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**ALIGNING REGULATION WITH THE INFORMATIONAL
NEED: ECOSYSTEM SERVICES AND THE NEXT
GENERATION OF ENVIRONMENTAL LAW**

Keith H. Hirokawa and Elizabeth J. Porter**

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At dusk in Mexico, a bat flashes low over a coffee plantation, swiping a moth off a leaf and disappearing into the night. In a large city park halfway around the world, a jay screeches shrilly as it snaps up an acorn and swoops away, burrowing it neatly for the winter. In Texas, 100 million bats pour out from caves and from under bridges, feeding in a frenzy over 10,000 acres of cotton plantations. And in a Hawaiian forest, a thrush flutters down, nabs a red berry, and swoops to a perch, dropping the seed in alarm when the shadow of a hawk passes overhead. What do all of these actions have in common? They all involve the

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*feeding habits of birds and bats, our winged cousins. They also illustrate two frequently unrecognized ecosystem services: seed dispersal and pest control, services that are provided for free every day, all over the world.*¹

The above description details, in an important sense, a discovery. By acknowledging the processes through which these winged creatures participate in an ecosystem, we have discovered how humans rely on the continuity of such processes. This discovery invokes the notion of ecosystem services, which include the “wide range of conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life.”² Mitigation of storm energy in wetlands, crop pollination, carbon sequestration, and wildlife rearing are examples of the processes occurring in functioning ecosystems that provide substantial benefits to humans and human well-being.

Informational mandates included in natural resource statutes should be effective vehicles for integrating the valuation of ecosystem services into resource management decisions. The National Environmental Policy Act (“NEPA”),³ for instance, requires that the adverse impacts from a given action be assessed before an agency commits to an action, and the value of ecosystems to human welfare would seem relevant to that inquiry. Yet the effort to integrate ecosystem services valuation into law has yielded complicated and unsatisfactory results. The controversy in *Clinch Coalition v. Damon*,⁴ which involved an informational challenge to a proposed timber sale, illustrates a dismissive judicial disposition toward the valuation of ecosystem services as merely “a particular economic accounting methodology.”⁵ The *Clinch Coalition* decision is problematic for the district court’s understanding of the informational purposes of a variety of natural resources statutes and for the manner in which the court subjects ecosystem services assessment to agency discretion.⁶ The *Clinch Coalition* decision is important for

1. Heather Tallis & Stephen Polasky, *Assessing Multiple Ecosystem Services: An Integrated Tool for the Real World*, in NATURAL CAPITAL: THEORY AND PRACTICE OF MAPPING ECOSYSTEM SERVICES 34, 39 (Peter Kareiva et al. eds., 2011).

2. Gretchen Daily et al., *Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems*, 2 Issues in Ecology 1, 2 (1997) [hereinafter Daily et al., *Benefits Supplied by Natural Ecosystems*].

3. 42 U.S.C. §§ 4321-4370f (1970).

4. *Clinch Coalition v. Damon*, 316 F. Supp. 2d 364 (W.D.Va. 2004).

5. *Id.* at 380-381.

6. *Id.*

highlighting the informational role that regulation should play in ensuring the continuing availability of benefits provided by ecological resources.⁷

This article explores the *Clinch Coalition* decision to understand why the court would perpetuate a process that systematically rejects the relevance and value of ecosystem processes in the information gathering exercise entailed in these environmental regulations.⁸ The discussion begins with an introduction to ecosystem services as a study of human dependency on the services provided by functioning ecosystems. In the second section, the article turns to the *Clinch Coalition* decision to outline the arguments relied upon by the court to legitimize the Forest Service's decision to avoid an ecosystem services analysis.⁹ The article then presents the *Clinch Coalition* decision as an illustration of a fundamental misunderstanding of ecosystem services and their relevance and value in environmental regulation.¹⁰

This article suggests that, by characterizing ecosystem services valuation as merely an alternative economic analysis or accounting method, the court highlighted an important informational goal for the next generation of environmental law: if environmental regulation is intended to facilitate a more efficient management of resources by correcting for resource market inefficiencies resulting from incomplete information, regulatory intervention should employ investigatory methodologies that result in the production of a more informed resource management decision. This article first questions whether ecosystem services valuation is indeed an alternative methodology. This section describes ecosystem services analysis as a means of economic and environmental valuation that is more inclusive than a commodity-based analysis: an analysis of ecosystem services is a more relevant and complete understanding of economics and environmental decision-making, not alternative methodology. Therefore, by rejecting the call for an ecosystem services analysis, the court allowed the agency to ignore relevant information about ecosystem impacts: ecosystem services analysis demands a more inclusive estimation of the opportunity cost of *using and losing* the ecosystems that produce timber, fish, and other goods and services, as well as the benefits of *maintaining* the flow of the goods and services that ecosystems produce.

Second, this article concerns how to construct the notion of

7. *Id.*

8. *Id.*

9. *Id.*

10. *Id.*

“information” to improve the information gathering exercise that is found in “action-forcing” statutes such as NEPA.¹¹ Ecosystem services research supplies information on both economic values and ecosystem processes. Excluding an accounting of “ecosystem services” can produce decisions that do not accurately or efficiently reflect the interdependency between ecological and economic wealth. Understanding natural resources in terms of the value of ecosystem services that they produce helps to contextualize the relationships between public needs, private wealth, and the cost of ecosystem loss. Such information falls squarely into the informational mandate of our resource management goals, but more importantly, such information is currently excluded from most environmental and economic valuations.

I. NATURAL RESOURCES MANAGEMENT AND INFORMATION

Historically, markets have excluded information on ecosystem processes and services, at least where those processes and services have not been commodified. In the transition period between the environmental decade of the 1970s and the present, the field of vision has changed in irretrievable ways.¹² This is demonstrated by the fact that the practice of allowing markets to determine the types of information that are considered valuable and relevant is being abandoned, as evidenced by the increasing frequency with which we can point to market failures as evidence that market mechanisms, by themselves, are unable to adequately identify and value all of the relevant and necessary information. Environmental regulation has largely been designed to deal with environmental externalities, albeit in a variety of ways. Some laws are intended to correct the social, ecological, or economic effects or market failure, such as hazardous waste laws or technology-based air and water regulations. Other environmental laws seek to prevent market failures that result from decision making based on inadequate information or misinformation.

This article focuses on the latter—informational type of environmental regulation. Although the informational approach to environmental regulation appears straightforward, little has been written on the character of information that would simultaneously satisfy the letter of the law and respond to the economic efficiency purpose of the

11. 42 U.S.C. §§ 4321-4370f (1970).

12. RICHARD J. LAZARUS, *THE MAKING OF ENVIRONMENTAL LAW* (2004) (detailing developments of environmental law); KARL BOYD BROOKS, *BEFORE EARTH DAY: THE ORIGINS OF AMERICAN ENVIRONMENTAL LAW 1945-1970* (2009) (Same).

regulatory effort.¹³ The salient question for the next generation of environmental law, from this perspective, relates both to the character of the information sought, and to the whether the process employed in the regulatory schemes insures the incorporation of standards for more economically relevant and environmentally valuable information.

The ecological economics approach of ecosystem services provides some insights and direction for answering these questions. Resource valuation that incorporates ecosystem services empowers resource managers to wield both ecology and economics to capture the value of ecosystem processes that law has long ignored. This section presents the manner in which ecosystem services research offers a management framework that identifies and accounts for the services provided by natural resources that human societies rely upon. This section also examines NEPA to illustrate the mechanics and purposes of informational regulation.

A. *Ecosystem Services*

Ecosystems “provide basic life support for human and animal populations and are the source of spiritual, aesthetic, and other human experiences that are valued in many ways by many people.”¹⁴ In some instances, ecosystems provide benefits by producing goods such as timber and fuels, seafood, fruits and nuts, as well as ingredients used in the production of pharmaceuticals and other industrial products. However, ecosystems are valuable in other ways that are more difficult to quantify. The study of ecosystem services aims to develop information about and valuations of ecosystem goods and services that recognize the essential services that ecosystem processes provide.¹⁵

Ecosystem services analyses typically identify the types of

13. See, e.g., David W. Case, *The Law and Economics of Environmental Information as Regulation*, 31 ELR 10773 (July 2001); Bradley Karkkainen, *Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm*, 89 GEO.L.J. 257, 260 n.7 (2001) (discussing evidence of positive correlations between disclosure requirements and emission reductions); Peter S. Menell, *Structuring a Market-Oriented Federal Eco-Information Policy*, 54 MD. L. REV. 1435 (1995) (“The principal policy effort addressing environmental degradation has been focused on the supply side of markets—laws and regulations directly controlling emissions of pollution and disposal of wastes. Promoting green consumerism can complement the vast array of environmental laws and regulations by altering the demand for products.”).

14. EPA SCI. ADVISORY BD., VALUING THE PROTECTION OF ECOLOGICAL SYSTEMS AND SERVICES (EPA-SAB-09-012) 8 (May 2009), available at <http://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/ValProtEcolSys&Serv>.

15. See Daily et al., *Benefits Supplied by Natural Ecosystems*, *supra* note 2.

ecosystem services that have not been valued in the marketplace.¹⁶ Although we may have a sense of the value of bananas and clean water, the ecological processes¹⁷ that produce bananas (goods) and filter water (services) have not been valued in the marketplace;¹⁸ these services “have no market value for the simple reason that no markets exist in which they can be exchanged.”¹⁹ Most of these services have not been recognized because their value “accrue[s] directly to humans without passing through the economy at all. In many cases people are not even aware of them.”²⁰ That is, “economic markets . . . only reveal demand for marketed goods and services.”²¹

Of course, exclusion from the marketplace has not diminished the value of these services or, more specifically, has not altered the dependency of the human welfare on the continued receipt of ecosystem services. The value of the world’s ecosystem services has been estimated to exceed the global GNP by 1.8 times, highlighting “that ecosystem services provide an important portion of the total contribution to human welfare on this planet.”²² As dynamic and complex systems of interaction between living organisms and non-living environment, ecosystems “provide basic life support for human and animal populations and are the source of spiritual, aesthetic, and other human experiences that are valued in many ways by many people.”²³

16. James Salzman, Barton H. Thompson & Gretchen Daily, *Protecting Ecosystem Services: Science, Economics, and Law*, 20 STAN. ENVTL. L.J. 309, 311 (2001).

17. The terms “ecosystem processes” and “ecosystem services” are both used, but not interchangeably: “Ecosystem processes are essential for the provision of ecosystem services but processes are not synonymous with services. Until there is some person somewhere benefiting from an ecological process, it is only a process and not an ecosystem service.” Tallis & Polasky, *supra* note 1.

18. In addition to the scant attention given to ecosystem services by the market, the Environmental Protection Agency (“EPA”) has recently acknowledged that its regulation of environmental quality has largely omitted the analysis involved in the ecosystem services approach. EPA SCI. ADVISORY BD., *supra* note 14 (“Despite the importance of these ecological effects, EPA policy analyses have tended to focus on a limited set of ecological endpoints, such as those specified in tests for pesticide regulation (e.g., effects on the survival, growth, and reproduction of aquatic invertebrates, fish, birds, mammals, and terrestrial and aquatic plants) or specified in laws administered by the Agency (e.g., mortality to fish, birds, plants, and animals).”).

19. Salzman, Thompson & Daily, *supra* note 16.

20. Robert Costanza et al., *The Value of the World’s Ecosystem Services and Natural Capital*, 387 NATURE 253, 257 (1997).

21. Ida Kubiszewski et al., *The Production and Allocation of Information as a Good that is Enhanced with Increased Use*, 69 ECOL. ECON. 1344, 1347 (2010) (“However, many important goods and services are, in practice, ‘non-excludable’ and cannot be effectively privately owned.”).

22. Costanza et al., *supra* note 20, at 259. See also, Daily et al., *Benefits Supplied by Natural Ecosystems*, *supra* note 2; WALTER V. REID ET AL., ECOSYSTEMS AND HUMAN WELL-BEING: SYNTHESIS v (2005).

23. EPA SCI. ADVISORY BD., *supra* note 14.

By demanding a deeper, more functional understanding and valuation of the benefits derived from functioning ecosystems, the ecosystem services approach demands consideration of these previously ignored ecosystem functions.²⁴ This more complete analysis of assets—and by extension, more complete analysis of the cost of losing such services—results from the combination of ecology and economics found in ecosystem services:

The science of ecology has largely been devoted to exploring the importance of ecosystem processes in natural contexts, but has ignored exploration of human service values until recently. Similarly, economics as a discipline focuses on pricing in markets, but without information from ecologists about the delivery to humans of ecosystem services, the market necessarily will underrepresent those values in pricing and resource allocation decisions. Researchers in both fields, however, have begun to bridge the gap, to fill in the very large hole of knowledge surrounding how ecologically important ecosystem attributes are economically valuable services to humans.²⁵

Unfortunately, the value of many ecosystem services is hidden because the extent of human reliance on and benefits from the ecosystem processes that sustain such services are invisible until those processes are lost or disrupted.²⁶ Therefore, ecosystem services are critical pieces of an asset inventory on any scale. Such an inventory can provide baseline economic and environmental information to contextualize evidence that alterations in a landscape will “change the benefits associated with human activities or change the costs of those activities.”²⁷ An accounting of natural capital can also illustrate the

24. John Porter et al., *The Value of Producing Food, Energy, and Ecosystem Services within an Agro-Ecosystem*, 38 *AMBIO* 186, 186 (2009).

25. J.B. RUHL ET AL., *THE LAW AND POLICY OF ECOSYSTEM SERVICES* 24 (2007).

26. NAT'L RESEARCH COUNCIL, *COMM. ON ASSESSING AND VALUING THE SERVICES OF AQUATIC AND RELATED TERRESTRIAL ECOSYSTEMS, VALUING ECOSYSTEM SERVICES: TOWARDS BETTER ENVIRONMENTAL DECISION-MAKING* 154 (2004) (“[T]he value of ecosystem services becomes apparent only after such services are diminished or lost, which occurs once the natural processes supporting the production of these services have been sufficiently degraded.”); Gretchen C. Daily, *Introduction: What are Ecosystem Services?*, in *NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS* 5 (Gretchen C. Daily ed., 1997) (“[T]he nature and value of Earth's life-support systems have been illuminated primarily through their disruption and loss.”).

27. Such circumstances have value “insofar as they either change the benefits associated with human activities or change the costs of those activities.” Costanza et al., *supra* note 20, at 255. See also Gretchen C. Daily et al., *Ecosystem Services in Decision Making: Time to Deliver*, 7 *FRONT ECOL. ENVIRON* 21, 23 (2009) [hereinafter Daily et al., *Decision Making*] (“The main aim in understanding and valuing natural capital and ecosystem services is to make better decisions, resulting in better actions relating to the use of land, water, and other elements of natural capital.”).

consequences of policies that allocate rights to extract, use, or transfer natural resources by allowing for an analysis of discontinued ecological benefits.

B. The Informational Mandates of NEPA

Informational laws and regulations seek a variety of results, including the facilitation of a more informed and participatory public and more informed decision makers, both of which could operate to avoid poor natural resource decisions. NEPA, as an example of an informational law,²⁸ was initially adopted to insert a planning component into the normal progression of governmental decision-making. Congress enacted NEPA “[t]o declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man.”²⁹ This general declaration of purpose does seem to suggest a substantive policy of sustainable decision-making and effective long-term resource protection. NEPA provides as follows:

The Congress, recognizing the profound impact of man’s activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of [humankind], declares that it is the continuing policy of the Federal Government . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.³⁰

To implement this policy, Congress directed agencies “to the fullest extent possible” to interpret and administer laws with such ideas in mind, and also to engage the decision making process in a way that enhances consideration of the “unquantified environmental amenities and values” alongside of economic and technical considerations. NEPA requires decision makers to be informed; NEPA requires that the probable environmental impacts from a given action be studied before an

28. 42 U.S.C. §§ 4321-4370f (1970).

29. *Id.* at § 4321.

30. *Id.*

agency commits to an action.³¹ Specifically, Congress required that the federal government:

[I]nclude in every recommendation or report . . . a detailed statement by the responsible official on (i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, (iii) alternatives to the proposed action, (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.³²

At least conceptually, an ecosystem services analysis fits well into each of these elements of the “detailed statement.”³³ An analysis of disrupted ecosystem services certainly suggests impacts to the environment, including ones that cannot be avoided. Such an analysis will provide a basis to compare alternatives to the proposed action, including the differences between a short-term capture of ecosystem goods and the long-term benefit of functioning ecosystems. Similarly, an ecosystem services analysis will involve a valuation of those resources that are related to, and dependent on, the continuation of ecosystem processes for their productivity.

Agency compliance with the full directives of NEPA has been slow and contentious.³⁴ Nevertheless, much of the administrative process is now driven by NEPA procedures, including public review of environmental impacts and the preparation of an Environmental Impact Statement (“EIS”).³⁵ In this process, NEPA burdens federal actions heavily with information-gathering and transparent environmental review.³⁶ NEPA “impose[s] on agencies an affirmative obligation to seek out information concerning the environmental consequences of

31. *Id.*

32. *Id.*

33. Robert L. Fischman, *The EPA's NEPA Duties and Ecosystem Services*, 20 STAN. ENVT. L.J. 497, 507 (2001) (Although valuation of ecosystem services could aid in the analysis of any of these five issues, it is the fourth issue, concerned with the long-term productivity of the environment, which has the strongest connection to the work of ecological economists. It is the long-term productivity of soils, waters, and habitats that provide the services, such as pollution assimilation, that these researchers seek to quantify.)

34. *See, e.g.,* Calvert Cliffs Coordinating Comm., Inc. v. United States Atomic Energy Comm'n, 449 F.2d 1109 (D.C. Cir. 1971).

35. 42 U.S.C. § 4321.

36. *Id.*

proposed federal actions.”³⁷ Agencies are required to include information in environmental review relating to reasonably foreseeable adverse impacts where the information “is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant.”³⁸ Where information is difficult to obtain because “the overall costs of obtaining it are exorbitant or the means to obtain it are not known,” the agency is still required to identify and explain the significance of the missing information. In addition, the scope of information demanded by NEPA seems sufficiently broad to cover a wide variety of impacts in terms of type and intensity and across time.³⁹ NEPA requires an analysis of direct, indirect, and cumulative impacts from a proposed action.⁴⁰

Perhaps the most far-reaching consequence of the NEPA obligation is the assemblage of baseline ecological information.⁴¹ Robert Fischman contemplates a substantial investment in baseline information early in the NEPA process:

The establishment of an environmental baseline combines both the CEQ requirements to obtain information and address cumulative impacts. Once the study area is defined, the agency should collect baseline environmental data, determine gaps in the data, and design methods for collecting missing data. It must ensure that the analysts have access to data that will allow them to assess “past, present, and reasonably foreseeable” effects. The analyst may need habitat inventories, water quality surveys, and studies of social and economic patterns in a community. In some cases the collection of data may require sampling over four seasons or longer periods to ensure an understanding of the existing community social interactions, socioeconomic state, environmental conditions, or ecosystem processes. Historical data can sometimes be used to supplement the baseline database.⁴²

Such information provides what may be the only basis for understanding and quantifying environmental impacts after the commencement of construction (and perhaps even post-completion), especially where a project diverges from its original plan (such as to adapt to changing market preferences) or where construction encounters unforeseen

37. *Alaska v. Andrus*, 580 F.2d 465, 473 (D.C. Cir. 1978).

38. 40 C.F.R. § 1502.22(a) (2013).

39. 42 U.S.C. § 4321.

40. 40 C.F.R. § 1502.25 (2013).

41. 42 U.S.C. § 4321.

42. Fischman, *supra* note 33, at 513-14.

impacts (such as the accumulation of changes from construction processes and natural disasters).

II. THE EXAMPLE THAT CONFUSES THE RULE: *CLINCH COALITION*

Mandates included in informational statutes, such as the National Environmental Policy Act and the “little NEPAs” in the states, should have proven (and may yet prove) to be effective vehicles for integrating ecosystem services concepts into watershed, ecosystem, and other natural resource system management.⁴³ As Robert Fischman has argued, NEPA is “particularly well suited for the valuation of ecosystem services” due to the relationship between ecosystem services and the substantive goals of NEPA,⁴⁴ because ecosystem valuation would provide important but often ignored information necessary to informed decision making. And, further, because “valuation is in a state of development where a moderate increase in demand for information from the government would substantially advance the precision of valuation techniques.”⁴⁵ Furthermore, NEPA⁴⁶ is one of the very few regulatory tools that compels the aggregated consideration of environmental impacts on multiples levels and at multiple scales.

Given the purposes of the informational mandate of NEPA,⁴⁷ it may be difficult to grasp a judicial disposition that trivializes ecosystem function through a dismissive understanding of ecosystem services. Nevertheless, the courts have adopted ecosystem services in a fractured manner at best. NEPA has been construed as an action forcing statute, but one that is largely devoid of substantive standards.⁴⁸ Therefore, in *Robertson v. Methow Valley*,⁴⁹ the Ninth Circuit noted that “it would not have violated NEPA if the Forest Service, after complying with the Act’s procedural prerequisites, had decided that the benefits to be

43. 42 U.S.C. § 4321.

44. NEPA requires federal agencies to “use all practicable means and measures, including financial and technical assistance, in a manner calculated . . . to create and maintain conditions under which man and nature can exist in productive harmony,” and also to balance the needs of present and future generations, assure healthful and productive surroundings, “attain the widest range of beneficial uses of the environment,” and enhance environmental quality. 42 U.S.C. 4331(a)-(b) (1970).

45. Fischman, *supra* note 33, at 535.

46. 42 U.S.C. § 4321.

47. *Id.*

48. See *Strycker’s Bay Neighborhood Council, Inc. v. Karlen*, 444 U.S. 223, 227-228 (1980) (*per curiam*); *Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, Inc.*, 435 U.S. 519, 558 (1978).

49. *Robertson v. Methow Valley*, 490 U.S. 332 (1989).

derived from downhill skiing at Sandy Butte justified the issuance of a special use permit, notwithstanding the loss of 15 percent, 50 percent, or even 100 percent of the mule deer herd.”⁵⁰ The court concluded that although “[o]ther statutes may impose substantive environmental obligations on federal agencies . . . NEPA merely prohibits uninformed—rather than unwise—agency action.”⁵¹ At issue in the *Robertson* controversy was not the loss of ecosystem services suffered from the loss of mule deer.⁵² Nevertheless, the courts have indicated a reluctance to open the NEPA⁵³ process to ecosystem services.

The controversy in *Clinch Coalition v. Damon*⁵⁴ arose in the context of a proposed timber sale affecting public lands in the Bark Camp Area of the Jefferson National Forest.⁵⁵ It is relevant that this case implicated the scope of an agency’s informational duties under NEPA.⁵⁶ Although the District Court did not expressly disagree with Fishman’s vision for NEPA, it also rejected an understanding of NEPA that would require consideration of ecosystem services.⁵⁷

The *Clinch Coalition* controversy began with the observation that the Bark Camp Area was not in conformity with the Jefferson National Forest Management Plan.⁵⁸ The Jefferson National Forest was created in 1936 and, after it was combined with the George Washington National Forest in 1995, contained a geographical expanse of 1.8 million acres of land spread over Virginia, Kentucky, and West Virginia.⁵⁹ Initially, the Jefferson Forest was comprised on “lands nobody wanted” due to the resource extraction impacts and the transformative character of past uses of the land.⁶⁰ The Bark Camp area has since been maintained as a popular recreational destination, as well as subject to the continuing

50. *Id.* at 351.

51. *Id.*

52. *Id.* at 332.

53. 42 U.S.C. § 4321 (1970).

54. *Clinch Coalition v. Damon*, 316 F. Supp. 2d 364 (W.D.Va. 2004).

55. Areas designated in the National Forest system are intended to “improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States.” 16 U.S.C.A. § 475 (1987). Areas designated as National Forests are “administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes.” 16 U.S.C.A. § 528 (1960).

56. *Clinch Coalition*, 316 F. Supp. 2d.

57. *Id.*

58. *Id.* at 369.

59. See *Revised Land and Resource Management Plan: Jefferson Nat’l Forest*, U.S. DEP’T OF AGRICULTURE 1-6 (2004), available at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_000381.pdf.

60. *Id.* at 2-2 (“[B]y the early 1990s, much of the higher elevation mountains and ridges in southwestern Virginia had been transformed into charred stumps and brushfields.”).

extraction of oil and gas.⁶¹ The Management Plan called for the careful management of a diverse array of habitats to support a diverse population of wildlife.⁶² Yet, due in large part to the character and content of past forest management practices in the Jefferson National Forest, the Forest Service predicted that the Bark Camp Area would soon be devoid of early successional habitat.⁶³ To remedy this deficiency, the Forest Service formulated a vegetation management plan for the Bark Camp Area that was intended to bring the Area into conformance.⁶⁴ The plan included a finding that the objectives of the action would be best served by including commercial harvest of timber of approximately 700 acres of the Area.⁶⁵

In furtherance of this plan, the Forest Service prepared an Environmental Assessment (“EA”) under NEPA.⁶⁶ The EA examined the potential impacts of timber harvest on watershed functions due to sedimentation, considered the mitigation opportunities presented by the principles of the largely degree program, and discussed the economic impacts of the proposed timber sale.⁶⁷ The EA concluded that the sedimentation impacts were negligible, and that any short-term adverse impacts of timber sale on recreational uses would be offset by a long-term benefit from proper vegetation management.⁶⁸

The plaintiffs relied on a variety of legal sources—Multiple-Use Sustained-Yield Act (“MUSYA”),⁶⁹ the Forest and Rangeland Renewable Resources Planning Act (“FRRRPA”),⁷⁰ the National Forest Management Act (“NFMA”),⁷¹ NEPA,⁷² and Forest Service regulatory documents—to argue that the Forest Service was required to perform an ecosystem services analysis of the impacts of the proposed timber sale. The opponents to the sale called for an ecosystem services analysis and argued the area “may very well be acre for acre the greatest natural area

61. *Clinch Coalition*, 316 F.Supp.2d at 369.

62. *Id.*

63. *Id.*

64. *Id.* at 370.

65. *Id.* Opposition groups take credit for compelling the Forest Service to reduce the size of the proposed Bark Camp timber sale, which was first announced in 1997 to encompass 1,413 acres. *Hacking Away at High Knob*, GREENPEACE, USA (Oct. 1, 2004), <http://www.greenpeace.org/usa/en/news-and-blogs/news/the-high-knob-area-of-the-jeff/>.

66. 42 USC §4321 (1970).

67. *Clinch Coalition*, 316 F.Supp.2d at 370.

68. *Id.* at 371.

69. 16 U.S.C. §528 (1960).

70. 16 U.S.C. §1600 (1960).

71. National Forest System Land and Resource Management Plans, 16 USC §1604 (1976).

72. 42 U.S.C §4321 (1970).

in all of Virginia and one of the greatest east of the Mississippi River.”⁷³

The court was unable to locate an ecosystem services demand in the multiple use directive of the MUSYA, which requires “the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people,”⁷⁴ and found the statutory language “far from being a directive by Congress that the forest service must utilize a specific economic analysis, let alone the one Plaintiffs assert is required.”⁷⁵ However, MUSYA also requires the Forest Service to give “due consideration” for the “relative values of the various resources in particular areas,”⁷⁶ a directive that appears to require an analysis of the costs and benefits from a specific use. The court insisted that “MUSYA contains no specific mandate that the Forest Service utilize a particular procedure to analyze the economic impacts of a proposed project and its alternatives.”⁷⁷

Likewise, the district court rejected the Plaintiffs’ reliance on language in FRRRPA requiring management of forestlands “to secure the maximum benefits of multiple sustained yield management,”⁷⁸ finding “no clear direction from Congress mandating that the Forest Service gather the information by any particular economic analysis method.”⁷⁹ The court found no provision in NFMA “that mandates a particular methodology, particularly a methodology that quantifies the impact of timber harvesting on non-timber values,”⁸⁰ a conclusion bolstered by legislative history that identified “only direct timber

73. *Unique Features of High Knob*, THE CLINCH COALITION, <http://clinchcoalition.net/index.php?pr=unique> (last visited Jan. 31, 2013). Objectors voiced a concern that the Bark Camp timber sale would cause irreversible damage to important ecosystem processes in the area:

While only 1% of the logging will be “clearcut” as the Forest Service defines it, the logging will remove most of the forest canopy in the 700-acre area. Forest canopy is crucial to protect younger trees and wildlife and to shade the understory. Several ecologically sensitive areas are included in the timber sale, such as winter hibernation habitat for the endangered Indiana bat. The Clinch River, just six miles downstream from the timber sale area, is recognized worldwide for its tremendous aquatic diversity. The watershed is home to 27 species that are federally listed as threatened or endangered—the highest concentration of federally protected species in the country.

Hacking Away at High Knob, *supra* note 65.

74. 16 U.S.C. § 531 (1960).

75. *Clinch Coalition v. Damon*, 316 F.Supp.2d 364 (W.D.Va. 2004).

76. 16 U.S.C. § 531 (1960).

77. *Clinch Coalition*, 316 F. Supp.2d at 378.

78. 16 U.S.C. § 1601(d)(1) (1960).

79. *Clinch Coalition*, 316 F. Supp.2d at 378-79.

80. *Id.* at 379.

production costs and returns” for analysis.⁸¹ Although the court recognized that NEPA requires an economic analysis, it found that “the Forest Service complied with such mandate” in the EA, as NEPA “does not direct the Forest Service to use a particular economic accounting methodology, especially not the method asserted by plaintiffs that would require quantification of on non-timber values.”⁸² The district court left the matter of ecosystem services to the discretion of the Forest Service, largely unimpressed that an ecosystem services analysis would add to the process of taking a “hard look” at adverse environmental impacts.⁸³

III. CRITICAL OF *CLINCH*: ECOSYSTEM SERVICES AS BETTER INFORMATION

An examination of the *Clinch Coalition* court’s reasoning suggests a misunderstanding of what the ecosystem services approach entails, demands, and adds to the set of information that is made available to decision makers and resource managers.⁸⁴ Yet, the *Clinch Coalition* decision could prove to be benign.⁸⁵ Legislative or regulatory developments could provide specific guidance on the appropriate employment of ecosystem services principles with the understanding that resources decision should not be made without all of the necessary information. On the other hand, the court’s categorization of ecosystem services could instead provide a safe haven for shortsighted resource planning.

This section addresses *the Clinch Coalition* decision by borrowing insights from economics.⁸⁶ Specifically, this section looks to the role of information in avoiding market inefficiencies—an insight that has proven important in analyzing the recent failure of the financial institutions:⁸⁷

The current economic crisis has highlighted the need for government intervention in the event of the failure of a systemically important

81. *Id.*

82. *Id.* at 380-81.

83. *Id.* at 364.

84. *Id.*

85. *Id.*

86. *Id.*

87. We are mindful of the notion that framing causes despair in cross-disciplinary ventures, particularly when the relevant insights are not correlative. Another way of making this point: “knowing how ecosystem services operate ecologically will not guarantee sound economic and policy decisions about the environment, but not knowing how ecosystem services operate ecologically will guarantee unsound economic and policy decisions. So economists have something to learn as well.” J.B. RUHLET AL., *supra* note 25, at 35.

institution. But the need for massive intervention implies, in turn, the need to take actions to prevent the occurrence of such failures in the first place. Sometimes the damage done by actions that have adverse effects on others can be compensated for after the fact, but in the cases at hand, this is in general not possible. Policy interventions should be designed to make less likely the occurrence of actions that generate significant negative spillovers, or externalities.⁸⁸

Economics explains the importance of informational regulatory interventions because it supports the value of avoiding market failures that result from incomplete information, and as such, explains the value of regulations that employ informational mechanisms to avoid market failure.⁸⁹ Because economics directs the information-gathering process towards a larger set of relevant and important information, this framework will prove applicable to the informational needs in environmental regulation.

A. *The Economic Framework for Environmental Policy*

One of the most fundamental concepts of neoclassical economic theory is that markets that are competitive and free of government intervention⁹⁰ are the most efficient means of allocating and managing the resources (including natural resources) which are necessary for the production of goods and services. Adam Smith contended that free markets lead to efficient outcomes “as if by an invisible hand,”⁹¹ an assertion that has since been adapted by both economists and non-economists to argue for the efficacy of free markets. From this perspective, government regulation of private choices, public ownership of resources, and the provision of public goods and services interferes with the efficient allocation of resources.⁹²

88. Joseph E Stiglitz, *Regulation and Failure*, in NEW PERSPECTIVES ON REGULATION 11-23 (David A. Moss & John A. Cisternino eds., 2009).

89. Joseph E Stiglitz, *Government Failure vs. Market Failure: Principles of Regulation* (Paper Prepared for the Tobin Project’s conference on Government and Markets: Toward a New Theory of Regulation) (Yulee, Florida, Feb. 1-3, 2008) [hereinafter Stiglitz, *Government Failure v. Market Failure*].

90. Including regulation and/or the provision of public goods and services.

91. Joseph E Stiglitz, *Columbia Business School, Nobel Prize Lecture: Information and the Change in the Paradigm in Economics* (Dec. 8, 2001) [hereinafter Stiglitz, *Information and the Change in the Paradigm in Economics*].

92. Kenneth J. Arrow, *An Extension of the Basic Theorems of Classical Welfare Economics*, in PROCEEDINGS OF THE SECOND BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY 507-32 (Jerzy Neyman ed., 1951); GÉRARD DEBREU, *THE THEORY OF VALUE* (Yale Univ. Press 1959).

The first fundamental theorem of welfare economics provides a mathematically rigorous basis for the argument that competitive markets free from government intervention allocate and manage resources efficiently. The form in which this theorem is stated today and the conditions under which it holds true is generally attributed to 1950s economists Kenneth Arrow and Gérard Debreu.⁹³ The theorem sets forth a set of conditions, including the well-defined ownership or property rights to the goods and services and the availability of perfect information, under which Adam Smith's invisible hand works perfectly.⁹⁴ Competitive markets in which these conditions strictly hold achieve Pareto efficiency (i.e. no one in society can be made better off without making someone else in society worse off).⁹⁵ Given competitive markets for goods and services, perfect information, and well-defined property rights, society's economic resources are allocated efficiently.⁹⁶ Government intervention in markets would be superfluous, or worse, disruptive.

Most environmental problems that are framed in economic terms are posed as the failure of markets to correctly value environmental goods and services, a result of which is the creation of "externalities."⁹⁷ In theory, if all of the costs and benefits inherent in the production and consumption of goods and services are known and borne by market participants in the form of market prices, no externalities would result from market transactions.⁹⁸ Given that the economic theory behind perfectly functioning markets is based on a number of assumptions that are simply not realistic (especially in terms of environmental resources), some type of government intervention is required to internalize the externalities created through the production and consumption of goods and services. Regulatory efforts to correct for environmental externalities have traditionally included the use of direct interventions such as proscriptions (things producers may not do), or mandates (things producers must do). Often referred to as "command-and control" measures,⁹⁹ these types of regulatory interventions have been found easy

93. Arrow, *supra* note 92, at 507-32; DEBREU, *supra* note 92.

94. Stiglitz, Information and the Change in the Paradigm in Economics, *supra* note 91.

95. Issues of equity or distribution are not addressed in Pareto outcomes.

96. Stiglitz, Information and the Change in the Paradigm in Economics, *supra* note 91.

97. Loosely defined to reference the social, economic and environmental costs and benefits created in either the production or consumption of goods and services that are not borne by the decision makers in the market (i.e. cost and benefits not reflected in market prices).

98. WILLIAM J. BAUMOL & WALLACE E. OATES, THE THEORY OF ENVIRONMENTAL POLICY 7 (Cambridge Univ. 2d ed. 1988).

99. Erwin H. Bulte et al., *Payments for ecosystem services and poverty reduction: concepts,*

to mandate but inefficient to implement.¹⁰⁰

More recently, environmental policy has focused on creating what are called market-based instruments (“MBIs”).¹⁰¹ As de Groot argues, “[o]ne major reason for the continued loss and degradation of ecosystems is that the value (importance) of ecosystems to human welfare is still underestimated in most economic development decisions because the benefits of their services are not, or only partly, captured in conventional market economics.”¹⁰² The majority of the goods and services that ecosystems produce are not valued in current markets. The exceptions are often only valued as positive externalities resulting from the non-conversion of natural resources into products for the marketplace. Given that markets for the productive capabilities of ecosystems are often incomplete or even “missing,” resource managers lack the sufficient incentives necessary to invest in maintenance or preservation of ecosystem services. Neoclassical market theory maintains that in the absence of market price incentives which created through private ownership, natural resources will be unvalued or underpriced, creating incentives for society to use more of those resources than is socially efficient.¹⁰³ In order to correct for undervaluation and overconsumption of natural resources, government intervention is required to create the missing incentives or markets.¹⁰⁴ Instead of attempting to force adherence to market regulations, environmental policy that creates MBIs attempts to use economic incentives to change the behavior of market participants. There are two main forms of MBIs: (1) pollution taxes and subsidies and (2) tradable pollution permits.¹⁰⁵

Although there have been many successes in creating market-based instruments¹⁰⁶ (such as emission trading schemes),¹⁰⁷ their potential is

issues, and empirical perspectives, ENVIRONMENT AND DEVELOPMENT ECONOMICS 13, 245-254 (2008).

100. *Id.*

101. Robert Stavins & Bradley Whitehead, *Market-Based Environmental Policies*, in THINKING ECOLOGICALLY (Marian Chertow & Daniel Esty eds., Yale Univ. Press 1997).

102. Rudolf de Groot, *Ecosystem Services*, IUNC (Jan. 31, 2013), http://www.iucn.org/about/union/commissions/cem/cem_work/cem_services/.

103. BAUMOL & OATES, *supra* note 98 at 7.

104. Forest Reinhardt, *Market Failure and the Environmental Policies of Firms: Economic Rationales for “Beyond Compliance” Behavior*, 3 J. INDUST. ECOLOGY, no. 1, 1999, at 9–21.

105. ASAFU-ADJAYE, U.N. ECON. & SOC. COMM’N FOR ASIA & THE PAC., INTEGRATING ECONOMIC AND ENVIRONMENTAL POLICIES: THE CASE OF PACIFIC ISLAND COUNTRIES: DEVELOPMENT PAPERS NO. 25 (2004).

106. Robert Stavins, *Market-Based Environmental Policies*, in PUBLIC POLICIES FOR ENVIRONMENTAL PROTECTION 31-2 (Paul Portney & Robert Stavins eds., 2000).

considered limited.¹⁰⁸ As Wegner and Pascualb argue, “[i]ndividuals may perceive intangible benefits from nature, may not always have sufficient understanding of ecosystem services, and may not always decide independently from others on what value to attribute to ecosystem services.”¹⁰⁹ Given that the theoretical conditions necessary for markets to produce an efficient allocation of resources never hold, there is no guarantee that using market based instruments to incentivize resource managers will generate more efficient management of natural resources or that they will prevent resource use from passing ecological tipping points. At the end of the day, “the notion of economic value is of little use when an ecosystem approaches a critical ecological threshold and ecosystem services become non-substitutable and absolutely scarce.”¹¹⁰

B. *The Role of Information and Informational Regulation*

Information about the role and value of natural capital affects decision making about how resources are used in every context: on a personal level, within organizations and firms, in political processes. Although the failure of markets to capture and prevent environmental externalities and to create the incentives necessary for the efficient use of natural resources are both significant considerations, such issues derive from an availability of information about the total economic and ecological value of natural resources.¹¹¹ Theoretically, a complete set of information about the quantity and quality of all of the goods and services that natural resources produce, and the role and the value of the natural resources themselves, would be available to all decision makers and resource managers. Decision makers would also have complete information regarding all of the opportunity costs that would be created in the conversion of natural resources into goods and services for the market, and all of the benefits of maintaining the natural resources in

107. Pavan Sukhdev, *Putting a Price on Nature: The Economics of Ecosystems and Biodiversity*, 1 *SOLUTIONS*, no. 6, at 34-43, available at <http://www.thesolutionsjournal.com/node/823>.

108. Frank Ackerman & Kevin Gallagher, *Getting the Prices Wrong: The Limits of Market-based Environmental Policy* (Global Dev. & Envtl. Inst., Working Paper No. 00-05, 2000).

109. Giulia Wegner & Unai Pascualb, *Cost-benefit analysis in the context of ecosystem services for human well-being: a multidisciplinary critique* (Ecosystem Servs. Econ., Working Paper No. 13, 2000), available at <http://dx.doi.org/10.1016/j.gloenvcha.2010.12.008>.

110. *Id.*

111. A key theoretical assumption of neoclassical economics is that “humans are omniscient actors; that is to say, we have complete information and perfect understanding of our set of choices, and hence we can always form preferences over goods and services.” *Id.*

their current state for other current and future production possibilities. Given complete information and a competitive market for the goods and services which resources produce,¹¹² collective decision making would lead to the most efficient allocation of resources.

The problem faced when projecting the economic framework to problem solving is that information available to decision makers can never be complete or perfect. Producers and consumers of goods and services inevitably lack sufficient information about the social, economic and environmental impacts of their production and consumption decisions. In addition, we lack sufficient information about the role and value of the goods and services, which ecologies in and of themselves create. Limited by the availability information, markets fail to reflect the full social and economic costs and benefits of the production or consumption of a good or service or of the conversion of natural resources into goods or services. As a consequence, markets will not provide Pareto efficiency.¹¹³ Given imperfect or incomplete information, the market outcome will not be the most efficient or beneficial societal allocation of our natural resources.¹¹⁴

Where incomplete information leads to the failure of the market to provide an efficient use of resources, the provision of a larger set of information should resolve the inefficiency. By requiring the availability of a larger and more inclusive set of relevant (and symmetrical)¹¹⁵ information before resource decisions are made, the more we move towards efficient outcomes. As such, and given the relationship between incomplete information and the failure of markets to provide the most efficient or beneficial allocation of resources, government interventions that mandate information-gathering and disclosure may be thought to increase societal and economic efficiency by making Pareto improvements to the circumstances.¹¹⁶ As Greenwald and Stiglitz have highlighted, “[m]arket forces do not necessarily lead to full (or efficient) disclosure of information,” leading to the conclusion that “there is a good rationale for disclosure requirements. Markets cannot function well with distorted and imperfect information; hence, requirements that lead to improved information can (by and large) lead

112. Ceteris parabus, assuming all other first theorem conditions hold.

113. Bruce C. Greenwald & Joseph E. Stiglitz, *Externalities in Economies with Imperfect Information and Incomplete Markets*, 101 QUARTERLY J. ECON., no. 2, 1986, at, 229-264.

114. Market Failure and Ecological Goods and Services.

115. Vs. asymmetrical information, where one party in a transaction has more or superior information compared to another.

116. Greenwald & Stiglitz, *supra* note 113.

to better resource allocations.”¹¹⁷

C. *Not Just Another “Economic Methodology”*

Given the foregoing introduction to information and its role in making Pareto improvements, it is worth noting that the *Clinch Coalition* court did not opine that an ecosystem services analysis would yield less or inadequate information.¹¹⁸ The court did not rule that an ecosystem services analysis would violate informational duties relevant to the timber sale.¹¹⁹ Rather, the court ruled that ecosystem services represented an alternative method of information gathering and assessment; presumably, that it would yield the same information but package it differently.¹²⁰ Such a ruling misunderstands the relationship between ecosystem services and the economic concept of efficient resource management.

Given the history of drive toward investigating ecosystems and nonmarket worth, it is not surprising to see some resistance against ecosystem services principles. J.B. Ruhl and his colleagues note that “estimates of nonmarket ecosystem service value is perhaps the most vexing in the long run in terms of policy development [because] . . . non market value estimates are essentially *models* of economic value rather than the direct measure that market prices provide.”¹²¹ However, by characterizing ecosystem services as merely another economic theory or accounting method, the court seems to have missed the profound contribution that information about ecosystem services makes to efficient and sustainable environmental decision making in both the short- and long-run, and to well-functioning markets for natural resources.¹²² The court has also somewhat diminished the spirit of NEPA by discounting the critical value of information in decision-making and in the efficient management of natural resources.¹²³

The study of ecosystem services punctuates the idea that natural capital is exhaustible and demonstrates the falsity of the notion that human productivity “operates at too small a scale relative to natural processes to interfere with the free provision of natural goods and

117. Stiglitz, *Government Failure v. Market Failure*, *supra* note 89.

118. *Clinch Coalition v. Damon*, 316 F. Supp. 2d 364 (W.D.Va. 2004).

119. *Id.*

120. *Id.*

121. Ruhl et al., *supra* note 25.

122. *Clinch*, 316 F. Supp. 2d at 364.

123. *Id.*

services.”¹²⁴ Such “free” services must be accounted for to accurately reflect the costs of losing such services. An analysis of relevant ecosystem services helps to identify the types of information not recognized or accounted for in other valuation approaches. It is important to note, for instance, that the market has borne little information on the value of photosynthesis: “[o]ne does not have to purchase photosynthesis or the radiation screening effects of the ozone layer, and therefore no data on market price are available for them.”¹²⁵ In contrast, ecosystem services valuation centralizes the notion that ecosystems “provide basic life support for human and animal populations and are the source of spiritual, aesthetic, and other human experiences that are valued in many ways by many people.”¹²⁶ As such, “[a]ssessing ecosystem services implies focusing on how the environment contributes to people’s well-being.”¹²⁷ Included in this analysis are access to extractable and marketable resources, nutrition and water, security, and sense of place and identity. The ecosystem services analysis requires an identification of the benefits and beneficiaries of relevant baseline ecosystem processes so that a proper and accurate accounting can be made after a proposed ecological transformation.

The ecosystem services analysis also provides an estimate of the costs of *using and losing* the ecosystems and ecosystem processes that produce goods and services, and as such, falls squarely into the demands of our resource management goals.¹²⁸ WRI notes that substantial benefits from employing ecosystem services analysis may particularly obtain on projects that:

- May lead to ecosystem change in contexts where people and communities have a high level of dependency on ecosystems to maintain their livelihoods and cultural identity and are therefore of vulnerable to ecosystem change. This includes remote areas that are opening to development.
- Depend on ecosystem services and are therefore vulnerable

124. Robert Costanza & Herman E. Daly, *Natural Capital and Sustainable Development*, 6 CONSERVATION BIOLOGY 37, 39 (1992).

125. Ruhl et al., *supra* note 25.

126. U.S. EPA, SCI. ADVISORY BD., VALUING THE PROTECTION OF ECOLOGICAL SYSTEMS AND SERVICES 8 (2009).

127. Florence Landsberg et al., *Ecosystem Services Review for Impact Assessment: Introduction and Guide to Scoping* 4 (WRI, Working Paper, Nov. 2011), available at http://ecosystemcommons.org/sites/default/files/wri_esr_for_ia_wp1.pdf.

128. See Keith H. Hirokawa, *Disaster and Ecosystem Services: From the Cuyahoga to the Deepwater Horizon*, 74 ALB. L. REV. 543 (2010/2011).

to ecosystem change. This includes projects that, for example, share water resources with other stakeholders, or require erosion control for viability.

- Are controversial and require the developer to be proactive in their relations with affected people to avoid legal battles or delays in project implementation or operation. This includes areas where citizens are actively involved and likely to demand project oversight.¹²⁹

In these circumstances, in which the needs and dependencies of ecosystem beneficiaries are brought to the fore, the ecosystem services analysis helps to establish values and terms that can capture the relevance of ecosystem changes to local, regional, and national audiences. Such insights were lost in the court's reliance on legislative history to reject the plaintiffs' NFMA argument: "Costs and benefits attributable to other resource values should be excluded *because of the lack of certainty involved in assigning values to other benefits derived and the impact on multiple use goals.*"¹³⁰ In the two decades that have passed between the legislative statement and the development of the economic analysis in ecosystem services, ecosystem services analysis has proven purposeful precisely in filling the information gap and providing greater "certainty . . . in assigning values to other benefits derived."¹³¹ Ecosystem services accounting is premised on economic principles and provides a fuller view of costs and benefits. Ecosystem services insights are not alternative to market values.

D. Ecosystem Services Analysis Provides Better Information

A recognition and valuation of ecosystem services is essential to governmental decision-making, community identity, and economic opportunity. The benefits produced by ecosystem services compel an understanding of ecosystems that recognizes not only the commodity values of goods produced by ecosystems, but also the value of the essential services that ecosystems provide. Indeed, our relationship with nature is one of dependency:

Natural systems provide foundational economic goods and services including oxygen, water, land, food, climate stability, storm and flood

129. Landsberg et al., *supra* note 127.

130. *Clinch Coalition v. Damon*, 316 F.Supp. 2d 364 (W.D.Va. 2004) (citing S. REP. NO. 94-893 (1976), reprinted in U.S.C.C.A.N. 6662, 6667 (1976)) (italics added).

131. Daily et al., *Benefits Supplied by Natural Ecosystems*, *supra* note 2, at 2; Costanza et al., *supra* note 20.

protection, recreation, aesthetic value, raw materials, minerals, and energy. All “built capital” is made of natural capital, including cars, buildings and food. An economy also requires hurricane protection, a stable climate, waste assimilation and other natural services. No economy can function without nature’s provision of economic goods and services.¹³²

Economies do not operate independently of natural capital, and as such, do not operate independently of ecosystems and ecosystem processes.

Based on these insights, it might seem intuitively compelling to seek more information on the processes by which ecosystems serve human needs. Yet, conventional markets, as endorsed by law, generally lack the requisite mechanisms to incentivize information gathering of the types of information that are essential to the valuation of public goods, including information relating to the protection of ecosystem services. Conventional markets discourage such information or otherwise change the question: “the root of the problem for ecosystem services has been the law’s utilitarian premise that developing natural resources invariably puts land to higher and better uses and maximizes social welfare where both are measured in monetary terms.”¹³³

This comparison—the values represented by ecosystem services and conventional valuation—does call into question the difficult task of identifying which and how much information is relevant to the problem-solving function of informational regulations. Here, understanding natural resource management through the economic framework provides tools that illustrate the relevant role of ecosystem services to the regulatory process. Regulation that mandates consideration of a more complete set of information concerning the environmental and economic impacts of resource use ensures more efficient management of resources by correcting for resource market inefficiencies resulting from incomplete information. Ecosystem services analysis generates a more complete set of information to decision makers than traditional economic/environmental analyses (such as cost-benefit analyses). An engaged investigation into relevant ecosystem services will discover the ecosystem processes that sustain those services of value to local communities and those other beneficiaries of such services.

132. DAVID BATKER ET AL., GAINING GROUND: WETLANDS, HURRICANES AND THE ECONOMY: THE VALUE OF RESTORING THE MISSISSIPPI RIVER DELTA 7 (2010), available at http://www.eartheconomics.org/FileLibrary/file/Reports/Louisiana/Earth_Economics_Report_on_the_Mississippi_River_Delta_compressed.pdf.

133. Christopher L. Lant, *The Tragedy of Ecosystem Services*, 58 BIOSCIENCE 969, 972 (Nov. 2008).

In neoclassical economic theory, the value of natural resources is limited to that of an input in the production function. The more natural capital is extracted and converted through the production process, the greater our capacity to produce the goods and services that increase society's wellbeing. In traditional market-based valuations of natural resources, only the benefit of converting resources through the production process is compared to the cost of converting those resources (including present and future costs and benefits inherent in the conversion of the resources into goods and services). The ecosystem services perspective not only recognizes that natural resources are producers of goods and services, but also that the goods and services produced by ecosystems might represent a greater economic, social, and environmental value than the goods and services acquired from the conversion of those natural resources over time.

The market reluctance to acknowledge ecosystem services is further illuminated by the types of services that ecosystems provide. Although the ecosystem services analysis provides a valuation of the services provided, the basis for that valuation is founded in the continuation of functions and processes in ecosystems. The range of services provided by ecosystems may be understood to include the following: "*provisioning services* such as food, water, timber, and fiber; *regulating services* that affect climate, floods, disease, wastes, and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and *supporting services* such as soil formation, photosynthesis, and nutrient cycling."¹³⁴ These ecosystem services illustrate our economic dependence on ecosystems, not as resources to be converted, but as the producer of goods and services critical to human needs, and economic and ecological wealth. As discussed above, ecosystem services employs market theory to assess costs and benefits in terms that represent market function. However, the economics of ecosystem services *is ecological*; it drives the way we understand the value of ecosystems and ecosystem functions, and as such, it largely determines the character of the ecological information that is gathered and the logic that such information invokes, such as whether the information indicates a significant adverse impact or a negligible (ecological) cost.

Applying the informational lessons of ecosystem services valuation to the *Clinch Coalition*¹³⁵ decision illustrates the informational

134. WALTER V. REID ET. AL., MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: SYNTHESIS v (2005), available at <http://www.maweb.org/documents/document.356.aspx.pdf>.

135. *Clinch Coalition v. Damon*, 316 F. Supp. 2d 364 (W.D.Va. 2004).

advantages of ecosystem services assessment. The *Clinch Coalition* decision provides the following description of the Forest Service's investigation:

The EA also discussed the economic impacts of the Project, both qualitatively and quantitatively. The EA included a discussion of the costs and revenues of the project planning and timber harvest activities associated with each alternative proposed by the Forest Service. The EA also concluded that the Project would at first negatively impact recreational use; however, the Project eventually would benefit recreational uses through, among other things, improvement of the view from the High Knob Tower and improvement of access for dispersed recreational pursuits. The EA also discussed several other economic impacts as well.¹³⁶

In contrast, the plaintiffs asked for a broader and deeper analysis of the certain impacts from the proposed time harvest:

The Plaintiffs next assert that “[i]n authorizing the Bark Camp timber sale, the Forest Service failed to account for the significant economic value associated with clean water, wildlife, recreation, scenery, non-timber forest products, and other non-priced ‘ecosystem services’ generated by the Bark Camp timber sale area in its existing condition.” In addition, the Plaintiffs assert that the Forest Service failed to account for the reduction in these economic values, which will result from logging and road building. Therefore, the Plaintiffs argue that the economic analysis provided by the Forest Service in the EA used to justify the Bark Camp timber sale was inadequate under NFMA and NEPA.¹³⁷

The plaintiffs' request was not based on speculation: logging and road building unquestionably impact “clean water, wildlife, recreation, scenery, non-timber forest products, and other non-priced ‘ecosystem services,’” and these services are associated with significant and readily available economic values.¹³⁸ The plaintiffs merely attempted to illustrate the ways in which “our largely un-marketed ecological wealth underpins our marketed economic wealth,”¹³⁹ not by proposing a novel or alternative methodology, but by proposing that the information be gathered and calculated in a way that is relevant to impacts on the economy and on human welfare.

136. *Id.* at 371.

137. *Id.* at 377.

138. *Id.*

139. John Porter et al., *The Value of Producing Food, Energy, and Ecosystem Services within an Agro-Ecosystem*, 38 *AMBIO* 186 (2009).

Ecosystem services is intended to further inform the regulatory process by giving a fuller value of resources by reference to ecosystem processes and the role that any particular ecosystem component might serve to the functionality of the system. That is, ecosystem services information is better information: ecosystem services information provides better baseline information for understanding changes to ecosystems by *facilitating the valuation of those changes*. The ecosystem services approach does not *merely* assess the value of goods and services produced by converting natural resources to commodities, it *also* demands an accounting of the goods and services that are produced by the natural resources themselves and the value of production over time. As such, “[i]t is far better economics to avoid wrecking productive natural systems, or to restore them when damaged, than attempt to displace or do without them.”¹⁴⁰

IV. CONCLUSION

One of the most interesting features of the ecosystem services perspective is its youth. The study of the value of ecosystem services is a recent trend.¹⁴¹ This does not mean that human settlements have been unable to identify natural systems, or that humans have failed to grasp the relevance of ecosystem processes, but that our current social and economic systems have failed to value ecosystems holistically for their function, location, and interactions. What we are finding, in looking more closely at the manner in which ecosystem processes benefit human welfare, is that ecosystems are critical to human survival: “without ecosystem services, we all die.”¹⁴²

Policymakers and resource managers are regularly called upon to prioritize the trade-offs concerning land conversion and environmental management. These decisions, even when benefitted by environmental impact statements, are too often made without fully accounting for the loss of goods and services produced by natural ecosystems.¹⁴³ Mindful of the notion that “[a]s a resource, information has unique characteristics

140. BATKER ET AL., *supra* note 132.

141. Harold Mooney & Paul Ehrlich, *Ecosystem Services: A Fragmentary History*, in NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS 11 (Gretchen C. Daily ed., 1997); J.B. Ruhl & James Salzman, *The Law and Policy Beginnings of Ecosystem Services*, 22 J. LAND USE & ENVTL. L. 157, 158-61 (2007) (identifying 1997-98 as the emergence of ecosystem services analysis).

142. Ruhl et al., *supra* note 25.

143. Pavan Sukhdev, *Putting a Price on Nature: The Economics of Ecosystems and Biodiversity*, 1 SOLUTIONS, no. 6, at 34-43, available at <http://www.thesolutionsjournal.com/node/823>.

that affect its allocation,”¹⁴⁴ this article builds on the potential of informational regulations to compel effective information gathering. Regulations play a key role in addressing market failures due to incomplete information¹⁴⁵ by forcing parties to gather and disclose a larger set of information. Regulations that require the disclosure of information, which would not necessarily be disclosed through market forces alone, are useful in seeking the more efficient management of resources.

The WRI has proposed that ecosystem services analysis, when addressed in a systemic manner, can provide significant assistance:

- *At the scoping stage*: systematically and comprehensively identify the ecosystem services to be addressed in further stages of [environmental impact review];
- *At the impact stage*: assess (1) the negative project impact on ecosystem services in terms of changes in the well-being of their beneficiaries and (2) the project dependence on ecosystem services in terms of changes in project performance; and
- *At the mitigation stage*: identify options through the mitigation hierarchy to enhance or at least maintain (1) the well-being affected beneficiaries derive from ecosystem services and (2) the performance the project derives from ecosystem services at acceptable levels.¹⁴⁶

When employed as such, an ecosystem services analysis allows stakeholders to better understand the projected project impacts in useful terms and in light of tradeoffs, to incorporate the value of co-benefits from the project or mitigation measures, and to ensure that the decision is founded on inclusive investigations and valuations. As Fischman argues, “ecosystem services can broaden the scope of cumulative analysis by defining the reasonably foreseeable horizon, and can contribute to making predictions about the type and extent of the impacts.”¹⁴⁷ In this light, the informational application of ecosystem services analysis can be seen to improve the informational regulation: “The main aim in understanding and valuing natural capital and ecosystem services is to make better decisions, resulting in better actions relating to the use of land, water, and other elements of natural

144. Ida Kubiszewski et al., *The Production and Allocation of Information as a Good that is Enhanced with Increased Use*, 69 *ECOL. ECON.* 1344, 1346 (2010).

145. Stiglitz, *Government Failure v. Market Failure*, *supra* note 89.

146. Landsberg, *supra* note 127, at 3.

147. Fischman, *supra* note 33.

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capital.”¹⁴⁸

148. Daily et al., *Decision Making*, *supra* note 27, at 23.