

Three Faces of Ecosystem Management

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Abstract: *The debate over the objectives and methods of ecosystem management has been confusing, in part because people truly mean different things when they use the term ecosystem management. These different meanings reflect differences in interests, values, and knowledge. I organized these meanings into three sets: "environmentally sensitive multiple use," an "ecosystem approach to resource management," and "ecoregional management." Environmentally sensitive multiple use takes an anthropocentric perspective that seeks to foster multiple human uses subject to an understanding of environmental constraints that goes beyond that considered in traditional multiple-use management. An ecosystem approach incorporates a biocentric view in which ecosystems are understood as a metaphor for holistic thinking requiring an expanded consideration of the dynamism and complexity of ecological systems, scale phenomena, and the need for management across ownership boundaries. Ecoregional management takes an ecocentric perspective that focuses on the management of specific landscape ecosystems defined as real geographic spaces and that shifts management focus toward ecosystem processes and away from biota. Understanding these three conceptualizations as different points along a continuum of resource management paradigms helps clarify the different visions of ecosystem management held by different groups. Because different places and groups are at various points on the continuum, progress comes from moving along the continuum and not necessarily by seeking a single state called "ecosystem management." Policy prescriptions, such as changes in law, incentives, and information provision, can be targeted more effectively to the realities of different settings. Ultimately, the conceptualization suggests that heterogeneity of ecosystem management approaches is desirable, as long as we learn from the diverse experiences that result.*

Tres Caras del Manejo de Ecosistemas

Resumen: *El debate sobre los objetivos y métodos del manejo de ecosistemas es confuso, en parte porque el término manejo de ecosistemas tiene significados muy diferentes. Estos significados diferentes reflejan diferencias en intereses valores y conocimientos. Organicé estos significados en tres conjuntos: "uso múltiple ambientalmente sensible," una "aproximación ecosistémica al manejo de recursos" y "manejo ecoregional." El uso múltiple ambientalmente sensible toma una perspectiva antropocéntrica que busca promover el uso múltiple sujeto al entendimiento de las limitantes ambientales que va más allá del considerado en el concepto tradicional de uso múltiple. Una aproximación ecosistémica incorpora una visión biocéntrica en la que los ecosistemas son entendidos como una metáfora de pensamiento holístico que requiere de una amplia consideración de la dinámica y complejidad de los sistemas ecológicos y los fenómenos de escala, así como la necesidad de manejar a través de límites de propiedad. El manejo ecoregional toma una perspectiva ecocéntrica enfocada al manejo de ecosistemas específicos definidos como espacios geográficos reales y cambia el enfoque del manejo hacia los procesos ecosistémicos y no hacia la biota. Entender estas tres conceptualizaciones como distintos puntos de un continuo ayuda a clarificar las distintas visiones del manejo de ecosistemas respaldadas por diferentes grupos. Debido a que hay diferentes sitios y grupos en diferentes puntos del continuo, el progreso resulta de moverse a lo largo del continuo y no necesariamente de la búsqueda de un estado único llamado "manejo de ecosistemas." Las derivaciones políticas, como cambios en las leyes, incen-*

tivos y suministro de información, pueden ser orientadas más efectivamente a las realidades de diferentes escenarios. Finalmente, la conceptualización sugiere que la heterogeneidad de enfoques del manejo de ecosistemas es deseable. Mientras, aprendamos de las diversas experiencias resultantes.

Introduction

If there is one thing about ecosystem management upon which people agree, it is that the term means different things to different people. When it became prominent on the public policy stage about 5 years ago, it was startling to hear groups with entirely different goals and perspectives all support ecosystem management. Agencies as diverse as the U.S. Forest Service, the U.S. Department of Defense, and the Florida Department of Environmental Protection all adopted ecosystem management as a guiding principle for resource management (Congressional Research Service 1994; R. S. Brown & Marshall 1996; Goodman 1996; Thomas 1996). Environmental groups and industry representatives spoke in favor of it at Congressional hearings. The unanimity of support from groups that had not agreed on anything for the past two decades made a number of observers wonder just what was meant by ecosystem management. Some said that when environmental groups heard the term *ecosystem management*, they heard *ecosystem*; when development and commodity interests heard the term, they heard *management*.

Multiple meanings of ecosystem management have confounded and complicated the debate about how to reform current practices. It is not the case, as is often alleged, that no one knows what ecosystem management is, only that it truly means different things to different people. Often these meanings reflect differences in interests, leading to a "politics of definition," (Grumbine 1997) as groups grapple for political advantage. But the meanings also represent differences in underlying values and knowledge drawn from different disciplines, cultures, and exposure. Debate over definitions and principles of ecosystem management has obscured these differences in meaning and has created an impression of profound disorder that has been confusing to policy-makers and practitioners.

The different ways people understand ecosystem management can be organized in a manner that helps inform the debate. I provide a typology of ecosystem management and organize the term's multiple meanings into three aggregate views: environmentally sensitive multiple use, an ecosystem approach to resource management, and ecoregional management. I place these three faces of ecosystem management within a broader continuum of resource management paradigms and describe the implications of this conceptualization. I draw on a review of the academic literature on ecosystem

management, interviews with practitioners (Yaffee et al. 1996), and my own observations from a year exploring the concepts and practice of ecosystem management.

Defining the multiple meanings of ecosystem management can help people clarify their positions, and the taxonomy can be used in research on people's attitudes toward ecosystem management. We can also map different institutional settings on the continuum and use that understanding to craft strategies for change. For many places, successful resource management should be seen as movement along the continuum and not one ultimate objective called "ecosystem management."

I also use the idea of a continuum of management paradigms that includes three different views of ecosystem management to argue that our aspirations for federal land management should lie on the ecosystem management end of the continuum and not in a revamped version of multiple use. The success of ecosystem management is likely to lie in an amalgam of different components of all three faces of ecosystem management chosen to match the values and needs of a particular setting. What the continuum ultimately suggests is that heterogeneity in the way we understand and approach ecosystem management is not only tolerable but desirable, as long as we learn from the diverse experiences that result.

The Confusion over Ecosystem Management

The ecosystem management literature shows a remarkable degree of consensus about the broad principles of ecosystem management. Most analysts identify a consistent set of elements: systems thinking, deeper understanding of the complexity and dynamism of ecological and social systems, more extensive consideration of different spatial and temporal scales, ecologically derived boundaries, adaptive management to deal with uncertainty, and collaborative decision making (Slocombe 1993; Clark & Minta 1994; Grumbine 1994; Moote et al. 1994; Christensen et al. 1996; Haeuber 1996; Franklin 1997; Kohm & Franklin 1997; Vogt et al. 1997).

Yet the ways in which people operationalize these terms and value the choices to be made differ significantly (Christensen et al. 1996; Czech & Krausman 1997; Gilmore 1997; Lackey 1998). Some people view the maintenance and restoration of ecosystem integrity or health—defined in various ways—as the overarching goal of management (Angermeier & Karr 1994; Grumbine 1994, 1997; Kimmins 1995; Sparks 1995). Others

view human needs as equally or more important (American Forest & Paper Association 1993; Salwasser 1994; Zeide 1998). And some view ecosystem management as simply a process of collaborative decision making in which goals emerge that are appropriate to the situation at hand (Keystone Center 1996). Some researchers view ecosystems largely in terms of their biotic components, emphasizing species diversity and habitat management (Blew 1996), whereas others describe them as volumetric landscape units defined as much by their abiotic characteristics (Rowe & Barnes 1994; Rowe 1997).

Some scientists argue that key concepts such as ecological integrity are undefinable (Wicklum & Davies 1995) and that desired conditions are impossible to determine from an understanding of ecosystem science because ecosystems are characterized more by dynamism and change than anything else (Hilborn & Ludwig 1993; Ludwig et al. 1993). Others argue that ecosystem management is simply a relabeling of current practices (Czech 1995; Wenger 1997), which in its extreme form is "smoke and mirrors" that hide an attempt to expand government control over private property (Fitzsimmons 1996a, 1996b). Some writers bemoan the "politicalization of forest science" and argue that the shift to nontraditional management practices is untested "hype" that is dangerous to forest health and social progress (Atkinson 1992). Others acknowledge that changes in management practice are needed but that ecosystem management lacks clear objectives and hence cannot be operationalized on the ground (Sedjo 1996). To some analysts, ecosystem management is fundamentally flawed because it will be defined by policymakers in anthropocentric terms and represents one more example of the "arrogance of humanism" (Stanley 1995).

The amount of confusion over these various definitions of ecosystems and ecosystem management has caused many to throw up their arms in frustration. The early enthusiasm for the concept in the American policy arena has been replaced by a deep sense of skepticism (Haeuber 1996; Sedjo 1996). The term *ecosystem management* has been de-emphasized by high-level government officials, and other buzzwords such as *collaborative stewardship* have taken its place. Many of the interest groups that in the early 1990s were pushing for ecosystem management as a new paradigm for management of public lands have largely abandoned the effort (S. Barth, personal communication).

The confusion over the definition of ecosystem management has concealed two important points. First, practitioners are moving ahead in spite of the academic and policy debates. Ironically, the lack of a policy consensus at the national level on ecosystem management has empowered people and organizations to attempt ad hoc experiments on the ground, and the early evidence is that such approaches are achieving success (Slocombe 1993; Yaffee 1996). Second, striving for some as-

pect of an ecosystem approach, as difficult as it might be, is better than what we are doing now (Sample 1994). The baseline for evaluation of new management approaches is not an idealized notion of where we could be, but rather the real environmental and human problems caused by past management paradigms. We need to move toward some conceptualization of an ecosystem-based approach because past approaches have not succeeded. A lack of certainty and unanimity is not a good enough excuse to avoid doing so.

Multiple Meanings of Ecosystem Management

One way to move ahead is to acknowledge and work with the different meanings people ascribe to ecosystem management. In the current debate, ecosystem management is taken to mean three related but different conceptualizations of appropriate resource management, with different groups and disciplines aligned with these varying conceptualizations. The different faces of ecosystem management are as follows:

- (1) *Environmentally sensitive, multiple-use management* aims at satisfying a diverse set of human needs and values, but it is acknowledged that this can only be achieved over the long term by being more sensitive to the limits of ecological systems. This vision represents an expanded version of the current federal public lands management regime.
- (2) *Ecosystem-based approaches to resource management* adopt many of the principles contained in the ecosystem management literature. Thus, managers work with a deeper understanding of ecological systems and ecological integrity or health are explicit goals, but rarely does this involve managing whole ecosystems. The term *ecosystem* is used more as a mental construct suggesting complexity and systems interactions than a real geographic entity. Most of the successful ecosystem management efforts to date fall into this conceptualization. For some of them, success lies in having adjacent landowners recognize their interconnectivity and talk to each other or having wildlife managers consider the habitat needs of multiple species.
- (3) *Ecoregional management* adopts many of the principles identified in the ecosystem-based approaches but emphasizes landscape-scale management as a fundamental goal. Landscape ecosystems are seen as real geographic units defined as much by their abiotic and floristic components as by the species and communities of animals that associate with them. Success comes through maintenance or restoration of ecological functions associated with those landscape units.

These three views of ecosystem management can be better understood by viewing them as points along a continuum of different resource management norms. There are five different paradigms of resource management: dominant use, multiple use, environmentally sensitive multiple use, an ecosystem approach to resource management, and ecoregional management (Table 1). They differ in terms of the goals and principles underlying management activities and their biotic and spatial focus. People grounded in these different paradigms have different views of the role of humans in the natural system and the character of ecosystems. Those operating with dominant or multiple-use paradigms view humans as apart from nature, which legitimizes placing human needs at the center of management actions. Those who adopt an ecosystem approach or ecoregional management seek to view human activity as a part of nature, which enhances the need to protect natural processes in order to sustain human activities. In the first four paradigms, an ecosystem is viewed as a social construct defined in relation to the problem at hand; in an ecoregional approach, ecosystems are viewed as specific places that can be mapped and managed as landscape units.

The distinctions between paradigms have as much to do with the values of their proponents as the science needed to carry them out, and science and values are necessarily interconnected. For example, an approach that has landscape ecosystems as its central focus deemphasizes the need to protect every "cog and wheel." Similarly, the focus on outputs in dominant and multiple-use approaches has led to the collection of specific stand- or population-level data that is less relevant to understanding ecosystem- or landscape-level dynamics.

Dominant use approaches seek to satisfy singular human objectives, often focusing on single species or single-resource management such as growing trees, deer, or forage for livestock (Brunson & Kennedy 1995). The focus generally is on economically valuable species managed through administratively defined or landownership boundaries, such as a timber stand, farm field, or river segment. Although maximum yield is often the management objective, more recent dominant-use notions work to protect the means of production, including species habitat, sometimes through active manipulation of ecological processes such as disturbance regimes.

Multiple-use norms evolved in public land management to recognize the diversity of human interests associated with a landscape (Sedjo 1996). Traditional multiple use sought to maximize the yield of these multiple outputs and to do so on a sustainable basis, where sustainability was taken to mean continuous production of desired outputs (Anderson 1995). In the case of timber resources, this definition was interpreted as a nondeclining and even flow of wood fiber from federal forests. Although nonquantifiable outputs often are included in the objective functions of multiple-use management, the

bureaucratic need to maximize outputs and provide accountability for managers has generally resulted in an emphasis on economically valuable species of plants and animals or sites with significant scenic or recreational qualities (Brunson & Kennedy 1995) managed in landscape units defined by administrative or landownership boundaries.

Multiple-use management views ecosystems as production platforms for the goods and services that human society demands. The approach internalized an industrial metaphor that was at the heart of our underlying models of society through much of the second half of the 1800s and first half of this century. As in most industrial models, control became a central theme in multiple-use management, so that production became more predictable and reliable, necessarily at the expense of environmental variability (Holling & Meffe 1996). Simplification of environmental systems became an objective of forestry and river-basin management, leading to large clearcuts replanted with a single tree species and arrow-straight river channels.

Environmentally sensitive, multiple-use management continues to focus on the primary objective of satisfying human interests by fostering production of different outputs desired by people, but it recognizes the constraints imposed by ecological systems and some aspects of their complexity. This type of management is still oriented toward species composition, although it often acknowledges a greater awareness of the spatial structure of the biota. Management is organized along administrative or landownership boundaries, although spatial scale is considered in relation to specific issues or problems to be solved. Hence, habitat maps may be overlaid on top of management units to evaluate the implications of specific concerns such as old-growth management or endangered species protection.

Key management principles underlying environmentally sensitive multiple use include sustained yield (though not necessarily maximizing yield), minimization of negative environmental impacts, including those that accumulate across space or time, and protection of species diversity. Economic implications of alternative management regimes are evaluated, as are the interests and concerns of stakeholder groups, through public involvement processes. Ecosystems are viewed both as constrained production platforms and pieces of landscape that influence management options and are affected by management decisions.

An *ecosystem approach to resource management* differs in several fundamental ways from the previous three views. The overall goal is reversed from that of multiple use. Rather than maximizing human use subject to environmental constraints, an ecosystem approach sets out to maximize ecological integrity or health subject to the need to allow sustainable human uses (Grumbine 1994; Jones et al. 1995; Sparks 1995). Although

Table 1. The continuum of natural resource management paradigms.

<i>Three faces of ecosystem management</i>					
	<i>Dominant use</i>	<i>Multiple use</i>	<i>Environmentally sensitive multiple use</i>	<i>Ecosystem approach to resource management</i>	<i>Ecoregional management</i>
Goals	promote single-purpose human use	promote multiple human uses	foster multiple human uses subject to environmental constraints	promote ecological integrity while allowing human use on a sustainable basis	manage at the ecoregional level, restoring and maintaining ecosystem function while allowing human use on a sustainable basis
Primary biotic focus	certain economically valuable species management unit	economically valuable species and sites; composition management unit	multiple species; composition and structure management unit plus "problem-shed"	species and ecosystems; composition, structure, and function regional-scale "problem-shed"; consideration of ecologically relevant boundaries	landscape ecosystems; function (ecological processes) landscape ecosystem units
Spatial focus/boundary					
Key principles	maximum yield; some protection of the means of production subject to economic feasibility	multi-objective maximum sustained yield; economic feasibility	sustained yield; minimize environmental and cumulative impacts; protection of species diversity; consideration of economic costs; public involvement	ecosystem as a metaphor for holistic thinking; systems perspective; spatial and temporal scale; ecosystem complexity and dynamism; collaborative decision making; explicit consideration of uncertainty; interorganizational cooperation	ecosystem as an integrated spatial unit, fitting within a nested hierarchy of geographic units; ecosystem complexity and dynamism; collaborative decision making decentralized to the ecoregion level; explicit consideration of uncertainty; reorganization of management along ecoregional lines
Concept of ecosystem	industrial production platform	industrial production platform	constrained production platform; landscape area affected by management actions and that affects management	problem at hand; focus on sets of interactions dominated by biotic elements	specific geographic places, defined as biocoystems or geoecosystems
Ethical precepts	anthropocentric	anthropocentric	anthropocentric	biocentric	ecocentric

many of the same trade-offs need to be made in management, this altered definition of the problem raises ecosystem protection to a first priority when balanced against the wants and needs of people (Francis 1993; Stanley 1995). The biotic focus of management includes both species and ecosystems and adds ecosystem function to species composition and structure as important management considerations. As a result, restoration or maintenance of ecological processes, such as nutrient cycling, disturbance regimes, or hydrological flow, becomes important for maintaining species composition and diversity (Sparks 1995). Rather than managing arbitrary administrative units or landownership boundaries, managers seek to define boundaries that match the problems or issues addressed, many of which should be defined by their ecological characteristics. Hence, water-quality problems are considered in the context of hydrological units such as watersheds, employment concerns are addressed in the context of regional labor markets, and species protection is viewed in the context of habitat and migration patterns.

An ecosystem approach uses the term *ecosystem* partly as a metaphor implying holistic and systems thinking (MacKenzie 1993; Hartig et al. 1998). That is, component parts of the management problem are fundamentally interconnected across space and time, and as a result decision makers need to appreciate the complexity and dynamism of these interconnections and consider the implications of different spatial and temporal boundaries. Vogt et al. (1997) emphasize this focus on ecosystems as a set of interactions rather than a set of specific places, noting that "it is important to stress the view that ecosystems should be seen as a construct, a way of looking at the biotic and abiotic components of the natural world and the interactions among them. As interactions are the focus of the ecosystem view, the use of the term ecosystem refers primarily to processes and functions."

An emphasis on the complexity of system-wide interactions highlights scientific uncertainty and results in the need to deal with this uncertainty explicitly by acting conservatively and managing adaptively (Holling 1978; Walters 1986; Lee 1993): setting a course of action based on a set of hypotheses, monitoring what happens, and reevaluating the direction based on what one learns. An adaptive management approach requires that decision makers maintain options for doing things differently because evaluation might lead to the conclusion that the earlier direction was wrong.

Because managers cannot possibly understand all of these dynamics on their own and need to act in concert with other landowners connected across a landscape, an ecosystem approach implies the need for interconnection of individuals and organizations in ways that are not needed in multiple-use management. Substantive cooperation among landowners, including interagency coordi-

ination and public-private partnerships, becomes critical (Hartig et al. 1998). Involvement of stakeholder groups needs to go beyond the perfunctory public involvement processes of multiple-use management because the level of knowledge needed about both natural and social systems is much greater than that required in multiple use. Instead, managers should engage the public in collaborative problem-solving through use of ecosystem- or problem-scale working groups (Keystone Center 1996; Yaffee & Wondolleck 1997).

At its most fundamental level, an ecosystem approach maintains diversity as a means of building resilience against catastrophic events in biological, economic, organizational, and political systems (Holling & Meffe 1996). It seeks to protect biological diversity, including important ecological and evolutionary processes (Clark & Zaunbrecher 1987; Grumbine 1994), as bounded by the range of natural variation (Swanson et al. 1994; Sparks 1995; Holling & Meffe 1996). It fosters the development of diversified economic systems to avoid unsustainable boom and bust cycles. An ecosystem approach means building management organizations that are modeled less on concepts of the industrial age and more on organizational theories relevant to an information age (Cleveland 1985; Osborne & Gaebler 1992; Knight & Meffe 1997). Such organizations seek new ideas and are willing to experiment with alternative management strategies (Kennedy & Quigley 1994; Yaffee 1994). They draw strength from the diverse capabilities and perspectives inherent in a pluralistic society and build supportive coalitions for management actions (Yaffee 1994).

An *ecoregional management* approach adopts many of these same principles for management but differs in its view of ecosystems and management. In this view, an ecosystem is no longer an abstract concept implying interconnectedness and complexity. Rather, ecosystems are identifiable places, real geographic units that can be mapped on the landscape and that fit together in a nested hierarchy (Rowe 1961, 1992; Rowe & Sheard 1981; Barnes et al. 1982; Omernik 1995). Ecoregions have been defined and mapped in a number of ways. Omernik (1995) defines ecoregions as "regions of relative homogeneity with respect to ecological systems involving interrelationships among organisms and their environment" and distinguishes between single-purpose and multi-factor mapping approaches.

Rowe and Barnes (1994) make a critical distinction between bioecosystems and geoecosystems. In their view, a bioecosystem tends to be "a conceptual device relatively elastic in its space/time dimensions, deriving its meaning or lack of meaning from organisms of interest wherever they chance to roam." That is, they view bioecosystems within the second face of ecosystem management, as a conceptual device focused on interactions that lack any absolute significance in the classification of geographic spaces. Bioecosystems are defined in a bot-

tom-up process that starts with organisms and includes other variables as needed, whereas geocologists proceed top-down by iteratively subdividing the landscape dependent on “the inherent diversity of the terrain interacting with human purpose.” In their view, an ecosystem is not best conceptualized as a cluster of organisms interacting with their environment but as a “three dimensional ‘natural body’ . . . within which organisms function as vital components.”

From an ecosystem management standpoint, how one defines an ecosystem does matter. For example, the geoecosystem approach makes it much easier to subdivide the landscape into the small units that are the necessary focus of land managers (B. V. Barnes, personal communication). For my purposes, though, the critical distinction between the second and third faces lies between thinking of an ecosystem as an abstract organizing concept or as a living geographic space. Geoecosystems best exemplify this latter mindset, but other ecosystem classification schemes can foster management of specific places within inclusive, ecologically derived boundaries.

In an ecoregional approach, management goals adopt the ecosystem approach’s concept of promoting ecological integrity while allowing human uses on a sustainable basis. Critical to achieving this goal is management at the ecoregional level. The primary biotic focus is on landscape ecosystems, and ecosystem structure and function take center stage. Management seeks to restore and protect critical ecosystem processes such as disturbance regimes and carbon sequestration. For some advocates of this approach, animal species are not important management foci. If the landscape is taken care of, the species associated with it will take care of themselves (Hunter 1991). Biodiversity depends on ecosystem diversity (Barnes et al. 1998).

The ecoregional approach has important implications for the organization of management. Because management focuses on ecosystems as spatial units, it should be reorganized to parallel those areas of space. More staff expertise is needed in physiography, soils, and botany. An ecoregional approach usually implies decentralizing goal setting and decision making to the ecoregion level, in part by establishing collaborative decision making units at that level (Press 1995). Some in the bioregional movement have argued for redefining political boundaries to conform to large-scale ecological boundaries and for developing sustainable economies within these regions (e.g., Sale 1985; Meeker-Lowry 1990).

Understanding ecosystems as specific places can be a powerful symbol and mobilizing force. Williams and Patterson (1996) suggest that one force promoting ecosystem management approaches is “a collective ‘sense of placelessness’ wrought by excessive commodification of natural landscapes—the dissociation of meaning from place.” Kemmis (1990) argues that a sense of place provides some of the glue that binds people together and is

critical to the development of effective civic culture. The importance of a sense of place to inspiring actions to protect it is well known. Simonson (1989) observed that “We vandalize, pollute and plunder what is separate from us; we revere, protect and cherish what we belong to.”

One of the clearest distinctions between these three faces of ecosystem management lies in their core ethical precepts and the responsibilities and values that they imply. Stanley (1995) describes ecosystem management approaches as a continuum of anthropocentric and biocentric values, and these three perspectives can be categorized along an ethical continuum. Environmentally sensitive multiple use is almost purely anthropocentric in nature. The environment is protected in order to sustain use for human purposes.

A biocentric ethic emerges in the second face of ecosystem management, allocating survival rights to nonhuman life. A good example lies in the absolute mandate to protect species that is codified in the U.S. Endangered Species Act. For some, such an ethic simply extends the definition of rights that has been evolving in the United States since the country’s origins, starting with white men, adding men of color and then women and children (Stone 1974; Nash 1989). Adding animals and plants to this evolution is not conceptually difficult in a society that tends to anthropomorphize them. For others, a biocentric ethic goes beyond such human associations and involves moral or spiritual dimensions that draw on an image of a shared Earth, with stewardship responsibilities assigned to humans (Rolston 1988).

Proponents of an ecoregional approach take biocentric ethics one notch higher as a core paradigmatic element and transform them into images of ecocentric ethics. In this approach, management needs to proceed not just with a sense of the rights assigned to specific elements of the biota but with a sense of the interconnections among all components of the ecosphere. Rowe (1990) presents an extreme view of this perspective, arguing that “Biocentrism that limits value-laden concerns to people, to endangered species, to animal rights and to biological phenomena in general is a dangerous detour from the Way — which is valuing the largest unities, the most complete realities that we can comprehend.” In his view, an “unshakable ethic for the Ecosphere will emerge when we believe in our heart and minds that our worldly environment is a reality more important than me, you and all of us. When such a conviction about Nature becomes second nature, we will know that we are *parts* of the ecological whole that produced us and sustains us.”

A Continuum of Resource Management Paradigms

It is tempting to view this continuum of management paradigms (Table 1) as a timeline of discrete periods, moving from the past (at left) to the future (at right). It is

possible to assign rough periods of time to these norms as they were codified in federal law and management practice. Hence, dominant use was the norm in the United States from the beginning of management in the 1870s through the 1950s; multiple use was mandated by statute in 1960; environmentally sensitive multiple use took center stage in the late 1970s and 1980s (Wilkinson & Anderson 1987); and the beginnings of an ecosystem approach developed in the 1990s. An ecoregional approach is evident only in a rudimentary form in current federal resource management (Avers et al. 1994).

Viewing the continuum as a timeline is not the most effective way to understand this diverse set of management styles, however. In fact, different management institutions are in different places on this continuum today due to varying traditions, laws, and capabilities (Gilmore 1997). Many agencies are far to the left on the continuum. For example, the statutes that guide some state resource management agencies emphasize maximizing the yield of single resources such as timber or huntable wildlife on public lands. Most private land-management norms also fall into the dominant-use category. Even federal agencies such as the U.S. Forest Service that have an ecosystem approach grafted onto an environmentally sensitive, multiple-use mandate have units that vary considerably in management style. Some are actively incorporating ecosystem concepts into management practices, whereas others are mired in a dominant-use approach.

It is important to understand this typology of management paradigms as a continuum of ideas and approaches and not a set of discrete points. Clearly, some dominant-use agencies have adopted environmentally sensitive management practices, and some single-species management schemes employ an understanding of ecosystem processes to maximize utilization. Some multiple-use agencies have been very effective at employing collaborative decision-making approaches. Nevertheless, some steps between approaches seem bigger than others. For example, the move from an environmentally sensitive, multiple-use approach to an ecosystem approach requires rethinking many basic assumptions of management (Grumbine 1997), including such sacrosanct notions as management boundaries, the primacy of use versus protection, and the amount of decision-making power shared with outside groups.

The continuum is a spectrum of ideals, not necessarily what has been achieved in practice, and this has important implications. Rarely are the ideals of one paradigm achieved in real-world management, whereas the problems inherent in it become evident over time. That leads to the development of other paradigms, as the failings of one cry out for a new management regime. Other sources of change, including new knowledge and changing public values and political dynamics, also contribute to this evolutionary process. The difficulties in achieving earlier ideals accumulate as we move to the right on the

continuum. By accumulating the burdens of previous management conceptualizations, paradigms become increasingly complex as one moves to the right, and people's expectations for management outcomes rise. Each successive system is held to a higher standard than its predecessor. Ironically, this means that management will increasingly fail to satisfy people's expectations. This situation can help explain the state of confusion, frustration, and cynicism evident today.

Is ecosystem management an old idea or a new one? The process of accumulating ideals over time helps answer this question. Some of the normative components of ecosystem approaches have been in existence for many years (Shelford 1933; Caldwell 1970; Slocombe 1993; Grumbine 1994; Czech 1995). Aldo Leopold (1949) was an articulate advocate of understanding the interconnectedness of landscapes and managing with a biocentric ethic (Callicott 1998). The use of management boundaries that make geographic sense has been a norm of watershed managers for many decades. But these ideals have not been achieved in practice and, as a result, get lumped and transformed into a new definition of appropriate management. Ecosystem management is an amalgam of old and new ideas that carries the burden of failed expectations for predecessor management ideals.

It is clear that different people and groups ascribe different meanings to the term *ecosystem management* based on 1) their current management approach and the difficulties and cost of transforming it; 2) professional norms and personal values as informed by different educational systems (Czech & Krausman 1997); and 3) where their values lie on the anthropocentric-biocentric-ecocentric continuum. In some ways, different people's definitions of ecosystem management tell more about the values and ways of thinking of a person than they do about ecosystem approaches. In summarizing the extensive social science literature on belief systems, Michael (1995:470) notes that these collections of values and thought processes "tend to maintain themselves and to resist change—learning—unless they face extraordinary threats to or opportunities for survival."

In working with conservation biologists and landscape ecologists on ecosystem management topics, I have been amazed to see how much their worldviews differ. Biologists focus primarily on genetic and species-level diversity, including gene-pool and habitat considerations at the species level. Even multiple species evaluations such as GAP analysis are still largely habitat- and animal-driven. Landscape ecologists on the other hand start from the perspective of large landscape units defined by their physical and floristic characteristics and characterized by patterns of ecosystem processes. Their analyses focus on mapping these units, understanding their processes, and managing the stresses facing these units. Whether one adopts a biocentric or an ecocentric view can lead to different management prescriptions. Al-

though the shift from multiple use to ecosystem-based management is often correctly viewed as a paradigm shift (Kessler 1992; Kimmins 1995), there are significant conceptual differences between the second and third faces that qualify as paradigmatic differences in Kuhn's (1996) definition of scientific paradigms.

Implications for Practice, Research, and Policy

Understanding the different ways people define and use the term *ecosystem management* can help practitioners and policymakers in several ways. The continuum of management styles can be used to help clarify what people mean by ecosystem management and how different groups understand it. Questions can be asked that promote clarification: Which face of ecosystem management comes closest to your view? If your view differs from these conceptualizations, how does it differ and where would you place it along the continuum? What accounts for the differences in your conceptualization? By better understanding the perspectives of different agencies and stakeholder groups, managers are much more likely to be able to develop strategies that deal with these differences. One of the first steps in collaborative decision making is the development of a shared definition of the problem (Gray 1989). The continuum can be a useful starting point in these multi-party deliberations.

It is important for research to continue to distill the multiple meanings of ecosystem management and the reasons different people hold to them. Research is needed that compares individual and group characteristics to the way ecosystem management is understood, and the continuum can be useful as a set of hypotheses that can be tested through survey research. The small amount of literature on public attitudes toward ecosystem management generally focuses on single respondent types or presents respondents with a unitary conceptualization of ecosystem management (Brunson et al. 1996; Tarrant et al. 1997). Jacobson and Marynowski (1997) and G. Brown and Harris (1998) have found significant differences in attitudes toward ecosystem management based on respondent type and socioeconomic characteristics. Reading et al. (1994) link these differences to underlying values. Aldo Leopold (1949) provided one classification of these different values within the conservation community in his classic essay "Land Health and the A-B Cleavage." All these researchers point to the importance of thoroughly understanding the attitudes of people affected by ecosystem management so that management processes are designed and explained appropriately, stakeholders are involved effectively, and correct decisions are made.

The notion of a multi-step, accumulative continuum also is helpful because it suggests that success lies in moving to the right on the continuum, no matter where

you are starting. This notion combats the common tendency of those writing about ecosystem management to use it as a catch-all term for a single set of prescriptions that can be summarized as "everything we should be doing differently." Some writers have presented dichotomies that characterize ecosystem approaches in relation to traditional resource management (e.g., Society of American Foresters 1993; Kennedy & Quigley 1994; Knight & Meffe 1997). Although useful in defining specific images of ecosystem management, often these dichotomies present two extreme ends of a range of real behaviors, in which "everything good" is ecosystem management and "everything bad" is traditional management. These taxonomies can be so caricatured that they become discouraging to practitioners.

It is important for land managers to understand that movement toward the ecosystem management end of the spectrum is good, even if it fails to achieve management of whole ecosystems. For a farmer, the first face of ecosystem management—environmentally sensitive multiple use—might require using fewer long-lived, synthetic pesticides. The second face—an ecosystem approach—suggests adopting sustainable agriculture practices, such as strip intercropping and composting and talking with neighbors and other stakeholders about their practices and problems. The third face—ecoregional management—suggests participation in cross-landscape planning that seeks to restore important ecosystem functions such as hydrological flow and nutrient cycles. All represent at least some progress. It is important to keep pushing behavior at the margins to understand that this evolutionary process of change is never ending.

From a policy perspective, this continuum can be used to map the status of current management regimes in different institutional settings and determine how to motivate changes of behavior. Different institutions are located at different points on this continuum. Some individuals and agencies are carrying out dominant or multiple use, whereas others are actively engaged in ecosystem management practices. It is important to understand where a particular institutional situation resides on the continuum in order to design appropriate policy interventions. Policy instruments, such as regulations, incentives, technical assistance programs, information provision, and training, need to be targeted on the realities of a specific institutional setting. Hence, bioregionalists can talk to farmers or timber managers about the need to adopt an ecocentric land ethic, but unless specific interventions are designed that can be related in some way to these land managers' current paradigm, it is unlikely that much change will come about. In this case, tax relief, demonstration projects, and technical assistance may be effective at shifting behavior rightward on the continuum. This does not mean that policy advocates should not seek more radical change. But even assuming such change could be adopted politically, implementa-

tion must be sensitive to the reality that people are at different starting points. Otherwise, desired changes may simply be met on the ground with blank stares.

The continuum also has significant implications for what we define as an appropriate set of goals for federal resource policy reforms. Although some institutions should be applauded for their movement toward environmentally sensitive multiple use, the state of the art in public resource policy should be seen as the second face of ecosystem management—an ecosystem approach—with experiments underway in ecoregional management. Although some groups understand ecosystem management to be environmentally sensitive multiple use, we should not bless that conceptualization as the appropriate endpoint of ecosystem management. Multiple use is inherently focused on maximizing outputs, even if environmental objectives are considered one set of those outputs. At its heart lies an industrial-era production mindset that is unlikely to lead to adequate protection of ecosystems. In practice, output levels have been prescribed by policymakers, with managers placed in the role of determining how to achieve specified levels (Kessler & Salwasser 1995; Franklin 1997). In a world dominated by short-term and fragmentary decision making by political institutions and markets, where aggregate human interests exceed the capacity of local and global ecosystems and such interests are well organized politically, management systems grounded in production will almost always overproduce in the short term. Environmentally sensitive multiple use is an improvement over current management in many places, but it is only a first step to a more effective resource management paradigm.

It is possible and necessary to make progress with ecosystem-based approaches to resource management, and, at minimum, the principles underlying this second face of ecosystem management should guide public resource management. Elements of an updated public lands policy might include policy statements that highlight the maintenance and restoration of ecosystem structure, composition, and function as goals; allow the listing of endangered ecosystems; restructure agency budgeting to encourage cross-landscape and cross-program interactions; and promote collaborative decision making among stakeholder groups. Further, public policy should promote innovation in the third face of ecosystem management. These efforts might include supporting national and regional GIS networks that seek to define and achieve concurrence on landscape-level units and experimenting with new organizational structures aimed at landscape-scale integration.

Conclusion

We should not fret so much that there are multiple definitions and goals for ecosystem management and that

the term means different things to different people. It is important to understand what different people mean and why, but at this stage of research and practice, heterogeneity is good (Yaffee 1996; Brunner & Clark 1997). If a diversity of biotic components is desirable as a source of resiliency, so is a diversity of ideas tested through experimentation and evaluation. Haeuber (1996) makes an interesting argument that premature policy definition at the federal level would have been the kiss of death to ecosystem approaches. That is, if one conceptualization of ecosystem management had been codified into law, it would have ultimately failed and derailed the real need to adopt elements of an ecosystem approach into management practice.

We need to acknowledge that what is being asked of ecosystem management is difficult and that there is more unknown than known about exactly how an ecosystem approach to resource management should be carried out (Haeuber & Franklin 1996). An early consensus on how to achieve ecosystem management is unlikely because there are no easy answers. How do we balance the time required to understand ecosystem complexity with the need to make timely management decisions? How can a desired future state be articulated to guide management when ecosystems are inherently dynamic and provide no absolute guidance as to what that future state should be? How do we define appropriate management boundaries when various problems and processes are organized differently spatially and temporally? How do we deal with the need for collaboration among diverse interest groups yet confront the reality that real value differences separate many of those groups? These and other issues are raised when ecosystem-based approaches to management are attempted, and they are exceedingly difficult to resolve.

The implementation of ecosystem management approaches also faces obstacles of many kinds (Cortner et al. 1996; Yaffee et al. 1996) and carries the burden of earlier management ideals that have not been realized. Overcoming the fears of private landowners and the incentives that face them, mitigating the bureaucratic tendencies of public resource managers, and dealing with the vagaries of public policies that subsidize depletion behavior and penalize conservation behavior are all significant obstacles for the proponents of ecosystem-scale activity. Landscape fragmentation also is reinforced by fragmentation of information, values, legal structures, and responsibilities; integration across bodies of knowledge, interests, space, and time is difficult (Yaffee 1997).

All of this is true, yet past approaches have not succeeded, and we need to move management practice rightward on the continuum. There are reasons to be optimistic. Advances in the scientific base underlying ecosystem management and early successes from on-the-ground practice suggest that real-world landscapes can benefit from an ecosystem approach. Although environ-

mental systems are dynamic, they show patterns of natural variability that can be used to predict spatial and temporal change and to craft management direction (e.g., Zak & Pregitzer 1990; Swanson et al. 1994). Developments in geographic information systems allow managers to better understand landscape-scale dynamics (Sessions et al. 1997). An array of efforts to map ecoregions and landscape ecosystems (Albert 1993; Omernik 1995; Luoma 1997; Ricketts et al. 1997; The Nature Conservancy 1997) has narrowed the debate about boundaries, and landscape ecosystems are being used as management units (Barnes 1993). Similarly, social scientists have developed an enhanced understanding of the dynamics of collaborative learning and problem-solving processes (Gray 1989; Wondolleck & Yaffee 1994; Selin & Chavez 1995; Daniels & Walker 1996) that is being used in cross-boundary management (Selin et al. 1997; Yaffee 1998).

In addition, many current innovations in resource management policy represent conscious moves toward the ideals underlying an ecosystem approach. These include efforts to reform state natural resource departments in Michigan and Florida and coordinated ecoregional planning efforts in California and Missouri (Press 1995; Brown & Marshall 1996). They also include the proliferation of regional-scale, multi-species, habitat conservation planning efforts (Aengst et al. 1997) and the development of ecoregion-scale, federally coordinated planning initiatives such as the Southern Appalachian Assessment (Southern Appalachian Man and the Biosphere 1996).

Ultimately, progress in defining ecosystem management will be achieved through meta-level adaptive management (Sampson 1993; Brunner & Clark 1997): experimenting with and evaluating alternative approaches and researching underlying questions and applying the results to practice, so that we learn and alter our ecosystem management conceptualizations appropriately. To achieve this, we need more effective networks of practitioners and researchers sharing their knowledge and experience, less dogma from different disciplines and stakeholder groups, and a greater willingness to articulate, share, and debate the different meanings they ascribe to ecosystem management. The term itself is not sacrosanct, but the direction it implies is. We need to move management toward more sustainable and ecologically sensitive approaches, and that will come from shifting management practice across the multiple faces of ecosystem management.

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