scalar adaptive management framework for THPSS. It is recommended that such a framework be incorporated into the priority action statement for EEC at both the Commonwealth and state scales. Figure 6 depicts a comprehensive adaptive management cycle, whereby, not only is adaptive management enacted within each scale, but the learning is transferred from one scale to another in a continuous, cyclical fashion. Further, monitoring and success evaluation of environmental and social factors needs to become a consistent element of rehabilitation and management of THPSS. Each is a vital component of rehabilitation and management, with an understanding of system changes difficult, if not impossible to ascertain without baseline data and subsequent monitoring and evaluation.

### **Conclusion**

This study has highlighted the current situation with regards to the management of THPSS, with a number of recommendations presented to enable consistent, adaptive approaches to rehabilitation. Through the adoption of an adaptive management framework (Figure 6), consistent monitoring and success evaluation and cross scalar sharing of information, better outcomes for human-environment systems become possible.

### **Acknowledgments**

Thank you to all who participated in the project and gave up their time to be interviewed. In particular, the members of PGBG who provided support, access to documents and numerous discussions around rehabilitation of THPSS in the Blue Mountains and the funding processes at the state scale, and BMCC who always endeavored to answer my questions and provide information as needed.

### **References**

- Brierley, G.J., Fryirs, K., Cook, N., Outhet, D., Raine, A., Parsons, L. and Healey, M. 2011. Geomorphology in Action: Linking policy with on-the-ground actions through applications of the River Styles framework. *Applied Geography*, 31: 1132-1143.
- Brown, C.J. and Purcell, M., 2005. There's nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum*, 36: 607-624.
- Davenport, M.A. and Anderson, D.H., 2005. Getting from sense of place to place-based management: An interpretive investigation of place meanings and perceptions of landscape change. *Society and Natural Resources*, 18: 625-641.
- Department of Environment and Heritage 2005. *Nationally threatened species and ecological communities: Temperate Highland Peat Swamps on Sandstone*. Retrieved, August 19, 2011 from: <http://www.environment.gov.au/biodiversity/threatened/publications/pubs/temperate-highland-peat-swamps.pdf>
- Grant, A.N., 2007. 'Lift-offs' Narrative Inquiry and Teacher/Researcher Learning. *Qualitative Research Journal*, 6(2): 45-66.

## 7ASM Full Paper

### Ashby et al. – Adaptive Management of Upland Swamps

- Haney, A. and Power, R.L., 1996. Adaptive management for sound ecosystem management. *Environmental Management*, 20(6): 879-886.
- Holling, C.S., 1978. *Adaptive environmental assessment and management*. John Wiley & Sons, New York.
- Howitt, R., 2001. *Rethinking resource management: Justice, sustainability and indigenous peoples*. Routledge, Oxon.
- Kohlhagen, T., Fryirs, K. and Semple, A., 2013. Highlighting the Need and Potential for Use of Interdisciplinary Science in Adaptive Environmental Management: The Case of Endangered Upland Swamps in the Blue Mountains, NSW, Australia. *Geographical Research*, 51(4): 439-453.
- Larson, S., De Freitas, D.M. and Hicks, C.C., 2013. Sense of place as a determinant of people's attitudes towards the environment: Implications for natural resources management and planning in the Great Barrier Reef, Australia. *Journal of Environmental Management*, 117: 226-234.
- Leydesdorff, L., Carley, S. and Rafols, I., 2013. Global maps of science based on the new Web-of-Science categories. *Scientometrics*, 94: 589-593.
- Office of Environment and Heritage, 2011. *Blue Mountains Swamps in the Sydney Basin Bioregion - vulnerable ecological community listing*. Retrieved, August 12, 2011 from: <http://www.environment.nsw.gov.au/determinations/BlueMountainsSwampsVulnerableEcologicalCommunity.htm>
- Pepper, C. and Wildy, H., 2009. Using Narratives as a Research Strategy. *Qualitative Research Journal*, 9(2): 18-26.
- Rogers, K.H., 2006. The real river management challenge: Integrating scientists, stakeholders and service agencies. *River Research and Applications*, 22: 269-280.
- Sayre, N.F., 2005. Ecological and geographical scale: parallels and potential for integration. *Progress in Human Geography*, 29(3): 276-290.
- Rutherford, I.D., Jerie, K., Marsh, N., 2000. *A Rehabilitation Manual for Australian Streams, Volumes 1 and 2*. Catchment Research Centre for Catchment Hydrology and Land and Water Resources Research and Development. Melbourne, 190 pp.