# Ecosystem Management and the Arrogance of Humanism

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**Abstract:** *The ecosystem management paradigm has gained wide acceptance among land resource managers. The definition of ecosystem management remains fuzzy, however, and two fundamentally different views of ecosystem management prevail. The first view is biocentric and considers human use of resources to be constrained by the primary goal of maintaining ecological integrity. The second view is anthropocentric and retains the importance of human use of resources, but it includes ecological and social considerations. In the 1981 book* The Arrogance of Humanism, *David Ehrenfeld examines the central tenets and assumptions of humanism. He provides several examples of human activities in which humanist assumptions are manifest and applies end-product analysis to these to demonstrate the arrogance and failure of humanist assumptions. In this essay, the anthropocentric view of ecosystem management (hereafter just ecosystem management) is discussed in the context of* The Arrogance of Humanism, *and it is shown that ecosystem management is ultimately humanistic. The underlying assumptions of ecosystem management are also discussed and are examined using end-product analysis. This analysis suggests that the belief in our ability to meet the assumptions of ecosystem management is unwarranted and that ecosystem management is yet another example of the arrogance of humanism. Solution of our land- and resource-management problems must begin with rejection of humanism's doctrine of final causes.*

El Manejo de los Ecosistemas y la Arrogancia del Humanismo

**Resumen:** *El paradigma del manejo de los ecosistemas ha ganado una amplia aceptación entre aquellos dedicados al manejo de la tierra y los recursos. Sin embargo, la definición del manejo de los ecosistemas resulta todavía confusa y prevalecen dos puntos de vista fundamentalmente diferentes sobre el manejo de los ecosistemas. El primer punto de vista, es biocéntrico y considera el uso humano de los recursos constreñido por el objetivo primario de mantener la integridad ecológica. El segundo punto de vista, es antropocéntrico y retiene la importancia del uso humano de los recursos, pero expande el contexto para incluir consideraciones ecológicas y sociales. En el libro publicado en 1981,* La Arrogancia del Humanismo, *David Ehrenfeld examina los principios y supuestos del humanismo. El autor provee varios ejemplos de actividades humanas en las cuales los supuestos humanistas están manifiestos y aplica el análisis de producto-final para demostrar la arrogancia y el fracaso de los supuestos humanistas. El punto de vista antropocéntrico del manejo de los ecosistemas (de ahora en adelante llamado manejo de ecosistemas) es discutido en el contexto de* La Arrogancia del Humanismo *y se demuestra que el manejo de los ecosistemas es en esencia humanístico. En este ensayo se discuten y examinan los supuestos subyacentes del manejo de los ecosistemas utilizando el análisis de producto-final. Este analisis sugiere que existe una falta de garantía en nuestra habilidad para satisfacer los supuestos del manejo de los ecosistemas y que el manejo de los ecosistemas, es en sí mismo un ejemplo de arrogancia del humanismo. La solución para los problemas de manejo de nuestra tierra y recursos tiene que comenzar por el rechazo de la doctrina humanista de las causas finales.*

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## Introduction

Ecosystem management is an emerging paradigm in land and resource management and is rapidly becoming accepted as the "way we should do business." Recently the Council on Environmental Quality described how ecosystem management can be used in the process of the National Environmental Policy Act (NEPA) to protect biodiversity (Council on Environmental Quality 1993), and the U.S. Secretary of the Interior has embraced the concept of ecosystem management for Interior agencies. The U.S. Forest Service, the Bureau of Land Management, and the U.S. Fish and Wildlife Service have developed definitions of ecosystem management and are attempting to implement ecosystem management on lands they administer. In the last year alone there have been at least four conferences or symposia devoted exclusively to ecosystem management (Sustainable Ecological Systems: Implementing an Ecological Approach to Land Management, Flagstaff, Arizona; Ecosystem Management: Beyond the Rhetoric, Fort Collins, Colorado; Ecosystem Management: Applications for Sustainable Forest and Wildlife Resources, Stevens Point, Wisconsin; Ecosystem Management Strategies for the Lake Superior Region, Duluth, Minnesota), and others are planned (for example, SIT 94 Stand Inventory Technologies for Forest Ecosystem Management, Portland, Oregon). Professional societies, such as the Ecological Society of America and The Wildlife Society, have formed committees and working groups to address ecosystem management issues. Several attempts to implement ecosystem management have been described (see Clark et al. 1991; Nicol & de la Mare 1993; Slocombe 1993).

Despite the widespread interest in ecosystem management, a rigorous and widely accepted definition of it has been elusive, and much disagreement remains over what it encompasses. One view of ecosystem management entails a fundamental reframing of how humans value nature (Grumbine 1994) and represents a shift from anthropocentric values towards biocentric values. This view of ecosystem management is characterized in the writings of Grumbine (1992, 1994), Keiter and Boyce (1991), and Noss and Cooperrider (1994). In a synthetic review of the ecosystem management literature, Grumbine (1994) identified 10 dominant themes of this biocentric view of ecosystem management and proposed the following working definition: Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and value framework toward the general goal of protecting native ecosystem integrity over the long term. Interestingly, this definition makes no mention of human use of resources or sustainability. Rather, human use is considered a goal, perhaps achievable or perhaps not, which is constrained by the overall goal of protecting ecological integrity.

In the federal land management agencies, where most of the opportunity for implementing ecosystem management lies, a very different view of ecosystem management prevails. This view is anthropocentric and retains the importance of actively managing the system to achieve multiple use and sustainability, but it includes ecological and social considerations (Kessler et al. 1992; Grumbine 1994). This view of ecosystem management is exemplified in the writings of Agee and Johnson (1988), Kessler et al. (1992), Wood (1994), and by the definitions of ecosystem management adopted by federal agencies. For instance, former U.S. Forest Service Chief F. Dale Robertson defined ecosystem management as "the use of an ecological approach to achieve multiple-use management of the national forests and grasslands by blending the needs of people and environmental values in such a way that the national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems" (Robertson 1992). The Bureau of Land Management defined ecosystem management as "an approach to sustain the integrity, diversity and productivity of ecological systems while providing resource products, uses, values and services for present needs and for future generations" (Bureau of Land Management 1993). Mollie Beattie, Director of the U.S. Fish and Wildlife Service, has said the service's ecosystem approach "represents a new way of managing natural resources that takes into account the entire ecosystem and balances recreational use, economic development, and conservation of wildlife so that each is sustainable" (U.S. Fish and Wildlife Service 1994). An important aspect of this anthropocentric view of ecosystem management is the implicit belief that we can continue to manipulate and manage ecosystems to satisfy human needs and desires while protecting ecosystem integrity. In contrast to the biocentric view of ecosystem management, in the anthropocentric view protecting ecosystem integrity does not take priority over human use. Clearly, the philosophical underpinnings of this view of ecosystem management differ from that described by Grumbine (1992, 1994) and others (Keiter & Boyce 1991; Noss & Cooperrider 1994).

In his book *The Arrogance of Humanism* (Ehrenfeld 1981), David Ehrenfeld examines humanism, which he calls "the religion of humanity." While acknowledging the potential for humanism to be a philosophic guide to nondestructive human behavior, Ehrenfeld exposes the destructive ideas fostered by humanism's most fundamental assumptions.

Ehrenfeld describes the core of humanism as "a supreme faith in human reason—its ability to confront and solve the many problems that humans face, its ability to rearrange both the world of nature and the affairs of men and women so that human life will prosper." Central to this view of humanism is the belief that humans have the right and the ability to control nature for the benefit of humanity. Ehrenfeld lists the following as fundamental assumptions of humanism: all problems are soluble by humans; many problems are soluble by technology; problems not soluble by technology alone have solutions in the social world (of politics, economics, etc.); and humans will apply themselves and work together for a solution before it is too late. Throughout the book, Ehrenfeld develops as one of his main theses the idea that "... we must come to terms with our irrational faith in our own limitless power, and with the reality that is the widespread failure ... of our inventions and processes, especially those that aspire to environmental control."

I examine the question of whether the anthropocentric view of ecosystem management (hereafter ecosystem management) is yet another manifestation of humanism, and whether there is a certain arrogance in the belief that we can manage ecosystems in this manner.

## The Humanism in Ecosystem Management

Ecosystem management is an intriguing and appealing paradigm that promises much. But how carefully have we scrutinized and questioned the foundation upon which it rests? For example, why do we judge ecosystem management to be an acceptable approach to land management? Likewise, what assumptions must be met to implement ecosystem management, and is it realistic to think they can be met? These questions are too often ignored in discussions of ecosystem management. It's as if the promise that ecosystem management holds for solving our land-management problems prevents us from questioning whether it should or can be done.

One possible explanation for the acceptance of ecosystem management as an approach to land management is that it is fundamentally humanistic. In *Merriam-Webster's Collegiate Dictionary* (1993), humanism is defined as "a doctrine, attitude, or way of life centered on human interests or values." In the U.S. Forest Service and Bureau of Land Management definitions of ecosystem management, we see that multiple-use, resource products, uses, values, and services, and the needs of people in the present and future are important components. By these definitions, ecosystem management is obviously humanistic because it is centered on human interests.

Ehrenfeld (1981), however, goes beyond the dictionary definition of humanism and examines it at a deeper level. He maintains that one of the central tenets of humanism is embodied in the "doctrine of final causes." In essence, this doctrine asserts that the features and objects of the natural world were created primarily for the benefit of humanity, and that it is the responsibility of humanity to acknowledge this gift and accept stewardship of the natural world (Ehrenfeld 1981). Ehrenfeld claims that adherence to the doctrine of final causes fosters the humanist belief that nature is ours to control.

Is ecosystem management humanistic at the deeper level with which Ehrenfeld is concerned? I believe it is and that at its foundation lies the doctrine of final causes. The paradigm of ecosystem management takes as a given our right to use nature for the benefit of humanity and never questions this outside a humanist context. It takes as a given that we will be stewards of the land because we can be, and because it is the only way to ensure our multiple demands for resources, stable local economies, recreation, biodiversity, ecosystem health, and so forth, are met. Finally, it takes as a given our right to control nature and justifies this with the claim that effective stewardship mandates control.

## The Assumptions of Ecosystem Management

*Merriam-Webster's Collegiate Dictionary* (1993) defines arrogance as "a feeling or impression of superiority manifested in ... presumptuous claims." What are the claims of ecosystem management, and are they presumptuous? To answer this we must look beyond claims that focus on how to implement ecosystem management or the benefits that will accrue from an ecosystem management approach; we must concentrate on the assumptions of ecosystem management and whether they can be met. Curiously, the vast majority of papers on ecosystem management published so far have avoided discussion of ecosystem management's assumptions. In fact, in only one paper were the assumptions explicitly stated (Cairns 1990). Ecosystem management is considered "a fundamental change in the way the agencies view and manage federal lands" (Wood 1994), and much effort is being expended to implement it. Examination of its assumptions and whether they can be met should certainly be a first step in this process.

According to Cairns (1990), three assumptions of ecosystem management are (1) that science can determine how ecosystems function; (2) that once function is known, the social/political system will be able to protect ecosystems to the extent needed for the survival of human society; and (3) that reality will take precedence over political expediency because Mother Nature cannot be fooled. I add a fourth assumption, that humans possess or can develop the technology needed to manage ecosystems.

A striking feature of these ecosystem management assumptions is the resemblance they bear to the humanist assumptions listed by Ehrenfeld (Table 1). For example, a corollary to Ehrenfeld's first assumption is that "with

**Table 1. A comparison of Ehrenfeld's (1981) humanist assumptions and the assumptions underlying ecosystem management.**

| *Humanist Assmptions* | *Ecosystem Management Assumptions** |
|---|---|
| (1) All problems are soluble by humans. | (1) Science can determine how ecosystems function. |
| (2) Many problems are soluble by technology. | (2) Humans possess or can develop the technology needed to manage ecosystems. |
| (3) Problems not soluble by technology alone have solutions in the social world (of politics, economics, etc.). | (3) The social/political system will be able to protect ecosystems. |
| (4) Humans will apply themselves and work together for a solution before it is too late. | (4) Reality will take precedence over political expediency because Mother Nature cannot be fooled. |

**Assumptions 1, 3, and 4 are from Cairns (1990).*

sufficient knowledge all problems are soluble by humans." Because science is the primary means by which humans acquire knowledge about ecosystems, the connection between the first humanist and the first ecosystem management assumption is obvious. The second and third humanist assumptions, that problems are soluble by technology or have solutions in the social world, clearly embody the second and third ecosystem management assumptions. Finally, the fourth humanist assumption, that we will apply ourselves and work together for a solution before it is too late, could be restated in a narrower context as follows: "When nature slaps us on the wrists, we will put aside our petty political differences and mobilize the resources needed to solve environmental problems." Restated in this manner, it is equivalent to the fourth ecosystem management assumption.

Ehrenfeld (1981) gave numerous examples of human activities and beliefs that have sprung from humanist assumptions. He then applied end-product analysis to these to examine whether or not the underlying humanist assumptions were justified. End-product analysis, as described by Ehrenfeld, is a process in which we "ignore claims and counter-claims concerning methods, intermediate goals, and theoretical objectives, and look exclusively at the final results of a technology or a set of humanistic beliefs." In other words, end-product analysis does not concern itself with claims, it concerns itself with end results. In all of the activities Ehrenfeld examined, end-product analysis demonstrated the widespread failure of humans to achieve stated goals and exposed the arrogance in our assumptions that science, technology, and social mechanisms can solve our problems, especially those related to environmental control. Given the similarity between humanist assumptions and the assumptions of ecosystem management, and the fact that Ehrenfeld's end-product analysis shows humanist assumptions to be false, it would be worthwhile examining ecosystem management's assumptions using end-product analysis.

A convenient place to start is with the first ecosystem management assumption (Table 1). Using end-product analysis, several questions can be framed. First, has science ever determined how an ecosystem functions? The answer to this question, even provided by an optimist, would have to be no. There have been and probably always will be limits to the resources and effort we can put into the study of one ecosystem. Thus, there will always be ecosystem functions that remain unstudied or unknown. More important, however, is simply that there are limits to what we can know. In *The Arrogance of Humanism* (1981), Ehrenfeld quotes Eric Kraus (a meteorologist):

> First, we can never know the present completely; second, we are not able to make errorless deductions from what we know; and third, our limited imaginations may prevent us from asking the right questions. Depending on the complexity of the system with which we are concerned, we always arrive—sooner or later—at a cut-off point beyond which reliance on scientific analysis becomes superstition because it can tell us no more than intuition or reliance on chance.

Kraus's statement is especially pertinent to ecosystems, which are open, highly dimensional, and nonlinear in many of their interactions.

It could be argued that, while science cannot "completely" determine how ecosystems function, it can determine the salient features of ecosystem function, and that this is adequate for purposes of ecosystem management. Superficially this is a reasonable claim, but are there end results to support this claim? Mono Lake, in eastern California, is a relatively simple and well-studied ecosystem. Yet, despite this simplicity, two independent panels of experts were unable to project environmental changes in the system due to water diversion (Wiens et al. 1993). Attempts to achieve sustainable use of resources, despite a foundation upon scientific information, have a history of failure (Hilborn & Ludwig 1993; Ludwig 1993; Ludwig et al. 1993), and the very concept of sustained yield may be illusory (Wood 1994). Yet a vision of scientific ecosystem management persists (Grumbine 1992) in which the goals of multiple use, sustainability, and ecosystem integrity are all met. This is simply not realistic. We cannot know the importance of ecosystem functions that remain undiscovered or are not understood. In the words of Holmes Rolston, III, "... managers cannot know what they are doing until they know what they are undoing" (Rolston 1994).

A second question for end-product analysis is "whether science has been able to generate reliable knowledge (see Romesburg 1981) about specific ecosystem functions." In studying ecosystem functions (such as carbon mineralization), we are hampered by the fact that we cannot directly observe the associated processes (the biochemical reactions leading to carbon mineralization); only the patterns that emerge can be observed. Thus, to acquire reliable knowledge about processes, it is often necessary to perform crucial experiments (see Platt 1964) under laboratory conditions, where tight controls can reduce the high variability inherent to ecosystems and eliminate confounding variables. In the words of Ehrenfeld, this is ". . . arbitrarily restricting the context of a problem in order to make it easier to solve." When we restrict the context of a problem in this manner we generate knowledge about processes, but how much knowledge have we really generated about ecosystem function? How valid will our laboratory results be when they are applied to a real ecosystem where processes interact and variability exists? Peters (1991) states that "laboratory experiments may be irrelevant to nature because they present an unnatural constellation of environmental conditions which constrains the organism to unnatural, irrelevant responses." It has even been suggested that an overemphasis on laboratory experiments can forestall development of ecological understanding (Redfield 1960). The point is that even though laboratory experiments can have high internal validity, their external validity is usually low. Thus, we may generate reliable knowledge about a process associated with ecosystem function, but we cannot be certain how much knowledge we have generated about ecosystem function.

One alternative to laboratory experimentation is field experimentation. Field experiments have greater external validity than laboratory experiments, but this gain is usually at the expense of internal validity. Internal validity can be maintained to some degree by randomization and replication of experimental units, but this is often difficult to achieve at the ecosystem level. Cost, logistical constraints, and the lack of suitable replicates make ecosystem-level experiments prohibitive. Furthermore, as Peters (1991) points out, the number of factors and variables in field experiments is large relative to the number of degrees of freedom attainable through replication. Thus, there is an increased risk that the manipulation will be confounded with some correlate. The difficulty in performing ecosystem-level experiments has largely precluded their use and, therefore, such experiments have played only a minor role in the acquisition of reliable knowledge of ecosystem function.

A third question for end-product analysis is whether "science has discovered laws or principles of ecosystem function that allow us to predict the effects of disturbance (in the broadest sense) on ecosystem function." The subject of prediction in ecology, or the lack thereof, has been the topic of much discussion (see Caswell 1976; Loehle 1983; Wroblewski 1983; Peters 1991). There is general agreement that ecology is not a predictive science and that our ability to predict is poor (Peters 1991). This is in part due to the extreme complexity of natural systems, but it is also due to our inability to verify and validate predictive models (Oreskes et al. 1994). The poor predictive power of ecology, as exemplified by the Mono Lake study (Wiens et al. 1993), sends a clear message that we do not know how ecosystems function.

End-product analysis of the assumption that science can determine how ecosystems function indicates that the assumption is unwarranted. While science can and no doubt will be a useful tool for ecosystem managers, it is a tool with limitations that must be recognized. In managing ecosystems, there will always remain an element of uncertainty that science cannot resolve and that, if not factored into management decisions, will result in destructive management practices and the proliferation of "normal accidents" (Ehrenfeld 1991). The fact that science cannot provide all the answers should be cause for concern among politicians and federal land managers charged with implementing ecosystem management. For without reliable knowledge of ecosystem function and the ability to predict the effects of disturbances, claims that we can manage for healthy, productive, and diverse ecosystems while simultaneously meeting current and future human resource needs begin to look presumptuous and mythical.

The second ecosystem management assumption, that humans possess or can develop the technology needed to manage ecosystems (Table 1), leads to two questions for end-product analysis: Have technological "fixes" been a reliable means of solving environmental problems, and have technologies developed to control nature been effective?

Meffe (1992) addresses the first question in an end-product analysis of the restoration of Pacific salmonid fisheries. He discusses why, despite hundreds of hatcheries producing millions of eggs, this technological "fix" has been and will remain unsuccessful. He contends that "humankind has adopted an arrogant and ultimately self-defeating attitude toward nature that places technological mastery over nature at the forefront of our approach to many environmental problems" and that the attempt to recover Pacific salmonid fisheries through the use of hatcheries is an overt example of this "techno-arrogance." Meffe calls for us to abandon such technological fixes, which address only the symptoms of the problem, and to focus on the causes of the problem. In the context of end-product analysis, Meffe's paper provides a striking example of the failure of technology to solve an environmental problem and should be regarded as a warning that technology is an unreliable safety net.

With respect to the second question, whether we have demonstrated control of nature through technology, it is tempting to point to our huge flood control and channelization projects and claim these as successes. But these are no more than illusions of success. Many of the nation's dams are filling through siltation and losing their capacity to store flood waters. Downstream flow regimes have been altered so drastically that often whole fish communities have been lost and riparian vegetation has not regenerated. In the Everglades, channelization has severely altered groundwater recharge and has affected the entire ecosystem. In 1993, channelization contributed to the worst flooding in years along the Mississippi River. Technologies that only temporarily control nature, and meanwhile create a number of undesirable secondary effects, cannot justifiably be called successes.

The use of technology to control pests is another area where it is tempting to claim success, but this too has proved an illusion. Millions of dollars are spent annually on the production and application of pesticides to control insect pests. Although this often leads to temporary control, resistant strains and new pests continually appear, requiring the development of even more-deadly pesticides that often affect nontarget species.

In the face of such failures and the propagation of secondary effects, it appears that our claim that we can control nature through technology is not justified. Despite huge efforts and state-of-the-art science, technology can offer only partial solutions to our management problems and often generates secondary problems. Ehrenfeld calls these technological fixes quasi-solutions, and the secondary problems resulting from their application residual problems. With respect to quasi-solutions, Ehrenfeld quotes Schwartz (1971) from the book *Overskill*:

> The dialectical process whereby a solution to one problem generates sets of new problems that eventually preclude solutions is summarized in the five steps of techno-social development.
>
> 1. Because of the interrelationships and limitations existing within a closed system, a techno-social solution is never complete and hence is a quasi-solution.
> 2. Each quasi-solution generates a residue of new techno-social problems arising from: (a) incompleteness, (b) augmentation, and (c) secondary effects.
> 3. The new problems proliferate at a faster rate than solutions can be found to meet them.
> 4. Each successive set of residue problems is more difficult to solve than predecessor problems because of seven factors: (a) dynamics of technology, (b) increased complexity, (c) increased cost, (d) decreased resources, (e) growth and expansion, (f) requirements for greater control, and (g) inertia of social institutions.
> 5. The residue of unsolved techno-social problems converge in an advanced technological society to a point where techno-social solutions are no longer possible.

These steps, which ultimately lead to problems technology cannot solve, are as applicable in an environmental context as in any other context. In implementing ecosystem management we need to recognize the limits of technology and the trap to which it leads, and we should not be so arrogant as to believe that we will not be caught in that trap.

For the third and fourth ecosystem assumptions (Table 1), an appropriate end-product analysis question is "whether social/political systems have been a reliable means of protecting ecosystems, or has political expediency usually taken precedence." Enlightening reading with respect to this question is a recent paper on the sustainable use of resources by Ludwig et al. (1993) and the rejoinder by Rosenberg et al. (1993). Ludwig et al. (1993) argue that contemporary plans for sustainable use, which is one of the primary goals of ecosystem management, "ignore the history of resource exploitation, that resources are inevitably overexploited often to the point of collapse or extinction." One of the reasons they give for this situation is that "Wealth or the prospect of wealth generates political and social power that is used to promote unlimited exploitation of resources." They cite instances in which this has occurred and describe how government subsidies often promote overharvesting. Rosenberg et al. (1993) attempt to challenge the claims of Ludwig et al. (1993) with examples from fisheries management. Despite their assertion that positive examples of sustainable resource use exist, they admit that overexploitation frequently occurs and that "when confronted with uncertainty, fishery managers have been under enormous pressure to allow continued harvest levels and scientific advice has been discounted."

From Ludwig et al. (1993) and Rosenberg et al. (1993) it is apparent that social and political mechanisms have failed to protect ecosystems. Societal demands for resources and the reluctance of managers to use scientific information in the face of political pressure result in failure of these methods. Given such a history, and the inability of governments to enforce laws and implement conservation policies (Soulé 1991), we must ask ourselves why we should expect anything different with ecosystem management. As human populations continue to grow, societal demand and political pressure to extract and harvest resources will only increase. It is going to get harder, not easier, to protect ecosystems. In implementing ecosystem management, we cannot assume that social and political mechanisms will be able to protect ecosystems, for end-product analysis shows such claims to be false.

## Conclusions

Can ecosystem management really do what we claim? The introspection this question provokes and the end-product analysis begun in this paper should bring realization that the assumptions underlying ecosystem management are presumptuous and false. Ecosystem management cannot deliver what it has promised, and to deny this is to set a destructive course destined to fail. Ehrenfeld recognized this when he said that "people are spending too much valuable time and causing too much damage by pretending that our efforts in politics, economics, and technology usually have the effects we intend them to have."

As currently espoused, ecosystem management is a magical theory (see Ludwig 1993) that promises the impossible—that we can have our cake and eat it too. Worse, however, it addresses only the symptoms of the problem and not the problem itself. The problem is not how to maintain current levels of resource output while also maintaining ecosystem integrity; the problem is how to control population growth and constrain resource consumption. And the solution to the problem is not anthropocentric-based ecosystem management, it is rejection of the doctrine of final causes. Humanity must begin to view itself as part of nature rather than the master of nature. It must reject the belief that nature is ours to use and control. Once this is accomplished, we can accept that the land has limits, and that to live within those limits we must halt population growth and reduce consumption. I believe this rejection of the doctrine of final causes is at the very heart of the biocentric view of ecosystem management (see Noss & Cooperrider 1994). Unfortunately, the "seismic shift" in the mindset of humans (Grumbine 1994) required by this view of ecosystem management may never occur and, if it does, it will be a slow process that may come too late.

In the meantime, the symptoms of the problem must be dealt with. Without intervention or active management, ecosystems will continue to degrade in the face of an ever increasing demand for resources. A number of authors have suggested land management approaches to deal with this predicament. For example, Ehrenfeld (1991) suggested that we manage land in a way that promotes "loose coupling." For large blocks of land, this would mean little or no active management, because more manipulation increases the risk of accidents (such as species loss). For fragmented or small blocks of land, this would mean "according each patch . . . the maximum of independence of its management protocol." In other words, patches would not be managed according to a single-theory, generalized management scheme. Instead, they would be managed in a way that accounts for the uniqueness of each patch (Ehrenfeld 1991). Noss (1992) has proposed a land-management strategy that links core reserves surrounded by buffers into a large network of wilderness areas. Core reserves and inner buffers would be protected, while outer buffers would permit a range of compatible human uses. Ludwig et al. (1993), in the context of sustainability but applicable here, have offered five principles of effective management that lead to a more cautious approach to resource exploitation. Perhaps the most important principle they suggest is that we "confront uncertainty." They state that "Once we free ourselves from the illusion that science or technology . . . can provide a solution to resource or conservation problems, appropriate action becomes possible." Costanza (1993), Fuentes (1993), and Hilborn and Ludwig (1993) offer useful suggestions for dealing with uncertainty in an ecological context.

In the short term, the above approaches offer some hope of maintaining ecological integrity while still permitting human use. Unfortunately, as has been recognized by others (Ehrenfeld 1991; Soulé 1991; Ludwig 1993; Meffe et al. 1993), such approaches are only temporary measures that in the long term must fail. For, "any gains we make are quickly offset by continued human population expansion and its associated promise of future destruction" (Meffe et al. 1993). Success in the long term will require that we address the problem rather than its symptoms, beginning with a rejection of the doctrine of final causes.

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