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Changing Nature: The Myth of the Inevitability of Ecosystem Management

BRUCE PARDY*

"Nature in the twenty-first century will be a nature that we make."

Daniel Botkin, *Discordant Harmonies*[1]

I. Introduction

Should nature be preserved? In the modern era of ecosystem management, the legitimacy of this question is in doubt. The mandate of ecosystem management is to measure, control and change ecosystems to produce the most desirable environment in human terms. Sometimes this means preserving particular ecosystems, but more often it does not. Ecosystem management is a utilitarian approach in which human ends define what kind of "nature" managers will choose to make.

Ecosystem management has risen to prominence in environmental law and policy within the past decade,[2] and the *modus*

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1. DANIEL BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST CENTURY 193 (1990).

2. J.B. Ruhl, *Ecosystem Management, the ESA, and the Seven Degrees of Relevance*, 14 NAT. RES. & ENV'T 156, 157 (2000); Rebecca W. Thomson, *Ecosystem Management: Great Idea, But What Is It, Will It Work and Who Will Pay*, 9 NAT. RES. & ENV'T 42 (1995); Robert B. Keiter, *Beyond the Boundary Line: Constructing a Law of Ecosystem Management*, 65 U. COLO. L. REV. 293 (1994); Stephen Owen, *Participation and Sustainability: The Imperatives of Resource and Environmental Management, in* LAW AND PROCESS IN ENVIRONMENTAL MANAGEMENT: ESSAYS FROM THE SIXTH CIRL CONFERENCE ON NATURAL RESOURCES LAW (Steven Kennett ed., 1993); Neil Gunningham & Darren Sinclair, *New Generation Environmental Policy: Environmental Management Systems and Regulatory Reform,* 22 MELB. U. L. REV. 592 (1998). Approval of the managerial approach has been broad, but not unanimous. Ten years ago Wolfgang Sachs said of the environmental movement, "what once had begun as a call for new public virtues is now about to be turned into a call for a new set of managerial strategies." *Quoted in* DAVID CAYLEY, THE AGE OF ECOLOGY 1 (Toronto: Canadian Broad. Corp. Transcript, 1990). Cayley himself notes, "Having thought myself for

operandus of most modern environmental regulatory regimes is some form of environmental management, either explicitly[3] or in practice. The debate between environmental utilitarianism and ecological preservation is not seriously entertained in current policy development. Yet there are many reasons to desire a natural state in ecosystems. Some reasons are philosophical: "deep ecologists", for example, contend that a state of nature is inherently more valuable than one designed by humans.[4] Some are pragmatic: there are risks that ecosystems changed by human action will not function as well as systems in a natural state. To the managers, such reasons are irrelevant. They say humans should change ecosystems because nothing else is possible - preserving a state of nature cannot be done. Human change to ecosystems is now inevitable, they say, and the only choices available are whether ecosystems are changed deliberately, producing the most desirable result in social, cultural, economic and environmental terms; or inadvertently, producing an environmental disaster. In his book *Discordant Harmonies*, Daniel Botkin states this case:

> Having altered nature with our technology, we must depend on technology to see us through to solutions. The task before us is to understand the biological world to the point that we can learn how to live within the discordant harmonies of our biological surroundings, so that they function not only to promote the continuation of life but also to benefit ourselves: our aesthetics, morality, philosophies, and material needs. . . . Nature in the twenty-first century will be a nature that we make; the question

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twenty years an environmentalist, I now found myself on the sidelines, muttering, like Eliot's J. Alfred Prufrock, 'That's not what I meant at all. That's not it at all.'" *Id.* For an example of the unresolved tension between environmental conservation and the mandates of environmental management, see Deborah Curran & Michael M'Gonigle, *Aboriginal Forestry: Community Management as Opportunity and Imperative*, 37 OSGOODE HALL L.J. 711 (1999).

3. For example, the purpose of the Manitoba Environment Act is "to develop and maintain an environmental management system. . .which will ensure that the environment is maintained in such a manner as to sustain a high quality of life, including social and economic development, recreation and leisure for this and future generations. . . ." Manitoba Environment Act, R.S.M. 1987-88 ch. 26, §1(1) (2003).

4. "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong otherwise." Aldo Leopold, *The Land Ethic, in* A SAND COUNTY ALMANAC, WITH ESSAYS ON CONSERVATION FROM ROUND RIVER 262 (photo. reprint 1970) (1949); *see* Arne Naess, *Deep Ecology and Ultimate Premises*, 18 ECOLOGIST 128, 130 (1988) (describing an eight-point platform for deep ecology). For an alternative view, see Keiter, who suggests that Leopold's land ethic is the "direct precursor of the contemporary concept of ecosystem management; it expresses a science-driven moral judgment about the appropriate relationship between humans and the natural environment." Keiter, *supra* note 2, at 297-98.

is the degree to which this molding will be intentional or unintentional, desirable or undesirable.[5]

If Botkin is correct, if now there is no choice but to make nature in our own image, then we must make it as well as we can. But if he is not correct, if human change to ecosystems is not inevitable, then there still are important decisions to be made. Should nature be managed, or should it be protected and left alone? In this article, I argue that the question can be asked: that it is possible for environmental law to have as its objective to maximize the "naturalness" of ecosystems, whether by preserving the present state that systems are in, or by restoring them to a former state. The meaning of "nature" will be considered in Part II below.[6]

The target of this analysis is the objective of change, not the means of achieving it. It does not question the use of rules or other legal instruments to achieve an environmental objective.[7] In this article, "management" is used to refer to the objective of changing ecosystems to suit human preferences, not to the utilization of laws in the environmental sphere. The issue is one of ends, not of means: are there any other feasible objectives for environmental law?[8] The argument presented here is not, except parenthetically, that natural is *preferable*. The purpose of this ar-

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5. BOTKIN, *supra* note 1, at 191, 193; *see also* S. LEVIN, FRAGILE DOMINION: COMPLEXITY AND THE COMMONS 15 (1999).

> The biosphere is a complex adaptive system whose essential structure has emerged in large part from adaptive changes that were mediated at local levels rather than at the level of the whole system. Humanity's program must therefore be to understand those changes, the forces that have shaped them, and their consequences at the larger level, and then to put that knowledge to work in determining where the pressure points are for effecting changes that will preserve critical ecosystem services.

Id.

6. See discussion *infra* Argument 1.

7. I do have concerns about the way in which environmental decisions are made, but that is a different issue. *See* Bruce Pardy, *Abstraction, Precedent, and Articulate Consistency: Making Environmental Decisions*, 34 CAL. W. L. REV. 427 (1998).

8. For the alternate view that ecological preservation and environmental utilitarianism coalesce into ecosystem management, see Keiter, *supra* note 2, at 296-97, stating:

> Utilitarianism, by definition, calls for using natural resources to maximize human benefits; it has evolved into the multiple-use management standard, which is primarily concerned with producing specific resources for human consumption. Preservationism, on the other hand, originally sought to preserve static landscapes and scenery from despoliation; it has evolved into the current system of national parks and wilderness preserves. . . . Both philosophies, however, are now converging around the notion of ecological management.

ticle is not to engage in the debate between ecological preservation and environmental utilitarianism, but to argue that that debate can and should occur. If science and law dictate that there are no other options but to deliberately change ecosystems, as the managers would have us believe, then the debate has no relevance. Thus, my case is not that ecological preservation is a better choice than environmental management, but that there is a choice to make.

The target of my criticism is not the *ecosystem* part of ecosystem management, but the *management* part. Under an ecosystem approach, decisions are made by measuring effects on systems rather than on their constituent parts in isolation from each other. Environmental law regimes are less effective when they apply only to particular elements such as air, water, soil or pesticides, or when their application is limited by jurisdictional boundaries. Many of the regulatory regimes in Canada, the United States, and elsewhere have these characteristics, which split up ecosystems into arbitrary pieces. The "ecosystem approach" aspired to in ecosystem management is environmentally superior to either. Ecosystems are indeed the appropriate units. The question is whether they must be managed and changed.

Environmental managers may object to the characterization of ecosystem management as antithetical to environmental protection because their objective is to protect ecosystems as well as possible within the realities of modern civilization. Ecosystem management is commonly promoted as good environmental stewardship. Whether this is so depends on what it is being compared to. Ecosystem management is undoubtedly a better choice than ecosystem *mis*management. It is preferable to manage and change ecosystems "for the better" than to disregard environmental impact and allow systems to deteriorate catastrophically.[9] But

9. Ruhl, *supra* note 2, at 157, states:

> The power of the ecosystem management idea, like ideas such as sustainable development and environmental justice, is that it offers only a binary policy choice and one of those choices is clearly incorrect. These normative expressions leave very little "yes, but" room. The term itself shapes the debate, so that it becomes a question of how much more ecosystem management (or sustainable development, or environmental justice) to have, not whether there should be any, or whether there is some alternative. . .no politically aware person wishing to rein in the spread and implementation of ecosystem management will do so by openly opposing the idea of ecosystem management, for that would be tantamount to proposing ecosystem *mis*management.

that is not the dichotomy in question here. Instead, the competing options are ecosystem management and ecosystem preservation.

II. NONEQUILIBRIUM AND THE ABSENCE OF PRISTINE SYSTEMS

The proposition seems compelling: in the twenty-first century, it is not possible to preserve ecosystems in a natural state. Human change to ecosystems is inevitable because (a) there are no pristine systems left; and (b) even in their natural state, ecosystems exist in nonequilibrium. The conclusion is wrong, but these two discoveries are not.

(a) No Pristine Ecosystems

There may be no ecosystem on the planet that remains completely unaffected by the human hand. Botkin states, "Since there is no longer any part of the Earth that is untouched by our actions in some way, either directly or indirectly, there are no wildernesses in the sense of places completely unaffected by people."[10] For some ecosystems, the degree of this change is monumental – consider the system that once existed where Manhattan now stands. Others, even those that appear to be physically unaltered such as those in remote and unpopulated regions, protected reserves, or the oceans, are affected in other ways. Climate change,[11] ozone layer depletion, migration of toxic substances, destruction of habitat, wildlife extinction, and transplantation of foreign species are six examples of an extensive list of effects documented in ecosystems around the globe, including those that appear to consist of wilderness. Indeed, in some cases, remote areas have experienced more pronounced effects than in industrialized or heavily settled regions. The deterioration in the Earth's ozone layer is most pronounced over the Antarctic.[12] Persistent organic pollutants have been found to collect most rapidly in the

10. BOTKIN, *supra* note 1, at 194.

11. The greenhouse effect is a more apt name than those who coined it imagined. The carbon dioxide and trace gases act like the panes of glass on a greenhouse – the analogy is accurate. But it is more than that. We have built a greenhouse, a human creation, where once there bloomed a sweet and wild garden.

BILL MCKIBBON, THE END OF NATURE 91 (1989).

12. U.S. ENVIRONMENTAL HEALTH CENTER, NATIONAL SAFETY COUNCIL, OZONE DEPLETION: WHEN LESS IS NOT ENOUGH, *in* REPORTING ON CLIMATE CHANGE: UNDERSTANDING THE SCIENCE 56 (2000).

Arctic.[13] The absence of intensive human settlement in these places does not qualify them as pristine. Moreover, human society continues to grow in size and activity, and the rate of interaction between human beings and the environment continues to accelerate.

(b) Nonequilibrium – Ecosystems Change Even When Not Affected by Humans

It was once thought that ecosystems developed into a state of equilibrium, or steady state.[14] They were believed to evolve from early or primitive states into fully developed or "climax" states, a process called succession. Within such a paradigm, a climax system was thought to exist in a state of equilibrium in which it remained unless disturbed by external forces. Homeostatic mechanisms within the system maintained system elements and relationships. The system was not considered to be static – for example, it was understood that populations of organisms could swing from low to high in accordance with the seasons and the system's other cycles – but its equilibrium levels remained constant over time and the system's pattern did not change. Equilibrium was the source of the "balance of nature" premise:

> Briefly stated, the Balance of Nature myth has three basic features: First, Nature, undisturbed by human influences, achieves a permanency of form and structure that persists indefinitely. Second, this permanent condition is the best condition for Nature: best for other creatures, best for the environment, and best for humans. Third, when disturbed from this natural state, Nature is capable of returning to it.[15]

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13. *See, e.g.*, U.S. ENVIRONMENTAL PROTECTION AGENCY, NEW PROTOCOL ON PERSISTENT ORGANIC POLLUTANTS NEGOTIATED UNDER THE UN ECONOMIC COMMISSION FOR EUROPE'S CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION (1998).

14. MICHAEL ALLABY, BASICS OF ENVIRONMENTAL SCIENCE 154 (1996); D.L. DeAngelis & J.L. Waterhouse, *Equilibrium and Nonequilibrium Concepts in Ecological Models*, 57 ECOLOGICAL MONOGRAPHS 1, 1 (1987); Sir Arthur George Tansley *quoted in* EUGENE P. ODUM, ECOLOGY AND OUR ENDANGERED LIFE-SUPPORT SYSTEMS 38 (1989); *see generally* Eugene P. Odum, *The Strategy of Ecosystem Development*, 164 SCI. 262 (1969).

15. Daniel Botkin, *Adjusting Law to Nature's Discordant Harmonies*, 7 DUKE ENVTL. L. & POL'Y F. 25, 26 (1996).

The balance of nature premise has been described as the ecological justification for what was once the dominant principle in environmental law: let nature be.[16]

Equilibrium theory no longer governs ecological thinking. Instead, ecosystems are thought to exist in a state of non-equilibrium.[17] They do not reach a climax state. Instead, they continue to evolve and change.

> Ecosystems are dynamic, and although some may endure, apparently unchanged, for periods that are long in comparison with the human lifespan, they must and do change eventually. Species come and go, climates change, plant and animal communities adapt to altered circumstances, and when examined in fine detail such adaptation and consequent change can be seen to be taking place constantly. The 'balance of nature' is a myth. Our planet is dynamic, and so are the arrangements by which its inhabitants live together.[18]

Just like there is no "end product" in the process of animal evolution because the most recent species continue to be subject to evolutionary forces, ecosystems continue to change through time even when they are free from human influence.[19] The replacement of equilibrium with nonequilibrium as the governing principle for the behavior of ecosystems is significant because it changes the conception of the ecosystem from stability to fluidity. Ecosys-

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16. A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law,* 27 LOY. L.A. L. REV. 1121, 1122 (1994). This principle was adopted by legislators, regulators, resource managers, and lawyers, and gradually replaced the progressive conservation movement's ethic of multiple use. Tarlock cites DAVIS LEWIS FELDMAN, WATER RESOURCES MANAGEMENT: IN SEARCH OF AN ENVIRONMENTAL ETHIC (1991), as providing a good case study of this evolution.

17. The equilibrium paradigm was flawed from the start, but until recently many scientists and policy makers believed the problem was the lack of necessary data rather than the paradigm itself. The alternative paradigm was neither clearly articulated nor widely accepted until the 1980s. It has, however, with pockets of resistance, been replaced with the more hard-edged probabilistic theories of nonequilibrium.

Tarlock, *supra* note 16, at 1128-29.

18. ALLABY, *supra* note 14, at 154.

19. There is also evidence that ecosystems may be naturally chaotic, which is not the same thing as nonequilibrium. Ecological chaos is "apparently random behaviour in ecosystems that would otherwise be expected to exhibit periodic and regular behaviour." BRUCE PARDY, ENVIRONMENTAL LAW: A GUIDE TO CONCEPTS 81 (1996); *see also* Alan Hastings et al., *Chaos in Ecology: Is Mother Nature a Strange Attractor?,* 24 ANN. REV. ECOLOGY SYS. 1, 4 (1993).

tems are not fixed but dynamic.[20] In other words, ecosystems can be described as "patches or collections of conditions that exist for finite periods of time."[21]

III. CRITIQUING THE ARGUMENTS FOR ECOSYSTEM MANAGEMENT: INTERPRETATIONS OF NONEQUILIBRIUM AND THE ABSENCE OF PRISTINE SYSTEMS

These two discoveries – nonequilibrium and the absence of pristine systems – are not in dispute. What is in question is the proposition that they require a management approach to the environment. The proposition can be summarized thus: Ecosystems change anyway, and there are no pristine ecosystems left. Therefore, there is no option but to continue to change them.[22]

To challenge this proposition, I will describe and criticize the more detailed arguments on which it depends.

Argument 1: Nonequilibrium - Whatever Humans Do is Natural

Ecosystems change naturally. (Correct)
Humans are elements of ecosystems. (Correct)
Therefore whatever humans do is natural. (Not correct)

When it comes to ecosystems, what does "natural" mean? Are humans in or out? According to the managers, they are in. Botkin writes, "the answers to the old questions – What is the character of nature undisturbed? What is the influence of nature on human beings? What is the influence of human beings on nature? – can no longer be viewed as distinct from one another. Life and the

20. "[A]n ecosystem is a thermodynamically open, far from equilibrium system." Eugene P. Odum, *Great Ideas for Ecology for the 1990s*, 42 BIOSCIENCE 542, 542 (1992). Odum is one of the original architects of the equilibrium model.

21. Tarlock, *supra* note 16, at 1129 (citing D.L. Urban et al., *Landscape Ecology*, 37 BIOSCIENCE 119 (1987)).

22. "[T]he accelerating interaction between humans and the natural environment makes it impossible to return to an ideal state of nature. At best, ecosystems can be managed, but not restored or preserved. Management will be a series of calculated risky experiments." Tarlock, *supra* note 16, at 1129 (citing D.L. Urban et al., *Landscape Ecology*, 37 BIOSCIENCE 119 (1987)). Houck describes the new approach this way:

> If we just manage nature right, we will have a win-win situation. This is the predicate of something called the New Ecology, a movement that has apparently discovered that everything changes in nature, and, therefore, we do not really need to try and preserve anything because, after all, it is going to change.

Oliver A. Houck, *Are Humans Part of Ecosystems?*, 28 ENVTL. L. 1, 5 (1998).

environment are one thing, not two, and people, as all life, are immersed in the one system."[23]

Botkin is quite right, and quite wrong. Human beings are very much part of ecosystems, and therefore in a sense are an inextricable part of nature. An ecosystem is "a community of organisms and their physical environment interacting as an ecological unit."[24] Any organism that interacts with others within an ecosystem is, by definition, a part of that ecosystem. Human beings are such organisms. As organisms, they help to determine the characteristics of the system. Ecosystems with tree frogs behave differently than ecosystems without tree frogs, and ecosystems with human beings behave differently than ecosystems without them. In this sense, it would be incorrect to say that human beings are not part of nature.

Nevertheless, sometimes they are not. Oil spills from tankers are not natural. The transformation of a wetland into a parking lot is not natural. If oil spills and parking lots *are* natural, then the word "natural" has no meaning. To properly diagnose environmental events, it is necessary to draw a line between human and non-human because human beings can have extraordinary effects upon the world. If humans are always included in the definition of nature, no distinction can be made and the label serves no purpose. The term would be redundant[25] because it would not distinguish anything from anything else. If all human effects are natural, then Chernobyl, Love Canal, oil spills and climate change are, by definition, natural. One may as well stop using the word.[26]

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23. BOKTIN, *supra* note 1, at 188; *see also* J.B. Ruhl, *Working Both (Positivist) Ends Toward a New (Pragmatist) Middle in Environmental Law,* 68 GEO. WASH. L. REV. 522, 531-32 (2000); *see generally* J.B. Wiener, *Beyond the Balance of Nature,* 7 DUKE ENVTL. L. & POL'Y F. 1 (1996).

24. R. LINCOLN ET AL., A DICTIONARY OF ECOLOGY, EVOLUTION, AND SYSTEMATICS 75 (1982).

25. As Houck explains, to include human beings as part of ecosystems is to strip the concept of any meaning. He suggests that "neither answer, people-are-in ecosystems or people-are-out, seems to work." Houck, *supra* note 22, at 3.

26. If humans are part of ecosystems, then whatever serves human needs is, by definition, a good ecosystem development.

> The danger in ecosystem management, as it is currently emerging in government planning, is that it tends to put – indeed, it intends to put – humans back into step one, into the definition of the ecosystem itself. The ecosystem management goal is not predicated on a natural system; it is predicated on human needs and desires.. . . Ecosystem management is whatever we want to do.

Houck, *supra* note 22, at 6, 10.

But if humans are part of ecosystems, and are therefore part of nature, how can we exclude them from the definition and still tell the truth? In the environmental sphere, where does nature end and "unnatural" human behavior begin? This is one of the most vexing problems in environmental law: how to define a baseline,[27] a brightline rule that defines when impact is environmentally harmful or environmentally benign. A baseline is difficult to achieve because of the dual role that humans can assume in ecosystems, behaving in one breath as native organisms that breathe, eat and decompose like any other, and in the next as alien intruders bent on transforming the system into something else. How do we distinguish the natural role from the unnatural?

To answer this question, I will use an analogy: the economic concept of a perfectly competitive marketplace. In a perfectly competitive market, the price at which a particular commodity is sold is determined by the individual decisions of a multitude of buyers and sellers. Each transaction between a buyer and a seller contributes to the "invisible hand" of the market that decides the going price. None of the many buyers and sellers controls enough of the market to be able to unilaterally decide the price of the commodity. In a perfectly competitive market, buyers and sellers all help to locate the market price, but none have sufficient market power to decide what it shall be; no one has any more influence than any other market participant.

In a market that is not perfectly competitive but instead is subject to monopoly or oligopoly power, buyers and sellers do not exert an equal degree of influence. The invisible hand of the market does not operate and the market does not find its "natural" level. Instead, a very few players exert a disproportionate impact on the way in which the market evolves.

This model can be applied to human impact on ecosystems in the following way. Human beings are part of nature when they are the ecological equivalent of one of the many competitive buyers and sellers in a perfectly competitive marketplace. Human beings are part of nature when they exist within an ecosystem as one of many perfectly competitive species; when they exert impact

27. *See, e.g.*, William F. Pedersen, *'Protecting the Environment' – What Does That Mean?*, 27 LOY. L.A. L. REV. 969 (1994); Richard A. Epstein, *Too Pragmatic by Half*, 109 YALE L.J. 1639 (2000) (reviewing DANIEL A. FARBER, ECO- PRAGMATISM: MAKING SENSIBLE ENVIRONMENTAL DECISIONS IN AN UNCERTAIN WORLD (1999)); R. Haeuber, *Setting the Environmental Policy Agenda: The Case of Ecosystem Management*, 36 NAT. RESOURCES J. 1, 5 (1996).

that, while it may contribute to the interactions in the system and thus influence the nature of the change that the ecosystem experiences, is not disproportionate to the impact exerted by other species in the system. That is, where humans are just one of the many elements in a system and through their participation as one of the elements, contribute to the evolution of the system (that is, the nonequilibrium of the system) then humans are part of nature and the change is natural. When any organism eats, breathes, dies and decays, those activities produce impacts on the system that are natural, whether the organism is a flower, tree frog or human. However, when humans exert a disproportionate influence on the state of a system, like a monopoly in a marketplace, they are not part of nature, but stand outside it. Their role is unlike that of any other organism. Under these conditions, the changes experienced by the system are not guided by the "invisible hand" of system interactions, but are wrought by one of its elements alone.

Thus, humans are not always excluded from the definition of nature. It depends upon their role within ecosystems, and on the kind of ecosystem impact they are causing. The impact caused by some human societies at some moments in history might qualify as natural. However, most of the impact of human civilization at the beginning of the twenty-first century does not. When concrete is poured over a marsh, or commercial fishing depletes fish stocks, monopoly power is being exercised in the ecosystem sense. Modern humans are far beyond being just one element in the system. Indeed, this is part of the case for management: We exert such a disproportionate impact on ecosystems that we have changed them all already, and there are no pristine systems left. Ecosystem management calls upon humans to act like a monopoly, unilaterally deciding how ecosystems change. Nature does not include the monopoly power of human civilization in the twenty-first century. The natural features of an ecosystem are those that have not been produced or changed by the effects of human disturbance.

Argument 2: Nonequilibrium – Any Change is Natural Change

Ecosystems change naturally. (Correct)

Therefore any change is a natural change. (Not correct)

Argument 2 suffers from a non sequitur. Wood floats. Therefore, anything that floats is wood.

Under the equilibrium paradigm, change to ecosystems was associated with human interference. Systems free from human influence were thought to be stable and predictable. Therefore, when change occurred, it could be attributed to human effects. Now it is understood that change within a system is not necessarily an indication of human impact. However, the implication of that discovery has been extrapolated too far. It does change the criteria for distinguishing between natural and unnatural, but it does not mean that there is no difference. Under the equilibrium paradigm, there was change (human) and stability (natural). Under the nonequilibrium paradigm, there is change caused by humans and change that occurs naturally. The change to a particular system caused by humans may be quite different from the change that would have occurred without human influence. For example, a marsh may gradually change into a glade, or it may be covered with concrete. The results are qualitatively different and belong in different categories.

An ecosystem that changes without human interference is as natural as it was before the change. Whether the change was "good" or "bad" is irrelevant to whether it is natural. A change can be good or bad only through human eyes. When it comes to nature, terms like "good" and "bad" have little meaning. An ecosystem that is changed by human action, intentionally or unintentionally, is less natural than it was before the change.

An ecosystem is not a thing, but a pattern. It is a collection of interactions and relationships. There is no 'thing' to preserve or protect. Compare ecosystems to the human body. The atoms and molecules that make up the body are continually being lost and replaced. Human bodies are made of different atoms and molecules today than they were made of last year, last week, or yesterday. Therefore, it would not be correct to define a human body as consisting of a collection of particular atoms and molecules. Instead, a body is a *pattern* of atoms and molecules. New ones take the place of the old ones in the pattern. Furthermore, each body changes through time. As it ages, the relationship between its atoms and molecules changes, a process that is continual and natural. Even when such change occurs, the body is the same body it was before. It is still a coherent pattern that is changing through time.

An ecosystem is a pattern that changes through time. It is that changing pattern that can be preserved. However, not all change to the pattern is natural change. A human body changes

as it ages. It also changes when hit by a truck. The first changes the pattern naturally. The second does not. The first is like natural change to an ecosystem. The second is like unnatural change caused by humans. They are qualitatively different.

Argument 3: Nonequilibrium - No Fixed Target

Ecosystems change on their own. (Correct)
Therefore, there is no final or stable state in ecosystems. (Correct)
Therefore, ecosystems cannot be preserved in a stable state that is natural. (Correct)
Therefore, a natural state cannot be preserved. (Not correct)

The equilibrium paradigm was the source of the balance of nature premise[28] – that if human impact on ecosystems was prevented, ecosystems would maintain themselves indefinitely in a self-regulating, self-perpetuating way. Equilibrium provided a base state, a target that rules could be designed to protect. Evidence that the system was changing was evidence of human interference with the system. Where people sought to restore an ecosystem to a natural state, that state could be identified as the equilibrium state that the system was in prior to being disturbed.

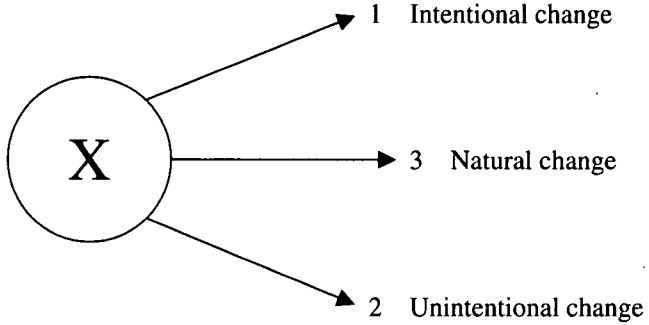
If ecosystems are not in equilibrium, protecting their natural state becomes more difficult because no base state can be identified. Even an undisturbed system may be dynamic and fluid, and change on its own. Therefore, evidence of change does not in itself establish that human disturbance has occurred.

The managerial argument is that the lack of a stable state means that there is no target to protect. In the equilibrium world, the target was the natural system in equilibrium. In a non-equilibrium world, there are no natural systems in equilibrium. But rather than that meaning that there are no targets, it means that the targets must be defined differently. In the equilibrium world, the target was the natural system in equilibrium; in the non-equilibrium world, the target is the natural system in non-equilibrium. A natural system in nonequilibrium is fluid and dynamic. It changes through time: it is a moving target. That makes the task of protecting it more difficult, but it does not mean there is nothing to preserve. The difficulty is in tracking the target, not in deciding what the target ought to be.

28. "Nonequilibrium ecology rejects the vision of a balance of nature. Further, it rejects the romantic idea that nature should be a place without humans, and returns to the problem posed in Genesis: How should one manage the Garden of Eden after it has been invaded by humans?" Tarlock, *supra* note 16, at 1129.

In legal terms, the difficulty is not definitional, but evidentiary. The managers say that protecting a natural state cannot be done because it is impossible to identify. A better way to characterize the effect of nonequilibrium is to say that it produces evidentiary problems.[29] The natural state of an ecosystem is that state the system would be in but for change caused by human action. In practice, depending upon which system is under consideration, that natural state may be difficult to identify. It may be difficult to tell which changes to the system were natural and which were produced by human action.[30] However, the presence of evidentiary uncertainty is not a significant obstacle to environmental decision-making in the law. It is a trite observation that legal decisions of all kinds are constantly made in the face of significant evidentiary uncertainty. These evidentiary difficulties hardly prevent law from making decisions or from identifying the natural system in nonequilibrium as the entity to be protected. Evidentiary difficulties do not change the fact that systems will change in one way in the absence of human disturbance, and in another way if that disturbance is present.

In Botkin's words, the only choices now available are whether human beings mould ecosystems intentionally, so as to produce a desirable environment, or unintentionally, so as to produce an environment that is undesirable.[31] In the diagram below, these are choices 1 and 2.



29. This means, for example, that it may be difficult to predict what effect relocating a herd of deer may have. But the conclusion that systems should be managed for the most desirable outcome is liable to be translated into a conclusion that a new parking lot is environmentally appropriate if overall it is a good thing for the community. It is not difficult to predict that pouring concrete over a marsh will cause a significant, unnatural change to that system.

30. *See, e.g.*, BOTKIN, *supra* note 1, at 51-54 (describing the dominant species in a New Jersey forest changing from oak and hickory trees to maple trees).

31. *Id.* at 191, 193.

The X in the circle represents an ecosystem in its present state. Choice 1 is to intentionally change that system so as to produce the most desirable environment in social, economic, aesthetic and environmental terms. Choice 2 is to allow unrestrained human impact on the system that causes inadvertent change. In both choices 1 and 2, human beings exercise monopoly power in the ecosystem sense. The third choice is to allow ecosystems to change naturally - to prevent the exercise of monopoly power in the ecosystem sense, and to allow the system to proceed as it otherwise would. Note that this choice does not freeze the system in its present state: it does not identify the ecosystem as a fixed target, but as one that changes through time.

Argument 4: Nonequilibrium – No Ability to Predict

Ecosystems change on their own. (Correct)
Therefore, there is no final or stable state in ecosystems. (Correct)
Therefore, changes in a system are not necessarily because of human impact. (Correct)
Therefore, it is difficult to identify the effect of human impact. (Correct)
Therefore, it is difficult to predict the effect of human impact. (Correct)
Therefore, it is not possible to preserve, but only to manage. (Not correct)

The purpose of certain kinds of legal processes, such as environmental assessments, is to evaluate the environmental impact of proposed projects. It is to predict to the extent possible the effect that a project will have on the local system, and to determine if that impact is acceptable. If the affected system may change in unknown ways even in the absence of the project, it is difficult to predict what the project's impact will be. Without an ability to predict and evaluate the changes that human activities will cause, ecological protection becomes more difficult and less certain. Indeed, the difficulties created by nonequilibrium, argue the managers, are so substantial that they leave us without the ability to measure the effects of human actions on the environment, and thus without an ability to predict what the effect of particular human actions is going to be.

Either ecological prediction is possible or it is not. In either case, the argument that it is not possible to protect a natural state but it is possible to manage ecosystems does not work. Assume first that it *is* possible to measure the effects of human actions on the environment, and to predict what the effect of particular human actions is going to be. Under such circumstances, protecting a natural state *is* possible. Human actions that will alter an

ecosystem's state can be identified and prohibited so that the only changes the system experiences are natural ones.

Assume next that the managers are correct, and that because of nonequilibrium, it is *not* possible to measure the effects of human action on the environment, and *not* possible to predict the effects of particular actions. If that is so, how are ecosystems going to be managed? To manage systems, one must control cause and effect. To be able to control cause and effect, one must be able to predict with a fair degree of certainty what the effect of particular actions is going to be. Without the ability to measure and predict, the tools for managing ecosystems do not exist. The attempt to fashion a new environment is no more than a stab in the dark, and is likely to produce an unforeseen result. If natural systems cannot be protected because of an inability to predict, then systems cannot be managed either.

Argument 5: No Pristine Systems – Past the Point of No Return

There are no pristine systems left. (Correct)
Therefore, humans have changed all ecosystems. (Correct)
Therefore, there are no fully natural ecosystems left. (Correct)
Therefore, there is no nature left to preserve. (Not correct)

A pristine system is one completely untouched by the human hand. If every ecosystem on the planet has been affected, even a little bit, by human activity, then there are no pristine systems remaining. Therefore, there are no fully natural ecosystems left. Therefore, the argument goes, we are already on our own and there is nothing left to preserve. This conclusion is not correct because it confuses "pristine" with "natural". Features of an ecosystem that have not been produced or changed by the effects of human activity are natural. All systems are unnatural to some degree, but some ecosystems are more unnatural than others. To deny the existence of anything natural is to say that downtown Manhattan and Shibogama Lake in northern Ontario are equally unnatural. It is more accurate to say that both environments have some natural characteristics, and Shibogama Lake has a greater proportion of natural characteristics than does Manhattan. For the leap from point (3) to point (4) to be valid, natural and pristine must mean the same thing: a complete absence of human disturbance. Under this formulation, the status of an ecosystem is a black and white question: either a system is completely natural, or it is completely unnatural. Under this reasoning, once a system is influenced in any way by human civilization,

it is deemed to be past the point of no return and managers should do with it what they think best.

Contrary to that approach, it is possible to measure the "naturalness" of a system on a spectrum. There are degrees of natural. The closer to a pristine state a system is in, the more natural it is. The more human impact has influenced a system, the less natural it is. Humans have changed all systems, but they have changed some systems more than others. Therefore, nature is still there to preserve.

There *is* an environmental point of no return, but that point is not crossed when an ecosystem is no longer pristine. Compare an ecosystem to a Rubik's Cube. If one starts with solid colors on all six sides, and then gives the cube a single twist, then the cube is no longer "pristine". But it is still highly organized. Squares of the same color are grouped together, and it is not difficult to reverse the twist and restore all sides to a solid color. The pristine state of the cube can still be identified, and there is a lot of "nature" left in the cube. The point of no return is reached when all the colors are hopelessly mixed up, when the cube is so changed that it does not resemble the cube in its original organization, and it is not possible to put the cube back into its pristine state. In this respect the analogy falls short: if one is clever enough, it is possible to return a Rubik's cube to its original state. The same may not apply to ecosystems. One danger of ecosystem management is that it allows and encourages ecosystems to be twisted away from solid colors. The more an ecosystem is changed, the closer to the real point of no return it becomes. However, until that point is reached, ecosystems have natural features that are capable of being legally protected.

IV. Conclusion

Ecosystem management is a policy choice masquerading as an inevitability. Neither nonequilibrium nor the absence of pristine systems demands that ecosystems be changed to suit human preferences. I have argued that natural is possible. Whether it is preferable is a different debate. Ecosystem management may in some circumstances be the best of the policy options to deal with a particular environmental problem, but to describe it as the only choice available is not accurate. Preserving nature is scientifically and legally difficult. It may well be politically and socially impossible, but that is a different question.

One of the risks of ecosystem management is that it will become a self-fulfilling prophecy. If ecosystem management does become inevitable, it will not be because of nonequilibrium or the absence of pristine systems, but because ecosystem management itself has altered systems past the point of no return. Natural is still possible, but not indefinitely so in the face of an extended period of deliberate human change. The more ecosystems are managed, the more they must be managed, and the results may not become apparent until the point of no return has indeed been reached.

V. Epilogue: The Future of Nonequilibrium and the Evolution of Scientific Ideas

Nonequilibrium, like equilibrium, is a theory about how ecosystems behave. Equilibrium has been shown to be an incomplete theory, and has been superseded by nonequilibrium. The history of science is full of such developments. The process of replacing one scientific theory with another is the rule rather than the exception. Far more remarkable would be the discovery of an idea that, through the centuries, proves to be unassailably correct. Nonequilibrium has been embraced as the governing feature of ecosystems for less than a quarter century. Can it be said that nonequilibrium is an idea that is unassailably correct? It is more likely that at some future time nonequilibrium, like equilibrium, will be shown to be an inaccurate or incomplete theory to explain the behavior of ecosystems. Like equilibrium, it will be modified or replaced with other discoveries or ideas. There is nothing wrong with this process, for this is the way of scientific progress. The problem occurs if the present theory is applied in a way that cannot be reversed. The management of ecosystems creates potentially permanent changes to the global environment. By the time nonequilibrium is itself superseded by a new theory, the environment may have been irretrievably altered. Some ecologists may profess to be certain that ecosystems do, in fact, exist in a state of nonequilibrium – they may be sure the theory is correct. Their confidence is irrelevant. As Oliver Wendell Holmes wrote, certitude is not the test of certainty.[32] To rely on it as a foundation for the alteration of the Earth's environment requires a leap of faith whose consequences are disproportionate to the strength of the assurances that are possible to give.

32. "Certitude is not the test of certainty. We have been cock-sure of many things that were not so." O.W. Homes, *Natural Law*, 32 HARV. L. REV. 40 (1918).