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Introduction to the Special Feature: Adaptive Management – Scientifically Sound, Socially Challenged?

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KEY WORDS: adaptive management, decision making, ecosystem management, experimentation, flexibility, implementation, management agencies, resources, risk, social aspects, special feature, stakeholders.

Published June 30, 1999.

Management of natural resources is often conducted under great uncertainty regarding future conditions, relationships among components, user response to management, management objectives, and even abundance of the resource itself. However, we know that human use of resources and the need for management will continue in spite of this uncertainty. If we hope to improve management, we must learn as we go.

Sometimes, the most effective way to learn is to view management actions as experiments and design them to produce critical information about the resource being managed. This information helps to reduce uncertainty and, more importantly, provides a broader base of knowledge and experience that helps us to manage more effectively in the face of continued uncertainty and ever-changing conditions. This "learning by doing" (Walters and Holling 1990) is the essence of adaptive management.

The foundations of adaptive management come from the field of industrial operation theory developed in the 1950s (Everett and Ebert 1986). The use of adaptive management as a resource management technique began in the 1970s (Holling 1978). Recently, the idea of being "adaptive" has become popular. A search of Cambridge Scientific Abstracts and SciSearch for 1997-1998 found 65 papers dealing with resource management that used the words "adaptive management" in their title, abstract, or key words. These papers addressed such diverse issues as management of deer, owls, waterfowl, forests, fisheries, and toxicants; effects of rock climbing on plant communities; effects of fishing gear on habitats; restoration of wetlands and coastal ecosystems; effects of fire on nutrient flux; control of hemorrhagic septicemia and rabies; and involving the public in adaptive management.

The adaptive management approach shows considerable promise, but many problems with implementation have been noted recently (Halbert 1993, McLain and Lee 1996, Roe 1996, Walters 1997). These problems include difficulties in developing acceptable predictive models, conflicts regarding ecological values and management goals, inadequate attention to nonscientific information, and an unwillingness by agencies to implement long-term policies seen as too risky or costly. Thus, in many applications of adaptive management, the promise has not been realized.

In light of this increasing interest in adaptive management, a symposium entitled "Adaptive Management: An Assessment of the Principles and the Practice" was organized at the 1997 Annual Meeting of the American Fisheries Society, in Monterey, California. The purpose of the symposium was to review the foundations of adaptive management, to assess how adaptive management has been interpreted by agencies and viewed by affected parties (stakeholders), and to suggest ways to improve the application of adaptive management. Some presentations from that symposium were developed into papers for this Special Feature of *Conservation Ecology*.

The papers in this special feature address a variety of issues. [Gunderson \(1999\)](#) considers the different ways that uncertainty can be manifest in resource management, using the example of the Florida Everglades. He indicates that adaptive management is not possible when either the natural system or the stakeholders are too inflexible to try new approaches. Flexibility might be increased through novel assessments, small-scale experiments, or a management crisis that restructures power relationships among stakeholders.

[Gilmour et al. \(1999\)](#) describe three case studies of adaptive management for urban water issues involving land use, water quality, and recreational access. The process increased participants' understanding of the management issues and reduced conflicts over both value-based and technical issues. The authors suggest that more emphasis be placed on using adaptive management workshops as forums for negotiation, and that having an "institutional champion" appears to be critical to providing long-term commitment.

[Johnson and Williams \(1999\)](#) describe an application of adaptive management to waterfowl harvest regulations and compare passive and active approaches. Adaptive management should help to reduce structural uncertainty in waterfowl population dynamics and help to determine the appropriate levels of aggregation or "management scale" for regulating harvests. The biggest impediment to improved management is a lack of well-defined objectives that results from unresolved value judgments about the resource.

[Johnson \(1999\)](#) considers how agencies make management decisions and describes how adaptive management can help to address problems in large, unique systems as well as small, replicated systems. He suggests that adopting an adaptive management approach will require a shift in agency philosophy from trying to maintain systems in a single optimal state to maintaining an optimal management capacity by creating resilience in the managed system and flexibility in management institutions.

[Shindler and Aldred Cheek \(1999\)](#) review research on public involvement in decision making for resource management. They conclude that public involvement is critical to interactive processes like adaptive management, and propose six concepts common to successful interactions between managers and citizens. They suggest that the cumulative effect of implementing these concepts is an enduring relationship between the agency and its constituents, which leads to increased support for innovative management.

[Pinkerton \(1999\)](#) suggests that innovative approaches to management are often developed by local, small-scale users, but that both management agencies and adaptive management have generally not operated at these scales and have not promoted cooperative management between users and agencies. She uses two case studies of salmon management in British Columbia to indicate that the primary barriers to cooperative management are a distrust of the process by agencies and a lack of political support for small-scale users. Opportunities for overcoming these barriers involve data sharing, building issue networks, linking local efforts to institutions operating at larger scales, and increasing institutional capacity for alternative solutions.

[Lee \(1999\)](#) feels that adaptive management has been more influential as an idea than as a practical tool, but that the type of social learning it proposes may be critical for future management. He suggests that, "adaptive management is an idea highly attractive to the scientifically sophisticated, who understand how little is really known about ... ecosystems ...," which may explain why the concept has remained influential despite problems with implementation. Implementation might be improved if stakeholders can agree on a collaborative structure and a set of questions before devising experiments. Lee closes by inviting comments on a series of questions regarding the philosophy and strategy of adaptive management.

Collectively, these papers and other recent critiques of adaptive management indicate that the most challenging

problems in applying adaptive management are not scientific, but rather in the social/political arena. I suggest three main problems that seem to emerge from these analyses.

1) Integrating stakeholders more effectively into decision making

Management is ultimately aimed at increasing the value of a resource to humans; thus, any management should consider how stakeholders value the resource and what knowledge they can contribute. Although adaptive management does not require consensus on objectives before implementing management experiments, a lack of well-defined objectives that reflect stakeholder values seems to result in less support for the process. Future applications of adaptive management might be improved by including more open discussion of differences in stakeholder values with the goal of developing some objectives, perhaps very broad, that most stakeholders can agree to. In addition, managers need to find ways to incorporate the nonscientific knowledge and data that stakeholders possess into the adaptive management process.

2) Developing institutions that are amenable to adaptive management

Most management institutions tend to resist change and wish to control the process of management as much as possible. Yet, adaptive management considers change and cooperation as inherent to management. Perhaps we need a new institutional paradigm that sees management agencies not as providers of solutions, but as facilitators and partners with citizens (i.e., true "civil servants") to help find joint solutions. In this context, the most critical agency personnel might be sociologists and planners rather than resource scientists. To help develop new institutional arrangements, we might apply adaptive management experiments not just to the resource, but also to institutions themselves. These experiments would explore the relationships within and among agencies and stakeholders to find new ways to promote flexibility, cooperative management, and a long-term outlook.

3) Embracing risk as a part of management

As with uncertainty, the risk of economic loss or of negative effects on the resource is inherent in all resource management, whether new and innovative or status quo, and can never be entirely eliminated. However, managing to maximize benefits may actually increase some types of risk. An alternative is to promote resilience of the natural system and of the management system, such that we maintain acceptable, but perhaps not maximal, levels of resource use while avoiding unacceptable negative effects and catastrophes. Adaptive management can help by determining the level of risk involved under different actions and incorporating that knowledge into policy choice. However, defining "acceptable use" and "catastrophe" is more a social than a scientific question.

I hope that this Special Feature of *Conservation Ecology* will stimulate thought and discussion among managers, researchers, and practitioners of adaptive management. Many papers in this special issue relate the perspective and judgment of their authors based on careful consideration of personal experience and published accounts. We invite others to respond with their own experiences in applying adaptive management and with their views on how, or if, adaptive management should be practiced in the future. To submit a response, please follow the link indicated at the end of each article.

RESPONSES TO THIS ARTICLE

Responses to this article are invited. If accepted for publication, your response will be hyperlinked to the article. To submit a comment, follow [this link](#). To read comments already accepted, follow [this link](#).

Acknowledgments:

I thank Steve Light for encouragement and discussion of adaptive management and the participants of the 1997 American Fisheries Society symposium for their willingness to share their experiences in adaptive management. This paper benefitted from review by Steve Gutreuter.

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