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Law and Policy for Ecosystem Services

Editors' Summary: On February 21, 2007, the Environmental Law Institute hosted a seminar on law and policy for ecosystem services. After the moderator provided an overview of the challenges and opportunities for regulation of ecosystem services, the panelists shared their expertise on a range of topics surrounding this issue, including the Millennium Ecosystem Assessment, the economics of ecosystem services, differences between provisioning services and regulating services, and information and incentive programs for the private sector. Below is a transcript of the event.

[Transcribed by ACE Transcription Service, Washington, D.C. The transcript has been lightly edited, and citations have been added, for ease of reading.]

Moderator:
Ira Feldman, President and Senior Counsel, Greentrack Strategies

Panelists:
Tundi Agardy, Millennium Ecosystem Assessment and Executive Director, Sound Seas
Richard S. Davis, Beveridge & Diamond
Bob Donaghue, Director, Pollution Prevention Assistance Division, Georgia Department of Natural Resources
Janet Ranganathan, Director of People and Ecosystems, World Resources Institute
J.B. Ruhl, Matthews and Hawkins Professor, Florida State University College of Law

I. Introduction

Scott Schang: Our moderator today, Ira Feldman, has a long and distinguished career in environmental issues. He is currently president and senior counsel of Greentrack Strategies in Washington, D.C. He formerly served as special counsel in the Office of Compliance at the U.S. Environmental Protection Agency (EPA) and was a member of the Environmental Management Task Force of the President's Council on Sustainable Development. Before that, he also practiced with law firms in both Washington and New York.

Ira Feldman: I would like to thank the Environmental Law Institute and those in the American Bar Association (ABA) responsible for this event, in particular a vice chair of my Sustainable Development Ecosystems and Climate Change Committee, Rich Blaustein, who labored hard to pull together the details here, and John Dernbach, the current chair of the committee, for his leadership and vision.

Scientists in recent years have called attention to critical services that ecosystems provide to communities and populations of all sizes. Commentators have also pointed to the economic, social, and cultural aspects of society that depend on ecosystem services. Further, good governance is increasingly predicated on proper management of natural resources, of which safeguarding ecosystems is an integral component. The proper safeguarding, utilization, and valuation of ecosystem services can thus be viewed as a central tenet to any effort to understand and realize sustainability.

Law and policy have recently entered the ecosystem services discourse with greater efforts in collective collaborations: state; local; and federal regulatory offices and significant recent legal scholarship to explore present and future means to effectively safeguard ecosystem services. Perhaps the boldest effort in this regard is the Millennium Ecosystem Assessment, a five-year global study on the state of the world's ecosystems, which included examination of human health and welfare, agriculture, biodiversity, and policy bearings of ecosystems and ecosystem services.

In addition to these large collaborations and individual investigations and scholarship, law practitioners are also beginning to advise their clients on ecosystem services connections to their clients' operations and the various economic and policy valuations that will be brought to bear on these clients' activities. Today's panel will discuss how ecosystem services as a framework or set of concepts is making a transition from the scientific and technical sphere to the policy, legal, and regulatory worlds. Along the way, we will discuss the current state of law and policy for ecosystem services, state regulatory efforts and law practitioners' attention to ecosystem services.

We have on our panel today J.B. Ruhl, the Matthews and Hawkins Professor of Property from Florida State University; Tundi Agardi, a principal in the group Sound Seas, and a coordinating lead author of the Millennium Ecosystem Assessment and an expert on coastal and marine scientific and policy issues; Bob Donaghue, the Director of the Pollution Prevention Assistance Division of the Georgia Department of Natural Resources and chairman of the Ecological Innovation and Integration Committee of the Multi-State Working Group on Environmental Perfor-

mance; Janet Ranganathan, Director of the People and Ecosystems Program at the World Resources Institute (WRI); and Richard Davis, a partner shareholder in the law firm Beveridge & Diamond.

Tundi Agardy: I am very pleased to be here, thank you. I come to this world of applied science for policymaking from a scientific background. For many years—decades, in fact—scientists and ecologists have been working on ecosystem services, trying to appraise where these services are being delivered, how they are being used, how they are affected by human activities, and so forth. All of this discussion has taken place largely within the realm of ecology and somewhat in the realm of conservation.

We have really had a kind of communication failure in terms of talking about services. In fact, even today when I give you a few words about the Millennium Ecosystem Assessment, I will find it hard to talk clearly and succinctly about ecosystem services and what they mean to human beings. I think this transition to better communication is happening, but until the scientific community develops better ways of communicating the importance of ecosystem services, it will not be grasped fully by the policymaking community. I am very hopeful that will happen, but I think we have to do a much better job on the ecology side.

J.B. Ruhl: In 1998, I attended what I think might have been the first major conference on ecosystem services. It was held at the Missouri Botanical Gardens in St. Louis and there were approximately 50 ecologists present. Gretchen Daily was the organizer of the ecologists' side. I estimated about 50 economists present. Geoff Heal from Columbia Business School was organizing their efforts. There were exactly two lawyers present; I happened to be one of them. I was struck by the fact that there were only two lawyers there at an event that struck me at the time as providing a potential organizing principle for environmental law from that point forward. I walked away convinced that law will have no choice but to incorporate the emerging scientific and economic principles of ecological economics.

My talk today will focus on what I think getting it right means for law, understanding the context, the science, the economics, and the geography. I happen also to be a geographer, so I come at this from a geographer's point of view as well. I think we as lawyers need to inventory the status of law as it exists today in terms of existing property rights, regulatory structures, and social norms. Then we have a big challenge ahead of us: designing ecosystem services law for the future.

Bob Donaghue: I have been in the environmental business for about 30-some years, mainly getting my hands dirty cleaning up Superfund sites, restoring wetlands, and for the last 15 years, working with business to promote sustainable business practices. What I have seen over the years that disturbs me is that we started out with just nature, and then we broke it into a thousand different pieces—solid waste, water, air, and all these different things. From my experience with the Georgia Department of Natural Resources and others, a lot of people that are in some of these environmental programs really have no clue that what their job is really just about nature. So what I am hoping is that the next stage of this environmental management evolution will be to bring all the pieces together, back to just nature again, and start looking at ecosystems and ecosystem services holistically.

Janet Ranganathan: Ecosystem services is a concept. It is perhaps the most exciting thing that I have come across in the 20 years I have been in the environment field. Ecosystem services changes the way we see and value ecosystems. It changes the debate from development and economics versus environment to actually putting development and ecosystem services central in that debate. Development depends upon ecosystem services and it affects it.

The second point I would like to make relates to what I believe is the greatest legacy that the Millennium Ecosystem Assessment leaves us, and that is the integrated framework of human well-being, ecosystems, scale across levels, and time. It speaks to the need to actually move from a reductionist approach to science and governance to a much more integrated approach, and I will touch on both those issues in my presentation.

Richard S. Davis: I am the duck out of water here, if ducks can be out of water, as a 25-year practitioner of water law. My interest in this is that I have seen a couple of trends in the old media-specific laws. The first is that people like many of you and me who have been slicing and dicing these laws over time have essentially taken the impetus from them. We have managed to routinize them to the point where, as Bob said, people do not realize the laws are about the environment; they think the laws are about §4261(b)(6). That is good defense law, but it is not particularly good environmental policy. The other trend is the lack of a motivating force. As Janet said, I think the engine is going to have to be the enthusiasm that ecosystem services, or a concept much like it, reintroduces into the debate and drives forward both on a legislative and on a policy basis.

Ira Feldman: I come from an environmental regulation, environment management systems, and sustainability and corporate social responsibility background. I agree with Janet's observation about this being potentially one of the most important concepts that we have come across as environmental professionals. Twelve years ago, few people gave much credence to the idea that environmental management systems as a concept would have much of an impact in environmental policy and regulatory spheres. But in fact, it did, and looking forward over the next 10 years, my strong belief is that ecosystem services will play a similar transformative role in big-picture policy and environmental regulation. For those of you who have often pondered the concept of how are we going to operationalize sustainability—that is something that comes up often in sustainability circles—I would like to suggest that understanding the ecosystem services is important to that.

Ecosystem services is going to be an important component of any future effort in EPA and state regulatory agency efforts. For those of you who are familiar with the set of studies in the mid- to late 1990s on the next generation or second generation environmental regulation, all of that is going to come up for reconsideration in the next couple of years. The most important piece that was not available to those of us who were involved in those efforts 10 to 12 years ago was the ecosystem services piece because the scientific and tech-

nical state of play was not yet at a point where it could be integrated with the emerging policy and regulatory ideas.

II. The Millennium Ecosystem Assessment

Tundi Agardy: You probably all know about the Millennium Ecosystem Assessment. As Ira said, it was a five-year process involving many hundreds of scientists from around the world. It was very much modeled on the Intergovernmental Panel on Climate Change, which meant that it was a consensus-building document that had to go through extreme scrutiny by all of the member states, all of the agencies that commissioned it, and by all of the institutions that supported it. It was a long, painful process, which culminated in many, many documents. You are probably familiar with some of the synthesis reports that have come out of it, including the initial synthesis, which is the framework document that Janet mentioned. There are summaries that are oriented toward each of the conventions that commissioned the ecosystem assessment.

Unfortunately, although it generated a lot of interest around the world, the Millennium Ecosystem Assessment has not gotten very much exposure in the United States. I think that is for a number of reasons that I would not go into now, but they probably have to do with a lack of resources to really market the effort and the report, and also with the mindset of people in the United States. Europe seems to be much more focused on ecosystems and the services they provide and the United States is not quite there yet. But I think that is changing.

There are two things that really are notable about the Millennium Ecosystem Assessment. There have been many, many assessments done by scientists on biodiversity, forests, and on all kinds of biomes. The thing that really sets this apart from all other assessments is that, for the first time, it looks specifically at delivery of services as opposed to delivery of goods.

The other point about the millennium assessment is that it was very much focused on the "so-what," because scientists have known for a long time that ecosystems deliver services that are vital to human well-being. But we really have not communicated the findings of how specifically ecosystem services are linked to human well-being. The Millennium Ecosystem Assessment really quantified human well-being and there are many ways of looking at various aspects of human well-being and the role that ecosystem services played in supporting that human well-being or improving on it.

The [Millennium] Ecosystem Assessment was not just navel-gazing on the part of thousands of scientists. It was meant to deliver specific products to conventions and treaties that have to do with protecting ecosystems. The main conventions included the Convention on Biological Diversity and the Convention on Combating Desertification. Other conventions were involved as well, and these were essentially the main audience for the Millennium Ecosystem Assessment. They asked that we take a look at the data globally on ecosystem conditions and trends and determine what is happening with respect to the services that those ecosystems provide and what can be done in the future.

In addition to the main global assessment, many multi-scale or sub-global assessments were done. This is really interesting because when we were working on the global assessment, we could only work with global databases, and you probably all know that there are very few good databases on global condition, trends, and ecosystems around the world. So we were somewhat confined in our global look at ecosystem services. But we were less confined at the sub-regional level, and we were able to develop storylines or vignettes about what was happening with respect to ecosystem services and human well-being. Many of these stories have very interesting lessons for policymakers and for legislators, because they demonstrate what happens when people overlook the importance of ecosystem services to human well-being or what happens when people become invested in protecting those ecosystems for the services they provide. There are many, many findings. Probably the most notable is that close to two-thirds of all the ecosystem services that were studied on a global scale are currently degraded. Even more alarming is that trends in ecosystem services are suggesting that we are heading on a path toward human well-being destruction globally.

Many different aspects of this trend towards greater degradation are localized in the sense that certain segments of society and certain regions of the world will feel the impacts of ecosystem degradation. All of the scenarios point to a dynamic world in which the final outcome 50 or 100 years hence depends on the responses that policymakers make today. We cannot predict what exactly is going to happen, but we can say that there is going to be a need for policymakers to focus on ecosystem services and the delivery of the services they provide.

There is nothing to focus the brain better than disaster. Immediately before the release of the Millennium Ecosystem Assessment, we had the tsunami event, which in a sense, the Millennium Ecosystem Assessment was predicting. It was not predicting that the tsunami event would happen, but it was predicting that in places where natural ecosystems had been degraded, people were going to be more at risk. If we look at the studies following the tsunami, we see that in those areas where governments and local communities were invested in protecting ecosystems, the services the systems provided for flood control and buffering land from storm events were really significant, and that those people had to suffer less loss of property and life.

With [Hurricane] Katrina and [Hurricane] Rita, we saw that there was crystallization in people's minds that ecosystems provide us services for free and that we would do well to protect those ecosystems for the services they provide. Economists will look at this and say: "How much protection is going to be worth x number of lives saved or x number of acres protected." For the Millennium Ecosystem Assessment, we could not really say that for any amount of protection of an ecosystem you will get this much better delivery of services. This is why I think the multi-scale and sub-global assessments are so powerful. In those cases, you could actually quantify the impacts of protecting ecosystems and see the services they provided in very clear terms. I should also say that we included cultivated systems as an ecosystem, and in fact urban systems as ecosystems. So, we were not focused specifically on the kind of [high-level] biodiversity kinds of systems, but all ecosystems.

A lot of the findings were wake-up calls to decision-makers, because the global picture is quite alarming when you look at certain kind of biomes and things like coral reefs and mangroves. Water is a big theme throughout the Millennium Ecosystem Assessment; the amount of water that is re-

tained in reservoirs and unavailable to natural systems, the amount of pollution into our waters, and so forth. There are obvious implications for human health as well with the degradation of ecosystems. This is a field that is going to pick up speed now as people are looking at not only the kinds of services that are provided, but also the very important role that ecosystems have in modulating and regulating pathogens and keeping human health going.

The Millennium Ecosystem Assessment did not only look at conditions and trends, but also looked at possible responses. We know that there are lots of options and we know the best thing we can do for decisionmakers is to explain the trade offs and choices that they are faced with and allow them to make the best possible decision based on scientific data. Even though the Millennium Ecosystem Assessment did not get very much attention in the United States, it does have a lot of relevance to the United States and to U.S. environmental policy. First of all, we are recognizing even more than we ever have in the past that ecosystem condition is related to national security, that if we anticipate changes in services—in other words, the degradation of services—or if we anticipate how restoration can increase the delivery of services to us, then we become in a much better position to better utilize what nature provides.

The last point I want to make is something that I really could go on for hours about: the role of the private sector. Here is an interesting place where law and public policy come together, because the private sector is really taking a very keen interest in ecosystem services. You see a lot of initiatives now with payments for ecosystem services. Markets are trying to do what the government has really failed to do, which is to try to get the investment in protecting ecosystem services. The business sector sees a financial benefit for itself, and that is why the markets developed. But the markets cannot really develop unless there is a strong regulatory environment. In other words, the business sector really will not become involved in protecting ecosystems for their services unless they feel comfortable that the regulatory environment is such that they can do this. Maybe in the discussion we can go into what some of those regulatory steps need to be put in place to allow markets to develop. But I think this is going to be the wave of the future. I think private sector investment and ecosystem services are really going to take off from here.

III. The Law and Economics of Ecosystem Services

J.B. Ruhl: The other lawyer, by the way, at the St. Louis Conference in 1998 was Jim Salzman, a lawyer and professor at that time at American University and now at Duke University Law School. Jim and I made a pact as we left the St. Louis Conference to essentially stake our academic careers on ecosystem services. We figured if it was a bomb, we would have someone else to go down in flames with. But we truly decided that we wanted to study how to take what the ecological economists were saying and turning it into law and policy.

What I will summarize for you today is where I am on that. I have divided my thinking into the following: what is the context that law needs, what is the status of the law now, and how do we design the future of law, taking into account what we are learning from the Millennium Ecosystem Assessment. We are all very good at seeing the human economy, but what we are being asked to do now is see nature's economy and understand the value it is providing to the built economy.

I think a lot of us understand, basically, what ecosystem services are. But I want to focus on the difference between what is called "provisioning services," which support the structural components of ecosystems that we consume directly through recreation and use of ecosystems, versus "regulating services," which are services that ecosystems provide such as gas regulation, climate regulation, disturbance regulation, and flood control that wetlands and coastal dunes provide.

To me, these are the tough nuts. These are the hardest problems for law to capture and operationalize, whereas it is easier to appreciate that ecosystem services provide food, timber, etc. And so, another way of looking at it is that at the top of this diagram we have natural capital ecosystems. But ecosystems provide two branches of services. One branch is supplying us commodities and the structural components of ecosystems we use directly; the other branch, the services we use directly. Now, how does law take those into account? Clearly, seeing nature's economy is not enough; it is not enough to read the Millennium Ecosystem Assessment. We have to take these service values into account, both in markets and in regulatory systems. The context question is, what is the knowledge base law must work from? The status question, which was of great interest to me, is, what is the law right now? How does the law treat ecosystem services today? And the design question is, how do we choose the right blend of instruments and institutions to move forward? Context, to me, is a question of ecology, geography, and economics. How does natural capital produce ecosystem services? How must law recognize this? The geography is, of course, where are they? What is the spatial and temporal distribution of ecosystem services? And the economics is, what are existing incentive structures?

The ecology is very complex. I think we all can appreciate that ecosystems are themselves complex adaptive systems. There are many trade offs that will be faced as we begin to think about ecosystem services and managing them. There will be trade offs within ecosystems and between ecosystems. This is a massive challenge for ecologists to inform law about the trade offs between ecosystems.

We think of ecosystems oftentimes as nested hierarchies—watersheds fit within larger watersheds. It is in fact much more complex than that. We have to think about the different scales and the trade offs between scales as well. These are political decisions. A local population might find an ecosystem service that it is trying to optimize, but that might have some effect for a regional population. So there are policy decisions that we have to confront in terms of the governance structure we developed.

The geography is also complex. Natural capital does not usually occur where the services are enjoyed. There is a spatial and temporal distance. We have to think about the sources, where they are, what the delivery channels of ecosystem services are, when they are sent into the channel, where they are enjoyed. Think of riparian wetlands as providing downstream flood mitigation control as a service. We have to trace how that ecological process works geographically.

The economics, of course, are also complex. For the most part, ecosystem services are what we would call public

goods—they are not excludable. It is hard for me as the owner of wetlands to prevent you from enjoying the downstream flood control services. They are also nonrival in the sense that all of you can enjoy them. It is not like a glass of wine where when I drink it, you cannot. It is not like a seat at a baseball stadium: "It is my seat, not yours." Rather, these tend to be publicly consumed.

The natural capital owner views the economics of the services as positive externalities. They are flowing off the boundaries of the property, whereas the ecosystem service user is going to tend to free-ride. So it is hard to get the two together in an economic transaction. The combined effect, of course, is we are undersupplying ecosystem services. That is the current economic incentive structure.

What about the status of law? I spent the better part of the past three years asking that question. What are the existing property rights with respect to ecosystem services? What does our regulatory system look like, and what are our social norms? Property rights, regulation, and norms are the three standard solutions to *The Tragedy of the Commons* that Garrett Hardin informed us about many years ago in his famous Article.[1] The problem is that our property rights structure is not just absent, it is a mess.

When you think about how we would want to align property rights with ecosystem services, we are dealing with transboundary stock-flow property rights, such as water rights. Our common law of property rights has developed over two centuries to actually tilt a bias against preservation of natural capital. We have a pro-development common law of property. And ecosystem service users, generally speaking, have no recognized property rights in the continued flow of ecosystem services from other lands. So, our property right structure simply does not match up with what our ecological understanding of ecosystem services is.

I surveyed federal and state laws on wetlands, federal and state laws on forests, and the Coastal Zone Management Act, looking for indicia of regulatory structures recognizing and operationalizing ecosystem services. Generally, I found none. A specific example: wetlands mitigation banking, a program that essentially unbundles the services of wetlands, moves the ecological service elsewhere, and we are left with technological fixes for the urban population that was enjoying wetland services.

In a recent article that Salzman and I published with [the Environmental Law Institute (ELI)], we geographically modeled all of the wetlands' impact sites and banking sites in Florida and showed that, in general, mitigation is being accomplished at least 15 miles away on average from where the largely urban wetlands are being lost.[2] Clearly, a different population is enjoying the banking wetland services than the population that is losing the urban services. Nowhere in the course of existing structure of wetlands mitigation banking is that taken into account.

There are some famous cases of the lobster gangs of Maine that developed a property rights-like system for managing a common pool resource. This would be very difficult to pull off in the current highly developed American property rights system and high-value land system. Most of the examples of social norms managing common pool resources come from other countries. Eleanor Ostrom from the University of Indiana is a leading figure in explaining how the social norms systems work; this would also be very difficult in our economy where we depend on off-the-shelf property transactions that cannot really wait for social norms to develop.

The design of law for the future will depend on understanding the drivers behind ecosystem service depletion, understanding the models that the ecologists and the economists can provide us, and understanding that there is going to be a tremendous transition as we move toward an ecosystem services economy and there will be trade offs not only ecologically, but economically. There are going to be winners and losers, and losers tend to resist transition. So we have to come up with ways of softening the transition for them with transition payments or other market-based instruments that can allow this transition to take place. Likely directions that I see are increased reliance on ecosystem management, adaptive management, complex systems models, and increased appreciation of the value of wetlands.

Believe me, we get it on the Florida Gulf Coast where I live. We understand the value of coastal dunes, and I think we will see a transformation of common-law property rights wherein parties will litigate over depletion of natural capital because of its effects on valuable land. I think we will see an increased reliance on transition payments, market incentives, and on nested sets of governance units that take into account the multi-scale nature of ecosystem service delivery.

An example that is quite promising—relatively new in Florida—is Florida's Rural Land Stewardship Act. This is a law that allows rural land owners to rezone their property, pool the environmental resources they have, and score the different layers of environmental resources that are present on the landscape—endangered species, water, etc., including ecosystem services. By agreeing to conserve the high-score environmental resources, the law allows them to transfer development rights elsewhere within this zone in a way that takes advantage of the economies of scale of development. It is creating value in the ecosystem services for that pooled landowner unit.

We are starting to see land owners voluntarily joining together in Florida to pull this off. There are now three projects that are an example of landowners understanding there is value out there in that natural capital, but law has to tap that value and move us from the public good mentality to the private good mentality.

IV. Pollution Prevention Assistance Programs

Bob Donaghue: As I said in my opening remarks, I'm a very hands-on, hands-dirty kind of person, and what I try to do is, with all this high-level policy and regulation, try to make sense of it and develop tools that can move us to a more ecologically based approach. I am with an organization that is one of seven divisions of the Georgia Department of Natural Resources. We are, interestingly, not buried within the Environmental Protection Division in its solid waste branch; we are an independent division within the Department of Natural Resources, which gives us equal status across the board with the other divisions. We are nonregulatory, voluntary, performance-based, and we try to inte-

1. Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243-48 (1968).

2. J.B. Ruhl & James Salzman, *The Effects of Wetland Mitigation Banking on People*, NAT'L WETLANDS NEWSL., Mar./Apr. 2006, at 1.

grate regulatory and nonregulatory programs to give companies a vehicle for going beyond compliance. We have been fairly successful at that.

Two goals that came out of our strategic planning effort with the Department of Natural Resources were very eye-opening. The first one is sustaining natural resources (including sustaining ecosystems). The second one is building a conservation ethic. There has really been a disconnect with the general public and the environment. We need to begin to reconnect them and help them to develop this ethic.

To support our technical assistance program at the Pollution Prevention Assistance Division (P2AD), we have engineers and scientists on our staff, which totals about 20 people. We also work very closely with Georgia Tech's engineering outreach and economic development technical assistance resources and also those at the University of Georgia and their outreach services. This partnership is a 10-year collaborative effort. It is one of the key resources providing technical support to our environmental leadership program, which I will be talking about in a minute.

I will give a few success stories from our program: we have worked heavily with the carpet industry, which is big in Georgia. In one case, our waste reduction team identified and eliminated the source of excess phosphorus in carpet effluents, and as a result, Dalton Utilities avoided spending $30 million to install a phosphorus treatment facility at its land application area. Delta Air Lines called us in to look at their plating operations and help cut their water use because the city of Atlanta's water and sewer rates were skyrocketing. We worked closely with their waste reduction team and saved them about half a million dollars just through water conservation efforts. The really interesting thing was once they developed their water conservation efforts within their plating operations, they expanded it across their entire technical operation center. They were able to reduce their water use so much that it provided additional capacity within their wastewater treatment plant to take in wastewater from other businesses in the area, and now they are making $1.5 million a year through a symbiotic relationship with their neighboring industries.

The State Farmers' Market in Georgia called us for help. They were spending $600,000 a year to dispose of food-grade wax cardboard in the landfill. My recycling expert did a patent search and found a company in California that took wax cardboard boxes and made fire logs out of them. So basically you have fire logs made of cardboard instead of all the junk they usually contain. This is food-grade wax so you can even cook on these fire logs. To make a long story short, the company came to Georgia, created 35 jobs in rural Georgia, and is in the process of expanding now.

The cornerstone of our program is our environmental leadership program, a performance-based program. The framework for that program is EPA's performance track. EPA has one level; we have four levels. Environmental leadership programs are popping up around the country. There are pollution prevention (P2) programs in basically every state. These programs are morphing into sustainability programs. As opposed to typical recognition programs where you get patted on the back for having a good project and get an award, our leadership program provides a systematic approach to achieving sustainability in which you have to work your way up to get to the top.It is more than just getting a pat on the back; it is a true partnership.

We have three levels within our leadership program that are focused on waste reduction and sustainability. At the lowest levels, the companies do not really have a plan; they do not really know what they need to do. We provide the technical assistance resources to help them. They can remain at the yellow level for three years before moving to the next level, the red and blue level. At the red and blue level, they have to go through an advisory panel, an external group made up of nongovernmental organizations (NGOs), business, academia, and regulators. The advisory panel decides whether the companies have made enough strides to get to the next level, where they then have access to regulatory incentives.

Right now, we have about 120 organizations within our partnership program. The carpet industry is our biggest member with 24 individual facilities. They are truly embracing sustainability. Another group we have within our partnership program is the [U.S.] Department of Defense; the [U.S.] Army is focused on sustainability. State parks and NGOs are also involved. The intent is to develop a critical mass of strong leadership to show that sustainability is the path.

One special incentive is our Green Retreat. One of the things that we have for our higher level partners are roundtables and retreats where we go off and get together with the regulators, the branch chiefs, the director, etc., and talk about issues that are relevant to the business. Our Green Retreats are designed to tap all the brain power from these leaders in industry, government, and academia by focusing it on addressing some particular concern. Our [last] Green Retreat [was] in March 2007, and our challenge [was] to develop a watershed-based environmental management system (EMS). EMS are pretty ubiquitous now; everybody understands them. So our task will be to figure out how to take that tool and form a bridge between current regulations and policy and ecosystem-based policy. We use this ecosystem-based EMS as a vehicle to do that and use the watershed as a proxy for ecosystems.

The initial EMS were focused just on a permit: "Are you in compliance or not?" They did not address anything else. Then they expanded to the facility level, which is where we are now—management of the whole facility, the industrial operations within the fenceline. We want to expand the range of the impact analysis to offsite, essentially, to look at potential impacts on ecosystems. I do not think this model would work for all companies, but I think the companies that are at the highest level in our program have committed to sustainability, and that is the group that we want to develop models with and really begin to try to understand this and operationalize it.

V. Information and Incentives

Janet Ranganathan: I am just going to quickly revisit the bottom line findings from the Millennium Ecosystem Assessment. Tundi mentioned that 15 out of the 24 ecosystem services assessed were actually degraded. What you see here is the provisioning service at the top, the regulating services, and the cultural services. Bear in mind the provisioning services are the ones that have a value in the marketplace. Alterations to ecosystems are often made to increase provisioning services. This is reflected in the fact

that three of the four services that were enhanced were provisioning services.

On the debit side, we had a whole slew of services that were degraded, in particular the "regulating services," such as water filtration, soil erosion, water regulation, and pollination, which mostly do not have a value in the marketplace. Carbon sequestration was found to be enhanced globally as a result of forest regrowth in parts of the northern hemisphere. I am going to share some examples of the extent of ecosystem change over the past 50 years.

We now "farm" about a third of the world's planet primarily for provisioning services such as crops, livestock, timber, and biofuel. Most land suitable for cultivation is already under cultivation. In order to feed a growing population we will primarily need to increase the amount of food generated per hectare of land. One consequence of intensification of agriculture is this growing problem of eutrophication. There is much talk about the global carbon cycle and how we have altered that. We have also altered the global nitrogen and phosphorus cycles. The resulting "dead zones" in lakes and coastal areas, reaching thousands of square kilometers, are already having significant impacts on human well-being. Nitrogen flows in rivers have increased in some places by 80% since the 1990s. Intensified agriculture is one major driver of these increases, primarily as a result of nitrogen and phosphorous runoff from the use of fertilizers. There is a dead zone in the Chesapeake Bay.

Clearly, the changes we have made to ecosystems to increase provisioning services have brought many benefits to people, but these gains are coming at a growing cost in the form of degradation to other ecosystem services, particularly the regulating and cultural services. As Professor Ruhl noted, the costs of lost regulating ecosystem services show up at the local level. The provisioning services are more portable. Here is another example of the scale of alterations we have made to ecosystems: the Aral Sea. This was once the world's fourth largest freshwater lake. It has decreased by about 60% in volume since about the early 1970s and it has dropped about 14 meters.

The main reason for this shrinkage is a decision in the late 1960s to divert two feeder rivers for the purposes of providing irrigation for cotton. As the volume of the sea got smaller, the salt concentration increased, and the fisheries crashed, with the loss of thousands of jobs. The area that was once water now forms a large dust bowl, containing sediments coated with salt and chemicals. The cancer rates in that area surrounding the Aral Sea are about 10 times higher than the background rate.

Here is another example from the Gulf of Fonseca in Honduras, where there are pristine mangroves. Like wetlands, healthy mangroves act as a speed hump during storms, reducing the flow and pressure of stormwater and, consequently, storm damage to local communities, Now, Honduras is the second largest exporter of shrimp after Ecuador. Former mangroves are great places to build shrimp farms. Many of these coastal mangrove areas were cleared in recent years to make space for shrimp farms.

Let's compare the value of mangroves versus shrimp farms, looking at the specific ecosystem services. The marketable services for a mangrove are small, mostly timber and nontimber products ($90 per year per hectare). If you owned the mangrove, you would want to convert it to a shrimp farm because you could net $2,000 per hectare per year from shrimp revenus. Shrimp farms are very popular locally because they provide a source of jobs, and that is kind of important.

Let's now redo the economic analysis, this time looking at the nonmarketed ecosystem services. We could actually assume an approximate value of $70 for fish nurseries—mangroves provide spawning grounds for fish. Still, the economics favor the shrimp farm. However, if you include the value of the ecosystem service of coastal protection it changes the economics completely. If you then take into account the subsidies that shrimp farms often enjoy, the economics look even less rosy for shrimp farms. Then if you take into account the pollution cost (an externality) from the shrimp farm as well as the restoration costs, the economics favor keeping the mangrove intact. After about five years, the yield drops off in a shrimp farm and the owner basically abandons the land and actually drains another area.

This example demonstrates the complete misalignment of economics with ecosystem stewardship. You should also ask yourself, who is getting the benefits of mangrove conversion to shrimp farms and who is bearing the cost? The benefits flow to a few (including those of you who enjoy cheap shrimp), while the costs of the degraded mangroves and loss of coastal protection are often born by poor coastal communities. So who is supporting whom here? Which way is aid really flowing?

The Millennium Ecosystem Assessment, by design, did not offer policy recommendations. It is always good not to mix scientific assessments with policy recommendations for obvious reasons. So after the Millennium Ecosystem Assessment was over, the WRI invited 17 experts from around the globe to make recommendations on the policy, institutional, and government implications of the findings. These are published as a WRI book, *Restoring Nature's Capital: An Action Agenda to Sustain Ecosystem Services* by Frances Irwin and Janet Ranganathan, available for download on WRI's website.[3]

The common thread between the papers was governance: Who makes decisions? How are they made and with what information? [Hurricane] Katrina was probably as much a failure of governance as a failure of the levees, for all the reasons that Professor Ruhl pointed out. There was a plan to restore the Louisiana coastal wetlands before [Hurricane] Katrina happened, with a price tag of $14 billion over 30 years. It was rejected as too expensive. Consider the fact that the clean-up price for New Orleans is approximately $200 billion—$14 billion now starts to look more reasonable. I will briefly summarize the key recommendations that came out of that review that WRI completed.

1. People failed to connect healthy ecosystems and the obtainment of social economic goals—a point I made at the beginning. It is hard to imagine a decision a business, or a local mayor or a national government makes that does not in some way depend upon or impact ecosystems. And yet, how many of us use or take into account information on ecosystem services when we are making our decisions? Probably very few.

2. Ecosystem stewardship does not always pay. We need to align the financial and economic incentives with ecosystem stewardship. Many ecosystem services that have high

3. *Available at* http://www.wri.org/biodiv/pubs_description.cfm?pid=4309#pdf_files.

value to society (such as the storm protection services of mangroves or wetlands) have no value in the marketplace, at least until they are lost. The economic argument for sustaining ecosystem service is weak, absolutely obscured, or missing altogether. And those that degrade ecosystem services do not always pay.

3. Local people often lack rights over the ecosystem services they depend upon for their livelihoods. We need to strengthen the rights of local people over ecosystems. This is especially true in developing countries where the government often owns much of the land. For the one billion people that live at the bottom of the pyramid, three-quarters live in rural areas and ecosystem services are their lifeline. Yet many of them, particularly the poor, indigenous groups, and women, have no control over the services that they depend upon for their livelihood. In the United States, the challenge is different—farmers and landowners have a lot of rights over their land—including the right to degrade ecosystem services that have societal value through discharging nitrogen effluents into waterways.

4. The management of ecosystem services is fragmented across agencies. These agencies often mirror the academic disciplines. If you are a forester, you join the Ministry of Forestry. If you are a dam builder, you go to the Bureau of Reclamation. If you are engineer, you go to Public Health. If you are a biologist, you go to Fish and Wildlife. These agencies often work at cross-purpose and make changes to ecosystems that create trade offs among ecosystem services of concern to other agencies. We are not good at collectively learning and managing services across agencies.

5. Government and business accountability mechanisms for decisions about ecosystem services are frequently absent or weak. Corruption flourishes when decisions are not transparent and sanctions are unavailable. We must improve accountability for decisions that affect ecosystem services through mechanisms such as greater public and private sector accountability in relation to use and effects on ecosystems.

I will provide three brief examples of what we are doing at the WRI to advance this agenda: WRI is focusing on the information and incentives elements of the agenda. Tundi mentioned the importance of the private sector. The private sector is clearly a major contributor to the degradation of ecosystem services. But they are also going to be a major part of the solution. After a decade of working with companies on climate change, I am convinced that they can actually play a constructive role in advocating for more effective policy to sustain ecosystem stewardship. If they understand what the risk is to their business and what the opportunities are, they are going to be a more constructive player in terms of policy. But one of the things they lack is a systematic methodology to assess their impact and dependence on ecosystem services. This includes their own operations as well as those of their customers and suppliers. WRI has teamed up with the World Business Council for Sustainable Development and the Meridian Institute to pilot-test a corporate ecosystem services risk assessment tool. The goal is to help business identify the services it impacts and depends upon. It then examines the condition and trend of those services and translates the results into business risk and opportunity.

The second example is from the Caribbean, where WRI is doing a valuation of the ecosystem services from coral reefs in three countries. This is assessing how three services from reefs contribute to the economies of the respective countries. We are also looking at the ecosystem services of coastal protection, fisheries, and tourism. We do not have the results yet, but I can tell you their value is not zero and potentially quite significant.

The last example of WRI work addresses the growing global problem of eutrophication by targeting actions that farmers can take to reduce their nutrient loadings on waterways. For a number of years, the WRI has been developing a methodology to calculate the nitrogen reductions associated with specific agriculture practices. We have developed an online market-based quantification and trading platform called Nutrientnet.[4] We hope to scale up this work in the Chesapeake Bay. This includes putting into place a point source to nonpoint source trading program for nutrient reductions among sewage treatment plants and farmers. We would also like to see the Farm Bill include payments to farmers for providing ecosystem services like carbon sequestration and freshwater.

VI. Transitioning Ecosystem Services Into the Regulatory World

Richard S. Davis: I want to talk about what I, as a private practitioner, see as challenges to the transition—not in the sense that these are roadblock stoppers, but they are challenges. I have tried to drop these into three categories. The first is valuation. If you are a business, valuation is a credibility question at base. How do you solve that? How do you try to manage that?

The second challenge is the identification of a suite of environmental services that we are seeking to quantify and to value in a broader sense. How do you identify that suite of services that you are trying to honor, manage, preserve, and hopefully augment? Third, where are the opportunities? What kinds of markets out there look like they might be the best opportunities for the first sets of change into the regulatory iteration of environmental services from the academic and the technical? You can do better or you can do worse in what Professor Ruhl describes as the normative change that we would want to see by choosing a particularly good first opportunity and succeeding at it.

Valuation is human relations and psychology. Monetization is a contentious feature of our lives. I think the leading current example of monetizing that I am familiar with in the environmental field is in the natural resource damages world, where monetizing the damage is the principal battleground after you get out of standing in some of the "I do not want to be in this room with you" conservations. That is where the fight gets fought. Those cases are settled in the vast majority of circumstances because the external factors playing on the parties have caused them to realize that settlement is in their best interest, that the value is about right. They are not agreeing on the legitimacy of those valuation techniques in most cases. They are simply done with the negotiation and they agree on a number. That is not true every place, but the vast majority of those cases settle, which makes me think that valuation continues to be a difficult nut to crack from the standpoint of acceptance.

I am a closet reader of some of the texts here, and the most recent one I read has to do with valuing water and water ser-

4. *Available at* http://www.nutrientnet.org/.

vices. It is a WRI publication, a 300-page survey of alternative evaluation techniques for water resources. It is a wonderful survey, describing the strengths and the weaknesses of each of those techniques in certain circumstances. What it says to me is that we are not yet at a mature science stage for valuation in terms of its acceptance. It may be academically mature, but it is not yet mature where a touchstone kind of work like that come out. It is not mature from the standpoint of acceptance, which is key to the environmental services world.

A tremendously positive step is Janet's discussion of the WRI's joint effort to come up with a risk assessment model to show the larger context in a way that is meaningful to business. Business values models that can be generated and gain currency, even if it is not down to the last dollar and dime, but in a range of values. I would encourage folks who are involved in that to bring into the fold of the development of those models as many of the industrial folks as they can because that is a buy-in you need.

There is one additional connection there. I see increasingly corporate environmental health and safety (EHS) professionals, particularly the highest level ones, worrying about convincing their keepers that you can value the services of the EHS department. They have a hard time doing that. They would like to be able to do that because, otherwise, they are a cost, which is not a good thing to be in an American corporation right now. Those folks have developed some very, very sophisticated and very interesting techniques for valuing their service and they are not exclusively cost-avoidance kinds of valuation. They are frequently value invested in the environment returned to the corporation.

There probably are many points of connection that I am not aware of, but I am routinely surprised when I walk into those rooms and those offices and those meetings and hear the level of sophistication that those folks are developing. But they might actually be useful here both in terms of the substantive value and in terms of building some connections between what would seem to be inimical interests.

Second was my point on the identification of a suite of environmental services to try to value and take seriously for a change. My note here says humility is good. My example is the rough history of Florida's Everglades and I give this rough history with great humility sitting next to [Professor] Ruhl.

Back in the mid-1800s, the highest and best use of the Everglades was to drain it and sell it to settlers. Land was given away, pushed away, and graphed and such in the effort to try to shrink the wet parts, which was only partially successful. By 1900, the focus had changed to maintaining large agricultural interests, which people talk about now just in terms of big sugar, but there are a whole suite of agricultural interests in central and southern Florida and in feeding water down to the Atlantic Coast population centers, which are eager consumers of that commodity.

Then in the 1980s, we come to the recognition that we are killing the Everglades. So we did a restudy, which generated a reclamation program and so on, the CERP [Comprehensive Everglades Restoration Program], but the reclamation program for the Everglades has created its own stepchildren, ecologically speaking, and they are all over the place. Two important ones are on the coasts; they are the drainage basins and the drains and sewers through which excess water goes when all of the other needs get met.

It is very easy to get to the point where you prioritize this value and forget that it exists within a larger sphere or larger scale, or you prioritize the larger scale and in the meantime you have killed a microenvironment off. I think that the questions of scale are probably the most fascinating ones I can think of, and the development of these nested regulatory systems that allow vetting of a decision through the different scales in an efficient way so that you can do it without relearning the basics every time would be tremendously valuable.

My last topic here is selecting good targets. What are the right targets? What does the honoring of environmental services do best? What does it not do so well? I suspect that you have a harder nut to crack where you have a vested set of interests in an existing market and have to change the way a multibillion dollar corporation does business. You are going to have to get through a whole flock of people like me who will tell you that they should be able to put out more methyl-ethyl death rather than less, and we will dice and slice all of the position papers and the new regulatory schemes trying to find the holes and the gaps. It may be a critical nut to crack in many cases, but it is a very tough nut to crack. Perhaps the best opportunity out there is on the ocean side, in part because the oceans are nobody's property. The law is the difference between what 17 countries say and what 42 countries decline to say about the Law of Sea. And while the oceans are truly exploited, in some cases pressured to the brink and beyond, they are, compared to the terrestrial environment, probably relatively unexploited. So the economics are yet to be created. The costs are yet to be assessed and built into somebody's business model. It seems to me that because it is a multinational scenario, because it is an evolving regulatory scheme, I think it is legitimately in the infancy of its evolution, and therefore, the interests have not quite butted heads and impacted yet in the way that they have in the terrestrial environment.

Similarly, one could look at development. Do you fix the inner city? Do you change the inner city? Do you put up green roofs? I'm all for green roofs. I think it is a great technology. If we could do what the Germans do, we would put them every place and it would be wonderful. Even with that, it is still a city.

The opportunity is in the urbanization of that ring around the city, which now is a suburban environment. The opportunity is in the suburbanization of the farms that are being turned over on the outside. I see a need for a mix of both regulatory development and technological innovation to allow development pressure to be expressed in a way that not only preserves the existing capital, but helps create some additional capital in those areas where the pressure to develop will be irresistible. I do not think we have those technologies or those regulatory systems in place at this point. I think we need those in order to capture that potential benefit that the pressure to develop creates.

VII. Questions and Answers

Audience member: Are we moving toward a legal framework, or driving toward a legal framework that monetizes ecosystem services at the expense of existing rules of law and approaches?

Audience member: What does designing the law mean? What is enough with respect to technology or regulation? Does it mean returning to common-law principles?

Audience member: Do we not have the tools in place already?

Audience member: Tundi, just to give you a little good news, the U.S. government is taking the Millenium Ecosystem Assessment much more seriously than is realized and is starting an Inter-Agency Working Group on Ecosystem Services to actually look at what is being done within the different agencies.

Tundi Agardy: I think we are wholly in a transition phase now. There are three different sectors converging on the idea of ecosystem services, whether or not they are valued in monetary terms or not being critically important to human well-being. The public sector is clearly recognizing this. Even National Marine Fisheries Service is going away from a very single-stalk kind of approach to fisheries management to move toward understanding whole ecosystems and the services that different components of the ecosystems provide. You see this on the state level in Georgia, California, and Massachusetts. Agencies are embracing new tools such as zoning marine areas and other kinds of tools to better protect the ecosystem services.

The private sector is obviously moving in this direction because they see a business benefit; these markets are developing quite quickly. In fact, if you look around the world, places like Australia and New Zealand have gone much further than the United States in developing private-sector payments for ecosystem services markets. Lastly, the science sector has moved away from a very myopic, specialized view of ecosystems to a much more integrated and holistic view.

This means that not only are we thinking about ecosystems as whole entities, thinking through the goods and services they provide, but we are also thinking much better about the linkages between various components of the ecosystems. Of course, humans are a critical component of the ecosystems as well. So, this is all converging on a future in which ecosystem services play a very central role in the way we manage the environment and develop regulations to do that.

Bob Donaghue: Again, I have heard the term operationalize, and my concern is that what I have seen historically is that means compartmentalize. We are dealing with living systems with a threshold that you cannot go beyond; otherwise, you have changed the system. We need to be very careful that we do not begin to compartmentalize ecosystem services much like we did with solid waste and other media over the last 30 years. Again, I would encourage any of you that do not have an ecology course in your background to please take Ecology 101. That is fundamental to understanding ecosystem services and understanding ecosystems as a living unit. It all comes down to nature. We start with nature. We need to work with nature.

Janet Ranganathan: I do not think it is just about monetizing services. I think incentives are clearly an important part of the agenda, but I think it is also about better information, rights to ecosystem services, accountability, and managing across levels and scales. I really believe that a lot can be done within the framework of existing institutions, but there is also a need for new institutions as well, some novel and creative institutions in some cases. These new forms of institutions are especially needed to address the current fragmentation of ecosystems and their services among different government agencies.

We already have a lot of tools, but are we using them? Unless the 1,300 scientists behind the Millennium Ecosystem Assessment got the results wrong, I would say that we are not using them effectively. The good news is that the advances in information and communication technology are going to enable us to manage complex systems like ecosystems and act collectively across agencies in ways that we could not previously have envisioned. I think we have some tools at our disposal now, so, I'm cautiously optimistic. Humans are after all incredibly ingenious and adaptive. But we do need to rethink how we currently value ecosystems in development decisions.

Richard S. Davis: My feeling is that what we will see is an amalgam; we will see some win-win situations like the transferable development rights, for example, which are win-win articulations of this design.

When you get to the win-lose circumstances, I think those will need to be cast as policy decisions. It is either a tax question, or we will impose that cost on whoever the degrader of that system is. I think the tolerance for change will find its own level and as there is more experience with this approach and more investment in it in a cognitive way, I think you will see the threshold of that norm move out beyond where you would expect it to fall today.

I think it was Tundi who said how difficult it is to communicate about ecosystem services. We keep talking about this. We need a communication strategy which describes this in a coherent way to the deregulated communities.

J.B. Ruhl: The questions on property rights and the common law were very on-point for me. That is exactly where I am focusing my work now. I think we are tending to overemphasize the valuation problem. Law gets a lot of mileage out of an understanding of causation—the common law in particular. We really understand the causation much better than we do the valuation. Common law is about causation. There is no reason why ecosystem services are inconsistent with long-held traditions in the common law.

I do not need to know the value of that coastal dune or wetland in the sense we have been talking about. All I need to know as the plaintiff is that someone harmed my property by X amount. Now, the common law to me is a potential engine in understanding causation.

Final point: The common law is widely regarded as having formed the foundation and legitimacy for modern pollution control regulation. The bread-and-butter of nuisance actions—I teach them—are smoke stacks and pollution. I think that we would be doing ecosystem services law a great disservice if we do not start to look carefully at the common law. It takes no torturing of common-law doctrine, once you get the causation down, to look at doctrines like public trust, public nuisance, private nuisance, and updated doctrines of adverse possession, waste, etc. The common law evolves and I think we are ready to see it evolve.