

ADAPTIVE MANAGEMENT IN THE 21ST CENTURY

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ABSTRACT

In the 1970s a few scientists formally advocated the use of experiments to improve natural asset management decision-making through explicit and detailed analyses of policy options and identification of inherent uncertainties. Since then, a number of studies designed to explore behaviour-based adaptive management techniques have been completed. Given that adaptive management will remain a necessary and important technique in 21st century, this paper outlines some of the variables requiring consideration during the design and application of projects and programs.

INTRODUCTION

Earth is a dynamic, uncertain place — always has been, always will be. Survival, therefore, is about biological and/or behavioural adaptation to Earth's ever-changing ecosphere. For example, people adjust, alter, or modify a tool, technique, or decision to reduce or eliminate a threat (reduce a risk) in order to live safer and longer. It means that people use data and/or information generated from an event, decision, or action to learn. Heinlein's (1973) adage that "you live and learn or you don't live long" underscores the rationale behind behaviour-based adaptive management. This paper summarizes behaviour-based adaptive management and describes some of the variables requiring consideration during the design and application of projects and programs.

ADAPTIVE MANAGEMENT DEFINED

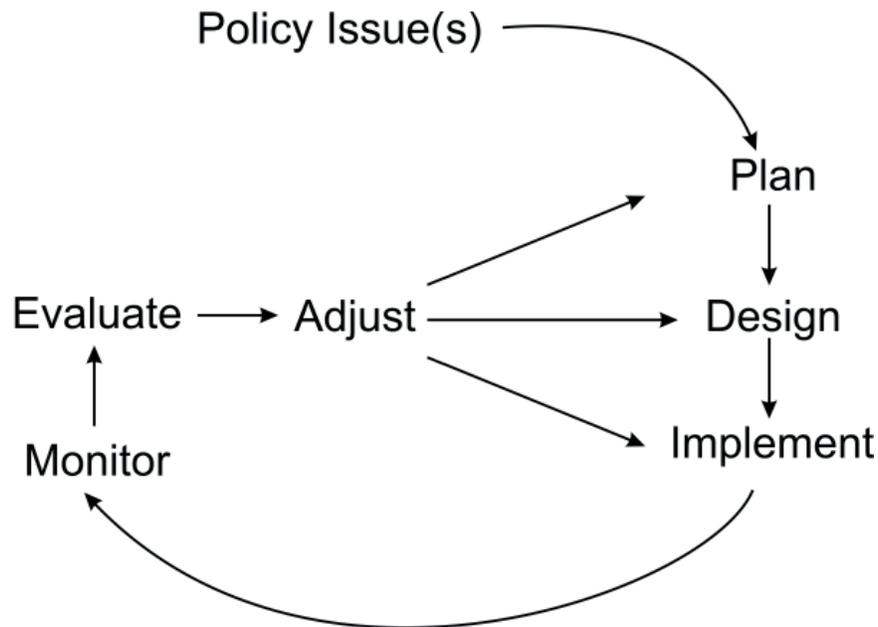
Behaviour-based adaptive management can be envisioned as a cyclical process of doing and learning using any number of feedback mechanisms available to natural asset managers. The cycle can be sophisticated or simple, subject to the approach selected by the sponsoring agency or organization. For example, a cycle can include planning, designing, implementation, monitoring, evaluation, and adjustment phases (Figure 1).

Behaviour-based adaptive management is perhaps best understood as a continuum of learning tools ranging from: 1) reactive, event-by-event, trial-and-error decision-making; to, 2) single policy design, implementation, monitoring, and modification as required (passive); to, 3) multiple policy evaluation using sophisticated active experiments and comparative analyses (Hilborn, 1992). Each of these tools uses some or all of the phases depicted in Figure 1.

With the reactive or "crisis management" approach, change (adaptation) results from one or more external drivers, including, but not limited to, public reaction to issues (MacDonald *et al.*, 1999), emerging socio-eco-

conomic trends, and threats to life and property. This elemental form of adaptation is based on a response to immediate and/or emerging circumstances using information derived from the event or crisis. While it can be used successfully (e.g., eliminate a behaviour that does not work should the crisis happen again in the future), the reactive approach provides little information to managers in support of proactive planning and the ability to mitigate the issue or impact before it occurs. Responsive adaptive management is also called management by trial-and-error (Walters, 1997).

Figure 1. A generic representation of an adaptive management cycle.



Passive adaptive management involves the implementation of a single policy or decision identified as the most likely to succeed. People learn when anticipated outcomes or targets are established and monitoring programs implemented to evaluate policy success. Harvest program targets established (and constantly adjusted) on the basis of long-term and ongoing wild life population monitoring exemplify this type of adaptive management, which is also referred to as management by monitor-and-correct (Walters, 1997).

Emphasis on a more rigorous approach to reducing uncertainties distinguishes active adaptive management from reactive and passive approaches where Walters and Hilborn (1976), Holling (1978), Walters (1997), and others advocate the use of experiments to make decisions based on explicit and detailed analyses of policy options and identification of major uncertainties. Experimental adaptive management requires replication of management strategies and use of control sites. Experimental management is most useful when there is significant uncertainty about the effects of a number of potential management policies (Fleming and Baker, 2002), and in cases where replication is, in fact, possible.

While active adaptive management is the most sophisticated and informative approach, it is the most difficult to design, and is not always possible to complete. Given that some adaptive techniques are global in scope (e.g., some of the management techniques implemented to combat global warming) and that financial and/or other resources may be limiting, agencies and organizations (including academic institutions, companies, and non-government organizations) equipped to use a variety of adaptive management techniques will be better suited for 21st century decision-making than those that are not.

FACTORS TO THINK ABOUT IN THE DESIGN OF AN ADAPTIVE NATURAL ASSET MANAGEMENT PROGRAM

The ability to adapt in the 21st century will, in large part, depend on agency and organization commitment and on how well staff and partners are equipped to deliver programs. The following variables may require consideration during project and program design and implementation:

1. Space and Time.

A spatial and temporal context for decision-making is critical because all species, small and large, short-lived and long-lived, specialists and generalists, survive by accessing a niche to eat or draw up nutrients, shelter, and reproduce. Natural asset management agencies responsible for wild life, for example, must therefore be capable of adaptive decision-making in a variety of small and large spatial contexts, including ecosystems (e.g., small ecosites to large ecozones), administrative units (e.g., Wild Life Management Units), and thematic units (e.g., parks and other types of protected areas), and according to short (e.g., minutes, days, and months) and long (e.g., months, years, decades, and centuries) periods of time.

2. Corporate Culture and Function.

Adaptive management is possible when institutional culture and function is used in support of programs designed to reduce uncertainty and risk. While an institution that promotes and supports experimental adaptive management is important (MacIver and Dallmeier, 2000), the ability to adapt to circumstances as they emerge (e.g., reactive adaptive management) is also required. Agencies and organizations should constantly assess the corporate capability to anticipate and respond to policy issues requiring some kind of adaptive approach.

3. Partnership.

No single agency or organization has cornered the market on expertise and know-how. And given the scope and complexity of global-local issues (e.g., climate change), no agency or organization can manage and care for a jurisdiction's natural assets alone. Therefore, partnership is a fundamental prerequisite to behaviour-based adaptation. The partnership literature is large and filled with case studies – there are many ways to work together, including advisory and expert committees, working groups, and work programs negotiated between managing parties that actively involve citizens in caring for natural assets. Success in any one of these relationships requires constant attention, encouragement, incentive, modification, and in some instances where the partnership is cyclical, revitalization. Sponsoring and participating organizations must ensure that the partnership remains viable and when necessary fine-tuned to enhance the chances of success (NRPTF, 1992; Trauger *et al.*, 1995) in our ever-changing world.

4. Data and Information Management.

Accessible data and information gathering and management programs (such as research, inventory, monitoring and assessment) to advance our knowledge of ecospheric function and human impact are fundamental requirements. It is important to note, however, that it is not practical to measure and monitor everything. Success at adaptive decision-making likely will be best realized through the careful selection of the unique data and information needs of each agency or organization (MacIver and Dallmeier, 2000; UNDP, 2003: 8), including decisions based on well-replicated experimental design and direct measurement of policy responses (Walters, 1997). Data and information sharing agreements can be used to strengthen agency and organization adaptive capabilities.

5. Strategic Planning.

Strategic planning is used to identify, establish, and modify short- and long-term direction in support of an organization's vision of the condition to which it aspires (e.g., sustainable living). Agencies or organizations committed to adaptive management constantly employ strategic planning to develop and assess scenarios about the future, often from a variety of perspectives and using a variety of spatial and temporal tools. Scenarios can introduce and describe several policy options, improve the quality of decision-making, and identify important but poorly understood questions for further study. For example, the Intergovernmental Panel on Climate Change (e.g., IPCC, 2001) uses scenarios to assess vulnerability (the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change) and risk to the eco-sphere caused by numerous climatic conditions resulting from a variety of human actions that might occur during the next 100 years.

6. Policy.

A policy is a statement of commitment that guides decisions and actions in response to program goals, objectives, and strategic direction. Rarely does a single solution to a natural resource management issue or problem exist, and policy must reflect this reality — agencies and organizations must constantly and where appropriate collaboratively search for a range of policy options. Policy formulation and the science that supports it must therefore be progressive and flexible, and permit managers to respond effectively to unexpected or unconventional issues and problems (Dovers and Handmer, 1992). Lee (1993) argues that natural resource policy formulation in a dynamic, uncertain world must subscribe to a simple imperative — *"policies are experiments; learn from them"*. Whenever possible, agencies and organizations should use data and information to compare expectations to reality and transform the comparison into learning by correcting the errors, improving imperfect understanding, encouraging commitment, and changing direction, action, or plans as needed.

7. Communication.

How well we discover, use, and share information and knowledge about ecosystem function and the impacts of people who live and work in each of them is critical to cultural, social, ecological, and economic health in the 21st century. The creation and maintenance of networks and other forums that allow people who are engaged in adaptation theory, policy, and implementation to work together will foster knowledge exchange and dissemination, and facilitate continuous learning (Parry *et al.*, 2005). In addition, knowledge dissemination through life-long learning opportunities that are accessible and current (e.g., education, extension, and training programs) can be used to optimize community-based decisions.

SUMMARY

The world is a dynamic, risky place, and agencies and organizations will need to use a variety of tools and techniques (some more sophisticated and scientific than others) to adapt. The ability to adapt in the 21st century will, in large part, depend on agency and organization commitment and on how well program staff are equipped to deliver behaviour-based adaptive management. An important part of being adaptive requires that program staff ask the right questions in support of the decisions that are required. In many situations, natural asset managers may find it helpful to examine requirements related to spatial and temporal context, corporate culture and function, partnership needs, data and information management needs, proactive action through strategic planning, dynamic policy formulation, and effective communication.

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