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Ecosystem Services as a Framework for Law and Policy

by *Ira R. Feldman and Richard J. Blaustein*

Editors' Summary: Law and policy have traditionally lagged behind economics and ecology as fields addressing the value and protection of ecosystem services. Environmental lawyers and policymakers need to work to close the gap in ecologist- and economist-dominated discourse on these vital services. In this Article, Ira R. Feldman and Richard J. Blaustein examine the potential intersections of ecosystem services and law and policy. They discuss how economic considerations like valuation, scale, and uncertainty might figure in the policy opportunities for ecosystem services. And they address how such considerations as taxation and payment arrangements, common-law rights, "constitutive" constitutional rights, and established international legal norms might work to protect ecosystem services.

Ecosystem services underpin human civilization in much the same way that law and public policy support the essential stability and security that enables communities and nations to function and endure. As Stanford University biologist Gretchen Daily writes: “Ecosystem services are absolutely essential to civilization, but modern life obscures their existence.”¹ In fact, ecosystem services and law and policy intersect at some of the central pillars of modern democratic life; both ecosystem services and legal property rights give real value to land and other capital holdings, enabling people to sustain themselves with natural and modified capital. The nexus of law and policy and ecosystem services also allows a democratic society to balance its central tenets of communal participation, equity, and liberty, as advanced by the continuous demarcating of rights and the equitable utilization of public goods.

Over the last 10 years, while the disciplines of economics and ecology have contributed to an improved conceptualization of ecosystem services, the law and policy framework has lagged behind. To be sure, we have seen the important contributions of a few legal scholars, led by James Salzman and J.B. Ruhl, who offer cogent proposals for protecting ecosystem services and a more recent emphasis by practitioners on the potential capture of the economic and other benefits of natural resources. However, despite these developments, it is clear that there must be substantial and significant law and policy input as ecologist and economist-dominated discourse on ecosystem services translates into policy agendas and regulatory applications that protect vital services for present and future generations. As Salzman suggests:

Just as the perspective of ecosystem services provides a valuable bridge linking ecologists and economists to policymakers, so, too, is it important for environmental lawyers to engage themselves in this research effort, both to explore the role ecosystem services should play in the law’s development and to influence the direction of research so that the services provided by nature may be accorded their proper value.²

The disconnect between law and ecosystem services is especially conspicuous because safeguarding ecosystem services is increasingly understood as an objective for environmental policy and regulation and fundamental to the management of natural resources. Moreover, there is a growing appreciation that the traditional single media focus (air, water, and waste) of environmental law and policy cannot secure provision of the resources, health, and communal needs that are central to human communities. Constructing law and policy informed by a cross-media understanding of ecosystem services would surmount that limitation of the current environmental regulatory regime. An ecosystems approach to law and policy would more effectively and seamlessly address ecosystem services-dependent human needs, such as safeguarding natural resources, ensuring health and well-being, and promoting effective stewardship of the natural and altered settings in which we live.

Ira Feldman, based in Bethesda, Maryland, is president and senior counsel at Greentrack Strategies, an independent think tank and consultancy specializing in regulatory innovation, strategic environmental management, sustainable business practices, and ecosystem services. Richard Blaustein is an environmental researcher and writer. He has represented Defenders of Wildlife at meetings of the Convention on Biological Diversity and the Climate Action Network.

Moreover, new domestic legal and policy understandings for the centrality of ecosystem services for local communities and for 21st-century national environmental governance would complement the international community's serious regard for sustainable development. International attention to ecosystem services has been reflected in vigorous participation in the 1992 United Nations (U.N.) Conference on the Environment and Development, the 2002 World Summit on Sustainable Development, prominent sustainable development accords such as the Convention on Biological Diversity (CBD)³ and the Convention on the Law of the Seas⁴ (both of which have a very high number of signatories), and the recent and widely noted global effort focused on ecosystems, the Millennium Ecosystem Assessment (MEA). In 2000, the U.N.'s Millennium Development Goals identified key goals to be achieved on the path to sustainable development. "Achieving most of these—eradicating poverty and hunger, reducing child mortality, improving maternal health, combating HIV/AIDS, eradicating malaria and other diseases, and ensuring environmental sustainability—will require major investments in ecosystem services."⁵

This Article examines the potential role of ecosystem services in law and policy. Whereas some policy considerations are heavily informed with legal understandings, others are largely propounded in the economics field, and these considerations will also be discussed. Important considerations of valuation, scale, gross aggregation of economic value, and uncertainty might or might not have salient legal characteristics but nonetheless figure large in the policy opportunities for ecosystem services. New and compelling possibilities for traditional legal understandings are potentially relevant to the safeguarding and equitable utilization of ecosystem services, and this Article will address such considerations as taxation and payment arrangements, common-law rights, "constitutive" constitutional rights, and established international legal norms.

I. FIRST ASSUMPTIONS: SUFFICIENT TOOLS, UTILITARIAN CONSTRUCTS, AND SERIOUS NEEDS

Real opportunities exist for legal and policy understandings for ecosystem services, but significant challenges in efforts to realize applications for ecosystem services loom large and need to be appreciated. These can relate to difficult questions, for example, with regard to valuing ecosystem services for policy and market estimations or the conflict of private property rights claims and public policy imperatives. However, the presence of real challenges or vagaries is not a legitimate excuse not to move forward with policy and legal applications for ecosystem services.

In addition to comprehending the critical role of ecosystem services and the frequently degraded circumstances in which they are manifest, it is also important to understand that law and policy in their current constructions and commitments do offer effective responses, remedies, settlement mechanisms, and fiscal measures for successful ecosystem services policy. Most of the thrust of environmental law as it exists in the United States today fails to provide integrated and effective protection for the ecosystem services on which communities depend, and will need some degree of either revision or reorientation in the future. In addition to legal paradigms and precedents, other recent policy designs, such as ecosystem service districts, show real promise in overcoming informational, institutional, and political obstacles that jeopardize ecosystem services. Examination and implementation of these formulated policies and legal applications are made incumbent by the current workings of media-specific environmental regimes that fail to synergize inputs and holistically address human needs.

Importantly, all offerings and analysis in this Article are motivated by an understanding of the utilitarian indispensability of ecosystem services. An emphasis on the utilitarian dimensions of ecosystem services does not imply in any way a dismissal of other paradigms of ecosystem services, such as a biocentric (or nonanthropocentric) outlook. Starting with the reasonable premise of the National Research Council's (NRC's) 2005 report, *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*, that "all kinds of value may ultimately contribute to decisions regarding ecosystem use, preservation, or restoration [including] that potential for non-anthropocentric sources of value,"⁶ this Article also agrees with the three central elements of the NRC report perspective that premises the economic basis for policy for ecosystem services. Listing the three elements, the NRC report states:

*The first is that ecosystems provide goods and services . . . to society
The second element is that in many cases these goods and services can be
quantified and an economic value can be placed on them. . . . A third*

element is that economic valuation can often be useful in support of environmental policy decision-making. . . . This valuation, in turn, becomes a necessary input to decisions about environmental conservation, particularly in situations where there is an apparent conflict between conservation or restoration and a conventional idea of economic progress, as indicated by gross national or state product measured at market prices.⁷

Thus, utility is the touchstone for facilitating deliberations and necessary estimations enabling real progress toward implementing policies for ecosystem services.

In addition to our interest in advancing tools for safeguarding ecosystem services in addressing the inability of single media environmental laws to address human needs linked to ecosystem services, this Article is also informed by a sense of urgency about the tenuous current situation for many vital and irreplaceable ecosystem services. The MEA cogently describes this condition, pointing out that

[h]umans are increasingly undermining the productive capability of ecosystems to provide the services that people desire. For example, world fisheries are now declining due to overfishing, and some 40 percent of agricultural land has been strongly or very strongly degraded in the past 50 years by erosion, salinization, compaction, nutrient depletion, biological degradation or pollution.⁸

This degradation of ecosystem services should be enough to spur on policy informed by ecosystem services. Given the seriousness of the state of the world's ecosystems and the universal communal dependence on ecosystem services, the continuous interdisciplinary discourse regarding ecosystem policy should inform policy post-haste. Perhaps the most compelling caveat policymakers should take to heart would be Daily's call that "[w]hile the academic community remains a long way from a fully comprehensive understanding of ecosystem services, the accelerating rate of disruption of the biosphere makes imperative the incorporation of current knowledge into the policy-making process."⁹

II. DEFINING AND PREDICATING ECOSYSTEM SERVICES: SUPPORTIVE AND DIFFERING UNDERSTANDINGS

Although different definitions of ecosystem services are offered, a general sense of ecosystem services in the context of policy is clearly discernable. For example, in the introduction to her influential 1997 book, *Nature's Services: Societal Dependence on Natural Ecosystems*, Daily states:

*Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage, timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products and their precursors. The harvest and trade of these goods represent an important and familiar part of the human economy. In addition to the production of goods, ecosystem services are the actual life-support functions, such as cleansing, recycling, and renewal, and they confer many intangible aesthetic and cultural benefits as well.*¹⁰

Daily's sampled enumeration services includes the following:

- purification of air and water and mitigation of floods and droughts;
- detoxification and decomposition of wastes;
- generation and renewal of soil and soil fertility;
- pollination of crops and natural vegetation;
- control of the vast majority of agricultural pests;
- dispersal of seeds and translocation of nutrients;
- maintenance of biodiversity, from which humanity has derived key elements of its agricultural, medicinal, and industrial enterprise; and
- partial stabilization of climate.¹¹

Similarly, the MEA, a five-year international collaboration culminating with a encyclopedic, multi-volume 2006 report examining the state of and policy recommendations for the world's ecosystems, explains ecosystem services:

*Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits.*¹²

Working from its distinction of ecosystem services as provisioning, regulating, supportive, or cultural, MEA's substantial enumeration of ecosystem services include the following:

Provisioning Services

Food and Fiber: This includes the vast range of food products derived from plants, animals, and microbes, as well as materials such as wood, jute, hemp, silk, and many other products derived from ecosystems.

Fresh Water: Fresh water is another example of linkages between categories, in this case, between provisioning and regulating services.

Regulating Services

Water Regulation: The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.

Erosion Control: Vegetative cover plays an important role in soil retention and prevention of landslides.

Water Purification and Waste Treatment:

Ecosystems can be a source of impurities in freshwater but also can help to filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems.

Regulation of Human Diseases: Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.¹³

In addition to Daily's seminal book and the MEA, the NRC report is significant for its general and specific enumeration of ecosystem services. The NRC report focuses mostly on aquatic ecosystem services but has broader application, and offers the following understanding of ecosystem services:

The biota and physical structures of ecosystems provide a wide variety of marketable goods—fish and lumber being two familiar examples. Moreover, society is increasingly recognizing the myriad life support functions, the observable manifestations of ecosystem processes that ecosystems provide and without which human civilization could not thrive These include water purification, recharging of groundwater, nutrient recycling,

*decomposition of wastes, regulation of climate and maintenance of biodiversity. Derived from the physical, biological, and chemical processes at work in natural ecosystems, these functions are seldom experienced directly by users of the resource. Rather, it is the services provided by the ecosystems . . . that create value for human users, such as flood risk reduction and water supply . . .*¹⁴

With important policy implications, the NRC report makes clear the distinction between ecosystem functions and ecosystem services. Included in the report's samples is an influential table by Rudolph de Groot (which was also sourced by the MEA) that lists the ecosystem function, its processes and components, and derivative goods and services. For example, for the function of water supply, the correlative ecosystem processes are “[f]iltering, retention, and storage of freshwater (e.g., in aquifers),” which in turn yield the ecosystem service of “[p]rovision of water for consumptive use.”¹⁵ This is quite an important distinction as economic valuations and legal applications will be shaped by whether an ecosystem feature is a service or a function, and thus the delineation will have an important bearing on economic values attached, the selection of legal tools, or even the possible course of negotiations over land or aquatic sources.

Utilizing similar distinctions, James Boyd and Spencer Banzhaf, with a focus on the importance of a gross aggregation of the worth of ecosystem services for market-premised mechanisms, are very critical of ecosystem services models that make weak distinctions as to functions and services. Offering a definition of ecosystem services as “components of nature, directly enjoyed, consumed or used to yield human well-being,” Boyd and Banzhaf point out that the phrase “‘directly enjoyed, consumed or used’ . . . signifies that services are end-products of nature.”¹⁶ Boyd and Banzhaf stress the need for accurate accounting due to the public goods nature of ecosystem services and the government's eventual and necessary role in designating value, aggregating the net worth of ecosystem services, and creating marketbased mechanisms to manage these natural resource outputs.

One mundane example vividly exemplifies the restrictions Boyd and Banzhaf would place on defining ecosystem services. Describing a scenario of recreational fishing, Boyd and Banzhaf state the following:

Ecosystem services associated with angling include the water body, visually available natural resources abutting it, and the target fish population. The water body is a service because it is necessary for angling. Visually available natural resources in proximity are a service because they contribute to the aesthetic enjoyment of the angling experience. The target fish population in the water body is a service—assuming that the possibility of a catch is important to the experience. Now consider things that are not ecosystem services associated with angling. The food web and water-purifying land uses on which the target population depends are not services, because they are intermediate products. Why isn't the angler's catch the ecosystem service? The catch is an inappropriate definition because it

*includes more than the contribution of the ecosystem; it includes the skill of the angler, the quality of equipment, and the time invested.*¹⁷

Boyd and Banzhaf's critique is significant for many reasons, perhaps foremost because it illustrates that there will be policy differences and challenges in the early defining and delineation of ecosystem services. While Boyd and Banzhaf raise important points in line with commonly articulated goals in ecosystem services discourse—namely, assignment of market values and an aggregated total for ecosystem services—the delineation of ecosystem services in most policy situations will need to be flexible and responsive to adaptive management.

Other ecosystem services descriptions, such as those presented by the MEA and by Daily (both of which Boyd and Banzhaf criticize), should be viewed as complementary and might still serve as the basis for policy actions. Moreover, as in the angling example, what is a function and what is a service is not so clear-cut, and need not be. For example, it is disputable that water purifying land uses being a function and not a service would lead to successful policy, as it would run counter to some of the most successful policies to date, such as the landmark Catskill Mountains water catchment program connected to New York City water provisions.¹⁸

On the divergence in distinguishing functions and services, the NRC report's comment on handling uncertainty in aquatic ecosystem service situations also responds to divergent ecosystem service delineations. The report states the following:

*The valuation of aquatic and related terrestrial ecosystem services inevitably involves investigator judgments and some amount of uncertainty. Although unavoidable, uncertainty and the need to exercise professional judgment are not debilitating to ecosystem valuation.*¹⁹

Boyd and Banzhaf legitimately point to the need for successful valuation linked to better specification of ecosystem services, but ecosystem services and functions sometimes overlap. This imprecision underscores the overarching and multiple contributions of ecosystem services that are of inestimable economic value. Nonetheless, Boyd and Banzhaf's criticism does point to the reality of different stresses and real policy challenges of ecosystem services, and they furthermore point to the need for serious delineations and value estimations to enhance successful policy and to redress the current neglect for ecosystem services in the policy dialogue and in the existing environmental regulatory scheme.

III. THE CHALLENGES OF VALUATION AND SCALE

Two central challenges in devising overarching and sitespecific policies for ecosystem services are the estimation of value and the delineation of scale. To some degree, the attribution of value and the specification of scale impose ad hoc measurements on resources that defy such attributions and are almost always larger than the monetary or spatial and temporal significations assigned to them. For example, a site that provides the valued ecosystem of water most certainly offers other services, too, underscoring the underestimated worth of the site's ecosystem services. As to scale for this water ecosystem service, many ecosystem functions that contribute to the provision would necessarily be excluded from the policy focus because no policy could encompass all the myriad and extensive ecosystem functions that synergistically yield an ecosystem service.

Nonetheless, for establishing an effective policy directed upon ecosystems services, certain factors of valuation and scale are most salient, and these would properly be the focus for designing a successful ecosystem policy. For example, it would be impossible to secure through policy distant transpiration rates that affect a given watershed; however, certain nearby estuary conditions and land uses probably would provide appropriate legal and policy targets for adequately safeguarding an ecosystem service associated with a watershed. Similarly, as for valuation, it would not be possible to estimate all possible values for a given watershed, but standard economic understandings—for example, estimates of tradability and/or willingness to pay—combined with new economic models for attributing value to highly regarded non-use values, such as recreation or multi-motivated pilgrimage landscapes, offer workable inputs for realizable policy for safeguarding ecosystem services.

Valuation appears to attract more cross-disciplinary attention than scale. Explaining in the broadest terms why valuation of ecosystem services is important, Andrew Wilcox and John Harte write the following:

Decision making that is blind to ecosystem values and to the negative externalities of development can lead to environmental degradation, negative economic feedbacks, and a decline in well being. In contrast, policy choices incorporating an appreciation of the benefits offered by ecosystems will allow establishment of sustainable levels and types of economic activity and assure continued provision of ecosystem services.²⁰

The NRC further exposts why ecosystem services should receive economic valuation, stating the following:

Some believe that environmental amenities and services lie outside the scope of economic analyses, arguing that the need to protect environmental assets is self-evident and not properly the subject of economic analyses However, wherever there is scarcity and the need to choose between alternatives, the question of relative values is unavoidable. . . .

Economic valuation requires that ecosystems be described in terms of the goods and services they provide humans or other beneficiaries. Goods and services in turn, must be quantified and measured on a common (though not necessarily monetary) scale if improvements to one ecosystem are to be compared to improvements to another.”²¹

In another exposition on the importance of valuation, the NRC explains the essential assignation of values for ecosystem services for effective ecosystem services policy, stating the following:

[T]here are a number of contexts in which quantification of such [ecosystem service] values may be useful or even necessary, including (1) informing policy decisions in which trade-offs are considered, (2) providing damage estimates for natural resource damage assessment (NRDA) or similar cases, and (3) incorporating environmental assets and services into national income accounts. . . .

In particular, for policy decisions that impact ecosystems, the benefits that the ecosystem generates through the various goods and services it provides must be included in calculating the benefits of preserving the ecosystem or the costs (foregone benefits) of allowing it to be degraded [F]ailure to assign a dollar value to these benefits (e.g., on the principle that they cannot be valued accurately or that the values are “incalculable”) effectively assigns them a zero value or a zero weight in the calculation of net benefits, implying that changes in those services will not be incorporated into the net benefit calculation.²²

Notwithstanding this first axiom of policy facilitated pursuant to economic valuation, inherent difficulties in valuation hinder the easy translation to market-based approaches and sometime necessitate that other policy measures—such as government payments, taxes, and strict regulation—are utilized to vouchsafe irreplaceable services. In particular, the public goods nature of ecosystem services coincides with difficulties in ascribing values to services that are not readily matched with monetary estimations. Public goods have very real economic value but do not quite lend themselves to “instant values” that afford transactions. Elaborating on public goods, Geoffrey Heal explains:

What is the difference between public and private goods? Most goods are private goods . . . for which consumption is “rival” and “excludable.”

Consumption is “rival” when my consumption of the good competes with or rivals yours: if I consume it, then you cannot. . . . Excludability means that the seller can ensure that only those who have paid for a good consumes it. . . . [P]ublic goods are nonrival and nonexcludable goods for which my consumption does not compete with yours and whose providers cannot exclude from their use those who have not paid for them. . . . The problem with public goods is that the market provides inadequate incentives for their provisions. The main reason is their non-excludability— the fact that the seller cannot prevent nonpayers from benefiting from them.²³

Adding to the understanding of ecosystem services as public goods and pointing to the difficulty of market emergence, Boyd and Banzhaf write:

Because most ecosystem services are public goods, markets are not available to provide clear units of account. . . .

The problem with ecosystem service markets is that the market itself does not define the units of trade (whereas conventional markets do). Instead, units of trade and compensation have to be defined by governments, governments being the trustees of environmental quality.²⁴

Notwithstanding the imperfect fit of markets upon ecosystem services, hybrid-type market approaches to ecosystems services offer great possibilities for successful policies. Heal explains that

[m]arket economics shows clearly that market price and importance to society are not the same From the perspective of conserving important natural ecosystems, this difference is not critical: what we need to establish is incentives for conservation, and this in turn depends on the ability of the owners of the system to appropriate as rewards some of the benefits they convey to others.²⁵

As Heal’s and Boyd and Banzhaf’s commentaries make clear, with the particular public-goods nature of ecosystem services, markets and market-resembling instruments will require the agency of governmental actions to maintain proper valuation, equitable utilization, and contented property rights holders. These actions and situations can be addressed given the tools of economics and law at hand. For example, new applications of legislative prerogatives, such as payment for services, and of common-law precepts, such as the public trust doctrine and common-law nuisance understandings, greatly contribute to the proper valuation and safeguarding of ecosystem services.

Applications of law and policy would also have to address the complex problem of scale, which, as noted above, is a prominent challenge in the design of policies for ecosystem services. “Many environmental problems originate from [the] mismatch between

the scale at which the ecological process occurs, the scale at which decisions are made, and the scale of institutions for decision-making.”²⁶ Complementing valuation exercises, questions of scale have interrelated scientific, policy, and economic aspects, with perhaps the scientific assessment of scale being the critical determinant that must inevitably suffice for the workings of other scale determinations.

Ultimately it is the framing of policy questions that sets the parameters for ecological and policy choices. Policy determinants are especially important to identify which services are the targets for policy measures. Salzman, for example, offers some guidance on how the question of scale would be best initially clarified in a policy context. “[R]egardless of the policy instrument employed—whether prescription, penalty, persuasion, property, or payment,” writes Salzman, “one must determine: (1) *what* services need to be delivered, (2) *how* they are to be provided, (3) *who* the providers and beneficiaries are to be, and (4) *how much* service provision is necessary.”²⁷

In addition to policy-type questions and guides in application to challenges of scale, scientific questions and assessments are absolutely necessary and will determine the success or need for modification of ecosystem services policy. Furthermore, an effective economic valuation of ecosystem services depends on the scientific setting of scale, and this scientific assessment involves some subjective determinations. As the NRC report explains:

The outcome of the valuation exercise will also depend on its spatial or geographic scale. Spatial scale has two components. The first is definition of the geographic extent of the relevant ecosystem(s). In defining the physical impacts of a given policy, one can restrict consideration to fairly localized impacts or consider spillover impacts on related ecosystems that are not impacted directly but change indirectly through those linkages. . . .

The second component of spatial or geographic scale is definition of the relevant population (i.e., the stakeholders). In estimating the value that individuals place on ecosystem changes, one must identify which individuals (whose values) to include. . . . For example, in valuing possible damages from a major oil spill, should calculations reflect damages to the local population, to the population within the state, to the population within the nation or to the world population? Because an oil spill that leads to loss of wildlife may negatively impact those outside the local area who value the existence of the animals, the aggregate measures of damages will generally vary directly with the extent of the population considered. . . .

In addition to the spatial or geographical scale, the valuation exercises is also affected by the temporal scale of the analysis (i.e., the period of time over which benefits and costs are distributed). . . . Most policy impacts last for extended periods, and some last (effectively) forever because they lead to irreversible changes. This is particularly likely in the context of ecosystems,

*where stock effects are important and losses of key ecosystem services may be irreversible.*²⁸

In addition to spatial and temporal considerations, the NRC report also emphasizes uncertainty as characteristic of ecosystem observation and policy and how uncertainty necessitates flexibility in policy design. As ecosystem services derive from dynamic, non-static ecosystem functions uncertainty is an inherent condition that is characteristic of this biological provision. With uncertainty at the front of ecosystem services thinking, the NRC explains the following:

Ecosystems vary in time and space. As ecologists extend their analyses of ecosystem structure and function to include potential goods and services, the uncertainty affecting assessments increases across both time and space. The interaction of ecological and social systems makes extrapolation of observations and prediction of future conditions exceptionally complex. The challenges that arise form the heterogeneity of ecosystems and values across space which complicates aggregation for assessment at larger scales, and from nonlinear system behavior that confounds forecasting. . . .

*The uncertainties associated with consideration of scale in assessment of ecosystem goods and services will only be resolved by continuing investigation of natural systems.*²⁹

Fortunately, the NRC offers guidance on managing the challenge of scale, recommending the following:

- Decisions about the scope and scale of analysis should be dictated by a clearly defined policy question.
- Estimates of value should be placed in context. Assumptions about conditions in ecosystems outside the ecosystem of interest should be clearly specified. Assumptions about human behavior and institutions should be clearly specified.
- Concerted efforts should be made to overcome existing institutional barriers.³⁰

With regard to the NRC recommendations and the earlier point on identifying stakeholders who may be nearby or spread widely, the legal precepts for legal standing and impacts would greatly aid in addressing these issues of scale. In this instance, an interface of law perspectives and scientific understandings would offer workable and needed responses to uncertainty challenges inherent in the scale attributes of ecosystem management for service provisioning. In the face of degrading and badly needed ecosystem services, law, policy, and participatory governance mechanisms help to ensure that the often-arcane issues of value and scale are processed, so that the ecosystem services people need are secured, rather than neglected due to the customarily unintegrated and segmented single media-based orientation of public policy for the environment.

IV. AGGREGATE TOTALS OF ECOSYSTEM SERVICES

Tied in to the policy imperative of valuation and scale estimates is the question of aggregate value of ecosystem services. The need for estimating aggregate value of ecosystem services ranges from persuasive purposes, i.e., raising compelling illustrations for the public and policymakers of the indispensability of ecosystem services to peoples' lives, to seriously held assumptions that only aggregate accounting can properly align market forces for the safeguarding of ecosystem services.

The NRC Report cautions “[u]nder no circumstances, however, should the value of a single ecosystem service be confused with the value of the entire ecosystem . . . [A] single ecosystem service represents only a partial valuation of the natural processes in an ecosystem [and] may provide a false signal of the total economic value . . . in an ecosystem.”³¹

While many are skeptical of the possibility of reasonable estimates of total value of ecosystem service and others question the necessity, some degree of aggregation is usually called upon, especially as it facilitates some movement toward a market framework for ecosystem services. For example, Boyd and Banzhaf stress the importance of some aggregate measure of ecosystem services pursuant to government policy as a prerequisite for the emergence of a fair market that will operate to safeguard ecosystem services. Pronouncing that their “ultimate goal is the development of national-scale environmental welfare accounting and performance assessment, potentially consistent with national income accounting and hence a broad ‘green GDP,’”³² Boyd and Banzhaf return to the argument that most ecosystem services

*must be procured by governments As public goods, these services suffer both from a lack of market provision and effective oversight. We believe that governments should be pushed to account for and communicate trends in ecological conditions. . . . Leaving aside the difficulties associated with weighting services according to their relative value, governments can begin systematically counting what is important about nature.*³³

Robert Costanza and colleagues attracted much attention—and criticism—for an early effort to estimate ecosystem services in aggregate. Their findings were presented in a May 1997 *Nature* magazine article, *The Value of the World's Ecosystem Services and Natural Capital*. They begin with a premise that “[t]he economies of the Earth would grind to a halt without the services of ecological life-support systems, so in one sense their total value to the economy is infinite.”³⁴

With respect to these limitations, Costanza and colleagues nonetheless aver “it can be instructive to estimate the ‘incremental’ or ‘marginal’ value of ecosystem services We have gathered together this large (but scattered) amount of information and present it here in a form useful for ecologists, economists, policy makers and the general public.”³⁵ With a process and an estimate that met with no scant amount of skepticism, they concluded:

*We estimate that at the current margin, ecosystems provide at least US \$33 trillion dollars worth of services annually. The majority of the value services we could identify is currently outside the market system, in services such as gas regulation . . . waste treatment . . . and nutrient cycling. . . . About 63% of the estimated value is contributed by marine systems. . . . Most of this comes from coastal systems. . . . About 38% of the estimated value comes from terrestrial systems, mainly from forests . . . and wetlands.*³⁶

In another framework for aggregating ecosystem service values, Laura Meyerson and colleagues have proposed

*[An option] to develop a national-level aggregate indicator of ecosystem services, an indicator that would command public attention, just as today’s economic indicators do (e.g., gross national product, inflation). . . . Like the economic indicators, an ecosystems services indicator would convey concise information on large-scale trends in ecosystem services, although it could not by itself provide all of the information necessary to make specific policy decisions. Despite these limitations, such an indicator would be useful and is greatly needed to provide a focus for broad discussion on whether the nation is gaining or losing services and how to respond to such changes if they occur, just as changes in unemployment are greeted with analysis and recommendations by the economic and fiscal policy community.*³⁷

In addition to having a purposeful resemblance to the indicator characteristic of the classic economic aggregate measure, gross domestic product, Meyerson and colleagues’ framework for estimating aggregate value also differs from Costanza and colleagues’ in that it is purposefully envisioned for more place-based, scaled examples for affording valuations in accord with regional needs, demands, and supplies. Explaining this emphasis, Meyerson and colleagues explain that

*the national economy is reasonably connected, or “well mixed,” and therefore lends itself better to a single aggregate indicator such as GNP. In contrast, ecosystems across the country are not necessarily connected. The ecological conditions in Florida are not closely related to the same indicator variable in Montana. Consequently, a geographically explicit mapping of our ecosystem services indicator will clarify the regional nature of the services and the scales at which they are occurring.*³⁸

With more clarification on why they advocate a framework for aggregating value that enunciates regional difference of value, Meyerson and colleagues explain:

[T]he services included in the equation will need to be weighted relative to each other and to account for the tradeoffs of increasing one service at the expense of another. Water is much more valuable in the arid [W]est than in the mesic [N]ortheast. Consequently, the “indicator equation” must have differential geographic weighting for different parts of the country. The indicator must be clear, concise, easily explained, and retain enough information to highlight the most important aspects of ecosystem services.³⁹

Despite the different methodologies for aggregating economic value of ecosystem services, both articles offer, the rationales for each process of aggregation strongly resemble one another and reinforce the fundamental motivation for producing a holistic value for ecosystem services. For example, Costanza and colleagues state:

Although ecosystem valuation is certainly difficult and fraught with uncertainties, one choice we do not have is whether or not to do it. Rather, the decisions we make as a society about ecosystems imply valuations . . . We can choose to make these valuations explicit or not; we can do them with an explicit acknowledgement of the huge uncertainties involved or not; but as long as we are forced to make choices, we are going through the process of valuation. . . . One practical use of these estimates we have developed is to help modify systems of national accounting to better reflect the value of ecosystem services and natural capital. . . . A second important use of these estimates is for project appraisal, where ecosystem services lost must be weighed against the benefits of a specific project.⁴⁰

Similarly, Meyerson and colleagues explain their rationale for offering a framework for aggregation of value: “Quantification of ecosystem services and communication of the information to decision makers and the public is critical to the responsible and sustainable management of natural resources.”⁴¹

In short, perspectives as to how to tabulate ecosystem services values vary but nonetheless point to some necessary process of aggregation in order for markets to emerge linked to policy options for decisionmakers. This aggregation of value not only aids in policy formulation but directly illuminates the extensive communal need for ecosystem services and the importance of crafting ecosystem services policies at community, state, and national levels.

V. ECOSYSTEM SERVICES DISTRICTS

Crafting specific programs that utilize an ecosystem services framework and sufficiently take into account issues of valuation and scale is challenging. Scale, in particular, raises difficult policy choices, as the most accurate geographic demarcations for services policy often conflict with political or administrative demarcations. One innovative policy formulation that integrates economic assessment, ecological surveying, and political and jurisdictional realities is the notion of ecosystem service districts (ESDs). ESDs would serve in the provisioning and safeguarding of ecosystem services by creating managerial consensus across political demarcations for all constituents or communities that depend upon a given set of ecosystem services. ESDs therefore enlist a significant amount of political brokering and will no doubt be most greatly facilitated by lawyerly inputs, such as Salzman’s payment scheme described below.

In one formulation of ESDs, Frances Irwin and Janet Ranganathan write:

*The goal of Ecosystem Service Districts is to protect and maintain natural capital at the local level in ways that support human needs. A District would identify ecosystem services, their sources, and their users. It would support analysis of both the ecological and economic character of the services. . . . In addition it would look at the costs and benefits of alternative management approaches.*⁴²

Adding to this introduction to ESDs, the seminal article on ESDs, *Protecting Natural Capital Through Ecosystem Service Districts*, emphasizes the opportunities of ESDs as a means of managing ecosystem services on a local district basis, averring that ESDs “could provide an institutional mechanism to help insure that natural capital is protected and maintained with the same care and concern as that given to built and human capital.”⁴³

Pointing to further implementation opportunities, the article underscores that ESDs have precursors in current natural resource districts, which are instituted legislatively or by local initiatives and that have authority over conservation and natural resource management. With the possibility that current natural resource authorities and regimes can serve as models—and perhaps agents—for the instituting of ESDs, the authors (Heal and colleagues) convincingly cite a few of these existing management districts:

Thousand of districts for soil conservation, resource conservation, flood control, and other local services are currently found across the United States. There are 2,935 soil conservation districts alone (encompassing 3,209 counties). . . . In some instances, these districts have been provided with significant legal authority, including the powers of taxation, eminent domain, and zoning. They do not, however, generally consider ecosystems

as providers of services. Flood control, for example, is managed at three different levels: nationally by the Bureau of Reclamation, regionally by interstate compacts, and within states by local flood districts. With rare exception, these institutions all carry the same toolkit, with three construction tools—dikes, dams, and levees—but no ecosystem service tools for assuring flood prevention. These districts do, however, provide an instructive starting point for the development of ESDs.⁴⁴

Whether or not building from existing natural resource management arrangements, the beginning organization of an ESD faces two main demarcation challenges for a successful model: conceptualizing and detailing the policy targets; and geographic mapping. A systematic quantitative characterizing of sources and outputs of ecosystem services and also of consumers of the services is a prerequisite for a successful policy. According to Heal and colleagues, this cataloging would entail analyzing services, consumers, economic estimations of value, the interdependencies of the service, and identifying “the social benefits and costs associated with alternative ways of managing ecosystem assets.”⁴⁵ The ESD cataloging serves not only local needs but also larger (national) inventories that contribute to regional and national valuations of ecosystem services.

The other challenge of geographic mapping of ecosystem services areas, would necessarily clarify three sets of information:

First, it would reveal the levels and types of services that could be supplied under alternative land management regimes. . . . Second, it would indicate the degree of spatial congruence in the supply of different services. . . . Finally, the mapping process could have an important dynamic component, forecasting changes in both services, and in societal need for them, under alternative future scenarios of demographic, land-use, and climate change. . . .⁴⁶

Irwin and Ranganathan also helpfully explain the “mapping of services” as “highlighting the spatial congruence of different services and helping identify the optimal allocation of services. The maps could also be useful in forecasting changes in services and thus help managers anticipate emerging effects of threats, such as climate change.”⁴⁷

As a particular challenge for ESDs, Heal and colleagues acknowledge the real possibility of legal challenges frustrating efficient ESD scope and functioning, and these legal challenges might include political and jurisdictional contests regarding service districts’ scope, challenges as to land use powers and taxation authority, and information generation. While these typically legal challenges present formidable obstacles to the formation of effective ESDs, they note that many of the decisionmaking capabilities for ESDs are already organized under municipal umbrellas of authority and emphasize the environmental and economic efficiencies ensuing for district formation.

Irwin and Ranganathan furthermore point out that instituting ESDs could also ameliorate existing political, managerial, and jurisdictional conflicts by better linking resources to funding possibilities or land choice mechanisms. They state:

Thus, over time, [ESDs] could develop as a vehicle not only for documenting a variety of service but also as the entity to direct investment in improving their condition, raising funds (for example, through taxation) and controlling land use (for example, through zoning). . . . [ESDs] could also provide communities with a forum for resolving conflicts that arise in using services.”⁴⁸

An ESD approach would not require expensive infrastructure rearrangements and might build on existing municipal arrangements that are already utilized by particular communities. These arrangements in turn would foster a holistic approach to safeguarding and providing ecosystem services that would incorporate small-scale ecosystem factors as well as larger ecological conditions that cross ESD borders, addressing many important policy challenges and serving as an efficacious paradigm for successful ecosystem services policy.

VI. NEW LEGAL UNDERSTANDINGS FOR ECOSYSTEM SERVICES

Perhaps the most salient missing formulation in the current policy assessment for ecosystem services, the one added factor that would ensure successful safeguarding and provisioning of ecosystem services, is the legal and regulatory policy component. Whereas the extension of law into ecosystem services has clearly not advanced at the same rate as the interdisciplinary and intradisciplinary examinations of economics and ecology, there are also vigorous and thoughtful legal advocacies that point to timely and relevant tools for bringing law to bear upon ecosystem services. The policy discussion to date has focused on enhanced applications of classic legal responses of the common law and statutory, legislative, and administrative actions. Progressive constitutional perspectives and international law that encompass natural resources also offer new normative understandings that are legally based and that have direct pertinence to ecosystem services.

In the United States, the law’s lag in embracing ecosystem services is due in part to certain historical absences of common-law linkages for articulated ecological goals, the assumptions against the utilitarian aspects of the public trust doctrine for ecosystem policy, and certain powerful—yet by no means inevitable—emphases in U.S. common-law understandings and jurisprudence. These emphases indicate a predisposition for economic

development, such as the eminence of familiar private property rights understandings, biases against non-utilitarian use of lands, and a restricted understanding of public nuisance. Needing direct redress is the insufficient attention to ecosystem services in the environmental policy and regulatory innovation dialogue, and the lack of recognition by legal institutions (law schools, bar associations, etc.) of the need to understand and appreciate ecosystem services.

Describing this unfavorable policy predisposition for ecosystem services, Salzman writes that “[d]espite their obvious importance to our well-being, perhaps surprisingly, ecosystem services have largely been ignored by environmental law and policy. Provision of services is only rarely considered in cost-benefit analyses, preparation of environmental impact statements, wetlands mitigation banking, Superfund remediations and oil spill cleanups.”⁴⁹ In a more recent article, Salzman writes:

*Indeed, it is fair to say that our laws were not designed with ecosystem services in mind. Legal protection of ecosystems was not a primary objective when the relevant laws were drafted over two decades ago. Generally speaking, our pollution laws (e.g., the Clean Air Act and Clean Water Act) rely on human health-based standards. Our conservation laws (e.g., the Endangered Species Act and Marine Mammal Protection Act) are species-specific. And planning under our resource management laws (e.g., the National Forest Management Act and Federal Land Policy and Management Act) must accommodate multiple and conflicting uses. Of course, parts of these laws, such as the Clean Water Act’s Section 404 wetlands permit program and use of water quality standards, the Endangered Species Act’s critical habitat provisions, and the National Forest Management Act’s use of indicator species . . . clearly can help to conserve ecosystem services. The point, though, is that these laws were not primarily intended to provide legal standards for conservation of natural capital and the services that flow from it and . . . in practice they usually do not.*⁵⁰

Adding to the historical sense of why ecosystem services are not safeguarded by law-based environmental policy, Ruhl points out that the landmark statutory benchmarks of environmental law, such as the National Environmental Policy Act, the Clean Water Act (CWA), and the Clean Air Act (CAA), had clear foundational connections and justifications in common-law understandings, in particular the law and remedies for “nuisance.” Ruhl avers that ecosystem- targeted legal responses and formulations have proved insufficient in large part due to their eschewing common law contexts and connections, this in contrast to the authoritative emissions-based legal regimes that were installed by environmental enactments in the early 1970s. Ruhl explains:

[T]he source, the very backbone of the wave of federal pollution control laws the federal government enacted in the 1970s, was the common law of nuisance. And many observers also agree that there has been a profound

shift of emphasis in environmental policy from controlling smokestacks and discharge pipes to managing ecosystem-wide phenomena such as habitat loss, invasive species nutrient runoff—what today goes under the umbrella term of ecosystem management. What is missing from this more recent focus on ecosystems and their sensitivity to human insult, however, is any notion that legislative initiatives might find some guidance in the framework of the common law.⁵¹

Explaining more about the historical context for ecosystem management ambitions, Ruhl adds:

Clearly, therefore, by the time Congress turned its attention to air, water, and land pollution in the early 1970s, the common law had established the causal connections between pollution and environmental harm; between environmental harm and economic injury, and endorsed the need for and practical availability of remedies. The common law thus provided much-needed legitimacy to the public law agenda for pollution control. . . . By contrast, the public law agenda for ecosystem management has no common law roots. In 1993, when Vice President Al Gore’s National Performance Review called for federal agencies to support a “proactive approach to ensuring a sustainable economy and a sustainable environment through ecosystem management” there was absolutely no foundation from which to begin common law or otherwise. . . . In other words, the ecosystem management was left to building itself from the ground up. . . . Perhaps out of arrogance, or ignorance, or the failure fully to appreciate the importance of the common law to antipollution legislation, ecosystem management legislation tried to leapfrog its common law formative stage, and it has gained little traction as a result.⁵²

While Ruhl discusses ecosystem management in these excerpts, his argument and advocacy is for ecosystem services law, which is essentially utilitarian in conception and significant in offering opportunities for reconnecting ecosystem safeguarding to common-law principles. The very shift in focus from ecosystems’ functional and environmental criteria to ecosystems services brings with it a policy reconfiguration placing front and center ecosystem service safeguarding policies that are strongly informed by common-law principles and remedies.

Importantly, the focus on ecosystem services bolsters new applications of public trust and nuisance remedies in much the same way that common-law nuisance understandings underpinned the landmark environmental statutes and subsequent environmental regimes over a generation ago. Eschewing premising ecosystem policy rationales on criteria of ecological integrity, the ecosystem services approach underscores potential harm and injury to custom and usage, well-being, and economic reliance in which ecosystem services figure. This emphasis reconnects ecosystem services with common-law roots and important economic criteria that courts and legislatures look to when they act

decidedly in ways that effect or effectuate policy. As Ruhl explains with reference to the common law:

So, what would be the organizing principles for the evolution of a common law doctrine of ecosystem management? . . . There has to be a concrete theme to motivate the interest and action of private litigants and the courts, and that theme must have dimensions fitting within the basic contours of common law doctrine and institutions. This includes articulating a coherent statement of rights and liabilities that are susceptible to analysis through commonly understood and applied principles of proof of breach, injury, and causation, as well as a remedial system that provides efficient and equitable outcomes. . . . Unfortunately, the discipline of ecosystem management is for the most part brimming with themes that are decidedly impractical for these purposes. Its organizing principles include conserving biodiversity, restoring naturalness, providing safe harbor for native species, and the implementation technique for adaptive management. Impressive sounding as these terms may be, they are square pegs to the common law's round holes. . . . But against that grain, the ecosystem services branch of ecology holds great promise for the common law. Most of ecosystem management is devoted to keeping ecosystem functions healthy for the sake of ecosystems; on the other hand, the study of ecosystem services is devoted to articulating which ecosystem functions provide service values to humans that would be costly, but clearly necessary or desirable, to replace were they to degrade in quantity or quality.⁵³

Ruhl offers ecosystem services, in contrast to ecosystem management, as attracting the power of precedent and engendering new leverage to enter the policy framework to safeguard ecosystem services. Whereas this linkage to common-law precedent will need supplement from other legal means, such as legislation, administrative rulemaking, and participatory mechanisms for public enlistment in the new appreciation of ecosystem services, the new leverage and linkage to legal precedents of common-law notion especially capitalizes on the essentially utilitarian aspect of ecosystem services and works directly to promote economic valuations.

As a starting point in assessing the linkage of common law to ecosystem services, the central common-law public trust doctrine is not only reinvigorated by an ecosystem services emphasis but also fosters distinct legal responses to supplement public policy assertions of the public trust. The public trust doctrine has its roots in Roman law, “which declared that there are three things common to all people: (1) air; (2) running water; and (3) the sea and its shores,”⁵⁴ and was subsequently incorporated into the common-law systems of both England and the United States, with a major thrust in navigable waterways, shores, and shoreways. In the context of ecosystem services, this common-law doctrine, which lacks precedents for applications in ecosystem management contexts, would be utilized with the authority it has in commercial and navigational settings.

Building on the influential 1970 article on the public trust by Joseph Sax, Ruhl and Salzman expound on the requirements and scope of the public trust doctrine:

First it has a geographic reach that must be defined. In the American version that has traditionally meant all lands subject to the ebb and flow of the tide, and all waters navigable in fact, such as rivers, lakes, ponds, and streams, though . . . the scope has been expanded in some states. Next the uses that the trust protects and prohibits must be defined. In American jurisprudence, fishing, commerce, and navigation have long been the core protected uses, with other uses such as boating, swimming, anchoring, and general recreation being recognized as well in most states. . . . Finally the public trust doctrine carries with it restrictions on the alienation of public trust lands to private interests when to do so would undermine the protected uses.⁵⁵

Critiques of public trust applications for protecting ecological conditions emphasize the public trust's "utilitarian origins and substance as critical liabilities in any project attempting to use it in advancing the law of environmental protection."⁵⁶ The point of the utilitarian nature of the public trust doctrine has proved especially strong, and this utilitarian aspect has its analogue in the pro-commerce basis of the public trust, predisposing the public trust doctrine to be less prone to apply to policies that center ecological integrity for its own sake.

The shift in emphasis to ecological services, however, raises new possibilities for public trust applications. As Salzman and Ruhl aver: "Although monetizing the value of natural capital and ecosystem services is more complex than estimating the economic value of a timber plantation or hunting reserve, no reasonable argument can be advanced that natural capital and ecosystem services are not economically valuable."⁵⁷ Further expounding on how ecosystem services fit well with the public trust doctrine, Ruhl and Salzman explain:

We propose using the concepts of natural capital and ecosystem services to change the ecological scope of the public trust doctrine from within, that is, without having to contest the conventional utilitarian features of the narrow doctrinal framework. Our argument is straight forward: traditional public trust resources often contain natural capital supplying economically valuable ecosystem services to the public; the public's enjoyment of those values is appropriately treated as a use of the trust lands within the meaning of the public trust doctrine; therefore, the restrictions applicable under the public trust doctrine attach to the natural capital found on trust lands. In short, we propose integrating natural capital and ecosystem services within the public trust doctrine's utilitarian core to make it more ecological on its surface. . . . The public uses the natural capital found on trust resources for economic benefit every bit as much as it uses the fishing ground and the navigation channels for economic benefit. The ecosystem services flowing

*from such natural capital can be significant in economic value and vitally important to the maintenance of economic systems.*⁵⁸

The public trust doctrine can be inclusive of ecosystem services underscores this common-law doctrine's applicability in a period of new understandings of the economic importance of ecosystem services. The very broadness and generality of the public trust doctrine would probably direct this understanding's application for ecosystem services to be most influential, not so much in new public trust policy enactments or court cases centrally decided on articulations of the public trust doctrine, but rather in its bolstering of other legal actions or policy enactments.

The common-law basis of nuisance is a very strong example of where the public trust doctrine offers some background support for new perspectives on established remedies that value and safeguard ecosystem services. Furthermore, nuisance is a central common-law precept that is amenable to ecosystems services focus, and especially so with new economic appreciations of ecosystem services. Reviewing the literature on the background for the landmark environmental enactments of the 1970s, Ruhl writes: “[O]ne entry finds almost universal support—that the source the very backbone of the wave of federal pollutions control laws that federal government enacted in the 1970s, was the common law of nuisance.”⁵⁹ Prominent jurisprudence establishing responsibility for pollution across locales and boundaries, such as the landmark 1907 U.S. Supreme Court case of *Georgia v. Tennessee Copper Co.*,⁶⁰ extended nuisance protections, remedies, and supported the enjoining force of states and parties in nuisance situations.

Furthermore, the nuisance jurisprudence in the decades of the 20th century dovetailed with understandings of the public trust, in which case law extended the public trust doctrine to environmental protections in some instances but prominently failed in others. For example, in the famous 1970 New York case, *Boomer v. Atlantic Cement Co.*,⁶¹ the state court declined to support nuisance type injunction relieve, while holding open the opportunity for later nuisance damages relief, but with significant deferring to legislatures the prerogative to address emissions public trust-type of obligations. Notwithstanding the failure in the synergies of nuisance and public trust, nuisance in U.S. environmental history remained strong, culminating in its significant informing of today's major statutes.

Recent jurisprudence, scholarship, advocacy, and policy discussions have created possibilities for extending nuisance remedies or guidance into ecosystem services policy, with commentators recently highlighting the perhaps inadvertent support Justice Antonin Scalia offers for ecosystem services in the 1992 Supreme Court case of *Lucas v. South Carolina Coastal Commission*.⁶² Matching Justice Scalia's first reflection that that regulation would not be a taking if it “does ‘no more than [simply] duplicate the result that could have been achieved in the courts—by adjacent landowners (or other uniquely affected persons) under the State's law of private nuisance, or by the State under its complementary power to abate nuisances that affect the public generally”⁶³ with his corresponding point in *Lucas* that “changed circumstances or new knowledge may make what was previously permissible [under common law] no longer so,” Ruhl points out that the current dialogue

regarding ecosystems services “changed circumstances and new knowledge,” and that common-law protections, most prominently nuisance remedies, are perfectly apt to figure in the effort to value and safeguard ecosystem services.⁶⁴

As an example of an enhanced application of nuisance, in the following vivid example, Ruhl offers a scenario in which an industrial facility’s emissions damage a nearby commercial apple orchard that receives ecosystem services from a forest tract on the other side of the facility. Offering different direct causes of damages for an examination of what would be actionable under classic nuisance understandings (and in a context of “new knowledge” regarding of ecosystem services), Ruhl writes:

The owner of the apple orchard has suffered a substantial decline in commercially marketable apple production and can prove both the cause and the economic damage. The alternative causes to consider are:

- *Emissions from the industrial facility drifting into the orchard are damaging the bark of the trees, causing them to decline in productivity.*
- *Emissions from the industrial facility drifting into the orchard are blemishing the skin of a substantial percentage of the unripe apples, causing them to be unmarketable.*
- *Emissions from the industrial facility drifting into the orchard leave a residue on the apple tree leaves and interferes with photosynthesis, causing the trees to decline in productivity.*
- *Emissions from the industrial facility drifting into the orchard are deterring visits from wild pollinators residing in the forest tract habitat, thus causing a reduction in successful fruit production.*
- *The owner of the forest tracts cuts down all the trees to build a shopping mall, eliminating that source of wild pollinator visits and thus causing a reduction in successful fruit production.*⁶⁵

With this scenario, Ruhl points out that “the first two of these scenarios are classic fodder for nuisance claims” while the next two “involve land uses that sever the flow of ecosystem services to the orchard,”⁶⁶ and avers that “[i]f these [latter] causal connections are proven, it is not clear why the common law would fail to recognize them as cognizable cause of action in nuisance if it does recognize the first two scenarios as such.”⁶⁷

While pointing out that with the fifth scenario (the forest tract owner converting his land to a shopping mall), successful nuisance claims would have more difficulty surmounting a test of reasonableness and estimation of duty on behalf of the forest tract owner, Ruhl shows that the nuisance claim in all scenarios would at least be actionable. The wide range of actionability would, in turn, figure into the broader policy edification for ecosystem services, here with a legal bolstering.

Admitting that “by no means . . . nuisance law . . . will fill all the gaps in ecosystem management law,” Ruhl points out that “nuisance law can play an indispensable role in the evolution of that larger body of [environmental] law, and that it has been overlooked at the expense of the ecological values we hope the law of ecosystem management will help us sustain.”⁶⁸ With a further summary point that points to contributions to policy for ecosystem services Ruhl states what might be the most important foundational contribution for ecosystems services in his examination of common-law nuisance: “At most therefore, I hope to have described a way for the common law of nuisance to operate at the interface of ecology and economics, to provide a foundation for public legislation and a forum for resolving private civil disputes over the reasonableness of behavior.”⁶⁹

Complementing nuisance, the public trust doctrine and other common-law understandings, administrative and legislative measures are also necessary for the safeguarding of ecosystem services, and some significant legal thought has already been given to this policy venue. In fact, the eventual proper valuations and effective policy response for ecosystem services will certainly comprise a mix of common law and administrative and legislative actions together. This mix will effectuate policies and mechanisms to ensure communities and sectors with the ecosystem services upon which they depend. The administrative and legislative actions for ecosystems services also appropriately tie in with public needs because of the public goods nature of ecosystems services, the indispensable role of government with regard to ecosystem services, e.g., establishing markets and/or valuations, identifying functions, and identifying suppliers, and the evident need for some instigating agency, in addition to court redress, to establish ecosystem service safeguards.

Salzman offers a substantive exposition on one administrative effort to safeguard ecosystem services that centers around payment arrangements for services. With substantive examples both domestically and from other countries, Salzman, in *Creating Markets for Ecosystem Services: Notes From the Field*, argues for thoughtful and sophisticated arrangements for administrations of payment for ecosystem services as a way to build on successful precedents and for timely action to broadly respond to degradation of ecosystem services and their underappreciation.

In addition to service payment examples from Australia and Costa Rica, Salzman discusses the example of ecosystem service policy for New York City water provision. He notes that “[w]hile the Catskill experience provides an important example of paying to manage a catchment for water purification services, paying landholders directly to change their practices represents a relatively small part of the program.”⁷⁰ Notwithstanding the lesser role played by direct payments to landowners for watershed land practices, the expected New York City payments “\$270 million on ‘partnership programs’ fostering water quality and economic development in the Catskill/Delaware Watershed, New York City’s regulatory authority over [the] watershed, the EPA mandate requiring action, the clear value of the cost avoided in not building a treatment plant and the ability to raise capital”⁷¹ point to a strong example of diverse administrative, legal-based actions with some degree of market interaction as future tools for safeguarding ecosystem services.

These administrative policy tools and public-private partnerships create opportunities for the future, but Salzman finds most pertinent the payment to landholders for land uses that support provisioning of ecosystem services. Recognizing that privately owned lands and natural resources figure significantly in the production of the public goods of ecosystem services, Salzman points out that “because of the public goods problems and the other challenges . . . , fully private markets are difficult to establish for most ecosystem services. As a result, in most cases government plays a critical role—typically as the dominant buyer to spur market provision of services.”⁷² Elaborating on the nature of markets and financial safeguards of ecosystem services, Salzman explains:

[S]pecifically, if we are interested in creating ecosystem service markets, we need a clear idea at the outset of who the buyers and sellers will be . . . [T]here is no locally discrete class of beneficiaries with whom landholders can negotiate for biodiversity conservation efforts As a result, to overcome collective action problems, most successful service markets to date operate as monopsonies, with only one buyer for multiple service provider sellers. . . . Whether for biodiversity or clean water, the government pays for these services on behalf of the citizenry. Such actions are entirely appropriate, it should be noted, since they correct the market failure posed by public goods.⁷³

Importantly, the arrangement of paying property owners for ecosystem services or behavior that safeguards ecosystems involves a partial privatization of a public good. This payment that ensues from partial privatization also redresses information discrepancies in which property owners restrict knowledge of their properties bearing on ecosystem services. This redress is very important as the payment mechanism spawns positive government-property owner interactions and transactions regarding ecosystem services. As Salzman explains:

[L]andowners know both the opportunity cost of a specific land use change and the prices they are willing to accept to implement this change. For its part, the government agency or water supplier knows how much it is willing to pay and which types of land use changes would be most valuable for service provision. The design challenge is how most efficiently to transfer both types of information—(1) willingness to pay/accept, and (2) service provision resulting from a land use change—from one party to another in a mutually reinforcing fashion. . . . [Whereas] it is difficult to obtain the sort of information necessary to precisely target a regulation, tax, or general subsidy[, by] partially privatizing a public good, payment schemes can create a mechanism to shift the costs of providing this information, but the scheme must be carefully designed, for without the landholder’s information, the government is at risk of overpaying. Equally, without the government’s information, the landholder has little sense of the relative value of the alternative land use or how to optimize the service provision.⁷⁴

Payments for services are also tied into to the evolution of common-law understandings of property rights, public goods, and the duty of care (which has a direct pertinence to the evolution of nuisance understandings in the ecosystem service context). Whereas at present there might not be a duty to care regarding a land use that affects the provisioning of ecosystem services, there might very well be in the future, especially with greater legal and administrative advocating of proactive ecosystem services policies. As a case in point, the situation of farmers and their land use is one that Salzman focuses on, and a group that at the present moment would be especially well-suited for a well thought-out ecosystem services payments program. The question of whether to pay farmers for safe uses or to regulate and penalize them for negatively impacting ecosystem services is a policy estimate, one very much tied to current applications of duty to care responsibilities and also tied to the complex estimation of the myriad positive and negative impacts that farming engenders. As Salzman illustrates:

Posing these questions more fundamentally, what is the proper paradigm for ecosystem service provision by farmers? Should we think of farmers as polluters, and therefore subject to the polluter-pays principle Or, by contrast, are farmers potential providers of valuable services who are as deserving of payments as water treatment plant operators? . . . [I]s the duty of care sufficiently strict and clear in the land management context such that paying farmers not to allow manure and soil into watercourses sounds . . . absurd?

At least at the moment . . . the answer is “probably not.” Otherwise, payments would seem ridiculous because regulations already made riparian fencing and grass swales mandatory [W]ithout a clearly defined duty of care the argument for payments becomes much stronger.⁷⁵

Explaining some more and with clear inferences for an evolving understanding of common-law public goods, nuisance claims, and private property rights, Salzman states the following:

[A] reasonable strategy may be . . . for ecosystem service markets . . . deciding where entitlements popularly rest now, paying for those services dependant on clear rights, and having a transitional system for those services that already are or should be public property rights. This recognizes the fact that, in the real world, there is genuine uncertainty about the bundle of rights and it may make sense to pay for some rights, even if you do not think they started out in the right place

While I have focused on the policy approach of transition payments linked to a rising duty of care, there are other instrument hybrids

Realize as well under this approach, the size of ecosystem service payments is directly correlated to the transition to the new duty of care.⁷⁶

The payment for ecosystem services may be a transitional policy or it may later be justified for a lengthy or indeterminate application. Significantly, this approach is legal-based, and necessarily incorporates law and legal-based policy. Furthermore, as enunciated by Salzman the payment of ecosystem services—or for modifying behavior that affects ecosystem services—is related to the evolution of other legal understandings in an ecosystem services context, such as the duty of care, which is integral to nuisance applications and assertions.

Most significantly, the payment for ecosystems services and its linkage to other legal notions and premises illustrates the readiness of law and policy to be applied to the safeguarding of ecosystem services. The ideas for ecosystem service payments, together with understanding of public trust and nuisance, are certainly not the only legal insights and perspectives available for application to ecosystem services, but they are examples of sophisticated means already available, and that would furnish the necessary additions of law and legal-based policy to the advanced economics-biological sciences discourse regarding ecosystem services provisioning for real world application. This ready availability of adding law to the ecosystems services formulations being discussed needs to be understood in a real-world context in which communities cannot survive without ecosystem services and in a world where ecosystem services are progressively degraded.

Three additional legal connections to ecosystem services need to be mentioned here that point to the strong justifications for law and policy bearings for ecosystem services. First, the above administrative and common-law understandings for ecosystem services are by no means exhaustive. Some commenters have even pointed out that the prominent statutory regimes that dominate U.S. environmental law would also be amenable to greater ecosystem services orientation, pursuant to administrative leadership and directives that would reorient part of the administrative thrust of the regimes to better safeguard ecosystem services. New interpretations of the CWA to safeguard water sources and wetland, and eventual action coordinating the CAA, the CWA and other laws to address nonpoint source pollution also offer potential for better addressing the degradation of ecosystem services.

Second, basic domestic rights and entitlements and international environmental law norms also point to a future in which the essentiality of ecosystem services for communal and democratic well-being would be greater appreciated. For example, Cass Sunstein has written on the dependence of private property assertions on government powers and delineations and how this government action has a corollary in basic “constitutive” rights that are implied in the interests addressed by the U.S. Constitution. As Sunstein explains:

Some rights can be located in a founding document; they are constitutional rights in the sense that the prevailing interpretation of the document finds them there. . . . Other constitutional rights are not mentioned expressly, but they are understood to be encompassed by the Constitution's terms The

founding document does not refer to them. . . . But these rights are nonetheless constitutive commitments. They have a special place in the sense that they are widely accepted and cannot be eliminated without a fundamental change in social understanding. These rights are genuinely constitutive in the sense that they help create, or constitute, a society's basic values. They are also commitments in the sense that they are expected to have a degree of stability over time. A violation would amount to a kind of breach of violation of trust.⁷⁷

Just as navigation and waterway travel rights can be seen as basic constitutive rights implied by the interests that the Constitution safeguards, so can ecosystem services be understood as a constitutive right upon which communities depend. This constitutive right, which also derives in part from being an essential public good, would run alongside established property rights. It would most often be realized in a manner that gives real value and its corollary of responsibility to property rights. Furthermore, in the most true sense of constitutive rights, ecosystem services constitutes a fundamental governmental supportive function that indispensably figures into the interests of union, communal survival, and the legal-based individualism that the Constitution protectively addresses. Similar to the right to a public education, which Sunstein points out is not enumerated in the Constitution but is now protected by constitutional understandings, so too should the safeguarding of ecosystem services figure in the administrative and jurisprudential understandings of environmental law, pursuant to greater articulation and advocacy of ecosystem services' indispensable role in communal life and in underpinnings commerce and property holdings.

Lastly, international environmental law and those prominent instances where environmental and human rights law coincide clearly indicate a growing international appreciation of the role ecosystem services play for groups and communities. International accords that address environmental degradation, indigenous peoples participation, fishery levels, and waterway health encompass the safeguarding of ecosystem services, sometime explicitly, as with the CBD's adoption of "the Ecosystem Approach" as a cross-cutting theme for conservation among its over 180 parties. In recent years, prominent international rights decisions, both in the U.N. system and, specifically in the Inter-American Commission on Human Rights fora, uphold readings of international treaties that vouchsafe natural resource access for local peoples who face loss of ecosystem goods and services. For example, in the 1993 case, *Apirana Mahuika et al. v. New Zealand*⁷⁸ (commonly known as the *Maori* case), rights to fisheries were upheld pursuant to a reading of the International Covenant on Civil and Political Rights' Article 27, which affirms rights of traditional peoples to "enjoy their own culture," in which cultural presuppositions extend to natural resource access, in this case fisheries.⁷⁹

Although these human rights cases and international environmental standards are not resorted to in American jurisprudence and administrations, they nonetheless serve as a background garnering clearer understanding of sustainable development in which ecosystem services play an integral part and also meet with legal status and value. In a very broad and foundational sense, this trend underscores the necessary role law will play for safeguarding

ecosystem services and illustrates the existence of very real rights premises for safeguarding ecosystem services.

VII. CONCLUSION

Ecosystem services play an indispensable role in communal life and in robust and sustainable economic relations. For well over 10 years, a discourse in the scientific and technical sphere has illuminated this role and has advanced this discourse to the point of fostering new policy opportunities to safeguard ecosystem services. This discourse has also offered important paradigms and tenets for more sophisticated tools and approaches for safeguarding ecosystem services such as market creation, valuation, aggregation of value, and the conceptualizing of ecosystem districts that will facilitate policy tailoring for ecosystem services.

Thus the new challenge to decisionmaking is to make effective use of new information and tools in this changing context in order to improve the decisions that intend to enhance human well-being and provide for a sustainable flow of ecosystem services. It seems clear that the choices of the past may not be the most appropriate strategy for the future, and that even the way people think about intervening in ecosystems must be revised to take account of new information, new tools, and new contexts.⁸⁰

Especially with the appearance of the MEA and its robust methodology with ecosystem services at its core, it is clear that the ecosystem services framework will inevitably transition from the scientific and technical sphere to the policy and regulatory realm. These ideas and innovations will require a strong legal component to enable ecosystem services policy to be implemented on a wide basis. Fortunately, new understandings of common law and administrative actions offer real possibilities for law to provide itself as the key factor for successful ecosystem services policy and for surmounting institutional barriers that prevent implementation.

This entry of law into the interdisciplinary ecosystem services discourse is especially apt, as ecosystem services are among the essential provisions for communal, democratic life and inevitably figure into the demarcating and safeguarding of value for property holdings. In this sense, as law and legal-based policy is enlisted to safeguard ecosystem services, new positive synergies arise, underscoring the essential underpinning role of ecosystem services for times present and future, as in times past.

Footnotes:

1. Gretchen C. Daily, Introduction: What Are Ecosystem Services?, in *Nature's Services: Societal Dependence on Natural Ecosystems* 7 (Gretchen C. Daily ed., 1997).
2. James Salzman, The Importance of an Ecosystems Perspective in Environmental Law, *Sustainable Dev., Ecosystems & Climate Change Comm. Newsl.* (American Bar Ass'n Section Env't, Energy & Resources), Apr. 2004, at 9 [hereinafter Salzman, *Ecosystems Perspective*].
3. U.N. Conference on Environment and Development, Convention on Biological Diversity, June 5, 1992, U.N. Doc. DPI/1307, reprinted in 31 *I.L.M.* 818 (entered into force Dec. 29, 1993).
4. U.N. Convention on the Law of the Sea, Oct. 7, 1982, U.N. Doc. A/CONF.62/12221, reprinted in 21 *I.L.M.* 1261 (entered into force Nov. 16, 1994).
5. MEA, *Ecosystems and Human Well-Being: A Framework for Assessment* (2003).
6. NRC, *Valuing Ecosystem Services: Toward Better Environmental Decision-Making* 33 (2005).
7. *Id.* at 27.
8. MEA, *supra* note 5, at 29-30.
9. Daily, *supra* note 1, at 10.
10. *Id.* at 3.
11. *Id.* at 3-4.
12. MEA, *supra* note 5, at 3.
13. *Id.* at 56-58.
14. NRC, *supra* note 6, at 17.
15. *Id.* at 81.
16. James Boyd & Spencer Banzhaf, What Are Ecosystem Services?: The Need for Standardized Environmental Accounting Units 8 (*Resources for the Future, Discussion Paper No. 2*, 2006), available at <http://www.rff.org/Documents/RFF-DP-06-02.pdf>.
17. *Id.* at 12.
18. For the New York Catskill example, there are many writings and commentaries. See, e.g., James Salzman, *Creating Markets for Ecosystem Services: Notes From the Field*, 80 *N.Y.U. L. Rev.* 870 (2005) [hereinafter Salzman, *Creating Markets*].
19. NRC, *supra* note 6, at 13.
20. Andrew Wilcox & John Harte, *Ecosystem Services in a Modern Economy: Gunnison County, Colorado*, in *Nature's Services: Societal Dependence on Natural Ecosystems* 325 (Gretchen C. Daily ed., 1997).
21. NRC, *supra* note 6, at 22.

22. *Id.* at 37, 40.
23. Geoffrey Heal, *Nature and the Marketplace: Capturing the Value of Ecosystem Services* 29, 30, 31 (2000).
24. Boyd & Banzhaf, *supra* note 16, at 3.
25. Heal, *supra* note 23, at 180.
26. MEA, *supra* note 5, at 18.
27. Salzman, *Creating Markets*, *supra* note 18, at 897.
28. NRC, *supra* note 6, at. 43 (citations and footnote omitted).
29. *Id.* at 83, 85 (citations omitted).
30. *Id.* at 126.
31. NRC, *supra* note 6, at 156.
32. Boyd & Banzhaf, *supra* note 16, at 1.
33. *Id.* at 23.
34. Robert Costanza et al., *The Value of the World's Ecosystem Services and Natural Capital*, *Nature*, May 15, 1997, at 253.
35. *Id.* at 259.
36. *Id.*
37. Laura A. Meyerson et al., *Aggregate Measures of Ecosystem Services: Can We Take the Pulse of Nature?*, *Frontiers Ecology & Env't*, Feb. 2005, at 56, available at <http://www.frontiersinecology.org/specialissue/articles/Meyerson.pdf>.
38. *Id.*
39. *Id.* at 58.
40. Costanza et al., *supra* note 34, at 255, 259.
41. Meyerson et al., *supra* note 37, at 58.
42. Francis Irwin & Janet Ranganathan, *Restoring Nature's Capital: An Action Agenda to Sustain Ecosystem Services* 48 (2007), available at http://pdf.wri.org/restoring_natures_capital.pdf.
43. Geoffrey Heal et al., *Protecting Natural Capital Through Ecosystem Service Districts*, 20 *Stan. Env'tl. L.J.* 333, 336 (2001).
44. *Id.* at 335.
45. *Id.* at 358.
46. *Id.* at 359.

47. Irwin & Ranganathan, *supra* note 42.
48. *Id.* at 49.
49. Salzman, *Ecosystems Perspective*, *supra* note 2, at 4.
50. Salzman, *Creating Markets*, *supra* note 18, at 880-81 (footnotes omitted).
51. J.B. Ruhl, *Toward a Common Law of Ecosystem Services*, 18 *St. Thomas L. Rev.* 1, 2 (2005).
52. *Id.* at 10, 12.
53. *Id.* at 11, 12.
54. J.B. Ruhl & James Salzman, *Ecosystem Services and the Public Trust Doctrine: Working Change From Within*, *Se. Envtl. L.J.* (forthcoming) (manuscript at 2, on file with the authors).
55. *Id.* at 3.
56. *Id.* at 4.
57. *Id.* at 8.
58. *Id.*
59. Ruhl, *supra* note 51, at 2.
60. 206 U.S. 230 (1907).
61. 26 N.Y.2d 219 (1970).
62. 505 U.S. 1003, 22 *ELR* 21104 (1992).
63. Ruhl, *supra* note 51, at 3.
64. Ruhl & Salzman, *supra* note 54, at 10 (quoting *Lucas*, 505 U.S. at 1029, 1031).
65. Ruhl, *supra* note 51, at 15.
66. *Id.*
67. *Id.*
68. *Id.* at 19.
69. *Id.*
70. Salzman, *Creating Markets*, *supra* note 18, at 896.
71. *Id.* at 879-80.
72. *Id.* at 876.
73. *Id.* at 901-02.

74. Id. at 914-15.

75. Id. at 929-30.

76. Id. at 946-47. CCPR/C/70/D/547/1993 (2000).

77. *Cass Sunstein, The Second Bill of Rights: FDR's Unfinished Revolution and Why We Need It More Than Ever* 61, 62 (2004).

78. Commc'n No. 547/1993, U.N. Human Rights Comm., U.N. Doc.

79. Id. §8.2.

80. MEA, *supra* note 5, at 179.