An Ecosystem Approach to Management: A Context for Wilderness Protection

Paul A. Gray
Robert J. Davidson

Abstract—Sustainable development, ecosystem management and ecosystem health are three prominent catch phrases that now permeate the scientific and popular media, and form the basis of a growing number of private sector, government and academic programs. This discussion paper briefly explores the definition and application of these concepts as a context for wilderness protection programs by arguing that the idea of "sustainable living" is preferred over "sustainable development" as a vision for the future, an ecosystem approach to management is one method by which sustainable living might be achieved, and that an ecosystem approach to management must provide for a balanced spectrum of human activities that cumulatively contribute to ecosystem health.

Organisms derive their existence from the ecosphere, and humans are no exception. People depend on Earth, her processes and resources to survive. But unlike the other 10-30 million species, humans have evolved the ability to transform unprecedented numbers and amounts of ecosystem services and products. Insignificant and isolated at first, human endeavor had little influence on the ecosphere, but the rates at which, and methods by which, people currently consume resources are jeopardizing ecospheric health and the long-term future of humankind. For example, in the past, wilderness surrounded people as encompassing, roadless and untouched areas. Today, remaining patches of wilderness have been relegated to the more remote places on Earth. The existence of wilderness now depends on human goodwill and associated actions.

Many agree with the need to recast the ecospheric-human relationship. Over the past 20 years, jurisdictions around the world have acknowledged that the altering power of unchecked human endeavor needs to be brought into balance with Earth's metabolism. For example, global reciprocity was provided some tenure as an element in the controversial and much debated concept of sustainable development articulated by the World Commission on Environment and Development in its report, "Our Common Future" (World Commission on Environment and Development 1987). Predictably, the popular, scientific and agency literature has exploded with ideas, guidelines and recommendations to assist in the quest for initiatives (such as ecosystem management) that will lead to a new ecospheric-human relationship. This discussion paper briefly examines the definition, relationship and application of sustainable development, ecosystem management and ecosystem health as a context for programs such as wilderness management.

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Paul A. Gray is a Policy Advisor, Natural Heritage Section, Lands and Natural Heritage Branch and Robert Davidson is a Conservation Geologist, Ontario Parks, Ministry of Natural Resources, 300 Water Street, Peterborough, Ontario, K9J 8M5, Canada, e-mail: paul.gray@mnr.gov.on.ca; bob.davidson@mnr.gov.on.ca

Sustainable Development (Sustainable Living)

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). It is an unfortunate catch phrase. To sustain is to keep, to preserve, to continue to maintain something (Shields and others 1993). Generically, the word is linked to the idea of well-being, but carries a different meaning for each person, a function of individual values, perspectives, education and life-experiences. And when linked with "development" in reference to ecospheric well-being, its meaning is further clouded by the conflicting concepts and paradoxes that result.

Some people identify more with the "sustainable" part and work in support of efforts devoted to ecological and social transformation. Others identify with "development" and interpret it to mean a redefined version of the *status quo* (Wackernagel and Rees 1996). From this perspective, the World Commission on Environment and Development's definition (and its derivatives) has been challenged because, among other concerns, many suggest it advances an anthropocentric and utilitarian perspective that underwrites a recipe for perpetual growth (industrial development, for example), continued deterioration of ecosystems and loss of constituent biological assets (Dovers and Handmer 1993; Pearce and others 1989; Rees 1990; Robinson 1993; Robinson and others 1990; Willers 1994). Many of the questions that have emerged from the examination of, and associated debates over, sustainable development are about values and beliefs that ultimately guide human behavior in the finite ecosystems that provide the products, services and experiences required for life—sustained life. While admittedly anthropocentric, the ideas associated with the concept of "sustained life" are perhaps more tenable because they signify balance—balance between the people who draw from and use Earth's processes and resources to survive and the ecosystems of which they are a part. Accordingly, sustainable living is envisioned as an ecosphere filled with healthy ecosystems and healthy people—a condition or state of

ecospheric-human balance that society predicts can be attained and maintained.

While the concept of sustainable living can serve as the basis for an optimistic vision of (a prediction about) the future, it does not provide the means or the path to get there. Despite the limitations of the original concept(s) of "sustainable development," the associated debates have highlighted the need to examine human conduct in the ecosphere. For example, in the decade following publication of "Our Common Future," the literature has been populated with reports on initiatives that examine the notion of culture as the primary cause and possible cure for Earth's ecological ills (one of the paradoxes), managing for uncertainty, intergenerational and intragenerational equity, individual versus collective interests, empowerment, the adaptive ability of humans and their institutions to cope with change and the sustainable scale of the human economy relative to the life-support system(s) upon which that economy relies (that is, what are the ecospheric limits to growth?). But how do we transform these issues and ideas, and any decisions about them (for example, to protect or not protect wilderness) into tangible action in, on and above Earth's landscapes and waterscapes? An ecosystem approach to management is one available path.

The Concept of an Ecosystem Approach to Management

Fundamentally, an "ecosystem approach" is based on the idea that if humans subscribe to and apply an appropriate set of values and are equipped with the required knowledge and tools, they can protect and maintain ecosystems, derive a quality existence from them and simultaneously ensure that opportunities for future generations are retained (Gray and others 1995, 1996). An ecosystem approach is an adaptive process that employs a suite of integrated programs to care for Earth's natural assets by managing our relationship with the other components of ecosystems and ensuring that our perceptions, values and behaviors work in support of ecosystem function. It is an encompassing process that captures the range of cultural, social, economic and ecological values that ultimately define human-ecosystem relationships (fig. 1). An ecosystem approach to management is a method that can assist committed people in their efforts to keep landscapes and waterscapes working (Merriam 1994)—an absolute requirement for the attainment and maintenance of healthy ecosystems and healthy people and a necessary prerequisite for successful wilderness protection programs.

"Management" is a sweeping, generic term for the cadre of tools and techniques we use to meet our objectives and attain our goals. It is a controversial aspect of human endeavor and a frequent focal point of conflict because, as traditionally applied, it has failed to account for the range of values and philosophies held by the variety of peoples who comprise Earth's cultures and societies. For example, the neoclassical utilitarian's approach to management is radically different from the emergent eco-centrist's perspective and approach. In addition, the term often is used to imply that people understand the complex nature of ecosystem composition, structure and function when, in fact, we do not. Is ecosystem management possible? No, not now, or in the near future. But an ecosystem *approach* to management is an encompassing endeavor that:

- Captures the range of cultural, social, economic, and ecological values that ultimately define ecosystem-human relationships
- Requires decisions be made in the context of ecosystems as holistic entities with many natural assets, not individual resources
- Is sponsored by flexible, adaptive, accountable and learning-oriented institutions
- Is participatory and knowledge-based
- Is dynamic and adaptive so that the impacts (positive-neutral-negative) of human actions are identified, monitored and constantly evaluated against prescribed measures of healthy ecosystems and healthy people
- Results in a balanced spectrum of human activities (ranging from complete protection to active manipulation of natural assets) that are at least impact-neutral.

Historically, protected areas have been designated and managed as isolated patches of land and water. Early in the 20th century, this approach worked in many ecosystems because of the relatively remote and pristine nature of large tracts of land (such as the northern and mountainous reaches of North America) and the limited use of surrounding areas. However, this condition no longer exists in most jurisdictions—land use pressures now require protected areas to be linked and managed in concert with decisions that impact entire landscapes and waterscapes. The idea of a protected area system plan is simple enough—protected areas such as wilderness parks must be cared for in the context of the ecosystem(s) of which they are a part. Design and implementation of the system plan, however, is much more complex. So how do we organize ourselves to develop and implement effective and accepted systems management plans and area management plans that ensure the continued existence of the values for which a wilderness area is protected? Strategic, tactical and "on-site" management plans fill our bookshelves and our hard drives. They provide thousands of useful ideas and recommendations that implicate all sectors of society. But many are limited by organizational frameworks that constrain a society's ability to adequately cast natural assets (including humans) within an ecological context and to identify, explore and wisely employ the full

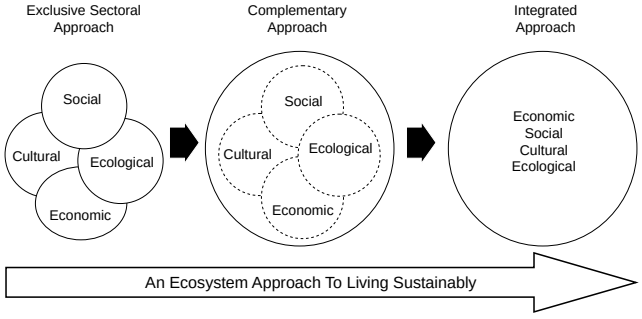

Figure 1—Sustainable living requires that society move from an exclusive sectoral approach to valuing and using natural assets to an integrated approach.

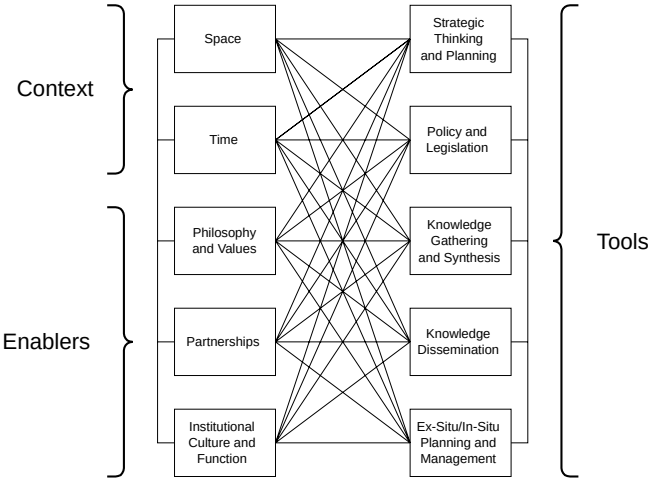

Figure 2—An ecosystem approach to management framework. The modules are linked and often employed simultaneously or in unison to develop and deliver ecologically-based programs (e.g., wilderness protection) (adapted from Gray and others 1995).

spectrum of social conditions and forces that determine human behavior and impact ecospheric function. In this paper, we suggest that wilderness management programs can be enhanced by commitment to, and application of, a unifying, ecologically oriented framework comprised of three themes and nine interrelated modules (fig. 2):

A. An ecologically meaningful spatial and temporal *context* in which to manage human activity in the ecosphere. It requires that we:
   1. Define and describe Earth's ecosystems in-space-in-time and align our decisions and actions accordingly

B. The appropriate *enabling* mechanisms, including:
   2. A philosophy and corresponding suite of societal values that enable natural asset managers to take effective action
   3. Institutional cultures and structures that sponsor proactive and integrated programs
   4. Programs involving all sectors of society as partners and participants in decision-making processes

C. The appropriate suite of *tools* to help us understand Earth and to guide human behavior in, on, and above her landscapes and waterscapes. Accordingly, society must sponsor:
   5. Useful data and information gathering and management programs (such as research, inventory, monitoring and assessment) to advance our knowledge of ecospheric function and human impacts
   6. Knowledge dissemination through life-long learning opportunities that are accessible and current (education, extension, and training programs)
   7. Strategic thinking and planning to identify, establish and modify short- and long-term direction
   8. Policy, legislation, and regulation to guide society in adoption and attainment of sustainable lifestyles
   9. In-situ and ex-situ planning and management techniques designed to protect the pieces, the patterns and the processes.

The importance of a commitment to care for Earth's natural assets cannot be overstated—it is a critical element of any successful initiative. But commitment is meaningless in the absence of an integrated, unified and practical protocol for action. The modules provide a basis to identify the appropriate questions and organize the suite of programs (ecosystem description, research, inventory, policy development, on-site protection, etc.) required for implementation. Detailed description and analysis of each module is beyond the scope of this paper. And while all modules are important, establishment of an ecologically meaningful spatial framework (a physical context) is a fundamental requirement for successful implementation of an ecosystem approach to management. Accordingly, the following section summarizes a few ideas about the definition and description of ecosystems.

Ecosystem Defined

Our ideas about an ecosystem approach to management are based on the concept that Earth operates as a series of interrelated systems, within which all components are linked. Rowe (1961), Bailey (1996) and many others argue that an ecosystem is a definable entity that has currency as a context in which to pursue sustainable living objectives – it is a recognizable chunk of Earth space, in which the flow of energy and the transformation of matter in-space-in-time create networks of organisms (such as plants and animals, including humans), atmosphere, rock, soil and water, interacting with each other and with other ecosystems. As the fundamental context for wilderness management, ecosystems are used as bounded, geographic units of the landscape, waterscape and airscape that include all natural phenomena.

Why use an ecological perspective, a relatively new and little tested technique, as the spatial context within which to pursue sustainable living objectives and associated programs like wilderness protection? After all, over the last few thousand years, societies throughout the world have invested significant resources in the creation of spatially based jurisdictional or administrative (for example, country, province, district and township) and thematic (such as mineral resources, species habitat, protected areas and forested land) units to define their relationships with other societies and Earth's natural assets. The simple fact is that ecosystems have sponsored life for billions of years. And no society, however well endowed with knowledge and technology, can escape the reality that life derives from the ecosphere and her constituent ecosystems—life does not equal organisms; life equals organisms plus the ecosystem(s) upon which they depend (Rowe 1992a). And sustained life, through appropriate long-term management of human activities in, on and above Earth's landscapes and waterscapes, depends on our success at identifying the interrelationships between the natural assets that comprise each ecosystem—understanding ecosystem composition, structure and function (fig. 3).

In contrast to jurisdictional and thematic units, the ecosystem provides an integrating framework within which natural asset managers can work to address the spectrum of cultural, social, economic and ecological factors and forces. Now that human actions have created significant impacts of continental and global proportions, an ecological context is

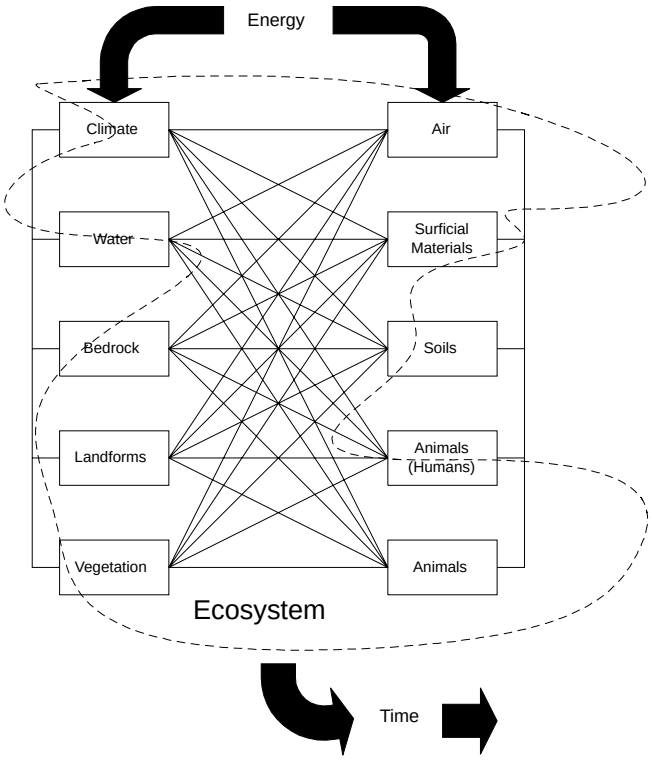

Figure 3—The forces and factors that create and shape ecosystems. The dashed line represents the permeable ecosystem boundary through which various forms of energy come and go. In this regard, it is important to recognize that ecosystems constantly change in space and time.

increasingly required to scope out and understand the issues, establish partnerships and design appropriate management programs.

Ecosystems can be very large (indeed, the ecosphere is the largest earthly ecosystem) and very small (a pond, for example), where the smaller ecosystems fit into the larger ecosystems. This hierarchical organization has been described as "successively encompassing levels of interacting components or units" (Grobstein 1974) that constitute a system of "discrete interactive levels" (Pattee 1973). An hierarchical approach helps us perceive complex systems by dividing them into understandable levels. Natural asset managers must be able to make decisions about human activities in ecosystems of all sizes, which requires that they know the location of ecosystem boundaries. The task of spatially and temporally delineating and describing ecosystems is called ecosystem classification (in Canada, the national program is referred to as ecological land classification).

Each ecosystem is unique and complex, and its boundaries exist as a gradient between neighboring systems. This presents natural asset managers and users with a problem. How can we hope to understand ecosystems in all their complexity and diverse shapes and sizes if they are all different? Fortunately, advances in ecological theory, analytical techniques and spatial technologies now permit managers to apply integrated and interactive ecosystem delineation tools and techniques (see Rubec [1992] and Sims and Uhlig [1992] for a summary of some programs). While not perfect by any means, scientists and managers have identified criteria and rules with which to define and describe ecosystems as recognizable chunks of space-in-time (fig. 4). The criteria are based on the factors and forces that create and shape ecosystems (see fig. 3). For example, the boundaries of large ecosystems can be delineated by integrating climate and landform patterns, while smaller ecosystems can be identified through examination of soils and vegetation patterns.

The Concept of Ecosystem Health

A principal indicator of sustainable living is ecosystem health. But what is it, and can society protect wilderness by maintaining healthy ecosystems, or vice versa? Are wilderness and ecosystem health convergent or divergent concepts? In its simplest terms, health measures system performance

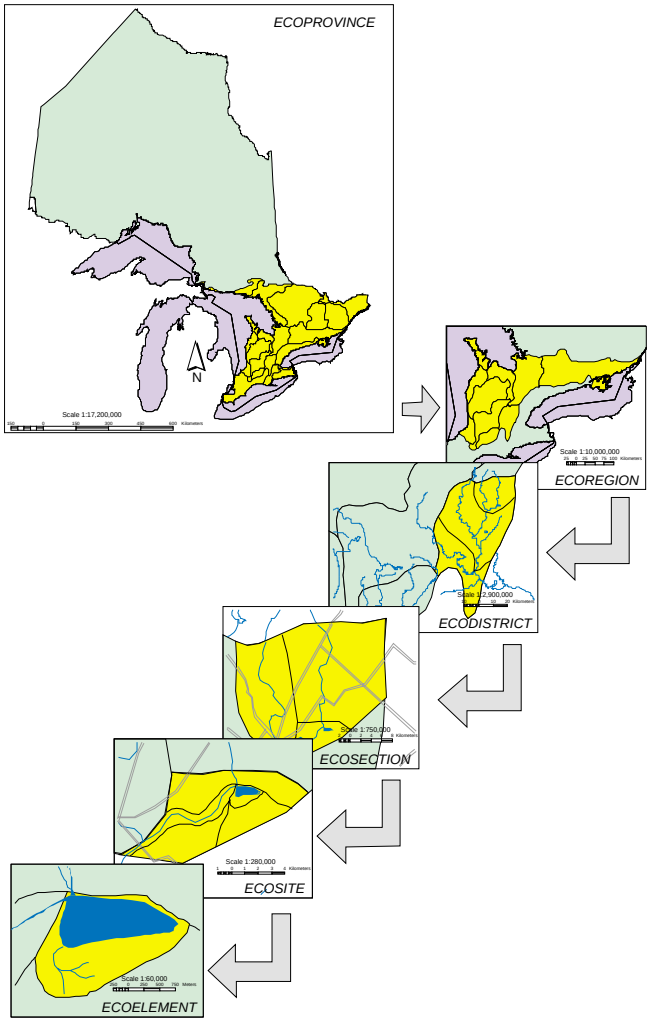

Figure 4—Using the national Ecological Land Classification terminology, this spatial simulation model demonstrates how ecosystems of varying size and shape are related to each other in ladder-like levels. Use of this type of classification system allows natural asset managers to design and deliver programs within an ecologically meaningful spatial framework.

through the behavior (function) of its parts (composition and structure) (Costanza and others 1992). Costanza and Patten (1995) suggest that a system is sustainable if and only if it persists in a nominal behavioral state as long or longer than its expected existence time—that it attains its full expected life span within the nested hierarchy of systems in which it is embedded.

While most people immediately and correctly equate ecosystem health with lots of indigenous plants and animals relative to the ecosystem(s) in which they evolved, abundant clean water, forests and wetlands, there is more. Humans are an important part of the ecosphere. From this perspective, Rapport (1995) characterizes ecosystem health as a measure of the level of distress in the ecosystem, the ecosystem's resilience to perturbation, the ecosystem's ability to sustain itself, the degree to which an ecosystem's function does or does not impair the healthy functioning of adjacent ecosystems and the extent to which the ecosystem supports healthy human communities. Therefore, ecosystem health is an integrated combination of cultural health, social health, economic health, and ecological health (fig. 5).

Does a healthy ecosystem equal wilderness? No, not necessarily. It depends on the state or condition of ecosystem health to which we aspire. In this regard, ecosystem health has operational meaning only when it is defined in terms of a desired state or condition for that ecosystem—a condition or state that we predict can be achieved and sustained. For example, society may elect to pursue activities conducive to the protection of wilderness (such as the creation of wilderness parks and strictly controlled ecotourism activities inside them), or sustained yield of timber, or agricultural products, or all of these. Each prescription requires unique decisions that result in the evolution of a unique ecosystem (Lackey 1994). Similarly, Rowe (1992b) asks to what extent should we maintain natural (areas designated for preservation—in some cases wilderness), semi-natural (areas in which resources are managed for sustained use), artificial (devoted to high input, intensive use such as farming and forestry) ecosystems, and to what extent do we establish restoration and rehabilitation programs for entire ecosystems? These questions are, of course, critical to visioning, establishing goals (such as healthy ecosystems and healthy people) and setting management objectives (such as wilderness protection targets). And, in large part, the answers are contingent upon a commitment to, and decisions respecting attainment of, a prescribed level of ecosystem health.

Figure 5—A commitment to sustainable living and implementation of an ecosystem approach to management strives to establish a balance between Earth's ecosystems (ecological health) and the people who live in them (cultural, social, and economic health). Therefore, ecosystem health is an integrated combination of cultural health, social health, economic health, and ecological health.

Summary

Most people now live in ecosystems that have been degraded and impaired to some degree, and societies throughout the world continue to accumulate natural debt to which the ecosphere has begun to respond. Recognition that the cumulative effects of human activity require mitigation is one of many factors contributing to a global call to change the ways people think about and work the Earth – a call to repair what is broken and degraded and to maintain and/or protect what works. Accordingly, societies around the world are exploring the type of change required and the ways of implementing it. Routinely, this change is expressed through the lofty concepts of sustainable development, ecosystem management, and ecosystem health – three prominent catch phrases that now permeate the scientific and popular media, and form the basis of a growing number of private sector, government, and academic programs. In this regard, the protection or enhancement of remaining wilderness will depend on a conscious commitment to it, on adoption of sustainable living as a vision of the future, and on the development and implementation of an encompassing, ecologically oriented approach to management.

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