

The emergence of ecosystem management as a tool for meeting people's needs and sustaining ecosystems

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Abstract

Ecosystem management is an approach that attempts to involve all stakeholders in defining sustainable alternatives for the interactions of people and the environments in which they live. Its goal is to restore and sustain the health, productivity, and biodiversity of ecosystems and the overall quality of life through a natural resource management approach that is fully integrated with social and economic needs. For practical purposes, ecosystem management is generally synonymous with sustainable development, sustainable management, sustainable forestry and a number of other terms being used to identify an ecological approach to land and resource management. Ecosystem management emphasizes place- or region-based objectives, with scopes and approaches defined appropriately for each given situation. Because natural ecosystems typically cross administrative and jurisdictional boundaries, managing them requires interactions among different stakeholders and institutions. Ecosystem management remains an evolving force that must yet respond and adapt to numerous challenges. © 1998 Elsevier Science B.V.

Keywords: Ecosystem management; Socioeconomics; Objectives; Multiple-scales

1. Introduction

We occupy a time of historic change in the way people view, understand and value the natural world. In the United States, not since the turn of the last century have so many varied interests had such an intense focus on the role of public lands and the professional management of the resource values con-

tained there. The current development of an ecologically based approach to management has evolved from a series of events, understandings and articulated values provided over time by the scientific community, natural resource managers, legislative actions, judicial reviews, wide spread public comment, failing rural economies, and concerns over the long term health and viability of the environment and our ability to provide for desired goods and services from public lands. The reason an ecosystem perspective is needed is simple. Continued growth in human populations and increases in their production, use and disposal of resources are not matched by corresponding growth in the land base available to meet those demands under traditional resource man-

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agement approaches while sustaining desired levels of environmental quality (Silver and DeFries, 1990).

Some give credit for the fundamental core of the concept of ecosystem management to Aldo Leopold (Knight and Bates, 1995; Grumbine, 1994). Although not using the term ecosystem management, Leopold recognized many of the interdisciplinary principles of ecology, socioeconomics, and human interests in natural resource management that today are associated with managing natural ecosystems. Others say that the roots of the ecosystem management concept rest in the advent of basic ecosystem science during the 1960s and 1970s (Golley, 1993). Whatever its origins, ecosystem management arose in response to increasing recognition that traditional approaches to natural resource management are inadequate and if perpetuated will likely result in further losses of biodiversity and ecosystem sustainability (Grumbine, 1992). Clearly however, it is an evolutionary and not revolutionary approach. One that takes natural resource management to the next level based on our improved understanding and capability for dealing with larger volumes of information and their integration into management decisions and policies.

Among the events that coalesced the different aspects of ecosystem management into an applied interdisciplinary and holistic practice were the grizzly bear and northern spotted owl controversies (Thomas et al., 1990). In the 1970s and 1980s, these events influenced the integration of ecosystem science, conservation biology (see Crumpacker, 1998; Knight, 1998), traditional natural resource management, socioeconomics, institutional arrangements, and diverse stakeholders interests. By the late 1980s, this synthesis had resulted in an ecosystem approach to land management. And, it was during this period that usage of the term 'ecosystem management' to mean an ecosystem approach to resource management became common.

As a result, this special issue explores a range of current views and perspectives on the development of the concept of ecosystem management primarily in the United States and its implementation. It is divided into three sections: (1) the concept of ecosystem management and its complexity, (2) analyses, information needs and applications, and (3) issues, commentaries and perspectives.

2. The ecosystem management concept

What exactly does 'ecosystem management' mean? An ecosystem is a community of organisms and their environment that function as an integrated unit. Forests are ecosystems, as are ponds, rivers, rotting logs, rangelands, whole mountain ranges, and the planet. They exist at many different scales, from micro sites to the biosphere. Their species composition, structure, and function change continually. Moreover, the boundaries between them are not clearly delineated. Ecosystems grade into one another and are nested within a matrix of larger ecosystems. We describe the boundaries of ecosystems for specific purposes.

Management means using skill or care in treating or handling something. Thus, 'ecosystem management' means using skill and care in handling integrated units of organisms and their environments. It implies that the whole system, or integrated ecological unit, is the context for management, rather than just its individual parts.

Ecosystem management is an approach that attempts to involve all stakeholders in defining sustainable alternatives for the interactions of people and the environments in which they live. It adopts a combination of numerous established ecological concepts and principles that address human–environmental interactions. It is a way to better understand and manage lands and resources, their conflicting resource uses and management objectives, and the activities that impact them. An ecosystem approach also attempts to address many environmental relationships across varying spatial, biological, and organizational scales, as compared to more traditional approaches of looking at individual projects and single components of a plan or a single species (but for a discussion on the value of individual species research to ecosystem based approaches, see Loeb et al., 1998). The ecosystem approach emphasizes place- or region-based objectives, with scopes and approaches defined appropriately for each given situation. It can potentially be used by many interests, for a wide range of purposes and missions. Thus, the word 'management' in its name should not be construed as limiting.

Ecosystem management is an approach that is scale-dependent. Many significant biological re-

sponses and cumulative effects become more evident at greater scales than at smaller ones. Consequently, framing problems and solutions at the appropriate scale is critical to evaluating management options. Planners and managers are increasingly aware that adequate assessment of any options requires consideration of their effects at all levels.

Ecosystem planning must consider the dynamics of landscape scale patterns, both natural and managed, and their effects on hydrology, wildlife, and other resources as well as their impacts on human needs and expectations. For example, the planning process for a national forest needs to recognize the context in which that forest resides, such as what actions are being taken in surrounding areas. This would include consideration of significant changes in surrounding, nonpublic land as reason to revise plans. In some places, the emphasis will be on ecological conditions and environmental services, while in others, it will be on resource products and uses. Overall, the mandate should be to protect environmental quality while also producing resources that people need. Therefore, ecosystem management cannot simply be a matter of choosing one over the other. It must chart a prudent course to attain both of these goals together. This can only happen in areas that are large enough to allow compatible patterns of different uses and values.

Ecosystem management is not a linear, highly standardized, or certain means to identify the one right way to manage resources. This approach will aid in the development of better options and sustainable solutions by incorporating human needs and values, with our best understanding of the environment, while recognizing that science alone has not and will not produce a single 'right' answer for resource use and management objectives. Instead, decisions will continue to be a complex blending of social, economic, political (see Freemuth and McGregor Cawley, 1998), and scientific information and interests.

Ecosystem management differs from traditional resource management, including the multiple use concept, by addressing both biotic and abiotic components of the environment and their interactions within landscape settings as well as by incorporating substantial cultural components (Grumbine, 1994; Slocombe, 1993a,b, 1998; Wood, 1994). Simply put,

the term ecosystem management implies an interdisciplinary, holistic environmental approach to maintaining natural diversity and productivity of the landscape while sustaining human culture (Gore, 1993; IEMTF, 1995; Brussard et al., 1998; Lackey, 1998). To achieve this, consideration is directed toward whole ecosystems rather than to single species or single uses of natural resources. Because natural ecosystems typically cross administrative and jurisdictional boundaries, managing them requires interactions among different stakeholders and institutions (Cortner and Moote, 1994). The ecosystem approach to resource management therefore is a strategy based on integrating ecosystem science and socioeconomic principles (Underwood, 1998). Institutional coordination and change (Cortner et al., 1998; Kennedy and Quigley, 1998), stakeholder participation, and collaborative decision making are key components of the process.

3. Humans as an integral part of the system

Humans must be considered as parts of almost all ecosystems, making it logical that the idea of sustainability be applied to human economies, societies, and to development as well as to ecosystems and biodiversity. Advocates of ecosystem management recognize that delineation of ecosystems is problematic and that manipulation of complex ecosystem components to achieve some desired goal far exceeds the knowledge about ecosystem science and resource management science. However, they have learned over the past several decades that management of land and water to maximize yields of selected resources or to optimize one or a few uses without regard to the myriad connections and interactions among the vast components, compartments, and functional processes within ecosystems fails to sustain those systems and their biodiversity (Francis, 1993; Knight and Bates, 1995).

Among the commonalities between the grizzly bear controversy in the greater Yellowstone area and the spotted owl controversy in the Pacific Northwest was the necessity of managing resources across traditional land-control and ownership boundaries involving different government agencies, private owners, and diverse stakeholders in both public and private

lands. Thus, governmental arrangements and stakeholder involvement in collaborative decision making became important concerns and distinguishing components of ecosystem management. Both administrative interactions and cooperative determinations largely were missing from traditional resource management. The intent of ecosystem management is not to prescribe land-use practices and policies on private lands but rather to use the knowledge gained about conditions of those lands when making decisions on public lands and allowing private landowners the ability to address practices on public lands that might impact their lands.

Having the objective of assuring both environmental and economic sustainability, ecosystem management recognizes that the two goals are interrelated and associated with sustaining ecosystem biodiversity, structure, and function. While the scientific foundation of ecosystem management rests with applied ecosystem science, scientists, including ecologists, must accept that there is far more involved than applied science alone. The concept encompasses humans and their socioeconomic culture as part of ecosystems, and as a consequence, the principle of sustainability reaches beyond conservation biology and traditional ecology to include social and economic development, i.e., sustainable development (but see Crumpacker, 1998; Knight, 1998; Slocombe, 1993b, 1998). Part of the uncertainty over the development of ecosystem management arises from the concurrent development of other closely related concepts. These include such fields as ecosystem health, ecosystem risk assessment, ecosystem valuation, ecosystem economics, ecosystem ethics, human ecology, political ecology, and ecosystem law, all of which, like ecosystem management, are outgrowths of an emerging new paradigm in natural resources management (Costanza, 1991; Costanza et al., 1992; Francis, 1993; Gunderson et al., 1995; Knight and Bates, 1995; Rapport, 1995; Shrader-Frechette, 1998; Wagner et al., 1998; Wood, 1994). Like it or not, the emerging paradigm of ecosystem management, or the ecosystem approach to resource management, is as much about people as it is about other life forms and the abiotic environment (Salwasser, 1994). Thus, a tenant of the ecosystem management paradigm is that people must learn how to understand and respect nature and its limits, to

augment nature where feasible, and to benefit from such management (Francis, 1993; Grumbine, 1994; Slocombe, 1993a,b).

4. Development of a national policy

An attempt to develop a uniform federal policy on ecosystem management arose in 1993 from the White House's National Performance Review (for perspectives on ecosystem management policy development, see Fitzsimmons, 1998; Hacuber, 1998; Morrissey, 1998; Norton, 1998). As part of the review, Vice President Gore called for the federal government to adopt an approach for ensuring sustainable economic development while also sustaining the environment through ecosystem management (Gore, 1993). The federal ecosystem management initiative thus led the White House Office of Environmental Policy to establish an Interagency Ecosystem Management Task Force in 1993 to carry out the environmental mandate of the National Performance Review.

Most federal land management agencies had anticipated such action as evidenced by the creation in 1992 of an informal Interagency Ecosystem Management Coordinating Group for exchanging views and information relative to ecosystem management among their staffs. Thus, when the report of the task force was issued in 1995 most of the relevant agencies had independently initiated actions toward adopting the principles of ecosystem management to foster their stewardship of public lands (IEMTF, 1995).

The report of Interagency Ecosystem Management Task Force identified barriers to implementing ecosystem management and proposed ways the federal government could foster overcoming the barriers (see Huke and Gelburd, 1998; Szaro et al., 1998). To help assure interagency implementation of ecosystem management policies and programs, the task force report recommended that the federal agencies participating in the task force should become parties to a memorandum of understanding affirming their intent to implement the report's recommendations.

The first major effort in this regard was the 'Ecological Stewardship Project' which brought together many agencies, environmental groups, industry associations, and private foundations (Szaro et

al., 1996b). Each agency has several years of experience in developing elements of an ecological approach. None have a complete and totally operational package. All have developed an improved understanding of an ecological approach over the last several years. The project was a beginning point in consolidating, documenting, and sharing this experience to increase the rate at which organizations are able to apply an ecological approach in a range of situations. The project's objectives were as follows.

- To develop a framework for implementation of an ecosystem approach on federal lands and waters. The framework and related information are not intended to provide prescriptive solutions for individual sites or places but should provide the foundation for the development of agency implementation plans and strategies.

- To publish a reference text that: (1) outlines the management options and alternatives for implementing an ecologically-based approach to the stewardship of federal lands and waters, and (2) documents the scientific foundations and identifies scientific shortcomings for those options and alternatives.

- To serve as the foundation for ongoing efforts: accelerating implementation, improving resource management, advancing partnerships, and sharing data. The workshop is not an end point, but rather a beginning point for improving and evolving future on-the-ground resource management.

It is useful to think of this 'ecological approach' as the 'tool kit' from which managers can select activities that might aid them in understanding landscapes and resources (see Sexton, 1998). The term ecological approach, (or ecosystem management, or sustainable resource management, or several other terms) is a convention for identifying a unifying concept and related set of tools for applying the concept in a particular situation or context. Each agency, each manager, each situation might choose a different set of tools to best address concerns in any specific circumstance. In relationship to past management, an ecological approach expands the tool kit available to land managers to understand resources and the potential effects of various management strategies. While some have expressed concerns about 'cookie-cutter' approaches and prescriptive solutions, the view of the project is that a sound ecological approach inherently provides more options and

more flexibility for analytical efforts to support resource managers.

Some elements of an ecological approach that need broad agency collaboration include the need to: look at larger areas as a means of understanding the context for particular resources and features on public lands; examine resources across several scales as a means of understanding relationships more thoroughly; understand process and function as a means to understand effects and long-term sustainability better; assess historical patterns and features, particularly in regard to disturbance, as a means to describe conditions, trends and historical ranges of events; discuss desired conditions across large areas as means of communicating about and cooperating on management across jurisdictions to understand various groups' goals. In many cases, federal agencies share the need for this information and have a clear incentive, especially at broader scales, to collect and synthesize information cooperatively. The final reference document is seen as a key step in defining common tasks and identifying those essential 'tools' that can be developed through partnerships.

5. Conclusion

The inadequacy of the traditional resource management paradigm, which primarily focused on site based management strategies, to deal with multiple scales and larger areas that encompass both public and private lands coupled with the growing concern over decreasing biodiversity and loss of ecosystems gave rise to the concept of ecosystem management. Ecosystem management remains an evolving force that must yet respond and adapt to numerous challenges. A formal process of adaptive management, a continuing process of action-based planning, monitoring, researching and adjusting with the objective of improving the implementation and achieving the desired goals and outcomes, is needed to maximize the benefits of any option for land and natural resource management (Lessard, 1998). For practical purposes, ecosystem management is generally synonymous with sustainable development, sustainable management, sustainable forestry and a number of other terms being used to identify an ecological approach to land and resource management. Ecosys-

tem management is a goal-driven approach to restoring and sustaining healthy ecosystems and their functions and values while supporting communities and their economic base (Szaro et al., 1996a). It is based on a collaboratively developed vision of desired future ecosystem conditions that integrates ecological, economic, and social factors affecting a management unit defined by multiple boundaries including ecological and political ones (see Sexton et al., 1998; Sexton and Szaro, 1998). While the ongoing federal ecosystem management initiative has developed to the point that ecosystem management has achieved tangible substance and credibility, the path it will follow in the future remains an open question. However, the concept is well on its way towards being the de facto if not the official standard for natural resource management in the United States.

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