# Enhancing Science Impact in the Coastal Zone through Adaptive Learning

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## ABSTRACT

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The impact of science to support coastal management may be reduced through social and institutional barriers. Some of these barriers include ineffective community engagement, lack of interaction between scientists and decision makers, and institutional decision-making tradition related to hierarchical mandates. A three-year project has commenced to examine the role of adaptive learning in overcoming some of these barriers to maximize pathways for science and improve decisions made in the coastal zone. Adaptive learning is one of five project areas targeted to enhance science impact, being undertaken by a consortium of nine Australian universities funded through the CSIRO Collaboration Fund. Two of the strategies being explored to maximize adaptive learning to improve science impact include: (i) development of an on-line toolkit for embedding adaptive learning within coastal organizations; and (ii) development and testing of monitoring and evaluation frameworks to improve adaptive learning interventions. While focused on an Australian context, the project addresses broad issues of social and institutional barriers that have relevance for many coastal scientists and decision makers around the globe.

**ADDITIONAL INDEX WORDS:** *Social learning,, coastal management, data forms, organizations*

## INTRODUCTION

Complexity, uncertainty and high decision-stakes are typical characteristics of many coastal systems. Adaptive management has recently emerged as a paradigm for responding to ecological and social uncertainty within coastal systems, yet little attention has been focused on mechanisms crucial to its success (SMITH and SMITH, 2006). Adaptive management has been used as a model for experimentation (adaptive experimental management) that focuses on 'how' to manage (see PARKES et al., 2006), as well as a model for collaboration (adaptive collaborative management) that focuses on 'what' to manage and 'who' ought to manage (see BUCK *et al.*, 2001). While these differences may confound practice (see DUNCAN, 2001; PARMA *et al.*, 1998; WILDHERE, 2002) relating to specific issues, we posit that the capacity of institutions to integrate information (to actively learn at all levels within and between institutions) is the major impediment to realizing the benefits of an adaptive management approach when responding to uncertainty (see DOVERS, 2001a, 2003; SMITH and SMITH, 2006). This particularly applies to complex problems, with multiple affecting and affected communities, such as exist in coastal zone management.

In such circumstances, social learning (shared learning by decision makers, scientists, communities and institutions) is needed to drive the adaptive management process and facilitate connections between the best available knowledge and collective management action. This will maximize pathways for science and other forms of knowledge to influence change in management. Therefore, adaptive learning, in the case of coastal zone management, needs to embrace the processes of social learning, to include purposeful reflection by multiple stakeholders, on multiple data sources, towards modifying individual and collective actions.

This paper explores adaptive learning to enhance science impact in the coastal zone through discussion of: (i) the key dimensions of adaptive learning for coastal management; and (ii) a proposed approach to understanding adaptive learning to enhance science impact in the coastal zone.

## KEY DIMENSIONS OF ADAPTIVE LEARNING FOR COASTAL MANAGEMENT

Key dimensions of adaptive learning for coastal management include social learning, sustainability learning, organizational learning, and a bias towards reviewing and changing policy and management practice. That is, adaptive learning, while embracing these other forms of learning, is linked to the adaptive management paradigm. This necessarily introduces the need to consider the inputs (data forms and sources) that stimulate learning at different levels within organizations and the degree of overlap and sharing that occurs between organizations.

### Social learning and Sustainability Learning

Lester Milbrath was the first to associate social learning with progress towards sustainability in his book *Envisioning a Sustainable Society: Learning Our Way Out* (MILBRATH, 1989). Certainly, collective decision-making has been shown to be enhanced through social learning processes (PAHL-WOSTL and HARE, 2004). Furthermore, holistic social learning processes in sustainability contexts should involve the diversity of overlapping and inter-related communities (see THOMSEN et al., this edition) that include affected and affecting stakeholders, citizens, decision-makers, researchers, and relevant organizations (SMITH and LAZAROW, 2006). However, as TÀBARA and PAHL-WOSTL (2007) have highlighted, social learning does not necessarily facilitate sustainability outcomes. Similarly, GLASSER (2007) noted that social learning may be active or passive. Consequently, TÀBARA and PAHL-WOSTL (2007) introduced the notion of "sustainability learning" as being action-orientated and content driven with an explicit focus on developing "the capacity to manage options for the adaptation of human societies to the limits and changing conditions that are imposed by their own socio-ecological systems" (TÀBARA and PAHL-WOSTL, 2007, p.11). In this sense, adaptive learning represents a subsidiary concept of sustainability learning, but inextricably linked to the processes of adaptive management.

In addition, SMITH and SMITH (2006) point out that the structure of learning is also important as learning approaches are often unstructured, re-active, piecemeal, and do not support the higher level systems or conceptual thinking required to address sustainability issues and to convert knowledge to action (SMITH in press). As THOMSEN (2008) suggests, learning (through mechanisms such as community-based research) can help facilitate sustainability outcomes by encouraging a shift in emphasis from social interaction and social learning to sustainability learning: a concept amplified by JACOBSON et al. (in press) when identifying an approach to integrating and expanding community input to adaptive experimental management (see PARKES et al., 2006).

### Organizational Learning

Coastal management organizations are fundamental to facilitating sustainability learning. "In the knowledge economy, more and more organizations are seeking to create and use knowledge through learning" (LINDLEY, 2002, p. 115). In Australia, organizations are increasingly committed to adopting and implementing learning organization principles (PHILLIPS, 2003). In learning organizations, people learn how to learn, with an emphasis on the facilitation and application of learning and knowledge (BOYLE, 2002). The effective facilitation of learning processes – the ability to acquire applicable knowledge, to reflect and learn, and, most importantly, to adopt, integrate adapt and apply new insights – is vital to coastal management organizations

to inform successive cycles of adaptive management. Efficiency and synergy will increase where processes exist to facilitate sharing of knowledge between organizations (and communities).

Learning organizations appear to have eight common characteristics: "a systems approach to learning; commitment to lifelong learning; flexibility and adaptability; shared vision; flat management structure; participation in a co-operative industrial framework; a wide view of learning; and acceptance by managers that learning and work are intertwined" (BURNS, 1995, p. 65). Additionally, human development, expressed in both human and social capital, is at the core of the learning organization (NYHAN et al., 2004). BARTOL et al. (2008, p. 364; after PHILLIPS, 2003) proposed a ten-pillar learning organization model that characterizes an ideal learning organization. The organizational attributes are:

1. **will:** passionate and enthusiastic commitment to continuous improvement through continuous learning;
2. **leadership:** facilitative, coaching, supportive/caring, emotional intelligence;
3. **strategic thinking and vision:** clarity and acceptance of strategic direction, realistic and achievable goals;
4. **communication:** free and open communication, idea sharing, knowledge and insights, trust;
5. **learning and development:** a continuous learning philosophy based on both individuals and teams, learning by doing (experiential learning), acquisition of new knowledge and technology;
6. **innovation and decision-making:** innovative mindset across the organization, encouragement for initiative and experimentation;
7. **change management:** challenge and change, continual questioning of the core knowledge base;
8. **intellectual capital and knowledge management:** sharing of responsibility for development of intellectual capital, diffusion of new information, benchmarking and adoption of best practice;
9. **measurement and assessment:** indicators of attitude, behavior, performance change, and commitment to continuous improvement;
10. **reward and recognition:** improves performance, strengthens motivation, encourages personal learning and advancement and fosters job satisfaction.

To these attributes, we add **sharing and exchange** with other learning organizations across and between all levels in the organizational structure. These eleven attributes guided and informed the design and research methods of this project.

## PROJECT OVERVIEW

Social and organizational barriers to science impact in the Australian coastal zone are being explored through a multi-organizational research program, including nine universities and the CSIRO. The research program is operating over three years and is focused on the themes of: (i) governance and organizational arrangements; (ii) socio-cultural context; (iii) knowledge systems; (iv) adaptive learning; (v) Indigenous, tropical and remote contexts, and (vi) integration and synthesis. The focus of this paper is on the adaptive learning theme.

## PROJECT OBJECTIVES

The aim of the adaptive learning theme is to provide knowledge to coastal managers, researchers, and community groups to enable enhanced learning for progressive improvement in coastal management. The adaptive learning theme has two main components: (i) the development of an on-line toolkit to enhance

adaptive learning; and (ii) the development and testing of a monitoring and evaluation framework to assess the impacts of scientific research in sustainable coastal zone management. To successfully complete the two components, the adaptive learning theme will:

- analyze the barriers and opportunities to embed adaptive learning within coastal organizations;
- determine the processes by which adaptive learning frameworks function in the coastal management context;
- assess organizational adaptability success factors; and
- develop and test a monitoring and evaluation framework for assessing science impact in the coastal zone.

## PROPOSED APPROACH

The principal focus of the research is on adaptive learning within and between organizations, be they businesses, government, NGOs, or community groups, and the level of sharing of information and learning. That is, what information is used in decision-making and how does this vary within organizational structures, what are its sources, and what processes facilitate the integration and application of new knowledge throughout the organizational hierarchy.

The research is based on two principal assumptions that effective coastal management requires: (i) adaptive learning organizations; and (ii) learning networks between these organizations. These assumptions are based on literature from a range of relevant contexts including coastal management, natural resource management, resilience, and sustainability science (see for example LEE, 1993; HOLLING, 1995; DOVERS, 2001b; FOLK *et al.*, 2002; BELLAMY *et al.*, 2005; SMITH and SMITH, 2006; WALKER and SALT, 2006; JACOBSON, in press) and are being explored through: (i) the characteristics of adaptive learning organizations; (ii) data use at levels within organizations; and (iii) identifying the nature and characteristics of adaptive learning networks.

### Exploring Adaptive Learning Organizations

Adaptive learning organizations are characterized by:

- proactively seeking current information and using multiple sources and forms of data to guide decision-making;
- being open to change in practice and reward the application of learning;
- having formalized processes for monitoring and evaluating the management process/es;
- having formalized processes for reflection on management and proactive modification of management action/s; and
- being proactive in seeking knowledge sharing partnerships.

With the ten attributes of learning organizations identified by BARTOL *et al.* (2008), these characteristics provide the framework for identifying indicators of processes and definition of data sources used at different levels within organizations to facilitate learning and adaptive management.

### Exploring Data Use

Different levels in the organizational hierarchy and different functional roles use different forms of data (raw data, analyzed data, synthesized data, interpreted data, and integrated data) in decision-making. Higher levels in the organizational hierarchy tend to be more influenced by socio-political perspectives, give greater attention to risk (including personal exposure), and use interpreted data more than lower levels. Lower levels in the hierarchy are more likely to use scientific data in decision-making, but may be constrained by corporate policy.

These concepts provide the framework for considering the role of data (qualitative vs quantitative, intuitive vs empirical, theoretical vs applied, social vs disciplinary, raw vs extrapolated) in learning and decision making at different levels in the organizational structure. They will also be used to identify the major influences on adaptive management and impediments to the use and exchange of information within and between organizations.

### Exploring Adaptive Learning Networks

The need for the same information exists for many coastal zone managing organizations and often the cost of acquiring information works against informed decision making and use of best available knowledge (see SEYMOUR et al., 2008). Learning networks therefore may exist between learning organizations because the individual organizations collectively appreciate the advantages of partnerships in knowledge sharing.

Learning networks are needed:

- to maximize access to available data and experience;
- to enact adaptive management within and between organizations at various scales;
- to maximize the effect and mutual benefit gained from collaborative action.

Different levels in organizational hierarchies have different opportunities to establish and maintain knowledge sharing networks. The types of information shared will vary between organizational levels and between organizations. Again, the principles outlined above provide a framework for defining the existence and nature of knowledge sharing and learning networks.

### Expected Insights From The Research

We expect:

- finding truly adaptive learning organizations relevant to coastal zone management will be unlikely, but we will find benchmarking examples within organizations;
- adaptive learning networks will exist, but they will be fragmented, not comprehensive and exist mostly where information exists in a form of relevance to different levels in the hierarchy;
- different levels in the hierarchy will be dominated by different types of learning (e.g., experiential versus collaborative);
- science will influence management more at lower levels in the organizational hierarchy;
- adaptive learning will be constrained by access to relevant information and data forms at all levels in organizational hierarchies;
- within organizations, elements of the adaptive learning process will be developed to varying degrees, which will be an indicator of an organizations capacity for adaptive learning and hence its adaptive learning status;
- to find a fear of reporting and reflecting on failure, and hence the loss of important adaptive management insights;
- monitoring and evaluation of management actions not to be comprehensive; and
- limited pathways for the effective and efficient integration of information relating to contemporary issues such as climate change.

### Methods

To maximize research uptake and ground the research within specific contexts, participatory methodologies, where feasible, will be adopted. Multi-methods will also be used to triangulate

data sources and analysis to maximize transferability of research outputs. Data will be gathered through key informant interviews, focus groups, participant observation, document content analysis, and in-depth analysis of exemplar adaptive learning processes. Data will be analyzed using both quantitative and qualitative means to determine trends and add depth and meaning to analyzes.

The adaptive learning theme will focus research in South East Queensland (SEQ), but include cases for comparative analysis in Western Victoria and in the South West of Western Australia. The comparative analysis will be focused on 'sea-change' regions in the three locations and enhance the transferability of the research findings. The comparative assessment will also allow greater integration with other research themes of governance and organizational arrangements and knowledge systems. The SEQ activities will build on past CSIRO activities in Moreton Bay and also the recent Ag-SIP funded project "Enhancing Community Engagement in NRM"; as well as, be linked to existing and emerging CSIRO initiatives in the region, particularly those of the Climate Adaptation Flagship in relation to building adaptive capacity to respond to climate change.

## PROJECT DELIVERABLES

Expected project deliverables include:
- an on-line toolkit for embedding adaptive learning within coastal organizations and other organizations, including:
- mechanisms to enable adaptive learning within coastal organizations (what to do and how to do it);
- principles of adaptive learning (including a searchable annotated bibliography);
- a trouble-shooting guide for overcoming barriers to embedding adaptive learning;
- examples of adaptive learning successes (i.e., examples of functioning pathways to science impact);
- a simplified framework for coastal organizations to monitor and evaluate their institutionalization of adaptive learning;
- a report that details a framework for monitoring and evaluating science impact in the coastal zone; and
- a report benchmarking science impact in the coastal zone.

## EXPECTED OUTCOMES

Expected project outcomes include:
- embedding of adaptive learning within coastal management organizations;
- enhanced pathways for on-going science research impact in the coastal zone;
- enhanced uptake of science to maximise economic, social and environmental wealth in the coastal zone.

## CONCLUSIONS

Adaptive learning is crucial to the success of adaptive coastal management, yet little is known about the factors contributing to institutionalizing adaptive learning within coastal organizations. This project seeks to expand the understanding of adaptive learning through exploring: (i) the characteristics of adaptive learning organizations; (ii) data use; and (iii) adaptive learning networks. It is expected that the project will provide tools and processes to support the transition of coastal management organizations towards becoming learning organizations and thus facilitate enhanced science impact in the coastal zone.

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