NEW SCIENCE BUT OLD LAWS: THE NEED TO INCLUDE LANDSCAPE ECOLOGY IN THE LEGAL FRAMEWORK OF BIODIVERSITY PROTECTION

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† *My thanks to Keith Wagner for his helpful comments on an early draft of this Article. Special thanks to Joseph Schofield for his thorough (and expeditious) editing on the final draft.*

I. INTRODUCTION

Large-scale, national environmental legislation erupted in the United States in the late 1960s and early 1970s at a time of acute environmental awareness.[1] Since then, new scientific insights have led some commentators to ask whether the original laws, especially those protecting biodiversity,[2] are effective enough.[3] Human-caused habitat alteration, the primary cause of loss of biodiversity, must be regulated.[4] Current law is ineffective protecting biodiversity largely because it does not adequately regulate habitat alteration by humans.[5]

To best address this shortcoming, the principles of landscape ecology must be introduced into the regulatory process.[6] Landscape ecology needs to be incorporated into the regulatory process proactively, because these principles will be less effective once most habitat within a landscape has been altered.[7] However, proactive planning may be at odds with society's desire for certainty, and any legal framework that destroys certainty will not be implemented.[8]

Simply stated, the problem is in finding a legal framework that will proactively manage human alteration of habitats while respecting society's desire for certainty and retaining flexibility through adaptive management. The problem is immense, and any proposed legal framework must be not only scientifically valid, but also politically and socially acceptable. This Article will propose a possible legal framework for achieving those goals.

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[1] *See* MARIAN R. CHERTOW & DANIEL C. ESTY, THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 2 (1997).

[2] *See, e.g.*, REED F. NOSS & ALLEN Y. COOPERRIDER, SAVING NATURE'S LEGACY: PROTECTING AND RESTORING BIODIVERSITY 27 (1994).

[3] *See id.* Biodiversity is defined here to include not only the number of species of animals and plants, but also the genetic variation within those species. This definition is important because it places value on not only protecting species from extinction, but also in maintaining the largest possible populations of those species. *Id.* at 4-6. Noss and Cooperrider use the disappearance of bison from most of their former range as an example of how biodiversity can decline without a species becoming endangered. *Id.* at 63.

[4] *See id.* at 99-100.

[5] *See* REED F. NOSS ET AL., THE SCIENCE OF CONSERVATION PLANNING: HABITAT CONSERVATION UNDER THE ENDANGERED SPECIES ACT 4-13 (1997).

[6] *See infra* Part IV (discussing the need for a regulatory framework that allows for proactive planning). The concentration on landscape ecology in this Article is not intended to suggest that disciplines such as conservation biology are unimportant. Landscape ecology is the focus simply because it concentrates on large-scale processes.

[7] *See infra* Part IV.C (discussing the need for landscape ecology principles during the early phases of landscape transformation).

[8] *See infra* Part III.C (discussing society's desire for certainty).

This Article will accomplish two things. First, it will detail the current dilemma between society's desire for certainty and science's need for adaptive management. Second, it will present a potential solution to that dilemma. This Article's purpose is neither to attack the effectiveness of the current regulatory structure[9] nor to advocate for its removal.[10] The purpose of this Article is simply to advocate for an additional mechanism to make the current regulatory structure more effective at protecting biodiversity. Any need for wholesale change in the current regulatory structure is beyond the scope of this Article.

II. What Science Says About Biodiversity Protection

A. Lack of a Balance of Nature

In *Earth in the Balance*, Albert Gore defined ecology as the "study of balance."[11] This definition is wrong: ecology is about change, not balance.[12] Gore is not alone in his error, however, as the "balance of nature" is a common phrase of environmentalists, policy makers, and the press.[13]

As intuitively appealing as the idea of a balance of nature is, it simply is not an accurate reflection of the natural world.[14] Through the study of empirical data, ecologists such as Daniel Botkin began to develop a new way of viewing the world. New Ecology recognizes that the world is not in a state of equilibrium, but is instead dynamic.[15] This dynamic view of the world has many impli-

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[9] The current regulatory structure has had an important role in achieving several preliminary environmental goals. However, it is not sufficient to get us to the next level. *See* CHERTOW & ESTY, *supra* note 1, at 3. Chertow and Esty frame the issue in terms of "first-order" and "second-order" environmental goals. First-order goals such as clean air and water have been dealt with effectively by the command-and-control schemes of the late 1960s and early 1970s. However, second-order environmental goals will require a different regulatory scheme. *Id.*

[10] Without command and control laws such as the Endangered Species Act to provide an imperative, landowners will have no incentive to engage in proactive planning. *See* Oliver Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 MINN. L. REV. 869, 959 (1997).

[11] ALBERT GORE, EARTH IN THE BALANCE 11 (1992).

[12] *See* John Hart, *Nothing is Permanent Except Change*, *in* MANAGEMENT OF DYNAMIC ECOSYSTEMS 2-16 (James M. Sweeney ed., 1990) (arguing that imposing stability on dynamic ecosystems has impaired their health. He uses fires and floods as examples of natural disturbances that have been prevented, causing losses in long-term productivity of ecosystems).

[13] *See* WALLACE KAUFMAN, NO TURNING BACK 94 (1994).

[14] *See, e.g.*, Fred P. Bosselman & Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847, 870 (1994).

[15] For a thorough discussion of the principles of New Ecology, *see* DANIEL B. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE 21ST CENTURY (1990).

cations to environmental law, because managing for change requires a fundamentally different approach than managing for constancy.[16]

Managing for change does not mean accepting all human-caused change in ecosystems. Environmentalists fear that accepting change opens a "Pandora's Box."[17] This fear is driven by the belief that once change is accepted people will gradually accept all human changes as natural.[18] However, acceptance of natural change does not necessarily require acceptance of all change.[19] When assessing human changes to ecosystems, the key is to measure the overall rate of change and compare that with the natural rate.[20]

1. Chaos Theory

Further insight into the constant change of natural systems is provided by chaos theory. The classic example of a chaotic system is weather,[21] which appears to be randomly created but is actually following deterministic rules. The reason that weather forecasters have such a tough time predicting weather is that making accurate predictions is dependent on exact knowledge of current conditions. Even the smallest error in measurement will be amplified by what is known as the "butterfly effect."[22] The common illustration of this phenomenon is "if a butterfly flaps its wings in Tokyo, then a month later it may cause a hurricane in Brazil."[23] So, a small error in the measurement of today's weather will lead to progressively more inaccurate forecasts as the length of prediction increases. This effect explains why you don't see weather forecasts more than a few days in advance. They would simply have little accuracy to them.[24]

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[16] *See* Daniel B. Botkin, *Adjusting Law to Nature's Discordant Harmonies*, 7 DUKE ENVTL. L. & POL'Y F. 25, 26 (1996); Jonathan B. Wiener, *Beyond the Balance of Nature*, 7 DUKE ENVTL. L. & POL'Y F. 1, 24 (1996).

[17] *See* Botkin, *supra* note 15, at 156.

[18] *See id.*

[19] *See id.* Botkin uses fire as an example of not accepting all change. He argues that even though fire has a positive impact on sequoia, only fire that occurs at the correct frequency and proper intensity is to be valued. Accepting fire as a positive management tool does not require all fires to be valued equally.

[20] *See* Jonathan B. Wiener, *Law and the New Ecology: Evolution, Categories and Consequences*, 22 ECOLOGY L. Q. 325, 350-57 (1995).

[21] For a thorough discussion of weather as a chaotic system, *see* JACK COHEN & IAN STEWART, THE COLLAPSE OF CHAOS 191-193 (1994). For a concise introduction to chaos theory, *see* IAN STEWART, NATURE'S NUMBERS 108-27(1995).

[22] *See* COHEN & STEWART, *supra* note 21, at 191.

[23] *Id.*

[24] *See id.*

What implication does chaos theory have for biodiversity protection? By demonstrating that a small error in initial measurement will cause amplified errors at a later stage in management, the theory points out the need for adaptive management in habitat protection plans.[25] Ecosystems are enormously complex systems that cannot be accurately measured with current knowledge.[26] Therefore, any management plan for protecting ecosystems will likely have errors in measurement. Those errors will be amplified as time passes, unless adaptive management is used to adjust a management plan as new information becomes available.

B. *The Promise and Limitations of Science*

1. *Science as Procedure*

Science has been described as having two elements, procedure and substance.[27] The procedural aspect of science is the method by which scientific knowledge is obtained and verified.[28] Science follows the procedural steps of "observation, communication, informed criticism, and response."[29] This procedure helps to increase the validity of substantive knowledge acquired through scientific process. Even so, this validated knowledge is not always correct,[30] especially when evaluating complex systems such as ecosystems.[31] In short, answers obtained through scientific process are not always right, and any management plan that forgets this is doomed to fail.

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[25] Adaptive management allows planners to adjust management systems as new information is obtained. In this way, improvements may be made faster than traditional trial-and-error methods. *See* KAI N. LEE, COMPASS AND GYROSCOPE: INTEGRATING SCIENCE AND POLITICS FOR THE ENVIRONMENT 51-86 (1993).

[26] E.O. WILSON, CONSILIENCE: THE UNITY OF KNOWLEDGE 84 (1998).

[27] *See generally* Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*. 75 WASH. U. L.Q. 1029, 1057 (1997) (describing problems that using science as justification for species listings has created).

[28] *See id.* at 1057.

[29] *See id.*

[30] *See id.* at 1069.

[31] *See id.*

2. Science Cannot Make Value Judgments

It has been noted that "some questions simply cannot be answered in an objective, universally valid manner."[32] An excellent example of this principle is an experience I had while working as a spotted owl surveyor. One afternoon I encountered a pair of barred owls, which are taking over some of the former habitat of spotted owls. I was initially disappointed to see these barred owls, because their presence likely meant that no spotted owls lived in this habitat patch. My disappointment reflected a value judgment. Science cannot answer the question of whether it is better to have barred owls or spotted owls in a particular habitat patch. Similarly, science cannot answer whether we should have a shopping mall or a wetland. Only people can make these value judgments.

C. A Quick Survey of Answers Needed From Science

1. Ecosystem Function

E.O. Wilson states that the "greatest challenge today . . . in all of science, is the accurate and complete description of complex systems."[33] This statement underscores both the importance of understanding ecosystems, and the current lack of understanding. The success of ecosystem management is dependent on knowing how ecosystems work.[34] Despite vast scientific advances, science still has not determined how individual ecosystems function.[35]

2. Complexity Theory

One possible method of discovering how ecosystems function is the emerging field of complexity theory. Complexity theory may be defined as "the search for algorithms used in nature that display common features across many levels of organization."[36] Most of the study of complexity theory is being conducted by

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[32] *Id.* at 1065.
[33] WILSON, *supra* note 26, at 84.
[34] *See id.* at 85.
[35] *See id.*
[36] *Id.* at 87.

a group of scientists at the Santa Fe Institute. Using insights gained from the study of chaos theory, these scientists have developed a theory that complex systems can be understood by finding the mathematical patterns that govern their function.[37]

The potential impact of complexity theory on the way that we manage ecosystems is enormous. If complexity theorists are able to develop methods for predicting ecosystem behavior, ecosystem management will be improved greatly. For now, scientists are split on whether complexity theory will achieve the answers it seeks.[38] Until this question is resolved, environmental policy makers will lack some of the information necessary to make wise decisions about ecosystem management.

3. Faunal Collapse

The focus of preserving biodiversity has often involved setting plots of land aside as reserves.[39] However, there is evidence that many species now surviving in reserves will not continue to exist there.[40] The Theory of Island Biogeography suggests that the smaller and more isolated an island is, the fewer species that will survive there.[41] With habitat fragmentation, many reserves and parks have become virtual islands, even though the surrounding habitat is not as much a barrier to dispersal as water around an island.[42]

In a study of mammalian extinction rates in Western North American National Parks it was found that these parks act very much like land-bridge islands.[43] Land-bridge islands start out connected to the mainland, then become surrounded by water. Through time these islands lose some species that lived

[37] The scientists at Santa Fe Institute have published many books dealing with chaos theory, fractal geometry, and complexity theory. *See, e.g.*, JACK COHEN & IAN STEWART, THE COLLAPSE OF CHAOS (1994); STUART A. KAUFMANN, THE ORIGINS OF ORDER: SELF-ORGANIZATION AND SELECTION IN EVOLUTION (1992); IAN STEWART, DOES GOD PLAY DICE? (1989); M. MITCHELL WALDROP, COMPLEXITY (1992).
[38] *See* WILSON, *supra* note 26, at 88.
[39] *See* RICHARD PRIMACK, ESSENTIALS OF CONSERVATION BIOLOGY 301 (1993).
[40] *See* NOSS & COOPERRIDER, *supra* note 2, at 142.
[41] *See generally* R.H. MACARTHUR & E.O.WILSON, THE THEORY OF ISLAND BIOGEOGRAPHY (1967) (describing effects of island size and distance from mainland as predictor of number of species).
[42] *See* NOSS & COOPERRIDER, *supra* note 2, at 52.
[43] *See* William D. Newmark, *Extinction of Mammal Popluations in Western North American National Parks* 9 CONSERVATION BIOLOGY 512 (1995).

there before separation from the mainland.[44] This study is significant because if parks and reserves act like land-bridge islands, current reserves will not be enough to preserve biodiversity.[45]

There has been a significant amount of studies examining habitat fragmentation, island biogeography, and faunal collapse.[46] The effects of habitat fragmentation and island biogeography on the design of nature reserves is well accepted by scientists and can be counted as part of reasonably certain scientific knowledge. For now, to what extent faunal collapse will occur in habitat patches is not known.

4. Extinction Debt

Another possible danger to biodiversity is the extinction debt phenomenon.[47] The debt referred to is the time lag between habitat destruction and extinction of species. Like faunal collapse, the extinction debt model predicts that survival of some species in remnant habitat patches will be only temporary.[48] The more fragmented the habitat, the greater the extinction debt will be.[49]

The most disturbing prediction of the extinction debt model is that competitively superior species will be the most affected by habitat fragmentation.[50] This prediction is based on the idea of an ecological "trade-off."[51] This trade-off exists because species that are good competitors are generally poor dispersers.[52] When a habitat first becomes fragmented, the good competitors will be abun-

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[44] *See* Jared Diamond, *Biogeographic Kinetics: Estimation of Relaxation Times for Avifaunas of Southwest Pacific Islands*, 69 PROC. OF THE NAT'L ACAD. OF SCI. 3199 (1972).

[45] *See* NOSS & COOPERRIDER, *supra* note 2, at 142.

[46] For an introduction to faunal collapse, *see* Tormod Burkey, *Extinction Rates in Archipelagos: Implications for Populations in Fragmented Habitats*, 9 CONSERVATION BIOLOGY 527 (1995).

[47] *See* David Tilman et al., *Habitat Destruction and the Extinction Debt*, 371 NATURE 65 (1994). *See also* S. Nee & R.M. May, *Dynamics of Metapopulations: Habitat Destruction and Competitive Coexistence*, 61 J. ANIMAL ECOLOGY 37 (1992) (predicting that competitive species will be lost due to habitat fragmentation).

[48] *See id.* at 65.

[49] *See id.* at 67.

[50] *See id.* at 65.

[51] *See id.*

[52] *See* J.P. GRIME, PLANT STRATEGIES AND VEGETATION PROCESSES (1979); R. MACARTHUR AND E. O. WILSON, THE THEORY OF ISLAND BIOGEOGRAPHY (1967).

dant.[53] As time passes, however, these species will go extinct because they are poor dispersers.[54]

One expert has questioned the validity of the extinction debt phenomenon.[55] Extinction debt models assume that trade-offs are complete, but some studies show "no significant negative correlation" between colonizing ability and competition ability for six different species of plants.[56] When the extinction debt model assumes imperfect trade-offs, the "debt" is decreased. Species extinctions occurred earlier and more predictably with imperfect trade-offs assumed.[57]

If this phenomenon exists, prevention of fragmentation is even more important than currently believed. Species that are the best competitors are often very important to ecosystem function.[58] Fragmentation will lead not only to extinction of species, but to extinction of highly important species. If valid, this theory would make proactive management of landscapes critical. Waiting for the enforcement mechanisms of the Endangered Species Act to start would be a very ineffective method of dealing with the extinction debt problem. Further, any management plan that assumes the survival of good competitors within fragmented habitat will be unsuccessful.

5. Climate Change

One of the biggest questions currently facing science is the possibility of climate change as a result of the Greenhouse Effect.[59] If even some of the predictions come true, biodiversity protection will have to adjust.[60] It is not the pur-

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[53] *See* Tilman et al., *supra* note 47, at 66.
[54] *See id.*
[55] See John E. Banks, *Do Imperfect Trade-Offs Affect the Extinction Debt Phenomenon?* 78 ECOLOGY 1597 (1997). *But see* Craig Loehle & Bai-Lian Li, *Habitat Destruction and the Extinction Debt Revisited*, 6 ECOLOGICAL APPLICATIONS 784 (1996). This study found that the extinction debt did apply in "real-world situations". It is particularly interesting that the authors found that the extinction debt will be even more pronounced when landscape transformation occurs randomly. *Id.* at 788. This provides additional evidence that proactive landscape planning is needed.
[56] *See id.* at 1599.
[57] *See id.* at 1600.
[58] *See* John Pastor et al., *Geology, Soils and Vegetation of Blackhawk Island, Wisconsin*, 108 AM. MIDLAND NATURALIST 265, 267 (1982).
[59] *See generally* ROBERT PETERS & THOMAS LOVEJOY, GLOBAL WARMING AND BIOLOGICAL DIVERSITY (1992) (detailing potential impacts of global warming on ecosystems).
[60] *See id.* at 13.

pose of this Article to discuss global warming, but climate change must be considered in implementing environmental law. If ecosystems are affected by this phenomenon, rigid management regimens will fail.[61]

D. What Good is Science Then?

If science does not provide absolute answers and cannot make value judgments, one might ask whether it is useful at all in environmental law. The answer to that question is a resounding yes, for two reasons. First, science did introduce the five uncertainties just discussed. Asking the question is often as important as answering it.[62] Asking forces other scientists and eventually policy makers to confront the question, and increases the odds of finding the answer.[63]

Second, despite the current lack of knowledge, science is the most likely method of obtaining the right answer. In addition to providing substantive knowledge, the procedural methods of science can be useful for environmental law through their potential use in proactive planning. Science's value in this context may be shown by a hypothetical. Assume that a landscape plan is being developed for a particular to protect biodiversity. Further assume that a committee has been chosen to consider ten proposed plans. The committee could allow a team of scientists to decide which plan is best, it could allow a citizen's group to decide which plan is best, or it could choose at random. Most people would agree that the team of scientists is most likely to choose the correct plan, i.e., the plan that will best protect biodiversity. It is possible that the citizen's group or even an arbitrary decision would choose the best plan, but the principles of science provide the highest probability of being correct.

This example demonstrates science's value in proactive planning. As previously mentioned, science is also valuable in providing substantive knowledge, but proactive planning will often involve making choices without the luxury of that substantive knowledge. Using scientific procedure along with adaptive management provides the best hope of protecting biodiversity through proactive planning.

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[61] *See id.*

[62] *See* WILSON, *supra* note 26, at 298 ("Historians of science often observe that asking the right question is more important than producing the right answer. The right answer to a trivial question is also trivial, but the right question, even when insoluble in exact form, is a guide to major discovery.").

[63] *See id.*

III. THE CURRENT REGULATORY STRUCTURE

A. Single-Species Management

The advocates for single-species management have compelling arguments for continuing to manage species individually. Perhaps the most persuasive defender of single-species management is Professor Oliver Houck. In two recent articles, he stresses the importance of a bottom line in environmental law, and proclaims that species provide this line.[64] Houck's argument has force for two reasons. First, science has been unable to establish bottom lines for ecosystems.[65] Currently, we have no way to know at what point an ecosystem becomes so fragmented or altered that it ceases to function. We do know when a species goes extinct. Setting out a policy of preventing extinction is a legally enforceable bottom line.[66] Second, species are easier to classify then ecosystems, although occasional controversies occur even at the species level. For example, ornithologists do not agree on whether the Bullock's oriole and Baltimore oriole are separate species, or different subspecies of the northern oriole.[67]

Houck and other proponents of single-species management believe that the best way to manage ecosystems is to manage for indicator species within those ecosystems.[68] By managing particular species, ecosystem processes will be protected. Relying on this concept, Houck asserts that the Endangered Species Act (ESA) has been a success.[69] He argues that the ESA, through single-species management, provides a bottom line that protects ecosystems by preventing extinctions within them.[70]

The ESA is a prime example of a law based on single-species management, and is the primary legal protection against loss of biodiversity in the United States.[71] Despite its importance, the ESA has been a controversial law. Environ-

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[64] *See* Houck, *supra* note 10, at 959.
[65] *See* NOSS AND COOPERRIDER, *supra* note 2, at 76-77.
[66] *See id.*
[67] *See* Frank Graham, *Baltimore Orioles Score*, 98 AUDUBON 24 (1996).
[68] *See id.* at 5.
[69] *See id.* at 959.
[70] *See id.*
[71] *See, e.g.*, COMM. ON SCIENTIFIC ISSUES IN THE ENDANGERED SPECIES ACT, NAT'L RESEARCH COUNCIL, SCIENCE AND THE ENDANGERED SPECIES ACT 1 (1995).

mentalists and scientists have attacked the ESA for being too reactionary, for failing to provide real recovery for listed species, and for failing to protect ecosystems.[72] Landowners have attacked the ESA because they feel it places too large a burden on them.[73]

Despite the criticisms of the ESA, almost no one suggests that it should cease to exist. Representative Don Young of Alaska, quite possibly the most ardent anti-environmentalist currently holding public office, introduced a bill in 1996 along with Representative Richard Pombo of California.[74] This bill, which never reached the House floor, would have required government compensation for any devaluation of private land greater than twenty percent due to enforcement of the Endangered Species Act.[75] It is informative that a staunch property rights advocate sponsored a bill recognizing the continuance of the ESA and acknowledging that landowners should pay a portion of the costs of protecting biodiversity.

B. Ecosystem Management

Ecosystem management has been defined as "an approach that attempts to involve all stakeholders in defining sustainable alternatives for the interactions of people and the environment in which they live."[76] The proponents of ecosystem management believe that the single-species approach is too narrowly focused and that the best way to preserve biodiversity is to manage ecosystems. There are many advantages to an ecosystem approach. First, ecosystem management more closely reflects the holistic focus of ecology.[77] Since ecology studies the interactions among species, it makes sense that any management strategy should be based on those principles.

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[72] *See, e.g.*, J.B. Ruhl, *Who Needs Congress? An Agenda for Administrative Reform of the Endangered Species Act*, 6 N.Y.U. ENVTL. L.J. 367 (1998); Timothy H. Tear et al., *Recovery Plans and the Endangered Species Act: Are Criticisms Supported by Data?* 9 CONSERVATION BIOLOGY 182 (1995).
[73] *See, e.g.*, KAUFFMAN, *supra* note 13; Tobie Murray, *An Endangered Habitat Act to Help Landowners Protect Wildlife*, 24 ECOLOGY L. Q. 689 (1997); Susan Shaheen, *The Endangered Species Act: Inadequate Species Protection in the Wake of the Destruction of Property Rights*, 55 OHIO ST. L. J. 453 (1994).
[74] H.R. 2275, 96th Cong. (1996).
[75] *See id.* at § 101.
[76] Robert C. Szaro et al., *The Emergence of Ecosystem Management as a Tool for Meeting People's Needs and Sustaining Ecosystems*, 40 LANDSCAPE & URB. PLAN. 1 (1998).
[77] D.S. Slocumbe, *Implementing Ecosystem Based Management*, 43 BIOSCIENCE 612, 616 (1993).

Second, the main cause of the biodiversity loss is habitat loss, and ecosystem management can better protect habitat for a broad variety of species.[78] Third, ecosystem management is more cost effective than spending money managing individual species.[79] Fourth, ecosystem management forces humans to be part of any solution.[80] Finally, ecosystem management is proactive.[81]

These advantages have been well accepted by both scientists and policy makers, but not everyone agrees that ecosystem management is the best method to protect biodiversity.[82] Even advocates of an ecosystem approach have recognized the necessity for some single-species management. In an article advocating an ecosystem approach to biodiversity protection, Reed Noss cautioned that "management of individual species on a population or metapopulation level remains a necessary part of any conservation strategy."[83] The problem seems to be that science recommends an ecosystem approach, but political realities favor a species approach.[84] Any proposal to protect biodiversity must find a method to solve this dilemma.

C. Society's Desire for Certainty

Solutions designed to protect biodiversity must first take into account the cause of the problem. The driving force behind the loss of biodiversity is human activity.[85] It is humans that cut forests, cultivate grasslands, and divert water from streams into urban swimming pools. Any regulation of human activity must be done through political and legal means, which necessitates a focus on societal concerns. Any solution that is not politically, economically, or socially acceptable will not be implemented.[86] The importance of addressing human

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[78] Frank J. McCormick, *Principles of Ecosystem Management and Sustainable Development*, in JOHN D. PEINE, ECOSYSTEM MANAGEMENT FOR SUSTAINABLITY 9 (1999).

[79] *See id.*

[80] *See id.* at 8.

[81] *See* Julie. B. Bloch, *Preserving Biological Diversity in the United States: The Case for Moving to an Ecosystems Approach to Protect the Nation's Biological Wealth*, 10 PACE ENVTL. L. REV. 175, 201.

[82] *See* Oliver Houck, *Are Humans Part of Ecosystems?* 28 Envtl. L. 1 (1998).

[83] Reed F. Noss, *Some Principles of Conservation Biology as They Apply to Environmental Law*, 69 CHI-KENT L. REV. 893, 900 (1994).

[84] *See* Houck, *supra* note 10, at 975.

[85] *See* Deborah J. Forester & Gary E. Machlis, *Modeling Human Factors That Affect the Loss of Biodiversity*, 10 CONSERVATION BIOLOGY 1253, 1254 (1996).

[86] *See* HANNA J. CORTNER & MARGARET A. MOORE, THE POLITICS OF ECOSYSTEM MANAGEMENT 141 (1999).

concerns is increased by the fact that private lands must be part of any protection strategy.[87] Landowners will be more willing to cooperate if protection measures protect their values.[88]

Society's desire for certainty is illustrated by the response to Secretary Babbitt's "No Suprises" policy. In the ten years prior to the announcement of No Surprises, only fourteen Habitat Conservation Plans (HCPs) were approved.[89] In the three years after announcement, approximately 130 incidental take permits were issued.[90] This indicates that landowners are willing to spend heavily to achieve certainty.

Throughout history our laws and jurisprudence have favored certainty and the promotion of social order. Professor Frazier has termed these goals the "stability principle."[91] He uses a familiar property case, *Johnson v. M'Intosh*, to illustrate this principle.[92] One of the Justice Marshall's justifications for refusing to acknowledge land grants by Native Americans was that it would upset the ownership status of too many landowners. Frazier also discusses the "reliability principle,[93] which promotes investment by providing certainty to people purchasing and building on land.

The most important protection of private property rights is the Fifth Amendment's Takings Clause, which reflects the principle that owners of private property should not be required to bear the burden of providing benefits to the general public.[94] It is the position of this Article that any long-term solution to biodiversity protection will have to respect this principle. It is important that landowners consider the ecological consequences of actions on their land, but the public should help pay costs that unfairly burden individual landowners. By doing so, society protects the interests of landowners and sends the message that environmental protection is a valued public benefit.

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[87] *See* Michael J. Bean, *The Endangered Species Act and Private Land: Four Lessons Learned from the Past Quarter Century*, 28 ELR 10701, 10704 (1998).
[88] *See id.*
[89] *See* Donald J. Barry, *Opportunity in the Face of Danger: The Pragmatic Development of Habitat Conservation Plans*, 4 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 129, 130 (1997).
[90] *See id.* at 130.
[91] *See* Terry W. Frazier, *Protecting Ecological Integrity Within the Balancing Function of Property Law*, 28 ENVTL. L. 53, 77 (1998).
[92] *See* Johnson v. M'Intosh, 21 U.S. 453 (1823).
[93] *See* Frazier, *supra* note 91, at 80.
[94] Armstrong v. United States, 364 U.S. 40, 49 (1960) (stating that purpose of Fifth Amendment was to "bar Government from forcing some people alone to bear public burdens which, in all fairness and justice, should be borne by the public as a whole.").

D. Current Attempts to Provide Certainty and Ecosystem Management

In response to the dual and often conflicting needs of ecosystem management and certainty, new programs have been added to the ESA. These programs have attempted to focus on proactive protection of habitat while providing landowners with greater flexibility and certainty. These programs are Habitat Conservation Planning, Natural Communities Conservation and Planning, and No Surprises.

1. Habitat Conservation Plans

In 1982 Congress amended section 10 of the ESA to allow the incidental take of an endangered species when a conservation plan is developed.[95] Donald Barry, former Deputy Director of the U.S. Fish and Wildlife Service, has stated that "without exception, the concept of Habitat Conservation Planning is probably the most important development for endangered species conservation since the passage of the original act."[96] The idea of HCPs was a bold step in implementing proactive habitat protection. However, the current HCP process is far from satisfactory. First, standards for approval of HCPs are not specific.[97] It is possible to have approval of an HCP that would allow harm to an endangered species.

Second, HCPs are often not based on scientific information.[98] Third, they often involve small pieces of habitat. Even though 243 incidental take permits were issued by September 30, 1998, only 28 completed HCPs involved areas exceeding 10,000 acres.[99] The majority of HCPs are for areas of less than 1000 acres.[100] Large-scale landscape planning cannot occur if HCPs cover only small areas. Finally, HCPs are often based on the needs of single species.[101] This prac-

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[95] Endangered Species Act § 10(2)(A), 16 U.S.C. § 1539 (2)(A) (1998).
[96] *See* Barry, *supra* note 89, at 129.
[97] *See* NOSS ET AL., *supra* note 5, at 32.
[98] *See* B.B. Bingham and Barry R. Noon, *Mitigation of Habitat "Take": Application to Habitat Conservation Planning*, 11 CONS. BIO. 127 (1997).
[99] U.S Fish and Wildlife Service, *Habitat Conservation Plans and the Incidental Take Permitting Process* (last visited August 29, 1999) <http://www.fws.gov/r9endspp/hcp/hcpplan.html> (on file with author).
[100] *See id.*
[101] *See* NOSS ET AL., *supra* note 5, at 36.

tice is in accordance with the mandates of the ESA, but does not contribute to the goal of large-scale landscape planning.

2. Natural Communities Conservation and Planning

In 1991 California created the Natural Communities Conservation and Planning program (NCCP)[102] in response to the conflict between developers in Southern California and the need to conserve the coastal sage scrub community.[103] The imminent listing of the California gnatcatcher, a songbird that depends on coastal sage scrub for its survival, provided the incentive for the planning efforts.[104]

NCCP was designed to provide habitat planning at an ecosystem management scale and in that respect is superior to the HCP process. In many respects, however, the NCCP process works like a multispecies HCP. Participants receive exemption from the California ESA under the NCCP act.[105] Exemption from sanctions under the federal ESA is granted either by normal section 10(a) HCP standards or by special rule 4(d).[106] Section 4(d) specifically applies to the California gnatcatcher.[107] In addition, participants are also covered under No Surprises assurances.

NCCP has distinct advantages over both the traditional section 9 take prohibitions and the traditional HCP process. These advantages include 1) a focus on biodiversity instead of species-by-species, 2) collaborative participation across legal boundaries, 3) research that will lead to better management, 4) a requirement that local governments do the monitoring, 5) interagency cooperation, 6) proactivity, and 7) certainty to landowners.[108]

These advantages do make the NCCP process preferable to small-scale HCPs, but the NCCP process still does not address the overall weaknesses of the ESA. Primarily, the process is not proactive enough. Without an endangered

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[102] CAL. FISH & GAME CODE § 2800 (West 1998).
[103] *See* Steve Johnson, *Natural Community Conservation Planning: A Targeted Approach to Endangered Species Conservation*, 4 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 135 (1998).
[104] *See* NOSS ET AL., *supra* note 5, at 43.
[105] CAL. FISH & GAME CODE § 2800 (West 1998).
[106] Endangered Species Act § 4(d), 16 U.S.C. § 1533(d).
[107] *See* 58 Fed. Reg. 16,758 (1993).
[108] See DeAnne Parker, *Natural Community Conservation Planning: California's Emerging Ecosystem Management Alternative*, 6 U. BALT. J. ENVTL. L. 107, 131 (1997).

species to provide urgency, the NCCP process is unlikely to be triggered.[109] Also, the No Surprises guarantees do not allow for adaptive management. In short, the NCCP idea is a positive step toward proactive landscape planning. However, it does not go far enough and should not be considered the long-term solution to biodiversity protection.

3. No Surprises

To encourage landowners to develop Habitat Conservation Plans, Secretary Babbitt announced the No Surprises policy in 1994.[110] This policy assures landowners who participate in HCPs or NCCPs that no further commitments of land or finances will be required for a specified period of time, usually one hundred years.[111] No Surprises is successful in encouraging landowners to develop HCPs. As mentioned earlier, only fourteen HCPs were issued in the ten years prior to No Surprises, while 130 permits were issued in the three years following enactment of the policy.[112] Notwithstanding these figures, the success of No Surprises cannot be measured simply by how many landowners enter into HCPs and NCCPs. The true test of any environmental policy must be whether it protects the resource it is intended to protect. For the purpose of this Article, that resource is biodiversity protection.

Does No Surprises increase biodiversity protection, or does it compromise protection? Professor Bosselman, who was involved in the NCCP process, has touted the No Surprises policy, arguing that it benefits both endangered species and landowners.[113] He also argues that both the ESA and the Constitution mandate the No Surprises policy.[114]

Bosselman's arguments are convincing, because a No Surprises policy is necessary if society is to proactively protect biodiversity. Without a method of assuring landowners, proactive planning will never happen. Without proactive

[109] *See id.* at 132.
[110] *See* U.S. Fish and Wildlife Serv., U.S. Dep't of Interior, Endangered Species Habitat Conservation Planning Handbook, 3-29 (1996).
[111] *See id.*
[112] *See* Barry, *supra* note 89, at 130.
[113] *See* Fred Bosselman, *The Statutory and Constitutional Mandate for a No Surprises Policy*, 24 ECOLOGY L.Q. 707 (1997).
[114] *See id.*

planning, society will never effectively protect biodiversity.[115] However, the No Surprises policy must be altered.

Rather than provide absolute certainties, No Surprises must allow for adaptive management. Providing certainty to landowners is not only necessary to encourage cooperation, but it is a fair method of spreading the burden of environmental protection.[116] However, the desire to achieve certainty must not come at the expense of adaptive management. A No Surprises policy that protects both landowners and biodiversity is possible. To accomplish this goal, a reliable source of funding is necessary to pay for any further protection necessary during the No Surprises period. Without that source of funding, further protection will not occur when it is necessary.[117]

IV. LANDSCAPE ECOLOGY

Landscape ecology has been defined as the "study of the response of species or communities to patterns across more than one patch."[118] Landscape ecology is different from other branches of ecology in that it focuses on the large-scale processes that affect entire landscapes or regions, rather than focusing on individual species or habitat patches.[119] This focus allows landscape ecology to provide important insights into the protection of biodiversity, particularly in light of the fact that the primary cause for loss of biodiversity is habitat loss through human actions.[120] In the language of landscape ecology, habitat loss is known as landscape transformation.[121] Landscape transformation is both the primary cause of biodiversity loss and the central focus of landscape ecology; therefore, landscape ecology as a scientific discipline is uniquely capable of analyzing human caused declines in biodiversity.[122]

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[115] *See infra* Part IV (detailing the need for landscape ecology in efforts to protect biodiversity).
[116] *See supra* Part III.C (arguing that landowner values must also be considered in any successful framework of biodiversity protection).
[117] Without a source of funding to compensate landowners for changes needed, adaptive management will not be possible. *See infra* Part V.B.4 (describing the need for a source of funding that will not depend on congressional appropriations).
[118] *See* MICHAEL L. MORRISON, BRUCE G. MARCOT, AND R. WILLIAM MANNAN, WILDLIFE-HABITAT RELATIONSHIPS (1992).
[119] *See* RICHARD T.T. FORMAN, LAND MOSAICS: THE ECOLOGY OF LANDSCAPES AND REGIONS (1995).
[120] *See* MORRISON ET AL., *supra* note 118, at 42.
[121] *See* FORMAN, *supra* note 119, at 412.
[122] *See id.* at xvi-xix.

A. Basic Concepts

In landscape ecology, all landscapes consist of three spatial elements: patches, matrix, and corridors.[123] Patches are nonlinear homogeneous areas that are different from surrounding habitat.[124] A stand of old growth redwood forest is a patch. Matrix is the background area surrounding the patches and corridors.[125] An example of matrix is the farmland surrounding a wetland. Corridors are strips of land that differ from the land on both sides.[126] A riparian forest with grasslands on either side is an example of a corridor.

A landscape made up of a mixture of these patches, matrix, and corridors is a mosaic. It makes intuitive sense that the relative amount of each element in the landscape will affect ecosystem function. However, other landscape properties affect ecosystem function within the landscape. These include the size of individual patches, the shape of the patches, the width of corridors, the sharpness of boundaries, and conditions in adjacent landscapes.[127] Through consideration of these properties, landscape ecology seeks to provide solutions to conflicts between human activity and ecosystems.[128]

B. Processes of Landscape Transformation

Fragmentation, which occurs when larger patches of habitat are broken into smaller patches,[129] is the most often studied aspect of landscape transformation.[130] This process has been studied heavily throughout various scientific disciplines and is considered one of the primary factors in the decline of animal populations.[131] However, fragmentation is one of only five processes of land transformation. The other four are perforation, shrinkage, attrition, and dissection.[132]

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[123] *See id.* at 6.
[124] *See id.* at 39.
[125] *See id.* at 39.
[126] *See id.* at 38.
[127] Forman develops the importance of these properties throughout his book. *Id.*
[128] *See id.* at xviii.
[129] *See id.* at 406.
[130] *See id.*
[131] M. Rupert Cutler, *The Watchdog Role of Nongovernmental Environmental Organizations*, *in* BIODIVERSITY AND LANDSCAPE: A PARADOX OF HUMANITY 376 (Ke Chung Kim & Robert D. Weavers eds., 1994).
[132] *See* FORMAN, *supra* note 119, at 407-08.

Perforation occurs when a hole is made in a patch of habitat.[133] Perforations can be caused by many activities, such as logging. Wind can create perforations by blowing down trees. Building a house in the middle of a grassland is a perforation. Perforations affect patches by lowering the amount of interior habitat, by reducing the total amount of habitat, and by creating more edge within the patch.[134]

Shrinkage occurs when a decrease in the size of patches occurs through the removal of habitat from around the edges.[135] Fire is a common cause of shrinkage. Expansion of suburban areas into rural areas is another common cause of shrinkage. The effects of shrinkage are similar to the effects of perforation, but the impact on interior habitat is not as severe. Also, amount of edge is decreased, because the boundary area is smaller.[136]

Attrition is the complete removal of a patch or corridor.[137] A catastrophic fire that burns an entire stand of trees is an example. Filling in a wetland is another example. Attrition obviously results in habitat loss. Attrition also reduces the number of patches, which could lead to reduced interpatch movement.[138]

Dissection is the division of a patch into two or more separate patches by a strip of consistent width. Natural examples of dissection are rare. Roads and railroads are human created dissections. Dissections increase the number of patches, but decrease patch size and interior habitat.

It is important to note that the five processes of land transformation occur both naturally and by human disturbance.[139] By helping human disturbance patterns mimic natural disturbance, landscape ecology principles can be an effective tool for managing human impacts on ecosystems. While the effects of fragmentation have received the most attention, the other processes are of similar importance.[140] In particular, perforation and attrition have been implicated in the process of desertification.[141]

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[133] *See id.*

[134] *See id.*

[135] *See id.*

[136] *See id.*

[137] *See id.*

[138] *See id.*

[139] *See id.*

[140] *See id.* at 415.

[141] N.P. Hanan et al., *Assessment of Desertification Around Deep Wells in the Sahel Using Satellite Imagery*, 28 J. APPLIED ECOLOGY 173 (1991).

C. What Studies Tell Us

Jerry Franklin and Richard Forman have studied the impacts of landscape transformation.[142] In a 1987 study, the transformation of a coniferous forest through logging was evaluated using a checkerboard model.[143] This study provided two insights that could be very important to managing for biodiversity. First, most major ecological changes occur within the initial 50% of land transformation.[144] Second, "the most critical time for land planning and conservation appears to be when the landscape has 60 to 90% of its area in natural vegetation."[145]

The implications of that last sentence are enormous for how to manage landscapes for biodiversity. If this statement is true, the Endangered Species Act will never efficiently protect biodiversity. The ESA is designed to take effect only when a species is faced with extinction. By the time this threat occurs, the landscape has already been altered significantly. Loss of habitat is the leading cause of species endangerment.[146] The enforcement measures of the ESA are powerful, but by the time they are triggered, the opportunity for proactive landscape planning has ceased to exist.[147]

The importance of proactive landscape planning is also supported by findings in other studies. According to a study on the effects of forest harvest practices, there is significant evidence that where and how logging occurs is as important as how much logging occurs.[148] If the sequence of landscape transformation has large effects on the quality of ecosystems within that landscape, then proactive planning is essential. Only through proactive planning can landscape

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[142] Jerry Franklin & Richard Forman, *Creating Landscape Patterns by Forest Cutting: Ecological Consequences and Principles*, 1 LANDSCAPE ECOLOGY 5 (1987).

[143] *See id.* A checkerboard model is a landscape transformation model in which clear-cuts (or other disturbances) are dispersed as evenly as possible. When 50% of the landscape has been clear-cut, the landscape will look like a checkerboard. *Id.* at 7.

[144] *See id.* at 12.

[145] FORMAN, *supra* note 119, at 417.

[146] *See* MORRISON ET AL., *supra* note 118, at 42.

[147] *But see* Houck, *supra* note 10, at 959 (arguing that the Endangered Species Act does allow for proactive planning).

[148] *See* H. Li et al., *Developing Alternative Forest Cutting Patterns: A Simulation Approach*, 8 LANDSCAPE ECOLOGY 63 (1993).

transformation be done in the "ecologically optimum" manner.[149] There will never be any ecologically optimum sequence chosen through the use of the Endangered Species Act. The ESA wasn't designed to even consider the possibility.

D. Possible Models for Landscape Transformation

Forman has proposed a possible optimal arrangement of landscape transformation that could be used in any type of landscape. The aggregate-with-outliers principle states that we should "aggregate land uses, yet maintain corridors and small patches of nature throughout developed areas, as well as outliers of human activity spatially arranged along major boundaries."[150] This principle incorporates seven key attributes.[151] These are 1) large patches of natural vegetation, 2) grain size, 3) risk spreading, 4) genetic variation, 5) boundary zone, 6) small patches of natural vegetation, and 7) corridors.[152]

In addition to the ecological advantages of following this principle, Forman listed ten direct benefits to humans. These are 1) a wide range of settings, 2) locations for suburban dwellers as well as individual homesites, 3) fine-scale areas where jobs, homes, school, and shops are close together, 4) efficiency of human transportation, 5) prevention of strip development, 6) specialization within cities, 7) urban garden areas, 8) large patches for efficient resource extraction, 9) limits on the difficulties of scattered farms, and 10) visual diversity.[153]

Whether the aggregate-with-outliers principle is the best method for using landscape ecology principles is outside the scope of this Article. Some other model for landscape transformation could be used, such as the "jaws model,"[154] which reduces the negative effects of landscape transformation by allowing encroachment of matrix from only two adjacent edges.[155] Following the jaws model reduces fragmentation, improves connectivity, and maintains large blocks of

[149] *See* FORMAN, *supra* note 119, at 437. The term "ecologically optimum" comes from Forman. *Id.* at 426. Forman hypothesizes that for any landscape there exists an "optimal spatial arrangement of ecosystems and land uses to maximize ecological integrity." *Id.* at 522.

[150] *See id.* at 437.

[151] *See id.* at 438.

[152] *See id.*

[153] *See id.* at 439.

[154] *See id.* at 429-32.

[155] *See id.* at 429.

habitat.[156] Other models for optimum landscape planning exist,[157] and landscape ecologists will continue to develop new ones.

This Article does not advocate for the use of any particular landscape transformation model, but it is important that landscape ecology principles are used in protecting biodiversity. Without a legal framework that allows inclusion of these principles, biodiversity protection will continue to be random, inefficient, and ineffective. If the legal community is serious about protecting biodiversity, that framework must be developed and implemented.

V. A Proactive Method of Including Landscape Ecology

A. *Professor Ruhl's Idea for Proactive Planning*

Professor J.B. Ruhl has developed a plan for dealing with the problem. His plan is based on the passage of a "unified biodiversity conservation statute" that he calls the Biological Resources Zone Management Act.[158] His proposal has three stages. First, states identify and nominate biological resource zones. Second, local and private groups develop biological resource zone management plans that are subject to federal approval. Third, the management plan bypasses the federal regulatory structure.

Ruhl's plan has advantages. First, it is proactive. Second, it brings local and state governments into the planning process, which helps reduce resentment of top down federal environmental laws.[159] Finally, it eliminates many of the hurdles to landscape planning through incentives for landowners and local governments.[160] Any plan that will work is going to need these elements.

Despite the merits of Ruhl's plan, it is not workable as currently designed. Most importantly, it assumes a level of scientific knowledge that does not exist at this time. The entire basis of Ruhl's plan is that a biological resource zone management plan can be designed that will protect biodiversity.[161] Earlier in this Article it was argued that science is currently unable to provide answers that

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[156] *See id.* at 430.
[157] *See id.* at 428.
[158] J.B. Ruhl, *Biodiversity Conservation and the Ever-Expanding Web of Federal Laws Regulating Nonfederal Lands: Time for Something Completely Different?* 66 U. Colo. L. Rev. 555, 662 (1995).
[159] *See id.* at 645.
[160] *See id.* at 663.
[161] *See id.* at 662.

would enable the design of perfect landscape plans. Ruhl has written other articles discussing the role of complexity theory in law, which perhaps explains his overly optimistic view of science's ability to provide landscape plans that will need no changes in the future.[162]

Complexity theory, as discussed earlier, has the potential to be one of the greatest scientific achievements. If the complexity theorists can find ways to understand complex systems and predict their behavior, planners will know exactly how much land to preserve in order to maintain ecosystem function. At best, we do not have that knowledge now. At worst, we will never have that knowledge. E.O. Wilson has probably provided the proper view of complexity theory for purposes of environmental law. He said:

> I would like to be a true believer . . . my heart is with them. But my mind is not, at least not yet. I believe with many other centrists that they are on the right track — but only more or less, maybe, and still far short of success.[163]

Since we cannot rely on complexity theory or any other current scientific knowledge to design perfect landscape plans, adaptive management must be a part of any successful plan. Ruhl's plan does not allow for adaptive management, and therefore it will not be successful at protecting biodiversity.

Even if science were able to develop perfect landscape plans that need no adaptive management, Ruhl's plan has another flaw. Ruhl assumes that these plans designed by local governments and private parties will follow the best available science. There is nothing in his plan that supports this assumption. It is not enough to simply generate a plan; that plan must be scientifically valid as well.

In short, Ruhl's idea goes a long way toward solving the problem. However, it is not a workable solution as designed. In an attempt to provide a workable solution, this Article will now offer a legal framework that shares many elements with Ruhl's plan. However, several important differences make this framework scientifically defensible as well as socially acceptable.

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[162] *See* J.B. Ruhl, *The Fitness of Law: Using Complexity Theory to Describe the Evolution of Law and Society and Its Practical Meaning for Democracy*, 49 VAND. L. REV. 1407 (1996); J.B. Ruhl, *Complexity Theory as a Paradigm for the Dynamical Law and Society System: A Wake Up Call for Legal Reductionism and the Modern Administrative State*, 45 DUKE L. J. 849 (1996).

[163] WILSON, *supra* note 26, at 88.

B. Proposal of a Possible Method

1. Plan for Entire Landscape

The first step in the process must be to develop a plan for the entire landscape in question, using an interdisciplinary panel that allows for both ecological and human needs to be addressed. The NCCP experiment has provided a workable model for how plans could be formed. By allowing plans to be developed at the local level, we use the power of local government to implement land use planning.[164] It is important, however, for local plans to be integrated into overall regional and nationwide planning schemes.

An important element of the planning process will be a veto power for the scientists on the panel. It is imperative that any plan consider ecological needs first, or the planning process will be meaningless.[165] A veto power for the social scientists on the panel is unnecessary because societal values will be protected in other parts of the process. Developing a proactive landscape plan will allow landscape ecology principles to be used. It is important to remember the findings of Franklin and Forman,[166] which tell us that most significant impacts on spatial characteristics occur at the beginning of landscape transformation.[167] Therefore, more proactive plans will more successful.

2. Landowner Enrollment

After the plan is developed, landowners within the landscape will be offered the choice of enrolling in the plan. In return for enrollment, the landowner receives a hundred-year No Surprises guarantee. This Article has already discussed the problems with No Surprises and its effect on adaptive management.[168] To allow for adaptive management, the landscape plan is reviewed every twenty

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[164] *See* TIMOTHY BEATLEY, HABITAT CONSERVATION PLANNING: ENDANGERED SPECIES AND URBAN GROWTH 204-06 (1994).

[165] *See* NOSS ET AL., *supra* note 5, at 211.

[166] *See* Franklin & Forman, *supra* note 142, at 12.

[167] *See id.*

[168] *See supra* Part III.D.3 (discussing absolute guarantees as interfering with adaptive management).

years.[169] Landowners would be compensated for eighty percent of any additional cost of conservation caused by adaptive management.[170]

Three things are accomplished by compensating landowners at the eighty-percent level. First, doing so provides certainty, which is important if we hope to change society's view of landscape planning. Second, by leaving the landowner responsible for twenty percent of additional costs, landowners have incentive to support well-designed initial landscape plans. Finally, potential additional expense encourages landowners to follow the plan closely to avoid the need for revisions.

3. Refusal of Landowner to Join Plan

A landowner that refuses to join the landscape plan will be subject to the full regulatory force of all environmental laws, including the Endangered Species Act. By joining the plan, a landowner can avoid the uncertainty of future species listings. This will be a powerful motivating factor for landowners to join. If landowner participation is consistently low, additional incentives may need to be developed.

4. Funding to Pay for Adaptive Management

Implementing landscape plans will be expensive in most areas. Setting aside land as reserves will be necessary in many landscape plans. Therefore, it will be necessary to establish a fund for initial land acquisitions or conservation easements. Also, a fund must be established for compensating landowners for any twenty-year revisions. One possible source for this funding is the Land and Water Conservation Fund.[171] However, the Land and Water Conservation Fund

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[169] The suggestion of a 20-year period is not based on any exact principle. It merely seems to be a reasonable figure. That number could be adjusted in accordance with recommendations from other more knowledgeable people.

[170] The 80% level of compensation is based on the figure in the Young-Pombo Bill. H.R. 2275, 96th Cong. (1996). Like the 20-year period for revisions, it could be adjusted if necessary. Environmentalists angered at the idea of compensating landowners should remember that the current No Surprises policy pays for 100% of any additional costs. Political realities as well as basic fairness require that landowners be provided with certainty.

[171] This fund was created by 16 U.S.C. § 460d (1998).

would likely not be adequate by itself, and it has been underused in the past.[172] Development of a more secure source of funding will be necessary.

VI. Advantages of the Proposed Framework

A. Proactive

The greatest advantage of this legal framework is that it is proactive. First, planning proactively allows landscape ecology principles to be used when they will be most valuable.[173] Second, proactive planning allows protection of species to occur before they become endangered. Early intervention provides a greater hope for species survival than the current crisis management approach. Third, proactive planning provides landowners with advance notice of what will be required of them, providing certainty.

B. Reduces Animosity Between Environmentalists and Landowners

There are at least four ways that this legal framework will reduce animosity between environmentalists and landowners. First, it will provide certainty to landowners. Once a landscape plan is developed, landowners will know what will be expected for at least a twenty-year period. Further, they will know that the burden of paying for any revisions made after that twenty-year period will not be theirs alone.

Second, landowners will feel as if the public is genuinely concerned about their values. This is accomplished by having landowners pay only twenty percent of costs for revisions to the plan. Landowners will be less likely to resent environmental laws if they perceive that they are not paying a disproportionate share of the cost.[174] Proactive planning allows costs to be spread out over all landowners in an area by establishing what protective measures are necessary and who should pay for those measures across an entire landscape. The Endangered Species Act creates unfairness by forcing the landowner that develops last

[172] *See* John R.E. Bliese, *Conservative Principles and Environmental Policies*, 7 KAN. J. L. & PUB. POL'Y 1, 16 n. 98 (1998) (citing BUDGET OF THE UNITED STATES GOVERNMENT, FISCAL YEAR 1998, APPENDIX 625 (1997))("of the $900 million in annual receipts in 1996, 1997, and 1998 Congress appropriated a mere $168 million, $179 million, and $197 million respectively for land and water conservation.").
[173] *See* FORMAN, *supra* note 119, at 416.
[174] *See* Bradley C. Karkkainen, *Biodiversity and Land*, 83 CORNELL L. REV 1, 92 (1997).

to bear the costs alone, while those landowners whose actions caused the species to become endangered pay nothing.[175]

Third, the local nature of the planning process will help eliminate animosity created by federally imposed regulations. Landscape planning can use the existing local land use structures, which are regarded with less animosity by landowners than are federal regulations.[176] Local processes give landowners a voice, helping them feel their values are being protected.[177]

Finally, landowners will have the option of not joining the landscape plan. Many landowners will elect to become part of the landscape plan because of the certainty it provides. However, the fact that the landowner has a choice is important. Landowners are more likely to resent environmental laws when they are seen as part of what Ruhl calls the Coercion Model.[178] The legal framework proposed in this Article works on principles consistent with Ruhl's Cooperation Model.[179]

C. Interdisciplinary Planning Process

Forman discusses the ability of landscape ecology to provide a common language for a variety of disciplines.[180] Professionals across a broad spectrum have difficulty in communicating because of different training.[181] However, most professionals do understand the spatial language of landscape ecology, allowing multiple disciplines to work together in landscape planning.[182]

Interdisciplinary planning provides two advantages. First, many problems can be addressed at one time. Forman has stated this well in saying, "Society gains by no longer having to consider or implement plans developed only by engineers, only by economic planners, or only by ecologists."[183] Plans using the expertise of diverse disciplines are more likely to be "wise and long-term."[184]

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[175] *See id.*
[176] *See* Ruhl, *supra* note 158, at 645.
[177] *See id.*
[178] *See id.* at 632-41.
[179] *See id.* at 643-45.
[180] *See* FORMAN, *supra* note 119, at 442.
[181] *See id.*
[182] *See id.*
[183] *Id.* at 441.
[184] *See id.*

Second, interdisciplinary planning allows scientists to participate throughout the entire process. It is not enough that scientists are given a veto over plans after they have been formulated. Scientists should be a part of the planning process at an early stage, so that science will be the foundation for the plan.[185] This increases the chance of generating scientifically valid plans.

D. Allows for Adaptive Management

Even the best landscape plans are likely to need some revisions. This is especially true when considered in the light of advancing scientific knowledge. As science provides new solutions, landscape plans need the ability to incorporate that new knowledge. The twenty-year period for revisions provides for a hundred-year No Surprises guarantee to the landowner while still allowing adaptive management to take place.

E. Allows for Regional and Continental Planning

The scale of planning can be taken beyond the landscape level. The proposed legal framework is designed to accomplish a method of implementing landscape level planning, but the opportunities for planning do not end there. Just as landscape planning allows us to consider the effect of changes on habitat patches to landscapes, regional planning allows us to consider the effect of landscape changes on regions.[186]

Individual landscape plans will be assessed in their validity for that landscape, but it is also possible to assess an individual plan's impact on other landscape plans within the region. All landscape plans could be implemented within the framework of a larger regional plan. The next step would be to incorporate those regional plans into a larger continental plan. The potential advantages of continental plans have been the impetus behind ideas like the Wildlands Project.[187] Under the narrow focus of the current regulatory structure, opportunities like these will never happen.

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[185] *See* NOSS ET AL., *supra* note 5, at 124.

[186] *See* FORMAN, *supra* note 119, at 27.

[187] *See* Michael Soule, *A Vision for the Meantime*, WILD EARTH, Special Issue 1992, at 7, 8 (discussing need for land-use planning at regional levels to be followed by coordination of regional plans into national and continental plans).

F. Responds to Houck's "Bifurcation Process"

Professor Houck has talked of the need to separate questions of ecosystem protection from questions of human needs.[188] He argues that without this bifurcation, there will be no protection for ecosystems. The process of developing landscape plans under this framework addresses this concern. Every panel that designs landscape plans under this system would include scientists. The scientists on the panel would have veto power over any plan that did not adequately address ecological concerns. This arrangement will prevent the approval of plans that underprotect.

Another safeguard against plans that inadequately address ecosystem protection is the provision that requires federal approval of local and regional plans. Even if an inadequate plan were developed at the local level, that plan would have to undergo the scrutiny of federal approval. No level of scrutiny can guarantee that all plans would adequately address ecosystem concerns. However, no environmental law, even the rigid Endangered Species Act, absolutely protects ecosystems.

G. Forces Society to Analyze Long-Term Cumulative Impacts

Landscape planning requires that society examine the impacts of its actions on a broad scale. This requirement will alleviate the problem of failing to assess cumulative impacts.[189] Under the current regulatory structure, habitat destruction is largely uncontrolled or unquestioned unless a wetland is drained or a listed species is harmed. This situation stems from the fact that legal standards such as prevention of all extinctions are a double-edged sword.[190] On the one hand, they provide inviolable rules. On the other hand, however, strict legal standards allow society to become complacent.[191]

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[188] *See* Houck, *supra* note 82, at 2, 6, 10. Houck argues that if ecosystems are defined by human needs, then ecosystem management will be meaningless. He illustrates the need for bifurcation by using his puppy as an example. The puppy would eat to the point of illness if the puppy chow were not high on a shelf. Houck suggests that a bifurcation process will work in much the same way, keeping humans "out of the chow." *Id.* at 10.

[189] *See* FORMAN, *supra* note 119, at 522-23.

[190] *See id.* at 440.

[191] *See id.* Forman describes this problem in terms of allowing planners to use standards as protection from their errors. The planner is absolved from responsibility as long as "one follows the code." *Id.*

The danger of complacency has been well demonstrated by the inadequate actions of society under these rigid legal standards. Under narrowly focused regulations, broader concerns are not properly addressed. Instead of asking the important questions about what effects our actions will have across space and throughout time, we end up asking narrowly focused questions. Questions such as whether the Delhi sands fly is going extinct are important. However, it is crucial to address broader problems. For example, the Endangered Species Act never forces us to determine how we can provide resources for an ever-increasing population of humans without losing biodiversity.

In addition to limiting the questions asked to a narrow focus, current regulations provide a false sense of security. Society is led to believe that environmentally destructive activities such as habitat loss are acceptable as long they can take place without violating standards.[192] Suburban sprawl, unsustainable logging, and fragmentation of habitat continue with little concern from society, because it is believed that the standards will prevent serious environmental harm.[193]

Having standards is important, but not as important as forcing society to confront the long-term impacts of management decisions. Landscape planning ensures that society will be more informed about the consequences of its actions. This is crucial if society is going to address biodiversity loss on a long-term basis. The Endangered Species Act and other current regulations, because they assume that environmental problems are temporary, will never create long-term solutions. There is no biodiversity "crisis" in the true meaning of that word, because the problem is not temporary. Human activities will always threaten biodiversity. Genuine solutions must be based on this premise.

VII. Response to Possible Criticisms

A. What If Landowners Don't Participate?

Some landowners will not choose to join particular landscape plans in areas without endangered species, because the incentive to join a landscape plan will be less urgent. There is also the potential for individual landowners to be

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[192] *See id.*
[193] *See id.*

free riders. These problems are inherent in any system based on voluntary participation.

The alternative to such a system would involve forcing landowners to join. This alternative is not socially acceptable, and would not be implemented.[194] Since a mandatory system is unacceptable, the problems of the voluntary system are inevitable issues that must be faced.

The problem of non-participation can be addressed. First, there are strong incentives for landowners to join a plan. The certainty provided by the No Surprises assurances will benefit landowners. Landowners who do not join a landscape plan will be subject to the current regulatory structure which could result in the full force of the Endangered Species Act being used against them. Second, if enough landowners in an area do not choose to join a landscape plan, then no plan for that area will be developed. At worst, an area would be regulated under the inefficient and ineffective method that currently exists in our regulatory structure.

Finally, if landowner participation becomes a significant problem, new incentives can be developed. Just as adaptive management is effective for managing natural resources, it may be used to make legal frameworks more effective. Proactive planning is flexible, unlike the rigidity of the current regulatory structure. Unworkable elements of the legal framework may be changed without affecting effective portions of the framework.

B. Requires a Fund to Be Established

In many areas, implementing landscape plans could be very expensive. Also, the No Surprises assurances will require that eighty percent of costs for twenty-year revisions be paid for out of public funds. Without a permanent funding source in place, land acquisitions and revisions would most likely never occur, because state and federal legislative bodies might be reluctant to release the funds.[195] This problem is so severe enough that any solution without a permanent funding source would likely fail.

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[194] Ruhl discusses this problem in response to any suggestion that federal land use planning is possible. Any mandatory federal land-use planning scheme would face fierce opposition. *See* Ruhl, *supra* note 158, at 651-54.

[195] *See* Bliese, *supra* note 172, at 16.

Will the public be willing to spend the money necessary to provide a permanent source of funding? If a recent poll of the U.S. public is correct, support for biodiversity protection exists.[196] The public must be informed that protecting biodiversity is expensive. Hopefully, society is willing to provide funds to implement true protection for both biodiversity and landowners. Of course, the public should be reminded that the current regulatory structure is expensive. It is not known whether the proposed framework would cost more.

C. How Much Protection?

The current regulatory structure has rigid bottom lines that help answer this question. "No extinctions" or "no net loss of wetlands" are clear answers to the question of how much protection. Landscape planning will not always have clear answers, and that is one of the trade-offs of implementing proactive planning.

The question of how much protection is needed will need to be asked by the panels that develop landscape plans. Standards like no extinctions and no net loss of wetlands will obviously need to be part of any landscape plan. Having a veto for the scientists on the panel will help ensure that inadequate landscape plans will not be approved.

D. Babbitt-Watt Test

Houck talks of the need for any environmental law to meet the "Babbitt-Watt" test.[197] The idea of this test is that the evaluation of any discretionary measure in an environmental regulation must not only be what Bruce Babbitt might do with that discretion, but what James Watt might do with that discretion. This test is an illustration of the dangers of not having a bottom line. However, there are two responses to the Babbitt-Watt test.

An artificial bottom line is not likely to be established within a proactive planning program. However, the procedural devices put into the plan will provide protection from any discretionary abuses. No landscape plan will be ap-

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[196] A poll conducted in 1996 found that 92% of those polled thought biodiversity protection was either "very important" or "somewhat important". *See* Roper Poll of 3/12/96 *available in* Westlaw POLL database, Question ID # USBELDEN.96ECOL R52.

[197] *See* Houck, *supra* note 10, at 975 n. 641.

proved at the local or regional level if scientists on the panel veto it for lack of scientific validity. Once the plan is developed, the federal government also must approve it. If abuse of discretion by a political authority such as the Secretary of Interior is a concern, a biodiversity panel could be created to take charge of authorizing landscape plans. While ways to minimize abuse of discretion should be developed, fear of abuse must not block creation of effective solutions.

Second, concern over problems like the Babbitt-Watt test rests on a solid foundation, which is that the people of the United States have not fully accepted the importance of biodiversity protection. Until society accepts biodiversity protection as a goal, biodiversity will continue to decline.

One reason why people have not accepted biodiversity protection is that current laws are often seen as unfair.[198] Command and control regulations have been the traditional tools for protecting the environment. As Ruhl points out in his analysis of the Coercion model, force creates resentment of environmental laws.[199] In a democracy, laws that are resented by the public will always be in danger of being replaced. Even if those laws are not repealed, additional legislation has much less chance of being enacted because of fear that the new laws will interfere with other societal values.[200] That is a frightening problem when one considers that nearly all scientists agree that the current amount of protection is not enough.

If command and control legislation is incapable of protecting biodiversity then new protective methods must be found. What is the solution to this dilemma? The solution lies in recognition by the U.S. public that biodiversity protection should be a permanent part of national law.[201]

Biodiversity protection must gain status similar to that of past controversial issues. It is probably safe to assume that virtually every person in the United States now believes that women should have the right to vote. Thus, there is no movement to retain women's suffrage. Notwithstanding the Nineteenth Amendment, there is no danger of women losing the right to vote, because the U.S. public recognizes that women's suffrage is a basic component of our democracy.

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198 *See* Karkkainen, *supra* note 174, at 92-94.
199 *See* Ruhl, *supra* note 158, at 632-36.
200 *See* CHERTOW & ESTY, *supra* note 1, at 5.
201 *See* CHERTOW & ESTY, *supra* note 1, at 5-6.

If biodiversity protection is ever to achieve a similar status as women's right to vote, the public must accept it as a necessity.[202] Command and control regulations like the Endangered Species Act do provide a legally defensible bottom line to meet the Babbitt-Watt test, but at what cost? Part of that cost is the loss of trust of the very public who control the political process by which these laws are enacted and reauthorized.

VIII. CONCLUSION

This Article has attempted to outline the central dilemma that must be solved in order for biodiversity to be protected. The dilemma involves finding a way to proactively protect habitat, allow science to provide answers through adaptive management, and respect society's desire for certainty. Until a solution is developed and implemented that will solve that dilemma, biodiversity protection will continue to be ineffective, inefficient, and unfair.

Landscape ecology holds much promise as a scientific discipline and management tool, because it focuses on the large-scale processes that affect ecosystems through study of habitat transformation, which is the leading cause of loss of biodiversity. By using landscape ecology in a legal framework to protect biodiversity, human impacts can be examined proactively, rather than waiting for species to become endangered. Society has stated that it wants biodiversity protection, and this message has been communicated both in polls and by passage of laws designed to protect species. It is now time for policy makers to get serious about achieving that goal.

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[202] Of course, biodiversity protection will never achieve the same status as a woman's right to vote, nor should it. Denying women the right to vote would be a violation of a basic human right, and rights such as these are subject to the highest level of protection under our Constitution. The analogy of a woman's right to vote was chosen because it shows how an issue that was controversial less than one hundred years ago has become an unassailable facet of our society. Biodiversity protection is not as simple a concept as granting women the right to vote. Once it is decided that women have that right, then it can be implemented universally to all women in the United States. Accepting biodiversity protection as an absolute goal will still require an everyday examination of the effects of human management decisions.